UFUDU MARINE NAMIBIA CC

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SCOPING/ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED PROVISION OF IN-WATER HULL CLEANING SERVICES USING THE SCHOMBERG VACU-CART AND RECLAMATION FILTRATION SYSTEM IN WALVIS BAY, ERONGO REGION, NAMIBIA

Prepared on behalf of

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CONTENTS

ACRONYM

BCC Benguela Current Commission

BCLME Benguela Current Large Marine Ecosystem

BOD Biological Oxygen Demand

CO_2 Carbon Dioxide

DCs Decompression sickness

DO Dissolved Oxygen

EAP Environmental Assessment Practitioner

EIA Environmental Impact Assessment

EMP Environmental Management Plan

ECC Environmental Clearance Certificate

IAS Invasive Alien Species

IOD injury on duty

MEFT Ministry of Environment, Forestry and Tourism

MFMR Ministry of Fisheries and Marine Resources

NAMPORT Namibia Ports Authority

NCRST National Commission on Research, Science and Technology

P/A index polycheate to amphipod index

SOPs standard operations procedures

SSTs seas surface temperatures

TDS total dissolved solids

TORs terms of references

TSS total suspended solids

UN United Nations

UNCLOS United Nation Convention on Law of the Sea

CONSULTING COMPANY'S DETAILS

NAME OF CONSULTING COMPANY

ECUTS

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COMPANY REGISTRATION NUMBER

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LIST OF PROJECTS

Since establishment in 2013, ECUTS had completed more than 20 projects across various economic sectors including the following:

1. **Waste management/tourism** (EIA/scoping for the Mudumu National Park/Ministry of Environment and Tourism, Kongola, Zambezi region, 2013).
2. **Off-shore mining** (Benthic baseline study for Deb-marine, Windhoek, 2014).
3. **Training** (Strategic coastal management training for NACOMA/Ministry of Environment and Tourism, Erongo region, 2015).
4. **Agriculture** (Climate resilience readiness country study in Namibia on behalf of the Technical Centre for Agricultural and Rural Co-operation, Windhoek, 2016).
5. **Tourism** (EIA/scoping for upgrading of Rhino campsite for Brandberg White Lady Lodge, Erongo region, 2019).
6. **Mineral exploration** (EIA/scoping for Exploration Activities on EPLs 7795, 7796, 7797, 7798, 7799 and 7800 for Mangroove PTY LTD, Omaheke and Hardap regions, 2021).
7. **Waste management/maritime transport** (EIA/scoping to perform under-water cleaning for Walvis Bay Diving & Salvage cc, Walvis Bay, 2021).
8. **Mariculture** (Full EIA/Baseline Environment specialist study to construct and operate a cage finfish farm for Benguela Blue Aqua Farm, Lüderitz, 2022).
9. **Maritime pollution** (Development of a national oil dispersant use policy for Namibia on behalf of the Ministry of Works. Transport, 2022), **Tourism/aviation transport** (EIA/scoping to construct and operate a private airstrip for Brandberg White Lady Lodge, 2022).
10. **Waste management/maritime transport** (EIA/scoping to perform in-water cleaning for Ufudu Marine Namibia cc, 2022).

PROJECT DETAILS

PROJECT TITLE

Provision of underwater hull cleaning services using the Scomberg Vacu-Cart and Reclamation Filtration System in Walvis Bay, Erongo region, Namibia.

ENTITIES REPRESETNTING GOVERNMENT REPUBLIC OF NAMIBIA

Ministry of Environment, Forestry and Tourism (Permitting Authority).

Ministry of Fisheries and Marine Resources (Competent Authority).

Ministry of Works and Transport (Key Stakeholder).

KEY LEGAL INSTRUMENTS

Environmental Management Act (No. 7 of 2007) and EIA regulations of 2012.

Marine Traffic Act (no. 2 of 1981).

Merchant Shipping Act (no. 57 of 1951).

Pollution Control and Waste Management Bill.

TARGET ECONOMIC SECTOR & ACTIVITY

Maritime transport & Waste Management.

PROPONENT

Ufudu Marine Namibia cc.

EIA PROCESS AND TIMELINES

SEPTEMBER 2022 (phase I):

- *Advert in the Namib Times newspaper and Confidente newspaper: 02 September 2022.*
- *Advert in the Namib Times newspaper and Confidente newspaper: 09 September 2022.*
- *Release of BID to Client and registered IAPs.*
- *Release of draft EIA and EMP Reports and request for consent letter from the Competent Authority.*

OCTOBER 2022 (phase III):

- *Public meeting in Walvis Bay.*
- *Launch application with MEFT and upload all documents on the EIA portal.*

NOVEMBER- 30 NOVEMBER 2022 (phase III):

- *Waiting period for GRN/MEFT and the EC to issue a Record Decision.*

OPERATIONAL WINDOW

- Purchase/acquisition of underwater cleaning Equipment (phase IV): 01 December 2022.
- Equipment commissioning & operation of underwater hull cleaning (phase V): 05 December 2022.
- Renewal of ECC (end of phase V): December 2025.

EXECUTIVE SUMMARY

1. Introduction and background

Ufudu Marine Namibia cc (the proponent) intends to clean vessel hull surfaces by removing a bio-film that build-up as a result of bio-fouling organisms. In-water cleaning operations will take place within the Walvis Bay port. The proposed cleaning technology is the Schomberg Vacu-Cart and Reclamation Filtration system. This in-water technology is able to reclaim the bio-film waste which is removed and separate it into solid and liquid wastes which will be treated before disposal at an approved Walvis Bay Land-fill site.

In-water hull cleaning is approved by the IMO (International Maritime Organisation) and had been adopted in many coastal states as a preferred in-water hull cleaning method. IMO had established guidelines to help operators undertake safe operations and also assist developing coastal states to regulate and control cleaning operations and prevent the bio-risks of introduced aquatic species.

2. Project desirability and motivation

Currently many consumers of seafood and users of ocean space belong to generations Y and Z. Due to their population size, many producers are targeting consumers in these generations. These consumers are conscious about where and how seafood products are harvested and environmental impacts that occur along the seafood value chain distribution. As a result, seafood producers are increasingly investing in environmentally friendly practices and technologies to satisfy consumer demand. As more members of the Y and Z generation grow and become decision-makers in governments, in the near future port authorities will soon be compelled to implement sustainable seafood systems and eco-labelled bio-fouling systems.

Based on the above, there is a need to provide in-water hull cleaning in Namibia. Namibia will benefit more by implementing in-water hull cleaning operations. The Walvis Bay port is currently a preferred port of destination in southern Africa. Critically, if in-water hull cleaning operations are not implemented soon, Namibia will lose more as more vessels will avoid docking in a port heavily infected with introduced aquatic species and harmful pathogens.

The proponent intends to use the Schomberg Vacu-Cart and Reclamation Filtration System. The Schomberg Vacu-Cart and Reclamation Filtration System presents several advantages to both the Proponent, the Competent Authority, vessel operators and the environment:

- *Some organisms that form part of the reclaimed biofilm could still be alive or intact and could be collected as samples by MFMR as part of monitoring to generate data about marine organisms that maybe introduced into the Walvis Bay port;*
- *Cleaner vessel hull surfaces allow vessels to operate more efficiently, thereby reducing higher fuel consumption, and*
- *Ultimately, both monitoring and low fuel consumption will benefit the environment through early detections of introduced aquatic species and harmful pathogens as well as reduced emission of GHGs.*

3. Receiving environment and environmental impacts

The project will take place in the port of Walvis Bay, which is bathed by waters from Benguela Current Large Marine Ecosystem (BCLME). Due to higher productivity, the BCLME supports a huge fishery leading to a successful Namibian fishing sector which is worth more N$10 billion, annually. Fish and seafood from Namibia's waters is highly demanded due to a healthy ecosystem and the GRN (Government Republic of Namibia) needs to defend and preserve this near-pristine ecosystem against pollution and potential bio-security risks.

GRN recognizes a potential of the blue economy as a catalyst for economic development; therefore, a need to reinforce peace and security at sea. Patrol of the EEZ and territorial waters only guarantee peace but does not defend against the bio-security risks.

Globally, efforts had been made experimenting with various types of anti-fouling systems to avoid accumulation of bio-fouling organisms:

- *Dry-dock method entails the removal of vessels from waters to remove and clean the bio-film;*
- *Use of anti-fouling paints involve painting hull surface to prevent formation of the bio-film. However, organotoxin compounds in marine paints have several negative environmental impacts;*
- *Commercial in-water cleaning involves removal of bio-film using hand-held tools which are unable to reclaim the removed bio-film, which means the bio-film material is discarded into the seawater, and*
- *Vacu-Cart in-water is similar to the commercial in-water hull but is more value-added because the bio-film removed is reclaimed and separated into liquid and solid waste for proper disposal.*

The above efforts demonstrate that there is a move-away from unsustainable practices to more sustainable and eco-friendlier bio-fouling systems.

4. Legislation framework

Members of the Y and Z generations demand more 3rd generation human rights when compared to member of the X generation who are concerned more with 2nd generation rights. 2nd generation human rights such equality and right to life and freedoms are considered as basic rights and appear as fundamental human right in the Namibian Constitution (or the Constitution).

However, members of the Y and Z generations demand more than fundamental human rights. Such human rights are often found in agreements that are termed 'soft' laws. Normally these agreements are:

- *Part of the international law,*
- *Not legally binding to all states, and*
- *More focused on environmental protection.*

Article 144 of the Namibian constitution (or the Constitution), allows for domestication of international Conventions and Agreements:

- *As party to the Ballast Water Convention (BWT), Namibia is required under article 6 of this Convention to generate baseline information about distribution and abundance of IAS (introduced alien or aquatic species) and harmful pathogens in ports.*
- *The International ICCHAS (International Convention on the Control of Harmful Anti-Fouling Systems on Ships) banned use of anti-fouling marine paints.*
- *The IMO (International Maritime Organization) recognizes advantages of the in-water hull cleaning as a preferred bio-fouling control system.*

Despite advantages of the proposed in-water Vacu-Cart hull technology, additional precautionary environmental measures will be needed:

- *Under article 95 (l) of the Constitution, the State is required to protect the environment.*
- *The Environmental Management Act (no. 7 of 2007) (or the Act) and its regulations requires that new proposed activities should be undertaken only upon approval by the State.*

5. EIA process and stakeholder consultations

Ufudu Marine Namibia cc has a strict environmental company policy which is geared towards environmental protection. Hence, in addition to procurement of the Schomberg Vacu-Cart equipment, Ufudu Marine Namibia cc had committed additional resources to undertake an EIA/scoping study:

- *The adverts were placed for 2 weeks in local newspapers on 02 September and 09 September 2022.*
- *Release of EIA/scoping and EMP reports (22-30 September 2022). The main advantage of first releasing draft reports before holding a public meeting is because it provides an ideal opportunity for IAPs to read through the reports before the public meeting.*
- *The public meeting will take place on 21 October 2022 in Walvis Bay.*
- *The EIA/scoping and EMP reports were availed for comments to registered IAPs and GRN entities.*

6. Conclusions and recommendations

Based on evaluation of the Vacu-Cart in-water hull operations in South Africa, Australia, USA and other ports, this technology meets strict IMO requirements. There is a need to do away with the old cleaning methods in the Walvis Bay port and embrace environmentally friendly methodologies and practices in order to meeting IMO standards.

The proposed Vacu-Cart in-water hull cleaning is a value added and innovative technology and it will present several advantages to both the proponent, the Competent Authority, vessel operators and the environment. However, in undertaking this activity, there will be negative environmental impacts which will need to be mitigated as will be demonstrated in the EMP:

- *During mitigations, emphasis will be on monitoring of the water and sediment quality;*
- *Samples will be taken before, during and after each in-water hull cleaning operation;*
- *Environmental monitoring reports about state of the environment will be submitted to GRN entities twice a year as recommended in the Scoping/EIA and EMP reports.*

It is therefore recommended that the proponent should be issued with ECC in order to undertake the proposed in-water cleaning activity.

CHAPTER 1

1. INTRODUCTION AND BACKGROUND

1.1. Introduction

Ufudu Marine Namibia cc (the proponent) 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 methods and 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 tends to increase fuel consumptions which lead to higher emissions of GHGs (greenhouse gases). Furthermore, bio-fouling accumulation is likely to increase the biosecurity risk of invasive aquatic species (IAS) and harmful pathogens.

The proposed diver-operated Schomberg Vacu-Cart and Reclamation Filtration system will clean MVs while at sea. This means there will not be a need to remove the MVs from water. The debris removed will be reclaimed, treated via the filtration system and will be discarded according to approved disposal methods.

This chapter provides a background of the project in context of the Namibian and Walvis Bay economy as well as the need and motivation to have this project implemented.

1.2. Project motivation

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 organisms from sticking on hull surface as well as reduce growth by slowly releasing biocide antifouling paint on the hull surfaces.

Negative environmental impacts associated with anti-fouling paints is 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 in-water hull cleaning as the most preferred anti-fouling method with least environmental impacts.

1.3. Project alternatives

Before proposing this project, the proponent considered various alternatives:

1.3.1. "Dry-dock cleaning" alternative

MVs are removed from the water and the bio-film is exposed to air before being removed by v manual scrapping or high-pressure water spray. The removed bio-film or debris is partially contained and could either fall on the ground and cleared or washed off into the sea. Many marine organisms that are alive pose a higher risk of being re-introduced into seawater.

The proponent found this alternative too costly and not environmentally friendly.

1.3.2. Use of anti-fouling paints" alternative

Application of anti-fouling marine paints 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.

This alternative will cause more pollution and was not considered.

1.3.3. "Commercial in-water hull cleaning" alternative

Scuba divers remove the biofouling using hand-held tools to scrape the hull surface to clean. No containment of bio-film and discarded biofouling debris sinks to the bottom of the ocean floor where viable marine organisms may potentially become established. Bio-film is not treated or disposed following approved waste disposal procedures.

The proponent found this alternative too costly and not environmentally friendly.

1.3.4. "Vacu-Cart in-water hull cleaning" alternative

Containment of biofouling debris through a sub-mergeable electric slurry suction pipe, which transfers the biofouling debris into the shaker. Hydraulic, diver-operated machine removes the biofouling through the high powered, rotating cleaning disks. Biofouling debris is deposited into a certified landfill site.

The proponent found this alternative less costly and environmentally friendly.

1.4. Discussions, conclusions and recommendations

Vacu-Cart in-water hull cleaning is cheaper and could be a better option to MVs operators compared to other methods. 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?

There is a need for the private sector and entities representing the GRN to work together to benefit the environment. While performing in-water cleaning operations, the Proponent will take samples on behalf of MFMR. This will provide an ideal opportunity for MFMR to get access to samples from foreign MVs and document the diversity of species found on hull surfaces. Through this, MFMR will be able to generate data about IAS and harmful pathogens as required by article in the Ballast Water Convention.

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 in-water hull cleaning technologies. All documents considered and the body of literature reviewed are provided in the bibliography.

2.3. Field surveys

2.3.1. Site visit

The site visits were undertaken on 30 August 2022 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 was 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, namely Namib Times and Confidente newspapers.

2.4.4. Release of BID

The BID was released to IAPs and entities representing GRN to inform them about intention to apply for ECC. The BID and the request for consent letter were also send to MFMR (on 29 September 2022) and MWT (on 22 September 2022) to seek approval which will be needed to support application for ECC.

2.4.5. Release of draft EIA/scoping and EMP reports

Release of draft reports was important to create a dialogue for the consultants and the IAPs to discuss issues and concerns about the project. Early release of reports was important as it creates an opportunity to respond to issues and concerns early in the EIA process.

2.4.6. Public meetings

The public meeting was held in Walvis Bay on 21 October 2022. The main advantage to first release EIA/scoping and EMP reports before holding a public meeting is because it provides an ideal opportunity for IAPs to read through the reports before the public meeting.

2.6 Environmental impact assessment methods

2.6.1 Leopold matrix method

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

2.6.2. Valued ecosystem components

Project activities to be undertaken will have impacts on the essential physical, biological, and human components of the environment. These environmental components are 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).

Valued ecosystem component	**Environmental resource**	**Potential impacts on the valued ecosystem component**
Air and climate	Air quality	• Heavy diesel emission. • Health implications for all users. • Effects on ambient air and the atmosphere. • Main Sustainability issue: *is air pollution a critical concern locally?*
	Climate	• Greenhouse emission. • Contribution to global warming. • Main Sustainability issue: *is climate change a concern locally?*
Land, seabed and seascapes	Landscape Sediment Seascapes, canyon and seamounts	• Land sensitivity and conservation status. • Increase in turbidity and widespread sediment transportation. • Change in sedimentology and benthic ecology. • Solid waste disposal. • Oil and chemical spills. • Use of non-renewable energy. • Effects of waste disposal methods. • Risks of ships grounding or sinking. • Sustainability issues: *-Since the area is declared an EBSA, is the conservation and*

		ecological status of the area critically endangered and which human activities caused this? *-Which species are endangered or extinct and how many are introduced through mariculture activities?*
Ocean	Seawater quality	• Detritus in the form of fish feed waste and fish excreta. • Increased seawater turbidity. • Oil and chemical spills. • Pollution implications for ecosystem and marina fauna. • Sustainability issues: *-Is seawater pollution a critical concern locally?*
Ecology and aquatic biodiversity	Terrestrial ecology and aquatic biodiversity	• Effect of introduced species on NIMPA. • Introduction of bio-fouling organisms that accumulate on artificial structures 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 entanglements of seals, cetaceans and birds in cages. • 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 mariculture). • 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. • Marine traffic accidents, theft and property damage.

2.6.3. Mapping of 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.	Oil spills and leaks
	Environmental monitoring

	Underwater noise

2.6.4. Impacts evaluation

The third stage in the Leopold matrix was evaluation of importance of each impact 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.

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

2.7. Environmental impact assessment

Impacts were evaluated using the Leopodt Matrix by looking at environmental resource sensitivity and the scope and coverage of impact as well as their magnitude, probability and significance.

2.7.1. Sensitivity of environmental resources

SENSITVITY RATING		**CRITERIA**
1	Negligible	The environmental resource is resistant to impacts or has less environmental value.
2	Low	The environmental resource could either absorb impacts or is able to rebound its original state after the impacts, or is of low environmental or social value or is of local importance.
3	Medium	The environmental resource is either unable to absorb impacts or after impacts is unable to rebound to original state, or is of high environmental or social value, or is of national importance.
4	High	The environmental resource has moderate capacity to absorb impacts, has some environmental or social value, or is of regional importance.
5	**Very high**	The environmental resource has little or no capacity to absorb change without fundamentally altering its present character, is of very high environmental or social value, or is of international importance.

2.7.2. Magnitude of impacts

0	No observable impact
1	Low impact
2	Tolerable impact
3	Medium high impact
4	High impact
5	Very high impact

2.7.3. Duration of impacts

T	Temporary
P	Permanent

2.7.4. Geographic coverage

L	Localized impacts or limited to location
O	Impact of importance to municipality
R	Regional impacts
N	National impact
I	International

2.7.5. Probability

LP	**Low** probability (possibility of impact occurring is low, below 25%).
P	**Probable** (there is a distinct possibility that it will occur, approximately 50%).
HP	**Highly probable** (the impact is most likely to occur, 75%).
D	**Definite** (the impact will occur, 100%).

2.7.6. Significance

	ENVIRONMENTAL RESOURCE CHARACTERISTICS				
IMPACT SEVERITY **[Magnitude, duration, extent, probability]**	**Very high 5**	**High 4**	**Medium 3**	**Low 2**	**Negligible**
Very high 5	**Major [5/5]**	**Major [4/5]**	Moderate [3/5]	Moderate [2/5]	Minor [1/5]
High 4	**Major [4/5]**	**Major [4/4]**	Moderate [3/4]	Moderate [2/4]	Minor [1/4]
Medium 3	**Major [3/5]**	Moderate [3/4]	Moderate [3/3]	Minor [2/5]	None [1/3]
Low 2	Moderate [2/5]	Moderate [2/4]	Minor [2/5]	None [322]	None [1/2]
Negligible 1	Minor [2/5]	Minor [2/5]	None [3/1]	None [2/1]	None [1/1]

2.7.6.1. 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?

2.8. Discussions, conclusions and recommendations

There are various types of environmental assessments; namely *Tier 1* and *Tier 2* assessments. *Tier 2* type of assessments takes into consideration both accumulative and non-accumulative impacts on the environment. However, *Tier 1* assessment considers only non-cumulative impacts; this means the focus is only on environmental impacts that are directly linked to the proposed project.

An EIA is a *Tier 1* type of assessment and it is often argued that EIA as an instrument for environmental assessment is not sufficient in evaluating development projects because it is limited in space and time (Cashmore, 2004). EIA 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 the operation phase.

Therefore, to make up for this it is recommended that other environmental support instruments such as an EMP and 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 which are higher level legislations.

Article 140 of the Namibian Constitution allows for all laws that were in force immediately before independence to remain until they are repealed. This means where a policy or legislation cited in this report was formulated before independence, it will still be considered a Namibian law, unless if it has been repealed by the Act of Parliament.

Ports adheres to strict international laws and Conventions and in cases where Namibia has ratified these laws and Conventions, they will be considered in this analysis. This is provided in article 144 of the Namibian Constitution.

3.2. Environmental principles

Environmental policies and legislations are expected to feature principles that are related to the environmental protection. However, not all environmental policies and legislations features these principles because some only focus on certain aspect of the environment, for example:

- Environmental policies and legislations that protect natural resources;
- Environmental policies and legislations that promote exploitation of natural resources, and
- Environmental policies and legislations that contain environmental principles but are silent about environmental protection.

Environmental principles are important to ensure that users of the marine space protect the environment while undertaking various maritime activities.

Such principles include:

- *Precautionary principles* – where it is difficult to determine whether there are negative environmental impacts, safety measures should be taken in case environmental damage occurs;

- *Prevention principles* – prevention measures should be taken to avoid pollution or environmental damage.
- *Environmental impacts should be rectified at source* – measures should be implemented to ensure negative impacts are mitigated at point-source before they spread further.
- *The polluter pays principle* – this principle dictates that whoever causes pollution should pay for damage that results from such pollution whether directly or indirectly.
- *The integration principle* – while protecting the environment, this should be done in alignment with sector or policies.

3.3. Environmental Impact Assessment Regulations of 2012

The Environmental Impact Assessment Regulations of 2012 guides on how the Act should be implemented by providing direction. The below is a summary of the regulations.

3.3.1. 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 ensure that the EIA procedures are followed.

3.3.2. 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.

3.3.3. 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.

3.2.4. Registration 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.

3.4. Namibian environmental legislations

Table 5: list of local environmental policies and legislations.

Legislation	Summary	Environmental principles
Environmental Management Act no. 9 of 2007	The Act covers a broad range of environmental principles including *conservation, pollution, environmental protection and monitoring,* among others.	Prevention. Precautionary. Mitigation of impacts at point source. Polluter pay principle. Integration approach.
Marine Traffic Act (no. 2 of 1981) as Amended Namibian Ports Authority Act of 1991	Ships may not be repaired within territorial sea or internal waters outside a harbor or fishing. No person shall sink a ship or dump ship wreck within territorial sea or internal waters outside a harbor or fishing.	Prevention of waste from ship repairs and ship wrecks.
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	The environmental principle specific to this Bill is pollution control.

	and odor pollution; to establish a 'system of waste planning and management; and to enable Namibia to comply with its obligations under international law in this regard.	
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.	Integration approach.
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.
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.
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 development of aquaculture resources; and to provide for related matters.	Environmental principles of this act are to promote sustainable aquaculture; management, protection and conservation of marine and inland aquatic ecosystems.
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.	Environmental principles specific to this act are: harmonization and streamlining of spatial planning in order to avoid land use conflicts, delays in decision making and to minimize negative environmental impacts.

Atmospheric Pollution Prevention Ordinance 11 of 1976	To provide for the prevention of the pollution of the atmosphere	To prevent atmospheric pollution and minimize environmental impacts associated with it.
Water Resources Management Act 11 of 2013	To provide for the management, protection, development, use and conservation of water resources; to provide for the regulation and monitoring of water services and to provide for incidental matters.	Manage water resources, prevent water pollution and control water storage and provision.
Public and Environmental Health Act 1 of 2015	To provide a framework for a structured uniform public and environmental health system in Namibia.	Principles of this act includes protecting individuals and communities from public health risks, encourage community participation 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.

3.4.1. Blue economy policy

Namibia has no blue economy policy; however, efforts are under way to formulate this policy. 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 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. 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.

3.5. International environmental conventions and agreements

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.	These guidelines are intended to provide a globally consistent approach to the management of biofouling organisms, which could present a bio-risk in local ports.	Prevent the transfer of invasive species and coordinating a timely and effective response to invasions which requires cooperation and collaboration among governments.
Stockholm Convention on Persistent Organic Pollution (2001)	Is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for longer periods.	To protect human health and the environment from persistent organic pollutants; especially those used in marine paints.
Vienna Convention for the protection of ozone layer (1985)	This Convention is aimed to promote cooperation among nations by exchanging information on the effects of human activities on the ozone layer.	To take control actions to protect the ozone layer.

Montreal protocol (1997)	Is a global agreement to protect the earth's ozone layer by phasing out the chemicals that depletes it.	Control substances and chemicals production that are depleting the ozone layer.
UN Framework on climate change (1992)	This framework was introduced to stabilize greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference 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
Conventions on Wetland of International Importance (1971)	Conserving wetlands (swamps, marshes, lakes, mudflats, peat bogs and other bodies of water whether natural or artificial, permanent or temporary).	This convention establishes a management framework aimed at conserving the wetland and ensuring its wise use. The Walvis Bay is recognized under this convention.
Paris Agreement (2015)	Is a legally binding international treaty on climate change.	To limit global warming to preferably 1.5 degrees Celsius, compared to pre-industrial levels.
United Nations Convention on Law of the Sea of 1982 (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	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

	oceans and seas establishing rules governing all uses of the oceans and their resources.	jurisdiction over marine science research and environmental protection.
International Convention for the Control of and Management of Ships' Ballast Water and Sediments of 2004.	This Convention seeks to prevent the spread of harmful aquatic organisms from one region to another, by the establishment of standards and procedures for the management and control of ships' ballast water and sediments.	Protect the oceans from invasive aquatic species
International Convention for the Prevention of Pollution from Ships (MARPOL) and the protocol of 1978.	This convention is aimed at the prevention of pollution from ships caused by operational or accidental causes.	Prevention of pollution by sewage, oil and garbage from ships in the sea; Prevention of air pollution from ships; prevent pollution by Harmful Substances carried at sea in packaged form.
International Convention of the Safety of life at Sea of 1974 (SOLAS).	SOLAS is an international maritime treaty which sets minimum safety standards in the construction, equipment and operation of merchant ships.	Convention allows for flag states to compel ships under their flags to comply with safety requirements including fire-fighting equipment and nuclear containment facilities in order to prevent impacts associated with risks of transportation of dangerous goods.
Convention on the Prevention of Marine Pollution by dumping of wastes and other matters, 1972 (as amended by the protocol of 1996).	This convention protects the marine environment from human activities such as pollution.	Take practicable steps to prevent pollution of the sea, promote the effective control of all sources of marine environment caused by dumping at sea; (black and grey list).
International Convention on Oil Pollution Preparedness, Response and Co-operation of 1990 (OPRC Convention) with its Protocol of 2000 (OPRC-HNS Protocol).	Convention was developed by the International Maritime Organization (IMO) to further prevent pollution from ships and it requires coastal states to prepare and response to oil spills risks.	Convention compels states to carry onboard oil pollution emergency plan 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 optional clause enabling States Parties to apply certain provisions to their territory, including their territorial sea.	It provides a sound legal basis for coastal states to remove wrecks which pose a hazard to the safety of navigation as well as the marine and coastal environments.
Internal Convention on Biological Diversity	Among others, this Convention aims at conservation of biological diversity and promote sustainable development of biological components.	Conservation of biological diversity, sustainable use and equitable sharing of utilization of biodiversity, ecosystem assessment and monitoring and mitigation of adverse environmental impacts.
International Convention on the Control of Harmful Anti-fouling Systems on Ships (2001)	The convention prohibits the use of harmful organotin in anti-fouling paints used and establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems.	It is preferable to minimize the accumulation of biofouling on vessels and movable structures.

3.6. Discussions, conclusions and recommendations

The Environmental Management Act (no. 7 of 2007) (or the Act) and its regulations of 2012 are the key legislations that allows the Ministry of Environment and Tourism to permit listed development project activities. However, such permission is issued in consultation with other line Ministries that are determined depending on the receiving environment and the economic sector under which project activities are taking place.

The Ministry of Fisheries and Marine Resources was identified as the Competent authority because it is the custodian of the ocean where the proposed cleaning operation will be taking place. Furthermore, the Ministry of Works and Transport is also the main stakeholder as a custodian of the maritime transport sector. Subsequently, the proponent needed to seek consents from these authorities for MEFT to issue the ECC.

CHAPTER 4

4. PROJECT DESCRIPTION

4.1. Introduction

Many countries had adopted the in-water hull cleaning to perform hull cleaning because it is cheap and environmentally friendly. The International Convention on the Control of Harmful Anti-fouling systems on Ships (2001) prohibit use of organotin compounds in marine paints. Various in-water hull cleaning technologies had been developed and tested in different coastal and marine environments. In Australia the anti-fouling and in-water hull cleaning is widely applied, and guidelines had been developed (Department of the Environment, 2015).

The IMO approved and had also developed guidelines on in-water hull cleaning to ensure operations are safely performed by various operators and for governments to be able to regulate these operations.

IMO released the latest guidelines for in water hull cleaning procedures in January 2021. These guidelines are now widely accepted as the measure for hull cleaning technology and the IMO established GloFouling committee convenes regularly to update and amend guidelines as necessary.

The Schomberg Vacu-cart and Reclamation Filter System had been tested and used in Durban against these guidelines under the supervision of Australian independent environmental consultants.

4.2. Schomberg Vacu-Cart and Reclamation System

The Schomberg Vacu-cart and Reclamation Filter System entails a cost-effective method of hull surface cleaning, which allows for the time-saving operations that negate the need to remove MVs from the water. The removed biofouling is reclaimed, while also undertaking the sanitizing of biotic materials in the return water.

During operations the Schomberg Vacu-cart and Reclamation Filter System will be used and technicians, including a diver, are transported to the site by vehicle. The required equipment will be towed on a trailer to the site. The figure below indicates the cleaning operation underway at a berth in Durban and shows that minimal area is occupied by the operational equipment.

The correct application of the in-water hull cleaning method via the Vacu-cart will remove over 99% of the biofouling from the ships' hull surface. This is a significantly higher removal rate in comparison to other methods such as the drydocking cleaning method. In addition, initial investigations indicate that more than 95% of the removed materials is contained and sifted through the filtration system.

***Figure 1**:* Image indicating ship undergoing hull cleaning with filtration system identified (Schomberg Investments).

Details of the various equipment utilized in the Schomberg Vacu-cart and Reclamation Filter System cleaning operations are provided below.

4.2.1. Design Aspects

The Schomberg Vacu-cart and Reclamation Filter System comprises of a two-stage facility, namely:

- *The Vacu-cart* – this is immersed within the water and effectively scours or careens the biofouling from the vessel's hull and

- *The filtration system* – this separates the physical material that is dislodged from the ship from the intake water and sanitizes the water of living tissue prior to discharge.

These components are described below.

4.2.1.1. The Vacu-Cart

The vacu cart is a diver operated machine that careens biofouling organisms from the hull of the ship. The machine is approximately 2.2 m and 1.4m, 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 act to contain bio fouling debris within the area of suction. The Vacu-Cart has two counterrotating discs in the rear and a single rotating disc in the front to which 450mm diameter brushes or bladed discs are attached. The discs are hydraulically driven, and the total width of clean in one pass is 1100mm.

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 material are drawn through a central port to a central suction line which leads into the 100mm hose to the submersible pump. A neutral buoyancy float is shaped and fitted to the upper side of the cart to provide neutral buoyancy of the unit underwater.

Figure 2: image of the Vacu-Cart (Schomberg Investments).

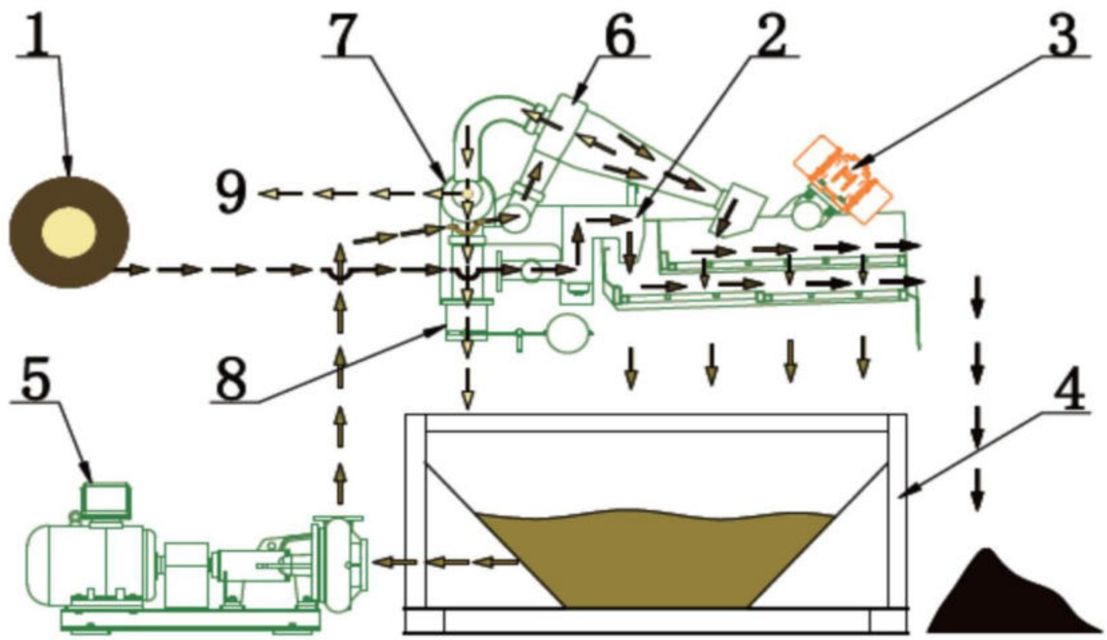
Figure 3: *Different cleaning discs and wheels could be fitted to the cart for different cleaning tasks (Schomberg Investments*).

Various cleaning discs and wheels can be fitted to the cart for different cleaning tasks:

- A combination of steel and nylon bristle brushes for heavy fouling removal on hulls, biocide-free coatings or other hard substrates,
- All nylon bristles for biocidal conventional or copolymer antifouling coatings, and
- 45^0 nylon blades for contactless cleaning.

The vacuum associated with the Vacu-cart is generated by a submersible pump, which acts to drive all dislodged material, along with intake water into the filtration system which is positioned on the surface or support vessel. Additional vacuum/suction is generated by the cart's central pump and the hydrodynamic vortices generated by the brushes. The capacity of the suction system has been demonstrated in the trial to be 2,500 l/min of water, which ensures that significant levels of debris (+/-99%) of material is retained within the Vacu-Cart.

Intake water from the Vacu-Cart is driven through hoses under a negative pressure to the filtration systems. The filtration, treatment and containment processes are a 5-stage process. ***Figure 5*** below provides an illustration of the various components associated with the process.



4.2.1.2. <u>Screening and Filtration process.</u>

Water enters the solids separation unit through a double particle screen where all particles larger than 100 microns are filtered out and captured into capture bag for removal. (4). All the water of the process falls through the screens into the catchment tank where it is then pumped (8) directly into the triple filtration system which follows after the separation stage of the process (9).

From the outlet pipe (9) of the first stage solids separation, the water will pass to a HUR 5 x 170FL – XP- 316 tangential entry, up-flow cartridge filter housing. The tangential inlet and the integral inner-can, create a centrifugal flow that induces pre-filtration by heavy particle separation. The "up-flow" self purges, thus eliminating by-pass contamination and removes particles that are larger than 30 microns. This level of solid separation aligns with IMO and USCG specifications for hull cleaning operations, effectively eliminating most singular eukaryotic cells.

This section of filtration uses the eco-friendly technology that exceeds the prevailing statutory standards and requirements for the protection of the sensitive maritime ecosystem. The first process of the third stage, removes all organisms and sedimentary particles larger than 20 μm.

The filter modules are cleaned automatically by a specially designed backflush extraction without effecting the flow during operation. The second process of the third stage is the disinfection by the UV-Reactor. The micro-organisms in the water are exposed to the UV light, which renders them completely harmless. The UV light breaks the DNA chain resulting in an internal connection (T+T) making it impossible for the micro-organisms to reproduce. Since the water is not affected chemically, there is no environmental impact**.**

Figure 6: Alfa Laval Pure Ballast 3 Filtration System

4.2.1.3. <u>Waste Disposal</u>

All the separated bio-film debris from the filtration process is captured in one-ton pallet bags or drums for on shore disposal at a registered landfill site or incorporation into other land-based processes.

The Vacu-Carts method of removal and waste disposal ensures that no biofouling debris is discharged back into the water, preventing any establishment of IAS and harmful pathogens within the shipping harbor.

All bio fouling material collected within the Vacu-Cart is:

- Removed to a water tight container/drum,
- The container is sealed and labelled with a copy of this label/manifest to be kept with the dive operator. The label/manifest provides:
  - Name of ship cleaned,
  - Date and period of cleaning operations,
  - Destination land fill site, and
  - State that material is classified as 'hazardous'.
- The container will be collected by a registered waste management operator and removed to an approved landfill site.
- Suitable treatments may be applied under consideration, to the container to ensure that there is complete breakdown of any living or biotic material.

4.3. Operations and materials

All hydraulic fluids utilized in the operation of the Vacu-Cart will be vegetable oils and classified as organic and non-hazardous.

- Plantosyn 32 HVI is the accepted hydraulic fluid for use in the Vacu Cart.
- Plantosyn 32 HVI meets ISO 15380 standards and is EU – Ecolabel compliant. It is not classified as hazardous under HAZCOM 2012.

4.4. Dust and air emissions

The operation of the Vacu-Cart is not likely to establish any air emissions that exceed the regulated emissions of NOx and other SO_2. A diesel generator that meets SABS standards will be utilized in operations.

4.5. Project area

Figure 6: Port of Walvis Bay map.

4.6. The Proponent

The project proponent is Ufudu Marine Namibia cc. The private sector has a role to play in the blue economy development and Ufudu Marine Namibia cc would like to play this role. Ufudu Marine Namibia cc is part of Ufudu Marine Environmental Solutions (South Afica) and would like to extend their operation in Namibia.

During operations, the proponent adheres to the following environmental principles:

- *Prevention:* the proponent will take measures required to prevent, avoid or minimize negative environmental impacts.
- *Rectification at source:* the proponent will take 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 will work together with stakeholders to promote environmental protection and sustainable development.
- *Environment monitoring*: the proponent will keep part of the bio-film as samples for further laboratory analysis to be analyzed by MFMR scientists to investigate presence of any IAS and harmful pathogens.

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 and facilitate 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.

4.7. Discussions, conclusions and recommendations

In-water 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 in-water hull cleaning technologies. These countries have done this in order to protect their internal and territorial waters from spread of IAS and harmful pathogens and avoid ecosystem impacts associated with AIS and harmful pathogens.

Though the proposed in-water hull cleaning technology using Vacu-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 GRN 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

The marine environment will be indirectly affected by the project activity and these impacts which are cumulative will be only assessed objectively using the *Tier 2* environmental assessments later during the operation phase.

The proposed underwater hull cleaning will take place in a coastal environment and impacts will be on this environment.

This chapter provides a description of baseline physical environment and biological diversity. The physical environmental 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 oceanography

Climate in the south east Atlantic Ocean is mainly influenced by 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 where 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 reduce abilities of crustaceans to absorb Calcium needed for exoskeleton formation.

During operation water samples will be collected to test for CO_2 concentration.

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.

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 conditions 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 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:
    - o <u>Orange River mouth</u> – 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.
    - o <u>Lüderitz lagoon</u> – located south of Lüderitz, it is an important stop point for migrant birds and also hosts a number of marine shorebirds.
    - o <u>Walvis Bay lagoon</u> – 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.
    - o <u>Kunene River mouth</u> – 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 handles 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. Seaweeds

A list of some of the 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

5.4.1. 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 because their distribution do not overlap with the port area.

There are no impacts on fish diversity arising from the proposed activity.

5.4.2. Whales

Marine mammals in the proposed area includes several species of whales, dolphins and one resident seal species (Hutchings et al, 2021). Whales comprise of 33 species of whales and dolphins determined from sightings and or strandings. Information on the Namibian shelf and deeper waters has been poorly studied with most available information in deeper waters (>200 m) arising from historic whaling records.

The seasonal distribution of sightings of the right whales in Namibian waters, from June to December with a peak in September, is supported by the seasonal occurrence of southern right whales in other calving areas in Australia, Patagonia, and South Africa. Although aerial surveys of northern Namibia have not been undertaken consistently over time, there has only been one sighting of a cow-calf pair right whales seen at Conception Bay (23°57.75'S) on 19 September 2003. The present-day distribution of right whales therefore seems to be concentrated largely in southern Namibia. Additionally, southern right whales in Namibia are said to be an immigration from South Africa (Roux et al. 2020). They calve and nurse in bays protected from high winds and swell e.g. Conception Bay and Chameis Bay. Southern right whale (*Eubalaena australis*) and the pygmy right whale (*Caperea marginata)* have been recorded in Namibian waters, primarily off the continental shelf during winter months.

The humpback whales are migratory species with a summer distribution in polar waters and a winter distribution in lower latitudes. These whales have been found off the Namibian coast in summer (Pulfrich et al., 2020) but are not likely to use the proposed site as migratory route when they migrate between June and December. Records of Dwarf (*Kogia sima*) and pygmy *(K. breviceps)* sperm whales, were investigated by Elwen et al., (2013), who found them to occur in pelagic waters around southern Africa, including Namibia. A further 11 species are resident within the offshore area of the Namibian coastline in water depths of over 500m. These include the long-finned pilot whale (*Globicephala melaena*), Grays beaked whale (*Mesoplodon grayii*), Layard's beaked whale (*Mesoplodon layardii*), Bryde's whale (Balaenoptera edeni), false killer whale (*Pseudorca crassidens*), sperm whale (*Physeter macrocephalus*), Cuvier's beaked whale (*Ziphius cavirostris*), Pygmy killer whale (*Feresa attenuata*) and killer whales (*Orcinus orca*) which are found throughout Namibian waters.

Whales are not likely to be affected by the proposed activity.

5.4.3. Dolphins

The endemic Heaviside's Dolphin (*Cephalorhynchus heavisidii*), and the dusky dolphin (*Lagenorhynchus obscurus*), are found in the extreme nearshore region between the northern Namibian border and Cape Point. Moreover, the Heaviside's dolphins are a common sighted cetacean along the Namibian coast in water less than 125 m deep, with most sightings occurring from Walvis Bay to the southern Namibian border, particularly through autumn, spring and summer in high waters. It has a restricted distribution to inshore waters, seen within 5 nautical miles off the shore.

For the dusky dolphin, they are the least known of the 'coastal' dolphins of southern Africa. In Namibia, they hardly ever come close to shore (Namibian Dolphin Project, 2022). The majority of sightings were recorded in the Lüderitz area, within the Namibian Islands' Marine Protected Area (NIMPA). Most of the Namibian EEZ is predicted to be a suitable habitat for dusky dolphins, especially the NIMPA and north of the EEZ in autumn, however, model predictions by De Rock et al., (2019), predicted absence, in waters deeper than 2000 m. The deepest sighting of a dusky dolphin was reported at 2,970 m depth and 90 km from shore, during summer. Other species such as, the southern right-whale dolphins *(Lissodelphis peronii*) have an extremely localised year-round distribution associated with the continental shelf and the shelf-edge in the region between 24° and 28°S.

Dolphins are not likely to be affected by the proposed activity.

5.4.4. Cape fur seals

Cape fur seals (*Arctocephalus pusillus pusillus*), are marine mammals commonly found along the Namibian coast, with several large breeding colonies, occurring from south of Lüderitz to Cape Frio in the Skeleton Coast (Namibia Tourism, 2022). Two species of seals occur off the southern African west coast, of which the Cape fur seal is the most common. The breeding of Cape fur seals occurs at the same time every year, between late October and early January, with adult males arriving at the breeding colony in October to establish territories and the pregnant females begin to arrive in late October–early November. Births usually occur by mid-December. After birth, mothers alternate between foraging at sea and suckling on shore, until the pups are weaned about 8-11 months later (corresponding to around July–November) (Skern-Mauritzen et al., 2009). Cape fur seals, typically dive to depths less than 100m, swimming primarly near the surface.

The risk these mammals may face is entanglement in vessel propellers and fishing gears (Hutchings et al., 2020). Cape fur seals are not likely to be affected by the proposed activity.

5.4.5. Avifauna

Seabirds as top predators, forms a fundamental component of the marine ecosystem and are excellent indicators of changes in the marine environment and good indicators of the health status of the environment. Namibia has a lot of offshore islands, islets and rocks (all are within the Namibian Islands Marine Protected Area) that are inhabited by different species of seabirds such as Bank Cormorants, Cape Cormorants, Crowned Cormorants, White-breasted Cormorants, African penguins, Cape gannet, kelp gulls, swift terns, African black oystercatchers and many more.

These seabirds breed along the Lüderitz peninsula along the coast as well as on shipwrecks, islands, islets, caves and unused and abundant jetties. The islands are all located in southern Namibia in the Luderitz vicinity and access to the islands is very strict and is managed and controlled by the MFMR. The offshore islands and the Lüderitz peninsula provide breeding and roosting grounds for all the different seabird species of high economic and conservation importance. However, seabirds are facing some serious threats such as competing with commercial fisheries for prey that has been exploited in the past (Kemper, 2007). Other factors threatening seabirds are diseases, predation, natural disasters, unsustainable harvesting practices and human activities such as mariculture farming activities.

Bird striking with the Vacu-cart is not likely to occur with adults seabirds. Operation in nursey areas will be avoided to avoid bird striking with juvenile birds. Indirect cumulative effects will be monitored and will not have long-term impacts on seabirds.

5.4.6. Aquatic invertebrates

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.

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.

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, Cerianthеopsis 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 due to low sea water temperature which inhibit their growth compared to native species. However, if seawater temperature increases 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 in marine environments 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.

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 in-water 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 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 in abundance and distribution of plankton and benthic invertebrates;
- Plankton and benthic 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

The proposed project is located in Walvis 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 other coastal towns of 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 Namibia, 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), mariculture, maritime transport 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 states.

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 fisheries resources as well as mineral resources.

6.2.2. Demography

There are 150,809 people in Erongo region according to 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**	**Population density**	
Arandis	10,093	Low	
Henties Bay	5,170	Low	
Karibib	4,720	Low	
Swakopmund	5,132	Low	
Usakos	44,725	Medium	
Walvis Bay	62,096	High	
Omaruru	6,300	Low	

6.2.3. Fishing

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. 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 the 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 contributes 15% to the country's total exports (Leandrea, 2019). In addition, the capture 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 most 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 areas. Permits had however been 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, MFMR publicly announce new applications, after which dully processes are followed to award fishing rights. Fishing quotas are awarded on annual basis and are allocated to fishing right 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 7 years while hake is 15 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.

6.2.4. 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 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 factors, 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.

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 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 which 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). It is no doubt that marine diamond mining in Namibia is an economic lifeline with significant contributions to both treasury and employment creation. 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 socio-economic benefits, maritime diamond mining remains a significant sector of the Namibian economy. 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.

6.2.5. Maritime 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.

6.3. 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.

6.3.2. Invasive aquatic species

IAS and harmful pathogens 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. COVID-19 pandemic

It is important to analyze the Namibian 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. 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.

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.

Furthermore, negative impacts of COVID-19, have led to a drastic increase in prices of food and other commodities in Namibia. Especially, the increase in food prices which was being absorbed by GRN through COVID-19 relief measures are now being felt by consumers as relief measures had been lifted.

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 winter season in Namibia but also due to emergence of new COVID-19 virus variants. The different COVID-19 virus variants recorded in different countries were: Alpha (UK), Beta (South Africa), Gamma (Brazil), Delta (India), Epsilon (California), Eta (New York) and Lota (York City).

Socio-economic impacts post-COVID-19 are 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. Impacts are now exacerbated by geo-political instability in Ukraine.

6.5. Discussions, conclusions and recommendations

Namibia possesses a remarkable coastline and a vast marine area and in the last two decades, the country commenced to embrace the concept of the blue economy, as well as, adopting the blue economy narrative. 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. The country'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 disagreements, conflict 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.

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
Mr. Shaheed Saban	Namibia Port Authority	Draughtsman	saban@namport.com.na
Mr. Stafenus Gariseb	Namibia Port Authority	Manager: SHREQ	s.gariseb@namport.com.na
Mr. Shapua Kalomo	Department of Maritime Affairs	Environmental Officer	Shapua.Kalomo@mwt.gov.na
Ms. Nangula Amutenya	Walvis Bay Municipality	Environmental Manager	namutenya@walvisbaycc.org.na

Ms. Lovisa Hailalula	Walvis Bay Municipality	Environmental Officer	lhailaula@walvisbaycc.org.na
Mr. Titus Shaanika	NNF	Environmental co-ordinator	Titus@NNF.ORG.NA
Mr. Stephanus Hamutenya	MFMR	Biologist	Steven.hamutenya@mfmr.gov.na
Mr. Rendan Ractliffe	KWINT Offshore Services Namibia (Pty) Ltd	Project Supervisor	brendan@kwintnamibia.com
Mr. Victor Libuku	MFMR	Fisheries Biologist	Victor.Libuku@mfmr.gov.na
Mr. Ferdinand Hamukwaya	MFMR	Fisheriues Research Assistant	Ferninand.Hamukwaya@mfmr.gov.na

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 02 September 2022 and 09 September 2022.

7.5. Minutes from public meetings

The public meeting was held on 21 October 2022 in Walvis Bay.

7.6. Issue and responses

Comments from IAPs were summarized and responses provided.

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 are 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 resource 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. <u>Brushing and cutting action of the Vacu-cart equipment</u>

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 when underwater cleaning takes place and will need to be monitored.

8.3.2. Hydrodynamic vortices generated by the Vacu-cart equipment

The hydrodynamic vortices generated by the Vacu-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. Occupation risks at sea

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. Use of higher rich carbon oils

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

Discussions, conclusions and recommendations

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

The project has potential to positively contribute to employment creation and revenue generations in Walvis Bay. However, this depends on whether the proponent will hire local persons.

There is a need for the proponent to design an effective EMP in order to mitigate negative environmental impacts. 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 monitoring plan detailing which environmental indicators will be monitored and the SOPs to be used each indicator. Lastly, it will also be useful to state in the EMP 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 leads to sea level rise. This is indirectly related to higher fuel consumption and emission GHGs.
OCEAN AND SEAS	**Seawater quality**	Release of bio-film material 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 Vacu-Cart hull cleaning equipment could contain, if untreated, IAS and harmful pathogens.
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.	In-water hull cleaning operation is a listed activity with potential negative impacts. However, such 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 affect sediment quality.

	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.
	Potential space use conflicts	In-water hull cleaning operation 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 of 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 maritime transport sub-sector.
	Occupational safety and public health	Diving is an internationally regulated activity and a diving licence will be required.
		Proposed activity is the in-water 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: receiving environment sensitivity.

IMPACTS	PHYSIO-CHEMICAL COMPONENT					BIOLOGICAL COMPONENT						HUMAN COMPONENT					
SENSITVITY RATING 1 Negligible 2 Low 3 Medium 4 High 5 Very high	i. Air Quality	ii. Seawater Quality	iii. Seabed & topography	iv. Sediment Quality	v. Organic matter & nutrient content	vi. Phytoplankton & zooplanktons	vii. Benthic Communities	viii. Fishes	ix. Turtles	x. Seabirds	xi. Cetaceans	xii. Fishing Industry	xiii. Mineral exploitation & mining	xiv. Other in-water cleaning operators	xv. Tourism & Recreation	xvi. Shipping activities	xvii. Public health and sustainability concerns
1. Use of higher rich carbon oil and release of GHGs	1	2	1	1	1	2	1	1	1	1	1	1	1	1	1	2	1
2. Ocean acidification due to increased atmospheric Carbon Dioxide.	1	2	1	1	1	2	1	1	1	1	1	1	1	1	1	2	1

3.	Release of bio-film materials into seawater	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4.	Settling or deposition of organic waste and effects on sediment quality.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5.	Release of viable adult, juvenile and larval stages of IAS and harmful pathogens.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6.	Accidental striking of seabirds and cetaceans by the Vacu-Cart	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7.	Exclusion of other users from the area	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8.	Dumping of marine litter such as plastics	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

9. Risks of diving including decompression sickness (DCS), arterial air embolism and drowning.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10. Communicable diseases and CVD (cardiovascular diseases).	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
11. Injuries on duty (IODs) including being hit by falling objects, slipping on greasy, wet or dirty surfaces.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
12. Fire, drowning, risks of ships grounding or sinking.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
13. Accidental oil and chemical spills.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
14. Tripping over loose objects	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2

on floors, stairs and platforms.																	

Table 17: magnitude.

0	No observable impact
1	Low impact
2	Tolerable impact
3	Medium high impact
4	High impact
5	Very high impact

IMPACTS	PHYSIO-CHEMICAL COMPONENT					BIOLOGICAL COMPONENT						HUMAN COMPONENT					
	i. Air Quality	ii. Seawater Quality	iii. Seabed & topography	iv. Sediment Quality	v. Organic matter & nutrient content	vi. Phytoplankton & zooplanktons	vii. Benthic Communities	viii. Fishes	ix. Turtles	x. Seabirds	xi. Cetaceans	xii. Fishing Industry	xiii. Mineral exploitation & mining	xiv. Other mariculture users	xv. Tourism & Recreation	xvi. Maritime Transport	xvii. Public health and sustainability
1. Use of higher rich carbon oil and release of GHGs	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
2. Ocean acidification due to increased atmospheric Carbon Dioxide.	2	2	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0
3. Release of bio-film material into seawater	0	4	4	4	4	4	4	3	3	3	3	0	0	0	0	0	0
4. Deposition of organic waste and effects on sediment quality.	0	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0
5. Release of viable adult, juvenile and larval stages of 'introduced' Atlantic Salmon.	0	3	3	3	3	3	3	3	3	3	3	3	0	0	0	0	0
6. Exclusion of other users from the area	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	
7. Risks of diving including decompression sickness (DCS), arterial air embolism and drowning.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5

8. Communicable diseases and CVD (cardiovascular diseases).	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
9. Injuries on duty (IODs) including being hit by falling objects, slipping on greasy, wet or dirty surfaces.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
10. Fire, drowning, risks of ships grounding or sinking.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
11. Accidental oil and chemical spills.	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
12. Tripping over loose objects on floors, stairs and platforms.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 16: Duration.

T	Temporary
P	Permanent

IMPACTS	PHYSIO-CHEMICAL COMPONENT					BIOLOGICAL COMPONENT						HUMAN COMPONENT					
	i. Air Quality	ii. Seawater Quality	iii. Seabed & topography	iv. Sediment Quality	v. Organic matter & nutrient content	vi. Phytoplankton & zooplankton	vii. Benthic Communities	viii. Fishes	ix. Turtles	x. Seabirds	xi. Cetaceans	xii. Fishing Industry	xiii. Mineral exploitation & mining	xiv. Other mariculture users	xv. Tourism & Recreation	xvi. Maritime Transport	xvii. Public health and sustainability
1. Use of higher rich carbon oil and release of GHGs	P	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
2. Ocean acidification due to increased atmospheric Carbon Dioxide.	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
3. Release of bio-film material into seawater	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
4. Settling or deposition of organic waste and sediment quality.	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
5. Release of viable adult, juvenile and larval stages of ‘introduced’ Atlantic Salmon.	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
6. Accidental striking of seabirds and cetaceans by the Vacu-Cart.	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
7. Exclusion of other users from the area	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
8. Risks of diving including decompression sickness (DCS), arterial air embolism and drowning.	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	P

9. Communicable diseases and CVD (cardiovascular diseases).																	
10. Injuries on duty (IODs) including being hit by falling objects, slipping on greasy, wet or dirty surfaces.																	
11. Fire, drowning, risks of ships grounding or sinking.																	
12. Accidental oil and chemical spills.																	
13. Tripping over loose objects on floors, stairs and platforms.																	

Table 19: Geographical coverage.

IMPACTS	PHYSIO-CHEMICAL COMPONENT					BIOLOGICAL COMPONENT						HUMAN COMPONENT					
L: Localized impacts or limited to location O: Impact of importance to municipality R: Regional impacts N: National impact I: International	Air Quality	Seawater Quality	Seabed & topography	Sediment Quality	Organic matter & nutrient content	Phytoplankton & zooplanktons	Benthic Communities	Fishes	Turtles	Seabirds	Cetaceans	Fishing Industry	Mineral exploitation & mining	Other mariculture users	Tourism & Recreation	Maritime Transport	Public health and sustainability
1. Use of higher rich carbon oil and release of GHGs																	
2. Ocean acidification due to increased																	

	atmospheric Carbon Dioxide.																	
3.	Release of bio-film materials into seawater.																	
4.	Settling or deposition of organic waste and effects on sediment quality.																	
5.	Effects of artificial lights on ‘free-floating’ plankton communities.																	
6.	Release of viable adult, juvenile and larval stages of ‘introduced’ Atlantic Salmon.																	
7.	Accidental striking of seabirds and cetaceans by the Vacu-Cart																	
8.	Exclusion of other users from the area																	
9.	Risks of diving including decompression sickness (DCS),																	

arterial air embolism and drowning.																	
10. Communicable diseases and CVD (cardiovascular diseases).																	
11. Injuries on duty (IODs) including being hit by falling objects, slipping on greasy, wet or dirty surfaces.																	
12. Fire, drowning, risks of ships grounding or sinking.																	
13. Accidental oil and chemical spills.																	
14. Tripping over loose objects on floors, stairs and platforms.																	

Table 20: Probability.

IMPACTS	PHYSIO-CHEMICAL COMPONENT				BIOLOGICAL COMPONENT							HUMAN COMPONENT					
LP **Low** probability (possibility of impact occurring is low, below 25%). P **Probable** (there is a distinct possibility that it will occur, approximately 50%). HP **Highly probable** (the impact is most likely to occur, 75%). D **Definite** (the impact will occur, 100%).	**i. Air Quality**	**ii. Seawater Quality**	**iii. Seabed & topography**	**iv. Sediment Quality**	**v. Organic matter & nutrient content**	**vi. Phytoplankton & zooplanktons**	**vii. Benthic Communities**	**viii. Fishes**	**ix. Turtles**	**x. Seabirds**	**xi. Cetaceans**	**xii. Fishing Industry**	**xiii. Mineral exploitation & mining**	**xiv. Other mariculture users**	**xv. Tourism & Recreation**	**xvi. Maritime Transport**	**xvii. Public health and sustainability**
1. Use of higher rich carbon oil and release of GHGs																	
2. Ocean acidification due to increased atmospheric Carbon Dioxide.																	
3. Release of bio-film material into seawater																	
4. Settling or deposition of organic waste and																	

effects on sediment quality.																	
5. Release of viable adult, juvenile and larval stages of IAS and harmful pathogens.																	
6. Accidental striking of seabirds and cetaceans by the Vacu-Cart.																	
7. Exclusion of other users from the area																	
8. Risks of diving including decompression sickness (DCS), arterial air embolism and drowning.																	
9. Communicable diseases and CVD (cardiovascular diseases).																	
10. Injuries on duty (IODs) including being hit by falling objects, slipping on																	

greasy, wet or dirty surfaces.																	
11. Fire, drowning, risks of ships grounding or sinking.																	
12. Accidental oil and chemical spills.																	
13. Tripping over loose objects on floors, stairs and platforms.																	

Table 21: Significance.

IMPACTS	PHYSIO-CHEMICAL COMPONENT				BIOLOGICAL COMPONENT							HUMAN COMPONENT					
Major 5/5 Moderate 4/5 Minor 2/5 None 1/1	i. Air Quality	ii. Seawater Quality	iii. Seabed & topography	iv. Sediment Quality	v. Organic matter & nutrient content	vi. Phytoplankton & zooplanktons	vii. Benthic Communities	viii. Fishes	ix. Turtles	x. Seabirds	xi. Cetaceans	xii. Fishing Industry	xiii. Mineral exploitation & mining	xiv. Other mariculture users	xv. Tourism & Recreation	xvi. Maritime Transport	xvii. Public health and sustainability
1. Use of higher rich carbon oil and release of GHGs																	
2. Ocean acidification due to increased atmospheric Carbon Dioxide.																	
3. Release of bio-film material into seawater.																	
4. Settling or deposition of organic waste and increase in sediment thickness.																	
5. Release of viable adult, juvenile and larval stages of IAs and harmful pathogens.																	
6. Accidental striking of seabirds and cetaceans by the Vacu-Cart.																	
7. Exclusion of other users from the area																	

8. Dumping of marine litter such as plastics.																	
9. Risks of diving including decompression sickness (DCS), arterial air embolism and drowning.																	
10. Communicable diseases and CVD (cardiovascular diseases).																	
11. Injuries on duty (IODs) including being hit by falling objects, slipping on greasy, wet or dirty surfaces.																	
12. Fire, drowning, risks of ships grounding or sinking.																	
13. Accidental oil and chemical spills.																	
14. Tripping over loose objects on floors, stairs and platforms.																	

9. DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

Although technologies may not solve all environmental problems; when combined with innovation and entrepreneurship they have a potential to provide environmental solutions. In-water hull cleaning technology is cheaper and tends to be a better option to MV operators compared to other cleaning methods.

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 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 and sediment 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 invertebrates belonging to polycheata and amphipoda groups 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 proponent should design an EMP detailing how negative impacts will be mitigated.
- The EMP should focus on monitoring abundance in planktons and other benthic invertebrates.
- Invertebrate samples should be taken before, during and after each in-water hull cleaning operation.
- Water samples should be taken before, during and after each in-water hull cleaning operation.

- 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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