SKORPIO ALTERNATIVE FUELS NAMIBIA (PTY) LTD

SEAWEED AQUACULTURE PILOT PROJECT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) REPORT
FOR THE PROPOSED CONSTRUCTION AND OPERATION OF LAND-BASED
SEAWEED AQUACULTURE PONDS

WLOTZKASBAKEN SETTLEMENT, ERONGO REGION, NAMIBIA

AUGUST 2025

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ENVIRONMENTAL CONSULTANT'S EXPERTISE

I.N.K Enviro Consultants cc is the independent firm of environmental consultants that has been appointed by SKORPIo Alternative Fuels Namibia (Pty) Ltd to conduct and manage the ESIA process.

Immanuel N. Katali, an Environmental Assessment Practitioner, possesses a Bachelor of Arts (Honours) in Geography, Environmental Studies, and Sociology, and is currently pursuing a Master of Philosophy in Sustainable and Environmental Health Studies at Africa Research University (ARU). With a decade of experience in conducting and overseeing Environmental and Social Impact Assessments (ESIAs) as well as Environmental Compliance and Monitoring Audits in Namibia, Immanuel is recognized as a certified Environmental Assessment Practitioner by the Environmental Assessment Professionals Association of Namibia (EAPAN).

DECLARATION OF INDEPENDENCE AND DISCLAIMER

I.N.K Enviro Consultants cc herewith declare that this report represents an independent assessment of the proposed Construction and Operation of the Land-Based Seaweed Aquaculture Ponds, on the request of SKORPIo Alternative Fuels Namibia (Pty) Ltd. The Environmental Consultant has prepared this report based on an agreed scope of work and acts in all professional manner as an Independent Environmental Consultant to SKORPIo Alternative Fuels Namibia (Pty) Ltd and exercises all reasonable skill and care in the provision of its environmental professional services and in a manner consistent with the level of expertise exercised by members of the environmental profession.

The information, statements and commentary contained in this report have been prepared by I.N.K Enviro Consultants cc from information provided by SKORPIo Alternative Fuels Namibia (Pty) Ltd, relevant Specialist Studies, Site Visits and the Public Participation Process. I.N.K Enviro Consultants cc does not express an opinion as to the accuracy or completeness of the information provided, the assumptions made by the party that provided the information, or any conclusions reached. I.N.K Enviro Consultants cc has based this report on information received or obtained, on the basis that such information is accurate and, where it is represented to I.N.K Enviro Consultants cc as such, complete. I.N.K Enviro Consultants cc is not responsible and will not be held liable to any other person or organization for any loss or damage suffered by any other person or organization arising from matters dealt with or conclusions expressed in this report. This report is the sole property of SKORPIo Alternative Fuels Namibia (Pty) Ltd and must not be altered or added to without the prior consent of SKORPIo Alternative Fuels Namibia (Pty) Ltd.

EXECUTIVE SUMMARY

Project Background

SKORPIo ALTERNATIVE FUELS NAMIBIA (PTY) LTD (hereinafter referred to as (SKORPIoN) seeks to obtain an Environmental Clearance Certificates (ECCs) for their proposed IConstruction of Seaweed Aquaculture Ponds.

The objective is to establish seaweed aquaculture ponds covering a cumulative footprint of 6-hectares (ha), situated along the Namibian coastline in Wlozkasbaken Settlement between Swakopmund and Henties Bay, in proximity to the existing Erongo Desalination Plant and conveniently near the Walvis Bay Port. Although the settlement is situated within the boundaries of the Dorob National Park, the Wlotzkasbaken townlands are expressly excluded from the park's jurisdiction.

This initiative seeks to cultivate approximately 12 tonnes (t) of seaweed (*Ulva lactuca*) per day, in raceway ponds or paddlewheel ponds, fed by water pumped from the sea. The proposed ponds are approximately 50 - 100 m long, and 10 m wide with a water depth of approximately 70 cm, excavated into the sand and lined with a specialized white pond liner. The paddle wheels will be driven by electric motors, powered by on-site renewable energy (solar & wind) that will be installed.

The source of water in the aquafarm will be the continuous exchange of sea water from the Atlantic Ocean. SKORPIoN, is expected to pump 42,000 cbm of seawater per day. The harvested seaweed will undergo pulping and be utilized for anaerobic digestion to produce biogas.

The produced biogas will be split into methane (app. 500kg pd) and biogenic CO2 (approximately 1tpd). The methane be stored in road tankers (a set of two tanker, like CNG) with one tanker being on site, acting as storage and the other tanker being in the port of Walvisbay to fuel vessels. Regular 20ft ISO tanks on trailers can be used.

The Pilot Project is a continuation of the prior assessment undertaken in 2024 for the Proposed Deployment of WaveRoller devices designed to harness electricity and the Installation of Underground Cable from the sea to the proposed site. Consequently, the Seaweed Aquaculture Project along with its ancillary infrastructure—including the Bulk Water Supply Pipelines, Land-Based Seaweed Aquaculture Ponds, a 2 MWp Solar Photovoltaic Plant, two (2) Four (4)

MWp Wind Turbines, and a Green Hydrogen and Biofuels Production Facility—constitutes the second phase of the Pilot Project.

The objectives of the proposed project include the following:

- Sustainable cultivation and harvesting of seaweed
- Local Employment
- Significant investment in the project area.
- Training and research opportunities
- Demonstration of seaweed aquaculture farming applications.

Project Need and Desirability

The proposed seaweed aquaculture ponds represent a pivotal element of the ancillary infrastructure for the Seaweed Aquaculture Farm Pilot Project. The primary aim of this initiative is to cultivate seaweed (Ulva lactuca) from the Namibian oceanic waters (approximately 200 to 300 meters offshore), to the aquaculture farm positioned about 1.3 kilometers inland from the sea. The harvested seaweed will subsequently undergo a pulping process, which will be utilized for anaerobic digestion, into biogas and its processing into biomethane and e-fuel, by means of splitting and combination with green hydrogen. Consequently, the construction of the proposed ponds is essential for the successful realization of the Seaweed Aquaculture Pilot Project. In the absence of this implementation, the project's objectives and goals will remain unfulfilled, thereby jeopardizing the overall feasibility of the Project.

Public Participation Process

The public participation process for the proposed project is conducted to ensure that all persons and/or organizations that may be affected by, or interested in the proposed project, were informed of the project and could register their views and concerns. By consulting with relevant authorities and I&APs, the range of environmental issues to be considered in this Report has been given specific context and focus.

Included below is a summary of the I&APs consulted, the process that was followed and the issues that were identified.

General Assumptions and Limitations

The key assumptions and limitations of this ESIA Report are detailed below.

- It is assumed that the information provided by SKORPIoN, relating to the project activities is accurate and that the project will be implemented and operated as described.

- The predictions of the impacts of the seaweed aquaculture ponds, on the terrestrial environment need to be validated by regular field observations and subsequent monitoring.
- The results of specialist study formed the basis for the assessment of impact significance. The specialist investigations are conducted by independent specialists considered to be experts in their fields. It was assumed that the information from these sources is relevant and accurate.
- Considering the dynamic nature of the marine environment and its susceptibility to the influence of climate change e.g. sea level rise, increases in frequency of wave storms, are not evidently considered in this study.
- Area is frequented by the Orano Desalination Plant activities, recreational fishers and off-road driving, as such the area is not entirely pristine.

Project Alternatives

The proposed seaweed aquaculture ponds represent a pivotal element of the ancillary infrastructure for the Seaweed Aquaculture Farm Pilot Project. The primary aim of this initiative is to cultivate seaweed (*Ulva lactuca)* from the Namibian oceanic waters (approximately 300 to 500 meters offshore), to the aquaculture farm positioned about 1.3 kilometers inland from the sea. The harvested seaweed will subsequently undergo a pulping process, which will be utilized for anaerobic digestion, combined with hydrogen to produce biogas (e-methanol). Consequently, the construction of the proposed ponds is essential for the successful realization of the Seaweed Aquaculture Pilot Project. In the absence of this implementation, the project's objectives and goals will remain unfulfilled, thereby jeopardizing the overall feasibility of the Project.

Therefore, proceeding with the Project, will contribute to the feasibility of the overall seaweed aquaculture farm and create a significant positive economic impact such as employment and procurement of goods and services.

The challenge facing the Project Proponent is its contribution towards achieving these goals while at the same time preventing and/or mitigating potential negative social and environmental impacts. The proponent will have to ensure that the identified mitigation measures and commitments to address the potential impacts, will appropriately be implemented and adhered to.

Assessment Approach and Methodology

The site visit and beach survey collected sediment for grain size analysis, as well as sediment samples for invertebrates. Counts of avifauna and marine flora were also taken into consideration. This approach is deemed adequate for placing into context the potential impacts associated with the establishment of the proposed aquaculture ponds for this pilot project.

An assessment of the potential positive and negative impacts associated with the construction and operations phase of the ponds is provided below. As an outcome, specialist input was requested for some of the environmental issues and has been included in this assessment.

Each observed species and habitat type were assessed and ranked according to ecological sensitivity criteria, including endemism, conservation status, reproductive vulnerability, and habitat specialization. Particular attention was given to marine species, endemic reptiles, lichens, and nesting birds.

Other potential environmental impacts resulting from the proposed project activities and facilities (also identified during the ESIA) were assessed by I.N.K and are also presented below.

Impacts are considered in a cumulative manner where possible such that the impacts of the proposed Project are seen in the context of the baseline conditions described in Section 6.

- Both the criteria used to assess the impacts and the Method of determining the frequency/severity of the impacts is outlined.

Conclusions and Recommendations

Exclusion/No-go zones are proposed where channel are found within the Project site to prevent irreversible degradation.

The Drainage Pattern and Exclusion Zone Map for the overall project site has been developed as a critical planning and environmental management tool for the proposed Seaweed Aquaculture Project.

The flora, fauna, and avifauna in the Wlotzkasbaken Coastal Zone are ecologically sensitive and highly endemic. Impacts from aquaculture infrastructure must be mitigated through strict environmental safeguards, including habitat buffers and exclusion zones, timing of activities to avoid sensitive seasons, and continuous monitoring. The findings in Seely and Pallett (2008) affirm the critical need to

prioritize biodiversity protection in this arid coastal region.

The potential inland impacts may arise from the land clearing and preparation which could disturb the sensitive fauna and flora.

However, the mitigation measures that have been identified and recommended by I.N.K will promote the positive impacts of the project, as well as reduce the negative impacts to acceptable levels. An ESMP was further developed which identifies potential impacts of the project during the construction and operation phases. The ESMP is a legally binding document to which SKORPIoN must adhere to.

Despite these impacts, I.N.K concludes that the Proponent should be allowed to undertake the proposed Project, provided the potential impacts in the ESMP are implemented.

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LIST OF ACRONYMS, ABBREVIATIONS AND UNITS

Acronyms / Abbreviations / Units	Definition
BCLME	Benguela Current Large Marine Ecosystem
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BID	Background Information Document
CBM	Cubic Meters
CO_2	Carbon Dioxide
DAE	Department of Agricultural Engineering
DEA	Directorate of Environmental Affairs
DO	Dissolved Oxygen
EAP	Environmental Assessment Practitioner
ECC	Environmental Clearance Certificate
EEZ	Exclusive Economic Zone
ESIA	Environmental and Social Impact Assessment
EIB	European Investment Bank
EMA	Environmental Management Act
ESF	Environmental and Social Framework
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Safeguard
GW	GigaWatt
ha	Hectares
HAB	Harmful Algae Blooms
IPF	Investment Project Financing
IRR	Issues and Response Report
IMO	International Maritime Organization
I&APs	Interested and Affected Party
Km	Kilometer
kW	kiloWatt
M	Meter
MAWLR	Ministry of Agriculture, Water and Land Reform
MD	Ministry of Defense
MEFT	Ministry of Environment, Forestry and Tourism

Acronyms / Abbreviations / Units	Definition
mm	Millimeter
MME	Ministry of Mines and Energy
MWh	MegaWatt hour
MWT	Ministry of Works and Transport
NACOMA	Namibian Coast Conservation and Management
NAMPOWER	Namibia Power Corporation
NDP	National Development Plan
PAN	Pesticides Action Network
PPAH	Pollution Prevention and Abatement Handbook
PPP	Public Participation Process
PTO	Power Take-Off
SEA	Strategic Environmental Assessment
SOLAS	Safety of Life at SEA
SST	Sea Surface Temperature

1 INTRODUCTION

1.1 Purpose of the Report

Interested and/or Affected Parties (I&APs) relating to the proposed Pilot Project are invited to comment on this ESIA Report. The final report, including comments received from I&APs, will be submitted to the Ministry of Environment, Forestry and Tourism (MEFT): Department of Environmental Affairs (DEA), who will make the final decision on the application for an environmental clearance.

Five (5) separate ECC Applications will be submitted to MEFT; DEA, in accordance with the proposed Project activities outlined below:

1. Two Bulk Water Supply Pipelines.
2. Land-Based Seaweed Aquaculture Ponds.
3. 2 MWp Solar PV Plant.
4. 2x Four (4) MWp Wind Turbines.
5. Green Hydrogen and Biofuels Production Facility.

This ESIA Report exclusively addresses the Land-Based Seaweed Aquaculture Ponds. Distinct ESIA Reports have been compiled to assess the Bulk Water Supply Pipelines, 2 MWp Solar Photovoltaic Plant, and Two (2) Four (4) MWp Wind Turbines and, Green Hydrogen and Biofuels Production Facility.

Prior to the commencement of the project, an environmental clearance is required based on an approved Environmental and Social Impact Assessment (ESIA) and Environmental and Social Management Plan (ESMP). This report describes the ESIA process being followed and provides an overview of the affected environment. It includes an assessment of the environmental impacts that the proposed activities are likely to have and sets out the consultants' recommendations. The proposed management and mitigation measures related to the proposed activities are documented in an ESMP.

1.2 Project Background

SKORPIo ALTERNATIVE FUELS NAMIBIA (PTY) LTD (hereinafter referred to as (SKORPIoN) seeks to obtain an Environmental Clearance Certificates (ECCs) for their proposed Installation of Seaweed Aquaculture Ponds.

The objective is to establish seaweed aquaculture ponds covering a cumulative footprint of 6-hectares (ha), situated along the Namibian coastline in Wlozkasbaken Settlement between Swakopmund and Henties Bay, in proximity to the existing Erongo Desalination Plant and conveniently near the Walvis Bay Port. Although the settlement is situated within the boundaries of the Dorob National Park, the Wlotzkasbaken townlands are expressly excluded from the park's jurisdiction.

This initiative seeks to cultivate approximately 12 tonnes (t) of seaweed (*Ulva lactuca*) per day, in raceway ponds or paddlewheel ponds, fed by water pumped from the sea. The proposed ponds are approximately 50 - 100 m long, and 10 m wide with a water depth of approximately 70 cm, excavated into the sand and lined with a specialized white pond liner. The paddle wheels will be driven by electric motors, powered by on-site renewable energy (solar & wind) that will be installed.

The source of water in the aquafarm will be the continuous exchange of sea water from the Atlantic Ocean. SKORPIoN, is expected to pump 42,000 cbm of seawater per day. The harvested seaweed will undergo pulping and be utilized for anaerobic digestion to produce biogas.

The produced biogas will be split into methane (app. 500kg pd) and biogenic CO2 (approximately 1tpd). The methane be stored in road tankers (a set of two tanker, similar to CNG) with one tanker being on site, acting as storage and the other tanker being in the port of Walvisbay to fuel vessels. Regular 20ft ISO tanks on trailers can be used.

The Pilot Project is a continuation of the prior assessment undertaken in 2024 for the Proposed Deployment of WaveRoller devices designed to harness electricity and the Installation of Underground Cable from the sea to the proposed site. Consequently, the Seaweed Aquaculture Project along with its ancillary infrastructure—including the Bulk Water Supply Pipelines, Land-

Based Seaweed Aquaculture Ponds, a 2 MWp Solar Photovoltaic Plant, two (2) Four (4) MWp Wind Turbines, and a Green Hydrogen and Biofuels Production Facility—constitutes the second phase of the Pilot Project.

The objectives of the proposed project include the following:

- Sustainable cultivation and harvesting of seaweed
- Local Employment
- Significant investment in the project area.
- Training and research opportunities
- Demonstration of seaweed aquaculture farming applications.

SKORPIoN is an innovative sub-commercial pilot initiative aimed at transforming the production of biofuels, e-fuels and the lengthening of the green hydrogen value chain, particularly in line with Namibia's strategy to develop this industry. This pioneering endeavor is a collaboration between SKORPIo Alternative Fuels Namibia (Pty) Ltd and SeaH4 (Pty) Ltd.

I.N.K Enviro Consultants cc (hereinafter referred to as I.N.K), an independent firm of environmental consultants, has been appointed to undertake the Environmental and Social Impact Assessment process for this project. For more details on the ESIA process that was followed, please refer to Section 1.

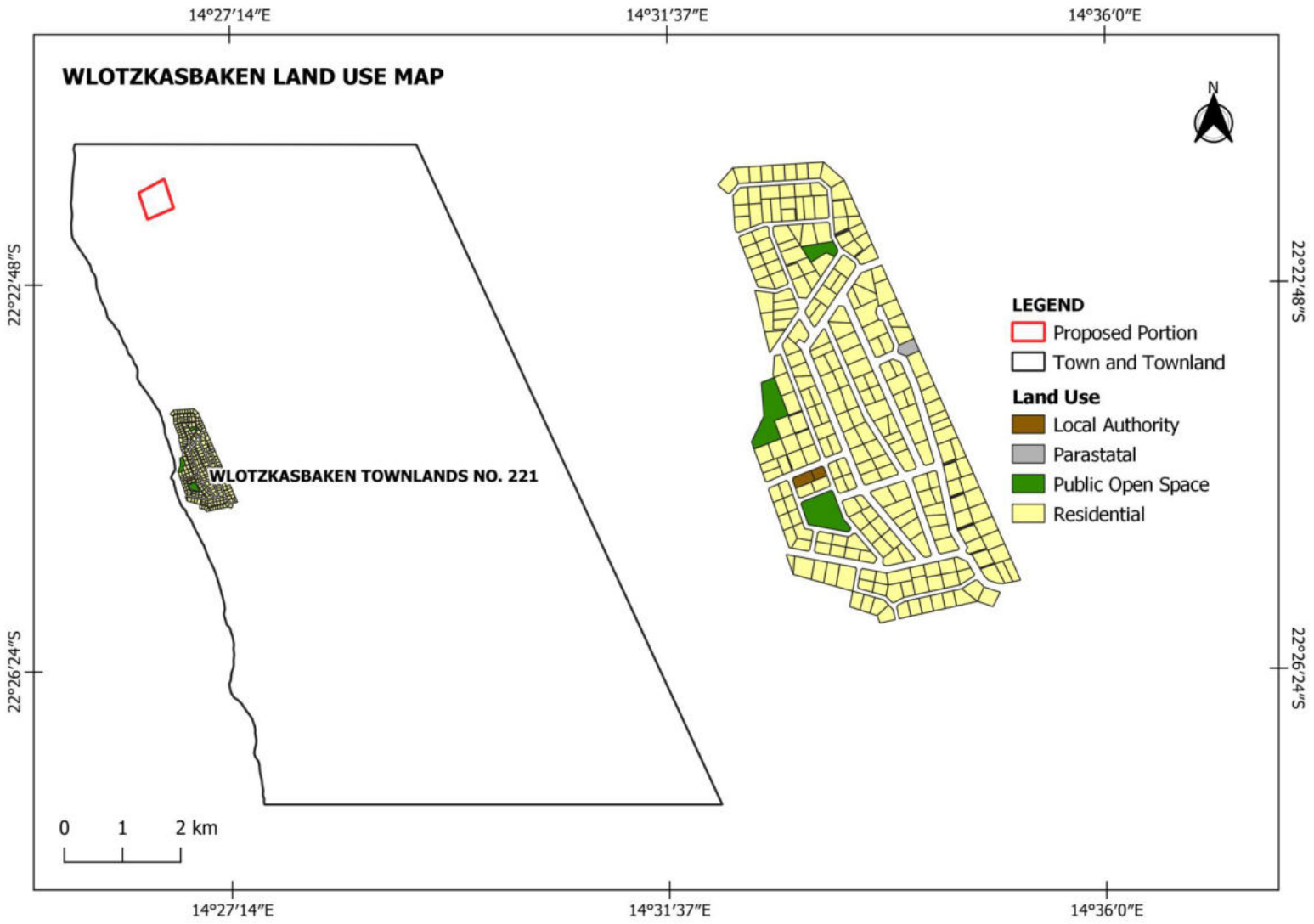


Figure 1: Site Locality Map

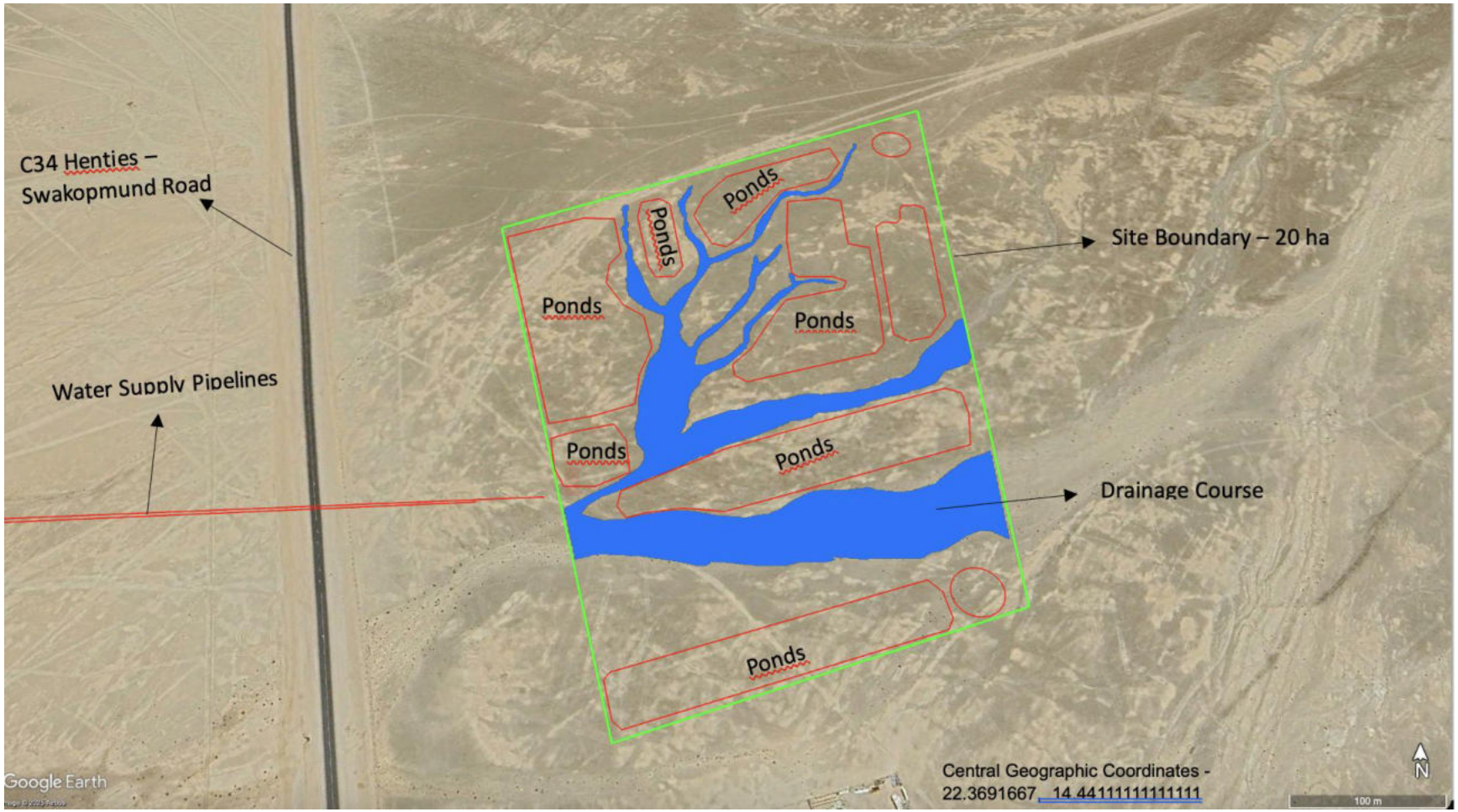


Figure 2: Proposed Seaweed Aquaculture Ponds

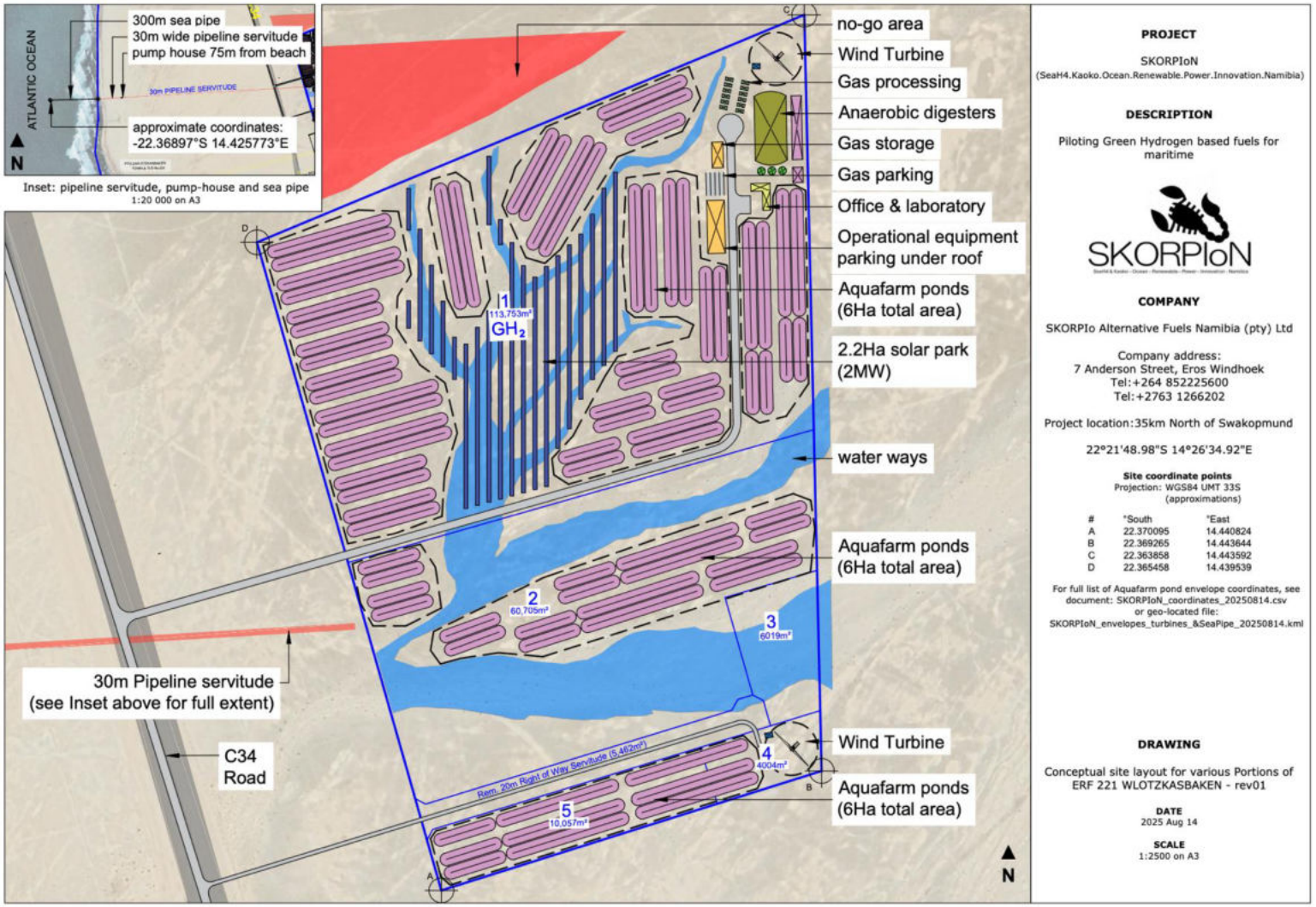


Figure 3: Proposed Seaweed Aquaculture Pilot Project Site Layout

1.3 Project Need and Desirability

The proposed seaweed aquaculture ponds represent a pivotal element of the ancillary infrastructure for the Seaweed Aquaculture Farm Pilot Project. The primary aim of this initiative is to cultivate seaweed (Ulva lactuca) from the Namibian oceanic waters (approximately 200 to 300 meters offshore), to the aquaculture farm positioned about 1.3 kilometers inland from the sea. The harvested seaweed will subsequently undergo a pulping process, which will be utilized for anaerobic digestion, into biogas and its processing into biomethane and e-fuel, by means of splitting and combination with green hydrogen. Consequently, the construction of the proposed ponds is essential for the successful realization of the Seaweed Aquaculture Pilot Project. In the absence of this implementation, the project's objectives and goals will remain unfulfilled, thereby jeopardizing the overall feasibility of the Project.

1.3.1 The Seaweed Aquaculture Project's Contribution to Namibia's Green Energy Efforts

The Government of Namibia is focusing efforts on achieving large-scale, low-cost renewable energy development and designing models for sustainably maximizing fiscal revenue and local development in renewable energy investment and green hydrogen production. Namibia's world-class solar and wind resources give it a long-term competitive advantage in producing green hydrogen (Namibia Green Hydrogen Council, 2022).

Therefore, Namibia is aiming to become a green hydrogen superpower in the coming decade by positioning itself as a leader in the emerging markets and an international exporter of green hydrogen. The production of green hydrogen will be an important source of foreign investment, foreign currency and be important for the country's energy security and transition. In addition, this technology enables a localizing, deepening and lengthening of the GH2 value chain in Namibia, multiplying the impact of the entire industry for Namibia.

In addition, Namibia is investing significant resources in expanding its port in Walvis Bay to safeguard sea routes and establish itself as a maritime powerhouse in the region and keep up to date with multilateral developments such as green routes and the IMO introduced MEPC83 regulations for the reduction of carbon emissions in the maritime sector. This endeavor aims to leverage the increasing demands in shipping, rising cargo volumes, the oil and gas industries, commercial activities, recreational uses, and more. The development of the Walvis Bay port is

part of Namibia's broader ambition to evolve into a pivotal logistics center for southern Africa. The proposed project will therefore aim to maximize on the port expansion by supplying vessels with biofuels and e-fuels.

Considering the above, the proposed project holds significant potential in enhancing Namibia's logistics capabilities by establishing crucial supply of biofuels in the logistics sector, and elevating Walvis Bay's stature as a regional logistics hub.

1.4 Introduction to the Environmental and Social Impact Assessment Process

Environmental and Social Impact Assessments are regulated by the Ministry of Environment, Forestry and Tourism (MEFT) in terms of the Environmental Management Act, 7 of 2007. This Act was gazetted on 27 December 2007 (Government Gazette No. 3966) and enacted on 6 January 2012. The Environmental and Social Impact Assessment Regulations: Environmental Management Act, 2007 (Government Gazette No. 4878) were promulgated on 6 January 2012.

1.4.1 ESIA Process

The ESIA process that has been followed is summarized in the table below:

Table 1: ESIA Process

ESIA OBJECTIVES	CORRESPONDING ACTIVITIES
Project initiation, Screening Phase	
◆ Understanding of the environmental and social baseline relating to the proposed Project. ◆ Notify the decision-making authority of the proposed Project. ◆ Initiate the Environmental and Social Impact Assessment process. ◆ Site visits and identify environmental issues. ◆ Identify key stakeholders and early identification of other I&APs.	◆ Project Inception and initiation meetings to discuss the Project and ESIA process requirements. ◆ Liaise with the Specialists. ◆ Draft ESIA Schedule. ◆ Initiate baseline studies. ◆ Submit Application for authorisations and a Background Information Document (BID) to the authorities. ◆ Register the Project and Applications for environmental clearances with MEFT (DEA) on its online portal. ◆ Early identification of environmental aspects and potential impacts associated with the proposed Project.
Assessment Phase	

ESIA OBJECTIVES	CORRESPONDING ACTIVITIES
◆ Notify other regulatory authorities and I&APs of the proposed Project (via newspaper advertisements, BID, emails, site notices and telephone calls). ◆ Conduct Key Stakeholder and Public meetings. ◆ Carry out specialist investigations and establish baseline environmental conditions. ◆ Determine the terms of reference for additional assessment work. ◆ Compile Scoping Report and Issues and Response Report (IRR) ◆ Distribute the Scoping Report for review and comment by relevant authorities and I&APs. ◆ Assessment of potential issues, consider comments received and compile the ESIA final report.	◆ Develop Public Participatory Process (PPP) Programme. ◆ Develop I&AP database. ◆ Prepare BID and distribute to I&APs. ◆ Notify government authorities and IAPs of the Project and ESIA process (telephone calls, e-mails, BID newspaper advertisements and site notices). ◆ IAP registration and comments. ◆ Meetings with authorities and IAPs. ◆ Investigations by appointed specialists. ◆ Compilation of Scoping Report and ESMPs. ◆ Distribute Scoping Report and ESMP to all I&APs for review and comments. ◆ Assess potential issues, obtain comments and update the Scoping Report and ESMP.

Within this framework, the required components of the ESIA report are discussed in more detail as part of the ESIA Methodology in Section 8.

ESIAs are influenced by national legislation and a range of guidelines. The legislation applicable to this project and the ESIA process is discussed further in Section 3 below.

2 SCOPING METHODOLOGY

2.1 Information Collection

An assessment focusing on both the potential marine and terrestrial disturbances and displacements, while assessing the potential effects on marine and terrestrial fauna and flora as a consequence of the ancillary infrastructure for the Pilot Project, was previously undertaken as part of the phase 1 (Deployment of the WaveRoller Devices and Installation of Underground Cables from the sea to the proposed Aquaculture site) Project in 2024. Therefore, marine data for the ancillary infrastructure conducted in 2024 has been updated for this project.

From desktop study methodology and literature review, the description will be based on a review of existing information and data from local and international scientific literature and information sourced from the internet sources and complemented by a biodiversity assessment, beach and site survey.

Therefore, I.N.K used various information sources to identify and assess the issues associated with the proposed project as per the following:

- Site visit by I.N.K.
- Consultation with SKORPIoN Project Technical Team.
- Where applicable, consultation with local conservation experts and review of research by BirdLife Namibia, Gobabeb Research Centre, and NACOMA provided regional ecological insights and validated species presence and habitat importance.
- Consultation with MEFT via online application system.
- Similar ESIA report in the vicinity of Wlotzkasbaken - Desalination Plant and Water Carriage System to Secure Water Supply to the Central Coast, Windhoek and En-Route Users (SLR, 2021).
- Consultation with I&APs.
- Observations were used to document ecological features, including breeding zones, and fauna and flora.
- Atlas of Namibia.
- Google Earth.
- Internet sources.

2.2 Scoping

The main purpose of scoping is to indicate which environmental aspects relating to the proposed project might have an impact on the environment, to assess them and provide management and mitigation measures to avoid or minimize these impacts.

Table 2 outlines the Scoping requirements as set out in Section 8 of the Environmental and Social Impact Assessment Regulations that were promulgated in January 2012 in terms of the Environmental Management Act, 7 of 2007.

Table 2: Scoping Requirements Stipulated in the ESIA Regulations.

Requirements for a Scoping Report in terms of the February 2012 regulations	Reference in report
(a) the curriculum vitae of the EAP who prepared the report.	Appendix A
(b) a description of the proposed activity.	Section 4
(c) a description of the site on which the activity is to be undertaken and the location of the activity on the site.	Section 4
(d) a description of the environment that may be affected by the proposed activity and the manner in which the geographical, physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed listed activity.	Sections 6
(e) an identification of laws and guidelines that have been considered in the preparation of the Scoping Report.	Section 3
(f) details of the public consultation process conducted in terms of regulation 7(1) in connection with the application, including - (i) the steps that were taken to notify potentially interested and affected parties of the proposed application. (ii) proof that notice boards, advertisements and notices notifying potentially interested and affected parties of the proposed application have been displayed, placed or given. (iii) a list of all persons, organisations and organs of state that were registered in terms of regulation 22 as interested and affected parties in relation to the application. (iv) a summary of the issues raised by interested and affected parties, the date of receipt of and the response of the EAP to those issues.	Sections 2.3, 2.4, 2.5 and Appendix B
(g) a description of the need and desirability of the proposed listed activity and any identified alternatives to the proposed activity that are feasible and	Sections 1.3 and 5

reasonable, including the advantages and disadvantages that the proposed activity or alternatives have on the environment and on the community that may be affected by the activity;	
(h) a description and assessment of the significance of any significant effects, including cumulative effects, that may occur as a result of the undertaking of the activity or identified alternatives or as a result of any construction, erection or decommissioning associated with the undertaking of the proposed listed activity;	Sections 7 and 8
(i) terms of reference for the detailed assessment; and	Section 7 & 8
(j) a management plan, which includes - (i) information on any proposed management, mitigation, protection or remedial measures to be undertaken to address the effects on the environment that have been identified including objectives in respect of the rehabilitation of the environment and closure. (ii) as far as is reasonably practicable, measures to rehabilitate the environment affected by the undertaking of the activity or specified activity to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development. (iii) a description of the manner in which the applicant intends to modify, remedy, control or stop any action, activity or process that causes pollution or environmental degradation and remedy the cause of pollution or degradation and migration of pollutants.	Separate document

2.3 Public Participation Process

The public participation process for the proposed project is conducted to ensure that all persons and/or organizations that may be affected by, or interested in the proposed project, were informed of the project and could register their views and concerns. By consulting with relevant authorities and I&APs, the range of environmental issues to be considered in this Report has been given specific context and focus.

Included below is a summary of the I&APs consulted, the process that was followed and the issues that were identified.

2.3.1 Identification of Stakeholder Groups

A stakeholder for the proposed Project is defined as a person, group or organization that has direct or indirect stake in a Project because it can affect or be affected by the Project or its

Proponents' actions, objectives and policies. Stakeholders vary in terms of degree of interest, influence and control they have over the Project or the proponent.

During the environmental and social impact assessment consultations process, various activities as part of the development of the public consultation program were conducted to determine the relevant stakeholders. From the field-consultations, key stakeholder groups were identified and categorized them as Primary and Secondary stakeholders, based on the nature and extent of impact of project and influence of stakeholders on the project.

2.4 The Proposed Project I&APs

The table below provides a broad list of persons, group of persons or organizations that were informed about the project and were requested to register as I&APs should they be interested and/or affected.

Table 3: SKORPIoN's Project Stakeholders

IAP Grouping	Organisation
Government Ministries	◆ Ministry of Environment, Forestry and Tourism (MEFT) ◆ Ministry of Agriculture, Fisheries, Water and Land Reform (MFMR) ◆ Ministry of Works and Transport ◆ Ministry of Industries, Mines and Energy
Local Authorities	◆ Erongo Regional Council ◆ Arandis Constituency Office ◆ Wlotzkasbaken Settlement Office ◆ Swakopmund Municipality
Parastatal	◆ ErongoRed ◆ Namwater ◆ Namport ◆ Nampoer ◆ Namcor ◆ Environment Investment Fund ◆ Electricity Control Board
Nearest Communities	◆ Residents in Wlotzkasbaken ◆ Wlotzkasbaken Homeowners Association

IAP Grouping	Organisation
Other	◆ Erongo Desalination Plant ◆ UNAM Henties Bay Campus ◆ Nantional Commission on Research Science and Technology (NCRST) ◆ Confederation of Namibia Fishing Associations ◆ Kelp Blue Namibia ◆ SASSCAL ◆ Namibia Green Hydrogen Researh Institute ◆ Debmarine Namibia ◆ Monjasa ◆ Namibia Energy Institute ◆ Platonic Academy Namibia ◆ Benguela Current Convention ◆ Namibia Training Authority ◆ NIMT ◆ Namibia Nature Foundation ◆ UNDP ◆ Namibia Investment Promotion Development Board ◆ Ocean Conservation Namibia (OCN)
Media	Newspaper adverts placed on 9 and 16 June 2025, in the following newspapers: ◆ Die Republikein ◆ The Allgemeine Zeitung ◆ The Namibian Sun.
Other interested and affected parties	Any other people with an interest in the proposed project or who may be affected by the proposed project.

2.5 Steps in the Consultation Process

Table 4 sets out the steps that were followed as part of the consultation process:

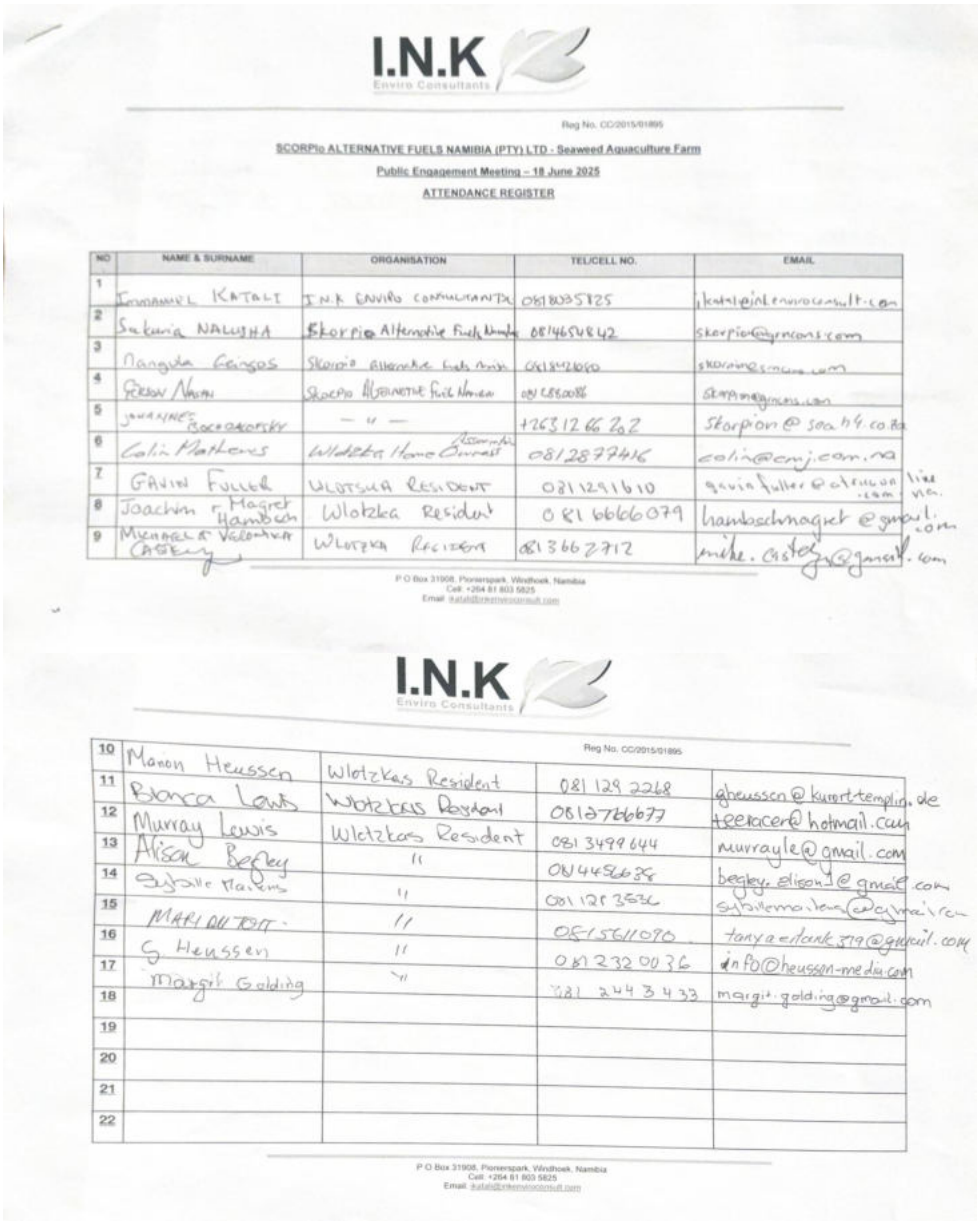
Table 4: Consultation Process with I&APs and Authorities

TASK	DESCRIPTION
Notification - Regulatory Authorities and IAPs	

TASK	DESCRIPTION
Notification - Regulatory Authorities and IAPs	
Notification to MEFT	I.N.K submitted the Application Form (online system) as a form of project registration and notification to MEFT.
I&AP identification	A stakeholder database was developed for the proposed project and ESIA process. Additional I&APs will be updated during the ESIA process as required.
Distribution of background information document (BID), flyers and stakeholders meeting invitation letters	BIDs were made available to all I&APs on the project's stakeholder database. Copies of the BID were available on request to I.N.K. Stakeholder meeting invitation were given out to the residents of Wlotzkasbaken. The purpose of the BID was to inform I&APs and authorities about the proposed project, the ESIA process, possible environmental impacts and means of providing input into the ESIA process. Attached to the BID was a registration and response form, which provided I&APs with an opportunity to submit their names, contact details and comments on the project.
Newspaper Advertisements	Block advertisements were placed as follows: ◆ Die Republikein (9 and 16 June 2025) ◆ The Namibian Sun (9 and 16 June 2025) ◆ Allgemeine Zeitung (9 and 16 June 2025) Please refer to Figure 3.
Scoping Meetings	Several consultations were made with I&APs. This included meetings and telephonic discussions. A public meeting (Figure 4) was held with I&APs as follows: ◆ Date - Wednesday, 18 June 2025 ◆ Venue - The Wlotzkasbaken Settlement Office The due date to register as an I&AP and submit comments was 7 July 2025. Please refer to Figure 5 for the attendance register.
I&AP Review	The report is distributed for a 7-day comment period.
Comments and Responses	Minutes and Issues and Response of the meetings were recorded.
MEFT review of ESIA Report and ESMP	A copy of the final ESIA Report, including authority and I&AP review comments, will be submitted to MEFT via the online application system, on completion of the public review process.

Figure 4: Newspaper Advert - 9 and 16 June

Figure 5: Public Consultation Meeting – 18 June 2025



I.N.K Enviro Consultants

Reg No. CC/2015/01895

SCORPIo ALTERNATIVE FUELS NAMIBIA (PTY) LTD - Seaweed Aquaculture Farm

Public Engagement Meeting – 18 June 2025

ATTENDANCE REGISTER

NO	NAME & SURNAME	ORGANISATION	TEL/CELL NO.	EMAIL
1	Immanuel Katali	I.N.K Enviro Consultants	0818035825	ikatali@inkenviroconsult.com
2	Sakaria Nalusha	Skorpio Alternative Fuels Namibia	0814654842	skorpion@yahoo.com
3	Nangula Gangos	Skorpio Alternative Fuels Namibia	0813421650	skorpion@yahoo.com
4	Gideon Nauyoma	Skorpio Alternative Fuels Namibia	0812680086	skorpion@yahoo.com
5	Jeanette Boschoroff	— " —	+26381266202	Skorpion@soa.hg.co.za
6	Colin Mathews	Walvis Bay Ratepayers Association	0812877416	colin@enj.com.na
7	Gavin Fuller	Walvisbay Resident	0811291610	gavin.fuller@ctruck.com
8	Joachim & Magret Hamboon	Walvisbay Resident	0816666079	hamboschmagret@gmail.com
9	Michael & Valentina Castley	Walvisbay Resident	0813667712	mike.castley@gmail.com

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Reg No. CC/2015/01895

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13	Alison Begley	"	0814456636	begley.alison1@gmail.com
14	Sybille Mertens	"	081 121 3536	sybillemertens@gmail.com
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16	G Heussen	"	081 232 0036	info@heussen-media.com
17	Margit Golding	"	081 244 3433	margit.golding@gmail.com
18				
19				
20				
21				
22				

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Figure 6: Attendance Register

2.6 General Assumptions and Limitations

The key assumptions and limitations of this ESIA Report are detailed below.

- It is assumed that the information provided by SKORPIoN, relating to the project activities is accurate and that the project will be implemented and operated as described.

- The predictions of the impacts of the seaweed aquaculture ponds, on the terrestrial environment need to be validated by regular field observations and subsequent monitoring.
- The results of specialist study formed the basis for the assessment of impact significance. The specialist investigations are conducted by independent specialists considered to be experts in their fields. It was assumed that the information from these sources is relevant and accurate.
- Considering the dynamic nature of the marine environment and its susceptibility to the influence of climate change e.g. sea level rise, increases in frequency of wave storms, are not evidently considered in this study.
- Area is frequented by the Orano Desalination Plant activities, recreational fishers and off-road driving, as such the area is not entirely pristine.

3 IDENTIFICATION OF APPLICABLE ENVIRONMENTAL AND SOCIAL GUIDELINES

3.1 Introduction

The Republic of Namibia has five tiers of law and several policies relevant to environmental assessment and protection, which include:

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

As the main source of legislation, the Constitution of the Republic of Namibia (1990) makes provision for the creation and enforcement of applicable legislation. In this context and in accordance with its constitution, Namibia has passed numerous laws intended to protect the natural environment and mitigate against adverse environmental impacts.

The management and regulation of the activities in the Namibian ocean fall within the jurisdiction of the Ministry of Fisheries and Marine resources. The environmental regulations are guided and implemented by the DEA within the MEFT.

In the context of the proposed project activities, there are several laws and policies currently applicable.

The Marine resources Act 27 of 2000 provides for the conservation of the marine ecosystem, the responsible utilization, conservation, protection, promotion of marine resources in a sustainable manner and for the control of marine resources for these purposes. The Minister of Fisheries is empowered to make regulations under section 61 on a broad number of topics including “regulating or prohibiting the discharge in the sea or discarding on the seashore and land of specified substances or materials, or substances or materials not complying with specified requirements or having specified properties”

The EIA Policy (1995) is enforced through the Environmental Management Act, 7 of 2007 and the EIA Regulations of 6 January 2012 (EIA Regulations). In terms of this legal framework certain identified activities may not commence without an environmental clearance issued by MEFT.

3.2 Applicable Authorities

3.2.1 Ministry of Environment, Forestry and Tourism

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

The MEFT's Department of Environmental Affairs ("DEA") is mandated to give effect to Article 95L of the Constitution by promoting environmental sustainability. The Environmental Commissioner serves as head of the DEA. The DEA is responsible for, inter alia, the administration of the EIA process undertaken in terms of the Environmental Management Act, 2007 and the EIA Regulations 2012. The DEA will be responsible for issuing a decision on the application for an ECC, based on the recommendations from MAFWLR. If approved, the DEA will issue an Environmental Clearance Certificate.

3.2.2 Ministry of Agriculture, Fisheries, Water and Land Reform (MAFWLR)

This Ministry is responsible for the management and development of fisheries and aquaculture in Namibia. The Ministry is comprised of four directorates; two of which include the Directorate of Resource Management and Directorate of Operations and Surveillance. The Directorate of Resource Management is responsible for scientific research and providing advice on the state of commercially important marine fish stocks and recommending catch quotas. It is also responsible for managing and regulating species fish size limits, dates of closed fishing seasons, declaring areas closed to fishing and determining fishing gear use.

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

The MAFWLR is a key stakeholder in the project and the ESIA process due to the proposed construction of the seaweed aquaculture ponds. The construction of the ponds, with water supplied from the sea, has the potential to have both negative and positive impact on the marine ecology and the fishing industry.

3.3 The Integrated Coastal Management Bill

Once enacted, the Integrated Coastal Management Bill (2014) aims to establish a system of integrated coastal management in Namibia in order to promote the conservation of the coastal environment, maintaining the natural attributes of the coastal landscapes and seascapes, and ensuring the sustainable development and use of the natural resources within the coastal zone that is also socially, economically and ecologically justifiable.

3.4 Coastal Strategic Environmental Assessments

Two Namibian coastal Strategic Environmental Assessments (SEAs) were undertaken between 2006 and 2008, i.e. one for the northern regions of Kunene and Erongo and another for the southern regions of Karas and Hardap. These draw on international experience and were undertaken at a time of mounting production sector pressures within Namibia. Being an initiative of the Namibian Government through MEFT, the two SEAs seek to inform political and technical decision makers at local, regional and national levels.

The 2008 “SEA for the coastal areas of the Erongo and Kunene Regions” compiled by the Namibian Coast Conservation & Management Project (NACOMA) is aimed at ensuring informed decisions on issues related to biodiversity conservation, land use planning and socio-economic development planning in the Kunene and Erongo coastal regions.

3.5 Relevant Namibian Policies

Namibia’s policies provide the framework to the applicable legislation. Whilst policies do not often carry the same legal recognition as official statutes, policies are used in providing support to legal interpretation or guidance for civil servants and other stakeholders in the implementation of government objectives.

3.5.1 The Namibia Vision 2030

The principles that underpin Vision 2030, a policy framework for Namibia's long-term national development, comprise the following:

- Good governance
- Partnership
- Capacity enhancement
- Comparative advantage
- Sustainable development
- Economic growth
- National sovereignty and human integrity
- Environment
- Peace and security

Vision 2030 states that natural environments are disappearing quickly. Consequently, the solitude, silence and natural beauty that many areas in Namibia provide are becoming sought after commodities and must be regarded as valuable natural assets. Vision 2030 emphasises the importance of promoting healthy living which includes that most Namibians are provided with safe drinking water. The importance of developing wealth, livelihood, and the economy is also emphasized by Vision 2030. This includes infrastructure provision like transport, communication, water, and electricity.

3.6 Other Relevant Local Policies and Legislation

Below (Table 5) is a list of other applicable local policies and legislation for the proposed project.

Table 5: List of local policies and legislation

Local Legislation, and adopted Policies, Protocols and Agreements	Summary	Environmental principles
Marine Resources Amendment Act no. 9 of	This act provides for the sovereign exercise of ownership	Principles of this act is to manage, protect, harvest

2015, Marine Resources Act 27 of 2000	by the State over marine resources; to amend the provisions relating to the total allowable catch and allocation of quotas	and utilize marine resources in Namibia.
Marine Traffic Act (no. 2 of 1981) as Amended Namibian Ports Authority Act of 1991	Ships may not be repaired within territorial sea or internal waters outside a harbor or fishing. No person shall sink a ship or dump shipwreck within territorial sea or internal waters outside a harbor or fishing.	Prevention of waste from ship repairs and shipwrecks.
Pollution Control and Waste Management Bill	This Act promote sustainable development; to provide for the establishment of a body corporate to be known as the Pollution Control and Waste Management Agency; to prevent and regulate the discharge of pollutants to the air, water and land; to make provision for the establishment of an appropriate framework for integrated pollution prevention and control; to regulate noise, dust and odor pollution; to establish a 'system of waste planning and management; and to enable Namibia to comply with its obligations under international law in this regard.	The environmental principle specific to this Bill is pollution control.
Territorial sea and exclusive economic zone of Namibia Act 3 of 1990	This Act determines and defines the territorial sea, internal waters, contiguous zone, exclusive economic zone and continental shelf of Namibia and to provide matters incidental thereto.	Minimize the exploitation of natural resources of the sea.
Walvis Bay and Offshore Islands Act 1 of 1994	An Act to make provision for the smooth transfer of control over Walvis Bay and the offshore islands from the Republic of South Africa to the Republic of Namibia effective as of 1 March 1994.	Provide provision for governance; fishing authorization, fishery management and conservation.
Namibia Ports Authority Act	To provide for the establishment of the Namibia Ports Authority to	To manage and exercise control over the

2 of 1994	undertake the management control of ports and lighthouse in Namibia and the provision of facilities and services related thereto.	operation of ports and lighthouse and other navigational aids in Namibia and its territorial waters.
Aquaculture Act 18 of 2002	This Act regulate and control aquaculture activities; to provide for the sustainable development of aquaculture resources; and to provide for related matters.	Environmental principles of this act are to promote sustainable aquaculture, management, protection and conservation of marine and onshore aquatic ecosystems.
Urban and Regional Planning Act no. 5 of 2018	This Act consolidate the laws relating to urban and regional planning; to provide for a legal framework for spatial planning in Namibia; to provide for principles and standards of spatial planning.	Environmental principles specific to this act are harmonization and streamlining of spatial planning in order to avoid land use conflicts, delays in decision making and to minimize negative environmental impacts.
Atmospheric Pollution Prevention Ordinance 11 of 1976	To provide for the prevention of the pollution of the atmosphere	To prevent atmospheric pollution and minimize environmental impacts associated with it.
Water Resources Management Act 11 of 2013	To provide for the management, protection, development, use and conservation of water resources; to provide for the regulation and monitoring of water services and to provide for incidental matters.	Manage water resources, prevent water pollution and control water storage and provision.
Public and Environmental Health Act 1 of 2015	To provide a framework for a structured uniform public and environmental health system in Namibia.	Principles of this act includes protecting individuals and communities from public health risks, encourage community participation to create a healthy environment; and provide for early detection of diseases and public health risks.

National Climate Change Policy	This policy identifies technology development and transfer to be a key issue for which strategies and action plans should be developed.	Promote and encourage new and clean technologies to be developed to reduce greenhouse gas emissions.
Convention on Biological Diversity (CBD)	Namibia ratified the Convention on Biological Diversity in 1992. As a party to the CBD, the Namibian government is obliged to develop a national strategy for the conservation of biodiversity.	Environmental principles of this are to establish a system of protected areas and integrate biodiversity considerations into development planning.
Convention to Combat Desertification (UNCCD)	Namibia ratified the UN Convention to Combat Desertification in 1995. This convention addresses the socio-economic and biophysical drivers of land degradation and desertification.	Objectives are to adopt integrated strategies that improve land productivity, rehabilitate degraded areas, and ensure sustainable management of land and water resources, with a focus on improving community livelihoods.
Road Traffic and Transport Act, (No. 22 of 1999).	provides for the establishment of the Transportation Commission of Namibia, and for the control of traffic on public roads, the licensing of drivers, the registration and licensing of vehicles, and the control and regulation of road transport across Namibia's borders. It also addresses matters incidental to these areas.	To control of traffic on public roads, including traffic signs, speed limits, accidents, and offences related to driving.

3.7 Relevant International Standards

3.7.1 Equator Principles

In addition to international conventions, environmental and social standards such as the Equator Principles are applicable. These principles guide project finance and require that environmental and social impacts be addressed through a robust Environmental and Social Impact Assessment (ESIA). The Equator Principles emphasize:

- Baseline environmental and social condition assessments.
- Compliance with national and international legal obligations.
- Sustainable resource management using independent certification systems.

3.7.2 The EIB's Statement of Environmental and Social Principles and Standards (EIB, 2009)

The European Investment Bank (EIB) adopted an Environmental Statement in 1996 to underline its commitment to protecting and improving the natural and built environment according to EU policy (EIB, 209). The statement focuses on, a) the principles on which the EIB approach to environmental and social issues are based and b) the environmental and social performance standards that ensure compliance with Bank requirements. The principles and standards are derived from EU policy and law and supplemented by other examples of international good practice. The EIB requires that all the projects it is financing are acceptable in environmental and social terms by applying appropriate safeguards to all its operations.

3.7.3 The EIB's Environmental and Social Handbook (EIB, 2013)

The EIB Environmental and Social Handbook provides an operational translation of the policies and principles contained in the 2009 EIB Statement of Environmental and Social Principles and Standards (see above). Principles include the Environmental and Social Impact Assessment process of identifying predicting, evaluating a project's positive and negative environmental and social impact on the biophysical and human environment as well as identifying ways of avoiding, minimizing, mitigating and compensating, including offsetting in the case of the environment and remedying in the case of social impacts, by applying the mitigation hierarchy. This process includes consultation with direct and indirect stakeholders and the elaboration of an

environmental and social management plan detailing the implementation of the mitigation measures.

3.7.4 World Bank Environmental and Social Framework

The W orld Bank's Environmental and Social Framework (ESF) enables the World Bank and Borrowers to better manage environmental and social risks of projects and to improve development outcomes. The ESF offers broad and systematic coverage of environmental and social risks. It makes important advances in areas such as transparency, non-discrimination, public participation, and accountability - including expanded roles for grievance mechanisms. It brings the World Bank's environmental and social protections into closer harmony with those of other development institutions.

The ESF consists of:

- The World Bank's Vision for Sustainable Development.
- The World Bank's Environmental and Social Policy for Investment Project Financing (IPF) which sets out the requirements that apply to the Bank.
- The 10 Environmental and Social Standards (ESS), which set out the requirements that apply to Borrowers.
- Bank Directive: Environmental and Social Directive for Investment Project Financing
- Bank Directive on Addressing Risks and Impacts on Disadvantaged or Vulnerable Individuals or Groups.

3.7.5 World Bank's Pollution Prevention and Abatement Handbook (PPAH)

The Pollution Prevention and Abatement Handbook (PPAH) promotes the concepts of sustainable development by focusing attention on the benefits, both environmental and economic, of pollution prevention, including cleaner production and good management techniques. In many cases, the guidelines provide numerical targets for reducing pollution, as well as maximum emissions levels that are normally achievable through a combination of cleaner production and end-of-pipe treatment. The guidelines are designed to protect human health, reduce mass loading to the environment, draw on commercially proven technologies, be

cost effective, follow current regulatory trends and promote good industrial practices, which offer greater productivity and increased energy efficiency.

3.7.6 Applicable International Finance Corporation (IFC) Performance Standards

IFC's Environmental and Social Performance Standards define IFC clients' responsibilities for managing their environmental and social risks. The Performance Standards provide guidance on how to identify sustainability risks and impacts and are designed to help avoid, mitigate, and manage them as a way of doing business in a more sustainable way.

The following are the performance standards that are applicable to the construction and operation of the project and are used as the basis of investigation for the ESMP:

Table 6: Applicable Performance Standards

IFC Performance Standard	Description	Applicable	Not Applicable
1. Environmental and Social Management System	An environmental and social management system (ESMS) helps companies integrate plans and standards into their core operations—so they can anticipate environmental and social risks posed by their business activities and avoid, minimize, and compensate for such impacts as necessary. A good management system provides for consultation with stakeholders and a means for complaints from workers and local communities to be addressed.	☑	☐
2. Labour and Working Conditions	It asks that companies treat their workers fairly, provide safe and healthy working conditions, avoid the use of child or forced labor, and identify risks in their primary supply chain.	☑	☐
3. Pollution Prevention and Control	It guides companies to integrate practices and technologies that promote energy efficiency, use resources—including energy and water—sustainably, and reduce greenhouse gas emissions.	☑	☐
4. Occupational	It helps companies adopt responsible practices to	☑	☐

IFC Performance Standard	Description	Applicable	Not Applicable
Health and Safety, Public Health and Security	reduce such risks including through emergency preparedness and response, security force management, and design safety measures.		
5. Land Acquisition and Involuntary Resettlement	It advises companies to avoid involuntary resettlement wherever possible and to minimize its impact on those displaced through mitigation measures such as fair compensation and improvements to and living conditions. Active community engagement throughout the process is essential.	☐	☑
6. Biodiversity and Ecosystems	It recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and managing living natural resources adequately are fundamental to sustainable development.	☑	☐
7. Rights and Interests of Indigenous People	It seeks to ensure that business activities minimize negative impacts, foster respect for human rights, dignity and culture of indigenous populations, and promote development benefits in culturally appropriate ways. Informed consultation and participation with IPs throughout the project process is a core requirement and may include Free, Prior and Informed Consent under certain circumstances.	☑	☐
8. Cultural Heritage	Cultural heritage encompasses properties and sites of archaeological, historical, cultural, artistic, and religious significance. It also refers to unique environmental features and cultural knowledge, as well as intangible forms of culture embodying traditional lifestyles that should be preserved for current and future generations. PS8 aims to guide companies in protecting cultural heritage from adverse impacts of project activities and supporting its preservation. It also promotes the equitable sharing of benefits from the use of cultural heritage.	☑	☐

3.8 International Conventions and Agreements

Below (Table 7) is a list of applicable international conventions and agreements for the proposed project.

Table 7: International conventions and agreements

Legislation	Summary	Environmental principles
2011 Guidelines for the Control and Management of Ship's Biofouling to minimize the Transfer of invasive Aquatic Species.	These guidelines are intended to provide a globally consistent approach to the management of biofouling organisms, which could present a bio-risk in local ports.	Prevent the transfer of invasive species and coordinating a timely and effective response to invasions which requires cooperation and collaboration among governments.
Stockholm Convention on Persistent Organic Pollution (2001)	Is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for longer periods.	To protect human health and the environment from persistent organic pollutants; especially those used in marine paints.
Vienna Convention for the protection of ozone layer (1985)	This Convention is aimed to promote cooperation among nations by exchanging information on the effects of human activities on the ozone layer.	To take control actions to protect the ozone layer.
Montreal protocol (1997)	Is a global agreement to protect the earth's ozone layer by phasing out the chemicals that depletes it.	Control substances and chemicals production that are depleting the ozone layer.
UN Framework on climate change (1992)	This framework was introduced to stabilize greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference	Countries should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects.

	with the climate system.	
Kyoto protocol (1997)	It is also designed to assist countries in adapting to the adverse of climate change. It facilitates the development and deployment of technologies that can help increase resilience to the impacts of climate change.	Reduce GHG emission at least by 18%.
Basel Convention (1992)	To protect human health and the environment against the adverse effects of hazardous wastes.	Reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes
Conventions on Wetland of International Importance (1971)	Conserving wetlands (swamps, marshes, lakes, mudflats, peat bogs and other bodies of water whether natural or artificial, permanent or temporary).	This convention establishes a management framework aimed at conserving the wetland and ensuring its wise use. The Walvis Bay is recognized under this convention.
Paris Agreement (2015)	Is a legally binding international treaty on climate change.	To limit global warming to preferably 1.5 degrees Celsius, compared to pre-industrial levels.
United Nations Convention on Law of the Sea of 1982.	It's a legal framework for marine and maritime activities. It lays down a comprehensive regime of law and order in the world's oceans and seas establishing rules governing all uses of the oceans and their resources.	It provides that coastal States have sovereign rights in a 200-nautical mile Exclusive Economic Zone (EEZ) with respect to natural resources and certain economic activities, and exercise jurisdiction over marine science research and environmental protection.

International Convention for the Control of and Management of Ships' Ballast Water and Sediments of 2004.	This Convention seeks to prevent the spread of harmful aquatic organisms from one region to another, by the establishment of standards and procedures for the management and control of ships' ballast water and sediments.	Protect the oceans from invasive aquatic species
International Convention for the Prevention of Pollution from Ships (MARPOL) and the protocol of 1978.	This convention is aimed at the prevention of pollution from ships caused by operational or accidental causes.	Prevention of pollution by sewage, oil and garbage from ships in the sea; Prevention of air pollution from ships; prevent pollution by Harmful Substances carried at sea in packaged form.
International Convention of the Safety of life at Sea of 1974 (SOLAS).	SOLAS is an international maritime treaty which sets minimum safety standards in the construction, equipment and operation of merchant ships.	Convention allows for flag states to compel ships under their flags to comply with safety requirements including fire-fighting equipment and nuclear containment facilities in order to prevent impacts associated with risks of transportation of dangerous goods.
Convention on the Prevention of Marine Pollution by dumping of wastes and other matters, 1972 (as amended by the protocol of 1996).	This convention protects the marine environment from human activities such as pollution.	Take practicable steps to prevent pollution of the sea, promote the effective control of all sources of marine environment caused by dumping at sea; (black and grey list).
International Convention on Oil Pollution Preparedness, Response and Co-operation of 1990 (OPRC Convention) with its Protocol of 2000 (OPRC-HNS Protocol).	Convention was developed by the International Maritime Organization (IMO) to further prevent pollution from ships, and it requires coastal states to prepare and response to oil spills risks.	Convention compels states to carry onboard oil pollution emergency plan to effectively respond to oil pollution incidents.

Nairobi International Convention on removal of wrecks (18 May 2007).	The Convention provides a set of uniform international rules aimed at ensuring the prompt and effective removal of wrecks located beyond the territorial sea. The Convention also includes an optional clause enabling States Parties to apply certain provisions to their territory, including their territorial sea.	It provides a sound legal basis for coastal states to remove wrecks which pose a hazard to the safety of navigation as well as the marine and coastal environments.
Internal Convention on Biological Diversity	Among others, this Convention aims at conservation of biological diversity and promote sustainable development of biological components.	Conservation of biological diversity, sustainable use and equitable sharing of utilization of biodiversity, ecosystem assessment and monitoring and mitigation of adverse environmental impacts.
International Convention on the Control of Harmful Anti-fouling Systems on Ships (2001)	The convention prohibits the use of harmful organotin in anti-fouling paints used and establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems.	It is preferable to minimize the accumulation of biofouling on vessels and movable structures.

3.8.1 Applicable Listed Activities

The EIA Regulations promulgated in terms of the Environmental Management Act, identify certain activities which could have a substantially detrimental effect on the environment. These listed activities require environmental clearance from MEFT prior to commencing. The following listed activities (Table 8) identified in the regulations apply to the proposed project:

Table 8: Listed activities triggered by the proposed Project.

Listed activity
7. Agriculture and aquaculture activities
7.1 The construction of facilities for aquaculture production, including mariculture and algae farm where the structures are not situated within an aquaculture development zone declared in terms of the Aquaculture Act, 2002.

4 Project Description

4.1 Introduction

As mentioned in section 1.2, the initiative seeks to cultivate approximately 12 tonnes (t) of seaweed (Ulva lactuca) per day, in raceway ponds (Figure 3) or paddlewheel ponds (Figure 4), fed by water pumped from the sea. The proposed ponds are approximately The proposed ponds are approximately 50 - 100 m long, and 10 m wide with a water depth of approximately 70 cm, excavated into the sand and lined with a specialized white pond liner. The paddle wheels will be driven by electric motors, powered by on-site renewable energy (solar & wind) that will be installed.

4.2 Seaweed (*Ulva lactuca*)

Ulva is a genus of marine and brackish water green macroalgae. It is edible and often called 'Sea Lettuce'. Ulva grows attached to stones or other substrates, but it easily detaches and grows well free floating, often forming dense mats– sometimes even called “green tides”. Ulva is an opportunistic species with a capability to proliferate fast upon fortunate environmental conditions, such as high ambient nutrient concentrations and light. There is a colimitation of growth by light and nitrogen (N), meaning that to utilize high N concentrations and achieve high growth rates, incoming irradiance must be high.

Figure 7: Ulva lactuca

Seaweed aquaculture is a practice well established in Namibia (Luderitz) and many parts of the world. The project location is selected based on the abundance Ulva lactuca that can be found on this part of the Namibian coastline. Cultivating seaweed might be preferable to wild harvesting as it does not remove algal biomass from the system and is simpler to monitor and regulate.

4.3 Raceway Ponds

The pond is made of a closed loop recirculation channel with a water depth of approximately 70 cm with paddlewheel. The paddlewheel mix, circulate the algal biomass and prevent the sedimentation, settling and subsequent attaching to the pond liner. Each pond will require daily water quality monitoring. The monitoring team will close an aggregation device in the ponds due for harvest on any specific day, with the following harvest teams 'scooping' the seaweed from the water into draining trailers behind tractors.

Figure 8: Raceway Ponds (For illustrative purposes only)

4.4 Paddlewheels

Paddlewheels are commonly used in raceway ponds to circulate and mix the water, ensuring seaweed is evenly distributed and exposed to light and nutrients. This mixing is crucial for efficient seaweed growth and preventing it from settling at the bottom of the pond.

The paddle wheels are driven by electric motors, with app. 2.2kW each, powered by on-site installed renewable energy. The paddlewheels will require 120 to 240kW from the renewable energy.

Figure 9: Paddlewheel Pond (For illustrative purposes only)

4.5 Pumps

Two (2) 508mm pipelines are proposed to deliver 42,000 cbm of seawater per day to the ponds. A preliminary design for the bulk supply pipeline has been established, incorporating a hybrid of a weighted pipeline and a steel jetty, with the water intake situated at -3m CD, approximately 200 to 300 meters from the high-water mark. It comprises of 3 pumps each pumping 600 cubic meter per hour. Choosing a series of smaller pumps offering a degree of redundancy but also affords continued efficient pumping as SKORPIoN improves efficiencies in the water

replacement, which is expected to be reduced to as little as 10% per day, compared to 100% that the aquaculture facility is designed for. The pumps will be housed in a container with forced ventilation, installed on concrete plinths. 60 to 120kW will be required to pump the water to the ponds.

4.6 Drying of Excess Seaweed

Whilst the seaweed is growing all year around and is being harvested daily, growth rates during summer exceed those during winter roughly by a factor 3. To have continuous production throughout the year and optimise the CAPEX for the anaerobic digester, excess production in summer will be sundried, to be rehydrated and added to the lower production of seaweed in winter. Since the weather is generally dry and land available in abundance, drying is planned to be achieved spreading the excess out under the sun to dry, after which it can be pressed for storage.

4.7 Rehydration Pond

This pond will be filled with seawater and used to turn the dried summer excess production into wet seaweed to bump up feed in winter, when production of seaweed is lower. The size will be determined by trials, based on the volumes of seaweed to be reconstituted and its duration to do so.

4.8 Construction Phase

4.8.1 Construction

The construction working areas include the following:

- mobile stores for storing the construction materials.
- temporary lay-down areas.
- mobile waste collection and storage areas.

- temporary parking area for cars and equipment.
- toilets facilities (preferably mobile toilets) that will be serviced regularly.

Construction activities will take place during the establishment and preparation of the sites. Therefore, it is expected that construction will involve the following activities:

- Appoint contractors, laborers, etc.
- Clearing and grubbing and other earth moving activities.
- Stockpiling topsoil and sub-soil.
- Foundation excavations.
- Setting up contractor's laydown areas.
- General building/construction activities including, amongst others: mixing of concrete; operation of construction vehicles and machinery; civil, mechanical and electrical works; painting; grinding; welding; etc.
- Disposal or treatment of potentially contaminated soil
- Water utilisation
- Operation and movement of construction vehicles and machinery
- Refueling of equipment
    - Hydrocarbon wastes
- Handling, storage and disposal of non-hazardous waste
    - Domestic waste
    - Other construction waste
- Transportation of fuel in small quantities
- Handling and storage of hazardous material
    - Fuel
    - Lubricants

4.8.2 Site preparations for infrastructure

Site preparation includes the demarcation of the 6-ha footprint of the ponds and the laydown area to be located ±15 m for each of the proposed project component and infrastructure site, for the storage and partial assembly of the project material or equipment to be constructed. The proposed site for the ponds will require land clearing and excavations at a depth of approximately 70 cm will be dug for the ponds.

4.8.3 Access Roads

The construction traffic, inland, will use the C34 Swakopmund - Henties Bay public road, and existing off-roads currently used by fishermen and Orano. Vehicles used for the construction phase will include trucks for moving materials and 4x4 vehicles for workers. The existing road infrastructure will be used into the construction area. However, additional access roads for all construction and service vehicles will be established, if needed.

4.8.4 Refueling of Construction Vehicles

The construction vehicles and machinery such as the graders and tipper trucks will be refueled in Henties Bay or Walvis Bay. No refueling of vehicles will be taking place on site.

4.8.5 Topsoil Removal

Topsoil will be excavated to lay the foundation of the ponds at a depth of approximately 70 cm in the ground.

4.8.6 Employment and housing

The construction will be carried out by contractors. Contractors for the construction phase will be engaged on a short term, temporary basis. The construction workforce/contractors will commute to the designated sites each day and will be accommodated in Swakopmund and Henties Bay. No accommodation or any permanent structures will be constructed on site. Approximately 30 workers will be required for the construction of the ponds.

4.8.7 Power Supply for Construction Activities

Mobile generators will supply power for the construction phase.

4.8.8 Sanitation during construction

Mobile toilets with will be used. The septic tanks will be emptied on a regular basis and the effluent disposed of at a licensed facility off-site.

4.8.9 Waste Management during Construction

Waste is anticipated to be generated on site during construction. The pilot project will make use of waste skips during the construction phase. These skips should be emptied on a regular basis.

Waste will be transported off site and disposed of at the nearest landfill site in Henties Bay or Swakopmund. No waste will be disposed of or burnt on site.

All hazardous waste, i.e., chemical containers, hydrocarbon contaminated materials, used hydrocarbons etc., will be separated from the general waste and removed from site and disposed of at a licensed hazardous waste disposal site in Walvis Bay.

4.8.10 Timeline

Construction commencement is subject to regulatory approval, i.e. approval of the ESIA and issuing of an ECC by MEFT.

The construction phase for the ponds would take approximately 12 months to complete before commissioning and subsequent operations can commence.

4.8.11 Rehabilitation of temporary construction sites and laydown area

The removal of all temporary construction equipment will be undertaken at the end of construction activities. This will be done as per Environmental and Social Management Plan recommendations.

4.9 Operational phase

The main activities will include routine inspections and maintenance as required, as well as harvesting and water quality monitoring.

4.9.1 Employment

Overall, the seaweed aquaculture farm (all components of SKORPIoN) will create employment opportunities as follows:

- 4x Water Quality monitoring (Dayshift only)
- 8x Harvest Team (Dayshift only)
- 1x Maintenance (Dayshift only)
- 1x Operator Biogas (24 / 7)
- 4x Labourer Biogas (Dayshift only)
- 1x Operator Gas Upgrading (24/7)
- 1x labourer Gas Upgrading (dayshift only)

- 1x Operator PTX (24/7)
- 1x Labour PTX (night) / 2x Labour PTX (day)
- 1x gate control (24 / 7)
- 1x perimeter control (24 / 7)
- 1x canteen (24/7)
- 1x maintenance (dayshift only)
- 2x cleaning (night shifts only)

4.9.2 Housing and Accommodation

The workforce will be commuting daily from their regular residence. No permanent accommodation or dwellings will be established on site.

4.9.3 Operational Traffic

Other than the need for routine inspections and maintenance which will use the existing service tracks and additional access roads created during construction, the operations of the aquafarm will generate operational traffic of approximately 5 units of 50HP tractors with hydraulic power units that will be required for the harvest. No traffic from the aquafarm will enter the road or leave the site.

4.9.4 Trailers

The trailers will be used to transport the harvested seaweed from the aquafarm to the biogas plant. The trailers will be slotted to allow drainage of the seaweed. The design will require some on site development and testing and thus be fabricated in house. No trailer from the aquafarm will enter the road or leave the site.

4.9.5 Power Supply for Operation Activities

The renewable energy harnessed from oceanic waves, solar panels, and wind turbines will suffice to generate the power required for the operational activities of the ponds. These three modalities will complement one another, further backed up by a 10 MWh BESS (Battery Energy Storage System), particularly during periods of intermittent and short power supply. This does

not only underscore the potential of sustainable energy but also seeks to enhance the resilience and efficiency of energy production coastal environments and for the Project. By integrating diverse renewable sources, the Project aspires to mitigate the challenges posed by energy fluctuations, ensuring a more reliable and consistent power supply.

4.9.6 Waste Management

Domestic waste will be generated on site during operations. Waste will be transported off site and disposed of at the nearest landfill site. No waste will be disposed of or burnt on site.

All hazardous waste, i.e., chemical containers, hydrocarbon contaminated materials, used hydrocarbons etc., will be removed from site and disposed of at a licensed hazardous waste disposal in Walvis Bay.

4.9.7 Security

Security at the aquafarm will be limited to perimeter fencing and CCTV, as well as 24/7 access/gate and perimeter control.

4.10 Decommissioning

At the end of the seaweed aquaculture farm operations, the site including all linear infrastructure will be decommissioned and suitably rehabilitated. Where possible, rehabilitation will be undertaken progressively during operation as areas become available. This approach will allow the operational team to determine the best and most effective method of rehabilitation for the various areas disturbed by Project activities.

5 PROJECT ALTERNATIVES

5.1 Alternative Site Selection

The Seaweed Aquaculture site is selected due to the following factors:

- Proximity to the existing Orano/Erongo Desalination Plant, which is a key component in the project, for the supply of fresh water for green hydrogen production.
- Proximity to the existing substation, whereby surplus electricity generated from wave, wind and solar can be fed into the grid to supply electricity to nearby communities.
- Proximity to the Walvis Bay Port, where the biofuels and e-fuels are proposed to be transported to supply vessels with these biofuels, therefore making it financially viable to transport the fuels to the port.
- The site is situated on a significantly low elevation (20 m above sea level), which would make it suitable, viable and efficient to pump water from the sea to the aquaculture ponds, as also evident from the Erongo Desalination Water Pumping activities.
- The Seaweed (Ulva) is widely found in the area, creating an abundance supply of seaweed for harvesting and therefore contributing to the sustainability of the Project.
- This section is free of dunes (compared to the stretch between Swakopmund and Walvis Bay, which otherwise would require SKORPIoN to transverse them with the pipelines or threated to bury the project as they move.

5.2 Alternative source of power

The Seaweed Aquaculture Pilot Project aims to harness electricity from renewable energy sources, specifically wave, wind, and solar power. These three modalities will complement one another, further backed up by a 10 MWh BESS particularly during periods of intermittent and short supply. This does not only underscore the potential of sustainable energy but also seeks to enhance the resilience and efficiency of energy production coastal environments and for the Project. By integrating diverse renewable sources, the project aspires to mitigate the challenges posed by energy fluctuations, ensuring a more reliable and consistent power supply.

5.3 Alternative source of water

The Seaweed Aquaculture Pilot Project intends on using the underutilized pipelines from the existing Erongo Desalination Plant, to pump seawater straight into the aquafarm, instead of building own pipelines.

5.4 The “no project” option

As mentioned in section 1.3, the proposed seaweed aquaculture ponds represent a pivotal element of the ancillary infrastructure for the Seaweed Aquaculture Farm Pilot Project. The primary aim of this initiative is to cultivate seaweed (Ulva lactuca) from the Namibian oceanic waters (approximately 300 to 500 meters offshore), to the aquaculture farm positioned about 1.3 kilometers inland from the sea. The harvested seaweed will subsequently undergo a pulping process, which will be utilized for anaerobic digestion, combined with hydrogen to produce biogas (e-methanol). Consequently, the construction of the proposed ponds is essential for the successful realization of the Seaweed Aquaculture Pilot Project. In the absence of this implementation, the project's objectives and goals will remain unfulfilled, thereby jeopardizing the overall feasibility of the Project.

Therefore, proceeding with the Project, will contribute to the feasibility of the overall seaweed aquaculture farm and create a significant positive economic impact such as employment and procurement of goods and services.

The challenge facing the Project Proponent is its contribution towards achieving these goals while at the same time preventing and/or mitigating potential negative social and environmental impacts. The proponent will have to ensure that the identified mitigation measures and commitments to address the potential impacts, will appropriately be implemented and adhered to.

6 DESCRIPTION OF THE CURRENT/BASELINE ENVIRONMENT

6.1 Marine/Offshore Baseline

6.1.1 Benguela Upwelling

Namibia's ocean space is part of a unique natural marine environment, the Benguela Current Large Marine Ecosystem (BCLME), which is considered as one of the most productive marine regions of the world's oceans. It boasts high biological productivity with abundant zooplankton, phytoplankton, important fisheries, and healthy top predator populations such as the Cape fur seals. Namibia's marine environment is controlled by the seasonal changes in the south Atlantic high-pressure system, bringing southerly winds throughout the year, albeit stronger in winter and spring.

The project site is in NWCRA and BCLME (Benguela Current Large Marine Ecosystem); mainly influenced by the cold Benguela Current Upwelling System. The BCLME is driven by southerly winds, which induces transportation of deep cold and nutrient-rich waters near the coast. Among others, several physical factors that play a critical role during the upwelling process are Carbon Dioxide (CO2), SSTs (Sea Surface Temperatures), DO (Dissolved Oxygen), sun radiation and nutrients. When describing the central BCLME based on SSTs and DO; generally, the ecosystem appears to display low mean annual SSTs and low DO throughout the year, with upwelling at its maximum during winter.

Although the project is in this ecosystem, the current predominantly flows in deeper water. The Lüderitz Upwelling Cell is far to the south and the project site is far from the most important and sensitive areas in the south, i.e. Mercury Island, Ichaboe Island, Halifax Island and Possession Island.

6.1.2 Activities in the Area

The Orano Desalination Plant and its associated linear infrastructure (pipelines) is one of the key activities and it is located approximately 75 m south of the proposed pilot study area.

Other activities include, recreational angling, which is an activity in the central coast primarily from Swakopmund to Henties Bay, targeting species such as Silver Kob, Blacktail, Galjoen and West Coast Steenbras. Silver Kob is the main recreational fish species of importance on the

vicinity of the proposed pilot area. The Wlotzkasbasken area is an important spawning site for Silver Kob (Figures 10 and 11).

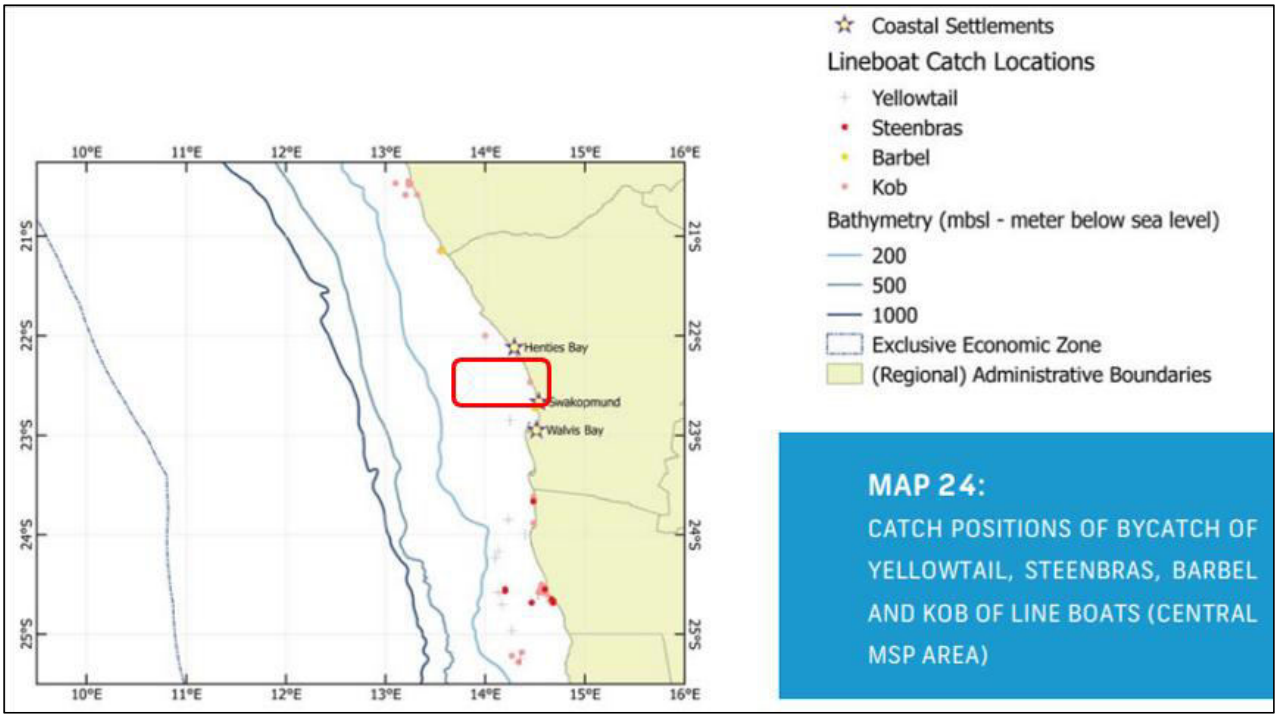


Figure 10: Map showing catch positions for recreational fish species in vicinity of pilot area

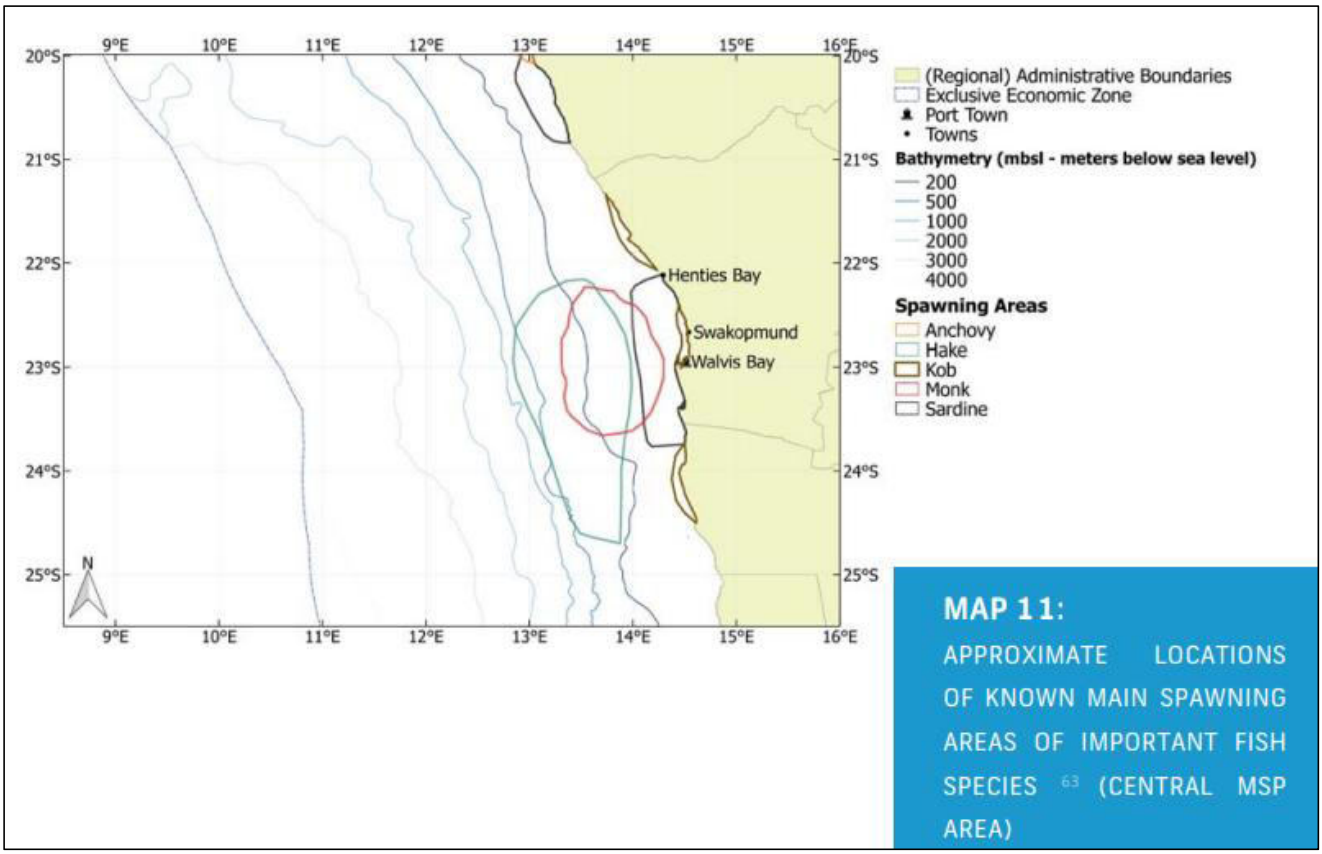
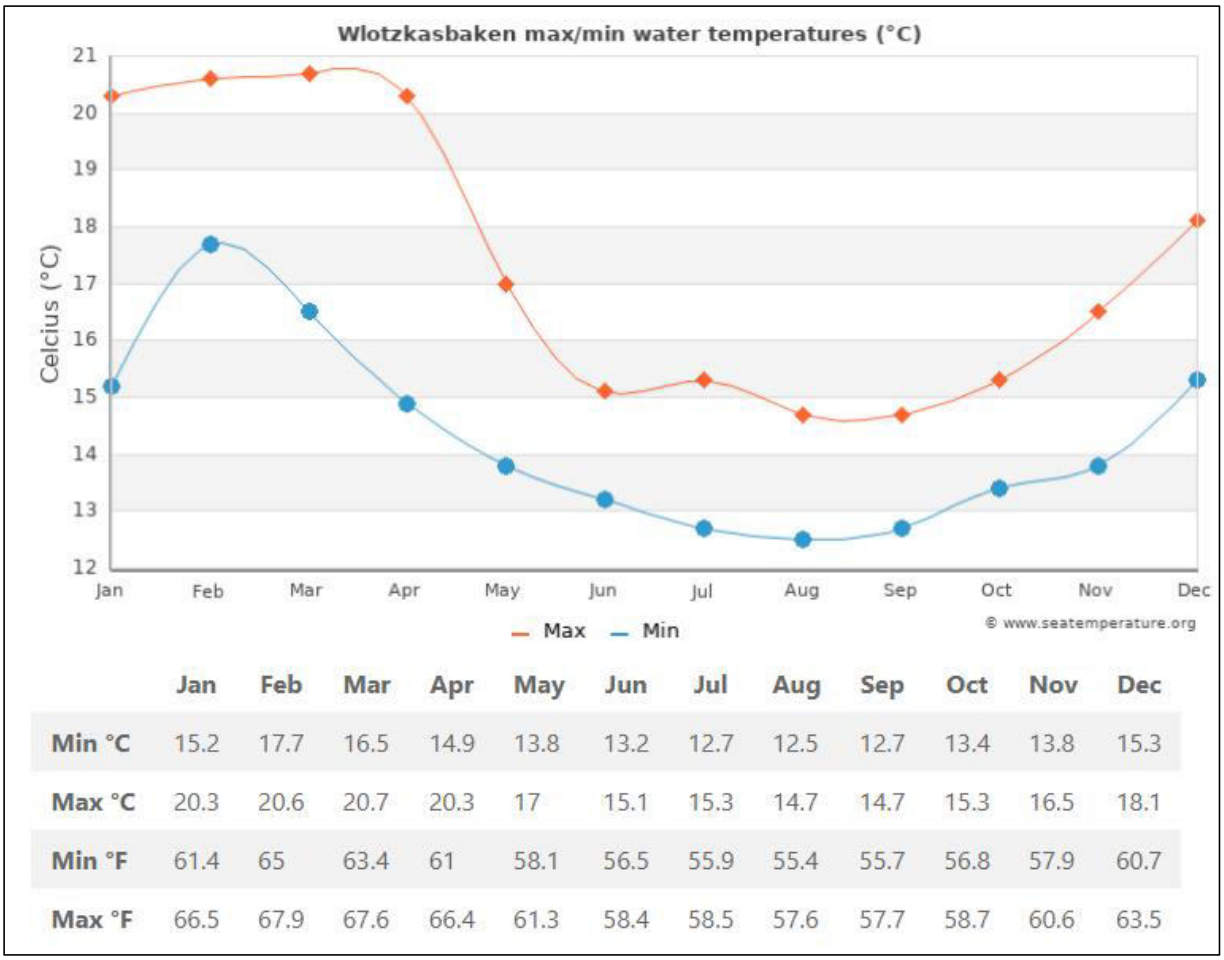


Figure 11: Known spawning locations for fish species in the central coast of Namibia

6.1.3 Sea Surface Temperatures and salinity

Based on historical data, **Figure** 12 shows the average seawater temperatures for the general Wlotzkasbasken area. The measurements for the water temperature are provided by the daily satellite readings provided by the NOAA. The temperatures given are the sea surface temperature (SST) which is most relevant. The average warm and cold sea surface temperatures in the area are 19.1°C in February, and 13.6°C in August respectively. A high seasonality is displayed by these temperature variations. Salinities range between 34.5‰ and 35.5‰ are observed for the area.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min °C	15.2	17.7	16.5	14.9	13.8	13.2	12.7	12.5	12.7	13.4	13.8	15.3
Max °C	20.3	20.6	20.7	20.3	17	15.1	15.3	14.7	14.7	15.3	16.5	18.1
Min °F	61.4	65	63.4	61	58.1	56.5	55.9	55.4	55.7	56.8	57.9	60.7
Max °F	66.5	67.9	67.6	66.4	61.3	58.4	58.5	57.6	57.7	58.7	60.6	63.5

Figure 12: Min/Max water SST at Wlotzkasbasken, source: SeaTemperature.org

6.1.4 Dissolved Oxygen (DO) Concentration and Nutrients

After upwelling, dissolved inorganic nutrients are converted into organic nutrients and through photosynthesis, oxygen is released. Literally, waters associated with upwelling are supposed to be rich in DO. However, this is not the case for the Namibian shelf. Anoxicity is a common feature in the northern BCLME and has a peak in summer between January and March annually. It accounts for huge losses of crustaceans and pelagic fish species. Water with concentrations below 2 ml/l is considered oxygen deficient while water below 5 ml/l are oxygen depleted. Concentrations <0.5 ml/l are recorded in the BCLME near 15°S. The continental shelf waters of the Benguela system are characterized by low oxygen concentrations, especially on the bottom. Nutrient concentrations of upwelled water of the Benguela system attain 20 µM nitrate-nitrogen, 1.5 µM phosphate and 15-20 µM silicate, which indicate typical nutrient enrichment.

6.1.5 Turbidity and Total Suspended Solids (TSS)

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulate matter. Typically, Concentrations of suspended particulate matter in shallow coastal waters can vary both spatially and temporally, typically ranging from a few mg/ℓ to several tens of mg/ℓ, depending on suspended sediments in interest. Turbidity is caused by presence of solids in water due to physical (e.g. rock weathering), chemical or biological (e.g. decay of phytoplankton biomass) activities and anthropogenic activities such as dredging, benthic sampling and disposal of tailings overboard, disturbance of seafloor etc. The major source of turbidity in the swell-influenced nearshore areas off Namibia is the redistribution of fine inner shelf sediments by long-period Southern Ocean swells. The reported current velocities typical of Benguela are 10-30 cm/s, which can be responsible for resuspending quantities of sediments.

6.1.6 Phytoplankton flora

Phytoplankton flora are well found in the specific study area. Phytoplankton is important because it forms a basis of the productivity of the marine environment. Additionally, they play a key role as sinks of excess atmospheric carbon dioxide released from heavy fuel diesel systems used as fuel in vessels or any other fossil fuels burn. Phytoplankton has a higher potential for reduction of atmospheric carbon and mitigation of air pollution. Moreover, through the photosynthesis process, phytoplankton release oxygen which is essential for respiration by marine organisms. There are phytoplankton species that are toxic to humans when ingested through consumption of shellfish. Harmful phytoplankton species are associated with HABs (harmful algae blooms), with its season from July to October and a peak in August. Eutrophication is a main contributing factor to HABs and is caused by several natural factors such as intense upwelling activity, but anthropogenic factors such as river run-off, sewage discharge and others may also contribute. Higher upwelling in the BCLME mainly accounts for HABs when nutrient-rich waters are transported near the coast and in the euphotic zone. It should be noted that SKORPIoN's system reduces the risk of HABs locally by removing surplus nutrients from the water.

6.1.7 Benthic Fauna

Marine sediments form one of the largest habitats on earth by covering more than 80% of the ocean floor. Despite high size variations of the benthos, the benthic biomass is dominated by the macrofaunal invertebrates (>0.5 mm), including many species of *polychaetas, crustaceans, mollusks and echinoderms.* Amongst the benthic communities, the macrofauna is the community that includes invertebrates that are retained on a 0.5 mm sieve. The main taxa that comprise the macrofauna are the *phyla: Arthropoda* (mainly *crustaceans* of the *malacostraca* group), *Mollusca* (mainly bivalves and gastropods) and Annelida (mainly polychaetas). Macrofauna has been widely used as indicators of pollution in marine environments. These calcifiers are profiting from the SKORPIoN project, removing carbon dioxide and reducing acidity locally.

In addition to importance as indicator of anthropogenic impacts, macrofauna plays a major role in ecosystem functions such as organic matter mineralization and nutrient recycling. Primarily, the bacteria inhabiting the seabed carry out these tasks, but macrofauna enhances them through active biological transport, i.e. bioturbation (active mixing of sediment) and bio-irrigation (active flushing of solutes). These processes produce an increase in the supply of oxygen and other electron acceptors of the seabed surface with the porewater. This increases the metabolic capacity of bacteria and, in turn, of the sediment, to mineralize organic matter and recycle nutrients. Benthic fauna has reduced mobility compared with other groups of species such as fish, marine mammals, and marine birds and so, they tend to remain on the site after the impact has occurred.

6.1.8 Waves

The central coast of Namibia is characterized by sea waves generated locally by the persistent south-westerly winds. Historical weave data for Wlotzkasbasken is scarce, however literature indicates average wave heights in the range of 1.5 m to 2.5 m, occurring frequently over the area. For most of its length, the Namibian coast is exposed and open to buffering from heavy wave action. Also, seasonal shoreline sand waves with wavelengths ranging from 2 to 8 km come in from an easterly direction, often relaxing wave action due to increased temperatures.

6.1.9 Topography and sediments

Figure 13 shows the typical seafloor geomorphic features of the Namibian coastal seafloor.

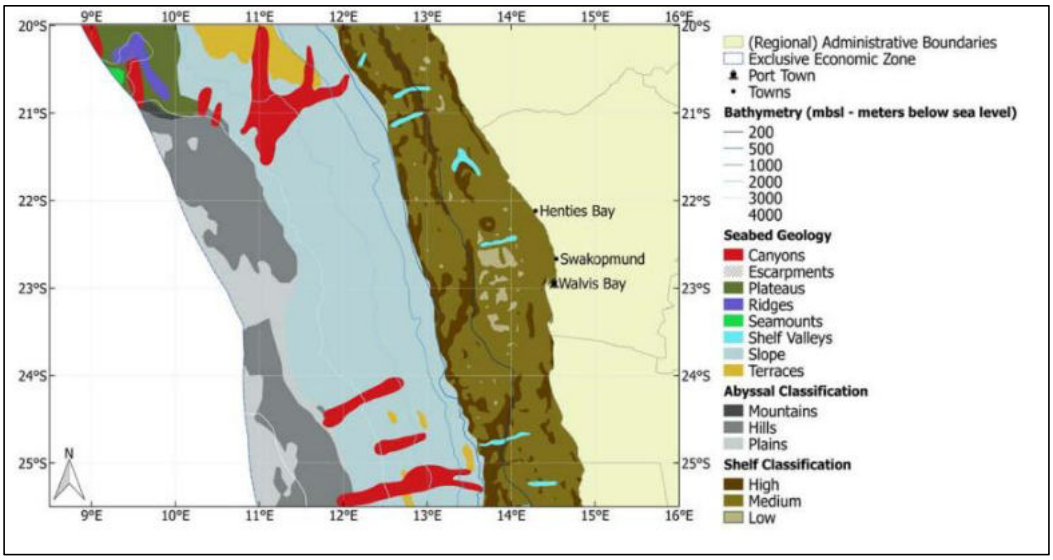


Figure 13: Seafloor geomorphic features. Source: MFMR 2018

The images taken during the beach survey, show the topography of the selected seaweed aquaculture ponds. Generally, the peripherical sediments in the intertidal and low-shore areas are generally dominated by moderately to well-sorted fine to medium sand with median particle sizes of 200- 400 µm. Northwards, in the vicinity of the proposed route, the sediments become coarser and contain proportions of gravel and pebbles, with extensive pebble beds in the mid- and low-shore, especially station 3. Beyond the low water mark inshore, the pilot area has rock outcrops, running along the seafloor appearing as the dominant topography in the pilot area. Existing information suggests a rock plate sloping very gently into the intertidal area.

The rock surface appears rough in some areas and smooth on others with a micro relief of approximately 0.5–1.0 m. Literature indicate that that offshore, about 200m, the seabed comprises smooth, flat bedrock with sparse patches of sand. Additionally, the area is characterized by small, shallow gullies of 0.5 – 1 m wide and 0.3 m deep orientated perpendicular to the coast. The general characterization of the topography along the Namibian coast, comprises of few rocky outcrops (16%) and intertidal reefs that characterize the coast, covered in seaweed and marine invertebrate epi-fauna such as but not limited to barnacles,

limpets, black mussels and sea anemones whilst the sandy escarpments (which makes up 58% of the coastal shore environment) are home to infauna e.g. amphipods, polychaetas etc. The bottom sediments of up to 2km offshore, constitute clean coarse-grained sand and shells, with water depths increasing at 10 -15 km from the shore.

6.2 Inland/Onshore Baseline

6.2.1 Climate

The meteorological conditions along the Namibian coast are controlled by the ever-present South Atlantic anticyclone, the northward-flowing Benguela Current (with associated upwelling) and the divergence of the south-east trade winds along the coast. Climatic conditions in the region vary from cool, foggy, windy and hyper-arid conditions along the coast to dry and hot weather towards onshore from which is separated by the Great Escarpment.

6.2.2 Temperature, Rainfall and Fog

Namibia is a hot country with temperatures along the coast being relatively constant but fluctuating daily and seasonally in the interior. The coastal area around Swakopmund receives less than 50 mm of rainfall per annum, but approximately a third of the year are characterised as fog days. Fog is the most distinctive climatic feature Namibia's coast, with 100-125 days of fog per year in the vicinity of Wlotzkasbaken. Fog usually forms when moist maritime air moves over cold upwelled water adjacent to the coast and is the predominant source of precipitation for the coastal areas.

Many plants and animals rely on the fog in these areas as water source and is an important driver of the establishment and growth of lichens. Average rainfall increases and fog days decrease towards the east. Heavy rainfall in the interior of the country rarely reaches the sea, except as occasional floods in the Omaruru, Swakop and Kuiseb rivers. Evaporation rates in Namibia are generally high, however lower rates of evaporation are experienced at the coast due to cooler and more humid coastal conditions.

6.2.3 Surface Wind

The presence of the subtropical South Atlantic Anticylcone off Namibia's coast drives the wind pattern, generating strong to gale force south-westerly winds along the coast in all seasons but most frequently during mid-summer and spring. These strong winds cause upwelling in the ocean, bringing nutrient rich water to the surface and consequently resulting in the high biological productivity characteristic of Namibian coastal waters. Additionally, the coastal southwesterly wind is responsible for transporting sand to the Namib Sand Sea. Occasional hot, dry and powerful easterly winds ("Berg Winds") during winter cause large quantities of dust and sand to be blown offshore, affecting sediment input into the coastal marine environment. The abrasive effect of the sand and dust transported by Berg winds is an important consideration in the design of power lines and other infrastructures. Wind in the interior blows mainly from north, north-east and easterly directions, and carries moist air into Namibia. Wind in the interior blows mainly from north, north-east and easterly directions, and carries moist air into Namibia.

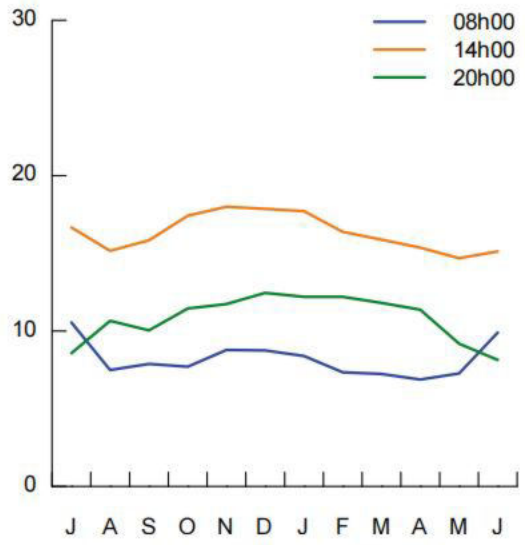


Figure 14: Mean Wind Speeds in Wlotzkasbaken

6.2.4 Topography and Drainage

The landscape is classified as being in a flat western coastal plain composed of mobile dunes and gravel sandy plains, an area of dissection and erosional cutback. The site is not located

within a river catchment and surface runoff would be in a westerly direction towards the Atlantic Ocean. The local landscape, and the site and its immediate surroundings, is generally flat with poorly developed drainage systems (Geo-Pollution, 2023). Figure 15 below indicated the drainage courses within the site boundaries.

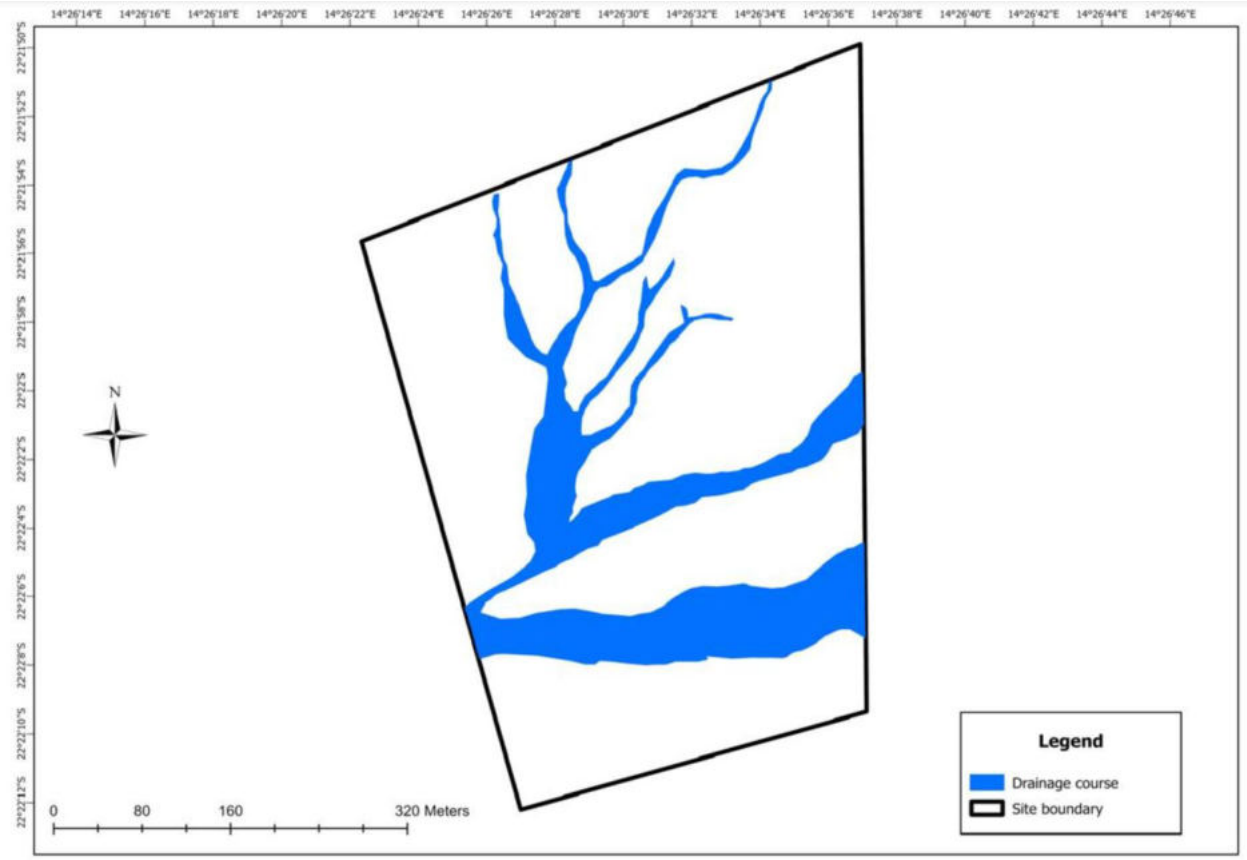


Figure 15: Thematic map indicating the drainage courses within the 20 ha Project site boundaries

6.2.5 Geology and Hydrogeology

Schists and dolomites, with patches of granite and complex rock types, predominantly underlie the proposed project area. The eastern part around Windhoek is characterised by schistsThe dominant soil types of the proposed project area are petric Gypsisols, pertic Calsisols, eutric Regosols, and lithic and eutric Leptosols, with interspersed rocky outcrops. The desert areas of the proposed project area are sparsely covered with lichen and vegetation.

Local geological features in the area are defined by the presence of marble, schist, conglomerate, quartzite, and dolerite sills and dykes originating from the Namibian Age – Damara Sequence. The superficial geology of the site consists of a layer of shallow, coarse brown sand. The flow of groundwater mainly transpires through primary porosity in the topsoil and along fractures, faults, and other geological structures that exist within the underlying hard rock formations (Geo-Pollution, 2023).

6.2.6 Soils

The two main soil units on the site, are Solonchaks and Leptosols. Approximately one third of the profiles are Solonchaks, which are predominantly found in the plain habitat and characterised by a salic horizon. However, these soils are shallow and partly with a high gypsum content, as expressed by the qualifier 'Gypsic'. Profiles with shallower bedrock and lower gypsum content are classified as Leptosols. In some places, especially on the calcite marble, only very shallow soils or substrate layers cover the bedrock. Texture ranges from sand to silty sand and sandy silt. Clay contents are very low (Biota, 2010).

Pattern analogies in the soil and vegetation distribution are not very prominent but evident and are analogous to topographic features. Higher plants are concentrated along the drainage courses that (i) receive more water by run-on effects and (ii) have lower salt contents by run-off salt export. Although the annual rainfall is very low, a few events within decades might suffice to transport at least the highly soluble salts into deeper topographical positions or even out of the system (Biota, 2010).

6.2.7 Surface Water

Although the surface water features in the study area are not of particular significance for aquatic ecology, dry rivers and drainage lines act as resource sinks that attract and provide habitat for plants and animals. Dry rivers and drainage lines channel water during rains, often characterised by flash floods, and play a critical role in the landscape in terms of transporting water and nutrients downstream. Drainage lines and other surface water features are thus of significance for terrestrial biodiversity and ecology. In Namibia, where surface water is very sparse, groundwater is a critical resource. Little or no groundwater exists between the coast and

~ 15°15'E, hallower groundwater areas are often associated with surface water features (ephemeral rivers and dry rivers).

6.2.8 Biodiversity

The proposed ponds are located within the sensitive ecosystem zone, which raises critical biodiversity considerations. This area is globally recognized for its ecological uniqueness, harboring numerous endemic species and specialized life forms that rely on fog, sparse vegetation, and temperature regulation. The study area is ecologically diverse, hosting rocky intertidal zones, estuarine systems, and coastal wetlands. These ecosystems provide critical habitats for various flora and fauna and a breeding area for avian species. The proximity to the Skeleton Coast and Namib Desert adds to the ecological importance of the site. The proposed site for the project, in the settlement of Wlotzkasbaken, falls in the Erongo coastal zone region (NACOMA, 2007). The Erongo coastal zone is approximately 300 km long, and features Namibia's only coastal urbanised sub-region, incorporating the municipalities of Walvis Bay, Swakopmund and Henties Bay, and the declared settlement area of Wlotzkasbaken.

Within the locality of Wlotzkasbaken, the extensive lichen fields and the bird species are of ecological importance.

6.2.9 Flora

6.2.9.1 Lichen Fields

The Namib Desert lichen fields near Wlotzkasbaken are ecologically significant and a unique coastal habitat characterised by high biodiversity and endemism. These fog-dependent systems host lichens such as *Teloschistes capensis* and *Ramalina spp*., which stabilise soils and support nutrient cycling. As noted by Seely and Pallett (2008), these habitats are fragile and recover slowly from disturbance. These lichen mats support distinct arthropod assemblages, including beetles, spiders, and insects. They are extremely fragile and highly sensitive to dust, trampling, and physical disturbance, with recovery taking decades. The lichen field is densely distributed towards, on the outside of the northern ERF perimeter.

This area is one of the richest in lichen diversity due to extremely favourable climatic conditions characterised by high air humidity, dew and fog precipitation. Several of the recorded taxa are

endemic to the Namib Desert, and one species, *Phloeopeccania pulvinulina,* was recorded for the first time in Africa (Schultz et al. 2009).

Crustose lichens have the highest cover just outside the study area, while foliose and fruticose lichens are also common. Vehicle tracks have caused disturbances, but crustose lichens like *Lecidella crystallina, Buellia sipmanii, and Caloplaca volkii* are recolonizing these areas.

These vegetation types are foundational to the coastal Namib ecosystem. Lichens initiate soil formation and create habitats for micro-fauna. Hummock plants act as fog traps and shelter a variety of species, including arthropods, small mammals, and ground-nesting birds (Burke, 2001; Henschel & Seely, 2000).

The high-density lichens extend northwards from the northwestern boundary of the site while the the specific study area consist of low-density lichens. There is a global biodiversity and climate change monitoring station in the Wlotzkasbaken lichen fields, approximately 6.5 km North-Northeast of the proposed site.

6.2.9.2 The Coastal Hummock Species

The coastal hummock belt refers to a narrow stretch of area from the high-water mark, directly inland from the littoral zone. The inland site hosts the primary vegetation species which are very distinct and dominated by *Arthraerua leubnitziae, and Zygophyllum stapffi*i (Figures 16 and 17). Other Hummock species in the general area include, *Zygophyllum clavatum, and Brownanthus kuntzei.*

Hummocks are critical landforms that enhance desert biodiversity by retaining soil moisture, moderating temperatures, and reducing wind erosion.

The ecological significance of the hummocks is profound, serving as a buffer zone that protects inland habitats from saltwater intrusion and erosion. These ecosystems are not only pivotal for local wildlife, providing essential habitat for numerous bird and small mammal species, but they also play a critical role in nutrient cycling. The unique soil composition here, often characterized by salinity and specific organic matter, supports the growth of halophytes and other specialized plant species.

In addition to *Arthraerua leubnitziae and Zygophyllum stapffii*, other notable flora includes *Cambiscanthus bracteatus* and *Limonium spp*., both of which contribute to the biodiversity of the region. The pollinators visiting these plants further enhance the ecosystem diversity, establishing intricate relationships between species. Conservation efforts in the Wlotzkasbaken area aim to maintain these vital habitats, as they face threats from climate change, invasive species, and human activities such as off-road driving. The preservation of such ecological communities is essential not only for maintaining local biodiversity.

Figure 16: *Arthraerua leubnitziae (Pencil Bush)* observed on site

Figure 17: *Zygophyllum stapffii (Dollar Bush)* observed on site

Figure 18: Vegetation distribution of *Arthraerua leubnitziae and Zygophyllum stapffii, and* along drainage channels through the site

6.2.10 Fauna

Desert-adapted fauna, including Tenebrionid beetles, gerbils, and geckos, inhabit the lichen fields and dune systems. These organisms perform essential ecological roles such as detritus decomposition and seed dispersal. According to Seely and Pallett (2008), these species are finely tuned to the microclimatic conditions created by lichen coverage.

Desert-adapted fauna that can be found in the study area are as follows:

- True Bugs:
    - *Nysius ericae* (Lygaeidae): A widespread seed bug that breeds mostly on Asteraceae.
    - *Reduvius nigricephalus* (Reduviidae): Found in multiple desert observatories.
- Butterflies and Moths:
    - *Azanus jesous jesous and Vanessa cardui*: Considered an autochthonous species of the area.
    - *Ectochela nigrilineata* (Noctuidae): Considered an autochthonous species of the area.
    - *Pecticossus gaerdesi* (Cossidae): Larvae bore into roots and stems of *Zygophyllum stapffii*, a desert plant.
    - *Eilema s.l.* (Arctiidae): Larvae feed on lichens, which are abundant in the Namib Desert.
- Large and Small Mammals:
    - Occasional sightings of brown hyenas, jackals and springboks: Adapted to arid environments and rely on the dune systems for habitat
- Reptiles
    - Reptiles such as skinks and geckos

Dominant invertebrates include tenebrionid beetles such as *Onymacris unguicularis*, which harvest fog using specialized dorsal structures (Henschel et al., 2020). These beetles are

integral to nutrient cycling and are highly susceptible to habitat alteration, especially from vehicle tracks and sediment disruption.

Reptilian diversity includes over 80 species, with endemics such as *Pachydactylus rangei* (Namib web-footed gecko) displaying adaptations like burrowing and nocturnality to escape extreme daytime temperatures (Herrmann & Branch, 2013).

Larger mammals such as springboks and brown hyenas coexist with smaller rodents and herbivores, relying on seasonal vegetation and natural water catchments (Kinahan, 2005).

6.2.11 Avifauna

The site is also home to a variety of Avian species, reported to be about 270 bird species. These include resident birds such as Kelp Gulls *(Larus dominicanus*), cormorants, and terns, as well as migratory birds like Lesser Flamingos (*Phoeniconaias minor)*, Curlew Sandpipers *(Calidris ferruginea),* Damara Terns, Ludwig's Bustards, Rüppell's Korhaans, African Black Oystercatchers, and Gray's Larks. The site is part of a major migratory route and is crucial for roosting and feeding. The area is a favorable breeding ground based on the characteristics as outlined below:

Sparsely Vegetated Gravel Plains: The flat, open gravel plains and sand flats around Wlotzkasbaken are ideal for ground-nesting birds such as the Damara Tern *(Sternula balaenarum).* These areas offer high visibility to detect predators and have minimal vegetation, making them preferred nesting substrates.

Proximity to Marine Food Resources: Birds breeding in this zone have immediate access to nutrient-rich coastal waters that support abundant fish and crustaceans. This proximity improves foraging efficiency during the critical breeding season, thereby increasing chick survival rates.

Low Human Density and Disturbance: Historically, Wlotzkasbaken area has had limited development, resulting in minimal disturbance to breeding birds. The low level of infrastructure and traffic ensures birds are less likely to abandon nests due to stress or habitat degradation.

Evolutionary Adaptation and Habitat Suitability: Several bird species in this region, such as the Damara Tern and Dune Lark, have evolved reproductive strategies that align with the

seasonal fog cycles and specific substrate characteristics of the area. The habitat is not only suitable but essential for their survival.

Conservation Significance: Due to its ecological uniqueness and the presence of near-endemic species, this coastal zone is classified as an Important Bird Area (IBA) by BirdLife International. The site supports globally significant breeding populations and requires high conservation priority.

Breeding birds are susceptible to disturbance especially when the construction activity takes place during the critical time in the breeding cycle, when the eggs are not hatched or when there are newly hatched chicks, this could lead to abandonment of nest or premature fledging.

However, the most prevalent avian species inhabiting the region include the Damara Tern *(Sternula balaenarum)*, notable for its ground-nesting behavior, the *Ammomanes grayi* (Gray's Lark), a species distinctly adapted to arid desert environments, and the *Cercomela tractrac* (Tractrac Chat), which thrives under desert conditions. These birds exemplify remarkable adaptations essential for survival in their harsh surroundings. The Damara Tern, with its unique nesting habits, demonstrates resilience against the challenges posed by terrestrial predators. Meanwhile, the Gray's Lark showcases its exceptional camouflage and foraging strategies, enabling it to find sustenance amidst the sparse vegetation of the desert. The Tractrac Chat, with its melodious calls and agile movements, adds a vibrant note to the arid landscape, illustrating the intricate balance of life that persists even in such inhospitable environments.

These species exhibit a range of remarkable adaptations that enable them to thrive in the extreme aridity of the Namib Desert, including feeding on lichens, utilizing moisture from fog, and flourishing amidst sparse vegetation. The flora and fauna within this environment are critical for a delicate balance to sustain the biodiversity characteristic of the Namib Desert. Vegetation such as drought-resistant shrubs and hardy grasses not only provides crucial nesting sites but also serves as a vital food source for both resident and migratory birds.

Birds such as the *Phoenicurus mertensii* (Redstart) may also be spotted, taking advantage of seasonal blooms that attract insects. Furthermore, the presence of water bodies, albeit seasonal, contributes significantly to the biodiversity, drawing migratory birds like the Numidia meleagris (Guinea Fowl) during wetter months. The unique climatic conditions of

Wlotzkasbaken shape not only the avifauna but also the behaviors and survival strategies of its resident species. The diurnal patterns of the *Ammomanes grayi* exhibit fascinating adaptations; these birds often forage during the cooler morning hours to avoid the intense midday heat. Similarly, the *Cercomela tractrac* has developed a remarkable ability to utilize its environment, often hunting insects by darting in and out of the sparse vegetation that defines the region's landscape.

In addition, the ecological balance here is delicately maintained by predatory species such as the *Milvus migrans* (Black Kite), which soar overhead, keenly observing the activities below. Their presence acts as a natural regulator and influences the foraging habits of smaller birds. The seasonal migrations bring a temporary influx of variation, introducing transient species that interact with the established residents, leading to dynamic changes in feeding behaviors and nesting strategies. This intricate web of life within Wlotzkasbaken highlights the resilience of desert ecosystems.

6.2.12 Noise

The only source of noise in the area is the natural sounds from wind, ocean, the vehicles and the day-to-day operational activities of the Erongo Desalination Plant. Wlotzkasbaken Settlement is the immediate community located approximately 4 km from the proposed activities. The sensitivity of noise receptors usually increases at night when conditions are still, and ambient noise levels are at their lowest.

6.2.13 Air Quality

The only source of dust in the area is from 4x4 off-road vehicles and by sand picked up by wind.

6.2.14 Heritage Resources

No archaeological sites were noted within the perimeter of the sites during I.N.K's visit or identified by the locals.

6.2.15 Visual and Sense of Place

The nearest settlement is Wlotzkasbaken, located approximately midway between Henties Bay and Swakopmund along the C34 road and approximately 4 km from the site. Established in the

1930s as a leisure angling destination, the settlement remains devoid of electrification, with water being transported via road and stored in private water towers that define the skyline. The absence of walls or fences is notable; instead, boundaries are delineated by rocks. In the year 2000, the Erongo Regional Council augmented the total number of erven to 248, offering existing leaseholders the opportunity to purchase the parcels of land they had previously rented and developed. Adjacent to the settlement, a mere 75 meters south of the proposed project site, lies the current Erongo Desalination Plant, constructed to furnish the Areva Trekoppie mine with water.

The surrounding landscape is characterized by its captivating natural beauty, where the arid terrain meets the coastline. Despite its remote setting, Wlotzkasbaken has gradually attracted those in search of solitude.

Figure 19 indicates the ground view of the proposed site from the Wlotzkasbaken residential establishments. The Wlotzkasbaken Settlement is approximately 4 km from the site. The proposed site is located north of the Erongo Desalination Plant, which will partially obscure the view to the site. The figure indicates a low visibility of the site due to its significant distance. Other visual features include the ocean to the west, Erongo Desalination Plant Pipelines and vehicles frequently traveling on the C34. However, the area is dominated by the pristine natural environment.

Figure 19: Ground view of the site from the Wlotzkasbaken residential area

As development progresses in the region, there is potential for evolution in infrastructure, which might enhance the quality of life for residents while preserving the settlement's intrinsic character. The balance between modernization and the preservation of Wlotzkasbaken's calm environment is a point of collective consideration, ensuring that future growth aligns with the community's values and aspirations.

7 IDENTIFICATION OF ENVIRONMENTAL ASPECTS AND POTENTIAL IMPACTS

The scoping phase which included a consultation process with key stakeholders that included government authorities and I&APs allowed the opportunity to raise the issues associated with the project development.

The relevance of the potential impacts ("screening") is also presented in the tables below to determine aspects to be assessed in further detail (Section 8 of this report).

Table 9: Environmental Aspects and Potential Impacts

ASPECT	APPLICABLE PHASE	POTENTIAL ENVIRONMENTAL IMPACT	RELEVANCE (SCREENING) OF POTENTIAL IMPACT	Significance and Impact Rating
Waste Management (Brine discharges and Accidental hydrocarbon spills from vehicles, heavy machinery generators and equipment)	Construction and Operational	◆ Potential impact on surface and marine water quality ◆ Water quality degradation ◆ Potential impact on marine and terrestrial fauna and flora ◆ Potential soil impacts ◆ Loss of habitat ◆ Loss of biodiversity	Potential hydrocarbon runoff during the construction phase may result in the contamination of both groundwater and surface water. Hydrocarbon spillages from the construction phase are expected from the heavy machinery, generators, while during operations, spillages are expected from the frequent and constant running of mechanical and electric equipment and machinery such as motors and pumps. Therefore, considering potential hydrocarbon spillages, the potential impacts have been assessed further in section 8.	**Medium (M)**
Land clearing and preparation for pond construction		Alteration of drainage courses that may potentially affect natural drainage patterns and fauna and flora habitats ◆ Habitat alteration ◆ Habitat fragmentation	The hummock species *(Arthraerua leubnitziae, and Zygophyllum stapffii)* are found along and associated with the drainage channels within the aquafarm site boundaries and could potentially be disturbed from alterations of the drainage courses. The drainage channels support globally significant breeding populations and require high conservation priority. Therefore, exclusion zones of the drainage courses should be taken into consideration. In addition, the construction activities could potentially be	**High (H)**

		and displacement ◆ Physical damage and root disturbance ◆ Displacement of reptiles and small mammals due to habitat disturbance, increased predation risk in fragmented environments. ◆ Interference with natural drainage courses.	disturbing the breeding birds associated with vegetation along drainage courses, such as *Kelp Gulls (Larus dominicanus), Lesser Flamingos (Phoeniconaias mino, Damara Tern (Sternula balaenarum), Ammomanes grayi (Gray's Lark), Curlew Sandpipers (Calidris ferruginea), Cercomela tractrac (Tractrac Chat), Phoenicurus mertensii (Redstart), Ludwig's Bustards, Rüppell's Korhaans, African Black Oystercatchers and Ammomanes grayi. Reptiles* such as Geckos may be adversely affected by artificial lighting and construction-induced vibrations. Therefore, considering the sensitive nature and severity of altering natural drainage courses and cumulative impacts on the terrestrial ecosystem, the potential impacts have been assessed further in section 8.	
		Potential Impacts on the lichen fields	The assessment found that the proposed construction of the ponds would severely compromise the newly regenerating southern portion of the existing high density lichen field. To prevent damage to these fields, SKORPIoN redesigned its infrastructure layout to ensure that the high-density lichen fields are avoided by the project activities. With the new design, these fields are located just outside the site boundaries to the north. Therefore, lichen species that are densely distributed are taken into consideration by not having them included within the site boundaries as part of the project layout and design. However, low density lichen distribution is still found within the site. Though the construction phase is not poised to impact the significant and recognized high-density lichen distribution north of the site, impacts on the low distribution of lichens within the site will still likely take place, with a high significance rating. Considering the sensitive nature of the lichen fields, the potential impacts on these ecologies have been further evaluated in Section 8.	**High (H)**
		Potential impacts on archaeology sites	There's no evidence of archaeological remains in the area. Therefore, no impacts are expected for this issue. No further assessment is required. However, should there be any archaeological/heritage discoveries on site during the construction and operations, the related management and mitigation measures stipulated in the ESMP should be followed.	**Low (L)**
		Noise Impacts on the closest sensitive receptors.	The only source of noise in the area is the natural sounds from wind, ocean, the vehicles and the day-to-day operational activities of the Erongo Desalination Plant.	**Low (L)**

			Wlotzkasbaken Settlement is the immediate community located approximately 4 km from the proposed activities. However, the closest sensitive receptor is the workforce at Erongo Desalination Plant which is situated at a distance of approximately 250 m from the proposed ponds. Noise from the construction of the ponds and operational activities would be from land clearing and excavation activities, vehicle movement and operations of mechanical machinery and equipment, however, considering that only 10 heavy machinery are expected on site during construction, noise levels would not be expected to be high and cause a nuisance to the Wlotzkasbaken community located approximately 4 km from the site. The operational noise levels will further depend on the efficiency of the machinery employed, as well as the timing of the activities, which are typically scheduled to minimize disturbances during peak hours. Therefore, scheduling high-noise tasks during off-peak hours. Moreover, as the construction progresses, measures will be implemented to assess the impact of noise on surrounding communities. Regular monitoring will be conducted during construction and operations to regulate sound levels and to mitigate any unexpected increases in sound levels. Continuous communication with Wlotzkasbaken residents and Erongo Desalination Plant, will also be prioritized to address concerns and provide updates on construction activities. The relevant management and mitigation measures are outlined in the ESMP.	
		Air Quality Impacts	The only source of dust in the area is from 4x4 off-road vehicles. The construction of the ponds will have vehicles and trucks delivering material and equipment to laydown areas potentially generating dust that could impact sensitive receptors at the Erongo Desalination Plant. However, this potential impact is deemed minimal due to a low number of vehicles expected during this phase. The relevant management and mitigation measures are outlined in the ESMP.	**Low (L)**
Visual conditions	Operational	Changes in visual conditions.	The current Erongo Desalination Plant, built to supply the Areva Trekoppie mine with water, is located on the outskirts of the settlement and adjacent to (75 m south) the proposed project site. Therefore, the general area consists of existing water supply pipelines to the Erongo Desalination Plant from the sea and to the Areva Mine. In addition, apart from the wind turbines, the SKORPIoN infrastructure will be obscured by the silouette of the Erongo Desalination Plant, from Wlotzkasbaken viewpoint,	**Low (L)**

			that is approximately 4 km away from the site. The visual management and mitigation measures are stipulated in the ESMP, and no further assessment was conducted.	
Working with heavy industrial tools, equipment and machinery during pond construction	Construction	Potential health and safety risks and injuries to workers	The excavation activities entail working with heavy industrial tools and equipment, that can potentially cause injuries if risks are not carefully mitigated and health and safety measures are not appropriately enforced. In addition, these activities could generate dust that can pose a health risk. Therefore, considering the significance and severity of the potential impact, the potential health and safety impacts are assessed further in section 8.	**Medium (M)**
Employment and resource management	Construction and Operations	Positive socio-economic impacts ◆ Employment Opportunities ◆ Skills and knowledge transfer ◆ Training and research opportunities ◆ Significant investment in local area.	The construction will be carried out by contractors. Contractors for the construction phase will be engaged on a short term, temporary basis. Approximately 60 workers will be required for the construction. The overall project will generate operational employment of approximately 28 Workers. Therefore, the proposed activities have the potential to create a significant positive socio-economic contribution. The relevant management and mitigation measures are stipulated in the ESMP.	**High+(H+)**

8 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

8.1 Assessment Approach and Methodology

The site visit and beach survey collected sediment for grain size analysis, as well as sediment samples for invertebrates. Counts of avifauna and marine flora were also taken into consideration. This approach is deemed adequate for placing into context the potential impacts associated with the establishment of the proposed pond construction for this pilot project.

An assessment of the potential positive and negative impacts associated with the construction and operations phase of the ponds is provided below. As an outcome, specialist input was requested for some of the environmental issues and has been included in this assessment.

Each observed species and habitat type were assessed and ranked according to ecological sensitivity criteria, including endemism, conservation status, reproductive vulnerability, and habitat specialization. Particular attention was given to marine species, endemic reptiles, lichens, and nesting birds.

Other potential environmental impacts resulting from the proposed project activities and facilities (also identified during the ESIA) were assessed by I.N.K and are also presented below.

Impacts are considered in a cumulative manner where possible such that the impacts of the proposed Project are seen in the context of the baseline conditions described in Section 6.

- Both the criteria used to assess the impacts and the Method of determining the frequency/severity of the impacts is outlined in Table 14.

This Method complies with the EIA Regulations: EMA, 2007 (Government Gazette No. 4878) EIA regulations. Both mitigated and unmitigated scenarios are considered for each impact in the ESIA results.

The matrix is explained as follows:

Duration

- The length of time a risk is present or active.

- While not a separate axis on a standard matrix, it can influence the ratings of probability and severity.

Probability/Likelihood

- The chance of a risk or hazard actually happening.

Severity/Consequence

- The magnitude of the consequences if the risk occurs.
- It considers potential harm to people, property, or operations.

The overall risk level is determined by combining the likelihood and severity ratings, often by multiplying their numerical values.

The result: The final risk rating (e.g., Low, Medium, High) is a single score that indicates the overall significance of the risk, often visually represented on the matrix with a color-coded area.

Table 10: Frequency/Severity Rating

Likelihood/ Frequency	Definition	Probability	Rating	Consequence/ Severity				
				Insignificant	**Minor**	**Moderate**	**Major**	**Critical**
				Very minor or no impact.	Minor impact that can be contained	Impact may have moderate effects	Serious impact/effect	Permanent Impact/effect
				1	**2**	**3**	**4**	**5**
Very high	Almost certain Extremely likely	>90%	**5**	Low	**Medium**	High	Extreme	Extreme
				5	10	15	20	25
High	Very likely Will probably occur	60-90%	**4**	Low	**Medium**	**Medium**	High	Extreme
				4	**8**	12	16	20
Medium	Likely to happen	40-59%	**3**	**Low**	**Low**	**Medium**	**Medium**	High
				3	**6**	**9**	12	15
Low	Possible but unlikely	10-39%	**2**	**Low**	**Low**	**Low**	Medium	**Medium**
				2	**4**	**6**	8	**10**
Very low	Conceivable but extremely unlikely	<10%	**1**	**Low**	**Low**	**Low**	**Low**	**Low**
				1	**2**	**3**	**2**	**2**

8.2 Issue: Waste Management - Accidental oil spills from vehicles, generators and equipment

Applicable Phase: Construction and Operational

Potential hydrocarbon runoff during the construction and operational phases may result in the contamination of the two main drainage channels running through the site. The hydrocarbon seepage into the ground is imminent and though over long periods, the contamination of the acquifer could be victim of this hydrocarbon spillages. In addition, any hydrocarbon volumes on site are fuels and lubricants for vehicle operation. The only hydrocarbon that will be produced is gaseous and cannot leak into the ground in case of spillage.

SKORPIoN will be required to implement waste management strategies during construction and operational phases, to manage and implement ongoing water quality monitoring of the drainage channels, which is crucial to promptly identify any signs of contamination, allowing for the implementation of remediation techniques before significant ecological damage occurs. Mitigation strategies must be implemented to prevent hydrocarbon spills, including proper containment measures, routine inspections, and immediate response plans in case of an incident.

Given the above, the cumulative unmitigated severity is **medium (9)** but may be reduced to **Low (6)** with the successful implementation of the mitigation measures outlined in the ESMP.

Table 11: Waste management - accidental oil spills from vehicles, generators and equipment

				Severity	
Likelihood	**Definition**	**Probability**	**Rating**	**Unmitigated**	**Mitigated**
Medium	Likely to happen	40-59%	3	Medium (9)	Low (6)

Relevant Management and Mitigation Measures

- Regular training for staff members on spill response and containment procedures
- Conduct routine inspections of equipment
- Establish emergency response plans
- Ensure suitable receptacles with lids for waste disposal is available on site at all times.

- If rubbish containers are used, ensure these can be sealed from strong wind
- Regular environmental awareness should include potential risks associated with hydrocarbons.
- Soil contaminated with hydrocarbons shall be excavated and transported for disposal at the nearest disposal facility (Walvis Bay Hazardous Disposal Facility).
- Adequate separate containers for hazardous and domestic waste must be provided on site.
- The workforce must be sensitized to dispose of waste in a responsible manner and not to litter.
- Oils and lubricants are prevented from spilling using drip trays or other suitable containers.
- Accidental spills must be cleaned immediately.

8.3 Issue: Direct destruction and disturbance of Lichen Fields

Applicable Phase: Construction

The possible effects on the lichen fields that are densely distributed towards the northern boundary of the site, are outside of the site. However, the site consist of low densely distribution of lichens and that may be impacted due to dust and physical damage and destruction as a result of the construction phase (land clearing and preparation activities for the construction of the ponds). The construction activities involving workforce, vehicle and heavy machinery movement may generate dust, cause trampling, or result in runoff that degrades lichen communities which are highly vulnerable and sensitive.

Construction activities can create habitat for flora species to establish e.g. disturbed soil is favourable for the establishment of weeds and invader species. Additionally, such disturbances can alter nutrient availability in the soil, thereby impacting the types of vegetation that thrive in the area. Over time, these changes can lead to shifts in the type of vegetation found in the project area, as established species may outcompete native flora for resources.

It is essential to monitor and manage these areas to promote biodiversity, as invasive species can disrupt local habitats.

8.3.1 No-go/Exclusion Zone of densely concentrated Lichen fields

The assessment has identified and mapped regions where lichen populations are densely concentrated as no-go/exclusion zones, within which no developmental activities should be undertaken in these ecologically sensitive areas. Furthermore, the preservation of these delicate ecosystems is important, as any disturbance could irrevocably disrupt the balance that sustains both lichen growth and the broader environmental context. SKORPIoN is urged to recognize the significance of these protected zones and to implement strategies that prioritize conservation efforts over development in order to safeguard biodiversity and ecological integrity. Engaging in responsible land management practices will not only benefit these areas but will also enhance the overall resilience of the surrounding habitat.

Protecting areas with dense lichen distributions is not merely an ecological imperative, but a moral one, as it reflects the respect for the environment and commitment to a sustainable future. By adapting ecological principles into development, land-use planning and project design, SKORPIoN can ensure that their actions resonate with the ethical practice of environmental protection. Therefore, SKORPIoN has rearranged its design, to avoid the densely populated areas but will include the less densely distributed lichen within their ERF, into security fencing, meaning enhanced protection of those fields, avoiding 4x4 driving in these areas and no access to poachers, i.e. these areas will be better protected than outside of the ERF.

Given the above, the cumulative unmitigated severity is **Extreme (25)** but may be reduced to **Medium (10)** with the successful implementation of the mitigation measures outlined in the ESMP.

Table 12: Potential Impact on Lichens during inland construction

				Severity	
Likelihood	**Definition**	**Probability**	**Rating**	**Unmitigated**	**Mitigated**
Very High	Almost certain and extremely likely	>90%	5	Extreme (25)	Medium (10)

Relevant Management and Mitigation Measures

- Areas where Lichens are densely distributed should be avoided.

- No development will occur on established ecological no-go areas and exclusion zones for densely distributed lichen fields.
- Management will implement a zero-tolerance policy concerning the killing or collecting of any plants. This applies to people directly employed by SKORPIoN as well as any contractors working on their behalf. Develop a policy that limits independent movements of all workers into the veld. Strictly prevent poaching, harvesting or possession of any such wildlife resources without an appropriate permit.
- Keep destruction of Lichens and Hummock species to a minimum. Strictly control vehicle and machinery movement in the area where lichens and individual plants occur.
- Map lichen-dominated areas in more detail, use to guide planning of infrastructure positions.
- Backfill excavated areas continuously.
- Do not clear areas that are not within the infrastructure footprint
- Maintain track discipline – i.e. slow speeds (e.g. 40km/h) and no off-road driving throughout the area.
- Ongoing awareness to contractors and SKORPIoN Employees (i.e. Regular toolbox talks) should be promoted about the value of biodiversity and the negative impacts of disturbance, especially to lichens and hummocks, as well as the negative impacts of illegal collecting of plants.
- Monitor the clearing of vegetation prior to construction to ensure that the requirements stipulated in the EMP are adhered to.
- Monitor management adherence to waste management requirement frequently.
- Monitor quantities of waste material production, dust and wastewater.

8.4 Issue: Alteration of drainage courses due to the construction of the ponds may affect fauna and flora habitats.

Applicable Phase: Construction

The assessment findings indicate that the two drainage systems on site have an important role in the general area of Wlotzkasbaken. The drainage channels are adorned with vegetation that provides habitat for avian species, including Kelp Gulls *(Larus dominicanus*), Lesser Flamingos (*Phoeniconaias mino,* Damara Tern *(Sternula balaenarum)*, Ammomanes grayi (Gray's Lark),

Curlew Sandpipers *(Calidris ferruginea), Cercomela tractrac* (Tractrac Chat), *Phoenicurus mertensii* (Redstart), Ludwig's Bustards, Rüppell's Korhaans, African Black Oystercatchers and *Ammomanes grayi*.

Drainage channels not only serve as crucial nesting sites but also foster a rich biodiversity, attracting a myriad of bird species and supporting their reproductive endeavors. The interplay of flora within these channels creates a dynamic ecosystem, where the intricate relationships between different species flourishes. Collectively, these species highlight the rich biodiversity of the region and serve as a testament to the extraordinary processes in desert ecosystems. Due to its ecological uniqueness and the presence of near-endemic species, this coastal zone is classified as an Important Bird Area (IBA) by BirdLife International. The site supports globally significant breeding populations and requires high conservation priority.

Understanding natural drainage patterns helps prevent the destruction of infrastructure from being placed in flood-prone or erosion-sensitive zones. Surface water movement, even in arid environments like the Namib, can become hazardous during episodic rainfall events, leading to:

- Damage to infrastructure such as seaweed aquaculture ponds.
- Soil erosion and sediment displacement.
- Risk to worker safety.

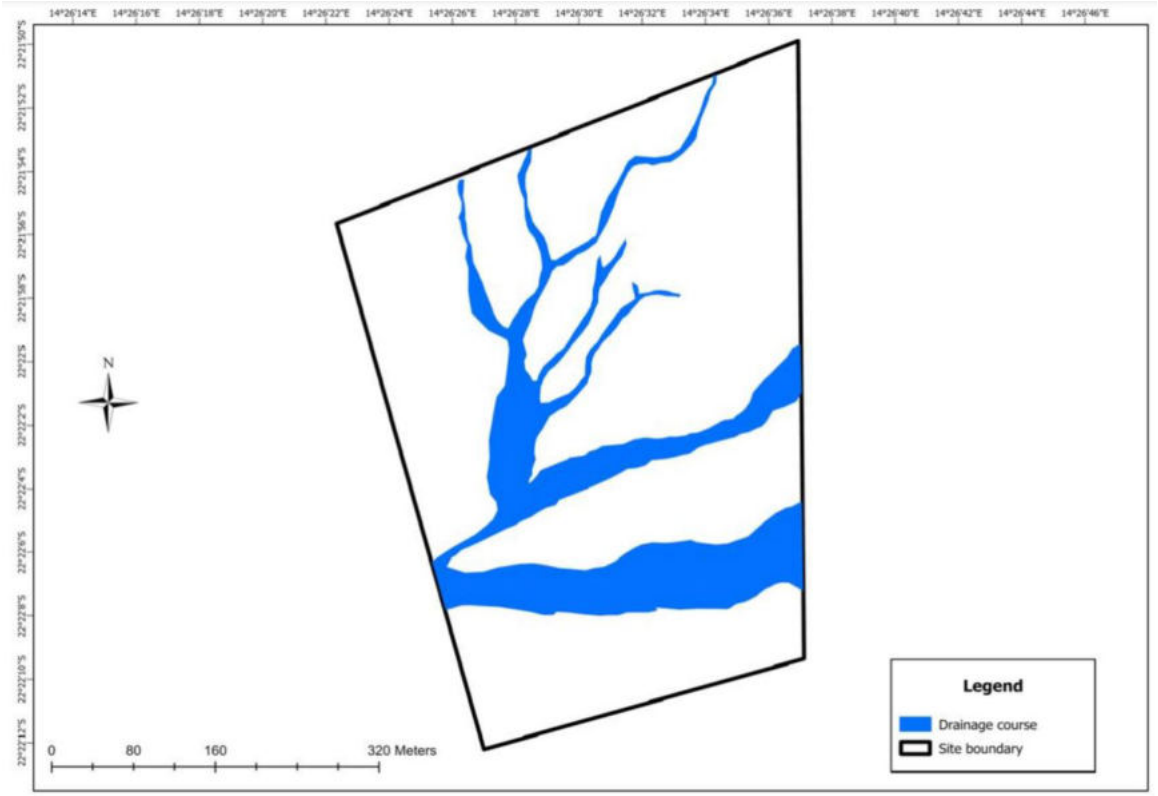
Hummock plants are found along the drainage courses and act as fog traps and shelter a variety of species, including arthropods, small mammals, and ground-nesting birds (Burke, 2001; Henschel & Seely, 2000). The potential development impacts associated with the construction of the seaweed aquaculture ponds within the site boundaries can alter surface hydrology, leading to the flattening or degrading of hummock structures. The assessment noted that in the proposed development, severe degradation of this belt is noted due to anthropogenic activities and stretches along drainage channels. However, patches of pristine habitat remain. A similar trend is noted along the rest of the Namibian coast (which hosts this habitat), as recreational activities and related access roads fragment the habitat, isolating endemic hummock invertebrates, thereby reducing their ranges, interrupting gene flow and diminishing their ability to adapt and survive into the future. Therefore, SKORPIoN has rearranged its design, to avoid the waterways and the associated natural ecology along these channel courses. SKORPIoN will include security fencing within their ERF, meaning enhanced protection of those ecologies,

avoiding 4x4 driving in these areas and no access to poachers, i.e. these areas will be better protected than outside of the ERF. Construction may only occur under heightened care not to disturb flora or fauna and the natural flow of water.

8.4.1 No-go/Exclusion Zone of main drainage courses

Due to its ecological uniqueness and the presence of near-endemic bird species, this coastal zone is classified as an Important Bird Area (IBA) by BirdLife International. The drainage channels support globally significant breeding populations and require high conservation priority. Conservation efforts in Wlotzkasbaken are paramount, given the increasing pressures from anthropogenic activities and environmental changes. Safeguarding this habitat is essential for the continued survival of biodiversity species. It is imperative that SKORPIoN recognize the significance of such ecosystems and work collaboratively to implement strategies that mitigate disruption.

Furthermore, the presence of such fauna and flora enhances the ecological integrity of the region, contributing to the overall health of the environment. The vitality of these drainage systems underscores their importance in sustaining wildlife populations and preserving the natural heritage of the area.



Given the above, the cumulative unmitigated severity is **Extreme (25)** but may be reduced to **Medium (10)** with the successful implementation of the mitigation measures outlined in the ESMP.

Table 13: Potential Impact on Alteration of main drainage courses

				Severity	
Likelihood	**Definition**	**Probability**	**Rating**	**Unmitigated**	**Mitigated**
Very High	Almost certain and extremely likely	>90%	5	Extreme (25)	Medium (10)

Relevant Management and Mitigation Measures

- Any work within a buffer zone of 30m to channel courses may only occur under heightened care not to disturb flora or fauna and the natural flow of water.
- High-impact construction should be limited during key migratory and breeding periods: - October to April: Migratory bird season, May to August: Local breeding period. Project calendars should be informed by avian ecological data.

- Monitor quantities of waste material production such as ash, air emission concentrations, wastewater and other effluent production and quality.

8.5 Issue: Socio-Economic Benefits

Applicable Phase: Construction and Operational

This project has the potential to create significant socio-economic benefits through employment creation and economic contributions. The construction phase has benefits linked to the procurement of goods and services. While approximately 60 temporary jobs will be created during the construction phase, approximately 28 permanent jobs will be created for the operational phase of the Project.

Additionally, the project offers the region an opportunity to develop sustainably through its collaborative links with the local authorities, in fast tracing development in the region, to enhance improved public service delivery and social welfare in the region.

Given the above, the cumulative unmitigated severity is **positive high** but may be increased to **extreme** with the successful implementation of the mitigation measures outlined in the ESMP.

Table 12: Assessment - Socio-Economic Benefits

				Severity	
Likelihood	**Definition**	**Probability**	**Rating**	**Unmitigated**	**Mitigated**
Very High	Almost certain Extremely likely	>90%	5	Positive High (15)	Positive Extreme (25)

Relevant Management and Mitigation Measures

- Local people be preferentially selected to encourage social growth and development in the settlement, region and Namibia as a country.
- Management is urged to begin local selection and provide technical training as soon as possible to enable local people to compete for the lower skilled jobs and upskill themselves in anticipation of the proposed project.

1.1 Issue: Negative Impacts on the Socio-economic Environment

Although the project may benefit the socio-economic environment, the project may also draw people to the Wlotzkasbaken settlement (in-migration), which may place pressure on existing services and opportunities and may create pressure on services, such as housing, health, and sanitation. The influx of people may also result in an increase in negative social behaviors including an increase in the crime rate.

Given the above, the cumulative unmitigated severity is **high** but may be reduced to **low** with the successful implementation of the mitigation measures outlined in the ESMP.

Table 13: Assessment - Negative Impacts on the Socio-Economic Environment

				Severity	
Likelihood	**Definition**	**Probability**	**Rating**	**Unmitigated**	**Mitigated**
Very High	Almost certain Extremely likely	>90%	5	High (15)	Low (5)

Relevant Management and Mitigation Measures

- Local people be preferentially selected to encourage social growth and development in the region and Namibia as a country.
- Management should work closely with the Erongo Regional Council and the Wlotzkasbaken Homeowners Association to manage in-migration, and the effects thereof.
- Management is urged to begin local selection and provide technical training as soon as possible to enable local people to compete for the lower skilled jobs and allow potential candidates to upskill themselves.

9 CONCLUSIONS AND RECOMMENDATIONS

Exclusion/No-go zones are proposed where channel courses are found within the Project site to prevent irreversible degradation (Figure 22).

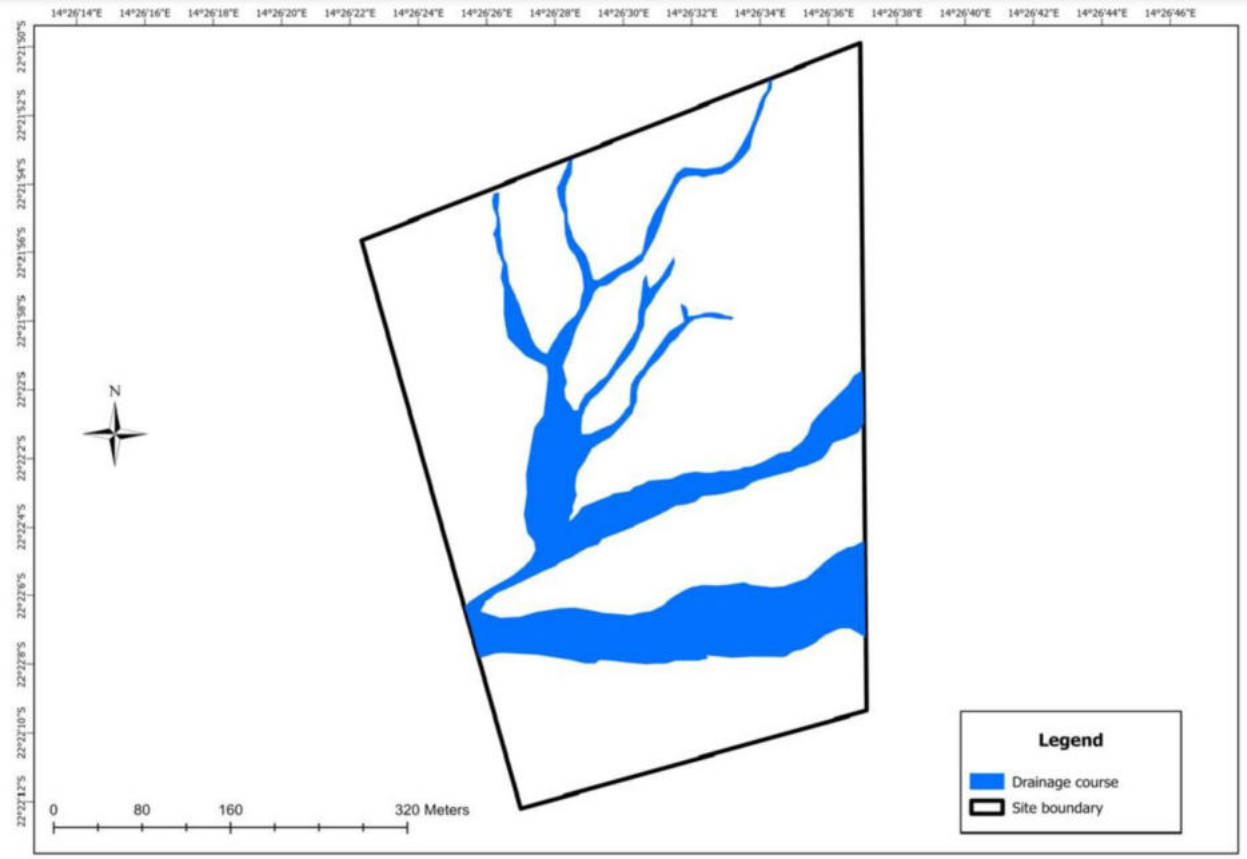


Figure 20: No-go zones within the Project site

The Drainage Pattern and Exclusion Zone Map for the overall project site has been developed as a critical planning and environmental management tool for the proposed Seaweed Aquaculture Project.

The flora, fauna, and avifauna in the Wlotzkasbaken Coastal Zone are ecologically sensitive and highly endemic. Impacts from aquaculture infrastructure must be mitigated through strict environmental safeguards, including habitat buffers and exclusion zones, timing of activities to avoid sensitive seasons, and continuous monitoring. The findings in Seely and Pallett (2008) affirm the critical need to prioritize biodiversity protection in this arid coastal region.

The potential inland impacts may arise from the land clearing and preparation which could disturb the sensitive fauna and flora.

However, the mitigation measures that have been identified and recommended by I.N.K will promote the positive impacts of the project, as well as reduce the negative impacts to acceptable levels. An ESMP was further developed which identifies potential impacts of the project during the construction and operation phases. The ESMP is a legally binding document to which SKORPIoN must adhere to.

Despite these impacts, I.N.K concludes that the Proponent should be allowed to undertake the proposed Project, provided the potential impacts in the ESMP are implemented.

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