APP-003775

JETTY CONSTRUCTION AND OPERATIONAL ACTIVITIES ON ERF 1239 IN THE FISHING HARBOUR OF WALVIS BAY

UPDATED ENVIRONMENTAL IMPACT ASSESSMENT SCOPING REPORT

Assessed by:

GEO Pollution Technologies Namibia

Assessed for:

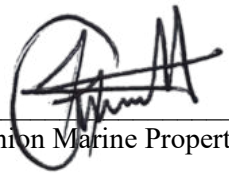
Union Marine Properties (Pty) Ltd

May 2022

Project:	**JETTY CONSTRUCTION AND OPERATIONAL ACTIVITIES ON ERF 1239 IN THE FISHING HARBOUR OF WALVIS BAY: UPDATED ENVIRONMENTAL IMPACT ASSESSMENT SCOPING REPORT**	
Report: **Version/Date:**	Draft May 2022	
Prepared for:	Union Marine Properties (Pty) Ltd P.O. Box 5981 Walvis Bay Namibia	
Lead Consultant	**Geo Pollution Technologies (Pty) Ltd** PO Box 11073 Windhoek Namibia	Tel.: (+264-61) 257411 Fax.: (+264) 88626368 E-mail: gpt@thenamib.com
Main Project Team:	**André Faul (Leader)** (B.Sc. Zoology, Biochemistry); (B.Sc. (Hons) Zoology); (M.Sc. Conservation Ecology); (Ph.D. Medical Biosciences) **Pierre Botha** (B.Sc. Geology/Geography); (B.Sc. (Hons) Hydrology/Hydrogeology) **Quzette Bosman** (BA. Geography/Sociology); (BA Environmental Management)	
Cite this document as:	**Bosman Q, Faul A, Botha P, 2022. Jetty Construction and Operational Activities on Erf 1239 in the Fishing Harbour of Walvis Bay: Updated Environmental Impact Assessment Scoping Report**	
Copyright	Copyright on this document is reserved. No part of this document may be utilised without the written permission of Geo Pollution Technologies (Pty) Ltd.	
Report Approval	 André Faul Conservation Ecologist	

I, Gideon J C Kirsten acting as the below company's representative, hereby confirm that the project description contained in this report is a true reflection of the information provided to Geo Pollution Technologies. All material information in our possession that reasonably has or may have the potential of influencing any decision or the objectivity of this assessment is fairly represented in this report.

Signed at Walvis Bay on the 23 day of May 2022.



Union Marine Properties (Pty) Ltd

CY/1972/02007
Business Registration Number

EXECUTIVE SUMMARY

Geo Pollution Technologies (Pty) Ltd, was appointed by Union Marine Properties (Pty) Ltd to update the existing environmental impact assessment (EIA) for the proposed jetty and cold storage construction and operations on erf 1239 in the fishing harbour of Walvis Bay. The project will include the demolition of their existing wooden jetty and replacing it with two concrete jetties on concrete piles. A concrete quay wall section will also be constructed. Some redundant infrastructure on land will be removed to accommodate a cold storage facility which will be able to store 1,200 tons of frozen fish and fish products. Methods for the construction as well as operational uses of the jetties, quay walls and cold storage unit will include the following:

Construction activities:

- Demolition of existing wooden jetty,
- Land based concrete casting of piles and decks,
- Piling and placement of concrete decks,
- Installation of support infrastructure such as water supply lines, power lines, etc.,
- Concrete works for quay wall construction,
- Local dredging,
- Placing of scour rock,
- Demolition of redundant infrastructure,
- Construction of a cold storage facility.

Operational activities:

- Berthing of vessels,
- Offloading of fish,
- Replenishing food supplies and potable water,
- Removing sludge from the vessels,
- Minor repairs and maintenance on vessels,
- Receiving of frozen fish from vessels or by trucks,
- Storage of frozen fish,
- Dispatch of frozen fish to customers.

This study is conducted to update all environmental, safety, health and socio-economic impacts associated with the construction and operational use of the jetties, quay wall and the cold storage facility. Environmental data was updated by making use of secondary data and from a reconnaissance site visit. Potential identified environmental impacts and associated social impacts are also updated and addressed in this report.

Due to the nature and location of the development, impacts can be expected on the surrounding environment. The facility is within an industrial area in the fishing harbour of Walvis Bay. It is recommended that environmental performance be monitored regularly to ensure compliance and that corrective measures be taken if necessary.

The fishing industry is one of the major contributors to the Namibian economy and provides employment to a large number of people. The improvements on erf 1239 will contribute to the local economy by creating new jobs and providing opportunities for continued diversification of economic activity. By appointing local contractors and employees and implementing educational programs the positive socio-economic impacts can be maximised while mitigating any negative impacts.

The major concerns related to the construction and operations of the jetties, quay wall and cold storage facility, are that of health and safety, noise, waste production and marine ecosystem impacts. Noise pollution should at all times meet the minimum World Health Organization requirements to prevent hearing loss and not to cause a nuisance to nearby receptors. Contaminated water and any waste products must be prevented from entering the ocean at all costs. Health and safety regulations should be adhered to in accordance with the regulations pertaining to relevant laws and internationally accepted standards of operation. Any waste produced must be removed from site and disposed of in an appropriate way or re-used or recycled where possible. Hazardous waste, for example asbestos, must be disposed of at an approved hazardous waste disposal site.

The tables below provide a summary of the expected negative and positive impacts expected from all related construction and operational activities to take place. A more negative value indicates a potentially greater negative impact whereas a positive value indicates a positive or beneficial impact. These ratings are provided for impacts prior to the administration of preventative or mitigation measures and impacts after preventative or mitigation measures have been implemented are expected to be more favourable.

The updated environmental management plan should be used as an on-site reference document during both construction of, and operational use, of the jetties, quay walls and the old storage facility. Parties responsible for transgression of the EMP should be held responsible for any rehabilitation that may need to be undertaken. A health, safety, environment and quality (HSEQ) policy could be used in conjunction with the environmental management plan. Operators and responsible personnel must be taught the contents of these documents. Municipal or national regulations and guidelines must be adhered to and monitored regularly as outlined in the environmental management plan.

Summary of expected impacts prior to mitigation:

Impact Category	Impact Type	Construction	Operations
	Positive Rating Scale: Maximum Value	5	5
	Negative Rating Scale: Maximum Value	-5	-5
EO	Skills, Technology and Development	3	3
SC	Revenue Generation and Employment	3	4
SC/EO	Demographic Profile and Community Health	-1	-3
EO	Traffic	-2	-3
SC/EO	Health, Safety and Security	-2	-4
EO	Fire	-2	-3
PC	Air Quality	-3	-2
PC	Noise	-3	-2
PC/BE	Waste production	-2	-2
PC/BE	Ecosystem and Biodiversity Impact	-1	-1
PC	Surface Water Contamination	-2	-2
EO	Impacts on Utilities and Infrastructure	-3	-2
PC/EO	Seabed Scouring and Erosion		-2
SC	Visual Impact	-1	-1

BE = Biological/Ecological EO = Economical/Operational PC = Physical/Chemical SC = Sociological/Cultural

TABLE OF CONTENTS

LIST OF PHOTOS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
BCLME	Benguela Current Large Marine Ecosystem
CH_4	Methane
DMAF	Dredged Material Assessment Framework
EMP	Environmental Management Plan
EMS	Environmental Management System
FSSC	Food Safety System Certification
GPT	Geo Pollution Technologies
H_2S	Hydrogen Sulphide
Ha	Hectare
HACCP	Hazard Analysis Critical Control Point
HFO	Heavy Fuel Oil
HIV	Human Immunodeficiency Virus
I&APs	Interested and Affected Parties
ISO	International Standard of Operation
IUCN	International Union for Conservation of Nature
Km	Kilometer
kVA	Kilovolt Ampere
kWp	Kilowatt Peak
m/s	Meter per second
mamsl	Metres Above Mean Seal Level
MARPOL	International Convention for the Prevention of Pollution from ships
MBL	marine atmospheric boundary layer
mbs	Meters below surface
mCD	Metres Chard Datum
MEFT	Ministry of Environment Forestry and Tourism
mm/a	Millimetres per annum
MMO	Marine Mammal Observer
MSDS	Material Safety Data Sheet
PAH	Polycyclic Aromatic Hydrocarbons
PAM	Passive Acoustic Monitoring
PPE	Personal Protective Equipment
SADC	Southern African Development Community
SAH	South Atlantic High
SANS	South African National Standards
TBT	Tributyltin
TSS	Total Suspended Solids
UN	United Nations
WHO	World Health Organization

GLOSSARY OF TERMS

Alternatives - A possible course of action, in place of another, that would meet the same purpose and need but which would avoid or minimize negative impacts or enhance project benefits. These can include alternative locations/sites, routes, layouts, processes, designs, schedules and/or inputs. The "no-go" alternative constitutes the 'without project' option and provides a benchmark against which to evaluate changes; development should result in net benefit to society and should avoid undesirable negative impacts.

Assessment - The process of collecting, organising, analysing, interpreting and communicating information relevant to decision making.

Competent Authority - means a body or person empowered under the local authorities act or Environmental Management Act to enforce the rule of law.

Cumulative Impacts - in relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

Environment - As defined in the Environmental Assessment Policy and Environmental Management Act - "land, water and air; all organic and inorganic matter and living organisms as well as biological diversity; the interacting natural systems that include components referred to in sub-paragraphs, the human environment insofar as it represents archaeological, aesthetic, cultural, historic, economic, palaeontological or social values".

Environmental Impact Assessment (EIA) - process of assessment of the effects of a development on the environment.

Environmental Management Plan (EMP) - A working document on environmental and socio-economic mitigation measures, which must be implemented by several responsible parties during all the phases of the proposed project.

Environmental Management System (EMS) - An Environment Management System, or EMS, is a comprehensive approach to managing environmental issues, integrating environment-oriented thinking into every aspect of business management. An EMS ensures environmental considerations are a priority, along with other concerns such as costs, product quality, investments, PR productivity and strategic planning. An EMS generally makes a positive impact on a company's bottom line. It increases efficiency and focuses on customer needs and marketplace conditions, improving both the company's financial and environmental performance. By using an EMS to convert environmental problems into commercial opportunities, companies usually become more competitive.

Evaluation – means the process of ascertaining the relative importance or significance of information, the light of people's values, preference and judgements in order to make a decision.

Hazard - Anything that has the potential to cause damage to life, property and/or the environment. The hazard of a particular material or installation is constant; that is, it would present the same hazard wherever it was present.

Interested and Affected Party (I&AP) - any person, group of persons or organisation interested in, or affected by an activity; and any organ of state that may have jurisdiction over any aspect of the activity.

Mitigate - The implementation of practical measures to reduce adverse impacts.

Proponent (Applicant) - Any person who has submitted or intends to submit an application for an authorisation, as legislated by the Environmental Management Act no. 7 of 2007, to undertake an activity or activities identified as a listed activity or listed activities; or in any other notice published by the Minister or Ministry of Environment & Tourism.

Public - Citizens who have diverse cultural, educational, political and socio-economic characteristics. The public is not a homogeneous and unified group of people with a set of agreed common interests and aims. There is no single public. There are a number of publics, some of whom may emerge at any time during the process depending on their particular concerns and the issues

involved.

Scoping Process - process of identifying: issues that will be relevant for consideration of the application; the potential environmental impacts of the proposed activity; and alternatives to the proposed activity that are feasible and reasonable.

Significant Effect/Impact - means an impact that by its magnitude, duration, intensity or probability of occurrence may have a notable effect on one or more aspects of the environment.

Stakeholder Engagement - The process of engagement between stakeholders (the proponent, authorities and I&APs) during the planning, assessment, implementation and/or management of proposals or activities. The level of stakeholder engagement varies depending on the nature of the proposal or activity as well as the level of commitment by stakeholders to the process. Stakeholder engagement can therefore be described by a spectrum or continuum of increasing levels of engagement in the decision-making process. The term is considered to be more appropriate than the term "public participation".

Stakeholders - A sub-group of the public whose interests may be positively or negatively affected by a proposal or activity and/or who are concerned with a proposal or activity and its consequences. The term therefore includes the proponent, authorities (both the lead authority and other authorities) and all interested and affected parties (I&APs). The principle that environmental consultants and stakeholder engagement practitioners should be independent and unbiased excludes these groups from being considered stakeholders.

Sustainable Development - "Development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs and aspirations" – the definition of the World Commission on Environment and Development (1987). "Improving the quality of human life while living within the carrying capacity of supporting ecosystems" – the definition given in a publication called "Caring for the Earth: A Strategy for Sustainable Living" by the International Union for Conservation of Nature (IUCN), the United Nations Environment Programme and the World Wide Fund for Nature (1991).

1 BACKGROUND AND INTRODUCTION

In 2016, an environmental clearance certificate (ECC) was issued to Namsov Fishing Enterprises for the construction of two new jetties and a fish factory on a property (Erf 1239) of their subsidiary, United Fishing Enterprises (Pty) Ltd, in Walvis Bay. These activities were never initiated and operations on the site mostly ceased in subsequent years. Azul Bay Investments (Pty) Ltd now acquired United Fishing Enterprises and applied to change the name from United Fishing Enterprises to Union Marine Properties (Pty) Ltd. As the new owners of Erf 1239, Union Marine Properties (the Proponent) proposes to resume construction and operational activities on the erf.

Geo Pollution Technologies (Pty) Ltd was appointed by the Proponent to apply for renewal of the existing ECC and to transfer the renewed clearance to Union Marine Properties (Pty) Ltd. To renew the ECC, an updated environmental assessment scoping report and environmental management plan (EMP) were prepared for the proposed construction and operational activities on the property. Renewal of the ECC is required as per the Environmental Management Act No. 7 of 2007 (EMA). The updated scoping report and EMP will be submitted to the Environmental Commissioner, Ministry of Environment, Forestry and Tourism (MEFT), in support of the renewal and transfer of the ECC.

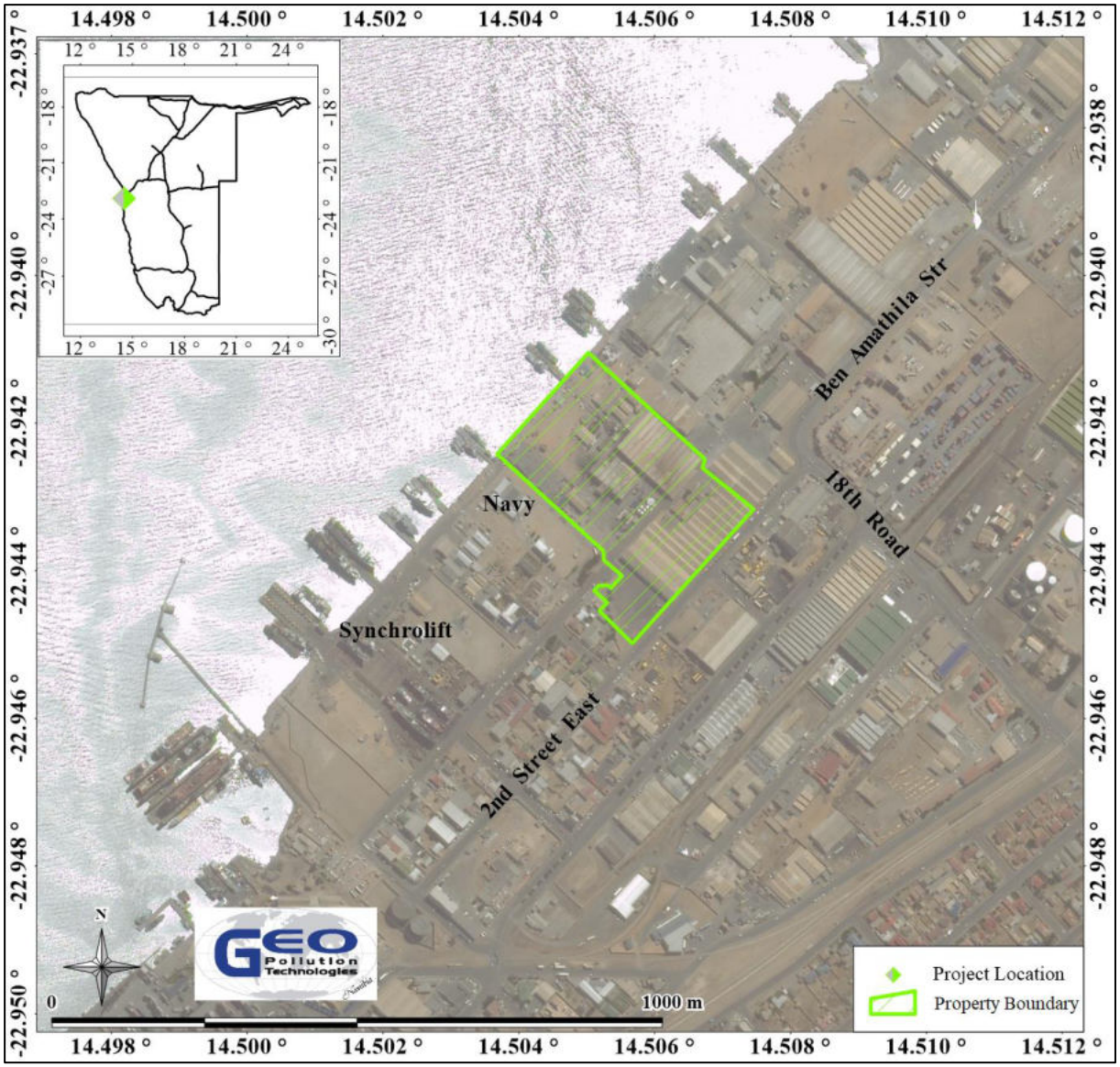


Figure 1-1 Project location

The project will include the demolition of their existing wooden jetty and replacing it with two concrete jetties on concrete piles. A section of quay wall will also be constructed. Redundant infrastructure on land will be removed to accommodate a cold storage facility, able to store 12,000 tons of frozen fish. Construction as well as operational uses of the jetties, quay walls and cold storage facility will include the following:

Construction activities:

- Demolition of existing wooden jetty,
- Land based concrete casting of piles and decks,
- Piling and placement of concrete decks,
- Concrete works for quay wall construction,
- Local dredging,
- Placing of scour rock,
- Construction of a cold storage facility, and
- Installation of support infrastructure such as water supply lines, power lines, refrigeration plant, generator room, etc.

Operational activities:

- Berthing of vessels,
- Offloading of fish,
- Replenishing food supplies and potable water,
- Removing sludge from the vessels,
- Minor repairs and maintenance on vessels,
- Receiving of frozen fish from vessels or by trucks,
- Storage of frozen fish,
- Dispatch of frozen fish to customers.

A detailed project description is provided in section 4. The potential impacts of the project on the environment, resulting from various operational, maintenance and construction, and possible decommissioning activities, were determined through the risk assessment as presented in this report. The environment being defined in the Environmental Management Act as "land, water and air; all organic and inorganic matter and living organisms as well as biological diversity; the interacting natural systems that include components referred to in sub-paragraphs, the human environment insofar as it represents archaeological, aesthetic, cultural, historic, economic, paleontological or social values". The environmental assessment was conducted to apply for an environmental clearance certificate in compliance with Namibia's Environmental Management Act (Act No 7 of 2007) (EMA).

Project Justification – Walvis Bay is earmarked as an industrial town and is where the majority of the fishing industries are situated. The construction of the new jetties, the quay wall and the cold storage unit will improve productivity in the fisheries sector. This is in line with the Ministry of Fisheries and Marine Resources vision of sustainable and meaningful investments and job creation.

Potential direct benefits of the project include:

- Employment,
- Education and skills transfer,
- Increased jetty space increases operational efficiency,
- More reliable and secure jetties,
- Improved access to fishing vessels with cranes and other operational and maintenance vehicles and equipment.

Potential indirect benefits of the project include:

- The fishing industry is a major contributor to Namibia's gross domestic product and it is thus essential to maintain state of the art facilities and infrastructure.

2 SCOPE

The scope of the environmental assessment is to:

1. Determine the potential environmental impacts emanating from the construction and operations of the jetties, quay wall and cold storage facility;
2. Comply with Namibia's Environmental Management Act (2007);
3. Provide sufficient information to the MEFT to make an informed decision regarding the construction and operational activities associated with the jetties, quay wall and cold storage unit.

3 METHODOLOGY

The following methods were used to investigate the potential impacts on the social and natural environment due to both the construction and operational processes:

1. Baseline information about the site and its surroundings was obtained from existing secondary information, a marine mammal specialist study, as well as from a reconnaissance site visit.
2. As part of the scoping process to determine potential environmental impacts, Interested and Affected Parties (I&APs) were consulted during the initial environmental assessment process about their views, comments and opinions and comments received were considered in this report.

4 CONSTRUCTION AND RELATED ACTIVITIES

A brief description of the proposed construction and operational activities is provided in this section.

4.1 JETTIES AND QUAY WALL

The property currently has one wooden jetty. This jetty will be demolished completely and two new concrete jetties of 121 x 21.5 m each will be constructed. A 61 m concrete quay wall section will be constructed between the two jetties. See Figure 4-1 for the proposed jetty and quay wall masterplan.

The jetties will be similar to typical concrete jetties used in the port of Walvis Bay and will be constructed using similar techniques that includes pile driving of precast concrete piles. The following is a brief description of the design and construction process for a jetty. Final designs and construction may differ slightly.

Rectangular concrete piles of 420 x 420 mm in size as well as concrete components of the jetty deck will be cast on land. For the first 32 m of the jetty, four piles will be spaced over the width of the jetty (this is referred to as one jetty bay). For the rest of the jetty seven piles will comprise one jetty bay. Jetty bays will be 8 m apart over the length of the jetty thus 96 piles will be placed for the entire jetty. Each pile will be put in place with a crane where it will be supported by a temporary steel guide. Initially the pile penetrates the seabed under its own weight assisted by jetting. Jetting is a process by which the sediment underneath and around the pile is fluidized with seawater or air jets, allowing the pile to sink into the seabed. This process continues until the pile is about 1 m above its final position. For the last 1 m the pile is driven into the seabed using a drop hammer consisting of a 3 tonne steel weight raised and dropped with a crane. Piles are typically driven about 10 m into the sediment.

Installation of piles will take place one jetty bay at a time. The time required for the actual pile driving of piles with the drop hammer is approximately 20 minutes per pile. Once the piles for one jetty bay has been constructed a precast sections (cope units and through units) of the jetty deck is put in place. The precast sections of the jetty deck is covered with in situ cast concrete to finish the jetty off. The estimated time required for the construction of one jetty bay is one week. As the jetty bays are constructed the crane moves along the already completed section and continue construction of the jetty seawards.

Once the jetty has been completed all support infrastructure will be installed, including power supply, water supply, fuel supply and fish offloading infrastructure.

The construction of the quay structures follows a similar methodology to the jetty in that the structure comprises precast concrete driven piles supporting a precast and in situ concrete deck. The driving energy and installation times are thus similar to the jetty piles. The main difference for the quay is that deeper water is required closer to the existing shoreline and that requires some local dredging and slope trimming followed by the placing of a rock protection layer to prevent the slope being disturbed by wave or propeller action (scour protection).

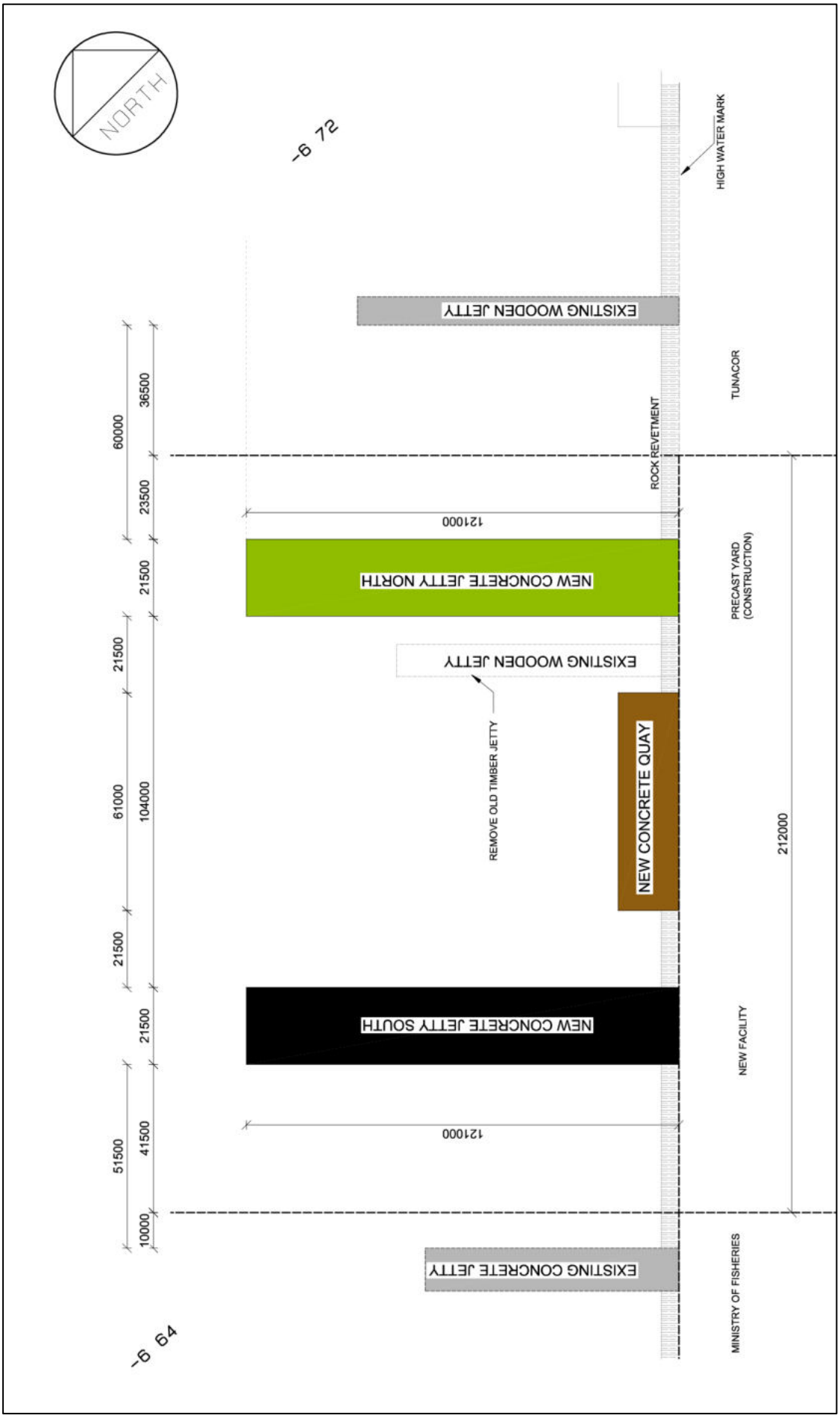


Figure 4-1 Proposed jetty and quay wall masterplan (Drawing number WML-CMRT_JTY-22, WML Coast, 2022)

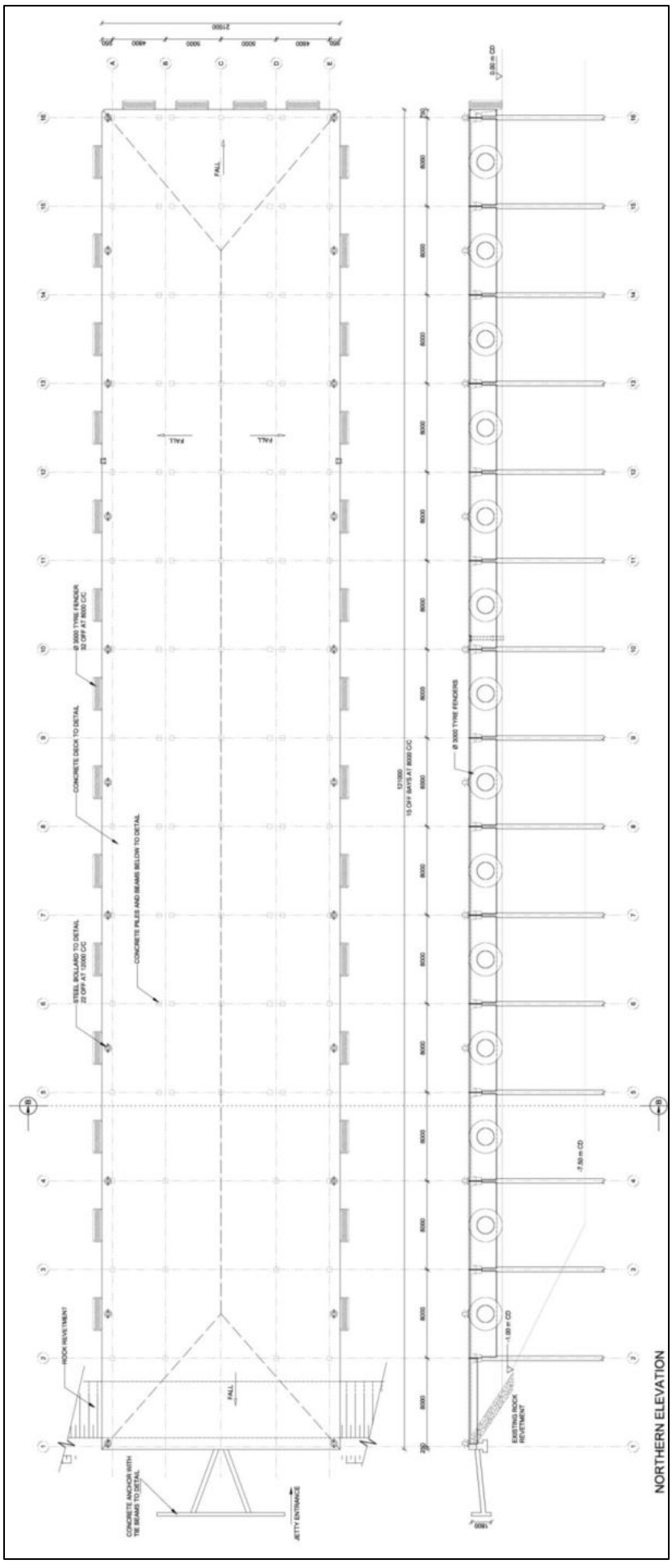


Figure 4-2 Jetty design – top and northern elevation (Drawing number WML-CNRT_JTY-22, WML Coast, 2022)

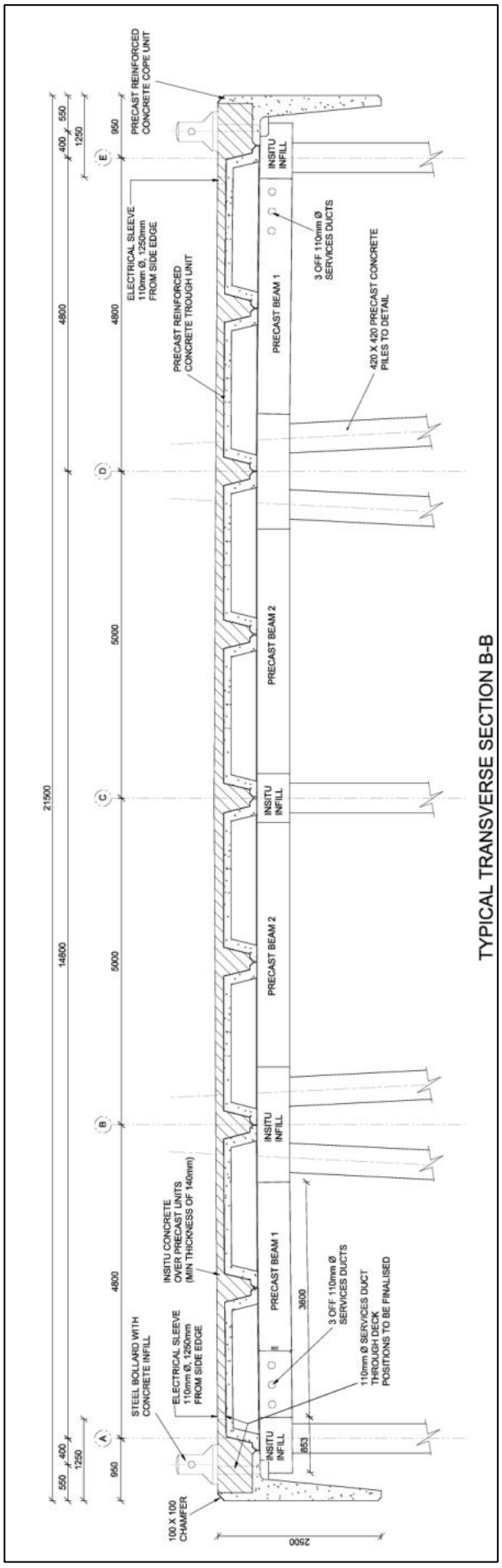


Figure 4-3 Jetty design – transverse section of one jetty bay (Drawing number WML-CNRT_JTY-22, WML Coast, 2022)

4.2 COLD STORAGE FACILITY

A new cold storage facility will be constructed on the north-western corner of the erf near the jetties and quay (Figure 4-4 and Figure 4-5). Some land based infrastructure that will not be involved in future operations, will be demolished to accommodate the cold storage facility and associated infrastructure. Some infrastructure which will be demolished contains asbestos. These will be demolished and disposed of under very strict and approved procedures, as prescribed in Namibian legislation, for the protection of workers on site.

Preliminary cold store designs envisions the main building housing four separate cold storage rooms with support infrastructure consisting of offices, reception area, ablution facilities, workshop and maintenance area, receiving and sorting area, dispatch area (vehicle loading), refrigeration plant room, sub-station, generator room and pallet storage area. The building will be constructed using a combination of concrete, steel and aluminium.

The refrigeration plant is likely to use ammonia as cooling medium. Various screw compressors and evaporative condensers will be employed to produce the cooling effect required for the cold storage facilities. Due to the potential danger of leaking ammonia form the system, real-time leak detectors will be employed as safety mechanism. Depending on final designs, the Proponent may decide to utilise carbon dioxide as cooling medium instead of ammonia.

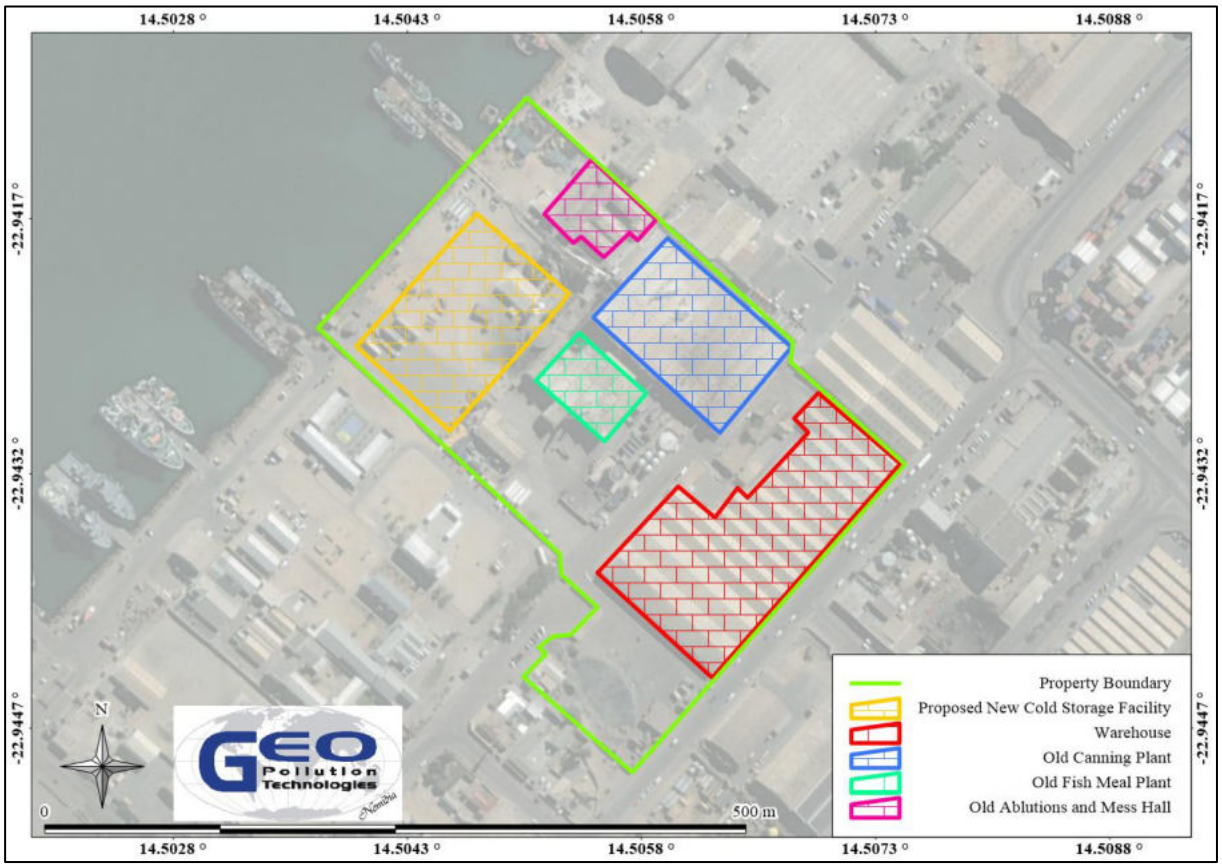


Figure 4-4 Main land-based infrastructure components (current and planned)

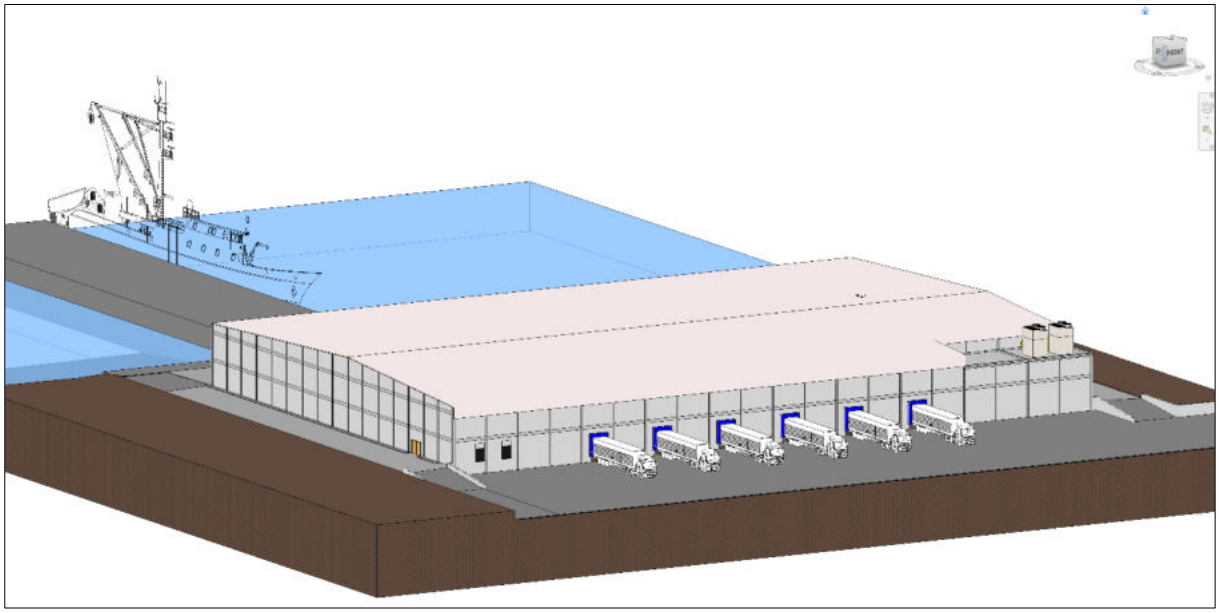


Figure 4-5 Schematic presentation of the cold storage facility

4.3 ELECTRICITY SUPPLY AND PHOTOVOLTAIC PLANT

An electrical substation will be constructed which will be connected to the Erongo Red electricity supply network. It will include the necessary switchgear and step-down transformers. To augment electricity supply, a photovoltaic plant is planned to be installed on the roof of the cold store (approximately 3,000 m^2 of panels and walkways). It will be used to augment electricity supply to the facility with a system peak power of approximately 500 kWp or 625 kVA. Two 700 kVA diesel standby generators will be installed for use during power failures. An uninterrupted power supply system of 30 kVA will also be present to provide electricity to essential equipment for short periods of time (between onset of a power failure and the start-up of the standby generators.

4.4 WAREHOUSING AND BUILDINGS

The property has existing warehousing and buildings that were used for fishing and fish processing related activities by previous operators on site. This mainly includes on large warehouse, a fish canning plant, a fish meal plant and some ablution and mess hall facilities (Figure 4-4). The warehouse and canning plant have since been adapted for product storage such as grain and other commodities. These are operated by third parties (tenants) and where required, such tenants operate under their own ECCs and EMPs, and as such their operations are not included in this EIA. Depending on final site layout designs, the old fishmeal plant and ablution / mess hall facilities may be incorporated into the current operations or may be demolished to make space for current operations.

Various fuel installations are present on site and include diesel and heavy fuel oil storage facilities. The Proponent will operate these, but has commissioned a separate environmental assessment process related to it and they thus also fall outside the scope of this assessment.

4.5 GENERAL

Provision will be made for fire prevention, detection and protection by means of automatic fire detection and alarm systems. Fire protection equipment will include fire hydrants, hose reels and portable extinguishers.

Security gates with access control will regulate entrance to and exit from the site. Closed circuit television will be installed throughout the site for 24 hour security surveillance and monitoring.

5 OPERATIONS AND RELATED ACTIVITIES

5.1 GENERAL OPERATIONS

The property used to operate as a fish processing plant and cannery and required the use of jetties for the docking of fishing vessels for loading and offloading purposes. During recent years no fish processing or canning has taken place on site. Once the jetties, quay, cold store and related infrastructure construction are completed, Union Marine Properties will commence operating the cold storage facility and related activities on the site.

The new cold storage facility will be focussed on storing frozen fish products. Current plans are that approximately 90% of product to be stored and handled will be horse mackerel while up to 10% will potentially be a variety other fishing products. This may however change depending on external factors such as fishing quotas, market demand, etc. The Proponent does not operate fishing vessels themselves, but will receive fish from third parties. Such fish will be received directly from fishing vessels who catch, process and bulk package fish on the vessel and offload at the jetty, or by truck from other fishing factories.

Fish received from fishing vessels will be offload by cranes onto the jetty from where forklifts will be used to move the fish to the cold store. Trucks delivering fish will park at one of the docking bays for fish offloading. Inside the cold store the products will be stacked in the cold rooms awaiting collection for customer deliveries. No further processing of fish is envisioned at this stage, but this may be considered at a later stage. However, if any packaging of the stored fish are damaged during the handling and storage process, the fish will be repackaged.

While the vessels are docked at the jetty, some general ships maintenance and cleaning occurs. All waste on board is offloaded for disposal and the freshwater supply on board is replenished. The vessels are refuelled and restocked before heading back to sea. Other general operations on the jetty also includes the operations of cranes, forklifts and small trucks or vehicles.

Day to day operations will further include site maintenance and cleaning as well as site security and access control. The long term plans of the Proponent may see up to 500 people being employed at the facility.

The Proponent intend to subscribe and operate according to various internationally accepted standards of operation and management systems related to health, safety, quality and the environment.

5.2 MAINTENANCE DREDGING

As part of the general operations, some maintenance dredging of the area surrounding the jetty may have to be performed. This is to ensure that the water depth remains sufficient (currently at -7 mCD) to allow the vessels safe entry and docking. Over time natural sedimentation and seabed scouring can reduce water depth and subsequently volumes to be dredged are minimal resulting in dredging activities only conducted when required.

Dredging will be conducted with a grab dredger operated from the finished jetty. The grab will be emptied into tipper trucks parked on the jetty. The truck will remain on the jetty to allow excess water to drain from the dredged material and back into the sea. Dredged sediments will then be disposed of at the municipal waste handling facility.

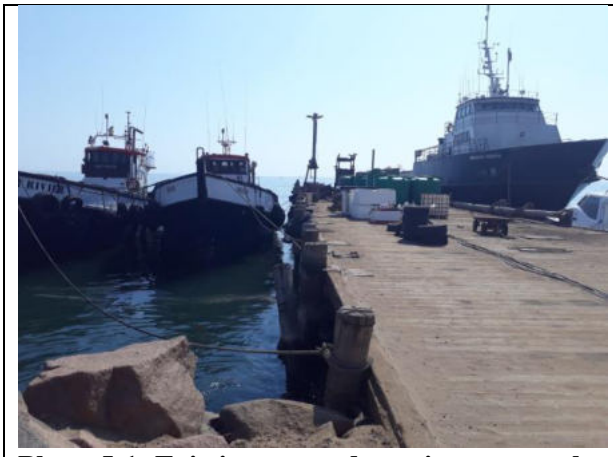


Photo 5-1 Existing wooden jetty to be demolished and replaced with concrete jetty

Photo 5-2 Area for new quay construction

Photo 5-3 Area for new cold store

Photo 5-4 Old building to be demolished for new cold store construction

6 ALTERNATIVES

The Property of Union Marine Properties is situated in the fishing harbour of Walvis Bay, surrounded by properties of similar nature. There is no alternative space which is available for the construction and operations of the jetties, since the port is operating near its maximum capacity. The close proximity of the proposed jetty to the Proponent's premises will ensure that fish are offloaded as close to the cold storage unit as possible and this will prevent additional environmental impacts, such as increased traffic in Walvis Bay. Optimising the seafront area for better usage will extend the usable area of the fishing area and will delay development of a fishing harbour elsewhere.

7 ADMINISTRATIVE, LEGAL AND POLICY REQUIREMENTS

To protect the environment and achieve sustainable development, all projects, plans, programmes and policies deemed to have adverse impacts on the environment require an environmental assessment, as per the Namibian legislation. The legislation and standards provided in Table 7-1 to Table 7-3**Error! Reference source not found.** governs the environmental assessment process in Namibia and/or are relevant to the facility.

Table 7-1 Namibian law applicable to the project

Law	Key Aspects
The Namibian Constitution	♦ Promote the welfare of people ♦ Incorporates a high level of environmental protection ♦ Incorporates international agreements as part of Namibian law

Law	Key Aspects
Environmental Management Act **Act No. 7 of 2007, Government Notice No. 232 of 2007**	♦ Defines the environment ♦ Promote sustainable management of the environment and the use of natural resources ♦ Provide a process of assessment and control of activities with possible significant effects on the environment
Environmental Management Act Regulations **Government Notice No. 28-30 of 2012**	♦ Commencement of the Environmental Management Act ♦ List activities that requires an environmental clearance certificate ♦ Provide Environmental Impact Assessment Regulations
The Water Act **Act No. 54 of 1956**	♦ Remains in force until the new Water Resources Management Act comes into force ♦ Defines the interests of the state in protecting water resources ♦ Prohibits pollution of the sea ♦ Controls the disposal of effluent ♦ Numerous amendments
Water Resources Management Act **Act No. 11 of 2013**	♦ Provide for management, protection, development, use and conservation of water resources ♦ Prevention of water pollution and assignment of liability ♦ Not in force yet
Dumping At Sea Control Act **Act No. 73 of 1980**	♦ Provide for the control of dumping of substances in the sea ♦ Provides for permits to be issued to allow dumping at sea of scheduled substances
Marine Resources Act **Act No. 27 of 2000**	♦ Prevents the discharge of anything that may be injurious to marine resources or may disturb ecological balance in any area of the sea or which may detrimentally affect the marketability of marine resources, or which may hinder their harvesting
The Namibian Ports Authority Act **Act No. 2 of 1994**	♦ Provide for the establishment of the Namibian Ports Authority and its functions ♦ Responsible to protect the environment within its areas of jurisdiction
Marine Traffic Act **Act No. 2 of 1981**	♦ Regulate marine traffic in Namibia
Local Authorities Act **Act No. 23 of 1992, Government Notice No. 116 of 1992**	♦ Define the powers, duties and functions of local authority councils ♦ Regulates discharges into sewers
Public and Environmental Health Act **Act No. 1 of 2015, Government Notice No. 86 of 2015**	♦ Provides a framework for a structured more uniform public and environmental health system, and for incidental matters ♦ Deals with Integrated Waste Management including waste collection disposal and recycling; waste generation and storage; and sanitation
Labour Act **Act No 11 of 2007, Government Notice No. 236 of 2007**	♦ Provides for Labour Law and the protection and safety of employees ♦ Labour Act, 1992: Regulations relating to the health and safety of employees at work (Government Notice No. 156 of 1997)
Hazardous Substances Ordinance **Ordinance No. 14 of 1974**	♦ Applies to the manufacture, sale, use, disposal and dumping of hazardous substances as well as their import and export ♦ Aims to prevent hazardous substances from causing injury, ill-health or the death of human beings

Law	Key Aspects
Pollution Control and Waste Management Bill (draft document)	♦ Provides for prevention and control of pollution and waste ♦ Provides for procedures to be followed for licence applications ♦ Not in force yet
Prevention and Combating of Pollution of the Sea by Oil Act, 1981 (Act No. 6 of 1981)	♦ Provides for the prevention of pollution of the sea where oil is being or is likely to be discharged
Prevention and Combating of Pollution of the Sea by Oil Amendment Act (No. 24 of 1991)	♦ Amends the Prevention and Combating of Pollution of the Sea by Oil Act of 1981 to be more relevant to Namibia after independence
Draft Wetland Policy of 2003	♦ Considering the Walvis Bay Lagoon, the Wetland Policy of 2003 is of importance and includes ○ Protection and Conservation of wetlands and ecosystems ○ As well as, including fulfilling Namibia's International obligations to the Ramsar Convention and the SADC Protocol on Shared Water Systems
Road Traffic and Transport Act **Act No. 52 of 1999 Government Notice No 282 of 1999**	♦ Provides for the control of traffic on public roads and the regulations pertaining to road transport ♦ Road Traffic and Transport Regulations (Government Notice No 53 of 2001): Prohibits the transport of goods which are not safely contained within the body of the vehicle; or securely fastened to that vehicle, and which are not properly protected from being dislodged or spilled from that vehicle

Table 7-2 Municipal by-laws, guidelines and regulations

Municipal By-laws, Guidelines or Regulations	Key Aspects
Integrated Urban Spatial Development Framework for Walvis Bay	♦ Overall vision to transform Walvis Bay to being the primary industrial city in Namibia ♦ Aims to ensure that appropriate levels of environmental management is enforced for all developments in Walvis Bay
Integrated Environmental Policy of Walvis Bay (Agenda 21 Project)	♦ Indicates the directions that the Municipality of Walvis Bay will move towards in the forthcoming years to fulfil its responsibilities to manage the environment of Walvis Bay together with the town's residents and institutions ♦ Strong focus on conservation and protection of environment
Municipal By-law 19 and 20 on Effluents Entering Sewers	♦ Regulates the discharge of effluent into sewers and prohibits the introduction of certain wastes or products including steam into the sewers system
Town Planning Scheme No. 35	♦ Manages and regulates development related to land use ♦ Proposes and identifies areas for specific future land use

Table 7-3 Relevant multilateral environmental agreements for Namibia and the project

Standard or Code	Key Aspects
Benguela Current Convention of 2013	♦ The Convention is a formal treaty between the governments of Angola, Namibia and South Africa that sets out the countries' intention "to promote a coordinated regional approach to the long-term conservation, protection, rehabilitation, enhancement and sustainable use of the Benguela Current Large Marine Ecosystem, to provide economic, environmental and social benefits.

Standard or Code	Key Aspects
Convention on Biological Diversity, Rio de Janeiro, 1992	♦ Under article 14 of The Convention, EIAs must be conducted for projects that may negatively affect biological diversity.
The Convention on Wetlands of International Importance especially as Waterfowl Habitat (referred as the Ramsar Convention)	♦ It is a framework for international cooperation in the conservation and wise use of wetlands and their resources ♦ Recognizes the Walvis Bay Nature Reserve – a tidal lagoon consisting of Pelican Point, adjacent intertidal areas, sandbars serving as roosting sites and mudflats exposed during low tide (12,600 ha) as a Wetland of International Importance
UN Convention for the Prevention of Marine Pollution from Land-based Sources	♦ Concerns itself with the protection of marine fauna and flora by preventing marine pollution from land-based sources. ♦ Contracted parties, are committed to take all possible steps to prevent pollution of the sea as well as the direct or indirect introduction of substances or energy by humans into the marine environment resulting in such adverse effects as harm to living resources and to marine ecosystems, hazards to human health, damage to services/ facilities or interference with other legitimate uses of the area
Stockholm Declaration on the Human Environment, Stockholm 1972.	♦ Recognizes the need for a common outlook and common principles to inspire and guide the people of the world in the preservation and enhancement of the human environment
International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)	♦ Dealing with the prevention of pollution of the sea by oil, sewage and garbage from ships
Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter (London Convention, 1972)	♦ Aims at controlling and preventing marine pollution and contains guidelines for dredged material known as the Dredged Material Assessment Framework (DMAF). ♦ Provides guidelines for dredging and disposal operations to minimize environmental damage
Namport Specifications and Legislation	♦ Enforced Standards and Codes which governs construction and operations relating to the port

The project is listed as a project requiring an environmental clearance certificate as per the following sections of Government Notice No. 29 of 2012:

Section 1: Energy Generation, Transmission and Storage Activities: 1. The construction of facilities for -(a) the generation of electricity;

The Proponent intends to construct a photovoltaic plant for the generation of electricity. Although the size of the plant is small enough to warrant exemption from environmental assessment it is included in this report.

Section 9: Hazardous Substance Treatment, Handling and Storage: 9.1 The manufacturing, storage, handling or processing of a hazardous substance defined in the Hazardous Substances Ordinance, 1974.

No hazardous substances were ever defined in the Hazardous Substance Ordinance. However, ammonia is a hazardous substance that will be stored on site as part of the refrigeration system.

Section 10: Infrastructure: 10.1 The construction of- (e) any structure below the high water mark of the sea.

The Proponent intends to demolish one wooden jetty and construct two new concrete jetties and a concrete quay which will both involve construction of components below the high water mark of the sea.

8 ENVIRONMENTAL CHARACTERISTICS

This section lists the most important environmental characteristics of the study area and provides a statement on the potential environmental impacts on each.

8.1 LOCALITY AND SURROUNDING LAND USE

The Proponent will operate on erf 1239 within the fishing harbour in Walvis Bay (22.9420°S; 14.5043°E). The onshore premises is zoned for industrial use and is surrounded by properties of similar nature. Union Marine Properties is neighboured to the southwest by the Navy (Ministry of Defence) and the MEFT. To the northeast by Tunacor Properties and Logistic Support Services. Southeast of the site is MPact and Namdock. The site falls within the jurisdiction of the Municipality of the Walvis Bay and Namport.

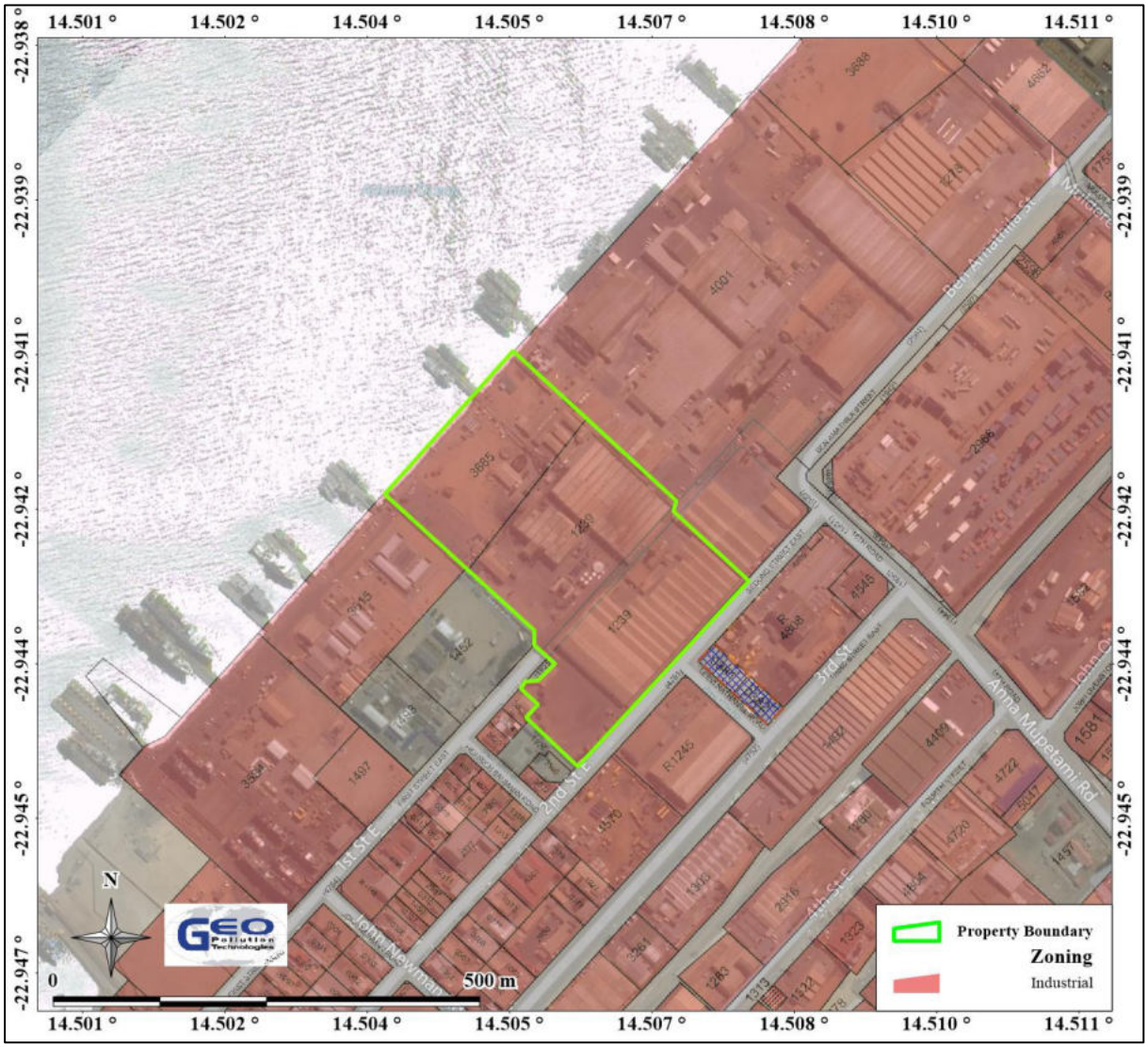


Figure 8-1 Zoning at the project location

Implications and Impacts

The planned construction and future operations of the jetty is in line with activities conducted in the fishing harbour and on industrial properties.

8.2 CLIMATE

Namibia's climate is dominated by dry conditions for most of the year and particularly so in the west. The location of Namibia with respect to the Intertropical Convergence Zone, Subtropical High Pressure Zone and Temperate Zone is what determines the climate, with the Subtropical High Pressure Zone being the major contributor to the dry conditions (Atlas of Namibia Project, 2002; Bryant, 2010), see Figure 8-2.

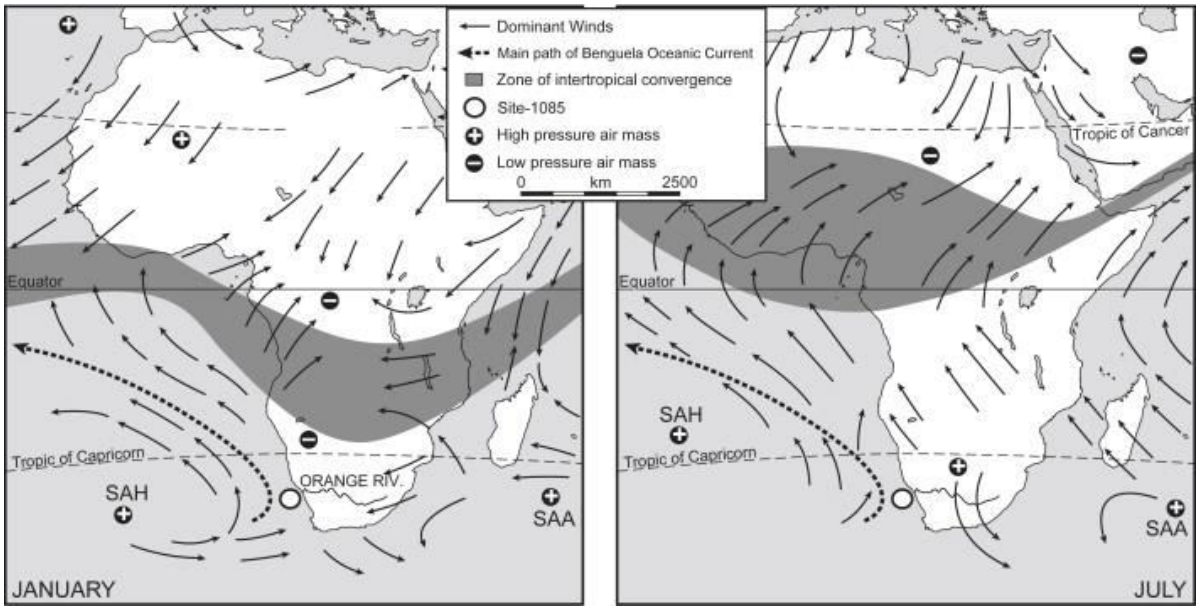


Figure 8-2 Map indicating the intertropical convergence zone, subtropical high pressure zone (SAH+), BENGUELA current and temperate zone south of tropic of capricorn (not indicated) (from: http://www.meteoweb.eu)

Precipitation over Namibia is mainly controlled by the South Atlantic High (SAH), a high pressure cell (anticyclone) situated west of Namibia in the Subtropical High Pressure Zone. The SAH shifts during the year and is at higher latitudes in winter and lower latitudes in summer. In winter, as a result of being situated more north, the high pressure cell pushes any moisture originating from the Intertropical Convergence Zone northwards, preventing rain over Namibia. In summer, because the high pressure cell moves further south, and has less of an effect on the Intertropical Convergence Zone, moist air reaches Namibia, resulting in summer rains.

Studies indicate the presence of a thermal inversion layer at Walvis Bay. Originally this was thought to be at approximately 500 mamsl (Taljaard and Schumann 1940), but recent studies indicate it as low as 200 mamsl (Patricola and Chang, 2017; Corbett, 2018). A marine atmospheric boundary layer (MBL) exists offshore of the coastline that thins from more than 500 mamsl to 200 mamsl as it nears the coast (Figure 8-3). The MBL is a layer of cool, well-mixed, stable air that is capped by a thermal inversion (Patricola and Chang, 2016; Corbett 2018). This thermal layer or inversion layer will prevent the escape of pollutants such as smoke higher into the atmosphere. The MBL however contribute to high velocity wind speeds by funnelling the winds created by the SAH, resulting in what is referred to as the Benguela Low-Level Coastal Jet. Since the MBL overlap partially with the coastal plain, the wind generated by the Benguela Low-Level Coastal Jet also reaches inland, but diminishes relatively quickly further inland.

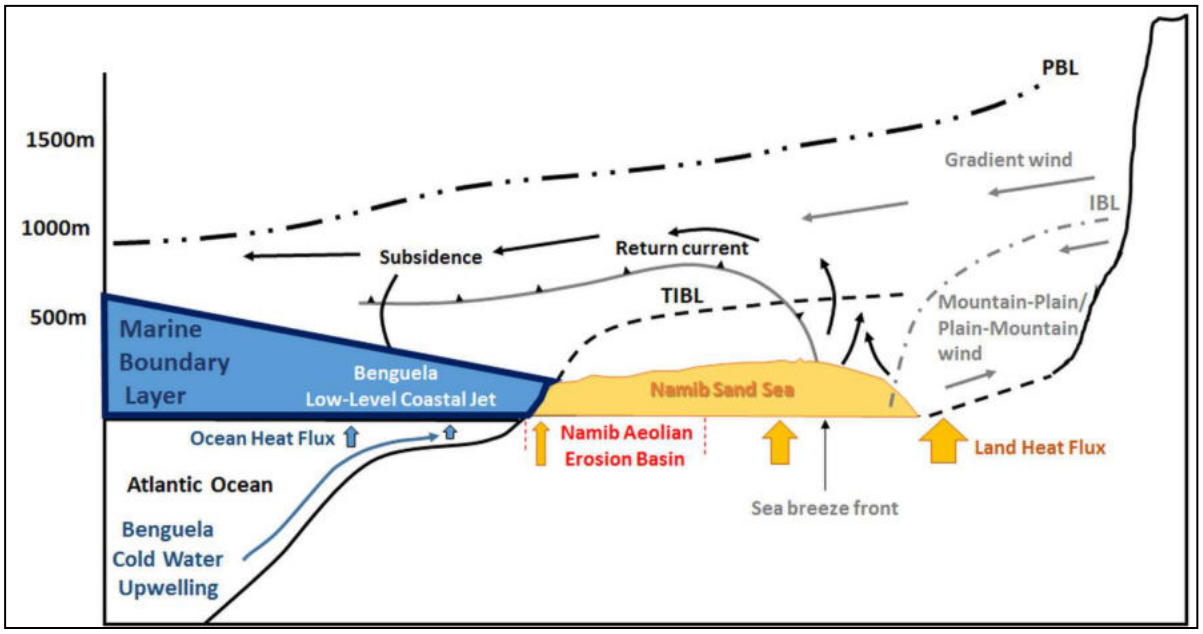


Figure 8-3 Marine atmospheric boundary layer (from: Corbett, 2018)

On a more localised scale, the climatic conditions on the central Namibian coast, and inland thereof (coastal plains), are strongly influenced by the cold Benguela Current, the SAH and the relatively flat coastal plains that are separated from the central highlands by a steep escarpment.

The anticlockwise circulation of the high pressure SAH and the action of the earth's Coriolis force results in strong southerly (longshore) winds blowing northwards up the coastline of Namibia (Bryant, 2010; Corbett, 2018). This longshore wind is responsible for upwelling of the cold, deep waters of the Benguela Current. As a result of the temperature difference between the cold surface water of the Benguela Current and the warm coastal plains, the southerly wind is diverted to a south south-westerly to south-westerly wind along the coast. At Walvis Bay the temperature gradient that forms over the warmer darker sands south of the Kuiseb River, compared with the cooler, lighter coloured gravel plain to the north of the river, leads to the formation of cyclonic circulation (localised low-pressure systems) centred over the dune area, due to warm air that rises over the dune area. This, together with topographical changes and land-use, causes a local deflection of wind flow over the Walvis Bay area, from south to southwest in Walvis Bay (Figure 8-4), to more southwest to westerly further inland, as well as reduced wind speeds. The more low speed, westerly winds are for example experienced at the Walvis Bay Airport (Rooikop).

The winds are strongest in early to mid-summer (September to January) when the SAH is at its strongest and most persistent, and the temperature difference between the sea and the desert plains are at its greatest. Wind speeds then occasionally exceed 32 km/hr and usually peaks late morning to early afternoon. In winter, the SAH loses strength and the southerly to south-westerly winds are at their weakest. Winter winds do not have enough strength to reach far inland. Autumn to winter conditions do however promote the formation of east wind conditions (berg winds) that can reach speeds of more than 50 km/hr and transport a lot of sand. East winds occur when the inland plateau is cold with a localised high pressure cell, while a low pressure system is present at the coast. The high pressure cell forces air off the escarpment and as the air descents, it warms adiabatically as well as create a low pressure system due to the vertical expansion of the air column. The warm air flows toward the coastal low and as it passes over the Namib plains, it heats up even further. The wind manifests itself as very strong, warm and dry wind during the mornings to early afternoon, but dissipate in the late afternoon.

Throughout the year the prevailing night time regional wind is a weak easterly wind. This results when the mainland cools to below the temperature of the coastal water. This results in a coastal low versus an onshore high pressure system with first no wind in the early evening, when temperatures between water and land is similar, and then weak easterly winds as the temperature

difference increase. Wind within the MBL remains dominated by the Benguela Low-Level Coastal Jet, causing a localised southerly wind over Walvis Bay, see Figure 8-4.

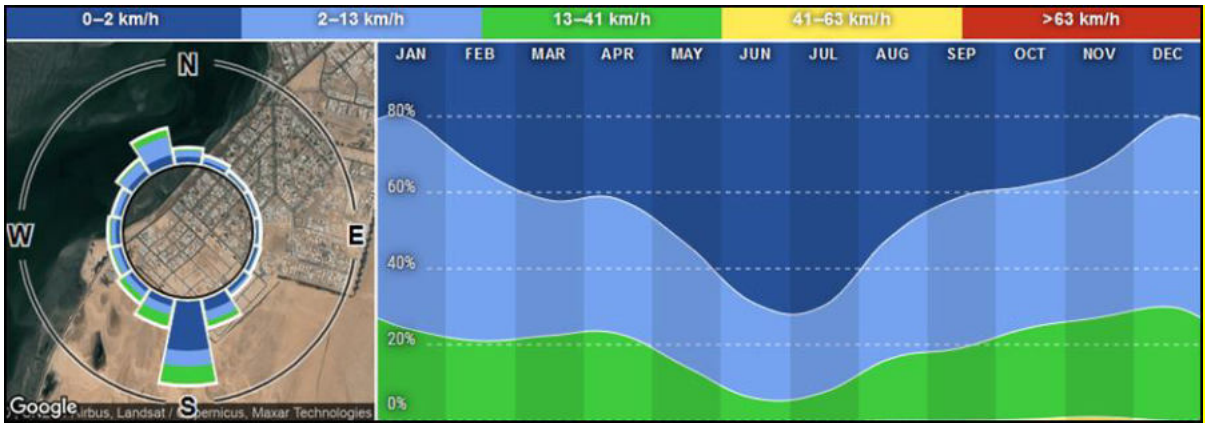


Figure 8-4 Wind direction and strength at the Walvis Bay Lagoon as measured between 2013 and 2020 (from: www.windfinder.com/windstatistics/walvis_bay_airport)

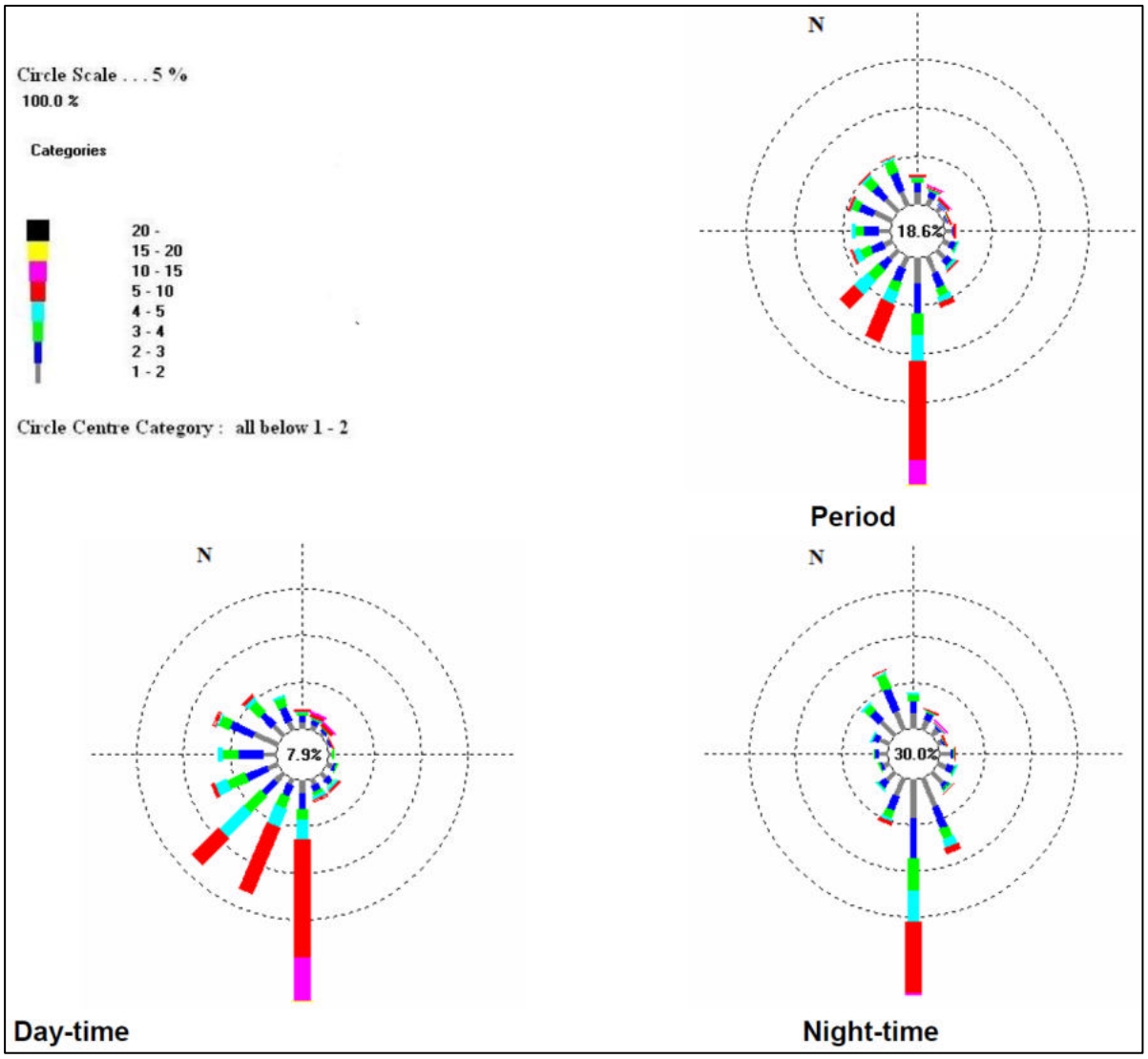


Figure 8-5 Period, daytime and night-time wind roses for Walvis Bay town for the period 2006 (Petzer, G. & von Gruenewaldt, R., 2008)

Temperature at Walvis Bay is strongly regulated by the cold Benguela current. As a result, there is typically limited variation between diurnal and seasonal temperatures. Average annual temperatures are approximately 18 °C to 19 °C with the maximum temperature seldom above 30 °C and minimums rarely below 5 °C (Figure 8-6). The only real temperature extremes are experienced during east wind conditions in the autumn to early winter months when temperatures can reach the upper thirties or even low forties. This results in these months having an average maximum temperature ranging from 30 °C to 35 °C. As one moves inland from Walvis Bay, daytime temperatures increases rather quickly while night time temperatures can get significantly colder in the desert environment.

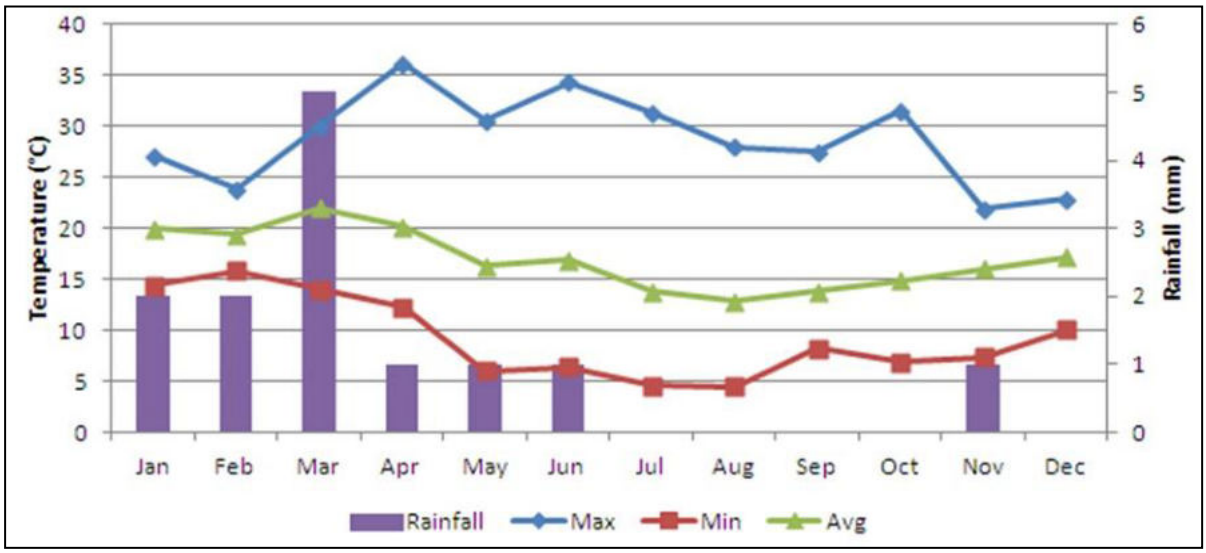


Figure 8-6 Temperature and rainfall at Walvis Bay (from: uMoya-NILU, 2020)

As explained above, the SAH severely limits the amount of rainfall over Namibia and especially at the coast and over the Namib Desert. As such, the average annual rainfall in Walvis Bay is below 50 mm (Figure 8-6), with 100% variation in annual rainfall. Infrequent, heavy rainfall does occur and typically results in rather chaotic conditions as Walvis Bay, and other coastal towns, has not been developed to cater for large volumes of storm water. Fog plays a very significant role as source of water for many plants and animals along Namibia's coast and the Namib Desert. Walvis Bay has up to 900 hours of fog per year and it results from the cold Benguela water cooling the humid air above it to such a temperature that the water vapour condenses to form fog and low level clouds (Mendelsohn et al., 2002).

Implications and Impacts

The construction and operations of the jetties and quay walls should not be negatively affected by the typical weather experienced in Walvis Bay. Occasional rainfall events may wash any pollutants present on the jetty surface into the ocean. Periods of strong westerly to south-westerly wind, as well as north winds may carry airborne dust to nearby receptors.

8.3 CORROSIVE ENVIRONMENT

Walvis Bay is located in a very corrosive environment, which may be attributed to the frequent salt-laden fog, periodic winds and abundance of aggressive salts (dominantly NaCl and sulphates) in the soil. The periodic release of hydrogen sulphide (H_2S) from the ocean is expected to contribute to corrosion. See Figure 8-7 for corrosion comparison data with other centres.

The combination of high moisture and salt content of the surface soil can lead to rapid deterioration of subsurface metal (e.g. pipelines) and concrete structures. Chemical weathering of concrete structures due to the abundant salts in the soil is a concern.

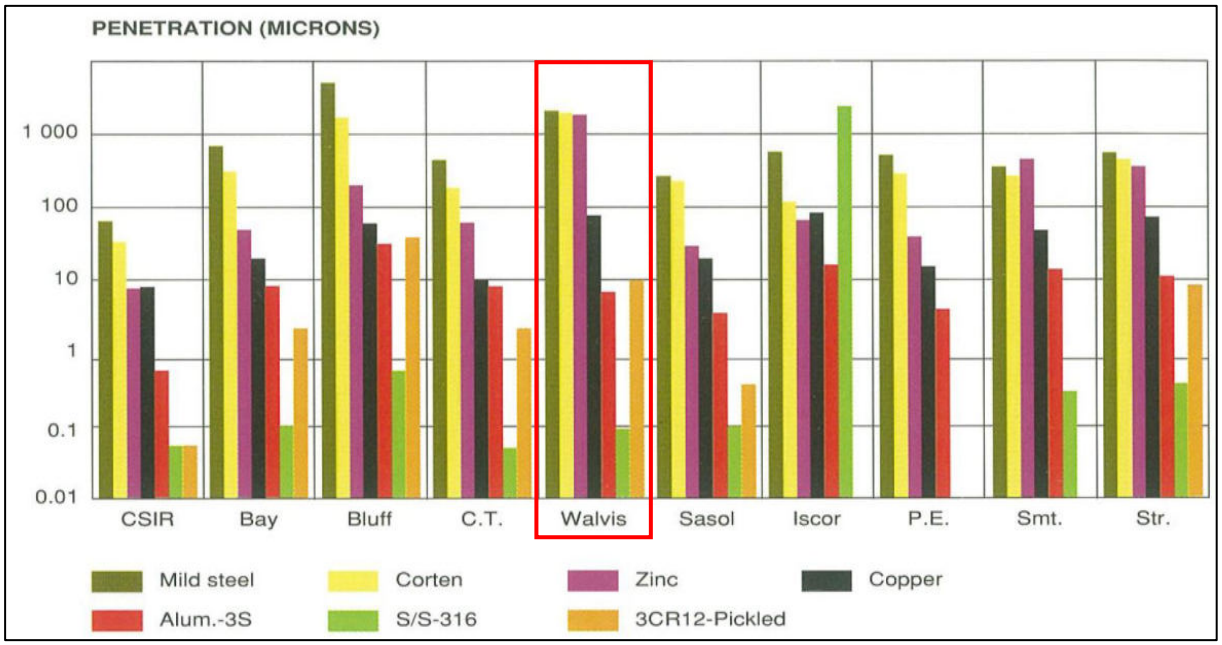


Figure 8-7 Twenty year corrosion exposure results in southern African towns (Callaghan 1991)

Implications and Impacts

Corrosion levels may be high and must be kept in mind when planning the maintenance of the facility and related infrastructure.

8.4 GEOLOGY AND HYDROGEOLOGY

Walvis Bay is located in the Central Western Plain of Namibia. The Kuiseb River forms the southern boundary of this landscape group, with the Namib Dune Field being present south of the Kuiseb River. Northerly dune migration is forcing the Kuiseb River in a northerly direction, with Kuiseb River paleochannels being present as far south as Sandwich Harbour.

Following the breakup of West-Gondwana during the early Cretaceous (130 – 135 Ma ago), continental uplift took place, enhancing erosional cutback and the formation of the Namibian Escarpment. A narrow pediplain formed, mainly over Damara Age rocks. The South Central started filling in over the pediplain, with marine conditions established around 80 Ma ago. Towards the end of the Cretaceous (70 – 65 Ma ago) a relative level surface was created, on which later deposition of sediments took place. Marine deposition took place in the parts covered by the newly formed South Central Ocean, while terrestrial deposits took place on land. Further continental uplift moved the shoreline to its present position.

Northwards migration of sand covered parts of the exposed marine deposits, with Kuiseb floods also depositing material over the marine sediments. Depth to bedrock in Walvis Bay is expected to be deeper than 40 m below surface. Based on previous work conducted in the area, it is expected that the sediments under the project area would consist of medium to coarse grain sand with thin lenses of more clayey material and layers of shell material.

Groundwater in the area is expected less than 2 m below surface and most probably related to seawater intrusion. Shallow freshwater lenses might be present. The origin of these freshwater lenses would mostly be freshwater leakages from the water supply reticulation as well as from the semi purified ponds present near the effluent treatment works.

Implications and Impacts

Groundwater is not utilised in the area. Pollution of the groundwater is however still prohibited. Adherence to Namibian law or better in relation to correct handling and storage of hazardous substances, and spill control structures installed and maintained where hazardous substances are stored and handled will successfully prevent pollution of groundwater, surface water or soil.

Shallow groundwater may lead to rapid lateral spreading of contaminants. This may further have potential impact on underground utilities and may cause impacts on neighbouring properties.

8.5 PUBLIC WATER SUPPLY

Public water supply to Walvis Bay and the surrounding developments is provided by NamWater from the NamWater Kuiseb Water Supply Scheme.

Implications and Impacts

Groundwater is saline and not used as potable water source. No potential contamination impact on water supply is thus expected. Water usage by the facility will be mainly for domestic use and is thus not expected to have a negative impact on public water supply.

8.6 DEMOGRAPHIC AND ECONOMIC CHARACTERISTICS

At local level Walvis Bay has an urban population size of 62,096 (Namibia Statistics Agency, 2014) although the current estimate is around 90,000 to 100,000. Walvis Bay is the principal port of Namibia, and is an import/export facility for processed fish, mining products and beef. The area is linked to Namibia's air, rail and road network, making its port well situated to service Zambia, Zimbabwe, Botswana, Southern Angola and South Africa. The fishing industry is the major employer of low skilled workers on a permanent and seasonal basis. The total employment of this sector is estimated at 2% of the total Namibian workforce. Economic activities relate mostly to businesses within the area and around the site.

Table 8-1 Demographic characteristics of Walvis Bay, the Erongo Region and nationally (Namibia Statistics Agency, 2011)

	Walvis Bay	Erongo Region	Namibia
Population (Males)	30,500*	79,823	1,021,912
Population (Females)	29,000*	70,986	1,091,165
Population (Total)	62,096	150,809	2,113,077
Unemployment (15+ years)	30%	22.6%	33.8%
Literacy (15+ years)	99%	96.7%	87.7%
Education at secondary level (15+ years)	86%	71.8%	51.2%
Households considered poor	Not available	5.1%	19.5%

Implications and Impacts

The facility will provide employment to people from the area. Some skills development and training also benefit employees during the operational phase.

8.7 HERITAGE, CULTURAL AND ARCHAEOLOGICAL ASPECTS

There are no church, mosques or related buildings in close proximity to the site. No known archaeological resources have been noted in the vicinity since the urbanisation of the area. No other structures, sites or spheres of heritage of cultural significance was determined to be in close proximity to the site.

8.8 AQUATIC ENVIRONMENT

8.8.1 Currents and Tides

The Benguela Current flows in a north-westerly direction along the Namibian coast. The average speed of the current is between 0.25 and 0.35 m/s (DMC-CSIR, 2010). The most important hydraulic conditions are shown in Table 8-2 (Tractebel, 1998; COWI, 2003a; DMR-CSIR, 2010).

Water enters and exits the bay at the northern tip of Pelican Point (DMC-CSIR 2010). Water entering is flowing below the exiting water. Current velocities are on average 0.12 m/s with sporadic maximums up to 0.25 m/s.

A study in 1965 indicated a pre-dominant clockwise circulation of currents in the bay (Tractebel, 1998). This was later confirmed in the COWI (2003b) and DMC-CSIR (2010) studies. Circulation occurs mostly in the upper layer and it depends on the wind direction. The current pattern is clockwise in the morning, towards the south. At Pelican Point, the current moves mostly northward for the whole day. A general northward current is found along the east side of the bay very close to the coast.

Water currents prior to the construction of the new container terminal as well as modelling of currents once construction is completed are depicted in Figure 8-8. From this figure, in the vicinity of the proposed jetty, the water current flows in a strong north-easterly direction along the quay walls.

Table 8-2 The oceanographic and hydraulic conditions of the bay and the sea (adapted from Tractebel, 1998; COWI, 2003b; DMR-CSIR, 2010).

Hydrological Conditions	Description
Tides and sea level -Tide statistics for Walvis Bay from SA Tide Tables	Highest Astronomical Tide +1.97 Mean High Water of Spring Tide +1.69 Mean High Water of Neap Tide +1.29 Mean Level +0.98 Mean Sea Level +0.966 Mean Low Water of Neap Tide +0.67 Mean Low Water of Spring Tide +0.27 Lowest Astronomical Tide 0.00
Waves	60 % southerly 23 % south-south-westerly 7 % south-westerly
Ocean current	The Benguela current runs north-westerly along the Namibian coastline at a speed between 0.25 m/s to 0.35 m/s
Tidal current	Negligible

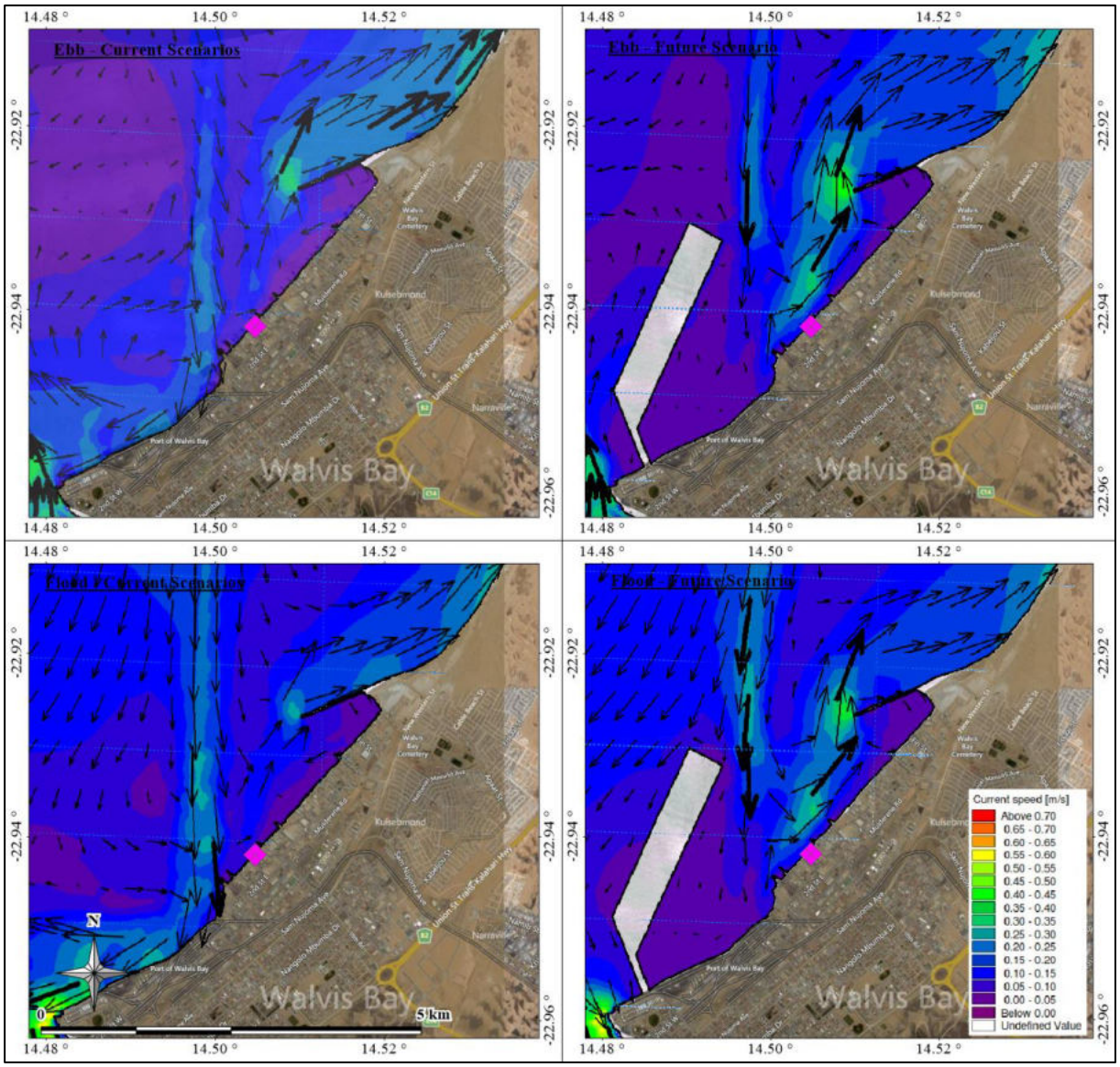


Figure 8-8 Comparison of ebb (top) and flood (bottom) scenarios for before and after the construction of the new container terminal (Source: Hydrodynamic Modelling Report of DMC-CSIR 2010)

Implications and Impacts

The construction and operations relating to the jetties, quay walls and cold storage unit may cause pollutants to enter the water and these could be carried towards sensitive receptors, specifically seawater intakes of the fishing industry.

8.8.2 Sediment Quality

Sediment in harbours are prone to contamination as a result of industrial activities related to harbours and shipping. Prior to maintenance dredging of the fishing harbour in 2015, sediment samples were analysed for chemicals of concern and the sampling locations closest to the Proponent's property are presented in Figure 8-9 (Botha and Faul, 2015). Composite samples consisted of three grab samples each were collected and analysed. The results of the analyses are presented in Table 8-3. Metal concentrations are compared to the Benguella Current Large Marine Ecosystem (BCLME) guidelines and are presented in three categories: 1) lower than BCLME guideline values; 2) higher than BCLME guideline values; and 3) higher than BCLME probable effect concentrations. Some chemicals of concern were elevated above BCLME recommended and probable effect concentrations in a number of locations. Notable

among these are copper, chromium and tributyltin. The contaminated sediment was removed during the 2015 dredging campaign, but recontamination may occur again over time.

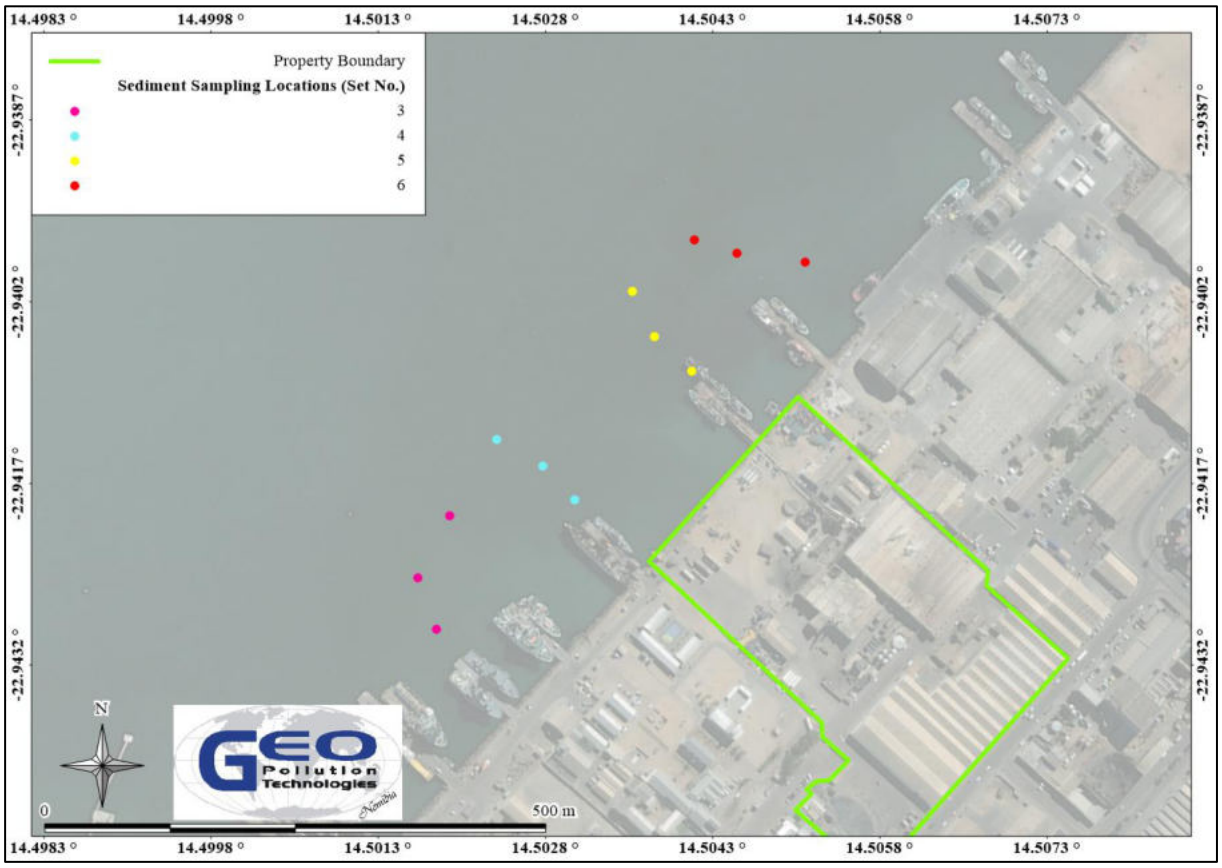


Figure 8-9 Sediment sampling locations prior to maintenance dredging in 2015 (Botha and Faul, 2015)

Table 8-3 Sediment sampling results (sample sets 3 to 6) prior to maintenance dredging in 2015 (Botha and Faul, 2015)

Walvis Bay Fishing Harbour Baseline Sediment Sampling

Project number	G139-18
Certificate number	2015101521
Start date	15-09-2015
Report date	22-09-2015
Date sampling	08-09-2015
Sampler	P. Botha

Map Number				3	4	5	6
Analysis	**Unit**	**BCLME Sediment (Recommended Guideline Value)**	**BCLME Sediment (Probable Effect Concentration)**				
TerrAttesT							
Version number				7.23	7.23	7.23	7.23
Characteristics							
Dry matter	% (w/w)			51.2	31.6	55.8	61.8
Organic matter	% (w/w) dm			4.8	8.9	4.4	3.7
Fraction < 2 µm (Clay)	% (w/w) dm			6.9	24.5	5.9	5.1
Metals							
Arsenic (As)	mg/kg dm	7.24	41.6	22	29	17	17
Barium (Ba)	mg/kg dm	No Value	No Value	44	59	39	35
Cadmium (Cd)	mg/kg dm	0.68	4.21	3.2	7	2.7	2.2
Chromium (Cr)	mg/kg dm	52.3	160	27	53	27	25
Copper (Cu)	mg/kg dm	18.7	108	150	210	110	110
Lead (Pb)	mg/kg dm	30.2	112	43	84	34	28
Molybdenum (Mo)	mg/kg dm	No Value	No Value	4.9	11	4.4	3.2
Nickel (Ni)	mg/kg dm	15.9	42.8	9.3	16	9.8	8.3
Vanadium (V)	mg/kg dm	No Value	No Value	19	34	18	19
Zinc (Zn)	mg/kg dm	No Value	No Value	140	260	120	100
Cobalt (Co)	mg/kg dm	No Value	No Value	3.4	4.8	3.2	2.9
Mercury (Hg)	mg/kg dm	0.13	0.7		0.092	0.066	
Polycyclic Aromatic Hydrocarbons							
Pyrene	mg/kg dm	153	1398	0.03	0.09	0.03	0.02
PAH 16 EPA (sum)	mg/kg dm	1684	16770	0.09	0.41	0.15	0.04
Phenanthrene	mg/kg dm	86.7	544	0.01	0.04	0.02	
Fluoranthene	mg/kg dm	113	1494	0.02	0.06	0.03	0.01
Chrysene	mg/kg dm	108	846	0.02	0.06	0.02	0.01
Benzo(b)fluoranthene	mg/kg dm	No Value	No Value	0.01	0.04	0.02	
PAH 10 VROM (sum)	mg/kg dm	No Value	No Value	0.05	0.27	0.1	0.03
Benzo(a)anthracene	mg/kg dm	74.8	693		0.02		
Benzo(k)fluoranthene	mg/kg dm	No Value	No Value		0.02		
Benzo(a)pyrene	mg/kg dm	88.8	763		0.03	0.01	
Benzo(ghi)perylene	mg/kg dm	No Value	No Value		0.02	0.01	
Indeno(123cd)pyrene	mg/kg dm	No Value	No Value		0.02		
Phtalates							
Bisethylhexylphtalate	mg/kg dm	No Value	No Value	0.6	1.7	0.8	0.6
Phtalates (sum)	mg/kg dm	No Value	No Value	0.6	1.7	0.8	0.6
Total Petroleum Hydrocarbons							
TPH (C12-C16)	mg/kg dm	No Value	No Value	20	69	24	15
TPH (C16-C21)	mg/kg dm	No Value	No Value	38	93	40	30
TPH (sum C10-C40)	mg/kg dm	No Value	No Value	110	280	110	68
TPH (C21-C30)	mg/kg dm	No Value	No Value	28	69	30	16
TPH (C30-C35)	mg/kg dm	No Value	No Value	13	35	13	
TPH (C35-C40)	mg/kg dm	No Value	No Value	6.4	11		
Miscellaneous Organic compounds							
Tributyltin (TBT)	mg/kg dm	No Value	No Value	0.35	0.77	0.31	0.098
Triphenyltin (TPhT)	mg/kg dm	No Value	No Value	0.05	0.05	0.05	0.05
Tributyltin (TBT) Sn	mg Sn/kg dm	0.005	0.07	0.14	0.32	0.13	0.04
Triphenyltin (TPhT) Sn	mg Sn/kg dm	No Value	No Value	0.017	0.017	0.017	0.017
Organotin sum Sn factor 0,7	mg Sn/kg dm	No Value	No Value	0.16	0.33	0.14	0.052
Organotin sum (factor 0.7)	mg/kg dm	No Value	No Value	0.39	0.81	0.35	0.13

Notes:

Only parameters detected are reported on

Not Detected / No Guideline Value
< BCLME Sediment (Recommended Guideline Value)
> BCLME Sediment (Recommended Guideline Value) < BCLME Sediment (Probable Effect Concentration)
> BCLME Sediment (Probable Effect Concentration)
> BCLME Sediment (Probable Effect Concentration) x 100

Implications and Impacts

Maintenance dredging may mobilise contaminants contained within sediments in the water column.

8.9 FAUNA OF THE BAY

The site is located within an industrial area which has previously been cleared of all vegetation. Of note nearby (3.5 km southwest) is the Walvis Bay Lagoon, the salt works and the southern part of the bay west of the lagoon, which are the key components of the 12,600 ha Ramsar site (Wetland of International Importance). It is important both as an over-wintering area for Palaearctic migrant wader species as well as for African species such as Greater and Lesser Flamingos, Great White Pelican and Chestnut-Banded Plovers.

The sewerage ponds, situated about 2.5 km southeast of the facility, are regarded as sensitive manmade wetlands. Although a manmade fresh water source, they are an attraction for pelicans and flamingos. These wetlands also support 53% of the duck and geese population in the area. The wetland is formed by the constant inflow of semi-purified water and supports extensive stands of reeds. There is also a flight path for birds between the sewerage ponds, the lagoon and the offshore bird breeding platform (Ghwano Island) 7.5 km northeast of the site. The site is near the flight paths for the three major habitats (lagoon, sewage ponds and Ghwano Island).

The marine mammals, occurring at various times in the Walvis Bay area, are the cetaceans which are the Common Bottlenose Dolphins, the Namibian endemic Heaveside's Dolphins, Dusky Dolphins, Humpback Whales, Southern Right Whales and Pigmy Right Whales as well as the Cape Fur Seals. The Common Bottlenose Dolphin, Heaveside's dolphin and Cape Fur Seal are seen most frequently (daily), the Pigmy Right Whale less frequently (monthly) and the rest infrequently as they are seasonal or infrequent visitors. The Common Bottle Nose Dolphin with a population of less than a 100 individuals is thought of as quite unique in being one of the smallest mammal populations in Africa.

The Namibian coastal waters are home to five species of turtles and all five species are listed as threatened under the IUCN which is controlled through CITES. The most common occurring turtles near the proposed development are the Leatherback Turtle and Green Sea Turtle with the Hawksbill Sea Turtle occurring occasionally.

Implications and Impacts

Whales, dolphins and seals are often considered as flagship species to which people attach great inherent value. This is evident from the million dollar tourism industry based on the presence of these mammals. Their role in the ecosystem is also of significant importance. Pollutants entering the marine environment may negatively impact on these animals as well as on the food chains that sustain them.

Noise generated by pile driving may result in physiological damage or negatively impact on marine mammal populations.

Lighting negatively affects birds flying at night and causes disorientation and collisions.

9 PUBLIC CONSULTATION

Consultation with the public forms an integral component of an EIA investigation and enables Interested and Affected Parties (I&APs) e.g. neighbouring landowners, local authorities, environmental groups, civic associations and communities, to comment on the potential environmental impacts associated with the proposed development and to identify additional issues which they feel should be addressed in the EIA.

During the initial EIA full public consultation were conducted and all comments or input from I&APs were included and considered in the EIA.

10 MAJOR IDENTIFIED IMPACTS

During the scoping exercise a number of environmental impacts have been identified. The impacts are mainly as a result of both construction and operational activities for the jetties, the quay walls and the cold storage unit. The major identified impacts are as follows:

10.1 HEALTH AND SAFETY IMPACTS

Safety risks are associated with the construction phase, maintenance dredging and normal operations. The operations of heavy machinery and cranes poses a risk of injury to personnel on site. During dredging the release of harmful H_2S gas may negatively affect people in the vicinity of the dredger. H_2S gas is initially detected as a rotten egg odour but one quickly reaches olfactory fatigue at which stage you no longer detect the odour although it may still be present. Continued exposure to high concentrations of H_2S gas will ultimately lead to unconsciousness or death.

During the construction phase buildings containing asbestos materials will be demolished. Asbestos fibres can cause serious health effects if inhaled.

During operations health and safety impacts are associated with the presence of heavy machinery on site or falling into the ocean which may lead to hypothermia or drowning. Operational activities associated with the cold storage unit include accidents and injuries from the use of heavy machinery, stacked items tipping over, slipping on wet floor, etc.

Accidental release of ammonia form the refrigeration system can pose health and safety risks. Ammonia is corrosive and can cause freeze burns. Should carbon dioxide be used as refrigerant, it can cause suffocation if release in large volumes in confined spaces.

10.2 NOISE IMPACTS AND VIBRATION IMPACTS

The major noise producing activities will be the presence of heavy machinery on site as well as the pile driving phase of construction of the jetty. Pile driving will include some vibration impacts. Noise will also be caused from the demolition of the wooden jetty and buildings.

10.3 SURFACE WATER CONTAMINATION

Surface water contamination can occur when pollutants enter the ocean. Such pollutants may originate from accidental spills during the construction phase or incorrect storing of chemicals (mainly cleaning materials) during normal operations.

The suspension of sediments during maintenance dredging will reduce the water quality in the fishing harbour. Sediments within harbours often contain high levels of heavy metals and compounds found in antifouling paints like tributyltin (TBT). During dredging these toxic materials as well as increased total suspended solids (TSS) may become mobilised in the water column and may impact on nearby receptors such as the seawater intakes of the fishing industry.

10.4 IMPACT OF LIGHTING ON BIRDS

Birds flying at night, for example flamingos, are disorientated by lights and this can result in bird collisions with manmade infrastructure. The property is situated close to the flight path between Bird Island and the Walvis Bay Lagoon.

10.5 MARINE MAMMAL IMPACTS

The Marine Mammal specialist study (Appendix A) which assessed the potential impacts of jetty construction on marine mammal species in the vicinity of the fishing harbour suggests that the activities which may potentially influence cetaceans will be pile driving activities and increased shipping activity from both construction of the new jetties and more ships making use of the newly constructed jetties. Identified impacts include direct habitat loss, noise pollution, hydrocarbon pollution, entanglement/ digestion of human generated debris and ship interaction and strikes. Of these, only pile driving is likely to have some impact on cetacean communities since the magnitude of the project is small enough not to exceed background levels for most impacts. For pile driving the noise that will be generated is also not likely to exceed background noise levels due to the small size of piles and hammer.

10.6 TRAFFIC

The site is situated in an area with generally heavy traffic, many of which are trucks. The operations of the Proponent entail frequent delivery and collection of commodities. As such significant traffic is generated around the site which can lead to traffic congestion, collisions and other accidents. This impact is a strongly cumulative in nature.

10.7 FIRE AND EXPLOSIONS

Some flammable products will be stored on site. Ammonia, if present in low volumes in air becomes flammable and a fire risk is present if ammonia leaks from the refrigeration system occur. Carbon dioxide as cooling medium requires much higher pressures and thus a system constructed to handle those pressures. While carbon dioxide is considered a more environmentally friendly cooling medium, it does come with its own inherent dangers of possible explosions when there are leaks.

10.8 SOCIO-ECONOMIC IMPACTS

The fishing industry employs a significant portion of the Namibian workforce. Union Marine Properties will provide employment to Namibians during both the planned construction and all operational activities associated with the Proponent.

11 ASSESSMENT OF IMPACTS

The purpose of this section is to assess and identify the most pertinent environmental impacts and to provide possible mitigation measures that are expected from the construction and operation activities related to the jetties, quay walls and cold storage unit.

The identified impacts will be assessed and evaluated for both construction and operation activities. Mitigation measures are also proposed for different impacts. There are specific policies and guidelines that address environmental issues related to the construction and operational activities. The policies and guidelines were referred to in the legal section.

The Rapid Impact Assessment Method (Pastakia, 1998) will be used during the assessment. Ranking formulas are calculated as follow:

A = A1 x A2
B = B1 + B2 + B3
Environmental Classification (ES) = A x B

The Environmental Classification of impacts are provided in Table 11-1 while the assessment criteria is provided in Table 11-2 and Table 11-3.

Table 11-1 Environmental classification of impacts according to the rapid impact assessment method of Pastakia 1998

Environmental Classification (ES)	Class Value	Description of Class
72 to 108	5	Extremely positive impact
36 to 71	4	Significantly positive impact
19 to 35	3	Moderately positive impact
10 to 18	2	Less positive impact
1 to 9	1	Reduced positive impact
0	-0	No alteration
-1 to -9	-1	Reduced negative impact
-10 to -18	-2	Less negative impact
-19 to -35	-3	Moderately negative impact
-36 to -71	-4	Significantly negative impact
-72 to -108	-5	Extremely Negative Impact

Table 11-2 Assessment criteria

Criteria	Score
Importance of condition (A1) – assessed against the spatial boundaries of human interest it will affect	
Importance to national/international interest	4
Important to regional/national interest	3
Important to areas immediately outside the local condition	2
Important only to the local condition	1
No importance	0
Magnitude of change/effect (A2) – measure of scale in terms of benefit / disbenefit of an impact or condition	
Major positive benefit	3
Significant improvement in status quo	2
Improvement in status quo	1
No change in status quo	0
Negative change in status quo	-1
Significant negative disbenefit or change	-2
Major disbenefit or change	-3
Permanence (B1) – defines whether the condition is permanent or temporary	
No change/Not applicable	1
Temporary	2
Permanent (or for as long as the operations continue)	3
Reversibility (B2) – defines whether the condition can be changed and is a measure of the control over the condition	
No change/Not applicable	1
Reversible	2
Irreversible	3
Cumulative (B3) – reflects whether the effect will be a single direct impact or will include cumulative impacts over time, or synergistic effect with other conditions. It is a means of judging the sustainability of the condition – not to be confused with the permanence criterion.	
Light or No Cumulative Character/Not applicable	1
Moderate Cumulative Character	2
Strong Cumulative Character	3

Table 11-3 Criteria for impact evaluation (Directorate of Environmental Affairs, 2008)

Risk Event	**Description of the risk that may lead to an impact.**
Probability	Refers to the probability that a specific impact will happen following a risk event. **Improbable** (low likelihood) **Probable** (distinct possibility) **Highly probable** (most likely) **Definite** (impact will occur regardless of prevention measures)
Confidence Level	The degree of confidence in the predictions, based on the availability of information and specialist knowledge. **Low** (based on the availability of specialist knowledge and other information) **Medium** (based on the availability of specialist knowledge and other information) **High** (based on the availability of specialist knowledge and other information)
Significance (no mitigation)	**None** (A concern or potential impact that, upon evaluation, is found to have no significant impact at all.) **Low** (Any magnitude, impacts will be localised and temporary. Accordingly the impact is not expected to require amendment to the project design.) **Medium** (Impacts of moderate magnitude locally to regionally in the short term. Accordingly the impact is expected to require modification of the project design or alternative mitigation.)

Risk Event	Description of the risk that may lead to an impact.
	High (Impacts of high magnitude locally and in the long term and/or regionally and beyond. Accordingly the impact could have a 'no go' implication for the project unless mitigation or re-design is practically achievable.)
Mitigation	Description of possible mitigation measures
Significance (with mitigation)	**None** (A concern or potential impact that, upon evaluation, is found to have no significant impact at all.) **Low** (Any magnitude, impacts will be localised and temporary. Accordingly the impact is not expected to require amendment to the project design.) **Medium** (Impacts of moderate magnitude locally to regionally in the short term. Accordingly the impact is expected to require modification of the project design or alternative mitigation.) **High** (Impacts of high magnitude locally and in the long term and/or regionally and beyond. Accordingly the impact could have a 'no go' implication for the project unless mitigation or re-design is practically achievable.)

11.1 RISK ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN

The EMP provides management options to ensure impacts of the facility are minimised. An EMP is a tool used to take pro-active action by addressing potential problems before they occur. This should limit the corrective measures needed, although additional mitigation measures might be included if necessary. The environmental management measures are provided in the tables and descriptions below. These management measures should be adhered to during the various phases of the construction and operations of the jetties and cold storage facility. This section of the report can act as a stand-alone document. All personnel taking part in the operations of the facility should be made aware of the contents in this section, so as to plan the operations accordingly and in an environmentally sound manner.

The objectives of the EMP are:

- to include all components of construction activities (upgrades, maintenance, etc.) and operations of the jetties and cold storage facility;
- to prescribe the best practicable control methods to lessen the environmental impacts associated with the project;
- to monitor and audit the performance of operational personnel in applying such controls; and
- to ensure that appropriate environmental training is provided to responsible operational personnel.

Various potential and definite impacts will emanate from the operations and decommissioning phases. The majority of these impacts can be mitigated or prevented. The impacts, risk rating of impacts as well as prevention and mitigation measures are listed below.

11.1.1 Planning

During the phase of planning for construction, operations and decommissioning the facility, it is the responsibility of Proponent to ensure they are and remain compliant with all legal requirements. The Proponent must also ensure that all required management measures are in place prior to and during all phases, to ensure potential impacts and risks are minimised. The following actions are recommended for the planning phase and should continue during various other phases of the project:

- Ensure that all necessary permits from the various ministries, local authorities and any other bodies that governs the construction (inclusive of maintenance) activities and operations of the facility remains valid (e.g. building plans, electricity generation licences, etc.).
- Ensure all appointed contractors and employees enter into an agreement which includes the EMP. Ensure that the contents of the EMP are understood by the contractors, sub-contractors, employees and all personnel present or who will be present on site.
- Make provisions to have a Health, Safety and Environmental Coordinator to implement the EMP and oversee occupational health and safety as well as general environmental related compliance at the site.
- Have the following emergency plans, equipment and personnel on site where reasonable to deal with all potential emergencies:
    - Risk management / mitigation / EMP/ Emergency Response Plan and HSE Manuals
    - Adequate protection and indemnity insurance cover for incidents;
    - Comply with the provisions of all relevant safety standards;
    - Procedures, equipment and materials required for emergencies.
- If one has not already been established, establish and maintain a fund for future ecological restoration of the project site, should project activities cease and the site is decommissioned and environmental restoration or pollution remediation is required.
- Establish and / or maintain a reporting system to report on aspects of construction activities, operations and decommissioning as outlined in the EMP.
- Keep monitoring reports on file for bi-annual submission to allow for environmental clearance certificate renewal as required by the MEFT.
- Appoint a specialist environmental consultant to update the EIA and EMP and apply for renewal of the environmental clearance certificate prior to expiry.

11.1.2 Skills, Technology and Development

Various construction activities at the planned facility are specialised and require specialised skills for execution and operations. Skills development and training continuously benefit employees of contractors. During operations new technologies are continuously invested in and periodic maintenance, upgrades and repairs benefit local contractors whose employees are also periodically trained.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction (including repairs, upgrades and maintenance)	Employment, technological development and transfer of skills	3	1	2	3	2	21	3	Definite
Daily Operations	Employment, technological development and transfer of skills	3	1	2	3	2	21	3	Definite
Indirect Impacts	Transfer of skills and technological development in the region	2	1	2	3	1	12	2	Probable

Desired Outcome: To see an increase in skills of local Namibians, as well as development and technology advancements in the fishing industry.

Actions

Enhancement:

- If the skills exist locally, employees and contractors must first be sourced from the town, then the region and then nationally. Deviations from this practice must be justified.
- Skills development and improvement programs to be made available as identified during performance assessments.
- Employees to be informed about parameters and requirements for references upon employment.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- Record should be kept of training provided.
- Ensure that all training is certified or managerial reference provided (proof provided to the employees) inclusive of training attendance, completion and implementation.
- Bi-annual summary report on all training provided.

11.1.3 Revenue Generation and Employment

The optimisation of land use will lead to changes in the way revenue is generated and paid to the national treasury. An increase of skilled and professional labour will result due to the operations of the Proponent. Employment is sourced locally while skilled labour/contractors may be sourced from other regions. Additional revenue will be generated though employment, purchasing of goods and use of services.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction (including repairs, upgrades and maintenance)	Employment and contribution to local economy	2	2	2	2	2	24	3	Definite
Daily Operations	Employment contribution to local economy	3	2	2	2	2	36	4	Definite
Indirect Impacts	Decrease in unemployment, contribution to local economy	3	2	2	2	3	42	4	Definite

Desired Outcome: Contribution to national treasury, a positive trade balance and provision of employment to local Namibians.

Actions

Enhancement:

- The Proponent must employ local Namibians where possible.
- If the skills exist locally, employees must first be sourced from the town, then the region and then nationally.
- Deviations from this practice must be justified.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Bi-annual summary report based on employee records.

11.1.4 Demographic Profile and Community Health

The project is reliant on labour with a significant workforce. Impacts related to the demographic profile and community health relate to the influx of people to the town (job-seekers) and the transport industry, and the potential social ills and deviant behaviour that often accompany such events. This includes the spread of communicable diseases such as HIV/AIDS and increased criminal activities. Additional employment opportunities also mean more spending power which can lead to increased misuse of alcohol and drugs. The cumulative impact on the demographic profile, (immigration towards Walvis Bay) (urbanisation) of people in search of employment. Urbanisation may lead to an increase of informal settlements within which social ills and communicable disease like HIV/AIDS and alcoholism/drug abuse disease may be more prevalent.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction (including repairs, upgrades and maintenance)	In-migration and social ills related to unemployment	2	-1	1	1	2	-8	-1	Probable
Daily Operations	In-migration and social ills related to unemployment	2	-2	2	2	2	-24	-3	Probable
Indirect Impacts	The spread of disease	2	-1	2	2	1	-10	-2	Probable

Desired Outcome: To prevent the in-migration and growth in informal settlements, prevent the spread of communicable disease and prevent / discourage socially deviant behaviour.

Actions:

Prevention:

- Employ only local people from the area, deviations from this practice should be justified appropriately.
- Appointment of reputable contractors where applicable.
- Adhere to all local authority by-laws relating to environmental health which includes, but is not limited to, sanitation requirements for employees.
- Provide educational, awareness information for employees on various topics of social behaviour and HIV/AIDs.
- Disciplinary steps, within the legal parameters of Namibia, to be taken for socially deviant behaviour during working hours should be clearly stipulated in employment contracts.

Mitigation:

- Take disciplinary action against employees not adhering to contractual agreements with regard to socially deviant behaviour (e.g. alcohol or drug abuse during working hours).

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Facility inspection sheet for all areas which may present environmental health risks, kept on file.
- Bi-annual summary report based on educational programmes and training conducted.

11.1.5 Traffic

During construction and operations of the facility traffic flow to the site will increase and this will contribute to the cumulative collision risk and congestion of surrounding roads, especially during the peak traffic hours. Traffic management and road degradation should however be considered cumulatively for all operations and businesses within the area. Should traffic related problems persist, a combined initiative, from all businesses together with the Walvis Bay Municipality, should be considered to address possible issues such as traffic congestion and road degradation.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction (including repairs, upgrades and maintenance)	Delivery of equipment and building supplies	2	-1	2	2	2	-12	-2	Probable
Daily Operations	Increased traffic, road wear and tear and accidents	2	-2	2	2	2	-24	-3	Definite

Desired Outcome: Minimum impact on traffic and no transport or traffic related incidents.

Actions

Prevention:

- Erect clear signage regarding access and exit points at the facility.
- All vehicles owned by the Proponent to operate within the Traffic and Transport Act regulation, specifically also in terms of roadworthiness.
- Trucks making deliveries or doing pick-ups may not be allowed to park in streets for extended periods or be allowed to obstruct neighbouring properties' entrances.

Mitigation:

- If any traffic impacts are expected, possibly as a result of delivery of equipment or construction material, traffic management should be performed to prevent these.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Any complaints received regarding traffic issues should be recorded together with action taken to prevent impacts from repeating itself.
- A bi-annual report should be compiled of all incidents reported, complaints received, and actions taken.

11.1.6 Health, Safety and Security

Activities associated with the construction and operational phases are reliant on human labour and therefore exposes them to health and safety risks. Activities such as the operation of machinery and handling of hazardous chemicals, poses the main risks to employees. Storage of incompatible chemicals, if any, in close proximity to each other may result in flammable, explosive or toxic conditions to result when cross-contamination occur. A risk of falling into the sea, potentially resulting in hypothermia or drowning, exists. Asbestos present in buildings to be demolished poses a significant health risk. Ammonia used in the refrigeration system is corrosive and a health hazard if leaks are present. Security risks are related to unauthorized entry, theft and sabotage.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction (repairs, upgrades and maintenance)	Physical injuries, exposure to chemicals and criminal activities	1	-2	3	3	1	-14	-2	Probable
Daily Operations	Physical injuries, exposure to chemicals and criminal activities	3	-2	3	2	2	-36	-4	Probable

Desired Outcome: To prevent injury, health impacts and theft.

Actions

Prevention:

- Implement and maintain an integrated health and safety management system, to act as a monitoring and mitigating tool.
- Comply with all health and safety standards as specified in the Labour Act and related legislation (including those pertaining to the possession and operations of boilers).
- All chemicals must be stored and handled according MSDS instructions. This includes segregation of incompatible products (e.g. acids and reducing agents and alkalis).
- Clearly label dangerous and restricted areas as well as dangerous equipment and products.
- Provide all employees with required and adequate personal protective equipment (PPE) where required.
- Ensure that all personnel receive adequate training on the operational procedures of equipment and machinery and the handling of chemicals and hazardous substances. Ensure that staff understand the importance of segregating incompatible materials even if it is only empty packaging material with residual traces of chemicals. Also ensure that more than one employee is trained on these aspects to ensure an adequately trained and qualified person is always present on site to ensure appropriate handling and storage of chemicals (e.g. in the event of personnel being on leave).
- Train selected personnel in first aid and ensure first aid kits and equipment are available on site and regularly serviced/replaced.
- The contact details of all emergency services must be readily available.
- Implement a maintenance register for all equipment whose malfunction can lead to injury or exposure to hazardous substances.
- Apply and adhere to all industry specific health and safety procedures and regulations applicable to the handling of food produce for markets.
- Equipment that will be locked away on site must be placed in a way that does not encourage criminal activities (e.g. theft).
- Ammonia has a strong smell and leaks are typically quickly detected by smell only. However, leak detectors should be considered since personnel will not always be present in the compressor rooms.

- An asbestos survey should be conducted and the presence of any asbestos materials identified and recorded. During construction asbestos sheets and materials must be removed by a certified contractor and disposed of at a Municipal approved site.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- Any incidents must be recorded with action taken to prevent future occurrences.
- Asbestos removal and disposal certificates on file.
- A bi-annual report should be compiled of all incidents reported. The report should contain dates when training were conducted and when safety equipment and structures were inspected and maintained.

11.1.7 Fire

Chemicals and fuels stored on site may be flammable and pose fire risks. Fires can result from incorrect handling of such chemicals and fuels e.g. incorrect storage or cross-reactivity or from faulty electrical equipment. Ammonia, if released from the refrigeration systems, present in a 15% to 28% mixture with air, is explosive. The site is located next to built-up areas which increases the difficulty of fighting fires.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction (including repairs, upgrades and maintenance)	Fire and explosion risk	1	-2	2	2	1	-10	-2	Probable
Daily Operations	Fire and explosion risk	2	-2	2	2	1	-20	-3	Probable

Desired Outcome: To prevent property damage, possible injury and impacts caused by uncontrolled fires.

Actions:

Prevention:

- Prepare a holistic fire protection and prevention plan. This plan must include evacuation plans and signage, an emergency response plan and a firefighting plan.
- Personnel training (safe operational procedures, firefighting, fire prevention and responsible housekeeping practices).
- Ensure all fuel and chemicals, including ammonia, are stored and handled according to MSDS and SANS instructions.
- Regular site, mechanical and electrical inspections and maintenance.
- Regular maintenance of firefighting equipment.
- The compressors rooms must have emergency response plans specific to ammonia related fire risks if leaks or accidental release of ammonia occur. This include explosive proof lighting, extractor fans, PPE and water hoses with water diffusing nozzles. Water absorbs ammonia vapour if sprayed by a fine mist or droplets of water. Refer to MSDA and SANS 10147.
- Ammonia has a strong smell and leaks are typically quickly detected by smell only. However, leak detectors should be considered since personnel will not always be present in the compressor rooms.

Mitigation

- Clean all spills / leaks according to MSDS instructions.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- A register of all incidents must be maintained. This should include measures taken to ensure that such incidents do not repeat themselves.
- A bi-annual report should be compiled of all incidents reported. The report should contain dates when fire drills were conducted and when fire equipment was tested and training given.

11.1.8 Air Quality

Dust may be generated during construction, maintenance or upgrade activities on site. During dredging activities there is a risk of gaseous emissions engulfing personnel. Hazardous gasses are likely to be hydrogen sulphide (H_2S) and methane (CH_4) that are formed and trapped in the decaying organic matter layer on the seafloor. During dredging H_2S may be released and it is very dangerous and can be fatal to humans for concentrations anywhere from 300 to 600 ppm. H_2S is initially discerned as a rotten egg smell. Within a short period the olfactory nerves becomes fatigued and it is no longer detected. At this stage it may be thought that the gas is no longer present, but the contrary could be true.

Operations do not entail any activity that will release noxious gases or foul smelling odours. Ammonia or carbon dioxide may be accidentally released from the refrigeration system. Vehicles accessing the site do however contribute to reduced air quality as a result of the release of exhaust gases.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction (including repairs, upgrades and maintenance)	Excessive dust generated from construction, maintenance and upgrade activities Release of H_2S or CH_4 during dredging	2	-2	2	2	2	-24	-3	Probable
Daily Operations	GHG emissions and the release of ammonia or carbon dioxide from the refrigeration plant	3	-1	2	2	2	-18	-2	Definite

Desired Outcome: To prevent health impacts and reduce the carbon footprint.

Actions

Prevention:

- During construction dust suppression should be conducted if required.
- During dredging H_2S levels in the ambient air must be monitored. Should levels become elevated, dredging must be stopped and all personnel in the vicinity of the dredging area evacuated.
- Dredging activities must comply with the capital and maintenance dredging EIA and EMPs of Namport.
- Compressor rooms and ammonia storage rooms must have extractors in case of leaks or accidental ammonia or carbon dioxide releases.
- Ammonia has a strong smell and leaks are typically quickly detected by smell only. However, leak detectors should be considered since personnel will not always be present.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- Any complaints received regarding reduced air quality or incidents occurring should be recorded with notes on action taken.
- All information and reporting to be included in a bi-annual report.

11.1.9 Noise

Noise pollution will exist due to heavy motor vehicles accessing the site to offload and load construction material and audible warning signals on trucks and forklifts. Construction activities and especially pile driving for jetty construction are noisy, but short lived.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction (including repairs, upgrades and maintenance)	Excessive noise generated from construction activities – nuisance and hearing loss	2	-2	2	2	2	-24	-3	Definite
Daily Operations	Noise generated from the operational activities – nuisance and health impacts	2	-1	2	2	2	-12	-2	Definite

Desired Outcome: To prevent any nuisance and hearing loss due to noise generated.

Actions

Prevention:

- The site is situated in an industrial area and no limitations on the operating hours exist.
- The World Health Organization (WHO) guidelines on maximum noise levels (Guidelines for Community Noise, 1999) to prevent hearing loss should be adhered to.
- Consider noise reduction methods such as switching from audible warning signals on trucks and forklifts to flashing lights or white noise systems.
- All machinery must be regularly serviced to ensure minimal noise production.

Mitigation:

- Hearing protectors as standard PPE for workers in situations with elevated noise levels.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- WHO guidelines.
- Maintain a complaints register.
- Bi-annual report on complaints and actions taken to address complaints and prevent future occurrences.

11.1.10 Waste Production

Various waste streams are produced during the construction and operational phases. Waste may include hazardous waste associated with the handling of asbestos containing products, chemicals, etc.; recyclable wastes such as glass, metal, paper and plastic; and domestic waste. Waste presents a contamination risk and when not removed regularly may become a fire hazard. Contaminated soil and water are considered as hazardous wastes.

During maintenance dredging, the dredged sediment is regarded as a potentially hazardous waste.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction (including repairs, upgrades and maintenance)	Excessive waste production, littering, illegal dumping, contaminated materials	1	-2	2	2	2	-12	-2	Definite
Daily Operations	Excessive waste production, littering, contaminated materials	1	-2	2	2	2	-12	-2	Definite

Desired Outcome: To reduce the amount of waste produced, and prevent pollution and littering.

Actions

Prevention:

- Waste reduction measures must continue to be implemented and all waste that can be re-used / recycled must be kept separate.
- Ensure adequate temporary waste storage facilities are available and that waste cannot be blown away by wind.
- Prevent scavenging (human and non-human) of stored waste.
- All regulations and by-laws relating to environmental health should be adhered to.
- Waste should be disposed of regularly and at appropriately classified disposal facilities, this includes hazardous material (asbestos, empty chemical containers, contaminated rugs, paper water and soil).
- See the MSDS available from suppliers for disposal of contaminated products and empty containers.
- Continue to liaise with the municipality regarding waste, handling of hazardous waste and waste water.
- Dredging activities must comply with the capital and maintenance dredging EIA and EMPs of Namport
- Dredged material must be disposed of at an approved municipal waste treatment facility.
- Transport of dredged sediments must adhere to traffic and transport regulations as stipulated in the Road Traffic and Transport Act Regulations (2001).

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- A register of hazardous waste disposal should be kept. This should include type of waste, volume, disposal method/facility and safe disposal certificates.
- Any complaints received regarding waste should be recorded with notes on action taken.
- All information and reporting to be included in a bi-annual report.

11.1.11 Ecosystem and Biodiversity Impact

The property is already developed. Biodiversity impacts are related to marine mammal impacts during jetty construction (habitat loss and noise), dredging impacts, the impact of bright lights impacting birds flying at night, and pollution of the ocean (surface water contamination). Pile driving is noisy and will have short term impacts on marine mammals that may be nearby. Birds like flamingos fly at night and can be blinded by bright lights resulting in disorientation and collisions with manmade structures. Uncontained chemicals and waste may wash into the ocean where it may deteriorate water quality and impact on biodiversity.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction and dredging (including repairs, upgrades and maintenance)	Habitat loss and impact on biodiversity	1	-1	3	2	2	-7	-1	Probable
Daily Operations	Impact on biodiversity and especially birds	1	-1	3	2	2	-7	-1	Probable

Desired Outcome: To avoid pollution of and impacts on the ecological environment.

Actions.

Prevention:

- Sound proof all machinery known to cause disturbances and ensure all receive good maintenance.
- Namport's existing oil response contingency plan should be followed in the event following hydrocarbon pollution.
- Records of all entanglements must be made and sent to the Marine Mammal Department situated at the Ministry of Fisheries and Marine Resources of Swakopmund.
- All lights directed downwards to working surfaces.
- Nesting by birds on manmade structure on the premises should be discouraged.

Mitigation:

- Report any extraordinary animal sightings to the MEFT.
- During operations minimum lighting required must be used at night.
- Mitigation measures related to waste handling and the prevention of groundwater, surface water and soil contamination should limit ecosystem and biodiversity impacts.
- Remove all waste that may attract scavengers timeously.
- The establishment of habitats and nesting sites at the facility should be prevented where possible.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- All information and reporting to be included in a bi-annual report.

11.1.12 Surface Water Contamination

Dredging may contaminate the water column through the suspension of contaminated dredged sediments. Construction and operations entail the storage and handling of some potentially hazardous chemicals such as paints and paint products, cleaning materials, ammonia, etc. which present an environmental contamination risk. Contamination may either result from failing facilities or spills and leaks associated with incorrect handling or human error. Such spills may contaminate surface water.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction and dredging (including repairs, upgrades and maintenance)	Contamination from hazardous material spillages leakages	2	-1	2	2	1	-10	-2	Probable
Daily Operations	Contamination from hazardous material spillages and hydrocarbon leakages	2	-1	2	2	1	-10	-2	Probable

Desired Outcome: To prevent the contamination of water and soil.

Actions

Prevention:

- Dredging activities must comply with the capital and maintenance dredging EIA and EMPs of Namport.
- Spill control structures and procedures must be in place for all temporary or permanent fuel and chemical storage and handling areas.
- The procedures followed to prevent environmental damage during service and maintenance, and compliance with these procedures, must be audited and corrections made where necessary.
- Proper training of operators must be conducted on a regular basis (chemical handling, spill detection, spill control).

Mitigation:

- Any spill must be cleaned up immediately and spill clean-up means must be readily available on site as per the relevant MSDS.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- A report should be compiled bi-annually of all spills or leakages of chemicals.
- The report should contain the following information: date and duration of spill, product spilled, volume of spill and remedial action taken.

11.1.13 Impacts on Utilities and Infrastructure

Any damage caused to existing infrastructure and services supply like harbour infrastructure, roads and utilities like water pipelines, sewers, telecommunication lines, electricity supply, etc.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction (including repairs, upgrades and maintenance)	Disruption of services and damage infrastructure	2	-2	2	2	1	-20	-3	Probable
Daily Operations	Disruption of services and damage infrastructure	2	-1	2	2	1	-10	-2	Probable

Desired Outcome: No impact on utilities and infrastructure.

Actions

Prevention:

- Appointing qualified and reputable contractors is essential.
- The contractor must determine exactly where amenities and pipelines are situated before construction commences (utility clearance e.g. ground penetrating radar surveys).
- Where trucks will cross underground pipelines and utilities, the necessary infrastructure should be in place to prevent damage.
- Liaison with the suppliers of services is essential.

Mitigation:

- Emergency procedures for corrective action available on file.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- A bi-annual report should be compiled of all incidents that occurred and corrective action taken.

11.1.14 Seabed Scouring and Erosion

Scouring of the seabed caused by vessel propellers resulting in unsafe vessel manoeuvring areas.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	Seabed scouring	-1	-2	2	2	1	-10	-2	Probable

Desired Outcome: To prevent scouring of the seabed and accelerated sedimentation leading to shallow water.

Actions

Prevention:

- Scour protection should be installed where necessary to protect the seabed from scouring and to prevent siltation of adjacent berthing areas.

Mitigation:

- Regular maintenance dredging to be performed when necessary

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Regular surveys of water depth in vessel manoeuvring areas and around jetties and quays.

11.1.15 Visual Impact

This is an impact that not only affects the aesthetic appearance, but also the integrity of the facility.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction (including repairs, upgrades and maintenance)	Aesthetic appearance and integrity of the site	1	-1	2	2	2	-6	-1	Probable
Daily Operations	Aesthetic appearance and integrity of the site	1	-1	2	2	2	-6	-1	Probable

Desired Outcome: To minimise aesthetic impacts associated with the facility.

Actions

Mitigation:

- Regular waste disposal, good housekeeping and routine maintenance on infrastructure will ensure that the longevity of structures are maximised and a low visual impact is maintained.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- A bi-annual report should be compiled of all complaints received and actions taken.

11.1.16 Cumulative Impact

Possible positive cumulative impacts associated with the construction and operational phases include increased employment, development of the workforce and revenue generation. Negative cumulative impacts are mostly associated with increased traffic in the area, noise and potential surface water contamination.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Construction (including repairs, upgrades and maintenance)	The build-up of minor impacts to become more significant	2	-2	2	2	2	-24	-3	Probable
Daily Operations	The build-up of minor impacts to become more significant	2	-2	2	2	2	-24	-3	Definite

Desired Outcome: To minimise cumulative all impacts associated with the facility.

Actions

Mitigation:

- Addressing each of the individual impacts as discussed and recommended in the EMP would reduce the cumulative impact.
- Reviewing biannual reports for any new or re-occurring impacts or problems would aid in identifying cumulative impacts and help in planning if the existing mitigations are insufficient.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- Bi-annual report on all other impacts must be created to give an overall assessment of the impact of the operational phase.

12 CONCLUSION

Union Marine Properties proposed operations will form an important part of the Namibian fishing industry, a major contributor of the Namibian economy and major provider of employment. The Proponent will contributed locally to employment opportunities for both locals and contractors. Skills transfer and training development of the local workforce will take place during both construction of the jetties, quay wall and cold storage facility and the operational activities associated with their use.

During the environmental assessment, potential environmental impacts resulting from the construction and operations of the jetties, quay wall and cold storage unit have been identified. To prevent or mitigate these, noise pollution should at all times meet the minimum World Health Organization requirements to prevent hearing loss and not to cause a nuisance to nearby receptors. Health, safety and security regulations should be adhered to in accordance with the regulations pertaining to relevant laws and internationally accepted standards of operation. Fire prevention and fire response is crucial especially due to the possibility of flammable ammonia – air mixtures if leaks in the refrigeration system occur. Special concerns with regards to the effects of H_2S on air quality from dredging activities should be highlighted. It is of utmost importance that mitigation methods are followed closely to prevent any serious impacts from occurring.

Only the major impacts related to maintenance dredging are mentioned in this assessment and EMP, however any dredging that takes place must be done according to the EIA and EMPs for capital and maintenance dredging in the harbour that are in possession by Namport.

Any waste produced must be removed from site and disposed of in an appropriate way or re-used or recycled where possible. Hazardous waste must be disposed of at an approved hazardous waste disposal site. Surface water contamination is a serious concern and should be prevented by safe work practices and regular inspection and maintenance of equipment.

Negative impacts related to construction of the jetties may play a role in causing harm to marine life found in the nearby vicinity. The Proponent must therefore take note of mitigation methods prescribed to prevent these impacts from occurring and ensure that monitoring is done on a regular basis.

The EMP should be used as an on-site reference document for all the construction and operational activities. Parties responsible for transgressing of the EMP should be held responsible for any rehabilitation that may need to be undertaken. United Marine Properties should ensure that at all times they follow their in-house Health, Safety, Security and EMS in conjunction with the EMP. It is imperative that all operational personnel are taught the contents of these documents to ensure better environmental practises all round.

Union Marine Properties must take special note of all impacts and mitigation measures specified in this assessment and EMP. This will ensure best environmental practises. Monitoring as indicated in the EMP is also crucial and based on monitoring results alternative methods and techniques may have to be investigated and implemented.

Based on the information supplied in this assessment, and if all preventative, mitigation and monitoring methods are strictly adhered to, Union Marine Properties should be able to perform all construction activities and continue its operations without significant environmental impacts.

Summary of expected impacts prior to mitigation:

Impact Category	Impact Type	Construction	Operations
	Positive Rating Scale: Maximum Value	5	5
	Negative Rating Scale: Maximum Value	-5	-5
EO	Skills, Technology and Development	3	3
SC	Revenue Generation and Employment	3	4
SC/EO	Demographic Profile and Community Health	-1	-3
EO	Traffic	-2	-3
SC/EO	Health, Safety and Security	-2	-4
EO	Fire	-2	-3
PC	Air Quality	-3	-2
PC	Noise	-3	-2
PC/BE	Waste production	-2	-2
PC/BE	Ecosystem and Biodiversity Impact	-1	-1
PC	Surface Water Contamination	-2	-2
EO	Impacts on Utilities and Infrastructure	-3	-2
PC/EO	Seabed Scouring and Erosion		-2
SC	Visual Impact	-1	-1

BE = Biological/Ecological EO = Economical/Operational PC = Physical/Chemical SC = Sociological/Cultural

13 REFERENCES

Atlas of Namibia Project. 2002. Directorate of Environmental Affairs, Ministry of Environment and Tourism (www.met.gov.na). [Accessed from http://www.unikoeln. de/sfb389/e/e1/download/atlas_namibia/index_e.htm]

Botha P, Faul A. 2015. Capital and Maintenance Dredging of the Fishing Harbour – Port of Walvis Bay Environmental Monitoring Baselines.

Bryant R. 2010. Characterising the Wind Regime of Sand Seas: Data Sources and Scaling Issues. Global Sand Seas: Past Present and Future. Working Group Conference: Royal Geographical Society in London.

Callaghan B. 1991. Atmospheric corrosion testing in Southern Africa – results of a twenty-year national programme. Nickel Development Institute. http://www.nickelinstitute.org/~/Media/Files/TechnicalLiterature/ StainlessSteelsinABC_GuidelinesforCorrosionPrevention_11024_.pdf Accessed 08/05/2013

COWI, 2003a. Walvis Bay Local Agenda 21 Project Namibia. Coastal Area Study. Marine Pollution. Danida 2003.

COWI, 2003b. Walvis Bay Local Agenda 21 Project Namibia. Coastal Area Study. Hydrodynamic Modelling. Danida 2003.

COWI, 2006. Update of Environmental Impact Assessment and Environmental Management Plan.Port of Walvis Bay Dredging Activities 2006-2010. Project 44/98 - COWI for Namibian Ports Authority.

Digital Atlas of Namibia Unpublished Report. Ministry of Environment & Tourism

Directorate of Environmental Affairs, 2008. Procedures and Guidelines for Environmental Impact Assessment (EIA) and Environmental Management Plans (EMP), Directorate of Environmental Affairs, Ministry of Environment and Tourism, Windhoek.

DMC-CSIR, (Delta Marine Consultants & Centre for Scientific and Industrial Research), 2010. EIA Study for Strategic Expansion of the Walvis Bay Container Terminal. Final Environmental Impact Report and Environmental Management Plan.

http:// www.weatherunderground.com accessed 14 January 2015

http://www.meteoweb.eu/2012/11/litcz-scivola-a-sud-dellequatore-nellafrica-australe-prende-vita-la-stazione-delle-piogge-levoluzione-per-i-prossimi-mesi/166037/ accessed 8 April 2020

https://www.windfinder.com/windstatistics/walvis_bay_airport accessed 8 April 2020

Mendelsohn J, Jarvis A, Roberts C, Robertson T. 2002. Atlas of Namibia: A Portrait of the Land and its People. David Philip Publishers, Cape Town.

Namibia Statistics Agency. Namibia 2011 Population and Housing Census Main Report.

Namibia Statistics Agency. Namibia household Income and Expenditure Survey 2009/2010.

National Planning Commission, 2012. Namibia 2011 Population and Housing Census – Preliminary Results.

Nickel Development Institute. http://www.nickelinstitute.org/~/Media/Files/TechnicalLiterature/StainlessSteelsinABC_GuidelinesforCorrosionPrevention_11024_.pdf Accessed 08/05/2013

Pastakia, C.M.R.; 1998; The Rapid Impact Assessment Matrix (RIAM) – A new tool for Environmental Impact Assessment.

Patricola C, Chang P. 2017. Structure and dynamics of the Benguela low-level coastal jet. Climate Dynamics 49: 2765–2788.

Petzer, G. & von Gruenewaldt, R., 20092008. Air Quality Specialist Assessment for the Proposed Paratus Power Plant Extension in Walvis Bay, Midrand: Airshed Planning Professionals.

Taljaard JJ and Schumann TEW. 1940. Upper air temperatures and humidities at Walvis Bay, South West Africa. Bulletin of the American Meteorological Society 21: 293 – 296.

Tractebel, 1998. Environmental Impact Assessment study for the dredging of the port of Walvis Bay - Final Report. February 1998.

uMoya-NILU (2020): Air Quality Specialist Study for the EIA and Clearance for the NamPower Firm Power Project in Walvis Bay, Namibia, Report No. uMN059-2020, 17 March 2020.

APPENDIX A: MARINE MAMMAL SPECIALIST STUDY

THE POTENTIAL IMPACTS ON CETACEANS OF THE CONSTRUCTION OF NEW CONCRETE JETTIES FOR NAMSOV FISHING ENTERPRISES (PTY) LTD AT THEIR UNITED FISHING ENTERPRISES (PTY) LTD ("UFE") FACILITIES IN THE FISHING HARBOUR OF WALVIS BAY

APRIL 2016

PREPARED BY:
DR. S. ELWEN & DR. T. GRIDLEY
SEA SEARCH AFRICA – NAMIBIAN DOLPHIN PROJECT
4 BATH RD, MUIZENBERG, CAPE TOWN, 7945
www.seasearch.co.za

EXECUTIVE SUMMARY

Namsov Fishing Enterprises (Pty) Ltd aims to demolish their existing wooden jetty and replace it with two newly constructed concrete jetties within the existing Fishing Harbour in Walvis Bay. This document serves to describe and evaluate the potential impact of this project on marine mammals.

Walvis Bay hosts a wide diversity of cetacean (whale and dolphin) species, including a small (<100 individuals) population of common bottlenose dolphins (*Tursiops truncatus*), which regularly uses the bay area. The cetacean community in Walvis Bay is of critical importance to the marine tourism industry, which directly employs approximately 80 people and generates a revenue of about N$ 30 million per year. As cetaceans are highly reliant on acoustic channels for orientation within their environment, feeding and social communication, they are sensitive to man-made sources of noise including those generated during construction, destruction, acoustic surveying and vessel operation. Noise pollution can cause behavioral disturbance and hearing damage and avoidance of key habitats, and is thus a primary concern.

The potential impacts of the proposed development on the cetacean community of Walvis Bay are considered to be: habitat loss, noise pollution (especially pile driving), hydrocarbon (oil and fuel) pollution, and entanglement with or ingestion of human-generated debris. With the exception of pile driving, none of these potential threats is likely to exceed background levels already existing in the harbour. Planned pile installation will consist of relatively small piles (0.39 x 0.42 x 18 m), which will be sunk using water jets and only impacted for a short period using a 3 tonne steel drop hammer. Given the relatively small size of the piles and hammer, likely noise propagation in a shallow, sandy bottomed environment and existing background noise, it is deemed unlikely that this will physically impact or injure cetaceans, or impact behaviour in a significantly negative manner.

1. Table of Contents

2. Consultants' declaration of expertise

This report relating to the effect of construction of new concrete jetties in the Walvis Bay fishing harbour on cetaceans in Walvis Bay was prepared by Dr Simon Elwen and Dr Tess Gridley in consultation with Mr Pierre Botha & Mr Andre Faul (Geo Pollution Technologies Ltd).

Simon Elwen has MSc and PhD degrees from the University of Pretoria with both degree theses focusing on cetacean biology in South Africa. Simon Elwen has more than 15 years experience studying cetacean ecology off the west coast of Africa.

Tess Gridley has a Masters degree (MRes) in Marine and Fisheries Science from the University of Aberdeen (Scotland) and a PhD focusing on acoustic communication in bottlenose dolphins from the University of St Andrews (Scotland, UK). Tess Gridley has moer than 12 years experience working in marine science and with marine mammals in the UK and Africa.

This specialist report was compiled as a desktop study on behalf of Geo Pollution Technologies (Ltd).

The compilation followed a review process of published (peer reviewed) and unpublished literature and data to provide the most up-to-date information on the potential impacts of this project on the cetacean community of Walvis Bay, Namibia.

We do hereby declare that we are financially and otherwise independent of Geo Pollution Technologies (Ltd).

Simon Elwen, PhD

Tess Gridley, PhD

3. Preface

The wording below provides a summary of relevant information on the proposed activities and was extracted from the background information document (BID):

Namsov Fishing Enterprises (Pty) Ltd aims to demolish its existing wooden jetty and replace with newly constructed concrete jetties within the existing Fishing Harbour in Walvis Bay, for the docking of fishing vessels for loading and offloading purposes. The jetties will be similar to the typical concrete jetties used in the port of Walvis Bay. The bulk of the construction process will include cement works and piling.

Rectangular concrete piles of 18 m in length and ***390 x 420 mm in size*** *as well as concrete sections of the jetty deck will be cast on land. For the jetty, four piles will be spaced over the width of the jetty (this is referred to as one jetty bay) and jetty bays will be 7 m apart over the length of the jetty. Approximately 68 piles will be installed in total per jetty.*

Each pile will be put in place with a crane where it will be supported by a temporary steel guide. Initially the pile penetrates the seabed under its own weight assisted by jetting. Jetting is a process by which the sediment underneath and around the pile is fluidized with seawater or air jets, allowing the pile to sink into the seabed. This process continues until the pile is about 1 m above its final position. For the last 1 m the pile is driven into the seabed using ***a drop hammer*** *consisting of a* ***3 tonne steel*** *weight raised and dropped with a crane. Piles will be driven 9.5 m into the sediment.*

Installation of piles will take place one jetty bay at a time. The time required for the actual pile driving of piles with the drop hammer is approximately 20 minutes per pile. The estimated time required for the construction of one jetty bay is one week. Once the jetty has been completed all support infrastructure will be installed, including power supply, water supply, fuel supply and fish offloading infrastructure.

The construction of the quay structures follows a similar methodology to the jetty in that the structure comprises precast concrete driven piles supporting a precast and in situ concrete deck. The piles for the quay structure are normally slightly smaller than those for a jetty being ***around 350mm square****. The driving energy and installation times are however similar to the jetty piles. The main difference for the quay is that deeper water is required closer to the existing shoreline and that requires* ***some local dredging and slope trimming*** *followed by the placing of a rock protection layer to prevent the slope being disturbed by wave or propeller action.*

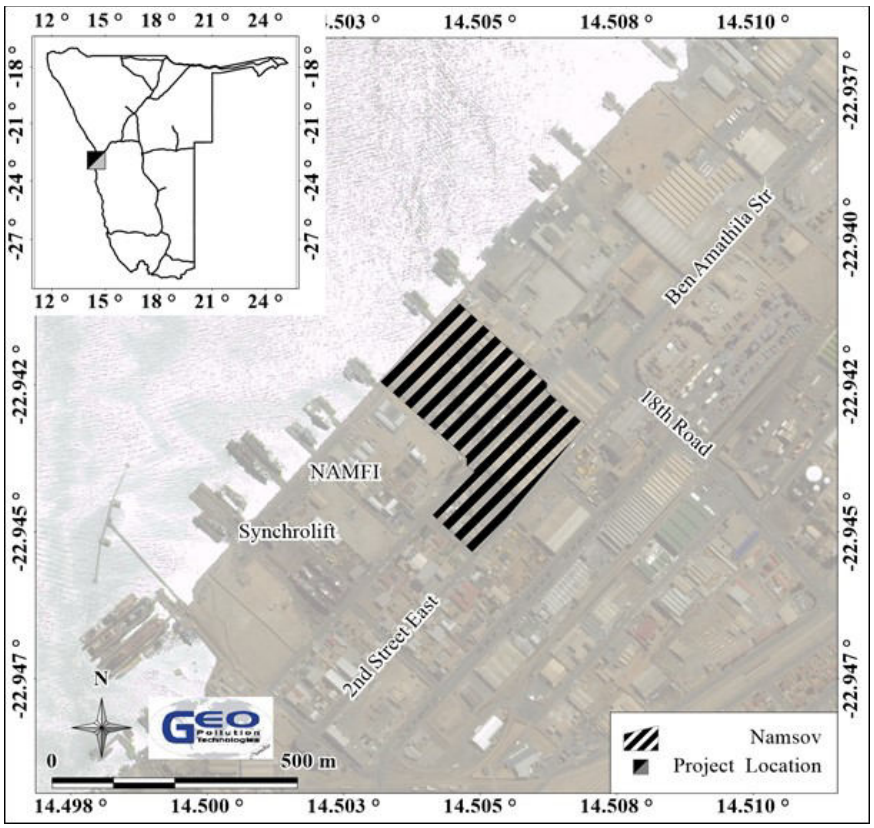


FIGURE 1: LOCATION OF PROPOSED DEVELOPMENT SITE IN WALVIS BAY (TAKEN FROM BID PREPARED BY GEOPOLLUTION TECHNOLOGIES)

4. Activities which may influence the cetacean community of Walvis Bay include:

- Demolition of existing wooden jetties,
- Piling and placement of concrete decks,
- Concrete works for quay wall construction.
- Local dredging, and
- Placing of scour rock.

5. Cetacean community of Walvis Bay

Cetaceans are comprised of two taxonomic groups, the mysticetes (filter feeders with baleen) and the odontocetes (predatory whales and dolphins with teeth). The term 'whale' is used to describe species in both these groups and is taxonomically meaningless (for example, the killer whale is a member of the Odontoceti, family Delphinidae and thus a dolphin). Due to differences in sociality, communication abilities, ranging behavior and acoustic behavior, these two groups should be considered separately for reports such as this.

Walvis Bay is the largest bay along the Namibian coastline and as such is geographically and biologically unique. Including stranding records, more than 20 different species of cetacean have been recorded in or near Walvis Bay (NDP unpubl. data). It is considered to be a hotspot for cetacean strandings, with regular occurrences of rarely seen pygmy right whales (*Caperea marginata*) stranding here as well as pygmy sperm whales (*Kogia breviceps*), humpback whales and several other species (Findlay *et al.*, 1992, NDP unpubl. data; Elwen *et al.*, 2013; Leeney *et al.*, 2013). For example, in 2013 alone, 7 species of cetacean stranded in Walvis Bay (NDP unpubl. data). Discounting stranding events, six species of cetacean occur in Walvis Bay with some regularity, and are the most likely to be impacted by developments within the bay. The occurrence of these species is described in more detail below:

5.1. Common bottlenose dolphin (*Tursiops truncatus*)

Encounter frequency in Walvis Bay: Daily

Common bottlenose dolphins (*Tursiops truncatus*) are widely distributed in tropical and temperate waters throughout the world, but frequently occur in small (10s to low 100s) isolated coastal populations. The only inshore population of common bottlenose dolphins around Namibia and South Africa inhabits the very near shore coastal waters (mostly <15m deep) of the central Namibian coastline making it vulnerable to human impacts within this coastal zone. Walvis Bay is the largest embayment within this range and appears to be the core habitat for this population, acting as both an important feeding and resting area. The distribution range of this population was historically thought to extend from Sandwich Harbour to Cape Cross (Findlay *et al.*, 1992; Best, 2007). However, low levels of human presence beyond this range mean that this is likely to have been an underestimate. Recent 'extra-limital' records from Lüderitz, combined with the reduced sightings in Walvis Bay suggest that this population may be using Walvis Bay less and extending its range to encompass much of the coastline between Lüderitz and the Skeleton Coast National Park (NDP unpubl. data).

Bottlenose dolphins are found throughout Walvis Bay from Pelican Point and Long Beach in the north to near the pump station and well into the lagoon in the south, mostly in water < 15m deep (Fig. 2). The highest density areas of use are the east coast between the harbour wall and Long Beach (overlapping with the new fuel tanker jetty) and the area on the protected, eastern side of Pelican Point (Fig. 2a). The area of lowest use within Walvis Bay is the dredged harbour basin itself (Fig. 2a), suggesting that this area is lower quality habitat. Recent estimates place the population size of bottlenose dolphins inhabiting Walvis Bay at less than 100 individuals, making it one of the smallest populations of mammals in Namibia (Elwen *et al.*, 2011; Elwen *et al.*, *In prep*)

5.2. Heaviside's dolphin (*Cephalorhynchus heavisidii*)

Encounter Frequency in Walvis Bay: Daily

Heaviside's dolphins are endemic to the Benguela ecosystem and are relatively abundant within Namibian waters. The population using the Walvis Bay area has been estimated to number around 500 individuals (Elwen *et al.*, 2011). Heaviside's dolphins range across the entire continental shelf to 200m depth but are more common in waters between the coast and ~100m deep (Elwen *et al.*, 2006; Best, 2007). Despite their wide habitat range, they show strong site fidelity to relatively small areas of coastline ~50-80km along shore.

In Namibia, Heaviside's dolphins regularly aggregate in predictable coastal areas, apparently for feeding and socialising (mating) activities. The area surrounding Pelican Point, (the north west corner of Walvis Bay) is such an aggregation site and over 100 animals may be found here on some days. Aggregation here is likely to be predominantly for feeding, although socializing is also seen frequently, due to oceanographic conditions caused by mixing of the currents leaving the bay with oceanic water. Heaviside's dolphins can be found within a ~2 km radius of Pelican Point almost every day, with 24 hour presence, although data collected using automated echolocation click detectors, CPODS (Leeney *et al*., 2011) shows that numbers and activity may peak at night. Sighting surveys between Sandwich Harbour and Swakopmund, demonstrate that the highest density of Heaviside's dolphins is in the region of Pelican Point, making this area a habitat of *critical importance* within the central Namibian coast area.

5.3. Dusky dolphins (*Lagenorhynchus obscurus*)

Encounter frequency in Walvis Bay: Infrequent visitor

Dusky dolphins are resident year round throughout the Benguela ecosystem from False Bay in South Africa to southern Angola in waters from the coast to at least 500 m deep (Findlay *et al*., 1992, Best, 2007). A possible hiatus in the population distribution occurs in the region of the Orange River suggesting that populations in the Northern and Southern Benguela may be separate. No information is available on the size of the population in either South Africa or Namibia. Dusky dolphins are encountered regularly in the near shore waters of southern South Africa (Elwen *et al*., 2010) suggesting a relatively large population of several thousand at least. In Namibia, dusky dolphins appear to use the very coastal environment (< 2km from shore) far less frequently than in South Africa and they are infrequently encountered in Walvis Bay.

5.4. Humpback whales (*Megaptera novaeangliae*)

Encounter frequency in Walvis Bay: Seasonal with daily encounters in July-September

The Namibian coast is along the migration route of humpback whales moving between Antarctic feeding grounds and breeding grounds in the tropical waters off West Africa. Although humpback whales may be encountered in Namibian waters *year round*, numbers peak seasonally between July (peak of northward migration) and September (peak of southward migration). The population or stock to which these animals belong has been estimated to number in excess of 9000 individuals (IWC, 2011) and is well recovered from the depredations of commercial whaling in the 20th century.

Within the Walvis Bay area, the majority of humpback whales pass by outside of the bay (west of Pelican Point), but individuals occasionally come well into the bay as far as the harbour and even yacht club area (Elwen et al. 2014, Fig 2c).

5.5. Southern right whales (*Eubalaena australis*)

Encounter frequency in Walvis Bay: Infrequent seasonal visitor

Southern right whales encountered along the Namibian coast are part of the population breeding predominantly off the south coast of South Africa (Roux et al. 2015). This population is regarded as healthy due to its high rate of increase (~7% per year) and relatively large size, estimated at nearly 5000 animals in 2008 (Brandão *et al*., 2011). Range expansion back into

historically used areas including southern Mozambique and Namibia has occurred as the population has increased in size (Roux et al. 2015). In Namibia, southern right whales are still relatively rare and even during the peak winter months (June-August) only a few 10's are seen along the coast at any one time, predominantly in the southern half of the coast (Roux *et al.*, 2011).

5.6. Pygmy right whale (*Caperea marginata*)

Encounter frequency in Walvis Bay: Monthly, peak in summer

The smallest of the baleen whales, the pygmy right whale (*Caperea marginata*), occurs in Namibian waters and has a history of stranding within or near Walvis Bay (Leeney *et al.* 2013). The small size, solitary nature and inconspicuous behaviour of the species mean that sightings at sea are rare (Best, 2007). Strandings are concentrated in the summer months (November-March) and are predominantly juvenile animals suggesting that the central Namibian coast may act as a nursery area (Leeney *et al.*, 2013). There are no data on the abundance or conservation status of this species, although since it was not subjected to commercial whaling, the population is expected to be near to original carrying capacity, subject to unknown impacts on the population from other human activities such as overfishing.

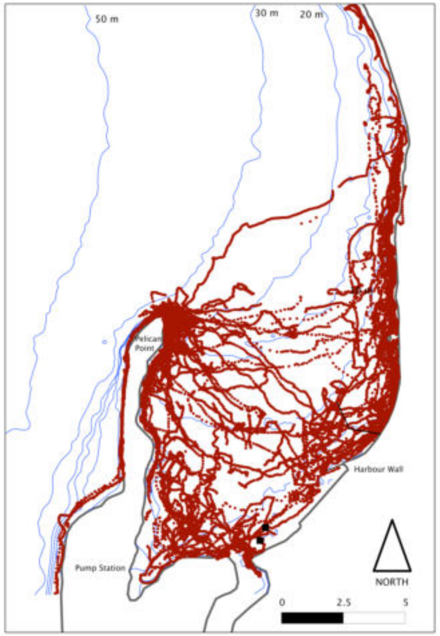


Fig 2a: Tracks of focal follows of bottlenose dolphins (*Tursiops truncatus*) recorded between 2008 and 2012 in Walvis Bay, Namibia*.

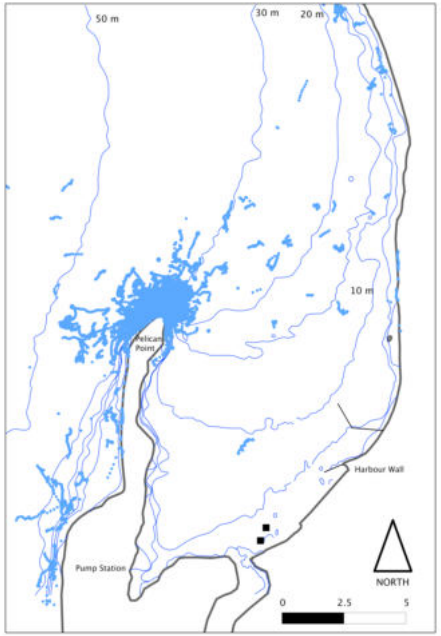


Fig 2b: Tracks of focal follows of Heaviside's dolphins (*Cephalorhynchus heavisidii*) recorded between 2008 and 2012 in Walvis Bay, Namibia.

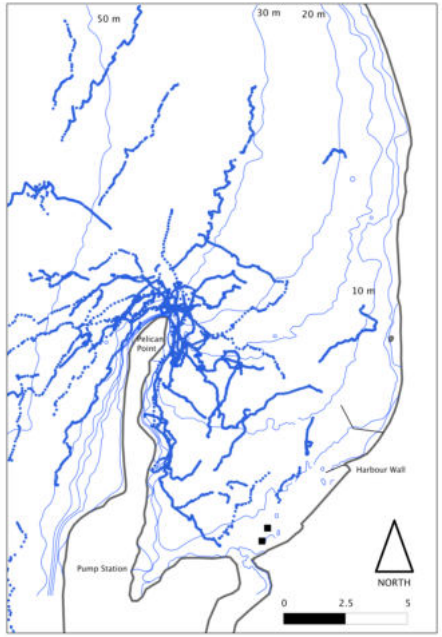


Fig 2c: Tracks of focal follows of humpback whales (*Megaptera novaeangliae*) recorded between 2008 and 2012 in Walvis Bay, Namibia.

* Due to vessel restrictions within the Ramsar Listed Lagoon area and the shallow depths, dolphins were never followed into the lagoon, although they regularly go in there, especially around spring tides.

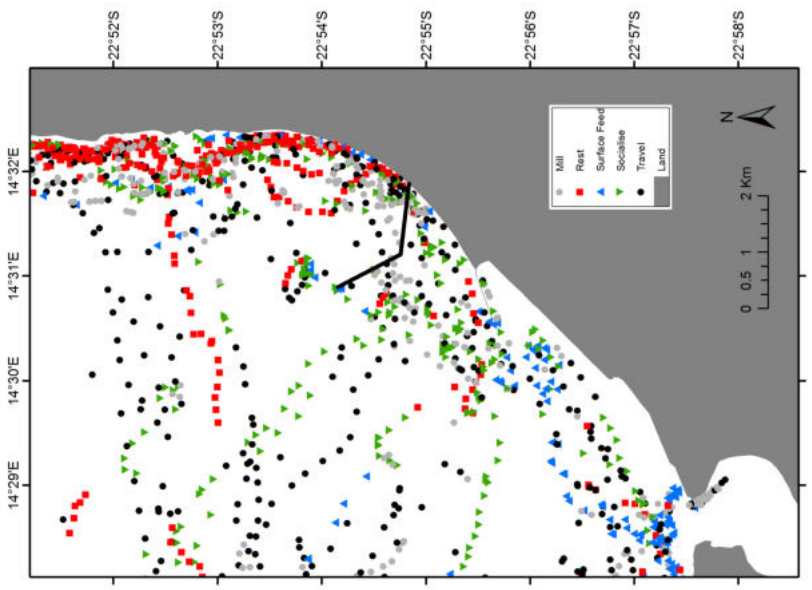


Fig 3b. Close up on impact site showing spatial distribution of bottlenose dolphin behaviour from 2009 to 2012.

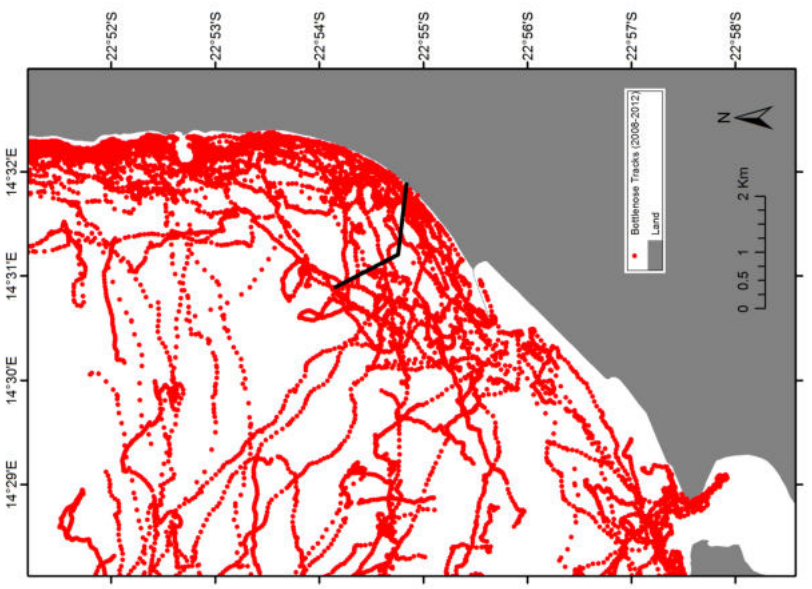


Fig 3a. Close up of impact site showing estimated position of new tanker berth to north of main harbour and overlap with the bottlenose dolphins (shown as combined track data from focal follows of bottlenose dolphins from 2008 to 2012). Note apparent avoidance of main harbour areas between

6. Economic importance of cetaceans in Walvis Bay

The marine wildlife watching tourism industry is well developed in Walvis Bay (Leeney 2014). When assessed in 2010, 11 companies operated 23 boats, providing the equivalent of at least 80 full time jobs and direct revenue of over N$ 30 million. Over 66,000 passengers took part in a marine tours in Walvis Bay in 2010 (Leeney, 2013). The marine tourism industry relies heavily on the presence of cetaceans and seals, especially bottlenose dolphins and Heaviside's dolphins and a number of habituated fur seals and birds, which are core attractions on their trips.

A short term reduction (days to weeks) in cetacean numbers in Walvis Bay is unlikely to affect the industry as a whole, as many of the passengers are pre-booked well in advance. However, any long term reduction (months to years) in numbers and sighting frequency of cetaceans and seals will affect the quality of the marine trips on offer and have potentially serious impacts on the turn-over and employment level of the industry as a whole.

7. Cetacean vocalisation and hearing

7.1. Vocalisations

Mysticete (baleen) whales produce a wide repertoire of sounds, concentrated in the 12 Hz to 8 kHz frequency range (Richardson *et al.*, 1995). Vocalisations may be produced throughout the year (Dunlop *et al.*, 2007; Mussoline *et al.*, 2012; Vu *et al.*, 2012), with peaks in call rates during breeding seasons in most species including humpback whales (Winn and Winn, 1978).

Odontocetes also produce a wide spectrum of vocalizations. A long-term study of the acoustic behaviour of bottlenose dolphins inhabiting Walvis Bay has been conducted since 2009 by the Namibian Dolphin Project. The repertoire consists of echolocation clicks, whistles, burst pulse sounds and low frequency (<1 kHz) narrowband calls. Whistles are long distance communication signals that help individuals to maintain contact with each other. They can transmit over several kilometers (Janik, 2000). The whistles of Walvis Bay bottlenose dolphins range in frequency from 1.6 to 23.2 kHz, with an average peak frequency of 8.43 kHz. Average whistle duration is around 1.1 s (Gridley et al. 2015). Both bottlenose dolphins and dusky dolphins produce broadband echolocation clicks and burst pulse sounds which contain ultrasonic components (Au, 1993; Au and Würsig, 2004). However, unlike bottlenose dolphins, dusky dolphins rarely whistle (Au *et al.*, 2010). Heaviside's dolphins do not whistle but produce high frequency clicks in the 125 kHz range (Morisaka *et al.*, 2011, NDP unpubl. data), well outside the human hearing threshold or the frequency band of most man-made construction noise.

7.2. Hearing

Marine mammals as a group have wide variations in ear anatomy and hearing ranges (Table 3, section 5). The hearing threshold is the amplitude necessary for detection of a sound. This threshold varies with frequency across the hearing range (Nowacek *et al.*, 2007). For most species, hearing sensitivity corresponds closely to the frequencies at which they vocalise, however it is likely that hearing range is broader than the vocalisation range (Bradley and Stern, 2008).

No psycho-acoustical or electrophysical work on the sensitivity of baleen whales to sound has been conducted (Richardson *et al.*, 1995) and hypotheses regarding the effects of sound on baleen whales are extrapolations from what is known to affect odontocetes or other marine mammals and from observations of behavioural responses. The combined information strongly suggests that baleen whales are likely to be most sensitive to sounds from 10's of Hz to around 10 kHz (Southall *et al.*, 2007) and they are thus likely to be sensitive to low frequency construction noise.

Audiograms for odontocetes demonstrating the threshold necessary to hear sounds at different frequencies are shown in Fig 4. Odontocete hearing is most sensitive at frequencies between 10 and 100 kHz (Richardson *et al.*, 1995) and dolphins have quite insensitive hearing below 1 kHz (Madsen *et al.,* 2006). It should be noted that no audiogram is currently available for the Heaviside's dolphin, although it is likely to be similar to that of other dolphin species.

Seals can hear in the low frequency range (i.e. < 1 kHz). Otariid seals (eared seals, including the fur seals) have the most sensitive underwater hearing between 4 and 28 kHz (Moore and Schusterman, 1987).

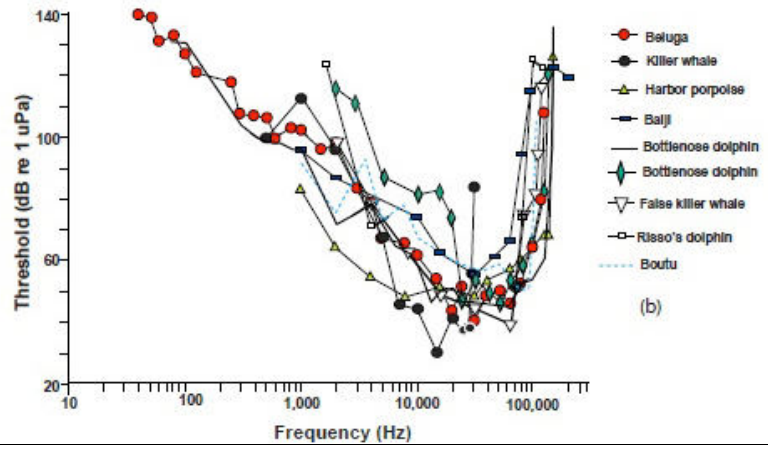


FIGURE 4: AUDIOGRAM FOR ODONTOCETES (TOOTHED WHALES) INCLUDING BOTTLENOSE DOLPHIN (FROM REYNOLDS AND ROMMEL, 1999).

7.3. Impact assessment and mitigation activities

The potential impacts of constructing the new jetties are summarised below. There is some overlap in the potential impacts, for instance both construction and ships generate noise pollution. To minimise repetition, the impacts of the construction and operation will be discussed under the following headings:

1. Direct habitat loss
2. Noise pollution
3. Hydrocarbon (oil and fuel) pollution
4. Entanglement with / ingestion of human-generated debris
5. Ship interaction and strike

8. Direct Habitat Loss

8.1. Nature of Impact

Direct habitat loss occurs when habitats are physically altered and is discussed here in the terms of loss of habitat due to the physical presence of new structures within the bay. The construction of the new jetties will not result in any significant direct habitat loss for any species of cetacean in Walvis Bay as they are replacing existing structures and are located in an area which already has a very low encounter rate of cetaceans (Fig 2).

8.2. Suggested Mitigation: Habitat loss

None

9. Noise pollution

9.1. Nature of Impact: Noise pollution in general

Many of the activities associated with the destruction of the old jetties and the construction and operation of the new jetties will generate sound, either intentionally (e.g. echo-sounders on ships) or as a byproduct of other activities (e.g. during piling activities, engine noise). Table 1 lists the typical source levels of different activities in the marine environment in order of source level. Activities which will generate sound during the construction and operation of the jetties include: demolition of the existing jetties, pile installation, dredging, placing of scour rock and increased vessel noise. Understanding how sound propagates in shallow water habitats such as Walvis Bay is problematic as the transmission properties of different sites are highly variable and theory must be combined with site specific empirical data to obtain reliable propagation predictions (Richardson *et al.*, 1995). To the author's knowledge, no such empirical data exists for Walvis Bay. Inferences can be made from other studies, but these must be viewed with caution as every habitat is different and sound transmission properties can vary widely.

Cetaceans are highly acoustically orientated and reliant on acoustic channels for feeding, social communication and orientation within their environment, and are thus particularly vulnerable to the impacts of human generated sounds (Tyack and Clark, 2000). The observed effects of noise on cetaceans include: changes in vocalization, respiration rate, swim speed, migration routes, diving and foraging behaviour, physical and auditory damage (either temporary or permanent) and in extreme cases, death and/or strandings (Weilgart, 2007). In the long term, exposure to low-frequency noise may be a chronic cause of stress (Rolland *et al.*, 2012). Chronic stress from man-made noise can be detrimental to marine mammal health and reproductive success.

In general, there can be a wide variation in the reaction of marine mammals to sound, depending on the species, individual, age, sex, prior experience and behavioural state. Also important is the sound level, frequency and other properties of the sound, including its novelty, together with the prevailing acoustic characteristics and the ecological features of the environment in which the animal encounters the sound (NRC, 2003). In some instances sources of sound may be tolerated and apparently harmless.

TABLE 1. AN OVERVIEW OF THE ACOUSTIC PROPERTIES OF SOME ANTHROPOGENIC SOUNDS. * NOMINAL SOURCE, ** HIGHER SOURCE LEVELS FROM DRILL SHIPS USE OF BOW THRUSTERS, *** PROJECTION BASED ON LITERATURE DATA LEVELS BACK CALCULATED AT 1 M. ADAPTED FROM OSPAR (2009)

Activity	Source level (dB re 1 µPa m) *	Bandwidth	Main Energy	Duration (ms)	Directionality
Explosives: TNT	272 - 287 peak	2 Hz - 1 kHz	6 Hz-21 Hz	~1 -10	Omni-directional
Seismic air gun arrays	260 - 262 peak-to-peak	10 Hz - 100 kHz	10 Hz-120 Hz	30 - 60	Downwards
Pile driving (impact)	228 Peak 243 - 257 P to P	20 Hz - >20 kHz	100 Hz-500 Hz	50	Omni-directional
Echo-sounders	235 Peak	Variable	Variable (1.5 kHz - 36 kHz)	5-10	Vertically focussed
Mid-frequency military sonar	223-235 Peak	2.8- 8.2 kHz	3.5 kHz	500-2000	Horizontally focussed
Low-frequency military sonar	215 Peak	100-500 Hz	-	600 -1000	Horizontally focussed
Shipping (large vessels)	180 - 190 rms	6 Hz - > 30 kHz	> 200Hz	Continuous	Omni-directional
Drilling	145-190	10Hz- 10 kHz	< 100 Hz	Continuous	Omni-directional
Dredging	168 - 186 rms**	30Hz - >20kHz	100Hz-500Hz	Continuous	Omni-directional
Small boats and ships	160 - 180 rms	20kHz - > 1 kHz	> 1 kHz	Continuous	Omni - directional
Acoustic Deterrent Devices	132 - 200 rms ***	5 kHz - 30 kHz	5 kHz - 30 kHz	Variable 15 - 500 ms	Omi-directional

Richardson *et al.*, (1995) defined 4 zones of impact around a man made noise source; 1) the zone of audibility - the area within which the mammal might hear the noise, 2) the zone of responsiveness - the region in which the animal reacts behaviourally or physiologically, 3) the zone of masking - the region within which noise is strong enough to interfere with detection of other sounds, 4) the zone of hearing loss, discomfort or injury - where the received sound level is high enough to cause discomfort or tissue damage to auditory or other systems. The range of the impact zones depend on the source level of the sound, the transmission loss properties of the habitat and the hearing abilities of the animals (Madsen *et al.*, 2006).

The zone of audibility is the most spatially extensive and is defined as the receiver's ability to detect sound. In order to be perceived, anthropogenic noise needs to exceed both the ambient noise and the hearing threshold. Natural ambient noise levels in the Walvis Bay region tend to be low, with little broadband biological noise (i.e. snapping shrimp, reef noise - NDP, unpubl. data), but background noises levels in the harbour and near the main anchorage and shipping channels are substantially louder (NDP unpublished data). However, no calibrated recordings are publically available which are necessary for effective mitigation and monitoring (see sections below).

Southall et al., (2007) propose a dual criterion for assessing behavioural changes and injury from noise based on the peak sound pressure level (SPL) and sound exposure level (SEL) (a measure of injury that incorporates the sound pressure level and duration), with the one that is exceeded first used as the operative injury criterion. The range of SPL and SEL that are likely to cause behavioural disturbance are shown in Table 3 relative to single pulsed, multi-pulse (e.g. pile driving) and continuous sound (e.g. boat engines) sources. From this, we can see that behavioural responses start at received levels of 80 dB re 1µPa for marine mammals in water, and 60 dB re. 20 µPa for marine mammals (seals) in air. However, there is much variability in sound levels that can cause behavioural disturbance. If it takes place over a long time or wide area, displacement may reduce foraging success and the availability of suitable habitat for other critical behaviours such as resting and mating, which could ultimately impact individual and population level fitness (i.e. survival and reproduction). In Walvis Bay, the impact is likely to be the greatest on the bottlenose dolphin population as it is most vulnerable due to its small population size and preference for habitat close to the construction area (Fig. 2).

Man-made noise can interfere with the detection of acoustic signals such as communication calls, echolocation sounds and environmental sounds important to marine mammals. If the noise is strong enough relative to the received signal the sound will be 'masked' and undetectable (Richardson *et al.*, 1995). Pile installation and shipping may easily mask the low frequency calls produced by humpback and southern right whales, should they be vocalising, as well as the low frequency and mid frequency vocalisations of bottlenose dolphins. In contrast, the high frequency and narrowband nature of Heaviside's vocalisations (Morisaka *et al.*, 2011), means that there is little chance of masking the echolocation clicks of this species.

Hearing damage or loss can take the form of temporary threshold shift (TTS, temporarily raising a marine mammal's threshold of hearing) to a permanent threshold shift (PTS, permanently raising a mammal's threshold of hearing) (Bradley and Stern, 2008). Injury (PTS) is likely to occur at received sound pressure levels of 230 dB re. 1µPa for low, mid and high frequency cetaceans and sound exposure levels of 198 db re. 1µPa²-s. The criteria for seals in water are somewhat lower (see table 3).

TABLE 3. FUNCTIONAL HEARING GROUPS, AUDITORY BANDWIDTH (ESTIMATED LOWER TO UPPER FREQUENCY HEARING CUT-OFF) AND PROPOSED INJURY AND BEHAVIOURAL RESPONSE CRITERION OF MARINE MAMMALS FOUND IN WALVIS BAY (ADAPTED FROM SOUTHALL *ET AL.*, 2007).

	Injury criteria (values likely to induce PTS)			Behavioural response criteria (minimum levels at which responses have been observed)		
Functional hearing group & estimated auditory bandwidthz	Sound Pressure Level: Reference water: 1µPa (peak) (flat), reference air: 20 µPa (peak) (flat) Sound Exposure Level: Reference water: 1µPa²-s. Reference air: (20µPa)²-s					
	Single pulses	Multiple pulses	Non pulses	Single pulses	Multiple pulses	Non pulses
Low frequency cetaceans 7 Hz to 22 kHz e.g. All baleen whales	230 dB 198 dB	230 dB 198 dB	230 dB 215 dB	224 dB 183 dB	110-180 dB n/a	90 - 150 dB n/a
Mid frequency cetaceans 150 Hz to 160 kHz E.g. *Tursiops, Lagenorhynchus, Orcinus*	230 dB 198 dB	230 dB 198 dB	230 dB 215 dB	224 dB 183 dB	120 - 180 dB n/a	80 - 200 dB n/a
High frequency cetaceans 200 Hz to 180 kHz E.g. *Cephalorhynchus, Kogia*	230 dB 198 dB	230 dB 198 dB	230 dB 215 dB	224 dB 183 dB	n/a	80 - 170 dB n/a
Pinnipeds in water 75 Hz to 75 kHz E.g. *Arctocephalus*	218 dB 186 dB	218 dB 186 dB	218 dB 203 dB	212 dB 171 dB	150 - 180 dB n/a	100 -140 dB n/a
Pinnipeds in air 75 Hz to 30 kHz E.g. *Arctocephalus*	149 dB 144 dB	149 dB 144 dB	149 dB 144.5 dB	109 dB 100 dB	60 - 80 dB n/a	110 - 120 dB n/a

9.2. Nature of Impact: Destruction of Existing Jetties

The existing jetties are to be demolished but no explosives are to be used, destruction will be limited to cutting, pulling or bulldozing. Sound levels from these activities will be lower than those produced during pile driving and likely not significantly exceed the sound levels produced by existing shipping.

9.3. Nature of impact: Pile installation noise

The amount of noise generated during pile installation will depend on several parameters including the diameter and number of piles installed, the method used for pile installation and the seabed type the piles are being installed into. The transmission of sound generated will also vary according to the environment in which the pile driving takes place. The method of pile installation during the construction of the tanker berth involves the pile sinking under it's own weight and combined with sea water jetting with actual pile driving only taking place for the final one meter of placement for an approximate duration of 20mins per pile and 4 piles per jetty bay, one bay per week).

Very few studies have measured the source level and characteristics of pile installation and most have concentrated on impact pile driving in relatively deep water, which generates pulsed sound of high intensity (estimated source levels of as 226 dB re 1µPa at 1 m for a 1.8m diameter piles, Bailey *et al.,* (2010)), which are substantially larger than those to be used in the current project (0.39 x 0.42 m). During impact pile driving sound energy is concentrated at low frequency, 100 Hz to 2 kHz, however energy may extend up to 10 kHz (Bailey *et al.*, 2010).

Although directly comparable data is not available, evidence suggests that the noise generated by pile installation of the smaller piles to be used in this project is likely to be concentrated at low frequencies, with some sound extending into the mid frequency. It is unlikely that hearing damage of marine mammals will result from pile installation, particularly as the sediment is sand/mud. It should be noted that noise levels are likely to be higher if pile installation takes place into hard substrates. Behavioural disturbance is a possibility and masking of biologically relevant sounds generated by low and mid frequency cetaceans and seals (Table 1) may occur, especially if animals are passing close to the sound source. The sounds generated during pile installation are likely to be audible within Walvis Bay.

Impact on cetaceans: The largest impact of noise pollution on cetaceans in Walvis Bay is likely to be on the bottlenose dolphin population, which is the only species that regularly uses the south eastern part of the bay near the harbour. However, the historic data available (Fig 1), shows that the animals rarely use the dredged part of the harbour itself, suggesting that avoidance already occurs of this suboptimal habitat possibly due to existing noise pollution, ship activity or low prey levels. Given the location of the construction site within the existing harbour confines, high level of current harbour noise from other ships, echo-sounders, construction etc. and the relatively small size of the hammer – pile driving is unlikely to have any serious negative effects on the cetacean populations above and beyond the existing background levels of noise.

9.4. Nature of impact: Shipping noise

It is unclear from the BID how much new or additional vessel traffic will be associated with the destruction and construction of the jetties or if ship movements will increase markedly with the addition of a new jetty structure. We provide below some context on the potential impacts of shipping at a global level.

The influence of shipping noise in the world's oceans has increased dramatically over the past 150 years. The amount of noise generated from vessels will depend on the speed of the vessel, the number and type of engines, its age, the load, maintenance and prevailing oceanographic conditions. Source levels range from 160-190 dB re 1 µPa rms depending on the vessel size (reviwed in OSPAR, 2009). Large vessels generate low-frequency noise that propagates

efficiently in the marine environment. Such shipping noise overlaps with the vocalizations of baleen whales and many species of fish and seals (Richardson *et al.*, 1995) potentially masking biologically important sounds and causing chronic stress in cetaceans (Rolland *et al.*, 2012). Smaller vessels generate noise which extends into the mid frequency range and can mask the communication sounds of mid frequency cetaceans such as dolphins (Jensen *et al.*, 2009). As well as propeller-generated noise, most vessels are fitted with echo-sounders, which produce loud (230dB - 245dB re 1µPa rms) directional pulses in the mid and high frequency range. As ships are transitory, animals can move out of their path before being exposed to high sound levels, reducing the chance of hearing damage. Disturbance and masking of sounds are more likely impacts. Behavioral responses to boats include avoidance, attraction and changes in dive duration and vocalisations, many of which may occur at considerable distances from the vessel (Janik and Thompson, 1996; Bejder *et al.*, 1999; Buckstaff, 2004; Goodwin and Cotton, 2004; Lemon *et al.*, 2006). Our own work has shown clear shifts in the frequency and duration of dolphin whistles recorded in the presence of small motor boats in Walvis Bay (Heiler et al.)

Impact on cetaceans: The new jetty and slip way is not likely to result in a significant increase in the number, size or movements of vessels above and beyond existing levels within the Walvis Bay harbour. Thus it is likely to have a negligible impact on cetaceans in Walvis Bay.

9.5. Nature of impact: Noise impacts on prey species

In addition to the effects mentioned above, dolphin presence in Walvis Bay may be affected indirectly by elevated sound levels impacting prey species. A full discussion of the impacts of the current project on fish are outwith the scope of this report. However, anthropogenic sounds affect fish as widely as they do mammals, with impacts ranging from death and injury, through hearing loss and threshold shift to site avoidance (Slotte *et al.*, 2004; Caltrans Report, 2009; Popper and Hasting, 2009).

Impact on cetaceans: Given the existing evidence of low use of the dredged part of the existing harbour by dolphins, the likely sound propagation and duration from pile driving and existing background noise – the impact of prey avoidance on dolphin presence and health is likely to negligible.

9.6. Suggested mitigation: Noise pollution

There are few reports of the noise characteristics produced during general construction activities, and none for Walvis Bay. Further studies, taking into account the variations in environmental characteristics (e.g. depth, salinity profiles and substrate characteristics), are required to adequately characterise these for Namibian waters. Activities shown to generate source levels above those known to cause injury or disturbance to marine mammals should be tightly controlled and monitored to minimise negative impacts. A precautionary approach during construction and operation of the new jetty is recommended using the mitigation measures highlighted below:

- Construction noise can be reduced by sound proofing machinery and ensuring good maintenance.
- Shipping noise can be reduced by using modern and well maintained ships and propellers and avoiding unnecessary use of generators and dynamic positioning. No attempt should be made to approach cetaceans should they be observed at sea.
- As Walvis Bay is small, the use of acoustic deterrent devices is not recommended, as these could increase cause additional noise pollution in the bay.

10. Hydrocarbon (oil & fuel) Pollution

This is considered to be a low risk, only likely to occur from ships, or additional fuel used during the construction phase, and is not likely to significantly exceed existing background levels in the harbour

10.1. Suggested mitigation: oil pollution

Namibia and NAMPORT have an existing oil response contingency plan that should be implemented in the case of any spills.
http://www.itopf.com/fileadmin/data/Documents/Country_Profiles/namibia.pdf

11. Entanglement with / ingestion of human-generated debris

11.1. Nature of Impact

Human debris, particularly ropes, packaging bands, fishing line and other similar materials pose an entanglement risk to marine mammals. Entanglement in discarded waste such as packaging bands and netting and is a significant case of mortality in fur seals (reviewed in Derraik, 2002). This is an issue in Walvis Bay, where Cape fur seals are frequently seen entangled in fishing line or packaging bands or with scars from previous entanglement (NDP unpubl. data). At least 26 species of cetacean have been documented to ingest plastics (Baird and Hooker, 2000) and in Walvis Bay, Heaviside's dolphins have been observed entangled in fishing line and with scars of entanglement (NDP unpubl. data). Entanglement in and ingestion of foreign objects by marine mammals can lead to reduced health and death.

11.2. Suggested mitigation: Entanglement with / ingestion of human-generated debris

Namibia is a signatory of the International Convention for the Prevention of Pollution from Ships (MARPOL), under which the disposal into the sea of all forms of plastics is prohibited. The construction site and associated ships must adhere to the MARPOL rules at all times and every effort must be made to correctly stow equipment and properly dispose of rubbish in order to avoid entanglement incidents or accidental ingestion of foreign objects. All entanglement incidents should be recorded to the Marine Mammal Department at the Ministry of Fisheries and Marine Resources in Swakopmund (contact Mr Beau Tjizoo) and to the Namibian Dolphin Project (Dr Simon Elwen). Where possible, action should be taken by the relevant authorities to disentangle the victim, without causing further injury to victim and/or rescue teams. Training may be required to ensure personnel have the relevant skills and equipment.

12. Ship interaction and ship strike

Although ship and small boat traffic levels will increase in the immediate vicinity of the new jetties, these levels are unlikely to significantly increase relative to existing levels in the harbour and are occurring in an area which already has a very low encounter rate of cetaceans (Fig 2).

12.1 No additional mitigation required

13. Literature Cited

Au, W. W. L. (1993). The sonar of dolphins (Springer-Verlag New York, Inc, New York).
Au, W. W. L., Lammers, M. O., and Yin, S. (2010). "Acoustics of dusky dolphins," in The dusky dolphn: master acrobat of different shores, edited by B. Würsig, and M. Würsig (Academic Press, London), pp. 75-98.
Au, W. W. L., and Würsig, B. (2004). "Echolocation signals of dusky dolphins (Lagenorhynchus obscurus) in Kaikoura, New Zealand," The Journal of the Acoustical Society of America 115, 2307-2313.
Bailey, H., Senior, B., Simmons, D., Rusin, J., Picken, G., and Thompson, P. M. (2010). "Assessing underwater noise levels during pile-driving at an offshore windfarm and its potent
Baird, R. W., and Hooker, S. K. (2000). "Ingestion of plastic and unusual prey by a juvenile Harbour Porpoise," Marine Pollution Bulletin 40 719-720.
Bejder, L., Dawson, S., and Harraway, J. A. (1999). "Responses by Hector's dolphins to boats and swimmers in Porpoise Bay, New Zealand. ," Marine Mammal Science 15 738-750.
Best, P. B. (2007). Whales and dolphins of the Southern African Subregion (Cambridge University Press, Cambridge).
Bradley, D. L., and Stern, R. (2008). "Underwater sound the marine mammal acoustic environment: a guide to fundamental principals," p. 79.
Brandão, A., Best, P. B., and Butterworth, D. S. (2011). "Monitoring the recovery of the southern right whale in South African waters. ."
Buckstaff, K. C. (2004). "Effects of watercraft noise on the acoustic behavior of bottlenose dolphins, Tursiops truncatus, in Sarasota Bay, Florida," Marine Mammal Science 20, 709-725.
Caltrans Report (2009). "Final Technical Guidance for Assessment & Mitigation of the Hydroacoustic Effects of Pile Driving on Fish.," p. 298.
Committee on Potential Impacts of Ambient Noise in the Ocean on Marine Mammals: National Research Council of the National Academies (NRC) (ed). (2003). Ocean Noise and Marine Mammals (The National Academic Press, Washington DC).
Derraik, J. G. B. (2002). "The pollution of the marine environment by plastic debris: a review," Marine Pollution Bulletin 44, 842-852.
Dunlop, R. A., Noad, M. J., Cato, D. H., and Stokes, D. (2007). "The social vocalization repertoire of east Australian migrating humpback whales (Megaptera novaeangliae)," Journal of the Acoustical Society of America 122, 2893-2905.
Elwen, S. H., Bester, M. N., and Leeney, R. H. (In prep). "Boat avoidance as a source of capture heterogeneity in Heaviside's (Cephalorhynchus heavisidii) and bottlenose (Tursiops truncatus) dolphins in Namibia: Implications for mark-recapture estimates of abundance," Marine Mammal Science.
Elwen, S. H., Gridley, T., Roux, J.-P., Best, P. B., and Smale, M. J. (2013). "Records of Kogiid whales in Namibia, including the first record of the dwarf sperm whale (K. sima)," Marine Biodiversity Records 6, 1-8.
Elwen, S. H., Meÿer, M. A. M., Best, P. B., Kotze, P. G. H., Thornton, M., and Swanson, S. (2006). "Range and movements of a nearshore delphinid, Heaviside's dolphin Cephalorhynchus heavisidii as determined from satellite telemetry.," Journal of Mammalogy 87, 866-877.
Elwen, S. H., Snyman, L., and Leeney, R. H. (2011). "Report of the Nambian Dolphin Project 2010:Ecology and consevation of coastal dolphins in Namibia - Submitted to the Ministry of Fisheries and Marine Resources, Namibia," pp. 1-36.
Elwen, S. H., Thornton, M., Reeb, D., and Best, P. B. (2010). "Near-shore distribution of Heaviside's (Cephalorhynchus heavisidii) and dusky dolphins (Lagenorhynchus

obscurus) at the southern limit of their range in South Africa," African Journal of Zoology 45, 78-91.
Findlay, K. P., Best, P. B., Ross, G. J. B., and Cockcroft, V. G. (1992). "The distribution of small odontocete cetaceans off the coasts of South Africa and Namibia," South African Journal of Marine Science 12, 237-270.
Goodwin, L., and Cotton, P. A. (2004). "Effects of boat traffic on the behaviour of bottlenose dolphins (Tursiops truncatus)," Aquatic Mammals 30, 279-283.

Gridley T, Nastasi A, Kriesell HJ, Elwen SH (2015) The acoustic repertoire of wild common bottlenose dolphins (Tursiops truncatus) in Walvis Bay, Namibia. Bioacoustics 24:153–174

Heiler J, Elwen SH, Kriesell HJ, Gridley T Changes in bottlenose dolphin whistle parameters related to vessel interaction, surface behaviour and group composition. Anim Behav:1–5

Roux J-P, Braby RJ, Best PB (2015) Does disappearance mean extirpation? The case of right whales off Namibia. Mar Mammal Sci 31:1132–1152

Heiler J, Elwen SH, Kriesell HJ, Gridley T Changes in bottlenose dolphin whistle parameters related to vessel interaction, surface behaviour and group composition. Anim Behav:1–5

IWC (2011). "Final Report on the Assessment of the Southern Hemisphere Humpback Whale Breeding Stock B, SC/63/Rep6."
Janik, V. M. (2000). "Source levels and the estimated active space of bottlenose dolphin (Tursiops truncatus) whistles in the Moray Firth, Scotland," Journal of Comparative Physiology a-Sensory Neural and Behavioral Physiology 186, 673-680.
Janik, V. M., and Thompson, P. M. (1996). "Changes in surface behaviour of bottlenose dolphins in response to boat traffic.," Marine Mammal Science 12 597-602.
Jensen, F. H., Bejder, L., Wahlberg, M., Aguilar Soto, N., Johnson, M., and Madsen, P. T. (2009). "Vessel noise effects on delphinid communication," Marine Ecology Progress Series, 161–175.
JNCC (2010). "Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise. Available from: jncc.defra.gov.uk/pdf/JNCC_Piling%20protocol_August_2010.pdf."
Leeney, R. H. (2013). "Towards Sustainability of Marine Wildlife-Watching Tourism in Namibia: A report to NACOMA, October 2013."
Leeney, R. H., Carslake, D., and Elwen, S. H. (2011). "Using Static Acoustic Monitoring to Describe Echolocation Behaviour of Heaviside's Dolphins (Cephalorhynchus heavisidii) in Namibia," Aquatic Mammals 37.
Leeney, R. H., Post, K., Hazevoet, C. J., and Elwen, S. H. (2013). "Pygmy right whale Caperea marginata records from Namibia," African Journal of Marine Science 35, 133-139.
Lemon, M., Lynch, T. P., Cato, D. H., and Harcourt, R. G. (2006). "Response of travelling bottlenose dolphins (Tursiops aduncus) to experimental approaches by a powerboat in Jervis Bay, New South Wales, Australia," Biological Conservation 127, 363-372.
Madsen, P. T., Wahlberg, M., Tougaard, J., Lucke, K., and Tyack, P. (2006). "Wind turbine underwater noise and marine mammals: implications of current knowledge and data needs," Marine Ecology-Progress Series 309, 279-295.
Moore, P. W. B., and Schusterman, R. J. (1987). "Audiomatric assessment of northern fur seals, Callorhinus ursinus," Marine Mammal Science 3, 31-53.
Morisaka, T., Karczmarski, L., Akamatsu, T., Sakai, M., Dawson, S., and Thornton, M. (2011). "Echolocation signals of Heaviside's dolphins (Cephalorhynchus heavisidii)," Journal of the Acoustical Society of America 129, 449-457.

Mussoline, S. E., Risch, D., Hatch, L. T., Weinrich, M. T., Wiley, D. N., Thompson, M. A., Corkeron, P. J., and Van Parijs, S. M. (2012). "Seasonal and diel variation in North Atlantic right whale up-calls: implications for management and conservation in the northwestern Atlantic Ocean," Endangered Species Research 17, 17-26.
Namibia, G. P. T. (2013). "Background Information Document for the New Port of Walvis Bay Marine Petroleum Product Import/Export Terminal and Pipeline," pp. 1-8.
Nowacek, D. W., Thorne, L. H., Johnston, D. W., and Tyack, P. L. (2007). "Responses of cetaceans to anthropogenic noise," Mammal Review 37, 81-155.
OSPAR (2009). "Overview of the impacts of anthropogenic underwater sound in the marine environment," in Biodiversity sseries, edited by O. Commission.
Popper, A. N., and Hasting, M. C. (2009). "The effects of human-generated sound on fish. ," Integrative Zoology 4 43-52.
Reynolds, J. E., and Rommel, S. A. (eds). (1999). Biology of Marine Mammals (Smithsonian Institution Press, Washington DC).
Richardson, W. J., Greene Jr, C. R., Malme, C. I., and Thomson, D. H. (1995). Marine Mammals and Noise (Academic Press, London).
Rolland, R. M., Parks, S. E., Hunt, K. E., Castellote, M., Corkeron, P. J., Nowacek, D. P., Wasser, S. K., and Kraus, S. D. (2012). "Evidence that ship noise increases stress in right whales," Proceedings of the Royal Society B Available online, 1-7.
Roux, J.-P., Braby, R., and Best, P. B. (2011). "Southern right whales off Namibia and their relationship with those off South Africa. Paper SC/S11/RW16 submitted to the IWC Southern Right Whale Assessment Workshop, Buenos Aires 13-16 Sept. 2011.."
Roux, J.-P., Braby, R and Best P.B. (2013). "Does disappearance mean extirpation? The case of the Namibian right whale. Paper SC/65a/22. Submitted to the Scientific Committee of the International Whaling Commission."
Slotte, A., Kansen, K., Dalen, J., and Ona, E. (2004). "Acoustic mapping of pelagic fish distribution and abundance in relation to a seismic shooting area off the Norwegian west coast.," Fisheries Research 67 143-150.
Southall, B. L., Bowles, A. E., Ellison, W. T., Finneran, J. J., Gentry, R. L., Greene, C. R. J., Kastak, D., Ketten, D. R., Miller, J. H., Nachtigall, P. E., Richardson, W. J., Thomas, J. A., and Tyack, P. L. (2007). "Marine mammal noise exposure criteria: initial scientific recommendations. ," Aquatic Mammals 33, 411-521.
Tyack, P. L., and Clark, C. W. (2000). "Communication and acoustic behavior of dolphins and whales," in Hearing by Whales and Dolphins, edited by W. W. L. Au, P. A. N., and R. R. Fay (Springer, New York), pp. 156-224.
Vu, E. T., Risch, D., Clark, C. W., Gaylord, S., Hatch, L. T., Thompson, M. A., Wiley, D. N., and Van Parijs, S. M. (2012). "Humpback whale song occurs extensively on feeding grounds in the western North Atlantic Ocean," Aquatic Biology 14, 175-183.
Weilgart, L. S. (2007). "A brief review of known effects of noise on marine mammals," International Journal of Comparative Psychology 20, 159-168.
Winn, H. E., and Winn, L. K. (1978). "The song of the humpback whale Megaptera novaeangliae in West-Indies," Marine Biology 47, 97-114.

APPENDIX B: CONSULTANT'S CURRICULUM VITAE

ENVIRONMENTAL SCIENTIST **André Faul**

André entered the environmental assessment profession at the beginning of 2013 and since then has worked on more than 160 environmental impact assessments including assessments of the petroleum industry, harbour expansions, irrigation schemes, township establishment and power generation and transmission. André's post graduate studies focussed on zoological and ecological sciences and he holds a M.Sc. in Conservation Ecology and a Ph.D. in Medical Bioscience. His expertise is in ecotoxicological related studies focussing specifically on endocrine disrupting chemicals. His Ph.D. thesis title was The Assessment of Namibian Water Resources for Endocrine Disruptors. Before joining the environmental assessment profession he worked for 12 years in the Environmental Section of the Department of Biological Sciences at the University of Namibia, first as laboratory technician and then as lecturer in biological and ecological sciences.

CURRICULUM VITAE ANDRÉ FAUL

Name of Firm	:	Geo Pollution Technologies (Pty) Ltd.
Name of Staff	:	ANDRÉ FAUL
Profession	:	Environmental Scientist
Years' Experience	:	21
Nationality	:	Namibian
Position	:	Environmental Scientist
Specialisation	:	Environmental Toxicology
Languages	:	Afrikaans – speaking, reading, writing – excellent
		English – speaking, reading, writing – excellent

First Aid Class A	EMTSS, 2017
Basic Fire Fighting	EMTSS, 2017

EDUCATION AND PROFESSIONAL STATUS:

B.Sc. Zoology	:	University of Stellenbosch, 1999
B.Sc. (Hons.) Zoology	:	University of Stellenbosch, 2000
M.Sc. (Conservation Ecology)	:	University of Stellenbosch, 2005
Ph.D. (Medical Bioscience)	:	University of the Western Cape, 2018

PROFESSIONAL SOCIETY AFFILIATION:

Environmental Assessment Professionals of Namibia (Environmental Practitioner)

AREAS OF EXPERTISE:

Knowledge and expertise in:

- Water Sampling, Extractions and Analysis
- Biomonitoring and Bioassays
- Biodiversity Assessment
- Toxicology
- Restoration Ecology

EMPLOYMENT:

2013-Date	:	Geo Pollution Technologies – Environmental Scientist
2005-2012	:	Lecturer, University of Namibia
2001-2004	:	Laboratory Technician, University of Namibia

PUBLICATIONS:

Publications:	5
Contract Reports	+160
Research Reports & Manuals:	5
Conference Presentations:	1