APP-004587

GRIT BLASTING OPERATIONS AND MAINTENANCE DREDGING AT NAMIBIA DRYDOCK AND SHIP REPAIR IN THE PORT OF WALVIS BAY

ENVIRONMENTAL ASSESSMENT SCOPING REPORT

Assessed by:

Assessed for:

July 2024

Project:	**GRIT BLASTING OPERATIONS AND MAINTENANCE DREDGING AT NAMIBIA DRYDOCK AND SHIP REPAIR IN THE PORT OF WALVIS BAY: ENVIRONMENTAL ASSESSMENT SCOPING REPORT**	
Report: Version/Date:	Final July 2024	
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Report Approval	 **André Faul** Conservation Ecologist	

I Warrick Williams, acting as representative of Namibia Drydock and Ship Repair (Pty) Ltd, hereby confirm that the project description contained in this report is a true reflection of the information which the Proponent provided to Geo Pollution Technologies. All material information in the possession of the Proponent that reasonably has or may have the potential of influencing any decision or the objectivity of this assessment is fairly represented in this report and the report is hereby approved.

Signed at Walvis Bay on the 22 day of August 2024.

Namibia Drydock and Ship Repair (Pty) Ltd — 2003/390 Company Registration Number

EXECUTIVE SUMMARY

Namibia Drydock and Ship Repair (Pty) Ltd (NAMDOCK) operates a ship repair facility consisting of three floating dry docks in the Port of Walvis Bay. Geo Pollution Technologies (Pty) Ltd was appointed by NAMDOCK to update the environmental impact assessment (EIA) for the facility. Operations included in this EIA, for the purpose of obtaining an environmental clearance certificate for grit blasting, are the following:

- Docking and floating of ships at the NAMDOCK ship repair yard
- Cleaning of the hulls of the ships by scraping and spraying with pressurized water
- Grit blasting of the ships' hulls to remove paint and provide a smooth finish in preparation of painting
- Painting and ship mechanical repairs and maintenance
- Submerging of docks to return ships to the ocean
- Maintenance dredging to ensure sufficient water depth is maintained for safe operations
- General day to day administrative tasks

This study is conducted to determine all environmental, safety, health and socio-economic impacts associated with the operations of NAMDOCK at the ship repair facility. Relevant environmental data has been compiled by making use of secondary data and from a reconnaissance site visit. Potential environmental impacts and associated social impacts are identified and addressed in this report.

Due to the nature and location of the development, impacts can be expected on the surrounding environment. It is thus recommended that environmental performance be monitored regularly to ensure compliance and that corrective measures be taken if necessary.

The operations of the grit blasting facility contributes to the local economy by contributing to job creation and providing opportunities for continued diversification of economic activity. By appointing local contractors and employees and implementing educational programs the positive socio-economic impacts can be maximised while mitigating any negative impacts. It also supplies valuable ship repair and maintenance services to vessels operating along the west coast of Africa.

The major concerns related to the construction of the facility is that of health and safety, dust, noise, waste production and marine impacts. Noise pollution should at all times meet the Health and Safety Regulations of the Labour Act and minimum World Health Organization guidelines on community noise to prevent hearing loss and not to cause a nuisance to nearby receptors. The generation and dispersal of dust should be minimized and personnel must be issued with PPE including dust masks. Contaminated water, spent blasting grit, particulate matter and dust must be prevented from entering the ocean. Health and safety regulations should be adhered to in accordance with the regulations pertaining to relevant laws and internationally accepted standards of operation. Any waste produced must be removed from site and disposed of at a registered waste disposal facility, or re-used or recycled where possible. Hazardous waste must be disposed of at an approved hazardous waste disposal site.

The environmental management plan prepared as part of this EIA should be used as an on-site reference document during grit blasting operations. Parties responsible for transgression of the EMP should be held responsible for any rehabilitation that may need to be undertaken. A health, safety, environment and quality (HSEQ) policy, or similar, should be used in conjunction with the EMP. Operators and responsible personnel must be taught the contents of these documents. Municipal or national regulations and guidelines must be adhered to and monitored regularly as outlined in the EMP.

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LIST OF ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
BCLME	Benguela Current Large Marine Ecosystem
BID	Background Information Document
CBD	Convention on Biological Diversity
CITES	Convention on International Trade of Endangered Species
dB	Decibel (expression of the relative loudness of the un-weighted sound level in air)
dBA	Decibel (expression of the relative loudness of the A-weighted sound level in air)
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
EA	Environmental Assessment
ECC	Environmental Clearance Certificate
EIA	Environmental Impact Assessment
EMA	Environmental Management Act, 2007 (Act no. 7 of 2007)
EMP	Environmental Management Plan
EMS	Environmental Management System
GHG	Greenhouse Gas
GPT	Geo Pollution Technologies (Pty) Ltd
ha	Hectare
HIV	Human Immunodeficiency Virus
HMV	Heavy Motor Vehicle
HPP	Harambee Prosperity Plan
Hr	Hour
IAP	Interested and Affected Parties
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature
km	Kilometre
km/hr	Kilometre per hour
m	Meter
m/s	Meter per second
m^3	Cubic meter
Ma	Million years
mbs	Meters below surface
MEFT	Ministry of Environment, Forestry and Tourism
mm	Millimetre
mm/a	Millimetres per annum
MME	Ministry of Mines and Energy
MSDS	Material Safety Data Sheet
NAMDOCK	Namibia Drydock and Ship Repair (Pty) Ltd
NaCl	Sodium Chloride
NDP	National Development Plan
NGO	Non-Government Organisation
NTU	Nephelometric Turbidity Unit
^oC	Degrees Celsius
PPE	Personal Protective Equipment
SADC	Southern African Development Community
SANS	South African National Standards
SEA	Strategic Environmental Assessment
TDS	Total Suspended Solids
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization

GLOSSARY OF TERMS

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

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

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

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

Dredging - a process to remove sediment. Dredging sediment to construct new ports and navigational waterways or maintain existing ones is essential for vessels to be able to enter shallow areas. Maintenance dredging is required because sediment suspended in the water eventually settles out, gradually accumulating on the bottom. If dredging were not done, harbours would eventually fill in and marine transportation would be severely limited.

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

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

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

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

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

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

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

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

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

Minister or Ministry of Environment & Tourism.

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

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

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

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

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

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

1 BACKGROUND AND INTRODUCTION

Namibia Drydock and Ship Repair (Pty) Ltd (NAMDOCK) (the Proponent) operates a ship maintenance and repair facility in the Port of Walvis Bay (Figure 1-1). The facility consists of three floating dry docks as well as land based support infrastructure and buildings. In short, the main operations of the facility include:

- Docking and floating of ships in the floating dry docks
- Cleaning of the hulls of the ships by scraping and spraying with pressurized water
- Grit blasting of the ships' hulls to remove paint and provide a smooth finish in preparation of painting
- Painting and general ship maintenance and repairs
- Submerging of docks to return ships to the ocean
- General day to day administrative tasks

NAMDOCK has an existing environmental clearance certificate (ECC) for their operations at the ship maintenance and repair facility. Geo Pollution Technologies (Pty) Ltd, was appointed by the Proponent to update their environmental impact assessment (EIA) and apply for a new ECC. This amended EIA is required to include routine maintenance dredging in their operational activities. Dredging is the activity of deepening water areas to ensure sufficient water depth is maintained for safe manoeuvring of vessels, and in the case of NAMDOCK, their floating dry docks.

The risk assessment will be updated to determine any new potential impacts resulting from their operations on the environment. The environment being defined in the Environmental Assessment Policy and Environmental Management Act as "land, water and air; all organic and inorganic matter and living organisms as well as biological diversity; the interacting natural systems that include components referred to in sub-paragraphs, the human environment insofar as it represents archaeological, aesthetic, cultural, historic, economic, paleontological or social values".

The environmental assessment was updated to apply for an amended environmental clearance certificate in compliance with Namibia's Environmental Management Act.

Company Background –NAMDOCK has been operating in Namibia since 2006 and currently operates three floating dry docks in the Port of Walvis Bay. NAMDOCK is internationally recognised as one of the leading ship repair companies along the west coast of Africa.

Project Justification – Walvis Bay is earmarked as an industrial town and promoted as the key port of call on the west coast of Africa. Ship maintenance and repair is a vital component of port services and it provides essential repair services to, among others, the fishing, offshore mining and exploration, and cargo transport industries.

Potential benefits of NAMDOCK's operations include:

- Ship repair facilities, including grit blasting and painting, provides important services to the local and international shipping industry.
- Economic growth of Walvis Bay and Namibia as a whole.
- Employment of and skills transfer to local Namibian citizens.
- Stimulation of economic development (e.g. employment, housing, better markets and access to public services etc.)
- Expansion of trade and industrial activity in the town and country as a whole.
- Encouragement of additional investments in the town or region.

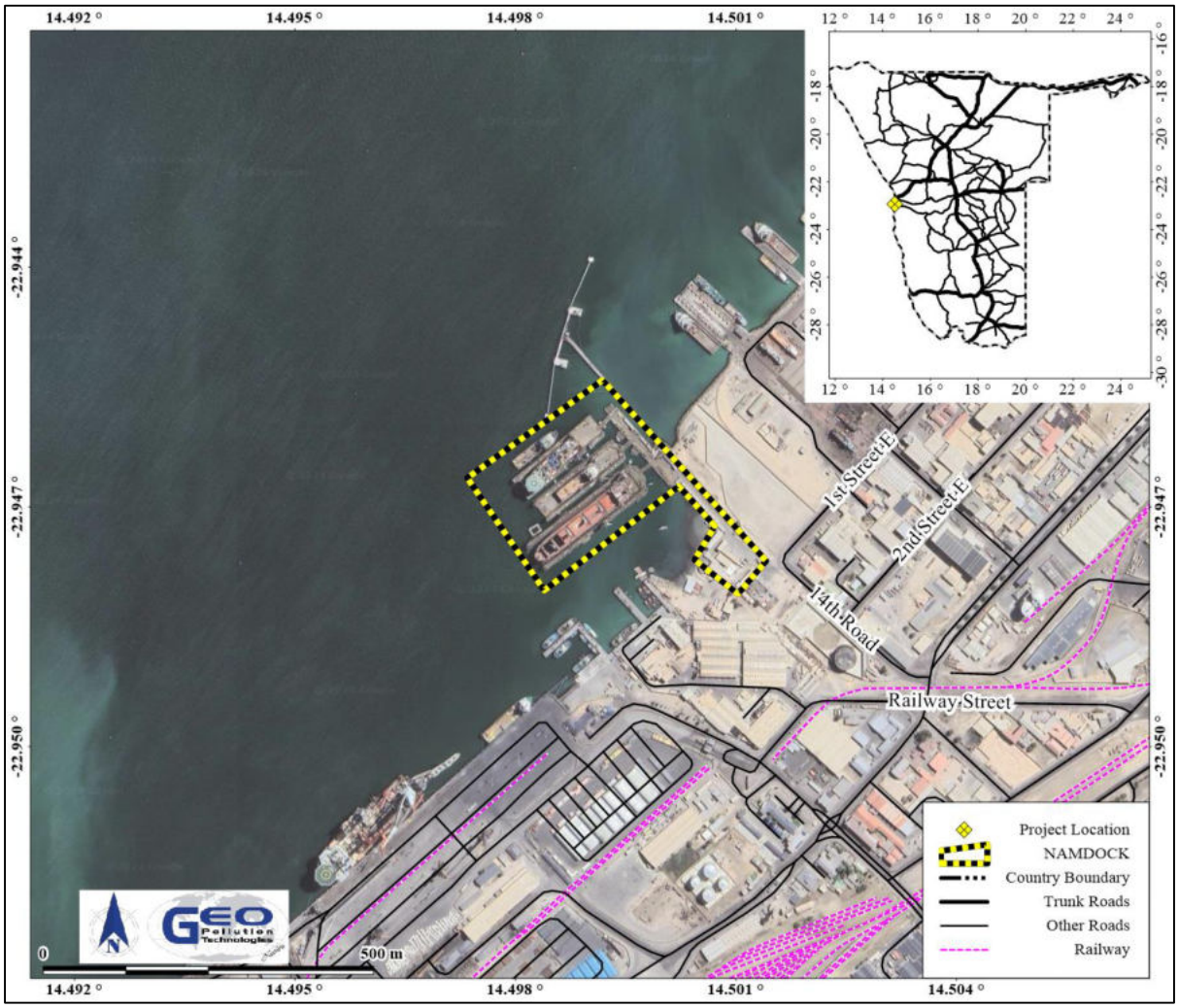


Figure 1-1 Project location

2 SCOPE

The scope of this amended report is to, in compliance with the requirements of Environmental Management Act (EMA):

1. Present a detailed, updated project and environmental description related to the Proponent's activities.
2. Determine potential additional environmental impacts emanating from the Proponent's proposed dredging activities.
3. Identify a range of management actions to mitigate the potential adverse impacts to acceptable levels.
4. Provide sufficient information to the relevant competent authority and the MEFT to make an informed decision regarding the amended project and the issuing of an environmental clearance certificate.

3 METHODOLOGY

The following methods were used to investigate the potential impacts on the social and natural environment due to the grit blasting and proposed dredging operations:

1. Baseline information about the site and its surroundings was updated by using up to date existing secondary information as well as from a reconnaissance site visit.

2. Existing and newly identified environmental impacts emanating from the operations, including the proposed dredging, and decommissioning of the facility were determined, and possible enhancement measures were listed for positive impacts while mitigation / preventative measures were provided for negative impacts.
3. As per the findings of this amended scoping report, an updated environmental management plan (EMP) was incorporated into this report to be submitted to the Ministry of Environment, Forestry and Tourism (MEFT).

4 ADMINISTRATIVE, LEGAL AND POLICY REQUIREMENTS

To protect the environment and achieve sustainable development, all projects, plans, programmes and policies deemed to have adverse impacts on the environment require an EIA, as per the Namibian legislation. The legislation and standards provided in Table 4-1 to Table 4-4 governs the EIA process in Namibia and/or are relevant to the facility.

Table 4-1 Namibian law applicable to the development

Law	Key Aspects
The Namibian Constitution	♦ Promotes the welfare of people ♦ Incorporates a high level of environmental protection ♦ Incorporates international agreements as part of Namibian law
Environmental Management Act Act No. 7 of 2007, Government Notice No. 232 of 2007	♦ Defines the environment ♦ Promotes sustainable management of the environment and the use of natural resources ♦ Provides a process of assessment and control of activities with possible significant effects on the environment
Environmental Management Act Regulations Government Notice No. 28-30 of 2012	♦ Commencement of the Environmental Management Act ♦ Lists activities that requires an Environmental Clearance Certificate ♦ Provides Environmental Impact Assessment Regulations
Water Resources Management Act Act No. 11 of 2013	♦ Provides for management, protection, development, use and conservation of water resources ♦ Prevention of water pollution and assignment of liability
Dumping At Sea Control Act Act No. 73 of 1980	♦ Provides for the control of dumping of substances in the sea ♦ Provides for permits to be issued to allow dumping at sea of scheduled substances
Marine Resources Act Act No. 27 of 2000	♦ Prevents the discharge of anything that may be injurious to marine resources or may disturb ecological balance in any area of the sea or which may detrimentally affect the marketability of marine resources, or which may hinder their harvesting.
The Namibian Ports Authority Act Act No. 2 of 1994	♦ Provides for the establishment of the Namibian Ports Authority and its functions ♦ Responsible to protect the environment within its areas of jurisdiction
Marine Traffic Act Act No. 2 of 1981	♦ Regulates marine traffic in Namibia
Local Authorities Act	♦ Defines the powers, duties and functions of local authority councils

Act No. 23 of 1992, Government Notice No. 116 of 1992	♦ Regulates discharges into sewers
Public and Environmental Health Act Act No. 1 of 2015, Government Notice No. 86 of 2015	♦ Provides a framework for a structured more uniform public and environmental health system, and for incidental matters ♦ Deals with Integrated Waste Management including waste collection disposal and re-refining; waste generation and storage; and sanitation.
Labour Act Act No 11 of 2007, Government Notice No. 236 of 2007	♦ Provides for Labour Law and the protection and safety of employees ♦ Labour Act, 1992: Regulations relating to the health and safety of employees at work (Government Notice No. 156 of 1997)
Atmospheric Pollution Prevention Ordinance Ordinance No. 11 of 1976	♦ Governs the control of noxious or offensive gases ♦ Prohibits scheduled process without a registration certificate in a controlled area ♦ Requires best practical means for preventing or reducing the escape into the atmosphere of noxious or offensive gases produced by the scheduled process
Hazardous Substances Ordinance Ordinance No. 14 of 1974	♦ Applies to the manufacture, sale, use, disposal and dumping of hazardous substances as well as their import and export ♦ Aims to prevent hazardous substances from causing injury, ill-health or the death of human beings
Pollution Control and Waste Management Bill (draft document)	♦ Provides for prevention and control of pollution and waste ♦ Provides for procedures to be followed for licence applications ♦ Not in force yet
Prevention and Combating of Pollution of the Sea by Oil Act, 1981 (Act No. 6 of 1981)	♦ Provides for the prevention of pollution of the sea where oil is being or is likely to be discharged
Prevention and Combating of Pollution of the Sea by Oil Amendment Act (No. 24 of 1991)	♦ Amends the Prevention and Combating of Pollution of the Sea by Oil Act of 1981 to be more relevant to Namibia after independence
National Marine Pollution Contingency Plan of 2017	♦ Coordinated and integrated national system for dealing with oil spills in Namibian waters.
Aquaculture Act (2002)	♦ Provides for water quality monitoring to protect aquaculture activities
Namibia's Draft Wetland Policy (2004 Draft)	♦ Aims to protect and conserve wetland diversity and ecosystem functioning without compromising human needs. ♦ Promotes the integration of wetland management into other sector policies. ♦ Recognises and fulfils Namibia's international and regional obligations concerning wetlands, including those laid down in the Ramsar Convention and the SADC Protocol on Shared Water Systems.

Table 4-2 Municipal by-laws, guidelines and regulations

Municipal By-laws, Guidelines or Regulations	Key Aspects
Integrated Urban Spatial Development Framework for Walvis Bay	♦ Completed during 2014 and in the final stages of acceptance ♦ Overall vision to transform Walvis Bay to being the primary industrial city in Namibia

	♦ Aims to ensure that appropriate levels of environmental management is enforced for all developments in Walvis Bay
Integrated Environmental Policy of Walvis Bay (Agenda 21 Project)	♦ Indicates the directions that the Municipality of Walvis Bay will move towards in the forthcoming years to fulfil its responsibilities to manage the environment of Walvis Bay together with the town's residents and institutions ♦ Strong focus on conservation and protection of environment

Table 4-3 International conventions and standards

Standard or Code	Key Aspects
Benguela Current Commission	♦ Interim Agreement between Namibia, South Africa and Angola to establish a permanent mechanism for the sustainable management the marine environment and its resources, the Benguela Current Large marine Ecosystem (BCLME) ♦ Proposes a set of sediment and water quality guidelines.
Convention on Biological Diversity	♦ Primary goal is the conservation of biodiversity ♦ Prescribes the precautionary principle ♦ Parties to the convention are obliged to: ♦ Establishes a network of protected areas; o Create buffer areas adjacent to these protected areas using environmentally sound and o sustainable development practices; and o Rehabilitate degraded habitats and populations of species.
The Convention on Wetlands of International Importance especially as Waterfowl Habitat (referred as the Ramsar Convention)	♦ It is a framework for international cooperation in the conservation and wise use of wetlands and their resources. ♦ Recognizes the Walvis Bay Nature Reserve – a tidal lagoon consisting of Pelican Point, adjacent intertidal areas, sandbars serving as roosting sites and mudflats exposed during low tide (12,600 ha) as a Wetland of International Importance.
UN Convention for the Prevention of Marine Pollution from Land-based Sources	♦ Concerns itself with the protection of marine fauna and flora by preventing marine pollution from land-based sources. ♦ Contracted parties, are committed to take all possible steps to prevent pollution of the sea as well as the direct or indirect introduction of substances or energy by humans into the marine environment resulting in such adverse effects as harm to living resources and to marine ecosystems, hazards to human health, damage to services/ facilities or interference with other legitimate uses of the area.
Stockholm Declaration on the Human Environment, Stockholm 1972.	♦ Recognizes the need for a common outlook and common principles to inspire and guide the people of the world in the preservation and enhancement of the human environment

Table 4-4 Standards, codes of practice

Standard or Code	Key Aspects
ISO 9001:2015	♦ Specifies requirements for a quality management system (NAMDOCK is ISO 9001: 2015 certified)
ISO 45001:2018	♦ Specifies requirements for an occupational health and safety management system (NAMDOCK is ISO 45001: 2018 certified)
Namport Specifications and Legislation	♦ Enforced standards and codes which govern construction and operations relating to the port. ♦ Includes the EMP for the operations of the Port of Walvis Bay. ♦ Includes the EIA and EMP for dredging within the Port

NAMDOCK's operations is listed as a project requiring an ECC as per the following listed activity under the Environmental Management Act (section 9 of Government Notice No. 29 of 2012):

- "Any activity entailing a scheduled process referred to in the Atmospheric Pollution Prevention Ordinance, 1976."
- "The import, processing, use and recycling, temporary storage, transit or export of waste."
- "Any process or activity which requires a permit, licence or other form of authorisation, or the modification of or changes to existing facilities for any process or activity which requires an amendment of an existing permit, licence or authorisation or which requires a new permit, licence or authorisation in terms of a law governing the generation or release of emissions, pollution, effluent or waste."

5 OPERATIONS AND RELATED ACTIVITIES

Regular ship maintenance and repair is a crucial aspect to ensure safety and reliability of seagoing vessels. Due to the nature of some repairs and maintenance, e.g. for cleaning and painting of the hull, vessels have to periodically be removed from the water. Due to the size of some vessels, this poses a significant challenge without proper equipment. As such, vessels can either be lifted out of the water and moved onto land with a specially designed ship lift system, or manoeuvred into a dry dock where it remains until all work is completed. Two types of dry docks exist. The one being a submerged dock, or rectangular basin dug into the land or built along the shoreline, of which the entrance to the dock is closed-off by gates once a vessel entered. The water is then pumped out and the dock remains dry for the period of maintenance and repairs. The second is a floating dry dock which is a floating U-shaped dock that can be submerged by filling its ballast tanks with water. The ship then enters, and the water is pumped out of the ballast tanks so that the dock with the vessel is re-floated, and the work area remains dry. NAMDOCK operates three floating dry docks, NAMDOCK I, NAMDOCK II and NAMDOCK III, with a combined lifting capacity of 30,000 tons.

One of the main activities performed by NAMDOCK, and in most ship repair yards, is grit blasting. This is the process by which some form of abrasive material is propelled, at high speed, towards a surface to clean a surface of paint, rust or dirt. It is also used to treat surfaces before coating or as a post coating finish. The most common example is sand blasting although several modern techniques using a variety of abrasive materials are available. The latest technologies however does not use an abrasive material, but use highly pressurised water jets.

Maintenance dredging involves the periodic removal of sediments, debris, and other materials from the bottoms of water bodies such as harbours, rivers, and canals. This process is essential for maintaining the navigability of these waterways, ensuring they remain at the necessary depth and width to accommodate shipping and other activities. In the context of ship floating docks, maintenance dredging is critical for several reasons. Firstly, it ensures adequate depth for floating docks and berths to accommodate ships of various sizes, preventing sedimentation from hindering docking and undocking processes. Secondly, it prevents the grounding of ships by removing silt and other materials that could

cause damage and operational delays. Lastly, it facilitates safe navigation by keeping navigational channels clear, thereby reducing the risk of accidents and collisions.

The following operational procedures are part of the grit blasting process, although it is not limited only to grit blasting and dredging, nor is it the only operational procedures performed by NAMDOCK at the floating dry docks.

5.1 Docking and Floating

Floating dry docks are submersible platforms which allows for the lifting of ships out of the water without taking it on land. The working platform is above a large ballast tank and the long sides of the dock also consist of tanks. The ballast tanks are flooded to allow the dock to submerge below the water surface. The ship in need of repair or maintenance is manoeuvred into the dry dock and secured in place. The ballast tanks are then drained and the dock becomes more buoyant, lifting the ship and working platform out of the water. Ballast water contained in the ship may be released during the floating process.

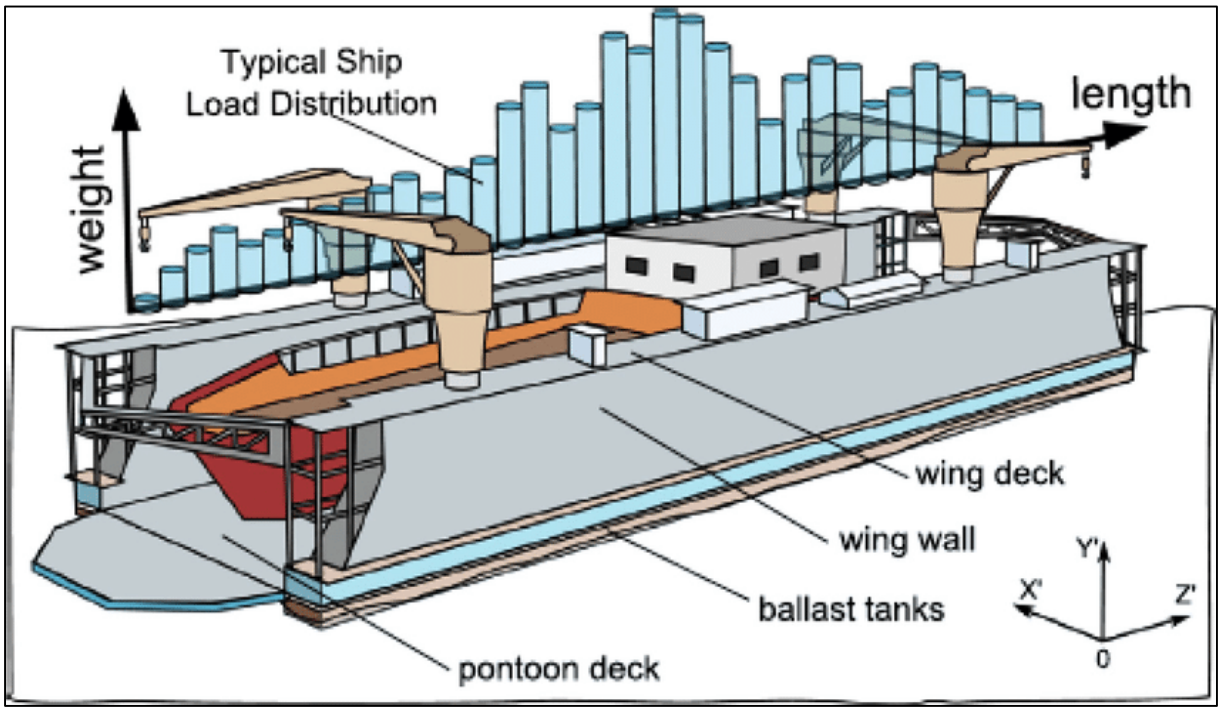


Figure 5-1 Conceptual drawing of a dry dock (Kimera and Filemon, 2020)

Photo 5-1 NAMDOCK's dry docks

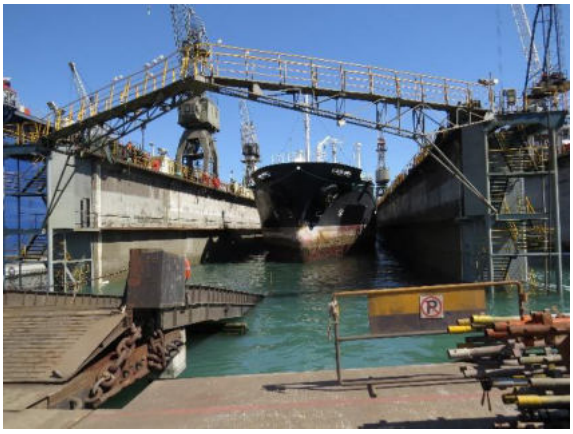


Photo 5-2 Dry dock with a ship being floated

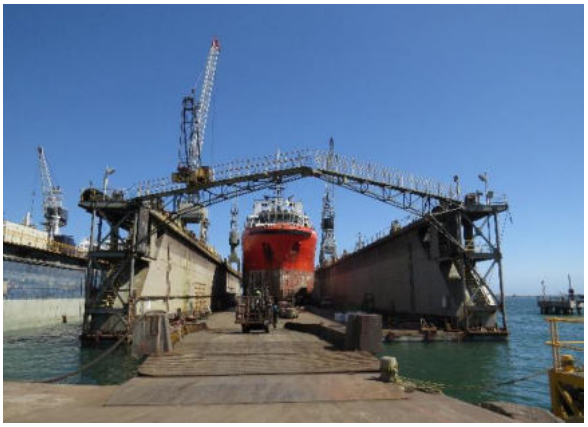


Photo 5-3 Dry dock with ship being worked on

Photo 5-4 Dry dock with ship being worked on

Photo 5-5 Operations on the dry dock

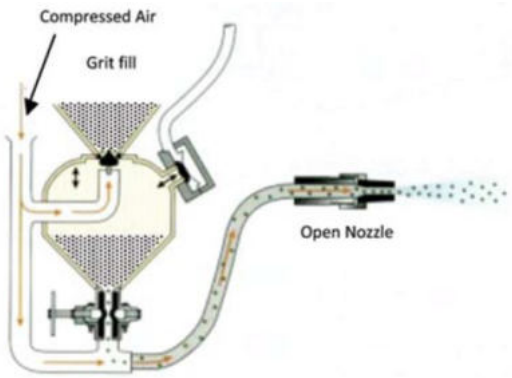
5.2 Scraping and Pressurized Water Cleaning

Once the ship has been lifted from the water it has to be prepared for grit blasting. Depending on the condition of the ship's hull, it is typically manually scraped to get rid of any marine biofouling like molluscs and algae attached to the hull (see Photo 5-6). The hull is then washed using pressurised freshwater jets (Photo 5-7). The waste wash water is collected in the ballast tanks and the sludge is allowed to settle before the water is pumped out to sea. The sludge is frequently removed from the tanks and disposed of at the Municipal waste disposal facility.

5.3 Grit Blasting

Different grit blasting techniques exist and NAMDOCK uses pressure abrasive blasting. The typical setup consists of an air compressor connected to a blast hose and a blast pot. The blast pot is

pressurised and holds the blasting grit which is gravity fed into the blast hose and propelled through



the blasting nozzle towards the surface to be blasted (
Photo 5-8).

The ship repair facility of NAMDOCK has three floating docks in the port of Walvis Bay at which grit blasting can be conducted. On average six to eight ships are blasted per month. Blasting is however weather dependent and this may influence the number of ships blasted. The average amount of blasting grit used per ship is 100 to 150 tonnes.

To limit grit, dust and other blasting related waste from entering the environment (e.g. windblown dust) during blasting, high density mesh netting is suspended at the front and rear openings of the dry dock. NAMDOCK estimates that these nets, together with the high sides of the floating dry docks, contain up to 90% of the grit, dust and waste. However, windy conditions, as well as where ships are higher than the dry docks' sides, reduce this efficiency.

5.4 General Repairs and Maintenance

Vessels in the docks can also undergo general repairs, maintenance and replacement of parts. This include work on for example rudders and propellers which are not accessible for major work while vessels are in the water. Such equipment are usually removed from the vessel and sent off-site for repair or servicing and then returned and refitted.

5.5 Return of Ships to Ocean

When all work is completed and ships are ready to be returned to the ocean, water is pumped into the ballast tanks of the dry docks allowing it to sink. Before this takes place NAMDOCK cleans the entire dry dock working platform to minimize waste and pollutants entering the ocean when the platform is submerged.

Photo 5-6 Biofouling

Photo 5-7 Compressor for freshwater pressurized cleaning

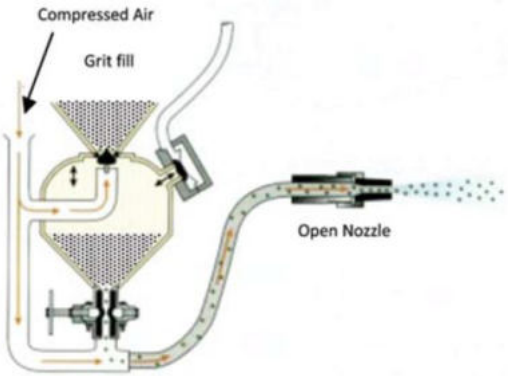


Photo 5-8 Pressure abrasive blast system (www.airbestpractices.com)

Photo 5-9 NAMDOCK blast pot

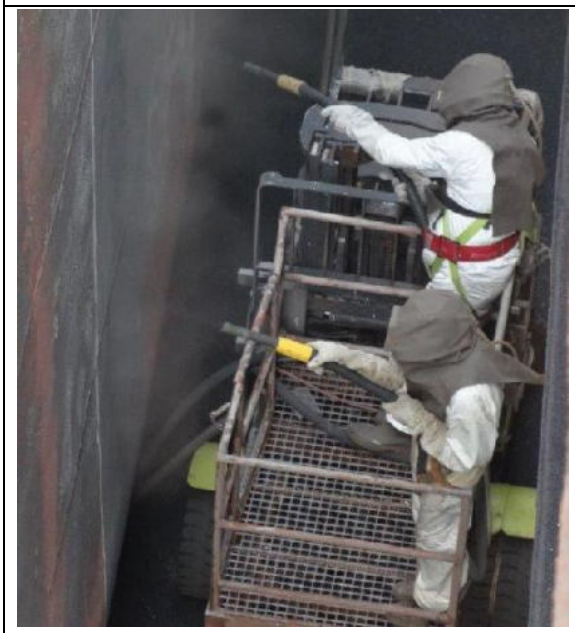


Photo 5-10 Operators busy with blasting

Photo 5-11 Copper slag used for blasting

5.6 Maintenance Dredging

NAMDOCK wants to incorporate maintenance dredging into their EMP. Dredging is required to ensure the required depth of the dry dock operational area is maintained for operational and safety purposes. Over time, sedimentation and seabed scouring by vessel propellers and thrusters result in water depth becoming shallower. It is thus important to periodically remove this sediment to maintain sufficient water depth.

The Proponent will appoint a contractor to perform dredging operations. The dredger that will be used will likely be a mobile dredge pump operated from a floating platform mounted with a crane. The platform can be self-propelled or be manoeuvred to dredging locations with support vessels. There it will be anchored and the dredge head lowered to the seafloor with the crane. The dredge pump, being a hydraulic suction dredger, uses a centrifugal pump to draw up a slurry of sediment and water and transport it away from the site. For the Proponent's planned dredging, the slurry

will be pumped via a floating discharge pipeline to a temporary land-based site, adjacent to the ship repair facility, before being transported to the Municipal landfill site.

The onshore intermediate dredge sediment storage area is required to allow the sediment to sufficiently dry before being carted away. It will consist of a temporary, walled, dam-like structure. Water will be allowed to seep from the dam, back to the ocean, without carrying sediment with it. Once suitably dry, the sediment will be loaded onto trucks, and transported to the Municipal landfill. If the sediment is high in contaminants, the landfill will be the hazardous waste disposal facility.

The area to be dredged include the entire area around and beneath the floating dry docks, and will be executed if and / or when required.

Figure 5-2 Proposed site for dredged material disposal

6 ALTERNATIVES

Alternatives as referred to within the EMA and its regulations, are require for any proposed development as part of the environmental assessment process. Such alternatives proposed within a project framework aims at ensuring the most suited and environmentally sustainable options. Alternatives related to the project are considered and each of these alternatives is discussed. The alternatives can roughly be grouped into three main groups namely:

- Location alternatives
- Technical and service alternatives;
- No go alternative.

6.1 Location Alternatives

For purposes of this assessment, it should be noted that the site is already established and operational, and no alternative location will be presented for the ship repair and maintenance facility. Location alternatives are however considered for the disposal of dredged sediments.

Dredged sediments are typically disposed of at or in the following ways:

- At a dedicated offshore disposal site (Namport has an existing offshore dredge sediment disposal site located north of Pelican Point)
- At a nearby, offshore location, not used by seafaring vessels

- At an onshore waste disposal site (dredged sediments have in the past been disposed at the Municipal landfill site)
- For beneficial use to reclaim land (e.g. the recently constructed container terminal)
- For onshore landfilling purposes (e.g. landfilling took place at the future Port of Walvis Bay SADC Gateway)

NAMDOCK considers two options for disposal of the dredged sediments: 1) At a nearby offshore location (Figure 6-1); and 2) at the Municipal landfill site. Since harbour sediments are often contaminated by a variety of potentially hazardous substances, offshore disposal of such sediments is not recommended. These substances include heavy metals and hydrocarbons, often originating from ships and especially ship repair facilities. Therefore, the onshore disposal of the sediments, at the Municipal waste disposal facility is recommended.

Figure 6-1 Alternative disposal site off-shore

6.2 Technical and Services Alternatives

The type of technology used within the industry is well known. The grit blasting process, is well established within the industry, but evolving technology in this sector should be considered.

6.2.1 Hydro Blasting Robots

Hydro blasting for ships uses ultra-high pressure water (up to 40,000 psi) to clean and remove paint, rust, and marine growth from ships' hulls. If applied correctly, this method is environmentally friendly, eliminating the need for abrasive materials and chemicals, limiting dust, and it minimizes waste and disposal costs, while effectively preparing surfaces for repainting. Hydro blasting ensures high cleaning quality while protecting the underlying material.

Recent methods of hydro blasting employs "robots" that automate the cleaning process, improving efficiency and safety. These robots can navigate the ship's hull, and the automation reduces the need for manual labour, minimises risks to workers, and ensures consistent cleaning quality. It also capturers the waste water and channels it to a temporary holding tank for eventual safe disposal. Such disposal usually entail filtering of the waste water, disposal of

solids at a hazardous waste disposal facility, and re-using the water or disposing the water in the ocean.

Hydro blasting is a recommendation to replace grit blasting in the future. The potential impacts on the environment can be reduced, but attention should be given to the recycling and discharge of water used in the process. Hydro blasting should be considered if and / or when the Proponent has the sufficient resources to properly implement such a new system.

Photo 6-1 Hydro robot used on a ship, as a demonstration by a possible supplier

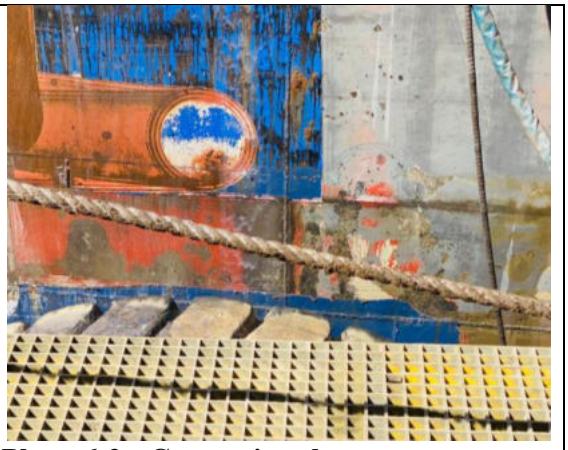


Photo 6-2 Comparison between an area cleaned by the hydro robot and an area not blasted

NAMDOCK was provided a demonstration of a hydro blasting robot and took a sample of the effluent (after filtration), to establish the potential impact on water quality. The results of the water analysis can be seen in Table 6-1.

The analysis of the NAMDOCK Effluent Sample EW3 reveals deviations from the BCLME Water Quality Guidelines and the Effluent Standards of Namibia's General Standard values.

The pH level of the sample is 7.9, which falls within the acceptable range of 6.5 to 9.5. However, the electrical conductivity at 174.1 mS/m exceeds the Namibia standard of less than 75 mS/m above the intake potable water quality. The turbidity is very high at 2,816 NTU, surpassing the Namibia standard of less than 12 NTU. The total dissolved solids (TDS) measure 1,092 mg/l, which exceeds the Namibia standard of less than 500 mg/l above the intake potable water quality. Similarly, the total suspended solids (TSS) are at 1340 mg/l, above the acceptable limit of 100 mg/l.

In terms of alkalinity and hardness, the sample shows high levels, with total alkalinity as CaCO3 at 225 mg/l and total hardness as CaCO3 at 497 mg/l, though no specific comparison values are provided. The chloride concentration is 256 mg/l, exceeding the Namibia standard of less than 70 mg/l above the intake potable water quality. The fluoride concentration is well within both standards at 0.1 mg/l. Nitrate and nitrite levels are within acceptable limits, at 3.4 mg/l and 0.09 mg/l, respectively. However, sodium, at 192 mg/l, surpasses the standard of less than 90 mg/l above the intake potable water quality. Potassium, magnesium, calcium, manganese, and iron levels are reported without specific standards for comparison.

The chemical oxygen demand (COD) is high at 1,370 mg/l, exceeding the Namibia standard of less than 100 mg/l. Copper levels are within the Namibia standard but exceed the BCLME guideline, measured at 0.28 mg/l. The zinc concentration is significantly high at 28.00 mg/l, exceeding the Namibia standard of less than 5.0 mg/l and the BCLME guideline. Cyanide, at 0.02 mg/l, is within the Namibia standard, but above the BCLME guideline. Lead, at 1.1 mg/l, surpasses both standards, and aluminium, at 42 mg/l, exceeds the Namibia standard of less than 0.2 mg/l. Heavy metals like lead will be from the ships paint as it used to be used to prevent-biofouling of the ship's hull or to increase paints' durability.

For total petroleum hydrocarbons (TPH), the GRO C6-C10 is measured at 3,700 µg/l, above the BCLME guideline of 500 µg/l. The TPH C10-C28 and TPH C28-C40 levels are reported without specific standards for comparison.

Given the results of the water sample analysis, it is clear that the water originating from the hydro blasting should not be allowed to indiscriminately enter the environment. Hydro blasting may however still be beneficial, if the water can be contained, as the potentially hazardous grit is no longer required and the production of dust is minimized.

Table 6-1 Water quality results from a hydro blasting robot effluent after filtration compared to various standards

Parameter	Unit	BCLME Water (Recommended water quality guidelines for toxic substances)	General Standard Effluent Standards Of Namibia (Water Resources Management Act, 2013)	NAMDOCK Effluent Sample EW3
pH			6.5 – 9.5	7.9
Electrical Conductivity	mS/m		<75 mS/m above the intake potable water quality (at 25 °C	174.1
Turbidity	NTU		<12 NTU	2,816
Total Dissolved Solids (calc.)	**mg/l**		<500 mg/litre above the intake potable water quality	1,092
Total Suspended Solids	**mg/l**		<100	1,340
P-Alkalinity as $CaCO_3$	**mg/l**			<10
Total Alkalinity as $CaCO_3$	**mg/l**			225
Total Hardness as $CaCO_3$	**mg/l**			497
Ca-Hardness as $CaCO_3$	**mg/l**			312
Mg-Hardness as $CaCO_3$	**mg/l**			185
Chloride as Cl-	**mg/l**		<70 mg/litre above the intake potable water quality	256
Chlorine, Residual as Cl	**mg/l**	0.003	< 0.3 Dependent on recipient water body	
Fluoride as F-	**mg/l**	5.0	2.0	0.1
Sulphate as SO_4^{2-}	**mg/l**		< 40 mg/litre above the intake potable water quality	306
Nitrate as N	**mg/l**		<20	3.4
Nitrite as N	**mg/l**		<3	0.09
Sodium as Na	**mg/l**		<90 mg/litre above the intake potable water quality	192
Potassium as K	**mg/l**			18
Magnesium as Mg	**mg/l**			45

Parameter	Unit	BCLME Water (Recommended water quality guidelines for toxic substances)	General Standard Effluent Standards Of Namibia (Water Resources Management Act, 2013)	NAMDOCK Effluent Sample EW3
Calcium as Ca	**mg/l**			125
Manganese as Mn	**mg/l**		<0.4	0.31
Iron as Fe	**mg/l**		<1.0	22
Stability pH, at 25°C				7.1
Langelier Index				0.8
Ryznar Index				6.2
Corrosivity ratio				3.0
Fat, oil & grease	**mg/l**		<2.5	38
Chemical Oxygen Demand as O2	**mg/l**		<100	1370
Cyanide as CN-	**mg/l**	0.004	<0.1 (free) <0.2 (recoverable)	0.02
Copper as Cu	**mg/l**	0.0013	<2.0	0.28
Zinc as Zn	**mg/l**	0.0015	<5.0	28.00
Cadmium as Cd	**mg/l**	0.0055	<0.05	0.01
Lead as Pb	**mg/l**	0.0044	<0.1	1.1
Aluminium as Al	**mg/l**		<0.2	42
TPH results 1):				
GRO C6-C10	**ug/l**	500 (C6 Benzene)		3,700
TPH C10-C28	**ug/l**			750
TPH C28-C40	**ug/l**			<382
TPH C10-C40	**ug/l**			<382

6.3 The No-Go Alternative

The "no-go" alternative is the option of not proceeding with the project and it typically means that the current status quo of the site and surrounds will remain. The dry docks and the operations are already well established. If the project does not continue, vital ship repair and maintenance activities will no longer be available which will significantly pressurise the nearby land-based ship repair yard. The changes proposed in this assessment are to incorporate maintenance dredging, as well as reviewing the mitigation measures for grit blasting. If maintenance dredging is not allowed, a full dredging program would have to be established in the future, that will involve greater impacts, it will also impact the Proponent's normal daily operations. The no-go alternative is as such not recommended.

7 ENVIRONMENTAL CHARACTERISTICS

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

7.1 Locality and Surrounding Land Use

The floating dry docks of NAMDOCK is located in the Port of Walvis Bay (22.9467°S; 14.4991°E). The onshore premises is zoned for industrial land use and is surrounded by properties of similar nature. Offshore operations fall within the port limits which is managed by Namport. To the south is the fishing jetty and facilities of Etosha Fishing, followed by the small craft jetty and the commercial harbour to the southwest. To the north is the now old fuel tanker jetty, with the Syncrolift (ship repair facility) and the fishing harbour to the northeast.

NAMDOCK's floating dry docks and grit blasting operations falls under the authority of the Municipality of the Walvis Bay Town Council (land area) and Namport (sea area).

Figure 7-1 Land use at the project location

Implications and Impacts

NAMDOCK's grit blasting operations is in line with activities on industrial properties and is typical of operations in harbour developments. Pollution from contaminated ballast water, windblown dust, or suspension of sediments during dredging activities, may impact on Etosha Fishing's seawater intake for fish processing activities and other nearby receptors.

If water flowing back to the ocean from the dredged sediments disposed on land is not sufficiently filtered, and it transports high levels of sediment and potential contaminants, water quality at water intakes of fish processing facilities northeast of the site may also be impacted.

7.2 Climate

Walvis Bay is centrally located on the Namibian coastline in the arid Namib Desert. The arid conditions are a result of dry descending air and upwelling of the cold Benguela Current.

Namibia is situated within an anti-cyclone belt of the Southern Hemisphere. Winds generated from the high-pressure cell over the Atlantic Ocean blow from a southerly direction when they reach the Namibian coastline. As the Namibian interior is warm (particularly in summer), localised low-pressure systems are created which draws the cold southerly winds towards the inland desert areas. These winds manifest themselves in the form of strong prevailing south-westerly winds, which range from an average of 20 knots (37 km/h) during winter months to as high as 60 knots (110 km/h) during the summer. Winds near Walvis Bay display two main trends; high velocity and frequency south to south-westerly winds in summer and high velocity, low frequency east to north-easterly winds during winter. The wind plots in Figure 7-2 represents wind data for the Meersig area of Walvis Bay for the period 2008 to 2015. It should be noted that there is also wind data available for the Yacht Club in Walvis Bay, which would be more representative of the dry dock area. However, this is short term data which will not be as accurate. It does seem that the wind at the Yacht Club has a greater westerly component than at Meersig. During winter, the east winds generated over the hot Namib Desert have a strong effect on temperature, resulting in temperature in the upper 30's degrees Celsius and tend to transport plenty of sand.

Thick fog or low stratus clouds are a regular occurrence in Walvis Bay. This is due to the influence of the Benguela Current and forms the major source of water for the succulent and lichen flora in the Namib Desert. Variation in annual rainfall is very high and most communities within this environment are dependent on regular fog occurrences. Months with the highest likelihood of rainfall is January to April. Wind is predominantly south-westerly to south south-westerly except in winter months when regular, strong east to northeast winds occur.

Table 7-1 Summary of climate data for Walvis Bay (Atlas of Namibia)

Precipitation (mm/a)	0-50
Variation in annual rainfall (%)	> 100
Average annual evaporation (mm/a)	2,800-3,000
Water deficit (mm/a)	1,901-2,100
Temperature (°C)	18-19

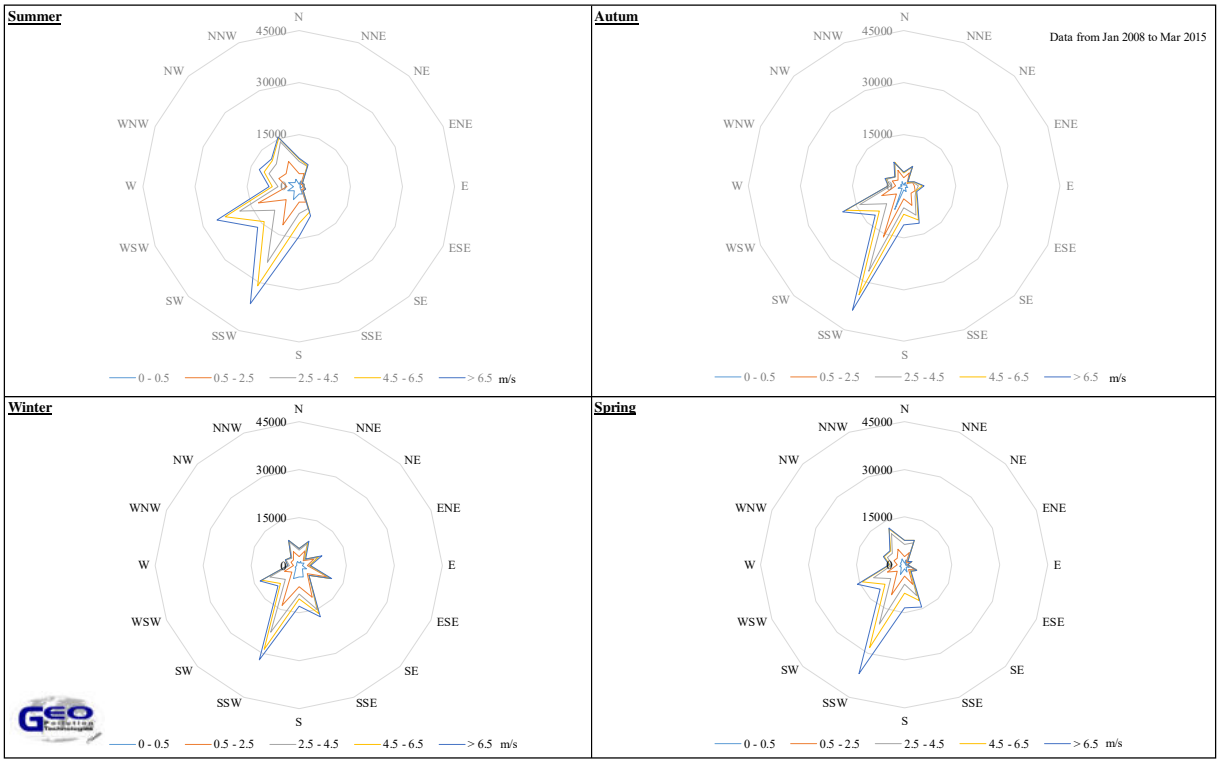


Figure 7-2 Wind data for Meersig area (source: www.weatherunderground.com)

Implications and Impacts

Strong winds are a regular occurrence in Walvis Bay. This may result in dust being blown into the ocean or towards other nearby receptors during grit blasting operations.

7.3 Surface Water

No fresh surface water sources are found nearby, but the grit blasting operations and maintenance dredging takes place on and around the floating dry docks in the Port of Walvis Bay.

Implications and Impacts

Any pollutants not contained can deteriorate the water quality within the harbour and this can spread to nearby receptors such as the fish factory water intakes or the lagoon. Similarly, suspension of potentially contaminated sediments during dredging may also negatively impact receptors.

An effluent discharge permit is required from the Directorate of Water Affairs for the release of water resulting from pressurized cleaning of ships into the ocean.

7.4 Geology and Hydrogeology

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

Northwards migration of sand covered parts of the exposed marine deposits, with Kuiseb floods also depositing material over the marine sediments. Depth to bedrock in Walvis Bay is expected to be deeper than 40 m. Based on previous work conducted in the area it is expected that the

sediments under the project area would consist of medium to coarse grain sand with thin lenses of more clayey material and layers of shell material.

Groundwater is not abstracted for human consumption in Walvis Bay. The Municipality of Walvis Bay currently purchase fresh/potable water from NamWater, which source water from the Kuiseb Water Supply Scheme.

Implications and Impacts

As the facility is mainly operating offshore no groundwater impacts are expected.

7.5 Public Water Supply

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

Implications and Impacts

Groundwater at the site is not a source of potable water and as such public water supply should not be at risk as a result of activities at the facility. Should hydro blasting be implemented, it will place additional strain on the Kuiseb Water Supply Scheme.

7.6 Aquatic Environment

7.6.1 Currents and Tides

The Benguela Current flows in a north-westerly direction along the Namibian coast. The average speed of the current is between 0.25 and 0.35 m/s (DMC-CSIR, 2010). The most important hydraulic conditions are shown in Table 7-2 (Tractebel, 1998; COWI, 2003a; DMR-CSIR, 2010). Water enters and exits the bay at the northern tip of Pelican Point (DMC-CSIR 2010). Water entering is flowing below the exiting water. Current velocities are on average 0.12 m/s with sporadic maximums up to 0.25 m/s.

A study in 1965 indicated a pre-dominant clockwise circulation of currents in the bay (Tractebel, 1998). This was later confirmed in the COWI (2003b) and DMC-CSIR (2010) studies. Circulation occurs mostly in the upper layer and it depends on the wind direction. The current pattern is clockwise in the morning, towards the south. At Pelican Point, the current moves mostly northward for the whole day. A general northward current is found along the east side of the bay very close to the coast. Water currents prior to the construction of the new container terminal as well as modelling of currents once construction is completed are depicted in Figure 7-3. From this figure, in the vicinity of the dry docks, the water current splits into a strong north-easterly flowing current as well as a weak south-westerly flowing current along the quay walls.

Table 7-2 The oceanographic and hydraulic conditions of the bay and the sea (adapted from Tractebel, 1998; COWI, 2003b; DMR-CSIR, 2010).

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

Implications and Impacts

Current patterns near the dry docks are such that pollutants entering the water from grit blasting operations may be carried towards sensitive receptors at the harbour and Ramsar site, although the new container terminal should provide a barrier to the Ramsar site. As a result of the container terminal, it is possible that currents will circulate in the container terminal basin, trapping the pollutants there.

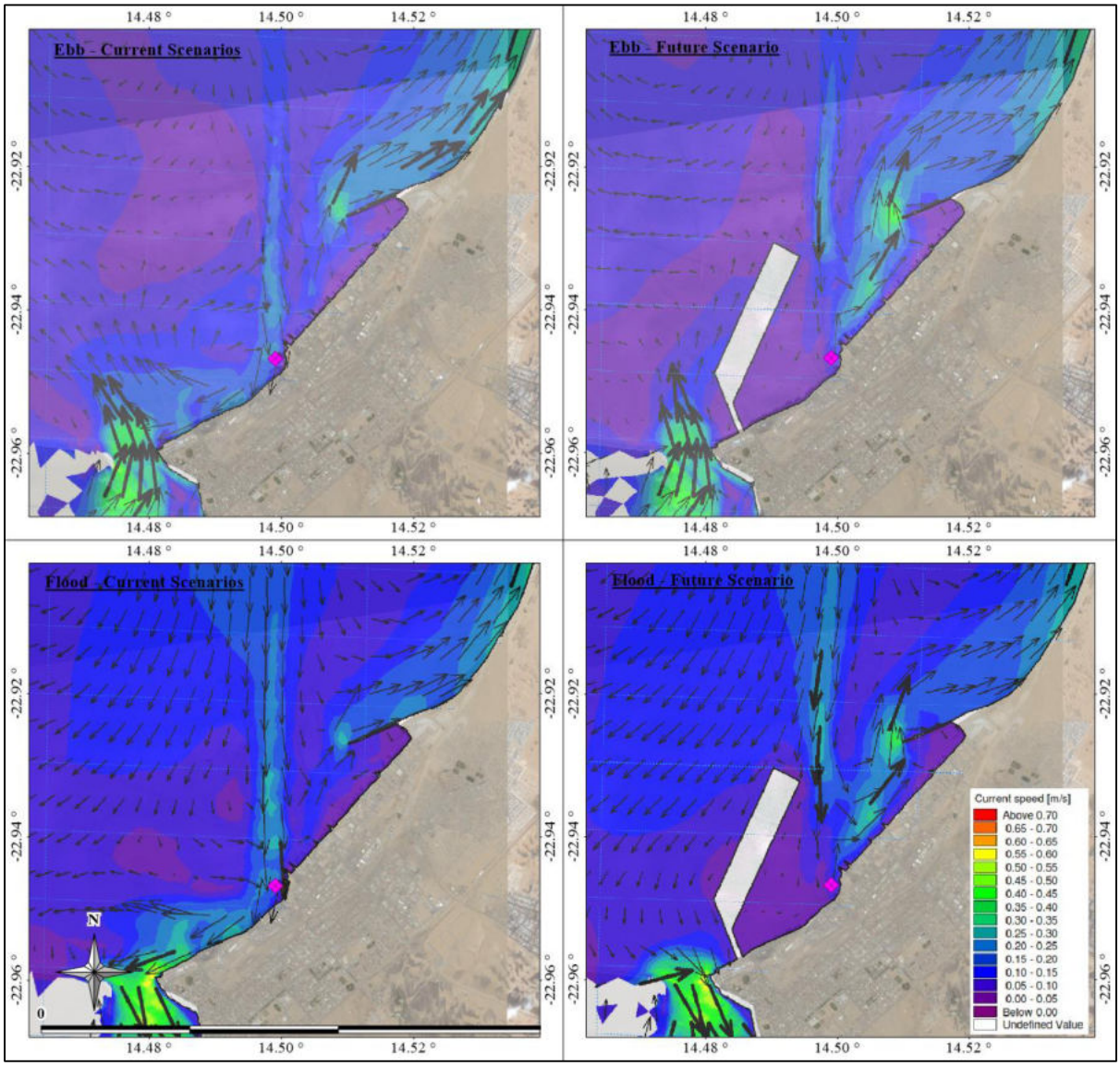


Figure 7-3 Comparison of ebb (top) and flood (bottom) scenarios for before and after the construction of the new container terminal (Source: Hydrodynamic Modelling Report of DMC-CSIR 2010)

7.6.2 Water and Sediment Quality

Harbour sediments often contain elevated concentrations of toxic compounds, most typically heavy metals, poly aromatic hydrocarbons (PAH) and/or tributyltin (TBT). TBT originates from marine paints which typically contain an agent to prevent fouling of the ship with barnacles and other organisms, which eventually will slow the ship and impede its movements.

Historic analysis data of heavy metals in the sediments of Walvis Bay harbour are presented in Figure 7-4 and Figure 7-5. These analysis were done as part of the Container Terminal project as well as prior to the 2010/2011 dredging campaign. Metal concentrations are compared to the BCLME guidelines and are presented in three categories: 1) lower than BCLME guideline values; 2) higher than BCLME guideline values; and 3) higher than

BCLME probable effect concentrations. Note that the locations with high concentrations of heavy metals seems to be associated mostly with the beginning of the entrance channel where finer sediments were found (Botha 2011).

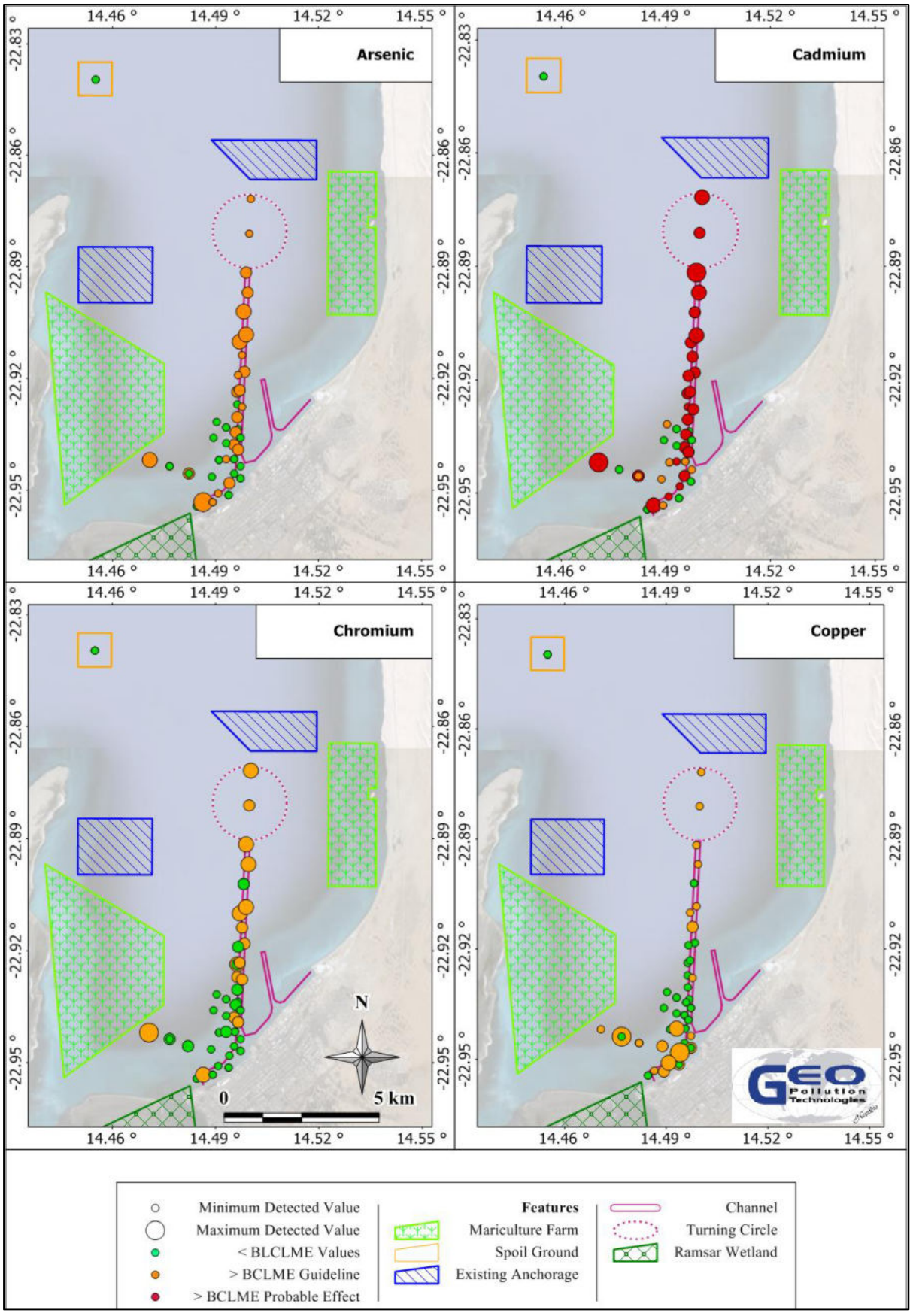


Figure 7-4 Historic sediment analysis part 1 (Botha 2011)

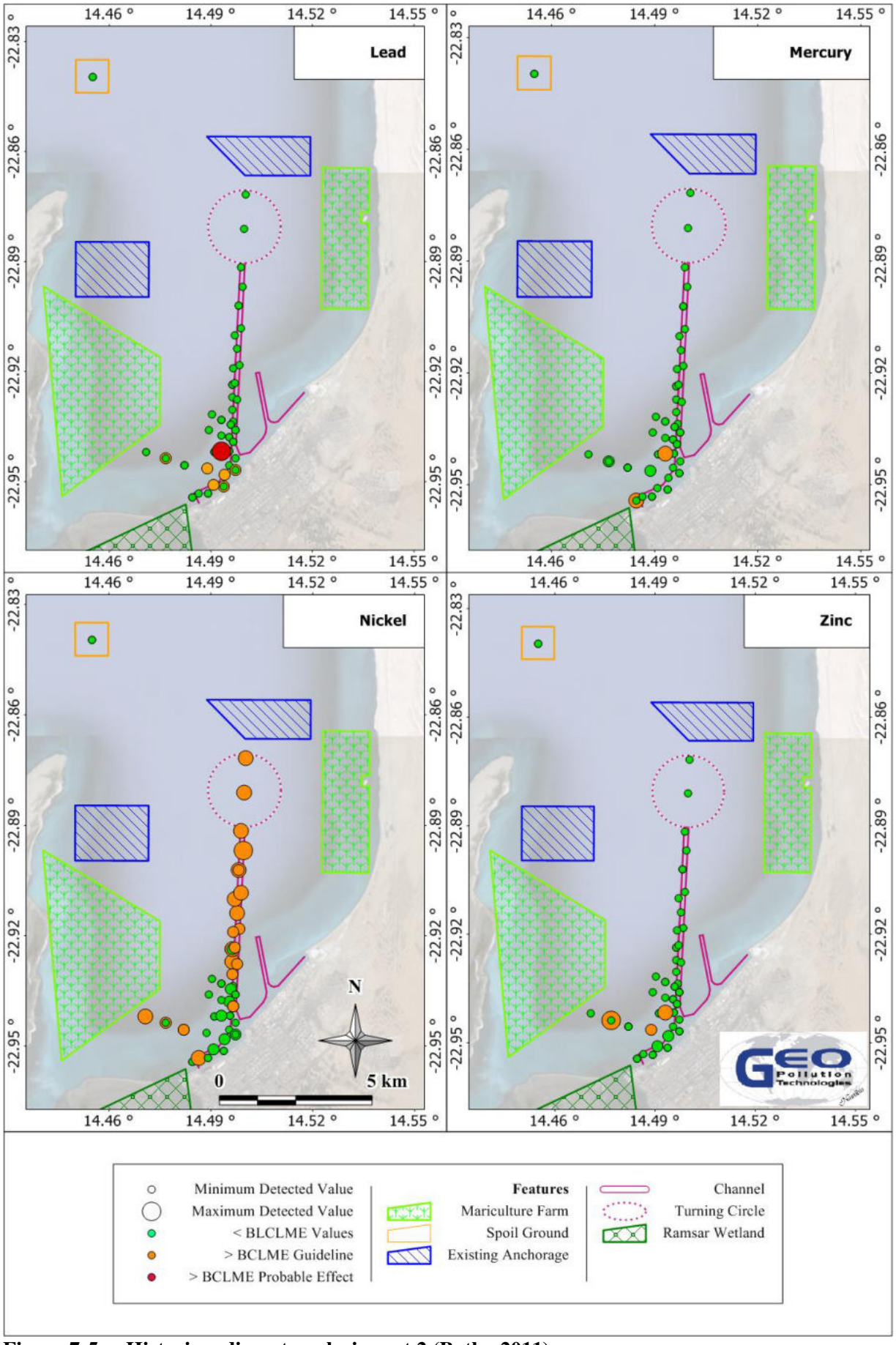


Figure 7-5 Historic sediment analysis part 2 (Botha 2011)

Sediment sample locations for the maintenance dredging of the fishing harbour in 2015 are presented in Figure 7-6 (Botha and Faul, 2015). Thirty composite samples consisting of three samples each were collected and analysed. The results of the analyses are presented in Table 7-3 to Table 7-5. Some chemicals of concern were elevated above BCLME recommended and probable effect concentrations in a number of locations. Notable among these are cadmium, lead, arsenic, copper, chromium and TBT. Note that sampling point 1 is closest to the floating dry docks and arsenic, cadmium, copper and TBT was elevated above BCLME recommended guideline values at this location.

Figure 7-6 Sediment sampling locations prior to maintenance dredging in 2015 (Botha and Faul, 2015)

Table 7-3 Sediment sampling results (samples 1 to 10) prior to maintenance dredging in 2015 (Botha and Faul, 2015)

Walvis Bay Fishing Harbour Baseline Sediment Sampling												
Project number	G139-18											
Certificate number	2015101521											
Start date	15-09-2015											
Report date	22-09-2015											
Date sampling	08-09-2015											
Sampler	P. Botha											
	Map Number			1	2	3	4	5	6	7	8	9	10
Analysis	**Unit**	**BCLME Sediment (Recommended Guideline Value)**	**BCLME Sediment (Probable Effect Concentration)**										
TerrAttesT													
Version number				7.23	7.23	7.23	7.23	7.23	7.23	7.23	7.23	7.23	7.23
Characteristics													
Dry matter	% (w/w)			65.1	69.4	51.2	31.6	55.8	61.8	45.5	26.8	40.4	36.5
Organic matter	% (w/w) dm			4	2.1	4.8	8.9	4.4	3.7	5.5	10.8	5.9	6.7
Fraction < 2 µm (Clay)	% (w/w) dm			3.2	3.8	6.9	24.5	5.9	5.1	7.3	27.9	21.2	15.3
Metals													
Arsenic (As)	mg/kg dm	7.24	41.6	14	18	22	29	17	17	19	33	24	19
Barium (Ba)	mg/kg dm	No Value	No Value	28	41	44	59	39	35	39	56	44	41
Cadmium (Cd)	mg/kg dm	0.68	4.21	1.5	1.5	3.2	7	2.7	2.2	3.5	7.3	4.9	4.4
Chromium (Cr)	mg/kg dm	52.3	160	16	22	27	53	27	25	29	50	35	33
Copper (Cu)	mg/kg dm	18.7	108	87	110	150	210	110	110	120	220	150	110
Lead (Pb)	mg/kg dm	30.2	112	21	34	43	84	34	28	44	73	47	47
Molybdenum (Mo)	mg/kg dm	No Value	No Value	1.7	2.7	4.9	11	4.4	3.2	4.8	8.6	5	6.2
Nickel (Ni)	mg/kg dm	15.9	42.8	5.4	6.7	9.3	16	9.8	8.3	10	15	11	12
Vanadium (V)	mg/kg dm	No Value	No Value	12	16	19	34	18	19	20	28	22	24
Zinc (Zn)	mg/kg dm	No Value	No Value	51	83	140	260	120	100	140	190	130	140
Cobalt (Co)	mg/kg dm	No Value	No Value		3.1	3.4	4.8	3.2	2.9	3.2	4	3.4	3.6
Mercury (Hg)	mg/kg dm	0.13	0.7				0.092	0.066		0.06	0.077	0.058	0.063
Phenols													
p-Cresol	mg/kg dm	No Value	No Value	0.02	0.05								
Cresols (sum)	mg/kg dm	No Value	No Value	0.02	0.05								
Phenol	mg/kg dm	No Value	No Value										
Polycyclic Aromatic Hydrocarbons													
Pyrene	mg/kg dm	153	1398	0.01	0.02	0.03	0.09	0.03	0.02	0.04	0.11	0.05	0.06
PAH 16 EPA (sum)	mg/kg dm	1684	16770	0.01	0.09	0.09	0.41	0.15	0.04	0.19	0.39	0.24	0.19
Phenanthrene	mg/kg dm	86.7	544		0.02	0.01	0.04	0.02		0.02	0.04	0.02	0.02
Fluoranthene	mg/kg dm	113	1494		0.02	0.02	0.06	0.03	0.01	0.03	0.03	0.03	0.04
Chrysene	mg/kg dm	108	846		0.01	0.02	0.06	0.02	0.01	0.03	0.05	0.04	0.03
Benzo(b)fluoranthene	mg/kg dm	No Value	No Value		0.01	0.01	0.04	0.02		0.02	0.03	0.02	0.02
PAH 10 VROM (sum)	mg/kg dm	No Value	No Value		0.05	0.05	0.27	0.1	0.03	0.13	0.2	0.15	0.12
Benzo(a)anthracene	mg/kg dm	74.8	693				0.02						
Benzo(k)fluoranthene	mg/kg dm	No Value	No Value				0.02			0.01	0.01	0.01	0.01
Benzo(a)pyrene	mg/kg dm	88.8	763				0.03	0.01		0.02	0.02	0.02	0.02
Benzo(ghi)perylene	mg/kg dm	No Value	No Value				0.02	0.01		0.02	0.02	0.01	
Indeno(123cd)pyrene	mg/kg dm	No Value	No Value				0.02			0.01	0.01	0.01	
Fluorene	mg/kg dm	21.2	144								0.06	0.02	
Anthracene	mg/kg dm	46.9	245								0.02		
Naphtalene	mg/kg dm	34.6	391										
Phtalates													
Bisethylhexylphtalate	mg/kg dm	No Value	No Value	0.2	0.2	0.6	1.7	0.8	0.6	2.6	2	0.6	0.8
Phtalates (sum)	mg/kg dm	No Value	No Value	0.2	0.2	0.6	1.7	0.8	0.6	2.6	2	0.6	0.8
Dimethylphtalate	mg/kg dm	No Value	No Value										
Total Petroleum Hydrocarbons													
TPH (C12-C16)	mg/kg dm	No Value	No Value	15	13	20	69	24	15	12	78	55	27
TPH (C16-C21)	mg/kg dm	No Value	No Value	17	22	38	93	40	30	33	100	73	52
TPH (sum C10-C40)	mg/kg dm	No Value	No Value	43	65	110	280	110	68	65	300	200	120
TPH (C21-C30)	mg/kg dm	No Value	No Value		18	28	69	30	16	14	59	43	24
TPH (C30-C35)	mg/kg dm	No Value	No Value		7.8	13	35	13			36	13	7.1
TPH (C35-C40)	mg/kg dm	No Value	No Value			6.4	11				23	7.2	
TPH (C10-C12)	mg/kg dm	No Value	No Value									12	
Miscellaneous Organic compounds													
Biphenyl	mg/kg dm	No Value	No Value										
Volatile Organic Hydrocarbons													
1,2,4-Trimethylbenzene	mg/kg dm	No Value	No Value										
1,3,5-Trimethylbenzene	mg/kg dm	No Value	No Value										
Styrene	mg/kg dm	No Value	No Value										
Organic Chlorinated Pesticides													
4,4 -DDT	mg/kg dm	No Value	No Value										
DDT/DDE/DDD (sum)	mg/kg dm	No Value	No Value										
Dieldrin	mg/kg dm	No Value	No Value										
Drins (sum)	mg/kg dm	No Value	No Value										
4,4 -DDD + 2,4 -DDT	mg/kg dm	No Value	No Value										
PolyChlorinated Biphenyl (PCB)													
PCB 101	mg/kg dm	No Value	No Value										
PCB 138	mg/kg dm	No Value	No Value										
PCB 153	mg/kg dm	No Value	No Value										
PCB 180	mg/kg dm	No Value	No Value										
PCB (6) (sum)	mg/kg dm	21.6	189										
PCB (7) (sum)	mg/kg dm	21.6	189										
Miscellaneous Organic compounds													
Tributyltin (TBT)	mg/kg dm	No Value	No Value	0.076	0.22	0.35	0.77	0.31	0.098	0.18	0.28	1.1	0.25
Triphenyltin (TPhT)	mg/kg dm	No Value	No Value		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Tributyltin (TBT) Sn	mg Sn/kg dm	0.005	0.07	0.031	0.091	0.14	0.32	0.13	0.04	0.075	0.11	0.43	0.1
Triphenyltin (TPhT) Sn	mg Sn/kg dm	No Value	No Value		0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
Organotin sum Sn factor 0,7	mg Sn/kg dm	No Value	No Value	0.043	0.1	0.16	0.33	0.14	0.052	0.087	0.13	0.44	0.12
Organotin sum (factor 0.7)	mg/kg dm	No Value	No Value	0.11	0.26	0.39	0.81	0.35	0.13	0.22	0.32	1.1	0.29

Notes:

Only parameters detected are reported on

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

Table 7-4 Sediment sampling results (samples 11 to 20) prior to maintenance dredging in 2015 (Botha and Faul, 2015)

Walvis Bay Fishing Harbour Baseline Sediment Sampling													
Project number	G139-18												
Certificate number	2015101521												
Start date	15-09-2015												
Report date	22-09-2015												
Date sampling	08-09-2015												
Sampler	P. Botha												
	Map Number			11	12	13	14	15	16	17	18	19	20
Analysis	**Unit**	**BCLME Sediment (Recommended Guideline Value)**	**BCLME Sediment (Probable Effect Concentration)**										
TerrAttesT													
Version number				7.23	7.23	7.23	7.23	7.23	7.23	7.23	7.23	7.23	7.23
Characteristics													
Dry matter	% (w/w)			51.3	40.1	55	47.5	32.4	41.1	28.2	40.4	56.1	44.3
Organic matter	% (w/w) dm			4.5	6.4	5.5	4.8	8.1	5.4	8.6	6.1	3.7	4.6
Fraction < 2 µm (Clay)	% (w/w) dm			8.2	22.6	15.1	6.1	18.3	7.5	22.7	9	2.7	6.2
Metals													
Arsenic (As)	mg/kg dm	7.24	41.6	16	22	14	14	26	9.4	25	19	11	12
Barium (Ba)	mg/kg dm	No Value	No Value	41	50	35	35	53	36	49	45	34	33
Cadmium (Cd)	mg/kg dm	0.68	4.21	3.2	4.2	2.4	3.2	5.6	2.9	5.7	3.5	1.4	2.2
Chromium (Cr)	mg/kg dm	52.3	160	30	37	28	28	46	29	45	34	17	23
Copper (Cu)	mg/kg dm	18.7	108	100	150	99	99	200	69	180	130	46	73
Lead (Pb)	mg/kg dm	30.2	112	35	46	26	24	44	33	45	34	43	19
Molybdenum (Mo)	mg/kg dm	No Value	No Value	4	6.6	4	3.8	7	8.6	7.1	5.9	2.8	4.1
Nickel (Ni)	mg/kg dm	15.9	42.8	10	13	9.6	9.2	14	11	15	13	6.2	8.4
Vanadium (V)	mg/kg dm	No Value	No Value	21	23	16	19	25	23	26	20	14	21
Zinc (Zn)	mg/kg dm	No Value	No Value	120	180	120	110	200	120	170	140	430	86
Cobalt (Co)	mg/kg dm	No Value	No Value	3.6	4	3.4	2.6	3.6	3.3	3.6	3.2	2.8	2.8
Mercury (Hg)	mg/kg dm	0.13	0.7	0.052	0.064			0.069		0.057	0.083		
Phenols													
p-Cresol	mg/kg dm	No Value	No Value					0.02					
Cresols (sum)	mg/kg dm	No Value	No Value					0.02					
Phenol	mg/kg dm	No Value	No Value									0.06	
Polycyclic Aromatic Hydrocarbons													
Pyrene	mg/kg dm	153	1398	0.04	0.05	0.04	0.03	0.08	0.06	0.06	0.04	0.01	0.03
PAH 16 EPA (sum)	mg/kg dm	1684	16770	0.09	0.18	0.09	0.04	0.27	0.15	0.19	0.07	0.01	0.05
Phenanthrene	mg/kg dm	86.7	544		0.02	0.01		0.04		0.02			
Fluoranthene	mg/kg dm	113	1494	0.02	0.03	0.01	0.01	0.02	0.03	0.02	0.02		0.02
Chrysene	mg/kg dm	108	846	0.02	0.03	0.02		0.02	0.01	0.02			
Benzo(b)fluoranthene	mg/kg dm	No Value	No Value		0.02			0.02	0.02	0.02	0.01		
PAH 10 VROM (sum)	mg/kg dm	No Value	No Value	0.04	0.11	0.04	0.01	0.17	0.08	0.09	0.02		0.02
Benzo(a)anthracene	mg/kg dm	74.8	693					0.01					
Benzo(k)fluoranthene	mg/kg dm	No Value	No Value		0.01			0.02					
Benzo(a)pyrene	mg/kg dm	88.8	763		0.01			0.02	0.01	0.01			
Benzo(ghi)perylene	mg/kg dm	No Value	No Value		0.01			0.02	0.01	0.01			
Indeno(123cd)pyrene	mg/kg dm	No Value	No Value										
Fluorene	mg/kg dm	21.2	144	0.02		0.02				0.02			
Anthracene	mg/kg dm	46.9	245					0.01					
Naphtalene	mg/kg dm	34.6	391					0.01	0.01	0.01			
Phtalates													
Bisethylhexylphtalate	mg/kg dm	No Value	No Value	0.9	2	1.9	1.8	4	1.2	2.4	1.8	0.4	1.1
Phtalates (sum)	mg/kg dm	No Value	No Value	0.9	2	1.9	1.8	4	1.5	2.4	1.8	14	1.1
Dimethylphtalate	mg/kg dm	No Value	No Value						0.2			14	
Total Petroleum Hydrocarbons													
TPH (C12-C16)	mg/kg dm	No Value	No Value	54	76	64	100	190	68	140	49	38	120
TPH (C16-C21)	mg/kg dm	No Value	No Value	76	94	88	120	240	110	170	71	56	130
TPH (sum C10-C40)	mg/kg dm	No Value	No Value	200	310	260	430	790	330	620	220	150	450
TPH (C21-C30)	mg/kg dm	No Value	No Value	42	69	56	100	190	82	150	44	29	97
TPH (C30-C35)	mg/kg dm	No Value	No Value	14	36	27	40	83	28	67	28	14	35
TPH (C35-C40)	mg/kg dm	No Value	No Value	6	24	17	28	57	25	53	20	11	30
TPH (C10-C12)	mg/kg dm	No Value	No Value	5	12	13	30	38	13	27	6	4.9	44
Miscellaneous Organic compounds													
Biphenyl	mg/kg dm	No Value	No Value					0.014					
Volatile Organic Hydrocarbons													
1,2,4-Trimethylbenzene	mg/kg dm	No Value	No Value						0.38				
1,3,5-Trimethylbenzene	mg/kg dm	No Value	No Value						0.21				
Styrene	mg/kg dm	No Value	No Value									0.4	
Organic Chlorinated Pesticides													
4,4 -DDT	mg/kg dm	No Value	No Value							0.003			
DDT/DDE/DDD (sum)	mg/kg dm	No Value	No Value							0.003			0.004
Dieldrin	mg/kg dm	No Value	No Value							0.003			
Drins (sum)	mg/kg dm	No Value	No Value							0.003			
4,4 -DDD + 2,4 -DDT	mg/kg dm	No Value	No Value										0.004
PolyChlorinated Biphenyl (PCB)													
PCB 101	mg/kg dm	No Value	No Value										
PCB 138	mg/kg dm	No Value	No Value										
PCB 153	mg/kg dm	No Value	No Value										
PCB 180	mg/kg dm	No Value	No Value										
PCB (6) (sum)	mg/kg dm	21.6	189										
PCB (7) (sum)	mg/kg dm	21.6	189										
Miscellaneous Organic compounds													
Tributyltin (TBT)	mg/kg dm	No Value	No Value	0.31	0.31	0.1	0.12	0.23	0.36	0.24	0.14	0.034	0.052
Triphenyltin (TPhT)	mg/kg dm	No Value	No Value	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Tributyltin (TBT) Sn	mg Sn/kg dm	0.005	0.07	0.13	0.13	0.042	0.051	0.093	0.15	0.097	0.056	0.014	0.021
Triphenyltin (TPhT) Sn	mg Sn/kg dm	No Value	No Value	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
Organotin sum Sn factor 0,7	mg Sn/kg dm	No Value	No Value	0.14	0.14	0.054	0.063	0.1	0.16	0.11	0.067	0.026	0.033
Organotin sum (factor 0.7)	mg/kg dm	No Value	No Value	0.34	0.34	0.14	0.16	0.26	0.39	0.27	0.17	0.069	0.087

Notes:

Only parameters detected are reported on

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

Table 7-5 Sediment sampling results (samples 21 to 30) prior to maintenance dredging in 2015 (Botha and Faul, 2015)

Walvis Bay Fishing Harbour Baseline Sediment Sampling													
Project number	G139-18												
Certificate number	2015101521												
Start date	15-09-2015												
Report date	22-09-2015												
Date sampling	08-09-2015												
Sampler	P. Botha												
	Map Number			21	22	23	24	25	26	27	28	29	30
Analysis	**Unit**	**BCLME Sediment (Recommended Guideline Value)**	**BCLME Sediment (Probable Effect Concentration)**										
TerrAttesT													
Version number				7.23	7.23	7.23	7.23	7.23	7.23	7.23	7.23	7.23	7.23
Characteristics													
Dry matter	% (w/w)			59	66.4	65.7	63.2	25.6	39.6	52.3	68.6	49.7	29.8
Organic matter	% (w/w) dm			4.7	2.7	2.4	2.5	10.1	6.2	3.7	2.4	4.4	8.7
Fraction < 2 µm (Clay)	% (w/w) dm			3.8	7.3	5.3	5.5	16.4	13.5	6.5	4.5	8.6	17.4
Metals													
Arsenic (As)	mg/kg dm	7.24	41.6	5.1	8.9	12	12	23	17	9.6	15	19	20
Barium (Ba)	mg/kg dm	No Value	No Value	34	27	21	30	55	50	39	35	38	53
Cadmium (Cd)	mg/kg dm	0.68	4.21	2.4	1.5	1.5	1.7	5.8	4.3	2.8	1.7	2.9	6.4
Chromium (Cr)	mg/kg dm	52.3	160	25	21	21	20	40	32	26	22	27	43
Copper (Cu)	mg/kg dm	18.7	108	16	35	49	45	100	71	50	72	96	130
Lead (Pb)	mg/kg dm	30.2	112	9.5	12	12	13	53	32	37	28	41	74
Molybdenum (Mo)	mg/kg dm	No Value	No Value	2.9	1.3	1.7	1.2	8.3	3.5	3.1	2	2.4	6.5
Nickel (Ni)	mg/kg dm	15.9	42.8	9.2	6.8	7.9	6.6	14	11	9.6	7.7	8.7	14
Vanadium (V)	mg/kg dm	No Value	No Value	20	16	14	15	29	22	20	17	22	27
Zinc (Zn)	mg/kg dm	No Value	No Value	27	27	34	38	100	96	66	61	82	130
Cobalt (Co)	mg/kg dm	No Value	No Value	2.8	2.1	2.1	2.1	3.8	3.1	3	2.7	2.9	3.8
Mercury (Hg)	mg/kg dm	0.13	0.7					0.065	0.054			0.061	0.062
Phenols													
p-Cresol	mg/kg dm	No Value	No Value	0.02	0.22		0.09						
Cresols (sum)	mg/kg dm	No Value	No Value	0.02	0.22		0.09						
Phenol	mg/kg dm	No Value	No Value	0.68	0.17	0.05	0.04						
Polycyclic Aromatic Hydrocarbons													
Pyrene	mg/kg dm	153	1398									0.02	0.03
PAH 16 EPA (sum)	mg/kg dm	1684	16770									0.07	0.07
Phenanthrene	mg/kg dm	86.7	544									0.02	
Fluoranthene	mg/kg dm	113	1494										0.02
Chrysene	mg/kg dm	108	846									0.01	0.02
Benzo(b)fluoranthene	mg/kg dm	No Value	No Value										
PAH 10 VROM (sum)	mg/kg dm	No Value	No Value									0.03	0.04
Benzo(a)anthracene	mg/kg dm	74.8	693										
Benzo(k)fluoranthene	mg/kg dm	No Value	No Value										
Benzo(a)pyrene	mg/kg dm	88.8	763										
Benzo(ghi)perylene	mg/kg dm	No Value	No Value										
Indeno(123cd)pyrene	mg/kg dm	No Value	No Value										
Fluorene	mg/kg dm	21.2	144									0.01	
Anthracene	mg/kg dm	46.9	245										
Naphtalene	mg/kg dm	34.6	391										
Phtalates													
Bisethylhexylphtalate	mg/kg dm	No Value	No Value									0.3	0.5
Phtalates (sum)	mg/kg dm	No Value	No Value									0.3	0.5
Dimethylphtalate	mg/kg dm	No Value	No Value										
Total Petroleum Hydrocarbons													
TPH (C12-C16)	mg/kg dm	No Value	No Value			53				12	9.5	29	30
TPH (C16-C21)	mg/kg dm	No Value	No Value			48				15	16	36	41
TPH (sum C10-C40)	mg/kg dm	No Value	No Value			210				66	73	110	150
TPH (C21-C30)	mg/kg dm	No Value	No Value			46				16	21	23	32
TPH (C30-C35)	mg/kg dm	No Value	No Value			17				7.7	13	13	24
TPH (C35-C40)	mg/kg dm	No Value	No Value			14				11	13	8.8	21
TPH (C10-C12)	mg/kg dm	No Value	No Value			27				3.8		4.4	3.1
Miscellaneous Organic compounds													
Biphenyl	mg/kg dm	No Value	No Value										
Volatile Organic Hydrocarbons													
1,2,4-Trimethylbenzene	mg/kg dm	No Value	No Value										
1,3,5-Trimethylbenzene	mg/kg dm	No Value	No Value										
Styrene	mg/kg dm	No Value	No Value										
Organic Chlorinated Pesticides													
4,4 -DDT	mg/kg dm	No Value	No Value										
DDT/DDE/DDD (sum)	mg/kg dm	No Value	No Value										
Dieldrin	mg/kg dm	No Value	No Value										
Drins (sum)	mg/kg dm	No Value	No Value										
4,4 -DDD + 2,4 -DDT	mg/kg dm	No Value	No Value										
PolyChlorinated Biphenyl (PCB)													
PCB 101	mg/kg dm	No Value	No Value					0.004					
PCB 138	mg/kg dm	No Value	No Value					0.01					
PCB 153	mg/kg dm	No Value	No Value					0.009					
PCB 180	mg/kg dm	No Value	No Value					0.008					
PCB (6) (sum)	mg/kg dm	21.6	189					0.031					
PCB (7) (sum)	mg/kg dm	21.6	189					0.031					
Miscellaneous Organic compounds													
Tributyltin (TBT)	mg/kg dm	No Value	No Value	0.42	0.032	0.032	0.032	0.064	0.061	0.043	0.032	0.34	0.48
Triphenyltin (TPhT)	mg/kg dm	No Value	No Value	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.05
Tributyltin (TBT) Sn	mg Sn/kg dm	0.005	0.07	0.17	0.013	0.013	0.013	0.013	0.025	0.018	0.013	0.14	0.2
Triphenyltin (TPhT) Sn	mg Sn/kg dm	No Value	No Value	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
Organotin sum Sn factor 0,7	mg Sn/kg dm	No Value	No Value	0.19	0.021	0.021	0.021	0.021	0.037	0.03	0.021	0.15	0.21
Organotin sum (factor 0.7)	mg/kg dm	No Value	No Value	0.46	0.057	0.057	0.057	0.11	0.096	0.078	0.057	0.37	0.52

Notes:

Only parameters detected are reported on

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

Implications and Impacts

Introduction of pollutants and specifically heavy metals and TBT during grit blasting operations could have potential deleterious effects on marine biodiversity and humans, sediment disruption caused by maintenance dredging could disperse pollutants within the harbour area. Mitigating measures must be in place to prevent the grit blasting dust and waste, as well as sediment dispersion from dredging activities, from entering the marine environment.

7.7 Fauna of the Bay

Of note nearby is the Walvis Bay Lagoon, the salt works and the southern part of the bay west of the lagoon, which are the key components of the 9,000 km^2 Ramsar site (Wetland of International Importance). It is important both as an over-wintering area for Palaearctic migrant wader species as well as for African species such as Greater and Lesser Flamingos, Great White Pelican and Chestnut-Banded Plovers.

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

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

Implications and Impacts

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

7.8 Demographic Characteristics

At local level Walvis Bay has an urban population size of 51,618 (Namibia Statistics Agency, 2024). Walvis Bay is the principal port of Namibia, and is an import/export facility for processed fish, mining products and beef. Mining products and raw material imports/exports are on the rise with the present upheaval in the uranium industry.

The area is linked to Namibia's air, rail and road network, making its port well situated to service Zambia, Zimbabwe, Botswana, Southern Angola and South Africa. The fishing industry is the major employer of low skilled workers on a permanent and seasonal basis. The total employment of this sector is estimated at 2% of the total Namibian workforce.

Implications and Impacts

The project provides employment to people from the area. Skills development and training would also be a benefit to employees. The development may have an influence on further stimulating economic growth of the town and region which may result in more job opportunities.

Table 7-6 Demographic characteristics of Walvis Bay, the Erongo region and nationally (Namibia Statistics Agency, 2023; Namibia Statistics Agency, 2023)

	Walvis Bay Urban	Erongo Region	Namibia
Population (Males)	26,212	122,322	1,474,224
Population (Females)	25,406	117,884	1,548,177
Population (Total)	51,618	240,206	3,022,401
Population Density (persons/km^2)	2,730.8	3.8	3.7

8 PUBLIC CONSULTATION

Consultation with the public forms an integral component of an EIA investigation and enables I&APs e.g. neighbouring landowners, local authorities, environmental groups, civic associations and communities, to comment on the potential environmental impacts of projects and to identify additional issues which they feel should be addressed in the EIA. Full public participation was conducted during the 2015 EIA process. No comments or concerns where received during that period.

9 MAJOR IDENTIFIED IMPACTS

During the scoping exercise a number of environmental impacts have been identified. The impacts are mainly as a result of toxic contaminants released during the blasting process and the source of these contaminants can be the surface material being blasted, the surface coating, the abrasive material as well as any other contaminants present on the blasting surface or contained within the abrasive material. See Table 9-1 for a list of typical sources and contaminants of grit blasting processes in ship repair yards. In September 2014 Geo Pollution Technologies analysed a sample of spent blasting grit from a blasting operation at the NAMDOCK dry dock. The sample thus contains the residual grit, pulverised grit (from impact with ship hull), paint and any other material that could have been present on the hull. Appendix A presents the results of the sample analysis while Table 9-2 provides a summary of those results exceeding at least the Benguela Current Large Marine Ecosystem (BCLME) guideline values for marine water. As can be seen the metals; chromium, copper, nickel and zinc are present in very high concentrations. Tributyltin (TBT) is also present in high concentration in this sample, which would indicate that the ship that was blasted contained TBT in its paint as an antifouling agent. The potential harmful effects of these metals are well documented in scientific literature and lead and TBT specifically have been banned as ingredients of paints. Anthracene, naphthalene and phenanthrene are polycyclic aromatic hydrocarbons (PAHs) which may be present as a result of contamination of the blasting grit or the hull with oil or other forms of hydrocarbons.

Table 9-1 Typical air contaminants encountered during grit blasting of ships (https://www.osha.gov)

Source	Potential Contaminants
Base Material (steel, aluminium, stainless steel, galvanized steel, copper-nickel and other copper alloys, etc.)	Aluminium, cadmium, chromium, copper, iron, lead, manganese, nickel, and zinc
Surface Coatings (pre-construction primers, anticorrosive and antifouling paints, etc.)	Copper, barium, cadmium, chromium, lead, tributyltin compounds, zinc
Abrasive Blasting Material (coal slag, copper slag, nickel slag, glass, steel grit, garnet, silica sand, etc.)	Arsenic, beryllium, amorphous silica, cadmium, chromium, cobalt, crystalline silica, lead, manganese, nickel, silver, titanium, and vanadium

Table 9-2 Spent blasting grit (copper slag) analysis results exceeding BCLME soil recommended guideline values

Contaminant	Value (ppm)	BCLME Soil Recommended Guideline Values (ppm)	BCLME Soil Probable Effect Concentration (ppm)
Anthracene	0.4	0.0469	0.245
Arsenic	20	7.24	41.6
Chromium	22,000	52.3	160
Copper	14,000	18.7	108
Lead	300	30.2	112
Mercury	4	0.13	0.7
Naphthalene	0.126	0.0346	0.391
Nickel	1,500	15.9	42.8
Phenanthrene	1.353	0.0867	0.544
Tributyltin (TBT) as Sn	150	0.005	0.07
Zinc	700	124	271

Simultaneous with the grit sample analysis two water samples, one from near the dry docks and one from the entrance channel, were also analysed (see appendix B). The water sample taken at the dry docks had elevated TBT levels.

9.1 Health Risks

A number of health risks are associated with grit blasting activities typically related to the inhalation and dermal contact with dust and particulate matter generated during blasting. Toxic contaminants released during blasting, such as silicates and heavy metals, can result in a variety of health problems of which respiratory complications and cancer are the most frequent occurrences. Other health risks include neurological, circulatory, excretory, reproductive and dermal complications.

Physical injuries can also occur as a result of the deflection of grit from the blasting surface which can cause cuts and bruises or eye injuries. Other health impacts include mechanical equipment and moving parts causing physical injury, slipping and falling on wet surfaces, etc. Falling from heights can also cause serious injury or death.

During dredging activities, there is a risk of gaseous emissions engulfing dredger personnel. Hazardous gasses are likely to be hydrogen sulphide and methane. Except for being flammable, hydrogen sulphide gas is specifically very dangerous and can be fatal to humans at concentrations anywhere from 300 to 600 ppm. It is initially recognised as a rotten egg smell, but within a short period the olfactory nerves adapt to the smell, and it is no longer detected. At this stage it may be thought that the gas is no longer present, but the contrary could be true. The Labour Act sets the following occupational exposure limits for workers: a Time Weighted Average (TWA) over an 8 hour work day, or a 40 hour work week, for hydrogen sulphide of 10 ppm or 14 mg/m^3, with a short term exposure limit of 15 ppm or 21 mg/m^3.

The maximum limit of hydrogen sulphide set by the World Health Organization is 150 $\mu g/m^3$ (0.015 ppm) for an average concentration over 24 hours (WHO, 2000). To prevent unpleasant odours, a 30 minute average ambient air concentration not exceeding 7 $\mu g/m^3$ (0.007 ppm) is recommended. See Table 9-3 for typical H_2S air quality health effects that can be expected.

Contaminated dredge material, e.g. when containing high levels of heavy metals, used for land filling, may pose health effects on land-based receptors. Additionally, when the sediment dries, the release of toxic fugitive dust and sand particles (PM10) could have significant negative impacts on the general public, predicted to be moderate and medium-term.

Table 9-3 H_2S air quality effects

H_2S Concentration (ppm, in air)	Effects Observed
4-6	Easy detected, moderate odour.
10-20	Unpleasant odour, Possible eye irritation. TWA up to 10 ppm = more than 8 hours per day. Short Term Exposure Limit (STEL) up to 15 ppm = Max of 4 exposures per day, no more than 15 minutes each.
50-100	Loss of sense of smell after about 15 minutes exposure. Irritation of throat of eyes. Altered respiration, pain in the eyes and drowsiness after 15-30 minutes followed by throat irritation after 1 hour.
100-200	Loss of sense of smell within seconds, with irritation of throat and Eyes. Haemorrhage and death beyond 8 hours exposure.
200-500	Loss of balance and consciousness within 30 minutes and paralysis of the respiratory system. Artificial respiration must be applied immediately. Haemorrhage and death after 2 to 4 hours exposure.
500-700	Loss of consciousness within 15 minutes of exposure. Respiration stops and death is inevitable after 15 to 30 minutes exposure if the victim is not immediately treated.
700-1,000	Immediate loss of consciousness. Brain damage or death if first aid is not immediately applied. Inevitable death after 15 minutes exposure.
1,000-1,500	Immediate collapse and death after 2 minutes exposure.
Above 1,500	Immediate death.
43,000	Lower Explosion Limit
450,000	Upper Explosion Limit

9.2 Noise Impacts

Some of the typical noise sources of grit blasting are nozzle air discharge, abrasive impact on blasting surface and air compressor noise. Noise levels associated with abrasive blasting can be in excess of 100 dB which can result in permanent hearing loss.

The noise impacts associated with the maintenance dredging activities are predicted to be negligible and short-term due to the nature of operations taking place in a commercial and industrial area, which is already accustomed to such activities. However, the disposal of dredged material at the inshore site could generate significant additional noise and vibrations from earthmoving equipment. This impact is expected to be minor and short-term since the activity will be brief and most work will occur during normal working hours (between 08:00 and 17:00). Only three residential properties, along the section of the street opposite the proposed inshore dumping site, could be affected, and thus no mitigation measures are deemed necessary due to the limited temporal scale and the pre-existing industrial character of the land use in the area.

9.3 Marine Impacts

Marine impacts will be as a result of grit blasting waste and pressure washing water entering the ocean. Potentially the same toxic materials as listed in Table 9-1 can be released into the water from where it can settle to the sea floor or be dispersed by water currents until it settles out elsewhere. Toxic materials like heavy metals can accumulate in marine organisms and magnify up the food chains until it reaches levels with harmful effects such as reproductive and growth problems or even mortality. Particulate matter may also damage gills and cause mortality.

Ballast water released from ships when being floated at the dry docks can introduce alien species into the Namibian coastal waters. These species may become invasive and disrupt the local ecosystem.

The dredging activities in Walvis Bay significantly impact several key areas of the marine environment. Initially, seabed removal leads to habitat destruction, which has a moderate direct impact in the short term. The cumulative effects from ongoing maintenance and periodic capital dredging are expected to be more substantial (Bray and Cohen, 2004). Regular dredging, coupled with the dynamic nature of the Namibian offshore environment, helps mitigate some of these impacts (Faul, *et al*., 2022).

Sediment suspension during dredging increases water turbidity, which can degrade water quality. The suspended sediments reduce light penetration, affecting photosynthetic marine organisms, and can release contaminants trapped in the sediment (Van Bloois and Frumau, 2009). Turbidity and the potential release of toxic substances are significant concerns. These contaminants can adversely affect marine life, particularly benthic organisms that are in direct contact with the seabed (Eke, *et al*. 2023)

Benthic organisms, including bacterial communities, are especially vulnerable to dredging activities. The physical disruption of their habitat and the subsequent changes in sediment composition can delay their regeneration. These organisms may take longer to recover, leading to prolonged ecological impacts. This disruption can affect the entire benthic food web, impacting species diversity and ecosystem functions (Faul, *et al*., 2022).

The sediment in Walvis Bay contains varying levels of contaminants, which can be released during dredging. The disposal of dredged material, especially at inshore and on-land sites, poses a risk of spreading these contaminants.

The ongoing nature of maintenance dredging has long-term ecological effects. Natural sediment transport and dispersion can mitigate some impacts, but continuous dredging leads to cumulative environmental stress. This stress can result in habitat loss, changes in species composition, and decreased biodiversity.

9.4 Dust and Air Quality

Windy conditions are a common occurrence in Walvis Bay. Dust generated during grit blasting can be blown to nearby receptors in windy conditions. Prevailing winds are in a south-westerly direction towards the Syncrolift and fishing harbour where people and the marine environment can be affected.

The potential dust and air quality impacts associated with the dredging activities are primarily related to the release of fugitive dust and sand particles when dredged material is disposed of inshore. These particles, including PM10, can become airborne and pose significant health risks to the general public if not properly managed. The drying of sediment can lead to the release of these toxic particles, which can have moderate negative impacts in the medium term.

9.5 Socio-Economic Impacts

NAMDOCK is responsible for a current workforce of approximately 760 people of which 326 are permanent NAMDOCK employees, and the rest are comprised of various fixed term contractors. NAMDOCK provides an essential service by providing ship repair facilities on the southwest coast of Africa. Through their operations, numerous local specialists, businesses and contractors are engaged and thus revenue is generated locally, livelihoods of workers sustained, and contributions made to the national treasury.

10 ASSESSMENT OF IMPACTS

The purpose of this section is to assess and identify the most pertinent environmental impacts that are expected from the construction, operational and potential decommissioning activities of the proposed project. An EMP based on these identified impacts are also incorporated into this section.

For each impact an environmental classification was determined based on an adapted version of the Rapid Impact Assessment Method (Pastakia, 1998). Impacts are assessed according to the following categories: Importance of condition (A1); Magnitude of Change (A2); Permanence (B1); Reversibility (B2); and Cumulative Nature (B3) (see Table 10-1)

Ranking formulas are then calculated as follow:

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

The environmental classification of impacts is provided in Table 10-2.

The probability ranking refers to the probability that a specific impact will happen following a risk event. These can be improbable (low likelihood); probable (distinct possibility); highly probable (most likely); and definite (impact will occur regardless of prevention measures).

Table 10-1 Assessment criteria

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

Table 10-2 Environmental classification (Pastakia 1998)

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

10.1 Risk Assessment and Environmental Management Plan

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

The objectives of the EMP are:

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

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

As depicted in the tables below, impacts related to the operational phase are expected to mostly be of medium to low significance and can mostly be mitigated to have a low significance. The extent of impacts are mostly site specific to local and are not of a permanent nature. Due to the nature of the surrounding areas, cumulative impacts are possible and include groundwater contamination and traffic impacts.

10.1.1 Planning

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

- Ensure that all necessary permits from the various ministries, local authorities and any other bodies that governs the the project are in place and remains valid.

- Ensure all appointed contractors and employees enter into an agreement which includes the EMP. Ensure that the contents of the EMP are understood by the contractors, sub-contractors, employees and all personnel present or who will be present on site.
- Make provisions to have a health, safety and environmental (HSE) coordinator to implement the EMP and oversee occupational health and safety as well as general environmental related compliance at the site. Provision should be made for monthly environmental performance audits and reports during the initial phases.
- Have the following emergency plans, equipment and personnel on site where reasonable to deal with all potential emergencies:
  - Risk management / mitigation / EMP/ emergency response plan and HSE manuals
  - Adequate protection and indemnity insurance cover for incidents;
  - Comply with the provisions of all relevant safety standards;
  - Procedures, equipment and materials required for emergencies.
- Establish and / or maintain a reporting system to report on aspects of construction activities, operations and decommissioning as outlined in the EMP.
- Submit bi-annual reports to the MEFT to allow for environmental clearance certificate renewal after three years, if required. This is a requirement by MEFT.
- Appoint a specialist environmental consultant to update the EIA and EMP and apply for renewal of the environmental clearance certificate prior to expiry, if required.

10.1.2 Employment

NAMDOCK provides employment to a significant workforce. Dredging operations will require a small crew consisting of local Namibians. Some support services will be provided by local Namibian companies and consultants and thus local employment will be created and/or sustained.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Dredging Operations	Sustaining or creating employment opportunities through normal operations, dredging and through support services offered to NAMDOCK and the dredging contractor	3	1	2	2	1	15	2	Definite

Desired outcome: Provision of employment to local Namibians and adhering to Namibian legal requirements with respect to work permits.

Actions:

Enhancement:

- If the skills exist locally, contractors and employees must first be sourced from the town, then the region and then nationally. Deviations from this practise must be justified.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- Employee contracts on file
- Bi-annual reporting, whichever comes first, based on employee records that provides details on number of employees and demographic profile such as male vs. female, local vs. foreign, and disabled employees.

10.1.3 Skills, Technology and Development

During various phases of operations, training will be provided to a portion of the workforce. Skills are transferred to an unskilled workforce for general tasks. Development of people and technology are key to economic development.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	Employment, technological development and transfer of skills	2	1	2	3	2	14	2	Definite
Indirect Impacts	Transfer of skills and technological development	2	1	2	3	3	16	2	Definite

Desired Outcome: Increasing the skills of local Namibians, as well as development and technology advancements in associated industries.

Actions

Enhancement:

- If the skills exist locally, contractors and employees must first be sourced from the town, then the region and then nationally. Deviations from this practise must be justified.
- Skills development and improvement programs to be made available as identified during performance assessments.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

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

10.1.4 Revenue Generation

An increase of skilled and professional labour is a result of the continuing operations and related wages and salaries will be paid. Revenue will be generated through the contracting of port and related contractors' services.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	Employment contribution to local economy	3	1	3	3	2	24	3	Definite
Indirect Impacts	Decrease in unemployment, contribution to local economy	3	1	3	3	3	27	3	Definite

Desired Outcome: Contribution to the local and national economy. Contribution to national treasury.

Actions

Enhancement:

- The Proponent must employ local Namibians and source Namibian contractors, goods and services as far as is practically possible. Deviations from this practise must be justified.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Bi-annual summary report based on employee records.

10.1.5 Demographic Profile and Community Health

The operations of the dry docks are reliant on labour during the operational phases. Community health may be exposed to factors such as communicable disease like HIV/AIDS and alcoholism/drug abuse, associated with increased spending power of the labour force. Foreign persons in the area may increase the cumulative risk of communicable disease in Walvis Bay.

Positive impacts will related to employees and contractors' increased economic resilience and improved livelihoods.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	In-migration and social ills related to unemployment	1	-1	1	1	2	-4	-1	Probable
Indirect Impacts	The spread of disease	1	-1	2	1	2	-4	-1	Probable

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

Actions:

Prevention:

- Employ local people from the area where possible, deviations from this practise should be justified appropriately.
- Adhere to all municipal by-laws relating to environmental health which includes, but is not limited to, sanitation requirements for workers on site.
- Appointment of reputable contractors.

Mitigation:

- Educational programmes for employees on HIV/AIDs and general upliftment of employees' social status.

Responsible Body:

- Proponent

Data Sources and Monitoring:

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

10.1.6 Ship Repair and Maintenance Services

Ship repair and maintenance services at the dry docks involve various activities such as grit blasting, painting, welding, and mechanical repairs. These operations are crucial for maintaining the functionality and safety of maritime vessels, but come with environmental, health, and safety risks. Proper management and mitigation strategies are essential to minimise these impacts and ensure sustainable operations.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	Provision of ship repair and maintenance services	4	3	3	2	2	84	5	Definite

Desired Outcome: Provision of ship repair and maintenance services.

Actions:

Enhancement:

- Implement adequate health, safety and environmental policies and procedures to ensure the operations of the facility, and provision of ship repair and maintenance services, can continue without disruptions.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- The number of vessels handled on the floating dry dock to be included in a six monthly environmental monitoring report.

10.1.7 Health, Safety and Security

Activities associated with the operational phases are reliant on human labour and therefore exposes them to health and safety risks. Activities such as the operation of machinery, unsafe stacking, falling from heights and handling of hazardous chemicals (inhalation of dust and potential health effects chemicals), poses risks to employees. If not contained, windblown dust may further pose health risk to nearby receptors.

The Namibian coast is characterised by very cold water and rough conditions. Falling from the quay, the dry docks or dredging platform, and being exposed to cold water, will quickly result in hypothermia which may rapidly become fatal.

During dredging activities, there is a risk of gaseous emissions engulfing personnel. Hazardous gasses are likely to be hydrogen sulphide and methane. Hydrogen sulphide gas is specifically very dangerous and can be fatal to humans at concentrations anywhere from 300 to 600 ppm. It is initially recognised as a rotten egg smell, but within a short period the olfactory nerves adapt to the smell, and it is no longer detected. At this stage it may be thought that the gas is no longer present, but the contrary could be true.

Security risks are related to unauthorized entry, theft and sabotage.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	Physical injuries, exposure to chemicals and gaseous emissions, and criminal activities	2	-2	3	2	2	-28	-3	Highly Probable

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

Actions

Prevention:

- All Health and Safety standards specified in the Labour Act, or better, should be followed.
- Clearly label dangerous and restricted areas as well as dangerous equipment and products. This includes fencing of the temporary land-based dredged sediment disposal area with strict security to prevent unauthorised entry.
- Provide all employees with required and adequate personal protective equipment (PPE) including dust masks and protective clothing for workers in close proximity to, or working with, the dust producing equipment. Accidental inhalation, ingestion, dermal or eye contact with dust must be prevented at all times.
- Ensure that all personnel receive adequate training on operations of equipment / handling of harmful materials.
- Equipment on site must be stored in a way that does not encourage criminal activities (e.g. locked away to prevent theft).
- Security procedures and proper security measures must be in place to protect workers.
- Strict security that prevents unauthorised entry into the site.
- The build-up of static electricity must be prevented by grounding the surface to be blasted.
- Appointment of a reputable dredging contractor with a known history of responsible and safe operations.
- All seafaring vessels used must have all the required safety and emergency equipment as per maritime standards.
- To prevent and/or mitigate the impacts of hydrogen sulphide and methane gas, the following must be in place:

- Ensure that the dredging and support vessels are equipped with appropriate technology, and correct placement of such technology, to avoid poisonous gases from affecting crew.
- Ensure that appropriate breathing apparatuses are available to crew to protect them from any dangerous gas that is liberated from the submerged and dredged material.
- Continuous hydrogen sulphide monitoring must be performed in all areas identified to be at risk of being engulfed by the gas. This include real time remote monitoring or portable (handheld) monitoring devices to be carried on person. Areas to be monitored include all areas of the vessel that are at risk and on the dry docks, quays, jetties and berths, when dredging is in close proximity thereof.
- Near the quays, jetties and berths, dredging must be done mainly while there are fewer activities.
- Seafaring traffic may not come within 100 m of the dredger unless authorised to do so and must, if possible, pass upwind of the dredger.
- Real time H_2S monitoring sensors with alarm levels set at 150 $\mu g/m^3$ (0.015 ppm) must be placed between the temporary land disposal area and nearby receptors (dry docks, Syncrolift, etc..

Mitigation:

- Selected personnel should be trained in first aid and a first aid kit must be available on site. The contact details of all emergency services must be readily available.
- Implement and maintain an integrated health and safety management system, to act as a monitoring and mitigating tool, which includes operational, safe work and medical procedures, permits to work, emergency response plans, housekeeping rules, MSDS's and signage requirements (PPE, flammable etc.).
- Implement emergency response procedures in case of incidents.
- Emergency wash stations in case of accidental exposure to chemicals or dust.
- If sensors are triggered, dredging must stop and gas levels allowed to drop to acceptable safe levels. If required, the dredging vessel must be manoeuvred away from the area where high gas levels are detected.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- Industry standards and protocols, etc.
- An up-to-date health and safety file to be maintained.
- Any incidents or complaints must be recorded with action taken to prevent future occurrences.
- A bi-annual report should be compiled of all incidents reported. The report should contain dates when training were conducted and when safety equipment and structures were inspected and maintained, incidents or complaints received, including action taken to prevent future occurrences, must be included.

10.1.8 Traffic

The removal of dredged material will increase the volume of trucks accessing the port area. The normal daily operations will not have an effect on the current traffic in the area. This will increase traffic on the roads through town, to and from the port. Heavy motor vehicles may result in an increased, cumulative impact on the road surface of the area, especially when turning on these roads. Trucks may block neighbouring business' entrances and increase the likelihood of accidents and incidents.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	Impact from increased traffic.	1	-1	1	1	2	-6	-1	Probable

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

Actions

Mitigation:

- Trucks collecting waste produced from maintenance dredging should not be allowed to obstruct any traffic in surrounding areas and the town.
- Trucks associated with the facility should not be allowed to park or overnight in the port area or near the entrance/exit gates, and may only overnight at areas designated for this purpose.
- Adhere to The Road Traffic and Transport Regulations, 2001 and all other applicable legislation related to road transport and maximum axle loads.
- If any traffic impacts are expected, traffic management should be performed to prevent these.
- The placement of signs to warn and direct traffic will mitigate traffic impacts.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- The Road Traffic and Transport Regulations, 2001.
- Any complaints received regarding traffic issues should be recorded together with action taken to prevent impacts from repeating itself.
- A bi-annual report should be compiled of all incidents reported, complaints received, and action taken

10.1.9 Air Quality Related Impacts

Reduced air quality as a result of pulverised blasting grit, paint and other materials present on the surface blasted will be created and it can be dispersed in strong winds. This may have localised health impacts, but is possible to disperse due to the prevailing south-westerly winds in Walvis Bay.

Air quality as a result of windblown dust can cause health effects, especially through chronic inhalation of such dust, in the nearby communities. The risk is related to the toxic/irritant nature respirable fractions (PM_{10}) and thoracic fraction ($PM_{2.5}$) of dust containing harmful chemicals from grit blasting.

During dredging activities, there is a risk of gaseous emissions at the onshore disposal site. Hazardous gasses are likely to be hydrogen sulphide and methane. Apart from being foul smelling, it may also pose health risks to any nearby people

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	Dust generated from operational activities	2	-2	3	2	2	-28	-3	Definite

Desired Outcome: To prevent health impacts and to reduce greenhouse gas emissions.

Actions

Mitigation:

- Due to the potential toxic nature of dust created its dispersion in the air should be mitigated as much as operationally possible.
- Mesh netting to enclose the front and rear ends of the docks must be used at all times.
- Grit blasting must be stopped when wind speeds are high enough to disperse dust to nearby receptors.
- Alternative blasting techniques such as wet blasting or centrifugal shot blasting should be investigated.
- The World Health Organization - Hazard prevention and control in the work environment: Airborne dust (WHO, 1999) should be consulted.
- See section 10.1.7 for preventative and mitigation measures related to hydrogen sulphide and methane.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- Any complaints received regarding dust must be recorded, investigated and the problem rectified.
- Any incidents must be recorded with action taken to prevent future occurrences.
- A bi-annual report should be compiled of all incidents and complaints reported. The report should contain dates when safety equipment and structures were inspected and maintained.

10.1.11 Fire

Operational activities may increase the risk of the occurrence of fires if proper maintenance and housekeeping are not conducted. Some chemicals used on site are flammable. The facility is located adjacent to the existing fuel offloading facility. Fuel spillages during offloading may create a risk to human life and material. Methane and hydrogen sulphide can be released from dredged material and both are flammable.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	Fire risk due to flammable products stored on site.	1	-2	2	2	2	-12	-2	Probable
Daily Operations	Fire risk due to flammable products in close proximity to site.	2	-3	2	2	2	-36	-4	Probable

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

Actions:

Prevention:

- Prepare and regularly update the firefighting and prevention plan and equipment according to the materials stored on site, keeping in mind the activities on neighbouring properties.
- Share the requirements for firefighting on site with Namport.
- Ensure all materials are stored strictly according to MSDS instructions. This include segregation of incompatible products.
- Maintain regular site, mechanical and electrical inspections and maintenance. This should include ensuring that all grounding (earthling) structures are in place.
- Clean all spills / leaks immediately.
- Stop operations if dust containment fails and dust becomes airborne. Operations can continue once the cause is rectified.
- Ensure sufficient firefighting and fire prevention measures are in place for the specific products being stored and handled on site. This includes specific fire suppressants compatible with the materials used/stored.
- Real-time explosimeter monitoring should be conducted on the vessel.
- Mitigation:
- A holistic fire protection and prevention plan is needed for flammable products. This plan must include an emergency response plan, firefighting plan and spill recovery plan, and should include specific substances handled at the site. The plan should consider risks posed to and by neighbouring properties.
- Maintain firefighting equipment, implement good housekeeping and conduct personnel training (firefighting, fire prevention and responsible housekeeping practises).
- Proper communication systems between oil companies and NAMDOCK. Oil companies must prevent fuel from spreading towards NAMDOCK and must inform NAMDOCK as priority of any fuel spillage. NAMDOCK to abandon all work on the floating docks and evacuate all staff and visitors to a safe area.
- If fuel is observed on water the same procedure must be followed.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- A register of all incidents must be maintained. This should include measures taken to ensure that such incidents do not repeat themselves.

- A bi-annual report should be compiled of all incidents reported. The report should contain dates when fire drills were conducted and when fire equipment was tested and training given.

10.1.12 Noise and Vibration

Noise pollution will exist due to compressors and high pressure blasting. Vibration might affect the operators' hands. As the site is situated in a port area, noise impacts are expected. The cumulative impact of noise sources originating from the port is however a nuisance in the nearby residential areas. The operations and maintenance or upgrade phases may generate excessive noise for short periods of time.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily operation	Impact on fauna and loss of biodiversity, displacement, disturbance	1	-1	3	2	2	-7	-1	Improbable
Daily operation	Noise and vibration caused by dredging activities.	1	-2	3	2	2	-14	-2	Definite
Daily operation	Noise will exist due to compressors and high pressure blasting. Vibration may affect the operators' hands and arms.	1	-2	3	2	2	-14	-2	Definite

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

Actions

Mitigation:

- The Health and Safety Regulations of the Labour Act and World Health Organization (WHO) guideline on maximum noise levels (Guidelines for Community Noise, 1999) to prevent hearing impairment for workers on site and not to be a nuisance to communities should be considered during the construction and operational phases.
- Confine noise generating operational activities to daytime hours as far as possible.
- Hearing protectors must be issued as part of PPE.
- Mechanisms to reduce vibration impact must be employed. This includes frequently rotating operators of grit blasting equipment and wearing of PPE such as vibration absorbing gloves.
- Hearing protectors as standard PPE for workers in situations with elevated noise levels.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- Health and Safety Regulations of the Labour Act and WHO Guidelines.
- Maintain a complaints register.
- Bi-annual report on complaints and actions taken to address complaints and prevent future occurrences.

10.1.13 Waste production

Various waste streams will result from the operational phase and development of the facility. Waste may include hazardous waste associated with the handling of hazardous products and contaminated packaging material (e.g. during operations and maintenance). Hull scraping and pressurised cleaning with water produces organic waste as well as water potentially contaminated with paint containing anti-biofouling chemicals such as tributyltin (TBT). Blast material consisting of used copper grit and dust of removed materials (i.e. paint, rust, etc.) are produced and is a potentially toxic waste that must be disposed of in an appropriate manner. Waste / dredged material accumulated by maintenance dredging activities to be stored at an adjacent inshore site until it can be discarded at the appropriate waste site. Domestic waste will be generated by the facility and related operations. Waste presents a contamination risk and when not removed regularly, may become a fire hazard. Contaminated soil and water is considered as a hazardous waste.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	Waste as a result of blasting material.	2	-2	2	2	2	-24	-3	Definite
Daily Operations	Waste as a result of maintenance dredging.	2	-2	2	2	2	-24	-3	Definite
Daily Operations	Waste of a domestic nature.	1	-1	1	1	1	-3	-1	Definite

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

Actions

Prevention:

- Waste reduction measures should be implemented and all waste that can be re-used / recycled must be kept separate.
- Ensure adequate temporary waste storage facilities are available.
- Ensure waste cannot be blown away by wind.
- Prevent scavenging (human and non-human) of waste.

Mitigation:

- Waste should be disposed of regularly and at appropriately classified disposal facilities, this includes hazardous material (empty chemical containers, contaminated rugs, paper, water and soil).
- Due to the potential toxic nature of blast material, it should be disposed of in an appropriate way at an appropriately classified waste disposal facility. Material Safety Data Sheet instructions for disposal should be followed.
- Due to the potential toxic nature of dredged sediments, it should be disposed of in an appropriate way at an appropriately classified waste disposal facility.
- Liaise with the municipality regarding waste and handling of hazardous waste.
- To prevent people from using potentially contaminated containers for transport or holding of drinking water, all containers that will be discarded must be crushed or punctured prior to disposal.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

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

10.1.14 Ecosystem and Biodiversity Impact

The nature of the operational activities is such that the probability of creating a habitat for flora and fauna to establish is low. No significant impact on the biodiversity of the area is predicted as the site is void of natural fauna and flora. Further impacts will mostly be related to pollution of the marine environment.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	Impact on fauna and flora. Loss of biodiversity	2	-1	3	2	2	-14	-2	Improbable

Desired Outcome: To avoid pollution of and impacts on the ecosystem and biodiversity.

Actions.

Mitigation:

- Report any extraordinary ecological sightings to the Ministry of Environment, Forestry and Tourism.
- Mitigation measures related to waste handling and the prevention of groundwater, surface water and soil contamination should limit ecosystem and biodiversity impacts.
- Avoid scavenging of waste by fauna.
- The establishment of habitats and nesting sites at the facility should be prevented where possible.

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Record any bird strikes and identify problem areas.
- All information of extraordinary ecological sightings to be included in a bi-annual report.

10.1.15 Water resources, Surface Water and Soil Contamination – Dry Dock Operations

The entire property is paved and blasting activities take place within a dry dock that is closed off using mesh. Dredging activities will disrupt the sediment, and the dredged material will be stored on an adjacent inshore site. Pollution of soil and surface water is thus likely. Dust that is not contained can reach sensitive receptors, like the nearby ocean, during times of strong wind. Oil, hydraulic fluid and fuel leaks from vehicles may also present a pollution risk.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	Waste water, blasting material, particulate matter and dust not being contained may end up in the ocean.	1	-1	3	2	2	-7	-1	Probable

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

Actions

Prevention:

- Regularly inspect and maintain all infrastructure, to minimize the chances of infrastructure failure.Training of operators must be conducted on a regular basis to limit product containment damage due to incorrect handling.

Mitigation:

- Clean-up action must be taken immediately for all instances where chemicals or dust is not contained (e.g. spillages and torn bags) or spillages occur (e.g. trucks leaking fuel or oil, or paints and solvents during construction, maintenance and painting of vessels)
- Proper containment of blasting dust, to mitigate dust blown into the surrounding environment.
- During blasting and spray painting mesh nets must be suspended at the front and rear ends of the dry dock to contain dust and spray paint.
- Grit blasting must be stopped if excessive dust plumes originate from the dry dock area.
- During blasting the thruster pit must be adequately covered to prevent any contaminants from entering the water in the pit that will eventually be pumped into the ocean.
- After grit blasting and before the dry dock is submerged the entire working platform must be cleaned to ensure no residue dust, grit and other contaminants enter the ocean.
- Monitoring must be conducted on a quarterly basis. Seawater samples must be collected, while blasting is in progress, as follow: One at Buoy 6 in the main entrance channel (control site); One within the harbour between the floating docks and Etosha Fishing, one at the seawater inlet at United Fishing, and one at the Syncrolift area.
- The following parameters should be investigated: Tributyltin, Cadmium (Cd), Mercury (Hg), Copper (Cu), Chrome (Cr), Lead (Pb), Zinc (Zn), Arsenic, Nickel, Barium (Ba), Beryllium (Be), Hydrocarbons and PAHs and Turbidity or suspended material.
- Updated chemicals of concern should be identified based on new antifouling paint content and grit used.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- The procedures followed to prevent environmental damage during service and maintenance, and compliance with these procedures, must be audited and corrections made where necessary.

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

10.1.16 Water resources, Surface Water and Soil Contamination - Dredging

Dredging can result in the excessive suspension of particulate matter in the water column. This may negatively affect aquatic organisms and seawater intakes. Excessive suspension of particulate matter in the water column can especially occur where very fine, diatomaceous oozes are present. Agitation of the seabed by the dredger, will be the main cause of suspension of particulate matter. The use of a plain suction dredger, and the disposal of sediments via a pipeline on land, will significantly reduce the suspension of sediments if operated correctly.

Impacts of increased suspension of such particulate matter include: reduced light penetration in the water column and thus reduced photosynthesis by algae resulting in less oxygen production; clogging of fish gills, inundation of benthic organisms when suspended particles settle to the seafloor; and increasing the bioavailability of toxic elements that may occur naturally in, or may have accumulated through anthropogenic impacts in, the substrate. Increased bioavailability of heavy metals like cadmium or lead for example, may result in reproductive abnormalities and reduced fertility, which may put the local food web at risk. It may also accumulate in organisms, especially filter feeders like mussels.

Various preventative and mitigating methods can be employed to prevent excessive suspension of particulate matter. Some of these are listed below, but it is important to note that not all of the modifications or procedures mentioned should necessarily be employed. It is the responsibility of the contractor, in consultation with the Proponent, to determine which modifications or procedures would best prevent particulate matter suspension, while keeping in mind operational timeframes and financial feasibility. Also, dredging techniques that result in lower suspension of particulate matter, that, as a result of the techniques required to lower such suspension occur over longer periods of time, may have more serious adverse effects. This is because acute, high level exposure to negative impacts may have less consequences than, chronic low level exposure.

Environmental conditions that may increase the risk of elevated total suspended solids reaching the sensitive receptors include: tidal conditions; rough sea conditions (high wave/swell action); wind conditions. Total suspended solids is determined through turbidity measurements (nephelometric turbidity units (NTU)) that can be converted to total suspended solids (mg/ml) through turbidity sensor calibration techniques.

Dredged material stored on the adjacent site will be contained in a trench with sand embankments. This allows water to seep back into the ocean. Should the embankments break, it will result in potential contaminated dredged sediment flowing back into the ocean, potentially in large volumes.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Dredging Operations	Sediment disturbed by dredging activities, contaminates the marine environment.	2	-2	3	2	2	-14	-3	Probable
Dredging Operations	Disposed dredged material contaminating soil.	1	-1	2	2	2	-6	-1	Probable

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

Actions

Prevention:

- Appointment of a reputable dredging contractor with a known history of environmental responsibility.

- Determine the baseline turbidity / TSS conditions at strategic locations throughout the harbour for at least one month prior to dredging. The results must serve as baseline for real time turbidity monitoring as indicated in the dredging contractors responsibility below.
- For any once-off dredging exercise targeting more than 5,000 m^3 of material, appoint an independent specialist to determine baseline water quality conditions by analysing for elevated levels of chemicals of concern (see list below).
- Prior to dredging, devise a turbidity monitoring and water sampling protocol, with the aim of providing information with regard to spread of suspended solids and contamination in the water column. The data generated must inform the dredging operator and Namport on the effectiveness of preventative and mitigation measures aimed at preventing the mobilisation and spread of particulate matter and contaminants. Real time turbidity monitoring can act as a warning system for situations where excessive suspension of particulate matter occur. As real-time water quality (chemicals of concern) monitoring is not possible, turbidity monitoring must act as a pro-active approach to prevent the spread of contaminants while chemical of concern monitoring, with delayed results, will serve to guide future dredging, rather than dictating current dredging.
- Continue the turbidity monitoring during dredging as per the dredging contractor's responsibility outlined below.
- Water samples must be analysed for at least: tributyltin (TBT), cadmium (Cd), mercury (Hg), copper (Cu), chromium (Cr), lead (Pb), zinc (Zn), arsenic (As), nickel (Ni), polychlorinated biphenyls (PCBs), total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAHs)
- The analysis must be carried out by an accredited laboratory, using suitable analytical methods with a detection limit below the current BCLME maximum limit values for the given parameter.
- Compare results with BCLME guidelines (if available) and compile baseline report.
- Repeat sampling and analysis during dredging as per the dredging contractor's responsibility outlined below.
- Appoint an independent consultant to conduct real-time turbidity (TSS) monitoring specifically aimed at protecting sensitive receptors (fish factory processing water abstraction points).
- The following TSS concentrations for the upper portion (-3 m) of the water column are recommended as threshold values for determining responses to real time monitoring:
  - < 20 mg/l or 80^{th} percentile of background levels – desirable low risk scenario.
  - 20 – 80 mg/l for continuous periods of three days or longer - lower threshold of possible adverse ecological effects.
  - 80 – 100 mg/l for more than six hours - probable adverse effects, mitigation measures must be considered.
  - 150 mg/l - proven negative impacts, cease dredge operations.
- The TSS of the water at monitoring locations must not exceed 80 mg/l or the 80^{th} percentile of the background TSS as determined by a baseline study, whichever is the highest value.
- Preventative measures used to reduce suspension of particulate matter include:
  - Using the most appropriate dredger and the dredgers most suitable draghead to reduce particulate matter suspension
  - Shielding of the suction head
  -
- Water sampling and analysis by an independent consultant has to be repeated as follows:
  - For less than 5,000 m^3 no water sampling required
  - Maintenance dredging: one water sample before and one water sample after dredging 10,000 m^3 dredged material, or part thereof.
- Water quality during dredging must be compared with baseline data and mitigation measures implemented if a deterioration in water quality, that is suspected to result from dredging activities, is discerned.

Mitigation:

- Mitigation measures used to prevent impacts resulting from suspended particulate matter include:
  - Slowing down the rate of dredging or ceasing dredging altogether when suspended solids reach a predetermined cut-off level (based on baseline results).
  - The use of silt curtains (not effective in strong currents)
- Coordinating dredging near sensitive receptors to coincide with tides, tidal currents and winds that will take plumes away from such receptors.

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

- The procedures followed to prevent environmental damage during service and maintenance, and compliance with these procedures, must be audited and corrections made where necessary.
- A report should be compiled of all dredging sampling and monitoring results.

10.1.17 Marine Impact

Toxic blasting material, particulate matter, waste water and dust entering the ocean and impacting on marine life.

Introduction of alien species through ballast water discharge. Benthic fauna will be displaced and destroyed. Birds may be disturbed by the activities however; this is perceived to be negligible. Marine mammals (especially seals) occur occasionally in the harbour, but not in numbers that will be cause severe impacts on the populations.

Dredging pose risks to marine life. Potential negative impacts of dredging include habitat destruction, smothering of benthic communities due to settling of suspended particulate matter, possible temporary displacement of animals (including birds) from the areas that are dredged, marine mammal strikes by the vessels or their propellers, and reduced water quality due to the suspension of particulate matter or through pollution.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	Toxic blasting material, particulate matter, waste water and dust entering the ocean and impacting on marine life	4	-2	2	2	3	-56	-4	Highly Probable
Daily Operations	Dredging may displace and destroy benthic habitats. Birds may be disturbed by the activities	3	-2	2	2	3	-42	-4	Highly Probable

Desired Outcome: To mitigate adverse effects to the surrounding marine environment as much as practically possible.

Actions:

Prevention / Mitigation:

- Due to the potential toxic nature of spray paint and dust created, its dispersion in the air should be mitigated as much as practically possible.
- Mesh netting to enclose the front and rear ends of the docks must be used at all times.
- Grit blasting and spray painting must be stopped when wind speeds are high enough to disperse spray paint and dust to nearby receptors (e.g. ocean).
- Alternative blasting techniques such as wet blasting or centrifugal shot blasting should be used in areas where dispersion of dust cannot be prevented.
- The World Health Organization - Hazard prevention and control in the work environment: Airborne dust (WHO, 1999) should be consulted.
- Follow procedures of International Maritime Organization (IMO): The International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention).
- On ship treatment of Ballast Water can also take place on ships already fitted with treatment plants, via two step treatment processes recommended in IMO guidelines and relevant published information on Ballast Water Treatment methods.
- It is advised that all guidelines in the IMO are followed strictly with regards to both Ballast Water Exchange and Ballast Water Treatment to ensure minimal introduction of invasive species.
- Clearly define the area to be dredged and monitor the dredging contractor’s adherence to dredging only this area in order to minimize the impact footprint.
- Limit dredging and disposal to within the boundaries of the areas defined by the Proponent.

- If any mortalities in marine fauna are observed at or around the dredging location, all dredging activities should be ceased and the cause investigated. Dredging can continue once it is determined to be safe to do so.

Responsible Body:

- Proponent
- Contractor

Data Sources and Monitoring:

- NAMDOCK must collect and keep a 1 kg sample of spent grit blasting material from each ship being blasted for future analysis if required.
- A surface water and sediment sampling regime must be undertaken quarterly to monitor the condition of the environment.
- A once-off water analysis regime must be performed to analyse pressure cleaning water collected in ballast tanks before such water is released into the ocean. This will determine whether this practice should be allowed to continue.
- All monitoring data must be included in a Bi-annual environmental monitoring report.

10.1.18 Visual Impact

This is an impact that not only affects the aesthetic appearance, but also the integrity of the facility. The site is within an area zoned for port use. The development of the site is in line with the port character.

Project Activity / Resource	Nature (Status)	(A1) Importance	(A2) Magnitude	(B1) Permanence	(B2) Reversibility	(B3) Cumulative	Environmental Classification	Class Value	Probability
Daily Operations	This is an impact that affects the aesthetic appearance.	1	-1	3	2	2	-7	-1	Probable

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

Actions

Mitigation:

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

Responsible Body:

- Proponent
- Contractors

Data Sources and Monitoring:

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

10.1.19 Cumulative Impact

These are impacts on the environment, which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of who undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time. In relation to an activity, it means the impact of an activity that in itself may not be significant, may become significant when added to the existing and potential impacts resulting from similar or diverse activities or undertakings in the area.

Possible cumulative impacts associated with the operational phase include increase in noise and dust as a result of ship repair at the NAMDOCK Dry Docks as well as the Syncrolift and other industrial properties nearby. The industrial activity and ship repair may also lead to a cumulative impact on the marine environment in terms of pollutants entering the water. The cumulative effect of lighting on birds due to industrial developments may increase the risk of collisions and interference with bird flight paths at night.

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

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

Actions

Mitigation:

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

Responsible Body:

- Proponent

Data Sources and Monitoring:

- Review bi-annual summary reports based on all other impacts to gain an overall assessment of the impact of the operational phase.

10.2 Impact Summary

As depicted in the tables above, impacts related to the operational phase are expected to mostly be of medium to high significance but can mostly be mitigated to have a low significance. The extent of impacts are mostly site specific to local and are not of a permanent nature. Due to the nature of the surrounding areas cumulative impacts are possible and include noise and visual impact should the facility not be maintained. The EMP will ensure that the impacts of the operational phase are minimised and include measures to reduce the identified impacts during operations of the facility. All operational personnel should be made aware of the content of this report so as to plan the operations accordingly

10.3 Decommissioning and Rehabilitation

Closure and decommissioning of the floating dry docks, as a whole, is not foreseen during the validity of the environmental clearance certificate, or in the near future. However, it possible that certain components of the project may be decommissioned or replaced at a later stage. Decommissioning is therefore included for this purpose as well as the fact that construction activities may also include modification and decommissioning of infrastructure. Future land use after decommissioning should be assessed prior to decommissioning and rehabilitation initiated if the land will not be used for similar future purposes. Should decommissioning occur at any stage, rehabilitation of the area may be required. Decommissioning will entail the complete removal of all infrastructure including buildings and support infrastructure. Any pollution present on the site must be remediated. The impacts associated with this phase include noise and waste production as structures are dismantled. Noise must be kept within Health and Safety Regulations of the Labour Act and/or WHO standards. Waste should be contained and disposed of at a dedicated waste disposal site and not dumped in the surrounding areas. Implementation of the waste management plan for especially the disposal of contaminated products will be paramount. The EMP and waste management plan for the project will have to be reviewed at the time of full decommissioning to cater for changes made to the site and to implement any update guidelines and mitigation measures.

11 CONCLUSION

NAMDOCK contribute locally to employment opportunities for both locals and contractors. Skills transfer and training develop the local workforce during ship repair and maintenance activities as well as dredging.

The EMP should be used as an on-site reference document for operations. Parties responsible for transgressing of the EMP should be held responsible for any rehabilitation that may need to be undertaken. NAMDOCK could use an in-house Health, Safety, Security and Environment Management System in conjunction with the EMP. Operational personnel must be taught the contents of this document.

Noise pollution should meet the minimum requirements of the Health and Safety Regulations of the Labour Act and/or World Health Organization to prevent hearing loss and not to cause a nuisance to nearby receptors. The generation and dispersal of dust should be minimized and personnel must be issued with PPE including dust masks. Contaminated water, spent blasting grit, particulate matter and dust must be prevented from entering the ocean.

In terms of dredging, the contractor must adhere to the laws and regulations governing the maritime industry. The dredging vessel(s) must be equipped with the necessary technological features designed to minimize negative impacts. This include air quality monitoring equipment to detect hydrogen sulphide released from dredged material and devices and measures to reduce suspension of particulate matter in the water column. The latter can be physical modifications to the dredger to for example reduce seafloor substrate agitation or procedural methods such as minimizing dredging speed, duration or location during specific conditions.

Health and safety regulations should be adhered to in accordance with the regulations pertaining to relevant laws and internationally accepted standards of operation.

Any waste produced must be removed from site and disposed of in an appropriate way or re-used or recycled where possible. Hazardous waste must be disposed of at an approved hazardous waste disposal site.

Monitoring as indicated in the EMP is crucial and based on monitoring results alternative methods and techniques may have to be investigated and implemented.

12 REFERENCES

Bray N.and Cohen.M. 2004. Dredging for development. International Association of Dredging Companies

Kimera, D and Fillemon N, N. 2020. Improving ship yard ballast pumps' operations: A PCA approach to predictive maintenance. Maritime Transport Research. 1. 100003. 10.1016/j.martra.2020.100003

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

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

Eke C. C, Frank U. P., Ahaji V. K., Ezeh P., Amadi C. C. and Okeke O. C. 2023. Dredging of Harbours and Rivers: Review of Practices and Associated Environmental Impacts. IIARD International Journal of Geography & Environmental Management (IJGEM) Vol. 9 No. 5 2023

Faul A, Botha P, Coetzer W. 2022. Update on the Environmental Impact Assessment for the Capital and Maintenance Dredging of Walvis Bay Harbour

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

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

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

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

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

http://www.airbestpractices.com/industries/metals/industrial-sandblasting-%E2%80%93-where-does-all-air-go accessed 22 April 2015

https://www.osha.gov/dts/maritime/standards/guidance/shipyard_guidance.html#ref4 accessed 22 April 2015

Van Bloois, Frumau, 2009. SS. Ocean Mining: Deep Sea Mining: A New Horizon for Dredging Technology. In Offshore Technology Conference (pp. OTC-20047).

Appendix A: Chemical Analysis of Spent Grit (Copper Slag)

Sample #	GPTN2306	Maximum	Guideline 1	Guideline 2
Media	Soil	Values	BCLME Soil RECOMMENDED GUIDELINE VALUES	BCLME Soil PROBABLE EFFECT CONCENTRATION
Job	G47-1			
Source	G47-1/Grit			
Depth (m)	0			
Sample method	Grab			
Lab ID	16842			
Sample Date	11-Sep-2014			
Analysis Date	22-Sep-2014			
Units	(ppm)	(ppm)	(ppm)	(ppm)
Total Petroleum Hydrocarbons (analysed)	154	154	No Value	No Value
Acenaphthylene	0.064	0.064	No Value	No Value
Anthracene	0.4	0.4	0.0469	0.245
Arsenic (As)	20	20	7.24	41.6
Benzo(a)pyrene	0.003	0.003	0.0888	0.763
Benzo(g,h,i)perylene	<0.00001		No Value	No Value
Benzo(k+b)fluoranthene	0.341	0.341	No Value	No Value
Beryllium	1	1	No Value	No Value
Cadmium	1	1	0.68	4.21
Chromium (Cr)	22000	22000	52.3	160
Copper	14000	14000	18.7	108
Dibenz(a,h)anthracene	<0.00001		0.00622	0.135
Ethylbenzene	5.2	5.2	No Value	No Value
Fluoranthene	0.08	0.08	0.113	1.494
Fluorene	0.007	0.007	0.0212	0.144
Indeno (1,2,3CD) pyrene	0.186	0.186	No Value	No Value
Lead	300	300	30.2	112
Mercury	4	4	0.13	0.7
MTBE	<5		No Value	No Value
Naphthalene	0.126	0.126	0.0346	0.391
Nickel	1500	1500	15.9	42.8
Phenanthrene	1.353	1.353	0.0867	0.544
Pyrene	0.064	0.064	0.153	1.398
TAME	<5		No Value	No Value
Tributyltin (TBT) as Sn	150	150	0.005	0.07
Toluene	<10		No Value	No Value
C9 (n-nonane)	<1		No Value	No Value
C10 (n-decane)	<1		No Value	No Value
C11 (n-undecane)	<1		No Value	No Value
C12 (n-dodecane)	<1		No Value	No Value
C13 (n-tridecane)	<1		No Value	No Value
C14 (n-tetradecane)	<1		No Value	No Value
C15 (n-pentadecane)	<1		No Value	No Value
C16 (n-hexadecane)	<1		No Value	No Value
C17 (n-heptadecane)	<1		No Value	No Value
C18 (n-octadecane)	<1		No Value	No Value
C19 (n-nonadecane)	<1		No Value	No Value
C20 (n-eicosane)	<0.01		No Value	No Value
C22 (n-docosane)	<0.01		No Value	No Value
C24 (n-tetracosane)	<0.01		No Value	No Value
C25 (n-pentacosane)	<0.01		No Value	No Value
C26 (n-hexacosane)	<0.01		No Value	No Value
TPH Aliphatic (C10-12)	<1		No Value	No Value
TPH Aliphatic (C12-16)	<1		No Value	No Value
TPH Aliphatic (C16-35)	<1		No Value	No Value
Xylenes	30	30	No Value	No Value
Zinc	700	700	124	271

Values in VIOLET exceed Guideline Value 1

Values in RED exceed Guideline Value 2

Appendix B: Chemical Analysis of Effluent Water Samples

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P. O. Box 86782, Windhoek, Namibia

TEST REPORT I240964/1

To: **NamDock**
P.O.Box 2840
Walvis Bay

Date received: 08/May/24
Date analysed: 08 - 17 May 2024
Date reported: 20/May/24

Attn: Jonas Kamati
e-mail: jonas.kanati@namdock.com
Tel: 081-140 6515

Client Reference no.: Verbal
Quotation no.: QUA-80859
Lab Reference: I240964
Enquiries: Ms Helena P. Daniel

Sample details	Effluent
Location of sampling point	NamDock 3
Description of sampling point	EW3
Date of sampling	2024/05/07; 12h55
Test item number	I240964/1

				Recommended maximum limits Human consumption			
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**Livestock watering**
p H	**7.9**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**174.1**	**mS/m**	B	150	300	400	
Turbidity	**2816**	**NTU**	D	1	5	10	
Total Dissolved Solids (calc.)	**1092**	**mg/l**					6000
Total Suspended Solids	**1340**	**mg/l**					
P-Alkalinity as $CaCO_3$	**<10**	**mg/l**					
Total Alkalinity as $CaCO_3$	**225**	**mg/l**					
Total Hardness as $CaCO_3$	**497**	**mg/l**	B	300	650	1300	
Ca-Hardness as $CaCO_3$	**312**	**mg/l**	A	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**185**	**mg/l**	A	290	420	840	2057
Chloride as Cl^-	**256**	**mg/l**	B	250	600	1200	1500-3000
Fluoride as F^-	**0.1**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**306**	**mg/l**	B	200	600	1200	1000
Nitrate as N	**3.4**	**mg/l**	A	10	20	40	100
Nitrite as N	**0.09**	**mg/l**					10
Sodium as Na	**192**	**mg/l**	B	100	400	800	2000
Potassium as K	**18**	**mg/l**	A	200	400	800	
Magnesium as Mg	**45**	**mg/l**	A	70	100	200	500
Calcium as Ca	**125**	**mg/l**	A	150	200	400	1000
Manganese as Mn	**0.31**	**mg/l**	B	0.05	1.0	2.0	10
Iron as Fe	**22**	**mg/l**	D	0.1	1.0	2.0	10
Stability pH, at 25°C	**7.1**						
Langelier Index	**0.8**	scaling		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**6.2**	scaling		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**3.0**	increasing corrosive tendency		Applies to water in the pH range 7-8 which also contains dissolved oxygen ratios <0.2 no corrosive properties ratios >0.2 increasing corrosive tendency			

Approved Technical Signatory
Ms. Helena Daniel

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P. O. Box 86782, Windhoek, Namibia

TEST REPORT I240964/1

To: **NamDock**
P.O.Box 2840
Walvis Bay

Date received: 08/May/24
Date analysed: 08 - 17 May 2024
Date reported: 20/May/24

Attn: Jonas Kamati
e-mail: jonas.kanati@namdock.com
Tel: 081-140 6515

Client Reference no.: Verbal
Quotation no.: QUA-80859
Lab Reference: I240964
Enquiries: Ms Helena P. Daniel

Sample details	Effluent
Location of sampling point	NamDock 3
Description of sampling point	EW3
Date of sampling	2024/05/07; 12h55
Test item number	I240964/1

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
Fat, oil & grease	**38**	**mg/l**					
Chemical Oxygen Demand as O_2	**1370**	**mg/l**					
Cyanide as CN^-	**0.02**	**mg/l**	A	0.2	0.3	0.6	≤0.07
Copper as Cu	**0.28**	**mg/l**	A	0.5	1	2	≤2
Zinc as Zn	**28.00**	**mg/l**					≤5
Cadmium as Cd	**0.01**	**mg/l**		0.01	0.02	0.04	≤0.003
Lead as Pb	**1.1**	**mg/l**	D	0.05	0.1	0.2	≤0.01
Aluminium as Al	**42**	**mg/l**	D	0.15	0.5	1.0	

TPH results 1):		
GRO C6-C10	**3700**	**ug/l**
TPH C10-C28	**750**	**ug/l**
TPH C28-C40	**<382**	**ug/l**
TPH C10-C40	**<382**	**ug/l**

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TEST REPORT I240964/1

Remark: Overall classification of water, considering only constituents that have been tested for:
Group D: high risk or water unsuitable for human consumption
[1] outsourced to EPL, SA

Interpretation based on guidelines for the evaluation of drinking water for human consumption, DWA, Namibia, April 1988 and South African Water Quality Guidelines Volume 5: Agricultural water use: Livestock watering, Second Edition, 1996

For practical reasons, the guidelines are divided into four groups.
The highest group assigned to any of the constituents determines the classification of the water as a whole.
Group A: excellent quality water
Group B: good quality water
Group C: low risk water
Group D: high risk or water unsuitable for human consumption

Ideally water should be either Group A or Group B. If water is classified as Group C, the situation is not yet critical, but attention should be given to those constituents over the Group B limit. If however, the water is classified as Group D urgent and immediate attention is required to reduce the levels of the problem constituents in the water to suitable levels.

Sample acceptance: Sample was collected in bottles provided by the laboratory.
Sample was suitable for testing

Approved Technical Signatory
Ms. Helena Daniel

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TEST REPORT I240964/1

Assessment of water quality for human consumption

Naturally occurring chemicals that are of health significance in drinking water
Fluoride: Exposure to high levels of fluoride, which occurs naturally, can lead to mottling of teeth and, in severe cases, crippling skeletal fluorosis.
0-1.0 mg/l fluoride: no adverse health effects or tooth damage occurs

Chemicals from agricultural activities that are of health significance in drinking water
Nitrate and nitrite: In water it has been associated with methaemoglobinaemia, especially in bottle-fed infants
0-6 mg/l nitrate as N: no adverse health effects

Some of the naturally occurring chemicals which occur in drinking water at concentrations below those at which toxic effects may occur.
Chloride: high concentrations of chloride give a salty taste to water. Concentrations in excess of 250 mg/l are increasingly likely to be detected by taste.
Hardness: Depending on the interaction of other factors, such as, pH and alkalinity, water with a hardness above approximately 200 mg/l may cause scale deposition in the pipe work and tanks. On heating, hard waters form deposits of calcium carbonate scale.
pH: Optimum pH 6.5-8.
pH does not exert direct health effects, but may exert indirect health effects via metal solubility.
Sodium: The average taste threshold for sodium is about 200 mg/l.
Sulphate: It is generally considered that the taste impairment is minimal at levels below 250 mg/l.
Magnesium: The average taste threshold for magnesium is about 70 mg/l
Total dissolved solids: The palatability of water with a TDS level of less than 600 mg/l is generally considered to be good; drinking water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000 mg/l.

Turbidity is a measure of the light-scattering ability of water and is indicative of the concentration of suspended matter in water.
Microorganisms are often associated with turbidity, hence low turbidity minimises the potential for transmission of infectious diseases. Turbidity also affects the aesthetic quality of water.
Turbidity in water is caused by the presence of suspended matter which usually consists of a mixture of inorganic matter, such as clay and soil particles and organic matter.
Turbidity may also be associated with the presence of inorganic ions such as manganese(II) and iron(II).
The consumption of turbid water *per se* does not have any direct health effects, but associated effects due to microbial contamination or the ingestion of substances bound to particulate matter, do.
Aesthetic effects (appearance, taste, odour) of turbidity can be mitigated or removed by decantation or by filtration (or by both), accelerated, if necessary, by previous aeration

Approved Technical Signatory
Ms. Helena Daniel

Appendix C: ISO Certificates

ISO 45001:2018

bsi.

Certificate of Registration

OCCUPATIONAL HEALTH & SAFETY MANAGEMENT SYSTEM - ISO 45001:2018

This is to certify that:

Namibia Drydock & Ship Repair (Pty) Ltd
(Namdock)
2nd Street East
WalvisBay
Namibia

Holds Certificate No: **OHS 641727**

and operates an Occupational Health and Safety Management System which complies with the requirements of ISO 45001:2018 for the following scope:

Ship and vessel repairs, including floating docks and workshops.

Previously certified for OHSAS 18001 since 20/12/2015

For and on behalf of BSI:

Andrew Launn, EMEA Systems Certification Director

Original Registration Date: 2022-06-17
Latest Revision Date: 2022-06-17

Effective Date: 2022-06-17
Expiry Date: 2025-06-16

Page: 1 of 1

...making excellence a habit.™

This certificate was issued electronically and remains the property of BSI and is bound by the conditions of contract.
An electronic certificate can be authenticated online.
Printed copies can be validated at www.bsigroup.com/ClientDirectory

Information and Contact: BSI, Kitemark Court, Davy Avenue, Knowlhill, Milton Keynes MK5 8PP. Tel: + 44 345 080 9000

BSI Assurance UK Limited, registered in England under number 7805321 at 389 Chiswick High Road, London W4 4AL, UK.

ISO 9001:2015

ABS Quality Evaluations

Certificate Of Conformance

This is to certify that the Quality Management System of:

Namibia Drydock & Ship Repair (Pty) Ltd (NAMDOCK)

2nd Street East, Synchrolift Industrial Area

Walvis Bay

Namibia

(WITH ADDITIONAL FACILITIES LISTED ON ATTACHED ANNEX)

has been assessed by ABS Quality Evaluations, Inc. and found to be in conformance with the requirements set forth by:

ISO 9001:2015

The Quality Management System is applicable to:

THE PROVISION OF SHIP REPAIR AND MARINE ENGINEERING SERVICES

This certificate may be found on the ABS QE Website (www.abs-qe.com). For certificates issued in the People's Republic of China information may also be verified on the CNCA website (www.cnca.gov.cn).

Certificate No:	50596
Certification Date:	06 November 2014
Effective Date:	18 October 2023
Expiration Date:	23 October 2026
Revision Date:	18 October 2023

Dominic Townsend, President

Validity of this certificate is based on the successful completion of the periodic surveillance audits of the management system defined by the above scope and is contingent upon prompt,written notification to ABS Quality Evaluations, Inc. of significant changes to the management system or components thereof.

ABS Quality Evaluations, Inc. 1701 City Plaza Drive, Spring, TX 77389, U.S.A.

Validity of this certificate may be confirmed at www.abs-qe.com/cert_validation.

Page 1 of 2

ABS Quality Evaluations

ISO 9001:2015

Certificate Of Conformance

ANNEX

Certificate No: 50596

Namibia Drydock & Ship Repair (Pty) Ltd (NAMDOCK)
At Below Facilities:

Facility:	Namdock Site - Head Office 2nd Street East, Synchrolift Industrial Area Walvis Bay Namibia	Facility:	Namdock Site - Docks EBH Floating Docks, Synchrolift Industrial Area Walvis Bay Namibia
Activity:	The provision of ship repair and marine engineering services	Activity:	Ship repair

Validity of this certificate may be confirmed at www.abs-qe.com/cert_validation.

Page 2 of 2

Appendix D: Curriculum Vitae

ENVIRONMENTAL SCIENTIST **André Faul**

André entered the environmental assessment profession at the beginning of 2013 and since then has worked on more than 220 environmental impact assessments and related environmental reports, including assessments for the petroleum industry, harbour expansions, irrigation schemes, township establishment and power generation and transmission. André's post graduate studies focussed on zoological and ecological sciences and he holds a M.Sc. in Conservation Ecology and a Ph.D. in Medical Bioscience. His expertise is in ecotoxicological related studies focussing specifically on endocrine disrupting chemicals. His Ph.D. thesis title was The Assessment of Namibian Water Resources for Endocrine Disruptors. Before joining the environmental assessment profession he worked for 12 years in the Environmental Section of the Department of Biological Sciences at the University of Namibia, first as laboratory technician and then as lecturer in biological and ecological sciences.

CURRICULUM VITAE ANDRÉ FAUL

Name of Firm	:	Geo Pollution Technologies (Pty) Ltd.
Name of Staff	:	ANDRÉ FAUL
Profession	:	Environmental Scientist
Years' Experience	:	23
Nationality	:	Namibian
Position	:	Environmental Scientist
Specialisation	:	Environmental Toxicology
Languages	:	Afrikaans – speaking, reading, writing – excellent English – speaking, reading, writing – excellent

First Aid Class A	OSH-Med 2022
Basic Fire Fighting	OSH-Med 2022

EDUCATION AND PROFESSIONAL STATUS:

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

PROFESSIONAL SOCIETY AFFILIATION:

Environmental Assessment Professionals of Namibia (Environmental Practitioner)

AREAS OF EXPERTISE:

Knowledge and expertise in:

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

EMPLOYMENT:

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

PUBLICATIONS:

Publications:	5
Contract Reports:	+220
Research Reports & Manuals:	5
Conference Presentations:	1