ENVIRONMENTAL MANAGEMENT PLAN (EMP)

EXISTING AND OPERATIONAL UNIVERSITY OF NAMIBIA MARICULTURE RESEARCH FACILITY (SANUMARC)

Portion 70 of the farm of Henties Bay Townland No. 133

Assessed by:

NYEPEZ CONSULTANCY CC

Assessed for:

University of Namibia (Dr. Nujoma Campus) Mariculture facility
P.O Box 462, Henties Bay
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July 2023

ACRONYMS/GLOSSARY

EA	Environmental Assessment
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EMA	Environmental Management Act
ESMP	Environmental and Social Management Plan
ESMMP	Environmental & Social Mitigation Management Plan
MoE	Ministry of Education
MoE	Ministry of Environment & tourism
CBNRM	Community Based Natural Resource Management
SANUMARC	Sam Nujoma UNAM Campus houses both the Sam Nujoma Marine and Coastal Resources Research Centre

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CHAPTER ONE
GENERAL INTRODUCTION

1.1 Introduction

University of Namibia (Sam Nujoma Campus) is the proponent and developer of the existing and operational Mariculture research facility and the freshwater lab where researchers conduct experiments on live organisms ranging from Marine and Freshwater Finfish, Shellfish, Macro and Micro Algae, Zooplankton, Benthic organisms, Microbes, and other aquatic organisms. The facility/facilities are equipped with standard aquaculture equipment that maintain water quality, the labs are segmented and provide necessary environment for various aquatic organisms. The Mariculture facility extracts seawater from the PVC pipes with slits that are buried 2 meters under the beach sand, seawater is then pumped into the 10 X 10 000L reservoir tanks before being utilized in the facility.

The Sam Nujoma UNAM Campus houses both the Sam Nujoma Marine and Coastal Resources Research Centre (SANUMARC) and the Department of Fisheries and Aquatic Sciences (DFAS). The Sam Nujoma Marine and Coastal Resources Research Centre (SANUMARC) is a fully-fledged Research Centre of the University of Namibia, with the mandate to promote research and development activities in the field of Marine Science and Coastal Resources. The Campus offers students a tranquil learning environment close to the ocean

It is therefore required by the appointed EAP to conduct Scoping and/or Environmental Management plan for the Mariculture facility in order to obtain an Environmental Clerance Certificate (ECC). The ECC is required to renew the licence for the mariculture aquaculture facility that expired on 1st February 2021. Aquaculture License is a legal document that authorize the Sam Nujoma Campus to keep live lab specimen

It therefore further required as per the Environmental Act no. 7 of 2007 that a scoping report and/or an updated (complainant) Environmental Management Plan be crafted and submitted to the Ministry of Environment, Forest & Tourism for approval. The compliance

EMP report detailing all environmental, physical changes and impacts is thus required for completion and submition to the Ministry through the office of the Environmental Commissioner for approval. Hence this submission.

University of Namibia (Dr. Nujoma Campus) Mariculture facility

REPUBLIC OF NAMIBIA

MINISTRY OF FISHERIES AND MARINE RESOURCES
(Aquaculture Licensing Regulation 3, Annexure B)

Aquaculture Licence issued under the Aquaculture Act, 2002 (Act No 18 of 2002)

Name of Licensee: Dr Sam Nuyoma Marine and Coastal Research Center.
Licence Number: HENTIES BAY 0052-06
Date of Issue: 1st FEBRUARY 2006

The person or entity described in this licence is licensed in accordance with the Aquaculture Act, to engage in the type of aquaculture in such parts of Namibia or Namibian waters as described below, for the period described in this licence and in accordance with the terms and conditions set out in the Aquaculture Act and the conditions set out in this licence.

1. The name and business address of the licence holder;
   Prof O Mwandemele, Dr Sam Nuyoma Marine and Coastal Research Center, P O Box 462, Henties Bay.

2. Location, size and description of the site at which the aquaculture is authorized;
   South of Henties Bay. The area designated by the Town Council for aquaculture purposes. An area of 15ha.
   North of Henties Bay at the Dr Sam Nuyoma Marine and Coastal Research Center.

3. The aquatic organism to be cultivated and type of grow out system to be used to which the authorization applies;
   All marine species to be farmed with for research purposes.
   Ponds, tanks and aquaria.

4. The maximum annual production authorized (number of weight);
   For research purposes.

5. The source of water supply at the aquaculture facility;
   Ocean water.

5. The source of water supply at the aquaculture facility;

Ocean water pumped onshore.

6. The composition and annual, quantity of any effluent to be discharged from the aquaculture facility.

No effluent containing toxins or environmental pollutants should be discharged back to the ocean. Discharge sea water should be filtered through and gravel/sand filter prior to be pumped back to the ocean.

CONDITIONS OF LICENCE

A. This licence is to be utilised within the Aquaculture Act and Regulations.

B. To abide by conditions laid down by Henties Bay Town Council pertaining to the abstraction and discharge of sea water.

7. Notifications required.

Any changes to the company and ownership of this licence, the site and effluent discharges, should be communicated to the office of the Permanent Secretary, Ministry of Fisheries and Marine Resources.

PERIOD OF VALIDITY

Subject to the Aquaculture Act, and the Regulations made there under, this licence is valid from 1st day of February 2006, to the 1st February day of February 2021.

Dr Abraham Iyambo
MINISTER

DATE

MINISTRY OF FISHERIES+MARINE RESOURCES
2006 -02- 01

Figure 1: Research facility expired operating license

1.2 Project area location jurisdiction

The Sam Nujoma Campus, a thriving residential campus, is situated on portion 70 of the farm of Henties bay townland no. 133, on a 100-ha site located north of Henties Bay, on dunes overlooking the ocean and the Omaruru Riverbed. The mariculture facility section is part of the integrated existing development, embedded structural building and infrastructure facility established within the 100 hectares. The research facility covers only 15 hectares of the entire portion of land currently developed by the University of Namibia's Sam Nujoma Campus. As a result, the remaining 75 hectares of land allocated for the University has not been fully developed. This undeveloped portion of land is earmarked for the University's Campus future growth and expansion

Henties Bay is a coastal town in the Erongo Region, located in western Namibia. It is located 70 km north of Swakopmund and is an important holiday destination. The seal colony of Cape Cross is 70 kilometres to the north of the town.

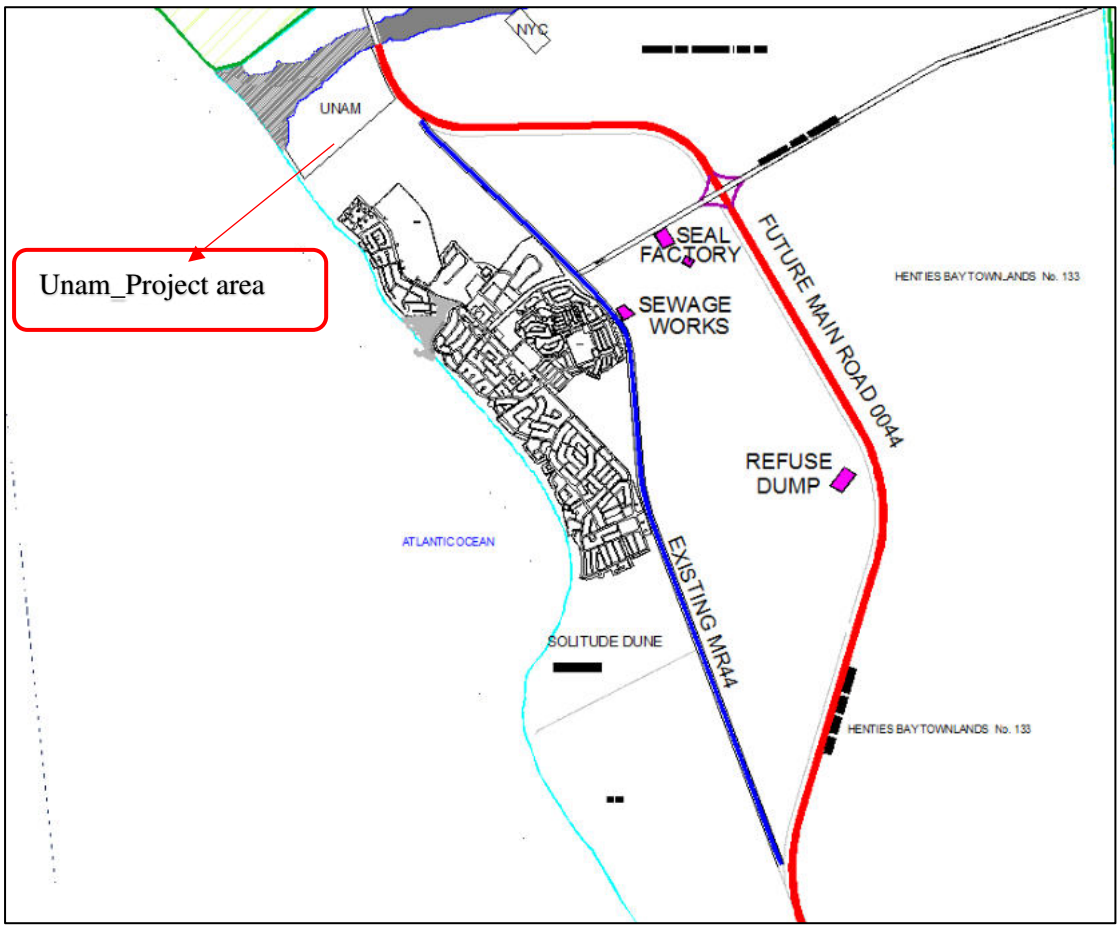


Figure 2: *project area locality map*

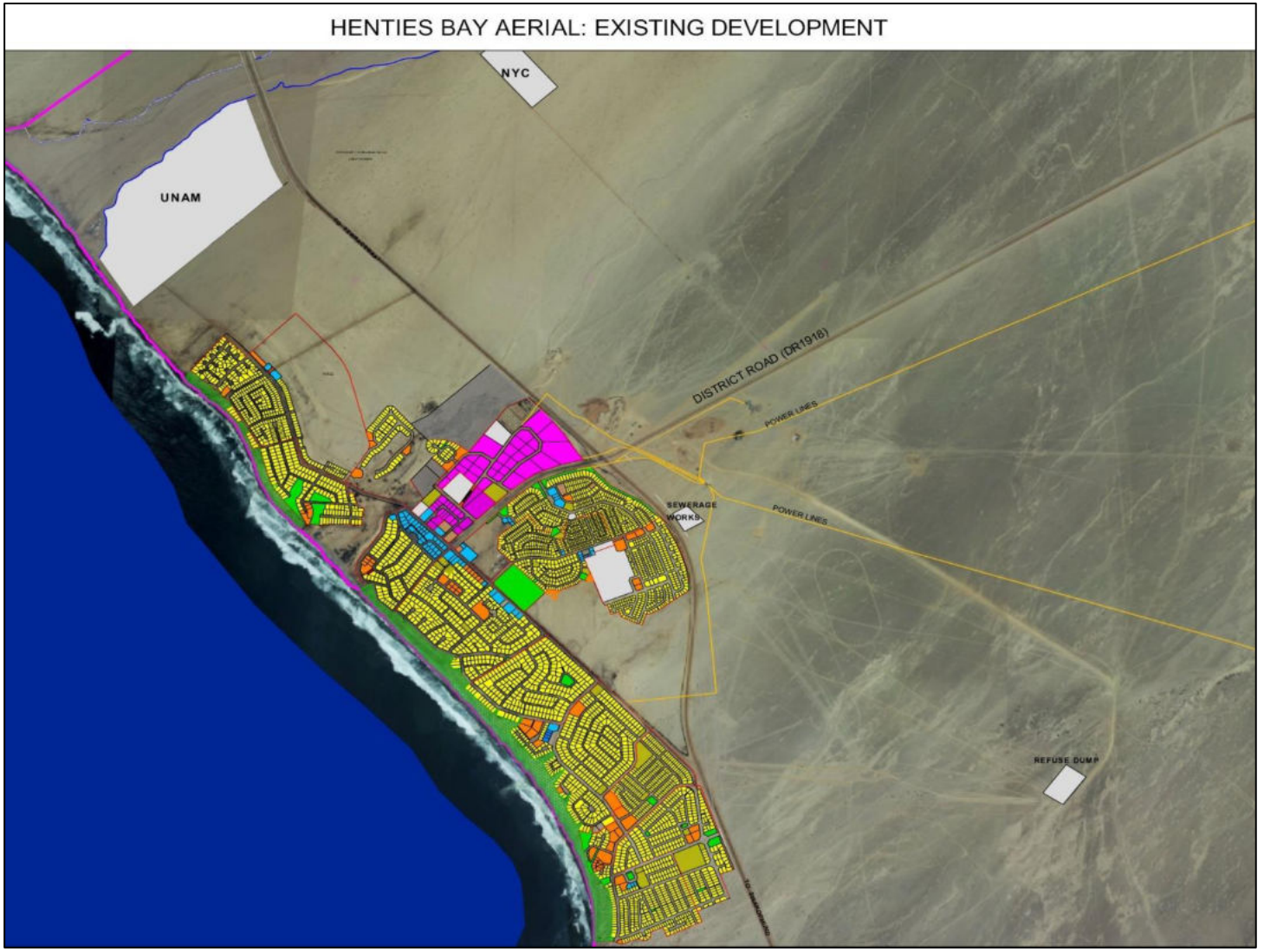
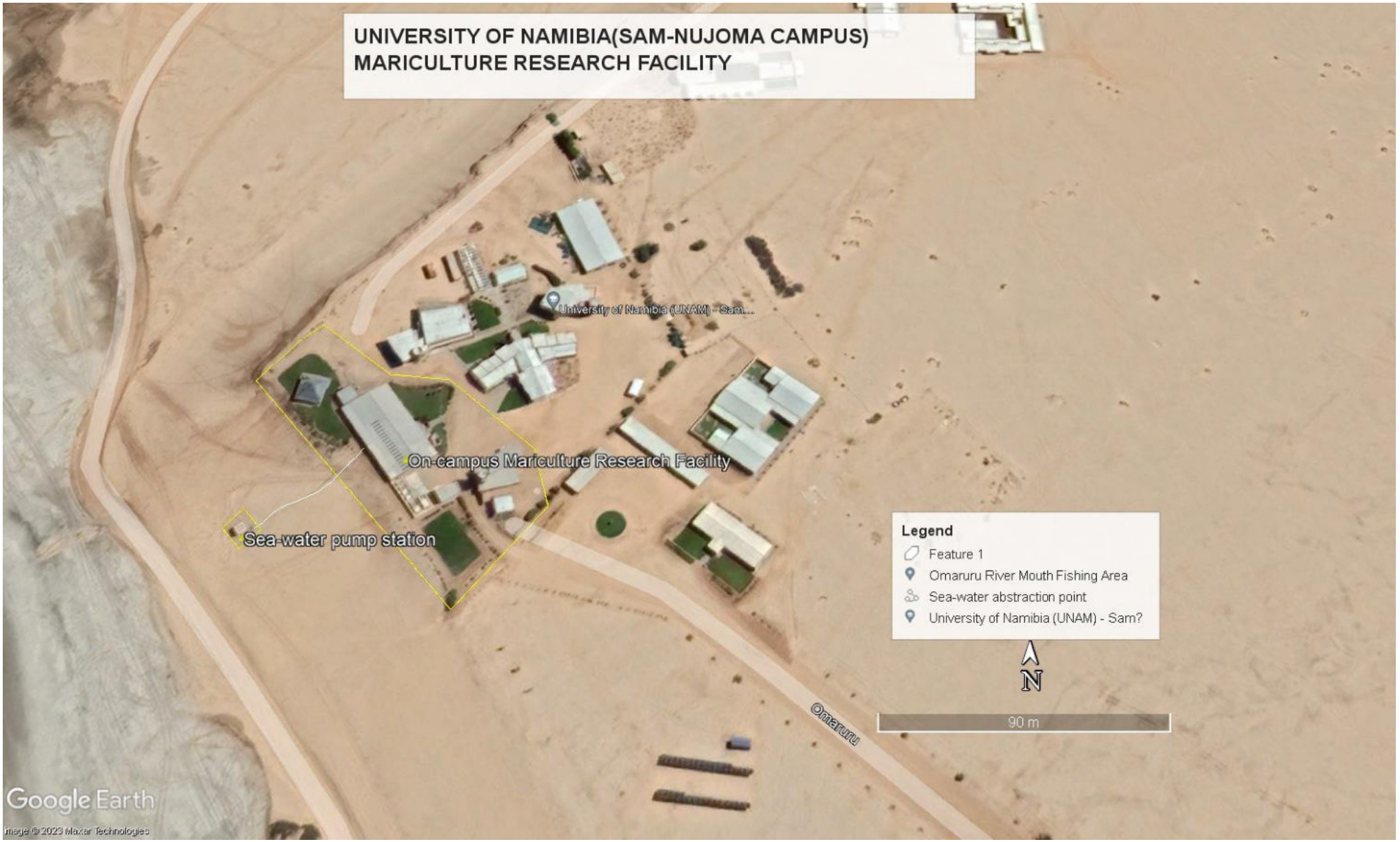


Figure 3: *Project area locality & zoning map*


UNIVERSITY OF NAMIBIA(SAM-NUJOMA CAMPUS)
MARICULTURE RESEARCH FACILITY
University of Namibia (UNAM) - Sam...
On-campus Mariculture Research Facility
Sea-water pump station
Legend
Feature 1
Omaruru River Mouth Fishing Area
Sea-water abstraction point
University of Namibia (UNAM) - Sam?
N
90 m
Omaruru
Google Earth
Image © 2023 Maxar Technologies

1.3 Objectives of the Assignment

The objectives of the Assignment per the Terms of Reference (ToR) were to develop:

- To produce a Scoping Report or Detailed updated EMP Report, which should provide sufficient information to enable the Directorate of Environmental Affairs (DEA) at Ministry of Environment, Forestry and Tourism (MEFT) to make an informed decision.
- To report and provide relevant and applicable environmental data on environmental changes, impact and mitigations measures for the mariculture facility to the DEA and Campus management
- To obtain the Environmental Clearance Certificate for the mariculture facility at University of Namibia, Sam Nujoma campus, Henties Bay.

1.4 Scope of Work

The scope of work included the following:

a) Identification of environmental and social impacts.

b) Description of the characteristics of the impacts - magnitude, distribution, duration, significance and who will be affected.

c) Proposed mitigation and management measures.

d) Proposed Environmental and Management Plan (EMP) which defines specific actions for mitigations, appropriate monitoring indicators, frequency of monitoring, person(s) responsible for the task and costs.

1.5 Justification for the EMP

The EMP, a mitigative plan for impacts created as a result of development interventions has its precedence from several local and international laws and policies. Most notable among these are the Environmental Management Act of 2007, and World Bank Operational Policies. Primarily, the EMP is to establish and ensure the implementation of a programme of measures and actions for mitigating the social and environmental risks and impacts. It is a combination of policies and operational practices designed to prevent impacts whenever technically and financially feasible or to enhance positive or beneficial impacts based on the following mitigation hierarchy:

- Avoidance;
- Minimization; and
- Compensation

CHAPTER TWO
PROJECT DESCRIPTION

2.1 Introduction

This section outlines the specifics of the project. It gives an overview of the University of Namibia's Mariculture Research facility, stating where the project resides, the specific project location, facilities, the environmental screening category under which the project sub-activities falls and the description of operational works inclusive in the project.

2.2. Overview of University (Mariculture research facility) Initiative

The intention for applying for the Environmental clearance certificate is therefore, to ensure the identification of different environmental factors and issues that might affect the environment as a result of the operation of the existing project; to ensure the incorporation of the new project activities into the environmental management plan (EMP) for possible identification of major environmental issues, for continuous application of suitable mitigation, monitoring of operational activities of the facility.

As a result, this will require the accountability of the project to operate in an eco-friendly and sustainable way. The aim is to follow the Principles of Eco-development and offer academics and students a safe, quality environment, create and enhance a suitable learning environment is attained. Eco-project development is about uniting conservation, communities, and sustainable environmentally friendly project by minimizing impact on the environment

- To minimize the impact of proposed development on the Environment, including natural resources, local residents and existing surrounding land uses;
- To ensure site selected for mariculture research facility is appropriate for long term operation and that methods are sustainable;
- To ensure proper consideration of the effects of any new developments on the environment and surrounding areas;
- To ensure compliance with environmental requirements, provide training to schools and institutions of higher learning

Introductory Plan of the Facility

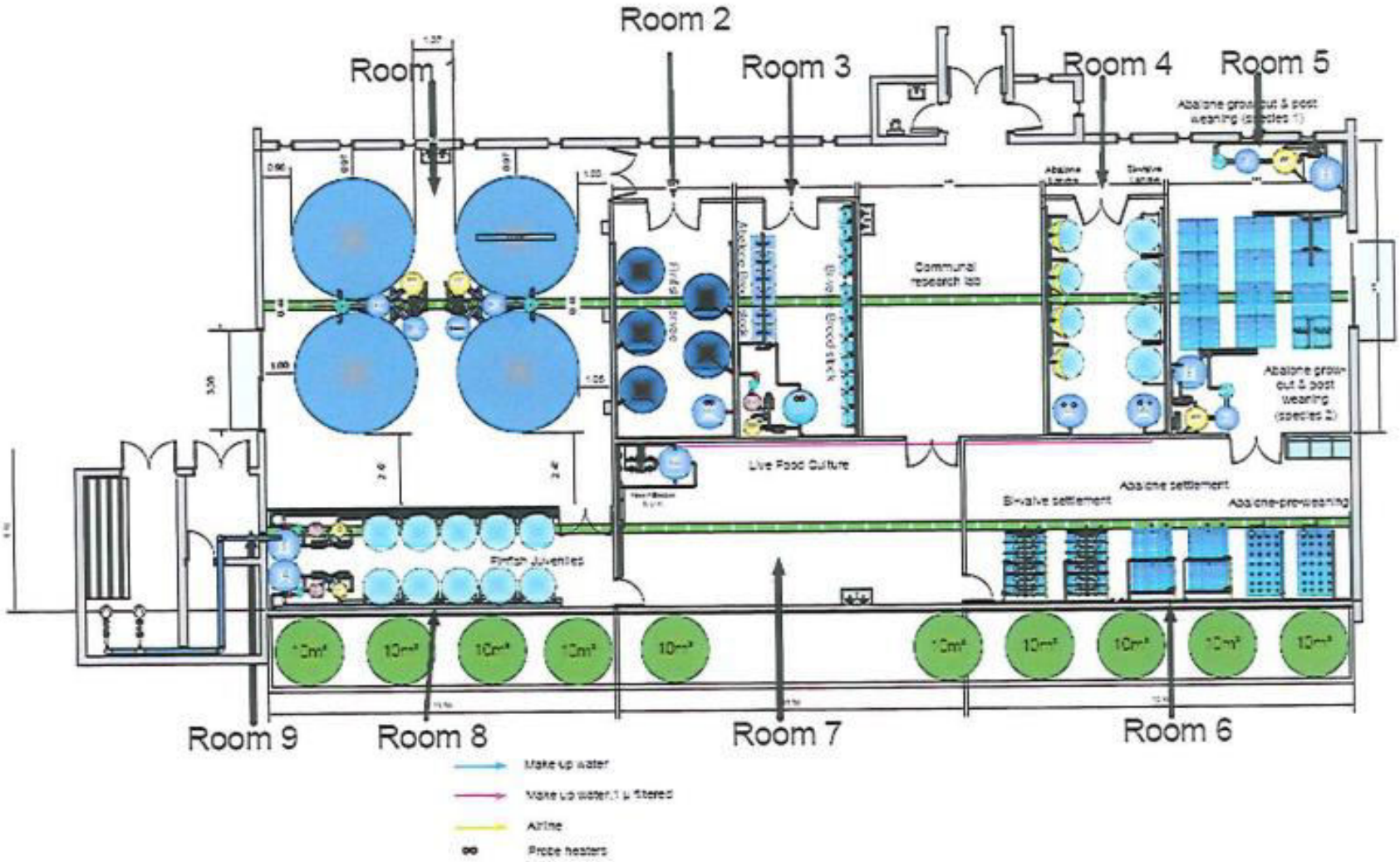


Figure 4: Complete drawing showing systems installed in the research facility (Source: Nam Acquaculture operational manual, 2006)

2.3 Mariculture Research facility operation activities

The existing and operational constructed mariculture reticulation system works as follows; that each of the reticulation systems are made up of various components that completes the process plant. The components are detailed in the sections below with additional information relating to operational issues. The system installed are generally arranged in the following order of operation:

1. Header tank or sump tank
2. Pump
3. Foam fractionator and associated equipment
    a. Level controller
    b. Venturi
    c. Venturi pump
4. Biofilter and associated equipment
    a. Airlift
    b. Airlift box
5. Culture tanks

2.3.1 Header tank or sump tank

Tanks designed to receive water from the main water supply, fine filtration system or alternatively return water from the tanks themselves. Tanks are sized largely based on flow rates and pump sizes. Three different sized tanks have been used. These are 500, 1000 and 1500 litre tanks. All tanks are moulded in poly ethylene plastic and should have a life span of in access to 15years. All header and sump tanks are manufactured in food grade plastics.

All sump and header tanks have been installed with waste drains at the bottom of the tanks to allow for periodic cleaning of the tanks. This should be done on a regular basis, like once every three months.

2.3.2 Pumps

Various pumps are used in the different systems. The University's Research facility have chosen the speck pumps for their simplicity and their durability. Pumps will be either of 0.45, 1.1 or 1.5 kW. These pumps are locust and generally simple to repair or inexpensive to replace.

Pumps will be either process pumps or venturi pumps. All pumps are connected to the main switchgear

Pumps have been plumbed with flow control valves to adjust flows and unions on each side of the pump for easy removal and replacement. Flow rates through the infiltration systems may be controlled by adjusting the valves. Pumps should not be run with valves closed. Pumps are equipped with internal leaf strainers which catch any loose material prior to the water passing through the impeller. This is a protective mechanism. Leaf strainers should be cleaned.

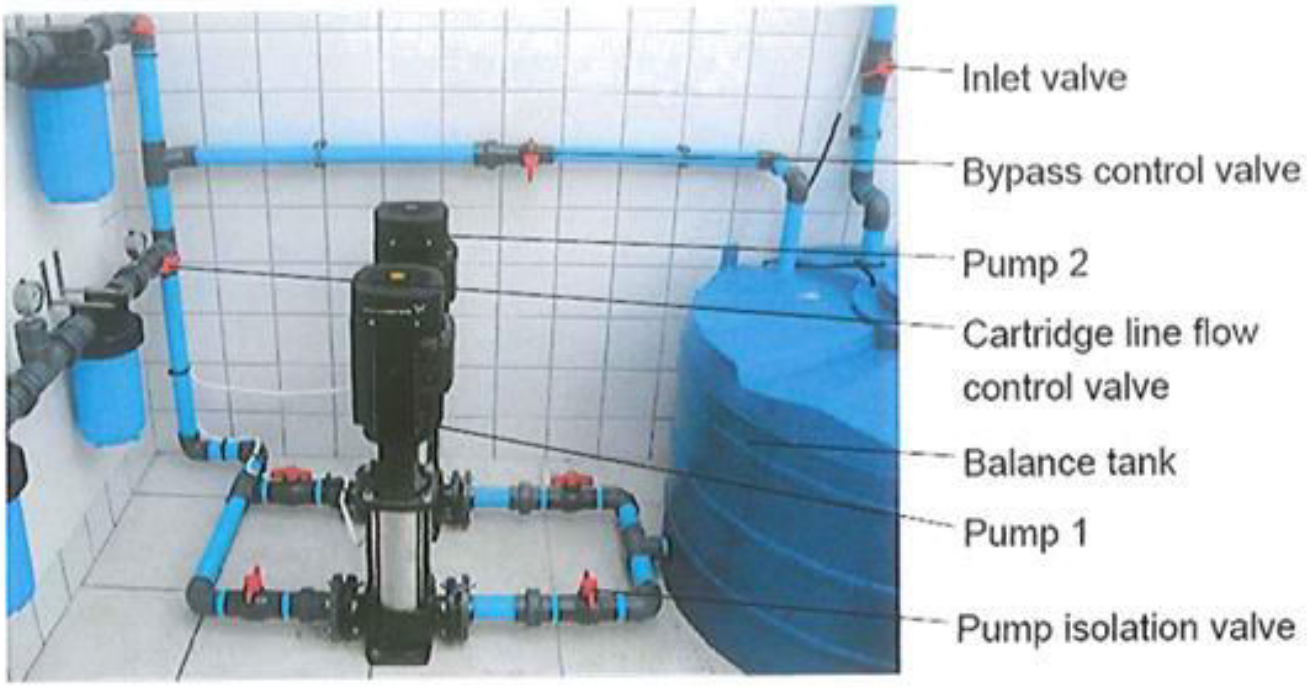


Figure 5 : *pumps on the fine filtration system (Source: Unam Acquaculture operational manual,2006)*

2.3.2.1 Circulation pumps

Circulation or process pumps are used on the recirculation systems to drive the water through the process or recirculation plant. Water is drawn by the pumps from the header or sump tank and is pumped through the form fractionator. Thereafter water runs by gravity through the biofilter and returns to the tanks

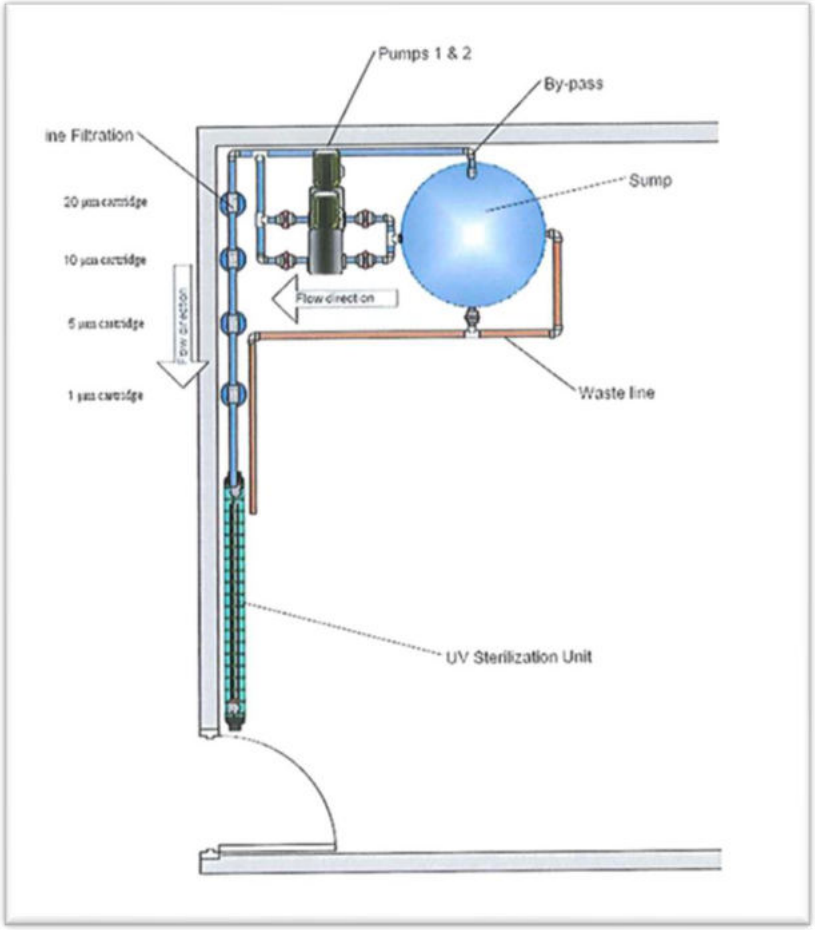


Figure 6: *Sump on the fine filtration system, (Source: Unam Acquaculture operational manual, 2006)*

2.3.2.2 Venturi pumps

Each foam fractionator is equipped with a venturi and associated pump. The venturi line runs as a separate circuit taking fractionated water from the bottom of the foam fractionator, pumping it through the venturi and back into the fractionator column. Water from the venturi will enter the column close to the bottom so as to maximise the length of contract of the bubbles with the water in the column

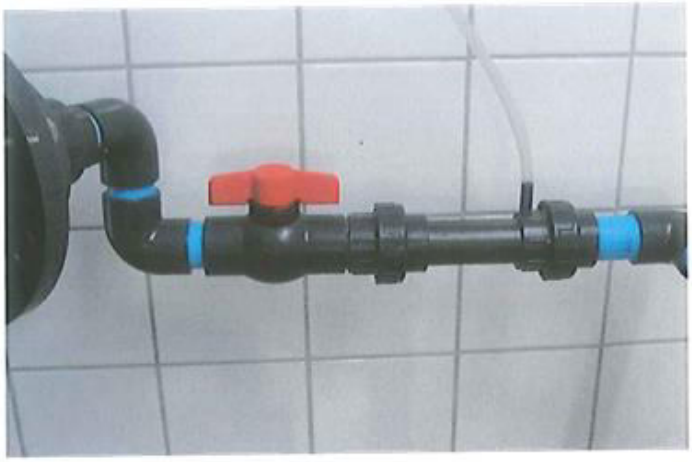


Figure 7*: The Venturi system installed on all foam fractionator (Source: Unam Acquaculture operational manual, 2006).*

2.3.3 Biofilters

Biofilters are used on all the recirculation systems. The vary in size depending on the volume of the system and the expected mass of culture animals to be held in the system. The biofilters make use of the moving-bed biofilter concept. The biomedia is an extruded plastic moulding, cut up into thousands of tiny individual pieces. The biomedia has been specifically designed to present an extremely large surface area to volume ration which ensures maximum space for biofilm growth.

The extruded media has a rough calculated surface area around 700m²/m3. these are slightly positively buoyant and are kept moving in the body water in the biofilter through vigorous aeration. The continuous aggressive movement ensures that the bacterial layer on the surface of the media remains thin and uncluttered by old and excessive growth. A health bacterial biofilter ensure that toxic ammonia and nitrite are adequately broken down to nontoxic nitrate which is removed from the system when water exchanged

Figure 8: *plastic biofilter media for use in biofilters(Source:Unam Acquaculture operational manual, 2006).*

2.4 Introduction to the research facility system

The Mariculture facility together with the freshwater lab are facilities used by academic researchers to conduct experiments on live organisms ranging from Marine and Freshwater Finfish, Shellfish, Macro and Micro Algae, Zooplankton, Benthic organisms, Microbes, and

other aquatic organismsGround opening of the development. This is done in line with Namibia Aquaculture Act. The facility constructed at SANUMARC Henties bay is specifically designed for purposes of conducting research and development on various marine species. These fish species include fish, bivalves and gastropod molluscs. Table below indicate the type of systems used for fish species development through a flow through systems.

Table 1: Type of systems used for fish species development through a flow through systems

System no.	Room no.	System	Reticulation/flow through
1	1	Fish broodstock	Reticulation
2	2	Fish larvae	Flow through
3	8	Fish juvenile	Reticulation
4	3	Abalone broodstock	Reticulation
5	4	Abalone larvae	Flow through
6	6	Abalone settlement	Flow through
7	6	Abalone weaning	Flow through
8	5	Abalone grow-on	Reticulation
9	3	Bi-valve broodstock	Flow through
10	4	Bi-valve larvae	Flow through
11	6	Bi-valve settlement	Flow through

The flow through system as indicated above is a simple systems where fresh sea water is supplied to the tank, is used and polluted within the tank by the culture species and is then flushed from the tanks to waste. These systems have a constant flow of water running which provide the culture species with clean well oxygenated water whist the effluent water flushes the solid waste, dissolved waste and CO_2. For water quality to remain acceptable within the tanks, a steady flow of water needs to be provided. Flow through is particularly important in the stages of cultural cycle where micronutrients for an important part of the growth base of the species.

This flow system has been used in the larvae system of the fish and shellfish as well as the settlement system for shellfish. These systems require fresh sea water which is rich in nutrients and yet unpolluted by waste from the culture species. A number of the flow through system are equipped with heating units. These are set to provide the required water temperatures in the

culture tanks. Independent heating control units are provided for each individual system. Other flow through systems is supplied with fine filtered water from the fine filtration unit which is equipped to provide water filtered to 1um

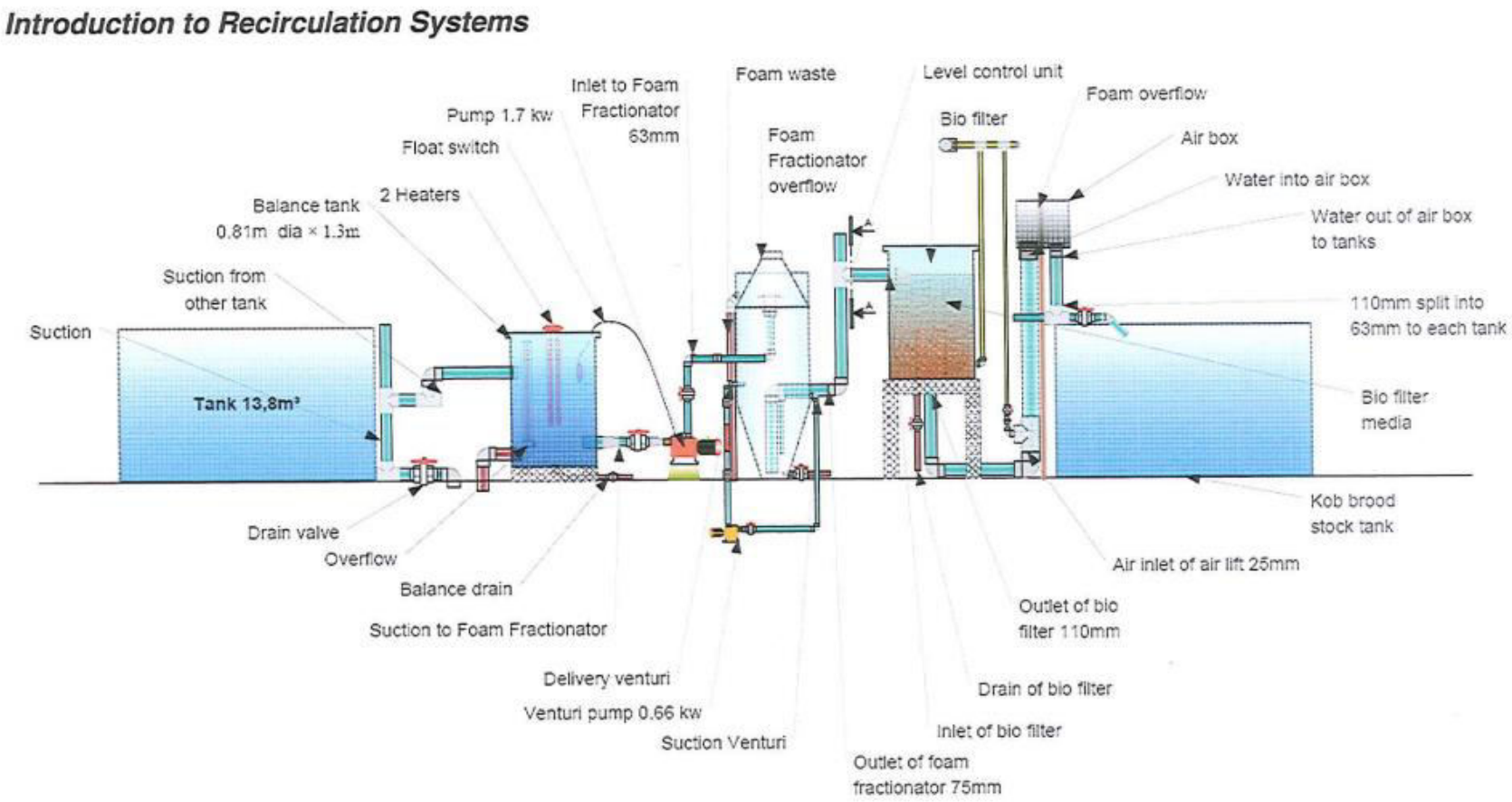


Figure 9: *Side view of the large recirculation system (fish broodstock) (Source: Unam Acquaculture operational manual, 2006).*

2.4.1 The existing operation flow of the fish individual system

The existing and operational reticulation systems are installed on the fish broodstock tanks. Each set of two tanks has a separate reticulation unit which includes temperatures control. This allows each unit to be run at a different temperature. Temperatures in the tanks can be manipulated through adjusting the temperature controllers as mentioned in the heating section.

Water flows are governed by the water flow control valves as indicated in the various photographs. Valves should not be closed completely while pumps are running. All systems and process plant should be cleaned on a regular basis. Tank, biofilter tanks, fractionators and header/sump tanks are equipped with waste valves that lead to common waste drain. These valves should be cracked open daily or weekly to ensure that no waste accumulates in the pipes and poison the water. Below is the table of compomers making up the fish brood stock systems.

Table 2: Compomers making up the fish brood stock systems

No.	**Components**	**Dimensions & comments**
1	700mm ϕ GRP foam fractionator	63mm inlet union, 75mm outlet elbow, 100mm venturi inlet flange, 50mm drain line, 50mm foam overflow elbow & GRP dome inside
2	Overflow line	50mm foam overflow line manifold
3	Level control	75mm outlet /level control unit manifold
4	Venturi	Venturi suction & delivery manifold and flexible hose
5	Venturi pump	Venturi boost pump with stand and spanner

Figure 10: *UNAM research facility's operational components*

2.5 Environmental Screening Category

Based on the Namibian Environmental Act and the World Bank's categorisation and screening result, the process of clearing of land and development of infrastructures such as the University of Namibia's Mariculture Research facility fall under Category B also known as Schedule 2.

Screening of sub-projects prior to their implementation is a key requirement of the project. According to the environmental Act Operational Manual, screening is carried out to decide whether a sub-project requires assessment or not, and the level of assessment that may be required. Upon screening, a determination is made for the next step and the level of assessment that will be required for each sub-project.

The World Bank (1999) & Namibian Environmental Act of 2007, classifies projects into categories. Category 'A' projects are categorised as highly risky or contentious or complex projects. Such projects require full Environmental and Social Impact Assessment (ESIA) by both the World Bank and the Environmental Management Act of Namibia. Projects are categorised as 'B' according to the World Bank standards if the adverse environmental and social impacts on human populations or environmentally important areas-including wetlands, forests, grasslands, and other natural habitats are less adverse than those of Category 'A' (World Bank, 1999). The impacts of projects under Category 'B' are site specific, a few of them being irreversible, and mitigation measures quite easy to be defined than those of Category 'A' projects.

CHAPTER THREE
POLICY, ADMINISTRATIVE AND LEGAL FRAMEWORK FOR ENVIRONMENTAL AND SOCIAL MANAGEMENT IN NAMIBIA

3.1 Introduction

This chapter deals with the legal and policy frameworks as well as the administrative set-up for preparing EMPs in Namibia. the chapter also looks at the existing legal and policy framework for land acquisition and differences between National and World Bank policies.

3.2 Legal and Policy Frameworks

Table below shows the environmental policy and assessment legislations and procedures of Namibia and those of the World Bank, which are relevant to the Project. In principle, the two sets of policies and procedures on environmental and social assessment are similar in many respects.

Table 3: Legal and Policy Frameworks

LEGISLATION/GUIDELINE/POLICY	APPLICABLE CLAUSE/POLICY	COMMENTS
Environmental Management Act No. 7 of 2007	Section 2 outlines the objectives of the Act and means to achieve that. Section 3 details the principles of environmental management	The development should be informed by the EMA
Namibia 's Environmental Assessment policy (1995)	List of activities that require EA.	Tourism facilities need to be assessed in terms of the impact on the natural and social environmental and resources.
Communal Land Reform Act	List of activities that may not be undertaken without a clearance certificate: 6.tourism development activities	Conduct a EA in terms of the tourism development and submit to MET in order for a clearance certificate to be issued.
1994 White paper on tourism (MET 1994)	Tourism must provide direct benefits to local people and aid conservation.	Emphasis should be on local benefits from tourism.
1995 policy on wildlife, management, utilisation and tourism in communal area (MET 1995a)	To allow rural communities on state land to undertake tourism ventures and to enter into cooperative agreements with commercial tourism organisations to develop tourism activities on state land.	JV agreements with benefits to local communities should be negotiated between developers and local conservancies.
Inland fisheries resources act,2003 and regulations	Promotion, sustainable utilisation and protection of inland fisheries resources. Restrictions by limiting number of nets, mesh, sizes, net length and damaging fishing methods.	A fishing licence need to be obtained from the regional office to engage in recreational fishing in any inland waters by means of any regulated fishing gear.
Local Authorities Act No. 23 of 1992	The Local Authorities Act prescribes the manner in which a town or municipality should be managed by the town or municipal council Section 34-47 makes provision for the aspects of water and sewerage	The development has to comply with the provisions of the Local Authority Act
Water act no. 54 of 1956	Section 23 (1) deals with the prohibition of pollution of	The pollution of water resources should be avoided during

	underground and surface water bodies	construction and operation of the development

Table 4: Other relevant legal frameworks related to waste management in Namibia

Framework	Emphasis
Atmospheric Pollution Prevention Act No. 45 of 1965	*Prevention of pollution of the atmosphere.*
Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, 1992	*Environmental sound management of hazardous waste and other wastes through the reduction of their movements, for the purpose of reducing their impacts on human health and environment*
Hazardous Substances Ordinance No. 14 of 1974	*Control of toxic substances (including manufacture, use, disposal, import and export).*
Pollution Control and Waste Management Bill of 1999	*Prevention and regulation of air, water and land pollutants; establishment of an appropriate framework for integrated pollution prevention and control, regulation of noise, dust and odour, as well as an establishment of a system of waste planning and management.*
Pollution Prevention Ordinance No. 11 of 1976	*Prevention of air pollution.*
Prevention and Combating of Pollution of Sea by Oil Act No. 6 of 1981	*Prohibits the discharge of oil from ships, tanker or off-shore installation and gives the state certain powers to prevent such pollution and deal with removal of oil spills.*
Prevention and combating of pollution of the sea by oil Act 24 of 1991	*Prevention of sea pollution by oil.*
UN Convention on the Law of the sea, 1982	*Protection and preservation of the marine environment including the seabed, ocean floor, subsoil and the resources in the environment.*
Water Resources Management Act No. 24 of 2004	*Prevention of water pollution.*

CHAPTER FOUR
ENVIRONMENTAL AND MANAGEMENT PLAN (EMP)

4.1 Environmental Management Plan & Estimated cost

The Environmental Impact Assessment Regulations require the developer to provide an Environmental and Social Management Plan. An EMP is a document where all the measures that are required for environmental protection, which will include the mitigation measures and the monitoring plan, will be found for easy reference. The aim of an environmental management plan is to avoid, minimize, or ameliorate effects or impacts resulting from project implementation and where possible, enhance beneficial effects.

This EMP seeks to limit the interaction of disturbed with undisturbed lands at proposed project site and through the various processes of project implementation, restore the disturbed land to a predetermined form of land-use or to a productivity level similar to that occurring prior to disturbance. The Environmental Management Plan for the management of the identified environmental impacts associated with this project consists of three main components:

- Implementing the Impact Mitigation Plan.
- Monitoring the implementation of the EMP.

4.2 Impact Mitigation Plan

The impact mitigation plan allocates the responsibilities for implementation of the proposed mitigation measures to the various stakeholders and indicates at what stage in the project they should be performed. The Plan is presented in this section and it addresses the negative impacts generated by the project and presents the associated cost estimates of mitigating the adverse impacts. The key components of the proposed impact mitigation plan are:

(i) Surface and ground water quality management

(ii) Soil erosion Control

(iii) Vegetation and Flora

(iv) Wildlife and Fauna Habitats

(i) Bush fires

(ii) Noise and vibrations

(iii) Occupational Health and safety

(iv) Land use and Soil

(v) Air Quality

(vi) Landscape, land use and Aesthetics

Socio-economic components of the mitigation plan include:

(i) Cultural and Historic Sites

(ii) Employment and conditions of service

4.3 Surface and ground water management

Surface and ground water are an important component of agricultural, ecological and human use of the land in the proposed project. The aim of the water management program is to ensure that where practical, flows into and through the project sites is maintained and that ground water sources (boreholes within the project area) are used efficiently to prevent inconsistent draw down of water during abstraction. The following will be undertaken to protect surface and ground water:

- An effective drainage system will be put in place to capture all waste water.
- Oil spillages from vehicles and machinery will be avoided on site. Compliance with the Hazardous Waste Regulations will be priority.
- A good and effective monitoring system will be put in place during operations. Regular surface and ground water samples will be collected and analysed. Bi-annual results will be submitted to the Namibian Environmental directorate.
- Ensuring that boreholes and septic tanks are at least 60 meters apart.

4.4 Soil conditions and climate

Henties Bay is a coastal town situated in the Erongo Region of Western Namibia, it lies on longitude 14.3001900 E and latitude 22.5502700 S. The town is one of Namibia's best-known and most popular holiday destinations located 70 km north of Swakopmund where natural resources such as uranium ore is mined for commercial purposes. The climate of the town is characterised by aridity. Some prominent features of the climate include, very low rainfall of about 15 mm at the coastline, coastal fog, and the southerly and south-westerly winds that sometimes occasion the mobility of entire desert surface and tailings.

Soil in Henties bay have a less likelihood of soil erosion. However, the nature of the soil in high rainfall or winds may be prone to erosion. The soil erosion mitigation methods to be

employed by university will ensure less risk of soil erosion and less water-runoff to nearby developments and settlements

4.5 Vegetation and Flora

According to Elongo Chris (2019), Henties bay town inclusive of the University of Namibia's Mariculture Research facility and project site falls within a developed urban setup, a desert area well-known to have less than 10 plant species. However other parts of Henties bay have plant species such as; Pencilbush (Arthraerualeubnitzia), dollar bush (Zygophyllumstapfii), lichens, shepherd's tree (Bosciaalbitrunca), welwitschia (Welwitschia mirabilis). Pencil bush (Arthraerualeubnitzia) is dominant in that area.

Figure 11: *Pencil bush (Arthraerualeubnitzia)*

The University research facility project area has a large portion of disturbed land that has been used for university academic research activities and social human activities, (mostly by Henties bay residents). Most of the flora is dispersed as the area is a desert associated with dry to humid conditions and most plants do not grow well in this kind of weather. A number of management initiatives were and/or have been implemented to reduce further potential impacts and disturbance of flora and vegetation. These conservation initiatives include clearly marking and restricting access to areas of high conservation value; concentrate operations to areas already disturbed.

4.6 Wildlife and Fauna habitats

Due to the project area's locality and other anthropogenic activities on the land, the University of Namibia's Mariculture Research facility has no sign, no evidence of availability of large animals that are disturbed or likely to migrate due to on-going research facility operational activities. However, in the event that small identified animals are threatened, it is most likely that the species will tend to migrate from areas of greatest activity during site preparation and operation but will return during the night and more stable years of the operations. The selected potential impacts on fauna are therefore reduced by restricting disturbance and clearing of habitats to the minimum required, for safe, efficient operations of the project and progressively rehabilitating disturbed areas to re-establish habitats for such animals.

4.7 Bush fires

The impact of fires is more significant in the dry season as the risk of flora and fauna disturbance and threat is high. This is so because the flora and grass are dry and of little moisture likely to provide more means of fuel for ignition. Other than ignition, and fuels, other factors such as east-wind seasons, wind pattern and proximity with human settlement plays an important role in open burning. Such factors have been identified and ascertained by the University as appropriate timing of burning may facilitate a good burn and at the same time minimize air pollution impact. Consideration of the regional factors will enable classification of the area in terms of air pollution risks.

4.8 Noise and vibrations

Operation of machinery at the research facility have little negative impact on the local community residents as the noise levels emitted from the facility is operating within the acceptable audible levels. The development around the University research facility is at reasonable distances unlikely to receive destructive noise levels. The University has also ensured that only well serviced machineries are used to avoid generating noise levels that are above the recommended limit. Operations will be limited to day time only.

4.9 Employment and conditions of service

The University of Namibia's Mariculture Research facility project will employ up close to +-15 research employees and about 100 academic research student who use the facility for research on a full-time daily basis. In accordance with its employment policy, the University hires employees based on affirmative actions, where the University employees constitute thirty

(30%) of women. The company works to uphold the government directive under the labour laws to pay all workers the stipulated minimum wage. Further, the University observes all labour related regulations pertaining to normal working hours and other conditions of employment.

4.10 Cultural and Historic Sites

The Project area have no cultural, historical or archaeological sites that are deemed sensitive or that maybe disturbed by the project operation activities from pre-construction to decommissioning phases.

4.11 Capacity development and training

Training in the implementation of the EMP is and will be provided to the University's staff responsible for EMP implementation, contractors, CSC and/or Field engineer and local authority during subproject implementation activities. This is to ensure that:

(a) The new proposed amendment subproject activities will be adequately screened;

(b) Mitigation measures are included in the bidding documents and contracts and supervision and monitoring of the contractor performance is conducted by the University and/or its environmental consultant; and

(c) Close consultation with local agencies and communities is carried out throughout subproject planning and implementation. The cost estimate of this training is as per the institute approved budget and included in the cost of project safeguards training

4.11.1 Training for the hatchery manager

The research facility hatchery manger is a person with experience in fish breeding and fish culture, with managerial qualities. He/she will be responsible for the overall technical, financial and organizational management. Training needed for activity position are fish production programming, hatchery management, financial planning and budgeting, and personnel planning. The training will be conducted before the operation of the hatchery.

4.11.2 Training for Fisheries Biologist

The University's fisheries Biologists (usually employed by the University of Namibia) is responsible for fish breeding, nursing and culturing. The Biologist need to know all aspects of

fish breeding, nursing and culturing. Several training courses are offered to these people. There includes:

1. Fish breeding
2. Fish nursing
3. Fish culture
4. Fish feed and feeding
5. Fish disease
6. Water quality
7. Hatchery management
8. Fisheries extension

These trainings were done during the construction of the research facility, prior to full operation.

4.12 Available Infrastructure Municipal Services

4.12.1 Electricity power grid

The University of Namibia's Mariculture Research facility have existing three (3) phase transformer PowerGrid, where power supply to the existing and operational development is connected. Hence power supply is already installed and working within the project area. However, the transformer is being maintained by Henties bay ErongoRed. The University of Namibia's is usually charged for daily usage levy though prepaid meter.

4.12.2 Water source

Water supply to the existing and operational research facility is existing and is being used for the operation of the research facility. This water is often pumped from the ocean into water tanks. The Mariculture extracts seawater from the PVC pipes with slits that are buried 2 meters under the beach sand, seawater is then pumped into the 10 X 10 000L reservoir tanks before being utilized in the mariculture facility (as explained in the previous chapter).

Figure 12: *Sea-water pump station and the x3 10,000 litre water reserve tanks*

4.12.3 Roads

There is an existing municipal gravel-salt road (called Omaruru street) that serves as an access road to the University Research facility. This entails that the access road is operational and is being used to access most development situated north of Henties bay. Hence the project site can be accessed through Omaruru main road and/or through the existing "Henties Terrace bay Road". The site is located 10 meters from the terrace-bay Road, (See figure 3 & 4).

4.12.4 Sewage Treatment and Disposal

A Septic tank liquid waste system already exist on the University's premises. This sewer system consists of x 4 installed septic tanks, covering about 496m3. The development of multiple septic tanks on the project area is a s a result of the size of the University development, the different compartments of the University, hence the development of multi septic tanks to cater for the carrying capacity of the liquid waste produces from the entire University departments including "students hotel". The breakdown of the septic tanks at the project site are as follows;

- DFAS = 7.3m x 5m x 2.2 = 80.3m3
- Male Hostel = 7m x 5m x 2 = 70m3
- Female hostel & Dining hall = 15m x 7.5m x 1.8 = 202.5m3
- Administration Building = 8m x 9m x 2m = 144m3

Giving a normal combined total estimate for these facilities is around **496m3.**

These septic tanks were installed and developed in line with the required building standards and regulations approved by the Council of Henties Bay Municipality. Liquid waste contraction chemical reduction is constantly used and injected inside the septic tank to prevent the waste water. These septic tanks are also drained by Municipality workers on regular basis and wastes disposed at the Henties bay designated sewer plant.

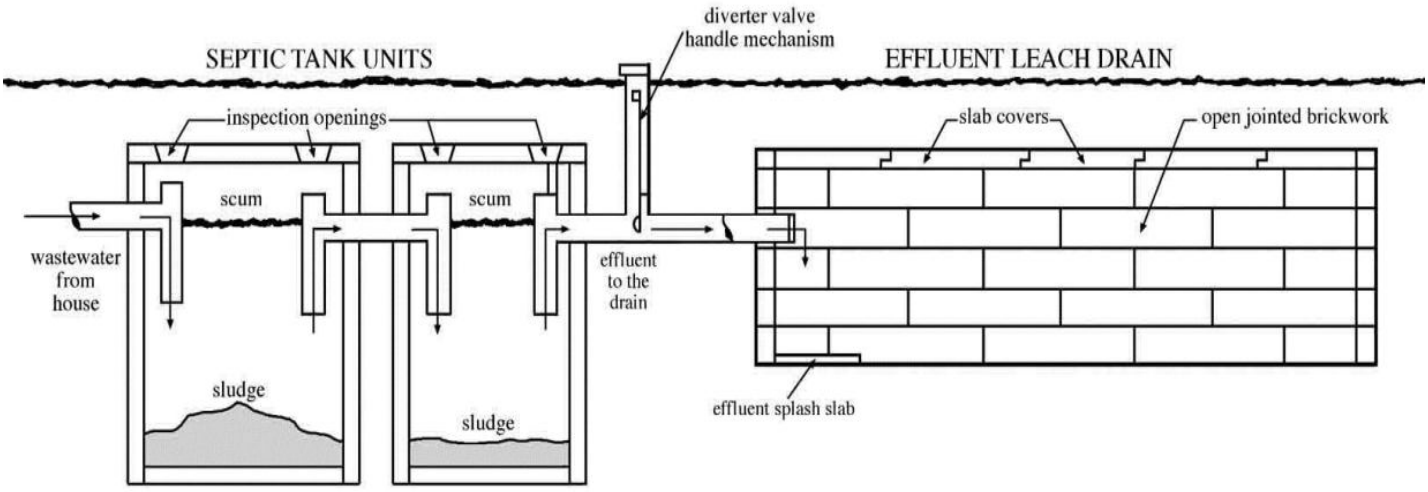


Figure 13: *Typical example of existing (x 4) septic tank*

4.12.5 Hydrology and Water Resources

Groundwater is classified by hydrogeological rock type and in Henties Bay a combination of different rock formation exists namely; hard rock terrain and aquitard or aquiclude. The many sources of water for Henties Bay community comes from the Omdel aquifer situated east of Henties Town. This water is safe for both human and livestock or animal consumption

4.12.6 Solid waste

All Domestic solid waste will be generated during the construction and operational phase of the research facility project are often disposed of at the Henties Bay designated Dumping site, in accordance with the waste management regulations. Furthermore, Wheel bins, dustbins and garbage boxes are being placed on the University premises, in designated areas of the university. The collection of the solid waste materials is usually carried out by the Henties bay Municipality through the division of environmental health

5. EIA EVALUATION METHOD

Before the project commences, an authorization is required from the Department of Environmental Affairs (DEA), Ministry of Environment and Tourism, in line with the Environmental Management Act of 2007 and the EIA Regulations No 30, 6 February 2012. Therefore, the research facility project activities, is a listed activity and an EIA scoping or updated management plan should be drafted and submitted for approval. The application for the Environmental Clearance Certificate (ECC) will be submitted to DEA. The following subheading describes what will be covered in the Scoping and Environmental Assessment. The assessment criteria ensure that a comprehensive assessment of potential impacts is undertaken in order to determine the overall impacts significance. The following criteria is and should be taken into consideration:

- The nature of impact i.e. positive, negative, direct, indirect;
- The extent and location of the impact;
- The duration of the impact i.e. short term, long term, intermittent or continuous;
- The magnitude/intensity of the impact occurring;
- The extent to which the impact can be reversed;
- The degree to which an impact may cause irreplaceable loss of a resource;
- The cumulative impacts;
- The mitigatory of potential impacts; and
- The significance of the impact on local, regional or global level.

Mitigation measures should subsequently be identified and recommended for all impacts to reduce the overall impact significantly to an acceptable level, where applicable. Mitigation measures should aim to address the following:

- More environmentally sound designs, concepts, layouts, technologies, etc., are investigated and implemented, if feasible;
- Environmental benefits of proposed activity are enhanced;
- Negative impacts are avoided, minimized or enhanced; and
- Residual negative impacts are within acceptable levels.

Table 5: Description of criteria used to evaluate potential impacts.

Significance Rating	LIST OF CRITERIA USED IN ASSIGNING A SPECIFIC RATING		
	INTENSITY	**EXTENT**	**DURATION**
High Significance	High	Regional	Medium Term
	High	National	Short Term
	High	Local	Long Term
	Medium	National	Medium Term
	Medium	Regional	Long Term
Medium Significance	High	Local	Medium Term
	High	Regional	Short Term
	Medium	National	Short Term
	Medium	Regional	Medium Term
	Medium	Local	Long Term
	Low	National	Medium Term
	Low	Regional	Long Term
Low Significance	Medium	Local	Medium Term
	Medium – High	Local	Short Term
	Medium	Regional	Short Term
	Low	National	Short Term
	Low	Regional	Medium Term
	Low	Local	Long Term
Very low Significance	Low	Local	Medium Term
	Low	Regional	Short Term
	Very low	Local	Short Term
Neutral/No impact	Zero intensity with any combination of extent and duration		

5.1 Potential Impacts during constructional stage

- Noise Pollution
- Dust
- Waste generation
- Ecological disturbance

Table 6: Potential impacts during constructional stage

Aspect	Type of Impact	Scale	Duration	Magnitude	Probability	Significance	
						Unmitigated	Mitigated
Noise	Negative	1	1	2	1	M	L
Dust	Negative	1	1	2	1	L	L
Waste	Negative	1	1	0	1	M	L
Ecology	Negative	1	1	2	1	L	L
Cumulative Impacts	Negative	1	3	4	3	L	L

Summary of all potential impacts expected during Project expansion activities: In general, all impacts assessed are expected to be low to medium and mostly short term and only applicable to the targeted study area and not affecting the surrounding. However, mitigation measure outlining options on how to reduce or lessen these potential impacts will be discussed in the Environmental Management Plan (EMP) attached.

6. THE IMPLEMENTATION OF THE ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The section below outlines the management of the environmental elements during the planning and operational phases of the research facility. It further provides a brief summary of the management of the Project area. Contents of these tables could be incorporated into a HSEQ management system. The proponent is responsible to assign the responsibilities and ensure that the tasks are executed. This section also describes the environmental mitigation requirements to be followed by the Contractor and measures to be carried out by the Contractor related to environmental protection.

Contractors shall follow all Namibia's Environmental laws and regulations related to environmental protection. Additionally, the Contractor shall provide an environmental mitigation and monitoring plan in connection with the submission of the Program based on the provisions of the Environmental Management Plan. The University of Namibia has put up strict mechanisms and measures to ensure compliance and prevent further impacts of the project environment. DO NOT:

1. Do not permit rubbish to fall freely from any locations of the project and/or access by animals (dogs, cats, pigs). Use appropriate containers;
2. Do not throw away tools or other materials;
3. Do not raise or lower any tool or equipment by its own cable or supply hose;
4. Use grounding straps equipped with clamps on containers to prevent static electricity buildup; and
5. Do not allow hunting of animals by workers in protected areas.

6.1 Special note on flammable/explosive materials:

1. Store flammable or explosive materials such as gasoline, oil and cleaning agents apart from other materials.
2. Keep flammable and explosive materials in proper containers with contents clearly marked.
3. Dispose of greasy, oily rags and other flammable materials in approved containers.
4. Store full barrels in an upright position.

5. Store empty barrels separately.
6. Post signs prohibiting smoking, open flames and other ignition sources in areas where flammable and explosive materials are stored or used.
7. Store and chain all compressed gas cylinders in an upright position.
8. Mark empty cylinders and store them separately from full or partially full cylinders.
9. Ventilate all storage areas properly.
10. Ensure that all electric fixtures and switches are explosion proof where flammable materials are stored.

6.1.1 Health, Safety and Accidents

The research facility manager shall ensure, to the extent that is reasonable, the work environment health, safety and welfare of employees including those of his sub-contractors and of all other persons on the site. The University's research site and work places shall generally be in accordance with the existing safety regulations in Namibia. The manager's responsibilities shall include:

(a) The provision and maintenance of construction plant, equipment and systems of work that are lighted, safe and without risks to health.

(b) The execution of suitable arrangements for ensuring safety and absence of risks to health in connection with the use, handling, storage, transport and disposal of articles and substances.

(c) The provision of protective clothing and equipment, first aid stations with such personnel and equipment as are necessary and such information, instruction, training and supervision as are necessary to ensure the health and safety at work of all persons employed on University Campus in accordance with the Laws of Namibia.

(d) The provision of a qualified officer or designation as Safety Officer who has specific knowledge of safety regulations, and experience of safety precautions on similar works and who shall advise on all matters affecting the safety of workmen and on measures to be taken to promote such safety.

(e) The provision and maintenance of access to all places on the site in a condition that is safe and without risk of injury.

(f) The provision of adequate waterborne sanitation, refuse collection and disposal, complying with the Laws of Namibia, all local by-laws and to the satisfaction of the Engineer, for all houses, offices, workshops and laboratories erected on the facility sites.

(h) The execution of appropriate measures in consultation with the appropriate Public Health Authority to control within the Site, including the laboratory site, mosquitoes, flies and pests including the application of suitable chemicals to breeding areas.

(i) Reporting details of any accident to the University Director and the Police, when appropriate as soon as possible after its occurrence.

6.1.2 Protection of Water Resources

(i) During construction, the contractor shall carry the full administrative and legal responsibility for any pollution of surface waters according to the existing legislation.

(ii) The contractor shall ensure that no oil products, fuel, lubricants, detergents, paint or other harmful substances are introduced into streams and irrigation or drainage facilities.

(iii) The storage or production or waste as well as filling and parking of machinery or cars is not permitted within a distance of 100 m of any stream including drainage or water facilities. The discharge of oil and fuel onto open soils is prohibited. Filling of any machinery shall be restricted to stationary and or mobile filling stations and shall exclusively be carried out by using suitable taps or nozzles. The contractor shall make all necessary arrangements to ensure that pollution of soils and groundwater will be avoided as far as possible.

(iv) The contractor shall submit a plan to the relevant authorities (University of Namibia) indicating the type of installation and their respective locations e.g., fuel and material storage, stationary filling sites, asphalt plant, mixing plant, car wash facilities etc.

(v) The Contractor shall submit to the University Engineer an emergency plan for hazardous spills and leakage subject for approval before commencement of the works. This does not overrule requirements of the section i) above vi) the direct discharge of sewage from worker's houses into any sea or stream is prohibited. Sewage from these installations shall be collected in septic tanks or soaking pits.

6.1.3 Noise Control

The Contractor (which is the University of Namibia-Sam Nujoma Campus) shall follow all the existing laws and regulations concerning the noise control in construction works and research facility activities. The contractor shall submit a plan to the relevant authorities (Henties bay Municipality) indicating the type of installation and their respective locations, which is subject for approval before commencement of the works. The Contractor shall elaborate and adopt effective measures both in management and technology to minimize noise, especially in proximity to residential areas. The contractor should conduct appropriate prior maintenance to minimize the noise-level of equipment. The use of high-level noise generating plant and equipment shall not be carried out at night unless otherwise approved by the University Engineer. All noise not relating to the construction and operation of the research facility shall be avoided as far as possible.

6.1.4 Dust Control

The contractor will specify and follow mitigation measures to control dust from the operation of equipment and construction. If any noisy operation activities are undertaken at site, care shall be taken to ensure that any dust or noise emanating from the operations is contained to prevent nuisance to adjoining properties. The Contractor shall submit a plan indicating the proposed routes for material transport and make statements on the proposed method of dust control where transport through settlements cannot be avoided.

6.1.5 Solid waste from construction and construction site

(i) Wherever possible recycling/re-use of materials shall be considered; (ii) As a rule, solid wastes generated during the construction phase shall be systematically collected, stored and disposed of in suitable locations approved by the relevant local authority and in accordance with national and local relevant regulations.

(a) Construction debris shall generally be removed from the site in an orderly manner and disposed of in accordance with the existing regulations.

(b) Clean soil material, i.e. later indicated as Spoil Material that is not reusable shall be removed from the site and transported to the designated dumping areas in accordance with relevant regulation, or designated in the design documents.

(c) Domestic waste from temporary construction activities shall be systematically collected and hauled to the designated areas in accordance with the relevant regulation. Should construction camps be erected within a reasonable distance to larger settlements, camp's solid waste may be integrated into existing collection and disposal facilities of nearby communities by their approval.

6.1.6 Fire Protection

The Contractor (Unam) shall comply with the provisions for fire protection according to Namibian legislation or as otherwise directed by the University Engineer.

6.1.7 Materials

The contractor will restrict the use of materials to sources appropriately licensed under Namibia's legislation for permits. The contractor will be responsible for having on file evidence of such permits.

6.1.8 Sewage & Social Issues

The contractor will contain, collect, and treat any sewage in accordance with the requirements of environment protection and as approved by the facility Manager and the local department of environmental protection. The contractor will follow social mitigation actions as indicated in the designs provided for the table below. In the case of disputes, the contractor will refer the issue to the facility project manager. Specific concerns include but are not limited to access to residences, source of income generation, and water and other utilities.

6.1.9 Chance Finds

In line with Namibian law on Protection of Cultural Heritage, when construction work or any other activity bring to light cultural property such as monuments, ruins, ancient objects, remains of inhabited sites, ancient burial sites, engravings or any property likely to be of interest in the study of prehistory, history, archaeology, ethnology, paleontology or other branches of science dealing with the past or of human sciences in general, the person finding the property and the owner of the site where it was discovered are obliged to stop the construction work and immediately make a declaration to the local police, who shall transmit it to the Governor of the Erongo region without delay. The Governor shall in turn inform the competent authority and shall take the measures necessary to ensure the protection of the objects and the site.

6.1.10 Supervision and Monitoring

The University engineer or research facility manager will be responsible for monitoring and verifying that all construction and operations are in compliance with the terms of the EMP and that there have been no deviations from neither the terms of this contract or the EMP.

Environmental Aspect	Objectives	Monitoring frequency	Mitigation and enhancement measures	Responsible person	Monitoring costs (N$)
PREPARATION & CONSTRUCTION PHASE					
Site selection	Conduct a screening through careful site investigation with participation of professional experts	Once, before start of project	Consult with local authority and people; Make sure that problems flood, erosion, depression, damage to significant cultural resources, land acquisition and resettlement, loss of biodiversity to be adequately managed before commencement of detailed design	University Director/ Management	N$ 20,000
Surface Water Quality	To protect contamination of storm water.	Seasonal	Construction of proper drains alongside access roads and drains within the project area and operation areas	Facility project manager	4,200
Ground Water Quality	To protect ground water contamination from oil spills and chemical run off.	Quarterly	Drip trays will be used when removing used oils from equipment waiting servicing.	Project Manager	3,400
			Fuel storage tanks will be placed in a banded wall and concreted surface. The bunding shall have a volume equivalent to 110% the volume of the fuel tank. A sump shall be constructed in such a way as to drain any oil that has spilled	Project Manager	

			Used oil storage facility shall be kept under lock and key, concreted and bunded	Project Manager	-
			Drainage systems in the project site will be constructed to prevent chemical runoff during site operations and rainy season	Project Manager	-
Ambient Air Quality	Suppression of dust from construction sites and access roads	Weekly	The project area is and/or shall have a water bowser that shall be used to suppress dust on the main road and other access roads and construction sites where there is dust.	Project Manager	-
			If available molasses will be sprayed on roads and construction sites to suppress dust formation. Emissions and dust levels will be monitored by way of periodical air sampling using mobile dragger pump. Results will be submitted to DEA quarterly.	Project Manager	1,400
Soil Contamination	To protect soil from contamination from fresh and used oil spills, and fuel.	Quarterly	Refuelling & repair of construction equipment will be done in designated areas and periodic maintenance will be done on all equipment to avoid oil leaks getting into the soil	Project Manager	-
			Drip trays will be used in maintenance areas to drain used oil from equipment.	Project Manager	-

			Fresh and used oil will be stored in separate and lockable shades whose floors shall be concreted	Workshop manager	-
			A bioremediation plan shall be established for the purpose bioremediation of oil contaminated soils.	Project Manager	3,000
Soil Erosion	To protect the soil from erosion	Monthly	Storm water drains will be constructed around construction sites to collect storm water and there by prevent soil erosion *(However no severe storm water or rain have been experienced in this part of the Erongo region)* Control soil erosion/sedimentation through use of dikes, fiber mats, mulches, grasses, slope, drains and other devices.	Project Manager	-
			Access roads and the plant periphery will be left with trees and this will protect soil erosion	Project Manager	-
Noise	Minimise Noise to acceptable levels	Monthly	All project site equipment's will be subject to a routine maintenance to ensure they are in good working order, hence minimising noise levels. Restrict operations to day time only. The construction equipment will strictly conform to Namibia noise standards; Vehicles and equipment used shall be fitted with exhaust silencers and shall be	Project Manager	-

			checked regularly; Noisy construction activities will be at least a distance of 100m from the hospitals, educational institutions		
			Employees shall wear ear muffs or ear plugs and other necessary Personal Protective Equipment (PPE).	Project Manager	3,000
	To protect workers from noise exceeding acceptable levels	Monthly	Periodical monitoring of noise levels shall be conducted.	Project Manager	-
			Selection of low noise level equipment when purchasing farm and workshop equipment will be first priority.	Project Manager	-
Land Use	To rehabilitate the project area and try to restore to its original state.	Annually	The mitigations here shall only come at closure. Buildings like the research facility house, workers houses, fuel storage facility, used oil storage shed and the mini workshop will be demolished, area cleared and rehabilitated and other research equipment removed also. Pumps shall be roved and caped. The land shall be re-vegetated and or allowed to naturally re-vegetate.	Contractor	1,800
Flora	To protect the local flora where possible.	Quarterly	The project was implemented mostly to utilise spaces or land which was already disturbed. The project site is within a surveyed portion.	Project Manager	1,800

Fauna	To protect local fauna.	Quarterly	Identified fauna in the project site will be preserved by taking it to areas that will remain undisturbed.	Project Manager	1,200
Archaeology and cultural sites	To protect cultural heritage from damage	Project Inception	Any cultural heritage site discovered during construction will be preserved and the cultural heritage commission informed accordingly.	Project Manager	1,500
Public Safety	To minimise health and safety risks.	Quarterly	Pre-employment and regular medical examinations will be carried out on all employees to ascertain their health.	Project Manager	1,450
			All plant equipment will be subject to a routine maintenance programme to ensure they are in good working order, hence minimising health and safety risks.	Project Manager	-
			All workers including contractors will be subject to wearing appropriate personal protective equipment (PPE) depending on the work type and place	Project Manager	-
			All workers to go through safety and health inductions upon employment.	Project Manager	-
	To protect members of the public from hazards associated with construction activities.		Only authorised workers will be allowed to enter construction areas. No members of the public will be allowed to enter construction sites as well as the farm premises	Project Manager	-

			"Danger" warning signs to be placed in different points along the boundary of the project area and along the access road.	Project Manager	-
			Warning signs to be written in symbols, English and Vernacular language for easy interpretation.	Project Manager	-
Landscape and Visual characteristics	To protect visual characteristics of the landscape.	Project inception	Where there shall be no roads and buildings, the visual characteristics of the landscape shall not be altered.	Project Manager	1,100
Hazardous Waste	To safely keep generated hazardous waste and dispose of appropriately	Throughout Project	Used oil and used batteries storage areas shall be constructed according to environmental guidelines. Lockable, concreted and bunded shed shall be constructed.	Project Manager	1,200
Sewerage Waste	To protect sewer waste from contaminating the soil and or ground water	Throughout Project	A septic tank system shall be revamped and/or constructed to treat sewer waste since Henties Bay University research facility & surrounding areas are not fully serviced by municipal infrastructures	Project Manager	1,250
Solid Waste	Dispose solid waste at construction site accordingly	Throughout Project	Wheel bins and garbage boxes will be stored in designated areas and sold or given to authorised scrap metal dealers or given to the locals for domestic use.	Health officer	1,450
			Cement empty bags and containers will be re-used or returned to supplier for re-use.	Project Manager	

OPERATIONAL PHASE					
Surface and ground Water Quality	To protect contamination of surface and ground water	Quarterly	Proper maintenance of storm water drains along access roads and drains within the project area	Project Manager	-
			The transport of hazardous materials to and from project site will be done in accordance with laid down procedures. Requirements will Include: documentation and inventory control through chain of custody; emergency response training for spills.	Project Manager	-
			Only designated transport routes shall be used to transport chemicals such as fertiliser, fungicides, herbicides, fuel, used oil, fresh oil, lime and pesticides to and from the business.	Project Manager	-
			Contracted transporters of chemicals shall be licenced with Ministry of Mines & Energy.	Project Manager	-
			Contracted transporters of petroleum products shall be licenced with the Energy Regulation Board	Project Manager	-
			Application of fertilisers, fungicides, pesticides and herbicides will be in accordance will the law and guidelines.	Project Manager	-
	The quality of source water can also have a	Quarterly	Water quality will be tested and further treatment may be required to ensure that the quality meets specific	Project Manager	-

	major effect on the viability of an aquaculture operation		purposes of the mariculture research facility operation and is in accordance with national technical regulation (i.e. Sub-decree on Water Pollution Control)		
Fish populations	Protection of the genetic integrity of wild populations of fish.	Quarterly	For each species, a brood stock comprising at least 50 individuals will be maintained and any type of hybridization will be prohibited. Furthermore, brood stock will be replenished annually from local sources	Project Manager	-
Fish escapement (Hatchery)	Conservation of fish stocks for research	Quarterly	All pond and canal inlets and outlets should be screened with synthetic netting. An appropriate hatchery pond design will further reduce the risk of fish escapement.	Project Manager	-
Fish escapement (Grow-out systems)	Conservation of fish stocks & population for research	Quarterly	Non-native species will be grown-out (raised) only in confined, low water exchange 'closed systems' i.e. concrete tanks or artificial earth ponds with no hydrological connection to the river system. Furthermore, only tanks and ponds located outside of the flood zone and not in close proximity to water courses of the river system or ocean will be permitted to grow-out non-native species. As an additional	Project Manager	-

			precaution, all inlets and outlets will be screened with appropriate size mesh screens.		
Wastewater	To protect contamination of surface and ground water	Throughout Project	To prevent the problem of aquaculture wastewater, the hatchery has been designed with a water treatment pond. This pond will receive water from hatchery, cement tanks, brood stock ponds and nursing ponds. The capacity of this pond is 1,956 m3, equivalent to 4 nursing ponds. The remaining nutrients will be stripped off the water through the natural food web or wet land system. Afterwards the water will be sent back into the reservoir for recycling. On the other hand, all wastewater from house and office should be treated using the water treatment tank (septic tank). A monthly monitoring of wastewater quality is necessary to ensure that wastewater discharge meets national standard requirements.	Project Manager	5,000
Control of diseases and parasites	Control of diseases and parasites	Throughout Project	Broodstock and progeny will be monitored daily for signs of disease and parasites and treated only, when necessary, with approved drugs and treatments. Movements of fish will be controlled if signs of disease or parasites exist	Project Manager	5,000

Ambient Air Quality	To prevent contamination of air due to dust emissions from vehicles and trucks operating on dirt roads	Quarterly	The project area shall have a water bowser which shall be used to suppress dust on access roads and construction sites where there is dust.	Project Manager	1,250
			If available molasses will be sprayed on roads and construction sites to suppress dust formation	Project Manager	-
	Low fume and gas emissions		Planted Trees or natural plants will be left along access roads and on the periphery of the proposed project site to act as a wind breaker and thereby reduce dust levels	Project Manager	1,000
			Diesel equipment to be equipped with gas absorbers	Project Manager	-
Soil	Protection of soil from contamination by hazardous waste	Quarterly	Hazardous waste shall be kept in a lockable, concreted and bunded storage facility	Project Manager	-
	Protection of Soil from contamination by fertiliser, pesticides, fungicides and herbicides	Quarterly	Pesticides. Herbicides, fertiliser and fungicides shall be kept in a properly constructed area with proper ventilation, concreted floor, bunded and lockable shed	Project Manager	-
			Application of these chemicals shall follow the right procedures	Project Manager	-
Soil Erosion	To protect the soil from erosion	Quarterly	Storm water drains will be periodically maintained to collect storm water and there by prevent soil erosion.	Project Manager	-

			Access roads and the plant periphery will be left with trees and this will protect soil erosion	Project Manager	
Noise	To minimise noise levels to acceptable levels	Quarterly	All project equipment will be subject to a routine maintenance programme to ensure they are in good working order, hence minimising noise levels.	Project Manager	1,450
	To protect workers from noise exceeding acceptable levels		Employees will wear appropriate ear protection in workplaces where noise levels exceed. The Proponent will enforce the use of PPE in the project site.	Project Manager	-
Land Use	Protect land from being used in other ways	Throughout project life	The University research facility project is and/or will be strictly for university academic research purposes and for research information publications. Any other use will be prohibited.	Project Manager	-
Flora	To protect the local flora where possible	Throughout project life	All the trees left after the construction phase shall not be cut for whatever reason. A procedure for cutting of trees shall be put in place. Progressive planting of trees shall be carried out and encouraged in areas where trees had been carelessly cut.	Project Manager	-
	Extinction of endangered plant species.		Identified Endangered plant species shall be preserved and planted elsewhere at all costs if possible.	Project Manager	-

	Protection from introduction of invasive species		No invasive or alien species shall be introduced on this farmland in accordance with the invasive species act.	Project Manager	-
Fauna	To protect local fauna.	Throughout project life	Noticed fauna in the proposed project sites will be preserved relocating it to areas that will remain undisturbed	Project Manager	-
Archaeology and cultural sites	To protect cultural heritage from damage	Throughout project life	Any cultural heritage site discovered during operational phase other than the existing grave site will be preserved and the cultural heritage commission informed accordingly	Project Manager	-
Public Safety	To minimise health and safety risks.	Throughout project life	Pre-employment and regular medical examinations will be carried out on all farm employees	Project Manager	3,000
	To protect members of the public from hazards associated with construction activities		All plant equipment will be subject to a routine maintenance programme to ensure they are in good working order, hence minimising health and safety risks	Project Manager	-
			All workers whether contractor or not will be subject to wearing appropriate personal protective equipment (PPE) depending on the work type and place	Project Manager	-
			All workers to go through safety and health inductions when just employed	Project Manager	-

	To protect members of the public from hazards associated with construction activities	Throughout project life	Only authorised workers will be allowed to enter construction areas. No members of the public will be allowed to enter construction sites.	Project Manager	-
			"Danger" warning signage to be placed in different points along the boundary of the farm.	Project Manager	-
			Warning signs to be written in symbols, English and vernacular language.	Project Manager	-
Landscape and Visual characteristics	To protect visual characteristics of the landscape	Throughout project life	Where there shall be no roads and buildings, the visual characteristics of the landscape shall not be altered	Project Manager	-
Hazardous Waste	To safely store and handle generated hazardous waste	Throughout project life	Used oil and batteries storage areas shall be maintained according to environmental guidelines. Lockable, concreted and bunded shed shall be used.	Project Manager	-
Sewerage & effluent Waste	To protect sewer waste from contaminating the soil and/ or ground water	Throughout project life	A septic soak way system already exists on university campus of the project area. Thus, no construction of other septic tank will be required on the existing development.	Project Manager	-
Solid Waste	Disposal of solid waste	Throughout project life	Biomass from the plants will be stored and energy generation options evaluated	Project Manager	-

			Domestic solid waste will be disposed of at the Henties Bay designated Dumping site in accordance with the waste management regulations	Project Manager	-
Occupational health and safety	Wellness of employees and employee safety	Throughout project life	Staff and workers operating the research facility should be (i) annually trained in labour safety rules and first aid and (ii) provided with labour safety tools; the facility should be provided with qualified first-aid kits and fire-extinguishers at all times; Dangerous area if any, should be provided with a warning signboard	Health officer	10,000 annually

MONITORING PLAN

Phase	What parameter to be monitored?	Where parameter to be monitored?	How parameter to be monitored?/type of monitoring equipment	When parameter to be monitored? (frequency of measurement or continuous)	Cost	Responsibility for monitoring
Pre-construction						
a) Detailed design	Technical specifications		Review and appraisal by the panel of experts	Before commencement of construction	Preparation cost	University management
Construction						

Phase	What parameter to be monitored?	Where parameter to be monitored?	How parameter to be monitored?/type of monitoring equipment	When parameter to be monitored? (frequency of measurement or continuous)	Cost	Responsibility for monitoring
a) Noise disturbance and vibrations	a) Noise levels; sonometer	a) At and near work site	Inspection and supervision; according to Namibia noise standards	a) once a month or on complaint	Included in subproject cost	Contractor
b) Dust/air quality[1]	- TSP (24 hours average) - CO, NO_2 and SO_2 (1 hour average)	b) At and near work site	b) inspection	b) once every 3 months; unannounced inspections during material delivery and construction	Included in subproject cost	Contractor
c) Traffic disruption during construction activity	c) existence of traffic management plan; traffic patterns	c) At and near work site	c) inspection; observation	c) before works start; once per month at peak and non-peak periods	Included in subproject cost	Contractor
d) Vehicle and pedestrian safety when there is no construction activity	d) visibility and appropriateness	d) At and near work site	d) observation	d) once per month in the evening	Included in subproject cost	Contractor

Phase	What parameter to be monitored?	Where parameter to be monitored?	How parameter to be monitored?/type of monitoring equipment	When parameter to be monitored? (frequency of measurement or continuous)	Cost	Responsibility for monitoring
e) Soil erosion	e) Turbidity	e) At work site	e) Visual observation by Supervisor	e) Construction stage	Included in subproject cost	Contractor
f) Quarries, sand & borrow pits	f) Possession of official approval or valid operation license	f) Quarry, sand & gravel borrow pits	f) inspection	f) Before work begins	Included in subproject cost	Contractor
g) Drainage and flood hazard	g) Execution of work according to design	g) At work site	g) inspection	g) During construction	Included in subproject cost	Contractor
h) Water and soil pollution from improper material storage, management and usage	h) water and soil quality (suspended solids, oils, pH value, heavy metals)	h) runoff from site, material storage areas; wash down areas of equipment	h) inspection; observation	h) during material delivery and construction, especially during precipitation (rain, etc.)	Included in subproject cost	Contractor
i) Water and soil pollution from improper disposal of waste materials	i) water and soil quality (suspended solids, oils, pH value)	i) depository site	i) inspection; observation	i) once every 3 months during construction and on complaint	Included in subproject cost	Contractor
j) Potential contamination	j) water and soil quality (suspended)	j) At work site; construction equipment place	j) unannounced inspection	j) once every three months	Included in subproject cost	Contractor /field engineer

Phase	What parameter to be monitored?	Where parameter to be monitored?	How parameter to be monitored?/type of monitoring equipment	When parameter to be monitored? (frequency of measurement or continuous)	Cost	Responsibility for monitoring
of soil and water from improper maintenance of equipment	solids, oil, lubricants, fuel, pH value			during construction, on complaint, and in case of spillage		Contractor /field engineer
k) Air pollution from improper maintenance of equipment (asphalt plant and machinery)	k) Exhaust fumes, dust	k) At work site	k) Visual inspection during work	k) During work	Included in subproject cost	Contractor /field engineer
l) Staff safety	l) protective equipment; organization of bypassing traffic	l) At work site	l) inspection	l) unannounced inspections during work	Included in subproject cost	Contractor /field engineer
Construction	Worker's camp site conditions					
a) Overall workers' camp site conditions	a) Cleanliness, solid waste handling and disposal facilities, drainage conditions	a) On the camp site during construction activities	a) Unannounced inspection	f) According to the existing regulations	Included in subproject cost	Contractor /field engineer

Phase	What parameter to be monitored?	Where parameter to be monitored?	How parameter to be monitored?/type of monitoring equipment	When parameter to be monitored? (frequency of measurement or continuous)	Cost	Responsibility for monitoring
Operation						
Wastewater [2]	pH, BOD_5, COD, TSS,[3] NO_3^-, PO_4^{3-}, NH_3	water outlet of the hatchery facility	Inspection	Once every three months	Operation cost	Facility project manager
Surface water (Omaruru River water)	pH, BOD_5, Suspended Solid (SS), Dissolved Oxygen (DO), Coliform	Water intake	Inspection	Once every three months	Operation cost	Facility project manager
Protection of the genetic integrity of wild populations of fish.	Broodstock records including number of individuals by sex, age, maturity, condition, health, source (origin)	The research hatchery facility	Visual observation and record keeping (reporting).	Annually.	Operation cost	Facility project manager
Fish escapement prevention (Hatchery)	Ensure all pond and canal inlets and outlets screens are intact and in place.	Research hatchery facility	Observation	Daily	Operation cost	Facility project manager
Fish escapement Prevention	Ensure that non-native species are grown-out (raised) only in confined,	Participating CFi employing aquaculture as an	Field Observation	Monthly	Operation cost	Facility project manager

Phase	What parameter to be monitored?	Where parameter to be monitored?	How parameter to be monitored?/type of monitoring equipment	When parameter to be monitored? (frequency of measurement or continuous)	Cost	Responsibility for monitoring
(Grow-out systems)	low water exchange 'closed systems'	alternative livelihood.				
Fish escapement prevention (During transportation between hatchery, grow-out systems and markets)	Monitor fish releases or stocking activities in open waterbodies.	Waterbodies and river courses	Field observations	Continuous	Operation cost	Facility project manager
Control of diseases and parasites at the hatchery and at grow-out facilities.	Brood stock and progeny, and cultured fish monitored for signs of disease and parasites.	The research hatchery facility. Grow-out facilities	Visual observations in the field and lab. Further testing if necessary.	Daily	Operation cost	Facility project manager
Chemicals management	List of chemicals used for control of diseases and parasites.	The hatchery station	Review the list and check	Once every six months	Operation cost	Facility project manager
Solid waste	Proper collection and disposal	The hatchery station	Observation	Once every six months	Operation cost	Facility project manager

Phase	What parameter to be monitored?	Where parameter to be monitored?	How parameter to be monitored?/type of monitoring equipment	When parameter to be monitored? (frequency of measurement or continuous)	Cost	Responsibility for monitoring
Sediment disposal	Proper collection and disposal	The research facility	Observation	Once every six months	Operation cost	Facility project manager
Occupational health and safety	Training and awareness	The research facility	Interview of staff and workers and overseeing practice	Once a year	Operation cost	Facility project manager
Facility fine filtration system	Check pressure gauges on filter cartridge system & change of cartridge required	The research facility	Observation & tests	Daily, weekly, monthly	Operation cost	Facility project manager
Facility culture system	Check all pumps functioning correctly, check water flows, check water replacement valves and monitor temperature control units	The research facility	Observation, check-up & tests	Daily weekly, monthly	Operation cost	Facility project manager
Air system	Check for open and clean out air filter	The research facility	Observation, check-up & tests	Daily weekly, monthly	Operation cost	Facility project manager

7. RECOMMENDATION

Since the facility research project area is within the Local Authority's Townland area (called Portion 70 of the farm of Henties bay townland no. 133), the area is already disturbed, all potential impacts that were identified during the assessment process were minor and short only at constructional phase. These impacts can be minimized and managed successfully through the implementation of this Environmental Management Plan which is specific to the project. It is recommended that environmental performance through aspect monitoring be implemented regularly to ensure compliance measure as per the set Environmental Management Plan.

All options and benefits considered point that the entire Namibia institutions of higher learning, business investors, the Henties bay Local authority and its resident all benefit greatly from the operational activities of the mariculture research facility. As research on mariculture/aquaculture improves the country's information on fish ecological systems, the sustainability of the country's aquaculture farming or practices, which helps preserve the biodiversity of the oceans fishes and protect the habitats of wild fish populations. It is important for the ecological balance of the oceans to ensure the long-term sustainability of seafood production

REFERENCES

CSIR, 2000.*Guidelines for human settlement planning and design*. Chapter 9. Water supply

DWAF, 2008. Code of practice: Volume 1. Septic tank systems. General guidelines

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

Pastakia, C.M.R.1998.the Rapid Impact Assessment Matrix (RIAM) – Anew tool for Environmental Impact Assessment.

Food Association Organisation (FAO). 2012. Environmental impact assessment. Guidelines for FAO field projects. Report

Republic of Namibia. 2002. Aquaculture Act 18 of 2002. Accessed on 28 July 2023. https://www.lac.org.na/laws/annoSTAT/Aquaculture%20Act%2018%20of%202002.pdf

SUNUMARC. 2006. Aquaculture systems operational manual. Systems operations guide