

# SCOPING REPORT

## ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

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### ALGAE FARMING AND REFINERY FOR PRODUCTION OF BIOFUEL & CRUDE ALGAE OIL (CAO)

Portion X, Henties Bay State Land (Within Dorob National Park)  
Erongo Region, Namibia

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#### Prepared For (Proponent):

African-Link Energy Corporation (Pty) Ltd (ALEC)  
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#### Prepared By (Environmental Assessment Practitioner – EAP):

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Swakopmund, Namibia



#### Technical Research & Impact Advisory:

Institute for Impact Sciences & Research Design (IISRD)



#### Project Coordinates:

Latitude: -22.05770 & Longitude: 14.25485

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#### Land Extent:

Approximately 28,224 hectares (282,240,000 m<sup>2</sup>)

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Date: April 2026

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# DOCUMENT CONTROL PAGE

Item	Description
Project Title	Algae Farming and Refinery for Production of Biofuel & Crude Algae Oil (CAO)
Location	Portion X, Henties Bay State Land, within Dorob National Park, Erongo Region, Namibia
Coordinates	Latitude: -22.05770 / Longitude: 14.25485
Land Extent	Approximately 28,224 hectares (282,240,000 m <sup>2</sup> )
Proponent	African-Link Energy Corporation (Pty) Ltd (ALEC)
Environmental Assessment Practitioner (EAP)	Erongo Consulting Group
Technical Advisory	Institute for Impact Sciences & Research Design (IISRD)
Regulatory Authority	Ministry of Environment, Forestry and Tourism (MEFT)
ECC Application Number	260418007338
Report Type	Scoping Report (EIA Process)
Status	Submitted for Scoping Phase Review
Date	April 2026

## EXECUTIVE SUMMARY

This Scoping Report has been prepared as part of the Environmental Impact Assessment (EIA) process for the proposed:

***ALGAE FARMING AND REFINERY FOR PRODUCTION OF BIOFUEL & CRUDE ALGAE OIL (CAO), PORTION X, HENTIES BAY STATE LAND (WITHIN DOROB NATIONAL PARK), ERONGO REGION, NAMIBIA.***

The project is located north of Henties Bay, adjacent to the C34 coastal corridor within Dorob National Park, approximately 50 metres from the Atlantic Ocean. The total project area extends over approximately 28,224 hectares of non-arable coastal desert land.

The proposed development involves the establishment of a large-scale seawater-based algae cultivation and biorefinery system designed to produce renewable biofuel and Crude Algae Oil (CAO). The system will utilise seawater from the Atlantic Ocean and integrate cultivation, harvesting, and refining processes within a single industrial ecosystem.

The project is being developed by African-Link Energy Corporation (Pty) Ltd (ALEC), which has received initial consent from the Ministry of Environment, Forestry and Tourism (MEFT) to undertake feasibility and environmental studies. A formal application for an Environmental Clearance Certificate (ECC) has been submitted and registered under Application Number: 260418007338.

Strategically, the project aligns with Namibia's national priorities, including:

- Renewable energy transition and reduced dependence on imported fossil fuels
- Industrialisation and value addition within the biofuel and green energy sectors
- Productive utilisation of non-arable desert land

- Blue economy development through sustainable marine resource use
- Climate change mitigation through carbon capture potential

The development is expected to generate significant socio-economic benefits, including:

- Employment creation of up to 1,200 direct jobs
- Skills development and institutional collaboration
- Local and regional economic stimulation
- Attraction of investment into Namibia's emerging green economy

Potential environmental and social impacts associated with the project will be identified, assessed, and addressed through the EIA process. Key areas of assessment include marine ecology, water abstraction and discharge, biodiversity, socio-economic dynamics, and infrastructure development.

This Scoping Report provides an overview of the proposed project, identifies key environmental and social issues, and outlines the approach for further detailed assessment. Stakeholder engagement forms a critical component of the process, and all Interested and Affected Parties (I&APs) are invited to participate and provide input.

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## **INTRODUCTION TO THE REPORT**

This document constitutes the Scoping Report for the Environmental Impact Assessment (EIA) of the proposed algae farming and refinery project in Henties Bay, Erongo Region.

The purpose of this report is to:

- Introduce the proposed development
- Identify potential environmental and socio-economic issues
- Define the scope of further assessment
- Facilitate stakeholder engagement and participation

This report forms part of a new application for an Environmental Clearance Certificate (ECC) submitted to the Ministry of Environment, Forestry and Tourism (MEFT) in accordance with the Environmental Management Act (Act No. 7 of 2007) and the Environmental Impact Assessment Regulations (2012).

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## **DISCLAIMER**

This Scoping Report has been prepared by Erongo Consulting Group, as the appointed independent Environmental Assessment Practitioner (EAP), for African-Link Energy

Corporation (Pty) Ltd (ALEC) in support of an application for an Environmental Clearance Certificate (ECC).

The information contained in this report is based on available data, preliminary investigations, and stakeholder inputs at the time of compilation.

While reasonable efforts have been made to ensure accuracy, Erongo Consulting Group makes no warranties regarding the completeness of the information beyond the scope of this phase.

This report:

- Represents the scoping phase of the EIA process
- Does not constitute a final Environmental Impact Assessment
- Will be supplemented by detailed specialist studies in subsequent phases

Erongo Consulting Group shall not be held liable for decisions made outside the intended regulatory framework of this report.

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- Ministry of Environment, Forestry and Tourism (MEFT)
- Registered Interested and Affected Parties (I&APs)

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# PROFESSIONAL CERTIFICATION

## Environmental Assessment Practitioner Declaration

Erongo Consulting Group, as the appointed Environmental Assessment Practitioner (EAP), confirms that this Scoping Report has been prepared in accordance with applicable Namibian environmental legislation and professional standards.

All information presented is, to the best of our knowledge, accurate and based on available data and preliminary assessments.

**Signed:**   
**Name:** Emmanuel M. Hamadziripi  
**Designation:** Environmental Practitioner  
**Organisation:** Erongo Consulting Group  
**Date:** April, 2026

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## Proponent Declaration

I, the undersigned, representing African-Link Energy Corporation (Pty) Ltd (ALEC), confirm that all information provided for the purposes of this report is accurate and that the proposed project will comply with applicable regulatory requirements.

**Signed:** \_\_\_\_\_  
**Name:** \_\_\_\_\_  
**Designation:** \_\_\_\_\_  
**Date:** \_\_\_\_\_

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## ACRONYMS AND ABBREVIATIONS

This section provides a comprehensive list of acronyms used throughout the report, together with detailed explanations to support clarity, technical understanding, and regulatory interpretation.

<b>Acronym</b>	<b>Full Term</b>	<b>Detailed Explanation</b>
<b>ALEC</b>	African-Link Energy Corporation	The project proponent responsible for financing, developing, constructing, and operating the proposed algae cultivation and biorefinery system. ALEC carries ultimate responsibility for environmental compliance and implementation of mitigation measures.
<b>BID</b>	Background Information Document	A non-technical document prepared during the public participation process to inform stakeholders about the project, its potential impacts, and how they can participate in the EIA process.
<b>CBD</b>	Convention on Biological Diversity	An international treaty aimed at conserving biological diversity, promoting sustainable use of ecosystems, and ensuring equitable sharing of benefits derived from natural resources.
<b>CO<sub>2</sub></b>	Carbon Dioxide	A key greenhouse gas contributing to climate change. In this project, CO <sub>2</sub> is relevant as algae systems can absorb carbon dioxide, contributing to carbon capture and climate mitigation.
<b>ECC</b>	Environmental Clearance Certificate	A legally binding authorisation issued by the Ministry of Environment, Forestry and Tourism (MEFT), permitting a project to proceed subject to compliance with specified environmental conditions.
<b>ECO</b>	Environmental Control Officer	An independent environmental professional appointed to monitor compliance with the Environmental Management Plan (EMP), conduct inspections, enforce mitigation measures, and report on environmental performance.
<b>EIA</b>	Environmental Impact Assessment	A systematic process used to identify, predict, evaluate, and mitigate the environmental and socio-economic impacts of a proposed development prior to decision-making.
<b>EMP</b>	Environmental Management Plan	A detailed operational document outlining mitigation measures, monitoring requirements, responsibilities, and procedures to manage environmental impacts throughout the project lifecycle.
<b>EMF</b>	Environmental Management Framework	The overarching system that integrates environmental management principles, EMP implementation, monitoring systems, compliance mechanisms, and institutional responsibilities.
<b>ESF</b>	Environmental and Social Framework	A set of standards (e.g., World Bank ESF) used to manage environmental and social risks in development projects, often applied in internationally funded projects.
<b>FAO</b>	Food and Agriculture Organization	A United Nations agency that provides technical guidance on sustainable agriculture, food systems, and environmental management practices.
<b>GRN</b>	Government of the Republic of Namibia	The national governing authority responsible for establishing environmental laws, policies, and regulatory frameworks applicable to the project.

<b>IAIA</b>	International Association for Impact Assessment	A global professional organisation that develops international best practice principles for environmental and social impact assessment.
<b>IFC</b>	International Finance Corporation	A member of the World Bank Group that provides performance standards for environmental and social sustainability, widely used in project financing and ESG compliance.
<b>I&amp;APs</b>	Interested and Affected Parties	Individuals, groups, communities, organisations, or institutions that may be affected by or have an interest in the proposed project and are engaged during the public participation process.
<b>MAWLR</b>	Ministry of Agriculture, Water and Land Reform	Government authority responsible for water resource management, land allocation, and regulation of water abstraction and use.
<b>MEFT</b>	Ministry of Environment, Forestry and Tourism	The competent authority responsible for reviewing EIAs, issuing Environmental Clearance Certificates, and monitoring environmental compliance in Namibia.
<b>MET</b>	Ministry of Environment and Tourism	Former designation of MEFT; responsible for environmental policy development and publication of EIA guidelines.
<b>MFMR</b>	Ministry of Fisheries and Marine Resources	Government authority responsible for the protection and management of marine ecosystems, fisheries resources, and coastal environmental integrity.
<b>MME</b>	Ministry of Mines and Energy	Government authority responsible for energy policy, regulation, and alignment of projects with national energy strategies, including renewable energy initiatives.
<b>NBSAP</b>	National Biodiversity Strategy and Action Plan	Namibia's national framework for biodiversity conservation, ecosystem protection, and sustainable use of biological resources.
<b>NSA</b>	Namibia Statistics Agency	National institution responsible for collecting, analysing, and disseminating demographic, economic, and social data used in baseline assessments.
<b>UN</b>	United Nations	International organisation supporting global cooperation on environmental protection, sustainable development, and governance frameworks.
<b>UNEP</b>	United Nations Environment Programme	UN agency focused on environmental sustainability, ecosystem protection, and development of global environmental policies and guidelines.
<b>UNCLOS</b>	United Nations Convention on the Law of the Sea	International treaty governing the use, management, and protection of marine and coastal environments, including resource use and pollution control.
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change	International treaty addressing climate change mitigation, greenhouse gas reduction, and global climate governance.
<b>WHS</b>	Workplace Health and Safety	A system of policies, procedures, and practices aimed at ensuring the safety, health, and well-being of workers during project implementation.
<b>WHO</b>	World Health Organization	United Nations agency responsible for global public health standards, relevant to environmental health considerations.

## Additional Project-Specific Terms

Acronym	Full Term	Detailed Explanation
<b>BWh/BWk</b>	Arid Desert Climate Classification (Köppen-Geiger)	Climate classification indicating hot (BWh) and cold (BWk) desert conditions typical of the Namib coastal region, characterised by low rainfall and high evaporation.
<b>NYS</b>	National Youth Service	Government facility used as a venue for stakeholder engagement and public consultation meetings in Henties Bay.
<b>ESIA</b>	Environmental and Social Impact Assessment	An expanded form of EIA that integrates both environmental and social considerations into a single assessment framework.

# 1 INTRODUCTION

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## 1.1 Background and Context

The proposed **ALGAE FARMING AND REFINERY FOR PRODUCTION OF BIOFUEL & CRUDE ALGAE OIL (CAO)** represents a large-scale integrated bio-industrial development to be established on Portion X of Henties Bay State Land, within the Dorob National Park, Erongo Region, Namibia.

The project is located approximately 50 metres inland from the Atlantic Ocean, along the C34 coastal trunk road, north of Henties Bay, and is centred at:

- **Latitude:** -22.05770
- **Longitude:** 14.25485

The total project footprint extends over approximately **28,224 hectares (282,240,000 m<sup>2</sup>)** of non-arable coastal desert land.

This development is positioned within Namibia's broader transition towards:

- Renewable energy systems
- Blue economy development
- Industrial diversification
- Climate-resilient production systems

### 1.1.1 Scientific Basis of Algae Biofuel Systems

Algae are photosynthetic organisms ranging from unicellular microalgae to complex multicellular forms. These organisms utilise sunlight, carbon dioxide (CO<sub>2</sub>), and water to produce biomass through photosynthesis.

Algae are particularly relevant for biofuel production due to:

- High lipid content (2 - 40% by dry weight)
- Rapid growth rates
- Ability to grow in saline or wastewater environments
- High photosynthetic efficiency compared to terrestrial crops

(Wagner, 2007; FAO, 2009)

Unlike conventional agriculture, algae cultivation:

- Does not require arable land
- Does not compete with food systems
- Can operate in harsh desert environments

This makes it particularly suitable for Namibia's coastal desert conditions.

### 1.1.2 Project Development Context

In January 2026, the Government of Namibia, through the Ministry of Environment, Forestry and Tourism (MEFT), granted the proponent, African-Link Energy Corporation (Pty) Ltd (ALEC), permission to utilise a portion of State Land within the Henties Bay area for feasibility and environmental assessment purposes.

The project is further supported through:

- A joint venture agreement with an international technology partner
- A long-term off-take arrangement for biofuel products
- Alignment with Namibia's industrialisation and energy transition agenda

The development integrates:

- Seawater abstraction systems
- Open pond algae cultivation
- Biorefinery processing infrastructure
- Renewable energy production systems

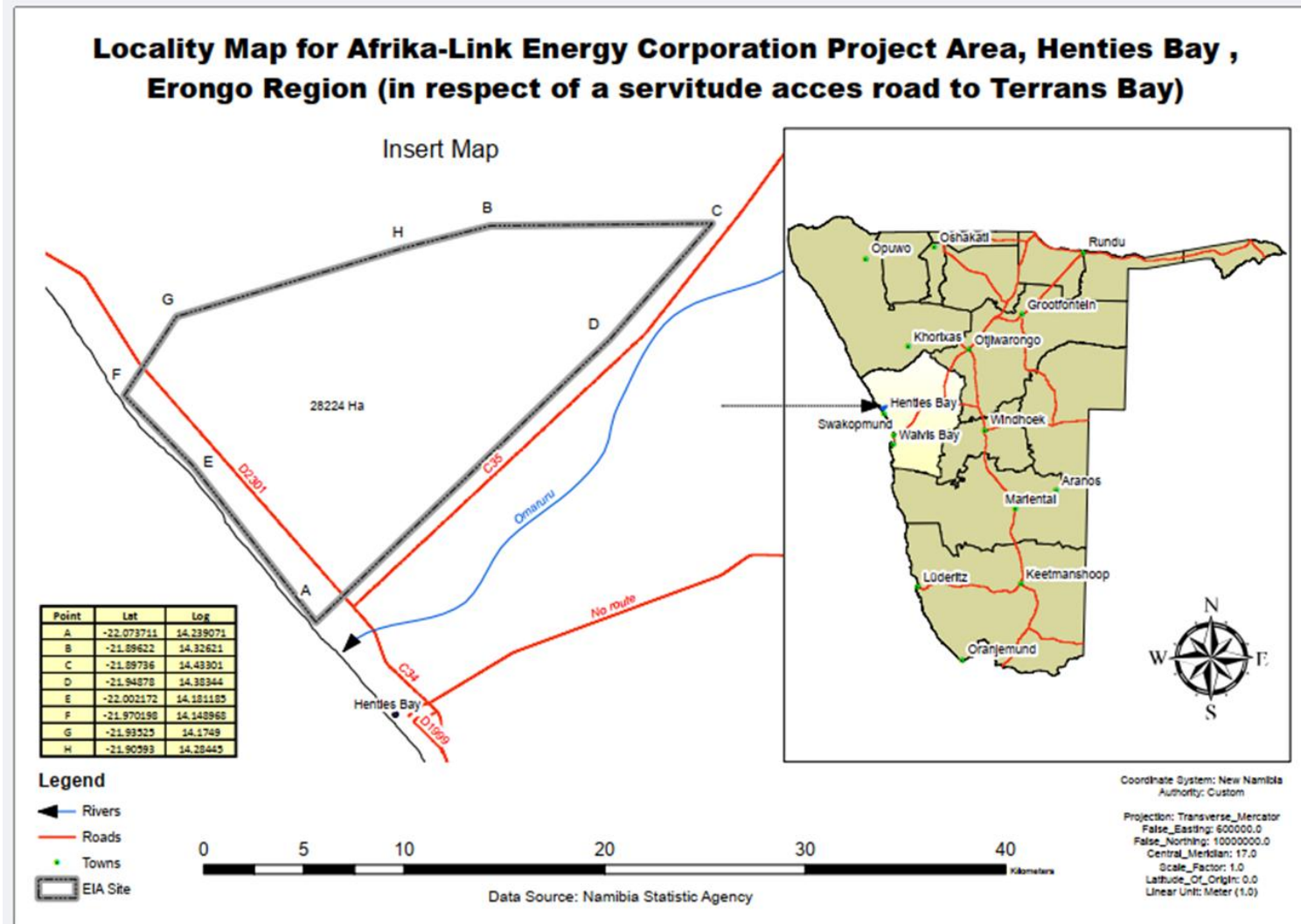
## 1.2 Purpose of the Scoping Report

This Scoping Report has been prepared as part of a new application for an Environmental Clearance Certificate (ECC) submitted to the Ministry of Environment, Forestry and Tourism (MEFT).

The purpose of this report is to:

- Introduce the proposed project and its components
- Identify key environmental and socio-economic issues
- Define the scope of specialist studies required
- Inform stakeholders and facilitate public participation
- Provide a foundation for the full Environmental Impact Assessment (EIA)

Figure 1: Locality Map of the Proposed Algae Farming and Refinery Project Area, Portion X, Henties Bay State Land (Dorob National Park), Erongo Region, Namibia, indicating site boundaries (~28,224 ha), proximity to Henties Bay, and access via the C34 coastal trunk road towards Terrace Bay.



This report represents the initial phase of the EIA process and does not constitute a final impact assessment.

## 1.3 Regulatory Context

The Environmental Impact Assessment (EIA) for the proposed development is undertaken in accordance with Namibia's primary environmental legislation, namely:

- **Environmental Management Act (Act No. 7 of 2007)**
- **Environmental Impact Assessment Regulations (Government Notice No. 30 of 2012)**

These legal instruments establish the framework for environmental governance, requiring that listed activities with potential significant environmental impacts obtain an Environmental Clearance Certificate (ECC) prior to implementation.

### 1.3.1 Triggered Listed Activities

The proposed **ALGAE FARMING AND REFINERY FOR PRODUCTION OF BIOFUEL & CRUDE ALGAE OIL (CAO)** constitutes a large-scale, integrated industrial and bio-production system, triggering multiple listed activities under the EIA Regulations, including:

- **Industrial Processing Activities**  
Establishment of a biorefinery for the processing of algal biomass into biofuel and Crude Algae Oil (CAO), including chemical and thermal conversion processes
- **Large-Scale Land Transformation**  
Development of approximately **28,224 hectares** of previously undisturbed desert landscape for cultivation ponds, processing infrastructure, and associated facilities
- **Water Abstraction, Desalination and Marine Interaction**  
Abstraction of seawater from the Atlantic Ocean, development of desalination infrastructure, and potential discharge streams, requiring careful regulation of marine-terrestrial interface impacts
- **Infrastructure Development within a Protected Area**  
The project is located within **Dorob National Park**, necessitating strict compliance with conservation policies and protected area management frameworks
- **Energy Generation and Distribution Systems**  
Integration of power supply systems, including grid connectivity and potential on-site energy generation to support industrial-scale operations
- **Waste Generation and Effluent Management**  
Handling of solid, liquid, and process waste streams associated with algae cultivation and refinery operations

### 1.3.2 Cross-Sector Regulatory Framework

In addition to the Environmental Management Act, the project is subject to a broader suite of sectoral legislation and policy frameworks due to its multi-dimensional nature:

#### **Water Resources and Desalination**

- **Water Resources Management Act (Act No. 11 of 2013)**  
Regulates water abstraction, desalination processes, water use licensing, and discharge standards

## **Marine and Coastal Environment**

- **Marine Resources Act (Act No. 27 of 2000)**  
Governs the protection and sustainable utilisation of marine ecosystems, particularly relevant for seawater abstraction and potential marine discharge
- **Benguela Current Convention (BCC) (Regional Framework)**  
Promotes sustainable management of the Benguela marine ecosystem

## **Protected Areas and Biodiversity**

- **Nature Conservation Ordinance (No. 4 of 1975)**
- **National Parks and Wildlife Management Policies**

These are particularly critical given the project's location within **Dorob National Park**, requiring ecological sensitivity and biodiversity safeguards

## **Land Use and Spatial Planning**

- **Urban and Regional Planning Act (Act No. 5 of 2018)**
- **Henties Bay Structure Plan (2020–2040)**

These regulate land use zoning, servitude registration, and spatial integration

## **Agriculture and Bio-Production Systems**

- **Controlled Wildlife Products and Bio-Resource Use Frameworks**
- Regulations relating to **non-traditional agriculture systems**, including aquaculture and algaculture

## **Energy and Industrial Development**

- **Electricity Act (Act No. 4 of 2007)**
- National policies on renewable energy and industrialisation

## **Pollution and Waste Management**

- **Pollution Control and Waste Management Bill (pending)**
- **Hazardous Substances Ordinance (No. 14 of 1974)**

These govern emissions, effluent discharge, and handling of chemical substances

### 1.3.3 Regulatory Sensitivity: Dorob National Park

The project’s location within Dorob National Park introduces a heightened level of regulatory oversight due to:

- Conservation priorities of coastal desert ecosystems
- Sensitivity of marine–terrestrial ecological interfaces
- Presence of endemic and protected species (flora and fauna)
- Tourism and ecological integrity considerations

As such, the project is subject to:

- Stricter environmental scrutiny
- Enhanced mitigation requirements
- Comprehensive stakeholder consultation
- Alignment with conservation and sustainable use principles

### 1.3.4 Institutional Oversight and Project Governance Framework

The proposed development is governed by a multi-layered institutional framework, integrating regulatory oversight, technical execution, infrastructure provision, and strategic economic facilitation.

#### **Institutional Framework and Roles (Full Project Ecosystem)**

*Table 1: Regulatory Authorities (Compliance & Approvals)*

<b>Institution</b>	<b>Role</b>
<b>Ministry of Environment, Forestry and Tourism (MEFT)</b>	Lead regulatory authority responsible for Environmental Clearance Certificate (ECC), environmental compliance, and oversight of Dorob National Park.
<b>Ministry of Agriculture, Water and Land Reform (MAWLR)</b>	Water abstraction licensing, desalination regulation, and land-use governance for non-traditional agriculture systems.
<b>Ministry of Fisheries and Marine Resources (MFMR)</b>	Protection of marine ecosystems, regulation of seawater abstraction and discharge impacts.
<b>Ministry of Mines and Energy (MME)</b>	Oversight of energy generation, grid integration, and renewable energy compliance.

*Table 2: Regional and Local Authorities (Planning & Implementation Interface)*

<b>Institution</b>	<b>Role</b>
<b>Erongo Regional Council</b>	Regional development coordination, socio-economic alignment, and facilitation of strategic projects within the region.
<b>Henties Bay Municipality</b>	Local planning authority responsible for zoning alignment, municipal services, infrastructure interface, and community engagement.

Table 3: Project Delivery and Technical Structure

<b>Institution</b>	<b>Role</b>
<b>African-Link Energy Corporation (Pty) Ltd (ALEC)</b>	Project Proponent and Developer responsible for financing, implementation, and overall project execution.
<b>Erongo Consulting Group (ECG)</b>	<b>Environmental Assessment Practitioner (EAP)</b> responsible for EIA coordination, regulatory compliance, stakeholder engagement, and submission of the ECC application.
<b>Institute for Impact Sciences &amp; Research Design (IISRD)</b>	<b>Technical Research &amp; Impact Advisory</b> responsible for impact modelling, socio-economic analysis, systems integration, and evidence-based decision support.
<b>Engineering &amp; Technology Partners (International)</b>	Provision of algae cultivation systems, refinery technologies, and process engineering expertise.

Table 4: Infrastructure and Utility Stakeholders

<b>Institution</b>	<b>Role</b>
<b>NamWater</b>	Advisory and potential integration on desalination systems, water infrastructure, and water resource management.
<b>Erongo RED</b>	Electricity supply, grid connection, and power infrastructure integration.
<b>Namport</b>	Export logistics through Walvis Bay Port, enabling international biofuel trade and supply chain integration.
<b>Roads Authority (Namibia)</b>	Approval and regulation of access points and transport connectivity via the C34 trunk road.

Table 5: Strategic, Investment and Economic Enablers

<b>Institution</b>	<b>Role</b>
<b>Namibia Investment Promotion and Development Board (NIPDB)</b>	Investment facilitation, project positioning within Namibia's green industrialisation strategy, and coordination of international investors.
<b>Ministry of International Relations and Cooperation (MIRCO)</b>	Facilitation of international partnerships, bilateral agreements, and cross-border collaboration frameworks.
<b>Namibia Chamber of Commerce and Industry (NCCI)</b>	Private sector mobilisation, industry engagement, and stakeholder network activation.
<b>Financial Institutions / Funding Partners</b>	Capital provision, project financing, and long-term investment structuring.

Table 6: Research, Knowledge and Environmental Advisory Institutions

<b>Institution</b>	<b>Role</b>
<b>Desert Research Foundation of Namibia (DRFN)</b>	Environmental research, climate resilience advisory, and sustainability guidance in arid ecosystems.
<b>University of Namibia (UNAM)</b>	Academic research, environmental monitoring, and skills development.
<b>IUM Research, Training and Conference Centre (Swakopmund)</b>	Applied research, innovation, and capacity building aligned to industrial and environmental systems.

### 1.3.5 Integrated Governance Approach

The project adopts an integrated governance model, combining:

- Regulatory compliance (MEFT-led)
- Scientific and technical validation (IISRD-supported)
- Implementation delivery (ALEC-led)
- Infrastructure integration (utilities and authorities)
- Investment and economic positioning (NIPDB and partners)

This ensures that the project is:

- Technically robust
- Environmentally compliant
- Economically viable
- Institutionally coordinated
- Internationally aligned

### 1.3.6 Strategic Positioning of the Project

The institutional structure reflects that the project is not a standalone development, but a:

- National strategic energy and industrial initiative
- Blue economy flagship project
- Platform for international investment and technology transfer

### 1.3.7 Summary

The proposed development is classified as a high-impact, multi-sector project, requiring integrated regulatory compliance across environmental, marine, water, energy, and land-use domains.

The EIA process therefore serves as a critical decision-support tool, ensuring that:

- Environmental risks are identified and mitigated
- Regulatory requirements are satisfied
- Sustainable development principles are upheld

## 1.4 Terms of Reference for the EIA

The Terms of Reference (ToR) for this Environmental Assessment include:

*Table 7: Environmental Impact Assessment (EIA) Objectives and Scope*

Objective	Detailed Description
<b>Baseline Assessment</b>	Establish a comprehensive understanding of existing environmental and socio-economic conditions within the project area and its zone of influence.

	<p>This includes climate, geology, soils, hydrology (surface and groundwater), marine environment, biodiversity (flora and fauna), land use patterns, and socio-economic dynamics (population, livelihoods, infrastructure). Baseline data is derived from literature review, field observations, and stakeholder inputs, forming the reference point against which all project impacts are measured.</p>
<b>Impact Identification</b>	<p>Systematically identify all potential environmental and socio-economic impacts associated with the project across its full lifecycle (pre-construction, construction, operation, and decommissioning). This includes direct, indirect, cumulative, and induced impacts related to land transformation, water abstraction, marine interaction, energy use, waste generation, biodiversity disturbance, and community-level changes.</p>
<b>Impact Evaluation</b>	<p>Assess the significance of identified impacts using established criteria such as magnitude, extent, duration, reversibility, and probability. The evaluation differentiates between positive and negative impacts and prioritises high-risk areas requiring intervention. This process supports evidence-based decision-making and determines whether impacts are acceptable, manageable, or require redesign of project components.</p>
<b>Legal and Regulatory Compliance</b>	<p>Ensure that the proposed development aligns with all applicable Namibian legislation, policies, and international obligations. This includes compliance with the Environmental Management Act (2007), EIA Regulations (2012), Water Resources Management Act, Marine Resources Act, and relevant planning frameworks. The process also ensures that all required permits, licences, and approvals are identified and incorporated into project planning.</p>
<b>Alternatives Analysis</b>	<p>Evaluate feasible project alternatives, including site alternatives, technology options (e.g., open ponds vs photobioreactors), process configurations, and the “no-go” option. The objective is to identify the most environmentally and economically sustainable option by comparing impacts, costs, technical feasibility, and long-term viability.</p>
<b>Mitigation Planning</b>	<p>Develop targeted mitigation measures to avoid, minimise, or offset identified negative impacts. This includes engineering controls, operational procedures, environmental safeguards, and design modifications. Mitigation measures are aligned with best practice and are structured to be practical, measurable, and enforceable throughout the project lifecycle.</p>
<b>Environmental Management Framework (EMP)</b>	<p>Develop a structured Environmental Management Plan (EMP) that outlines specific actions, responsibilities, monitoring requirements, and reporting mechanisms for managing environmental and social impacts. The EMP serves as an operational tool for implementation, ensuring compliance, accountability, and continuous environmental performance monitoring.</p>
<b>Stakeholder Engagement and Public Participation</b>	<p>Facilitate inclusive and transparent engagement with Interested and Affected Parties (I&amp;APs), including government institutions, local authorities, communities, and industry stakeholders. This process ensures that stakeholder concerns, inputs, and knowledge are incorporated into the assessment and decision-making process, in line with statutory requirements.</p>
<b>Monitoring and Adaptive Management</b>	<p>Establish monitoring systems to track environmental performance and effectiveness of mitigation measures during construction and operation. Adaptive management mechanisms are incorporated to allow for corrective actions in response to unforeseen impacts or changing conditions, ensuring long-term sustainability.</p>
<b>Decision Support and Reporting</b>	<p>Provide a structured, evidence-based framework to support regulatory decision-making by the Ministry of Environment, Forestry and Tourism (MEFT). The EIA outputs (Scoping Report, EIA Report, EMP) collectively</p>

inform whether the project should be approved, conditionally approved, or rejected.

## 1.5 Institutional Roles and Responsibilities

Table 8: Project Institutional Framework

Entity	Role
<b>African-Link Energy Corporation (Pty) Ltd (ALEC)</b>	Project Proponent and Lead Developer responsible for project financing, strategic direction, implementation, and operational management of the algae farming and biorefinery system.
<b>Erongo Consulting Group (ECG)</b>	<b>Environmental Assessment Practitioner (EAP)</b> responsible for the coordination and execution of the Environmental Impact Assessment (EIA), stakeholder engagement, regulatory compliance, and submission of the Environmental Clearance Certificate (ECC) application.
<b>Institute for Impact Sciences &amp; Research Design (IISRD)</b>	<b>Technical Research &amp; Impact Advisory</b> responsible for advanced impact modelling, socio-economic analysis, systems integration, and evidence-based decision support to strengthen environmental, economic, and policy outcomes.
<b>Ministry of Environment, Forestry and Tourism (MEFT)</b>	Lead Regulatory Authority responsible for environmental governance, review and approval of the ECC, and oversight of compliance within Dorob National Park.
<b>Ministry of Agriculture, Water and Land Reform (MAWLR)</b>	Oversight of water abstraction, desalination licensing, land-use regulation, and non-traditional agricultural systems including algaculture.
<b>Ministry of Fisheries and Marine Resources (MFMR)</b>	Regulation of marine resource use, protection of coastal and marine ecosystems, and oversight of seawater abstraction impacts.
<b>Namibia Investment Promotion and Development Board (NIPDB)</b>	Strategic investment facilitation, positioning of the project within Namibia's green industrialisation agenda, and coordination of international investors and partnerships.
<b>Ministry of International Relations and Cooperation (MIRCO)</b>	Facilitation of international cooperation, bilateral agreements, and strategic partnerships supporting technology transfer and market access.
<b>Erongo Regional Council</b>	Regional development coordination, alignment with regional economic priorities, and facilitation of stakeholder engagement within the Erongo Region.
<b>Henties Bay Municipality</b>	Local authority responsible for spatial planning alignment, zoning, municipal service coordination, and community interface.
<b>NamWater</b>	Technical advisory and potential infrastructure integration for desalination systems and water resource management.
<b>Erongo RED</b>	Electricity supply authority responsible for grid connectivity, power distribution, and energy infrastructure integration.
<b>Namport</b>	Strategic logistics partner enabling export of biofuel products via Walvis Bay Port and supporting international market access.
<b>Research &amp; Academic Institutions (UNAM, IUM, DRFN)</b>	Research collaboration, environmental monitoring, innovation support, and skills development aligned to project implementation.
<b>Funding Partners / Financial Institutions</b>	Provision of capital investment, financial structuring, and long-term project financing support.

<b>Stakeholders (Interested &amp; Affected Parties – I&amp;APs)</b>	Participation in the public consultation process, provision of inputs, concerns, and local knowledge contributing to informed decision-making.
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## 1.6 Scope of the Assessment

The Environmental Impact Assessment (EIA) for the proposed development adopts a comprehensive, multidisciplinary approach, covering biophysical, socio-economic, and project lifecycle dimensions. The scope is designed to ensure that all potential impacts are systematically identified, assessed, and managed in accordance with national regulatory requirements and international best practice.

### 1.6.1 Biophysical Environment

The assessment of the biophysical environment focuses on understanding the existing natural conditions and evaluating how these may be affected by the proposed development.

Key components include:

- **Climate and Meteorology**  
Assessment of local climatic conditions, including temperature regimes, wind patterns, fog occurrence, and precipitation levels, with specific consideration of coastal desert dynamics and their influence on project operations (e.g., evaporation, algae growth conditions).
- **Geology and Soils**  
Evaluation of underlying geological formations, soil types, erosion susceptibility, and ground stability to determine suitability for large-scale infrastructure development and pond construction.
- **Hydrology (Surface and Groundwater)**  
Analysis of groundwater systems (including aquifers such as Omdel), surface water dynamics, and potential interactions with project activities. This includes assessment of water abstraction, desalination processes, and potential contamination risks.
- **Marine Environment**  
Detailed consideration of the coastal and marine interface, including seawater abstraction, potential discharge impacts, marine water quality, and ecological sensitivity within the Benguela Current system.
- **Biodiversity (Terrestrial and Marine)**  
Identification and assessment of flora and fauna, including endemic and protected species, habitat sensitivity, and ecological connectivity. Particular attention is given to desert-adapted species and coastal ecosystems within Dorob National Park.

### 1.6.2 Socio-Economic Environment

The socio-economic assessment evaluates the human and economic context within which the project will be developed.

Key components include:

- **Local Livelihoods and Employment**  
Assessment of existing economic activities (e.g., tourism, fishing), employment patterns, and potential job creation opportunities associated with the project.
- **Tourism and Land Use**  
Evaluation of current land use patterns, including recreational and tourism activities, and potential interactions or conflicts with the proposed development.
- **Infrastructure and Service Systems**  
Analysis of existing infrastructure, including roads (C34), electricity supply (Erongo RED), water systems, and waste management services, as well as the project's demand on and contribution to these systems.
- **Community and Stakeholder Dynamics**  
Consideration of local community structures, stakeholder interests, and potential social impacts, including perceptions, expectations, and concerns.

### 1.6.3 Project Phases

The assessment considers impacts across the entire project lifecycle, recognising that impacts vary in nature and intensity at different stages.

- **Pre-Construction Phase**  
Activities such as site preparation, land allocation, planning approvals, and establishment of access routes.
- **Construction Phase**  
Physical development of infrastructure, including algae cultivation systems, processing facilities, desalination plant, access roads, and energy systems. This phase is associated with the highest level of disturbance.
- **Operational Phase**  
Ongoing algae cultivation, processing, water abstraction, energy use, and waste management activities. This phase represents long-term environmental and socio-economic interactions.
- **Decommissioning / Closure Phase**  
Potential future cessation of operations, including dismantling of infrastructure, site rehabilitation, and restoration of environmental conditions.

### 1.6.4 Cross-Cutting Themes

In addition to the above, the assessment integrates several cross-cutting considerations, including:

- Climate Change and Carbon Dynamics (including CO<sub>2</sub> sequestration potential)
- Resource Efficiency (water, energy, land use)
- Pollution Prevention and Waste Management
- Health and Safety Considerations
- Cumulative and Indirect Impacts

## 1.7 Study Area Overview

The study area for the Environmental Impact Assessment (EIA) is defined to capture both the direct footprint of the proposed development and the broader zone of influence within which environmental and socio-economic impacts may occur.

### 1.7.1 Primary Study Area (Project Footprint)

The primary study area comprises the core development footprint, covering approximately 28,224 hectares (282,240,000 m<sup>2</sup>) of State Land located north of Henties Bay within the Dorob National Park.

The site is:

- Situated along the C34 coastal trunk road (Swakopmund–Henties Bay–Terrace Bay corridor)
- Approximately 50 metres from the Atlantic Ocean
- Located within a coastal desert ecosystem characterised by high salinity, low rainfall, and strong marine influence

This area will accommodate:

- Algae cultivation systems (open ponds / raceway systems)
- Biorefinery and processing facilities
- Desalination and water management infrastructure
- Energy supply systems
- Internal access and operational infrastructure

### 1.7.2 Secondary Study Area (Zone of Influence)

The secondary study area includes surrounding terrestrial, marine, and socio-economic environments that may be indirectly affected by project activities.

This broader zone accounts for potential impacts associated with:

- **Water Abstraction and Marine Interaction**  
Effects of seawater abstraction and potential discharge on marine water quality, coastal processes, and ecological systems within the Benguela Current ecosystem
- **Hydrological and Groundwater Systems**  
Potential interactions with regional aquifers and subsurface conditions, including cumulative impacts on water resources
- **Infrastructure Development and Access**  
Impacts associated with transport (C34 corridor), energy supply (Erongo RED), and service infrastructure expansion
- **Socio-Economic Dynamics**  
Impacts on nearby communities, including Henties Bay, tourism activities, employment patterns, and regional economic systems

- **Cumulative and Induced Impacts**  
Secondary impacts arising from increased industrial activity, investment inflows, and land-use changes within the region

### 1.7.3 Environmental Characteristics of the Study Area

The study area is characterised by the following key environmental features:

- **Arid Coastal Desert Climate**  
Extremely low annual rainfall (typically <50 mm), high evaporation rates, and frequent fog events influenced by the cold Benguela Current
- **Geological and Soil Conditions**  
Predominantly sandy and saline soils with low fertility and high susceptibility to erosion, limiting conventional agricultural use
- **Low Terrestrial Biodiversity Density**  
Sparse vegetation dominated by desert-adapted species (e.g., lichens, pencil bush), with limited but ecologically specialised fauna
- **Marine–Terrestrial Interface Sensitivity**  
Proximity to the Atlantic Ocean introduces ecological sensitivity related to coastal processes, marine biodiversity, and water quality
- **Minimal Existing Land Use**  
The project area is largely undeveloped, with no formal agricultural or industrial activities currently taking place, making it suitable for non-arable land utilisation

### 1.7.4 Strategic Location Considerations

The location of the project presents several strategic advantages:

- Direct access to seawater resources for algae cultivation
- Proximity to existing transport infrastructure (C34 road)
- Access to energy infrastructure (Erongo RED grid)
- Relative isolation from dense settlements, reducing potential social conflict
- Alignment with coastal industrial development potential

### 1.7.5 Summary

The defined study area ensures that the EIA captures:

- Direct impacts within the project footprint
- Indirect and cumulative impacts within the surrounding environment
- Interactions between terrestrial, marine, and socio-economic systems

This integrated spatial approach supports a comprehensive and defensible assessment, aligned with regulatory expectations and best practice in environmental impact assessment.

Figure 2: Access Road to the Proposed Project Site along the C34 Coastal Trunk Road, Henties Bay, Erongo Region — illustrating existing transport infrastructure connecting Swakopmund, Henties Bay, and Terrace Bay, providing primary access to the project area.



## 1.8 Importance of the Project

Table 9: Strategic Importance of the Project

Strategic Area	Detailed Contribution
<b>Energy Transition and Security</b>	The project contributes to Namibia’s transition towards renewable energy by producing biofuel and Crude Algae Oil (CAO) as alternatives to imported fossil fuels. It supports diversification of the national energy mix, enhances energy security, and aligns with emerging green energy strategies, including low-carbon fuel production.
<b>Economic Development and Industrialisation</b>	The development establishes a new bio-industrial sector within Namibia, supporting value addition, downstream processing, and export-oriented production. It positions Namibia within the global biofuel market and contributes to GDP growth, foreign exchange earnings, and industrial diversification.
<b>Employment Creation and Skills Development</b>	The project is expected to generate approximately 1,200 direct jobs, alongside indirect employment opportunities across supply chains, logistics, services, and maintenance. It also supports skills transfer, technical training, and institutional collaboration with local research and academic institutions.
<b>Efficient Land Use and Spatial Planning</b>	The project utilises non-arable, saline desert land, thereby avoiding competition with food production systems. It demonstrates innovative land-use planning by transforming underutilised land into a productive industrial and agricultural asset.
<b>Environmental Sustainability and Climate Change Mitigation</b>	Algae cultivation has the capacity to capture and utilise carbon dioxide (CO <sub>2</sub> ), contributing to emissions reduction. The project promotes low-carbon development pathways, supports climate resilience, and reduces environmental pressures associated with conventional fossil fuel production.

<b>Water Resource Efficiency</b>	The use of seawater for algae cultivation significantly reduces dependence on scarce freshwater resources. Integration of desalination systems ensures sustainable water management within an arid coastal environment.
<b>Blue Economy Development</b>	The project supports Namibia’s blue economy framework through sustainable utilisation of marine resources, including seawater-based production systems. It strengthens coastal economic activity and aligns with regional marine ecosystem management principles.
<b>Technology Transfer and Innovation</b>	The project introduces advanced algae cultivation and biorefinery technologies, enabling knowledge transfer, innovation, and the development of new technical capabilities within Namibia’s energy and industrial sectors.
<b>Export Potential and Global Market Integration</b>	Through strategic partnerships and off-take agreements, the project positions Namibia as a producer and exporter of biofuels, enhancing participation in global green energy markets and strengthening international trade linkages.
<b>Regional Development and Infrastructure Integration</b>	The project contributes to the development of the Erongo Region by strengthening infrastructure utilisation (roads, energy, water systems), stimulating local economic activity, and supporting regional industrial growth corridors.

Overall, the project represents a strategic convergence of energy, environment, and economic development objectives, positioning Namibia as an emerging player in the global biofuel and green industrial economy.

## 1.9 Structure of the Report

This Scoping Report is structured to provide a systematic, transparent, and decision-support framework for the Environmental Impact Assessment process.

The document is organised as follows:

- **Chapter 1: Introduction**  
Overview of the project, objectives of the Scoping Report, regulatory context, scope of assessment, study area, and institutional framework.
- **Chapter 2: Project Background**  
Strategic context, national policy alignment, and justification for the proposed development.
- **Chapter 3: Project Description**  
Detailed description of the proposed development, including location, components, technologies, infrastructure, and project phases.
- **Chapter 4: Legal and Institutional Framework**  
Applicable legislation, policies, and institutional roles governing the project.
- **Chapter 5: Environmental Impact Assessment (EIA) Methodology**  
Methods and criteria used for impact identification, prediction, and evaluation.
- **Chapter 6: Analysis of Alternatives**  
Assessment of site, design, technology, and “no-go” alternatives.
- **Chapter 7: Impact Identification and Assessment**  
Evaluation of environmental and socio-economic impacts across all project phases.

- **Chapter 8: Environmental Management Framework**  
Environmental Management Plan (EMP), including mitigation, monitoring, and compliance mechanisms.
- **Chapter 9: Public Participation Process**  
Stakeholder engagement process, issues raised, and incorporation into the assessment.
- **Chapter 10: Conclusions and Recommendations**  
Summary of key findings, overall impact significance, project viability, and recommendations to the Environmental Commissioner regarding approval conditions and mitigation requirements.
- **References**  
Compilation of all legislation, policies, scientific literature, technical reports, and data sources used in the preparation of the Scoping Report.
- **Appendices**  
Supporting documentation, including stakeholder registers, meeting minutes, specialist inputs (if any), maps, figures, and additional technical data.

## 2 PROJECT BACKGROUND (STRATEGIC JUSTIFICATION AND POLICY ALIGNMENT)

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### 2.1 Introduction

This chapter presents the strategic, policy, and development context underpinning the proposed:

***ALGAE FARMING AND REFINERY FOR PRODUCTION OF BIOFUEL & CRUDE ALGAE OIL (CAO), PORTION X, HENTIES BAY STATE LAND (WITHIN DOROB NATIONAL PARK), ERONGO REGION, NAMIBIA.***

The purpose of this chapter is to demonstrate the strategic relevance and justification of the project by positioning it within Namibia's broader development trajectory, as well as its alignment with regional, continental, and global frameworks guiding sustainable development, energy transition, and industrialisation.

The analysis situates the project within the following interconnected policy and development frameworks:

- **National Development Priorities (Namibia)**  
Including Vision 2030, National Development Plans (NDPs), and sectoral strategies focused on industrialisation, renewable energy, and economic diversification.
- **Regional Frameworks (SADC)**  
Including the SADC Industrialisation Strategy, regional energy frameworks, and infrastructure development initiatives aimed at strengthening regional integration and value chains.
- **Continental Agendas (African Union)**  
Particularly Agenda 2063, which promotes inclusive growth, sustainable industrialisation, and environmentally resilient development across Africa.
- **Global Sustainability and Financing Frameworks**  
Including the United Nations Sustainable Development Goals (SDGs), the Paris Agreement on climate change, and priorities of international development finance institutions such as the World Bank, African Development Bank, and Green Climate Fund.

By aligning the proposed development across these multiple levels, the chapter establishes the project as a strategically integrated initiative that contributes to:

- Renewable energy development and energy security
- Industrial growth and value addition
- Climate change mitigation and low-carbon development
- Sustainable utilisation of marine and land-based resources
- Attraction of investment and international partnerships

The chapter therefore provides a policy-driven justification for the project, supporting its consideration within the Environmental Impact Assessment (EIA) process and informing decision-making by regulatory authorities.

## 2.2 National Development Alignment (Namibia)

Namibia’s development trajectory is guided by Vision 2030 and successive National Development Plans (NDPs), which collectively aim to transform the country into a prosperous, industrialised, and knowledge-based economy. These frameworks place strong emphasis on economic diversification, sustainable resource management, and inclusive socio-economic development.

Key national priorities include:

- Industrialisation and value addition
- Energy security and diversification
- Job creation and inclusive economic growth
- Sustainable natural resource management

In addition, Namibia’s policy direction increasingly supports renewable energy development, climate-resilient growth, and strategic investment in emerging sectors, including green fuels and alternative energy systems.

## 2.3 Project Alignment with National Priorities

The proposed **ALGAE FARMING AND REFINERY FOR PRODUCTION OF BIOFUEL & CRUDE ALGAE OIL (CAO)** directly contributes to these national priorities through a combination of industrial, environmental, and socio-economic interventions.

The project:

- Establishes a new biofuel industrial value chain, supporting local processing and value addition
- Enables export-oriented production, strengthening Namibia’s participation in global energy markets
- Creates employment opportunities (estimated ~1,200 direct jobs) and supports skills development
- Utilises non-arable coastal desert land, ensuring efficient and sustainable land use
- Promotes renewable energy production, contributing to national energy diversification

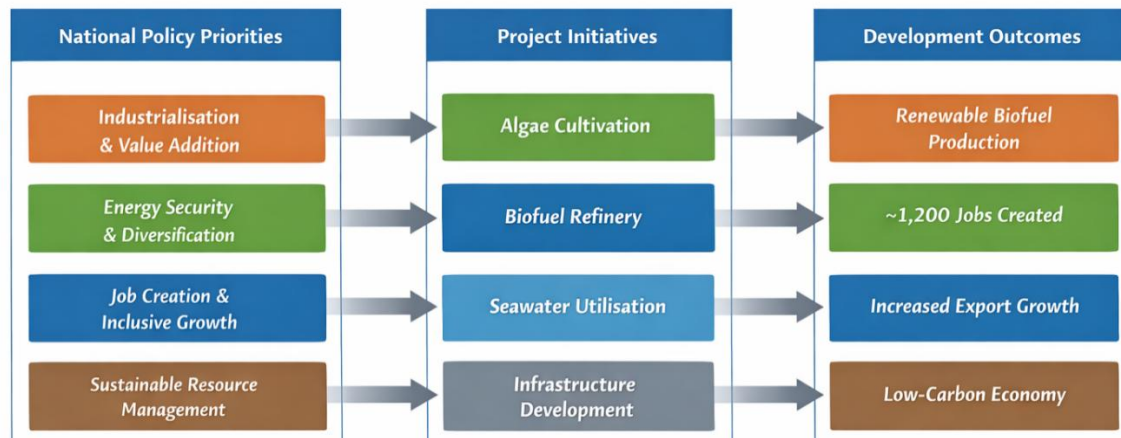
This positions the project as a practical implementation of national policy objectives, translating strategy into a large-scale, investable development initiative.

*Table 10: Conceptual Alignment with Namibia’s National Development Priorities*

National Priority Area	Policy Objective (Vision 2030 / NDPs)	Project Contribution	Expected Outcome / Impact
<b>Industrialisation and Value Addition</b>	Promote local manufacturing, processing, and industrial growth	Development of a biofuel production and refining industry based on algae biomass	Expansion of Namibia’s industrial base and increased value addition
<b>Energy Security and Diversification</b>	Reduce reliance on imported energy and	Production of biofuel and Crude Algae Oil	Enhanced energy security and

	increase renewable energy share	(CAO) as alternative energy sources	diversification of the national energy mix
<b>Job Creation and Inclusive Growth</b>	Generate employment and improve livelihoods	Creation of approximately 1,200 direct jobs and additional indirect employment	Improved socio-economic conditions and inclusive growth
<b>Sustainable Natural Resource Management</b>	Promote efficient and sustainable use of land and water resources	Use of non-arable desert land and seawater-based production systems	Reduced pressure on freshwater and agricultural land resources
<b>Economic Diversification and Export Growth</b>	Expand export sectors and reduce reliance on traditional industries	Development of export-oriented biofuel production systems	Increased foreign exchange earnings and economic resilience
<b>Climate Change Mitigation</b>	Support low-carbon development pathways	Algae systems enabling carbon capture and renewable fuel production	Contribution to emission reduction and climate resilience
<b>Regional Development (Erongo Region)</b>	Promote balanced regional economic development	Establishment of a large-scale project in the Erongo coastal corridor	Stimulation of regional growth and infrastructure utilisation

Figure 3: Conceptual Alignment of the Proposed Algae Farming and Biorefinery Project with Namibia's Vision 2030 and National Development Priorities



The figure illustrates the linkage between Namibia's key national policy priorities - industrialisation, energy security, employment creation, and sustainable resource management - and the corresponding project interventions, including algae cultivation, biofuel refining, seawater utilisation, and infrastructure development. These interventions translate into measurable development outcomes such as renewable biofuel production, job creation (~1,200 jobs), increased export growth, and contribution to a low-carbon economy.

## Synthesis

The proposed development demonstrates strong alignment with Namibia's national development agenda by:

- Converting policy priorities into implementable infrastructure

- Integrating energy, industrial, and environmental objectives
- Supporting both economic growth and sustainability goals

The project can therefore be considered a strategic national development initiative, contributing to Namibia’s transition towards a diversified, resilient, and low-carbon economy.

## 2.4 Regional Alignment (SADC Frameworks)

At a regional level, the proposed development aligns with the strategic priorities of the Southern African Development Community (SADC), which aims to promote regional integration, industrialisation, energy security, and infrastructure development across member states.

Key regional frameworks guiding this alignment include:

- SADC Industrialisation Strategy and Roadmap (2015–2063)
- SADC Renewable Energy and Energy Efficiency Strategy and Action Plan (REEESAP)
- Regional Infrastructure Development Master Plan (RIDMP)

These frameworks collectively seek to transform the SADC region into an integrated industrial economy, supported by reliable energy systems, efficient infrastructure, and cross-border trade networks.

### 2.4.1 Regional Contribution of the Project

The proposed algae farming and biorefinery project contributes to regional objectives through:

- **Regional Energy Security**  
By producing renewable biofuel and Crude Algae Oil (CAO), the project supports diversification of energy sources within the SADC region, reducing reliance on imported fossil fuels.
- **Industrial Value Chain Development**  
The project introduces a **new bio-industrial value chain**, with potential linkages to regional manufacturing, energy, and chemical sectors.
- **Cross-Border Trade and Export Capacity**  
Through proximity to the **Walvis Bay Port**, the project enhances Namibia’s role as a regional export hub, facilitating trade within SADC and beyond.
- **Development of Coastal Industrial Corridors**  
The project strengthens the **Erongo coastal corridor (Swakopmund–Henties Bay–Walvis Bay)** as a strategic industrial zone, supporting regional economic integration.

Table 11: Alignment with SADC Strategic Frameworks

Framework	Strategic Focus	Project Alignment	Regional Impact
<b>SADC Industrialisation Strategy (2015 - 2063)</b>	Industrial development, value addition, and economic diversification	Establishment of a biofuel production and refining industry	Strengthens regional industrial base and promotes value-added production
<b>REEESAP (Renewable Energy Strategy)</b>	Expansion of renewable energy and energy efficiency	Production of renewable biofuels and alternative energy sources	Enhances regional energy security and supports low-carbon energy transition
<b>RIDMP (Infrastructure Master Plan)</b>	Development of regional infrastructure (transport, energy, water)	Utilisation of transport (C34), port (Walvis Bay), and energy infrastructure	Improves regional logistics, connectivity, and trade facilitation

(SADC, 2015; SADC, 2012)

Table 12: Regional Integration of the Project within SADC Energy and Industrial Systems

Component	Project Role (Namibia Node)	Regional Linkage (SADC)	Outcome / Impact
<b>Biofuel Production (Algae-Based)</b>	Large-scale production of renewable biofuel and Crude Algae Oil (CAO) in the Erongo Region	Supply of alternative fuels to SADC member states	Enhanced <b>regional energy security</b> and diversification of fuel sources
<b>Biorefinery and Processing</b>	Conversion of algae biomass into refined biofuel products	Integration into regional industrial and energy value chains	Development of <b>regional industrial capacity</b> and value-added production
<b>Export Infrastructure (Walvis Bay Port)</b>	Export hub for biofuel products via Walvis Bay	Distribution to regional and international markets (SADC corridor)	Strengthened <b>cross-border trade</b> and logistics efficiency
<b>Transport and Logistics (C34 &amp; Corridor Linkages)</b>	Road connectivity linking production site to port and national networks	Integration with SADC transport corridors (Trans-Kalahari, Walvis Bay Corridors)	Improved <b>regional connectivity and trade facilitation</b>
<b>Energy Systems Integration</b>	Potential integration with regional energy markets and fuel systems	Contribution to SADC energy pool diversification	Support for <b>regional energy resilience and stability</b>
<b>Industrial Value Chains</b>	Creation of a new biofuel-based industrial sector	Linkages to manufacturing, chemical, and energy sectors across SADC	Expansion of <b>regional value chains and industrial ecosystems</b>
<b>Investment and Trade Platform</b>	Attraction of international and regional investment into Namibia	Positioning Namibia as a <b>regional energy and industrial hub</b>	Increased <b>FDI inflows and regional economic integration</b>

The table above presents the integration of the proposed project within SADC energy and industrial systems, illustrating Namibia’s role as a production, processing, and export node linking renewable energy production to regional markets.

(SADC, 2015; SADC, 2012)

## 2.5 Continental Alignment (African Union Agenda 2063)

The proposed development aligns with the African Union Agenda 2063, which provides a long-term strategic framework for Africa’s socio-economic transformation. The project particularly supports:

- **Aspiration 1:** A prosperous Africa based on inclusive growth and sustainable development
- **Aspiration 7:** Environmentally sustainable and climate-resilient economies

The project contributes to continental priorities through green industrial development, sustainable resource utilisation, and advancement of renewable energy systems.

Table 13: Alignment of the Project with African Union Agenda 2063

AU Aspiration / Goal	Strategic Focus	Project Contribution	Continental Impact / Outcome
<b>Aspiration 1:</b> Prosperous Africa based on inclusive growth and sustainable development	Industrialisation, value addition, economic transformation	Establishment of a <b>biofuel production and refining industry</b> using algae biomass	Supports Africa’s transition to <b>industrial economies</b> , enhances value addition, and reduces dependence on raw exports
<b>Aspiration 1 (Goal:</b> Modern Agriculture & Resource Efficiency)	Sustainable resource use and productivity	Utilisation of <b>non-arable desert land</b> and <b>seawater-based systems</b>	Promotes <b>efficient land and water use</b> , supporting climate-smart production systems across Africa
<b>Aspiration 7:</b> Environmentally Sustainable and Climate-Resilient Economies	Climate change mitigation and adaptation	Production of <b>renewable biofuel</b> and carbon capture potential through algae systems	Contributes to <b>low-carbon development pathways</b> and climate resilience across the continent
Energy Transition (Cross-Cutting Priority)	Energy access, diversification, and sustainability	Development of <b>alternative renewable fuel sources (CAO, biofuel)</b>	Supports <b>energy independence</b> , reduces fossil fuel reliance, and strengthens Africa’s energy security
Science, Technology and Innovation (STI)	Innovation-driven development and technology transfer	Introduction of <b>advanced algae cultivation and biorefinery technologies</b>	Enhances <b>technological capacity</b> , innovation, and knowledge transfer across African economies
Regional and Continental Integration	Trade integration and economic cooperation	Export-oriented production linked to <b>regional (SADC) and global markets</b>	Strengthens <b>intra-African trade</b> , supports AfCFTA objectives, and enhances continental market integration

Green Economy Development	Sustainable industries and environmental stewardship	Development of a <b>green bio-industrial sector</b>	Positions Africa within the <b>global green economy</b> and supports sustainable industrial growth
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Table 12 illustrates the alignment of the proposed project with African Union Agenda 2063 aspirations, demonstrating how project components contribute to continental goals related to industrialisation, sustainability, energy transition, and economic integration.

## 2.6 Global Development and Climate Frameworks

The proposed development aligns with the United Nations Sustainable Development Goals (SDGs), which provide a global framework for achieving sustainable economic growth, environmental protection, and social inclusion.

The project contributes directly to several SDGs through its integrated approach to renewable energy production, industrial development, resource efficiency, and environmental sustainability.

Table 14: Alignment of the Project with Sustainable Development Goals (SDGs)

SDG	Strategic Focus	Project Contribution	Expected Outcome / Impact
<b>SDG 7: Affordable and Clean Energy</b>	Access to sustainable and modern energy	Production of <b>renewable biofuel and Crude Algae Oil (CAO)</b>	Diversification of energy sources, improved energy security, and reduced reliance on fossil fuels
<b>SDG 8: Decent Work and Economic Growth</b>	Inclusive economic growth and employment	Creation of approximately <b>1,200 direct jobs</b> and indirect employment opportunities	Enhanced livelihoods, local economic stimulation, and skills development
<b>SDG 9: Industry, Innovation and Infrastructure</b>	Sustainable industrialisation and innovation	Establishment of a <b>biofuel industry and biorefinery infrastructure</b>	Strengthening of industrial capacity, innovation uptake, and infrastructure development
<b>SDG 13: Climate Action</b>	Climate change mitigation and adaptation	Algae-based systems supporting <b>carbon capture and low-carbon fuel production</b>	Contribution to emissions reduction and climate-resilient development pathways
<b>SDG 14: Life Below Water</b>	Conservation and sustainable use of marine resources	Controlled <b>seawater abstraction and discharge management systems</b>	Protection of marine ecosystems and sustainable utilisation of ocean resources
<b>SDG 12: Responsible Consumption and Production</b>	Resource efficiency and sustainable production systems	Use of <b>non-arable land and seawater-based production</b>	Improved resource efficiency and reduced environmental footprint

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*(additional – recommended)*

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<b>SDG 17: Partnerships for the Goals</b> <i>(additional – strategic)</i>	Multi-stakeholder partnerships	Collaboration with <b>government, private sector, and international partners</b>	Strengthened institutional cooperation and investment mobilisation
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*Table 13 illustrates how the proposed project contributes to key Sustainable Development Goals through integrated energy, industrial, environmental, and socio-economic interventions.*

## Synthesis

The project demonstrates a multi-dimensional contribution to global sustainability objectives by:

- Advancing **clean energy production (SDG 7)**
- Supporting **economic growth and employment (SDG 8)**
- Enabling **industrialisation and innovation (SDG 9)**
- Contributing to **climate change mitigation (SDG 13)**
- Promoting **sustainable marine resource use (SDG 14)**

### 2.6.1 Climate Change Commitments

Namibia is a signatory to the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC) and has committed, through its Nationally Determined Contributions (NDCs), to:

- Reduction of greenhouse gas (GHG) emissions
- Promotion of low-carbon development pathways
- Strengthening climate resilience and adaptation capacity

Namibia is particularly vulnerable to climate variability, including drought, desertification, and coastal ecosystem sensitivity, necessitating innovative, low-carbon development solutions.

### Project Contribution to Climate Commitments

The proposed algae farming and biorefinery project supports these commitments through:

- **Carbon Capture Potential**  
Algae systems absorb CO<sub>2</sub> during growth, contributing to carbon sequestration
- **Low-Carbon Fuel Production**  
Replacement of fossil fuels with **biofuel and Crude Algae Oil (CAO)**
- **Climate-Resilient Systems**  
Use of seawater and desert land reduces vulnerability to climate-induced water scarcity

Table 15: Alignment with Climate Change Commitments

Climate Objective	National Commitment (NDC / Paris Agreement)	Project Contribution	Expected Outcome / Impact
<b>GHG Emissions Reduction</b>	Reduction of national greenhouse gas emissions in line with Namibia's NDC targets	Algae-based systems enabling <b>carbon capture (CO<sub>2</sub> absorption)</b> and production of low-emission biofuels	Reduced carbon footprint and measurable contribution to national emissions reduction targets
<b>Low-Carbon Development</b>	Transition towards renewable and low-carbon energy systems	Production of <b>renewable biofuel and Crude Algae Oil (CAO)</b> as alternatives to fossil fuels	Diversification of energy sources and reduced dependence on imported fossil fuels
<b>Climate Adaptation and Resilience</b>	Strengthening resilience to climate variability, including drought and water scarcity	Use of <b>seawater-based production systems</b> in arid coastal environments	Reduced vulnerability to freshwater scarcity and improved climate resilience
<b>Sustainable Resource Utilisation</b>	Promotion of efficient and sustainable use of natural resources	Utilisation of <b>non-arable desert land</b> and marine resources for production	Development of climate-resilient and resource-efficient production systems

**Sources:** UNFCCC, 2015; Government of Namibia, Nationally Determined Contributions (NDCs); UNFCCC, 2015; Government of Namibia NDC Reports

## 2.7 Alignment with Development Finance Priorities

The proposed project aligns strongly with the priorities of major international development finance institutions (DFIs), positioning it as a bankable, climate-aligned investment opportunity.

## 2.8 World Bank Group Alignment

The World Bank Group prioritises:

- Climate-smart investments
- Renewable energy expansion
- Blue economy development

### Project Alignment

- Development of a **climate-resilient biofuel system**
- Integration of **marine-based production (blue economy)**
- Support for **low-carbon industrialisation**

### 2.8.1 International Monetary Fund (IMF) Alignment

The International Monetary Fund supports:

- Economic diversification
- Fiscal resilience
- Sustainable growth pathways

## Project Alignment

- Diversifies Namibia’s economy beyond mining and traditional sectors
- Supports export-led growth
- Enhances macroeconomic resilience

### 2.8.2 African Development Bank (AfDB) Alignment

The African Development Bank “High 5s” include:

- Light up and power Africa
- Industrialise Africa
- Improve the quality of life

## Project Alignment

- Renewable energy production (**biofuel systems**)
- Industrial value chain development
- Job creation and socio-economic upliftment

### 2.8.3 Green Climate Fund (GCF) Alignment

The Green Climate Fund supports:

- Low-emission development
- Climate adaptation initiatives

## Project Alignment

- Carbon reduction through algae systems
- Climate-resilient coastal production systems

*Table 16: Alignment with Development Finance Institutions*

Institution	Strategic Focus	Project Alignment	Funding Relevance
<b>World Bank Group</b>	Climate, energy, blue economy	Renewable biofuel + marine systems	Eligible for climate and blue economy financing
<b>IMF</b>	Economic stability and diversification	Export-driven industrial project	Supports macroeconomic resilience
<b>AfDB</b>	Energy, industrialisation, livelihoods	Biofuel production + job creation	Aligns with “High 5” priorities
<b>GCF</b>	Climate mitigation and adaptation	Carbon capture + low-emission fuels	Strong candidate for climate funding

Sources: World Bank, 2020; IMF, 2021; AfDB, 2015; GCF Frameworks

## 2.9 Blue Economy and Coastal Development

The project aligns with Namibia’s emerging blue economy strategy, which promotes sustainable utilisation of marine and coastal resources.

### Key Contributions

- Use of seawater-based production systems
- Development of coastal industrial infrastructure
- Integration of marine resource sustainability principles

It also aligns with the Benguela Current Convention (BCC), which promotes:

- Marine ecosystem protection
- Sustainable ocean resource management

Table 17: Alignment with Blue Economy and Coastal Development Principles

Blue Economy Component	Strategic Focus	Project Contribution	Expected Outcome / Impact
Marine Resource Utilisation	Sustainable use of ocean and coastal resources	Use of <b>seawater-based algae cultivation systems</b> for biofuel production	Sustainable utilisation of marine resources without over-extraction or ecosystem degradation
Coastal Industrial Development	Development of coastal economic zones and infrastructure	Establishment of a <b>large-scale biorefinery and algae production facility</b> within the Erongo coastal corridor	Strengthened coastal economy, industrial clustering, and regional economic growth
Environmental Protection	Conservation of marine ecosystems and water quality	Implementation of <b>controlled seawater abstraction and discharge systems</b> , including monitoring protocols	Protection of marine biodiversity, maintenance of water quality, and minimisation of ecological impacts
Regional Marine Governance	Compliance with regional marine agreements and frameworks	Alignment with <b>Benguela Current Convention (BCC)</b> principles and marine management guidelines	Enhanced compliance with regional environmental standards and sustainable marine resource governance
Blue Economy Innovation	Promotion of innovative marine-based industries	Introduction of <b>algae-based biofuel technologies</b> within a coastal desert environment	Advancement of blue economy innovation and diversification of marine-based industries
Climate–Ocean Nexus	Integration of climate mitigation with marine systems	Algae systems contributing to <b>carbon capture and low-carbon fuel production</b>	Strengthened linkage between ocean-based solutions and climate action strategies

Sources: Benguela Current Convention, 2013; Government of Namibia Blue Economy Frameworks; UN SDG 14

## 2.10 Strategic Rationale (Integrated Perspective)

The proposed development is driven by a convergence of multi-level strategic priorities, positioning it as a nationally significant and internationally relevant project.

The project integrates and responds to key development drivers across multiple scales:

- **National Priorities (Namibia)**  
Including energy security, industrialisation, employment creation, and economic diversification as articulated in Vision 2030 and National Development Plans.
- **Regional Integration (SADC)**  
Supporting regional energy systems, industrial value chains, and trade corridors within Southern Africa.
- **Continental Transformation (African Union – Agenda 2063)**  
Contributing to Africa’s long-term vision of sustainable industrialisation, innovation, and inclusive growth.
- **Global Commitments (SDGs and Climate Agreements)**  
Aligning with international frameworks such as the Sustainable Development Goals (SDGs) and the Paris Agreement on climate change.
- **Investment and Financing Opportunities**  
Positioning the project as a viable candidate for development finance, climate funding, and private sector investment, including support from international financial institutions.

Table 18: Integrated Strategic Alignment Framework

Level	Strategic Driver	Project Role	Expected Outcome / Impact
<b>National</b>	Vision 2030, National Development Plans (NDPs)	Establishment of a <b>biofuel-based industrial and energy project</b>	Economic growth, industrial diversification, and employment creation
<b>Regional</b>	SADC Industrialisation and Energy Frameworks	Integration into <b>regional energy systems and trade corridors</b>	Strengthened regional market linkages and energy security
<b>Continental</b>	African Union Agenda 2063	Development of a <b>green industrial sector</b>	Contribution to Africa’s industrial transformation and sustainability goals
<b>Global</b>	SDGs, Paris Agreement (UNFCCC)	Climate-aligned renewable energy project	Emissions reduction, sustainable development, and global environmental compliance
<b>Financial</b>	Development Finance Institutions (DFIs), Climate Funds	Structuring as an <b>investment-ready, bankable project</b>	Mobilisation of funding, investment inflows, and long-term financial sustainability

### Integrated Strategic Positioning Framework

The table above illustrates the multi-level alignment of the proposed project across national, regional, continental, global, and financial frameworks. It presents a layered structure showing how national policy priorities feed into regional integration, continental transformation, and global sustainability commitments, culminating in an investment-ready project aligned with development finance and climate funding mechanisms.

## Synthesis

The integrated strategic positioning demonstrates that the project is not a standalone development, but rather a:

- **Policy-aligned national initiative**
- **Regionally integrated industrial system**
- **Contributor to continental transformation**
- **Globally responsive climate solution**
- **Investment-ready development platform**

## 2.11 Conclusion

The proposed development is not only nationally relevant but also:

- Regionally integrated within SADC energy and trade systems
- Continentally aligned with African Union development priorities
- Globally responsive to climate and sustainability commitments

The project represents a high-impact, multi-dimensional development initiative, positioned at the intersection of:

- Energy transition
- Industrialisation
- Climate action
- Blue economy development

It is therefore considered strategically justified at all levels, subject to environmental and social safeguards identified through the Environmental Impact Assessment (EIA) process.

## 3 PROJECT DESCRIPTION (TECHNICAL CORE)

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### 3.1 Introduction

This chapter provides a comprehensive technical description of the proposed:

***ALGAE FARMING AND REFINERY FOR PRODUCTION OF BIOFUEL & CRUDE ALGAE OIL (CAO), PORTION X, HENTIES BAY STATE LAND (WITHIN DOROB NATIONAL PARK), ERONGO REGION, NAMIBIA.***

The purpose of this chapter is to present the design, layout, and operational characteristics of the proposed development, thereby establishing a clear understanding of the project's physical footprint, processes, and resource requirements.

The chapter outlines:

- The **location and spatial extent** of the project
- The **core technical components**, including algae cultivation systems and biorefinery processes
- The **supporting infrastructure**, such as water supply, energy systems, transport, and utilities
- The **operational processes** involved in biofuel and Crude Algae Oil (CAO) production
- The **project lifecycle phases**, from pre-construction through to decommissioning

This technical description forms the foundation for subsequent environmental and socio-economic impact assessment, enabling the identification of potential interactions between project activities and the receiving environment.

Furthermore, the chapter provides the necessary detail to:

- Support regulatory review and decision-making
- Inform the development of mitigation measures and environmental management strategies
- Ensure alignment between project design and environmental sustainability principles

### 3.2 Project Location

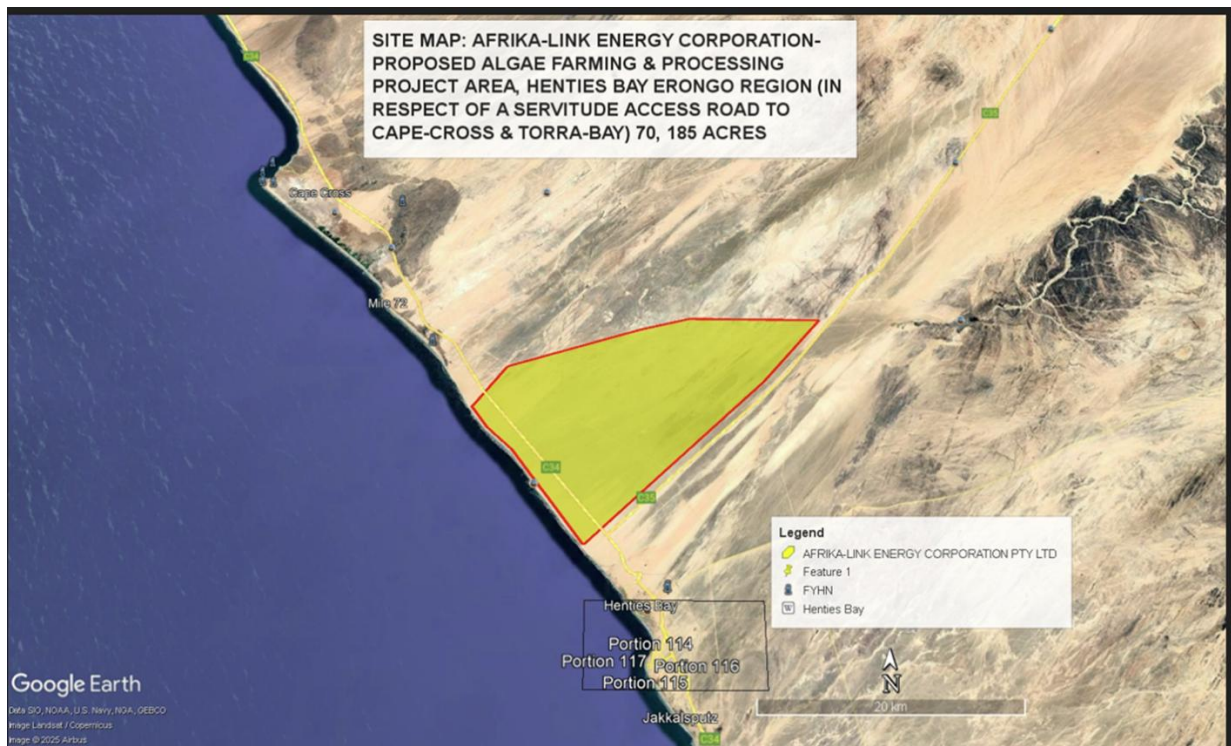
The proposed development is located on Portion X of Henties Bay State Land, within the Dorob National Park, in the Erongo Region of Namibia.

The site is strategically positioned within a coastal desert environment, characterised by arid climatic conditions and proximity to the Atlantic Ocean, making it suitable for seawater-based algae cultivation systems.

**The project area is situated:**

- Along the C34 coastal trunk road, forming part of the Swakopmund–Henties Bay–Terrace Bay corridor
- Approximately 50 metres inland from the Atlantic Ocean coastline
- Within a relatively undeveloped section of State Land with minimal existing infrastructure or competing land uses

*Figure 4: Project Site Location Map – Proposed Algae Farming and Processing Area, Henties Bay (Erongo Region)*



Map illustrating the location and spatial extent of the proposed Afrika-Link Energy Corporation algae cultivation and processing site along the Henties Bay coastal corridor, including proximity to Cape Cross and Torra Bay, as well as access routes and surrounding infrastructure. The delineated area highlights the project footprint within the Namib coastal desert environment. **Source:** Courtesy of Erongo Consulting Group (2026); base map imagery from Google Earth.

This location provides direct access to marine resources (seawater), as well as connectivity to regional infrastructure and logistics networks.

Figure 5: Satellite Map of the Proposed Project Site, Portion X, Henties Bay State Land (Dorob National Park), Erongo Region, Namibia - illustrating the project boundary (~28,224 ha / ~70,185 acres), spatial extent, and proximity to the Atlantic Ocean and C34 coastal trunk road.



### 3.2.1 Geographic Coordinates (Approximate Site Centre)

The approximate central coordinates of the proposed project site are as follows:

- **Latitude:** -22.05770° (South)
- **Longitude:** 14.25485° (East)

These coordinates represent the geographic centroid of the development area and are used as a reference point for mapping, spatial analysis, and environmental assessment.

The project boundary extends beyond this central point and is defined by a series of surveyed coordinates outlining the full extent of approximately 28,224 hectares.

All spatial data is referenced in accordance with the WGS 84 coordinate system, ensuring compatibility with Geographic Information Systems (GIS), satellite imagery, and regulatory mapping requirements.

### 3.2.2 Site Extent and Spatial Coverage

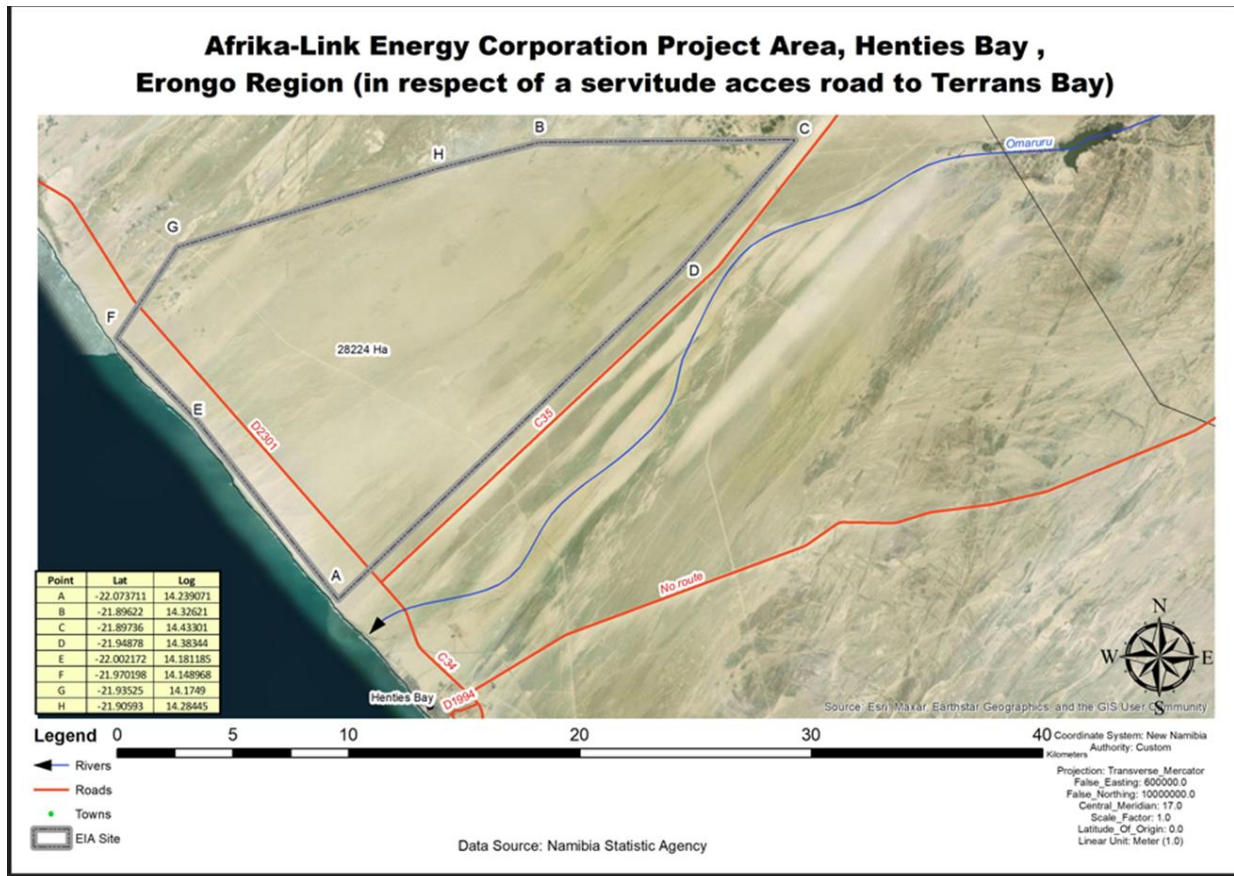
The proposed project occupies a total footprint of approximately:

- **28,224 hectares**

- Equivalent to approximately **282,240,000 m<sup>2</sup>**

This represents a large-scale, contiguous land parcel located within State Land in the Dorob National Park.

Figure 6: Henties Bay State Land & Project Area (Henties Bay Structure Plan, 2024)



Map illustrating the proposed Afrika-Link Energy Corporation algae cultivation and biorefinery project site ( $\pm 28,224$  ha) located north of Henties Bay in the Erongo Region. The figure shows the delineated project boundary (Points A–H), the designated state land extent in accordance with the 2024 Structure Plan, and the proposed servitude access road linking the site to Terrans Bay. Key regional infrastructure is indicated, including the C35, D2301, and C34 road networks, as well as ephemeral river systems and surrounding geographic features. Coordinates are presented in the Namibia Transverse Mercator projection.

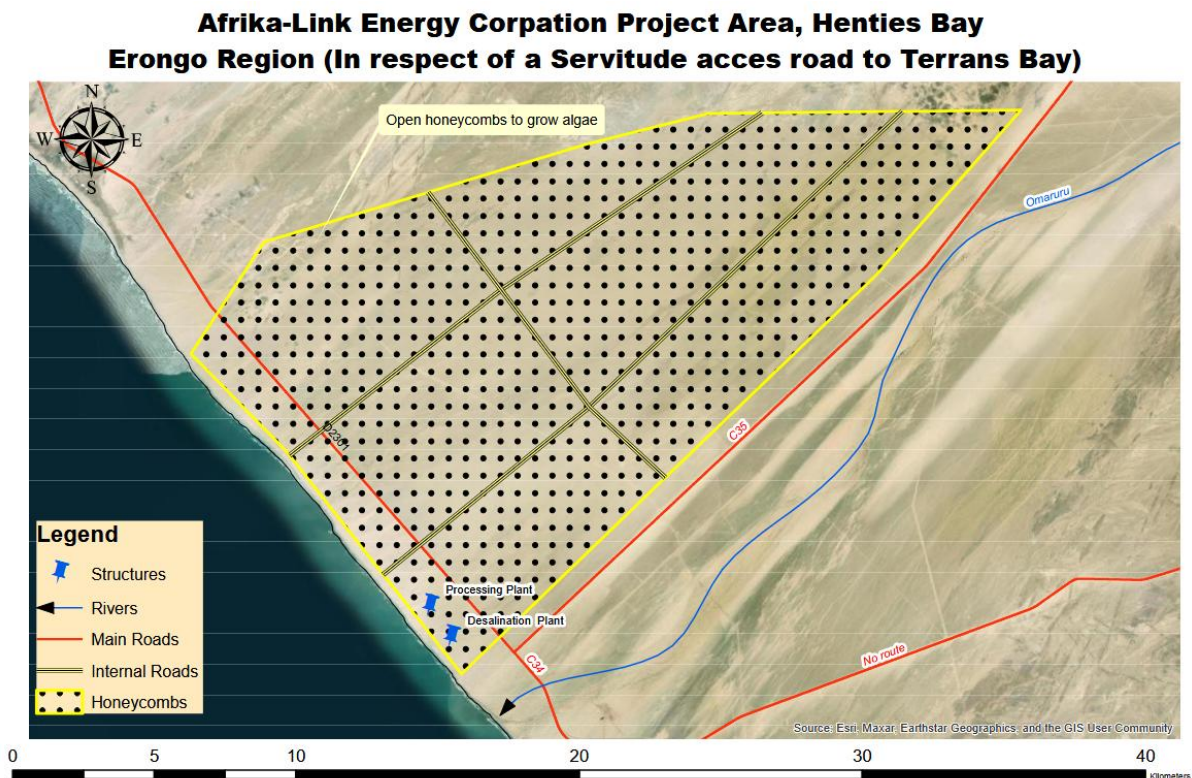
**Data sources:** Namibia Statistics Agency; **basemap:** Esri, Maxar, Earthstar Geographics.

## Spatial Characteristics

The site is characterised by:

- A **continuous and uninterrupted land area**, suitable for phased and integrated development
- Predominantly **flat to gently undulating terrain**, facilitating construction of large-scale algae cultivation systems
- Minimal existing infrastructure or competing land uses, reducing land-use conflict

Figure 7: Proposed Project Layout and Development Configuration – Algae Farming and Biorefinery, Henties Bay, Erongo Region, Namibia



Spatial layout of the proposed algae farming and biorefinery development at Henties Bay, illustrating the delineated project footprint, internal access road network, and planned infrastructure components including the processing plant and desalination facility. The layout highlights the modular “honeycomb” cultivation system for algae production, designed to optimise land use efficiency and operational scalability. The site is strategically positioned along the coastal corridor with direct access to seawater, supporting integrated cultivation and processing within a controlled development footprint.

Source: Erongo Consulting Group, 2026.

## Development Implications

The scale and configuration of the site enable:

- Establishment of extensive algae cultivation fields (pond systems)
- Integration of centralised processing and biorefinery facilities
- Development of support infrastructure, including water distribution networks, internal roads, and utilities
- Potential for phased expansion and modular development over time

## Land Use Considerations

The project utilises non-arable coastal desert land, which:

- Avoids competition with agricultural land and food production systems
- Aligns with sustainable land-use principles by activating underutilised land resources
- Minimises displacement of existing economic activities

## Strategic Significance of Scale

The large spatial footprint is essential to:

- Achieve economies of scale in algae cultivation and processing
- Support commercial viability of biofuel production
- Enable integration of industrial-scale infrastructure systems

### 3.2.3 Location Context and Accessibility

The site benefits from:

- Direct access via the C34 road, facilitating transport of materials, equipment, and personnel
- Proximity to Henties Bay, providing access to local services and workforce
- Connectivity to Swakopmund and Walvis Bay, including access to port infrastructure for export

The coastal positioning further supports:

- Efficient seawater abstraction systems
- Integration with marine-based production processes

## 3.3 Project Overview

The proposed development comprises a large-scale, integrated seawater-based algae cultivation and biorefinery system designed for the production of:

- **Biofuel**
- **Crude Algae Oil (CAO)**

The project represents a bio-industrial platform that combines primary biomass production with downstream processing and refining, forming a complete value chain from resource input to final energy products.

### 3.3.1 Integrated System Components

The development is structured as an interconnected system consisting of the following core components:

- **Algae Cultivation Infrastructure**  
Large-scale Pond systems (e.g., raceway ponds) for biomass production using seawater and solar energy
- **Processing and Biorefinery Facilities**  
Infrastructure for harvesting, dewatering, extraction, and refining of algae into biofuel and CAO
- **Water Abstraction and Desalination Systems**  
Seawater intake structures, distribution networks, and treatment systems to support cultivation and processing
- **Energy Supply Systems**  
Grid connection and/or renewable energy integration to support operational energy demand
- **Supporting Infrastructure**  
Internal road networks, storage facilities, administrative buildings, utilities, and waste management systems

### 3.3.2 System Integration

The project is designed as a closed-loop, resource-efficient system, where:

- Seawater is abstracted and utilised in cultivation processes
- Algae biomass is continuously harvested and processed
- Outputs are refined into usable energy products
- Residual materials may be reused or managed within the system

This integrated approach enhances:

- **Operational efficiency**
- **Resource optimisation**
- **Environmental sustainability**

### 3.3.3 Production Objective

The primary objective of the project is to establish a commercial-scale renewable energy production system, contributing to:

- Development of Namibia's biofuel industry
- Reduction in reliance on fossil fuels
- Expansion of export-oriented energy products

Table 19: Conceptual Overview of Integrated Algae Farming and Biorefinery System (Tabulated Process Flow)

Stage	Process Description	Key Inputs	Core Infrastructure / Technology	Outputs / Products	Environmental & Operational Considerations
<b>1. Seawater Intake</b>	Abstraction of seawater from the ocean for use in algae cultivation systems	Seawater, energy	Intake pipelines, pumps, screening systems	Raw seawater supply	Marine ecosystem disturbance, intake screening for biota protection, energy use
<b>2. Pre-Treatment</b>	Conditioning of seawater to optimize algae growth (filtration, nutrient balancing)	Seawater, nutrients (N, P, trace elements)	Filtration units, dosing systems	Conditioned growth medium	Chemical handling, nutrient sourcing, water quality control
<b>3. Cultivation</b>	Growth of algae in controlled systems (open ponds or photobioreactors)	Sunlight, CO <sub>2</sub> , nutrients, seawater	Raceway ponds / photobioreactors, CO <sub>2</sub> injection systems	Algal biomass (wet)	Land use footprint, evaporation losses, contamination risk, carbon capture potential
<b>4. Harvesting</b>	Separation of algae biomass from water	Algal culture	Centrifuges, flocculation systems, filtration units	Concentrated algal biomass	Energy intensity, chemical use (if flocculants applied), water recovery
<b>5. Dewatering &amp; Drying</b>	Reduction of moisture content in harvested biomass	Wet biomass, energy	Dryers (solar/mechanical), presses	Dry algal biomass	Energy demand, emissions (if thermal drying used)
<b>6. Biorefining / Processing</b>	Conversion of biomass into biofuels and value-added products	Dry biomass, catalysts, energy	Biorefinery units (transesterification, fermentation, extraction systems)	Biofuels, oils, proteins, biochemicals	Emissions, waste streams, chemical handling, process efficiency
<b>7. Residue Management</b>	Handling and reuse/disposal of process by-products	Residual biomass, wastewater	Anaerobic digesters, wastewater treatment systems	Biogas, treated water, residual solids	Circular economy potential, waste minimisation, compliance
<b>8. Storage &amp; Export</b>	Storage and transport of final products to markets	Final products	Storage tanks, pipelines, loading facilities, logistics systems	Export-ready biofuels/products	Spill risk, logistics footprint, port integration (Walvis Bay corridor)
<b>9. Water Recycling Loop</b>	Recovery and reuse of water within the system	Process water	Recycling systems, treatment units	Recycled water for cultivation	Reduced abstraction, salinity management, system efficiency

### 3.4 Algae Cultivation System

The project will utilise open pond (raceway) systems or equivalent large-scale cultivation technologies.

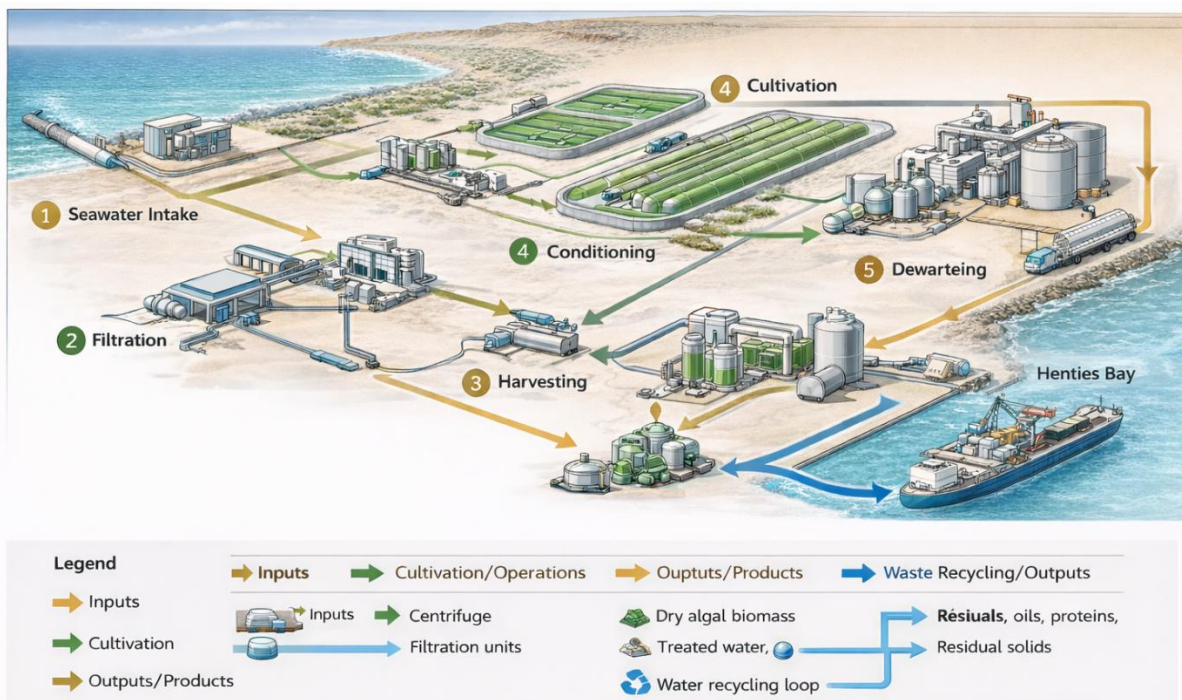
#### Key Features:

- Use of seawater as the primary growth medium
- Controlled circulation systems for nutrient distribution
- Exposure to solar radiation (high suitability in coastal desert climate)
- CO<sub>2</sub> absorption during algae growth

#### Operational Components:

- Intake and distribution channels
- Cultivation ponds
- Harvesting systems
- Biomass concentration units

Figure 8: Algae Cultivation System (Conceptual Layout)



Illustrative conceptual layout of the proposed integrated algae cultivation and biorefinery system at Henties Bay/ within Dorob National Park, showing key process components including seawater intake, filtration and conditioning, cultivation systems (raceway ponds/photobioreactors), harvesting, dewatering, and biorefinery processing. The diagram further highlights product outputs, residue management pathways, and internal water recycling loops, demonstrating a closed-loop, resource-efficient production system aligned with circular bioeconomy principles.

### 3.5 Biorefinery and Processing System

Harvested algae biomass will be processed in a biorefinery facility to produce:

- Crude Algae Oil (CAO)
- Refined biofuel products

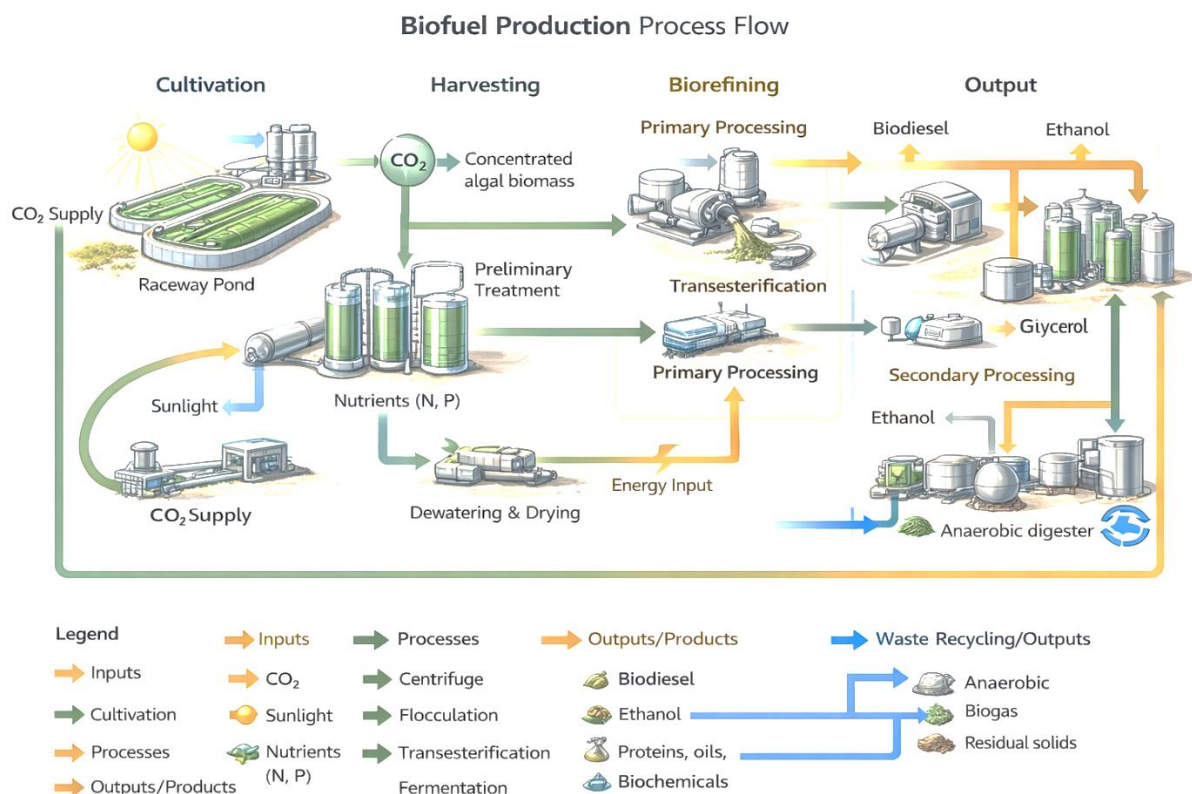
#### Key Processing Stages:

1. Biomass harvesting and dewatering
2. Oil extraction (mechanical / chemical processes)
3. Refining and upgrading
4. Storage and distribution

#### Outputs:

- Liquid biofuels
- By-products (e.g., residual biomass for potential secondary uses)

Figure 9: Biofuel Production Process Flow Diagram



Process flow diagram illustrating the conversion of cultivated algae into biofuel products. The figure outlines key stages including cultivation (with inputs such as sunlight, CO<sub>2</sub>, and nutrients), harvesting and dewatering, primary and secondary biorefining processes (including transesterification and fermentation), and final product outputs such as biodiesel, ethanol, and value-added biochemicals. The system also integrates waste recovery and recycling

pathways, including anaerobic digestion and water reuse, demonstrating a closed-loop, resource-efficient biofuel production model.

### 3.6 Water Supply and Desalination System

Water supply is a critical component of the project.

#### **Key Elements:**

- Seawater abstraction from the Atlantic Ocean
- Intake structures designed to minimise marine disturbance
- Desalination systems (where required for specific processes)
- Water distribution network across the site

#### **Environmental Considerations:**

- Controlled abstraction rates
- Brine and discharge management
- Monitoring of marine water quality

### 3.7 Energy Supply and Infrastructure

The project will require a reliable and scalable energy supply, potentially including:

- Grid connection via Erongo RED
- Supplementary renewable energy options (e.g., solar)
- Backup systems for operational continuity

#### **Infrastructure Components:**

- Internal road networks
- Storage facilities
- Administrative and operational buildings
- Waste management systems

### 3.8 Transport and Logistics

**The project benefits from proximity to key infrastructure:**

- C34 coastal road (primary access route)
- Linkages to Walvis Bay Port for export
- Integration with regional logistics corridors

### 3.9 Project Phases

The project will be implemented in phases:

Table 20: Project Phases and Activities

Phase	Key Activities	Characteristics / Impact Profile
<b>Pre-Construction</b>	Site surveys (topographical, ecological, geotechnical), environmental permitting (ECC), detailed design and planning, stakeholder engagement and consultation	Low physical disturbance; predominantly administrative and technical planning phase; critical for regulatory compliance, baseline data establishment, and risk identification
<b>Construction</b>	Land clearing and preparation, earthworks, construction of cultivation ponds/photobioreactors, installation of intake pipelines, roads, and biorefinery infrastructure	High-impact phase characterised by vegetation disturbance, soil movement, increased traffic, noise, dust emissions, and temporary habitat disruption
<b>Operation</b>	Algae cultivation, seawater abstraction and circulation, nutrient dosing, harvesting, dewatering, biorefining, storage and logistics	Long-term, continuous operations; moderate but managed impacts related to water use, energy consumption, emissions, and waste streams; includes opportunities for circular resource use and carbon capture
<b>Decommissioning</b>	Dismantling and removal of infrastructure, waste disposal, site rehabilitation, ecological restoration and monitoring	Transition phase focused on impact reversal; aims to restore site stability and ecological function in line with regulatory closure requirements

### 3.10 Waste Management

Waste streams may include:

- Organic residues from algae processing
- Brine from desalination
- General operational waste

Management will include:

- Recycling and reuse where possible
- Safe disposal systems
- Compliance with environmental standards

### 3.11 Environmental Design Considerations

The project incorporates environmental safeguards, including:

- The project incorporates environmental safeguards, including:
- Minimisation of land disturbance
- Controlled marine interaction
- Efficient water and energy use
- Integration of mitigation measures into design
- Adoption of a closed-loop water recycling system to reduce abstraction and discharge

- Buffer zones and layout optimisation to protect sensitive habitats and ecological corridors
- Modular infrastructure design to limit footprint expansion and enable phased development
- Dust, noise, and traffic management embedded into construction planning
- Use of energy-efficient systems and potential integration of renewable energy sources
- Spill prevention and containment systems for chemicals, fuels, and process inputs
- Climate-responsive design aligned with coastal desert conditions (wind, salinity, evaporation)

### 3.12 Summary

The proposed project represents a large-scale, integrated bio-industrial system, combining:

- Renewable energy production
- Marine resource utilisation
- Industrial processing infrastructure

The technical design supports:

- Operational efficiency
- Environmental sustainability
- Scalability and long-term viability

## 4 LEGAL AND INSTITUTIONAL FRAMEWORK

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### 4.1 Introduction

This chapter outlines the comprehensive legal, policy, and institutional framework governing the proposed seawater algae cultivation and biorefinery project at Henties Bay State Land (Erongo Region). It identifies applicable national legislation, sectoral policies, and international environmental agreements, and defines institutional roles, regulatory mandates, and approval processes required for project planning, implementation, operation, and eventual decommissioning.

The chapter further establishes the compliance context within which the project will be executed, ensuring adherence to statutory requirements, environmental safeguards, and best practice standards for sustainable resource utilisation and industrial development.

The framework ensures that the project is aligned with:

- Namibia’s environmental governance system
- Sustainable development principles
- Blue economy and green industrialisation strategies
- International environmental obligations
- Integrated environmental management principles, including the precautionary principle, polluter-pays principle, and lifecycle-based impact management

### 4.2 Constitutional and Policy Framework

#### 4.2.1 Constitution of the Republic of Namibia (1990)

The Constitution of the Republic of Namibia (1990) provides the supreme legal foundation for environmental protection and sustainable development in Namibia. Environmental governance is embedded within the **Principles of State Policy**, specifically under **Article 95(I)**, which obligates the State to actively promote and maintain the ecological integrity of the country.

**Article 95(I)** states that:

*“The State shall actively promote and maintain the welfare of the people by adopting, inter alia, policies aimed at the maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilisation of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future.”*

This provision establishes a clear constitutional mandate for:

- The protection of ecosystems and biodiversity
- The sustainable utilisation of natural resources
- The intergenerational equity principle, ensuring resources are preserved for future generations

Although the Principles of State Policy are not directly enforceable in a court of law, they serve as binding guiding principles for legislative development, policy formulation, and decision-making processes, including Environmental Impact Assessments (EIAs).

The proposed algae cultivation and biorefinery project aligns strongly with these constitutional obligations by promoting sustainable and innovative use of natural resources while minimising environmental impact.

*Table 21: Constitutional Alignment of the Proposed Project*

<b>Constitutional Provision</b>	<b>Key Requirement</b>	<b>Project Response / Alignment</b>
<b>Article 95(l): Maintenance of ecosystems</b>	Protection of ecological systems and environmental integrity	Project located on low-sensitivity, non-arable coastal land, reducing pressure on productive ecosystems
<b>Article 95(l): Sustainable utilisation of natural resources</b>	Use of natural resources in a sustainable and efficient manner	Utilisation of seawater instead of freshwater; integration of resource-efficient cultivation systems
<b>Article 95(l): Protection of biodiversity</b>	Conservation of flora, fauna, and ecological processes	Controlled cultivation systems minimise disturbance to natural habitats and biodiversity
<b>Article 95(l): Intergenerational equity</b>	Ensure resources are available for future generations	Renewable biofuel production and carbon capture contribute to long-term environmental sustainability
<b>Article 95(l): Promotion of ecological processes</b>	Maintain ecological balance and environmental resilience	Algae systems support carbon sequestration and potential ecosystem services (e.g., water treatment)

#### 4.2.2 National Development Frameworks

Namibia’s national development frameworks provide the strategic policy backbone within which large-scale projects such as the proposed seawater algae cultivation and biorefinery must be conceptualised, assessed, and implemented. These frameworks collectively articulate the country’s long-term vision for economic transformation, environmental sustainability, energy security, and social development, while guiding sectoral investments and infrastructure development.

At a strategic level, Namibia is actively transitioning towards a green, diversified, and climate-resilient economy, with increasing emphasis on renewable energy, sustainable industrialisation, and the optimisation of underutilised resources such as coastal and non-arable land. The proposed algae farming and biorefinery project is inherently aligned with this trajectory, as it introduces an innovative bio-based industrial system that integrates renewable energy production, carbon utilisation, and circular resource management.

Importantly, national policy direction has evolved beyond traditional economic growth models towards integrated development paradigms, including the green economy, blue economy, and bioeconomy. These paradigms prioritise low-carbon technologies, sustainable resource use, and ecosystem-based approaches to development. The project’s reliance on seawater, its capacity for carbon capture through algal biomass, and its potential to generate multiple high-value outputs (biofuels, feedstock, biochemicals) position it as a multi-sectoral intervention that responds directly to these policy shifts.

Furthermore, Namibia's development agenda places strong emphasis on:

- Energy diversification and independence, reducing reliance on imported fossil fuels
- Climate change mitigation and adaptation, in line with global commitments
- Industrial value chain development, particularly in emerging sectors
- Employment creation and regional development, especially within coastal economic zones

The Erongo Region, where the project is located, has been identified as a key industrial and energy corridor, with existing infrastructure, port access (Walvis Bay), and proximity to emerging green hydrogen developments. This enhances the strategic relevance of the proposed project within both regional and national development planning.

Against this background, the alignment of the proposed project with Namibia's core national development frameworks is presented in Table below.

Table 22: Alignment of the Proposed Project with National Development Frameworks

Framework / Policy Instrument	Key Objectives	Relevance to Project	Strategic Alignment
<b>Vision 2030 (GRN, 2004)</b>	<ul style="list-style-type: none"> <li>• Sustainable industrialisation</li> <li>• Environmental sustainability</li> <li>• Renewable energy development</li> <li>• Economic diversification</li> </ul>	<ul style="list-style-type: none"> <li>• Utilisation of non-arable coastal land for productive use</li> <li>• Development of a bio-based industrial system</li> <li>• Contribution to renewable energy supply (biofuels)</li> </ul>	<ul style="list-style-type: none"> <li>• Supports transition to a knowledge-based, industrial economy</li> <li>• Positions algae biofuel within emerging bioeconomy sectors</li> </ul>
<b>NDP5 (2017–2022)</b>	<ul style="list-style-type: none"> <li>• Economic progression</li> <li>• Environmental sustainability</li> <li>• Energy security</li> <li>• Infrastructure development</li> </ul>	<ul style="list-style-type: none"> <li>• Industrial-scale algae production supports energy diversification</li> <li>• Enhances local economic activity in Erongo Region</li> </ul>	<ul style="list-style-type: none"> <li>• Contributes to energy security and sustainable economic growth</li> </ul>
<b>NDP6 (2023–2028)</b>	<ul style="list-style-type: none"> <li>• Green and blue economy transition</li> <li>• Climate resilience</li> <li>• Job creation</li> <li>• Sustainable industrialisation</li> </ul>	<ul style="list-style-type: none"> <li>• Large-scale algae farming supports blue economy</li> <li>• Climate-resilient system using seawater</li> <li>• Employment creation across value chain</li> </ul>	<ul style="list-style-type: none"> <li>• Aligns with green industrialisation and coastal economic development priorities</li> </ul>
<b>Namibia Green Hydrogen Strategy (2022)</b>	<ul style="list-style-type: none"> <li>• Global green energy leadership</li> <li>• Renewable fuel production</li> <li>• Decarbonisation</li> <li>• Investment attraction</li> </ul>	<ul style="list-style-type: none"> <li>• Algae biofuel complements hydrogen as alternative green fuel</li> <li>• Enables CO<sub>2</sub> utilisation in cultivation systems</li> <li>• Supports integrated energy ecosystem</li> </ul>	<ul style="list-style-type: none"> <li>• Strengthens Namibia’s diversified green energy portfolio</li> <li>• Positions project within global low-carbon transition markets</li> </ul>
<b>National Climate Change Policy (2011)</b>	<ul style="list-style-type: none"> <li>• Climate mitigation and adaptation</li> <li>• Low-carbon development</li> <li>• Sustainable resource use</li> </ul>	<ul style="list-style-type: none"> <li>• Algae systems capture CO<sub>2</sub> and reduce emissions</li> <li>• Supports climate-resilient production systems</li> </ul>	<ul style="list-style-type: none"> <li>• Contributes to Namibia’s climate commitments and emissions reduction targets</li> </ul>

## 4.3 Legal Framework

### 4.3.1 Introduction

The proposed seawater algae cultivation and biorefinery project is subject to a comprehensive body of Namibian environmental, sectoral, and cross-cutting legislation. These legal instruments collectively regulate environmental protection, land use planning, water abstraction, marine resource management, pollution control, and industrial development.

Compliance with these legal requirements is mandatory throughout the project lifecycle, including planning, construction, operation, and decommissioning phases. This section identifies the key applicable legislation and outlines their relevance, core requirements, and implications for the proposed development.

*Table 23: Applicable National Legal Framework*

<b>Legislation</b>	<b>Key Provisions</b>	<b>Relevance to Project</b>	<b>Compliance Requirements</b>	<b>Responsible Authority</b>
<b>Environmental Management Act (Act No. 7 of 2007)</b>	Establishes principles of environmental management; requires EIAs and ECCs	Project is a listed activity requiring full EIA	Obtain Environmental Clearance Certificate (ECC); conduct public participation; implement EMP	Ministry of Environment, Forestry and Tourism (MEFT)
<b>Environmental Impact Assessment Regulations (2012)</b>	Defines EIA procedures and listed activities	Governs scoping, impact assessment, and reporting	Follow full EIA process and reporting standards	MEFT
<b>Water Resources Management Act (Act No. 11 of 2013)</b>	Regulates water abstraction, use, and discharge	Seawater abstraction and desalination processes	Obtain water abstraction permit; manage effluent discharge	Ministry of Agriculture, Water and Land Reform (MAWLR)
<b>Marine Resources Act (Act No. 27 of 2000)</b>	Protection and sustainable use of marine resources	Marine water intake and coastal interaction	Ensure no adverse marine ecological impacts; approvals for marine use	Ministry of Fisheries and Marine Resources (MFMR)
<b>Hazardous Substances Ordinance (No. 14 of 1974)</b>	Controls handling and disposal of hazardous substances	Chemicals used in biorefining and processing	Safe storage, transport, and disposal of hazardous materials	Ministry of Health and Social Services
<b>Atmospheric Pollution Prevention Act (No. 45 of 1965)</b>	Prevention of air pollution	Emissions from processing and drying stages	Control emissions; implement air quality	Ministry of Health / Environmental Authorities

			management measures	
<b>Pollution Control and Waste Management Bill (1999) (policy guidance)</b>	Integrated pollution and waste management framework	Waste streams from processing operations	Waste minimisation, treatment, and safe disposal	MEFT / Local Authority
<b>Prevention and Combating of Pollution of the Sea by Oil Act (Act No. 6 of 1981 &amp; Act No. 24 of 1991)</b>	Prevents marine pollution from oil and hazardous substances	Storage and transport of fuel products	Spill prevention measures and emergency response plans	Ministry of Works and Transport / MFMR
<b>Urban and Regional Planning Act (Act No. 5 of 2018)</b>	Regulates land use planning and zoning	Conversion and use of state land for industrial/agricultural purposes	Obtain land use approval; comply with spatial planning requirements	Ministry of Urban and Rural Development
<b>Local Authorities Act (Act No. 23 of 1992)</b>	Governs local authority powers and service provision	Waste management, local infrastructure, municipal compliance	Coordination with Henties Bay Municipality for services and approvals	Henties Bay Municipality
<b>Road Traffic and Transport Act (Act No. 22 of 1999)</b>	Regulates road transport and traffic	Transport of materials, equipment, and products	Compliance with road usage and transport regulations	Roads Authority / Ministry of Works and Transport

## 4.4 Policies, Plans and Local Planning Instruments

### 4.4.1 Introduction

In addition to statutory legal requirements, the proposed algae cultivation and biorefinery project is guided by a suite of national policies, local planning instruments, and strategic frameworks that inform sustainable development, land use management, and environmental protection in Namibia. These instruments provide policy direction, planning guidance, and implementation frameworks that complement legislative requirements and support integrated decision-making.

At a practical level, these policies ensure that the project is not only legally compliant but also strategically aligned with national priorities, local development plans, and environmental sustainability objectives. The following table summarises the key applicable policies and planning instruments and their relevance to the proposed development.

Table 24: Applicable Policies, Plans and Planning Instruments

Policy / Planning Instrument	Key Focus Areas	Relevance to Project	Project Alignment
Environmental Assessment Policy (1995)	<ul style="list-style-type: none"> <li>• Environmental assessment of development projects</li> <li>• Promotion of sustainable development</li> <li>• Integration of environmental considerations into planning</li> </ul>	Provides the foundation for EIA processes in Namibia	Project complies through full EIA process, impact assessment, and stakeholder engagement
Henties Bay Town Planning Scheme (2024)	<ul style="list-style-type: none"> <li>• Land use zoning</li> <li>• Development control</li> <li>• Compliance with permitted land uses</li> </ul>	Determines permissible land use within the project area	Project aligns through proposed rezoning/lease for special agricultural/industrial use
Henties Bay Urban Spatial Development Framework (2024)	<ul style="list-style-type: none"> <li>• Urban expansion planning</li> <li>• Infrastructure alignment</li> <li>• Sustainable spatial development</li> </ul>	Guides long-term development of Henties Bay and surrounding areas	Project supports planned industrial expansion and coastal economic development
National Climate Change Policy (2011)	<ul style="list-style-type: none"> <li>• Climate mitigation and adaptation</li> <li>• Low-carbon development</li> <li>• Sustainable resource use</li> </ul>	Provides national framework for climate-resilient development	Algae farming contributes to carbon sequestration, renewable fuel production, and reduced emissions
National Biodiversity Strategy and Action Plan (NBSAP)	<ul style="list-style-type: none"> <li>• Biodiversity conservation</li> <li>• Sustainable use of natural resources</li> <li>• Ecosystem-based management</li> </ul>	Ensures protection of ecosystems and biological resources	Project adopts controlled systems and minimises ecological disturbance while supporting sustainable use

#### 4.4.2 Strategic Policy Alignment

The above policy and planning instruments collectively reinforce Namibia’s transition towards a sustainable, low-carbon, and resource-efficient development pathway. The proposed algae cultivation and biorefinery project is well aligned with these frameworks in several key respects:

- It integrates environmental considerations into project design and implementation, consistent with the Environmental Assessment Policy
- It complies with local land use planning and zoning requirements, ensuring compatibility with the Henties Bay spatial development vision
- It contributes to climate change mitigation through carbon capture and renewable energy production
- It supports biodiversity conservation by minimising disturbance and utilising controlled cultivation systems
- It enhances regional economic development within a structured and policy-aligned planning framework

### 4.5 International Conventions and Agreements

#### 4.5.1 Introduction

Namibia is a signatory to a number of international environmental conventions and agreements that guide national policy, legislative development, and environmental governance. These instruments establish global standards for environmental protection, sustainable resource use, pollution control, and climate change mitigation.

Although international agreements are not directly enforceable unless domesticated into national law, they play a critical role in shaping Namibia’s regulatory framework and decision-making processes, including Environmental Impact Assessments (EIAs).

The proposed algae cultivation and biorefinery project aligns with several of these international commitments, particularly in relation to marine protection, biodiversity conservation, climate change mitigation, and sustainable resource management.

*Table 25: Applicable International Conventions and Project Alignment*

Convention / Agreement	Key Objectives	Relevance to Project	Project Alignment
<b>United Nations Convention on the Law of the Sea (UNCLOS, 1982)</b>	<ul style="list-style-type: none"> <li>• Protection and preservation of the marine environment</li> <li>• Sustainable use of ocean resources</li> </ul>	Regulates activities affecting marine ecosystems, including seawater abstraction	Project incorporates controlled seawater intake systems and minimises marine ecological disturbance
<b>Convention on Biological Diversity (CBD, 1992)</b>	<ul style="list-style-type: none"> <li>• Conservation of biodiversity</li> <li>• Sustainable use of biological resources</li> </ul>	Relevant to ecosystem protection and	Project adopts an ecosystem-based approach, minimises habitat disturbance, and

	<ul style="list-style-type: none"> <li>• Equitable benefit sharing</li> </ul>	resource utilisation	promotes sustainable use of biological resources
<b>Basel Convention (1992)</b>	<ul style="list-style-type: none"> <li>• Control of transboundary movement of hazardous waste</li> <li>• Environmentally sound waste management</li> </ul>	Applies to handling and disposal of hazardous substances and waste streams	Project includes waste management systems aligned with international standards and minimises hazardous waste generation
<b>Paris Agreement (2015)</b>	<ul style="list-style-type: none"> <li>• Climate change mitigation</li> <li>• Reduction of greenhouse gas emissions</li> <li>• Transition to low-carbon economies</li> </ul>	Relevant to renewable energy and carbon reduction initiatives	Project contributes through biofuel production, carbon capture via algae systems, and support for low-carbon industrial development

#### 4.5.2 Strategic International Alignment

The above conventions collectively reinforce Namibia’s commitment to sustainable development, environmental protection, and global climate responsibility. The proposed project demonstrates alignment with these international frameworks through:

- Adoption of environmentally responsible marine interaction systems, consistent with UNCLOS
- Implementation of an ecosystem-based approach to development, aligned with the Convention on Biological Diversity
- Integration of waste minimisation and safe handling practices, in line with the Basel Convention
- Contribution to climate change mitigation and decarbonisation, supporting the objectives of the Paris Agreement

Furthermore, the project positions Namibia within the global transition towards green energy and sustainable industrial systems, enhancing its role in international environmental and energy markets.

## 4.6 Institutional Framework

### 4.6.1 Introduction

The successful implementation of the proposed seawater algae cultivation and biorefinery project is dependent on a well-defined institutional framework that clarifies regulatory mandates, approval responsibilities, and oversight functions across national, regional, and local authorities.

In Namibia, environmental governance is characterised by a multi-institutional structure, where different ministries and agencies exercise jurisdiction over specific components of a project, including environmental management, water resources, marine systems, land use planning, and energy regulation.

For a project of this scale and complexity, effective coordination between these institutions is critical to ensure:

- Regulatory compliance across all sectors
- Efficient permitting and approval processes
- Ongoing monitoring and enforcement
- Alignment with national and regional development objectives

The key regulatory authorities and their respective roles are outlined in Table 4.5 below.

*Table 26: Key Regulatory Authorities and Institutional Responsibilities*

Institution	Mandate / Role	Relevance to Project	Key Responsibilities
<b>Ministry of Environment, Forestry and Tourism (MEFT)</b>	Environmental governance and protection	Primary environmental authority for the project	Review and approval of EIA; issuance of Environmental Clearance Certificate (ECC); monitoring environmental compliance
<b>Ministry of Agriculture, Water and Land Reform (MAWLR)</b>	Water resource management and regulation	Oversight of water abstraction and usage	Issuance of water abstraction permits; regulation of water use, desalination, and discharge systems
<b>Ministry of Fisheries and Marine Resources (MFMR)</b>	Marine resource management and conservation	Oversight of marine ecosystems and coastal interactions	Regulation of seawater intake; protection of marine biodiversity; monitoring marine impacts
<b>Ministry of Mines and Energy (MME)</b>	Energy policy and regulation	Oversight of renewable energy and biofuel integration	Alignment with national energy policies; support for biofuel production and energy diversification
<b>Henties Bay Municipality</b>	Local governance and service provision	Local authority jurisdiction over project area	Land use coordination; waste management; provision of municipal services; local compliance enforcement
<b>Erongo Regional Council</b>	Regional planning and development coordination	Regional oversight and development alignment	Coordination of regional development initiatives; alignment with regional economic strategies
<b>NamPower / Erongo RED</b>	Electricity generation and distribution	Provision of energy infrastructure	Supply of electricity; grid connection; infrastructure support for project operations

#### 4.6.2 Proponent and Consultant Roles

In addition to regulatory authorities, the roles and responsibilities of the project proponent and environmental consultant are critical to ensuring compliance and successful project execution.

*Table 27: Proponent and Consultant Responsibilities*

Entity	Role	Key Responsibilities
<b>African-Link Energy</b>	Project Proponent / Developer	Overall project development and implementation; securing permits and approvals;

<b>Corporation (ALEC)</b>		ensuring full legal and environmental compliance; financing and operational management
<b>Erongo Consulting CC</b>	Environmental Assessment Practitioner (EAP)	Preparation of EIA report; stakeholder engagement and public participation; regulatory liaison with authorities; development of Environmental Management Plan (EMP); advisory on compliance and mitigation measures

### 4.6.3 Institutional Coordination and Governance

Given the multi-sectoral nature of the project, effective institutional coordination will be required throughout all phases of development. This will be achieved through:

- Structured engagement with regulatory authorities during planning and approval stages
- Clear allocation of responsibilities between the proponent, consultant, and regulators
- Integration of regulatory requirements into project design and operations
- Ongoing communication and reporting mechanisms to ensure transparency and compliance

This coordinated institutional approach ensures that the project is implemented within a robust governance framework, reducing regulatory risks and enhancing approval efficiency.

## 4.7 Environmental Approval and Permitting Process

### 4.7.1 Introduction

The proposed seawater algae cultivation and biorefinery project is subject to a structured environmental approval and permitting process governed by Namibia’s environmental and sectoral legislation. This process ensures that all potential environmental and social impacts are identified, assessed, and appropriately mitigated prior to project implementation.

Given the multi-sectoral nature of the project - encompassing environmental management, water use, marine interaction, land use, and infrastructure development - multiple permits and approvals are required from different regulatory authorities. These approvals are interdependent and must be obtained in a coordinated manner to ensure full legal compliance and timely project execution.

*Table 28: Key Permits and Approvals Required*

<b>Permit / Approval</b>	<b>Description / Purpose</b>	<b>Responsible Authority</b>	<b>Relevance to Project</b>
<b>Environmental Clearance Certificate (ECC)</b>	Approval confirming that environmental impacts have been assessed and are acceptable	Ministry of Environment, Forestry and Tourism (MEFT)	Mandatory for commencement of project activities following EIA approval

<b>Water Abstraction Permit</b>	Authorisation for abstraction and use of water resources	Ministry of Agriculture, Water and Land Reform (MAWLR)	Required for seawater abstraction and desalination processes
<b>Coastal / Marine Use Approval</b>	Approval for activities affecting marine and coastal environments	Ministry of Fisheries and Marine Resources (MFMR)	Required for seawater intake systems and marine interaction
<b>Land Lease / Use Agreement</b>	Legal right to occupy and use state land for project purposes	MEFT / Government of Namibia (State)	Required for utilisation of state land within Dorab National Park
<b>Waste Disposal Approval</b>	Approval for handling, transport, and disposal of waste	Henties Bay Municipality / Local Authority	Required for management of solid and hazardous waste streams
<b>Access Road Approval</b>	Approval for establishment and use of access roads	Roads Authority / Ministry of Works and Transport	Required for construction and operational access to the project site

#### 4.7.2 Environmental Impact Assessment (EIA) Process

The Environmental Impact Assessment (EIA) process is the central mechanism through which environmental approval is obtained in Namibia. It is governed by the Environmental Management Act (2007) and the Environmental Impact Assessment Regulations (2012).

The key steps in the EIA process are outlined below:

*Table 29: EIA Process Steps*

<b>Step</b>	<b>Description</b>	<b>Purpose</b>
<b>1. Screening</b>	Identification of the project as a listed activity requiring environmental assessment	Determines whether an EIA is required and the level of assessment
<b>2. Scoping</b>	Identification of key environmental and social issues, and development of Terms of Reference	Defines the scope and focus of the EIA study
<b>3. Impact Assessment</b>	Detailed analysis of potential environmental and social impacts	Evaluates significance of impacts and identifies mitigation measures
<b>4. Public Participation</b>	Engagement with stakeholders, interested and affected parties	Ensures transparency and incorporation of stakeholder input
<b>5. Submission of EIA Report</b>	Compilation and submission of EIA report to MEFT	Provides decision-makers with comprehensive assessment findings
<b>6. ECC Decision</b>	Review of the EIA report and issuance (or refusal) of Environmental Clearance Certificate	Determines whether the project may proceed

### 4.7.3 Permitting Strategy and Sequencing

To ensure efficient project implementation, the permitting process will follow a coordinated and phased approach, where the Environmental Clearance Certificate (ECC) serves as the primary enabling approval upon which other permits are dependent.

Key strategic considerations include:

- The ECC must be obtained prior to commencement of construction or operational activities
- Sector-specific permits (water, marine, land use) will be pursued in parallel where possible, but aligned with EIA outcomes
- Early engagement with regulatory authorities will be undertaken to reduce approval timelines and regulatory risk
- All permitting requirements will be integrated into the project implementation schedule

## 4.8 Compliance and Monitoring Framework

### 4.8.1 Introduction

The effective implementation of the proposed seawater algae cultivation and biorefinery project will be underpinned by a comprehensive compliance and monitoring framework designed to ensure adherence to all applicable legal, regulatory, and policy requirements.

This framework translates the commitments made during the Environmental Impact Assessment (EIA) process into operational controls, monitoring systems, and accountability mechanisms throughout the project lifecycle. It ensures that potential environmental and social impacts are proactively managed, mitigation measures are effectively implemented, and compliance with permit conditions is continuously maintained.

The framework is aligned with the Environmental Management Act (2007) and international best practices in environmental and social governance, emphasising adaptive management, transparency, and continuous improvement.

### 4.8.2 Core Compliance Components

The project will implement the following key components:

*Table 30: Compliance and Monitoring Framework Components*

Component	Description	Key Functions	Implementation Approach
<b>Environmental Management Plan (EMP)</b>	Operational tool outlining mitigation measures and management actions	<ul style="list-style-type: none"><li>• Implementation of impact mitigation measures</li><li>• Assignment of responsibilities</li></ul>	EMP to be integrated into construction and operational procedures; regularly updated based on monitoring results

		<ul style="list-style-type: none"> <li>• Compliance with ECC conditions</li> </ul>	
<b>Monitoring and Reporting Systems</b>	Continuous tracking of environmental and social performance	<ul style="list-style-type: none"> <li>• Measurement of key indicators (water quality, emissions, biodiversity)</li> <li>• Compliance verification</li> <li>• Reporting to authorities</li> </ul>	Establish baseline indicators; periodic monitoring; submission of compliance reports to MEFT and relevant authorities
<b>Stakeholder Engagement Mechanisms</b>	Structured engagement with interested and affected parties	<ul style="list-style-type: none"> <li>• Information sharing</li> <li>• Grievance management</li> <li>• Ongoing consultation</li> </ul>	Maintain stakeholder database; implement grievance redress mechanism; conduct periodic consultations
<b>Incident and Risk Management Systems</b>	Systems to identify, manage, and respond to environmental and operational risks	<ul style="list-style-type: none"> <li>• Spill response</li> <li>• Emergency preparedness</li> <li>• Risk mitigation</li> </ul>	Develop emergency response plans; conduct training and drills; maintain incident reporting systems

### 4.8.3 Monitoring Indicators and Performance Tracking

The project will establish a set of Key Environmental Performance Indicators (KEPIs) to assess compliance and environmental performance. These may include:

- Water abstraction volumes and discharge quality
- Marine ecosystem health indicators
- Air emissions and energy consumption
- Waste generation and disposal rates
- Biodiversity disturbance indicators

Monitoring results will be used to:

- Evaluate the effectiveness of mitigation measures
- Inform adaptive management decisions
- Ensure compliance with regulatory thresholds

### 4.8.4 Institutional Responsibilities for Compliance

Compliance implementation will be shared among key stakeholders:

- **Proponent (ALEC):** Overall responsibility for compliance, implementation of EMP, and reporting
- **Environmental Consultant (EAP):** Advisory support, audits, and compliance monitoring
- **Regulatory Authorities (MEFT, MAWLR, MFMR):** Oversight, inspections, and enforcement

## 4.8.5 Adaptive Management and Continuous Improvement

The project will adopt an adaptive management approach, whereby monitoring results and stakeholder feedback are used to continuously improve environmental performance. This includes:

- Periodic review and updating of the EMP
- Adjustment of mitigation measures based on observed impacts
- Integration of new technologies and best practices
- Strengthening of risk management systems over time

## 4.9 Strategic Alignment and Positioning

### 4.9.1 Introduction

Beyond regulatory compliance, the proposed seawater algae cultivation and biorefinery project is strategically positioned within Namibia’s broader economic transformation agenda. The project responds directly to emerging national priorities around green industrialisation, energy diversification, coastal development, and climate resilience, and is aligned with both sectoral strategies and cross-cutting development frameworks.

This positioning elevates the project from a standalone development to a strategic national asset, contributing to long-term economic growth, environmental sustainability, and global competitiveness.

*Table 31: Strategic Alignment of the Project*

Strategic Area	National Priority Focus	Project Contribution	Strategic Value
<b>Blue Economy Strategy</b>	Sustainable utilisation of ocean and coastal resources for economic growth	Large-scale seawater-based algae cultivation and marine-integrated systems	Strengthens Namibia’s blue economy by unlocking value from coastal and marine resources
<b>Renewable Energy Transition</b>	Diversification of energy sources and reduction of fossil fuel dependence	Production of algae-based biofuels and renewable energy products	Enhances energy security and supports low-carbon energy systems
<b>Industrial Corridor Development (Erongo Coast)</b>	Development of coastal industrial hubs linked to logistics and export markets	Establishment of a bio-industrial facility within the Erongo coastal region	Reinforces Erongo as a key industrial and energy corridor with export potential
<b>Climate Change Mitigation Commitments</b>	Reduction of greenhouse gas emissions and transition to low-carbon economy	Carbon capture through algae cultivation and production of clean fuels	Supports Namibia’s commitments under the Paris Agreement and national climate policies

## 4.9.2 Strategic Positioning Summary

The project demonstrates strong alignment with Namibia's development trajectory by:

- Advancing the blue economy through innovative marine-based resource utilisation
- Supporting the green energy transition via renewable biofuel production
- Contributing to regional industrialisation, particularly within the Erongo coastal corridor
- Enhancing Namibia's role in global climate mitigation efforts through carbon capture and low-carbon technologies

This integrated alignment positions the project as a multi-sectoral catalyst, capable of delivering economic, environmental, and social value at both national and regional levels.

## 4.10 Conclusion

The proposed algae cultivation and biorefinery project is supported by a comprehensive and robust legal and institutional framework that promotes sustainable resource utilisation, environmental protection, and socio-economic development.

The analysis presented in this chapter demonstrates that the project is:

- Legally compliant, with clear alignment to applicable national legislation and regulatory requirements
- Policy-aligned, supporting Namibia's development frameworks, including Vision 2030, national development plans, and sectoral strategies
- Institutionally grounded, with well-defined roles and responsibilities across key regulatory authorities
- Environmentally responsible, incorporating mitigation measures, monitoring systems, and adaptive management approaches
- Globally relevant, aligning with international environmental conventions and climate commitments

Furthermore, the project is strategically positioned within Namibia's green industrial transition, contributing to renewable energy production, climate change mitigation, and the development of a sustainable blue economy.

Overall, the proposed development represents a forward-looking, policy-aligned, and environmentally sustainable investment, with strong potential to support Namibia's long-term economic transformation and environmental stewardship objectives.

# 5 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) METHODOLOGY

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## 5.1 Introduction

This chapter sets out the methodology applied to identify, predict, and evaluate the potential environmental and socio-economic impacts associated with the proposed seawater algae cultivation and biorefinery project at Henties Bay, Erongo Region.

The methodology provides a systematic, transparent, and replicable framework for assessing project impacts and supports evidence-based decision-making by regulators. It ensures that the assessment is aligned with Namibian legal requirements and international best practice, and that all conclusions are technically defensible.

The approach adopted is consistent with:

- Environmental Management Act (Act No. 7 of 2007)
- Environmental Impact Assessment Regulations (2012)
- Ministry of Environment and Tourism (MET) EIA Guidelines (2008)
- International Association for Impact Assessment (IAIA) Best Practice Principles (2017)

### 5.1.1 Overall Approach

The EIA follows a structured and iterative process, integrating baseline data, project design information, and stakeholder inputs to evaluate potential impacts across all project phases.

*Figure 10: EIA Methodological Framework*

Step	Description	Purpose
<b>Screening</b>	Identification of project as a listed activity	Confirm requirement for EIA
<b>Scoping</b>	Identification of key issues and receptors	Focus assessment on significant impacts
<b>Baseline Studies</b>	Collection and analysis of environmental and social data	Establish existing conditions
<b>Impact Identification</b>	Identification of potential impacts	Determine project–environment interactions
<b>Impact Prediction</b>	Estimation of potential changes	Understand magnitude and extent of impacts
<b>Impact Evaluation</b>	Assessment of significance	Support decision-making
<b>Mitigation Design</b>	Development of mitigation measures	Reduce negative impacts
<b>Monitoring &amp; Management</b>	Establish EMP and monitoring systems	Ensure ongoing compliance

## 5.2 Impact Identification

Potential impacts were identified using a combination of:

- Review of project activities (construction, operation, decommissioning)
- Analysis of baseline environmental and socio-economic conditions
- Stakeholder consultation and expert input
- Reference to similar projects and industry benchmarks

Impacts were categorised as:

- **Direct impacts** – resulting directly from project activities
- **Indirect impacts** – secondary or induced effects
- **Cumulative impacts** – combined effects with other developments

### 5.3 Impact Prediction

Impact prediction involves estimating the likely changes to environmental and social systems based on:

- Project design, scale, and operational characteristics
- Environmental sensitivities
- Scientific literature and comparable case studies
- Professional judgement and expert analysis

Where quantitative data is limited, a qualitative and semi-quantitative approach has been applied.

### 5.4 Impact Evaluation Criteria

Each identified impact was assessed using standard EIA criteria:

*Table 32: Impact Assessment Criteria*

<b>Criterion</b>	<b>Description</b>
<b>Nature</b>	Positive or negative impact
<b>Magnitude</b>	Degree of change (low, medium, high)
<b>Extent</b>	Spatial scale (site, local, regional)
<b>Duration</b>	Timeframe (short-term, medium-term, long-term, permanent)
<b>Reversibility</b>	Ability of the environment to recover
<b>Probability</b>	Likelihood of occurrence

### 5.5 Sensitivity of Receptors

The sensitivity of environmental and social receptors was determined based on:

- Ecological importance and conservation status
- Resource scarcity (e.g., water availability)
- Socio-economic vulnerability
- Legal and policy protection status

Table 33: Sensitivity Classification

Sensitivity Level	Description
Low	Resilient systems with low vulnerability
Medium	Moderately sensitive systems requiring management
High	Highly sensitive or protected systems

## 5.6 Impact Significance Determination

Impact significance was determined through the integration of magnitude and sensitivity, using a matrix-based approach.

Table 34: Impact Significance Matrix

Magnitude	Low Sensitivity	Medium Sensitivity	High Sensitivity
Low	Low	Low	Medium
Medium	Low	Medium	High
High	Medium	High	Very High

### Significance Classification

Significance Level	Description
Low	Minimal impact; no significant mitigation required
Medium	Manageable impact; mitigation required
High	Significant impact; requires strong mitigation
Very High	Critical impact; may affect project viability

## 5.7 Mitigation Hierarchy

Mitigation measures were developed following the internationally recognised **mitigation hierarchy**:

- **Avoidance** – prevent impact entirely
- **Minimisation** – reduce impact magnitude
- **Rehabilitation** – restore affected environments
- **Offsetting** – compensate for residual impacts

## 5.8 Assumptions and Limitations

The assessment is based on available data and reasonable assumptions, including:

- Reliance on regional datasets where site-specific data is limited
- Use of professional judgement in qualitative assessments
- Assumption of full implementation of mitigation measures

These limitations do not significantly affect the overall reliability of the assessment.

### 5.8.1 Conclusion

The methodology applied provides a robust, transparent, and defensible framework for impact assessment. It ensures that all potential impacts are systematically evaluated and that mitigation measures are appropriately defined.

This methodology forms the basis for the detailed impact assessment, where impacts are evaluated in terms of their significance and management requirements.

## 6 ANALYSIS OF ALTERNATIVES

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### 6.1 Introduction

This chapter evaluates feasible alternatives to the proposed seawater algae cultivation and biorefinery project located at Henties Bay State Land in the Erongo Region. The purpose is to demonstrate that the selected project configuration represents the most environmentally suitable, technically feasible, and economically viable option, in accordance with Namibian EIA requirements and international best practice (MET, 2008; IAIA, 2017).

The analysis considers:

- Site alternatives
- Design and layout alternatives
- Technology alternatives
- Operational alternatives
- The “No-Go” alternative

The assessment is guided by the principle of avoiding environmental harm, optimising resource efficiency, and maximising socio-economic benefits.

### 6.2 Methodological Approach

Alternatives were assessed using the following criteria:

*Table 35: Alternatives Assessment Criteria*

<b>Criteria</b>	<b>Description</b>
<b>Environmental Suitability</b>	Sensitivity of receiving environment
<b>Technical Feasibility</b>	Practicality of implementation
<b>Economic Viability</b>	Cost-effectiveness and scalability
<b>Resource Efficiency</b>	Water, land, and energy requirements
<b>Infrastructure Access</b>	Availability of roads and services
<b>Socio-economic Benefit</b>	Employment and economic contribution

### 6.3 Site Alternatives

#### 6.3.1 Proposed Site: Henties Bay Coastal Location (Preferred Option)

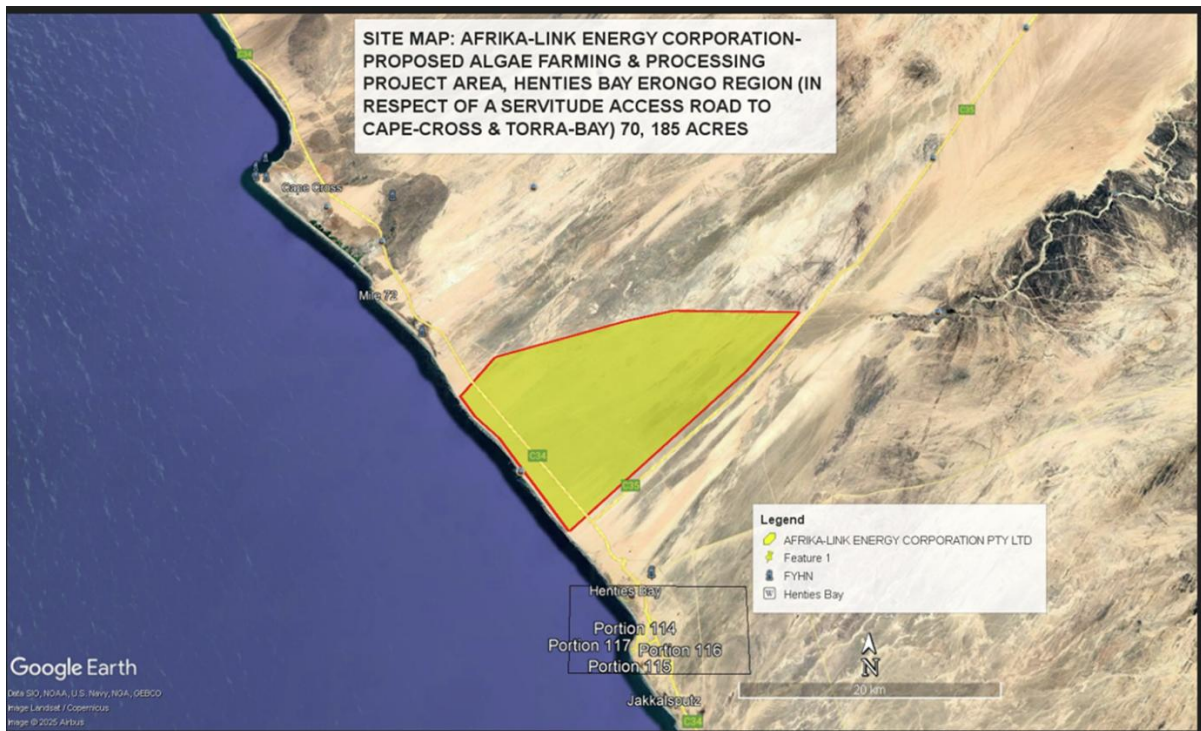
The proposed site is located along the Henties Bay coastal corridor between Henties Bay and Cape Cross, with direct access to the C34 and C35 road network. The site covers approximately 70,185 acres of state-owned desert land.

#### **Key Advantages:**

- Direct access to seawater, enabling sustainable algae cultivation without reliance on freshwater resources
- Strategic logistics positioning along the Erongo coastal transport corridor

- Low land-use conflict, as the site is non-arable and sparsely populated
- Large contiguous land area, allowing scalable and phased development
- Favourable environmental conditions, including low ecological sensitivity at a macro scale

Figure 11: Preferred Site Location within the Henties Bay Coastal Corridor (Alternatives Assessment Context)



Map illustrating the selected project site for the proposed algae cultivation and processing facility within the Henties Bay–Cape Cross coastal corridor. The delineated footprint highlights its strategic positioning adjacent to the Atlantic Ocean and along the C34/C35 transport routes, demonstrating clear advantages over inland alternatives in terms of seawater access, logistics connectivity, land availability, and reduced environmental and land-use constraints. Source: Courtesy of Erongo Consulting Group (2026); base imagery from Google Earth.

### 6.3.2 Inland Alternative

An inland site was considered as an alternative; however, this option presents several constraints:

- Dependence on scarce freshwater resources
- Increased infrastructure requirements (pipelines, transport)
- Higher environmental pressure on groundwater systems
- Reduced operational efficiency

Table 36: Site Alternatives Comparison

Criteria	Proposed Coastal Site	Inland Alternative
Water Source	Seawater (abundant)	Freshwater (limited)
Environmental Impact	Low–Medium	Medium–High

<b>Infrastructure</b>	Existing (C34/C35)	Limited
<b>Cost</b>	Moderate	High
<b>Suitability</b>	High	Low

**Preferred Option: Proposed Coastal Site**

## 6.4 Design and Layout Alternatives

### Option 1: Distributed Layout (Preferred)

- Spatially separated pond systems
- Reduced environmental concentration
- Improved airflow and operational efficiency

### Option 2: Compact Layout

- Smaller footprint
- Higher intensity impacts
- Reduced operational flexibility

*Table 37: Design Alternatives*

<b>Criteria</b>	<b>Distributed Layout</b>	<b>Compact Layout</b>
<b>Environmental Impact</b>	Lower	Higher
<b>Operational Efficiency</b>	High	Moderate
<b>Risk</b>	Lower	Higher

**Preferred Option: Distributed Layout**

## 6.5 Technology Alternatives

### Option 1: Open Pond Systems (Preferred)

- Cost-effective
- Suitable for large-scale production
- Compatible with local climatic conditions

### Option 2: Photobioreactors

- Higher efficiency
- High capital and operational cost
- Complex maintenance requirements

*Table 38: Technology Alternatives*

<b>Criteria</b>	<b>Open Ponds</b>	<b>Photobioreactors</b>
<b>Cost</b>	Low	High
<b>Scalability</b>	High	Moderate
<b>Complexity</b>	Low	High

<b>Suitability</b>	High	Moderate
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**Preferred Option: Open Pond Systems**

## 6.6 Operational Alternatives

### Option 1: Seawater-Based System (Preferred)

- Sustainable and abundant resource
- No reliance on groundwater

### Option 2: Freshwater-Based System

- Unsustainable in arid environment
- High environmental risk

**Preferred Option: Seawater-Based System**

## 6.7 The “No-Go” Alternative

The “**No-Go**” alternative represents a scenario where the project is not implemented.

### Implications

**Positive:**

- No environmental disturbance

**Negative:**

- No job creation
- Continued economic dependence on seasonal tourism
- Missed opportunity for renewable energy development
- No contribution to Namibia’s green industrialisation

*Table 39: No-Go vs Project Option*

<b>Criteria</b>	<b>No-Go Option</b>	<b>Project Option</b>
<b>Environmental Impact</b>	Minimal	Managed
<b>Economic Benefit</b>	None	High
<b>Employment</b>	None	Significant
<b>Sustainability</b>	Low	High

**Conclusion: Project Option is strongly preferred**

## 6.8 Preferred Alternative

Based on the assessment, the preferred alternative is:

- ✓ Coastal site at Henties Bay
- ✓ Seawater-based algae cultivation system
- ✓ Open Pond technology
- ✓ Distributed layout design

This configuration provides the optimal balance between environmental sustainability, technical feasibility, and economic viability.

## 6.9 Conclusion

The analysis demonstrates that the selected project option is the most appropriate and sustainable development pathway.

Key conclusions:

- Environmental impacts are lower than alternative options
- Technical feasibility is high
- Socio-economic benefits are significant and long-term
- The No-Go option results in lost economic and developmental opportunities

# 7 BASELINE ENVIRONMENTAL AND SOCIAL CONDITIONS

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## 7.1 Introduction

This chapter presents a comprehensive description of the existing biophysical and socio-economic environment within and surrounding the proposed seawater algae cultivation and biorefinery project area located at Henties Bay State Land, Erongo Region.

The baseline assessment establishes the environmental and social context within which the project will be implemented and provides the foundation for subsequent impact identification, assessment, and mitigation planning. It is a critical component of the Environmental Impact Assessment (EIA), as it defines the current state of environmental systems, identifies sensitive receptors, and supports the evaluation of potential project-induced changes.

The specific objectives of this baseline assessment are to:

- Establish the current environmental conditions prior to project implementation
- Identify environmental and social sensitivities and receptors
- Provide a scientifically informed reference point against which potential project impacts can be assessed
- Inform the design of appropriate mitigation, management, and monitoring measures
- Support evidence-based decision-making by regulatory authorities

The baseline has been developed using a combination of:

- Secondary data sources, including published reports, environmental atlases, policy documents, and previous studies
- Site observations and reconnaissance surveys undertaken within the project area
- Available regional environmental and socio-economic datasets relevant to the Erongo coastal zone

Where site-specific data is limited, regional data and established scientific literature have been used to provide a representative and scientifically grounded understanding of environmental conditions (Mendelsohn et al., 2002; MET, 2008).

This chapter is structured into key thematic components, reflecting the primary environmental and social systems that may be influenced by the proposed development.

These include:

- Climate and meteorology
- Topography, geology, and soils
- Hydrology (surface and groundwater systems)
- Biodiversity (flora, fauna, and ecological sensitivity)
- Socio-economic environment and livelihoods

Together, these components provide a holistic baseline profile, enabling a robust and integrated assessment of potential impacts in subsequent chapters and ensuring alignment with national EIA guidelines and best practice (MET, 2008; FAO, 2012).

## 7.2 Climate and Meteorology

### 7.2.1 Introduction

The project area falls within the Namib coastal desert climatic zone, which is characterised by hyper-arid conditions, low and highly variable rainfall, and a strong maritime influence from the cold Benguela Current along the Atlantic Ocean. This oceanic influence moderates temperatures and contributes to the formation of persistent fog, a defining feature of the central Namib coastal environment (Mendelsohn et al., 2002; Seely & Henschel, 1998).

Climatic conditions are a critical determinant of both environmental sensitivity and project feasibility, particularly for algae cultivation systems that depend on solar radiation, temperature stability, and water availability.

### 7.2.2 Climatic Characteristics

The climate of the Henties Bay area can be classified as arid desert (BWh/BWk under the Köppen-Geiger classification system), with the following key characteristics:

- **Average Annual Rainfall:** Approximately 0–50 mm, with high inter-annual variability (Mendelsohn et al., 2002)
- **Average Temperature:** Relatively mild and stable, ranging between 16°C and 18°C annually
- **Humidity:** Frequently above 80%, primarily due to coastal fog influence
- **Wind Regime:** Dominated by south-westerly winds, with occasional strong easterly winds during certain seasons
- **Solar Radiation:** High levels of solar irradiance typical of desert environments

A defining climatic feature of the region is the occurrence of coastal fog, which is recorded on approximately 80–100 days per year. This fog results from the interaction between the cold Benguela Current and warmer air masses, creating condensation that provides a critical moisture source for desert ecosystems (Seely & Henschel, 1998).

Table 40: Key Climatic Parameters

Parameter	Description	Implication for Project
Climate Type	Arid desert (BWh/BWk)	Suitable for controlled cultivation systems
Rainfall	0–50 mm/year	Minimal reliance on rainfall
Temperature	~16–18°C (stable)	Favourable for algae growth
Humidity	High (fog-influenced)	Supports moisture balance
Wind	Predominantly south-westerly	May affect infrastructure design
Fog Occurrence	80–100 days/year	Supplementary moisture source

### 7.2.3 Relevance to Project

The prevailing climatic conditions present both opportunities and constraints for the proposed algae cultivation and biorefinery project.

#### Favourable Conditions:

- High levels of **solar radiation**, supporting photosynthetic efficiency in algae systems
- **Stable temperature ranges**, reducing thermal stress on cultivation systems
- Presence of **coastal fog**, which contributes to ambient moisture and may reduce water loss

**Potential Constraints:**

- **High evaporation rates**, which may increase water demand within open cultivation systems
- **Wind-driven dust and sand movement**, potentially affecting infrastructure and operational efficiency
- Exposure to **coastal climatic conditions**, including salinity and corrosion risks

These factors will need to be incorporated into project design, including engineering specifications, water management systems, and operational controls.

**Summary**

The climate of the project area is typical of the Namib coastal desert, characterised by arid conditions, low rainfall, and strong marine influence (Mendelsohn et al., 2002). While environmental constraints exist, the overall climatic conditions are highly suitable for algae cultivation, particularly when supported by appropriate design and management measures.

## 7.3 Topography, Geology and Soils

### 7.3.1 Introduction

This section describes the physical characteristics of the project area, including topography, geological formations, and soil conditions. These components are important in determining site suitability, engineering considerations, and environmental sensitivity, particularly in relation to erosion risk, infrastructure development, and land use capability.

### 7.3.2 Topography

The project site is located within a flat to gently undulating coastal desert landscape, characteristic of the central Namib Desert (Mendelsohn et al., 2002). Elevation changes across the site are minimal, and the terrain is largely open and unobstructed.

This relatively uniform topography is typical of coastal desert plains shaped by long-term wind action and sediment deposition processes (Seely & Henschel, 1998).

**Implications:**

- Favourable conditions for large-scale infrastructure development
- Minimal need for major land levelling or earthworks
- Potential exposure to wind erosion due to lack of vegetation cover

### 7.3.3 Geology

The geology of the Erongo coastal region is complex and reflects a long geological history. The project area is underlain by a combination of:

- **Ancient crystalline basement rocks**, forming part of the Precambrian geological formations
- **Karoo Sequence formations**, consisting of sedimentary deposits associated with historical geological processes
- **Aeolian (wind-blown) sand deposits**, which dominate the surface layer and are characteristic of the Namib Desert environment (Mendelsohn et al., 2002; Miller, 2008)

These geological formations influence soil development, drainage characteristics, and structural stability of the land.

#### Implications:

- Generally stable geological conditions for development
- Surface layers may be loose and mobile due to sandy deposits
- Engineering design must consider soil–substrate interactions

### 7.3.4 Soils

Soils within the project area are typical of arid desert environments and are generally:

- **Poorly developed**, due to limited weathering and organic activity
- **Highly saline**, influenced by coastal processes and evaporation
- **Low in organic content**, resulting in limited fertility
- **Highly susceptible to erosion**, particularly wind erosion due to sparse vegetation cover (Mendelsohn et al., 2002; FAO, 2012)

Common soil types in the region include:

- **Leptosols** – shallow soils over hard rock
- **Gypsisols** – soils with high gypsum content
- **Acrisols** – weathered soils with low fertility

*Table 41: Soil Characteristics and Sensitivity*

Soil Property	Description	Implication for Project
<b>Soil Development</b>	Poorly developed, shallow and weakly structured soils typical of arid environments	Limited agricultural potential; suitable for non-soil-dependent systems such as algae cultivation
<b>Salinity</b>	High salinity levels due to coastal influence and evaporation processes	Unsuitable for conventional crops; supports alternative saline-tolerant systems
<b>Organic Content</b>	Very low organic matter content	Low soil fertility and minimal biological activity

<b>Erosion Risk</b>	High susceptibility to wind erosion due to loose sandy texture and sparse vegetation cover	Requires implementation of erosion control measures, dust suppression, and surface stabilisation during construction and operation
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### 7.3.5 Relevance to Project

The physical characteristics of the project area present both opportunities and constraints for development.

Key implications include:

- The land is unsuitable for conventional agriculture, making it highly suitable for alternative uses such as algae cultivation that do not rely on fertile soils (FAO, 2012)
- The flat terrain supports efficient layout of cultivation ponds and infrastructure
- High susceptibility to erosion necessitates careful construction and site management practices, including dust suppression and surface stabilisation measures
- Engineering design must account for loose sandy substrates and soil stability considerations

The topography, geology, and soils of the project area are typical of the Namib Desert coastal environment, characterised by flat terrain, mixed geological formations, and fragile, low-fertility soils (Mendelsohn et al., 2002).

While these conditions limit traditional land use options, they are well suited to the proposed algae farming system. With appropriate design and mitigation measures, potential risks - particularly related to erosion - can be effectively managed.

## 7.4 Surface and Groundwater Hydrology

### 7.4.1 Introduction

This section describes the hydrological characteristics of the project area and its surroundings, including surface water systems and groundwater resources. Understanding hydrology is critical for the proposed algae cultivation and biorefinery project, particularly given its reliance on seawater abstraction, proximity to the Atlantic Ocean, and the presence of regionally important groundwater systems.

The assessment considers water availability, hydrological processes, and potential sensitivities associated with water use and management, based on available regional studies and national water resource information (Mendelsohn et al., 2002; MAWRD, 2013).

### 7.4.2 Surface Water

The project area is located within an arid coastal desert environment, where surface water resources are extremely limited (Mendelsohn et al., 2002).

Key characteristics include:

- Absence of permanent rivers or surface water bodies within the immediate project area
- Presence of ephemeral drainage systems, which flow only during rare rainfall events
- Very low surface runoff, due to minimal precipitation and high evaporation rates typical of the Namib Desert climate (Mendelsohn et al., 2002)

These ephemeral systems may play an important ecological role during infrequent rainfall events by supporting temporary habitats and facilitating limited groundwater recharge.

*Table 42: Surface Water Characteristics*

Parameter	Description	Implication for Project
Permanent Water Bodies	No perennial rivers, streams, or surface water bodies within or adjacent to the project area	No direct impacts on permanent surface water systems anticipated
Ephemeral Systems	Presence of ephemeral drainage channels that flow only during infrequent rainfall events	Project design should avoid obstruction or alteration of natural drainage pathways
Surface Runoff	Extremely low due to arid climate, low rainfall, and high evaporation rates	Low flood risk; minimal stormwater management requirements

### 7.4.3 Groundwater

Groundwater is a critical resource in the Erongo Region, particularly for domestic and municipal supply. The primary groundwater source in the broader Henties Bay area is the Omdel Aquifer, which supplies water to coastal settlements including Henties Bay and Swakopmund (Mendelsohn et al., 2002).

Local hydrogeological conditions are characterised by:

- Low recharge rates, due to arid climatic conditions (MAWRD, 2013)
- Variable groundwater quality, often influenced by salinity and geological formations (Mendelsohn et al., 2002)
- Limited sustainable yield, making groundwater a sensitive and strategic resource

*Table 43: Groundwater Characteristics*

Parameter	Description	Implication for Project
<b>Main Aquifer</b>	Omdel Aquifer, a key regional groundwater resource supplying coastal settlements (Mendelsohn et al., 2002)	High strategic importance; requires protection from any project-related impacts
<b>Recharge Rate</b>	Low natural recharge due to arid climatic conditions (MAWRD, 2013)	Limited capacity for natural replenishment; abstraction must be carefully managed
<b>Water Quality</b>	Variable, often influenced by salinity and geological conditions (Mendelsohn et al., 2002)	Constraints on potable and agricultural use; reinforces suitability of seawater-based systems
<b>Sensitivity</b>	Moderate to high sensitivity due to limited availability and regional dependence	Strict contamination control measures required to protect groundwater integrity

#### 7.4.4 Relevance to Project

The proposed project design significantly reduces reliance on freshwater resources by utilising seawater abstraction for algae cultivation and associated processes. This represents a major environmental advantage in an arid region where freshwater resources are scarce (FAO, 2012).

Key implications include:

- Reduced pressure on regional groundwater resources, particularly the Omdel Aquifer
- Alignment with sustainable water use principles in water-scarce environments

However, several risk considerations must be addressed:

- Potential contamination pathways, particularly from chemicals, fuels, or process effluents
- Risk of groundwater pollution if waste management systems are not properly controlled
- Need for controlled discharge systems to prevent marine or soil contamination
- Implementation of closed-loop water recycling systems to minimise abstraction and discharge (FAO, 2012)

#### **Summary**

The hydrological baseline indicates that the project area has limited surface water resources and sensitive groundwater systems, typical of the Namib Desert environment (Mendelsohn et al., 2002). While constraints exist, the project's reliance on seawater and adoption of water-efficient systems significantly reduces potential impacts.

With appropriate design and mitigation measures, hydrological impacts are expected to be low and manageable.

### 7.5 Biodiversity (Flora and Fauna)

#### 7.5.1 Introduction

The project area is situated within the Namib Desert biome, one of the oldest and most arid ecosystems globally. This biome is characterised by low species richness but high ecological specialisation, with flora and fauna adapted to extreme conditions such as low rainfall, high salinity, temperature variability, and frequent fog events.

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*Figure 12: Pencil Bush (Arthroa leubnitziae) – Typical Desert Flora of the Project Area*



Example of *Arthroa leubnitziae* (Pencil bush), a drought-adapted shrub commonly found in the Namib Desert. The species is characteristic of arid environments with poor soils and low rainfall, reflecting the ecological conditions within the project area.

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*Figure 13: Namib Desert Landscape – Typical Terrain within the Project Area*



View of aeolian sand dunes and sparse vegetation characteristic of the Namib Desert environment. The landscape reflects the arid climatic conditions, wind-driven geomorphology, and low vegetation cover typical of the project area, highlighting its low agricultural potential and suitability for alternative land uses such as algae cultivation. Source: Courtesy of Erongo Consulting Group (2026).

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Despite its apparent sparsity, the Namib Desert supports unique and highly adapted species, many of which are sensitive to disturbance. As such, understanding the biodiversity baseline is essential for identifying ecological constraints and informing impact mitigation measures.

### 7.5.2 Flora

Vegetation within the project area is generally sparse and discontinuous, reflecting the arid desert conditions and poor soil development. Plant species present are typically xerophytic (drought-resistant) and adapted to saline and nutrient-poor environments.

Common species recorded in the broader Henties Bay and central Namib region include:

- *Arthroa leubnitziae* (Pencil bush)
- *Zygophyllum stapfii* (Dollar bush)
- *Welwitschia mirabilis* (occurring in the wider region, particularly inland)

In addition, lichen fields may occur in coastal zones and represent ecologically sensitive systems that rely heavily on fog as a moisture source.

Overall, vegetation cover within the immediate project footprint is limited, with low biomass and low structural complexity.

### 7.5.3 Fauna

Faunal diversity within the project area is constrained by the harsh environmental conditions; however, the Namib Desert supports a range of specially adapted species.

Typical fauna includes:

- **Small mammals**, such as rodents adapted to arid environments
- **Reptiles**, including geckos, lizards, and snakes adapted to desert conditions
- **Avifauna**, particularly bird species associated with coastal and desert ecosystems

Faunal activity is often spatially and temporally variable, influenced by environmental conditions such as fog, temperature, and food availability.

### 7.5.4 Ecological Sensitivity

The ecological sensitivity of the project area is assessed as low to moderate within the immediate project footprint, primarily due to the sparse vegetation and limited faunal presence.

However, areas of higher ecological sensitivity may occur in specific microhabitats, including:

- **Coastal zones**, where marine-terrestrial interactions support unique ecosystems
- **Lichen fields**, which are highly sensitive to physical disturbance and slow to recover
- **Ephemeral drainage lines**, which may support higher biodiversity and ecological functions during infrequent rainfall events

These areas require careful consideration during project planning and implementation.

Table 44: Biodiversity Sensitivity Overview

Component	Baseline Condition	Sensitivity Level	Key Considerations
<b>Flora</b>	Sparse, desert-adapted vegetation	Low	Limited clearance required
<b>Fauna</b>	Low diversity, highly adapted species	Low–Moderate	Avoid disturbance to habitats
<b>Lichen Fields</b>	Localised, highly sensitive systems	High	Strict avoidance recommended
<b>Coastal Zones</b>	Ecologically dynamic interface	Moderate–High	Controlled marine interaction required
<b>Ephemeral Drainage</b>	Occasional ecological hotspots	Moderate	Avoid disruption of natural flow patterns

### 7.5.5 Relevance to Project

The biodiversity baseline indicates that the project area is generally suitable for development, with manageable ecological constraints.

Key implications for the project include:

- Minimal vegetation clearance is anticipated due to low plant density
- Infrastructure placement should avoid sensitive microhabitats, particularly lichen fields and drainage lines
- Implementation of targeted mitigation measures to minimise ecological disturbance
- Adoption of an ecosystem-based management approach, consistent with national and international biodiversity frameworks

## 7.6 Socio-Economic Environment

### 7.6.1 Introduction

This section provides an overview of the socio-economic characteristics of the Henties Bay area and its surrounding region, within which the proposed seawater algae cultivation and biorefinery project will be implemented. The analysis considers population dynamics, economic activities, employment patterns, and livelihood structures, with the aim of identifying existing conditions, socio-economic sensitivities, and development opportunities.

Understanding the socio-economic baseline is essential for evaluating how the proposed project may influence local livelihoods, economic resilience, and regional development, and for identifying pathways through which positive impacts can be maximised.

### 7.6.2 Population and Settlement

Henties Bay is a relatively small coastal town in the Erongo Region, with an estimated population of approximately 7,500 inhabitants based on the 2023 Namibia Population and

Housing Census (NSA, 2023). The settlement pattern is characterised by low-density development typical of coastal desert environments.

A defining feature of the town is its seasonal population fluctuation, driven primarily by tourism. During peak holiday periods, particularly over December and January, the population increases significantly due to an influx of visitors. This seasonal variation places fluctuating pressure on infrastructure, services, and local economic systems (Mendelsohn et al., 2002).

Table 45: Population and Settlement Characteristics

Parameter	Description	Implication for Project
<b>Population Size</b>	Approximately 7,500 residents based on the 2023 Namibia Population and Housing Census (NSA, 2023)	Provides a moderate local labour pool for construction and operational phases
<b>Settlement Pattern</b>	Low-density coastal settlement typical of the Namib Desert region (Mendelsohn et al., 2002)	Limited land-use pressure; suitable for integration of industrial development
<b>Seasonal Variation</b>	High seasonal population fluctuations driven by tourism peaks	Opportunity to introduce stable, year-round economic activity and reduce seasonal dependency

### 7.6.3 Economic Activities

The local economy of Henties Bay is predominantly centred around tourism and coastal-based activities, with recreational fishing serving as the primary attraction. The town is widely recognised as a key angling destination within Namibia (Mendelsohn et al., 2002).

In addition to tourism, the economy includes small-scale commerce and service provision, such as retail, informal trade, accommodation, and transport services. However, these sectors are largely dependent on tourism inflows and therefore exhibit limited diversification and high seasonality (GRN, 2023).

Figure 14: Economic Activity and Logistics Infrastructure at Henties Bay



View of transport and service infrastructure in Henties Bay, illustrating ongoing economic activity, including fuel retail services and freight movement. The presence of heavy-duty trucks and logistics operations reflects the town’s role within the Erongo coastal corridor and highlights its strategic potential for industrial development, supply chain integration, and support to emerging sectors such as biofuel production.

*Figure 15: NAM Henties Bay Campus – Institutional Infrastructure Supporting Regional Development*



The University of Namibia (UNAM) Henties Bay Campus, illustrating the presence of educational and institutional infrastructure within the town. The campus contributes to local capacity building, skills development, and knowledge generation, reinforcing Henties Bay’s role in supporting regional human capital development and aligning with emerging industrial and economic opportunities. **Source:** UNAM Henties Bay Campus, Annotated by: Erongo Consulting Group (2026).

*Table 46: Economic Structure of Henties Bay*

<b>Sector</b>	<b>Key Activities</b>	<b>Characteristics</b>	<b>Implication for Project</b>
<b>Tourism</b>	Recreational fishing, hospitality services	Seasonal and dominant economic sector	Highlights need for economic diversification and stable year-round activity
<b>Small-Scale Commerce</b>	Retail trade, informal business activities	Limited scale and largely localised	Opportunity for expansion through increased demand generated by the project
<b>Coastal Services</b>	Accommodation, transport, tourism support services	Highly dependent on tourism flows	Vulnerable to seasonal fluctuations; can benefit from industrial workforce demand
<b>Fisheries (Small-Scale)</b>	Shore-based and subsistence fishing	Limited commercial scale; resource-dependent	Potential indirect impacts; requires consideration of coastal interactions
<b>Construction Sector</b>	Local contractors, building services	Intermittent and project-based	Likely to benefit significantly during project construction phase

<b>Transport and Logistics</b>	Movement of goods and people	Limited but strategic due to coastal location	Opportunity for expansion through supply chain and operational logistics
<b>Public Services</b>	Municipal services, administration, utilities	Limited capacity typical of small towns	Increased demand may require infrastructure strengthening
<b>Energy and Utilities</b>	Electricity distribution, water supply	Regionally constrained systems	Opportunity for infrastructure upgrades and integration with project needs
<b>Informal Economy</b>	Street vending, small services	Survival-based and unregulated	Potential for upliftment through increased local economic activity

#### 7.6.4 Employment and Livelihoods

Employment opportunities within Henties Bay are relatively limited and are primarily concentrated within the tourism and service sectors. As a result, many livelihoods are:

- Seasonal and dependent on tourism cycles
- Concentrated in low to medium-skilled employment categories
- Vulnerable to fluctuations in visitor numbers

This economic structure limits income stability and long-term employment security, particularly for local residents (NSA, 2023; GRN, 2023).

*Table 47: Employment and Livelihood Characteristics*

<b>Aspect</b>	<b>Current Condition</b>	<b>Implication for Project</b>
<b>Employment Availability</b>	Limited employment opportunities, primarily concentrated in tourism and service sectors	Restricted job access; strong justification for new employment-generating industries
<b>Income Stability</b>	Highly seasonal, with income fluctuations linked to tourism cycles	Economic vulnerability; need for stable, year-round income sources
<b>Skills Profile</b>	Predominantly low to medium-skilled workforce with limited technical specialisation	Opportunity for skills development, training, and capacity building through project implementation
<b>Economic Dependence</b>	Heavy reliance on tourism and related activities	Low economic resilience; high exposure to external shocks and seasonal downturns
<b>Youth Employment</b>	Limited formal employment opportunities for youth	Risk of unemployment and underemployment; project can support youth inclusion
<b>Income Diversification</b>	Minimal diversification of income sources	High vulnerability at household level; project can introduce alternative income streams
<b>Informal Livelihoods</b>	Presence of informal and survival-based economic activities	Potential for upliftment through formalisation and increased economic activity

<b>Gender Dynamics</b>	Employment opportunities may be uneven across gender groups (typical of tourism/service sectors)	Opportunity to promote inclusive employment and gender-balanced participation
<b>Economic Mobility</b>	Limited upward mobility due to constrained local economy	Project can enhance upward mobility through skills and job creation

### 7.6.5 Project Contribution and Socio-Economic Opportunities

The proposed algae cultivation and biorefinery project introduces a large-scale, year-round industrial activity, which has the potential to significantly transform the socio-economic landscape of Henties Bay.

Key anticipated contributions include:

- Creation of employment opportunities across all project phases
- Development of technical and operational skills within the local workforce
- Diversification of the local economy beyond tourism
- Stimulation of secondary economic activities and supply chains
- Contribution to regional industrial development within the Erongo corridor

Table 48: Anticipated Socio-Economic Benefits of the Project

<b>Contribution Area</b>	<b>Description</b>	<b>Expected Outcome</b>	<b>Strategic Significance</b>
<b>Job Creation</b>	Employment opportunities during construction and operational phases across multiple skill levels	Increased employment levels and reduced local unemployment	High positive impact on livelihoods and local economic stability
<b>Skills Development</b>	Provision of technical, vocational, and operational training in algae cultivation, processing, and environmental management	Enhanced local workforce capacity and long-term employability	Supports human capital development and aligns with national skills priorities
<b>Economic Diversification</b>	Introduction of a biofuel and biorefinery industry within a tourism-dependent economy	Reduced reliance on tourism and improved economic resilience	Structural transformation of local economy
<b>Secondary Economy</b>	Growth in supporting sectors such as logistics, maintenance, services, and supply chains	Local economic multiplier effects and increased business opportunities	Stimulates SME development and local enterprise growth
<b>Regional Growth</b>	Integration into the Erongo coastal industrial and energy corridor	Strengthened regional economic integration and competitiveness	Positions region within national industrialisation strategy
<b>Infrastructure Development</b>	Potential upgrades to roads, utilities, and service infrastructure to support project operations	Improved infrastructure benefiting both project and local community	Long-term development spillover benefits
<b>Investment Attraction</b>	Increased investor interest in renewable energy and	Catalysed further economic investments and partnerships	Enhances regional investment profile

	industrial projects in the region		
<b>Social Upliftment</b>	Improved income levels, job security, and community well-being	Enhanced quality of life and reduced socio-economic vulnerability	Supports inclusive and sustainable development

## Summary

The socio-economic baseline indicates that Henties Bay is characterised by a small population, tourism-dependent economy, and limited employment diversity, resulting in seasonal income patterns and economic vulnerability.

Within this context, the proposed project represents a strategically significant development opportunity, capable of enhancing employment, strengthening skills, diversifying the economy, and improving long-term socio-economic resilience.

## 7.7 Environmental Sensitivity Overview

Table 49: Environmental Sensitivity Summary

Environmental Component	Sensitivity Level	Key Considerations	Implication for Project
Climate	Low	Stable arid conditions with high solar radiation and minimal rainfall variability (Mendelsohn et al., 2002)	Favourable for algae cultivation; minimal climate-related constraints
Soils	Medium	High susceptibility to wind erosion and low structural stability (FAO, 2012)	Requires erosion control measures and careful construction management
Water Resources	Medium	Limited freshwater availability and sensitivity of groundwater (Omdel Aquifer) and marine systems (MAWRD, 2013)	Strict water management, pollution prevention, and controlled discharge required
Biodiversity	Low–Medium	Sparse vegetation with localised sensitive habitats (e.g., lichen fields, drainage lines) (MET, 2013)	Avoidance of sensitive areas and implementation of targeted mitigation measures
Socio-economic	Positive (High Opportunity)	Tourism-dependent economy with limited employment diversification (NSA, 2023)	Significant positive impact potential through job creation and economic diversification

## 7.8 Key Baseline Insights

The baseline environmental and socio-economic assessment indicates that the proposed project site is highly suitable for the development of a seawater-based algae cultivation and biorefinery system, with manageable environmental constraints and significant socio-economic opportunities.

Key insights derived from the baseline analysis are summarised below:

The site is environmentally suitable for algae cultivation due to:

- Non-arable land, characterised by poor soil quality, high salinity, and low agricultural value (Mendelsohn et al., 2002; FAO, 2012)
- Availability of seawater resources, reducing reliance on scarce freshwater systems and aligning with sustainable water use principles (MAWRD, 2013)

Environmental constraints are moderate but manageable, provided that appropriate mitigation measures are implemented, particularly in relation to:

- Soil erosion control during construction and operation
- Protection of groundwater resources and prevention of contamination
- Avoidance of ecologically sensitive areas such as lichen fields and drainage lines

The socio-economic environment presents strong positive impact potential, driven by:

- Limited local employment opportunities and high dependence on seasonal tourism (NSA, 2023)
- Need for economic diversification and stable, year-round economic activity (GRN, 2023)
- Opportunity for job creation, skills development, and regional economic growth

### **Summary Positioning**

Overall, the baseline assessment confirms that the project area represents a low-conflict, high-opportunity development zone, where environmental sensitivities can be effectively managed and socio-economic benefits can be maximised.

This provides a strong foundation for the subsequent impact assessment (Chapter 6), where potential impacts will be evaluated in detail and appropriate mitigation measures defined.

## 8 IMPACT IDENTIFICATION AND ASSESSMENT

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### 8.1 Introduction

This chapter presents the systematic identification, prediction, and evaluation of potential environmental and socio-economic impacts associated with the proposed seawater-based algae cultivation and biorefinery project located on Portion X, Henties Bay State Land, within the Dorob National Park, Erongo Region.

The impact assessment adopts an integrated approach, combining:

- Baseline environmental and socio-economic conditions (Chapter 6)
- Project description and technical design parameters (Chapter 3)
- Legal and institutional framework (Chapter 4)
- Stakeholder inputs and concerns identified during public participation (Chapter 9)

This ensures that the assessment reflects both scientific/technical analysis and stakeholder-informed priorities, enhancing the robustness and credibility of the EIA.

#### 8.1.1 Scope of Impact Assessment

Impacts are identified and assessed across all phases of the project lifecycle:

- **Pre-construction Phase**  
Planning, site preparation, and permitting activities
- **Construction Phase**  
Land disturbance, infrastructure development, and increased human activity
- **Operational Phase**  
Algae cultivation, seawater abstraction, processing, and long-term site activities
- **Decommissioning Phase**  
Decommissioning of infrastructure, site rehabilitation, and closure activities

#### 8.1.2 Approach to Impact Identification

Impact identification is informed by:

- Analysis of project activities and environmental interactions
- Specialist studies (marine ecology, botanical/lichen, water quality, etc.)
- Stakeholder concerns and Issue IDs (as documented in Chapter 9 and Annexure H)

Key stakeholder-informed themes incorporated into impact identification include:

- Marine ecosystem impacts and fishing livelihoods (**FM1–FM5**)
- Community development, water access, and employment (**SD1–SD3**)
- Biodiversity sensitivity, particularly lichen fields (**ES1–ES2**)
- Environmental management risks (wastewater, pollution, compliance) (**WM1–WM3**)
- Operational risks, including seawater quality variability (**WR1–WR2**)

### 8.1.3 Impact Evaluation Criteria

Each identified impact is evaluated based on:

- **Nature** (positive or negative)
- **Extent** (local, regional, national)
- **Duration** (short-term, medium-term, long-term, permanent)
- **Magnitude/Intensity**
- **Probability of occurrence**
- **Reversibility**

These parameters are used to determine the **overall significance of impacts**, both:

- **Before mitigation (unmitigated impact)**
- **After mitigation (residual impact)**

### 8.1.4 Objective of the Impact Assessment

The primary objective of this chapter is to:

- Identify and characterise potential impacts associated with the project
- Evaluate the significance of impacts in a transparent and systematic manner
- Demonstrate how stakeholder concerns have influenced impact identification and prioritisation
- Inform the development of targeted mitigation and management measures
- Provide a sound basis for environmental decision-making and regulatory review

## 8.2 Impact Assessment Methodology

The impact assessment methodology applied in this study follows a systematic, multi-criteria evaluation framework to determine the significance of potential environmental and socio-economic impacts associated with the proposed development.

The methodology is aligned with standard EIA practice and incorporates both:

- Technical/scientific assessment
- Stakeholder-informed considerations (Chapter 9)

### 8.2.1 Approach to Impact Assessment

The assessment process follows five key steps:

1. **Impact Identification**  
Identification of potential impacts based on:
  - Project activities
  - Baseline environmental conditions

- Specialist studies
  - Stakeholder inputs (Issue IDs)
2. **Impact Prediction**  
Determination of how impacts may occur, including:
    - Pathways (e.g., abstraction → marine disturbance)
    - Receptors (e.g., fish stocks, communities)
  3. **Impact Evaluation**  
Assessment of impact significance using defined criteria (see Section 8.2.2)
  4. **Mitigation Identification**  
Development of measures to avoid, minimise, or manage impacts
  5. **Residual Impact Assessment**  
Evaluation of remaining impacts after mitigation

## 8.2.2 Impact Assessment Criteria

Each impact is assessed using the following criteria:

### 1. Nature of Impact

- Positive (beneficial)
- Negative (adverse)

### 2. Extent (Spatial Scale)

Rating	Description
1	Site-specific (within project footprint)
2	Local (surrounding area / Henties Bay)
3	Regional (Erongo Region)
4	National
5	International

### 3. Duration

Rating	Description
1	Short-term (0–1 year)
2	Medium-term (1–5 years)
3	Long-term (5–15 years)
4	Permanent

### 4. Magnitude / Intensity

Rating	Description
1	Negligible (no measurable change)
2	Low (minor change, easily reversible)
3	Moderate (noticeable impact)
4	High (significant impact)
5	Very High (severe or irreversible impact)

## 5. Probability of Occurrence

Rating	Description
1	Very unlikely
2	Unlikely
3	Possible
4	Likely
5	Almost certain

## 6. Reversibility

Rating	Description
1	Fully reversible
2	Partially reversible
3	Irreversible

### 8.2.3 Significance Determination

The overall significance of an impact is determined by combining:

- Extent
- Duration
- Magnitude
- Probability

### Significance Formula (Qualitative-Quantitative Hybrid)

$$\text{Significance} = (\text{Extent} + \text{Duration} + \text{Magnitude}) \times \text{Probability}$$

### Significance Rating Categories

Score Range	Significance Level	Interpretation
0 – 20	Low	Minimal impact, easily managed
21 – 40	Medium	Moderate concern, requires mitigation
41 – 60	High	Significant impact requiring strong mitigation
> 60	Very High	Critical impact; may influence project viability

### 8.2.4 Impact Assessment Matrix

Each impact will be presented using a structured table format:

Impact	Phase	Nature	Extent	Duration	Magnitude	Probability	Significance	Mitigation	Residual Impact	Stakeholder Linkage
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### 8.2.5 Incorporation of Stakeholder Input

Stakeholder concerns are formally integrated into the assessment through:

- Direct linkage of impacts to Issue IDs (e.g., FM1, SD2, ES1)

- Prioritisation of impacts raised during public participation
- Inclusion of stakeholder-sensitive receptors (e.g., fishing communities, water access)

## Example

Impact	Stakeholder Linkage
Marine ecosystem disturbance	FM1, FM2
Coastal access restrictions	FM3
Community benefits expectations	SD1, SD3
Lichen disturbance	ES1

This ensures that stakeholder inputs are traceable, assessable, and addressed within the EIA.

### 8.2.6 Mitigation Hierarchy

Mitigation measures follow the standard hierarchy:

1. **Avoidance** – Prevent impact entirely
2. **Minimisation** – Reduce magnitude or extent
3. **Rehabilitation** – Restore affected areas
4. **Compensation/Offset** – Address residual impacts

### 8.2.7 Assumptions and Limitations

- Assessment is based on available baseline data and current project design
- Specialist studies inform key impact areas
- Some uncertainties may remain and will be addressed through adaptive management

## 8.3 Marine Impacts

### 8.3.1 Introduction

The proposed project is located in close proximity to the Atlantic Ocean and involves seawater abstraction for algae cultivation, introducing potential interactions with marine ecosystems.

Given stakeholder concerns (particularly from the fishing sector), marine impacts are considered a critical component of the EIA.

This section assesses potential impacts on:

- Marine biodiversity and ecosystems
- Fish stocks and fisheries
- Coastal processes and water quality
- Access to marine and coastal resources

### 8.3.2 Key Project Activities Affecting the Marine Environment

The following project components may influence the marine environment:

- Seawater abstraction via intake system
- Installation of intake infrastructure near the shoreline
- Pumping and transfer systems
- Operational water demand
- Potential accidental spills or system failures

### 8.3.3 Identified Marine Impacts

Impact 1: Disturbance to Marine Ecosystems from Seawater Abstraction

<b>Impact</b>	<b>Disturbance to marine ecosystems due to seawater abstraction</b>
<b>Phase</b>	Operation
<b>Nature</b>	Negative
<b>Extent</b>	2 (Local)
<b>Duration</b>	3 (Long-term)
<b>Magnitude</b>	2 (Low)
<b>Probability</b>	4 (Likely)
<b>Significance (pre-mitigation)</b>	Medium
<b>Stakeholder Linkage</b>	FM1, FM2

#### **Description**

Seawater abstraction may result in entrainment of small marine organisms, minor disruption to nearshore ecosystems, and localised changes in water dynamics.

#### **Mitigation Measures**

- Design intake with low-velocity screening systems
- Locate intake to minimise ecological sensitivity
- Implement marine monitoring programme
- Avoid abstraction during sensitive ecological periods (if applicable)

#### **Residual Impact**

Low

Impact 2: Impacts on Fish Stocks and Fishing Activities

<b>Impact</b>	<b>Potential impact on fish stocks and fishing activities</b>
<b>Phase</b>	Operation
<b>Nature</b>	Negative
<b>Extent</b>	2 (Local)
<b>Duration</b>	3 (Long-term)
<b>Magnitude</b>	3 (Moderate)

<b>Probability</b>	3 (Possible)
<b>Significance (pre-mitigation)</b>	Medium
<b>Stakeholder Linkage</b>	FM1, FM3, FM4

### Description

Stakeholders raised concerns that abstraction and infrastructure could affect:

- Fish movement and behaviour
- Fishing productivity
- Access to fishing areas

### Mitigation Measures

- Maintain unrestricted coastal access corridors
- Avoid locating infrastructure in key fishing zones
- Conduct fisheries impact monitoring
- Engage fishing stakeholders continuously

### Residual Impact

Low–Medium

### Impact 3: Restriction of Coastal Access

<b>Impact</b>	<b>Restriction of access to coastline and fishing areas</b>
<b>Phase</b>	Construction & Operation
<b>Nature</b>	Negative
<b>Extent</b>	2 (Local)
<b>Duration</b>	2 (Medium-term)
<b>Magnitude</b>	3 (Moderate)
<b>Probability</b>	3 (Possible)
<b>Significance (pre-mitigation)</b>	Medium
<b>Stakeholder Linkage</b>	FM3

### Description

Construction activities and land allocation up to the coastline may create perceived or actual access restrictions.

### Mitigation Measures

- Clearly define and maintain public access routes
- Avoid fencing off key access areas
- Communicate access arrangements to stakeholders

### Residual Impact

Low

## Impact 4: Marine Pollution Risk (Accidental Events)

Impact	Risk of marine pollution due to accidental spills or system failure
Phase	Construction & Operation
Nature	Negative
Extent	3 (Regional)
Duration	2 (Medium-term)
Magnitude	4 (High)
Probability	2 (Unlikely)
Significance (Pre-Mitigation)	Medium
Stakeholder Linkage	WM1, WM2

### Description

Although no discharge is planned, accidental spills or infrastructure failure could result in localized marine contamination.

### Mitigation Measures

- Implement spill prevention and response plans
- Regular inspection and maintenance of infrastructure
- Emergency response protocols
- Staff training

### Residual Impact

Low

## Impact 5: Impacts from Water Quality Variability (Sulfur Events)

Impact	Operational disruption due to poor seawater quality (sulfur events)
Phase	Operation
Nature	Negative
Extent	2 (Local)
Duration	3 (Long-term)
Magnitude	3 (Moderate)
Probability	3 (Possible)
Significance (Pre-Mitigation)	Medium
Stakeholder Linkage	WR1

### Description

Natural sulfur events in coastal waters may:

- Affect water intake quality
- Disrupt operations
- Influence marine ecological conditions

### Mitigation Measures

- Incorporate adaptive intake design
- Monitor water quality continuously
- Implement contingency operational protocols

### Residual Impact

Low–Medium

### 8.3.4 Summary of Marine Impacts

Impact Category	Pre-Mitigation Significance	Post-Mitigation Significance
Marine ecosystem disturbance	Medium	Low
Fish stocks & livelihoods	Medium	Low–Medium
Coastal access	Medium	Low
Pollution risk	Medium	Low
Water quality variability	Medium	Low–Medium

### 8.3.5 Conclusion

Marine impacts associated with the proposed project are generally localised and manageable, provided that:

- Appropriate engineering design measures are implemented
- Stakeholder concerns (especially fishing access) are addressed
- A robust monitoring and management framework is applied

No fatal flaws have been identified in relation to marine impacts; however, this remains a sensitive impact category requiring careful management and ongoing stakeholder engagement.

## 8.4 Terrestrial Biodiversity Impacts (Lichens and Desert Ecology)

### 8.4.1 Introduction

The project area lies within the Dorob National Park, characterised by arid desert ecosystems with specialised biodiversity, including lichen fields that are highly sensitive to disturbance.

Stakeholder concerns (ES1–ES2) emphasised the ecological importance of these systems.

## 8.4.2 Key Impacts

### Impact 1: Disturbance of Lichen Fields and Sensitive Vegetation

Impact	Disturbance or loss of lichen fields
Phase	Construction
Nature	Negative
Extent	2 (Local)
Duration	4 (Permanent)
Magnitude	4 (High)
Probability	4 (Likely)
Significance (Pre-Mitigation)	High
Stakeholder Linkage	ES1

#### Description

Construction activities (clearing, vehicle movement, infrastructure placement) may damage fragile lichen ecosystems, which have slow regeneration rates.

#### Mitigation

- Conduct detailed lichen mapping and avoidance planning
- Establish no-go zones and buffer areas
- Restrict vehicle movement to designated routes
- Environmental awareness training for contractors

#### Residual Impact

Medium

### Impact 2: Habitat Disturbance and Fragmentation

Impact	Habitat disturbance
Phase	Construction & Operation
Nature	Negative
Extent	2
Duration	3
Magnitude	3
Probability	3
Significance	Medium
Stakeholder Linkage	ES2

#### Mitigation

- Minimise footprint
- Progressive rehabilitation

#### Residual

Low–Medium

### 8.4.3 Conclusion

Biodiversity impacts are significant but manageable, provided strict avoidance and protection measures are implemented.

## 8.5 Socio-Economic Impacts

### 8.5.1 Introduction

Stakeholders strongly emphasised employment, water access, and community inclusion (SD1–SD3).

#### **Impact 1: Employment and Economic Opportunities (Positive)**

<b>Impact</b>	<b>Job creation and economic benefits</b>
<b>Phase</b>	Construction & Operation
<b>Nature</b>	Positive
<b>Extent</b>	3
<b>Duration</b>	3
<b>Magnitude</b>	4
<b>Probability</b>	5
<b>Significance</b>	High
<b>Stakeholder Linkage</b>	SD1, SD3

#### **Description**

The project will generate ~1,200 jobs, stimulate local economy, and support industrial development.

#### **Enhancement Measures**

- Prioritise local employment
- Skills development programmes

#### **Impact 2: Community Expectations and Social Pressure**

<b>Impact</b>	<b>Unrealistic expectations / social tension</b>
<b>Phase</b>	All
<b>Nature</b>	Negative
<b>Extent</b>	2
<b>Duration</b>	3
<b>Magnitude</b>	3
<b>Probability</b>	4
<b>Significance</b>	Medium
<b>Stakeholder Linkage</b>	SD1

## Mitigation

- Transparent communication
- CSR programmes

## Impact 3: Water Access (Positive/Indirect)

<b>Impact</b>	<b>Contribution to community water solutions</b>
<b>Phase</b>	Operation
<b>Nature</b>	Positive
<b>Significance</b>	Medium–High
<b>Stakeholder Linkage</b>	SD2

### 8.5.2 Conclusion

Socio-economic impacts are strongly positive, with manageable social risks.

## 8.6 Land Use and Infrastructure Impacts

### Impact: Land Transformation

<b>Impact</b>	<b>Large-scale land transformation</b>
<b>Phase</b>	Construction
<b>Nature</b>	Negative
<b>Significance</b>	Medium
<b>Stakeholder Linkage</b>	LU1

## Mitigation

- Optimised layout
- Minimise footprint

### Impact: Access and Spatial Use

<b>Impact</b>	<b>Access changes</b>
<b>Stakeholder Linkage</b>	LU2, LU3

## Mitigation

- Maintain access routes
- Improve mapping transparency

### 8.6.1 Conclusion

Land impacts are moderate and manageable.

## 8.7 Water Resources Impacts

### Impact: Seawater Abstraction

<b>Impact</b>	<b>Marine water abstraction</b>
<b>Significance</b>	Medium
<b>Stakeholder Linkage</b>	FM1

### Impact: Water Quality and Operational Risks

<b>Impact</b>	<b>Sulfur events and variability</b>
<b>Significance</b>	Medium
<b>Stakeholder Linkage</b>	WR1

#### 8.7.1 Conclusion

Water-related impacts are manageable with engineering controls.

## 8.8 Environmental Management and Pollution Risks

### Impact: Pollution and Waste Management

<b>Impact</b>	<b>Potential contamination</b>
<b>Significance</b>	Medium
<b>Stakeholder Linkage</b>	WM1–WM3

#### Mitigation

- No-discharge system
- Monitoring

#### 8.8.1 Conclusion

Pollution risks are low if properly managed.

## 8.9 Cumulative Impacts

### 8.9.1 Introduction

Cumulative impacts refer to the combined effect of the proposed project when considered alongside existing, approved, and reasonably foreseeable developments within the broader coastal and regional context. These impacts may arise from incremental changes over time, even where individual project impacts are assessed as low or moderate.

Given the project's location within the Erongo coastal corridor - an area experiencing increasing industrial, tourism, and infrastructure development - assessment of cumulative impacts is essential.

## 8.9.2 Sources of Cumulative Impact

The proposed development may contribute cumulatively in combination with:

- Existing and planned coastal industrial developments
- Ongoing and future marine resource utilisation activities (e.g., fishing, mariculture)
- Regional infrastructure expansion, including roads, energy, and water systems
- Broader blue economy initiatives within the Erongo Region

## 8.9.3 Key Cumulative Impact Areas

### 1. Coastal Industrial Development

The project contributes to the **progressive industrialisation of the Erongo coastal corridor**, which may result in:

- Increased pressure on land and coastal resources
- Visual and landscape transformation
- Potential cumulative ecological disturbance

#### **Assessment:**

The project is located within a designated development corridor and is aligned with national and regional industrialisation strategies. With appropriate planning and regulation, cumulative impacts are manageable and strategically aligned.

### 2. Marine Resource Use

Cumulative effects may arise from the interaction of:

- Seawater abstraction (this project)
- Commercial fishing activities
- Other marine-based developments

Potential risks include:

- Increased pressure on marine ecosystems
- Localised ecological changes

#### **Assessment:**

Given the relatively small scale of abstraction compared to the ocean system, and the absence of discharge, cumulative impacts are expected to be low to moderate, provided monitoring and management measures are implemented.

### 3. Regional Infrastructure and Resource Demand

The project may contribute to cumulative demand on:

- Transport infrastructure (C34 corridor)
- Energy systems
- Water resources (indirectly through industrial clustering)

#### **Assessment:**

The project is expected to support infrastructure development and economic growth, with impacts remaining within manageable limits, particularly where integrated regional planning is applied.

#### 8.9.4 Stakeholder Considerations

Stakeholder concerns (particularly related to marine ecosystems and livelihoods – **FM1–FM4**) highlight the importance of:

- Monitoring cumulative marine impacts
- Maintaining access to coastal resources
- Ensuring that development does not compromise existing economic activities

#### 8.9.5 Mitigation and Management of Cumulative Impacts

The following measures are recommended:

- Participation in regional environmental monitoring programmes
- Coordination with authorities on coastal zone management
- Ongoing stakeholder engagement with marine and fishing communities
- Integration of project monitoring data into broader regional datasets

#### 8.9.6 Conclusion

The assessment indicates that while the proposed development contributes to incremental cumulative impacts within the Erongo coastal region, these impacts are:

- Localised and manageable
- Aligned with regional development objectives
- Not expected to exceed environmental or socio-economic thresholds, provided that mitigation and monitoring measures are effectively implemented

No significant cumulative impacts of a scale that would preclude development have been identified.

## 8.10 Overall Impact Synthesis

### 8.10.1 Introduction

This section provides a consolidated synthesis of all impacts identified and assessed in this chapter, integrating:

- Biophysical impacts
- Socio-economic impacts
- Cumulative impacts
- Stakeholder concerns (Chapter 9)

The purpose is to present an overall evaluation of project feasibility from an environmental and socio-economic perspective.

### 8.10.2 Summary of Impact Significance

<b>Impact Category</b>	<b>Pre-Mitigation Significance</b>	<b>Post-Mitigation (Residual)</b>	<b>Key Sensitivity</b>
<b>Marine Environment</b>	Medium	Low	Fishing & ecosystems
<b>Terrestrial Biodiversity</b>	High	Medium	Lichen sensitivity
<b>Socio-Economic</b>	Positive	Positive	Community expectations
<b>Land Use</b>	Medium	Low	Spatial footprint
<b>Water Resources</b>	Medium	Low	Abstraction & variability
<b>Pollution Risk</b>	Medium	Low	Operational controls

### 8.10.3 Key Observations

The assessment demonstrates that:

- The majority of impacts are site-specific and manageable
- Significant impacts (e.g., lichen disturbance) can be reduced through avoidance and mitigation
- Socio-economic benefits are substantial and positive, particularly in terms of employment and industrial development
- Marine impacts, while sensitive, are limited in scale and controllable through design and monitoring

### 8.10.4 Influence of Stakeholder Input

Stakeholder engagement has materially influenced:

- Identification of key impact areas (marine, socio-economic, biodiversity)
- Inclusion of specialist studies

- Refinement of project design (e.g., no-discharge system, inland infrastructure positioning)
- Development of mitigation measures

This ensures that the assessment is both technically robust and socially responsive.

### 8.10.5 Residual Risk Profile

After implementation of mitigation measures:

- No impacts are classified as **Very High**
- Residual impacts are predominantly **Low to Medium**
- No **fatal flaws** have been identified

### 8.10.6 Environmental Feasibility Statement

Based on the findings of this assessment:

The proposed development is considered environmentally and socially feasible, provided that mitigation measures outlined in Chapter 10 (EMP) are effectively implemented and monitored.

### 8.10.7 Conclusion

The overall impact profile indicates that:

- The project aligns with national and regional development objectives
- Environmental risks are manageable within acceptable thresholds
- Stakeholder concerns have been adequately integrated and addressed

Accordingly, the project can proceed to the next stage of the EIA process, subject to regulatory approval and implementation of the Environmental Management Plan.

# 9 PUBLIC PARTICIPATION PROCESS

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## 9.1 Introduction

Public participation is a statutory and integral component of the Environmental Impact Assessment (EIA) process, aimed at ensuring that Interested and Affected Parties (I&APs) are adequately informed, meaningfully consulted, and afforded an opportunity to contribute to environmental decision-making.

The process facilitates:

- Early identification of potential environmental and socio-economic concerns
- Incorporation of local knowledge and stakeholder perspectives
- Enhancement of transparency, accountability, and procedural fairness
- Strengthening of the overall quality and credibility of the EIA

For the proposed Algae Farming and Refinery for Production of Biofuel & Crude Algae Oil (CAO) project, the public participation process has been undertaken in accordance with the provisions of:

- Environmental Management Act (Act No. 7 of 2007)
- Environmental Impact Assessment Regulations (2012)

These regulatory instruments require that stakeholders be:

- Notified of the proposed development
- Provided with relevant project information
- Given reasonable opportunity to comment
- Engaged throughout the EIA process

Accordingly, a structured and multi-faceted public participation programme was implemented during the Scoping Phase, incorporating both formal notification mechanisms and direct stakeholder engagement activities.

This chapter documents:

- The public participation methodology adopted
- Stakeholder identification and engagement processes
- Notification and information disclosure mechanisms
- Consultation activities undertaken
- Key issues raised by stakeholders
- Responses and commitments by the Proponent and Environmental Assessment Practitioner (EAP)
- Evidence supporting compliance with statutory requirements

This documentation provides a transparent and verifiable record of stakeholder engagement, forming a critical input into the environmental assessment and decision-making process.

## 9.2 Objectives of Public Participation

The objectives of the public participation process were to:

- Inform stakeholders of the proposed development
- Facilitate meaningful stakeholder engagement
- Identify environmental and socio-economic concerns
- Incorporate stakeholder input into project design and assessment
- Ensure transparency, inclusivity, and regulatory compliance

## 9.3 Legal and Regulatory Framework

Public participation for this project complies with statutory requirements, which mandate:

- Early disclosure of project information
- Stakeholder consultation
- Documentation of issues and responses
- Integration of stakeholder input into the EIA process

## 9.4 Stakeholder Identification

Stakeholders were identified based on their potential interest, influence, or exposure to project impacts.

### **Stakeholder Categories**

- National and regional government authorities
- Local authorities (Henties Bay Municipality, Erongo Regional Council)
- Fishing sector stakeholders
- Local communities and residents
- Environmental and conservation organisations
- Academic and research institutions
- Private sector stakeholders
- Development and investment institutions

A detailed stakeholder register is included in:

### **Annexure A: Stakeholder Database**

## 9.5 Public Participation Methodology

The public participation process was implemented through a multi-layered engagement approach, combining public notification, direct stakeholder engagement, and continuous consultation.

### **Core Methodological Components**

1. Stakeholder identification and database development
2. Information dissemination (BID, notices, emails)
3. Public notification through multiple platforms
4. Public consultation meeting
5. Site-based engagement and reconnaissance
6. Continuous consultation with the Proponent
7. Documentation of stakeholder issues and responses

This approach ensured both breadth (public awareness) and depth (technical engagement).

## 9.6 Public Notification and Information Disclosure

A comprehensive notification strategy was implemented to ensure wide stakeholder awareness.

### 9.6.1 Newspaper Advertisements

- Two (2) newspaper adverts were published in local/national publications
- Content included:
  - Project description
  - Location details
  - EIA process information
  - Invitation for public participation

#### **Annexure B: Newspaper Advertisements (x2)**

### 9.6.2 Site Notices and Posters

- Site notices and posters were placed at strategic locations in Henties Bay, including:
  - Municipal notice boards
  - Public access points
  - Community gathering areas

These notices provided:

- Project overview
- EAP contact details
- Instructions for stakeholder participation

#### **Annexure C: Site Notices and Posters**

*Figure 16: Environmental Clearance Notice displayed on-site within the project area, providing public notification and invitation for stakeholder participation in the EIA process for the proposed Algae*

Farming and Biofuel Refinery Project, Henties Bay. Courtesy: Erongo Consulting Group / Institute for Impact Sciences & Research Design (2026).



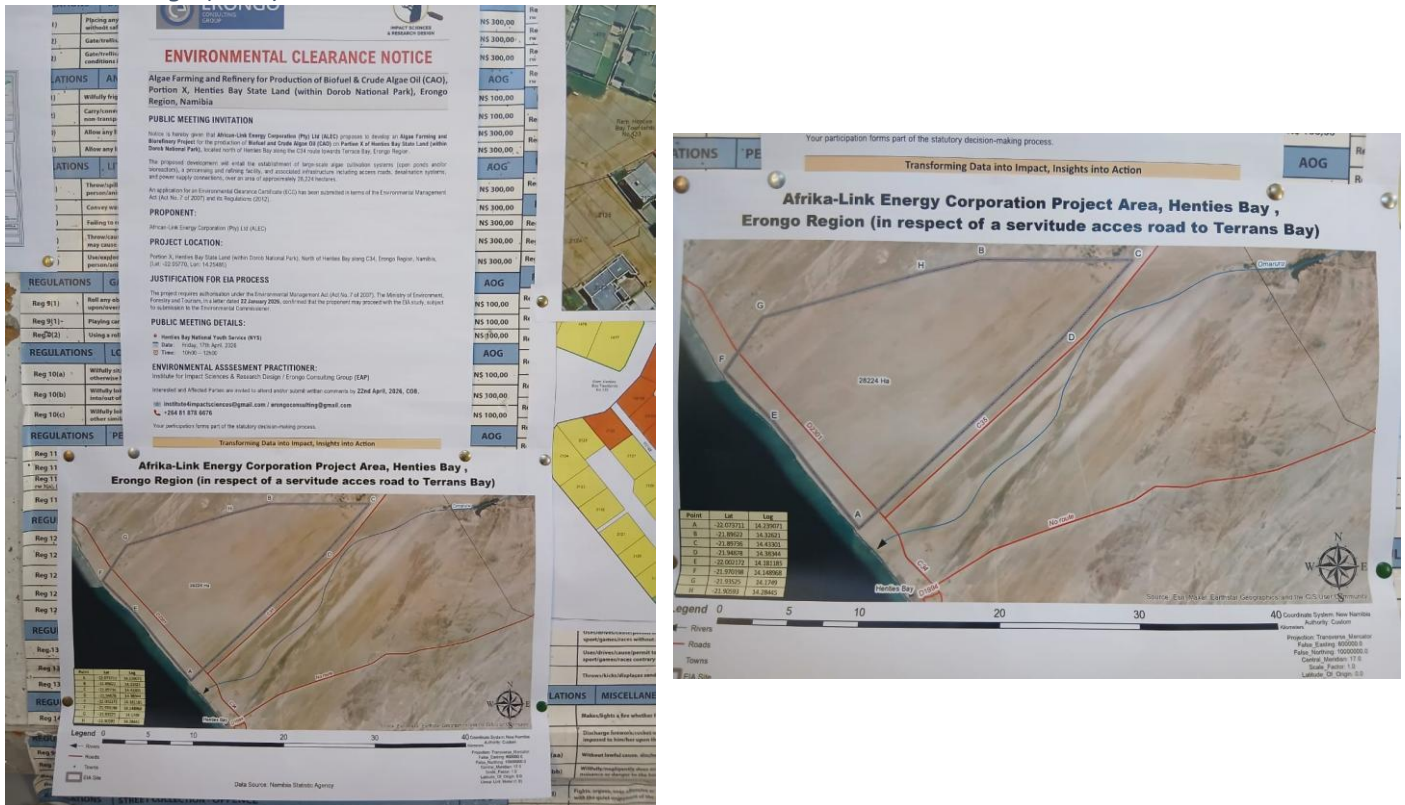
### 9.6.3 Notice Boards

Formal notices were displayed at:

- Henties Bay Municipality
- Erongo Regional Council
- Nampol Henties Bay, Nampol Swakopmund Town
- NYS Boardroom (meeting venue)
- Other relevant public institutions – Supermarkets,

This ensured institutional visibility and compliance.

Figure 17: Environmental Clearance Notice and Public Meeting Invitation displayed on a municipal notice board in Henties Bay, providing project information and inviting stakeholder participation in the EIA process for the proposed Algae Farming and Biofuel Refinery Project. Courtesy: Erongo Consulting Group / Institute for Impact Sciences & Research Design (2026).



## 9.6.4 Email Notifications to Strategic Stakeholders

Formal communication was circulated to key stakeholders, including:

- Ministry of Environment, Forestry and Tourism (MEFT)
- Ministry of Fisheries and Marine Resources (MFMR)
- Ministry of Agriculture, Water and Land Reform (MAWLR)
- Erongo Regional Council
- Henties Bay Municipality
- Namibian Investment Promotion and Development Board (NIPDB)
- Environmental organisations and research institutions
- Private sector stakeholders

These communications included:

- Project information
- Invitation to participate
- Request for input

## **Annexure D: Stakeholder Email Correspondence**

### **9.6.5 Background Information Document (BID)**

The BID was distributed to stakeholders to provide:

- Project overview
- EIA process explanation
- Contact details for feedback

## **Annexure E: Background Information Document (BID)**

### **9.7 Consultation Activities**

Public participation extended beyond notification to include direct engagement activities.

#### **9.7.1 Public Consultation Meeting**

<b>Item</b>	<b>Detail</b>
<b>Date</b>	23 April 2026
<b>Venue</b>	NYS Boardroom, Henties Bay
<b>Time</b>	10:30 – 14:00
<b>Facilitator</b>	Erongo Consulting Group

#### **Purpose of Meeting**

- Present the proposed project
- Explain the EIA process
- Obtain stakeholder input

#### **Participation**

The meeting included:

- Government representatives
- Fishing sector stakeholders
- Local community members
- Environmental stakeholders
- Proponent and technical team

## **Annexure F: Meeting Minutes & Attendance Register**

*Figure 18: Public Participation Meeting for the Proposed Algae Farming and Biofuel Refinery Project, held at the NYS Boardroom, Henties Bay (23 April 2026), illustrating stakeholder engagement during the EIA Scoping Phase.*



*Figure 19: Project presentation and stakeholder engagement session during the Public Participation Meeting for the proposed Algae Farming and Biofuel Refinery Project, NYS Boardroom, Henties Bay (23 April 2026), illustrating interactive discussion and information sharing in the EIA Scoping Phase.*



Figure 20: Stakeholder engagement during the Public Participation Meeting, showing Dr. Faye Brinkmann (IUM Research, Training and Conference Centre, Swakopmund) seeking clarification on the proposed project layout and development configuration for the Algae Farming and Biofuel Refinery Project, Henties Bay (23 April 2026).



Figure 21: Multi-stakeholder engagement session during the Public Participation Meeting for the proposed Algae Farming and Biofuel Refinery Project, held at the NYS Boardroom, Henties Bay (23 April 2026), illustrating active dialogue, stakeholder participation, and collaborative discussion during the EIA Scoping Phase.



Figure 22: EIA Public Participation presentation delivered by Erongo Consulting Group, outlining the proposed Algae Farming and Biofuel Refinery Project during the stakeholder engagement meeting at the NYS Boardroom, Henties Bay (23 April 2026).



Figure 23: NYS Boardroom facility, Henties Bay, Erongo Region, serving as the official venue for the Public Participation Meeting for the proposed Algae Farming and Biofuel Refinery Project (23 April 2026).



## 9.7.2 Site Reconnaissance and Technical Engagement

- A site visit was conducted with the Proponent
- Objectives:
  - Confirm project location and extent
  - Identify environmental sensitivities
  - Align technical understanding of site conditions

Outputs informed:

- Baseline assessment
- Impact identification
- Project design refinement

### **Annexure G: Site Reconnaissance Records**

## 9.7.3 Continuous Consultation with the Proponent

Throughout the Scoping Phase:

- Ongoing engagements were held between:
  - Erongo Consulting Group (EAP)
  - Project Proponent

Focus areas included:

- Technical clarification
- Design refinement
- Environmental risk identification
- Integration of stakeholder concerns

This ensured a dynamic and responsive assessment process.

## 9.8 Summary of Key Issues Raised

The public participation process generated a comprehensive set of stakeholder inputs reflecting environmental sensitivities, socio-economic expectations, and operational risks associated with the proposed development. These issues have been grouped into key thematic areas to support structured analysis and integration into the EIA.

### 9.8.1 Socio-Economic Issues

Stakeholders placed strong emphasis on the equitable distribution of project benefits and the need for tangible, long-term socio-economic outcomes.

Key concerns included:

- **Community benefits and development**  
Stakeholders highlighted the importance of ensuring that the project delivers measurable benefits to local communities beyond short-term construction employment. Expectations include local procurement, community investment programmes, and sustained economic participation.
- **Access to potable water**  
Concerns were raised regarding existing water supply constraints in surrounding areas, with stakeholders requesting that the project contributes to improving water access where feasible.
- **Employment and inclusion**  
Stakeholders emphasised the need for prioritisation of local employment, fair recruitment processes, and inclusive participation of local communities, particularly youth and vulnerable groups.

**Implication for EIA:**

These issues require assessment of socio-economic impacts, development of a Community Development Framework, and inclusion of local employment strategies within the EMP.

### 9.8.2 Capacity Development

Stakeholders identified capacity building as a critical component for ensuring long-term sustainability and local empowerment.

Key issues included:

- **Training programmes**  
The need for structured and continuous technical training aligned with project requirements (e.g., algae cultivation, processing, environmental monitoring).
- **Internships and scholarships**  
Stakeholders called for formalised internship and scholarship programmes to support students and graduates in relevant fields.
- **Institutional collaboration**  
Strong interest was expressed in partnerships with local and international academic and research institutions to strengthen knowledge transfer and innovation.

**Implication for EIA:**

Incorporation of a **Training and Skills Development Plan**, including institutional partnerships and capacity-building frameworks.

### 9.8.3 Marine and Fishing Concerns

Given the project's proximity to the coastline, stakeholders raised concerns regarding potential impacts on marine ecosystems and fishing livelihoods.

Key concerns included:

- **Impact on fish stocks and marine ecosystems**  
Potential effects of seawater abstraction and operational activities on fish behaviour, breeding patterns, and marine biodiversity.
- **Coastal access**  
Concerns regarding possible restriction of access to traditional fishing areas and shoreline use.
- **Livelihood risks**  
The potential for project activities to affect fishing-based livelihoods and income stability.

**Implication for EIA:**

Requirement for development of mitigation measures to safeguard access and livelihoods.

### 9.8.4 Environmental Management

Stakeholders raised critical concerns regarding environmental protection and compliance.

Key issues included:

- **Wastewater and pollution risks**  
Concerns about potential discharge of contaminated water and risks of environmental pollution.
- **Regulatory compliance and enforcement**  
Stakeholders emphasised the importance of strict adherence to environmental regulations and monitoring mechanisms.

**Implication for EIA:**

Development of a robust **Environmental Management Plan (EMP)**, including waste management systems, monitoring protocols, and compliance mechanisms.

### 9.8.5 Biodiversity and Biosecurity

Stakeholders highlighted risks related to ecological integrity and species management.

Key concerns included:

- **Use of indigenous algae species**  
Preference for the use of local species to avoid ecological disruption.
- **Ecological and biosecurity risks**  
Potential risks associated with unintended release, contamination, or ecosystem imbalance.

**Implication for EIA:**

Inclusion of a **Biosecurity Management Plan** and ecological risk assessment.

### 9.8.6 Land Use and Infrastructure

Concerns were raised regarding spatial planning, land allocation, and infrastructure positioning.

Key issues included:

- **Project footprint and scale**  
Stakeholders sought clarity on the extent of land use and its implications.
- **Mapping accuracy and transparency**  
Concerns regarding clarity and accuracy of maps presented during consultation.
- **Coastal interface and land allocation**  
Questions regarding land extending to the coastline and implications for public access.

#### **Implication for EIA:**

Refinement of spatial planning, provision of accurate mapping, and clear justification of land use.

### 9.8.7 Environmental Sensitivity

Stakeholders highlighted the ecological sensitivity of the project area, particularly given its location within a protected area.

Key concerns included:

- **Lichen and sensitive vegetation impacts**  
Potential disturbance to lichen fields and desert ecosystems.
- **Protected area considerations (Dorob National Park)**  
Need for strict compliance with conservation requirements.

#### **Implication for EIA:**

ensure alignment with protected area regulations.

### 9.8.8 Operational Risks

Stakeholders raised concerns regarding the technical and environmental robustness of the proposed system.

Key issues included:

- **Water quality variability (e.g., sulfur events)**  
Potential impacts of fluctuating seawater quality on operations.
- **System resilience and reliability**  
Ability of the system to operate under varying environmental conditions.

### **Implication for EIA:**

Inclusion of **engineering design considerations, risk mitigation strategies, and operational contingency planning.**

## 9.8.9 Synthesis of Stakeholder Concerns

The issues raised reflect three overarching themes:

- **Expectation of tangible socio-economic benefits and inclusion**
- **High sensitivity to marine and environmental impacts**
- **Need for technical clarity, transparency, and regulatory assurance**

These concerns have directly informed:

- The scope of specialist studies
- Impact identification and assessment (Chapter 8)
- Development of mitigation and management measures (Chapter 10 – EMP)

## 9.9 Issues and Response Register

All stakeholder concerns were captured and addressed through a structured Issues & Response Register.

### **Annexure H: Stakeholder Issues & Response Register**

## 9.10 Incorporation of Stakeholder Input

Stakeholder inputs obtained during the public participation process have been systematically reviewed, analysed, and integrated into the Environmental Impact Assessment (EIA), ensuring that the assessment reflects both technical findings and stakeholder concerns.

The incorporation of stakeholder input has informed multiple components of the EIA, as outlined below:

### 9.10.1 Identification of Key Impact Areas

Stakeholder concerns contributed directly to the identification and prioritisation of key environmental and socio-economic impact areas, including:

- Marine ecosystem interactions (seawater abstraction and coastal interface)
- Socio-economic impacts (employment, community development, water access)
- Biodiversity sensitivity (lichen fields and protected area considerations)
- Land use and spatial planning
- Operational and environmental risks

**Outcome:**

Enhanced scoping of potential impacts, ensuring that the EIA addresses both **technical and community-identified risks**.

### 9.10.2 Inclusion of Specialist Studies

Stakeholder inputs highlighted the need for targeted specialist investigations to address specific concerns. As a result, the following studies have been incorporated into the EIA:

- **Marine Ecology Assessment**  
To evaluate potential impacts of seawater abstraction and project activities on marine ecosystems, fish stocks, and coastal processes.
- **Botanical (Lichen) Specialist Study**  
To assess the presence, distribution, and sensitivity of lichen fields and other desert-adapted vegetation within the project area.
- **Water Quality and Hydrological Assessment**  
To evaluate seawater quality variability (including sulfur events), abstraction implications, and operational resilience.

**Outcome:**

Improved scientific robustness of the EIA and alignment with **stakeholder-identified environmental sensitivities**.

### 9.10.3 Refinement of Project Design

Stakeholder engagement informed key aspects of project planning and design, including:

- Consideration of **coastal access and avoidance of restricted public use areas**
- Improved clarity and refinement of **project layout and infrastructure positioning**
- Integration of **environmental safeguards into system design** (e.g., containment systems, no discharge approach)
- Consideration of **operational resilience under variable environmental conditions**

**Outcome:**

A more **responsive and context-sensitive project design**, aligned with stakeholder expectations and environmental constraints.

### 9.10.4 Development of Mitigation and Management Measures

Stakeholder concerns directly influenced the development of mitigation measures and management frameworks, including:

- **Environmental Management Plan (EMP)**  
Incorporating monitoring, compliance, and environmental protection measures
- **Marine and Fisheries Mitigation Measures**  
Addressing potential impacts on marine ecosystems and fishing livelihoods

- **Biosecurity and Species Management Protocols**  
Ensuring use of indigenous algae species and prevention of ecological risks
- **Socio-Economic Mitigation Measures**  
Including local employment strategies, training programmes, and community engagement
- **Water and Waste Management Systems**  
Ensuring no discharge into marine environments and minimising pollution risks

**Outcome:**

Translation of stakeholder concerns into **practical, enforceable management actions.**

### 9.10.5 Integration into EIA Chapters and Decision-Making

Stakeholder input has been integrated across multiple sections of the EIA, including:

- **Chapter 7/8:** Impact Identification and Assessment
- **Chapter 10:** Environmental Management Plan (EMP)
- **Specialist Studies and Technical Appendices**

**Outcome:**

A fully integrated EIA, where stakeholder engagement informs both analysis and mitigation, rather than being treated as a standalone exercise.

### 9.10.6 Summary of Integration Approach

The incorporation of stakeholder input followed an iterative and structured process:

**Stakeholder Input → Issue Identification → Technical Assessment → Design Refinement → Mitigation Development → EIA Integration**

This approach ensures that:

- Stakeholder concerns are traceable and addressed
- The EIA is responsive and adaptive
- Decision-making is informed by both technical and social considerations

## 9.11 Grievance Redress Mechanism

A formal Grievance Redress Mechanism (GRM) will be established to provide a structured and transparent process through which Interested and Affected Parties (I&APs) can raise concerns, lodge complaints, and seek resolution throughout the lifecycle of the project.

The GRM is designed to:

- **Receive stakeholder concerns and complaints**  
Provide accessible channels for stakeholders to submit grievances related to environmental, social, or operational aspects of the project.
- **Track, document, and manage issues**  
Ensure that all grievances are formally recorded in a **Grievance Register**, including details of the issue, date received, actions taken, and resolution status.
- **Facilitate timely resolution of grievances**  
Establish clear procedures and timeframes for acknowledging, investigating, and resolving complaints in a fair and efficient manner.
- **Ensure accountability and transparency**  
Maintain a transparent process whereby stakeholders are informed of the progress and outcomes of their submissions.

### 9.11.1 Grievance Submission Channels

Stakeholders will be able to submit grievances through multiple channels, including:

- Email (dedicated project contact)
- Telephone contact
- Written submissions
- In-person reporting through designated project representatives

### 9.11.2 Grievance Management Process

The grievance handling process will follow a structured workflow:

1. **Receipt and Registration**
  - Complaint is received and logged in the Grievance Register
  - Acknowledgement issued to the complainant
2. **Screening and Classification**
  - Assessment of the nature and severity of the grievance
  - Assignment to relevant responsible party
3. **Investigation**
  - Review of the issue, including site verification where required
  - Consultation with relevant stakeholders or specialists
4. **Resolution and Response**
  - Development and implementation of appropriate corrective actions
  - Communication of outcome to the complainant
5. **Closure and Record Keeping**
  - Confirmation of resolution
  - Documentation and archiving of the grievance

### 9.11.3 Institutional Responsibility

- The **Project Proponent** will be responsible for implementing and maintaining the GRM
- The **Environmental Assessment Practitioner (EAP)** will provide oversight during the EIA phase

- During construction and operation, the GRM will be integrated into the **Environmental Management Plan (EMP)**

#### 9.11.4 Monitoring and Reporting

- The Grievance Register will be regularly reviewed to identify recurring issues or systemic risks
- Summary reports may be included in environmental monitoring reports submitted to regulatory authorities
- Lessons learned from grievances will inform adaptive management measures

#### 9.11.5 Key Principles of the GRM

The mechanism will be guided by the following principles:

- Accessibility
- Transparency
- Fairness and impartiality
- Timeliness
- Responsiveness
- Continuous improvement

### 9.12 Ongoing Stakeholder Engagement

Stakeholder engagement for the proposed development is not limited to the Scoping Phase but will be maintained as a continuous and adaptive process throughout the full lifecycle of the project. This approach ensures sustained transparency, responsiveness to stakeholder concerns, and alignment with regulatory and social expectations.

#### 9.12.1 Engagement Across Project Phases

Stakeholder engagement will be undertaken across the following key phases:

- **EIA Phase**  
Continued engagement during the Environmental Impact Assessment phase will include:
  - Disclosure of the Draft EIA Report and Environmental Management Plan (EMP)
  - Invitation for stakeholder comments and inputs
  - Integration of feedback into final reporting
- **Construction Phase**  
During project implementation:
  - Stakeholders will be informed of construction activities, schedules, and potential disruptions
  - Mechanisms will be in place to address community concerns (e.g., noise, access, employment)

- Regular communication will support transparency and conflict avoidance
- **Operational Phase**  
During ongoing operations:
  - Stakeholder engagement will focus on environmental performance, compliance, and community relations
  - Feedback mechanisms will remain active to address emerging concerns
  - Periodic reporting will be undertaken to maintain accountability

### 9.12.2 Engagement Mechanisms

The following mechanisms will be utilised to facilitate ongoing stakeholder engagement:

- **Regular Updates and Communication**
  - Dissemination of project updates through email, notices, and stakeholder communication platforms
  - Sharing of key milestones, developments, and environmental performance
- **Follow-Up Consultations**
  - Additional meetings and engagements where required, particularly in response to emerging issues
  - Targeted consultations with specific stakeholder groups (e.g., fishing sector, local communities, authorities)
- **Public Disclosure of Findings**
  - Availability of EIA reports, EMP, and monitoring results to stakeholders
  - Transparency in reporting environmental performance and compliance
- **Grievance Redress Mechanism (GRM)**
  - Ongoing access to grievance submission and resolution processes (as outlined in Section 9.11)

### 9.12.3 Institutional Responsibilities

- The **Project Proponent** will be responsible for implementing ongoing stakeholder engagement during construction and operation
- The **Environmental Assessment Practitioner (EAP)** will oversee engagement during the EIA phase
- Engagement requirements will be formalised within the **Environmental Management Plan (EMP)**

### 9.12.4 Adaptive Engagement Approach

Stakeholder engagement will follow an adaptive management approach, whereby:

- Feedback from stakeholders informs ongoing project decisions
- Emerging issues are identified and addressed proactively
- Engagement strategies are refined based on stakeholder needs and project developments

### 9.12.5 Strategic Outcome

Ongoing stakeholder engagement will:

- Strengthen the project’s social licence to operate
- Enhance trust and transparency between stakeholders and the Proponent
- Support early identification and mitigation of risks
- Ensure long-term alignment with community and environmental expectations

### 9.13 Evidence of Public Participation Activities

The following activities collectively demonstrate compliance with public participation requirements:

Activity	Evidence
Newspaper adverts (x2)	Annexure B
Site notices & posters	Annexure C
Notice board displays	Annexure C
Email stakeholder engagement	Annexure D
BID distribution	Annexure E
Public meeting	Annexure F
Site reconnaissance	Annexure G
Continuous consultation	Documented records
Issues & response register	Annexure H

### 9.14 Compliance Statement

The public participation process undertaken for the proposed development has been conducted in full accordance with the requirements of the Environmental Management Act (Act No. 7 of 2007) and the Environmental Impact Assessment Regulations (2012).

The process demonstrates that:

- **Statutory compliance has been achieved**  
All required steps, including stakeholder notification, consultation, documentation of inputs, and integration of stakeholder feedback, have been undertaken in line with regulatory provisions.
- **Transparency and inclusivity have been upheld**  
The engagement process was designed to ensure broad stakeholder participation, providing accessible platforms for Interested and Affected Parties (I&APs) to obtain information and contribute meaningfully.
- **Verifiable evidence of stakeholder engagement is provided**  
The process is supported by documented evidence, including public notices, newspaper advertisements, stakeholder correspondence, meeting minutes, attendance registers, and an Issues & Response Register, all included as annexures to this report.
- **Stakeholder input has informed the EIA process**  
Concerns and recommendations raised during stakeholder engagement have directly

influenced the identification of key impact areas, the scope of specialist studies, and the development of mitigation and management measures.

## 9.15 Conclusion

The public participation process undertaken for the proposed development has provided a comprehensive and structured platform for stakeholder engagement, ensuring that the perspectives, concerns, and expectations of Interested and Affected Parties (I&APs) have been effectively captured and incorporated into the Environmental Impact Assessment (EIA).

Through this process, the following outcomes have been achieved:

- **Identification of key environmental and socio-economic concerns**  
Stakeholder inputs have highlighted critical issues relating to marine ecosystems, biodiversity sensitivity, community development, and operational risks, thereby strengthening the relevance and focus of the assessment.
- **Strengthening of the technical scope of the EIA**  
The issues raised have informed the inclusion of targeted specialist studies and enhanced the depth of impact identification and analysis.
- **Enhancement of transparency and accountability**  
The structured documentation of stakeholder engagement, including issues and responses, provides a clear and traceable record of how stakeholder input has influenced the assessment process.
- **Establishment of a foundation for ongoing stakeholder engagement**  
The process has created a framework for continued communication and engagement throughout the project lifecycle, supporting long-term stakeholder relationships.

The public participation process further confirms that the proposed project:

- **Is both socially and environmentally sensitive**, particularly given its location within a coastal and protected area context
- **Requires the implementation of robust mitigation and management measures** to address identified risks and stakeholder concerns
- **Must maintain continuous and adaptive stakeholder engagement** to ensure alignment with community expectations, regulatory requirements, and environmental safeguards

In conclusion, the public participation process has been comprehensive, inclusive, and compliant, and has made a meaningful contribution to the integrity, credibility, and defensibility of the EIA. It provides a solid foundation for informed decision-making by the relevant authorities.

# 10 ENVIRONMENTAL MANAGEMENT FRAMEWORK (EMF)

## 10.1 Introduction

This chapter sets out the Environmental Management Framework (EMF) for the proposed seawater algae cultivation and biorefinery project at Henties Bay. The EMF operationalises the findings of Chapter 7 by defining how impacts will be controlled, monitored, and reported across all project phases.

The framework is binding on the Proponent and Contractors and will form part of Environmental Clearance Certificate (ECC) conditions in terms of the *Environmental Management Act (Act No. 7 of 2007)* and the *EIA Regulations (2012)* (GRN, 2007; GRN, 2012).

## 10.2 Management Principles

Environmental management for the proposed project will be implemented in accordance with internationally recognised best practice principles and national regulatory requirements. These principles provide the foundation for ensuring that environmental risks are systematically identified, controlled, and continuously managed throughout the project lifecycle (GRN, 2007; MET, 2008; IAIA, 2017).

Table 50: Environmental Management Principles and Application

Principle	Definition	Application to Project	Compliance Reference
<b>Mitigation Hierarchy</b>	Sequential approach: avoid → minimise → rehabilitate → offset	Site selection avoids sensitive areas; impacts reduced through design and operational controls; rehabilitation applied post-disturbance	IAIA (2017); IFC (2012)
<b>Prevention over Correction</b>	Proactive risk avoidance through planning and design	Engineering design incorporates erosion control, closed-loop water systems, and waste minimisation	World Bank (2017); MET (2008)
<b>Compliance by Design</b>	Integration of legal requirements into project design	Project aligned with Environmental Management Act and EIA Regulations at design stage	GRN (2007); GRN (2012)
<b>Adaptive Management</b>	Iterative management based on monitoring and feedback	Monitoring programmes inform continuous improvement of mitigation measures	MET (2008); IAIA (2017)
<b>Accountability &amp; Traceability</b>	Clear roles, responsibilities, and auditable systems	ECO oversight, reporting systems, and compliance tracking mechanisms implemented	IFC (2012); GRN (2007)

## Summary Statement

The application of these principles ensures that environmental management is proactive, compliance-driven, and performance-based, enabling the project to maintain regulatory alignment while effectively managing environmental and socio-economic risks.

### 10.3 EMP Structure (Control by Phase)

The Environmental Management Plan (EMP) is structured around the full project lifecycle, ensuring that environmental risks are systematically managed at each stage of development. This phase-based approach enables the identification of phase-specific risks, implementation of targeted mitigation measures, and establishment of clear monitoring and compliance controls.

Each project phase presents distinct environmental risks and management requirements. The EMP therefore defines specific control priorities and operational focus areas to ensure that impacts are prevented, minimised, and managed effectively throughout implementation (MET, 2008; IAIA, 2017).

Table 51: Phase-Based Environmental Control Framework

Phase	Primary Risks	Control Focus	Key Management Actions
Pre-Construction	Permitting gaps; inappropriate site planning; stakeholder misalignment	Regulatory compliance and planning integrity	Secure all approvals; finalise site layout; stakeholder alignment; environmental induction planning
Construction	Soil disturbance; erosion; dust emissions; noise; habitat disruption	Impact minimisation and site control	Limit clearing footprint; implement erosion control; dust suppression; enforce site rules; delineate no-go areas
Operation	Water abstraction and discharge; waste generation; energy use; system failure risks	Resource efficiency and environmental protection	Operate closed-loop systems; treat effluent; implement waste management systems; continuous monitoring
Decommissioning	Residual contamination; abandoned infrastructure; land degradation	Site restoration and compliance closure	Remove infrastructure; rehabilitate site; stabilise soils; verify environmental recovery

## Summary Statement

This phased control framework ensures that environmental management is proactive, structured, and lifecycle-based, with clear alignment between project activities, associated risks, and required mitigation and monitoring actions.

## 10.4 Core Controls (What Actually Gets Done)

Table 52: Critical Mitigation Measures and Compliance Controls

Aspect	Control Standard	Verification Method	Responsibility
Soils	Limit vegetation clearing to approved footprint; stabilise exposed surfaces; implement erosion control measures	Monthly site inspections by ECO; photographic records; erosion checklists	Contractor / ECO
Water (Marine & Groundwater)	Operate closed-loop seawater systems; prohibit untreated discharge; implement spill prevention and containment	Laboratory water quality analysis; discharge monitoring records; incident reports	Proponent / ECO
Biodiversity	Establish and enforce no-go zones (e.g., lichen fields, drainage lines); minimise habitat disturbance	Pre-construction ecological walkdowns; site demarcation verification; ECO inspections	ECO / Contractor
Air Quality (Dust)	Implement dust suppression (water spraying); enforce speed limits; maintain equipment	Visual inspections; dust logs; complaint register	Contractor / ECO
Waste Management	Segregate waste streams; use licensed disposal facilities; prohibit illegal dumping	Waste manifests; disposal certificates; audit records	Proponent / Contractor
Noise	Restrict activities to daytime hours; maintain equipment to reduce noise levels	Noise complaints register; site inspections	Contractor / ECO

## 10.5 Monitoring and Triggers (Environmental Control Loop)

The monitoring framework establishes a closed-loop control system, linking environmental monitoring results to predefined trigger thresholds and mandatory corrective actions. This ensures that deviations from acceptable conditions are identified early and addressed immediately, in line with adaptive management principles (MET, 2008; IAIA, 2017).

Table 53: Environmental Monitoring Plan with Action Triggers

Parameter	Frequency	Trigger Condition	Corrective Action	Responsibility
<b>Water Quality (Effluent/Receiving Environment)</b>	Monthly	Exceedance of regulatory or baseline standards	Immediate containment; suspend discharge; investigate source; implement corrective measures	Proponent / ECO
<b>Dust (Air Quality)</b>	Weekly	Visible dust exceedance or verified complaints	Increase water spraying; enforce speed limits; adjust operations	Contractor / ECO

<b>Soil Erosion</b>	Monthly	Evidence of active erosion or sediment movement	Install erosion control measures; stabilise surfaces; re-vegetate where required	Contractor / ECO
<b>Waste Management Compliance</b>	Monthly	Missing records or improper disposal	Suspend activities; rectify records; ensure compliant disposal practices	Proponent / Contractor
<b>Biodiversity Disturbance</b>	Quarterly (or as needed)	Encroachment into designated no-go areas	Immediate stop-work; re-demarcate areas; enforce site controls; ECO clearance required to resume	ECO / Contractor

## Control Logic (Operational Principle)

The monitoring system operates on a **trigger-response basis**:

**Monitor → Detect deviation → Trigger → Immediate action → Verify compliance**

This ensures that:

- Environmental impacts are actively controlled, not passively observed
- Non-compliance is immediately corrected
- Environmental performance is measurable and auditable

## 10.6 Roles & Accountability

Effective implementation of the Environmental Management Framework (EMF) requires clearly defined roles, responsibilities, and lines of accountability. Each party involved in the project has specific obligations to ensure compliance with environmental legislation, Environmental Clearance Certificate (ECC) conditions, and the Environmental Management Plan (EMP).

*Table 54: Roles, Responsibilities and Accountability Framework*

<b>Role</b>	<b>Key Responsibilities</b>	<b>Accountability Mechanism</b>
Proponent (ALEC)	Overall environmental compliance; provision of resources; implementation of EMP; submission of compliance reports	Legally accountable under Environmental Management Act; subject to regulatory audits and ECC conditions
Environmental Control Officer (ECO)	Conduct site inspections; monitor compliance; maintain records; issue corrective actions; enforce stop-work where required	Independent oversight; reporting to Proponent and regulatory authorities; audit verification
Contractors	Implement mitigation measures; comply with site environmental requirements; maintain records; adhere to EMP	Contractual obligations; subject to ECO inspections and site compliance enforcement

Ministry of Environment, Forestry and Tourism (MEFT)	Regulatory oversight; review compliance reports; enforce ECC conditions; conduct inspections and audits	Statutory authority under Environmental Management Act; enforcement powers including penalties or suspension
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### 10.6.1 Accountability Structure

The project will operate under a hierarchical but enforceable accountability system:

- The Proponent retains ultimate legal responsibility for environmental compliance
- The ECO provides independent monitoring and enforcement at site level
- Contractors are bound through contractual obligations to implement all mitigation measures
- MEFT provides external regulatory oversight and enforcement

### 10.6.2 Key Governance Principles

- Clear lines of authority to prevent gaps in responsibility
- Independent monitoring (ECO) to ensure objectivity
- Contract-based enforcement for contractors
- Regulatory oversight to ensure legal compliance

## 10.7 Reporting and Audit Framework

A structured reporting and audit system will be implemented to ensure continuous compliance, transparency, and regulatory accountability throughout the project lifecycle. This framework establishes clear reporting lines, frequencies, and verification mechanisms aligned with Environmental Clearance Certificate (ECC) conditions and best practice environmental management standards (GRN, 2007; MET, 2008; IFC, 2012).

Table 55: Environmental Reporting and Audit Framework

Reporting Level	Frequency	Responsible Party	Purpose	Output
<b>Internal Compliance Reporting</b>	Monthly	Environmental Control Officer (ECO) → Proponent	Track implementation of EMP; identify non-compliance	Internal environmental compliance report
<b>Regulatory Compliance Reporting</b>	Quarterly	Proponent → MEFT	Demonstrate compliance with ECC conditions	Formal compliance report submitted to MEFT
<b>Independent Environmental Audit</b>	Annually	Independent Auditor	Verify compliance and environmental performance	Audit report with findings and recommendations

## Non-Compliance Management Protocol

All instances of non-compliance will be managed through a standardised corrective action process, ensuring traceability and closure:

## Identify → Record → Correct → Verify → Report

This includes:

- Immediate recording of non-compliance incidents
- Implementation of corrective actions within defined timeframes
- Verification of corrective action effectiveness by the ECO
- Documentation and inclusion in compliance reports

## Audit and Verification Principles

The reporting and audit system is based on:

- **Traceability** – all actions documented and verifiable
- **Accountability** – responsibilities clearly assigned
- **Transparency** – reporting to both internal and regulatory stakeholders
- **Continuous improvement** – audit findings inform system refinement

## 10.8 Risk and Emergency Controls

The project will implement a structured risk and emergency response framework to ensure that high-risk events are rapidly contained, controlled, and resolved, thereby minimising environmental harm and ensuring compliance with regulatory requirements.

Emergency response procedures will be integrated into site operations and supported by trained personnel, appropriate equipment, and clearly defined escalation protocols (MET, 2008; IFC, 2012).

Table 56: High-Risk Events and Immediate Response Measures

Event	Immediate Control Measures	Follow-Up Actions	Responsibility
<b>Chemical / Effluent Spill</b>	Contain spill; isolate source; deploy spill kits; notify ECO immediately	Investigate cause; remediate affected area; record incident; implement corrective measures	Contractor / ECO
<b>Marine Contamination Risk</b>	Immediately shut down discharge; activate containment measures; isolate affected systems	Conduct water quality assessment; implement remediation; notify authorities if required	Proponent / ECO
<b>Fire</b>	Activate fire response systems; evacuate personnel; notify emergency services	Assess damage; restore safe conditions; incident reporting and review	Contractor / Proponent
<b>System Failure (Operational)</b>	Controlled shutdown of affected systems; isolate fault; prevent environmental release	Repair system; test before restart; update maintenance protocols	Proponent / Technical Team

## Emergency Response Principles

The emergency response system is based on:

- Immediate containment and control to prevent escalation
- Clear communication and escalation protocols
- Protection of personnel, environment, and infrastructure
- Incident documentation and corrective action implementation

## Preparedness Measures

To ensure effective response, the project will maintain:

- Spill response kits and containment equipment on-site
- Firefighting equipment and trained personnel
- Emergency contact lists and reporting procedures
- Regular drills and training for staff

## 10.9 Training and Site Discipline

Effective environmental management requires that all personnel are adequately trained and operate within a clearly defined system of site controls. This section establishes the minimum training requirements and site discipline standards necessary to ensure consistent implementation of the Environmental Management Plan (EMP) (MET, 2008; IFC, 2012).

*Table 57: Environmental Training and Site Discipline Framework*

<b>Component</b>	<b>Requirement</b>	<b>Implementation Approach</b>	<b>Verification</b>	<b>Responsibility</b>
<b>Environmental Induction</b>	Mandatory for all personnel prior to site access	Induction sessions covering EMP, risks, and site rules	Attendance registers; induction records	Contractor / ECO
<b>Toolbox Talks</b>	Regular briefings linked to current site risks	Weekly or task-specific sessions (e.g., dust, spills, biodiversity)	Toolbox talk records; attendance logs	Contractor / ECO
<b>Site Rules and Controls</b>	Enforcement of environmental site rules	Demarcation of no-go areas; signage; waste handling procedures	Site inspections; compliance checklists	ECO / Contractor
<b>Spill Response Awareness</b>	Training on spill prevention and response	Practical demonstrations and drills	Incident response records; drill reports	Contractor / ECO
<b>Ongoing Awareness</b>	Continuous reinforcement of environmental responsibilities	Periodic refresher training and communication	Training logs; audit verification	Proponent / ECO

## Core Site Discipline Requirements

All personnel will be required to:

- Comply with designated no-go areas, including sensitive habitats such as lichen fields and drainage lines
- Follow approved waste management procedures, including segregation and disposal protocols
- Adhere to spill prevention and response procedures
- Report environmental incidents or risks immediately to site management or the ECO

Non-compliance will result in corrective action, retraining, or removal from site, depending on severity.

## Training and Compliance Principles

The training system is designed to ensure:

- **Competence** – personnel understand environmental risks and controls
- **Consistency**
- **improvement** – lessons learned integrated into training programmes

## 10.10 Decommissioning Standard

Decommissioning will be undertaken in a controlled and systematic manner to ensure that the site is restored to a stable, non-polluting condition, consistent with regulatory requirements and best practice environmental management (GRN, 2007; MET, 2008).

The objective is to eliminate residual environmental risks, rehabilitate disturbed areas, and formally close out environmental obligations associated with the project.

*Table 58: Decommissioning Requirements and Verification*

Activity	Requirement	Verification Method	Responsibility
<b>Infrastructure Removal</b>	Remove all plant, equipment, pipelines, and temporary structures	Site inspection; asset removal records	Proponent / Contractor
<b>Land Rehabilitation</b>	Regrade landforms; stabilise surfaces; implement erosion control measures	Visual inspection; rehabilitation checklist	Contractor / ECO
<b>Contamination Assessment</b>	Conduct soil and water sampling to confirm absence of contamination	Laboratory analysis; environmental sampling reports	ECO / Specialist
<b>Waste Clearance</b>	Remove all waste materials; dispose via licensed facilities	Waste manifests; disposal certificates	Proponent / Contractor
<b>Site Closure Certification</b>	Obtain formal environmental sign-off confirming compliance	ECO sign-off; regulatory approval (MEFT)	Proponent / ECO

## Decommissioning Principles

The decommissioning process will be guided by:

- Complete removal of environmental liabilities
- Restoration of site stability and safety
- Verification through sampling and inspection
- Formal closure and regulatory sign-off

## Closure Criteria

The site will be considered successfully decommissioned when:

- All infrastructure has been removed
- The site is physically stable and free from erosion risk
- No contamination is detected above acceptable thresholds
- All waste has been properly disposed of
- Final inspection and approval are granted by the ECO and relevant authorities

## 10.11 Compliance Statement

The Environmental Management Framework (EMF) has been designed to ensure full compliance with applicable Namibian environmental legislation, regulatory requirements, and recognised best practice standards. The framework is structured to be auditable, enforceable, and aligned with Environmental Clearance Certificate (ECC) conditions.

Specifically, the EMF complies with and is implemented in accordance with:

- The *Environmental Management Act (Act No. 7 of 2007)*, which establishes the legal basis for environmental assessment, management, and compliance in Namibia (GRN, 2007)
- The *Environmental Impact Assessment Regulations (Government Notice No. 30 of 2012)*, which define procedural requirements for environmental management, monitoring, and reporting (GRN, 2012)
- All conditions attached to the **Environmental Clearance Certificate (ECC)** issued for the project, which are binding and enforceable
- The Ministry of Environment and Tourism (MET), 2008: *Environmental Impact Assessment Guidelines*, which provide best practice guidance for environmental management and monitoring

## Compliance Assurance Approach

To ensure ongoing compliance, the EMF incorporates:

- Defined mitigation and control measures for all identified impacts
- Monitoring systems with trigger-based corrective actions
- Structured reporting and audit mechanisms
- Clear roles and accountability frameworks

- Documented records for verification and regulatory review

## **Audit and Enforcement Readiness**

The EMF is designed to support:

- Regulatory inspections and audits by MEFT
- Independent environmental audits
- Verification of compliance with ECC conditions
- Traceable documentation of environmental performance

## 10.12 Conclusion

The Environmental Management Framework (EMF) establishes a clear, structured, and enforceable system for managing environmental and socio-economic impacts associated with the proposed development.

The framework demonstrates that:

- **Control measures are clearly defined, measurable, and enforceable**, with direct linkage to identified impacts and regulatory requirements
- **Environmental risks are manageable**, supported by monitoring systems, trigger-based responses, and adaptive management mechanisms
- **Roles and responsibilities are explicitly assigned**, ensuring accountability, oversight, and effective implementation
- **Compliance is verifiable and auditable**, through structured reporting, monitoring, and independent audit processes

## **Final Position**

The EMF provides a fully operational and compliance-aligned management system, ensuring that the project can be implemented in a manner that meets regulatory expectations and minimises environmental risk.

**Outcome:** The project is implementation-ready and supported by a robust, auditable, and regulator-compliant environmental management framework.

# 11 CONCLUSIONS AND RECOMMENDATIONS

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## 11.1 Introduction

This chapter consolidates the key findings of the Environmental Impact Assessment (EIA) for the proposed seawater algae cultivation and biorefinery project at Henties Bay State Land, Erongo Region. It presents an overall evaluation of impact significance, project viability, and provides clear recommendations to the Environmental Commissioner regarding approval and conditions.

## 11.2 Summary of Key Findings

### Environmental context

- Site located on non-arable coastal desert land with low competing land uses
- No permanent surface water systems; reliance on seawater reduces freshwater pressure
- Low–moderate ecological sensitivity, with localised constraints (e.g., lichen fields, drainage lines)

### Impact profile (post-mitigation)

- Soils: **Low** (controlled disturbance)
- Water (marine/groundwater): **Low–Medium** (managed via closed-loop and treatment)
- Biodiversity: **Low** (avoidance + footprint control)
- Air/Noise/Waste: **Low** (standard controls)
- Socio-economic: **High Positive** (jobs, diversification, corridor growth)

### Alternatives

- Coastal, seawater-based option is clearly superior to inland/freshwater options
- Selected design (open ponds, distributed layout) is fit-for-purpose and scalable

### Public participation

- Multi-channel engagement completed (adverts, notices, BID, direct outreach)
- Formal meeting held (23 April 2026, Henties Bay NYS)
- Issues captured and integrated into design and EMP
- Process is compliant and auditable

## 11.3 Overall Impact Significance

After application of mitigation measures defined in the EMP:

- No fatal flaws identified
- Residual impacts are low to moderate and manageable

- Positive impacts are significant and long-term

Net outcome: Positive environmental and socio-economic balance

## 11.4 Project Viability

The project is considered:

- **Environmentally viable** – risks controlled through defined measures and monitoring
- **Technically feasible** – aligned with site conditions (seawater, climate, land availability)
- **Economically justified** – supports industrial diversification and regional growth
- **Strategically aligned** – contributes to Namibia’s green industrialisation and blue economy

## 11.5 Recommended Approval Position

It is recommended that the Environmental Commissioner:

**Approve the project**, subject to strict implementation of the Environmental Management Framework (EMF) and Environmental Management Plan (EMP).

## 11.6 Recommended Conditions of Approval (ECC Conditions)

The following conditions are recommended to ensure that the proposed project is implemented in full compliance with environmental legislation and in accordance with best practice environmental management standards. These conditions are **binding and enforceable** under the Environmental Clearance Certificate (ECC).

*Table 59: Recommended Environmental Clearance Certificate (ECC) Conditions*

Condition Area	Requirement	Specific Actions / Standards	Verification / Compliance Mechanism	Responsibility
EMP Compliance	Full implementation of EMP	EMP to be applied across all phases; integrated into contractor contracts	Site inspections; compliance reports; audit verification	Proponent / ECO
Environmental Monitoring	Ongoing environmental monitoring	Monthly monitoring of water, waste, and site conditions; quarterly reporting to MEFT	Monitoring records; submitted reports; regulatory review	ECO / Proponent
Water Management	Sustainable water use and discharge control	Operate closed-loop seawater systems; no untreated discharge; comply with water quality standards	Laboratory analysis; discharge monitoring logs	Proponent / ECO

Biodiversity Protection	Protection of sensitive habitats	Demarcate no-go areas (e.g., lichen fields); conduct pre-construction ecological walkdowns	Site inspections; ecological verification reports	ECO / Contractor
Waste Management	Proper waste handling and disposal	Use licensed waste contractors; maintain waste tracking and disposal records	Waste manifests; disposal certificates; audits	Proponent / Contractor
Environmental Control Officer (ECO)	Independent environmental oversight	Appoint qualified ECO prior to construction; ECO to conduct inspections and enforce compliance	ECO reports; inspection records; stop-work notices where applicable	Proponent
Stakeholder Engagement	Ongoing stakeholder communication	Maintain grievance mechanism; ensure continued engagement during construction and operation	Grievance logs; communication records; stakeholder reports	Proponent
Auditing and Compliance	Independent verification of compliance	Conduct annual environmental audits; submit audit reports to MEFT	Audit reports; corrective action tracking	Independent Auditor / Proponent

### 11.6.1 Implementation Note

All conditions must be:

- Incorporated into contractual obligations for contractors and service providers
- Supported by documented monitoring and reporting systems
- Subject to regulatory oversight and enforcement by MEFT

Failure to comply with these conditions may result in:

- Suspension of activities
- Penalties or enforcement action
- Withdrawal of the Environmental Clearance Certificate

### 11.6.2 Strategic Position

These conditions ensure:

- ✓ Full lifecycle environmental control
- ✓ Clear accountability and enforcement pathways
- ✓ Audit-ready compliance structure
- ✓ Alignment with Namibian law and international best practice

## 11.7 Commitments by the Proponent

The Proponent commits to implementing the proposed project in full compliance with applicable environmental legislation, regulatory requirements, and best practice environmental management standards. These commitments form the basis for responsible project execution and will be integrated into all phases of planning, construction, operation, and decommissioning.

*Table 60: Proponent Commitments and Implementation Measures*

<b>Commitment Area</b>	<b>Commitment</b>	<b>Implementation Measures</b>	<b>Verification Mechanism</b>
<b>Legal Compliance</b>	Full compliance with Namibian environmental legislation	Adherence to Environmental Management Act, EIA Regulations, and ECC conditions; integration into project design and operations	Regulatory inspections; compliance reports; audit outcomes
<b>Mitigation &amp; Monitoring</b>	Implementation of all mitigation and monitoring measures	Execution of EMP; application of mitigation hierarchy; continuous environmental monitoring programmes	Monitoring records; ECO reports; audit verification
<b>Transparency &amp; Reporting</b>	Transparent environmental reporting and stakeholder engagement	Submission of periodic compliance reports; maintenance of grievance mechanism; stakeholder communication	Submitted reports; grievance logs; stakeholder engagement records
<b>Continuous Improvement</b>	Ongoing improvement of environmental performance	Adaptive management; review of monitoring results; updating of mitigation measures and practices	Audit findings; performance reviews; corrective action tracking

### Commitment Framework

These commitments are underpinned by:

- Integration of environmental requirements into contracts and operational procedures
- Allocation of adequate financial and human resources for implementation
- Maintenance of documented systems for monitoring, reporting, and verification
- Adoption of adaptive management practices to respond to evolving conditions

### Accountability Statement

The Proponent accepts full responsibility for:

- Ensuring implementation of all environmental management measures
- Maintaining compliance with regulatory requirements and ECC conditions
- Supporting oversight by the Environmental Control Officer (ECO) and regulatory authorities

## Conclusion Statement

These commitments demonstrate that the Proponent is prepared to implement the project in a responsible, transparent, and compliance-driven manner, ensuring that environmental risks are effectively managed and socio-economic benefits are realised.

### 11.8 Conclusion

The Environmental Impact Assessment (EIA) has comprehensively evaluated the potential environmental and socio-economic impacts associated with the proposed seawater algae cultivation and biorefinery project at Henties Bay State Land.

Based on the findings of the assessment, the project is concluded to be:

- Environmentally manageable, with all identified impacts effectively mitigated through the implementation of the Environmental Management Plan (EMP) and associated control measures
- Socially acceptable, supported by a compliant and inclusive public participation process, and demonstrating clear socio-economic benefits for local communities
- Economically and strategically beneficial, contributing to industrial diversification, job creation, and Namibia's broader green economy and blue economy objectives

### Overall Impact Position

Following the application of mitigation measures and management controls:

- No significant or irreversible environmental impacts have been identified
- Residual impacts are low to moderate and within acceptable limits
- Positive socio-economic impacts are substantial and long-term

### Final Determination

The EIA confirms that the proposed development:

- Complies with applicable Namibian environmental legislation and regulatory requirements
- Aligns with national policy frameworks and international environmental commitments
- Is supported by a robust, auditable, and implementation-ready Environmental Management Framework (EMF)

### Recommendation

In light of the above, it is concluded that the project presents no unacceptable environmental risks, provided that all recommended mitigation measures and Environmental Clearance Certificate (ECC) conditions are fully implemented.

**The project is therefore recommended for approval by the Environmental Commissioner, subject to the prescribed conditions.**

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