PROTEA CHEMICALS' CHEMICAL HANDLING FACILITY IN THE PORT OF WALVIS BAY

UPDATED ENVIRONMENTAL MANAGEMENT PLAN

Assessed by:

Assessed for:

March 2022

Project	**UPDATED ENVIRONMENTAL MANAGEMENT PLAN FOR PROTEA CHEMICALS' CHEMICAL HANDLING FACILITY AT THE PORT OF WALVIS BAY**	
Report Version/Date	Version 03/2022 March 2022	
Prepared for	Protea Chemicals Namibia (Pty) Ltd P.O. Box 3058 Walvis Bay Namibia	
Lead Consultant	Geo Pollution Technologies (Pty) Ltd PO Box 11073 Windhoek Namibia	TEL.: (+264-61) 257411 FAX.: (+264) 88626368
Main Project Team	**André Faul (Leader)** (B.Sc. Zoology, Biochemistry); (B.Sc. (Hons) Zoology); (M.Sc. Conservation Ecology); (Ph.D. Medical Bioscience) **Pierre Botha** (B.Sc. Geology/Geography); (B.Sc. (Hons) Hydrology/Hydrogeology) Stefan Short **Wikus Coetzer** (B.Sc. Environmental and Biological Sciences) ; (B.Sc. (Hons) Environmental Sciences)	
Cite this document as	**Faul A, Botha P, Coetzer W. 2022. Updated Environmental Management Plan for Protea Chemicals' Chemical Handling Facility at the Port of Walvis Bay.**	
Copyright	Copyright on this document is reserved. No part of this document may be utilised without the written permission of Geo Pollution Technologies (Pty) Ltd.	
Report Approval	 André Faul Conservation Ecologist (Ph.D. Medical bioscience)	

I KARIKA V NIEKERK acting as the Proponent's representative (Protea Chemicals Namibia (Pty) Ltd), hereby confirm that we approve the Environmental Management Plan as presented in this document. All material information in the possession of the proponent that reasonably has or may have the potential of influencing the Environmental Management Plan was provided to the consultant.

Signed at WALVIS BAY on the 24th day of MARCH 2022.

Protea Chemicals Namibia (Pty) Ltd

2005/665

Company Registration Number

Table of Contents

List of Tables

List of Figures

LIST OF ABBREVIATIONS

AIDS	Acquired Immuno Deficiency Syndrome
Cefic	European Chemical Industry Council
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
HIV	Human Immunodeficiency Virus
IBC	Intermediate Bulk Container
ISO	International Standards Organisation
MCC	Master Control Room
MEFT	Ministry of Environment, Forestry & Tourism
MSDS	Material Safety Data Sheet
SANS	South African National Standards
t/a	Metric ton per annum
t	Metric ton
UN	United Nations
WHO	World Health Organisation

1 INTRODUCTION

Protea Chemicals (Pty) Ltd (the Proponent), requested Geo Pollution Technologies (Pty) Ltd to update their existing environmental management plan (EMP) for their chemical storage, handling and distribution facility in Walvis Bay. They operate under an existing environmental clearance certificate for the storage, handling and distribution of a wide range of chemicals. Protea Chemicals wish to update the existing EMP to include all current as well as foreseeable future operational activities. In addition to exiting operations, Protea Chemicals proposes the bulk storage of hydrogen peroxide 70% as well as the storage and handling of Nitric acid 55-60% at their mining chemicals site in the Port of Walvis Bay (section 2.7 & 2.8 below).

In order to comply with Namibian legislation, and to adhere to all codes and standards applied in their operations, the Proponent wishes to apply for renewal of their existing environmental clearance certificate (ECC) for the facility. In support of the ECC renewal application, the updated EMP will be submitted to the Ministry of Environment, Forestry and Tourism (MEFT). The EMP provides management options to ensure environmental impacts of the facility and related operations are continually minimised. The environment being defined in the Environmental Assessment Policy and Environmental Management Act as "land, water and air; all organic and inorganic matter and living organisms as well as biological diversity; the interacting natural systems that include components referred to in sub-paragraphs, the human environment insofar as it represents archaeological, aesthetic, cultural, historic, economic, paleontological or social values".

The EMP is a tool used to take pro-active action by addressing potential problems before they occur. This limits potential future corrective measures that may need to be implemented and allows for application of mitigation measures for unavoidable impacts. This document should continue to be used as an on-site reference document during all phases (planning, construction (care and maintenance), operations and decommissioning) of the facility. All monitoring and records kept should be included in a report to ensure compliance with the EMP. Parties responsible for transgression of the EMP should be held responsible for any rehabilitation that may need to be undertaken. A Health, Safety, Environment and Quality policy as well as Environmental (HSEQ) Policy could be used in conjunction with the EMP. Operators and responsible personnel must be taught the contents of these documents. Relevant regulations and guidelines must be adhered to and monitored regularly as outlined in the EMP.

The updated EMP will be used to apply for renewal of the existing ECC in compliance with Namibia's Environmental Management Act (Act No 7 of 2007).

2 CURRENT AND FUTURE INFRASTRUCTURE AND OPERATIONAL ACTIVITIES

2.1 Current Infrastructure

The following infrastructure are currently in place (see Figure 2-1):

- Two product warehouses each measuring 120 m long x 25 m wide (3,000 m^2) used for bagged or bulk product storage, including copper blister, copper sheets and bagged copper, depending on product demands at any given time. Each product warehouse has one set of bulk powder road tanker loading equipment located inside the warehouse.
- One 1,000 m^2 rub hall for storage of bagged and various other packaged products on the southern part of the property.
- Two buildings consisting of open-plan offices, board room, workshop, spares store, document storage, master control room (MCC) room, switchgear room, toilets and ablutions covering an area of 720 m^2.
- An equipment store.
- Two 1000 m^2 rub halls located on a 5000 m^2 paved area (old Basil Read warehouses) utilised for storage of chemicals and copper.

1 – Packed Warehouse No. 1
2 – Packed Warehouse No. 2
3 – Bulk Warehouse
4 – Administrative Block
5 – Equipment Storage
6 – Basil Reed Warehouse

Figure 2-1: Layout of the chemical Handling Facility

2.2 Proposed Development

The proponent further proposes the bulk storage, handling and distribution of Hydrogen Peroxide 70% at the site, which may require additional infrastructure to be developed. Hydrogen Peroxide will be supplied to clients at an estimated 23,000 metric tons per annum (t/a). It will be imported in isotainers and either transported directly to the client in the isotainers (option 1), or emptied into a bulk storage facility at the site and transported to the mine using rail tankers or road tankers, which will require the construction of a bulk storage facility on the site (option 2), see Figure 2-1 for the proposed location.

2.3 Operational Activities

The main operational activities of Protea Chemicals are: the receipt of chemicals from vessels in the Port of Walvis Bay; all handling of chemicals into storage; safe storage at designated areas and in prescribed manners; bagging, re-bagging and blending of chemicals; and loading and transportation of chemicals to clients. The following sections provides a brief overview of some of the bulk chemical shipments handled by Protea Chemicals. It also provides a short generic summary of the handling and transport of a range of chemicals handled in smaller volumes or chemicals that may be handled by Protea Chemicals in future depending on customer demands. Thus, not all chemicals dealt with in this assessment or listed in Appendix A are at all times present on site, but the capability to safely handle, store and transport these and other potential future chemicals exist. The estimated projection for chemical volume throughput in the near

future by Protea Chemicals in Walvis Bay is between 50,000 t and 150,000 t depending on demand. Of this approximately 25,000 t to 50,000 t will be hazardous chemicals.

2.4 Break-Bulk Shipments

A number of chemicals, for which there are a relatively large demand, are imported as break bulk in the form of 1-ton bulk bags. This for example include sodium bicarbonate, ferrous sulphate or other non-hazardous chemicals mentioned in appendix A. Break bulk bags are made from woven polypropylene, which in some instances are also sealed internally, or lined with low density polyethylene liners, to prevent moisture ingress. For storage, the bulk bags are stacked to a maximum height of 4-high in the warehouse.

2.5 Containerised and 'Bag-in-a-Box' Shipments

Some products like sodium bicarbonate are received in bag-in-a-box containers, which are containers equipped with dry bulk container liners. The product is thus enclosed in the liner which form a clean, dry, protective shield between the product and the floor and walls of the container. The product is discharged from the container into a road tanker by means of tilted mechanical loading. After discharge, the container liner is removed for recycling, leaving the container free of residue.

2.6 Sulphuric Acid

Protea Chemicals do not store sulphuric acid themselves. Instead sulphuric acid is stored at the neighbouring Rössing Uranium facility within the Port of Walvis Bay. Loading trees are situated on the Protea Chemicals site, next to the Rössing Uranium facility, and these are used for drawing acid directly from the acid tanks for loading into bulk tankers for transport to customers.

2.7 Hydrogen Peroxide 70%

Protea Chemicals will handle shipments of hydrogen peroxide which will be imported in isotainers through the Port of Walvis Bay. It is estimated that 23,000 t of hydrogen peroxide 70% will be handled and supplied to the customer annually. Two alternatives are considered for the storage and redistribution of Hydrogen Peroxide, these are discussed below.

Option 1, hydrogen peroxide supply (23,000 t/a) to the customer directly in isotainers. Isotainers arriving at the port will be loaded onto flatbed trucks, weighed at the site and immediately transported directly to the customer where the isotainers will be emptied and returned to the port's container terminal for return to suppliers. As a result, storage of isotainers containing hydrogen peroxide at the site is expected to be minimal to none. However, provision will be made for the storage of forty to eighty isotainers (both empty and containing hydrogen peroxide) at the site.

Option 2, hydrogen peroxide supply (23,000 t/a) to the customer via a bulk storage facility at the site. This will require the construction of a bulk storage facility with a total storage capacity of 3,000 t (volume of 2,325 m^3) to ensure a constant supply remains available to the customer. It is anticipated that the storage facility will consist of three 775 m^3 aboveground storage tanks or two tanks of 1,162.5 m^3 each. The amount of tanks used to achieve the desired volumes may however change during the final design based on feasibility and supply demands. Hydrogen peroxide will be offloaded into storage tanks using compressed air. Similarly, for supply to the customer, isotainers will be filled from the proposed bulk storage tanks via a H_2O_2 loading pump using compressed air. Isotainers will be transported to the client on flatbed trucks, see Figure 2-2.

Due to irregular international shipment of hydrogen peroxide, it is estimated that nearly three times the monthly customer demand will have to be stored at the site, to ensure a constant supply remain available to the customer. Hydrogen peroxide storage in bulk storage tanks at the site will thus be the preferred option.

The following safety measures will be in place according to Cefic H_2O_2 [hydrogen peroxide] Bulk Storage Guidelines of 2012 (Cefic, 2012):

- The bulk storage tanks will be situated in a sufficiently bunded areas, and dispensing and filling of tankers will take place on spill control surfaces;
- Isotainers will be stored on paved surfaces;
- All overflow, drains and pressure safety valve outlets will be collected in spill catchment pits;
- Water supply will be readily available for dilution of spilled products;
- All tanks will be properly vented to reduce fire and explosion risks;
- Tanks will be fitted with breather valves connected to a filter, the purpose of the filter is to prevent the tank content from becoming contaminated with potential particles in the air;
- Tanks will be fitted with temperature sensors at different levels, to give an early warning of decomposition (hydrogen peroxide decomposes to form water and oxygen with the rate of decomposition increasing with a rise in temperature, concentration, and pH);
- Pipework to and from the pumps, and all areas where hydrogen peroxide can get trapped in reticulation, will be fitted with relief valves.
- Additional safety measures relating to materials used etc. will be in place based on industry standards and best practice.

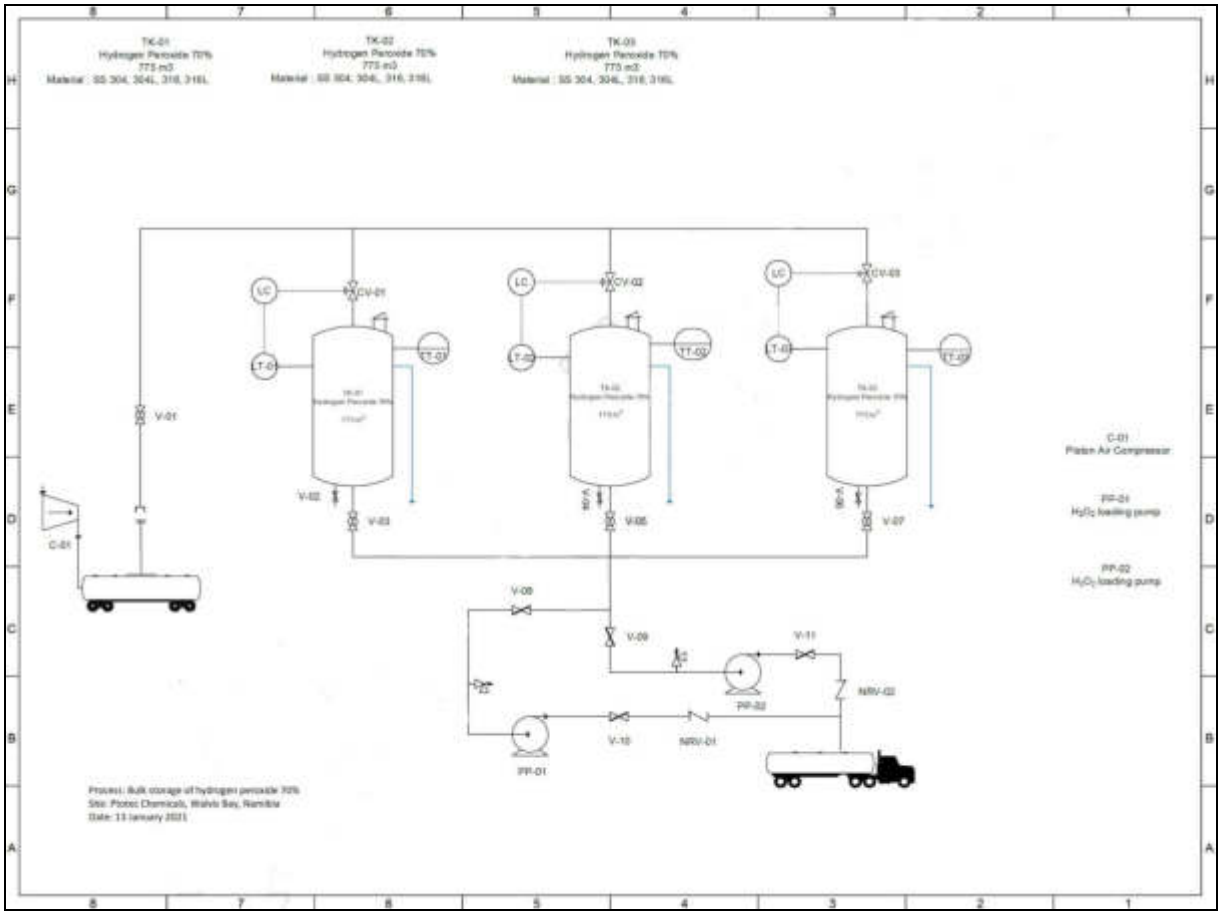

Figure 2-2 Process flow diagram for hydrogen peroxide storage and handling

2.8 Nitric acid 55 – 60%

Protea Chemicals proposes the storage of nitric acid 55 – 60% at the site. It is estimated that a total of 10,000 – 20,000 t will be handled annually. Nitric acid will be received and stored in 24 t isotainers and 1,000 *l* intermediate bulk containers (IBC). Isotainers will be stored on interlocked paving with a spill control lining under the paving. IBCs will be stored inside warehouses with solid concrete floors. Emergency response plans and spill clean-up means will be readily available.

2.9 Other Chemicals

Appendix A lists the range of chemicals that Protea Chemicals are currently handling or possibly could handle in the near future depending on customer demand. Most chemicals in this list, not discussed in detail in this report, will typically be handled in smaller volumes, but could also be handled in bulk bags or bulk containers should the demand arise. It is also possible that more chemicals may be added to this list and a typical example of chemicals that are not currently handled on site, but may be handled in future are chemicals used for the manufacturing of fertilizers. The important consideration is that all chemicals, including new chemicals added to the inventory, must at all times be handled as per their applicable material safety data sheets (MSDS) and where these are not available, these documents must be developed by suitably qualified and/or experienced personnel. The MSDS file must continually be updated and the relevant personnel informed and trained as per the MSDS contents. Some of the important aspects to be considered from the respective chemicals' MSDS documents include, but are not limited to:

- Hazard classification
- Incompatibilities (handling and storage) - especially important for storage and transport as cross contamination of certain chemicals can release harmful gases or result in fire and explosions.
- Personal Protective Equipment (PPE) requirements
- First aid measures / exposure control
- Firefighting measures
- Accidental release measures
- Disposal information (including empty containers/bags as these may still contain residual materials that may be incompatible with each other)
- Transport information

In addition to chemical handling and storage, Protea Chemicals will also handle and temporarily store copper in the form of blister, sheets or bagged product. These will be stored in any of the current or future warehouses, awaiting loading on ships for export.

2.10 Bagging, Re-bagging and Blending

In order to meet client demands and requirement Protea Chemicals may need to bag bulk cargo, re-bag break bulk cargo into smaller packaging (including smaller containers for liquids), or blend certain chemicals. These procedures takes place in designated areas equipped with the required spill control and safety infrastructure. All personnel involved wears the required PPE as per the MSDS requirements of chemicals.

2.11 Bag Recycling

In agreement with certain clients used, empty product bags are returned to Protea Chemicals. The bags are stored and processed through a bag bailer and compacted into bails. Once there are enough bails, they are transported to a registered waste recycler in South Africa through a local recycling firm.

2.12 Loading and Transport

Loading and transport methods depend largely on the type and volume of chemical cargo. Currently only road transport is utilized, but the option exist to make use of rail transport (rail tank cars and railcars) in future. Transport can be by powder or liquid road tanker for bulk powdered or liquid chemicals like sulphuric acid, soda ash, sodium bicarbonate and lime. For containerised chemicals, bagged chemicals ranging from 25 kg to 1,200 kg bulk bags, isotainers, drums, and other forms of packaged chemicals, flatbed trucks or other forms of applicable road trucks are used.

The loading of bulk powder road tankers are conducted from inside the warehouses, where for example the bulk soda ash, bulk bags of sodium bicarbonate and bulk bags of lime are loaded into bulk loading hoppers. The bulk powder road tankers park in designated loading bays outside the

warehouses from where they are filled from the loading hoppers using closed screw conveyors that protrude through the sides of the warehouses.

Loading of packaged cargo onto flatbed or other trucks are by means of forklift at the designated storage areas.

Due to the large volumes of chemicals used in the uranium metallurgical process, the relatively inert chemicals (soda ash, sodium bicarbonate, lime and solid caustic soda) will be delivered to the mine sites on a 24 hours per day, 7 days per week basis.

For the more dangerous and reactive caustic soda liquid and sulphuric acid, transportation in bulk liquid road tankers will only be permitted during normal daylight hours on a 5-days per week basis. The same goes for hydrogen peroxide that will be transported in isotainers.

In order to alleviate traffic congestion on the B2 coastal road, trucks delivering products to clients travel on the D1984 road behind the dunes. Prior to leaving Walvis Bay, trucks have to pass through the Roads Authority weighbridge.

2.13 Spill Control and Emergency Response

Protea Chemicals provides and maintains an emergency response trailer at its site in the Port of Walvis Bay, which is suitably equipped with the necessary tools, fire extinguishers, personnel protective equipment, spare bulk bags and chemical recovery equipment required for dealing with any emergency spill situation arising from the transportation of chemicals to clients. This emergency response trailer is currently stationed at the Port Facility and will be taken to any emergency situation by either Protea Chemicals or their appointed transport contractor's emergency response managers.

In the event of an accident occurring at any point along the route between the Port of Walvis Bay and any customer site, the transporter's control room will immediately notify the applicable local district's emergency response management official and the Protea Chemicals emergency response team. The emergency response personnel will proceed immediately and directly to the accident scene, and on arrival will assess the resources required to deal with the emergency. Protea Chemicals response personnel will take the emergency trailer out to the accident scene as quickly as possible so that the equipment is available as soon as possible after the incident.

At the accident scene, the responsible person who will assume management and control of the situation is determined by the emergency response procedure. He/she will also be responsible for directing the recovery, rescue and clean-up operations assisted by Protea Chemicals, as dictated by the emergency response procedures laid out in the 'Dangerous Goods Digest' or so-called Orange Book of Southern Africa.

Protea Chemicals' personnel will assist officials with containment of the spill and clean-up operations in an attempt to minimise the impact on the environment and/or injury to the general public.

Protea Chemicals carries out regular training programmes in Namibia for personnel who will most likely be called upon to assist with an emergency situation.

3 OBJECTIVES OF THE EMP

Protea Chemicals requires an updated EMP for their chemical storage and handling facility in Walvis Bay. All personnel taking part in the operations of this facility should be made aware of the contents of the EMP, so as to plan the relevant activities accordingly and in an environmentally sound manner.

The objectives of the updated EMP are:

- to include all components of the various current and proposed activities related to the facility;
- to prescribe the best practicable control methods to lessen the environmental impacts associated with the operations of the facility;
- to monitor and audit the performance of operational personnel in applying such controls; and
- to ensure that appropriate environmental training is provided to responsible operational personnel.

Protea Chemicals implements the International Standards of Operation (ISO) 14001 environmental management system (EMS) for its operations. An EMS is an internationally recognized and certified management system that ensure ongoing incorporation of environmental constraints. At the heart of an EMS is the concept of continual improvement of environmental performance with resulting increases in operational efficiency, financial savings and reduction in environmental, health and safety risks. An effective EMS includes the following elements:

- A stated environmental policy which sets the desired level of environmental performance;
- An environmental legal register;
- An institutional structure which sets out the responsibility, authority, lines of communication and resources needed to implement the EMS;
- Identification of environmental, safety and health training needs;
- An environmental program(s) stipulating environmental objectives and targets to be met, and work instructions and controls to be applied in order to achieve compliance with the environmental policy; and
- Periodic (internal and external) audits and reviews of environmental performance and the effectiveness of the EMS;
- An EMP.

4 THE EMP

The following general guidance for the EMP is based on the findings of the Updated EIA and EMP of 2018 (Faul & Botha, 2018), and primary and secondary information obtained regarding the facility and the proposed changes or additions to its current operations.

4.1 Land Use, Planning, Design, Operations – Identified Impacts

The following is the summary of the assessment of impacts:

- The facility is situated within the commercial harbour and is surrounded by similar industries;
- Hazardous chemicals are handled on site and pose fire, health and environmental risks;
- The risk of groundwater, surface water and soil contamination is possible.

4.2 Land Use, Planning, Design, Operations – Mitigating Measures

The following is a summary of the proposed EMP, which will make the facility safe taking into consideration all the identified impacts:

- To prevent health and safety risks and prevent contamination of the environment, all chemicals must be stored and handled according to their material safety data sheets and incompatible materials must be kept separate.
- Firefighting equipment and spill control / clean-up kits must be present on site and regularly serviced. Fire drills must be regularly conducted.

5 THE IMPLEMENTATION OF THE EMP

Table 1 and Table 3 outline the management of the environmental elements that may be affected by the different activities, grouped in each phase of development. These groups are as follows:

- Planning Phase
- Operational Phase
- Construction/Maintenance and Decommissioning Phases

The EMP is a living document that must be prepared in detail, and regularly updated, by the Proponent as the project progress and evolve. The tables below act as a guideline for the EMP to be established by the Proponent. Impacts addressed and mitigation measures proposed are seen as minimum requirements which have to be elaborated on. Delegation of mitigation and reporting activities should be determined by the proponent and included in the EMP.

All monitoring results must be reported on as indicated and submitted to the Ministry of Environment, Forestry and Tourism on a bi-annual basis. This is a requirement by the Ministry for any future renewals of the environmental clearance certificate.

Table 1. Planning for Operations, Maintenance and Future Decommissioning of the Project

Activity	Objective	Action	Timing	Proof of Compliance	Responsible Body
Compliance	To comply with all legal requirements for the operations of the facility in Namibia.	Where applicable, apply for / renew the necessary permits from the various ministries, local authorities and any other bodies that governs the operations of the proposed activity. Have environmental clearance certificate available on site. Finalise negotiations and resolve any outstanding issues, if any, over the allocation of user rights and zoning of the property on which the proposed activity will be located.	Ongoing throughout operations and prior to decommissioning	All contracts, permits, certificates and other legal documents on file.	Proponent
Appointments	To appoint reputable contractors and operational personnel and establish the EMP, a legal requirement that forms part of the contract with the contractor and employees.	Appoint a contractor and employees and enter into an agreement which includes the EMP. Ensure that the contents of the EMP are understood by the contractor, sub-contractors, employees and all personnel who will be present on site.	Ongoing throughout operations and prior to decommissioning	Contracts on file	Proponent
Management	Establish a management system to implement and monitor Health, Safety and Environment.	Make provisions to have a Health, Safety and Environmental Coordinator to implement the EMP and oversee occupational health and safety as well as general environmental related compliance at the site. Allocate the responsibility of liaison officer to a dedicated staff member who will be responsible for dealing with complaints and communication with neighbours and other potentially impacted parties (when required). Have the following emergency plans, equipment and personnel in place to deal with all emergencies:	Ongoing throughout operations and prior to decommissioning	Documentation on file Personal Protection Equipment (PPE) on site Signage related to restricted areas, dangerous areas, and PPE requirements on site Emergency response material on site	Proponent

Activity	Objective	Action	Timing	Proof of Compliance	Responsible Body
		Risk Management / Mitigation / Environmental Management Plan/ Emergency Response Plan and HSE Manuals Adequate protection and indemnity insurance cover for incidents; Comply with the provisions of all relevant safety standards; Procedures, equipment and materials required for emergencies.			
Restoration Fund/Insurance	To establish a fund/insurance for future environmental restoration or pollution remediation if ever required.	To establish a fund for future ecological restoration of the project site should project activities cease and the site is decommissioned and/or when environmental restoration or pollution remediation is required.	Ongoing throughout operations and prior to decommissioning	Financial statements/proof of restoration fund/insurance	Proponent; Independent Specialist Consultant
Reporting	To establish a reporting system to report on monitoring aspects of operations, construction/maintenance and decommissioning as outlined in the EMP.	Establish a reporting system to report on aspects of operations, maintenance and decommissioning as outlined in the EMP. Submit monitoring reports on a bi-annual basis to the MEFT to allow for environmental clearance certificate renewal where needed.	Ongoing throughout operations and prior to decommissioning	Monitoring reports	Proponent; Contractor
Environmental Clearance Renewal	To renew the environmental clearance certificate every three years.	Appoint a specialist environmental consultant to update the EIA and/or EMP and apply for renewal of the environmental clearance certificate.	Prior to expiry of environmental clearance certificate	Renewed environmental clearance certificate	Proponent; Independent Specialist Consultant

Table 2. The Operational Phase

Criteria	Nature	Mitigation	Monitoring	Responsible Body
Enhanced skills and technology transfer to Walvis Bay and the Erongo Region	People need skills to perform their jobs. The technology to do something is often not found locally. Development of people and technology are key to economic development.	Training must be provided to local Namibians to ultimately employ a predominantly Namibian workforce. This should be company policy for Protea Chemicals and their sub-contractors. Deviations from this practice must be justified appropriately.	Proof of appointment of local Namibians and training provided on file. Bi-annual summary report based on employee records.	Proponent
Demographic Profile and Community Health	The project relies on labour during the operational phase. Employment is sourced locally as far as possible. The community may still to some extent be exposed to factors such as communicable disease (e.g. HIV/AIDS) and alcoholism/drug abuse. This impacts on overall community health. Should an increase in foreign people (e.g. migrant workers) in the area take place, this may potentially increase the risk of criminal and socially/culturally deviant behaviour.	Employ only local people from the area, deviations from this practice should be justified appropriately. Adhere to all municipal by-laws relating to environmental health, such as sanitation requirements. Provide educational, awareness information for employees on various topics of social behaviour such as alcohol abuse and HIV/AIDs. Disciplinary steps, within the legal parameters of Namibia, to be taken for socially deviant behaviour during working hours should be clearly stipulated in employment contracts. Adopt a policy wherein derogatory and discriminative talk towards any gender or race is punishable under employee contracts. Educational programmes for employees on HIV/AIDs and general upliftment of employees' social status. Appointment of reputable contractors.	Proof of appointment of local Namibians on file. Proof of training and educational programmes. Bi-annual summary report based on training and educational programmes.	Proponent
Employment and Remuneration	The facility provides employment to locals. Remuneration increases the spending power of the local workforce.	Training must be provided to local Namibians to ultimately employ a predominantly Namibian workforce. Deviations from this practice must be justified appropriately.	Proof of appointment of local Namibians on file. Bi-annual summary report based on employee records.	Proponent
Economic and Technological Development	The supply of chemicals support mining, agricultural, manufacturing and other industrial developments. Revenue is generated and new technologies developed.	Maintain reliable and secure supply of chemicals. Support local businesses and industries.	Maintain records of chemical supply and demand data to ensure customer needs are met.	Proponent

Criteria	Nature	Mitigation	Monitoring	Responsible Body
Traffic	Traffic impacts as a result of chemical transport.	If significant traffic impacts are expected, preventative traffic management should be performed. Adhere to restrictions in terms of truck weight and predetermined and restricted routes. The placement of signs to warn and direct traffic will help mitigate traffic impacts. Adhere to all local, regional and national regulations pertaining to the trucking industry and road usage. Routes with minimum potential traffic impacts should be chosen. This includes the use of the M0044 road behind the dunes between Walvis Bay and Swakopmund. Trucks may not be overloaded and must report at the weighbridge. Trucks should not be allowed to park outside designated areas outside port limits for extended periods of time, neither should they obstruct neighbouring businesses. Identify vehicles on which hazardous substances are to be transported and handle all dangerous or hazardous goods according to MSDS instructions and under supervision of trained staff. Ensure the correct documentation (e.g. dangerous goods declaration, TREMCARD, etc.) is provided in the vehicle. Verify that the driver of the vehicle has undergone appropriate training.	Any complaints received regarding traffic issues should be recorded together with action taken to prevent impacts from repeating itself. All incidents reported, complaints received, and action taken to be included in bi-annual a summary report	Proponent

Criteria	Nature	Mitigation	Monitoring	Responsible Body
Health, Safety & Security	Chemicals handled and stored on site may be hazardous with inherent health risks to personnel on site when inhalation, accidental ingestion, eye or skin contact occurs. Injuries can occur due to incorrect lifting of heavy equipment and materials, falling from heights, stacked chemicals tipping over, getting caught in moving parts of machines, and accidents involving forklifts and vehicles.	All health and safety standards specified in the Labour Act should be complied with. Proper personal protective equipment to be worn at all times. Dermal contact, inhalation and accidental ingestion of chemicals must be avoided and all products handled according to their material safety data sheets. Personnel to be trained in correct chemical handling procedures, the dangers of chemical exposure, and potential risks of injuries on site. Selected personnel should be trained in first aid and first aid kits, emergency showers and eye wash stations must be available on site. The contact details of all emergency services must be readily available.	Inventory of safety information, equipment and administrative documentation to be kept. All incidents reported, complaints received, and action taken to be included in a summary report bi-annually. The report should contain dates when training were conducted and when safety equipment and structures were inspected and maintained.	Proponent
Noise	Noise pollution will exist due to heavy motor vehicles accessing the site to load chemical products and the use of forklifts and related machinery on site.	The World Health Organization guidelines on maximum noise levels (Guidelines for Community Noise, 1999) for industrial areas should be adhered to. All machinery must be regularly serviced to ensure minimal noise production. Switch to white noise audible alarms or flashing light systems on vehicles and machinery like forklifts operating at the facility, especially for after hour operations. Hearing protectors as standard PPE for workers in situations with elevated noise levels.	Any complaints received regarding excessive noise should be recorded with notes on action taken. All incidents reported, complaints received, and action taken to be included in a bi-annual summary report.	Proponent

Criteria	Nature	Mitigation	Monitoring	Responsible Body
Fire and Explosions	Some chemicals stored are flammable in nature and can even become explosive when exposed to incompatible materials (e.g. oxidisers such as hydrogen peroxide when mixed with combustible materials and organic substances like wood, paper, textiles and hydrocarbon fuels). Uncontrolled fires and explosions can cause extensive damage to the port or surrounding properties and can lead to casualties. For hydrogen peroxide concentrations below 74%, explosion risk is highly improbable. A fire risk remain in the presence of combustible materials, for concentrations below 70%.	Storage and handling of flammable or explosive products should be according to their material safety data sheet instructions. Incompatible chemicals and materials must be segregated. A holistic fire protection and prevention plan is needed for all phases of handling, storage and transport of chemicals. All fire precautions and fire control measures must be up to date. All spills must be cleaned immediately and waste disposed of regularly. Firefighting measures as per the material safety data sheet of products should be adhered to where relevant. For transport of explosive chemicals predetermined routes and times of transport should be followed. Concentrations of hydrogen peroxide stored on site should be below 74%, as this significantly reduces the risk of vapour and condensed phase explosion. The bulk storage facility for hydrogen peroxide should be constructed according to Cefic guidelines or better to prevent fire or explosion risk, this include, but is not limited to: ♦ Safe separation distances from combustible or organic materials; ♦ Properly vented tanks; ♦ Temperature sensors in tanks; ♦ Readily available water for firefighting and dilution purposes as well as cooling and flooding of the tank in the case of decomposition.	All incidents reported, complaints received, and action taken to be included in a bi-annual summary report**.** The report should contain dates when fire drills were conducted and when fire equipment was tested / serviced.	Proponent

Criteria	Nature	Mitigation	Monitoring	Responsible Body
Waste Production	Waste will be produced in the form of domestic waste from the administrative offices as well as hazardous waste like contaminated packing material (bags and containers), and spilled or contaminated chemicals. Containers contaminated with chemicals can pose health risks if discarded at regular disposal sites where it may be collected for re-use by people.	Waste reduction measures should be implemented and all waste that can be re-used must be kept separate. Waste should be disposed of regularly and at appropriately classified disposal facilities. Products that can be re-cycled should be kept separate and sent for recycling. Due to the nature of some hazardous materials they, or the containers they are packed in, should be disposed of in an appropriate way at an appropriately classified waste disposal facility. It should be ensured that personnel are trained in handling contaminated packing material or waste and continue to separate incompatible products. See the material safety data sheets available from suppliers for disposal methods.	A register of hazardous waste disposal should be kept. This should include type of waste, volume as well as disposal method/facility. Any complaints received regarding waste should be recorded with notes on action taken. All data recorded, incidents reported, complaints received, and action taken to be included in a bi-annual summary report.	Proponent
Groundwater, Surface Water and Soil Contamination	Groundwater is shallow and the ocean is in close proximity to the Protea Chemicals facility. These together with soil as well as sources along transport routes can become contaminated during normal operations with hazardous chemicals through: ♦ Windblown dust during offloading and handling of breakbulk cargo. ♦ Spillage during offloading of breakbulk cargo using grabs and conveyors. ♦ Rupture of breakbulk bags during offloading and handling. ♦ Insufficiently contained cargo blowing off trucks during transport. ♦ Spilled cargo during truck accidents on route to clients. ♦ Spilled fuel, oil or hydraulic fluids from forklifts and trucks.	Regular inspection and maintenance of all chemical handling equipment. To prevent the tearing of breakbulk bags a limit should be placed on stacking height during transport and storage. Only superior quality bags should be used. Offloading of bulk cargo during strong winds must be avoided as far as is practically possible. Emergency Response Plans and Spill Contingency Plans must be in place and include all chemicals being handled. These should be updated as new chemicals are added to those being handled. Use of reputable and well trained contractors are essential. Use spill control and spill catchment measures where appropriate (e.g. concrete floors and plastic sheeting). If a spill occurs, clean-up should be initiated immediately.	A bi-annual report should be compiled of all spills or leakages reported. The report should contain the following information: ♦ date of spill ♦ product spilled ♦ volume of spill ♦ remedial action taken ♦ comparison of pre-exposure baseline data (previous pollution conditions survey results) with post remediation data	Proponent; Independent Specialist Consultant

Criteria	Nature	Mitigation	Monitoring	Responsible Body
Ecosystem and Biodiversity Impact	Environmental contamination by chemicals or other forms of waste can have detrimental effects on wildlife. This is especially true for contamination of the ocean through windblown dust or spills during offloading of ships. Excessive lighting used at night and especially those that are directed upwards blinds birds like flamingos that fly at night. This may result in disorientation of birds and collisions with structures.	Mitigation measures to prevent pollution as above to be implemented. Use minimum lighting required at night and direct all light downwards to work surfaces.	Spill reporting as above. Any complaints received regarding waste, pollution or environmental damage should be recorded with notes on action taken. A report should be compiled bi-annually of all complaints reported.	Proponent
Dust and Air Quality	Windblown dust during offloading of bulk cargo from ships. Spilled or uncovered chemical powders can reduce air quality during strong winds which regularly occur in Walvis Bay.	Prevent spillage of chemicals and keep all bulk chemical powders covered at all times. Bulk cargo should not be offloaded during periods of strong winds as far as is practically possible. Mitigation: If spills occur clean-up should be initiated immediately. Use of reputable and well trained contractors are essential. Should dust become an issue a dust monitoring programme can be initiated to determine the extent of the problem.	Any complaints received regarding dust and air quality should be recorded with notes on action taken. A bi-annual report should be compiled of all complaints reported and corrective action taken.	Proponent

Criteria	Nature	Mitigation	Monitoring	Responsible Body
Cumulative Impact	These are impacts on the environment, which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of who undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time. In relation to an activity, it means the impact of an activity that in itself may not be significant, may become significant when added to the existing and potential impacts resulting from similar or diverse activities or undertakings in the area. Possible cumulative impacts associated with the operational phase include: increased risk of groundwater and soil contamination; increased traffic in the area will have a cumulative impact on traffic flow within the commercial harbour and the streets of Walvis Bay and increase the risk of accidents.	Addressing each of the individual impacts as discussed and recommended in the EMP would reduce the cumulative impact. Reviewing bi-annual reports for any new or re-occurring impacts or problems would aid in identifying cumulative impacts and help in planning if the existing mitigations are insufficient.	Review bi-annual reports for an overall assessment of the impact of the operational phase.	Proponent

Table 3. Maintenance and Decommissioning Phases

Criteria	Nature	Mitigation	Monitoring	Responsible Body
Waste Production	When performing maintenance or upon decommissioning waste will be produced in the form of building rubble, obsolete equipment and structures, obsolete or residual products and equipment or structures that can be used elsewhere or sold as scrap. Soil polluted by hydrocarbons must be treated as hazardous waste.	To reduce the amount of waste, all re-usable products and equipment must be removed to another site owned by the proponent or sold. Those items that can not be used again must be scrapped in the appropriate manner. Upon maintenance or demolition of the buildings any waste, concrete and rubble must be removed from the property and taken to an approved dumpsite designated by the Municipality of Walvis Bay. Rehabilitation if necessary are to be done using funds designated for the purpose.	Regular visual inspection. A register of hazardous waste produced and disposal methods should be maintained.	Proponent; Contractor
Ecological Impact	Operations spanning many years may create new habitat for fauna and flora. Upon maintenance or decommissioning these habitats may be destroyed.	The proponent would have to ensure that no new habitat is created for flora and fauna. Before decommissioning the health, safety and environmental officer would need to inspect every structural facility to ensure that the dismantling and removal of any structure would not affect any organism that has become dependent on those structures for survival, shelter or breeding. Where new habitats were created, that is now occupied by fauna or flora, the proponent must contact the Ministry of Environment, Forestry and Tourism (MEFT) or other appropriate organizations to establish the conservation status of it. The possibility of relocating the fauna or flora must be investigated and executed. Should the species be listed as vulnerable to extinction, or worse, a meeting should be held with MEFT in order to determine the appropriate handling of the situation.	A report should be compiled of any fauna and flora that established itself on the premises. The report should include all actions taken to relocate or deal with the situation.	Proponent; Contractor
Employment	Maintenance will require contractors. Decommissioning of the facility may lead to retrenchments or re-location of staff no longer required.	Restricted employment of local people and contractors only should be practiced. Deviations from this practice should be justified appropriately. Plan in advance for meeting the Labour Acts requirements for retrenching of staff if required. Where possible staff can be relocated to another facility	Employment contracts on file. During normal operations of the facility a bi-annual report must be compiled that includes the	Proponent

Criteria	Nature	Mitigation	Monitoring	Responsible Body
		or town where business continues in the same way.	appropriate plans for handling of employees should the facility be decommissioned. The report should include budgeting for retrenchments and possible alternative positions elsewhere.	
Dust	Dust may be generated during maintenance and decommissioning phases and might be aggravated during periods of strong winds.	It is recommended that regular dust suppression be included in the maintenance and decommissioning phases, when dust becomes an issue. Personnel should be issued with dust masks for health and safety reasons.	Regular visual inspection. A complaints register must be maintained, in which any complaints from the community must be logged. Complaints must be investigated and, if appropriate, acted upon.	Proponent; Contractor
Noise	Noise pollution will exist due to heavy vehicles accessing the site during maintenance or to collect rubble from demolished building materials. Cranes may be used for removing structures. Hammers, diggers and drills will be used.	The World Health Organization guidelines on maximum noise levels (Guidelines for Community Noise, 1999) for industrial areas should be adhered to. All personnel must be issued with hearing protectors and neighbours must be notified of the time and duration of maintenance or decommissioning. Notice of the start of major maintenance activities or decommissioning should be given to the local authorities with an invitation to give feedback at any time with regards the noise impact.	A complaints register must be maintained, in which any complaints from the community must be logged. Complaints must be investigated and, if appropriate, acted upon.	Proponent; Public Relations Personnel; Contractor.
Visual Impact	This is an impact that affects the aesthetic appearance	Visual impact could pose one of the most significant impacts. Visual impacts could be limited through keeping all maintenance and decommissioned areas clean and orderly at all times. Good housekeeping also reduces the risk of injuries. Notice of the start of the major maintenance activities or decommissioning should be given to the local authorities with an invitation to give feedback at any time with regards the visual impact.	A complaints register must be maintained, in which any complaints from the community must be logged. Complaints must be investigated and, if appropriate, acted upon.	Proponent; Contractor

Criteria	Nature	Mitigation	Monitoring	Responsible Body
Groundwater, Surface Water and Soil Contamination	Porous surface substrate can allow unwanted hazardous and ecologically detrimental substances to seep down to the water table.	All precautions are to be taken to prevent contamination of the soil as this could enter the ecosystem. Leakages from vehicles might occur especially if they are serviced on site. Care must be taken to avoid contamination of soil and groundwater. Groundwater might spread pollutants to neighbouring receptors and may create an impact on underground utilities (i.e. fresh water supply to buildings, sewerage system). Pollutants in the soil and building rubble must be transported away from the site to an approved, appropriately classified waste disposal site. Confirm MSDS information for any remaining chemicals that must be discarded. Regulations on sewerage discharge and the chemicals that may and may not be put into the sewerage system must be followed.	A baseline study must be carried out after the decommissioning. This is to assess the condition of soil substrate and any groundwater present. Comparisons with previous conditions survey data should be made and any discrepancies must be addressed before the site can be signed over.	Proponent; Contractor
Health, Safety and Security	During the maintenance and decommissioning phase similar risks to human beings as with the operational phase will be present.	The maintenance and decommissioning of the chemical storage facility can cause serious health and safety risks to workers on site. Occupational exposures are normally related to dermal contact, inhalation or accidental ingestion of chemicals For this reason adequate measures must be brought in place to ensure safety of staff on site, and includes: (Provide forms for all end users who monitor) ♦ Proper training of operators; ♦ First aid treatment; ♦ Medical assistance; ♦ Emergency treatment; ♦ Protective clothing, footwear, gloves and belts; safety goggles and shields; ♦ Manuals and training regarding the correct handling of materials and packages should be in place and updated as new or updated MSDS' become available; ♦ 24-hour security surveillance in case of opportunistic activities.	A register of all incidents must be maintained. This should include measures taken to ensure that such incidents do not repeat itself.	Proponent; Contractor

Criteria	Nature	Mitigation	Monitoring	Responsible Body
Fire and Explosion Hazard	Residual chemicals could be present and might pose a risk to the teams doing maintenance or dismantling the various structures. Fire and/or explosion events are still possible.	Ensure all residual chemicals are removed and safely discarded. A holistic fire protection and prevention plan is needed for all phases of handling, storage and transport of chemicals. All fire precautions and fire control measures must be up to date. Firefighting measures as per the material safety data sheet of products should be adhered to where relevant.	A register of all incidents must be maintained on a daily basis. This should include measures taken to ensure that such incidents do not repeat itself.	Proponent; Contractor

6 CONCLUSIONS

The above updated EMP, if properly implemented will help to continually minimise adverse impacts on the environment. Where impacts occur, immediate action must be taken to reduce the escalation of effects associated with these impacts. To ensure the relevance of this document to the specific stage of project, it needs to be reviewed throughout all phases.

The EMP should be used as an on-site reference document during all phases of the project, and auditing should take place in order to determine compliance with the EMP for the site. Parties responsible for transgression of the EMP should be held responsible for any rehabilitation that may need to be undertaken.

Monitoring reports must be submitted to the Ministry of Environment, Forestry and Tourism every six months to allow for the future renewal of the Environmental Clearance Certificate.

7 REFERENCES

CEFIC. 2012. European Chemical Industry Council, Peroxygens Sector Group, Hydrogen Peroxide Subgroup. H_2O_2 Bulk Storage Guideline.

Faul, A., Botha, P. 2018. Update of the Environmental Impact Assessment for Protea Chemicals' Chemical Handling Facility at the Port of Walvis Bay.

Faul A, Botha P. 2018. Updated Environmental Management Plan for Protea Chemicals' Chemical Handling Facility at the Port of Walvis Bay.

APPENDIX A: Chemical Inventory

Chemicals currently stored and handled by Protea Chemicals or expected to be stored and handled in near future. Volumes are estimates based on current customer demands and may change on short notice. Where volumes are indicated as NA no estimate is currently available. Packaging type and volumes may change depending on customer demands.

Chemical	Typical Packaging	Solid / Liquid	Estimated Volume	Expected Timeframe
Activated Carbon (Granular Activated Carbon)	bags (25 kg - bulk bags)	Solid	59 t	Current and/or Near Future
Borax	bags (25 kg)	Solid	16 t	Current and/or Near Future
Coagulants	bags (25 kg - bulk bags)	Liquid	3,356 t	Current and/or Near Future
Copper Sulphate	bags (25 kg - bulk bags)	Solid	300 t	Current and/or Near Future
Diatomaceous Earth	various bags	Solid	17 t	Current and/or Near Future
Diluent (Shellsol D70)	drums (200 *l*); bulk containers	Liquid	489 m^3	Current and/or Near Future
Extractant (Alamine 336)	drums (200 *l*), IBC (1000 *l*)	Liquid	21 m^3	Current and/or Near Future
Ferro Silicon	bulk bags	Solid	204 t	Current and/or Near Future
Ferrous Sulphate	bags (25 kg - bulk bags)	Solid	93,000 t	Current and/or Near Future
Flocculant (SNF FA 920 SH)	bags (25 kg - bulk bags)	Solid	6,150 t	Current and/or Near Future
Hydrochloric Acid	polycans (25 *l*), drums (200 *l*), IBC (1,000 *l*)	Liquid	320,000 *l*	Current and/or Near Future
Hydrogen Peroxide	isotainers	Liquid	17,000 t	Current and/or Near Future
Lead Nitrate	bags (25 kg - bulk bags)	Solid	256 t	Current and/or Near Future
Lime (Hydrated - CaOH)	bags (25 kg - bulk bags)	Solid	15,000 t	Current and/or Near Future
Lime (Quick /Burnt lime - CaO)	bags (25 kg - bulk bags)	Solid	120 t	Current and/or Near Future
Limestone Feed Lime	bags (25 kg)	Solid	360 t	Current and/or Near Future
Modifier (Isodecanol)	drums (200 *l*), IBC (1,000 *l*)	Liquid	10.5 m^3	Current and/or Near Future
Polyacrylamide Flocculants: - Cationic, Anionic, Non-ionic Powders	bags (25 kg - bulk bags)	Solid	12 t	Current and/or Near Future
Potassium Nitrate	bags (25 kg)	Solid	4 t	Current and/or Near Future
Pyrolusite (UF 74 Morocco 64% MnO2)	bags (25 kg - bulk bags)	Solid	43,846 t	Near Future
Salt feed grade	bags (25 kg)	Solid	120 t	Current and/or Near Future

Chemical	Typical Packaging	Solid / Liquid	Estimated Volume	Expected Timeframe
Silica	bags (25 kg - 50 kg)	Solid	4.6 t	Current and/or Near Future
Sodium Bicarbonate	bags (25 kg - bulk bags)	Solid	60,000 t	Current and/or Near Future
Sodium Carbonate (Light & Dense)	bags (25 kg - bulk bags)	Solid	16,000 t	Current and/or Near Future
Sodium Chloride	bags (25 kg - 50 kg)	Solid	8 t	Current and/or Near Future
Sodium Cyanide	bulk bags	Solid	300 t	Current and/or Near Future
Sodium Hydroxide	bags (25 kg - bulk bags)	Solid	40,000 t	Current and/or Near Future
Sodium Hydroxide (Caustic soda lye)	small to bulk containers	Liquid	2,160 t	Current and/or Near Future
Sodium lauryl ether sulfate (SLES)	containers (25 kg – 210 kg)	Liquid	110 t	Near Future
Sodium Metabisulphite	bags (25 kg - bulk bags)	Solid	12,000 t	Current and/or Near Future
Sodium Nitrite	bags (25 kg)	Solid	12 t	Current and/or Near Future
Sulphamic Acid	bags (25 kg)	Solid	12 t	Current and/or Near Future
Sulphuric Acid	polycans (25 l), IBC (1,000 l)	Liquid	5,000 - 10,000 t	Current and/or Near Future
Thiourea	bags (25 kg - bulk bags)	Solid	12 t	Current and/or Near Future
Ion Exchange Resin	bags (25 kg - bulk bags)	Solid	386 m^3	Current and/or Near Future
Urea Feed Grade	bags (25 kg)	Solid	360 t	Current and/or Near Future
Xanthate PAX	bags (25 kg)	Solid	100 t	Current and/or Near Future
Acetic Acid	drums (25 *l*/200 *l*/1,000 *l)*	Liquid	NA	Current and/or Near Future
Acetone	drums (25 *l*/200 *l)*	Liquid	NA	Near Future
Aluminium Sulphate	bags (25 kg - 500 kg)	Solid	NA	Current and/or Near Future
Ammonia Solution	drums (25 *l*/200 *l*/1,000 *l)*	Liquid	NA	Current and/or Near Future
Ammonium Chloride	bags (25 kg)	Solid	NA	Near Future
Ammonium Hydroxide	various containers	Liquid	NA	Current and/or Near Future
Ammonium Nitrate	bags (25 kg - bulk bags)	Solid	NA	Near Future
Ammonium Persulphate	bags (25 kg)	Solid	NA	Current and/or Near Future

Chemical	Typical Packaging	Solid / Liquid	Estimated Volume	Expected Timeframe
Ammonium Sulphate	bags (25 kg - bulk bags)	Solid	NA	Near Future
Ammonium Thiosulphate	various containers	Solid	NA	Near Future
Anthraquinone	bags (25 kg)	Solid	NA	Current and/or Near Future
Antifoam Emulsions	various containers	Liquid	NA	Near Future
Assay Flux	bags (25 kg)	Solid	NA	Current and/or Near Future
Assay Flux (Lead)	bags (25 kg)	Solid	NA	Current and/or Near Future
Assay Flux (Nickel)	bags (25 kg)	Solid	NA	Current and/or Near Future
Barium Carbonate	bags (25 kg)	Solid	NA	Current and/or Near Future
Bentonite	bags (40 kg)	Solid	NA	Current and/or Near Future
Bleaching Powder - (Chloride of lime)	various containers	Solid	NA	Current and/or Near Future
Borax (anhydrous, glass)	bags (25 kg - 50 kg)	Solid	NA	Current and/or Near Future
Boric Acid	bags (25 kg)	Solid	NA	Current and/or Near Future
Bromoform	various containers	Liquid	NA	Current
Calcium Carbonate	bags (25 kg - bulk bags)	Solid	NA	Near Future
Calcium Chloride Flakes	bags (25 kg)	Solid	NA	Current and/or Near Future
Calcium Hypochlorite (HTH)	tins (10 kg, 25 kg, 50 kg)	Solid	NA	Current and/or Near Future
Calcium Nitrate	bags (25 kg - bulk bags)	Solid	NA	Current and/or Near Future
Carboxy Methyl Cellulose (CMC)	various containers	Solid	NA	Current
Caustic Potash	various containers	Solid	NA	Current and/or Near Future
Citric Acid	bags (25 kg)	Solid	NA	Current and/or Near Future
Collectors (SIBX, PAX, SNPX, SEX, PIBX, PNBX, SIPX) - (Flotation reagents)	bags: (25 kg - bulk bags)	Solid	NA	Current and/or Near Future
Degreaser Solvent	various containers	Liquid	NA	Current and/or Near Future
De-ionised Water	polycans (25 *l*), IBC (1,000 *l*)	Liquid	NA	Current
Depressant/Dispersants - (Flotation reagents)	IBC (1,000 *l*)	Liquid	NA	Current and/or Near Future

Chemical	Typical Packaging	Solid / Liquid	Estimated Volume	Expected Timeframe
Diethylene Glycol Mono Butyl Ether	various containers	Liquid	NA	Current and/or Near Future
Di-ethylene Tri-amine (DETA)	drum (200 *l*), IBC (1,000 *l*)	Liquid	NA	Current
Diluent (High Flash Kerosene)	various containers	Liquid	NA	Current and/or Near Future
Di-octyl Phthalate	drum (200 *l*)	Liquid	NA	Current and/or Near Future
EDTA (Ethylene Diamine Tetra Acetic Acid)	bags (25 kg)	Solid	NA	Current and/or Near Future
Ferric Chloride	various containers	Liquid / Solid	NA	Current and/or Near Future
Ferric Sulphate	IBC (1,000 *l*), various containers	Liquid / Solid	NA	Current and/or Near Future
Flotation Reagents	various containers	Liquid / Solid	NA	Near Future
Fluorspar	bags: (25 kg - bulk bags)	Solid	NA	Current and/or Near Future
Formic Acid	various containers	Liquid	NA	Current and/or Near Future
Frothers - (Flotation Reagents)	IBC (1,000 *l*)	Liquid	NA	Current and/or Near Future
Glycerine	containers (30 kg - 250 kg)	Liquid	NA	Current and/or Near Future
Guar Gum	bags: (25 kg - bulk bags)	Solid	NA	Current and/or Near Future
Hibatex	polycans (25 *l*)	Liquid	NA	Current and/or Near Future
Hydrofluoric Acid (20/40/60/70%)	polycans (25 *l*), drums (200 *l*), (IBC 1,000 *l*)	Liquid	NA	Current and/or Near Future
Hydrogen Peroxide (35/50/70%)	polycans (25 *l*), (IBC 1,000 *l*), Isotainers (24 t)	Liquid	23,000 t/a	Current and/or Near Future
Hydroquinone	containers 4 kg	Solid	NA	Current
Iron Powder	bags (20 kg - 45 kg)	Solid	NA	Current and/or Near Future
Iso Propyl Alcohol (IPA)	polycans (25 *l*), drums (200 *l*), (IBC 1,000 *l*)	Liquid	NA	Current and/or Near Future
Kaolin	various containers	Solid	NA	Current and/or Near Future
Litharge	bags (50 kg)	Solid	NA	Current and/or Near Future
Magnesium Oxide	bulk bags	Solid	NA	Current and/or Near Future

Chemical	Typical Packaging	Solid / Liquid	Estimated Volume	Expected Timeframe
Manganese Sulphate	containers (25 kg)	Solid	NA	Current and/or Near Future
Mercury	NA	Liquid	NA	Current and/or Near Future
Methanol	polycans (25 *l*), drums (200 *l*)	Liquid	NA	Current and/or Near Future
Methyl Ethyl Ketone (MEK)	polycans (25 *l*), drums (200 *l*)	Liquid	NA	Current and/or Near Future
Methyl isobutylcarbinol (MIBC)	polycans (25 *l*), drums (200 *l*), (IBC 1,000 *l*)	Liquid	NA	Near Future
Methylated Spirits	polycans (25 *l*), drums (200 *l*)	Liquid	NA	Current and/or Near Future
Mono Ethylene Glycol	polycans (25 *l*), drums (200 *l*), (IBC 1,000 *l*)	Liquid	NA	Current and/or Near Future
Mono-isopropyl-amine, Salt of Dodecylbenzene Sulphonic Acid	polycans (25 *l*), drums (200 *l*)	Liquid	NA	Current and/or Near Future
Nickel Carbonate	bags (15 kg)	Solid	NA	Current and/or Near Future
Nickel Sulphate	various containers	Solid	NA	Near Future
Nitric Acid (Com/CP Grade 55 – 60%)	polycans (25 *l*), drums (200 *l*), (IBC 1,000 *l*), Isotainers (24 t)	Liquid	10,000 – 20,000 t/a	Current and/or Near Future
N-propyl alcohol	polycans (25 *l*), drums (200 *l*)	Liquid	NA	Current
Oxalic Acid	bags (25 kg)	Solid	NA	Current
Perchlorethylene	polycans (25 *l*), drums (200 *l*)	Liquid	NA	Current and/or Near Future
Phosphoric Acid	polycans (25 *l*)	Liquid	NA	Current and/or Near Future
Polyethylene Glycols	polycans (25 *l*), drums (200 *l*)	Liquid	NA	Current and/or Near Future
Polypropylene Glycol	polycans (25 *l*), drums (200 *l*)	Liquid	NA	Current
Potassium Bichromate	bags (25 kg)	Solid	NA	Current and/or Near Future
Potassium Carbonate	bags (25 kg)	Solid	NA	Current
Potassium Chloride	bags (25 kg)	Solid	NA	Current and/or Near Future
Potassium Hydroxide	bags (25 kg)	Solid	NA	Current and/or Near Future
Potassium Iodide	bags (25 kg)	Solid	NA	Current and/or Near Future
Potassium Permanganate	bags (50 kg)	Solid	NA	Current and/or Near Future

Chemical	Typical Packaging	Solid / Liquid	Estimated Volume	Expected Timeframe
Potassium Persulphate	bags (25 kg)	Solid	NA	Current and/or Near Future
Potassium Silicates	various containers	Solid / Liquid	NA	Current
Potassium Sulphite	bags (25 kg)	Solid	NA	Near Future
Priolenes (Oleic Acid)	polycans (25 *l)*	Liquid	NA	Current and/or Near Future
Pristerenes (Stearic Acid)	containers (25 kg)	Solid	NA	Near Future
Promoters (Dithiocarbamates, dithiophosphates) - Flotation reagents	IBC (1,000 *l)*	Liquid	NA	Near Future
Prosolve (Electric cleaner)	various containers	Liquid	NA	Current and/or Near Future
Quaternary Ammonium Compounds (QAC)	various containers	Liquid	NA	Current and/or Near Future
Silica (150#, 200#. 300#)	bags (50 kg)	Solid	NA	Current and/or Near Future
Silica Gels	containers (4 kg)	Solid	NA	Current
Silica Powders	bags (20 kg - 50kg)	Solid	NA	Near Future
Sodium Acetate	bags (25 kg)	Solid	NA	Near Future
Sodium Bichromate	bags (25 kg)	Solid	NA	Current
Sodium Bisulphate	bags (25 kg)	Solid	NA	Current and/or Near Future
Sodium Borate	various containers	Solid	NA	Current
Sodium Bromate	bags (25 kg)	Solid	NA	Current and/or Near Future
Sodium Bromide	various containers	Solid	NA	Current and/or Near Future
Sodium Carboxy Methyl Cellulose (CMC)	various containers	Solid	NA	Current
Sodium Fluoride	various containers	Solid	NA	Current and/or Near Future
Sodium Formate	bags (25 kg)	Solid	NA	Current and/or Near Future
Sodium Hydrosulphide	bags (25 kg - bulk bags)	Solid	NA	Current and/or Near Future
Sodium Hypochlorite	polycans (25 *l)*, drums (200 *l)*, (IBC 1,000 *l)*	Liquid	NA	Current and/or Near Future
Sodium Metasilicate	bags (25 kg)	Solid	NA	Current and/or Near Future

Chemical	Typical Packaging	Solid / Liquid	Estimated Volume	Expected Timeframe
Sodium Nitrate	bags (25 kg)	Solid	NA	Current and/or Near Future
Sodium Oxalate	containers (25 kg)	Solid	NA	Current and/or Near Future
Sodium Perborate	various containers	Solid	NA	Current and/or Near Future
Sodium Percarbonate	various containers	Solid	NA	Current and/or Near Future
Sodium Persulphate	containers (25 kg)	Solid	NA	Current and/or Near Future
Sodium Sesquicarbonate	various containers	Solid	NA	Current and/or Near Future
Sodium Silicates	containers (279 kg)	Liquid / Solid	NA	Current and/or Near Future
Sodium Sulphate	bags (25 kg - 50 kg)	Solid	NA	Current and/or Near Future
Sodium Sulphide	bags (25 kg)	Solid	NA	Current and/or Near Future
Sodium Sulphite	bags (25 kg)	Solid	NA	Current and/or Near Future
Sodium Thiosulphate	bags (25 kg - bulk bags)	Solid	NA	Current and/or Near Future
Sodium Tripolyphosphate	bags (25 kg)	Solid	NA	Current and/or Near Future
Solumix	polycans (25 *l*), drums (200 *l*), (IBC 1,000 *l*)	Liquid	NA	Current
Solvent Degreaser	polycans (25 *l*), drums (200 *l*), (IBC 1,000 *l*)	Liquid	NA	Current and/or Near Future
Solvent Extractants	polycans (25 *l*), drums (200 *l*), (IBC 1,000 *l*)	Liquid	NA	Current and/or Near Future
Solvents	polycans (25 *l*), drums (200 *l*), (IBC 1,000 *l*)	Liquid	NA	Current and/or Near Future
Sorbitol	polycans (25 *l*), drums (200 *l*), (IBC 1,000 *l*)	Liquid	NA	Current
Strontium Carbonate	various containers	Solid	NA	Near Future
Sulphonic Acid	polycan (25 *l*)	Liquid	NA	Current and/or Near Future
Sulphonic Powder	bags (25 kg)	Solid	NA	Current and/or Near Future
Sulphur	bag (25 kg - bulk bags)	Solid	NA	Current and/or Near Future
Surfactants	various containers	Liquid	NA	Current and/or Near Future
Tall Oil	drums (200 *l*)	Liquid	NA	Current
Tartaric Acid	containers (25 kg)	Solid	NA	Current and/or Near Future

Chemical	Typical Packaging	Solid / Liquid	Estimated Volume	Expected Timeframe
Tetra Bromo Ethane	containers (150 kg)	Liquid	NA	Current and/or Near Future
Toluene	drums (210 *l)*	Liquid	NA	Current and/or Near Future
Tri Calcium Phosphate	bags (25 kg)	Solid	NA	Current and/or Near Future
Trichloroethylene	drums (210 *l)*	Liquid	NA	Near Future
Triethanolamine	drums (210 *l)*	Liquid	NA	Current and/or Near Future
Urea	bag (25 kg - bulk bags)	Solid	NA	Current
Washing Soda (Hydrated Soda Carbonate)	bags	Solid	NA	Current and/or Near Future
White Spirits HA (17%)	drums (210 *l)*	Liquid	NA	Current and/or Near Future
White Spirits LA (3.5%)	drums (210 *l)*	Liquid	NA	Current and/or Near Future
Xylene	polycans (25 *l)*, drums (210 *l)*	Liquid	NA	Current
Zinc Chloride	bags (25 kg)	Solid	NA	Current and/or Near Future
Zinc Nitrate	bags (25 kg)	Solid	NA	Current and/or Near Future
Zinc Oxide	bags (25 kg)	Solid	NA	Current and/or Near Future
Zinc Sulphate	bags (25 kg)	Solid	NA	Current and/or Near Future
Sulphuric acid – (not stored or handled on site. Road tanker is loaded at Rossing Acid Facility. Protea has the contract for transport of the product. Only enters site when going over weigh bridge before deliver to the customer)	road tankers	Liquid	Not Applicable	Current and/or Near Future