Environmental Management Plan

PROPOSED CONSTRUCTION OF WALVIS BAY OIL REFINERY ON A PORTION OF PORTION 9 OF FARM NO. 58, WALVIS BAY, ERONGO REGION

PROPONENT:

Clasox Petroleum (PTY) LTD

P.O. Box 40193 Ausspannplatz

Windhoek

Tel: +264 811 241 976

REPORT DATE:

23 January 2023

AUTHOR:

Colin P Namene

P.O. Box 24213

Windhoek

Tel: 061 – 258 394

Fax: 061 – 258 470

Email: colin@environam.com

Signature

TABLE OF CONTENTS

LIST OF TABLES

ABBREVIATIONS

AIDS	Acquired Immuno-Deficiency Syndrome
DR	Developer's Representative
EA	Environmental Assessment
ECC	Environmental Clearance Certificate
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
EMP	Environmental Management Plan
GG	Government Gazette
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HIV	Human Immuno-deficiency Virus

I&APs	Interested and Affected Parties
NHC	National Heritage Council
Reg.	Regulation
S	Section
TB	Tuberculosis

1 INTRODUCTION

Clasox Petroleum (PTY) LTD is a duly registered company in Namibia. Clasox Petroleum (PTY) LTD established a partnership with Plama Refinery (PTY) Ltd, one of Bulgaria's largest and leading petroleum companies specializing in processing, refining, marketing and distribution of petroleum throughout Bulgaria.

Clasox Petroleum (PTY) Ltd, hereinafter referred to as the proponent, intends to build a modern oil refinery in Walvis Bay, Namibia. The project will be carried out in two distinct stages, each of which will have a duration of approximately 12 months.

Preliminary technical and marketing studies point to a viable project that has relevance across multiple sectors of the economy, as it aims to provide solutions to the country's energy needs. It does not only target the Namibian market but also has great potential to supply the regional fuel demand.

It is against this background that the JV has embarked on this opportunity to contribute towards energy self-sufficiency. The proponent appointed Environam Consultants Trading cc (ECT) to undertake the Environmental Assessment (EA) in order to obtain an Environmental Clearance Certificate (ECC) for the activity from the Office of the Environmental Commissioner in the Ministry of Environment, Forestry and Tourism (MEFT).

The process will be undertaken in terms of the gazetted Namibian Government Notice No. 30 Environmental Impact Assessment Regulations (herein referred to as EIA Regulations) of the Environmental Management Act (No 7 of 2007) (herein referred to as the EMA). The EIA process will investigate if there are any potential significant bio-physical and socio-economic impacts associated with the proposed development and related infrastructure and services.

The EIA process would also provide an opportunity for the public and key stakeholders to provide comments and participate in the process. It will also serve the purpose of informing the proponent's decision-making, and that of MEFT.

An EMP is one of the most important outputs of the EA process as it synthesises all of the proposed mitigation and monitoring actions, set to a timeline and with specific assigned responsibilities. This EMP details the mitigation and monitoring actions to be implemented during the following phases of this development:

- Planning and Design – the period, prior to construction, during which preliminary legislative and administrative arrangements, necessary for the preparation of the land, are made and engineering designs are carried out. The preparation of construction tender documents forms part of this phase;

- Construction – the period during which the proponent, having dealt with the necessary legislative and administrative arrangements, appoints a contractor for the construction of services infrastructure, buildings as well as any other construction process(s) within the development areas;
- Operation and Maintenance – the period during which the development will be fully functional, operational and maintained.

The decommissioning of this development is not envisaged; however, in the event that this should be considered some recommendations have been outlined in the EMP.

2 ROLES AND RESPONSIBILITIES

Clasox Petroleum (PTY) LTD (the Developer) is ultimately responsible for the implementation of the EMP, from the planning and design phase to the decommissioning phase of this development, if the development is in future decommissioned. The developer will delegate this responsibility as the project progresses through its life cycle. The delegated responsibility for the effective implementation of this EMP will rest on the following key individuals:

- Developer's Representative;
- Environmental Control Officer; and
- Contractor (Construction and Operations and Maintenance).

2.1 DEVELOPER'S REPRESENTATIVE

The Developer should assign the responsibility of managing all aspects of this development for all development phases (including all contracts for work outsourced) to a designated member of staff, referred to in this EMP as the Developer's Representative (DR). The Developer may decide to assign this role to one person for the full duration of the development, or may assign a different DR to each of the development phases – i.e. one for the planning and design phase, one for the construction phase and one for the operation and maintenance phase. The DR's responsibilities are depicted in **Table 2-1** as follows:

Table 2-1: DR's responsibilities

Responsibility	Project Phase
Making sure that the necessary approvals and permissions laid out in **Table 4-1** are obtained/adhered to	Throughout the lifecycle of this development
Making sure that the relevant provisions are addressed during planning and design phase.	Planning and design phase
Suspending/evicting individuals and/or equipment not complying with the EMP	• Construction • Operation and maintenance
Issuing fines for contravening EMP provisions	• Construction • Operation and maintenance

2.2 ENVIRONMENTAL CONTROL OFFICER

The DR should assign the responsibility of overseeing the implementation of the whole EMP on the ground during the construction and operation and maintenance phases to a designated member of staff, referred to in this EMP as the Environmental Control Officer (ECO). The DR/Developer may decide to assign this role to one person for both phases, or may assign a different ECO for each phase. During the operation phase the Developer may outsource the monitoring and evaluation of the EMP to an independent Environmental Consultant. The ECO will have the following responsibilities during the construction and operation and maintenance phases of these developments:

- Management and facilitation of communication between the Developer, DR, the contractors, and Interested and Affected Parties (I&APs) with regard to this EMP;
- Conducting site inspections (recommended minimum frequency is after every two months) of all construction and/or infrastructure maintenance areas with respect to the implementation of this EMP (monitor and audit the implementation of the EMP);
- Assisting the Contractor in finding solutions with respect to matters pertaining to the implementation of this EMP;
- Advising the DR on the removal of person(s) and/or equipment not complying with the provisions of this EMP;
- Making recommendations to the DR with respect to the issuing of fines for contraventions of the EMP; and

- Undertaking an annual review of the EMP and recommending additions and/or changes to this document.

2.3 CONTRACTOR

Contractors appointed by the Developer are automatically responsible for implementing all provisions contained within the relevant chapters of this EMP. Contractors will be responsible for the implementation of this EMP applicable to any work outsourced to subcontractors. In order to ensure effective environmental management, the aforementioned chapters should be included in the applicable contracts for outsourced construction, operation and maintenance work.

The management actions in **Chapter 5** detail the measures associated with the roles and responsibilities that have been laid out in this chapter.

3 ASSUMPTIONS AND LIMITATIONS

This EMP has been drafted based on the scoping-level Environmental Assessment (EA) conducted for the proposed development as represented by the developer. ECT will not be held responsible for the potential consequences that may result from any alterations to the initial layout.

It is assumed that construction labourers will be sourced mostly from the Walvis Bay area and that migrant labourers (if applicable) will be housed within the town of Walvis Bay.

4 APPLICABLE LEGISLATION

Legal provisions that have relevance to various aspects of this development are listed in **Table 4-1** below. The legal instrument and applicable corresponding provisions are provided.

Table 4-1: Legal provisions relevant to this development

LEGISLATION/POLICIES	RELEVANT PROVISIONS	RELEVANCE TO PROJECT
The Constitution of the Republic of Namibia as Amended	Article 91 (c) provides for duty to guard against "the degradation and destruction of ecosystems and failure to protect the beauty and character of Namibia." Article 95(l) deals with the "maintenance of ecosystems, essential ecological processes and biological diversity" and sustainable use of the country's natural resources.	Sustainable development should be at the forefront of this development.
Environmental Management Act No. 7 of 2007 (EMA)	Section 2 outlines the objective of the Act and the means to achieve that. Section 3 details the principle of Environmental Management	The development should be informed by the EMA.

LEGISLATION/POLICIES	RELEVANT PROVISIONS	RELEVANCE TO PROJECT
EIA Regulations GN 28, 29, and 30 of EMA (2012)	GN 29 Identifies and lists certain activities that cannot be undertaken without an environmental clearance certificate. GN 30 provides the regulations governing the environmental assessment (EA) process.	**Activity 1 (c)** The construction of facilities for refining of gas, oil and petroleum products. **Activity 9.2** Any process or activity which requires a permit, licence or other form of authorisation, or the modifications of or changes to existing facilities for any process or activity which requires an amendment of an existing permit, licence or authorisation or which requires a new permit, licence authorisation in terms of a law governing the generation or release of emissions, pollution, effluent or waste. **Activity 9.3** The bulk transportation of dangerous goods using pipeline, funiculars or conveyors with a throughput of 50 tons or 50cubic meters or more per day. **Activity 9.4** The storage and handling of dangerous goods, including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of more than 30 cubic meters per day. **Activity 9.5** Construction of filling stations or any other facility for the underground and aboveground storage of dangerous goods, including petrol, liquid petroleum gas or paraffin. **Activity 10.1 (a)** The construction of oil, water, gas and petrochemical and other bulk supply pipelines. **Activity 10.1 (b)** The construction of – Public roads. **Activity 10.2 (a)** The route determination of roads and design of associated physical infrastructure where – it is a public road.

LEGISLATION/POLICIES	RELEVANT PROVISIONS	RELEVANCE TO PROJECT
Convention on Biological Diversity (1992)	Article 1 lists the conservation of biological diversity amongst the objectives of the convention.	The project should consider the impact it will have on the biodiversity of the area.
Draft Procedures and Guidelines for conducting EIAs and compiling EMPs (2008)	Part 1, Stage 8 of the guidelines states that if a proposal is likely to affect people, certain guidelines should be considered by the proponent in the scoping process.	The EA process should incorporate the aspects outlined in the guidelines.
Namibia Vision 2030	Vision 2030 states that the solitude, silence and natural beauty that many areas in Namibia provide are becoming sought after commodities and must be regarded as valuable natural assets.	Care should be taken that the development does not lead to the degradation of the natural beauty of the area.
Water Act No. 54 of 1956	Section 23(1) deals with the prohibition of pollution of underground and surface water bodies.	The pollution of water resources should be avoided during construction and operation of the development.
The Ministry of Environment and Tourism (MET) Policy on HIV & AIDS	MET has recently developed a policy on HIV and AIDS. In addition, it has also initiated a programme aimed at mainstreaming HIV and gender issues into environmental impact assessments.	The proponent and its contractor have to adhere to the guidelines provided to manage the aspects of HIV/AIDS. Experience with construction projects has shown that a significant risk is created when construction workers interact with local communities.
Town Planning Ordinance 18 of 1954 (as amended by amongst others Town Planning Amendment Act 15 of 2000)	This Ordinance regulates rezoning of portions of land falling within a proclaimed Local Authority area.	The ordinance makes provision for the development of Town Planning Schemes.
Walvis Bay Town Planning Scheme.	The town planning scheme has as its general purpose the co-ordinated and harmonious development of the local authority area, or the area or areas situate therein.	Procedures to manage zoning are stipulated in the Town planning Scheme.
Local Authorities Act No. 23 of 1992	The Local Authorities Act prescribes the manner in which a town or municipality should be managed by the Town or Municipal Council.	The development has to be comply with the provisions of the Local Authorities Act
Labour Act no 11 of 2007	Chapter 2 details the fundamental rights and protections. Chapter 3 deals with the basic conditions of employment.	Given the employment opportunities presented by the development, compliance with the labour law is essential.
Public Health Act no 36 of 1919	Section 119 prohibits persons from causing nuisance.	Developer and Contractors are to comply with these legal requirements.
Nature Conservation Ordinance no 4 of 1975	Chapter 6 provides for legislation regarding the protection of indigenous plants	Indigenous and protected plants have to be managed within the legal confines.
Atmospheric Pollution Prevention Ordinance (No. 11 of 1976).	The Ordinance objective is to provide for the prevention of the pollution of	All activities on the site will have to take due consideration of the provisions of this legislation.

LEGISLATION/POLICIES	RELEVANT PROVISIONS	RELEVANCE TO PROJECT
	the atmosphere, and for matters incidental thereto.	

5 MANAGEMENT ACTIONS

The aim of the management actions in this chapter of the EMP is to avoid potential impacts where possible. Where impacts cannot be avoided, measures are provided to reduce them.

The following management actions are recommended to manage the potential impacts rated in the scoping-level EA conducted for this development. These management actions are applicable to the various project phases, namely:

- Planning and design phase;
- Construction phase;
- Operation and maintenance phase

The responsible persons at the Developer's team have assessed these commitments in detail and have committed to the specific management actions were indicated below.

5.1 ATMOSPHERIC AIR QUALITY

5.1.1 Construction Phase

During the construction phase, air emission monitoring will be conducted mainly by the construction contractors and subcontractors, who should ensure annual checking of exhaust gas quality from engines of vehicles and machinery to verify their compliance with the local environmental requirements in Namibia and of the international best practise.

Clasox should ensure periodic monitoring of compliance of contractors and subcontractors working on the construction site with the applicable local environmental requirements. To determine the background concentrations of impurities in atmospheric air and confirm the predicted concentrations during the construction phase it will be necessary to conduct background monitoring of atmospheric air within the area affected by the Clasox facilities in conformity with a program of routine environmental monitoring.

Loose bulk materials will be delivered to the construction site by trucks, covered with tarpaulin to prevent release of dust into the air. During unloading of loose materials, they will be sprayed with water to eliminate any dust. Sand and crushed stone will be stored in special areas under shelter and covered with tarpaulin. This means that loose materials will not be a source of atmospheric pollution. To prevent dust transfer from areas of earthmoving operations during warm season, the disturbed soil surface will be sprayed with water on a

regular basis. In order to reduce air emissions during the construction phase the following additional measures will be taken:

- Use of open fire to burn any materials or waste will be prohibited;
- Permanent monitoring of technological processes will be conducted to minimize emissions of pollutants;
- No materials and substances emitting toxic and carcinogenic substances will be used for construction;
- Equipment, machinery and transport vehicles used during the construction period will comply with the standards and specifications of manufacturers in relation to exhaust gas emissions approved by the sanitary supervisory agency;
- Minimization of exhaust gas emissions from diesel engines and adjustment of fuel systems will be carried out in due time;
- In the course of technical maintenance of machinery, special attention will be given to the verification and the adjustment of fuel feedstock, ignition and gas distribution systems of engines. This will ensure complete fuel combustion, reduce fuel requirement and decrease significantly exhaust gas emissions;
- Fuel spills will be eliminated in the process of filling the construction machinery. Filling will be carried out in special areas with hard paving and containment bunding.

5.1.2 Operation Phase

The following activities will be conducted by Clasox during Stage 1 operation period with respect to atmospheric air quality monitoring:

- Automatic monitoring at identified emission sources released to the atmosphere;
- Periodic monitoring (at least four times per day at the stationary station and up to 50 measurements of 8 pollutants per year with the aid of a mobile laboratory) with subsequent assessment of the safety level of the impact of emissions from the new facilities on public health;

The monitoring data will permit a review of compliance with the design parameters and demonstrate compliance with the regulatory requirements to atmospheric air quality in the nearest residential and industrial areas affected by the development.

In addition, the following measures are planned to resolve certain issues associated with emission reduction from water supply and wastewater removal facilities:

- Highly efficient water-cooling towers will be used in water recycling systems;
- Oil recovery devices with covered surface will be used;
- Manholes in the industrial sewer networks will be of enclosed type; manholes on the roads will have double lids and the space between the lids will be filled with sand;

- Wastewater treatment facilities will be of enclosed type to a maximum possible degree.

5.2 BEST AVAILABLE TECHNIQUES (BATs)

The petroleum refining industry plays an important role in the developed economies and also has a potential for pollution generation that must be controlled. The best solution for all (i.e., petroleum companies, the public, and the environment) is pollution prevention, because this option will protect all of them and will also reduce costs in terms of lower raw materials consumption as well as reducing potential fines.

European Union efforts resulted in the European Directive 96/61/European Commission, commonly known as the Integrated Pollution Prevention and Control Directive. This policy established the need for stricter environmental control to provide greater protection for the environment. To achieve this goal the directive strongly recommended pollution prevention options rather than traditional approaches, such as pollutant treatment. This policy required nearly all industrial operators to hold an environmental operating permit based on Best Available Techniques (BATs). Developing countries in general and Clasox in particular will do well to learn from these experiences, key BATs are delineated below (Rodríguez& Matinez, 2005).

5.2.1 BATs for minimization of NOx emissions from combustion processes

5.2.1.1 Low NOx Burners

Nowadays industries install low NO_x burners to reduce thermal NO_x generation by achieving lower flame temperatures. The main types of technologies being used involve either air or fuel staged addition. Some gas burners incorporate flue gas recirculation as an alternative to reduce flame temperature.

5.2.1.2 Selective Catalytic Reduction.

This is a proven technology that favours the reaction of combustion gases (including NO_x) with added NH_3 (supported by V_2O_5/TiO_2 catalyst). The presence of a catalyst enhances the reaction, lowering operating temperatures down to a range between 315 °C and 400 °C.

5.2.1.3 Use of Gaseous Fuels.

Substitution of conventional liquid (nitrogen-containing) fuels with gaseous fuel (nearly nitrogen-free) significantly reduces NO_x emissions; natural gas produces 159 mg/Nm^3 versus fuel oil production of 350 mg/Nm^3. In addition, there is a significant reduction in other atmospheric pollutants such as SO_2 (natural gas can be assumed to have a negligible sulfur content), particulate, and CO/CO_2.

To include this BAT in an industry is not always a straightforward task. It requires the full involvement of a planning team, and it is necessary to make an individualized economic

assessment. Key issues for consideration during this analysis are the following: (1) the need to burn fuel gas produced throughout the refinery, and (2) the need to burn residual liquid fuels that do not comply with commercial specifications. Twenty-first century refineries need to minimize heavy fuel production, especially residual fuels mentioned in the previous point. Moving away from heavier fuels reduces the amount of waste disposal required. There is a downside, however; often the cleaner fuels are more costly to use than the heavier fuels that would be readily available at a petroleum refinery.

5.2.1.4 Energy Integration.

Several energy integration techniques, such as Pinch Technology, help refiners to optimize their fuel consumption and, consequently, their atmospheric emissions. A typical application is a heat exchanger network or integration of a reboiler and condenser into the same heat exchanger. An energy integration plan for a 700 m^3/hr crude distillation unit can produce an annual financial saving of U.S.$700,000 because of the 684 kg/hr of non-burnt fuel (5470 mT/yr with an on-stream operating factor of 8000 hr/yr). This energy integration plan also produces an important reduction in atmospheric pollutants: (1) SO_2: 14.5 kg/hr, considering that sulfur fuel oil content is 2% wt, (2) NO_x: 4.2 kg/hr, (3) CO2: 2134 kg/hr, and (4) particulate matter: 0.9 kg/hr (Rodríguez& Matinez, 2005).

5.2.2 BATs to Reduce Liquid Effluents

The proposed BATs to be analyzed are the following: (1) integration of different water consuming processes, (2) liquid stream segregation, and (3) reverse osmosis units.

5.2.2.1 Integration of Different Water Consuming Processes.

There are two objectives of water integration: a reduction in the net amount of water consumed and a reduction in the total loading of pollutants that must be treated in WWTPs (wastewater treatment plants) for final discharge. These objectives can be accomplished by process water, storm water, and cooling water recycling and reutilization, in a two-stage process: (1) water mass balance throughout the refinery and for each process unit, and (2) setting min water feed quality requirements (max values for some pollutants) for each unit and effluent composition analysis. After completing these two stages to establish the vol and loadings to and from each unit, pollution prevention options applicable to those streams (individually or combined) can be developed.

After determining which option(s) will be pursued, objectives can be established, measured, and progress toward the goal/objective monitored. Previous studies on water conservation discussed several options for water consumption optimization and calculated the cost and efficiency of wastewater reduction.

Some of the limitations for water conservation studies are the following: (1) corrosion phenomena, (2) fouling and sedimentation, (3) loss of mass transfer in washing process using water, and (4) WWTP location in relation to the point of use because of the pumping cost. This can represent an unaffordable financial cost for the refinery.

5.2.2.2 Liquid Stream Segregation.

Water consumption optimization can be enhanced with proper stream segregation based on the nature or composition of those streams. An indiscriminate mixture of heavily contaminated aqueous streams with other lightly contaminated streams should be avoided, because any potential for reuse would probably be lost. Advantages of this selective segregation are as follows: (1) lower amount of water to be treated as wastewater, (2) selection of the most appropriate treatment for each stream avoiding unnecessary streams and avoiding dilution of other streams that would increase the difficulty of treatment, and (3) lower initial investment required as well as less operating costs for both water conditioning and water treatment.

Rational stream management is based on stream characterization, and classification is as follows: (1) oil free contamination streams, for example, steam condensate from heat exchangers; (2) accidentally oil contaminated streams, for example, storm water collected from process areas; and (3) continuously oil contaminated streams. They can be divided into high organic load streams (wastewater from tank area and crude desalters) and low organic load ones.

5.2.2.3 Reverse Osmosis (RO) Units.

RO units are a real option to improve water consumption in particular cases. Costs have been significantly reduced, and analysis of each case can show positive financial benefits. Typical applications of this are boiler feed water conditioning processes and water quality improvement of WWTP effluent, because it can be considered as a potential feed for the cooling water circuit. Advantages associated with the use of ROs are easy to evaluate and include a 90% efficiency rate in water pollutants removal, a lower risk of deposits in water coolers, lower sludge generation because of higher quality water, and a reduction in associated treatment. The main disadvantages are the high level of investment required for this and the importance of influent quality (pre-treatment usually required) (Rodríguez& Matinez, 2005).

5.2.3 BATs for Waste Minimization

The proposed BATs for waste minimization are described. Oily sludge BATs include the following: (1) integrated sludge management system, (2) tank bottoms minimization, and (3) oily sludge destruction in coking units without pre-treatment. Spent caustics BATs include the following: (1) segregation and cascade reuse, and (2) wet air oxidation units.

5.2.3.1 Integrated Sludge Management System.

This scheme has been selected as a candidate to be a BAT for the following reasons: (1) the reduction of solid build-up which otherwise tend to increase sludge generation, and (2) the improvement of oil recovery and its posterior recycling to process units.

5.2.3.2 Tank Bottom Minimization.

Minimization of generation of tank bottoms (heavy components that decant during storage time) can be achieved using dedicated emulsifying chemicals. An average composition of sludge tank bottoms may consist of the following: hydrocarbons 40– 90%, water 10–50%, and solids 2–50%. Emulsifiers can help to produce a homogeneous composition in the tank avoiding bottom generation. The main disadvantage is that entrainment emulsifiers can disrupt crude desalter operation. This is the reason why its usage must be carefully analysed in each particular case. Other options are available, such as tank design or programmed throughput, but these do not offer the same advantages as emulsifiers in terms of time of implementation and operational flexibility.

5.2.3.3 Oily Sludge Destruction in Coking Units Without Pre-treatment.

Refineries with coking units in their process scheme can use these to destroy the following oily streams without the need for pre-treatment: (1) American Petroleum Institute separator sludge, (2) dissolved air flotation unit sludge, (3) oily residual streams, and (4) sludge from heat exchanger cleaning process.

This operation allows hydrocarbon recovery, whereas solids get trapped inside the coke. The amount of sludge that can be destroyed is controlled by several factors: (1) coke quality: metals, ash, and VOC limit the quality required for commercial sale; (2) 1 kg of sludge per mT of coke production; and (c) max unit capacity: feeding these sludges reduces fresh feed rate.

The main advantages of these BATs are the ability to destroy hazardous wastes without any pre-treatment and the cost reduction arising from waste management processes no longer required. The main disadvantages are that this BAT entails a lower level of energy efficiency, a reduced coke quality, and a reduction in distillate production depending on the coke feeding system. Another point to take into account is the cost and efficiency of the process versus the disposal and beneficial use of a material that would otherwise be handled as a waste. This is a balance that must be assessed and managed in the light of both economic and process considerations.

5.2.3.4 Spent Caustics Segregation and Cascade Reuse.

The petroleum refining industry removes sulfur acid compounds from petroleum distillates using caustic solutions. Those impurities are mainly H_2S and mercaptanes. Unfortunately, this kind of chemical treatment generates a significant number of spent caustics.

These wastes cannot be massively fed to Waste Water Treatment Plants (WWTP) because of their COD values, mainly caused by compounds such as Na_2S, sodium mercaptides, and thiols. Proper segregation of spent caustics permits their efficient management. The criterion for this segregation is the nature of the pollutants (naphtenic, sulfidic, and phenolic) removed during neutralization processes. As a consequence of this segregation, the spent caustics may be reused in a cascade: spent caustic and distillate streams are mixed cross-currently to improve mass transfer of the pollutants; the spent caustic for one process unit can be reused in other processes that are less demanding in terms of the quality of the caustic. As a result, caustic consumption significantly decreases.

5.2.3.5 Wet Air Oxidation Units for Spent Caustics.

Oxidation of spent caustics with wet air at high pressure and temperature conditions allows refineries to send these caustics to WWTPs because of the COD reduction with values up to 80% and a nearly total destruction of phenols and other heavy sulfur compounds. Typical operating conditions are 270 °C and 100 kN/m2.

The main disadvantages, when comparing this with conventional process units, are the high level of investment required and the high operating costs. The degree of investment results from the equipment design conditions (design temperature and pressure, as well as metallurgy), which become necessary on account of the severe operating conditions in terms of pressure, temperature, and corrosive chemical species. High operating costs are incurred on account of the consumption of utilities, mainly high-pressure steam and electricity (Rodríguez& Matinez, 2005).

5.3 Decommissioning

It is not envisaged to decommission the development in the immediate future. However, should this be considered at the end of its useful life, the area has to be restored to *ante operam* conditions. It is recommended that a decommissioning plan should be developed within the first 24 months of operation.

Appendix A – Water Quality Guidelines

THE WATER ACT, 1956 (ACT 54 OF 1956) AND ITS REQUIREMENTS IN TERMS OF WATER SUPPLIES FOR DRINKING WATER AND FOR WASTE WATER TREATMENT AND DISCHARGE INTO THE ENVIRONMENT

1. INTRODUCTION

The provisions of the Water Act are intended, amongst other things, to promote the maximum beneficial use of the country's water supplies and to safeguard water supplies from avoidable pollution.

The drinking water guidelines are not standards as no publication in the Government Gazette of Namibia exists to that effect. However the Cabinet of the Transitional Government for National Unity adopted the existing South African Guidelines (461/85) and the guidelines took effect from 1April 1988 under the signature of the then Secretary for Water Affairs.

The sections of the Water Act that relate to the discharge of industrial effluents are:
- Section 21(1) which states that
-- The purification of waste water shall form an integral part of water usage and
-- that purified effluents shall comply with the General Standard Quality restrictions as laid out in Government Gazette R553 of 5 April 1962 and
- Section 21(2) which further stipulate that this purified effluent be returned as close as possible to the point of abstraction of the original water.
Where a local authority has undertaken the duty of disposing of all effluents from an industrial process the provisions of Section 21(1) and 21(2) apply to the local authority and not the producer of the effluents. If there is difficulty in complying with these provisions then the applicant may apply for an exemption from the conditions in terms of Section 21(5) and 22(2) of the Water Act. The Permanent Secretary after consultation with the Minister may grant the issuance of a Waste Water Discharge Permit under Sections 21(5) and 22(2) subject to such conditions as he may deem fit to impose.

After independence, the Government of the Republic of Namibia decided that for the interim the existing guidelines will continue to be valid and to remain in use until a proper study has been conducted and new standards have been formulated (Article 140 of Act 1 of 1990).

2. GUIDELINES FOR THE EVALUATION OF DRINKING-WATER QUALITY FOR HUMAN CONSUMPTION WITH REGARD TO CHEMICAL, PHYSICAL AND BACTERIOLOGICAL QUALITY

Water supplied for human consumption must comply with the officially approved guidelines for drinking-water quality. For practical reasons the approved guidelines have been divided into three basic groups of determinants, namely:

- Determinants with aesthetic / physical implications: TABLE 1.
- Inorganic determinants: TABLE 2.
- Bacteriological determinants: TABLE 3.

2.1 CLASSIFICATION OF WATER QUALITY

The concentration of and limits for the aesthetic, physical and inorganic determinants define the group into which water will be classified. See TABLES 1 and 2 for these limits. The water quality has been grouped into 4 quality classes:

- Group A: Water with an excellent quality
- Group B: Water with acceptable quality
- Group C: Water with low health risk
- Group D: Water with a high health risk, or water unsuitable for human consumption.

Water should ideally be of excellent quality (Group A) or acceptable quality (Group B), however in practice many of the determinants may fall outside the limits for these groups.
If water is classified as having a low health risk (Group C), attention should be given to this problem, although the situation is often not critical as yet.
If water is classified as having a higher health risk (Group D), urgent and immediate attention should be given to this matter.

Since the limits are defined on the basis of average lifelong consumption, short-term exposure to determinants exceeding their limits is not necessarily critical, but in the case of toxic substances, such as cyanide, remedial measures should immediately be taken.

The overall quality group, into which water is classified, is determined by the determinant that complies the least with the guidelines for the quality of drinking water.

TABLE 1: DETERMINANTS WITH AESTHETIC / PHYSICAL IMPLICATIONS

DETERMINANTS	UNITS*	LIMITS FOR GROUPS			
		A	B	C	D**
Colour	mg/l Pt***	20			
Conductivity	mS/m !at 25 °C	150	300	400	400
Total hardness	mg/l $CaCO_3$	300	650	1300	1300
Turbidity	N.T.U****	1	5	10	10
Chloride	mg/l Cl	250	600	1200	1200
Chlorine (free)	mg/l Cl	0,1- 5,0	0,1 – 5,0	0,1 – 5,0	5,0
Fluoride	mg/l F	1,5	2,0	3,0	3,0
Sulphate	mg/l SO_4	200	600	1200	1200
Copper	µg/l Cu	500	1000	2000	2000
Nitrate	mg/l N	10	20	40	40
Hydrogen Sulphide	µg/l H_2S	100	300	600	600
Iron	µg/l Fe	100	1000	2000	2000
Manganese	µg/l Mn	50	1000	2000	2000
Zink	mg/l Zn	1	5	10	10
pH****	pH-unit	6,0 – 9,0	5,5 – 9,5	4,0 – 11,0	4,0 – 11,0

* In this and all following tables “l” (lower case L in ARIAL) is used to denote dm^3 or litre
** All values greater than the figure indicated.
*** Pt = Platinum Units
**** Nephelometric Turbidity Units
***** The pH limits of each group exclude the limits of the previous group

TABLE 2: INORGANIC DETERMINANTS

DETERMINANTS	UNITS	LIMITS FOR GROUPS			
		A	B	C	D*
Aluminium	µg/l Al	150	500	1000	1000
Ammonia	mg/l N	1	2	4	4
Antimonia	µg/l Sb	50	100	200	200
Arsenic	µg/l As	100	300	600	600
Barium	µg/l Ba	500	1000	2000	2000
Beryllium	µg/l Be	2	5	10	10
Bismuth	µg/l Bi	250	500	1000	1000
Boron	µg/l B	500	2000	4000	4000
Bromine	µg/l Br	1000	3000	6000	6000
Cadmium	µg/l Cd	10	20	40	40
Calcium	mg/l Ca	150	200	400	400
Calcium	mg/l $CaCO_3$	375	500	1000	1000
Cerium	µg/l Ce	1000	2000	4000	4000
Chromium	µg/l Cr	100	200	400	400
Cobalt	µg/l Co	250	500	1000	1000
Cyanide (free)	µg/l CN	200	300	600	600
Gold	µg/l Au	2	5	10	10
Iodine	µg/l I	500	1000	2000	2000
Lead	µg/l Pb	50	100	200	200
Lithium	µg/l Li	2500	5000	10000	10000
Magnesium	mg/l Mg	70	100	200	200
Magnesium	mg/l $CaCO_3$	290	420	840	840
Mercury	µg/l Hg	5	10	20	20
Molybdenum	µg/l Mo	50	100	200	200
Nickel	µg/l Ni	250	500	1000	1000
Phosphate	mg/l P	1	See note below	See note below	See note below
Potassium	mg/l K	200	400	800	800
Selenium	µg/l Se	20	50	100	100
Silver	µg/l Ag	20	50	100	100
Sodium	mg/l Na	100	400	800	800
Tellurium	µg/l Te	2	5	10	10
Thallium	µg/l Tl	5	10	20	20
Tin	µg/l Sn	100	200	400	400
Titanium	µg/l Ti	100	500	1000	1000
Tungsten	µg/l W	100	500	1000	1000
Uranium	µg/l U	1000	4000	8000	8000
Vanadium	µg/l V	250	500	1000	1000

* All values greater than the figure indicated.

Note FOR Table 2 on phosphate: Phospates are not toxic and essential for all life-forms. Natural water will, however, seldom contain phosphate; it is generally seen as an indicator of pollution and is usually accompanied by other pollutants. Wherever drinking water is combined with or consists wholly of reclaimed or recycled water, it may be expected to contain phosphate. The general guideline for a concentration level to be aimed at is 1 mg/l as P. But in many cases this may be difficult to achieve technically. For this reason the Department will allow a phosphate concentration level of up to 5 mg/l as P in water intended for human consumption. Please refer also to the "Note on Phosphate" under Section 3: General Standards for Waste/Effluent.

2.2 BACTERIOLOGICAL DETERMINANTS

The bacteriological quality of drinking water is also divided into four groups, namely:

- Group A: Water which is bacteriological very safe;
- Group B: Water which is bacteriological still suitable for human consumption;
- Group C: Water which is bacteriological risk for human consumption, which requires immediate action for rectification;
- Group D: Water, which is bacteriological unsuitable for human consumption.

TABLE 3: BACTERIOLOGICAL DETERMINANTS

DETERMINANTS	LIMITS FOR GROUPS			
	A**	B**	C	D*
Standard plate counts per 1 ml	100	1000	10000	10000
Total coliform counts per 100 ml	0	10	100	100
Faecal coliform counts per 100 ml	0	5	50	50
E. coli counts per 100 ml	0	0	10	10

* All values greater than the figure indicated.
** In 95% of the samples.

NB If the guidelines in group A are exceeded, a follow-up sample should be analysed as soon as possible.

2.3 FREQUENCY FOR BACTERIOLOGICAL ANALYSIS OF DRINKING-WATER SUPPLIES

The recommended frequency for bacteriological analysis of drinking water is given in Table 4.

TABLE 4: FREQUENCY FOR BACTERIOLOGICAL ANALYSIS

POPULATION SERVED	MINIMUM FREQUENCY OF SAMPLING
More than 100 000	Twice a week
50 000 – 100 000	Once a week
10 000 – 50 000	Once a month
Minimum analysis	Once every three months

3 GENERAL STANDARDS FOR WASTE / EFFLUENT WATER DISCHARGE INTO THE ENVIRONMENT

All applications in terms of Section 21(5) and 22(2), for compliance with the requirements of Section 21(1) and 21(2) of the Water Act (Act 54 of 1956) that purified water shall comply with the General Standard as laid out in Government Gazette Regulation R553 of 5 April 1962.

TABLE 5 GENERAL STANDARDS FOR ARTICLE 21 PERMITS (EFFLUENTS)

DETERMINANTS	MAXIMUM ALLOWABLE LEVELS
Arsenic	0,5 mg/l as As
Biological Oxygen Demand (BOD)	no value given
Boron	1,0 mg/l as B
Chemical Oxygen Demand (COD)	75 mg / l as O
Chlorine, residual	0,1 mg/l as Cl_2
Chromium, hexavalent	50 µg/l as Cr(VI)
Chromium, total	500 µg/l as Cr
Copper	1,0 mg/l as Cu
Cyanide	500 µg/l as CN
Oxygen, Dissolved (DO)	at least 75% saturation**
Detergents, Surfactants, Tensides	0,5 mg/l as MBAS – See also Note 2
Fats, Oil & Grease (FOG)	2,5 mg/l (!gravimetric method)
Fluoride	1,0 mg/l as F
Free & Saline Ammonia	10 mg/l as N
Lead	1,0 mg/l as Pb
Oxygen, Absorbed (OA)	10 mg / l as O*
pH	5,5 – 9,5
Phenolic Compounds	100 µg/l as phenol
Phosphate	1,0 mg/l as P - See also Note 1
Sodium	not more than 90 mg/l Na more than influent
Sulphide	1,0 mg/l as S
Temperature	35°C
Total Dissolved Solids (TDS)	not more than 500 mg /l more than influent
Total Suspended Solids (TSS)	25 mg/l
Typical faecal Coli.	no typical coli should be counted per 100 ml
Zinc	5,0 mg/l as Zn

* Also known as *Permanganate Value* (or *PV*).
** In Windhoek the saturation level is at approx. 9 mg/l O_2.

Note (1) on phosphate: Phospates are not toxic and essential for all life forms. Natural water will seldom contain phosphate; it is generally seen as an indicator of pollution and is usually accompanied by other pollutants. Wherever drinking water is combined with or consists wholly of reclaimed or recycled water, it may be expected to contain phosphate. There is no general guideline for phosphate contained in the Regulation 553. But generally it is assumed that eutrophication or algal bloom in dams is promoted by nutrient concentrations as low as 0,01 mg/l as P; generally a phosphate concentration limit for dams of 0,1 mg/l is recommended. All water that is consumed and subsequently discharged, will eventually end up in rivers, dams or

groundwater – that is why for potable water, a concentration level of 1 mg/l as P is aimed at.
But, again, in many cases of waste and effluent treatment, this may be difficult to achieve technically, or the required waste and effluent treatment infrastructure is not available; as the required infrastructure is sophisticated and expensive. The current situation calls for a compromise and for this reason, this Department will judge each application individually on its merits and allow, in certain cases, a phosphate concentration level of up to 15 mg/l as P in any effluent or waste stream to be discharged into the environment. This regulation is subject to be reviewed every two years, calculated from the date of approval of this document.

Note (2) on detergents, surfactants and ten sides: The MBAS (or methylene blue active substances) – test does not encompass all surface active compounds currently, commercially available. The limit given is therefore only a guideline. Many of the cleaning agents are toxic to biological life-forms in rivers and dams.
It should be taken into consideration that some commercial products interfere with the effective removal of oil, fat and grease by grease and fat traps, by breaking up such long-chain molecules into shorter ones. These cleaning agents thus effectively allow such components to pass through the traps and land into sections of a treatment plant further down the line and interfere with the process there.
Many cleaning agents contain very powerful disinfectants, and/or biocides. Such substances may interact with biological treatment processes. They may reduce the effectiveness of such treatment or 'kill' it completely, if they land in septic tanks, biofilters or even activate-sludge plants. Their activity may be attenuated by dilution.

4. AUTHORIZATION

Herewith, the Guidelines for the Evaluation of Drinking Water for Human Consumption with regard to Chemical, Physical and Bacteriological Quality, as well as the General Standards for Article 21* Permits, amended for detergents, surfactants, ten sides, as well as phosphates, are confirmed and remain in force until further notice.

Issued under my hand with the authority vested in my office, within the Ministry for Agriculture, Water and Rural Development,

PERMANENT SECRETARY
Dr V Shivute

WINDHOEK, **DATE STAMP**