MARVIN
ENVIRONMENTAL PROJECT
CONSULTANTS CC
Experts in Sustainable Development

TUNACOR FISHERIES LTD.

FINAL ENVIRONMENTAL PERFORMANCE REPORT AND MANAGEMENT PLAN:

EXISTING SEA WATER TREATMENT AND DISCHARGING ACTIVITIES, WALVIS BAY INDUSTRIAL AREA, ERONGO REGION

SEPTEMBER 2020

tunacor

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

Below a list of acronyms and abbreviations used in this report.

Acronyms	Definition
(Pty) Ltd	Propriety Limited
ANZECC	Australian and New Zealand Environment and Conservation Council
BCLME	Benguela Current Large Marine Ecosystem
BOD	Biological Oxygen Demand
CIP	Clean-in-Place
CSIR	Council for Scientific and Industrial Research
DAF	Dissilved Air Flotation
DBNPA	Dibromonitrilopropionamide
DO	Dissolved Oxygen
DWAF	(South African) Department of Water Affairs and Forestry
E	East
EAPAN	Environmental Assessment Professionals Association of Namibia
EDTA	Ethylenediaminetetra-acetic acid
EIA	Environmental Impact Assessment
EPL	Exclusive Prospecting Licences
ESE	East-Southeast
H_2S	hydrogen sulphide
HAB	Harmful Algal Blooms
HWS	High Water Spring
I & J	Irvin and Johnson
IBAs	Important Bird Areas
IMDH	International Mining and Dredging Holdings
IUCN	International Union for Conservation of Nature
IWC	International Whaling Commission
LMC	Lüderitz Mariculture (Pty) Ltd
MET	Ministry of Environment and Tourism (now Ministry of Environment, Forestry and Tourism)
MFMR	Ministry of Fisheries and Marine Resources
ML	Mining Licence
MLA	Mining Licence Area
MLD	Megalitres per day

MME	Ministry of Minerals and Energy
MPAs	Marine Protected Areas
NDP	Namibian Dolphin Project
NIMPA	Namibian Islands Marine Protected Area
NNE	North-Northeast
NNW	North-Northwest
NW	Northwest
Pers. comm.	personal communication
PIM	Particulate Inorganic Matter
POM	Particulate Organic Matter
RO	Reverse Osmosis
S	South
SACW	South Atlantic Central Water
SADCAS	Southern African Development Community Accreditation Services
SAN	South African Navy
SD	Standard Deviation
SE	Southeast
SMBS	sodium metabisulfite
SME	Small and Medium Enterprise
sp.	species (singular)
spp.	Species (plural)
SSE	South-Southeast
SSW	South-Southwest
STPP	Sodium tripolyphosphate
SW	Southwest
TAC	Total Allowable Catch
TSP	Trisodium phosphate
TSPM	Total Suspended Particulate Matter
UNEP	United Nations Environment Program
US	United States
US-EPA	United States Environmental Protection Agency
WNW	West-Northwest

Units used in the report

Unit	Definition
°C	degrees centigrade
cm/s	centimetres per second
g	grams
g/ℓ	grams per litre
g/m^2	grams per square metre
km	kilometres
km/h	kilometres per hour
km^2	square kilometres
m	metres
m^3/day	cubic metres per day
mg/ℓ	milligrams per litre
Mℓ	megalitre (1,000 m^3)
MLD	megalitres per day
mm	millimetres
m/s	metres per second
ppt	parts per thousand
tons/km^2	tons per square kilometre
>	greater than
<	less than
%	percent
µg/ℓ	micrograms per litre
µM	microMol
µm	micron

1 INTRODUCTION

1.1 PROJECT BACKGROUND

In 2014, Tunacor Fisheries Limited (Tunacor) became 100% wholly Namibian owned fishing company from its predecessors South Africa and Spanish management. It was in 1958 that Tunacor was first established as a business infrastructure solely focused on Pilchard Cannery and Fishmeal. Over the years the company has grown and transformed into processing and the exporting of value-added fish products directly to retailers locally and international markets. The fishing factory currently employs over 2100 people and has a fishing fleet of 12 trawlers and 3 long liners. The fisheries processing factory is located in the industrial area of Walvis Bay, Erongo Region (refer to Figure 1-1 for the locality map). Tunacor fish factory premises encompass an area of about 119 078 m^2 that includes fish processing infrastructure such as, the seawater treatment plant, cannery, Wet fish factory associated with cold storage facilities, Maintenance facilities, substation, office and ablution facilities.

Tunacor ensures the most effective operational and maintenance system is implemented when water services are used. Fresh and Sea water is a key commodity in the maintenance and operations of the fish factory premises. The freshwater is supplied by the Municipality of Walvis Bay through an industrial water services supply network connection to the fish factory and a water metre is installed on the premises to ensure continuous monitoring and adherence to the municipal water supply connection services requirements.

Understanding the current demand in water supply services by the Municipality from an industrial point of view and the resultant strain on the Kuiseb river aquifer that supplies portable water to both residents and the industry of Walvis Bay, Tunacor has identified the need to abstract seawater and through various processes of treatment, supply to the fish processing factory for cleaning purposes and further monitor the quality of waste seawater before discharging back to the sea. Infrastructure including a water treatment plant and Ultra-violet water purifier system have already been installed to enable qualitative processing and analysis of the seawater prior to usage in the fish processing factory and discharging to the sea as waste seawater. The activity involving seawater abstraction, treatment and waste seawater discharge is currently operational. The Ministry of Agriculture Water and Land Reform's (MAWL) Department of Water Affairs (DWA) issued Permit 11166 for the seawater abstraction activity on the 20th of May 2016 and is valid for 5 years (Appendix 1). Tunacor has requested Namibia Health and Safety Environmental Consultancy (NAMHSE) to advise the environmental compliance process required for the discharging of waste seawater activity to the sea prior to further submitting an application for a seawater discharge permit from the regulating authority MAWL's DWA.

It is with this background that NAMHSE has advised an Environmental Impact Assessment (EIA) is undertaken. EIAs are regulated by the Ministry of Environment and Tourism (MEFT) in terms of the Environmental Management Act, 7 of 2007. This Act was gazetted on 27 December 2007 (Government Gazette No. 3966). Taking into consideration, activities associated with the discharging of waste seawater to the sea is already being undertaken at the fish factory, NAMSHE has advised the compilation of an Environmental Performance Report and Management Plan would identify and assess all environmental aspects associated with the existing seawater discharge activity and advise management and mitigation measures that should be implement in order to avoid further impacts. An Environmental Clearance Certificate (ECC) through the regulatory authority (Ministry of Environment, Forestry and Tourism (MEFT) should be submitted. NAMSHE has teamed up with EIA practitioners Marvin Environmental Project Consultants CC (Marvin Consultants) to compile and undertake the EIA process.

1.2 MOTIVATION (NEED AND DESIRABILITY)

Due to the growing increasing demand in water supply services by the Walvis Bay Municipality to the residents and industry, the fish processing industry is faced with the challenge to consider alternative and efficient water supply sources required for cleaning purposes in fish processing factories as opposed to using municipal potable water for this purpose. Tunacor currently abstracts about ± 407 000 m^3 of seawater per annum that is used in the fish processing factor for cleaning purposes only. About 101200 m^3 of potable water per annum supplied by the municipality is also used in the fish processing factory and other facilities. The abstracted seawater is treated through the already installed Water Treatment Facility prior to usage in the factory. An effluent's discharge filtering and screening system has been installed to ensure further screening of the resultant waste seawater from the fish processing factory to enable the collection of fish solid waste that is used as part of the fishmeal processing. This avoids further discharging of the solid material into the sea. Tunacor further undertakes qualitative monitoring and analysis through a certified lab Namibia Standards Institute (NSI). This is done to ensure the discharged waste sea quality is within the criterion used for the discharging of waste seawater at sea. **However, there is potential impacts that may be associated with the marine ecology that Tunacor has not identified yet through the existent operational activity of seawater abstraction and waste seawater discharging activities at sea. The waste seawater criterion currently used needs to be updated with additional guidelines relating to discharging of effluents at sea**. The proposed EIA process including an internal scoping process and assessment will allow an opportunity to identifying the aspects and impacts that will further advise the compilation of an Environmental Management Plan. The EMP documents the Management, Mitigation and Monitoring measures for implementation. This process will then proceed to an application for a waste seawater discharge permit with the MAWL after the MEFT has approved and issued the ECC.

Figure 1-1: Locality Map to Tunacor Fisheries Ltd.

1.3 ENVIRO- LEGAL CONTEXT

An EIA process was not previously undertaken for the existing waste seawater discharging activities at Tunacor Fisheries Ltd. This section identifies the environmental legal context associated with the ongoing waste seawater discharging activities including Seawater Abstraction and treatment.

EIA's in Namibia are regulated by the Ministry of Environment, Forestry and Tourism (MEFT) in terms of the Environmental Management Act, 7 of 2007. This Act was gazetted on 27 December 2007 (Government Gazette No. 3966). The list of activities that may not be undertaken without an Environmental Clearance Certification (ECC) and the Environmental Impact Assessment Regulations: Environmental Management Act, 2007 (Government Gazette No. 4878) were promulgated on 6 February 2012.

The following listed activities from the above-mentioned regulations are relevant to the existing seawater discharging activities:

8. Water Resource Developments

8.1 The abstraction of ground or surface water for industrial or commercial purposes.

8.6 Construction of industrial and domestic wastewater treatment plants and related pipeline systems.

9. Hazardous Substance Treatment, Handling and Storage

9.2 Any process or activity which requires a permit, license 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, license or authorisation or which requires a new permit, license or authorisation in terms of a law governing the generation or release of emissions, pollution, effluent or waste.

1.3.1 The Proposed EIA Process and this Report

Subject to the EIA regulations and the Environmental Management Act no.7 of 2007, a listed activity may not be undertaken prior to an EIA process undertaken and ECC issued by the regulatory authority MEFT.

The activity related to the discharging of waste seawater to the sea in the Walvis bay harbor is already an existent activity. An EIA process was not undertaken for the operational activities related to Tunacor's Fish processing factory including the discharging of waste seawater activity.

The waste seawater discharge activity is not listed in the EIA regulations. However, certain aspects and activities associated with the process of seawater abstraction, treatment and discharging (including content) of the waste seawater to the sea may trigger the need for an assessment to identify the related potential impacts, propose and compile the management, mitigation and monitoring requirements thereof.

An Environmental Performance Report and Environmental Management Plan (EMP) is recommended to identify potential impacts and document the management and mitigation measures associated with the

seawater treatment and discharge at sea. To ensure the measures raised are effective and comprehensive, **a scoping process including internal screening and impact assessment has been included and is part of the Environmental Performance component of the report. The impact assessment phase discusses and identifies all aspects and impacts and allows for the EMP to document the associated Management and Mitigation (including monitoring) action plan.**

1.3.2 ECC Application Submission

An EIA process described in this report is being conducted in terms of the Environmental Management Act, 7 of 2007. The ECC application including the Background Information Document (BID) have been completed and are to be submitted to the competent authority (MAWL's) Permanent Secretary's office that will review and provide their comments and forward the application to the regulatory authority (MEFT). The application for ECC was completed on the MEFT's EIA portal and an application number (APP 1934) is retained.
This report will provide sufficient information for the MEFT to make an informed decision and whether an Environmental Clearance Certificate can be issued.

1.3.3 Scoping process including Internal Screening

This report has taken the current restrictions and "lock-down" requirements in Namibia into consideration due to the COVID 19 Global pandemic. The Terms of Reference (TOR) for the Scoping process of the report has therefore been slightly modified to cater for these restrictions. However, depending on the future change in restrictions, the TOR might again have to be modified.

The Scoping process including internal screening corresponding activities are outlined in Table 1-1 below.

Table 1-1: Scoping Process including internal screening

Objectives	Corresponding activities
Project initiation/screening phase (May-April 2020)	
• Identify environmental aspects and potential impacts internally • Notify the decision-making authority of the required permitting process • Initiate the EIA Scoping process.	• Project initiation discussions with the project proponent. Identify environmental and social issues and determine legal requirements. • A pre-application discussion with MAWL and the submission of the ECC application form was done.
Internal Scoping phase (including assessment of impacts) (May- July 2020)	

• Identify interested and/or affected parties (IAPs) and involve them in the internal scoping process through information sharing and telephonic discussions. • Further identify potential environmental issues associated with the proposed project. • Provide a description of the potentially affected environment. • Assessment of potential environmental impacts associated with the current project. • Additional design requirements and management and mitigation measures. • Receive feedback on application from regulating Authority.	• Notify relevant government authorities and IAPs of the project and EIA process (telephone calls, e-mails, distribution of background information) • Site visit to Tunacor Fish Processing Factory; • Compilation of Environmental Performance and EMP Report. • Distribute Draft Report to relevant authorities and IAPs for review. • Forward finalized EMP Report with IAPs comments to MEFT for decision making.

1.3.4 Team that prepared this report

Marvin Environmental Projects Consultants CC (Marvin Consultants) is a registered independent company comprised of a team of experts and associates. Marvin Sanzila (MS) was appointed by NAMHSE to undertake the EIA process required for the existent activities. The EIA process management role is performed by Marvin Sanzila as the EIA practitioner. MS is a certified Environmental Practitioner and under the Environmental Assessment Professionals Association of Namibia (EAPAN) and serves on the board as the Secretary General. MS has eight years of relevant experience in environmental management, Project Management, conducting/managing EIAs, compiling EMPs and implementing EMPs and Environmental Management Systems. MS has assisted various consultants in conducting Environmental Impact Assessments (EIAs) for project appraisals with the regulating authorities. All projects experience related to EIAs have been successfully awarded Environmental Clearance Certificates (ECCs) by the regulating authority and are operational, enhancing both local and international business sector while implementing best practice environmental and social management tools. Apart from Project Management and Environmental Assessments, MS has presented and narrated two films, one that emphasizes the role of the environmental

Management Act no.7 of 2007 in the modern-day Namibian development context and the other that looks at Namibia's Wetlands and its potential for ecotourism.

Charles Cleghorn (Project Manager and Reviewer): An experienced SHEQ (Safety, Health, Environment and Quality) Manager, focussed on the development, implementation monitoring and improvement of effective Management Systems in Quality, Environment and Safety disciplines in developing countries with diverse cultures. Have developed documentation and submittals for various Permits to governments and compiling and reporting of Legal compliance. Charles experience with managing SHEQ departments in various African countries and companies. Has worked in several mining companies in Namibia and West Africa and extensively in the fishing industry in Namibia (both for private industry and the regulator)

He has extensive experience in the monitoring of compliance requirements according to the Lender (World Bank/ IFC Performance Standards and the Equator Principles), in country and international legislation and regulations.

Well experienced in negotiating with regulators from various government departments in different countries in obtaining permits and in auditing the requirements various organisations, EPCM and operational contractors' operations, staff performance and compliance levels in multiple sites in various countries. Able to identify SHEQ risks to operations and to include in controls set to reduce impacts on environmental and improve health safety and quality of operations.

Has obtained experience in working only for export driven companies in Namibia and West Africa (Liberia), implementing international standards in local factories and on mine sites. Conducting EMP updates and developments, and reviewing of EIA for multi-disciplinary projects in the mining industry. He has been a previous Director/Owner of a private construction and property development company in Namibia (Swakopmund and Walvis Bay for 4 years), focussing on residential, commercial, single and high-density developments over several years. Obtaining building approvals/permits, with engineering and municipal and national regulations incorporated in designs and final construction.

Currently consulting to the IAEA (Vienna, Austria), large export driven companies, property developments, industrial/manufactory companies, transport, tourism and engineering firms in Namibia in Environmental Impact Assessment (EIA).

The relevant curriculum vitae documentation is attached in Appendix 2. The environmental project team is outlined in Table 1-2 below.

Table 1-2: The environmental project team

Company	Name	Designation	Tasks and roles
Tunacor Fisheries Limited.	Günther Pfeiffer	Maintenance Manager	Project description Scope and Reviewer
	Thomas Harris	Group Quality Assurance Manager	Project description Scope and Reviewer
	Rebecca Kanjaba	HSE Officer	Project Description and Quality analysis reports.
	Rauna Nghifikwa	Quality Assurance and Environmental Representative	Environmental Management System and Environmental Monitoring Plan and Reports
NAMHSE including (Marvin Environmental Project Consultants cc)	Charles Cleghorn	Project Manager and Reviewer	Management and review of the process and Report.
	Marvin Sanzila	EIA Project Practitioner	Management of the EIA process and compilation of the report

2 ENVIRONMENTAL PERFORMANCE REPORT SCOPING METHODOLOGY

2.1 INFORMATION COLLECTION

The main sources of information for the preparation of this Scoping process:

- Project information provided by Tunacor which includes:
    - Description of the existing seawater discharging activities;
    - Infrastructure plans;
- Site visit;
- Consultation with Stakeholders including local authorities.
- Other EIAs and literature research similar to the project.

2.1.1 Environmental Performance Report (Scoping Process)

The main purpose of this Environmental Performance Report is to identify what environmental aspects relate to the existent waste sea-water discharge activity. The scope of this EIA process therefore only includes the impacts associated with the existing waste sea-water discharge. outlines the adapted Scoping process requirements contained in Section 8 of the Environmental Impact Assessment Regulations promulgated in February 2012 under the Environmental Management Act, 7 of 2007. The table includes reference to the relevant sections in the report.

Table 2-1: Scoping report requirements stipulated in the EIA regulation

Requirements for a Scoping Process and report in terms of the EIA regulations	Reference in report
(a) the curriculum vitae of the EAP who prepared the report;	Appendix 2
(b) a description of the proposed activity;	Section 4
(c) a description of the site on which the activity is being undertaken;	Section 4
(d) a description of the environment that may be affected by the activity and the manner in which the geographical, physical, biological, social, economic and cultural aspects of the environment may be affected by the activity.	Section 5
(e) an identification of laws and guidelines that have been considered;	Section 3
(f) details of the Stakeholders consultation process conducted and a summary of the issues raised.	Section 2.3
(g) a description of the need and desirability of the existing listed activity;	Section 1.2
(h) a description and assessment of the significance of any significant effects, including cumulative effects, that may occur as a result of the undertaking of the activity;	Section 7
(i) terms of reference for the detailed assessment; and	
(j) a draft management plan, which includes - **(i) information on any proposed management, mitigation, protection or remedial measures to be undertaken to address the effects on the environment that have been identified including objectives in respect of the rehabilitation of the environment and closure;** **(ii) as far as is reasonably practicable, measures to rehabilitate the environment affected by the undertaking of the activity or specified activity to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development; and** **(iii) a description of the manner in which the applicant intends to modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation remedy the cause of pollution or degradation and migration of pollutants.**	Section 8

2.2 PUBLIC CONSULTATIONS

Due to the COVID-19 restrictions, public meetings were not relevant in this period. However, Focus Group meetings with the local authorities and neighbouring business operators were undertaken.

2.3 STAKEHOLDERS ENGANGEMENT PROCESS AND COVID-19 PANDEMIC RESTRICTIONS

The COVID-19 pandemic is a pandemic of coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The outbreak was first identified in Wuhan, China, in December 2019. The World Health Organization declared the outbreak a Public Health Emergency of International Concern on 30th January, and a pandemic on 11th March. The COVID-19 pandemic reached Namibia on 14th March 2020. On 14 April 2020, the Government of Namibia stated a more aggressive state of emergency and declared a lockdown from midnight 17 April 2020 to midnight 4 May 2020. Prior to the lapse of the lockdown, a 4-stage strategy was developed to gradually ease restrictions. The EIA process was

undertaken in stage 3 of the Namibian Covid-19 guideline, activated on 1 June 2020. Stage 3 is envisaged to follow 28 days after stage 2. It will allow the reopening of schools and universities and a gradual opening of borders. Public gatherings of up to 50 people will be permitted. In order to avoid human contact and comply as much as possible to the national regulations on COVID-19, Focus group meetings with key stakeholders were undertaken at a maximum of 5 people per meetings. The Stakeholders participation process for the project aimed to ensure that all persons (i.e. neighbouring businesses and/or organisations) that may be affected by, or interested in, the activities were informed of the project and could raise their views and concerns. **By consulting with IAPs (refer to Appendix 3 for the Database, Appendix 4.1 on the notification of Draft EMP report for Review and Appendix 6 for all comments raised**) the range of environmental issues to be considered in the report has been given specific context and focus. Included below is a summary of the IAPs consulted, the process that was followed, and the issues that were identified.

2.3.1 Tunacor stakeholders

The following table (Table 2-2) provides a broad list of stakeholders that are relevant to the existent project. These stakeholders were consulted via telephonic and email (Appendix 4.1) to provide their input into the project. The comments and issues were only raised by the Ministry of Fisheries and Marine Resource (MFMR). The full stakeholder database for this project is included in Appendix 3 of the report.

Table 2-2: Stakeholders Consulted

Stakeholder Grouping	Organisation
Government Ministries	○ Ministry of Environment and Tourism (MEFT) ○ Department of Environmental Affairs ○ Ministry of Fisheries and Marine Resource (MFMR) ○ Ministry of Agriculture, Water and Land Reform (MAWL) ○ Municipality of Walvis Bay
Potentially affected	○ Neighboring business operators
Authorities	○ Regional authorities – Erongo Regional Council ○ Local Authorities – Walvis Bay Municipality
Other interested and / or affected parties	○ NAMPORT ○ Hangana Fishing (Pty) Ltd. ○ Gendev Group ○ Hodago Fishing (Pty) Ltd; ○ Etosha Fishing Corporation (PTY) Ltd; ○ Merlus Sea- food processors (Pty) Ltd.

2.3.2 Summary of issues raised

The above-mentioned stakeholders were consulted via email communication and Telephone calls . Refer to Appendix 4.1 for email correspondence with the stakeholders. MFMR proposed a Focus Group Meeting and raised comments and issues to be addressed ion the EMP report these are presented in the Issues and Response Report and the corresponding minutes in Appendix 5.1. The summary of issues raised can be summarized as follows.

Waste Seawater discharge at sea Guidelines

- The MAWL is the custodian for water regulations and should be able to identify and set the required wastewater and effluents disposal criterion including the required infrastructure such as the DAF Systems incorporated into the process flow. The existing Water guidelines do not specify any requirements for waste water discharge at sea neither have these been enacted formally.
- The BCLME guidelines do incorporate the criterion that could be used for waste water disposal at sea. MFMR has no structure appointed specific for this type of activity.

Monitoring

- NAMPORT has put together various management plans for the port activities. A contingency pollution plan should be available and serves good baseline on the directional movement of sea currents in the port area.
- With specific interest to this project, shall pollution occur at Tunacor Fisheries and this being discharge into the sea. It would be interesting to know the directional movement of such a plume, and would this affect other port users and the lagoon? However, Tunacor should comply to proposed measures regarding monitoring of discharged effluents and pumping velocities.
- Ensure the assessment of heavy metals is also included in the assement section of the EMP.
- Do all port users including fish processing factories have management plans in place that corresponds/ interlinks to the overall Namport Pollution contingency plan?
- Projects like these present an opportunity for monitoring related to understanding what sort of marine biota “planktons “is abstracted prior to treatment process and could be trapped in and among Screens/ Strainers. Various strategic approaches to the monitoring were raised during the meeting and included the involvement of UNAM to the process.
- Tunacor should establish critical sampling points for the seawater abstraction activity and discharging points for waste seawater discharge.

- The monitoring programme should include qualitative laboratory analysis as raised in the specific water guideline for effluents discharging at sea.
- Regular maintenance of the screens, strainers and the calibration of pumps velocities is essential to effective operation the abstraction and discharging system.

Compliance to EMP

- Tunacor should appoint an independent consultant to audit compliance to the EMP including the monitoring proposed thereof; Annual reports presenting compliance to EMP and Monitoring should be shared with the competent authorities and MFMR

3 ENVIRONMENTAL LEGISLATIVE REQUIREMENTS

3.1 NAMIBIAN LEGAL FRAMEWORK

The relevant Namibia legislation, with regard environmental aspects, that will require consideration during the EIA process is detailed as follows.

3.1.1 The Constitution of the Republic of Namibia

The Constitution of the Republic of Namibia (1990) provides the set of foundational principles according to which Namibia is governed. Article 95 (L) of the Constitution commits the state to promote sustainable development by "*maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of living natural resources on a sustainable basis for the benefit of all Namibians both present and future…"*.

The constitutional recognition of environmental concerns triggered widespread legislative reform relating to the management of natural resources in Namibia. The country's environmental protection effort is currently comprised of the Environmental Management Act (7 of 2007) and its Regulations (2012).

3.1.2 Namibia's Environmental Impact Assessment Policy

The Environmental Impact Assessment (EIA) Policy of 1995 promotes accountability and informed decision making through the requirement of EIAs for listed programmes and projects (activities). The EIA Policy is currently enforced through the Environmental Management Act (No. 7 of 2007 (EMA)) and the EIA Regulations of 6 February 2012.

3.1.3 Environmental Management Act

The EMA was promulgated in December 2007 and came into effect on 6 February 2012. Part 1 of the EMA describes the various rights and obligations that pertain to citizens and the Government. The main objectives of the Act are to ensure that:

- Significant effects of activities on the environment are considered carefully and timeously;
- There are opportunities for timeous participation by I&APs throughout the assessment process; and
- Findings are taken into account before any decision is made in respect of activities.

Part 2 of the EMA sets out a number of principles of environmental management which give effect to the provisions of the Constitution for integrated environmental management. Decision-makers must take these principles into account when deciding whether or not to approve a proposed project. In terms of this legal framework certain identified activities may not commence without an environmental clearance (or amendment thereto) that is issued by MEFT.

3.1.4 EIA Regulations

The EIA Regulations, promulgated on 6 February 2012 in terms of Section 56 of the Environmental Management Act, 2007 provides for the control of certain listed activities. These listed activities are provided in GN No. 29 and are prohibited until an ECC has been obtained from MEFT. Such ECCs, which may be granted subject to conditions, will only be considered once there has been compliance with the EIA Regulations 2012. GN No. 30 sets out the procedures and documentation that need to be complied with in undertaking an EIA process. Listed activities applicable to the proposed Project are presented in Section 1.3.1

3.1.5 Water Resources Management Act

The Water Resources Management Act (No. 11 of 2013 (WRMA)) provides a framework for the management, development, protection, conservation and use of water resources in a sustainable manner. Relevant principles of the Act include, inter alia:

- Equitable access for all people to safe drinking water is an essential basic human right to support a healthy productive life;
- Harmonisation of human water needs with the requirements of environmental ecosystems and the species that depend on them, while recognising that the water resource quality for those ecosystems must be maintained;
- Promotion of the sustainable development of water resources based on an integrated water resources management plan which incorporates social, technical, economic, and environmental issues;
- Development of the most cost-effective solutions, including conservation measures, to infrastructure for the provision of water; and
- Promotion of water awareness and the participation of persons having interest in the decision-making process should form an integral part of any water resource development initiative.

A person may not abstract and use water from a water resource, unless the person holds a licence issued by the Minister that authorises the abstraction and use of water from that water resource. The WRMA is relevant since the project already abstracts seawater and discharges effluent “waste seawater” back to the ocean. In terms of the WRMA a "water resource" is defined as “the whole or any part of a watercourse or an aquifer and includes the sea and meteoric water” and thus the provision of the WRMA apply to seawater abstraction. Tunacor does not have an existent seawater Abstraction and Discharge permit and therefore it is highly recommended an application for an abstraction and discharge permit should be undertaken through the authority immediately. Part 13 of the WRMA which deals with Water Pollution Control is relevant to waste water discharge considering various co-pollutants in the process is used for treatment activities. The opening section stipulates that “a person may not by any act or omission cause a water

resource to be polluted, either directly or indirectly, unless authorised to do so by or under this Act or any other law, and in accordance with that authorisation".

3.1.6 Water Quality Guidelines

As far as can be established, South Africa is the only southern African country that currently has an official set of guidelines for water quality of coastal marine waters (DEA, 2018). The approach of the South African guideline, and indeed many other jurisdictions, is to maintain or achieve receiving water quality such that the water body remains or becomes fit for all designated uses. Designated uses of the marine environment includes aquaculture, recreational use, industrial use, as well as the protection of biodiversity and ecosystem functioning. The accepted approach to such guidelines has moved away from targets for specific physico-chemical properties in favour of guideline values derived from a reference system (data set) that is appropriate to the locality and which is determined as the range defined by the 20th and 80th percentiles of the seasonal distribution (also consider event-driven changes) for the reference system.

In terms of policy, legislation and practice South Africa's operational policy for the disposal of land-derived wastewater to the marine environment is thus of relevance. Specifically, environmental quality objectives need to be set for the marine environment, based on the requirements of the site-specific marine ecosystems, as well as other designated beneficial uses (both existing and future) of the receiving environment. The identification and mapping of marine ecosystems and the beneficial uses of the receiving marine environment provide a sound basis from which to derive site-specific environmental quality objectives (SLR & Aurecon, 2014). To ensure that environmental quality objectives are practical and effective management tools, they need to be set in terms of measurable target values, or ranges for specific water column and sediment parameters, or in terms of the abundance and diversity of biotic components. The South African Water Quality Guidelines for Coastal Marine Waters (DWAF, 2005) provide recommended target values (as opposed to standards) for a range of substances, but these are not exhaustive (SLR & Aurecon, 2014). Therefore, in setting site-specific environmental quality objectives, the information contained in the DWAF guideline document is supported by additional information obtained from published literature and best available international guidelines (e.g. ANZECC 2000; World Bank 1998; EPA 2006).

Recommended target values are also reviewed and summarized in the Benguela Current Large Marine Ecosystem (BCLME) document on water quality guidelines for the BCLME region. As required by the WRMA, the Namibian Department of Water Affairs is in the process of compiling regulations for water quality standards for effluent disposal to ground, groundwater and surface waters, including territorial coastal marine waters. To meet this objective, a set of Special Water Quality Standards for effluents has been proposed. Although not specifically stipulated as such, these appear applicable to effluent discharges into

fresh water sources only. Nonetheless, for the sake of completeness, the proposed Special Water Quality Standards will be considered including the BCLME water guidelines for effluents discharge at sea, making reference to the various variables as proposed by other regulating bodies. These have been summarized in Table 3-1 and Table 3-2. Additional reference should be sourced from the BCLME guidelines.

Table 3-1: Currently proposed Special Water Quality Standards Effluents (DWAF 2014)

Determinant	Unit	Proposed Special Water Quality Standards for Effluents
Turbidity	NTU	<5
Colour		<10%
Suspended solids	mg/l	<25 mg/l
TDS	mg/l	<500 mg/l above the intake potable water quality
pH		6.5- 9.5
Temp	C	± 1ºC of ambient
Nitrate as N		< 15 mg/l (as N)
Nitrite as N	mg/l	<2 mg/l
Fluoride (F)	mg/l	< 1 mg/l
Na	mg/l	<50mg/l above the intake potable water quality
Ca	mg/l	Not specified
Mg	mg/l	Not specified
K	mg/l	Not specified
Chloride as Cl	mg/l	<40mg/l above the intake potable water quality
Alkalinity as CaCO3	mg/l	Not specified
Hardness as CaCO3	mg/l	Not specified
Sulphate as SO4	mg/l	<20mg/l above the intake potable water quality
Iron as Fe	mg/l	<200 µg/l

Table 3-2: Comparison of various water quality guidelines for effluents discharge at sea (Pulfrich 2020)

VARIABLE	SOUTH AFRICA (DWAF 2005, DEA 2018)	AUSTRALIA/NEW ZEALAND (ANZECC 2000)	WORLD BANK [a] (World Bank 1998)	US ENVIRONMENTAL PROTECTION AGENCY (EPA 2006)
Zone of impact / mixing zone	To be kept to a minimum, the acceptable dimensions of this zone informed by the EIA and requirements of licensing authorities, based on scientific evidence.	No guideline found	100 m radius from point of discharge for temperature	No guideline found
Temperature	The maximum acceptable variation in ambient temperature is ± 1°C	Where an appropriate reference system is available, and there are sufficient resources to collect the necessary information for the reference system, the median (or mean) temperature should lie within the range defined by the 20%ile and 80%ile of the seasonal distribution of the ambient temperature for the reference system.	< 3°C above ambient at the edge of the zone where initial mixing and dilution take place. Where the zone is not defined, use 100 meters from the point of discharge when there are no sensitive aquatic ecosystems within this distance.	No guideline found
Salinity[b]	33 – 36 psu Guideline values must be derived from a reference system (data set) that is appropriate to the discharge locality and should be determined as the range defined by the 20th and 80th percentiles of seasonal and/ or event-driven distributions, depending upon whether low salinity or high salinity effects are being considered (DEA 2018)	Low-risk trigger concentrations for salinity are that the median (or mean) salinity should lie within the 20%ile and 80%ile of the ambient salinity distribution in the reference system(s). The old salinity guideline (ANZECC 1992) was that the salinity change should be <5% of the ambient salinity.	No guideline found	No guideline found
Total residual Chlorine	No guideline (2005) 2 µg/ℓ (chlorine produced oxidants – chronic effects)(DEA 2018)	3 µg Cl/ℓ measured as total residual chlorine (low reliability trigger value at 95% protection level, to be used only as an indicative interim working level) (ANZECC 2000)[c]	0.2 mg/ℓ at the point of discharge prior to dilution	Long-term and short-term water quality criteria for chlorine in seawater are 7.5 µg/l and 13 µg/l, respectively
Total residual dibromonitrilopropionamide (DBNPA)	No guideline exists, suggest values ranging between 0.035 mg/ ℓ and 0.070mg/ ℓ	No guideline found	No guideline found	No guideline found

VARIABLE	SOUTH AFRICA (DWAF 2005, DEA 2018)	AUSTRALIA/NEW ZEALAND (ANZECC 2000)	WORLD BANK [a] (World Bank 1998)	US ENVIRONMENTAL PROTECTION AGENCY (EPA 2006)
Total Suspended Solids (TSS)	10% above ambient Guideline values must be derived from a reference system (data set) that is appropriate to the discharge locality and should not exceed the 80th percentile of the seasonal and/or event-driven distributions. Test data: Median concentration for period. Additionally, the natural euphotic depth (Zeu) should not be permitted to change by more than 10%. (DEA 2018)			
Dissolved oxygen (DO)	For the west coast, the dissolved oxygen should not fall below 10 % of the established natural variation. For the south and east coasts the dissolved oxygen should not fall below 5 mg/ℓ (99 % of the time) and below 6 mg/ℓ (95 % of the time)	Where an appropriate reference system is available, and there are sufficient resources to collect the necessary information for the reference system, the median lowest diurnal DO concentration for the period for DO should be >20%ile of the ambient dissolved oxygen concentration in the reference system(s) distribution. The trigger value should be obtained during low flow and high temperature periods when DO concentrations are likely to be at their lowest.	No guideline found	No guideline found
Nutrients	Waters should not contain concentrations of dissolved nutrients that are capable of causing excessive or nuisance growth of algae or other aquatic plants or reducing dissolved oxygen concentrations below the target range indicated for dissolved oxygen (see above)	Default trigger values of PO_4-P: 100 µg/ℓ NO_x-N: 50 µg/ℓ NH_4^+-N: 50 µg/ℓ for the low rainfall southern Australian region (Table 3.3.8 in ANZECC 2000)	No guideline found	No guideline found
Chromium	8 µg/ℓ (as total Cr)	Marine moderate reliability trigger value for chromium (III) of 10 µg./ℓ with 95% protection	0.5 mg/ℓ (total Cr) for effluents from thermal power plants	1 100 µg/ℓ for highest concentration at brief

VARIABLE	SOUTH AFRICA (DWAF 2005, DEA 2018)	AUSTRALIA/NEW ZEALAND (ANZECC 2000)	WORLD BANK [a] (World Bank 1998)	US ENVIRONMENTAL PROTECTION AGENCY (EPA 2006)
		Marine high reliability trigger value for chromium (VI) of 4.4 µg/ℓ at 95% protection.		exposure without unacceptable effect 50 µg/ℓ highest concentration at continous exposure without unacceptable effect
Iron	No guideline found	Insufficient data to derive a reliable trigger value. The current Canadian guideline level is 300 µg/ℓ	1.0 mg/ℓ for effluents from thermal power plants	No guideline found
Molybdenum	No guideline found	Insufficient data to derive a marine trigger value for molybdenum. A low reliability trigger value of 23 µg/ℓ was adopted to be used as indicative interim working levels.	No guideline found	No guideline found
Nickel	25 µg/ℓ (as total Ni)	7 µg/ℓ at a 99% protection level is recommended for slightly-moderately disturbed marine systems.	No guideline found	74 µg/ℓ for highest concentration at brief exposure without unacceptable effect 8.2 µg/ℓ highest concentration at continous exposure without unacceptable effect

[a] The World Bank guidelines are based on maximum permissible concentrations at the point of discharge and do not explicitly take into account the receiving environment, *i.e.* no cognisance is taken of the fact of the differences in transport and fate of pollutants between, for example, a surf-zone, estuary or coastal embayment with poor flushing characteristics and an open and exposed coastline. It is for this reason that we include in this study other generally accepted Water Quality guidelines that take the nature of the receiving environment into account.

[b] The ANZECC (2000) Water Quality guideline for salinity is less stringent than, but roughly approximates, the South African Water Quality guideline that requires that salinity should remain within the range of 33 psu to 36 psu (=ΔS of approximately 1 psu). Scientific studies have shown that effects on marine biota are primarily observed for increases of >4 psu above ambient level. ΔS 1 psu and 4 psu have been chosen for assessment purposes.

3.1.7 Other relevant Namibian legislation

The below provides a summary of other relevant environmental and social legislation that may be applicable to the project.

Table 3-3: Other relevant Environmental and social legislation relevant to the project

SECTOR	LAW	KEY PROVISIONS AND RELEVANCE TO THE PROJECT
Petroleum	*Petroleum Products and Energy Act, 1990 (No. 13 of 1990) and relevant regulations*	This Act provides for the application of environmental standards and the avoidance of environmental harm caused by the keeping, handling, conveying, using and disposing of petroleum products. No person may without authorisation discard, destroy or otherwise dispose of oil or possess or store or transport oil in containers that are not suitable for preventing destruction, loss or waste of the oil. Every person is obliged to take such precautions and exercise such care as may be reasonable in the circumstances in the storing, handling, conveying, disposing of any petroleum product in order to prevent risk of significant environmental harm. Provision is also made in the regulations for the disposal of petroleum products in a manner and at a place intended for the safekeeping of dumping thereof in accordance with good petroleum industry practices. Petrol, diesel and other hydrocarbons will likely be stored / handled at relevant sites during the construction phase of the project. Where volumes of such materials exceed the relevant thresholds then activities will have to comply with the requirements of the Act.
Transport	*Road Traffic and Transport Act, 1999 (No. 22 of 1999)*	This Act provides for the control of traffic on public roads, the licensing of drivers, the registration and licensing of vehicles, and the control and regulation of road transport across Namibia's borders. Vehicles supplying goods and services to the project during construction and operation will have to comply with the requirements of the Act.

Pollution / Waste	*Pollution Control and Waste Management Bill (3rd Draft September 2003)*	This Bill promotes sustainable development and provides for the prevention and regulation of the discharge of pollutants to the air, water and land; regulation of noise, dust and odour pollutions; and the establishment of a system of waste panning and management. Hazardous and non-hazardous waste will be generated during all projects phases and consideration should be given of the requirements of the bill.
	Marine Resources Act 27 of 2000	This Act provides for the conservation of the marine ecosystem; the responsible utilisation, conservation, protection, promotion of marine resources in a sustainable manner and for the control of marine resources for these purposes. The Minister of Fisheries is empowered to make regulations under section 61 on a broad number of topics including "regulating or prohibiting the discharge in the sea or discarding on the seashore and land of specified substances or materials, or substances or materials not complying with specified requirements or having specified properties" (61(1)(r)).
Environmental / Conservation	*Inland Fisheries Resources Act (Act 1 of 2003) Communal Land Reform Act, 2002 (No. 5 of 2002) Marine Resources Act 27 of 2000*	Conservation and protection of aquatic ecosystems. This Act provides for the allocation and administration of all communal land and makes provision for the prevention of land degradation and for mitigating the impacts of, amongst others, water provision on the natural environment. The Act gives certain rights to communal farmers and traditional authorities, and makes provision for regulations to address issues pertinent to conservation and sustainable management of water and water courses, of woods and to the combatting and prevention of soil erosion. This Act provides for the conservation of the marine ecosystem; the responsible utilisation, conservation, protection, promotion of marine resources in a sustainable manner and for the control of marine resources for these purposes. The Minister of Fisheries is empowered to make regulations under section 61 on a broad number of topics including "regulating or prohibiting the discharge in the sea or discarding on the seashore and land of specified substances or materials, or substances or materials not complying with specified requirements or having specified properties" (61(1)(r)).
	Hazardous Substances Ordinance, 1974 (No. 14 of 1974)Plant Quarantine Act, 2008 (No. 7 of 2008)Agricultural Pests Act, 1973 (No. 3 of 1973)	These provide for the control of toxic substances which may cause injury, ill health or death of human beings. Various chemicals would be used and stored during the operation of the water treatment plant and the fidh processing factory
	Labour Act, 2007 (No. 11 of 2007)	These Acts stipulate, amongst other things, sound labour relations, employment equity, fair employment practices, training, minimum basic conditions of service, workplace health and safety and retrenchment. Compliance is enforced and monitored by the Ministry of Labour through the office of the Labour Commissioner.
	Affirmative Action (Employment) Act, 1998 (No. 29 of 1998)Labour Act, 2007 (No. 11 of 2007)Hazardous Substances Ordinance, 1974 (No. 14 of 1974)	This Act aims to achieve equal opportunity in employment by redressing, through appropriate affirmative action plans, the conditions of disadvantage in employment experienced by persons in designated groups arising from past discriminatory laws and practices. These Acts stipulate, amongst other things, sound labour relations, employment equity, fair employment practices, training, minimum basic conditions of service, workplace health and safety and retrenchment. Compliance is enforced and monitored by the Ministry of Labour through the office of the Labour Commissioner. This Act provides for the prevention and punishment of corruption.

		This Act provides for the requirements and conditions for obtaining licences for the provision of electricity and to provide for the powers and obligations of licensees. These provide for the control of toxic substances which may cause injury, ill health or death of human beings.

4 DESCRIPTION OF THE EXISTING WASTE SEAWATER DISCHARGE ACTIVITIES

4.1 INFRASTRUCUTRE ASSOCIATED WITH THE WASTE SEAWATER DISCHARGE ACTIVITIES

Infrastructure associated with Tunacor's Fish factory's waste seawater discharge activity is related to the entire process flow involving seawater abstraction, treatment and fish processing activities. Figure 4-1 presents the infrastructure plan to Tunacor Fisheries Ltd. The infrastructure can be categorized as follows:

- Seawater intake and discharge system;
- The Water Treatment Plant;
- Infrastructure associated with the various processes within the Fish Processing Factory that uses the treated seawater for cleaning purposes.

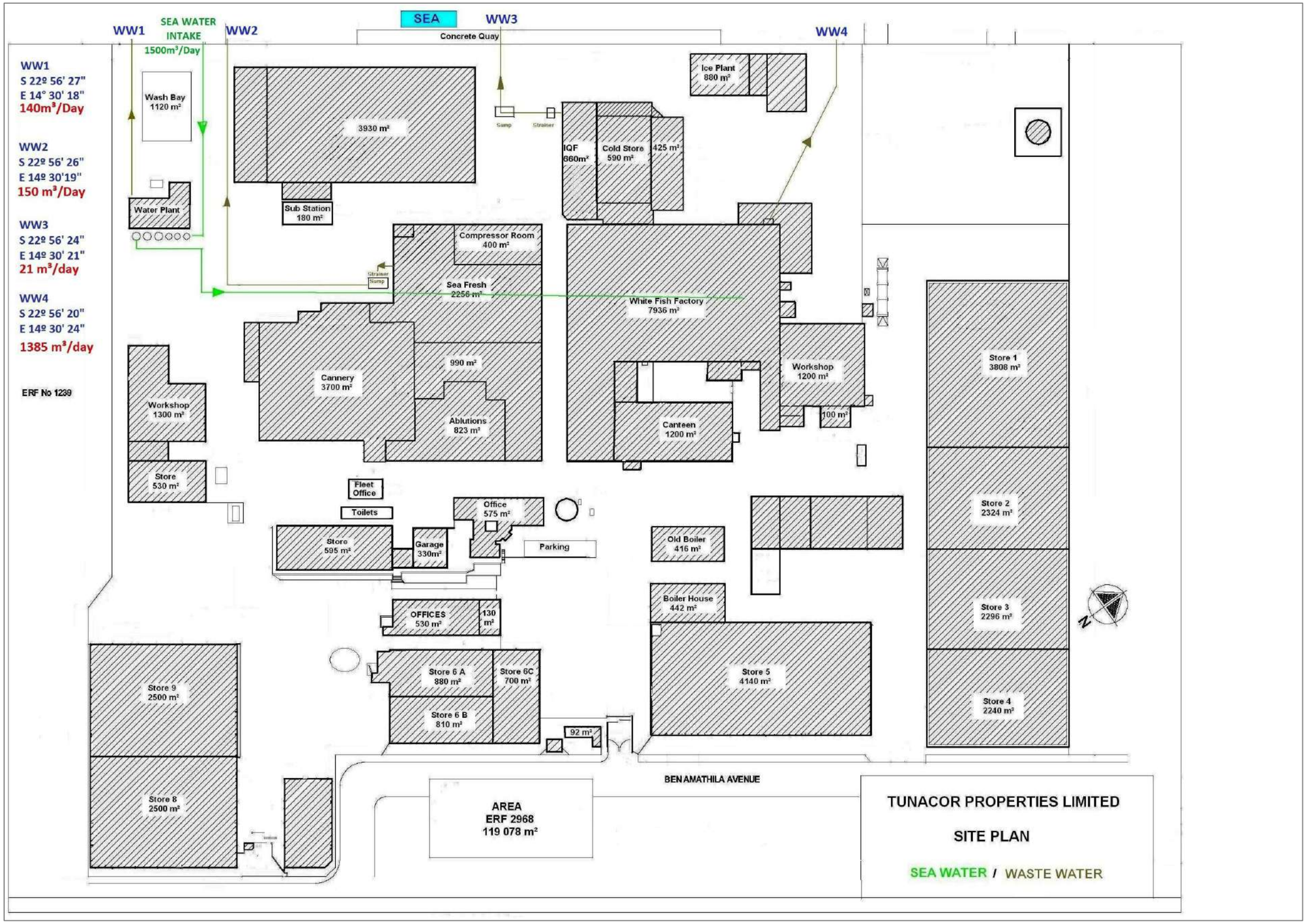

Figure 4-1: Tunacor Fisheries Ltd. Infrastructure map including Seawater Intake, Water Treatment Plant, Fish Processing Factory and Discharge points

4.1.1 Seawater Intake activities

The locality to the Seawater intake structure is presented in Figure 4-1. The raw Sea water is pumped from the sea at 3m below the high tide level. The water is not screened nor chemically treated and pumped directly to the water treatment plant by two 200m³/h pumps, one operating at a time, the other as standby. The pumps are started and stopped manual as required. The seawater is pumped through a 200 mm PVC pipe, fixed on the jetty, for 76 meters and then through a 250 mm underground PVC pipe for distance of 82m to the Water Treatment Plant before entering the raw water tanks (3x10m³) through a 6mm perforated strainer. The level sensor controls the water level of the tanks. At 60%, the raw water pump will be started, at 20% the raw water pump will be stopped, at 80 % the raw water valve will close and re-open at 50% to maintain the level in the tank between 50% and 80%.

The volumes in process flow can be summarised as below:

- Seawater abstraction rate = 1540 m³/day
- Total Volume Seawater abstraction = 407 000 m³/ year
- Total Volume of treated clean water pumped to the factory = 370 000 m³/year
- Scum discharge rate = 140 m³/day
- Total Volume Scum Discharge = 37000 m³

4.1.2 Water Treatment Plant

The below section follows additional illustration to the Water treatment process detailed in Figure 4-2.

4.1.2.1.1 Pre-treatment System

Seawater pumped from the raw water tanks (3x10m³) has Coagulant injected into the suction manifold of the raw water pumps and then Flocculant is injected into the water line after the pumps. The raw water is pumped to the bottom of the flocculation column. The water rises to the top of the drain pipe and by gravity drains to the Dissolved Air Flotation and Filtering Unit (DAFF). This creates a retention for the chemicals to be able to react. Chemicals used are Ultrafloc 3500 (Aluminium Chlorohydrate (ACH), Polyamine (U5100) and blue dye (Blue Colour 2021)) as coagulant and Ultrafloc 5100 (Polydimethylamine) as flocculant. The flocculant is diluted with water at a ratio 1:7 (C:W), and the coagulant at a ratio of 1:3 (C:W). The diluted chemicals are stored in separate tanks and are pumped into the raw water line by means of a dual dosing pump. The dosing rate is adjusted according to the turbidity of the raw water and the dosing pump is started once the raw water pump starts.

4.1.2.1.2 Flocculation Column and DAFF unit

The treated raw water is gravity fed from the flocculation column into the centre of the DAFF unit. Once the water level reaches the high-high level, a timer is activated and scum and dirt is allowed to overflow into the drain. After 60 seconds the outlet valve opens a fraction (10s) and allows water to pass through the sand filter into the intermediate tank. The level sensor detects four levels, low, working, high and high- high level. The unit should work at working level. Every 300 seconds the water level is verified and should be at working level. Should it be at high level, the outlet valve opens another fraction (1s) to increase the flow rate through the filter. Should the level be at working level, the valve remains in the same position. This valve adjustment is performed constantly throughout production. Every 2500 seconds the outlet valve closes for 30 seconds to allow the water level to rise to high-high in order to dump the floating scum on the surface through the overflow. Once the outlet valve opens again, the valve adjustment procedure starts again.

Should the outlet valve reach the fully open position and the level be high, the filter is dirty and this is indicated as such on the control panel. As the level in the intermediate tank rises, it will start the saturator pump at **50**%. The saturator pump will pump water from the intermediate tank into the saturator where the water is saturated under pressure with compressed air. This saturated water is fed into the middle of the Daff unit. Once this water is released, it forms tiny bubbles, which collect scum from the treated raw water as the bubbles rise to the surface. As the level in the intermediate tank rises, the intermediate pumps are started as follows: pump 1 at 70%, pump 2 at 80%, pump 3 at 90% and pump 4 at 100%. The intermediate pumps pump the clean water from the intermediate tank to the final water tanks. The intermediate pumps 2, 3 and four are stopped at a level of 60% and intermediate pump 1 is stopped at a level of 50%.

4.1.2.1.3 Chlorinator

As soon as any of the intermediate pumps start, the chlorine booster pump is started. The chlorine booster pump pumps water from the intermediate tank through an ejector into the clean water line. The chlorine concentration in the clean water line is measured by means of the chlorine cell, which in turn controls the chlorine regulator at the ejector. The free chlorine concentration in the clean water is set to be 0.8 ppm. The chlorine booster pump will stop once the last intermediate pump has stopped.

4.1.2.1.4 Air Saturator

The saturator level sensor indicates three levels, low-low, low and high level. Once the low level has been reached, the saturator valve opens. At high level the solenoid valve on the top of the saturator opens and allows compressed air to enter the vessel. At a pressure of 6 Bar the water is saturated with water. Should the water level reach low level, the air solenoid will close and the water level will rise to high level.

The saturator pump starts at 50% intermediate tank level and will be stopped when the raw water pump is stopped after production. When the pump is stopped, the water level in the saturator will drop, at low level the air solenoid will close and at low-low level the saturator valve will close.

4.1.2.1.5 Backwash Process

A DAFF unit can only be backwashed automatically if the unit is indicated as dirty on the control panel. Once the backwash cycle has been activated, the inlet and outlet valves will close and the DAFF drain valve will open to drain all water inside the DAFF unit. After 60 seconds the clean water valve will close and the backwash valve will open. Clean chlorinated water will then be pumped from the intermediate tank through the sand filter into the drain. This process lasts for 300 seconds where after the backwash valve closes and the clean water valve opens. After 20 seconds the drain valve closes and the inlet valve opens to fill the daff unit for production

4.1.2.1.6 Final Water Tank and UV unit

The chlorinated clean water is stored in the final water tanks (3x 125m^3). From these tanks the water is pumped by the final water pump through the UV unit to the factory. In order to control the water pressure in the factory, a bypass valve is installed after the UV unit to allow excess water to return to the final water tanks. The UV unit switches off should there be no flow (detected by the flow meter) or if the operating final water pump trips. Tripping of a pump sounds the alarm and another pump starts immediately.

4.1.3 Fish Processing Factories (Sea Fresh, Wet Fish and IQF)

Fish processing activities at Tunacor Fisheries Factory are undertaken at three fish processing facilities, the Sea Fresh Factory, the Wet Fish factory and the IQF factory. About 370 000m^3/year of treated seawater is pumped into the seawater network supplying the Sea Fresh Factory and Wet Fish Factory.

4.1.3.1 Seafresh Factory

At the Sea Fresh Factory, about 120m^3/day of treated seawater is used for cleaning surfaces and fish processing. All the resultant waste water is collected unto a floor drain leading to a Strainer. In addition to treated seawater, about 31m^3/day of Fresh water is also used in cleaning and processing of fish. The treated seawater and fresh water collects on the floor drain and screened through the strainer further collecting into a sump before being pumped at 151m^3/day to discharge at sea (Figure 4-2 and Figure 4-3).

4.1.3.2 Wetfish factory

About 1200m^3/day of treated seawater is pumped to the Wet Fish factory where it is used for de-icing, sorting, fish filleting and trimming purposes. Fresh water (185m^3/day) is also introduced at the Wet fish

factory. The freshwater is used in hand wash basins and while some is hosed down to clean surfaces. The drainage system in this factory is an open type channel, covered with grids to prevent solids from entering the channel. Solid waste emanating from the filleting machines and trimming tables is removed from the factory by means of an Interlock conveyor belt, designed to drain water from the waste and to transport the solids. The solid waste is collected in bins and collected by Exigrade to be processed into fishmeal. Solid waste collected from the floor is collected in red plastic bins and later emptied into the solid waste rocker bins. Waste water collects in a small sump from where it is pumped to sea. The pump is a self priming pump with a rated capacity of 1385m^3/day (Figure 4-2 and Figure 4-3). In order to further improve the waste water management and better comply with the regulations, Tunacor Fisheries Ltd has been in contact with Industrial Screening Technology Pty to provide a more sophisticated effluent screening system. This capital investment will be budgeted for in the next financial year.

4.1.2.3 *IQF Factory*

Frozen product, packed in cartons is received, unpacked and individually transported by means of conveyor through the tunnel freezer. Glazed product is fed through the glazing tank and returned to the tunnel freezer. Product not to be glazed is returned to the tunnel freezer by-passing the glazing tank. After the tunnel freezer the product is graded, batched and packed into bags. These bags are sealed, fed through the metal detector and packed into master cartons. The end product is stored in the cold store for distribution.

Water from the process drains through floor drains with build-in strainers into a 160mm PVC discharge pipe. This water is fed into the manhole, fitted with a removable strainer basket. Water draining through the basket runs into the effluent sump, which is divided into three sections. Each wall is fitted with overflow pipes to prevent solids and / or floating material to enter the last chamber from where it is pump to the sea. There are two pumps fitted, each having a capacity of 6.5 l/s at a head of 10m. The pumps are controlled by means of an ultrasonic level controller. Solid waste recovered is collected in rocker bins and removed by Exigrade to be processed to fishmeal (Figure 4-5 and Figure 4-1).

4.1.4 Waste Seawater Discharge Activities

The discharging activities at Tunacor are undertaken at four different discharge points as illustrated in Figure 4-1 and can be summarised below including the corresponding waste water discharging rates.

- WW1- Back wash discharge point (140m^3/day);
- WW2 - Sea Fresh Factory Discharge point (150m^3/day);

- WW3 – Individual Quick Freezing (IQF) (21 m^3/day);
- WW4 – Wet Fish Factory Discharge point (1385m^3/day)

The Sump design plans to Sea Fresh, Wet Fish and IQF are illustrated in (Figure 4-6, Figure 4-7 and Figure 4-8).

4.1.5 Maintenance activities

Tunacor undertakes regular routine inspection on infrastructure including equipment's to ensure the water treatment process is efficient and that water supply to the fish factory is constant and is as per operational requirements. The continuous functionality of the Water treatment Plant and associated infrastructure in vital in the process. The following presents a list of operation and maintenance activities associated with the Water treatment Plant:

Seawater intake and discharge system;

- Maintenance inspections on all pumping systems for corrosion and leaks.
- All pipes are PVC, valves are steel, pump impellers Brass.

Water treatment Plant;

- Inspection of waterlines, gaskets, seals, Filter heads and fittings for corrosion and leaks.
- Lubrication of pumps and all moving/ rotary equipment.
- Scales and Water meters calibration.
- Chemical feed pumps calibration.
- Cleaning of Water and chemical storage tank.
- Cleaning of Chemical Feedlines.
- Backwash process- scum discharge.

4.1.6 Waste Seawater Discharging Monitoring Activities

Tunacor currently implements a qualitative effluent (including waste sea-water) monitoring programme that includes the monitoring of the abstracted raw seawater, the treated seawater and effluents including treated waste seawater. Samples are undertaken on annual basis at the various locations that presents the Raw seawater intake system, resultant treated seawater and effluents from the Sea Fish, Wet Fish and IQF Factories. The baseline information allows Tunacor to monitor the quality in chemical determinant of the raw seawater in comparison to the treated seawater and discharged waste seawater from the fish processing factories. The chemical determinant analyzed is based on the Southern African Development Community Accreditation Services (SADCAS). The chemical determinant analysed falls within category Group D of water that is unsuitable for human consumption. The competent authority MAWL has not established localized guidelines for Waste water discharge at sea. Tunacor currently cross references the quality in discharged waste seawater with the raw seawater quality and ensures the difference in quality variables is not significant

to alter existing raw seawater quality standard. The waste seawater discharged is only subjected to a treatment process and the use of detergents in the fish processing factory. The chemical determinant analysed are presented in the table below.

Table 4-1: Tunacor Fisheries Ltd.'s treated Waste Seawater Chemical determinants

Chemical Determinants
pH
Conductivity (mS/m
Total Dissolved Solids calculated from conductivity
Sodium (Na)
Potassium (K)
Sulphate (SO_4)
Nitrate
Silicate (SiO_2)
Fluoride (F)
Chloride (Cl)
Total Alkalinity
Total Hardness
Calcium
Magnesium
Copper
Zinc
Cadmium
Lead
Turbidity
Colour

4.1.7 Waste Seawater Quality Analysis Results

The Waste seawater quality analysis results are presented in Appendix 7. Reference to the quality analysis results presented the following was identified:

- the chemical determinants analyzed is not consistent throughout the sampling points.
- The chemical analysis values for certain determinants i.e. Dissolved Oxygen and Chloride presents to be higher and lower than the recommended criterion.
- The existing monitoring plan does not present the monitoring data in a comprehensive manner to distinguish the level of compliance to the water guidelines being implemented.

For a comprehensive Monitoring programme, Tunacor Fisheries is recommended to implement the monitoring measures detailed in the EMP (Section 8 - Section 8.7).

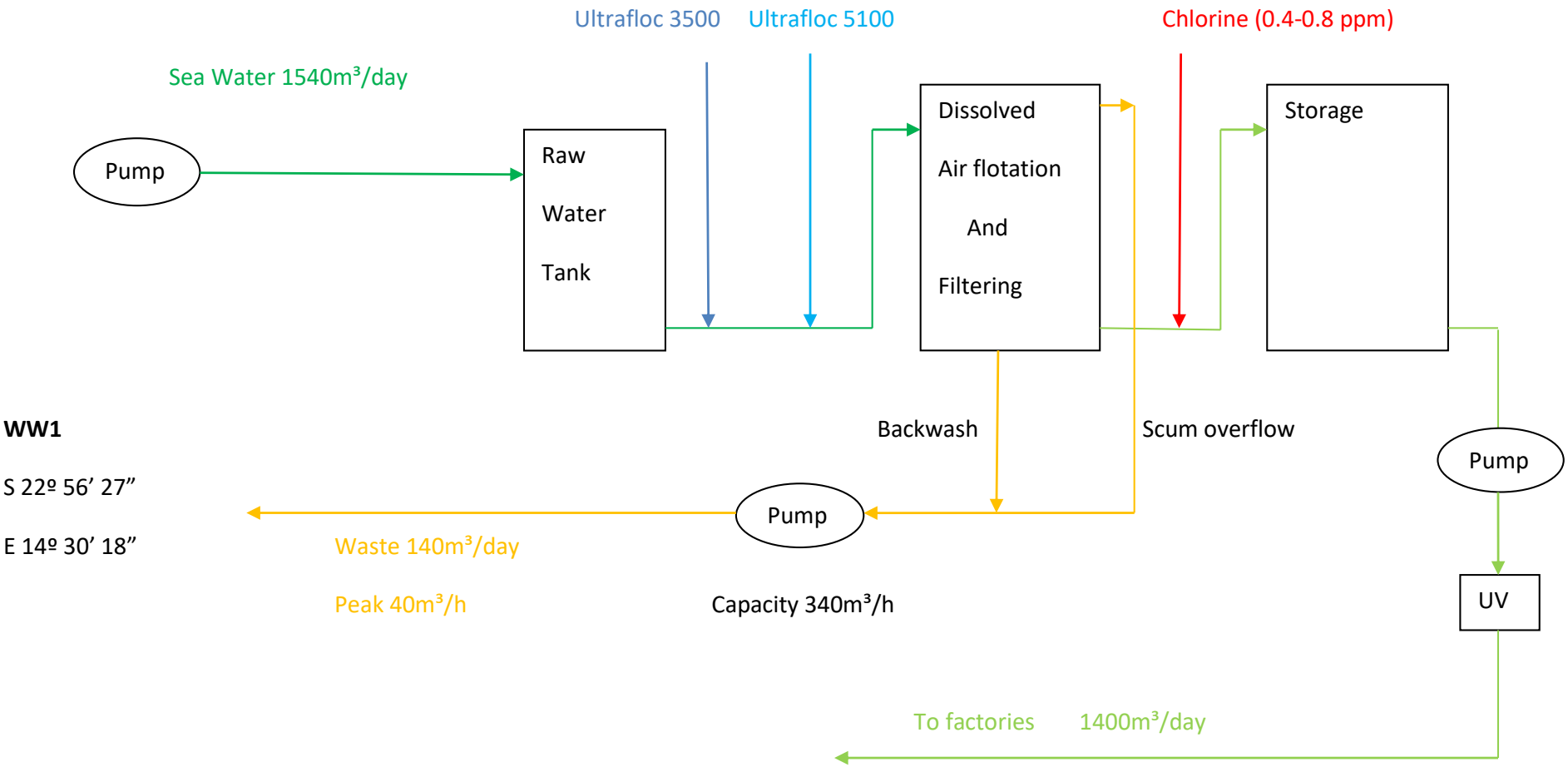

Figure 4-2: Illustrative diagram of Tunacor Fisheries Water treatment Plant process flow

SEA FRESH FACTORY

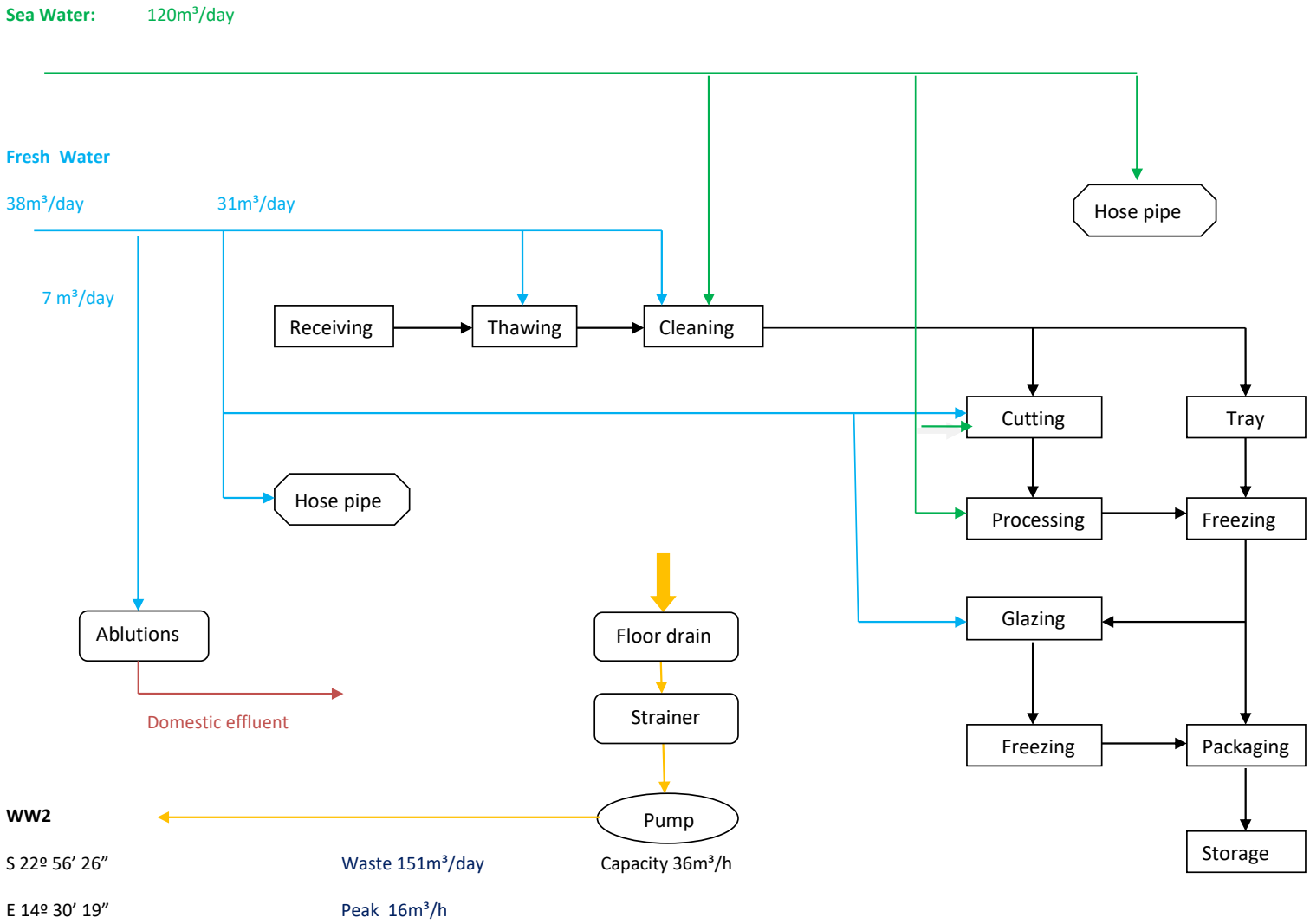

Figure 4-3: Treated Seawater process flow at Sea Fresh Factory

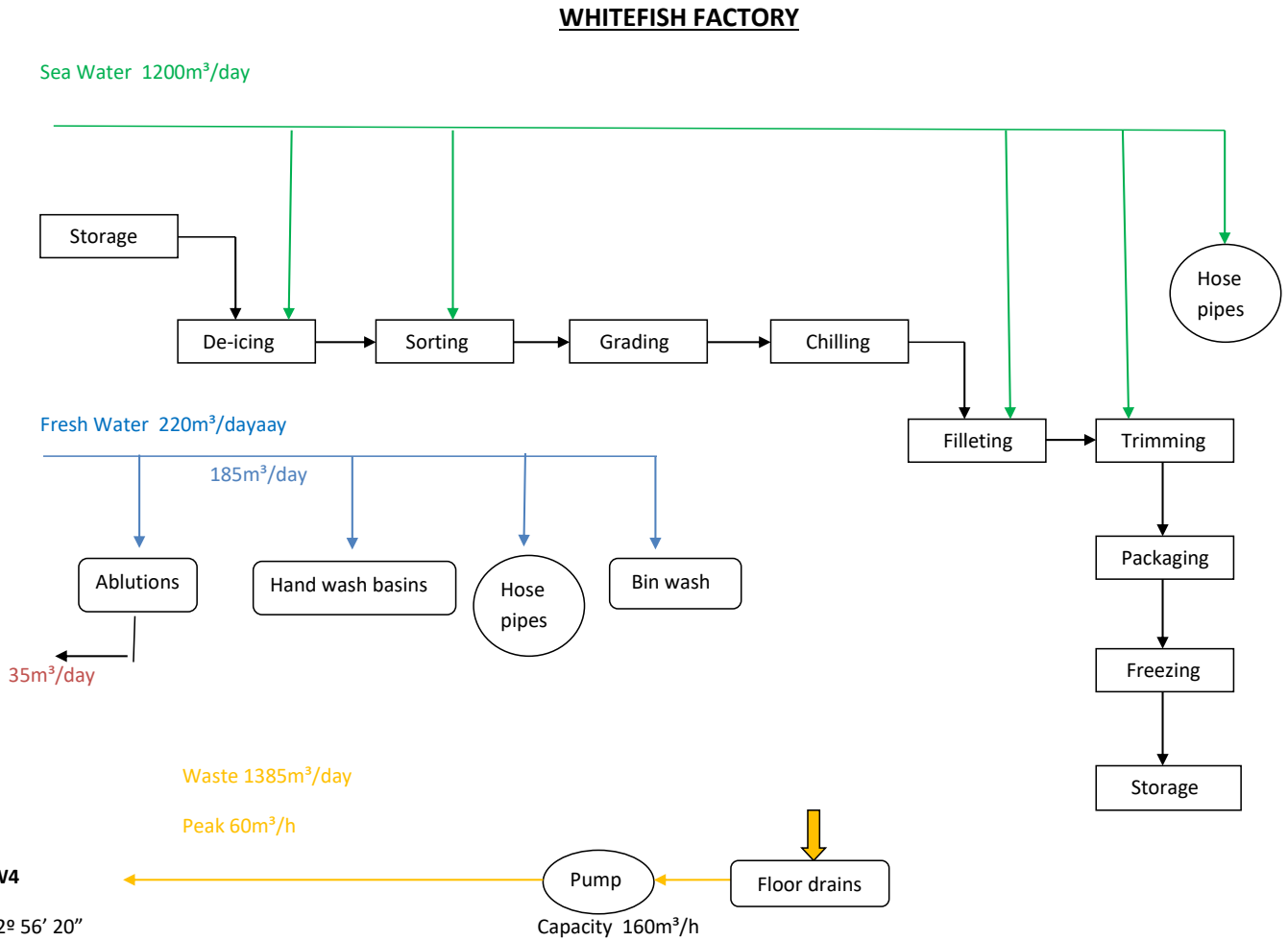

Figure 4-4: Treated Seawater process flow at Wet Fish Factory

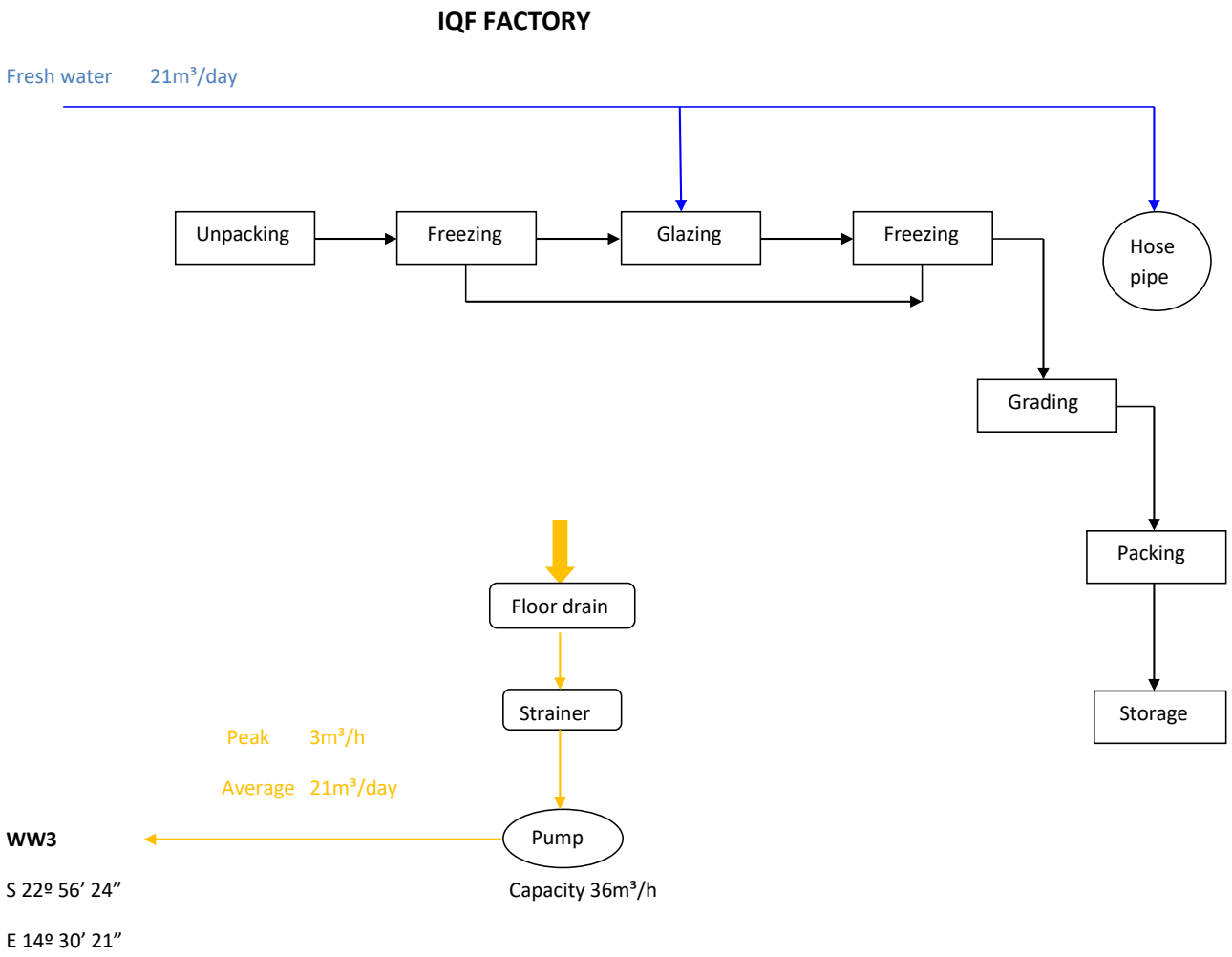

Figure 4-5: Water process flow at the IQF Factor

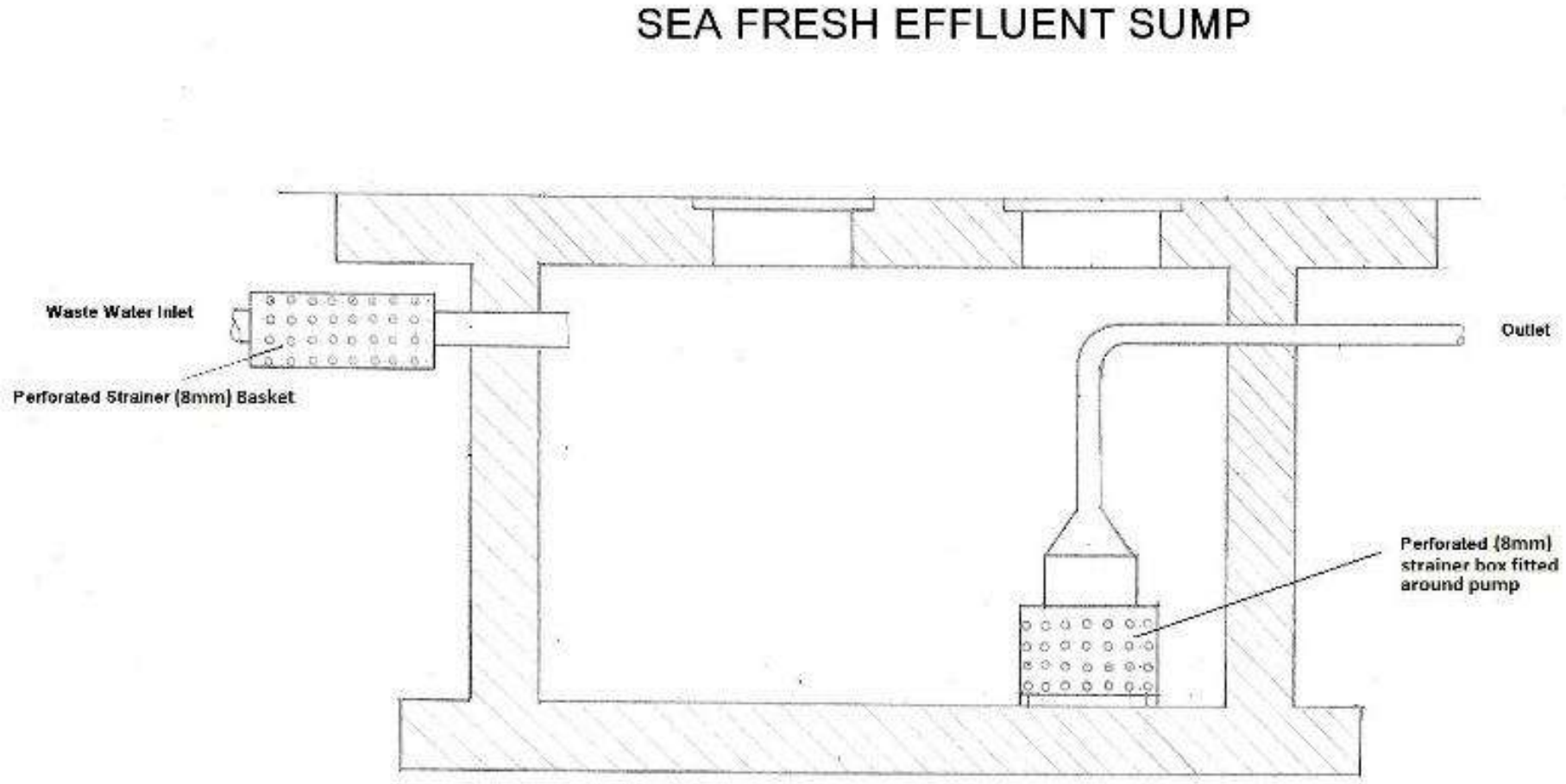

Figure 4-6: Sea Fresh Factory Effluents Sump

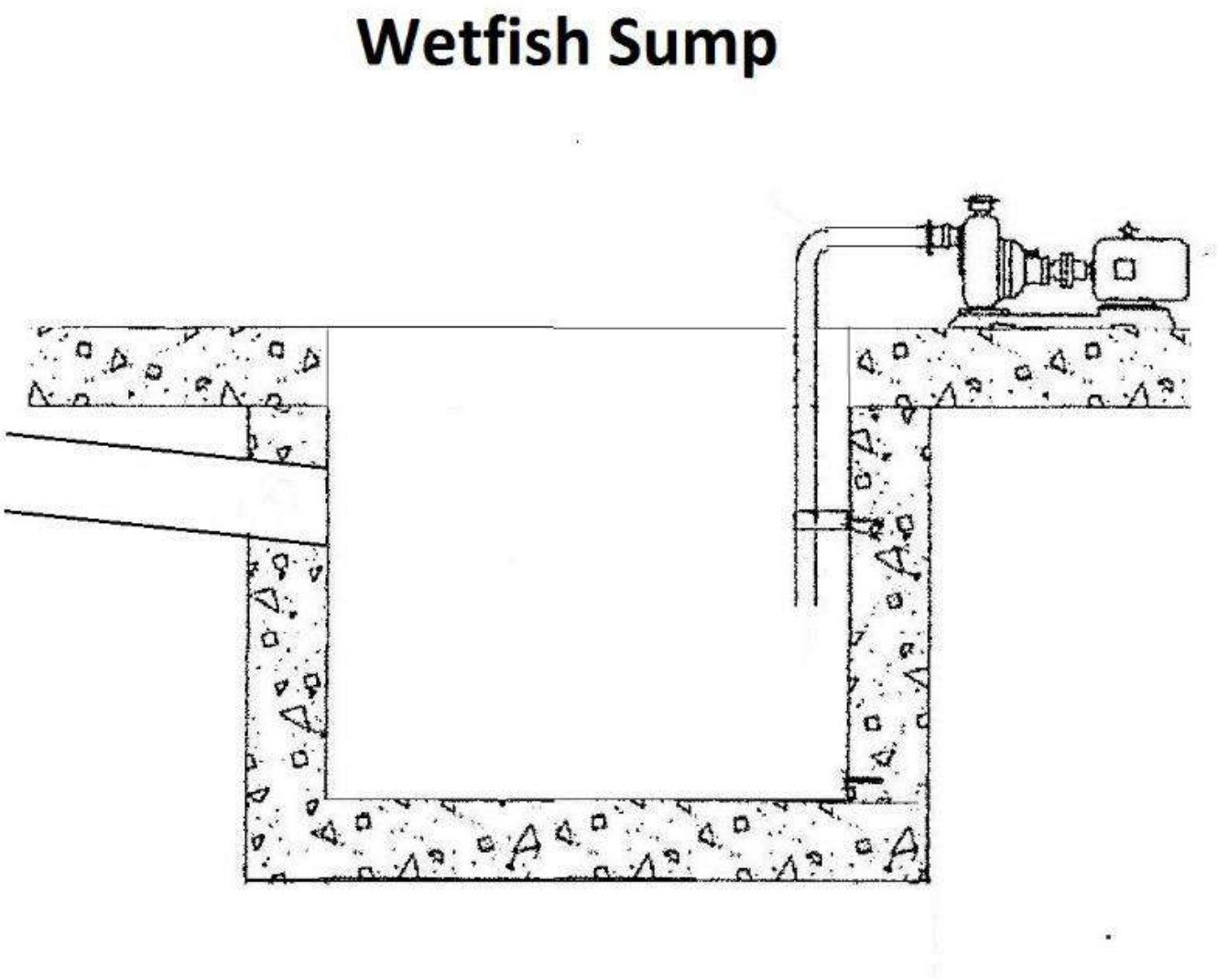

Figure 4-7: Wet Fish Factory Sump

IQF MANHOLE

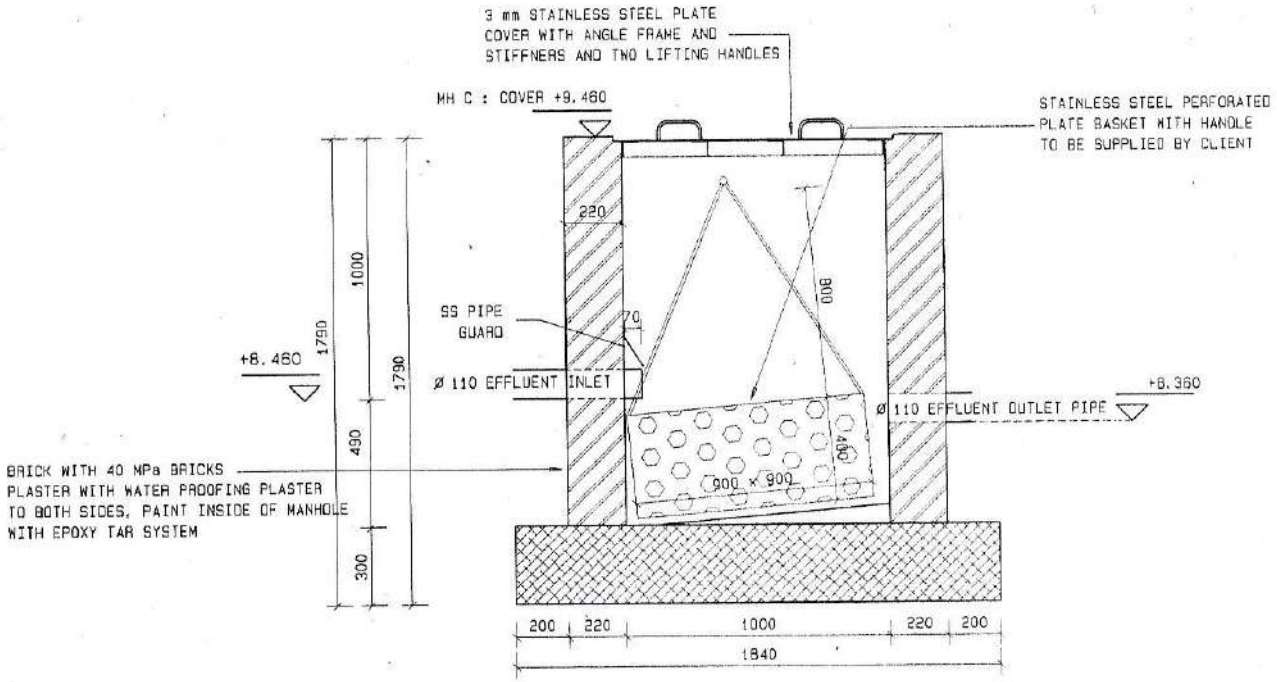

Figure 4-8: IQF Factory Sump

5 DESCRIPTION OF THE BASELINE ENVIRONMENT

The information presented in the section below was derived from the following sources:

- Visual observations during a site visit.
- Discussions with Stakeholders
- Google Earth
- Information from other EIAs conducted as referenced in the specific sections.

The description of the current environment only relates to the existent project location and its interception with the environmental aspects.

5.1 LAND USE

Tunacor is located in the industrial and commercial area of Walvis Bay. The location of the Tunacor fish factory is surrounded by other commercial and fishing factories. In context to the locality of the Tunacor, Walvis Bay is the second largest urban settlement in Namibia and the regional capital of the Erongo Region. The Walvis Bay area is approximately 1,124 km² in size (including ~60 km of coastline) and it is situated along the Atlantic Ocean between the Swakop (north) and Kuiseb Rivers (south). The area also includes the Langstrand Resort, the Dolphin Park Recreation Resort and the Afrodite Beach Development. On the eastern side, the Walvis Bay area extends to the Namib Naukluft Park, Namibia's largest conservation area. The area includes the Walvis Bay Wetland and the Kuiseb River and Delta (Maartens 2010). (Refer to Figure 5-1) for the aerial Map on land uses in Walvis Bay). The Walvis Bay Wetland was proclaimed a Ramsar Site, or Wetland of International Importance, in 1995. The Wetland comprises the more than 3,000 year old Walvis Bay Lagoon, and includes the inter-tidal mudflats and the eastern half of Pelican Point. The area is regarded as a biodiversity hotspot due to the following: the rich estuarine fauna; it supports about 129,000 birds and hosts Palaearctic and intra-African migrant birds, as well as six rare bird species; it is the most important wetland bird habitat on the Namib Coast and one of the ten most important wetlands in Africa.

The Kuiseb River and Delta is found in the National Namib Naukluft Park. The desert and dune areas around the Kuiseb River support unique and well-adapted communities of fauna and flora with low species density, but with high endemism (Maartens 2010). The 30 km stretch of coastline between Walvis Bay and Swakopmund, including the dune belt area, is also regarded as a biodiversity hotspot: the dune belt area host specially adapted desert organisms; the coastal section is designated as an Important Bird Area (IBA); and it has the most important breeding area for the endemic Damara Tern. As large dune areas are conserved in the Namib Naukluft Park, the area is not considered an important habitat for conservation purposes and it is currently categorised as a recreation area. It has been recommended that

the dune belt be included in the Walvis Bay Nature Reserve, and that the areas east of Long Beach and at Dune 7 be maintained as free zones for off-road driving.

Figure 5-1: Aerial Map of Walvis bay land uses (Martens 2010)

5.2 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. 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.

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 (37km/h) during winter months to as high as 60 knots (110km/h) during the summer. Winds near Walvis Bay display two main trends; high velocity and high frequency south to south-westerly winds in

summer and high velocity, low frequency east to north-easterly winds during winter. During winter, the east winds generated over the hot Namib Desert have a strong effect on temperature, resulting in temperatures in the upper 30 degrees Celsius and tend to transport plenty of sand. The variables in climatic data are present in Table 5-1 below.

Table 5-1: Climatic data of Walvis bay (Botha et al 2014)

Classification of Climate	**Desert**
Precipitation	0-50
Variation in annual rainfall (%)	< 100
Average annual Evaporation (mm/a)	2400-2600
Fog	Approximately 900 hours of fog per year
Temperature	Average annual >16 °C

5.3 CORROSION ENVIRONMENT

Walvis Bay is located in a very corrosive environment, which may be attributed to the frequent salt-laden fog, periodic winds and abundance of aggressive salts (dominantly NaCl and sulphates) in the soil. The periodic release of hydrogen sulphide (H_2S) from the ocean is expected to contribute to corrosion. The combination of high moisture and salt content of the surface soil can lead to rapid deterioration of subsurface metal (e.g. pipelines) and concrete structures. Chemical weathering of concrete structures due to the abundant salts in the soil is a concern. The corrosive environment does have significant impacts on the Tunacor infrastructure including the wear and tear of pipelines or corrosion of tanks.

5.4 TOPOGRAPHY

Walvis Bay is a natural harbour along the central Namibian Coast. The bay is formed by a peninsula commonly known as Pelican Point. On the southern part of the bay is a lagoon which used to be the mouth of the Kuiseb River. Dune migration however forced the flow of the Kuiseb River to the north. This flow was stopped through the construction of a flood control wall to prevent flooding of the town of Walvis Bay, thus forcing the flood waters to move through the dune area to the lagoon. The Kuiseb now rarely reaches the lagoon. The topography is generally flat with a local gentle downward slope in a westerly direction. Drainage is poorly developed due to the lack of rainfall <50mm/annum received in the area. A dune field is present southeast of Walvis Bay and also further to the northeast. These dunes generally migrate in a northerly direction.

5.5 GEOLOGY AND HYDROGEOLOGY

Walvis Bay is located in the Central Western Plain of Namibia. The Kuiseb River forms the southern boundary of this landscape group, with the Namib Dune Field being present south of the Kuiseb River. Northerly dune migration is forcing the Kuiseb River in a northerly direction, with Kuiseb River paleochannels being present as far south as Sandwich Harbour. Following the breakup of West-Gondwana during the early Cretaceous 130 – 135 Ma ago, continental uplift took place, enhancing erosional cutback and the formation of the Namibian Escarpment. A narrow pediplain formed, mainly over Damara Age Rocks. The South 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, from approximately just east of Dune 7 (Botha et. al 2014).

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 40m. 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. The hydraulic conductivity is expected to be moderate to high. The hydraulic head in the area is very low due to the relative horizontal water table. Pollutants are therefore not expected to rapidly spread, despite the relatively high hydraulic conductivity. The subsurface water is saline and not suitable for human consumption, thus 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. This area does not fall within a Water Control Area, but groundwater remains the property of the Government of Namibia. The fish processing industry currently looks at various cost effective and efficient alternatives to water usage.

5.6 THE MARINE ENVIRONMENT

The coastal water of Namibia is characteristic of cool surface waters and high productivity. This stems from the presence of the Benguela System that runs along the entire Namibian coast. The Benguela System is one of four major eastern boundary current upwelling systems of the world. Essentially what this means is that surface waters are moved northwards and offshore by prevailing south to south-westerly winds, while deeper cool water moves vertically to take its place. This cooler water brings along with it abundant nutrients resulting in high primary productivity in the photic zone. Thus, phytoplankton rich water supports an abundant marine life characterized by low biodiversity, but high species numbers.

A magnitude of dead phytoplankton accumulates on the seafloor where its decay replenishes the nutrients and thus the cycle can repeat itself. This layer of organic sediment is typically anoxic and accumulates at depths of 3 to 4m in the Bay of Walvis Bay.

An important characteristic, resultant from high primary productivity, of Namibian coastal waters is the occurrence of Sulphur eruptions. This is the release of Hydrogen Sulphide resulting in anoxic conditions in the water and a “rotten egg” smell in the air. Since the breakdown of organic matter in the sediment often occurs without oxygen, anaerobic bacteria reduce sulphates to obtain energy and in turn produce hydrogen sulphide. The formed hydrogen sulphide accumulates in the sediment of the sea floor until it reaches high enough levels to trigger its release. The abundance of hydrogen sulphide in the water kills or drives away many marine organisms and reduces air quality.

The chemical and biological oxygen demand COD and BOD of the bay’s water is an important abiotic consideration. It is largely determined by the amount of organic material that requires oxygen to be decomposed. It is thus closely linked to the hydrogen sulphide production in instances where oxygen as a resource for aerobic decomposers are depleted. Discharge of effluent from fish processing plants significantly increases the COD in the fishing harbour. These effluents are limited to a COD of 75 mg COD/l according to the 1956 Water Act. Measured effluent COD have however been much higher than the stated limit (Botha et al 2014).

5.6.1 Organic Inputs

The Benguela upwelling region is an area of particularly high natural productivity, with extremely high seasonal production of phytoplankton and zooplankton. These plankton blooms in turn serve as the basis for a rich food chain up through pelagic baitfish (anchovy, pilchard, round-herring and others), to predatory fish (snoek), mammals (primarily seals and dolphins) and seabirds (jackass penguins, cormorants, pelicans, terns and others). All of these species are subject to natural mortality, and a proportion of the annual production of all these trophic levels, particularly the plankton communities, die naturally and sink to the seabed.

Balanced multispecies ecosystem models have estimated that during the 1990s the Benguela region supported biomasses of 76.9 tons/km^2 of phytoplankton and 31.5 tons/km^2 of zooplankton alone (Shannon *et al*. 2003). Thirty six percent of the phytoplankton and 5% of the zooplankton are estimated to be lost to the seabed annually. This natural annual input of millions of tons of organic material onto the seabed off the southern African west coast has a substantial effect on the ecosystems of the Benguela

region. It provides most of the food requirements of the particulate and filter-feeding benthic communities that inhabit the sandy-muds of this area, and results in the high organic content of the muds in the region. As most of the organic detritus is not directly consumed, it enters the seabed decomposition cycle, resulting in subsequent depletion of oxygen in deeper waters overlying these muds and the generation of hydrogen sulphide and sulphur eruptions along the coast.

An associated phenomenon ubiquitous to the Benguela system are red tides (dinoflagellate and/or ciliate blooms) (see Shannon & Pillar 1985; Pitcher 1998). Also referred to as Harmful Algal Blooms (HABs), these red tides can reach very large proportions, with sometimes spectacular effects. Toxic dinoflagellate species can cause extensive mortalities of fish and shellfish through direct poisoning, while degradation of organic-rich material derived from both toxic and non-toxic blooms results in oxygen depletion of subsurface water. Periodic low oxygen events associated with massive algal blooms in the nearshore can have catastrophic effects on the biota (see below).

5.6.2 Low Oxygen Events

The low oxygen concentrations are attributed to nutrient remineralisation in the bottom waters of the system (Chapman & Shannon 1985). The absolute rate of this is dependent upon the net organic material build-up in the sediments, with the carbon rich mud deposits playing an important role. As the mud on the shelf is distributed in discrete patches, there are corresponding preferential areas for the formation of oxygen-poor water, the main one being off central Namibia (Chapman & Shannon 1985). The distribution of oxygen-poor water is subject to short (daily) and medium term (seasonal) variability in the volumes of oxygen depleted water that develop (De Decker 1970; Bailey & Chapman 1991). Subsequent upwelling processes can move this low-oxygen water up onto the inner shelf, and into nearshore waters, often with devastating effects on marine communities.

Oxygen deficient water can affect the marine biota at two levels. It can have sub-lethal effects, such as reduced growth and feeding, and increased intermoult period in the rock-lobster population (Beyers *et al.* 1994). The oxygen-depleted subsurface waters characteristic of the southern and central Namibian shelf are an important factor determining the distribution of rock lobster in the area. During the summer months of upwelling, lobsters show a seasonal inshore migration (Pollock & Shannon 1987), and during periods of low oxygen become concentrated in shallower, better-oxygenated nearshore waters.

On a larger scale, periodic low oxygen events in the nearshore region can have catastrophic effects on the marine communities. Low-oxygen events associated with massive algal blooms can lead to large-scale stranding of rock lobsters, and mass mortalities of other marine biota and fish (Newman & Pollock 1974; Matthews & Pitcher 1996; Pitcher 1998; Cockroft et al. 2000).

5.6.3 Sulphur Eruptions

Closely associated with seafloor hypoxia is the generation of toxic hydrogen sulphide and methane within the organically-rich, anoxic muds following decay of expansive algal blooms. Under conditions of severe oxygen depletion, hydrogen sulphide (H_2S) gas is formed by anaerobic bacteria in anoxic seabed muds (Brüchert *et al.* 2003, 2006, 2009). This is periodically released from the muds as 'sulphur eruptions', causing upwelling of anoxic water and formation of surface slicks of sulphur discoloured water (Emeis et al. 2004), and even the temporary formation of floating mud islands (Waldron 1901). The sulphur events have a strong seasonal cycle being highest between February and April during the seasonal oxygen minimum. Annual variability of sulphur events is also evident being enhanced in years with a lower annual mean of upwelling intensity, decreased oxygen supply associated of bottom waters, and a more southern position of the Angola Benguela Frontal Zone (Ohde & Dadou 2018). Such eruptions are accompanied by a characteristic pungent smell along the coast and the sea takes on a lime green colour. These eruptions strip dissolved oxygen from the surrounding water column. Such complex chemical and biological processes are often associated with the occurrence of harmful algal blooms, causing large-scale mortalities to fish and crustaceans (see above).

Sulphur eruptions have been known to occur off the Namibian coast for centuries (Waldron 1901), and the biota in the area are likely to be naturally adapted to such pulsed events, and to subsequent hypoxia. However, satellite remote sensing has shown that eruptions occur more frequently, are more extensive and of longer duration than previously suspected, and that resultant hypoxic conditions last longer than thought (Weeks *et al.* 2002, 2004).

Recently the role of micro-organisms in the detoxification of sulphidic water was investigated during the occurrence of a sulphidic water mass covering 7,000 km^2 of seafloor off the coast of Namibia (http://www.mpi-bremen.de/Projekte_9.html; http://idw-online.de/ pages/de/ news292832), when surface waters, however, remained well oxygenated. In the presence of oxygen, sulphide is oxidized and transformed into non-toxic forms of sulphur. An intermediate layer was discovered in the water column, which contained neither hydrogen sulphide nor oxygen. It was established that sulphide diffusing upwards from the anoxic bottom water is consumed by autotrophic denitrifying bacteria that inhabit the intermediate water layer. By using nitrate, the detoxifying microorganisms transform sulphide into finely dispersed particles of sulphur that are non-toxic, thereby creating a buffer zone between the toxic deep water and the oxygenated surface waters. These results, however, also suggest that benthic and demersal animals in coastal waters may be affected by sulphur eruptions more often than previously thought, and that many of these sulphidic events may go unnoticed on satellite imagery as the bacteria consume the hydrogen sulphide before it reaches the surface.

5.7 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 (Botha et al 2014). The Oceanographic and hydraulic conditions are indicated below in Table 5-2.

Table 5-2: The oceanographic and hydraulic conditions of the bay and the sea (botha et al 2014).

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 0.25m/s to 0.35m/s

5.7.1 Turbidity

Turbidity is a measure of the degree to which the water looses its transparency due to the presence of suspended particulate matter. Total Suspended Particulate Matter (TSPM) is typically divided into Particulate Organic Matter (POM) and Particulate Inorganic Matter (PIM), the ratios between them varying considerably. The POM usually consists of detritus, bacteria, phytoplankton and zooplankton, and serves as a source of food for filter-feeders. Seasonal microphyte production associated with upwelling events will play an important role in determining the concentrations of POM in coastal waters. PIM, on the other hand, is primarily of geological origin consisting of fine sands, silts and clays. PIM loading in nearshore waters is strongly related to natural inputs from rivers or from 'berg' wind events, or through resuspension of material on the seabed.

Concentrations of suspended particulate matter in shallow coastal waters can vary both spatially and temporally, typically ranging from a few mg/ℓ to several tens of mg/ℓ (Bricelj & Malouf 1984; Berg & Newell 1986; Fegley et al. 1992). Field measurements of TSPM and PIM concentrations in the Benguela current system have indicated that outside of major flood events, background concentrations of coastal and continental shelf suspended sediments are generally <12 mg/ℓ, showing significant long-shore

variation (Zoutendyk 1992, 1995). Considerably higher concentrations of PIM have, however, been reported from southern African west coast waters under stronger wave conditions associated with high tides and storms, or under flood conditions.

The major source of turbidity in the swell-influenced nearshore areas off Namibia is the redistribution of fine inner shelf sediments by long-period Southern Ocean swells. The current velocities typical of the Benguela (10-30 cm/s) are capable of resuspending and transporting considerable quantities of sediment equatorwards. Under relatively calm wind conditions, however, much of the suspended fraction (silt and clay) that remains in suspension for longer periods becomes entrained in the slow poleward undercurrent (Shillington et al. 1990; Rogers & Bremner 1991).

Superimposed on the suspended fine fraction, is the northward littoral drift of coarser bedload sediments, parallel to the coastline. This northward, nearshore transport is generated by the predominantly southwesterly swell and wind-induced waves. Longshore sediment transport, however, varies considerably in the shore-perpendicular dimension. Sediment transport in the surf-zone is much higher than at depth, due to high turbulence and convective flows associated with breaking waves, which suspend and mobilise sediment (Smith & Mocke 2002).

Zoutendyk 1992; Shannon & O'Toole 1998; Lane & Carter 1999).

6 IDENTIFICATION AND DESCRIPTION OF ENVIRONMENTAL ASPECTS AND IMPACTS

The activities associated with Tunacor Fisheries Ltd., discharging of waste seawater to the sea are already ongoing. As part of the EIA process, environmental Aspects and Impacts can be identified throughout the process flow of seawater abstraction, treatment fish processing and Discharging activities. The design criterion of the existing infrastructure, its operation and maintenance plans and understanding the sensitivities associated with the immediate biophysical and a scoping process to engage the various stakeholders including authorities is vital in identifying the aspects and impacts.

Table 6-1 provides a summary of the environmental aspects and the potential impacts associated with the Waste Seawater Discharge activities.

The relevance of the potential impacts (initial screening) are also presented in the table below to determine if certain aspects need to be assessed in further detail (Section 7 of this report).

Table 6-1: Potential environmental aspects and impacts associated with Tunacor Waste Seawater discharging activities

FACILITY / ACTIVITY	ASPECT	POTENTIAL ENVIRONMENTAL IMPACT	RELEVANCE (INITIAL SCREENING) OF POTENTIAL IMPACT
Legal Requirements			
Seawater intake system, treatment process and discharging activities.	Sea water abstraction process and presence of Co-pollutants in the Waste Seawater discharged at Sea.	Potential impacts associated with the marine environment.	• Tunacor has not yet obtained a waste sea water discharge permit. • Tunacor has so far implemented a proactive approach of best environmental management practice by undertaking monitoring and qualitative analysis of activities associated with the abstraction of seawater, treatment and discharging of waste seawater to the sea. • Without a defined waste seawater discharge to the sea criterion and compliance to local legal requirements i.e. that requires the submission of monitoring results to the authorities for scrutiny. It is likely that the continues discharging of waste seawater activities over a long period may result in potential cumulative impacts on the marine biota. • The waste seawater discharging activities at sea guidelines have been defined throughout the EIA process. • The marine biophysical impacts have been assessed. • Management and Mitigation measures have been incorporated in the EMP Section 8.
Operation and Maintenance activities associated with seawater abstraction and waste seawater discharging at sea activities			
Seawater intake	Abstraction and Discharge velocity	Impingement and entrainment	The size and type of screening system required depends on the quantity and type of the suspended matter present in the source water. These

			screens would usually be installed in the sea water pump station to remove larger pieces of organic matter. The intake of feed-water directly from the ocean would result in loss of marine species as a result of impingement and entrainment. Impingement refers to injury or mortality of larger organisms (e.g. fish, jellyfish) that collide with and are trapped by intake screens, whereas entrainment refers to smaller organisms that slip through the screens and are taken into the plant with the feed-water. Impingement mortality is typically due to suffocation, starvation, or exhaustion due to being pinned up against the intake screens or from the physical force of the rakes used to clear screens of debris. The reduction of the average intake velocity of the feed-water to ~0.1 - 0.15 m^3/s, which is comparable to background currents in the ocean, will allow mobile organisms to swim away from the intake under these flow conditions (UNEP 2008). Discharge velocities may also be determined to ease an even discharge flow with the sea current. This criterion is achievable and will not influence the required pumping capacities from the raw seawater tank to the treatment facility. Taking the above into consideration, the impacts associated with seawater intake is further discussed and assessed in Section 6. • In addition to pumping velocities, the type of pump technologies used is critical in ensuring and alleviating potential damage to zooplanktons and fish eggs. Consultation with the MFMR is recommended to source a semi-vortex pump (Ebara Model 80

			DVSU 62.22) that is widely used in Continues Underwater Fish Eggs Sampler) CUFES surveys. • Perforated Strainers and Screens used to filter solids and other organic matter could retain organic content that could be retained for further analysis and used as part of University and MFMR surveys/ research. Monitoring of this component is further recommended in the EMP.
	Servicing of equipment including pumps improper waste management causing pollution	Pollution of surface water	It is unlikely that hydrocarbon spillages can happen in the site of the pumping system as all the pumps installed at Tunacor are electric and remotely operated. However, there is a likelihood of litter in the area polluting the surface water and further being distributed by movement of waves. The litter would in this regard be from the employees in the area either undertaking monitoring sampling activities or regular work routine. This aspect can be easily mitigated through the implementation of mitigation measures and adhering to Tunacor Fisheries Ltd., company Environmental Health and Safety policies. Taking the above mentioned into consideration, the potential impacts will not be further discussed but mitigation have been raised in section 7.
	Operational pumping system and associated activities at Tunacor.	Noise impact	The pumping system and associated operational activities at Tunacor have the potential to emit noise impact. However, Tunacor is within the industrial area where various noise activities is undertaken in the background. The potential receptors i.e. residents are not within the area. Noise emitting from the pumping system would be limited to the

			pumping housing. Regular monitoring and maintenance of the pumps will continue to limit noise levels. No further assessment required.
Water Treatment Process	Pre-treatment	Detrimental effects on marine organisms due to residual chlorine levels in the mixing zone	A biocide is typically introduced into the intake water to ensure that the pumping systems are maintained free of biofouling organisms, for example, larvae of sessile organisms (e.g. mussels, barnacles, oysters) can grow in the intake pipe, and impede the intake flow of the feed-water. The main components of a chemical pretreatment system for seawater water treatment facilities include are: • Control of biofouling by addition of an oxidising (chlorine-based) or non-oxidising (e.g. Dibromonitrilopropionamide(DBNPA)) biocide, and dechlorination with sodium metabisulfite (in the case of chlorine-based products), • Removal of suspended material by flocculation bio flocculation), • Control of scaling by acid addition (lowering the pH of the incoming seawater) and/or dosing of special 'antiscalant' chemicals, • Cartridge filters as a final protection barrier against suspended particles and microorganisms. Tunacor introduces chlorine in dosage levels and flocculates into the system as detailed in Section 4.1.2. It is important to determine the

			water guidelines standards regarding limits associated with Chlorine usage and impacts associated with high levels of continuous discharging into the sea. The chlorine storage facilities should also meet the safety standards for Hazardous storage of chemicals i.e. should include installation of chlorine gas detection systems and alarms. The worst-case scenarios is considered in this process in an event of possible scaling and or biofouling "though not expected due to the current installation of PVC piping" and how the consideration of other options of chemical treatment highlighted above could be introduced to the process. It is relevant to consider the potential impacts associated with pre-treatment process, these are further discussed and assessed in Section 7.
	Backwash	Detrimental effects on marine organisms through discharge of Co-pollutants and scum backwash waters.	Reference to project description in Section 4.1.2 and further illustrative diagram in Figure 4-2, It is relevant to take into consideration all chemicals added to the process prior to backwashing. This is required in determining the co-pollutants, their quantities and influence on the marine ecology. In addition to this, the scum/ sludge overflow is also discharged in the process. It is relevant to understand what is the content in the scum (i.e. sediments, organic matter and filter coagulant chemicals) and influence on the marine ecology. The scum/ sludge discharge may lead to increases in turbidity and suspended matter and has blanketing effects on benthic communities (Lattemann & Höpner 2003; Sotero-Santos et al. 2007). Furthermore, maintenance activities may also be undertaken on the filters contributing to the backwash/ scum discharge. The potential impacts associated with the backwash process is further discussed and assessed in Section 7.

	Pumping and movement of waste seawater in the pipelines.	Elevated temperature in waste seawater	The temperature of the feed-water may increase slightly during its passage through feedlines and/ or warm waste water introduced into the drains to discharge at sea. However, this increase is not expected to exceed 1.5°C. further discussion and assessment is provided in section 7 as it is possible warm water could be introduced to the process.
		Depressed Oxygen concentrations in effluents	Dissolved oxygen (DO) is an essential requirement for most heterotrophic marine life. Its natural levels in sea water are largely governed by local temperature and salinity regimes, as well as organic content. A reduction in dissolved oxygen in the discharged waste seawater could occur if sodium metabisulfite (SMBS) is used as a neutralizing agent for the oxidising biocide “chlorine”. It is relevant to ensure effective dilution is undertaken throughout the process flow and therefore this aspect is further discussed and assessed in Section 8.

Fish Processing Factory and Discharge System	Additional dilution of the treated seawater with freshwater from cleaning purposes.	Positive impact: dilution of co-pollutants in the waste seawater discharge.	Throughout the waste seawater discharge process, Potable "Freshwater" is introduced at the following factories: • Sea Fresh Factory (31m^3/day); • Wet Fish Factory (185m^3/day; • IQF (21m^3/day). The portable "Fresh" water is discharged through the drain to mix with the waste sea water. However, no mixing is identified at the IQF, the portable water is discharged directly to the sea. This could be rediverted to mix with waste seawater prior to discharging and or used for further dilution of backwash and scum. Portable water will assist with further dilution of co-pollutant including detergents used in the process. Sections relevant to dilution of Biocides, Co-pollutants and Sediments highlights the use of portable water at IQF as optional dilution shall the water guidelines/ criterions be compromised. .

	Ineffective Effluents discharge screening system	Discharging of fish solids and sedimentary material into the sea.	As part of the maintenance activities at Tunacor, it is relevant to ensure the Discharging system at all factories works efficiently. Regular maintenance will ensure that solids including left over fish guts is not discharged into the sea. This has the potential to attract marine mammals including cape fur seals and bird's activity in the area. The effectivity of the Strainer system and potential impacts are further discussed in section 7. The potential of scouring of sediment around the discharge outlet (part of backwash/ scum discharge) is a serious design issue for an effluent system discharging volumes into a receiving water body. Taking into consideration the natural ocean wave action and relatively small volumes of discharge at all discharge points as presented in Section 4.1.3, It is still relevant for Tunacor to take into consideration the Turbidity quality of discharged material and cross reference these with the current water guidelines Turbidity and TDS as presented in Table 3-1 and Table 3-2. This aspect is further discussed and assed in Section 7.

With reference to Table 6-1 above, the following issue required **further** assessment.

- Potential impacts associated with the Marine Environment
- Impingement and entrainment
- Detrimental effects on marine organisms due to residual chlorine levels in the mixing zone
- Detrimental effects on marine organisms through discharge of Co-pollutants and scum backwash waters.
- Elevated temperature in waste seawater
- Depressed Oxygen concentrations in effluents
- Positive impact: dilution of co-pollutants in the waste seawater discharge.
- Discharging of fish solids and Sedimentary material into the sea.

Refer to Section 7 of this Scoping Report for an assessment of these issues.

7 ASSESSMENT OF IMPACTS

This section provides a discussion on the description of the identified potential impacts associated with the various project implementation phases associated with the Waste water discharging activities including **(Seawater abstraction and Treatment Process, Fish Processing activities and Waste water discharging activities**) as presented in Section 4. The Scoping process allowed an opportunity for participation of Interested and Affected Parties, where concerns and issues have been documented and summarised in Section 2.3.3. These have been taken into context of the assessment.

The description on Aspects and Impacts also intercepts the baseline on the environment provided in Section 6. Various similar EIA report findings and recommendations of the similar nature previously undertaken by Marvin Environmental Project Consultants CC and **Pisces Environmental Services (Pty) Ltd** have been used in this assessment and the associated Management and Mitigation measures have been documented in the EMP (Section 8).

7.1 IMPACT ASSESSMENT METHODOLOGY

Assessment of predicted significance of impacts for a proposed development is by its nature, inherently uncertain – environmental assessment is thus an imprecise science. To deal with such uncertainty in a comparable manner, standardised and internationally recognised methodology has been developed, and is applied in this report to assess the significance of the potential environmental impacts of the proposed construction and operation of the desalination plant.

For each impact, the SEVERITY (size or degree scale), DURATION (time scale) and EXTENT (spatial scale) are described (Table 7-1). These criteria are used to determine the CONSEQUENCE of the impact

Table 7-2), which is a function of severity, spatial extent and duration.

Table 7-1: Ranking criteria for environmental impacts

SEVERITY/INTENSITY	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Limited loss of resources.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Noticeable loss of resources.
	H	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Irreplaceable loss of resources.
DURATION	L	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
SPATIAL SCALE	L	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national

Table 7-2: Determining the Consequence

			SPATIAL SCALE		
SEVERITY	DURATION		Site Specific (L)	Local (M)	Regional/ National (H)
Low	Long term	H	Medium	Medium	Medium
	Medium term	M	Low	Low	Medium
	Short term	L	Low	Low	Medium
Medium	Long term	H	Medium	High	High
	Medium term	M	Medium	Medium	High
	Short term	L	Low	Medium	Medium
High	Long term	H	High	High	High
	Medium term	M	Medium	Medium	High
	Short term	L	Medium	Medium	High

The SIGNIFICANCE of an impact is then determined by multiplying the consequence of the impact by the probability of the impact occurring (Table 7-3) with interpretation of the impact significance outlined in Table 7-4

Table 7-3: Determining the Significance Rating

PROBABILITY (of exposure to impacts)		CONSEQUENCE		
		L	M	H
Definite/ Continuous	H	Medium	Medium	High
Possible/ frequent	M	Medium	Medium	High
Unlikely/ seldom	L	Low	Low	Medium

Table 7-4: The interpretation of the impact significance.

High	It would influence the decision regardless of any possible mitigation.
Medium	It should have an influence on the decision unless it is mitigated.
Low	It will not have an influence on the decision.

Once the significance of an impact has been determined, the CONFIDENCE in the assessment of the significance rating is ascertained using the rating systems outlined in the Table 7-5.

Table 7-5: Definition of Confidence Ratings

CONFIDENCE RATINGS*	CRITERIA
High	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Medium	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Low	Limited useful information on and understanding of the environmental factors potentially influencing this impact.

* The level of confidence in the prediction is based on specialist knowledge of that particular field and the reliability of data used to make the prediction.

Lastly, the degree to which the impact can be reversed is estimated using the rating system outlined in Table 7-6

Table 7-6: Definition of Reversibility Ratings

REVERSIBILITY RATINGS	CRITERIA
Irreversible	Where the impact is permanent.
Partially Reversible	Where the impact can be partially reversed.
Fully Reversible	Where the impact can be completely reversed.

Environmental Assessment Policy in Namibia requires that, "as far as is practicable", cumulative environmental impacts should be taken into account in all environmental assessment processes. EIAs & Scoping Reports have traditionally, however, failed to come to terms with such impacts, largely as a result of the following considerations:

- Cumulative effects may be local, regional or global in scale and dealing with such impacts requires coordinated institutional arrangements; and
- Environmental assessments are typically carried out on specific developments, whereas cumulative impacts result from broader biophysical, social and economic considerations, which typically cannot be addressed at the project level.

However, when assessing the significance of the project level impacts, cumulative effects have been considered as far as it is possible in striving for best practice. The sustainability of the project is closely linked to assessment of cumulative impacts.

7.1.1 Seawater Intake Activities

7.1.1.1.1 Impingement and Entrainment

The intake of feed-water directly from the ocean would result in loss of marine species as a result of impingement and entrainment. Impingement refers to injury or mortality of larger organisms (e.g. fish, jellyfish) that collide with and are trapped by intake screens, whereas entrainment refers to smaller organisms that slip through the screens and are taken into the plant with the feed-water. Impingement mortality is typically due to suffocation, starvation, or exhaustion due to being pinned up against the intake screens or from the physical force of the rakes used to clear screens of debris. The significance of impingement is related primarily to the location of the intake structure and is a function of intake velocity. The reduction of the average intake velocity of the feed-water to ~0.1 - 0.15 m^3/s, which is comparable to background currents in the ocean, will allow mobile organisms to swim away from the intake under these flow conditions (UNEP 2008). Various engineering design options exist to reduce and change the direction

of the intake water velocity, allowing fish and other mobile species to react more quickly to the velocity change and escape the intake system.

Planktonic organisms common in the Benguela region are likely to be prevalent in the surface waters of the project area. Plankton typically shows substantial temporal and spatial variations in species abundance, diversity and productivity, with most species having rapid reproductive cycles. Relative to Tunacor, the current seawater abstraction rate is 1540 m^3/day that translates to 0.018 m^3/s, is less than the proposed criterion (~0.1 - 0.15 m3/s). The proposed abstraction velocity should be used as a control measure. it seems unlikely that the operation of the current seawater intake system at 0.018 m^3/s will have a substantial negative effect on the ability of plankton organisms to sustain their populations. The entrainment of eggs and larvae from common invertebrate and fish species will also unlikely adversely affect the ability of these populations to reproduce successfully. Shall operational demand increase, the design capacity of the abstraction pumps should be adjusted to meet the proposed intake velocities this is achievable as the abstracted seawater is temporarily stored in the existing (3x10 m^3) raw water storage tanks before treatment and the pumping from the raw water storage is adjusted accordingly to the various pumping capacities required by the water treatment plant.

It has been suggested that the removal of particulate matter from the water column where it is a significant food source, may affect the productivity of coastal ecosystems (UNEP 2008; WHO 2007). The effects of this are, however, difficult to quantify. The effects of the current abstraction undertaken by Tunacor on the potential reduction in the particulate food source for the particle-feeding benthic macrofauna or flamingos would be difficult to quantify. The loss of marine species through impingement and entrainment is deemed of low severity, with rapid turn-over of plankton populations ensuring that any effects are quickly reversible. As the impact will persist over the operational life time of the plant it is deemed to be of LOW significance without mitigation. Despite the installation of screens and adjustment of intake velocities, entrainment of particulate matter is unavoidable and no further mitigation is deemed feasible.

Mitigation Measures

The following mitigation measures are recommended and should be implemented:

- Use the proposed <0.15 m^3/s abstraction velocity as control measure when operational demands increase to more than the current rate of abstraction.
- Ensure installation of screens on the end of the intake pipe, or the use of a screen box or shroud.

Loss of marine species through impingement and entrainment		
	Without Mitigation	***Assuming Mitigation***
Severity	*Low: limited loss of resources showing high spatial and temporal variability*	*Low*
Duration	*Low: rapid turn-over of plankton populations*	*Low*
Extent	*Low: limited to intake area*	*Low*
Consequence	*Low*	*Low*
Probability	*Continuous*	*Continuous*
Significance	*Low*	*Low*
Status	*Negative*	*Negative*
Confidence	*High*	*High*

Nature of cumulative impact	***Cumulative impacts of impingement and entrainment of plankton communities in the habour can be expected due to the number of seawater intakes serving fish processing and mariculture facilities.***
Degree to which impact can be reversed	***Any effects on marine plankton communities would be fully reversible***
Degree to which impact can be mitigated	***Medium***

7.1.2 Pre-treatment Activities and Backwash

7.1.2.1.1 Biocides

A biocide is typically introduced into the intake water to ensure that the pumping systems are maintained free of biofouling organisms. For example, larvae of sessile organisms (e.g. mussels, barnacles, oysters) can grow in the intake pipe, and impede the intake flow of the feed-water this could result in costly maintenance of feedlines.

There are two main groups of biocides: the oxidising biocides and the non-oxidising biocides. The classification is based on the mode of biocidal action against biological material. Oxidising biocides include

chlorine “currently used” and bromine-based compounds (e.g. Sodium hypochlorite (NaOCl)) and are non selective with respect to the organisms they kill. Non-oxidising biocides are more selective, in that they may be more effective against one type of micro-organisms than another. A large variety of active ingredients are used as non-oxidising biocides, including quaternary ammonium compounds, isothiazolones, halogenated bisphenols, thiocarbamates as well as others.

Sodium hypochlorite is typically used as an oxidising agent added intermittently at the seawater intake to as shock dosages to prevent marine growth. Chlorine concentrations are usually very low to non-detectable in the Waste water effluent (below the 3 µg/ℓ limit as permitted by ANZECC (2000) and the BCLME Water Quality Guidelines (CSIR 2006) for discharges to the marine environment, which provides one of the more conservative guideline value).

A major disadvantage of chlorination is the formation of organohalogen compounds. However, as only a few percent of the total added chlorine is recovered as halogenated by-products, and as by-product diversity is high, the environmental concentration of each substance can be expected to be relatively low. Dechlorination will further considerably reduce the potential for by-product formation. Nonetheless, there is some evidence that chlorinated-dechlorinated seawater increased mortality of test species and chronic effects of dechlorinated seawater were observed, which were assumed to be due to the presence of halogenated organics formed during chlorination (see UNEP 2008 for references). As only a very small percentage of the chlorine would transform into toxic by-products that cannot be eliminated by dechlorination, the likelihood of these affecting the biota in the receiving water is low. The use of a non-oxidising biocide such as DBNPA (see below) would reduce the risks of a potential impact on benthic communities.

The non-oxidising Dibromonitrilopropionamide (DBNPA) is frequently used as an alternative to sodium hyperchlorite. DBNPA has extremely fast antimicrobial action and rapidly degradates to relatively non-toxic end products such as ammonia, carbon dioxide, and bromide ions (US EPA 1994). Degradation end products (e.g. ammonia) will seemingly not be problematic in the marine environment, however, it is the specific biocidal action of residual DBNPA in the effluent streams that is the major concern. The dominant degradation pathway of DBNPA involves reaction with nucleophilic substances or organic material invariably found in water. Additional degradation reactions include hydrolysis, reaction with soil, and breakdown through light (US EPA 1994). The uncatalyzed hydrolysis of DBNPA proceeds via decarboxylation to the generation of an array of degradation products. These degradates include dibromoacetonitrile, dibromoacetamide, dibromoacetic acid, monobromoacetamide, monobromonitrilo-propionamide, monobromoacetic acid, cyanoacetic acid, cyanoacetamide, oxoacetic acid, oxalic acid, and malonic acid. The rate of hydrolysis is a function of pH and temperature, and increasing either or both pH and temperature will increase the decomposition rate. For instance, at pH 5 the half-life of DBNPA is 67 days as opposed to

63 hours at pH 7 and 73 minutes at pH 9. The receiving environment is slightly alkanine with a pH of around 7.2. DBNPA would thus hydrolyse rapidly into the above mentioned degradates, which in turn would degrade rapidly by aerobic and anaerobic aquatic metabolism (US EPA 1994). Exposure to sunlight is a futher factor increasing the rate of decomposition, which results in the formation of inorganic bromide ion. Aquatic toxicological studies have shown that DBNPA appears to be moderately toxic to estuarine fish and shrimp, and highly toxic to estuarine mysids, shellfish and larvae. However, due to the fast degradation of DBNPA, toxic effects are generally acute occurring within 24 hours of exposure, and chronic effects will not occur. Consequently, some risk assessment studies have concluded that the use of DBNPA in cooling systems does not pose an unacceptable risk to the environment (Klaine et al. 1996).

The seawater abstracted is shock dosed with free chlorine concentration set at 0.8 ppm. The chlorine booster pump would stop once the last intermediate pump has stopped. Although concentrations in the waste water will be extremely low, residual chlorine may be present in the effluent upon discharge into the marine environment, there is a significant decay of total residual oxidants (Saeed et al. 2015; Duan et al. 2016). The decay of total residual oxidants is typically considered to constitute a first order decay process, although more complex second order decay, double first order, and logarithmic decay processes may be more representative, particularly as the initial period of rapid decay upon discharge is then followed by a slower more steady decay process (Saeed et al. 2015). The decay of total residual oxidants is strongly dependent on the initial concentration being released, as well as the salinity, temperature and naturally-occurring organic material in the receiving marine waters. The decay rate increases with increasing initial discharge concentration, increasing seawater temperature and increasing organic matter. Assuming a first order decay, the half-life of total residual chlorine on discharge into the marine environment is of the order of 2 to 3 hours (Duan et al. 2016), although a much shorter half-life has been reported (Zeng et al. 2009). Fresh water is introduced into the process at the Sea Fresh (31m^3/day) and Wet Fish (185m^3/day) this will allow for further dilution of the waste water. Tunacor should ensure the drain and sump infrastructure allows for an effective dilution.

Should the oxidising biocide continue to be used and the set point criterion at a maximum of 0.8 ppm, the likelihood of the effluents having chlorine concentrations >3 µg/ℓ is very low any potential impacts would be of low, severity, highly localised and quickly reversible, resulting in the significance of the impact being LOW.

Mitigation Measures

The following mitigation measures are recommended:

- Undertake ‘pigging’ of intake pipeline to reduce the need for and costs of biocides if necessary.
- Use a non-oxidising biocide (DBNPA) in preference to chlorine.

- Shall chlorine continue to be used, ensure the dosage limit is within the 0.8ppm threshold.
- Ensure compliance to water guidelines relating to use of chlorine.
- Ensure the Freshwater introduced at the Sea Fresh and Wet Fish factories blends with the waste seawater prior to discharging.
- Freshwater discharge at IQF could be rediverted to mix and dilute with the waste seawater at Wet Fish factory before discharging.

Detrimental effects on marine organisms due to residual chlorine levels in the mixing zone		
	Without Mitigation	***Assuming Mitigation***
Severity	*Low: the biocide will be neutralized.*	*Low*
Duration	*Low: should impacts occur these would be quickly reversible*	*Low*
Extent	*Low: limited to discharge area*	*Low*
Consequence	*Low*	*Low*
Probability	*Unlikely*	*Unlikely*
Significance	*Low*	*Low*
Status	*Negative*	*Negative*
Confidence	*High*	*High*

Nature of cumulative impact	***No cumulative impacts are expected***
Degree to which impact can be reversed	***Any effects on marine plankton would be fully reversible***
Degree to which impact can be mitigated	***High***

7.1.2.1.2 Detrimental effects on marine organisms through discharge of Co-pollutants and scum backwash waters

In addition to the biocide dosing, the pre-treatment of the feed-water includes the removal of suspended solids, the control of scaling, and the periodical cleaning of the filters. As different chemicals are suited for different types filters, exact specifications for the existing filters should be determined. Manufacturers of Filters will provide relevant information in product manuals and are likely to offer consultation with regard to pre-treatment required. This section describes the use and effects of chemicals that are used in seawater treatment plants with an open water intake and where concentrations of suspended materials in the feed-water is comparatively high.

Removal of suspended material in the feed-waters is usually achieved by coagulation or flocculation, Dissolved Air Flotation and membrane ultrafiltration. The filters are backwashed periodically to clean off the particulate material and precipitates. The cleaning waste stream would produce a sludge that contains mainly sediments, and organic matter filter. If trickle-fed into and co-discharged with the waste water, the sludge may lead to localised increases in turbidity and have blanketing effects on benthic communities over the long term. As the feed-water is expected to have comparatively low suspended sediment loads, the likelihood of localised increases in turbidity near the outfall "all discharge areas" and smothering effects on benthic communities is very low. However, it is essential to continue monitoring the turbidity and TDS of backwash waters, specifically all the discharged water from the backwash and scum overflow at the seawater treatment facility. The presented Turbidity and TDS criterions in the Water Quality Guidelines (Section 3.1.6) should be adhered to. It is also essential to ensure the waste water is effectively diluted prior to discharging. Shall the backwash water present highly significant turbidity and TDS, it would be ideal to dilute the discharge with available freshwater discharged at the IQF factory. This would dilute the concentrations of any suspended particulate matter in the effluent, and consequently no effects of localised turbidity plumes are expected.

The discussion below relates to the use of antiscalants where relevant. The main representatives of scale-control additives used in Seawater treatment plants are typically organic, carboxylic-rich polymers such as polyacrylic acid and polymaleic acid. Although they have been phased out over the years, several of the acids and polyphosphates are still used to a limited degree. These have the potential to cause eutrophication in the vicinity of the outfall (see for example Shams et al. 1994). Polyphosphate antiscalants are easily hydrolysed to orthophosphate, which is an essential nutrient for primary producers. Their use may cause a nutrient surplus and an increase in primary production at the discharge site, through formation of algal blooms and increased growth of macroalgae (Lattemann & Höpner 2003; DWAF 2007). When the organic material decays, this in turn can lead to oxygen depletion. Phosphonate and organic polymer antiscalants have a low toxicity to aquatic invertebrate and fish species, but some substances exhibit an increased toxicity to algae (see UNEP 2008 for reference). The typical antiscalant dosing rate in water treatment facilities (1–2 mg/ℓ) is a factor of 10 times lower than the level at which a chronic effect can result (20 mg/ℓ), and it is 10 to 5,000 times lower than the concentrations at which acutely toxic effects can result.. Due to the antiscalants capability of binding nutrients they may, however, interfere with the natural processes of dissolved metals in seawater following discharge (see UNEP 2008 for reference). Some of these metals may be relevant micronutrients for marine algae. The blending of wastewater is relevant in the reduction of any subjected chemicals through the process.

Chemicals such as **detergents, oxidants, complexing agents and/or non-oxidising biocides** are often added to improve the cleaning process. These additional chemicals are usually generic types or special brands

recommended by the manufacturers. Common cleaning chemicals include Sulphuric acid, Ethylenediaminetetra-acetic acid (EDTA), Sodium tripolyphosphate (STPP), and Trisodium phosphate (TSP), and Dibromonitrilopropionamide (DBNPA) as the non-oxidising biocide. While the environmental fates and effects of these chemicals are variable, the toxicity of the various chemicals used in the pre-treatment process is relatively low and none of the products are listed as tainting substances (DWAF 1995). **After the cleaning process is complete it is essential to ensure that the waste water stream is effectively diluted with the introduced freshwater at the Fresh Fish, IQF and Wet Fish factories this will likely to have negligible effects on the receiving marine environment when discharged.**

The waste water from the treatment plant often contains low amounts of heavy metals that pass into solution when the plant's interior surfaces corrode. The Waste water may therefore contain traces of iron, nickel, chromium and molybdenum, but contamination levels are generally low (Hashim & Hajjaj 2005; Lattemann & Höpner 2003). Heavy metals tend to enrich in suspended material and finally in sediments, so that areas of restricted water exchange and soft bottom habitats impacted by the discharge could be affected by heavy metal accumulation. Many benthic invertebrates feed on this suspended or deposited material, with the risk that metals are enriched in their bodies and passed on to higher trophic levels. As they are an incidental by-product, **a confident assessment of the risk of potential heavy metals concentrations on the receiving environment is not possible.** However, due to the slightly turbulent nature of the receiving waters, it is predicted that the likelihood of the heavy metals accumulating in the sediments around the discharge is very low. It is recommended that limits are established for heavy metal concentrations in the effluent, and the discharge is periodically monitored to avoid exceedance of these limits.

Any impacts on marine organisms through discharge of antiscalants, residual cleaning solutions and heavy metals would be of low severity, highly localised and persist only in the short-term due to the turbulent nature of the receiving waters. The significance of the impacts of antiscalants, residual cleaning solutions and heavy metals is thus deemed to be of LOW significance without mitigation.

Mitigation Measures

The following mitigation measures are recommended:

- Ensure the Freshwater introduced at the Sea Fresh and Wet Fish factories blends with the waste seawater.
- However, it is essential to continue monitoring the turbidity and TDS of backwash waters, specifically all the discharged water from the backwash and scum overflow at the seawater treatment facility. The presented Turbidity and TDS criterions in the Water Quality Guidelines should be adhered to. Shall exceedance of the required constituents be reported often, it is relevant to consider diluting the waste water further with the available freshwater discharge at IQF Factory.
- Limit the use of scale-control additives to minimum practicable quantities.

- Avoid polyphosphate antiscalants.
- Use low-toxicity chemicals as far as practicable.

Detrimental effects on marine organisms through discharge of antiscalants, residual cleaning solutions and heavy metals in backwash waters		
	Without Mitigation	***Assuming Mitigation***
Severity	*Low: Concentrations of co-pollutants would be low due to blending of water with freshwater*	*Low*
Duration	*Low: should impacts occur these would be sublethal and quickly reversible*	*Low*
Extent	*Low: limited to discharge area*	*Low*
Consequence	*Low*	*Low*
Probability	*Unlikely*	*Unlikely*
Significance	*Low*	*Low*
Status	*Negative*	*Negative*
Confidence	*High*	*High*

Nature of cumulative impact	***No cumulative impacts are expected***
Degree to which impact can be reversed	***Any effects on marine communities would be fully reversible***
Degree to which impact can be mitigated	***High***

7.1.2.1.3 Increase in Temperature in the Effluent

The temperature of the feed-water may increase slightly during its passage through the intake pipelines and water treatment plant, but this increase is not expected to exceed 1.5°C. Temperatures will be highest in shallow water bodies such as the lagoon where wave action is minimal. Coastal winds across the bay are, however, expected to ensure thorough mixing of the water column in the bay during most of the year, and no stratification of the receiving waters is expected. The temperature of the discharged effluent will not be elevated above the naturally occurring maximum temperature occurring in the bay and therefore no thermal effects on local biota are expected. The impact is therefore considered to be of LOW significance without mitigation.

Mitigation Measures

The following mitigation measures are recommended:

- Ensure the Freshwater introduced at the Sea Fresh and Wet Fish factories blends with the waste seawater.
- Avoid discharging warm or hot water into the drains unless effectively mixed
- Monitor the temperature of discharged waste water.

Reduced physiological functioning of marine organisms due to elevated temperatures		
	Without Mitigation	***Assuming Mitigation***
Severity	*Low: temperature of the discharged effluent will not be elevated above the naturally occurring maximum temperature of the receiving environment*	*Low*
Duration	*Low: should impacts occur these would be sublethal and quickly reversible*	*Low*
Extent	*Low: limited to discharge area*	*Low*
Consequence	*Low*	*Low*
Probability	*Unlikely*	*Unlikely*
Significance	*Low*	*Low*
Status	*Negative*	*Negative*

Confidence	*High*	*High*

Nature of cumulative impact	***No cumulative impacts are expected***
Degree to which impact can be reversed	***Any effects on marine communities would be fully reversible***
Degree to which impact can be mitigated	***High***

7.1.2.1.4 Depressed Oxygen Concentrations in the Effluent

Dissolved oxygen (DO) is an essential requirement for most heterotrophic marine life. Its natural levels in sea water are largely governed by local temperature and salinity regimes, as well as organic content. Coastal upwelling regions are frequently exposed to hypoxic conditions owing to extremely high primary production and subsequent oxidative degeneration of organic matter. Increases in temperature and/or salinity result in a decline of dissolved oxygen levels.

A reduction in dissolved oxygen in the discharged Waste Water could occur if sodium metabisulfite (SMBS) if used as a neutralizing agent for the oxidising biocide. Although the reaction products are non-hazardous, SMBS is an oxygen scavenger and can severely deplete the dissolved oxygen in the discharged brine if dosing is not adjusted properly. In such cases, aeration of the effluent is recommended prior to discharge. For the current project this would happen by default as the effluent is discharged above the high water mark.

The likelihood of depressed oxygen concentrations in the effluent having detrimental effects on the intertidal and shallow subtidal biota is very low. The significance of the potential impact is therefore rated as LOW without mitigation. Ensuring accurate dosing of SMBS or the use of a non-oxidising biocide would further reduce the risks of a potential impact.

Mitigation Measures

The following mitigation measures are recommended:

- Ensure the Freshwater introduced at the Sea Fresh and Wet Fish factories blends with the waste seawater.
- Avoid overdosing with SMBS and aerate effluent at discharge.

Reduced physiological functioning of marine organisms due to reduced dissolved oxygen concentrations		
	Without Mitigation	***Assuming Mitigation***

Severity	*Low: the discharged effluent will not have depressed oxygen concentrations*	*Low*
Duration	*Low: should impacts occur these would be sublethal and quickly reversible*	*Low*
Extent	*Low: limited to discharge area*	*Low*
Consequence	*Low*	*Low*
Probability	*Unlikely*	*Unlikely*
Significance	*Low*	*Low*
Status	*Negative*	*Negative*
Confidence	*High*	*High*

Nature of cumulative impact	***No cumulative impacts are expected***
Degree to which impact can be reversed	***Any effects on marine communities would be fully reversible***
Degree to which impact can be mitigated	***High***

7.2 ASSESSMENT CONCLUSION

7.2.1 Environmental Acceptability

The impacts on marine habitats and communities associated with the existing waste sweater discharge activities are presented in the Table below.

Impact	Probability	Significance (before mitigation)
Potential impacts associated with the Marine Environment	Continuous	Low
Loss of species through impingement and entrainment	Continuous	Low
Detrimental effects on marine organisms due to residual chlorine levels in the mixing zone	Unlikely	Low
Reduced physiological functioning of marine organisms due to elevated temperatures	Unlikely	Low

Impact	Probability	Significance (before mitigation)
Reduced physiological functioning of marine organisms due to reduced dissolved oxygen concentrations	Unlikely	Low
Detrimental effects on marine organisms through discharge of antiscalants, residual cleaning solutions and heavy metals in backwash waters	Unlikely	Low
Discharging of fish solids into the sea.	Possible	Low

8 ENVIRONMENTAL MANAGEMENT PLAN

8.1 OBJECTIVES AND TARGETS

The aim of the Environmental Management Plan (EMP) is to detail the actions required to effectively implement mitigation and management measures. These actions are required to minimise negative impacts and enhance positive impacts associated with the existing Waste Water Discharge activities at Tunacor Fisheries Ltd.

The EMP gives the commitments, which form the environmental contract between Tunacor and the Government of the Republic of Namibia; represented by the Ministry of Environment, Forestry and Tourism (MEFT). Tunacor Fisheries Ltd., operational activities are implemented based on the ISO 22000 Food Safety Management System. ISO 22000 is an internationally recognised standard that combines the ISO9001 approach to food safety management and Hazard Analysis and Critical Control Point (HACCP) for the assurance of food safety at all levels. For an effective Environmental Management System (EMS) **it is recommended that Tunacor implements an EMS standard based on ISO 14001:2015 (EMS). The standard "ISO 1400 EMS" can be integrated with the existing ISO 2200/ HACCP to ensure an effective EMS framework and compliance to existing requirements and regulations regarding the existing Seawater abstraction and waste seawater discharge operations.**

The general principles of an ISO 14001: 2015 EMS is based on the following:

- Development of an environmental policy that reflects an organisation's commitments;
- The appointment of a person(s) responsible for the EMS's coordination;
- Identification of how the organisation interacts with the environment;
- Identification of actual and potential environmental impacts;
- Identification of environmental compliance requirements;
- Establishment of environmental objectives, targets and programs;
- Monitoring and measurement of the progress to achieve its objectives;
- Reviewing the system and environmental performance; and
- Continuous improvement of the organisation's environmental performance.

8.2 ORGANISATIONAL CAPACITY AND COMPETENCE

Tunacor will update the organisational structure with defined roles and responsibilities relevant to ensure an effective implementation this EMP through the above proposed ISO 14001 EMS. This is required as the responsibility in effectively implementing and complying to this EMP is dependent upon Tunacor's commitment in implementation of adaptable policies and compliance to legal requirements. The function of the current Environmental commitments is being managed by the Group Quality Assurance Manager and

the *Quality Assurance Officers.* The Group Quality Assurance Manager should ensure the appropriate resources and capacities exist to ensure an effective implementation of this EMP.

8.2.1 Top Management

- endorsing the environmental policy;
- ensuring appropriate resource allocation to enable the effective operation and continual improvement of the EMS and implementation of this EMP.

8.2.2 Manager: Environmental & Quality Assurance

- The Manager: Environmental & Quality Assurance shall approve and sign all EMS documents and ensure that all EMS requirements are established, implemented and maintained in accordance with the ISO 14001:2015.
- ensuring that sufficient resources are allocated for the effective implementation of the environmental policy and the EMS including this EMP.
- shall arrange an independent 3rd party audit to assess the level of compliance to the EMP;
- handles and investigates nonconformity and ensuring corrective and preventive action has been taken to mitigate any impacts caused;
- reports on the performance of this EMP to the top management for review and as a basis for improvement of the EMS.
- Completes annual reports and submits to MEFT, MAWL and MFMR

8.2.3 Factory Operational Manager

- Responsible for being compliant with and adhering to this EMP at all times;
- handles and investigates nonconformity and ensuring corrective and preventive action has been taken to mitigate any impacts caused;
- reports on the performance of this EMP to the top management for review and as a basis for improvement of the EMS.

8.2.4 Employees including Contractors

- Responsible for being compliant with and adhering to this EMP at all times
- Ensuring they have undertaken a site induction and are conversant with the requirements of this EMP
- Reporting of any operations and conditions that deviate from the EMP or any non-compliant issues or accidents to the proponent.

8.2.5 Training and Competence

- Training and competency will be managed accordingly to Tunacor's procedures on Awareness and Environmental Training
- Tunacor shall ensure all persons performing tasks for it or on its behalf, whose work may have a significant impact on the environment, are competent on the basis of appropriate education, training and/or experience, and shall retain associated records.

8.3 EMERGENCY PREPAREDNESS AND RESPONSE

The existing Emergency Preparedness and Response Plan Relevant procedure: Environmental Procedure no. 5 of the EMS as well as training given by the HSE officer shall be implemented accordingly.

The Emergency Preparedness and Response Plan is prepared on the basis of the risk assessment and existing HACCP Manual and should include:

- All areas where accidents and emergency situations may occur and communities or individuals that may be impacted;
- Procedures to respond to emergency situations;
- Provision of equipment and resources;
- Procedures for the use of safety equipment and facilities;
- Designation of roles and responsibilities during an emergency situation;
- Emergency contacts and communication protocols including interaction with Affected Communities, local government agencies and emergency response external services;
- Training plan and scheduled emergency drills in collaboration with emergency response services;
- Identification of evacuation routes and meeting points;
- Spill control and prevention of pollution procedures; and
- Procedure for incident communication and reporting.

8.4 GRIEVANCE MECHANISM

Internal communications will be handled in line with the existing procedure number 7 of the EMS on Enquiry / Complaint / Nonconformity Handling

8.5 EXTERNAL COMMUNICATIONS

External communications will be handled in line with the existing procedure: number 7 of the EMS.

8.6 ACTION PLANS TO ACHIEVE OBJECTIVES

Action plans to achieve the objectives are listed in tabular format together, separated by activities. The action plans also include the frequency for implementing the mitigation measures as well as identifying the

responsible party. It must be noted that these action plans only relate to activities associated with the Discharging of waste Seawater activities.

TABLE 8-1: Environmental (Marine) Mitigation Measures and Commitments – overall operation of the water treatment plant DAF system and Discharging activities

Activity	**Potential Impact**	**Management and Mitigation Measures**	**Action Plan**	
			Frequency	**Responsible Parties**
Operation of the Water Treatment Plant DAF System and discharging activities	Potential impacts associated with the Marine Environment.	- Ensure compliance to the Waste sea water discharge criterion presented in this report and the waste water discharge permit conditions from the Ministry of Agriculture Water and Land Reform. - Ensure compliance to the Environmental Policy	*Throughout the operation.*	*Factory Manager, Operator, Environmental and Quality Assurance Manager, Employees*

TABLE 8-2: Environmental Mitigation Measures and Commitments – Maintenance of equipment including pumps and Waste Management

Activity	**Potential Impact**	**Management and Mitigation Measures**	**Action Plan**	
			Frequency	**Responsible Parties**
Employees activities associated with the Operation and Maintenance of the Seawater Treatment Plant	Safety and Security	- All Access requirements including induction, Training and COVID-19 restriction currently being implemented by Tunacor's should be adhered to.	*Throughout the operation.*	*All management including contractors.*
	Waste Management	- Tunacor's standards and procedures regarding waste management shall be implemented accordingly and relevant to the following topics; o Material handling use and storage o Waste management including domestic waste and hazardous waste such paints, fuels and oils. o Equipment maintenance and storage. o Existing waste receptacles and in accordance to the requirements as indicated above shall be used accordingly. - Smoking is limited to designated smoking areas only - Have good house-keeping practices in place during all activities . - No dumping of materials into the intertidal and subtidal zones.	*Throughout the operation.*	*All management including contractors.*
	Noise	- Tunacor shall limit noise levels (e.g. install and maintain silencers on machinery). Appropriate directional and intensity settings are to be maintained on all hooters and sirens and no amplified sound shall be allowed on Site other than in Emergency situations. - Maintenance activities should be undertaken during business operating hours unless otherwise when necessary.	*Throughout the operation.*	*All management including contractors.*
	Fire	- Tunacor should install fire extinguishers in all areas prone to the risk of fires as identified in the Emergency Response Plan. - Ensure Safety risk Assessment is undertaken at all processes associated with the Water Treatment and Discharging activities.	*Throughout the operation.*	*All management including contractors.*

TABLE 8-3: Environmental (Marine) Mitigation Measures and Commitments – Seawater Abstraction activities

Activity	Potential Impact	Management and Mitigation Measures	Action Plan	
			Frequency	Responsible Parties
Seawater Abstraction activities	Impingement and Entrainment	- Ensure installation of screens on the end of the intake pipe, or the use of a screen box or shroud. - Regular maintenance on the screens and strainers to ensure effectivity is recommended. - Use the proposed <0.15 m^3/s abstraction velocity as control measure when operational demands increase to more than the current rate of abstraction. - In addition to pumping velocities, the type of pump technologies used is critical in ensuring and alleviating potential damage to zooplanktons and fish eggs. Consultation with the MFMR where necessary is recommended to source a semi-vortex pump (Ebara Model 80 DVSU 62.22) that is widely used in Continues Underwater Fish Eggs Sampler) CUFES surveys. - Ensure installation of screens on the end of the intake pipe, or the use of a screen box, shroud "Strainers". Perforated Strainers and Screens used to filter solids and other organic matter could retain organic content that could be retained for further analysis and used as part of University and MFMR surveys/ research. All areas fitted with screens shall be presented as sampling points for further collection of organic matter for analysis. - Additional monitoring of planktons including (Holo- Zooplanktons, Mero-zooplanktons) is proposed as part of baseline collection and university student's internship where relevant: Monitoring is to be undertaken at the abstraction pipeline, perhaps create a diversion point for sampling collection of the abstracted raw seawater adjusted at different abstraction velocities. This is required to understand and identify the type of marine organisms being abstracted at various velocities. This type of monitoring should Involve University students where necessary as part of their internship and or collaborative monitoring programme with the University of Namibia - Fisheries and Aquatic Science. - Establish Critical Control Points at all discharge points to collect samples and send to a certified lab for analysis as per discharge permit conditions and Waste Seawater discharge at sea BCLM criterion.	*Throughout the operation.*	*Factory Manager, Operator*

TABLE 8-4: Environmental (Marine) Mitigation Measures and Commitments Pre-Treatment Activities and Backwash

Activity	Potential Impact	Management and Mitigation Measures	Action Plan	
			Frequency	Responsible Parties
Pre-treatment Activity	Detrimental effects on marine organisms due to residual chlorine levels in the mixing zone	- Undertake 'pigging' of intake pipeline to reduce the need for and costs of biocides if necessary. - Use a non-oxidising biocide (DBNPA) in preference to chlorine. - Shall chlorine continue to be used, ensure the dosage limit is within the 0.8ppm threshold. - Ensure compliance to water guidelines relating to use of chlorine. - Ensure the Freshwater introduced at the Sea Fresh and Wet Fish factories blends with the waste seawater prior to discharging. - Freshwater discharge at IQF could be rediverted to mix and dilute with the waste seawater at Wet Fish factory before discharging	*Throughout the operation.*	*Factory Manager, Operator*
	Detrimental effects on marine organisms through discharge of Co-pollutants and scum backwash waters.	- Ensure the Freshwater introduced at the Sea Fresh and Wet Fish factories blends with the waste seawater. - However, it is essential to continue monitoring the turbidity and TDS of backwash waters, specifically all the discharged water from the backwash and scum overflow at the seawater treatment facility. The presented Turbidity and TDS criterions in the Water Quality Guidelines should be adhered to. Shall exceedance of the required constituents be reported often, it is relevant to consider diluting the waste water further with the available freshwater discharge at IQF Factory. - Limit the use of scale-control additives to minimum practicable quantities. - Avoid polyphosphate antiscalants. - Use low-toxicity chemicals as far as practicable	*Throughout the operation.*	*Factory Manager, Operator*

TABLE 8-5: Environmental (Marine) Mitigation Measures and Commitments – effluents passage through pipelines

Activity	Potential Impact	Management and Mitigation Measures	Action Plan	
			Frequency	Responsible Parties
Pumping and Movement of waste seawater in pipelines	Increase in temperature in effluent	- Ensure the Freshwater introduced at the Sea Fresh and Wet Fish factories blends with the waste seawater for an effective dilution.	Throughout the operation.	*Factory Manager, Operator*
		- Monitor the temperature of discharged waste water.	Throughout the operation.	*Factory Manager, Operator*
		- Do not discharge any warm effluents from the fish processing factory into the sea without these having cooled off or mixed with the freshwater.	Throughout the operation.	*Factory Manager, Operator*
	Depressed Oxygen concentrations in effluents	- Ensure the Freshwater introduced at the Sea Fresh and Wet Fish factories blends with the waste seawater.	Throughout the operation.	*Factory Manager, Operator*
		- Avoid overdosing with SMBS and aerate effluent at discharge.	Throughout the operation.	*Factory Manager, Operator*

8.7 RECOMMENDED MONITORING AND CONTINGENCY PLANS

It is recommended that an 'end of pipe' monitoring programme be compiled to enable Tunacor to regularly monitor the composition and quality of the effluent. A monitoring frequency of once a month for the initial six- to 12-month period of operation is recommended to ensure that the discharge system is functioning correctly. The monitoring data will serve to 'protect' the company from negative public perceptions on the discharge of effluents into the marine environment. It would also continue to provide evidence of due diligence that the water treatment plant is operating correctly and the effluent complies with discharge permit conditions. Effluent Water quality samples should continue to be submitted to an accredited analytical laboratory for analysis of trace metals (As, Cd, Cu, Cr, Fe, Hg, Ni, Mn, Pb, Zn), total suspended solids (TSS), total dissolved solids (TDS), Temperature, pH and for any biocides, antiscalants and CIP chemicals that are used in the plant.This information should be used to develop a contingency plan that examines the risk of contamination, and considers procedures that must be implemented to mitigate any unanticipated impacts (e.g. emergency incidents and upset conditions). The contingency plan must consist of stipulated procedures, schedules and responsibilities which include amongst others:

- standard operating procedures for detection of problems and responding to emergency incidents as well as upset conditions;
- programmes for the maintenance replacement and surveillance of the physical condition of equipment, facilities and pipelines;
- staff schedules;
- alternative personnel and services for the continued operation and maintenance of effluent discharge facilities during employee shortages;
- stocklists and suppliers for chemicals, spare parts and equipment components that can adequately ensure the continued operation of the effluent discharge facility during an emergency or breakdown;
- schedule of monitoring and sampling analyses when emergency or upset conditions occur at the plant;
- details on the type of mitigating measures to be implemented if effluent discharge into the coastal environment exceeds the limits prescribed in the Water quality guidelines as presented in Section 3.1.6;
- reporting procedures and protocols for events of malfunctioning of the effluent disposal system, as well as pollution events.

If 'end of pipe' values exceed the water quality guidelines (CSIR 2006) at any time, the operation would be in violation of the Waste Water and Effluent Disposal permit, and the cause of poor effluent quality must immediately be identified, reported and rectified. These events must be recorded as per internal procedures and must be reported to the responsible authorities on local, regional, and national levels, including, but not limited to the reporting of emergency incidents in terms of the Marine Resources Act and the Environmental Management and Assessment Act.

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MARVIN
ENVIRONMENTAL PROJECT
CONSULTANTS CC
Experts in Sustainable Development

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Appendix 1: Seawater Abstraction Permit no. 11166

REPUBLIC OF NAMIBIA

MINISTRY OF AGRICULTURE, WATER AND FORESTRY

Telephone: (061) 2087111
Fax: (061) 2087697
Enquiries: E Coetzee
Reference: 9/3/2/3/B

Department of Water Affairs
Private Bag 13193
Windhoek
9000

PERMIT NUMBER: 11 166 **DATE: 20 May 2016**

PERMIT FOR THE ABSTRACTION OF SEA WATER ISSUED IN TERMS OF SECTION 2 (m) OF THE WATER ACT, 1956 (ACT 54 OF 1956), AS AMENDED AND AS APPLICABLE ON SEA WATER

NAME OF PERMIT HOLDER	:	Tunacor Fisheries Limited
ADDRESS	:	P. O. Box 70, Walvis Bay
LOCATION	:	Walvis bay
DISTRICT	:	Walvis Bay
AREA WHERE WATER MAY BE ABSTRACTED	:	Atlantic Ocean
VALIDITY PERIOD	:	5 (five) years
PURPOSE FOR WHICH WATER MAY BE USED	:	Industrial
ABSTRACTION PER DAY	:	1 500m³ maximum

This permit authorizes the abstraction and use of water for industrial purposes from the Atlantic Ocean, subject to the following conditions:

REPUBLIC OF NAMIBIA

MINISTRY OF AGRICULTURE, WATER AND FORESTRY

Telephone: (061) 2087111
Fax: (061) 2087697
Enquiries: E Coetzee
Reference: 9/3/2/3/B

Department of Water Affairs
Private Bag 13193
Windhoek
9000

Factory Engineer
Tunacor Fisheries Limited
P. O. Box 70
WALVIS BAY

2016 -03- 24

Sir

APPLICATION FOR A PERMIT FOR THE ABSTRACTION OF WATER FROM THE ATLANTIC OCEAN AT WALVIS BAY FOR INDUSTRIAL PURPOSES, ERONGO REGION

1. The above-mentioned application has been approved. Attached please find permit number 11 166 which authorizes the abstraction of sea water for industrial purposes.

2. You are kindly requested to comply with all the permit conditions, especially conditions number 7, 8 and 10.

Yours faithfully

PERMANENT SECRETARY

1. The validity period shall be from 20 May 2016 to 19 May 2021.

2. An application for the extension of the validity period shall be in the possession of the Permanent Secretary at least 6 (six) months before the expiry date of the permit.

3. This permit is incident to the property and if the present owner sells the property, the permit shall be handed over to the new owner.

4. Sea water abstracted and desalinated is for the permit holder's use only.

5. No abstracted sea water may be sold to any third party without the written permission of the Ministry of Agriculture, Water and Forestry.

6. In order to sell desalinated water the permit holder has to be registered with this Ministry as a bulk water supplier.

7. All water abstracted shall pass through a water meter and the permit holder shall bear all costs for the supply, installation and maintenance of this meter. The Permanent Secretary shall be informed beforehand if a water meter is to be installed so that an inspection, if necessary, can be conducted. Installation of the meter shall be to the satisfaction of the Permanent Secretary.

8. The permit holder shall keep daily readings in cubic metres of the above-mentioned water meter and enter it quarterly on the prescribed return form WA-003, which shall be submitted on or before the 10th day of the following quarter, in respect of the previous quarter, to the Control Officer: Abstraction Control. If no water was abstracted during a quarter, a nil return form shall be submitted. Should you have inquiries regarding the completion of the above-mentioned form, you may contact the Geohydrology or Law Administration Division at telephone numbers (061) 2087102 or 2087228.

9. All installations, reservoirs, pipes, taps troughs and reticulation systems shall be leak proof to prevent any spillage of water. The permit holder shall take the necessary precautions to use the water on his property to the best advantage.

10. The plant reject/brine shall be discharged back to the sea through suitable diffusers and methods. The brine must be diluted with seawater of ambient salinity, in order to reduce its high salinity level, prior to discharge in the sea.

11. The Permanent holder is not allowed to discharge sewage or any other harmful substances onto the property or into the Atlantic Ocean or to re-use the said substances in such a manner or perform any act which could pollute any public or private water, including subterranean water in such a way as to render it less fit for:

    (a) the purposes for which it is or could ordinarily be used by other persons; or

    (b) the propagation of fish or other aquatic life; or for

    (c) recreation or other legitimate purposes.

12. The Permanent Secretary or his authorized representative shall have the right to:

(a) withdraw, amend or replace any condition of this permit or withdraw this permit in its entirety. After reasonable notice to the permit holder, and

(b) inspect the source at all reasonable times to determine whether the permit conditions are adhered to.

13. The Permanent Secretary shall not accept liability for damage or loss suffered by the permit holder should the period of validity of the permit not be extended or renewed for any reason which is beyond the control of the Permanent Secretary.

14. Should the permit holder not comply with any of the permit conditions:

(a) the permit holder may be held liable for any costs which the Permanent Secretary may incur as a result thereof, and

(b) the permit holder shall be guilty of an offence and shall, on conviction, be liable to the penalties prescribed in Section 170 of the Water Act, 1956 (Act 54 of 1956).

PERMANENT SECRETARY

Appendix 2: EIA Practitioners CV

CURRICULUM VITAE

Ph: +264 81 4788279

msanzila@slrconsulting.com

MARVIN NM SANZILA

ENVIRONMENTAL CONSULTANT

Environmental Management Systems, Impact Assessments, Permitting and Compliance.

- Qualifications

BSc	2007	Natural Resources
Cert	2014	Understanding and Auditing ISO 14001
Cert	2015	New Managers Development Programme

- **EXPERTISE**

- Environmental Assessments and Project Management
- ISO 14001: Environmental Management Systems; EMPs: Implementation and Coordination
- Environmental Auditing
- Stakeholder Management
- Film presenter and narrator:

Marvin Sanzila joined SLR Environmental Consulting (Pty) Ltd in March 2016 as an Environmental Assessments Practitioner and currently serves as a board member of the Environmental Assessment Professionals of Namibia (EAPAN). Prior to this venture, Marvin successfully implemented the Langer Heinrich Uranium's Environmental Management System (ISO 14001) for 5 years, ensuring compliance across the business sector and retention of the project's license to operate.

Marvin has assisted various consultants for 4 years in conducting Environmental Impact Assessments (EIAs) for project appraisals with the regulating authorities. All projects experience related to EIAs have been successfully awarded Environmental Clearance Certificates (ECCs) by the regulating authority and are operational, enhancing both local and international business sector while implementing best practice environmental and social management tools.

Apart from Project Management and Environmental Assessments, Marvin has presented and narrated two films, one that emphasizes the role of the environmental Management Act no.7 of 2007 in the modern day Namibian development context and the other that looks at Namibia's Wetlands and its potential for ecotourism. His diverse capabilities, skills and knowledge and growing passion for environmental management allows an opportunity for a dynamic Environmental Team.

- **PROJECTS**

Swakop Uranium PTY (LTD)

Environmental Impact Assessment process for the proposed Husab mine on-site 12 MW (Phase 1) (2019).

Role: Environmental Impact Assessment Practitioner and Project Manager (**successfully completed the EIA process and have obtained the Environmental Clearance Certificate (ECC) through the regulating authority for the project's development).**

Swakop Uranium PTY (LTD) has partnered with CGN Energy International Holdings CO. Limited (CGNEI), a sister Company of Swakop Uranium, to construct and operate a Solar Photovoltaic (PV) Power Plant with a capacity of 12 megawatt (MW) at the Husab Mine to supply power to the processing plant and associated activities.

Alten Renewable Energy Group (Alten) Environmental and Social Management Support for the proposed construction and operation of the 37 MW Solar Power Plant in Mariental, Namibia (2018)	Environmental and Social Management Support Manager. **Successfully completed construction phase of the project.** Successfully overseen the implementation of the Environmental and Social Management System during the construction and operation of a 37 MW Solar Power plant in Mariental. During the construction phase of the project, the Environmental and Social Management Plans (ESMPs) required their implementation in compliance to International Finance Corporation (IFC), Equator Principles (EPS) and the Namibian Regulations.
NAMWATER Environmental and social screening: Feasibility study for a desalination plant and water carriage system to secure water supply to central coast, Windhoek and en-route users (2019)	Role: Environmental Impact Assessment Practitioner (Project Management Assistant) (**Project On-going)** The Feasibility Study is financed through the Government of the Federal Republic of Germany, KfW Development Bank. Namibia Water Corporation Ltd. (NamWater) has been assigned by the Ministry of Agriculture Water and Forestry (MAWF), as the Project Executing Agency, to undertake a feasibility study for the development of a Desalination Plant and Water Carriage System, to secure water supply to the central coastal area of Namibia; Windhoek; as well as en-route users (i.e. towns). SLR and the Council for Scientific and Industrial Research (CSIR) (South Africa) were jointly appointed by the Project Management Team to undertake the Environmental Screening Study as input into to the overall Feasibility Study.
GALP Proposed offshore Exploration Well drilling in PEL 82 & 83, Orange Basin, Namibia. EIA Report and Environmental & Social Management Plan (ESMP), (2019)	Role: Project assistant Environmental Practitioner. EIA process for the proposed offshore Exploration Well drilling in PEL 82 & 83, Orange Basin, Namibia EIA Report and Environmental & Social Management Plan (ESMP).
Farm Skakel Environmental Performance Report And Management Plan For Water Abstraction Boreholes (WW10801 & WW10062) On Farm Skakel	Role: Environmental Impact Assessment Practitioner **(successfully completed the EMP compilation and an ECC has been issued by the regulating Authority for the project.** Environmental Performance Report And Management Plan For Water Abstraction Boreholes (WW10801 & WW10062) On Farm Skakel.
Farm Burnel Environmental Performance Report and Management Plan for Water Abstraction Boreholes (WW 200285 & WW 37681) on Farm Burnel	Role: Environmental Impact Assessment Practitioner **(successfully completed the EMP compilation and an ECC has been issued by the regulating Authority for the project.** Environmental Performance Report and Management Plan for Water Abstraction Boreholes (WW 200285 & WW 37681) on Farm Burnel.

Farm Finsterbergen Environmental Performance Report and Management Plan for Water Abstraction Boreholes on Farm Finsterbergen	Role: Environmental Impact Assessment Practitioner **(successfully completed the EMP compilation and an ECC has been issued by the regulating Authority for the project.** Environmental Performance Report and Management Plan for Water Abstraction Boreholes on Farm Finsterbergen.
Swakop Uranium PTY (LTD) Scoping report (including impact assessment) for the proposed changes to the Husab mine and linear infrastructure (2018-2019)	Role: Environmental Impact Assessment Practitioner **(successfully completed the EIA process and has obtained the Environmental Clearance Certificate (ECC) through the regulating authority for the project's development).** Swakop Uranium PTY (LTD) Swakop proposes further amendments to the approved Husab Mine plan and associated activities, as follows: • Further alterations of the WRD design; and • The Implementation and operation of an on-site incinerator for the purposes of improved waste management. • Six (6) new mobile communication antenna-poles for mobile communication road coverage along the access road to the mine from the B2 turn off.
Swakop Uranium PTY (LTD) Swakop Uranium Internal Scoping Report for the proposed New Raw Water Pond (2017).	Environmental Practitioner for the Scoping (including assessment) process. **(Successfully completed the EIA process and has obtained the Environmental Clearance Certificate (ECC) through the regulating authority for the project's development).** Swakop Uranium Projects and Processing Departments proposed to construct an additional raw water pond for the storage of Raw water supplied by NamWater. The additional pond is not only required to provide the plant with the required volumes of water, but also to ensure suitable volumes of water being stored during scheduled NamWater maintenance shutdown periods.
Shell Namibia Upstream B.V. EIA for proposed Deep Water Exploration Well Drilling in Petroleum Exploration Licence 39 (blocks 2913a and 2914b) off the coast of Southern Namibia (2017)	Project Assistant (Environmental Practitioner) for the Public Participatory Process (including Focus Group Meetings) of the EIA. Correspondence with Client and Project Management. **(Successfully assisted the EIA process and has obtained the Environmental Clearance Certificate (ECC) through the regulating authority for the project's development).** Shell Namibia Upstream BV holds PEL 39, which is located adjacent to the southernmost Namibian offshore border with South Africa. Shell is proposed to drill one or possibly two exploration wells in the northern portion of the licence area.
European Investment Bank and NamPower: Environmental Impact Assessment (EIA) for the proposed Encroacher Bush Biomass Power Project in Namibia (2017)	Project Assistant NamPower has partnered with the European Investment Bank (EIB) proposes to construct and operate a biomass power plant that will generate electricity by the combustion of wood from encroacher bush, growing in the surroundings of the proposed power plant area.

Tschudi Copper Mine: Environmental Audit Report-November 2017	Environmental Auditor (**Continues to support the Mine through compliance audit**) Environmental Audit for the EMP implementation of the Tschudi Mine in Tsumeb, Namibia.
Namibian National Parks Programme Phase IV(NamParks IV) Environmental considerations related to development of park management infrastructure in the Tsau //Khaeb national park in the /Karas Region (2017)	Environmental Practitioner (Project Manager) **(Successfully assisted the EIA process and has obtained the Environmental Clearance Certificate (ECC) through the regulating authority for the project's development).** On the 20th of June 2017, Lund Consulting Engineers cc (Lund) requested SLR Environmental Consulting (Namibia) (PTY) Ltd (SLR), to interpret the extent of environmental legal requirements for the proposed infrastructure development of NamParks Phase IV in the TKNP as detailed in the Concept Design Report. Design, site supervision and contract administration. NamParks is supported by the Federal Republic of Germany through the Kreditanstalt für Wiederaufbau (KfW) Development Bank. The programme (NamParks) has been implemented into development phases (1 to 4). NamParks Phase 4 (NamParks IV) is currently focused on Park Management infrastructure development in the Tsau //Khaeb (Sperrgebiet) National Park (TKNP).
Earthmaps CC Scoping Report and EMP for Earthmaps Consulting CC's Exploration Activities on EPLs 6339 and 6340, North-West of Tsumeb in the Oshikoto Region (2017)	Environmental Practitioner (Project Manager) for the EIA process of the proposed project activity. **(Successfully assisted the EIA process and has obtained the Environmental Clearance Certificate (ECC) through the regulating authority for the project's development).** Earthmaps Consulting CC (Earthmaps) founded in 2004, is a local consulting service based in Swakopmund, Erongo Region with vast experience in minerals' exploration and mining in Namibia and across Africa. Earthmaps holds the Exclusive Prospecting Licenses (EPLs) 6339 and 6340, located north-west (NW) of Tsumeb in the Oshikoto Region. Earthmaps required an environmental clearance certificate (ECC) from the Ministry of Environment and Tourism (MET): Department of Environmental Affairs (DEA) to conduct exploration activities in these EPLs.
Votorantim Metals Namibia (PTY) LTD Scoping Report (including assessment) and EMP for Votorantim Metals Namibia (PTY) LTD's Exploration Activities on EPL 6521, North-West of Otavi in the Otjozondjupa Region (2017)	Environmental Practitioner (Project Manager) for the EIA process of the proposed project activity. **(Successfully assisted the EIA process and has obtained the Environmental Clearance Certificate (ECC) through the regulating authority for the project's development).** Votorantim Metals Namibia (Pty) Ltd (Votorantim) is a wholly owned subsidiary of Votorantim Metais Zinco, a Brazilian mining company, specialising in zinc, lead and copper. Votorantim has successfully obtained an Exclusive Prospecting Licence (EPL) 6521 in the North-western side of Otavi in the Otjozondjupa Region. Votorantim require an environmental clearance certificate (ECC) from the Ministry of Environment and Tourism (MET): Department of Environmental Affairs (DEA) to conduct exploration activities on EPL 6521.

Namibian National Parks Programme Phase NAMPARKS Phase II Scoping Report for Infrastructure Development: Amendment for the proposed Addition of Entrance Gate, Tourist Reception, Staff Housing at Mudumu. (2016)	Environmental Practitioner for the EIA process of the proposed project activity. **(Successfully assisted the EIA process and has obtained the Environmental Clearance Certificate (ECC) through the regulating authority for the project's development).** An environmental Scoping Report and Environmental Management Plan (EMP) for the infrastructure development in the North-Eastern Parks was completed in March 2008 and the Environmental Clearance Certificate (ECC) subsequently issued in 2008, following the submission to the MET: Department of Environmental Affairs (DEA). Infrastructure provisions for the Mudumu South in the approved Scoping Report only included a Park Entrance gate. It has come to terms that additional infrastructure is required at the Mudumu South. SLR was consulted to undertake the EIA process for the proposed additional park infrastructure.
ErongoRed EIA for a new 44 kV powerline between Swakopmund reservoir and the Swakop River Plots (2016).	Environmental Practitioner (for the EIA process, including EIA write up, Public Participatory process, review of specialist report and project management). EIA for the proposed upgrading of the 22 kV to 44 kV powerline. A new overhead powerline to be constructed. **(Successfully assisted the EIA process and has obtained the Environmental Clearance Certificate (ECC) through the regulating authority for the project's development).**
Ministry of Agriculture, Water & Forestry (MAWF) EIA process for the Zone Irrigation Project , North west of Nkurenkuru, Kavango Region (2016, 2018)	Environmental Practitioner (EIA write up, process, review of specialist report and project management) The Ministry of Agriculture, Water & Forestry (MAWF) through the Division of Agricultural Engineering (DAE) intends to develop an Irrigation Project as part of the Government's Green Scheme in the Zone Area located about 30 km northwest of Nkurenkuru in the Western region of Kavango. An EIA process is required for the project to obtain an ECC.
Namibia Construction PTY Ltd. Scoping (Including Assessment) Report and EMP for Sand Mining project- 20km South West of Okahandja (2016)	Environmental Practitioner **(Successfully assisted the EIA process and has obtained the Environmental Clearance Certificate (ECC) through the regulating authority for the project's development).** Namibia Construction (Pty) Ltd is mining sand in the upper reaches of the Swakop River on Farm Osona 65, 20 km south-west of Okahandja town and 6 km East of Gross Barmen. Namibia Construction has been mining sand from this location in the Swakop River between 2011 to 2014 and resumed in 2015 after the river flow reinstated the river sand in the mined out areas. An EIA process was required as per EIA regulations and EMA
Tschudi Copper Mine Environmental Audit Report- November 2016	Environmental Auditor Environmental Audit for the EMP implementation of the Tschudi Mine in Tsumeb, Namibia

Swakop Uranium PTY LTD Scoping Report (including impact assessment) for the proposed amendment to the Husab Mine Linear Infrastructure - 33kV Overhead Powerline at the B2 Vehicle Staging Area (2016)	Environmental Practitioner (for the entire EIA process, including EIA write up, Public Participatory process, review of specialist report and project management. **(Successfully assisted the EIA process and has obtained the Environmental Clearance Certificate (ECC) through the regulating authority for the project's development).** Swakop Uranium proposes to erect a 33 kV overhead power line (±1.25 km in length) from the existing Erongo RED 22kV powerline to their B2 Vehicle staging area next to the B2 main road. And EIA process was required for the issue of the ECC.
Igneous Mining Environmental Certificate Clearance (ECC) Renewal for small scale mining activities on ML 135 in Sarusus Area, Skeleton Cost Park (2016)	Environmental Practitioner for the ECC Renewal Process. **(Successfully assisted the EIA process and has obtained the Environmental Clearance Certificate (ECC) through the regulating authority for the project's development).** Igneous Mining's environmental clearance certificate for ML 135 Small scale mining activities at Sarusus Area in the Skelton Coast Park is due for renewal. It's with this background that the project still intends to keep the Mining lease until such time that the lease lapses. It has come to terms that Igneous Mining needs to apply for a renewal of their ECC.
Swakop Uranium PTY LTD Swakop Uranium Internal Environmental Scoping Report for the proposed Sub-Economic Material Stockpiling Area (2016)	Environmental Practitioner **(Successfully assisted the EIA process and has obtained the Environmental Clearance Certificate (ECC) through the regulating authority for the project's development).** Swakop Uranium proposes a minor change and/or addition to the approved Husab Mine design plan and infrastructure specific to stockpiling of Sub Economic Material (SEM) with an average ore grade of 113 ppm. The SEM is proposed to be stockpiled on two dedicated "SEM stockpiles", located next to the Waste Rock Dump (WRD) within the perimeters of Pit Zone 1 and Pit Zone 2. An internal screening process was required to assess the impacts associated with the project activity
Langer-Heinrich Uranium PTY Ltd Environmental Compliance Coordinator (2014-2016)	Environmental Compliance Coordinator The primary purpose of this role is to coordinate the environmental compliance program at Langer Heinrich Uranium (LHU) in order to ensure LHU successfully integrate environmental compliance across the business and retains its licence to operate. • Coordinate and provide support to ensure impact /aspect and risk assessment registers are up to date • EMP implementation • Participate in environmental incident investigations • Training and awareness • Conduct assessment of company activities to ensure compliance with ISO /internal standards and facilitate or coordinate environmental audit programme • Document control • Environmental register • Co-ordination, communication & networking

Langer-Heinrich Uranium PTY Ltd. Environmental Technician (September 2011-2013)	Environmental Technician Roles: • Environmental Aspect and compliance monitoring • Incident management and data entry • EMP Compliance • Site-Contractors compliance to Environmental procedures, Environmental Management Plan, • Compliance to EMS ISO 14001; Environmental Internal Audits and Reports • Contribution to Monthly and Bi-Annual Environmental Reports • Waste management overall mining operation • Environmental Monitoring • Maintenance and Utilization of environmental Monitoring equipment • Training; Environmental awareness, Policy, Spill and Waste management
MAMOKOBO Video& Research, Ministry of Environment & Tourism. Documentary Film; Eco-tourism and Namibia's Wetlands: supporting livelihoods. (2011)	Presenter, Narrator. Filming Logistics and schedule planner
Risk Based Solutions cc Scoping Report: InnoWind Energy Namibia (PTY) LTD for the proposed 10 MW Solar array Project, Walvis Bay, Erongo Region (March 2011)	Environmental Junior consultant (Project assistant) • Project development stages, Socio- economic (Regional and Local Positive and Negative social impacts, Assessment methodology and procedures.
Risk Based Solutions cc Scoping Report: On Road Investment (PTY) LTD for mining of copper, zinc and gold at farm Elbe 10, EPL 4232 Okahandja, Otjozondjupa Region (November 2010)	Environmental Junior consultant (Project assistant) • Project development stages, Socio- economic (Regional and Local Positive and Negative social impacts, Assessment methodology and procedures, Health and Safety
Risk Based Solutions cc Scoping Report: Zhonghe Resources (Namibia) Development (PTY) LTD for proposed new uranium mine, EPL3602. Arandis area, Erongo region. (October 2010)	Environmental Junior consultant (Project assistant) • Project development stages, Socio- economic (Regional and Local Positive and Negative social impacts, Assessment methodology and procedures.

Risk Based Solutions cc Scoping Report: Logwood Investment (PTY) LTD for mining of Copper and Silver at Klein Aub, EPL 3663, Rehoboth District, Hardap Region (May 2010)	Environmental Junior consultant (Project assistant) • Project development stages, Socio- economic (Regional and Local Positive and Negative social impacts), Assessment methodology and procedures, Health and Safety
Alex Speiser Environmental Consultants CC (ASEC cc Environmental Background and Environmental Management Plan for the development of Eros Load Centre 66/11KV Substation and upgrade of the Olympia Load Centre (March 2010)	Environmental Junior consultant (Project assistant) • Baseline Assessment • Identification of potential impacts • Environmental Management Plan
UNDP-MET, Versacon cc Namibia Landscape Conservation Area Initiative" NAM-PLACE (Sept 2009)	Assistant Coordinator Development of Project Document for the "Namibia Landscape Conservation Area Initiative" NAM-PLACE. Pre-Feasibility and Baseline Assessment of the project focal areas and verification of the proposed PLACA demonstration Sites • Project coordination and management
Versatile Environment Consulting cc Namibia National Climate Change Policy and accompanying Strategic Action Plan (Mar 2009)	Assistant Coordinator • Administrative support and coordination.
Versatile Environmental Consulting cc (Feb 2009- Feb 2010)	Environmental Junior Consultant Technical environmental services to Versacon cc: • Project development, management and coordination • Project and programme environmental assessment, EIA.
MAMOKOBO Video & Research, Ministry of Environment &Tourism (MET) – Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) Environmental Management Act Film(Feb 2009)	Project Coordinator Assistant Marketing and Distribution of the Environmental Management Act no.7 of 2007 film "A Balancing Act".

MAMOKOBO Video & Research, Ministry of Environment &Tourism (MET) – Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) Environmental Management Act no.7 0f 2007, supporting film (A Balancing Act) Sept 2008- Dec 2008	Film Presenter/ Narrator • Participate in public consultation meetings • Conduct live interviews with various stakeholders
Risk Based Solution cc EIA for Northern Namibia Development Company (NNDC) PTY LTD proposed mining and ongoing exploration – EPL No. 2633 May - June 2008	Environmental Junior Consultant • Assessment of Environmental components (Fauna and flora Coastal Settings and the Kunene River Mouth settings, likely impact and management) • Review of the Legal Framework relevant to the project.
SAIEA- Millennium Challenge Account (MCA) Strategic Environmental Impact Assessment of the construction of a new veterinary cordon fence along Namibia-Angola border (April 2008)	Consultant- Enumerator • Baseline data collection and impact assessment of the proposed veterinary cordon fence
SAIEA- Millennium Challenge Account (MCA) Strategic Environmental Impact Assessment of the construction of a new veterinary cordon fence along Namibia-Angola border (April 2008)	Consultant- Enumerator • Baseline data collection and impact assessment of the proposed veterinary cordon fence
Versatile Environment Consulting cc Namibia National Climate Change Policy and accompanying Strategic Action Plan (Mar 2009)	Assistant Coordinator • Administrative support and coordination.

Versatile Environmental Consulting cc EIA for a Seismic Survey in Block 1911, offshore Namibia (April 2007)	Environmental Junior Consultant • Review of international, regional and national agreements/ policies/ legislation relevant to project • Provision of information and data about coastal and marine regarding sensitivity, ecological importance and other relevant attributes of block 1911 • Preparation and provision of information about the Kunene River mouth, key species, sensitivities and threats.
Versatile Environmental Consulting cc EIA for proposed development of guano platforms near Sandwich Habour Walvis Bay (March 2007)	Environmental Junior Consultant • Review of policies, legislation and international conventions in the context of the project and biodiversity conservation
SAIEA Trans-boundary issues of the Orange-Senqu river basin waters May 2007	Project Assistance
Versatile Environmental Consulting cc Data gathering and gap analysis for modeling of the cumulative effects of offshore petroleum exploration and production activities on the marine environment in the BCLME region. (February 2007)	Environmental Junior Consultant • Compilation of quantitative data on past, present, future petroleum industry activities and techniques for drilling in a GIS compatible format. • Identification and compilation of data on biological, physical and chemical elements most likely to be affected at sites of existing petroleum exploration and production activities. • Analysis of common impacts and project specific impact from oil/gas exploration
National Botanical Institute (NBRI), Namibia Biodiversity Database (NaBiD) Facilitation of baseline biodiversity data through the Brown Hyena Research Project for conservation planning of the Sperrgebiet National Park (Feb 2006- Jan 2007)	Data Coordinator Facilitation of baseline biodiversity data through the Brown Hyena Research Project for conservation planning of the Sperrgebiet National Park

Versatile Environmental Consulting cc EIA for a Seismic Survey in Block 1911, offshore Namibia (April 2007)	Environmental Junior Consultant • Review of international, regional and national agreements/ policies/ legislation relevant to project • Provision of information and data about coastal and marine regarding sensitivity, ecological importance and other relevant attributes of block 1911 • Preparation and provision of information about the Kunene River mouth, key species, sensitivities and threats.
Versatile Environmental Consulting cc EIA for proposed development of guano platforms near Sandwich Habour Walvis Bay (March 2007)	Environmental Junior Consultant • Review of policies, legislation and international conventions in the context of the project and biodiversity conservation.
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Versatile Environmental Consulting cc Data gathering and gap analysis for modeling of the cumulative effects of offshore petroleum exploration and production activities on the marine environment in the BCLME region. (February 2007)	Environmental Junior Consultant • Compilation of quantitative data on past, present, future petroleum industry activities and techniques for drilling in a GIS compatible format. • Identification and compilation of data on biological, physical and chemical elements most likely to be affected at sites of existing petroleum exploration and production activities. • Analysis of common impacts and project specific impact from oil/gas exploration
National Botanical Institute (NBRI), Namibia Biodiversity Database (NaBiD) Facilitation of baseline biodiversity data through the Brown Hyena Research Project for conservation planning of the Sperrgebiet National Park (Feb 2006- Jan 2007).	Data Coordinator
Ministry of Fisheries and Marine Resources (Marine Mammal Section) Cape fur seal Project Jan – Feb 2004	Assistant Fisheries Technician

1999 The Deep, Hull (1999 - 2004)	A large aquarium designed by Sir Terry Farrell & Partners. Located on the River Humber the site is split into two areas the main attraction being the aquarium and the other being the business centre. Design concept for a large entrance plaza, public spaces, car park and landscape to business centre. Responsible for the landscape design of the main external spaces around the visitor centre as well as the layout for the car parks. Liaison with Sir Terry Farrell & Partners and engineers to create a high quality design / interactive visitor experience. Subsequent implementation of site works.
• **MEMBERSHIPS**	
ENVIRONMENTAL ASSESSMENT PROFESSIONALS OF NAMIBIA (EAPAN)	Professional Membership

Resume of Charles Cleghorn

Tel: +264 81 128 4327

Email: cleghornconsult@gmail.com

EXECUTIVE SUMMARY

An experienced SHEQ (Safety, Health, Environment and Quality) Manager, focussed on the development, implementation monitoring and improvement of effective Management Systems in Quality, Environment and Safety disciplines in developing countries with diverse cultures. Have developed documentation and submittals for various Permits to governments and compiling and reporting of Legal compliance. Has experience with managing SHEQ departments in various African countries and companies. Has worked in several mining companies in Namibia and West Africa and extensively in the fishing industry in Namibia (both for private industry and the regulator)

He has extensive experience in the monitoring of compliance requirements according to the Lender (World Bank/ IFC Performance Standards and the Equator Principles), in country and international legislation and regulations.

Well experienced in negotiating with regulators from various government departments in different countries in obtaining permits and in auditing the requirements various organisations, EPCM and operational contractors' operations, staff performance and compliance levels in multiple sites in various countries. Able to identify SHEQ risks to operations and to include in controls set to reduce impacts on environmental and improve health safety and quality of operations.

Has obtained experience in working only for export driven companies in Namibia and West Africa (Liberia), implementing international standards in local factories and on mine sites. Conducting EMP updates and developments, and reviewing of EIA for multi-disciplinary projects in the mining industry. He has been a previous Director/Owner of a private construction and property development company in Namibia (Swakopmund and Walvis Bay for 4 years), focussing on residential, commercial, single and high density developments over several years. Obtaining building approvals/permits, with engineering and municipal and national regulations incorporated in designs and final construction.

Currently consulting to the IAEA (Vienna, Austria), large export driven companies, property developments, industrial/manufactory companies, transport, tourism and engineering firms in Namibia in Environmental Impact Assessment (EIA),

A Namibian citizen, Fluent in English and Afrikaans, with a basic understanding of German.

Key Strengths

- A motivated individual open for new challenges and opportunities, dedicated and committed.
- Ability to work with all cultures, individuals and groups from diverse back grounds, from various parts of the world.
- Team builder and facilitator, providing drive and leadership in pushing through company objectives on time and on budget.
- Ability to liaise and deal with various governmental departments, organising and chairing public meetings with regulators and resolving issues in order to obtain the relevant permits to operate at the various sites.
- Ability to convey complex requirements and standards to diverse groups and individuals, implementing cost effective solutions tailored to the local circumstances and to obtain buy in from superiors, subordinates, peers and contractors.
- Results driven and outcomes focussed. Working well as individual and in teams.

- Ability to adapt quickly to changing environment and circumstances and adjust approach accordingly to ensure outcomes is guaranteed.
- Always willing to go the extra mile and "….always gets the job done…."
- Attention to detail and focussed on professional service and deliverables to all stakeholders, inside and outside organisation.
- Effective communicator to all levels, all cultures inside and outside organisation and with regulators.

EDUCATION

FORMAL:

1997:	**M.Sc**. (Ecology: Mine Rehabilitation)
1994:	**Hons. B.Sc**. (Microbiology) University Stellenbosch, South Africa
1992;	**B.Sc.** (Science) University Stellenbosch, South Africa

COURSES:

2006:	**SAMTRAC Safety Management (NOSA Namibia)**
2005:	**Advanced** program in **HACCP/Risk Management** (Royal Institute of Public Health, Birmingham, England)
2004:	Program in **Project Management** (Masters Level) Stellenbosch Business School, Cape Town
2003:	**ISO 14001: Environmental Management/Legal/Auditing** (Modules 1-3) SABS, South Africa
2002:	**ISO 9001: 2000 Quality Management Systems** (Module 1-3) SABS
2000:	Louis Allen Management Course (SABS Managers)
1997:	**ISO 17025** (SANAS Laboratory accreditation)
1988:	**Bellville High School, Bellville, South Africa** Grade 12 with following subjects: • Afrikaans • English • Mathematics • Natural Science • Biology • Accounting

REGISTRATIONS:

- **Professional Natural Scientist: Environmental Sciences**
  (SACNASP: South African Council for Natural Scientific Professionals)

- **Approved Inspection Authority: Health + Safety** (Reg 156 of 1997: Min of Labour, Namibia)

- **Environmental Practitioner**: **EAPAN Namibia** (Environmental Practitioners in Namibia)

(Copies of all certificates available on request.)

CAREER HISTORY

(1) **December 2018 to date**

Current Contracting Employer: **International Atomic Energy Agency (IAEA)** in Vienna, Austria.

Position Holding: **Environmental Consultant**

Duties:
1) Training for International Uranium Mining Companies
2) Audits and Inspections for Environmental Performance of Mine sites
3) Advisory Services on EIA/ EMP and Scoping studies, development of specialist studies.
4) Rehabilitation Reviews and advisory services on Legacy Uranium Mines in Asia (Kyrgyzstan).

(1) **February 2017 to date**

Current Employer: **The Namibia Health, Safety and Environmental Consultancy (NamHSE)** in Windhoek/Swakopmund, Namibia (Health And Safety consulting/ Risk Assessments, HIRA/ Hazard Analyses, General Safety and Health Services, EIA and EMPs, Government Reporting and Liaising; specialist's studies, Training, general consultancy, Quality Management systems (NOSA, HACCP/ISO 9001, OASHAS 18001 and ISO 22001, etc.)

Position Holding: **Environmental + Safety Consultant (Director)**

Duties:
1) Company business development
2) Systems (NOSA, HACCP/SHEQ/EIA/EMP and ISO14001) development
3) Safety System Development (OSHAS 18001 + NOSA)
4) Environmental Management (EIA, EMP, Method statements, procedures, etc.), Mine Rehabilitation (IAEA)

(2) **September 2014 to October 2016**

Current Employer: **Avesoro Resources** in Liberia (London and Toronto Listed Comp). **Open cast Gold Mine** (constructed/commissioned/production during EBOLA crises)

Position Holding: **EHS advisor (Environmental, Health and Safety)**

Duties:
1) Implementing IFC/World Bank + Lenders Environmental + Safety Standards (IFC performance STD's/ Equator Principles) = IFC approved SHEQ practitioner
2) Development of required documents for Permit Applications and renewals, submittals, liaison with Government Departments (EPA and Ministry of Mines), chairing public meeting and obtaining of Environmental Permits and assist with expansion project applications.
3) Develop ISO 14001 + OSHAS 18001 procedures, STD's, Work Instructions, Management Programs, EMP's etc.

4) Audits and Inspections of sites + Contractors
5) All compliance monitoring (Water/Waste/Cyanide + Arsenic, Safety and Environmental) + reporting
6) Training and development of local staff (Contractors and Operational)
7) Manage water treatment plants (Met Plant/Domestic Camps, offices, etc.)
8) Managing all aspects of Biodiversity + Wetland Management/design, Inspections, permitting and construction
9) All aspects of waste management/Hazardous Materials handling of contractors and operational staff (all phases).
10) Advise+ Report on SHEQ matters to Management.
11) Reporting on contractor (Operational and construction) Environmental compliance and performance.
12) Managed Storm water Management mitigations at sites.
13) Assistant Met Laboratory Manager.
14) Coordinated EPA inspections, Lender visits, World Bank visits to site, etc.
15) Control and manage Hydrological, Biodiversity and other specialist's contractors/consultants

(3) **November 2012 to August 2014**

Previous Employer: **ArcelorMittal Liberia Ltd (Iron Ore Mining),**
ArcelorMittal Mining, London, UK

Previous Location: Buchanan / Yekepa, Grand Basso + Nimba Counties, Liberia, West Africa

Position holding; **Country Environment Manager (5 sites)**

Duties:
1) Managing 5 locations for environment (Mine site, Yekepa and Buchanan Towns, 1 quarry, linear infrastructure of Rail Road, Port/Workshop Facilities)
2) Government Liaison Person on Environmental Issues with the EPA of Liberia, Communities/ NGO, Permit renewals for Environmental Permits with the EPA. Public meetings, Discussions and negotiations and permit approvals.
3) Managing of Legal and Permit registers for operations and reporting to Government on progress, managing government audits to verify compliances +Auditing Legal compliances and reporting to Government.
4) Environmental Management System/ Procedures/Work Instructions/Manuals (ISO 14001)
5) Developing of Environmental Programs
6) Conduct Environmental/Safety Audits + Inspections + manage/control all SHEQ consultants.
7) Development and Manage Legal compliance register and permits registers.
8) Prepare sites for ISO 14001 certification (with Lloyds)
9) Integration of all EMP's and submittals to the EPA for contractor and operational activities on multiple sites
10) Storm water management and mitigation by mining contractors and EPCM contractors.

(4) **April 2007 to October 2012**

Previous Employer: **Langer Heinrich Uranium (Pty) Ltd/**

Paladin Energy Group of Companies **Australia** (Ltd)

Location: Namib Naukluft National PARK, Swakopmund, Namibia
Open Cast Uranium Mine in National Park

Position holding; **Environmental Manager**

Duties:
1) ISO 14001 Management Rep/ Implementer (Lloyds ISO 14001)
2) Government Liaison Officer on Environmental Issues + Compliance Manager (Due Diligence/Legal and EIA/EMP conditions) + Environmental, Heritage and Municipal Permits and Renewals + EPL conversion to ML applications, Mine Plans and Accessory Works applications + Develop and Manage Legal and Permit Registers, auditing compliance and reporting to stakeholders.
3) Environmental Management Systems implementation (Develop/Implement/Review/ Improve and audit)
4) Advise and assist other departments in Environmental matters/compliance/ implementation
5) Developing/Auditing of the Environmental Plans + Programs
6) Sustainability and Regulatory Reporting to Government Regulator and Stakeholders/HQ/NGO's
7) Audit coordinator and lead auditor or environmental performance in company
8) Manage on site Rehabilitation and Nursery
9) Manage all Hydrology and Geo-hydrological Aspects on site/Consultants
10) Lead company Systems and ISO auditor

(5) **Dec 2005 to February 2007**

Previous Employer: **Olthaver and List Group of Companies: Hangana Seafood Factory**

Location: Walvis Bay, Namibia

Position holding; **Safety, Environment, Health, Risk and Security Manager (SHER)**

Duties:
1) Responsible for implementation and management of an Occupational Health and Safety Risk Management Systems.
2) Audits and assistance of the HACCP systems
3) SHEQ training to subordinates
4) Manage the Occupational Clinic + Safety Compliance + Audits and Inspections.
5) Initiated development of the Safety Management System in the factory
6) Manage Security Team/Clinic on site
7) SHEQ training to subordinates

(6) **Jan 2002 to Nov 2005**

Previous Employer: **Skeleton Coast Trawling Ltd**
(NovaNam/**Pescanova** Group, SPAIN)

Location: Luderitz, Namibia

Position holding: **Senior Manager: Quality Management**/Technical Foods Division

Duties:	1) Responsible for implementing: ISO 9001:2000 at 3 Factories (Skeleton Coast Trawling/ Coastal Marine Industries/ Gendor + Deep Ocean) in group in Namibia (2 Luderitz/ 1 Walvis Bay). Initiate 2) Managing/Controlling/Reviewing HACCP Safety Risk Systems (Management Representative) 3) HACCP audits and improvements in factories 4) Managing staff and training (41 HACCP/Quality Inspectors with associated Supervisory levels) 5) Group liaison officer for Customer complaints (from Company in Spain).and Liaison with the EU Commissioners on Food Quality for the Company 6) Managing all inspection and monitoring QC's 7) Develop HACCP on 18 stern trawlers and 2 factory Freezers

(7) **February 1996 to December 2001**

Previous employer:	**South African Bureau of Standards (SABS)**
Location:	Walvis Bay, Namibia
Position holding;	**Manager: Test Laboratory** Technical Coordinator, Quality Control Manager of Lab
Duties:	1) Responsible for initiating laboratory accreditation (ISO 17025) Quality Management Systems 2) Water, raw and final product foodstuffs 3) Training/Managing of test officers/consulting to Fishing Industry. 4) HACCP/ISO 9002 Audits of exporting companies (with SABS lead auditors from the RSA) of most fishing companies in Walvis Bay.
Computer literacy:	Microsoft Office (Word/Excel/Power point)

REFERENCES:

Mr. Cristo van Niekerk
Previous Engineering Manager: Avesoro Resources (now MNG Gold), currently consulting
Avesoro Resources (now MNG Gold)
Grand Cape Mount County, North Western Liberia, West Africa
Mobile: + 27 72 691 8844
Cristovk19@gmail.com

Mr. Neil Seaward
HR Manager: Vemitco Bauxite Mine
Sierra Leone, West Africa
Mobile: + 27 71 636 0938
seawardneil61@gmail.com

Mr. Martin Cooks
Former Manager: Metallurgical Projects (now consulting)
Langer Heinrich Uranium (Pty) Ltd
Swakopmund, Namibia

Mobile: +27 72 219 0982
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Mr. Andrew Reid
Operations Manager: BCM International
Accra, Ghana, West Africa
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Mr. Nico Scholtz
Director/GM of Scarab Enterprises
Namibia/Tanzania
Mobile: + 264 81 328 6253 Namibia
+ 255 75 385 2103 Tanzania
nico@scarab.com.na

Appendix 3: IAPs Database

IAPS DATABASE

Organisation	Title	Lname	Inits	Fname	Capacity	Address1	Town	Country	Email
Ministry of Fisheries and Marine Resources	Mr	Victor	M	Libuku	Fisheries Biologist	Box 912	Swakopmund	Namibia	victor.libuku@mfmr.gov.na
Ministry of Fisheries and Marine Resources	Ms	La toya		Shivute	MFMR		Swakopmund	Namibia	latoya.shivute@mfmr.gov.na
Ministry of Fisheries and Marine Resources	Mr.	Hamukwaya		Ferdi	MFMR		Swakopmund	Namibia	ferdinand.hamukwaya@mfmr.gov.na
Ministry of Fisheries and Marine Resources	Ms	Kreiner	A	Anja	Subdivision Environment	P O Box 912	Swakopmund	Namibia	anja.kreiner@mfmr.gov.na
'Ministry of Fisheries and Marine Resources (Aquaculture/ Mariculture	Ms.	Skrypzeck		Heidi	Fisheries Biologist			Namibia	Heidi.Skrypzeck@mfmr.gov.na
Ministry of Agriculture Water and Land Reform	Mr.	Hambambi		Mattheus	MAWL		Windhoek	Namibia	mattheus.hambabi@mawf.gov.na
Ministry of Agriculture Water and Land Reform	Ms.	Afrikaner		Laurica	"water guidelines"			Namibia	lauricaafrikaner@mawf.gov.na
University of Namibia	Mr.	Akawa		Twalinohamba	UNAM		Swakopmund	Namibia	takawa@unam.na
NAMPORT	Mr	Gariseb	S	Stefanos	Manager: SHEQ			Namibia	s.gariseb@namport.com.na
Hangana Seafood	Mr.	Nakale		Gisbertus	Quality Assurance Manager		Walvis Bay	Namibia	gisbertus.nakale@ol.na
Gendev Group	Mr.	Jonas			Quality Assurance Manager		walvis Bay	Namibia	jonas@gendev.com
Hadago Fishing	Ms	Carelywn			Quality Assurance Manager		Walvis Bay	Namibia	carelywnna@venmar.com.na
Merlus Seafood (PTY) Ltd					Quality Assurance Manager		Walvis Bay	Namibia	rrconsultancy@iway.na

Merlus Seafood (PTY) Ltd					Quality Assurance Manager		Walvis Bay	Namibia	mrconsultancy@iway.na
Screens and Strainers'	Ms	Enkali		Lena			Walvis Bay	Namibia	
Walvis Bay Town Council	Ms	Monica	T	Thomas	Environmental Officer	Private Bag 5017, Walvis Bay, Namibia	Walvis Bay	Namibia	mthomas@walvisbaycc.org.na
Walvis Bay Town Council	Mr	Archer	R	Riaan	Inspector Hazardous Waste	Private Bag 5017, Walvis Bay, Namibia	Walvis Bay	Namibia	rarcher@walvisbaycc.org.na
Walvis Bay Town Council	Mr	David	U	Uushona	Manager Environmental	Private Bag 5017, Walvis Bay, Namibia	Walvis Bay	Namibia	Duushona@walvisbaycc.org.na
Walvis Bay Town Council	Mr	Ephraim	N	Namabahu	Town Planner	Private Bag 5017, Walvis Bay, Namibia	Walvis Bay	Namibia	enambahu@walvisbaycc.org.na

Appendix 4: I&AP Notification Correspondence

APPENDIX 4.1: EMAIL NOTIFICATION OF THE DRAFT REPORT FOR REVIEW

NOTIFICATION CORRESPONDENCE TO THE WALVIS BAY MUNICIPALITY

From: Marvin Sanzila <marvinconsultants@outlook.com>
Sent: Tuesday, 15 September 2020 11:55
To: David Uushona <duushona@walvisbaycc.org.na>; abrummer@walvisbaycc.org.na; Ephraim Nambahu <enambahu@walvisbaycc.org.na>; mthomas@walvisbaycc.org.na; 'rarcher@walvisbaycc.org.na
Cc: thomash@tunacor.com.na; rauna.n@tunacor.com.na; gunther@tunacor.com.na; cleghornconsult@gmail.com
Subject: EIA process for Tunacor Fisheries Ltd.'s existing Seawater Treatment and discharge activities, Walvis Bay

Dear Stakeholder,

Thank you for the opportunity to be able to share the below information and attached Draft Environmental Management Plan (EMP) for Tunacor Fisheries Ltd.'s existing Seawater Treatment and waste water discharge activities at sea, Walvis Bay industrial area. The Draft EMP is for your information, review and commenting purposes if necessary. Shall you wish to request for a meeting regarding the project "another opportunity for you to raise more comments" please don't hesitate to let me know before Friday the 18th of August 2020. The below information is relevant and please refer to the attached report for more in-depth.

Introduction:

Tunacor Fisheries Ltd., currently abstracts about ± 407 000 m³ of seawater per annum that is used in the fish processing factor for cleaning purposes only. About 101200m3 of potable water per annum supplied by the municipality is also used in the fish processing factory and other facilities. The abstracted seawater is treated through the already installed Water Treatment Facility prior to usage in the factory. An effluent's discharge filtering and screening system has been installed to ensure further screening of the resultant waste seawater from the fish processing factory to enable the collection of fish solid waste that is used as part of the fishmeal processing. This avoids further discharging of the solid material into the sea. Tunacor further undertakes qualitative monitoring and analysis through a certified lab Namibia Standards Institute (NSI). This is done to ensure the discharged waste sea quality is within the criterion used for the discharging of waste seawater at sea.

However, there is potential impacts that may be associated with the marine ecology that Tunacor has not identified yet through the existent operational activity of seawater abstraction and wastewater discharging activities at sea. The waste seawater criterion currently used needs to be updated with additional guidelines relating to discharging of effluents at sea. Tunacor appointed NAMHSE that has formed a joint venture with Marvin Environmental Project Consultants cc (Marvin Consultants) to provide the Environmental advisory support required for the Environmental Impact Assessment (EIA) Process

EIA Process:

The proposed EIA process including an internal scoping process and assessment will allow an opportunity to identifying the aspects and impacts that will further advise the compilation of an Environmental

Management Plan. The EMP documents the Management, Mitigation and Monitoring measures for implementation. This process will then proceed to an application for a seawater discharge permit with MAWL after the regulating authority Ministry of Environment Forestry and Tourism (MEFT) has approved and issued the Environmental Clearance Certificate (ECC).

As detailed above, Please don't hesitate to contact me for additional clarity.

Thank you

Marvin Sanzila

NOTIFICATION CORRESPONDENCE TO THE MINISTRY OF FISHERIES AND MARINE RESOURCES (MFMR)

From: Marvin Sanzila [mailto:marvinconsultants@outlook.com]
Sent: Tuesday, 8 September 2020 12:13
To: Anja Kreiner; Victor Libuku
Subject: Meeting Proposal_Tunacor existing seawater abstraction and discharge activities

Dear Anja and Victor.

I hope you are both surfing in the cold sea and still winning. I have been keeping great and busy.

I have just completed compiling an EMP for Tunacor Fisheries Limited's (Tunacor) existing sea water treatment and discharging activities. For a comprehensive finalised EMP, I would like to briefly discuss the report with both of you or anybody else available. This could be done over MS Teams or we could visit your office during your coffee break. The overall aim is to highlight key aspects and provide in-depth on the findings of the assessment and proposed management and mitigatory measures.

Are you available anytime this week? Please propose time best suiting your schedule.

Looking forward to your response

Kind regards

Marvin

NOTIFICATION CORRESPONDENCE TO GENDEV

From: Marvin Sanzila <marvinconsultants@outlook.com>
Sent: Tuesday, September 15, 2020 11:43 AM
To: jonas@gendev.com.na
Subject: EIA process for Tunacor Fisheries Ltd.'s existing Seawater Treatment and discharge activities, Walvis Bay

Dear Stakeholder,

Thank you for the opportunity to be able to share the below information and attached Draft Environmental Management Plan (EMP) for Tunacor Fisheries Ltd.'s existing Seawater Treatment and waste water discharge activities at sea, Walvis Bay industrial area. The Draft EMP is for your information, review and commenting purposes if necessary. Shall you wish to request for a meeting regarding the project "another opportunity for you to raise more comments" please don't hesitate to let me know before Friday the 18th of August 2020. The below information is relevant and please refer to the attached report for more in-depth.

Introduction:

Tunacor Fisheries Ltd., currently abstracts about ± 407 000 m^3 of seawater per annum that is used in the fish processing factor for cleaning purposes only. About 101200m3 of potable water per annum supplied by the municipality is also used in the fish processing factory and other facilities. The abstracted seawater is treated through the already installed Water Treatment Facility prior to usage in the factory. An effluent's discharge filtering and screening system has been installed to ensure further screening of the resultant waste seawater from the fish processing factory to enable the collection of fish solid waste that is used as part of the fishmeal processing. This avoids further discharging of the solid material into the sea. Tunacor further undertakes qualitative monitoring and analysis through a certified lab Namibia Standards Institute (NSI). This is done to ensure the discharged waste sea quality is within the criterion used for the discharging of waste seawater at sea.

However, there is potential impacts that may be associated with the marine ecology that Tunacor has not identified yet through the existent operational activity of seawater abstraction and wastewater discharging activities at sea. The waste seawater criterion currently used needs to be updated with additional guidelines relating to discharging of effluents at sea. Tunacor appointed NAMHSE that has formed a joint venture with Marvin Environmental Project Consultants cc (Marvin Consultants) to provide the Environmental advisory support required for the Environmental Impact Assessment (EIA) Process

EIA Process:

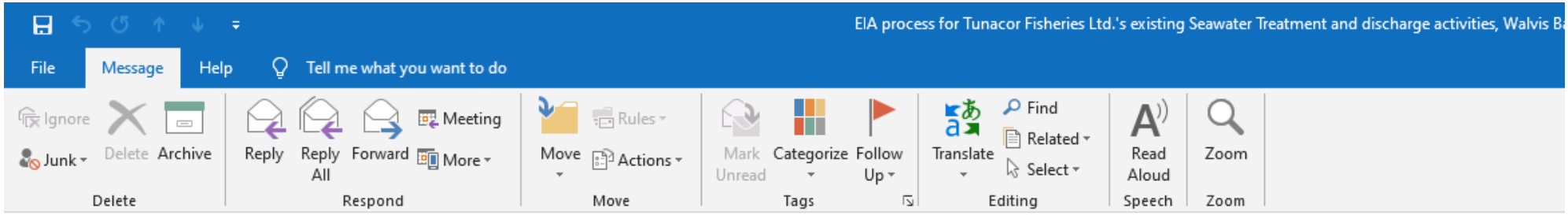
The proposed EIA process including an internal scoping process and assessment will allow an opportunity to identifying the aspects and impacts that will further advise the compilation of an Environmental Management Plan. The EMP documents the Management, Mitigation and Monitoring measures for implementation. This process will then proceed to an application for a seawater discharge permit with MAWL after the regulating authority Ministry of Environment Forestry and Tourism (MEFT) has approved and issued the Environmental Clearance Certificate (ECC).

As detailed above, Please don't hesitate to contact me for additional clarity.

Thank you

Marvin Sanzila

NOTIFICATION CORRESPONDENCE TO MAWF AND OTHERS



Tue 9/15/2020 11:38 AM

MS

Marvin Sanzila <marvinconsultants@outlook.com>

EIA process for Tunacor Fisheries Ltd.'s existing Seawater Treatment and discharge activities, Walvis Bay

To

Bcc mattheus.hambabi@mawf.gov.na; fellohambabi@gmail.com; gisbertus.nakale@ol.na; jonas@gendev.com; carelywnna@venmar.com.na; rrconsultancy@iway.na; mrrconsultancy@iway.na; cleghornconsult@gmail.com; lau

You forwarded this message on 9/15/2020 11:53 AM.

14-9-20 Tunacor Seawater Discharge Scoping EMP Report _G_R_MS_Draft.pdf
.pdf File

Dear Stakeholder,

Thank you for the opportunity to be able to share the below information and attached Draft Environmental Management Plan (EMP) for Tunacor Fisheries Ltd.'s existing Seawater Treatment an commenting purposes if necessary. Shall you wish to request for a meeting regarding the project "another opportunity for you to raise more comments" please don't hesitate to let me know be in-depth.

Introduction:

Tunacor Fisheries Ltd., currently abstracts about ± 407 000 m³ of seawater per annum that is used in the fish processing factor for cleaning purposes only. About 101200m3 of potable water per seawater is treated through the already installed Water Treatment Facility prior to usage in the factory. An effluent's discharge filtering and screening system has been installed to ensure furthe

Appendix 5: Minutes of Stakeholders Engagement

Appendix 5.1: Minutes to Focus Group Meeting with Ministry of Fisheries and Marine Resources (MFMR)

MINUTES OF FOCUS GROUP MEETING

MINISTRY OF FISHERIES AND MARINE RESOURCES (SWAKOPMUND)

MEETING DETAILS		
DATE	10 September 2020	
TIME:	15:00	
VENUE:	Ministry of Fisheries and Marine Resources (MFMR)- Swakopmund	
PURPOSE:	The objectives of the meeting was to: • Review the compiled draft EMP; • Provide an opportunity to the Stakeholder to raise comments and issues. • Describe the way forward.	
ATTENDANCE: (refer to Attendance Register in Appendix A.)	Name:	Organisation:
	Victor Libuku	MFMR
	Latoya Shivute	MFMR
	Ferdi Hamukwaya	MFMR
	Twalinohamba Akawa	UNAM- Fisheries and Aquatic Resource
	Marvin Sanzila	MARVIN

1. OPENING OF THE MEETING AND GENERAL INTRODUCTION

COVID-19 Regulations regarding Sanitisation, Masks and keeping a distance were emphasized prior to the presentation. It was also highlighted that the attendance to such meeting would be kept at least to a maximum of 10 people.

Marvin Sanzila (MS) from Marvin Environmental Project Consultants CC thanked everyone for making an effort to attend the meeting. This was followed by a brief introduction of each participant in attendance.

The meeting continued with revision of the Draft Environmental Management Plan (EMP) report facilitated by MS.

2. DISCUSSION (QUESTIONS AND ANSWERS)

The Focus Group Meeting participants raised a number of questions / comments / issues during the meeting. These have been recorded in Table 1. These issues will be addressed as part of the EIA process and responses provided in the Issues and Response Report, where relevant, attached to the EIA Scoping Report.

3. THE WAY FORWARD

WP outlined the way forward as follows:

- The Draft EMP will be shared with neighbouring business operators to Tunacor Fisheries Ltd and the Walvis Bay municipality and the Ministry of Agriculture, Water and Land Reform (MAWL).
- The stakeholders will be given at least 21 days to review and raise comment.
- A Focus Group Meeting will be proposed with each stakeholder.

4. CLOSE

The meeting closed at 17:00.

Table 1: Questions / Comments / Concerns raised

No.	Comment and issues raised
1.	The MAWL is the custodian for water regulations and should be able to identify and set the required wastewater and effluents disposal criterion including the required infrastructure such as the DAF Systems incorporated into the process flow. The existing Namibian Water guidelines do not specify any requirements for waste water discharge at sea neither have these been enacted formally.
2.	The BCLME guidelines do incorporate the criterion that could be used for waste water disposal at sea. MFMR has no structure appointed specific for this type of activity.
3.	Tunacor should establish critical sampling points for the seawater abstraction activity and discharging points for waste seawater discharge.
4.	NAMPORT has put together various management plans for the port activities. A contingency pollution plan should be available and serves good baseline on the directional movement of sea currents in the port area.
5.	With specific interest to this project, shall pollution occur at Tunacor Fisheries and this being discharge into the sea. It would be interesting to know the directional movement of such a plume, and would this affect other port users and the lagoon? However, Tunacor should comply to proposed measures regarding monitoring of discharged effluents and pumping velocities.
6.	Ensure assessment of heavy metals is also included in the report
7.	Do all port users including fish processing factories have management plans in place that corresponds/ interlinks to the overall Namport Pollution contingency plan?
8.	Projects like these present an opportunity for monitoring related to understanding what sort of marine biota “planktons “is abstracted prior to treatment process and could be trapped in and among Screens/ Strainers. Various strategic approaches to the monitoring were raised during the meeting and included the involvement of UNAM to the process.
9.	The monitoring programme should include qualitative laboratory analysis as raised in the specific water guideline for effluents discharging at sea.
10.	Regular maintenance of the screens, strainers and the calibration of pumps velocities is essential to effective operation the abstraction and discharging system.
11.	Tunacor should appoint an independent consultant to audit compliance to the EMP including the monitoring proposed thereof; Annual reports presenting compliance to EMP and Monitoring should be shared with the competent authorities and MFMR

APPENDIX A: ATTENDANCE REGISTER

TUNACOR FISHERIES LTD.

EMP COMPILATION CONSULTATION PROCESS: WASTE SEAWATER DISCHARGE INTO THE SEA AT WALVIS BAY, ERONGO REGION

ATTENDANCE REGISTER

Date: 10/9/2020

Venue: MFMR SWAKOPMUND

Time: 15:00

Please write clearly!

Name and Surname	Company and Job Title	Tel/ Cell No.	E-Mail	Signature
Lataya Shivute	MFMR, SFR	0812082784	lataya.shivute@mfmr.gov.na	
Victor Libuku	MFMR, FB	064 410157 .0811463142	victor.libuku@mfmr.gov.na	
Ferdi Hamukwaya	MFMR FRT	0812444495	Ferdinand.Hamukwaya@mfmr.gov.na	
Twalinohamba Akawa	UNAM/Fisheries	0813273053	takawa@unam.na	
M. Sanzica	MARUIN	0814708279	marin.consultants@mail.com	

Appendix 6: Stakeholders Engagement Issues and Response Report

Ref.	Comment	Date raised and corresp. type	Organisation	Response and reference in the Tunacor EMP report
1.	The MAWL is the custodian for water regulations and should be able to identify and set the required wastewater and effluents disposal criterion including the required infrastructure such as the DAF Systems incorporated into the process flow. The existing Namibian Water guidelines do not specify any requirements for waste water discharge at sea neither have these been enacted formally.	9 September 2020, Focus Group Meeting (FGM), Swakopmund	MFMR	Refer to Section 3.1.6 in the EMP report. The Benguela Current Large Marine Ecosystem (BCLME) water quality guidelines for the BCLME region and the South African guidelines including other international water guidelines have been used as reference to ensure the waste sea water discharge does not impact on the marine biota. The monitoring through qualitative analysis of sampled abstracted and discharge water is recommended as part of the monitoring programme. (Section 8). In addition to this Tunacor has already established critical sampling points and monitoring is ongoing. Additional monitoring of phytoplankton relating to abstraction and discharge velocities has also been recommended (Section 8)
2.	The BCLME guidelines do incorporate the criterion that could be used for waste water disposal at sea. MFMR has no structure appointed specific for this type of activity.	9 September 2020, Focus Group Meeting (FGM), Swakopmund	MFMR	Refer to the above point.
3.	Tunacor should establish critical sampling points for the seawater abstraction activity and discharging points for waste seawater discharge.	9 September 2020, Focus Group Meeting (FGM), Swakopmund	MFMR	Refer to point 1.

4.	NAMPORT has put together various management plans for the port activities. A contingency pollution plan should be available and serves good baseline on the directional movement of sea currents in the port area.	9 September 2020, Focus Group Meeting (FGM), Swakopmund	MFMR	Refer to baseline discussion on currents and tides including turbidity in Section 5.7.
5.	With specific interest to this project, shall pollution occur at Tunacor Fisheries and this being discharge into the sea. It would be interesting to know the directional movement of such a plume, and would this affect other port users and the lagoon? However, Tunacor should comply to proposed measures regarding monitoring of discharged effluents and pumping velocities.	9 September 2020, Focus Group Meeting (FGM), Swakopmund	MFMR	Refer to Section 7.1.2.1.2 for assessment on the detrimental effects on marine organisms through discharge of co-pollutants and backwash waters. Pollution relevant to this project only relates to biocides "antiscalants' and residual cleaning solutions and potential presence of heavy metals due top corrosiveness of the facilities interior surfaces. Any impacts on marine organisms through discharge of these would be of low severity, highly localised and persist only in the short-term due to the turbulent nature of the receiving waters. The significance of the impacts of antiscalants, residual cleaning solutions and heavy metals is thus deemed to be of LOW significance without mitigation.

6.	Ensure assessment of heavy metals is also included in the report			Refer to section 7.1.2.1.2 in the EMP. The waste water from the treatment plant often contains low amounts of heavy metals that pass into solution when the plant's interior surfaces corrode. The Waste water may therefore contain traces of iron, nickel, chromium and molybdenum, but contamination levels are generally low. Heavy metals tend to enrich in suspended material and finally in sediments, so that areas of restricted water exchange and soft bottom habitats impacted by the discharge could be affected by heavy metal accumulation. Many benthic invertebrates feed on this suspended or deposited material, with the risk that metals are enriched in their bodies and passed on to higher trophic levels. However, due to the slightly turbulent nature of the receiving waters, it is predicted that the likelihood of the heavy metals accumulating in the sediments around the discharge is very low**. It is recommended that limits are established for heavy metal concentrations in the effluent, and the discharge is periodically monitored to avoid exceedance of these limits.**
7.	Do all port users including fish processing factories have management plans in place that corresponds/ interlinks to the overall Namport Pollution contingency plan?	9 September 2020, Focus Group Meeting (FGM), Swakopmund	MFMR	According to NAMPORT, all operators should have independent EMPs. A plan is being put in place to ensure this is the case.

8.	Projects like these present an opportunity for monitoring related to understanding what sort of marine biota “planktons “is abstracted prior to treatment process and could be trapped in and among Screens/ Strainers. Various strategic approaches to the monitoring were raised during the meeting and included the involvement of UNAM to the process.	9 September 2020, Focus Group Meeting (FGM), Swakopmund	MFMR	This recommendation has been included in the EMP report. Refer to Section 6 Table 6-1 and Section 8, Table 8-3.
9.	The monitoring programme should include qualitative laboratory analysis as raised in the specific water guideline for effluents discharging at sea.	9 September 2020, Focus Group Meeting (FGM), Swakopmund	MFMR	Refer to section 8.7
10.	Regular maintenance of the screens, strainers and the calibration of pumps velocities is essential to effective operation the abstraction and discharging system.	9 September 2020, Focus Group Meeting (FGM), Swakopmund	MFMR	Refer to Section 8, Table 8-3.
11.	Tunacor should appoint an independent consultant to audit compliance to the EMP including the monitoring proposed thereof; Annual reports presenting compliance to EMP and Monitoring should be shared with the competent authorities and MFMR	9 September 2020, Focus Group Meeting (FGM), Swakopmund	MFMR	Refer to Section 8.2.2.

Appendix 7: Qualitative Chemical Water Analysis Results

NAMWATER
Namibia Water Corporation Ltd

Private Bag 13389, Windhoek Namibia
Tel (+264 - 61) 71 2257 Fax (+264 -61) 71 2097

CHEMICAL WATER ANALYSIS REPORT

DETAILS OF SAMPLE:

SAMPLE NUMBER	: DS56290
SENDER	: Tunacor Fisheries Limited
SAMPLE POINT NAME	: Tunacor Fisheries
AREA DESCRIPTION	: Seawater Plant (After UV Treatment)
LOCATION DESCRIPTION	: Treated Sea Water -
COMMENTS	: -
DATE SAMPLE TAKEN	: 10/06/2020
TIME TAKEN	: 01:22 PM
DATE SAMPLE RECEIVED	: 11/06/2020
DATE SAMPLE ANALYSED	: 16/06/2020

19.06.2020

DETERMINANT :	Value	Units	Classification
pH	7.6		A - Excellent
Conductivity mS/m	5540.0	mS/m	D - Unsuitable for stockwatering
Total dissolved solids calculated from conductivity	37118	mg/l	
Sodium as Na	7980	mg/l	D - Unsuitable for stockwatering
Potassium as K	480	mg/l	C - Low risk
Sulphate as SO_4	1940	mg/l	D - Unsuitable for stockwatering
Nitrate as N	<0.5	mg/l	A - Excellent
Nitrite as N	<0.1	mg/l	
Silicate as SiO_2	3	mg/l	
Fluoride as F	1.0	mg/l	A - Excellent
Chloride as Cl	16100	mg/l	D - Unsuitable for stockwatering
Total Alkalinity as $CaCO_3$	114	mg/l	
Total Hardness as $CaCO_3$	5692	mg/l	D - Unsuitable for stockwatering
Calcium as $CaCO_3$	900	mg/l	C - Low risk
Magnesium as $CaCO_3$	4792	mg/l	D - Unsuitable for stockwatering
Iron as Fe	0.01	mg/l	A - Excellent
Manganese as Mn	<0.01	mg/l	A - Excellent
Copper as Cu	0.01	mg/l	A - Excellent
Zinc as Zn	0.01	mg/l	A - Excellent
Cadmium as Cd	<0.01	mg/l	A - Excellent
Lead as Pb	0.02	mg/l	A - Excellent
Turbidity	1.2	NTU	B - Good
Colour	2.0	mg/l Pt	Within recommended limit

REMARKS :

CLASSIFICATION FOR CHEMICAL QUALITY OF DRINKING WATER IN RESPECT OF DETERMINANTS AS ABOVE :
Class D : Unsuitable for human consumption
Stockwatering : Unsuitable

CONDUCTIVITY: Conductivity is a function of the total dissolved solids in the water. A conductivity of 300 mS/m corresponds to approximately 2000 mg/l total dissolved solids.
SODIUM: Guideline values for sodium are based on taste considerations. High sodium levels can give high blood pressure.
POTASSIUM: Potassium concentrations above 340 mg/l give the water an unpleasant taste. High concentrations also have a laxative effect.
SULPHATE: Guideline values for sulphate are based on taste considerations. Water containing high concentrations of sulphate can have a laxative effect which is enhanced when consumed in combination with magnesium. Metal corrosion and degradation of concrete and asbestos cement may be increased by high sulphate levels.
CHLORIDE: Guideline values for chloride are based on taste considerations. High concentrations give rise to corrosion of metals.
TOTAL HARDNESS: Guideline values for total hardness are based on taste and household considerations. Depending on the calcium and magnesium salt combination, high levels can cause scaling. In addition, hard water results in excessive soap consumption and subsequent scum formation.
CALCIUM: Guideline values for calcium are based on taste and household consideration. High calcium concentrations cause scaling problems and excessive soap consumption.
MAGNESIUM: Magnesium concentrations greater than 420 mg/l give rise to an unpleasant taste. Magnesium, in association with sulphate, may have laxative properties, but the human body can adapt to this effect in time.

M.Conradie **Pr.Sci.Nat.**
Applied Scientific Services: Laboratory Services
conradiem@namwater.com.na
DS56290

NAMWATER
Namibia Water Corporation Ltd

Private Bag 13389, Windhoek Namibia
Tel (+264 - 61) 71 2257 Fax (+264 -61) 71 2097

CHEMICAL WATER ANALYSIS REPORT

DETAILS OF SAMPLE:

SAMPLE NUMBER	: DS56293
SENDER	: Tunacor Fisheries Limited
SAMPLE POINT NAME	: Seafresh discharge point
AREA DESCRIPTION	: -
LOCATION DESCRIPTION	: Effluent Water -
COMMENTS	: EW13946
DATE SAMPLE TAKEN	: 10/06/2020
TIME TAKEN	: 12:52 PM
DATE SAMPLE RECEIVED	: 11/06/2020
DATE SAMPLE ANALYSED	: 15/06/2020

DETERMINANT :	Value	Units
pH	6.9	
Conductivity mS/m	4770.0	mS/m
Total dissolved solids calculated from conductivity	31959	mg/l
Sodium as Na	62	mg/l
Fluoride as F	0.5	mg/l
Copper as Cu	<0.01	mg/l
Zinc as Zn	0.01	mg/l
Lead as Pb	<0.02	mg/l
Arsenic as As	<0.01	mg/l
Chromium as Cr	<0.01	mg/l
Boron as B	3.4	mg/l
Dissolved Oxygen as O2	0.47	mg/l
Chemical Oxygen Demand as COD	1460	mg/l
Oxygen Absorbed	70.0	mg/l
Biochemical Oxygen Demand as BOD	460	mg/l
Total Phosphate (Unfiltered) as P	7.0	mg/l
Ammonium as N	44.5	mg/l
Cyanide as CN	<0.01	mg/l
Total Dissolved Solids @ 180 deg. C	30642	mg/l
Sulphide as S	25.7	mg/l
Fat,Oil & Grease as FOG	<0.1	g/l
Temperature in °C	20.8	

REMARKS :

02.07.2020

M.Conradie Pr.Sci.Nat.
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DS56293

NAMWATER
Namibia Water Corporation Ltd

Private Bag 13389, Windhoek Namibia
Tel (+264 - 61) 71 2257 Fax (+264 -61) 71 2097

CHEMICAL WATER ANALYSIS REPORT

DETAILS OF SAMPLE:

SAMPLE NUMBER	: DS56292
SENDER	: Tunacor Fisheries Limited
SAMPLE POINT NAME	: IQF Discharge Point
AREA DESCRIPTION	: -
LOCATION DESCRIPTION	: Effluent Water -
COMMENTS	: EW13945
DATE SAMPLE TAKEN	: 10/06/2020
TIME TAKEN	: 12:47 PM
DATE SAMPLE RECEIVED	: 11/06/2020
DATE SAMPLE ANALYSED	: 15/06/2020

DETERMINANT :	Value	Units
pH	7.2	
Conductivity mS/m	155.5	mS/m
Total dissolved solids calculated from conductivity	1042	mg/l
Sodium as Na	84	mg/l
Fluoride as F	0.1	mg/l
Copper as Cu	<0.01	mg/l
Zinc as Zn	0.02	mg/l
Lead as Pb	<0.02	mg/l
Arsenic as As	<0.01	mg/l
Chromium as Cr	<0.01	mg/l
Boron as B	0.15	mg/l
Dissolved Oxygen as O2	0.59	mg/l
Chemical Oxygen Demand as COD	469	mg/l
Oxygen Absorbed	24.0	mg/l
Biochemical Oxygen Demand as BOD	480	mg/l
Total Phosphate (Unfiltered) as P	4.8	mg/l
Ammonium as N	17.3	mg/l
Cyanide as CN	<0.01	mg/l
Total Dissolved Solids @ 180 deg. C	638	mg/l
Sulphide as S	23.3	mg/l
Fat,Oil & Grease as FOG	<0.1	g/l
Temperature in °C	20.7	

REMARKS :

02.07.2020

M.Conradie **Pr.Sci.Nat.**
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DS56292

NAMWATER
Namibia Water Corporation Ltd

Private Bag 13389, Windhoek Namibia
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CHEMICAL WATER ANALYSIS REPORT

DETAILS OF SAMPLE:

SAMPLE NUMBER	: DS56294
SENDER	: Tunacor Fisheries Limited
SAMPLE POINT NAME	: Near Seawater Treatment Plant
AREA DESCRIPTION	: -
LOCATION DESCRIPTION	: Raw Seawater -
COMMENTS	: EW13947
DATE SAMPLE TAKEN	: 10/06/2020
TIME TAKEN	: 01:07 PM
DATE SAMPLE RECEIVED	: 11/06/2020
DATE SAMPLE ANALYSED	: 15/06/2020

DETERMINANT :	Value	Units
pH	7.5	
Conductivity mS/m	5430.0	mS/m
Total dissolved solids calculated from conductivity	36381	mg/l
Sodium as Na	750	mg/l
Fluoride as F	0.8	mg/l
Copper as Cu	<0.01	mg/l
Zinc as Zn	0.01	mg/l
Lead as Pb	<0.02	mg/l
Arsenic as As	<0.01	mg/l
Chromium as Cr	<0.01	mg/l
Boron as B	4.0	mg/l
Dissolved Oxygen as O2	4.9	mg/l
Chemical Oxygen Demand as COD	820	mg/l
Oxygen Absorbed	6.7	mg/l
Biochemical Oxygen Demand as BOD	1.00	mg/l
Total Phosphate (Unfiltered) as P	0.03	mg/l
Ammonium as N	1.3	mg/l
Cyanide as CN	<0.01	mg/l
Total Dissolved Solids @ 180 deg. C	37602	mg/l
Sulphide as S	6.9	mg/l
Fat,Oil & Grease as FOG	<0.1	g/l
Temperature in °C	20.8	

REMARKS :

02.07.2020

M.Conradie **Pr.Sci.Nat.**
Applied Scientific Services: Laboratory Services
conradiem@namwater.com.na
DS56294

NAMWATER
Namibia Water Corporation Ltd

Private Bag 13389, Windhoek Namibia
Tel (+264 - 61) 71 2257 Fax (+264 -61) 71 2097

CHEMICAL WATER ANALYSIS REPORT

DETAILS OF SAMPLE:

SAMPLE NUMBER	: DS56291
SENDER	: Tunacor Fisheries Limited
SAMPLE POINT NAME	: Production Discharge Point
AREA DESCRIPTION	: -
LOCATION DESCRIPTION	: Effluent Water -
COMMENTS	: EW13944
DATE SAMPLE TAKEN	: 10/06/2020
TIME TAKEN	: 12:32 PM
DATE SAMPLE RECEIVED	: 11/06/2020
DATE SAMPLE ANALYSED	: 15/06/2020

DETERMINANT :	Value	Units
pH	6.7	
Conductivity mS/m	5110.0	mS/m
otal dissolved solids calculated from conductivity	34237	mg/l
Sodium as Na	700	mg/l
Fluoride as F	0.6	mg/l
Copper as Cu	<0.01	mg/l
Zinc as Zn	<0.01	mg/l
Lead as Pb	<0.02	mg/l
Arsenic as As	<0.01	mg/l
Chromium as Cr	<0.01	mg/l
Boron as B	3.8	mg/l
Dissolved Oxygen as O2	0.44	mg/l
Chemical Oxygen Demand as COD	1250	mg/l
Oxygen Absorbed	36.0	mg/l
Biochemical Oxygen Demand as BOD	175	mg/l
Total Phosphate (Unfiltered) as P	2.8	mg/l
Ammonium as N	29.9	mg/l
Cyanide as CN	<0.01	mg/l
Total Dissolved Solids @ 180 deg. C	3380	mg/l
Total Suspended Solids @ 105 deg. C	78	mg/l
Sulphide as S	15.1	mg/l
Fat,Oil & Grease as FOG	<0.1	g/l
Temperature in °c	21	

REMARKS :

02.07.2020

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CHEMICAL WATER ANALYSIS REPORT

DETAILS OF SAMPLE:

SAMPLE NUMBER	: DS55119
SENDER	: Tunacor Fisheries (Pty) Ltd
SAMPLE POINT NAME	: Fresh Water Reservoir
AREA DESCRIPTION	: -
LOCATION DESCRIPTION	: Fresh Water -
COMMENTS	: -
DATE SAMPLE TAKEN	: 28/11/2019
TIME TAKEN	: 02:48 PM
DATE SAMPLE RECEIVED	: 29/11/2019
DATE SAMPLE ANALYSED	: 03/12/2019

Comply
06.12.2019

DETERMINANT :	Value	Units	Classification
pH	8.3		A - Excellent
Conductivity mS/m	120.6	mS/m	A - Excellent
Total dissolved solids calculated from conductivity	808	mg/l	
Sodium as Na	110	mg/l	B - Good
Potassium as K	16	mg/l	A - Excellent
Sulphate as SO_4	155	mg/l	A - Excellent
Nitrate as N	4.2	mg/l	A - Excellent
Nitrite as N	<0.1	mg/l	
Silicate as SiO_2	28	mg/l	
Fluoride as F	0.1	mg/l	A - Excellent
Chloride as Cl	127	mg/l	A - Excellent
Total Alkalinity as $CaCO_3$	230	mg/l	
Total Hardness as $CaCO_3$	343	mg/l	B - Good
Calcium as $CaCO_3$	210	mg/l	A - Excellent
Magnesium as $CaCO_3$	133	mg/l	A - Excellent
Iron as Fe	<0.01	mg/l	A - Excellent
Manganese as Mn	<0.01	mg/l	A - Excellent
Copper as Cu	<0.01	mg/l	A - Excellent
Zinc as Zn	<0.01	mg/l	A - Excellent
Cadmium as Cd	<0.01	mg/l	A - Excellent
Lead as Pb	<0.02	mg/l	A - Excellent
Turbidity	0.25	NTU	A - Excellent
Colour	<1.00	mg/l Pt	Within recommended limit

REMARKS :

CLASSIFICATION FOR CHEMICAL QUALITY OF DRINKING WATER IN RESPECT OF DETERMINANTS AS ABOVE :
Class B : Suitable for human consumption
Stockwatering : Suitable

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CHEMICAL WATER ANALYSIS REPORT

DETAILS OF SAMPLE:

SAMPLE NUMBER	: DS56295
SENDER	: Tunacor Fisheries Limited
SAMPLE POINT NAME	: Seawater Plant Discharge Point
AREA DESCRIPTION	: -
LOCATION DESCRIPTION	: Effluent Water -
COMMENTS	: EW13948
DATE SAMPLE TAKEN	: 10/06/2020
TIME TAKEN	: 01:17 PM
DATE SAMPLE RECEIVED	: 11/06/2020
DATE SAMPLE ANALYSED	: 15/06/2020

DETERMINANT :	Value	Units
pH	7.5	
Conductivity mS/m	5430.0	mS/m
Total dissolved solids calculated from conductivity	36381	mg/l
Sodium as Na	7300	mg/l
Fluoride as F	0.8	mg/l
Copper as Cu	<0.01	mg/l
Zinc as Zn	<0.01	mg/l
Lead as Pb	<0.02	mg/l
Arsenic as As	<0.01	mg/l
Chromium as Cr	<0.01	mg/l
Boron as B	4.0	mg/l
Dissolved Oxygen as O2	5.3	mg/l
Chemical Oxygen Demand as COD	840	mg/l
Oxygen Absorbed	8.0	mg/l
Biochemical Oxygen Demand as BOD	<1.00	mg/l
Total Phosphate (Unfiltered) as P	0.03	mg/l
Ammonium as N	0.04	mg/l
Cyanide as CN	<0.01	mg/l
Total Dissolved Solids @ 180 deg. C	36938	mg/l
Sulphide as S	6.5	mg/l
Fat,Oil & Grease as FOG	<0.1	g/l
Temperature in °C	21.0	

REMARKS :

02.07.2020

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