EIA/SCOPING REPORT:

Environmental Impact Assessment for the Proposed Underwater Hull Cleaning, Walvis Bay, Erongo Region

This Report is prepared

by

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DECLARATION

I **MR. SAMUEL SHIKONGO** (full name) hereby declare that I am the Team Leader for this project and consulting under Envirodu Consulting & Training Solutions cc. I further declare that I have no business, financial, personal or other interests in Walvis Bay Diving and Salvage cc, application or appeal in respect of which I was appointed other than fair remuneration for the work performed. Therefore, there are no circumstances that compromise the objectivity of this assessment and recommendations thereof.

……………………………………

Mr. Samuel Shikongo

EXECUTIVE SUMMARY

The proponent (Walvis Bay Diving & Salvage cc) intends to provide cleaning services by removing bio-fouling organisms from MVs in the Walvis Bay port. The main problem associated with bio-fouling organisms is higher maintenance costs; increased drag of MVs and higher fuel consumption as well as introduction of IAS and harmful pathogens by foreign MVs into local port waters. Globally, attempts had been made experimenting with various types of anti-fouling systems to avoid accumulation of bio-fouling organisms on hull surfaces of MVs.

Many coastal states recognize a potential of the blue economy as a catalyst for economic development; therefore, a need to reinforce security and bio-security at sea by all means including use of various technologies, such as drones and robotics. Patrol of the EEZ and territorial waters using patrol vessels only guarantee peace; however, it does not defend against the bio-security risk IAS. Furthermore, consumers and users of seas and oceans are increasingly investing in environmental friendly practices and technologies. Evidently, bio-fouling accumulation is not only an ecological risk but also an economic risk. In the future port authorities around the world will soon demand environmental friendly bio-fouling systems to be applied, before granting permissions to foreign MVs to dock in their ports. Additionally, MVs that had previously docked in ports which are known 'hotspots' for IAS and harmful pathogens may not be granted permissions in ports that are free from IAS and harmful pathogens.

The International ICCHAS (International Convention on the Control of Harmful Anti-Fouling Systems on Ships) banned use of organotin compounds in marine paints. Although, the ICCHAS does not apply to countries that has not ratified it; many countries voluntarily use underwater hull cleaning technologies in order to protect their internal and territorial waters from the biosecurity risk of IAS and harmful pathogens. Though the proposed underwater hull using the diver-controlled ROV-cart and filtration cleaning technology is a value added and innovative technology; there was still a need to undertake an EIA/scoping study to determine environmental impacts of this technology as well as prepare an EMP detailing how negative environmental impacts will be mitigated.

For the reason above, the proponent appointed Independent Consultants in June 2021 to undertake the EIA/scoping study and prepare the EMP report. Based on Consultants' assessment the proposed activity will not have significant negative environmental impacts. Therefore, it is recommended that the proponent should be issued with the ECC, on conditions that the EMP is fully implemented. Among others, it is advised that the proponent should samples after removing bio-fouling organisms and analyze these in order to generate baseline data about the origin and type of bio-fouling organisms carried by foreign MVs and their potential bio-security threat to our waters. This will also contribute to GRN's objectives to combat the bio-security risk of IAS and harmful pathogens introduced into the Walvis Bay port.

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ACRONYM

AIMS African Integrated Maritime Strategy

BCC Benguela Current Commission

BCLME Benguela Current Large Marine Ecosystem

BOD Biological Oxygen Demand

CO_2 Carbon Dioxide

COVID-19 coronavirus disease of 2019

DCs Decompression sickness

DO Dissolved Oxygen

DPSIR drivers, pressures, state, impacts, response

EAP Environmental Assessment Practitioner

ECC Environmental Clearance Certificate

ECUTS Envirodu Consulting and Training Solutions

EEZ Exclusive Economic Zone

EIA Environmental Impact Assessment

EMP Environmental Management Plan

GDP Gross Domestic Product

GHGs Greenhouse gases

GRN Government Republic of Namibia

HFOs Heavy Fuel Oils

I & APs Interested and Affected Parties

IAS Invasive Alien Species

ICCHAS International Convention on the Control of Harmful Anti-Fouling Systems

IMO International Marine Organization

IOD injury on duty

MDOs Marine Diesel Oils

MEFT Ministry of Environment, Forestry and Tourism

MEFT Ministry of Environment, Forestry and Tourism

MET Ministry of Environment and Tourism

MFMR Ministry of Fisheries and Marine Resources

MR main road

MVs Marine Vehicles

NAMDEB Namibia Diamond Corporation

NAMPORT Namibia Ports Authority

NCRST National Commission on Research, Science and Technology

NDP National Development Plan

NEMA Namibia Environmental Management Act

NGOs Non-Governmental Organisations

NM nautical miles

NUST Namibia University of Science and Technology

P/A index polycheate/amphipod index

SDG Sustainable Development Goals

SOPs standard operations procedures

SSTs seas surface temperatures

TBhT triphenyltin

TBT tributyltin

TDS total dissolved solids

TORs terms of references

TSS total suspended solids

ULSDs Ultra-Low Sulphur Diesels

UN United Nations

UNAM University of Namibia

UNCLOS United Nation Convention on Law of the Sea

UNCTAD United Nations Conference on Trade and Development

VECs valued environmental components

CHAPTER 1

1. INTRODUCTION AND BACKGROUND

1.1. Introduction

The proponent of this project is Walvis Bay Diving & Salvage cc. Walvis Bay Diving & Salvage cc would like to provide underwater hull cleaning services to various marine vehicles (MVs) within the Walvis Bay port. The proponent has recognized that the current technologies used to clean MVs is inefficient, expensive and time consuming and they discourage MV operators to regularly clean their MVs. Subsequently, if hull cleaning is not performed this will have more negative environmental impacts because accumulation of bio-fouling organisms tend to increase fuel consumptions which lead to higher emissions of GHGs (greenhouse gases). Moreover, bio-fouling accumulation is likely to increase the biosecurity risk of invasive aquatic species (IAS) and pathogens.

The proposed diver operated underwater hull cleaning using the ROV-cart equipment and filtration system will clean MVs while at sea. The debris removed will be reclaimed, treated via the filtration system and will be discarded according to approved disposal methods. This means there will not be a need to remove the MVs from water and also the bio-fouling wastes removed from the hulls will not be discharged back into the water.

This chapter provides a background of the project starting with the sector under which the proposed activity falls. Although the blue economy is still an emerging sector in Namibia, this report recognizes the maritime transport both as a sub sector in the blue economy as well as in the transport sector of the Namibian economy.

1.2. Blue economy

Namibia is endowed with coastal and marine resources; both renewable and non-renewables. The GRN (Government Republic of Namibia) has already prioritized stimulation and development of some of these blue economic sub sectors including fishing, aquaculture, maritime transport, mining, marine tourism and others.

1.2.1. *Maritime transport*

There is an increasing realization that oceans and seas are no longer seen as ‘barriers’ between continents but rather are perceived as ‘means of transportation’ to promote trading across the globe. Maritime transport sector, like other blue economic activities, has become a catalyst for global trade. This sector contributes to employment creation and generation of revenues not only to coastal states but also to land-locked states.

At the center of the maritime transport sector value chain are the MVs (marine vehicles) and their designs, speed and cargo space to transport a huge volume of cargo from one port to another across global oceans and seas cannot be overemphasized.

Figure 1: build-up of biofilms and fouling organisms increase vessel drag and fuel consumption (source: https://safety4sea.com/cm).

Despite improvements in the designs of MVs’ engineering, the global maritime sector is faced with a common challenge of bio-fouling organisms. Biofouling is the process by which aquatic organisms attach themselves to submerged surfaces of MVs (marine vehicles) such as hull, propellers, anchors, niche areas and fishing gears. Bio-fouling organisms include algae, seaweeds, mussels, barnacles and others. The build-up of bio-fouling organisms affect hull and propeller performance as well as MVs’ dynamics by increasing drag and reduce required propulsion. Bio-fouling organisms indirectly lead to higher fuel consumption and consequently, air pollution and emissions of GHGs. Furthermore, bio-fouling organisms attached on foreign MVs present a higher biosecurity risk of IAS (invasive aquatic species) and harmful pathogens.

1.3. The receiving environment

1.3.1. Locality and surrounding land use

Land in the port of Walvis Bay and surrounding areas could be divided into several use categories such as port terminal, dry dock, tourism, protected areas, fish processing, industrial, recreation and residential areas as briefly explained below.

- *Pelican Point* is a unique stretch land which forms a Peninsula in Walvis Bay. This Peninsula is important to marine tourism in Walvis Bay.
- *Lagoon* is located south of the new terminal and is a declared RAMSAR site which supports about 129,000 birds. It provides suitable conditions for Palae-arctic and African birds and it hosts 6 rare bird species.
- The *new port terminal* is an addition to Namibia's land area of 824,292 km^2. It is constructed on 0.4 ha of land reclaimed from the ocean.
- *Dry dock facility* is a synchro lift or shipyard facility where vessels are lifted out of the water for maintenance, repairs, cleaning and painting.
- *Fish processing facilities/jetties* consist of fish processing factories where fish is offloaded, processed, packed and stored for distribution. Namibia's fishing sector generates over 13,000 jobs (43% offshore and 57% onshore) and is the third contributor to the country's GDP.
- While *independence beach* seems to be less significant to the Namibian economy, its role to the local economy in Walvis Bay is extremely important it terms of tourism.
- The *New oil storage facility* was constructed with an aim to increase the capacity to handle oil cargo and facilitate transportation and distribution of oil in Namibia and southern Africa.

- *Dolfynstrand* is located about 20 km north of Walvis Bay and is seaside popular distination of sport fishing.
- *Lang strand* is a beach resettlement remotely located north of Walvis Bay. Langstrand is governed by the municipality of Walvis Bay.
- *Walvis Bay town* is located at 22.957^{0}S/14.505^{0}E and is the largest coastal town in Namibia.

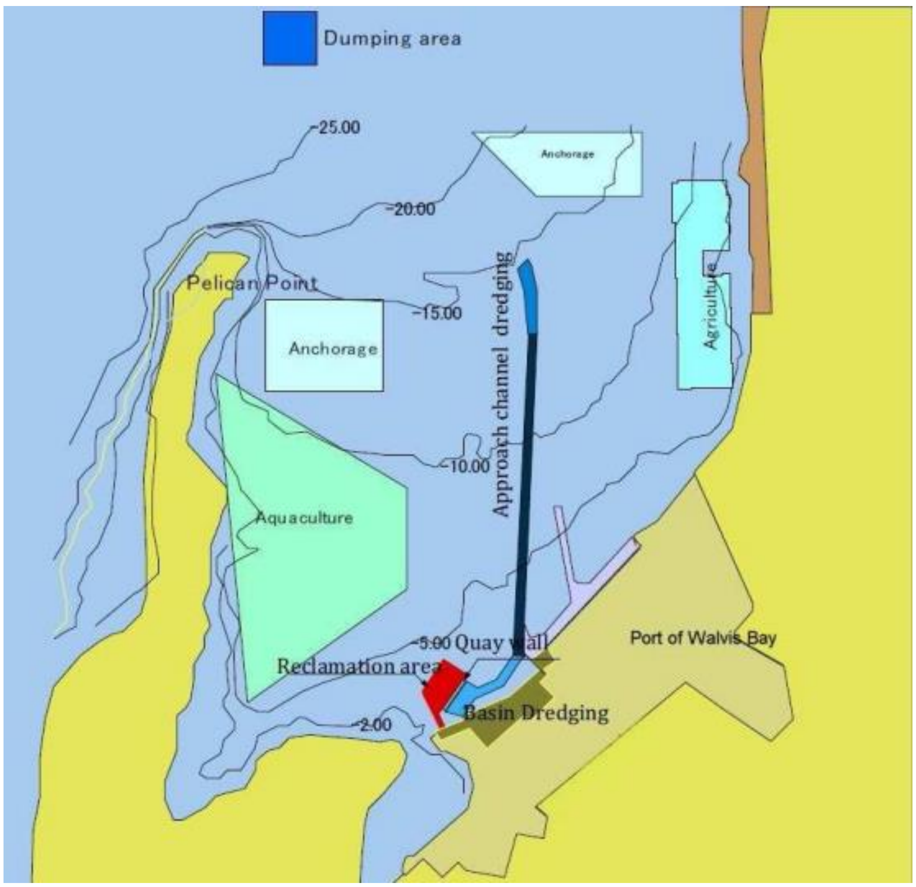


Figure 2: land use map (source: NAMPORT).

1.3.2. Maritime zones

It is important to make a distinction between the marine and coastal environments. The marine environment is that part of the ocean beyond the territorial sea; which covers the contiguous zone, EEZ (exclusive economic zone) as well as high seas and deep ocean floor (***Figure 2***). Whereas, the coastal environment is the sea within the 12 NM which include the territorial waters and territorial sea. The proposed underwater hull cleaning will take place in a coastal environment as illustrated below. The marine environment may be indirectly affected but not significantly.

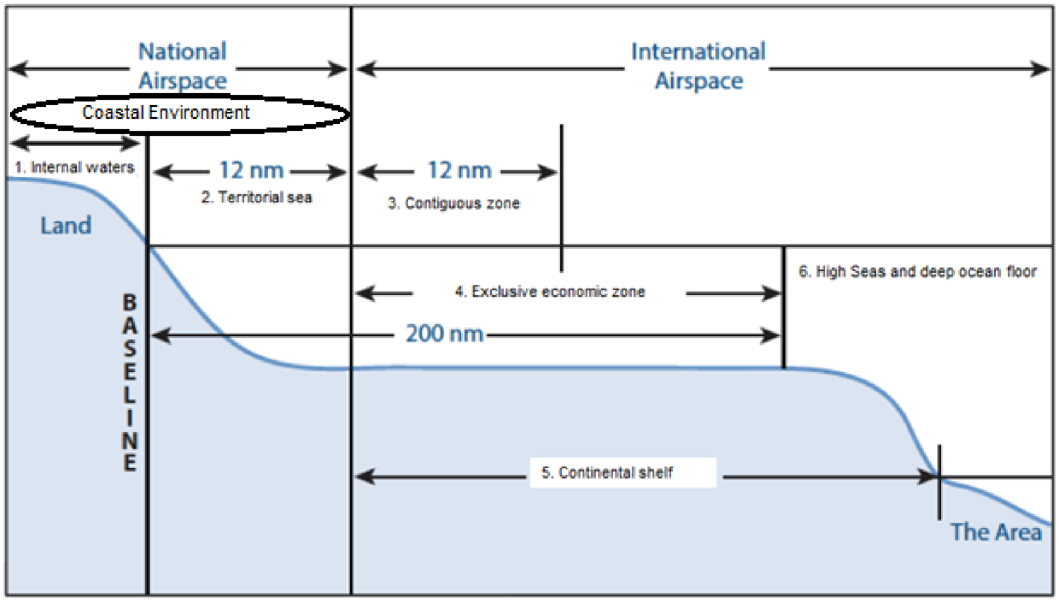


Figure 3: maritime zones showing the coastal environment as a main receiving environment.

1.3.3. Namibian coastal environment

Maritime zones from the baseline moving seawards are clearly defined because the 1982 UNCLOS (United Nation Convention on Law of the Sea) provides clear guidelines (UNCLOS, 1982). However, this is not the same when considering the coastal environment from the baseline landward. Obviously, the main borderline between the coastal and marine environment is the baseline; but the coastal borderline when moving from the baseline to land is not easy to define. Even during the Namibian coastal policy-formulation process, the coastal environment was defined based on 3 conflicting perspectives; namely socio-economic, geo-political and ecological boundaries (MET, 2009) as follows:

- *Socio-economic definition.* The socio-economic definition states that a coastal environment consists of the EEZ including the contiguous zone, territorial waters, internal waters and extend landward from the baseline to as far as those areas or regions where communities still benefit from coastal resources. This definition is too broad and makes it difficult to govern the coastal environment.

- *Geo-political definition.* The geo-political definition states that a coastal zone consist of the EEZ including the contiguous zone, territorial and internal waters, as well as regions of Karas, Hardap, Erongo and Kunene.
- *Ecological definition.* The ecological definition states that a coastal zone consist of the EEZ including the contiguous zone, territorial waters, internal waters and extend landward from the baseline to as far as those areas or regions where natural resources are affected by fog or benefit from fog.

Each definition above has strengths and weaknesses. The socio-economic definition is not clear in the sense that it does not define the types of coastal benefits. On the other hand, the geo-political definition is too broad because it includes areas (e.g. Keetmanshop, Mariental, Karibib and Omaruru) where fog rarely reach. Furthermore, the ecological definition is biased because, there are other resources like minerals which are not affected by fog.

This report argues that in addition to the definitions above, environmental impacts of specific coastal development projects could also be used to define geographic boundaries of the coastal environment. These environmental impacts can either be positive (e.g. employment creation) or negative (e.g. pollution). Therefore, for the purpose of this project, a distinction is made between the marine and coastal environments. The coastal environment will only constitute internal and territorial waters and is exclusive to Walvis Bay municipal boundaries. This is mainly because, positive (e.g. employment creation) and negative (e.g. pollution) will be localized in Walvis Bay; and partly because the maritime sector is a secondary or support sector and is currently not significant in terms of contribution to Namibia's GDP when compared to, for example, the fishing sector.

1.3.4. Impacts on the environment

Larger MVs (for e.g. cargo and passenger ships) operate on heavy fuel oils (HFOs), while tugs and fishing vessels tend to operate on distillate oil such as marine diesel oils (MDOs), marine gas oil (MGOs) as well as ultra-low sulphur diesels (ULSDs). HFOs, MDOs and

MGOs immensely contribute to GHGs' emissions because of their higher carbon concentrations and this has negative environmental impacts. Historically, the maritime transport sector operated with limited environmental management. For example, shipping and ports companies were not held accountable for marine and coastal pollution or other biosecurity risks emanating from ballast waters, accidental oil spills and other shipping activities. Increased incidents of oil spills in the 1960s triggered ratification of the MARPOL (International Convention for the Prevention of Pollution from Ships). Additionally, the International Maritime Organization (IMO) began using various environmental instruments to protect the coastal and marine environment from shipping activities. Despite these efforts by IMO, impacts on the coastal and marine environments continued to increase. These impacts include air pollution, emissions of GHGs, releases of ballast waters and sediment containing IAS (invasive aquatic species) and harmful pathogens, historical uses of anti-fouling paints, accidental oil and chemical spills, dry dock cargo releases, garbage, underwater noise pollution, ship strike on marine megafauna, risks of ships grounding or sinking and widespread bio-fouls contamination of ports during trans-shipment.

1.4. Project motivation

In Namibia, the blue economy is expected to play an extremely important economic role. In order to benefit more, Namibia needs to develop its blue economy aimed at managing and developing various blue economic activities including maritime transport.

The 2050 African Integrated Maritime Strategy (AIMS) aspires '*To foster increased wealth creation from Africa's oceans and seas by developing a sustainable thriving blue economy in a secure and environmentally sustainable manner."* Whether through fishing, aquaculture, marine and cruise tourism, maritime transport or dry dock facilities, Namibia needs to expand her blue economic potential.

There are already vital signs that the blue economy development is taking place in Namibia. This is evident from various developments such as expansion of the Walvis Bay Port and others as explained below.

1.4.1. New Container Terminal on reclaimed land

The new port terminal construction which commenced in 2014 was completed in 2019. It is constructed on a 40 ha of land reclaimed from the Ocean. As a result of this facility the Walvis Bay Port is now considered a logistic hub for southern Africa with increased capability to meet demand for freight services and maritime transportation to landlocked states in southern Africa.

Figure 3: port terminal in Walvis Bay (https://www.a1v2.pt/en/portfolio).

1.4.2. New national oil storage facility

Construction of the new national oil storage facility started in 2015. The aim is to increase the capacity to handle oil cargo and facilitate transportation and distribution of oil in Namibia and southern Africa.

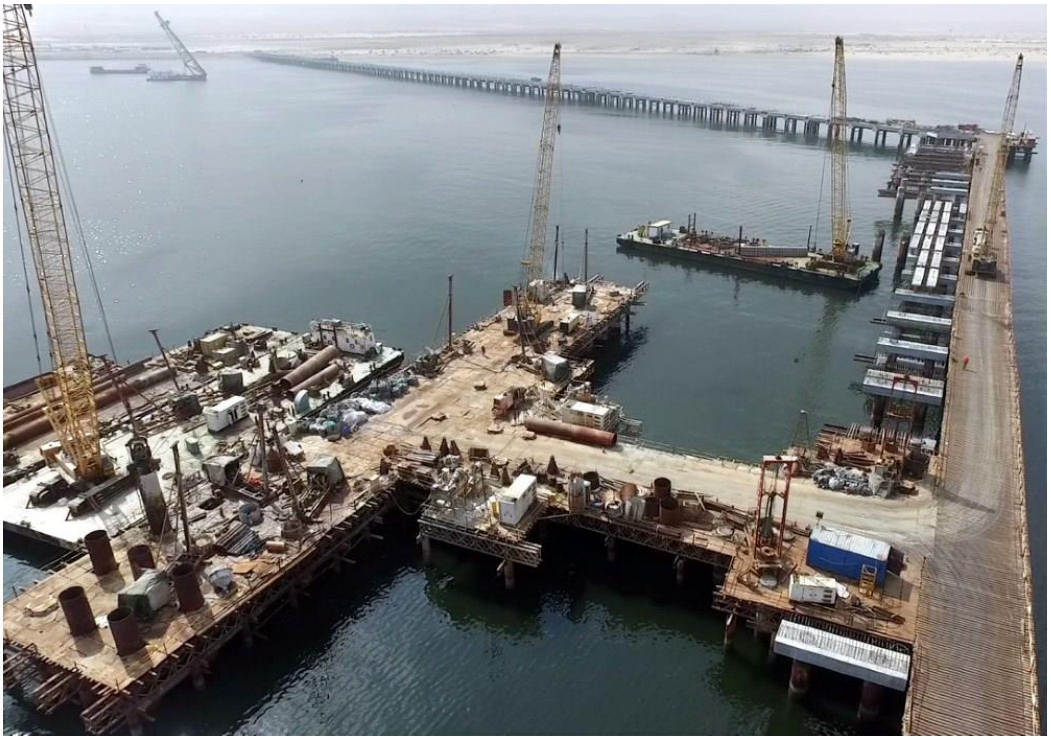


Figure 4: oil storage facility in Walvis Bay (https://www.logupdateafrica.com/).

1.4.3. New road construction

Completion of the Swakopmund-Henties Bay-Uis Higherway has a potential for new business opportunities which are linked to the blue economy. Upgrading of this road comprises MR (Main Road) 44 and the MR 76 stretch from Swakopmund to Henties Bay (MR 44) to Uis with the MR 76 onto Khorixas which ends at Kamanjab in the Kunene region. It is divided into 2 phases; whereby phase I had started from Swakopmund to Henties Bay (90 km). This phase is completed until Henties Bay but will continue up to Uis afterwards (96 km). Phase II will continue from Uis to Khorixas but had not yet commenced as the contractor had not yet been appointed.

1.5. Problem statement

The above vital signs indicate that the blue economy in Namibia has a huge potential for economic growth. There are prospective and constraints associated with each emerging economic sector. While blue economy activities are expected to contribute to employment creation and revenue generations, other activities such as air pollution, emission of GHGs, hull cleaning, ballast water release, garbage disposal, etc will have various negative impacts on the coastal and marine environments.

The problem associated with increased drag of MVs and higher fuel consumption is mainly caused by bio-fouling organisms. Attempts have been made experimenting with various types of anti-fouling paints that prevent bio-fouling to stick on hull surface as well as reduce growth by slowly releasing biocide antifouling paint on the hull surfaces. The main environmental impacts with anti-fouling paints is water pollution through release of organotin compounds such as tributyltin (TBT) and triphenyltin (TPhT).

The International Convention on the Control of Harmful Anti-fouling systems on Ships (2001) banned use of organotin compounds in marine paints. To this effect many organizations had adopted the underwater hull cleaning as the most preferred anti-fouling method with least environmental impacts.

1.6. Project alternatives

1.6.1. "Dry-dock cleaning and use of anti-fouling paints" alternative

The alternative to clean MVs while on dry-dock as well as use of marine anti-fouling paints are the common anti-biofouling systems used to clean MVs in Walvis Bay port.

1.6.2. "Underwater hull-cleaning technologies" alternative

The other alternative is to clean MVs using underwater hull cleaning technologies. There are various operators (e.g. KWINT Offshore Services Namibia (Pty) Ltd and Barbarian Diving Marine Services) currently providing underwater hull cleaning using the Automated Hull-Wiper technology.

1.7. Discussions, conclusions and recommendations

Underwater hull cleaning technologies are cheaper and could be a better option to MVs operators compared to dry-dock cleaning or use of anti-foul paints. Technology may not solve all environmental problems; but when combined with innovation, it has a potential to provide some of the environmental solutions. Critically, real solutions are practical, flexible and adaptable to different situations and contexts. The real world and human mindsets are triggered by practical solutions. Usually in Namibia, the private sector is prepared to contribute in providing environmental solutions, for example by investing in various technologies; but are they recognized or supported?

All stakeholders (GRN institutions, port authorities, local authorities, NGOs, financial services providers, etc) need to recognize and support efforts by the cleaning service providers to invest in the underwater hull cleaning technologies. GRN needs to do away with the bureaucratic administration processes; promote actions that transform behaviors, and invest into these resilient pathways for effective environmental governance and sustainable development. It is our hope and aspiration that the ROV-cart technology will contribute to a safer coastal and marine environment in Namibia.

CHAPTER 2

2. APPROACH AND METHODOLOGY

2.1. Introduction

This chapter provides steps in the EIA procedures that were followed in carrying out the EIA/scoping study as well as steps involved in impacts assessment.

2.2. Desk studies and literature review

Desk studies and literature reviews were undertaken in order to gather facts, relevant background documents and information from literature and previous works about the site; gather information about similar services provided by other service providers; identify affected and interested parties; document current and past use of the underwater hull cleaning technologies. All documents considered and the body of literature reviewed are provided in the bibliography.

2.3. Field surveys

2.3.1. Study area

The site visits were undertaken on 18, 22 and 28 June 2021 to verify baseline conditions at the project site and confirm data and information from literature.

2.4. Public consultation process

2.4.1. Public notices at public places

It is required by law (EIA regulations) for public notices to be placed at various places in Walvis Bay.

2.4.2. Written notices to key I & APs

In addition to public notices, key I & APs were identified and notified of the intention by the proponent to apply for the ECC.

2.4.3. Advert in newspapers

Notices were placed in 2 (two) local newspapers, according to the EIA regulations.

2.4.4. Electronic meetings

Due to COVID-19, electronic meetings were crucial in reaching out to the public; this was for the safety of I & APs. Namibia reached a peak in COVID-19 infections between June and August 2021.

2.4.5. Public meetings

If electronic meetings are found to be ineffective, a public meeting will be conducted. The aim of a public meeting is to capture public views and opinions about the project. Due to COVID-19, a public meeting was not possible.

2.4.6. Release of draft EIA/scoping report

This was important as part of providing feedback to I & APs about the project progress since the last public consultation was held.

2.5. Environmental impact assessment methods

2.5.1. ***Leopold matrix method***

The Leopold matrix assessment was used in the evaluation of impacts. This is a qualitative environmental impact assessment method and it involved a series of stages including impacts prediction, description, and assessment as described below.

2.5.1.1. Valued ecosystem components

Project activities to be undertaken will have impacts on the essential biological, physical and human components of the environment. These environmental components are also well known as VECs (valued ecosystem components). The first requirement in the Leopold matrix was the identification of VECs as illustrated in the table below.

Table 1: valued ecosystem components (VECs).

Environmental resource	**Valued ecosystem component**	**Importance of the valued ecosystem component**
Air and climate	Air quality	• Heavy diesel emission. • Health implications for all users. • Effects on atmosphere.
	Climate	• Greenhouse emission.

		• Contribution to global warming.
Land	Geomorphology and landscape	• Oil and chemical spills. • Use of non-renewable energy. • Widespread sediment contamination. • Dry dock cargo releases. • Effects of waste disposal methods. • Risks of ships grounding or sinking.
Water	Potable water quality	• Sustainability issues (for e.g. is potable water resource a critical concern locally?). • Conflict use (cleaning, irrigation and drinking).
	Sea water quality	• Oil and chemical spills. • Higher water turbidity. • Historical uses of anti-foulants. • Conflict use (fisheries and mari-culture). • Health implications for consumers.
Ecology and aquatic biodiversity	Terrestrial ecology and aquatic biodiversity	• Introduction of bio-fouling organisms that accumulate on ship hulls and the probability of them being alien species. • Releases of ballast water containing invasive aquatic species and harmful pathogens. • Ship strike on marine megafauna. • Incidental intake of marine mesofauna by vacuum pumps.

		• Importance for ecosystem well-being and proper functioning.
Human Environment	Socio-economic & biodiversity	• Impacts of maritime activities on other blue economic activities (e.g. fisheries and mari-culture). • Employment opportunities. • Community welfare.
	Public health and safety	• Harmful algae blooms. • Introduction of toxic shellfish species. • Reduction on gas flaring.
	Noise pollution	• Underwater noise. • Influence on aquatic biodiversity. • Nuisance to local community and ecosystem.
	Light pollution	• Nuisance to local community and ecosystem. • Road accidents, theft and property damage.

2.5.1.2. Impact aspects

The second stage in the Leopold matrix was to identify and map the receiving environment by identifying various environmental aspects that will be affected by each project activities during each phase and this was done using the table below.

Table 2: impacts aspects.

Project component	**Environmental aspect**
Preparation – vessel inspection and preparation	Ship assessment to determine whether is safe to clean in port.
	Transport and equipment use
	Purchase and delivery of materials and services
	Personnel safety and use of equipment

	Increased marine traffic
Cleaning activities – cleaning, ROV-cart operation and de-commissioning.	Installation of ROV-cart unit, hose connection, power supply, drainage of liquid waste and others.
	Water extraction and debris bio-fouling reclamation.
	Waste disposal, clean-up, filtration, disinfection and water discharge.
General operational issues.	Spills and leaks
	Environmental monitoring
	Underwater noise

2.5.1.3. Impacts evaluation

The third stage in the Leopold matrix was evaluation of importance of each impacts in order to determine their significance on the receiving environment. Each impact was rated in terms of their level, duration, intensity, probability and significance as illustrated below.

Table 3: evaluation of importance of impacts.

Assessment of Impact	Rating	Description
Nature	(D) Direct	Caused by the project and occur simultaneously.
	(I) Indirect	Associated with project and may not happen immediately.
	(I) Cumulative	Combined impacts that could be associated with other existing activities or future activities not related to the project.
Extent	I	**Immediate**.
	L	**Local** (Walvis Bay).
	R	**Regional** (Erongo Region).
	N	**National** (Namibia).
	I	**International.**
Duration	ST	**Short term** (0-5 years).
	MT	**Medium term** (5-15 years).

	LT	**Long Term** (>15 years).
Magnitude	L M H	**Low** (the natural, cultural and social functions and processes are not affected). **Medium** (the affected environment is altered but natural, cultural and social functions and processes can continue). **High** (the affected environment is altered to the extent that natural, cultural and social functions and processes will temporarily or permanently stop).
Probability	LP P HP D	**Low** probability (possibility of impact occurring is low, below 25%). **Probable** (there is a distinct possibility that it will occur, approximately 50%). **Highly probable** (the impact is most likely to occur, 75%). **Definite** (the impact will occur, more than 100%).
Significance with mitigation measures (WM) and without mitigation measures (WOM)	L M H	**Low** (where natural, cultural, social and economic functions and processes are not affected). **Medium** (where the affected environment is altered but natural, cultural, social and economic functions and processes can continue). **High** (where the affected environment is altered to the extent that natural, cultural, social and economic functions and processes will temporarily or permanently stop).

2.5.1.4. Mapping of significant impacts

The last stage was to provide a detailed evaluation of impacts as well as their summary evaluation, combining magnitude and importance. This summary evaluation highlighted significant impacts that should receive higher priority during impacts mitigation and was the basis for developing a sound EMP.

This was a critical stage during which Consultants were to probe issues in details, for example by asking the following questions:

- What are the project impacts and which VECs are more vulnerable?
- Which impact is most significant?
- Which impact should be prioritized during mitigation?
- Which impacts should be monitored and how?

2.6. Discussions, conclusions and recommendations

The above questions were very important in the designing of an effective EMP and implementation of the baseline environmental monitoring plan. As often argued in literature, EIA as an instrument for environmental management and sustainable development is not sufficient in evaluating development projects because it has weaknesses (Cashmore, 2004). These weaknesses include the fact that the scope of EIAs is limited when measured on a temporary scale. It merely provides a snapshot overview of baseline conditions of a development project and fails to consider indirect environmental impacts or cumulative impacts that may occur as a result of a development project during operation.

Therefore, to make up for this it is recommended that an EMP and baseline environmental monitoring plan should be prepared and submitted along with the EIA/scoping report.

CHAPTER 3

3. ENVIRONMENTAL POLICIES AND LEGISLATIONS

3.1. Introduction

This chapter provides an outline of local and international environmental policies and legislations. The chapter deliberately start with analysis of policies; then moving to legislations. The reasoning behind this 'bottom-up' approach is because, often policies provide more clear guidelines compared to Acts.

While this report acknowledges that local policies and legislations are the most relevant in this project, it is also important to note that ports strictly adhere to maritime standards that are guided by international laws and Conventions.

Furthermore, this report argues that not all environmental policies and legislations are regarded as constituting environmental law. An important question is whether specific environmental policies and legislations would qualify as constituting environmental law merely based on relevance or potential relevance to environmental management. In this regard, environmental policies and legislations could be classified into broad categories as described in below.

Table 4: classification of environmental policies and legislations.

Category	**Example**
a) *Exclusive environmental policies and legislations* aim exclusively at environmental management and contain specific environmental principles.	**Soil Conservation Act 76 of 1969**. The environmental principle specific to this Act is *conservation of natural resources.* **Pollution Control and Waste Management Bill**. The environmental principle specific to this Bill is *pollution control.* **Environmental Management Act no. 7 of 2007**, etc. This Act covers a broad range environmental principle including *conservation, pollution, environmental protection and monitoring,* among others..

b)	Environmental policies and legislations that *predominantly* contain environmentally specific principles are formulated to promote an environmental object and predominantly contain environmental specific norms, but they also have other provisions.	For example, the **Animal Health Act 1 of 2011** predominantly deals with *prevention, monitoring* and *contro*l of animal diseases in order to protect public health but it also has other provisions (such as trade) that are not relevant to the environment.
c)	Environmental policies and legislations that *incidentally contain* environmental specific principles. These policies and legislations are not necessarily directed at environmental management but include provisions that may be contribute thereat.	The **Water Act no. 12 of 1997** incidentally cites terms such as *"more efficient use and control water resources"* because the Act itself mainly deals with establishment of the Namibian Water Co-operation Limited.
d)	Environmental policies and legislations with *indirect environmental relevance*. Often, these policies and legislations are not aimed at environmental management, but they include provisions that are indirectly of environmental significance.	E.g. the **Urban and Regional Planning Act no.** 5 of 2018 indirectly relates to marine spatial planning which will be critical in coastal land use planning during development of the Namibia blue economy.
e)	Environmental policies and legislations with *potential environmental relevance.* These policies and legislations are not aimed at environmental management, but includes provisions that are potentially of environmental significance.	E.g. **Appropriation Act no. 1 of 2017.** **Income Tax Act no. 24 of 1981.** **Land Tenure Act no. 32 of 1966.**
f)	Environmental policies and legislations which regulate *environmental exploitation* are aimed at promoting development of natural resources such as minerals, fisheries, tourism, etc.	E.g. **Marine Resources Amendment Act no. 9 of 2015**. **Mineral (Prospecting and Mining) Act 33 of 1992**.

g) Environmental policies and legislations with *no environmental relevance.*	**Labor Act 11 of 2007.**

3.2. Degree of relevance

It is appropriate to examine which of the above environmental policies and legislations would qualify as environmental laws. Environmental policies and legislations of categories *a)* and *b)* explicitly constitute environmental law while the last category *(g)* fall outside environmental law. Category *(c)* retains some characteristics of environmental law, although it also constitutes some provisions which seeks to further some other causes. Purely exploitive (category (f)) does not constitute environmental law, but if such policies and legislations are found to constitute environmental principles which promote environmental management, they could be qualified as environmental law.

The interesting question is whether category *(d)* and *(e)* should be recognized as environmental laws. The environmental significance of these legislations and policies only become relevant when they are interpreted to serve the cause of environmental protection. This means they are neutral; and they are often silent when it comes to environmental protection. Therefore, when misinterpreted in courts, they could also be used to harm the environment.

3.3. Local environmental policies and legislations

Below are some of the relevant local environmental policies and legislations:

- Environmental Assessment Regulations GN. 30 of 2012;
- Conservation of Biotic Diversity and Habitat Protection Policy of 1994;
- Environmental Management Act (no. 7 of 2007);
- Public Health Act 36 0f 1919 (as Amended by SWA (South-west Africa), prior to Namibia's independence), and
- Constitution of the Republic of Namibia (and First Amended Act 34 of 1998, Second Amended Act 7 of 2010, and Third Amended Act 8 of 2014);

Some of the environmental policies and legislations are summarized below.

3.1.1. <u>Environmental Impact Assessment Regulations GN. 30 of 2012</u>

For more about the regulations, the reader is referred to the EIA regulations (Environmental Assessment Regulations GN. 30 of 2012). The below is a mere summary of some of the regulations.

3.1.1.1. Duties of the proponent

According to *regulation 3*, it is the duty of the proponent to appoint independent Consultants who will guide in the EIA process. The regulations further require the proponent to provide information needed to complete the EIA and also ensure that the EIA procedures are followed

5.1.1.2. Appointed Consultants

Appointed Consultants should (*regulation 4*) have sufficient knowledge and experience in conducting EIAs as well as knowledge of the Act and relevant activities involved in the proposed project.

5.1.1.3. Public consultation process

According to *regulation 21*: *"The person conducting a public consultation process must give notice to all potential interested and affected parties of the application which is subjected to public consultation by:*

> *(a) fixing a notice board at a place conspicuous to the public at the boundary or on the fence of the site where the activity to which the application relates is or is to be undertaken;*
> *(b) giving written notice to: (i) the owners and occupiers of land adjacent to the site where the activity is or is to be undertaken or to any alternative site;*
> *(ii) the local authority council, regional council and traditional authority, as the case may be, in which the site or alternative site is situated;*
> *(iii) any other organ of state having jurisdiction in respect of any aspect of the activity.*

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

5.1.1.4. Regulations of affected and interested parties

According to *regulation 22*, ECUTS must open and maintain a register which contains the names and addresses of:

(a) all persons who, as a consequence of the public consultation process conducted in respect of that application, have submitted written comments or attended meetings with the applicant;
(b) all persons who, after completion of the public consultation process referred to in paragraph (a), have requested the applicant responsible for the application, in writing, for their names to be placed on the register; and
(c) all organs of state which have jurisdiction in respect of the activity to which the application relates. An applicant responsible for an application must give access to the register to any person who submits a request for access to the register in writing.

3.1.2. <u>Namibia's Environmental Assessment Policy</u>

Amongst others, this policy:

- Promotes sustainable development;
- Underscores the need to undertake EIAs for all development projects in Namibia;
- Encourages developers to practice 'reduction at source' in pollution control and waste management;
- Lists and describes all activities that require EIA;
- Describe the EIA process, and
- Stresses on the need to incorporate international accepted environmental norms.

3.1.3. <u>Namibia Climate Change Policy</u>

The National Climate Change Policy (NCCP) guides on how climate should be mitigated in Namibia. The NCCP shows 16 key climate change issues including:

- Sustainable energy and low carbon development;
- Technology development and transfer;
- Biodiversity and ecosystem services;
- Prioritize climate risk and integrate them into sectoral policies, and
- Sustainable development and ensuring environmental sustainability.

3.1.4. Other local environmental policies and legislations

The list of local environmental policies and legislations which are summarized below are not in any particular order of importance.

Table 5: list of local environmental policies and legislations.

Legislation	**Summary**	**Environmental principles**
Soil Conservation Act 76 of 1969	This act consolidates and amend the law relating to the combating and *prevention of soil erosion, the conservation, improvement and manner of* using the soil and vegetation and *the protection of water sources* and provide for matters incidental thereto.	Environmental principles specific to this Act are *conservation of soil.*
Pollution Control and Waste Management Bill	This Act promote sustainable development; to provide for the establishment of a body corporate to be known as the Pollution Control and Waste Management Agency; to prevent and regulate the discharge of pollutants to the air, water and land; to make provision for the establishment of an appropriate framework for integrated pollution prevention and control; to regulate noise, dust and odor pollution; to establish a 'system of waste planning and management; and to enable Namibia to	The environmental principle specific to this Bill is *pollution control.*

	comply with its obligations under international law in this regard.	
Environmental Assessment Policy (1995)	This policy aims to promote sustainable development and economic growth while protecting the environment in the long term. Therefore, Sector Ministries, the Private Sector, NGOs, and prospective investors and donors are urged to comply with this policy for all future development projects, programs and policies.	To use natural resources in a sustainable way for future purposes.
Land Use Planning Towards Sustainable Development Policy (1994)	This policy facilitates appropriate land-use planning and subsequent land use, support the process of consultation with appropriate institutions to ensure that local communities are involved in all decision-making process and ensure that they get maximum sustainable benefit from the land and natural resources with which they are associated and upon which they depend.	Environmental principles of this policy includes sustainable and integrated planning of land use in all environments throughout Namibia.
Territorial sea and exclusive economic zone of Namibia Act 3 of 1990	This Act determines and defines the territorial sea, internal waters, contiguous zone, exclusive economic zone and continental shelf of Namibia and to provide matters incidental thereto.	Minimize the exploitation of natural resources of the sea.
Walvis Bay and Offshore Islands Act 1 of 1994	An Act to make provision for the smooth transfer of control over Walvis Bay and the offshore islands from the Republic of South Africa to the Republic of Namibia effective as of 1 March 1994.	Provide provision for governance; fishing authorization, fishery management and conservation.
Namibia Ports Authority Act 2 of 1994	To provide for the establishment of the Namibia Ports Authority to undertake the management control of ports and lighthouse in Namibia and the provision of facilities and services related thereto.	To manage and exercise control over the operation of ports and lighthouse and other navigational aids in Namibia and its territorial waters.
Aquaculture Act 18 of 2002	This Act regulate and control aquaculture activities; to provide for the sustainable	Environmental principles of this act are to promote

	development of aquaculture resources; and to provide for related matters.	sustainable aquaculture; management, protection and conservation of marine and inland aquatic ecosystems.
Environmental Management Act no. 9 of 2007	This Act covers a broad range environmental principle including *conservation, pollution, environmental protection and monitoring,* among others.	*Prevent or minimize negative environmental impacts, pollution, function of the ecological systems.* *Reduce, reuse and recycle.*
Animal Health Act 1 of 2011	This Act predominantly deals with *prevention, monitoring* and *contro*l of animal diseases in order to protect public health but it also has other provisions (such as trade) that not relevant to the environment.	To *prevent* and *control animal diseases* in public and environment
Water Act no. 12 of 1997.	This Act incidentally cites terms such as *"more efficient use and control water resources"* however the Act itself mainly deals with establishment of the Namibian Water Co-operation Limited.	To *use* water in a *sufficient* or *sustainable* way
Urban and Regional Planning Act no. 5 of 2018	This Act consolidate the laws relating to urban and regional planning; to provide for a legal framework for spatial planning in Namibia; to provide for principles and standards of spatial planning; to establish the urban and regional planning board; to decentralize certain matters relating to spatial planning; to provide for the preparation, approval and review of the national spatial development framework, regional structure plans and urban structure plans; to provide for the preparation, approval, review and amendment of zoning schemes; to provide for the establishment of townships; to provide for the alteration of boundaries of	Environmental principles specific to this act are: *harmonization and streamlining of spatial planning* in order to avoid land use conflicts, delays in decision making and to *minimize negative environmental impacts.*

	approved townships, to provide for the disestablishment of approved townships; to provide for the change of name of approved townships; to provide for the subdivision and consolidation of land; to provide for the alteration, suspension and deletion of conditions relating to land; and to provide for incidental matters.	
Land Tenure Act no. 32 of 1966	To establish a Land Tenure Board; to provide for the acquisition and development of land for or for use in connection with farming purposes.	Environmental principles for this act are to provide land that is *suitable for use* in connection with development or farming purposes in order to prevent environmental impacts.
Income Tax Act no. 24 of 1981	To consolidate and amend the law relating to the taxation of income	For individuals or companies in Namibia to pay tax to the government. No specific environmental principles but it is important to environmental management.
Appropriation Act no. 1 of 2017	To appropriate amounts of money to meet the financial requirements of the State during the financial year ending 31 March 2018.	Meet the financial requirements needed by the state. No specific environmental principles but it is important to environmental management.
Marine Resources Amendment Act no. 9 of 2015.	This act provides for the sovereign exercise of ownership by the State over marine resources; to amend the provisions relating to the total allowable catch and allocation of quotas	Principles of this act is to manage, *protect, harvest* and *utilize marine resources* in Namibia.
Minerals (Prospecting and Mining) Act 33 of 1992	To provide for the reconnaissance, prospecting and mining for, and disposal of, and the exercise of control over, minerals in Namibia; and to provide for matters incidental thereto.	To protect minerals by ensuring that all mining activities in Namibia are licensed. No specific environmental principles but it

		is important to environmental management.
Atmospheric Pollution Prevention Ordinance 11 of 1976	To provide for the prevention of the pollution of the atmosphere	To prevent atmospheric pollution and *minimize environmental impacts* associated with it.
Water Resources Management Act 11 of 2013	To provide for the management, protection, development, use and conservation of water resources; to provide for the regulation and monitoring of water services and to provide for incidental matters.	Manage *water resources, prevent water pollution* and *control water storage* and provision.
Public and Environmental Health Act 1 of 2015	To provide a framework for a structured uniform public and environmental health system in Namibia.	Principles of this act includes protecting individuals and communities from public *health risks*, encourage community participation in order to create a *healthy environment*; and provide for early detection of diseases and public *health risks*.
National Climate Change Policy	This policy identifies technology development and transfer to be a key issue for which strategies and action plans should be developed.	Promote and encourage new and clean technologies to be developed in order to reduce greenhouse gas emissions.
Namibian Constitution (1990)	The constitution is the Supreme Law of Namibia, according to which all other laws are only valid if they are consistent with the rights contained within the Constitution	Specifically, Article 95 promotes welfare of the people and the environment.

3.4. International environmental policies and legislations

3.4.1. UN Stockholm Conference (1972)

The UN Stockholm Conference (1972) was the first world conference on the environment. It contains 26 principles which could be broadly classified into 3 categories: (a) global environmental assessment; (b) environmental management activities and (c) international measures to support assessment and management activities.

3.4.2. United Nations Convention on Law of the Sea

UNCLOS of 1982 was formulated to provide a legal framework for marine and maritime activities. Namibia and other 167 countries are party to the convention. UNCLOS guides on how each coastal states should delineate maritime boundaries, guard and control marine resources.

3.4.3. UN Conference on Environment and Development

The Rio Conference of 1992 sets goals aimed at addressing environmental problems. It was at the Rio Conference where the plan of action well known as *Agenda 21* was adopted. *Agenda 21* was reviewed continually through annual meetings of the Commission on Sustainable Development, including the 1997 UN General Assembly Special Session (otherwise known as the ***Rio+5***) and the World Summit on Sustainable Development (also known as the ***Rio+10***).

Table 6: list of international environmental policies and legislations.

Legislation	**Summary**	**Environmental principles**
2011 Guidelines for the Control and Management of Ship's Biofouling to minimize the Transfer of invasive Aquatic Species.	This guidelines are intended to provide a globally consistent approach to the management of biofouling, which is the accumulation of various aquatic organisms on ships' hulls	Prevent the transfer of invasive and coordinating a timely and effective response to invasions which requires cooperation and collaboration among governments
Stockholm Convention on Persistent Organic Pollution (2001)	Is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods.	To protect human health and the environment from persistent organic pollutants.

Vienna Convention for the protection of ozone layer (1985)	This Convention is aimed to promote cooperation among nations by exchanging information on the effects of human activities on the ozone layer.	To take control actions to protect the ozone layer
Montreal protocol (1997)	Is a global agreement to protect the earth's ozone layer by phasing out the chemicals that deplete it.	Control substances and chemicals production that are depleting the ozone layer
UN Framework on climate change (1992)	This framework was introduced to stabilize greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system.	Countries should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects.
Kyoto protocol (1997)	It is also designed to assist countries in adapting to the adverse of climate change. It facilitates the development and deployment of technologies that can help increase resilience to the impacts of climate change.	Reduce GHG emission at least by 18%
Basel Convention (1992)	To protect human health and the environment against the adverse effects of hazardous wastes.	Reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes
Convention on International Trade in Endangered Species of Wild Faunal and Flora (1963)	It is an international agreement between governments which is aimed to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species.	Control and regulate the trade of wild animals and plants between countries and protect them from over-exploitation.

Cartagena Protocol on Biosafety (2000)	International agreement which aims to ensure the safe handling, transport and use of modified living organisms resulting from modern biotechnology that may have an adverse effects on biological diversity, taking also into account risks to human health.	It seeks to protect biodiversity from the potential risks of living modified organisms (LMOs) resulting from modern biotechnology.
Conventions on Wetland of International Importance (1971)	Conserving wetlands (swamps, marshes, lakes, mudflats, peat bogs and other bodies of water whether natural or artificial, permanent or temporary).	This convention establishes a management framework aimed at conserving the wetland and ensuring its wise use.
Paris Agreement (2015)	Is a legally binding international treaty on climate change.	To limit global warming to preferably 1.5 degrees Celsius, compared to pre-industrial levels.
United Nations Convention on Law of the Sea of 1982 (UNCLOS).	It's a legal framework for marine and maritime activities. It lays down a comprehensive regime of law and order in the world's oceans and seas establishing rules governing all uses of the oceans and their resources.	It provides that coastal States have sovereign rights in a 200-nautical mile exclusive economic zone (EEZ) with respect to natural resources and certain economic activities, and exercise jurisdiction over marine science research and environmental protection; States are bound to promote the development and transfer of marine technology *'on fair and reasonable terms and conditions'*, with proper regard for all legitimate interests;
International Convention for the Control of and Management of Ships' Ballast Water and Sediments of 2004.	This Convention seeks to prevent the spread of harmful aquatic organisms from one region to another, by the establishment of standards and procedures for the management and control of	Environmental principles of this convention is to protect the oceans from invasive aquatic species

	ships' ballast water and sediments.	
International Convention for the Prevention of Pollution from Ships (MARPOL) and the protocol of 1978.	This convention is aimed at the prevention of pollution from ships caused by operational or accidental causes.	Prevention of pollution by sewage, oil and garbage from ships in the sea; Prevention of air pollution from ships; prevent pollution by Harmful Substances carried in sea in packaged form
International Convention of the Safety of life at Sea of 1974 (SOLAS).	SOLAS is an international maritime treaty which sets minimum safety standards in the construction, equipment and operation of merchant ships.	Convention allows for flag states to compel ships under their flags to comply with safety requirements including fire-fighting equipment and nuclear containment facilities in order to prevent impacts associated with risks of transportation of dangerous goods.
Convention on the Prevention of Marine Pollution by dumping of wastes and other matters, 1972 (as amended by the protocol of 1996).	This convention protects the marine environment from human activities such as pollution.	Take practicable steps to prevent pollution of the sea, promote the effective control of all sources of marine environment caused by dumping at sea; (black and grey list).
International Convention on Oil Pollution Preparedness, Response and Co-operation of 1990 (OPRC Convention) with its Protocol of 2000 (OPRC-HNS Protocol).	Convention was developed by the International Maritime Organization (IMO) to further prevent pollution from ships and it requires coastal states to prepare and response to oil spills risks.	Convention compels states to carry onboard oil pollution emergency plan in order to effectively respond to oil pollution incidents.
Nairobi International Convention on removal of wrecks (18 May 2007).	The Convention provides a set of uniform international rules aimed at ensuring the prompt and effective removal of wrecks located beyond the territorial sea. The Convention also includes an	It provides a sound legal basis for coastal states to remove wrecks which pose a hazard to the safety of navigation as well as the marine and coastal environments.

	optional clause enabling States Parties to apply certain provisions to their territory, including their territorial sea.	
Internal Convention on Biological Diversity	Among others, this Convention aims at conservation of biological diversity and promote sustainable development of biological components.	Conservation of biological diversity, sustainable use and equitable sharing of utilization of biodiversity, ecosystem assessment and monitoring and mitigation of adverse environmental impacts.
International Convention on the Control of Harmful Anti-fouling Systems on Ships (2001)	The convention prohibits the use of harmful organotin in anti-fouling paints used and establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems.	It is preferable to minimize the accumulation of biofouling on vessels and movable structures.

3.5. Discussions, conclusions and recommendations

On the outset; a major challenge in the field of environmental law are environmental legislations and policies that cut across divisional laws. This is because they constitute provisions for regulating other (traditional) fields of law other than the field of environmental law. Even more important, these pieces of legislations and policies are multiple and evolved compared to novel environmental legislations and policies. For example, policies and laws that regulate traditional documentations (e.g. identification document, birth certificate, passport, driver's license, vehicle license, fishing permits/licences, exclusive prospective license, permit to import/transport live animals and others) are well obeyed compared to novel environmental permits (e.g. ECC, water discharge and abstraction permits, etc). This is a challenge to the judiciary system when litigating court cases and it raises a critical question: *is there a need for establishment of environmental courts in Namibia?*

When analyzed in terms of the coastal environment, where different economic sectors operate within a limited space, the above challenge becomes even more overwhelming. With increase in blue economy activities, there is a need for a blue economy policy in Namibia which will harmonize economic sectors operating within the coastal and marine environments.

CHAPTER 4

4. PROJECT DESCRIPTION

4.1. Introduction

The International Convention on the Control of Harmful Anti-fouling systems on Ships (2001) has banned use of organotin compounds in marine paints. Subsequently, many countries had adopted the underwater hull cleaning as the most preferred anti-fouling method with least environmental impacts. Various underwater hull cleaning technologies had been developed and tested in different coastal and marine environments. The United States Coast Guards has endorsed this technology, and in Australia the anti-fouling and underwater cleaning is widely applied and guidelines had been developed (Department of the Environment, 2015).

In southern Africa, Propshine Saldanha (Pty) Ltd had prepared an environmental management procedure for operation of the ROV-cart and filtration system based on research and underwater cleaning observations in Durban and Mauritius. Walvis Bay Diving Company & Salvage cc (the proponent) intends to use the ROV-cart and filtration system which will be supplied by Propshine Saldanha (Pty) Ltd. The ROV-cart is a diver operated underwater hull cleaning and reclaim filtration system. The ROV-cart consist of a brush-cart equipment and a filtration unit. The brush-cart part which is deployed in water is used by the diver while underwater to clean. The diver uses the brush-cart to clean by scrubbing or careening the biofouling layer from the MVs' hull. The filtration unit is located onboard a support vessel where the reclaimed debris is received. Through the hose, the reclaimed water containing physical materials removed from the MVs' hulls, is pumped into a filtration system where it is separated into liquid and solid wastes. The liquid waste is treated before it is discharged back into the seawater. The remaining treated solid material is stored in drums for proper disposal according to the municipal procedures.

4.2. Project area

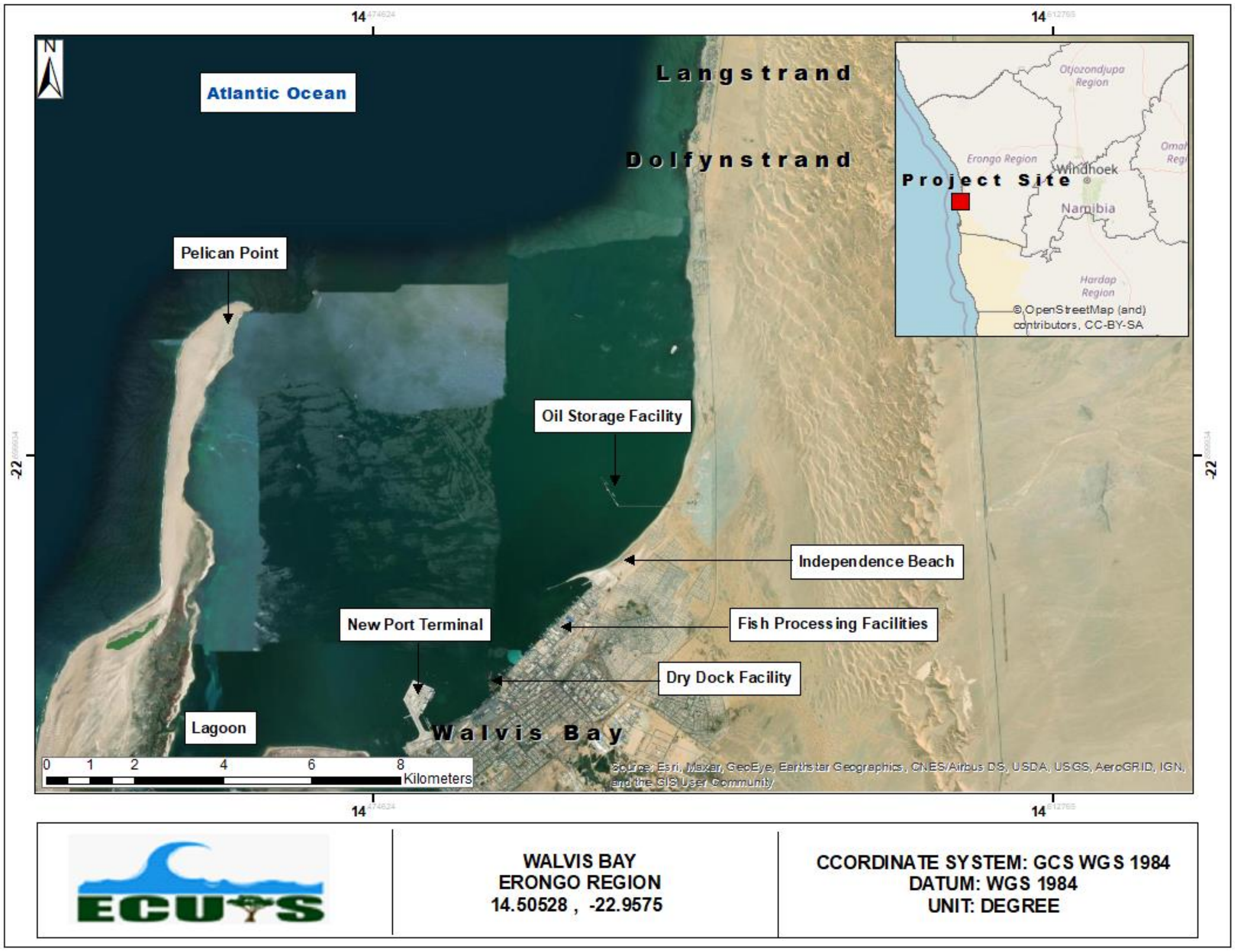


Figure 5: Walvis Bay map.

4.3. Description of the proposed technology

There are different types of underwater cleaning technologies; some are diver operated while some are automated. Each technology has advantages and disadvantages but this is not the focus of the report. The proposed underwater hull technology is the ROV-cart and filtration system; which is diver-controlled. The system consists of the ROV-cart and filtration unit.

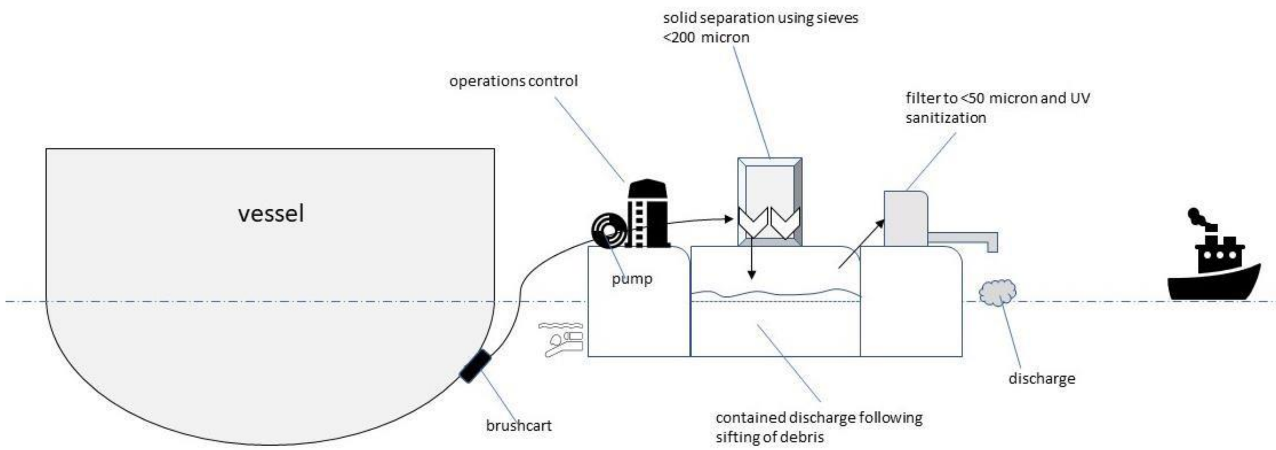


Figure 6: ROV-cart and filtration system.

4.3.1. Brush cart

The cart is controlled by the diver and while underwater it used to clean the hull by scrubbing or careening. The brush-cart is a diver-steered, hydraulically-powered unit with three rotating discs that can be fitted with either brushes or blades. For less regular surfaces, shrouded hand tools, and a containment box have been designed. Each cleaning tool has a suction shroud that connects separately to the central, fully enclosed suction system through which debris is pumped onto the support vessel or containment tank for treatment.

4.3.1.1. <u>Hull surface cleaning</u>

The brush cart is a diver operated machine that scrub or careens biofouling organisms from the MV hull. The machine is approximately 2.5 m and 1.5m, with the lower rim of the cart body being fringed by a shroud of dense, flexible bristles and an additional outer PVC flexible skirt that retains bio-fouling debris within the area of suction. The brush cart has two counter-rotating discs in the rear and a single rotating disc in the front to which 450 mm diameter brushes or bladed discs are attached. The discs are hydraulically driven, and the total width of clean in one pass is 1.1 m.

Suction of bio-fouling debris is generated by hydrodynamic vortices generated by the brushes, the centrally situated pump and a submersible pump. The water and physical material is drawn through a central port to a central suction line which leads into the 0.1 m hose to the submersible pump.

4.3.1.2. Niche cleaning

Since the brush cart cannot clean irregular (e.g. hull surfaces, invaginations or protrusions), the submersible pump is fitted with an additional 50 mm hose pipe for attachment of the interchangeable niche cleaning tools. Each tool has a suction shroud that connects separately to the central suction system which allows multiple, concurrent cleaning tasks.

Figure 7: ROV-cart equipment.

4.3.2. Filtration unit

The filtration unit is located onboard of a support vessel where the crew is transported. The water and bio-fouling debris removed from the hull is transferred to the filtration unit which is a fabric mesh filtration system and it removes debris >200µm into disposable bags. The discharge water is transferred into the holding tank on the cleaning barge where it is stabilized. UV treatment is used to denature cells and tissue that may be living within the intake water. This is to eliminate surviving bio-fouling organisms or larvae so that they do not exceed the IMO limit of 10 live cells/m^3. The sieving and removal of particles to 50 µm reduce turbidity of filtrate to levels similar to natural seawaters.

Furthermore, the processed filtrate is passed through the activated charcoal discharge tube. This system allows for the adsorption of metals and other dissolved species to the charcoal which further improve filtrate water quality before discharge back into the sea. The collection bags containing residue or solid waste are further treated with lime, loaded into leak proof waste skips and transported to an approved land fill site for proper disposal.

4.4. The Proponent

The project proponent is Walvis Bay Diving & Salvage cc. The private sector has a role to play in the blue economy development and Walvis Bay Diving & Savage cc is already playing a significant role. Walvis Bay Diving & Savage cc was established in 1996 as a commercial diving company operating in the port of Walvis Bay. The proponent specializes in general harbor work and support to the international cargo, fishing fleet, commercial and other vessels. Walvis Bay Diving & Salvage cc grew to be the best equipped diving company in Namibia with the most competent, devoted and experienced staff.

It is the purpose of the proponent to continue providing safe, efficient and cost-effective services to the maritime transport sector for underwater services, rapid response to crisis, diligent attention during operations, maintenance and refits by managing divers, marine crews and provide modern technology and equipment support. During operations, the proponent adheres to the following environmental principles:

- *Prevention:* the proponent takes measures required to prevent, avoid or minimize negative environmental impacts.

- *Rectification at source:* the proponent takes reasonable measures to ensure environmental damage or pollution is dealt with when it occurs.
- *Polluter pay:* the proponent understands that; should pollution occur as a result of their activity, the proponent will bear the cost of the damage caused.
- *Integration:* the proponent works together with stakeholders to promote environmental protection and sustainable development.

In an effort to expand its operations, the proponent would like to undertake the proposed underwater hull cleaning operation. The proponent understands certain negative impacts on the environment will be unavoidable and for this reason, the proponent has appointed ECUTS to undertake the EIA/scoping study and prepare the EMP report. According to regulation 3 in the EIA (GN. 30 of 2012), it is the duty of the proponent to appoint an independent Consultant to guide the EIA process. Subsequently, the proponent and Consultant had agreed on the below to be the terms of references in undertaking the EIA/scoping and EMP process.

4.5. Terms of references and objectives

The following are the terms of references (ToRs):

- Undertake a comprehensive literature review;
- Visit the proposed site;
- Prepare newspaper adverts/public notices and facilitate the public consultation process;
- Prepare BID (background information document) and inception report for the Client;
- Provide detailed scope of work and activities needed to complete the EIA study;
- Compilation of applicable and relevant local and international environmental policies and legislations;
- Identify and evaluate impacts as part of the EIA process;
- Complete and submit draft EIA and EMP reports for public comments/review as part of the EIA process;
- Submit final EIA and EMP report to MEFT;

- Launch application for ECC (environmental clearance certificate) at MEFT, and
- Delivery of ECC to Client.

4.6. Discussions, conclusions and recommendations

Underwater hull cleaning technologies had been adopted in many countries as the preferred method for hull cleaning. Although, the International Convention on the Control of Harmful Anti-fouling systems on Ships (2001) does not apply to countries that has not ratified it; many countries voluntarily encourage the use of the underwater hull cleaning technologies. These countries have done this in order to protect their internal and territorial waters from IAS and harmful pathogens and avoid ecosystem impacts associated with AIS and harmful pathogens.

Though the proposed underwater hull cleaning technology using ROV-cart is a value added and innovative technology; it is important to apply additional precautionary environmental measures. For this reason, it is recommended that:

- The proponent should ensure the EMP is properly implemented;
- Samples of waste water as well as solid waste should be taken for analysis to verify their quality or composition pose no environmental risk, and
- Before commencement of the underwater hull cleaning operations, the proponent shall submit to NAMPORT or other authorized entities a baseline environmental monitoring plan detailing on how negative environmental impacts will be mitigated.

CHAPTER 5

5. BASELINE PHYSICAL ENVIRONMENT AND BIOLOGICAL DIVERSITY

5.1. Introduction

While the proposed underwater hull cleaning will take place in a coastal environment, the marine environment will also be indirectly affected; though not significantly. As will be seen later, only some aquatic biota occur in the coastal environment. Aquatic biota that migrate between the marine environment could be indirectly affected by the proposed underwater hull cleaning. Often, the coastal environment is a breeding and nursery area for some species; after which they migrate offshore into the marine environment. Despite its location away from the project area, the marine environment cannot be completely disregarded because it is interconnected to the coastal environment.

This chapter provides a description of baseline physical environment and biological diversity. The physical environment component include air and climate, waves, currents, seawater quality, sediment and coastal land. The biological component which includes the flora and fauna are the major constituents of biofouling organisms. Globally, there are approximately 4,000 marine species that have been identified as biofouling organisms; all of which are invertebrates (Anderson and Hunter, 2000).

5.2. Climate and hydrography

Climate in the south east Atlantic Ocean is mainly influenced the cold Benguela current and to a less extent, the Agulhas and Angola warm currents. As part of the Benguela upwelling current system, the BCLME (Benguela current large marine ecosystem) is driven by southerly winds, including transportation of deep cold and nutrient-rich waters through Ekman transport (Mann & Lazier 1999). The resulting coastal upwelling process induces primary and secondary productivity in the BCLME (Strϕmme 1995; Bakun 1995). Among others, several physical factors that play a critical role during the upwelling are SSTs (sea surface temperatures), Carbon dioxide (CO_2), DO (dissolved oxygen), sun radiation and nutrients. When describing the central BCLME based on SSTs and DO; generally, the ecosystem appears to display low mean annual SSTs and low DO throughout the year. Although, there are years were SSTs are unusually higher and DO extremely low, physical conditions in the central BCLME sub-system seem to be more homogenized than heterogenic when compared to the northern and southern BCLME sub-systems where there are significant differences in physical conditions.

5.3. Physical environment indicators

Seawater quality is a VEC (valued environmental component) which will be directly affected by the proposed underwater hull cleaning. Seawater quality could be measured using a variety of indicators including physical/chemical characteristics (e.g. turbidity, pH, temperature, dissolved oxygen, organic and non-organic matter) and biological indicators (primary, secondary and tertiary productivity).

Selected indicators are explained below.

5.1.1. Carbon Dioxide

One major threat on crustaceans is ocean acidification, partly resulting from increased concentration of dissolved Carbon dioxide (CO_2) and other pollutants. The global average atmospheric CO_2 in 2017 was 405.0 mg/L. CO_2 levels today are higher than at any point in the past 800,000 years. When atmospheric CO_2 enter the seawater it reacts to form weak acids. Subsequently, excess concentration of acids in seawater, resulting from increased atmospheric CO_2 causes ocean acidification. Acidification and low pH inhibit exoskeleton formation in crustaceans. Acidification and low pH also reduces abilities of crustaceans to absorb Calcium needed for exoskeleton formation.

5.1.2. Sea surface temperatures

In terms of the heat budget, the BCLME is both a heat sink and source. The southern and northern sub-systems of the BCLME are described as heat sources due to influence of the Agulhas and Angola warm Currents, respectively. However, the central BCLME is classified as a heat sink with negative climatological SSTs anomalies of 5° to 6°C in areas of active upwelling cells (Shannon & O'Toole 1999). Temperate conditions in the central BCLME strongly influence the Namibian coastal and marine environments. This influence has given rise to cold and nutrient-rich coastal waters as well as cooling of the overlying air temperatures and arid coastal conditions. Due to coastal aridity, rainfall is scarce; which means nutrients loading into the coastal aquatic systems (e.g. port, lagoon and estuaries) through river systems is rare. Moreover, nutrient loading could be directly related to the central BCLME and not terrestrial runoff from local River systems.

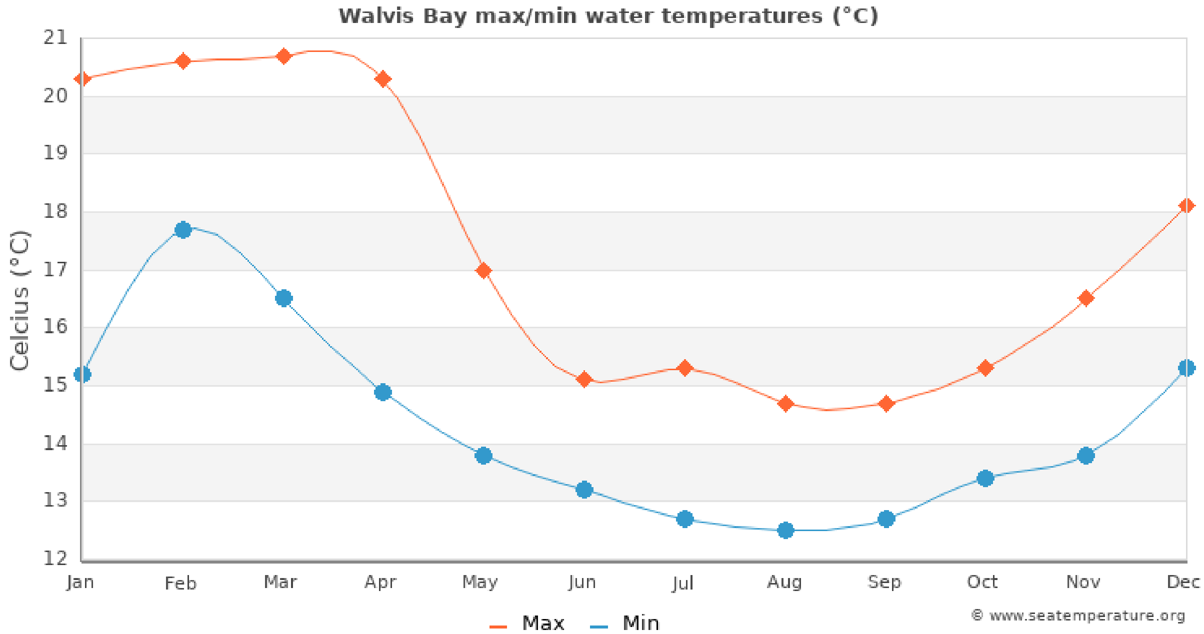


Figure 8: Winter in Walvis Bay starts in June and ends in early November; being replaced by summer as indicated by higher water temperatures from October to April (source: www.seatemperature.org).

5.1.3. Dissolved Oxygen (DO) concentration

After upwelling, inorganic nutrients are converted into organic nutrients and through photosynthesis, oxygen is released. Literally, water associated with upwelling is supposed to be rich in dissolved oxygen. However, this is not the case in many upwelling areas because of other physical and biological factors. Although causes of low DO (dissolved oxygen) is controversial; at least it is known that higher primary productivity is one of the contributing factors. Excess phytoplankton which is not used up in secondary production settles at the bottom to decompose. During the season of intense upwelling, primary productivity is so higher that biological oxygen demand (BOD) during the decomposition process causes deficit in the supply of DO; subsequently leading to DO deficient waters and formation of oxygen deficient layer. Longer period of DO deficiency waters leads to anoxic conditions when DO concentration falls below 5 mg/L. When aquatic organisms are unable to breath due to low concertation of DO, they suffer and die from suffocation. Anoxicity is a common feature in the central BCLME sub-system (e.g. off the coast of Walvis Bay) and has a peak in summer between January and March annually. It accounts for huge losses of crustaceans and pelagic fish species (Verheye et al. 2005; Hamukuaya *et al.* 1998; Reiss 1997).

5.1.4. Turbidity

Total solids (TS) is the total amount (measured in mg/L) of solids in water that is either due to physical (e.g. rock weathering), chemical or biological (e.g. decay of phytoplankton biomass) activities. Sediment loading of non-organic origin results from physical and chemical activities which usually leads to total dissolved solids (TDS) (e.g. salts, trace elements, etc) and also include total volatile solids (TVS). Together, they are used to indicate water clarity; which is usually referred to as turbidity.

5.1.5. Total suspended solids

Increase in sediment loading of biogenic origin could be due to removal of hull cleaning operations but also from other sources. These include solids that form due to biological activities and usually leads to total suspended solids (TSS) and also volatile solids.

5.1.6. pH

The level of pH indicates the quality of water and is affected by a number of factors including concentration of free Carbon dioxide, various pollutants, etc.

5.1.7. Other indicators

Other indicators of sea water quality are salinity, conductivity, trace metals, etc. All indicators of seawater quality had been covered more comprehensively in the BCC guideline on water quality where threshold limits had also been provided (BCC, 2017).

5.2. Ecosystem diversity

Namibia’s climate and weather is contrasting and shows huge variations at both spatial and temporal scales. Subsequently, ecosystem diversity shows several distinct biomes viz. coastal and marine, desert Karoo, tree and shrub savannah, acacia savannah and wetlands. Biomes are distinct biogeographical regions comprised of a diversity of flora and fauna that results from climatic forces. Climatic forces act at different scales and this often lead to formations of macro-habitats and micro-habitats.

The proposed project is located in the coastal environment. Even within the coastal environment; there are variations which could be loosely divided into several macro-habitats and micro-habitats; comprised of estuaries, sandy and rocky shores, lagoons, bays and others as described below.

- *Rocky and sand shores* – Namibia's coastal environment consist of sand shores (54%), mixed sandy and rocky shores (28%) and rocky shores (16%).
- *Lagoons and river mouths* – these makes up 2% of Namibia's coastal environment and include:
  - Orange River mouth – situated in the south of Oranjemund, it is proclaimed a RAMSAR site and it offers suitable breeding grounds for 15 Red data book bird species.
  - Lüderitz lagoon – located south of Lüderitz, it is an important stop point for migrant birds and also hosts a number of marine shorebirds.
  - Walvis Bay lagoon – situated south of Walvis Bay, this RAMSAR site supports about 129, 000 birds and provides suitable conditions for Palaearctic and African migrant birds and hosts six rare bird species.
  - Kunene River mouth – bordering Namibia and Angola, this site supports higher avian species richness than other River mouths.
- *Bays* – these are natural areas which are sheltered and many of these had been converted into ports such as:
  - Walvis Port – it offers port and docking facilities to local fishing vessels as well as international cargos and oil rigs. It also serves as an import/export zone for the southern African region. Deep-water anchorage is available inside the harbour, and is protected by the natural bay. The Walvis Bay port is compliant with the International Ship and Port Facility Security code (ISPS). The Walvis Bay port is Namibia's largest commercial port, receiving approximately 3,000 vessel calls each year and handling about 5 million

tonnes of cargo. The Walvis Bay port handles container imports, exports and transshipments, as well as bulk and break-bulk of various commodities.

  - Lüderitz port – it offers port and docking facilities to local fishing vessels as well as international cargo vessel of limited size.
  - Sandwich harbor – though still referred to as a harbor its use is discontinued; it supports 8 Red data book bird species.

- *Sperrgebiet National Park*– originally proclaimed a Diamond area, this area is now a National Park and is declared a global biodiversity 'hotspot' for Succulent Karoo flora.
- *Offshore islands* – mainly found in the vicinity of Lüderitz, they contain breeding grounds for seabirds.
- *Namib Naukluft Park* – it stretches from areas north of Lüderitz up to Swakopmund. Lichens and *Welwitchia mirabilis* fields are more abundant here than anywhere else, except in the Skeleton coast area.
- *Dorab National Park* – this national park was proclaimed in 2010 and is one of the newly proclaimed national parks in Namibia. It is bordered to the south by the Kuiseb river and to the north by the Ugab river. It popular for recreational artisanal fisheries including *Argyrosomus inodorus* (Kabeljou)*, Dichistius capensis* (Galjoen)*, Lithognathus aureti* (West coast steenbra)*, Diplodus sargus capensis* (Dasie) and other linefish species. When moving inland the park also support vast fields of lichens and *Welwitchia mirabilis.* Furthermore, it contains breeding grounds of the popular *Damara tern*. Mineral resources include Uranium and precious stones. In essence this is an important area both in terms of fishing, tourism and mining.
- *Cape Cross Seal colony* – it is about 70-KM north of Henties Bay and is the only largest land-based seal colony in the world.
- *Skeleton coast* – endowed with spectacular and breath taking landscapes and dunes, this is the coast's northern limit with some of the Desert adapted flora and fauna. Like the Naukluft area, it contains vast fields of lichens and *W. mirabilis*.

5.3. Flora diversity

5.3.1. Plants and trees

Flora diversity is very limited as observed from the absence of trees and bushes or shrubs due to arid conditions described earlier. However, there is a plant (*Salicornia* spp.) of particular interest due its increase in its vegetation cover in the last 10-15 years.

5.3.2. Phytoplankton diversity

Phytoplankton is important because it forms a basis for marine productivity. There are phytoplankton species that are toxic to humans when ingested through consumption of shellfish. Harmful phytoplankton species are associated with HABs (harmful algae blooms). The season for HABs is from July to October with a peak in August. Eutrophication is a main contributing factor to HABs and is caused by several natural factors but anthropogenic factors such as intense upwelling activity, river run-off, sewage discharge and others also contribute. Higher upwelling in the BCLME mainly accounts for HABs when nutrient-rich waters are transported near the coast and in the euphotic zone (Chikwililwa, et. al. 2019). It is postulated that HABs could also be induced by anthropogenic activities; however, this has not been scientifically proven.

Furthermore, many phytoplankton species are easily transported on hull surfaces of MVs; hence phytoplankton diversity is of particular interest in this study. Species composition of phytoplankton by major taxa near Walvis Bay is as follow: Dinoflagellates (48.2%), Diatoms (43.5%), flagellates (3.27%) and bacteria (0.04%). Composition of other phytoplankton taxa such as cysts, ciliates and ciliophora are all below 1%. Potentially toxic species, commonly found near Walvis Bay are: *Karlodinium veneficum*; *Dinophysis acuminata*; *Pseudonitszchia spp.* and *Gonyaulax spinifera* (Brown and Murta, 2013).

A list of phytoplankton species found in the BCLME is provided below.

Table 7: phytoplankton diversity.

Taxa or species name	**Ecological and conservation concern**
DIATOMS	
Thalassiosira sp.	Endemism: widespread
Thalassiosira subtilis	Endemism: widespread
Thalassiosira gravida	Endemism: widespread
Skeletonema japonica	Not known
Rhizosolenia satori	Not known
Rhizosolenia hebetata	Not known
Pseudo-nitzschia seriata gr.	Potential toxic, common in coastal waters
Pseudo-nitzschia delicattisima gr.	Potential toxic, common in coastal waters
Probuschia alata	Not known
Pleurosigma sp.	Not known
DINOFLAGELLATES	
Karlodinium veneficum	Potential toxic, common in coastal waters
Gonyaulax spinifera	Produces Yessotoxins with strains similar to *G. spinifera* found in Italy and New Zealand.
Scrippsiella trochoidea	Not known
Protoperidinium pallidum	Not known
Prorocentrum micans	Not known, common in coastal waters
Prorocentrum triestinum	Not known, common in coastal waters
Phalacroma rotundatum	Not known
Oxytoxum sp.	Not known
Heterocapsu illedifina	Not known

Gyrodinium sp.	Not known
Gymnodium sp.	Not known
Dinophysis fortii	Not known, common in coastal waters
Dinophysis acuminata	Potential toxic, common in coastal waters
Ceratium furca	
FLAGELLATES AND MICRO-ZOOPLANKTON	
Thalassiosira sp.	Not known
Skeletonema 'japonica'	Not known
Rhizosolenia imbricata	Not known
Probuscia alata	Not known
Pleurosigma. Sp	Not known
Pleurosigma sp.	Not known
Planktoniella sol	Common in coastal waters
Pennate	Not known
Navicula sp.	Not known
Guinardia sp	Common in coastal waters
Fragilariopsis karstenii	Common in coastal waters
Diplopsali gr.	Not known
Bacteriastum hyalinum	Not known

5.3.3. <u>Seaweeds</u>

A list of seaweed species found in the BCLME is provided below.

Table 8: seaweeds.

Seaweeds Species	**Ecological and conservation**

Ulva sp.	Potential commercial value, widespread
Laminaria pallida	Potential commercial value, widespread
Gymnogongrus glomeratus	Not known
Rhodymenia obtusa	Not known
Pachymenia carnosa	Not known

5.4. Fauna diversity

Fauna diversity comprises several phyla as explained in this section.

5.4.1. Avi-fauna

Avi-fauna occupy higher trophic levels and control populations of invertebrates and pelagic fish. All Palearctic and intra-African migratory birds use the Walvis Bay lagoon exclusively as a feeding ground. Only few resident birds (e.g. pelican and *Damara terns*) feed and breed in the Walvis Bay lagoon and surrounding areas.

The only introduced bird species common in Walvis Bay is the domestic pigeon (*Columba livea*). It is widespread along the coast; mainly in urban areas such as Lüderitz, Walvis Bay, Swakopmund and Henties Bay. It has no ecological threat to marine and coastal birds; though it is known to be a carrier of *Chlamydia psittacosis*. *Chlamydia psittacosis* is a bacterium that infest birds and occasionally infect people and causes psittacosis disease. Symptoms of psittacosis disease include mild illness or pneumonia.

Table 9: marine and coastal birds of concern.

Species name	**Common name**	**Conservation status**
Albatross		
Thalassarche chlororhynchos	Atlantic Yellow-rosed	Endagered
Thalassarche melanophris	Black browed	Endangered
Thalassarche cauta	Shy	Near threatened

Diomedea exulans	Wandering	Vulnerable
Cormorant		
Phalacrocorax neglectus	Bank	Endgered
Phalacrocotax capensis	Cape	Near threatened
Microcarbo coronatus	Crowned	Near threatened
Flamingo		
Phoenicoppterus roseus	Greater	Vulnerable
Phoeniconaias minor	Lesser	Vulnerable
	Gannet	
Morus capensis	Cape gannet	Endagered
Grebe		
Podiceps nigricollis	Black necked grebe	Near threatened
Others		
Haematopus moquini	**Oyster catcher** (African Black)	Near Threatened
Chrococephalus hartaubii	**Gull** (Hartlaub's)	Vulnerable
Pelecanus onocrotalus	**Pelican** (Great white)	Vulnerable
Spheniscus demersus	**Penguin** (African)	Endagered
Petrel		
Macronectes halli	Northen Giant	Near Threatened
Procellaria aequinoctialis	White-chinned	Vulnerable
Charadrius pallidus	**Plover (**chestnust banded)	Near Threatened
Tern		
Hydroprogne caspia	Caspian	Vulnerable
Sternula balaenarum	Damara tern	Endemic and near threatened

5.4.2. Fish

Fish species that are expected to occur in the port and surrounding areas are: small mullet, skates, rays and various line fish species are provided below. There are other fish species in the marine environment, of which many are of commercial and ecological importance but are not included in this analysis. A list of some of the marine fish species in Namibia is provided in *appendix* A.

5.4.3. Reptiles and amphibians

No reptiles and amphibian species are expected to occur in the port but they had been recorded in the marine environment.

5.4.4. Mammals

Mammals that are found in the surrounding Walvis Bay port are seals, bottle-nosed dolphins, whales and occasionally Black-backed jackals.

5.4.5. Aquatic invertebrates

5.4.5.1. <u>Aquatic invertebrates as ‘ecosystem engineers’</u>

Aquatic invertebrates are drivers of nutrient loading and energy flows in coastal and marine environments. Aquatic benthic fauna plays a critical role as ‘ecosystem engineers’ (Bruschetti, 2019). For example, benthic polycheates play a role similar to insects on land by burrowing through muddy sediment, displacing huge volumes of sediment; thereof creating new habitats for other organisms. Filter feeding epifauna play a key role in ecosystem functioning by filtering suspended particles from the water column and releasing them into the water column as waste. In turn, deposit feeding invertebrates (e.g., crabs) feed on this organic matter and store it as tissue or re-mineralize it back into the water column. Aquatic invertebrates are the most abundant fauna in aquatic systems and because of this they displace a large volume of sediment. Similarly, they filter large volumes of water and reduce phytoplankton biomass; which subsequently decrease water turbidity, recycle nutrients and mitigating effects of eutrophication in coastal and marine environments.

5.4.5.2. Life strategy

The life strategy of aquatic invertebrates is interesting because during metamorphosis they undergo through different body forms. The life cycle of all crustaceans (except copepods) begin as nauplius larva which, through several stages, grow to adult stage. The larval stage of copepods, which is the most evolutionary advanced among crustaceans, is a copepodite. During various stages crustacean zooplanktons occupy different habitats, for example some appear as both pelagic fauna (open water column), epifauna (attached to or near the bottom) and infauna (live in the sediment). Crustaceans that spend their entire life as members of the plankton community are known as holoplanktons; whereas those that spend only part of their life as members of the planktonic community are known as meroplanktons (Gibbons 1999).

Crustacean zooplanktons are generally classified based on size viz. macrozooplankton (2-20 mm), mesozooplankton (2 mm-200 µm) and microzooplankton (200-2 µm). As secondary producers, majority crustacean zooplanktons are herbivores but they also consume a wide range of other food items. It is normal for crustacean zooplankton populations of different size or trophic guild to co-exist and form one or more biological communities. This co-existence could be due to similarities in exploiting a resource or adaptation to micro-sites and micro-climatic conditions. More biologically diverse crustacean communities are likely to be more resilient to environmental impacts compared to less biologically diverse communities. Similarly, heterogeneous ecosystems are likely to support more species diversity as they provide a variety of micro-sites and micro-climates (Raven & Johnson 1999).

Unlike other aquatic animals, distribution and abundance of crustacean zooplanktons is biogeographically limited. This limited immobility implies that even zooplankton populations in the Walvis Bay port and lagoon or enclosed areas may little interact with those in the coastal and marine areas. It also implies that resident or specialised zooplankton species that are only adapted to conditions in the Walvis Bay port and lagoon could be sensitive to environmental impacts.

5.4.5.3. Ecosystem indicators

Crustaceans respond rapidly to environmental impacts and could be ideal indicators for ecosystem assessment and monitoring (Drira et al. 2018). However, first there is a need for baseline studies in order to identify which species are suitable indicators. Although, there are known species in the BCLME that could be used as potential indicators it is not clear is if the same species could be used in the WB lagoon.

The proposed hull cleaning is expected to have significant and direct impacts on plankton communities, epifauna and betho-fauna. For this reason, this part of the biota will be described more in detail and will form part of the EMP and monitoring plan. Below is a literature review of aquatic invertebrates that are expected or reasonably expected to occur in the port and its surrounding areas as summarized from Branch & Graffiths (2010).

Amphipoda

Like other crustacean groups, amphipods are diverse (about 7900 described species worldwide) and mainly occupy coastal and marine environments. Amphipoda are closely related to the Isopoda (together in the superorder Peracarida) and more distantly related to the Decapoda (together in the subclass Eumalacostraca). Because of their abundance and diversity in seawater, they have been called the 'insects of the sea.' However, over 1800 species (23%) of amphipods inhabit freshwater systems. Amphipods are more sensitive to pollution and experience high mortality after severe pollution events.

Annelida

The body plan of Annelids is one of the advanced among the coelomates as seen from various segments designed for flexibility and maneuverability. Among members of this phylum, polychaetes are usually the most abundant. Clam worms such as *Nereis sp.* are predators and their food items include crustaceans and other small organisms. Tubeworms are fertile feeders and filter water to extract food particles. Polycheates life cycle involve 6 stages including release and fertilization of eggs into the water which develop into a trochophore and metatrochophore stages; before they become juveniles. When the grow further into pre-adult and adult stages they become part of the benthic fauna. Poylcheates are frequently used as indicators species of ecosystem change.

Polychaetes could be used to monitor water quality especially in terms of the effects of pollutants on life history characteristics.
Among this phylum Annelida (segmented worms), polychaetes are the most common in the Walvis Bay port and lagoon. They are found mainly as infauna but also as epifauna living on seabed surface and sub-merged structures. The habitats they occupy depend on metamorphosis stages in which they are found.

The following species are reasonably expected to occur in the WB port: *Pseudonereis variegate, Platynereis dumerilii, Nephtys spp., Order Syllidae, Polydora spp., Dodecaceria pulchra, Timarete capensis* and *Gunnarea capensis.*

Other polycheats that are expected to occur in Walvis Bay port and lagoon *Lepidonotus semitectus, Perinereis nuntia vallata, Orbinia angapequensis, Thelepus spp.* and *Pectinaria capensis.*

Cnidaria

Cnidarians are exclusively restricted to marine ecosystems and are not found in freshwater systems. Sea anemones that are expected to occur in the Walvis port and lagoon are *Corynactis annulata, Ceriantheopsis sp., Anthothoe chilensis, Pseuactinia flagellifera, Bunodosoma capensis, Aulactinia reynaudi, Anthopleura michaelseni and Isanthus capensis.*

Jellyfishes common in the Walvis port and lagoon are *Physalia physalis* and *Beroe cucumis*. The common jellyfish (*Chrysaora hysoscella*) is pelagic and is easily observed floating in water. Jellyfishes are of particular concern mainly due to their increase in abundance and also as predators of fish eggs and larva. Jellyfish are carnivorous and feed mostly on fish eggs and larva, copepods, isopods, cladocerans and polychaetes. Jellyfishes have limited preys (e.g. spadefish, sunfish, sea turtles, etc) in the aquatic realm and this perhaps the reason for their increasing populations. Higher jellyfish population is a concern especially when found in areas where commercially valuable fish spawn and breed.

Nemertia and nematoda

Although they occur as free-living, many members of phyla Nemertea (ribbon worms) and Nematoda (roundworms) are parasites of fish or marine mammals. They are found in intertidal and epipelagic habitats as infauna or burrowers. Members of order Tricladida (Phylum) are expected to occur Walvis port and lagoon.

Echinodermata

Echinodermata have advanced bodies compared to other invertebrates. Common members of this phylum in the Walvis port and lagoon are sea stars, sea cucumbers, brittle stars and sea urchins. These species are found on the surface of seabed or attached to sub-merged structures.

Sea cucumbers has a potential for commercial farming in Namibia. Only one species is most likely to occur in Namibia (*Roweia frauenfeldii*). Distributions of other species (*Thyone aurea, pseudocnella insolens* and *Pentacta doliolum*) are restricted south of the BCLME.

Only one sea stars is likely to occur in the WB lagoon (*Asterina stellifera*). The other species (*Henricia Ornata*) has a range distribution of only up to south of Lüderitz.

Two species of brittle stars that are likely to occur in the Walvis port and lagoon are: *Amphiura capensis* and *Ophiothrix frafilis* and *Ampiopholis squamata*.

Only one species of sea urchin is likely to occur in the Walvis port and lagoon viz. *Parechinus angulosus*.

Mollusca

Mollusca occupy all marine, freshwater and terrestrial systems and include snails, mussels, oysters, clams and similar species. The IAS of ecological concern are the *Mytilus galloprovincialis* (Mediterranean mussel), *Semimytilus algosus (Chilean mussel)* and *Balanus gladula* (pacific barnacle). *M. galloprovincialis* is the most abundance and it was first introduced in South African waters in the 1970s. In Namibia, it was first recorded at Sylvia Hill in the 1990s. This species has now inhabited the central coastal environment; mainly recorded at Dolphin beach, Langstrand and near the Swakopmund river mouth. Although it is found occupying similar habitats as those occupied by indigenous species such as *Perna perna* and *Semimytilus algosus*, there are differences at microsite levels. For example, *Perna perna* is found in the low shore zone; whereas *M. galloprovincialis* occupy the mid shore zone (Deelie, 2015). Barnard (1998) reported that invasion of *M. galloprovincialis* does not appear to have negative environmental effect. This is supported in a similar study (Deelie, 2015) where it was found that there is no evidence to support negative environmental impacts of *M. galloprovincialis*. The inability of *M. galloprovincialis* to negatively affect local species is low sea water temperature which inhibit their growth compared to native species. However, if seawater temperature increase due to climate change and associated anthropogenic activities, abundance of *M. galloprovincialis* is most likely to increase and pose a threat to native species.

Branchiopoda

This is a group of primitive shrimps, most of which are extinct today. The brine shrimp (*Artemia sp.*) species found in Walvis Bay salt pans is not known but is different from the one that occur in the Swakopmund and Cape Cross salt pans. This species is of commercial value as a live feed in aquaculture. It is known that *Artemia sp.* contributes to water clarity, hence reduction in salt impurities. For this purpose, salt miners encourage growth of *Artemia* spp. in salt ponds.

Prorifera

All members in this phylum are only found strictly marine and are not found in fresh systems. They occur in both intertidal and pelagic habitats as epifauna. *Hymeniacidon perlevis* and *Laruncullia spinispiraefera* are reasonably expected to occur in the Walvis port while *Tethya aurantium* and *Cramber acuata* are expected to occur in the Walvis Bay lagoon.

Urochordates

This phylum includes salps, doilolida and sea squirts. Salps and doliolids that are likely in the Walvis Bay port and lagoon are *Thali* spp., and *Pyrosoma* spp. Salps and doliolids are very sensitive to cold temperatures and it is known that they prefer abundant phytoplankton (Martin, Koppelmann & Kassastov 2016).

Sea squirts that are reasonably expected to occur in the Walvis port and lagoon are *Pyura stolonifera* and *Styela angularis.*

Other sea squirts of ecological concern are *Pyura herdmani* and *Ciona intestinalis* because they are alien species. *Pyura herdmani* has already widely spread from the eastern coast of South Africa and it is possible that it has reached the BCLME.

Crustaceans

Crustaceans are more evolutionarily advanced than all other invertebrates; they have well developed tissues, bilateral symmetry and jointed appendages (Rave and Johnson 1999). Jointed appendages perform specialized functions, which in humans, are similar to ankles, hips or wrests. Another evolutionary development that makes them more successful is development of the exoskeleton made out of chitin. Apart from protecting the fragile tissue from desiccation or predation, the exoskeleton provides support to muscles and tissues.

Copepods Calanoides are the most important species in the BCLME in terms of abundance and ecosystem function. Amongst others, Calanoides (e.g. *Calanoides carinatus, Metridia sp.* and *Rhincalanus sp.*) could be used as keystone species in the BLCME due to their higher abundance and life strategies. Keystone species utilize resources in a similar way and are well adapted to their environment; hence could be used to describe and understand the environment as well as distribution of other species. The early life stages of Calanoides undergo several stages usually consisting of 5 copepodite stages (e.g. CI, CII, CIII, CIV and CV).

5.4.6. Life strategy

The life strategy of Calanoids is well documented and is strongly linked to different phases of the upwelling process in the BCLME. At the onset of the upwelling, pre-adult Calanoids (stage CV) ascend to the surface and near the shelf and develop into adult stage (stage CVI) ready to reproduce. During the quiescent upwelling phase, phytoplankton biomass increases and Calanoides copepoites graze rapidly and begin to develop into various copepodite stages. In the down-welling phase, most Calanoides would have developed into the pre-adult stage and are transported offshore and deeper along with old and poor-nutrient waters (Verheye et al. 2005). This is a critical stage, during which CV Calanoides undergo starvation due to lack of phytoplankton biomass below the photic zone.

While Calanoides could be easily used as keystone species during the intense upwelling season, it is not clear if this could be true in the Walvis Bay port and lagoon as they are rarely found in shallow areas.

5.4.7. Zooplankton diversity

A list of zooplankton species recorded in the BCLME are provided in in *appendix* A. This list is based on regular oceanographic surveys conducted in the marine environment (MFMR, 2015). There are however, a few surveys that are conducted in the coastal environment. It appears that there are fewer zooplankton species in the coastal environment compared to the marine environment, although this is perhaps due to limited zooplankton surveys in the coastal environment.

Only a few zooplankton species are found in the coastal marine environment; mainly small copepods and early stages of zooplankton or other crustaceans. The dominant mesozooplanktons are nauplii, copepodites, Poecilostomatoida and Harpacticoida. Jellyfish (only observed floating in water) is the common megazooplankton in the coastal environment.

Oithona spp. is a common copepod (Order Cyclopoida) species that occupy both marine and fresh water systems. *Oithona* spp. is a small trap-feeding omnivorous copepod which is adapted to a variety of marine habitats including pelagic and epipelagic areas. The life strategies of *Oithona* spp. including passive feeding, low metabolism, serial spawning and adaptation to a wide variety of climatic conditions makes them one of the most successful residents in aquatic systems.

Clausocalanus spp. have features that sets them apart from ‘true’ Calanoids and are often referred to as ‘false’ Calanoids together with other groups such as pseudocalanus, paracalanus, eulocalanus and neocalanus. Although their role, compared to large Calanoids (such as *Metridia* and *Carinatus*) is sometimes understated, they play a large role as grazers. They actively feed on microphytoplanktons in the euphotic zone and are important preys of larval and juvenile fish.

Cheatognaths (arrow worms) are cosmopolitan species which are widely distributed in all marine ecosystems but more common in warm and shallow marine areas. The genus has about 30 species of cheatognaths in southern Africa. *Sagitta spp*. is reasonably expected to occur in the Walvis Bay port.

5.5. Discussions, conclusions and recommendations

The receiving environment of impacts emanating from the proposed underwater hull cleaning will mainly be the coastal environment. The VECs more affected are the plankton communities as well as invertebrates. The coastal environment is a breeding and nursery area for some species; after which species may migrate offshore into the marine environment.

Many invertebrates are of particular interest in this EIA/scoping study as they are likely to be more significantly and directly affected by the proposed underwater hull cleaning activity. Fish, avifauna and mammals will be less affected and where affected the impacts will either be indirect and temporary. For example, higher turbidity and underwater noise generated during removal of the bio-fouling organisms will affect marine mammals and fish but suc impacts will be temporary.

Especially of particular focus will be phytoplankton, mesozooplanktons, epifauna and bentho-fauna as they will be more susceptible to sunction action of the ROV-cart pumps during water extraction and debris reclamation. Phytoplankton, mesozooplanktons, epifauna and bentho-fauna are also highly immobile compared to other taxa; subsequently they are likely to be more sensitive to a wide range of local anthropogenic activities (e.g. pollution, habitat modifications, resources exploitation, etc).

Usually when levels of seawater pollutants increase a change is observed whereby species richness decreases while the abundance of a few pollution tolerant species increase. The resultant changes in invertebrate fauna community structure, diversity and abundance are due to response of invertebrate fauna to the physical and chemical changes in their environment. Polychaetes and amphipods are potential indicators of water quality especially in terms of the effects of pollutants on their abundance. The polychaeta/amphipoda (P/A) index which is used to detect a changing ecosystem simply refers to the ratio between the abundance of polychaete species to abundance of amphipods when pollution increases. The P/A index is based on the observation that polycheata and amphipoda displays different sensitivity to pollution. While polychaeta are resistant to increase in pollutants; amphipods on the other hand are sensitive to pollution. This means after increase in pollution, many opportunistic polychaeta species increase in abundance while abundance of amphipods decreases.

It is recommended that:

- The EMP should focus on monitoring abundance in planktons and other aquatic invertebrates;
- Invertebrate samples should be taken before, during and after the underwater hull cleaning operation;
- Impacts on benthic fauna diversity is expected to be less compared to epifauna and zooplankton which occupy the water column. Therefore, the epifauna and zooplankton should be sampled more often compared to the benthic fauna which may be sampled only twice a year (i.e. every 6 month or twice a year).

CHAPTER 6

6. HUMAN ENVIRONMENT

6.1. Introduction

In Namibia the proposed project is located in Walvis Bay Bay in Erongo region. Walvis Bay is an economic epicenter in Erongo region and is expected to be the main driver of the blue economy compared to Lüderitz, Swakopmund, Henties Bay and Oranjemund.

The term blue economy is used in economics to describe exploitation of resources from the coastal and marine environment. The term, according to the United Nations Economic Commission for Africa (2016), emerged from exploitation of ocean resources; particularly within environment and development policy and practice in Africa. A related term used to describe the exploitation of agricultural resources is the green economy. Although the green economy still plays a significant role in the Namibian economy, particularly in terms of employment creation, it is threatened by climate risks. The blue economy vows to improve human wellbeing and equity, reduce climate risks and scarcity through seawater desalination (Childs & Hicks, 2019) and improved agricultural production.

Although the concept is touted as a catalyst in achieving long-term sustainable and equitable growth (Carver, 2019), the blue economy discussions in Namibia remain rhetoric. Paradoxically, the country remains to sufficiently benefit from the blue economy despite a huge base of renewable and non-renewable resources within the country's EEZ when compared to other coastal nations.

6.2. Erongo region

6.2.1. Climate

The Benguela upwelling current system dominates the climate in Erongo region and as such this climatic force had led to formation of the Namib Desert. Precipitation in the region is low and occur mainly in the form of fog. The fog supports less vegetation and the agriculture sector is not commonly practiced in the region. The region mainly depends on exploitation of marine and fisheries resources as well as mineral resources.

6.2.2. Demography

There are 150,809 people in Erongo region based on the 2011 population census. The population in Erongo region represent about 7% of the Namibian population. The annual population growth rate is 1.3% and is lower than the country's population growth. The most commonly spoken languages are Oshiwambo (37%), Afrikaans (21%) and Damara/Nama (21%). Many residents in Erongo, especially in urban areas are not born in the region and given a low population growth, this implies many residents in the region are immigrants. They migrate to Erongo region for employment and better opportunities. This immigration trend is likely to increase in the future due to increase in blue economic activities.

Table 10: population distribution in urban areas of Erongo region.

Urban area	**Population**	**% composition**
Walvis Bay	62,096	47%
Swakopmund	44,725	34%
Omaruru	6,300	5%
Arandis	5,170	4%
Henties Bay	4,720	4%
Karibib	5,132	4%
Usakos	3,585	3%
TOTAL	**131,728**	**100%**

6.2.3. Economy

Erongo region is the second richest region in Namibia with a per capita income of N$16,000 per year compared to Khomas region which has a per capita income of N$36,000 per year. Labor force increased from 71% to 79% between 2001 and 2011 in the region. About 70% of the population is employed; and compared to the country's higher unemployment rate, Erongo region relatively offers better employment opportunities. Walvis Bay is the mega economic epicenter mainly due to the well-developed fishing sector as well as the port and docking facilities that are of higher value and impacts.

6.2.4. Walvis Bay

In Namibia, the proposed project is located in Walvis Bay in Erongo region. The Walvis Bay town is the regional Capital of Erongo region. Walvis Bay was integrated into Namibia in terms of the Walvis Bay and Offshore Islands Act 1 of 1994. Walvis had been part of Namibia for 27 years and had made significant contributions to the country's economy. Fishing is the main pillar of the local economy; there are 16,000 people employed in this sector. Apart from direct employment, there are other secondary sectors that benefit indirectly from the fishing sector such as maintenance of vessels, boats, cargo and other marine vehicles. Other economic sectors include mining, aquaculture, maritime transport, marine tourism, etc. The town of Walvis Bay is expected to play a significant role in the development of the blue economy. However, this will depend on overcoming various challenges that have a potential negative impacts on the socio-economic growth.

6.3. Socio-economic challenges

Various threats facing the coastal social-economy include over-exploitation of resources (e.g. fisheries and minerals resources), marine pollution, IAS and harmful pathogens, habitat modification, climate change and variability. Other threats include HIV-AIDS, lack of skills, slow economic growth, lack of accountability and governance and infectious pathogens and new pandemics.

6.3.1. Overharvesting of resources

Namibia has experienced overharvesting of marine natural resources over the past 100 hundred years. Discovery of diamond in Lüderitz by Zacharias Lewala prompted the so-called 'diamond rush' in Namibia. After reaching a peak, many diamond mining (land-based) operations ceased and were diverted offshore. Similarly, since commencement of fishing in Namibia in the 1950s, many fisheries resources were heavily overfished including whales, pilchards and others.

Also associated with overharvesting of resources is the lack of accountability and insufficient governance by individual administrations both before and after Namibian independence. The recent *'fishrot'* scandal is a good example of lack of accountability and transparency *post*-independence.

6.3.2. Invasive aquatic species

Introduction of IAS (invasive aquatic species) has become a new biosecurity risk; mainly due to increased foreign fleets visiting the Walvis Bay port. As mentioned already global trading is connected more by maritime transportation. IAS are marine organisms and pathogens that are transported by foreign MVs either through ballast waters, sediments or as bio-fouling organisms attached on submerged structures of MVs. Sometimes these organisms survive during transportation and are accidentally introduced in local ecosystems where they grow in huge numbers and out-compete native or local species. As such they become a biosecurity risks to endemic or native species and may also become a threat to mariculture species.

6.3.3. Environmental injustice

The term environmental injustice is used to define violations of human rights (especially rights of women and children) in terms of distribution of natural resources; exposure to environmental risks (e.g. risks of pollution and climate change). Environmental injustice also manifests in a way the judiciary system operates whereby legislations are discriminatory either during formulation and implementation as well as when litigation proceedings are selective or biased.

In Namibia, all government regimes, both before and *post*-independence, had showed gross incompetence with regard to environmental rights and justice. For example, benefits from diamond mining were mostly used to fund apartheid rule and benefit the minority (mainly white males) before 1990; at the expense of the majority Namibian especially women and children. Furthermore, in the *post*-independence period, lack of transparency mainly in the fishing sector had not benefited the majority Namibians. The recent *'fishrot'* scandal is a good example of lack of transparency, corruption and financial crimes. This scandal is valued at more than USD 650 million and involve politically connected individuals and well known Namibian politicians.

6.4. Economic outlook

It is important to analyze the economy in context of the COVID1-19 pandemic. Outbreak of the COVID-19 had triggered economic stagnation and social disruption across the globe and in Namibia. Erongo region, especially had undergone a longest and continuous lock-down period between May and August 2020 compared to other regions. COVID-19 is an infectious disease caused by a coronavirus and it was first diagnosed in China in 2019. Infected victims of COVID-19 experience mild to moderate symptoms which include fever, dry cough, tiredness and headaches. There is no cure for COVID-19 and the disease is currently a higher risk threat with local and global economic impacts.

COVID-19 negatively affected all sectors of the Namibian economy including maritime transport, fishing, tourism, mari-culture and other sectors. GRN should be laudably applauded for providing a safety net which protected citizens from directly absorbing negative impacts of COVID-19 between April and August 2020. The safety net rolled out was valued at N$8.1 billion and comprised of N$5.9 billion in direct support to businesses, households and cash flows acceleration payments for services rendered to GRN. The remaining N$2.3 billion was related to off-balance sheet government liabilities.

In June 2021, COVID-19 infections in Namibia increased to a highest average of 1,647 persons per day. This increase was partly due to increase of the effects of the winter season in Namibia but also due to emergence of new COVID-19 virus variants. It is normal for a virus to mutate as it spread across different populations. The different COVID-19 virus variants recorded in different countries are: Alpha (UK), Beta (South Africa), Gamma (Brazil), Delta (India), Epsilon (California), Eta (New York) and Lota (York City). With effects of the season and new COVID-19 variants, infections in Namibia are predicted at least to reach a peak of 2,300 persons per day in Namibia by mid-August 2021 before it declines to its lowest by mid-September. This will depend on various factors, however socio-economic impacts of the third and fourth waves will be more detrimental compared to the initial impacts especially in the absence of GRN safety net.

Namibian consumers need to embrace for the worse and start looking for cheap sources of food and take required health precautions.

6.4.1. Lack of economic growth

Since June 2016, the Namibian economy has been in a protracted recession. The real GDP growth contracted 11 times consecutively since the second quarter of 2016. In the same period, the domestic economy was constrained by various factors, structural impediments, tighter financial conditions, as well as the introduction of fiscal consolidation measures. As the tough economic conditions persist during the period 2017-2020, growth of key sectors slowed significantly.

6.4.1.1. Mining sector

Improved economic performance was due to the mining sector; specifically quarrying, which improved from a contraction of 3.2% in 2016 to growth of 13.3% and 22% in 2017 and 2018, respectively. The positive growth was as a result of improved diamond production, production by and new uranium and tin mines.

6.4.2. Tourism sector

The tourism sector was the only sector where growth was recorded between 2017 and 2019. Depreciation of the Namibian dollar to strong currencies presented an advantage to the tourism sector. International visitors using strong currencies found it more affordable to travel in Namibia. Compared to other sectors, the tourism sector played a significant role in contributing to GDP until January 2020 when travelling was restricted due to implementation of COVID-19 measures.

6.4.3. Fishing sector

The fishing sector had also performed relatively well and this was largely attributed to the fact that 90% of fish is exported to luxurious markets. The ‘fishrot’ scandal does not seem to have negatively affected the price of Namibian fish in the international market.

6.5. Blue economy

Globally, the 'blue economy' concept is increasingly being advised by scholars and policymakers as a useful conception for conserving the world's ocean and its inherent resources (Okafor-Yarwood et al., 2020). Though falling short on environmental gains, the blue economy according to the African Union's Agenda 2063 is the continent's future. In an African context, the blue economy is defined by its heterogeneity in several ways (Childs & Hicks, 2019). The term is interchangeably used with the term 'green economy' however with specific attention on ocean resources for economic benefit while neglecting environmental gains, however, an inextricable link exists. Though interwoven used, the blue economy compared to ocean economy encompasses environmental sustainability, economic sustainability and social inclusion making it distinct from the ocean economy. Even if the country does have a common and succinct definition of this concept, the blue economy in Namibia includes fisheries, marine mining, marine and coastal tourism, maritime transport and coastal infrastructures such as ports, towns and coastal industries. Though Namibia's endowed with coastal and marine resources; both renewable and non-renewable, the blue economy remains far from the stable development concept that it promises to be. Hence, a call for a collaborative system approach that according to Okafor-Yarwood et al. (2020) advocates for the protection of critical habitats, reconciliation of coastal demands, and concomitantly promoting the resilience of coastal residents with the view to sustainably utilize ocean resources for economic growth without compromising the health of the ecosystem (World Bank 2017a). Cited in (UNECA, 2016; Zuma, 2015), the African blue economy covers aquatic and marine spaces, including oceans, seas, coasts, lakes, rivers, and underground water, and it comprises a range of productive sectors, such as fisheries, aquaculture, tourism, transport, shipbuilding, energy, bioprospecting, and underwater mining and related activities. It can therefore be said without reservation there is no clear, concise and globally agreed definition to date.

6.5.1. Fishing sector

Fishing commenced in the early 1950s, reaching a total annual catch at approximately 2 million tons in 1968. Commercially important fisheries resources include hake, horse mackerel, monk, snoek, kingklip and rock lobster. In Namibia, the fishing sector is now well developed, and the country's fisheries capture is ranked 3rd on the continent lagging behind South Africa and Morocco, and the 30th in world fisheries capture indicators (Finke et al, 2020). Namibian waters have one of the richest fishing grounds in the world and the fishing sector immensely contribute to the country's GDP. The sector has since grown to become the third economic sector; contributing 7.7% to the GDP. More so, the country's fish and fisheries products are valued at about N$10 billion, making fisheries the second largest forex earner after mining and it contribute 15% to the country's total exports (Leandrea, 2019). In addition, the marine fisheries total landings have been estimated at 550 000 tonnes. Despite the recent major fraud in the 'fishrot' scandals resulting in job losses, the sector directly provides livelihood to over 16,000 employees both onshore and offshore (Adam, 2019). Particularly, the fishing sector is important to the Walvis Bay local economy where fish processing and port/dry-dock facilities are located.

Several measures are used to manage fisheries resources including fishing rights, TACs, fishing permits, by-catch fees, closed fishing season and others. Permits can however be occasionally suspended on species such as pilchard and orange roughy to allow fish stocks to recover. In the event of rights expiration depending on the fish species, the MFMR (Ministry of Fisheries and Marine Resources) publicly announce new applications, after which dully processes rights are awarded. Fishing quotas are on annual basis allocated to rights holders up until such a time the rights expire. The fishing period rights varies between 7 and 20 years depending on the species i.e. horse mackerel is 15 years while hake is 20 years. Ironically, the sector as noted by Remmert (2019) has over the years been constrained by unprecedented tension between economic interests and environmental protection, hence, disagreements, conflict and legal action are a regular occurrence with which without effective changes and new operational approaches the sector could soon be in jeopardy.

6.5.2. Offshore diamond mining

Namibia has a vast geographical coastal coverage, stretching along the South-East Atlantic for about 1,572 km. Namibia's territorial waters and EEZ extend over 562,431 km^2 (Remmert, 2019).

According to Schneider (2020), systematic seafloor diamond mining with purpose-built barges later occurred in Namibian waters 50 years which saw Namibia emerge as the leading nation in marine diamond mining. Noting that heavier diamonds are often concentrated near river mouths while the lighter ones were taken further offshore by shore currents, marine diamond mining activities shifted to offshore reserves where over 90% of diamonds are of gem quality (Leeuwerik et al., 2021). Among other things, detailed exploration and technological enrichments on the other hand made deeper waters potential mining sites. Garnett (2017) reveals that large-scale marine diamond mining as an outcome of many years of exploration began a decade ago backed by government support and important technological developments most notably in positioning and geophysical exploration. Moreover, major sampling and mining systems were successfully developed in the process. Developments worth citing is the successful hiring of diamonds recovery equipment from the seabed borrowed from other industries, and the increased total output of sea diamonds from Namibian waters to 0.8 million carats annually and exceptionally exceeding diamonds from all the country's onshore sources (Garnett 2017). Despite other significant but smaller public companies are in various stages of development, NAMDEB - a corporation owned jointly with the government - is the principal marine diamond producer for which De Beers Marine acts as a contractor (Garnett, 2017). The government has thus entered into a 50% stake partnership agreement with De Beers. It is no doubt that marine diamond mining in Namibia is an economic lifeline with significant contributions to both treasury and employment creation and further potential higher production, lower grades, and increased throughput expected in future. The sector contributes 20% of foreign earnings making it the country’s biggest foreign exchange generator (Anon, 2014) and has in 2013 contributed more than 188 million US$ in royalties, taxes and dividends.

Notwithstanding raising concerns of transparency and degree of stakeholder engagement in environmental monitoring and environmental impact assessments, the precise nature of environmental impacts and future social and economic benefits among others, maritime diamond mining remains a significant sector of the Namibian economy and society. Of paramount though, as emphasized elsewhere by Leeuwerik et al. (2021), building stakeholders trust and legitimacy in marine diamond mining operations should not be limited to company and stakeholder dialogue, but also encompasses stakeholder processes and the role of the government in legal and political decision making for mining.

6.2.3 Renewable energy

As amplified in the International Energy Agency (IEA) 2020 Energy Progress Report, the Sustainable Development Goal (SDG) 7 aims to achieve universal access to affordable, reliable, sustainable and modern energy by 2030 (IEA et al. 2020). Abundantly blessed with plenty of renewable energy resources such as wind, solar, bioenergy, hydropower and ocean resources, Namibia can potentially harness low-carbon energy. With a well-established electricity supply industry (Amesho, 2019), renewable energy accounts for a slight portion of the country's energy consumption and largely depends on power imports. According to Kruger et al, (2019) country energy report, over 60 per cent of Namibia's electricity demand is met through imports from the Southern African Power Pool (SAPP) which is primarily governed by bilateral contracts with South Africa, Zambia, and Mozambique. The government has however acknowledged this significant potential towards energy generation from renewables and has prioritized the development of solar and wind energy projects. According to the United Nations (2017) paper titled *"UN Namibia goes solar, halving power consumption. Greening the Blue,* Namibia has the second-highest level of solar irradiation in the world with estimated power output at insolation of 2 200 kWh/m2/a, and a potential wind energy power estimated ranging between 27.201 MW and 36 TWh per year (Hamulungu, 2018).

Coastal climate conditions particularly in Lüderitz and Walvis Bay are suited for wind energy generation and investors are recognizing Namibia as a prime investment destination in clean energy. Namibia's first wind farm, Ombepo near Lüderitz with a capacity of 5 MW, has been generating power since August 2017. Another sizable wind energy project near Luderitz the 44 MW with expansion plans to increase it to 90 MW, Diaz wind farm is currently underway at an estimated total cost of US$106.9 million. Expected to be fully operational in 2022, Diaz Wind Power's - a part of United Africa Group (UAG) - construction is in line with domestic utility NamPower's new corporate strategy and business plan that seeks to make Namibia energy self-sufficient in the next five years. A 25-year power purchase agreement (PPA) has already been entered into and the project is expected to supply electricity to 10,000 Namibian homes. In part, Diaz Wind Power is also committed to upgrading the Namib substation and the Kokerboom substation. By 2019, Namibia has installed numerous renewable energy power plants with a combined capacity of 594 MW.

6.2.4 Maritime transport sector

In 2018, the United Nations Conference on Trade and Development (UNCTAD) reveals that over 80% of global trade by volume and more than 70% of its value are carried onboard ships. According to Walker (2019), maritime transportation drives 80-90% of global trade, moving of containers, solid and liquid bulk cargo in billions of tonnes across the world's oceans. In Namibia, the country's only two ports of Walvis Bay and Lüderitz constitute important trading routes for goods and commodities for export, import as well as re-export. Between April 2016 and March 2017, the ports facilitated over 1.5 million tons of cargo shipments export worth around N$27 billion and have in the same year contributed 2.1% to the country's GDP.

6.6. Competing blue economy activities

Blue economy activities are however taking place in a limited space – the coastal and marine environments. Within this space when such activities are interlinked and they economically and environmentally benefit each other; it is good for the GRN. On the contrary, not all blue economy activities and developments are mutually beneficial. A case to this point is mining and fishing which rarely complements one another and the same is also true for mining and tourism.

6.6.1. Blue economy policy

Namibia has no blue economy policy; however, efforts are under way to formulate this policy; stakeholders' consultations are at an advanced stage. Namibia has since independence established legal and regulatory instruments for environmental protection. Article 95 of the Namibia Constitution lays a foundation for this as it reads: *"maintenance of ecosystems, essential ecological processes and biological diversity of Namibian and utilization of living natural resources on a sustainable basis for all the…".* The blue economy does not appear in the country's National Development Plan (NDP) 1-4, however, it appears in the 5th National Development Plan (NDP5) - 2017/18 to 2021/22. Without providing a succinct definition of the blue economy, NDP 5 speaks of a blue economy that capitalizes on and equitably distributes, the economic benefits of its EEZ and resources therein. The NDP5 states: "*By 2022, Namibia will have implemented a Blue Economy governance and management system that sustainably maximizes economic benefits from marine resources and ensures equitable marine wealth distribution to all Namibians.*"

Moreover, the blue economy is one of the main focuses for AU (African Union) Agenda 2063 and 2050 Africa's Integrated Maritime Strategy (2050 AIM Strategy). The blue economy in Agenda 2063 is viewed as the catalyst towards achieving socio-economic change, whereas, in the 2050 AIM Strategy, the blue economy is mentioned in Africa's Integrated Maritime Strategy and is prioritized as the "new frontier of African Renaissance" (Nagy & Nene, 2021). Adapted in 2014 and later embedded in the African Union's Agenda 2063 in 2015 as a priority goal for Africa's inclusive growth and sustainable development, the 2050 African Integrated Maritime Strategy (AIMS) amongst others seeks to coordinate the maritime policies of the African Union members and African regional economic communities in strategic sectors such as knowledge and protection of the ocean space, transport, shipbuilding, energy, aquaculture, and marine law enforcement.

6.7. Discussions, conclusions and recommendations

Namibia possesses a remarkable coastline and a vast marine area but when compared to other coastal states Namibia had not benefited from the blue economy. As noted by Finke (2020), Namibia's marine and coastal environment are both unique and pristine natural environment where people come for recreation and experience of nature and in some parts an intensely used space for trade and economic activities, which constitute a valuable source of income for many Namibians. Given the vastness and uniqueness, it is beyond doubt that marine and coastal resources are a significant asset for the country both for the economy and livelihood. The blue economy in this respect is touted as a new mechanism through which Namibia can achieve long-term sustainable and equitable growth.

Compared to neighboring Angola and South Africa, Namibia has a comparative advantage in fisheries as well as offshore diamond mining. In terms of value, Namibia's capture fisheries that commenced in the early 1950s is ranked 3rd on the continent lagging behind South Africa and Morocco, and the 30th in the world contributing around 4.5% to the country's GDP. It is the third contributing sector to Namibia's GDP contributing 7.7% and the second-largest forex earner after mining.

The tension between economic interests and environmental protection resulting in conflicts and legal actions are regular occurrences negating the blue economy. The blue economy is thus increasingly impacted by the ocean stressors hence a call for stakeholders' engagements and collaboration to address them. In the absence of effective changes and new operational approaches, the country's promising blue economy could face challenges in the future. Notwithstanding the GRN's ample provisions for environmental protection and sustainable use of natural resources, and commitment to growing the economy in a sustainable inclusive manner, the sustainable management of coastal and marine environments and resources is of utmost priority in the new frontier of its blue economy. Lastly, in realizing the fact that Africa has been the epicentre of international maritime insecurity, Namibia should not operate in isolation as others commit to reinforcing security at sea through cooperation and information sharing with fellow African states.

CHAPTER 7

7. PUBLIC PARTICIPATION AND FEEDBACK

7.1. Introduction

This chapter describes steps involved in the public participation process during this EIA scoping study. The role of I & APs in the public consultation process is extremely significant. NEMA regulations (regulations of 2012), and specifically section 21 is explicit in guiding the public consultation process. As stipulated in section 21(2), notices were given as explained below.

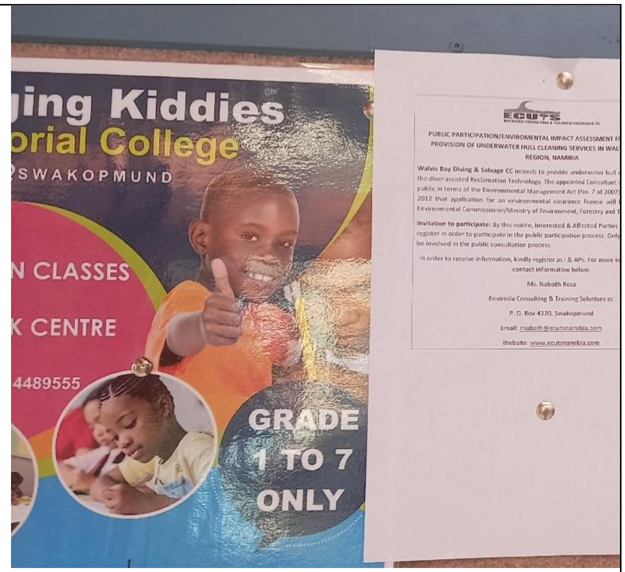
7.2. Public notices at public places

Public notices were placed at various places in Walvis Bay; near the Walvis Bay port, dry dock facility and in Swakopmund (at Woermann & Brock shopping centre and Swakopmund town centre notice boards) and various public places.

Table 11: public notices.


OKAKAMBE STABLES
CAR-BOOT SALE
Afternoon classes
N$ 200.00
EXCHANGE A KIDS BOOK FOR A KIDS NECKLACE


ging Kiddies
orial College
SWAKOPMUND
N CLASSES
K CENTRE
4489555
GRADE 1 TO 7 ONLY
PUBLIC PARTICIPATION/ENVIROMENTAL IMPACT ASSESSMENT FO
PROVISION OF UNDERWATER HULL CLEANING SERVICES IN WAL
REGION, NAMIBIA
Ms. Naboth Rosa
Envirolida Consulting & Training Solutions cc
P. O. Box 4120, Swakopmund


MARANAT
BEAUTY & SLIMMING SAL
Manicures & pedicures
Facials & massages
Tinting & waxing
Biosculpture gel nails
Acrylic nails
RegimA peel & heel treatments
Various slimming treatments
Any make up available
064 403787 / 081 221 6855


mrp


MARANATHA
1000 Endurance Run

7.3. Written notices to key I & APs

Invitation by emails were prepared and send to key stakeholders including: NAMPORT, Walvis Bay Municipality, Department of Maritime Affairs and Ministry of Fisheries & Marine Resources (see *appendix D*).

Table 12: invited I & APs.

I & AP	**Institution**	**Position**	**Email**	**Invitation to register confirmed** Y/N
Mr. Shaheed Saban	Namibia Port Authority	Draughtsman	saban@namport.com.na	Y
Mr. Stafenus Gariseb	Namibia Port Authority	Manager: SHREQ	s.gariseb@namport.com.na	Y
Mr. Shapua Kalomo	Department of Maritime Affairs	Environmental Officer	Shapua.Kalomo@mwt.gov.na	Y
Ms. Nangula Amutenya	Walvis Bay Municipality	Environmental Manager	namutenya@walvisbaycc.org.na	N
Ms. Lovisa Hailalula	Walvis Bay Municipality	Environmental Officer	lhailaula@walvisbaycc.org.na	N
Mr. Titus Shaanika	NNF	Environmental co-ordinator	Titus@NNF.ORG.NA	N
Mr. Stephanus Hamutenya	MFMR	Biologist	Steven.hamutenya@mfmr.gov.na	N
Mr. Rendan Ractliffe	KWINT Offshore Services Namibia (Pty) Ltd	Project Supervisor	brendan@kwintnamibia.com	Y
Mr. Victor Libuku	MFMR	Fisheries Biologist	Victor.Libuku@mfmr.gov.na	Y
Mr. Ferdinand Hamukwaya	MFMR	Fisheriues Research Assistant	Ferninand.Hamukwaya@mfmr.gov.na	y

7.4. Advert in newspapers

Notices were placed in 2 (two) local newspapers, namely Namib Times and Confidente newspapers once a week for 2 consecutive weeks between 24 June and 2 July 2021.

Table 13: newspaper adverts.

 Page 20 CONFIDÉNTE lifting the lid 24 - 30 June 2021 Classifieds Contact: Mandy • T: 061 24 6136 • C: 081 895 8296 • E: mandy@confidentenamibia.com PUBLIC PARTICIPATION/ENVIROMENTAL IMPACT ASSESSMENT FOR THE PROPOSED PROVISION OF UNDERWATER HULL CLEANING SERVICES IN WALVIS BAY, ERONGO REGION, NAMIBIA Walvis Bay Diving & Salvage CC intends to provide underwater hull cleaning services using the diver assisted Reclamation Technology. The appointed Consultant would like to notify the public in terms of the Environmental Management Act (No. 7 of 2007) and its Regulations of 2012 that application for an environmental clearance license will be launched with the Environmental Commissioner/Ministry of Environment, Forestry and Tourism. Invitation to participate: By this notice, Interested & Affected Parties (I & APs) are invited to register in order to participate in the public participation process. Only registered I & APs will be involved in the public consultation process. In order to receive information, kindly register as I & APs. For more information, kindly see contact information below. Ms. Naboth Rosa Envirodu Consulting & Training Solutions cc P. O. Box 4120, Swakopmund Email: rnaboth@ecutsnamibia.com I Website: www.ecutsnamibia.com	 Page 20 CONFIDÉNTE lifting the lid 01 - 07 July 2021 Classifieds Contact: Mandy • T: 061 24 6136 • C: 081 895 8296 • E: mandy@confidentenamibia.com PUBLIC PARTICIPATION/ENVIROMENTAL IMPACT ASSESSMENT FOR THE PROPOSED PROVISION OF UNDERWATER HULL CLEANING SERVICES IN WALVIS BAY, ERONGO REGION, NAMIBIA
 8 NAMIB TIMES COMMUNITY NEWS 9 JULY 2021 Orano Mining donates N$50 000 to "Ciske's Covid Task Force"  PUBLIC PARTICIPATION/ENVIROMENTAL IMPACT ASSESSMENT FOR THE PROPOSED PROVISION OF UNDERWATER HULL CLEANING SERVICES IN WALVIS BAY, ERONGO REGION, NAMIBIA Walvis Bay Diving & Salvage CC intends to provide underwater hull cleaning services using the diver assisted Reclamation Technology. The appointed Consultant would like to notify the public in terms of the Environmental Management Act (No. 7 of 2007) and its Regulations of 2012 that application for an environmental clearance license will be launched with the Environmental Commissioner/Ministry of Environment, Forestry and Tourism. Invitation to participate: By this notice, Interested & Affected Parties (I & APs) are invited to register in order to participate in the public participation process. Only registered I & APs will be involved in the public consultation process. In order to receive information, kindly register as I & APs. For more information, kindly see contact information below. Ms. Naboth Rosa Envirodu Consulting & Training Solutions cc P.O. Box 4120, Swakopmund	 6 NAMIB TIMES COMMUNITY NEWS 2 JULY 2021 More women at the helm at EME

7.5. Minutes from public meetings

Minutes of the electronic meetings held on 20 and 24 August 2021 are provided in appendices C1-2.

7.6. Comments from I & APs

Below are comments from some of the registered I & APs:

- Do you have a position in the port where hull cleaning operation will take place?

- Are the areas where hull cleaning operation will take place: outside or inside the port and how far from aquaculture farms (provided distance if known)?

CHAPTER 8

8. ENVIRONMENTAL IMPACT ASSESSMENT

8.1. Introduction

This chapter predicts, determines and assess impacts of the proposed activities on the environment. Mapping the receiving environment entails classification into various environmental resources that will be affected. Additionally, the environmental resources are subdivided into various environmental components which are well known as VECs (valued environmental components).

In total it is predicted that this project will affect 6 environmental resources. These impacts will vary in duration, significance and intensity. The sections below describe different types of environmental resources. This will be followed by other sections describing VECs and how they will be affected by the proposed project activities.

8.2. Environmental resources

Environmental resources are components of the environment that are essential either for ecosystem functioning, cultural integrity and political stability as described below.

8.2.1. Air and climate

Earth is the only planet known with a life-supporting atmosphere, hence air and climate is an essential environmental resource that the proposed project will consider while undertaking underwater hull cleaning operations. Air and climate constitutes aspects such as the particulate air content and local air quality which affect public health. Air and climate could be divided into 5 valued environmental components viz. technosphere, atmospheric composition, mesosphere, thermosphere and exosphere. For this proposed activity the focus will be more on technosphere and air composition as they will be more affected by this project. Technosphere is part of the atmosphere which is closest to land and which is more vulnerable to human activities. This is considered a VEC as it directly affects public health in a number of ways including oxygen supply.

8.2.2. Cryosphere

Cryosphere is that part which cannot be classified as the hydrosphere because water is in a solid state. Although this part, which include iceberg, sea ice, river ice and glaciers, is not directly affected by the underwater hull cleaning operations, it is indirectly influenced by emissions of GHGs and global warming. Higher fuel consumption partly contributes to emissions of GHGs and global warming.

8.2.3. Oceans and seas

This is part of the hydrosphere and since it makes up 70% of the earth's surface, it is an extremely important environmental resource which needs protection due to massive anthropogenic activities taking place in this sphere. All underwater hull cleaning operations will take within this sphere; specifically, in the coastal environment.

8.2.4. Lithosphere

Sediment will be more affected by the proposed underwater hull cleaning. Furthermore, land surface will also be affected. Other layers of the lithosphere (e.g. mantle, upper or mantle) which are more than 100 km deeper will not be affected.

8.2.5. Biosphere

This is part of the earth which is comprised of the biotic and non-biotic component. This is an important environmental resources and has been covered comprehensively in chapter 5.

8.2.6. Human environment

The human environment resource combines both human and natural components to show complex interactions, and feedback between them. The most internationally accepted framework for studying this system interaction is the DPSIR (drivers, pressures, state, impact, response) model.

The coastal DPSIR involves a chain of causal links starting with 'driving forces' (e.g. blue economic sectors, human activities, etc) to 'states' (physical, chemical and biological) and ‘impacts’ on the environment; leading to ‘policy’ response. A comprehensive analysis of the human environment is provided in chapter 6.

8.3. Environmental impact assessment

Environmental impacts assessment is provided in ***table 12.*** The following impacts will be most significant as explained below.

8.3.1. Brushing and cutting action of the ROV-cart equipment

During the cleaning, brushing and cutting action of the ROV-cart equipment will likely to increase sea water turbidity. Though, this impact will be temporary, it will occur regularly whenever underwater cleaning takes place and will need to be monitored.

8.3.2. Hydrodynamic vortices generated by the ROV-cart equipment

The hydrodynamic vortices generated by the ROV-cart equipment will likely to affect ‘free-floating’ plankton species. These species are less mobile when compared to mobile species such as fish. This activity is unavoidable but it can be mitigated through monitoring.

8.3.3. Removal of bio-fouling organisms

Although the ROV-cart and filtration system is designed to reclaim bio-fouling organisms and debris removed from the vessels, it will not be possible to reclaim all bio-fouling organisms and debris. As such it is possible that IAS and harmful pathogens that may be released into seawater will negatively affect the local marine biota.

Furthermore, accidental removal of anti-fouling paint containing organotin compounds such as TBT (tributyltin) and TPhT (triphenyltin) affect invertebrate population renewal. Alzieu (2000) found that TBT reduces embryogenesis and larval growth, inhibit fertilization, causes imposex and female sterilization in gastropods. Currently, use of TBT and TPhT as biocides in marine paints is banned and this impact is not expected to be significant. However, due ecotoxicology and bioaccumulation effect, historical releases into port waters will be mitigated as follows:

- Prevent by ensuring that the ROV-cart only removes bio-fouling organisms and not the marine paint.
- Prior to cleaning, the proponent should request for MV's Biofouling plan and inspect it by paying attention to:
    - Composition of hull paint and determine whether TBTs and TPhTs are present;
    - Date of last painting and cleaning; MV that were cleaned more than 2 years ago may pose an environmental risk and may only be cleaned under strict precautionary measures, and
    - The last 3 ports visited/entered in order to establish whether MV has been in ports of known IAS and harmful pathogens.

8.3.4. <u>Occupation risks at sea</u>

The Proponent shall ensure that persons, who are not in their employment but who are part of the underwater hull cleaning team, shall be competent and duly qualified for the nature of the work that they are going to perform during underwater hull cleaning activities. The Proponent shall ensure that such persons are familiar with the NAMPORT's procedures and rules as well as the underwater hull cleaning equipment that is to be used. The Proponent shall inform the working staff of the importance of environmental protection and safety during operations and provide them with appropriate training.

8.3.5. <u>Use of higher rich carbon oils</u>

Larger MVs (for e.g. cargo and passenger ships) operate on heavy fuel oils (HFOs), while tugs and fishing vessels tend to operate on distillate oil such as marine diesel oils (MDOs), marine gas oil (MGOs). HFOs, MDOs and MGOs immensely contribute to GHGs' emissions because of their higher carbon concentrations and this has negative environmental impacts. It is anticipated that environmental regulations will at some point see fuel oils displaced in favor of supposedly cleaner fuels. Also because, bio-fouling organisms tend to increase fuel consumption, hence release of GHGs, it is recommended that MVs perform regular hull cleaning.

8.3.6. Diving

Due to the higher risks of diving, NAMPORT may not permit any diving activity within the port unless the Proponent provides diving licences of employees undertaking diving activities.

8.3.7. Grit blasting

Grit with glass beads or metal particles such as aluminum oxide, steel grit, cast iron shot, garnet and slag have negative effect on air quality and may be done only upon approved method statement by NAMPORT.

8.4. Discussions, conclusions and recommendations

Oceans and seas, biosphere and the human environment will be most affected environmental resources. Seawater quality, sediment and aquatic invertebrates will be negatively affected. While the project has a potential to positively contribute socio-economic development, there are negative occupational health risks involved.

The project has a potential to positively contribute to employment creation and revenue generations in Walvis Bay. However, this will depend on mitigation of negative environmental impacts. Critically this mitigation will depend effective implementation of an EMP.

Often EMP are well designed, but they fail during implementation. Therefore, it is recommended that an EMP should be clear and concise in providing a baseline monitoring plan detailing which environmental indicators will be monitored and the SOPs to be used for each indicators. Lastly, it will also be useful (though not compulsory) to state whether technical capacity for environmental monitoring exist locally.

Table 14: prediction and description of impacts.

Environmental resource	**Description of VEC (valued environmental component)**	**Description of impacts**
AIR AND CLIMATE	**Technosphere** (also known as anthroposphere).	Poor ambient air quality and health implications to residents due to emissions of GHGs (greenhouse gases). Release of dust and metals particles into the air
	The **air composition** of the earth's atmosphere is different from air of other planets in that it consists of nitrogen (78%), oxygen (21%), water vapor (1%), inert gases (0.97%) and Carbon Dioxide (0.03%).	Ocean acidification due to Carbon Dioxide emission.
CRYOSPHERE	**Glaciers, icebergs, ice sheets and permafrost** are all valued component of the cryosphere.	Melting of the cryosphere due to global warming lead sea level rise. This is indirectly related to higher fuel consumption and emission GHGs.
OCEAN AND SEAS	**Seawater quality**	Release of bio-fouling content into water will increase turbidity and reduce water clarity. Reduced water clarity increase light absorption which in turn decrease photosynthesis and productivity. Release of IAS and harmful pathogens negatively affect aquatic biota. Release of pollutants from biocide antifouling paints cause water pollution. tributyltin (TBT) and triphenyltin (TPhT) are common constituents of antifouling paints. TBT mainly disrupt the hormonal system and could lead to sterilization of marine invertebrates. Discharge of reclaimed water from the ROVA-cart hull cleaning equipment could contain, if untreated, IAS and harmful pathogens.

		Increase in nutrients from anthropogenic sources (e.g.) could lead to eutrophication and increase in abundance of harmful algal blooms (HABs).
LITHOSPHERE	**Sediment morphology** entails classification of sediments into various categories either based on size (fine, coarse, etc), origin (lithogenous, biogenous, hydrogenous, etc) or color. Sediment characteristics have effects on bentho-fauna diversity in the sediment. Furthermore, different sediments are affected differently by anthropogenic activities such as dredging or hull cleaning.	Naturally, sediment transport and morphology is driven by waves, currents and wind. Anthropogenic activities including dredging and suctioning of sediment during port development and port waterway maintenance also drive sediment transport and morphology. Underwater hull cleaning operation is listed as anthropogenic activity with potential negative impacts. However, this impacts will significantly depend on the type of equipment used and its capacity to generate the hydrodynamic vortex force equal to the one created by waves, currents and wind. Sediment modification will negatively affect benthic fauna diversity and need to be mitigated and monitored.
	Sedimentation is the process of settling or being deposited as sediment.	Removal of bio-fouling organisms and their settlement to the bottom will increase sediment thickness.
	Land surface will impacted through waste generation, litter and illegal dumping.	Generation of solid and liquid waste and lack of waste management will negatively affect land surface.
	Land use conflict	Hull cleaning operations is not the only activities taking place within the port limits. There are activities such fish farming, fish processing, marine tourism, shipping and ship maintenance. The potential impacts these activities will have on one another and the

		environment will include increased traffic volume, illegal dumping, waste generation, air and water pollution, dredging, habitat modification and marine biodiversity loss.
BIOSPHERE	**Ecosystem and biological diversity**	Sediment modification and effect on epi-fauna and benthic fauna diversity.
	Anoxia is a common anomaly in the BCLME and is a result of decomposition in the absence of oxygen which lead to total depletion of dissolved oxygen.	Higher sedimentation rate cause incomplete decay of organic matter which deprive the ecosystem of dissolved oxygen; leading to anoxic conditions.
	Reduced plankton diversity	Effect on plankton species by pump suction action and vortex during reclamation of debris.
	Decreased primary productivity	Reduced water clarity increase light absorption which in turn decrease photosynthesis and productivity.
	Bio-fouling organisms	Some MVs of international origin that dock at port are infested with bio-fouling organisms from other ecosystems. These bio-fouling organisms could be biosecurity risks to endemic or local species in the BCLME.
	IAS and harmful pathogens	IAS and harmful pathogens could change the food web in the BCLME by destroying or replacing native species. IAS and harmful pathogens may provide little or no food value for marine biota. They can also alter the abundance or diversity of species that are important habitat for native marine biota.
	Marine biota	Effects of AIS and harmful pathogens on marine biota
		Impacts of underwater noise on marine biota.
HUMAN ENVIRONMENT	Blue economy development (driving force)	The proposed activity is a blue economic development within the marine transport sub-sector.

	Policy response (legislation and policy)	Establishing a coastal DPSIR framework for Namibia dates back to a year when NACOMA was formed to-date when the MSP (Marine Spatial Planning) tool was adopted. Currently no blue legislation exist on blue economy and this makes it difficult to regulate various blue economy activities.
	Occupational safety and public health	Diving is an internationally regulated activity and a diving licence will be required.
		Proposed activity is the hull cleaning.
		Vessel preparation
		Injury on duty (IOD)
		Reporting of incidents
		Termination of hull cleaning
		Removal of macro-fouling organisms of domestic or international origin
		Release into water of macro-fouling organisms of domestic or international origin
		Hull cleaning equipment
		Calibration and servicing of the equipment
		House keeping
		Inspection

Table 15: impact assessment.

VECs	Point-source	Impacts	Duration	Magnitude	Extent	Type	Probability

Air and climate	**Use of higher rich carbon oil such as HFOs, MDOs and MGOs by marine vehicles.**	Release of GHGs and implications on air quality and health of residents.	Long term	Medium	International	Direct	Definite
		Ocean acidification due to increased atmospheric Carbon Dioxide.	Long term	Medium	International	Indirect	Definite
	Grit blasting with glass beads or metal particles such as aluminum oxide, steel grit, cast iron shot, garnet and slag.	Release of dust and metals particles into the air and implication on public health.	Medium term	Low	Localized	Direct	Definite
Cryosphere	**Use of higher rich carbon oil such as HFOs, MDOs and MGOs by marine vehicles.**	Melting of ice and sea level rise due to global warming.	Long term	Medium	International	Indirect	Definite
Seawater quality	**Brushing and cutting action of the ROV-cart equipment.**	Effects of underwater noise on marine biota.	Short term	Low	Localized	Direct	Definite
		Increased turbidity during underwater cleaning.	Short term	Medium	Localized	Direct	Definite
		Release of pollutants from biocide antifouling paint.	Medium term	Low	Localized	Direct	Probable
Lithosphere	**Hydrodynamic vortices generated by the brushes**	Disturbance of sediment due to effects of hydrodynamic vortices.	Short term	Low	Localized	Direct	Low probability
	Removal of bio-fouling organisms	Settling or deposition of debris/bio-fouling removed during cleaning.	Short term	Low	Localized	Direct	Probable
Ecosystem and biodiversity	**Use of higher rich carbon oil such as HFOs, MDOs and MGOs by marine vehicles.**	Effects of acidification on shellfish and other invertebrates leading to poor formation of the exoskeleton.	Long term	High	International	Indirect	Definite
	Removal of bio-fouling organisms	Release of IAS and harmful pathogens and effects on local marine biota.	Long term	High	International	Indirect	Definite

		Effects of higher turbidity on visibility in water and ability of light reach the photic zone.	Short term	High	Localized	Direct	Definite
	Debris and water extraction through the suction shroud.	Impingement and entrainment of 'free-floating' plankton species, juvenile fish and invertebrates occupying the water column.	Short term	Medium	Localized	Direct	Definite
	Hydrodynamic vortices generated by the brushes	Effects hydrodynamic vortices on 'free-floating' plankton communities.	Short term	Low	Localized	Direct	Definite
	Discharge of treated water	Release of viable adult, juvenile and larval stages of bio-fouling organisms.	Long term	Low	Localized	Direct	Probable
Occupational safety and public health.	**Diving**	Risks of diving including decompression sickness (DCS), arterial air embolism and drowning.	Long term	Medium	Localized	Direct	Probable
	Occupation risks at sea	Communicable diseases and CVD (cardiovascular diseases).	Long term	Medium	Localized	Direct	Probable
		Injuries on duty (IODs) including being hit by falling objects, slipping on greasy, wet or dirty surfaces.	Long term	Medium	Localized	Direct	Probable
		Fire, drowning, risks of ships grounding or sinking.	Long term	Medium	Localized	Direct	Probable
		Accidental oil and chemical spills.	Long term	Medium	Localized	Direct	Probable
		Tripping over loose objects on floors, stairs and platforms.	Long term	Medium	Localized	Direct	Probable

Table 16: impact significance.

VECs	Point-source	Impacts	Significance	
			Significant	Not significant
Air and climate	**Use of higher rich carbon oil such as HFOs, MDOs and MGOs by marine vehicles.**	Release of GHGs and implications on air quality and health of residents.	X	
		Ocean acidification due to increased atmospheric Carbon Dioxide.	X	
	Grit blasting with glass beads or metal particles such as aluminum oxide, steel grit, cast iron shot, garnet and slag.	Release of dust and metals particles into the air and implication on public health.	X	
Cryosphere	**Use of higher rich carbon oil such as HFOs, MDOs and MGOs by marine vehicles.**	Melting of ice and sea level rise due to global warming.		X
Seawater quality	**Brushing and cutting action of the ROV-cart equipment.**	Effects of underwater noise on marine biota.		X
		Increased turbidity during underwater cleaning.	X	
		Release of pollutants from biocide antifouling paint.		X
Lithosphere	**Hydrodynamic vortices generated by the brushes**	Disturbance of sediment due to effects of hydrodynamic vortices.	X	
	Removal of bio-fouling organisms	Settling or deposition of debris/bio-fouling removed during cleaning.		X
Ecosystem and biodiversity	**Use of higher rich carbon oil such as HFOs, MDOs and MGOs by marine vehicles.**	Effects of acidification on shellfish and other invertebrates leading to poor formation of the exoskeleton.	X	
	Removal of bio-fouling organisms	Release of IAS and harmful pathogens and effects on local marine biota.	X	
		Effects of higher turbidity on visibility in water and ability of light reach the photic zone.		X

	Debris and water extraction through the suction shroud.	Impingement and entrainment of 'free-floating' plankton species, juvenile fish and invertebrates occupying the water column.		X
	Hydrodynamic vortices generated by the brushes	Effects hydrodynamic vortices on 'free-floating' plankton communities.	X	
	Discharge of treated water	Release of viable adult, juvenile and larval stages of bio-fouling organisms.		X
Occupational safety and public health	**Diving**	Risks of diving including decompression sickness (DCS), arterial air embolism and drowning.	X	
	Occupation risks at sea	Communicable diseases and CVD (cardiovascular diseases).	X	
		Injuries on duty (IODs) including being hit by falling objects, slipping on greasy, wet or dirty surfaces.	X	
		Fire, drowning, risks of ships grounding or sinking.	X	
		Accidental oil and chemical spills.		X
		Tripping over loose objects on floors, stairs and platforms.	X	

Table 17: priority and mitigation action.

VECs	**Point-source**	**Impacts**	**Priority** **High (1) Medium (2) Low (3)**	**Mitigation action**
Air and climate	**Use of higher rich carbon oil such as HFOs, MDOs and MGOs by marine vehicles.**	Release of GHGs and implications on air quality and health of residents.	3	Reduce and regulate.
		Ocean acidification due to increased atmospheric Carbon Dioxide.	2	Reduce and regulate.
	Grit blasting with glass beads or metal particles such as aluminum oxide, steel grit, cast iron shot, garnet and slag.	Release of dust and metals particles into the air and implication on public health.	2	Regulate.
Seawater quality	**Brushing and cutting action of the ROV-cart equipment.**	Increased turbidity during underwater cleaning.	1	Monitoring.
Lithosphere	**Hydrodynamic vortices generated by the ROV-cart equipment.**	Disturbance of sediment due to effects of hydrodynamic vortices.	1	Monitoring.
Ecosystem and biodiversity	**Use of higher rich carbon oil such as HFOs, MDOs and MGOs by marine vehicles.**	Effects of acidification on shellfish and other invertebrates leading to poor formation of the exoskeleton.	3	Regulation.
	Removal of bio-fouling organisms.	Release of IAS and harmful pathogens and effects on local marine biota.	1	Monitoring.
	Hydrodynamic vortices generated by the ROV-cart equipment	Effects hydrodynamic vortices on ‘free-floating’ plankton communities.	1	Monitoring.
Occupational safety and public health.	**Diving**	Risks of diving including decompression sickness (DCS), arterial air embolism and drowning.	2	Emergency preparedness and response. Diver training.
	Occupation risks at sea	Communicable diseases and CVD (cardiovascular diseases).	1	Prevention, emergency services, public education and awareness.
		Injuries on duty (IODs) including being hit by falling objects, slipping on greasy, wet or dirty surfaces.	1	Prevention, public education and awareness.

		Fire, drowning, risks of ships grounding or sinking.	1	Prevention.
		Tripping over loose objects on floors, stairs and platforms.	1	Prevention.

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

Although technologies may not solve all environmental problems; when combined with innovation and entrepreneurship they have a potential to provide some of the solutions. Underwater hull cleaning technology is cheaper and tends to be a better option to MV operators compared to cleaning while the MVs are in the dry-dock.

The receiving environment of impacts emanating from the proposed underwater hull cleaning will mainly be the coastal environment. The VECs more affected are the plankton communities as well as invertebrates. Many invertebrates are of particular interest in this EIA/scoping study as they are likely to be more significantly and directly affected by the proposed underwater hull cleaning activity.

Usually when levels of seawater pollutants increase a change is observed whereby species richness decreases while the abundance of a few pollution tolerant species increase. The resultant changes in benthic fauna community structure, diversity and abundance are the responses of these benthic fauna to the physical and chemical changes in their environment. Polychaetes and amphipods are potential indicators of water quality especially in terms of the effects of pollutants on life history traits. The polychaeta/amphipoda (P/A) index which is used to detect changes sediment simply refers to the ratio between the abundance of polychaete species to abundance of amphipods when pollution increases. The P/A index is based on the assumption that polycheata and amphipoda displays different sensitivity to pollution. While polychaeta are resistant to increase in pollutants; amphipods on the other hand are sensitive to pollution. This means after increase in pollution, many opportunistic polychaeta species increase in abundance while abundance of amphipods decreases.

It is recommended that the ECC should be issued on conditions that:

- The proponent commits to implement the EMP.
- The baseline environmental monitoring is undertaken.
- The EMP should focus on monitoring abundance in planktons and other aquatic invertebrates which are the main part of the bio-fouling organisms.

- Invertebrate samples should be taken before, during and after the underwater hull cleaning operation.
- Impacts on benthic fauna diversity is expected to be less compared to epifauna and zooplankton which occupy the water column.
- Therefore, the epifauna and zooplankton should be sampled more often compared to the benthic fauna which should may be sampled only twice a year (i.e. every 6 month or twice a year).

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