KAESO OIL FIELD SERVICES (Pty) Ltd

ENVIRONMENTAL IMPACT ASSESSMENT

PROPOSED NEW BULK STORAGE FACILITY FOR HAZADEOUS CHEMICALS PRODUCTS AT LÜDERITZ ERF 522

Proponent

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1 BACKGROUND, INTRODUCTION AND JUSTIFICATION

1.1 Background to the Development

An Environmental Impact Assessment (EIA) has been commissioned by KAESO OILFIELD SERVICES (PTY) LTD for the construction and operation of a storages for hazardous chemicals at erf 522 industrial area in Lüderitz.

KAESO OILFIELD SERVICES (PTY) LTD was established in Angola, and now its expanding to Namibia in Luderitz. The main business activity will involve providing bulk storage of Chemicals and drilling mud used in the petroleum exploration and production drilling offshore Namibia. Namibia at the moment is experiencing a high influx of exploration companies after recent discoveries in Orange basin. Hence a demand for offshore supply and logistics services is on demand. Hence, KAESO OILFIELD SERVICES (PTY) LTD sees this opportunity to provide a logistics of temporary handling and storage of chemicals in transit to the drilling rigs offshore Namibia, at the port of Lüderitz.

The construction, operational and decommissioning phases entail;

Construction Phase:

- Site preparation as required by geotechnical survey; Civil works required for chemical storage rooms;
- New buildings required for administration offices and security guard houses at gates;
- Construction of parking bays and driveways;
- Installation of associated electrical, water and sewerage utilities;

Operational Phase:

- Receiving of chemicals either by road or Lüderitz port facility (import);
- Storage and handling of hazardous chemical products in on-site warehouses;
- Loading of products to transportation by offshore vessels for delivery to the drilling rigs.

Decommissioning Phase:

Removal of all infrastructure not reused during future use
of land; and Rehabilitation of property.

1.1.1 Introduction

The project site (26°37'43.3"S; 15°10'16.0"E) is situated on Erven 522 (formerly in the industrial harbour area of Lüderitz. The site is currently surrounded by industrial land in all directions except the Atlantic Ocean to the west. See Figure 1 & Figure 2.

Centre for Geosciences Research cc, an independent consultant, was appointed to undertake the Environmental Impact Assessment of the proposed hazardous Chemical storage facility. This study is to enable decision makers to make informed decisions regarding the development from an environmental perspective. The environmental assessment was conducted to comply with Namibia's Environmental Assessment Policy and to the requirements of the Ministry of Mines and Energy.

1.1.2 Project Justification

KAESO OILFIELD SERVICES (PTY) LTD, and in particular its mother company in Angola have been in the logistics storage of chemicals used for offshore drilling activities for a number of years and are well versed in the business. The promotion of handling and storage of chemicals used for offshore petroleum drilling activities is an integral part of their business.

There is a need to have greater control over the offshore petroleum logistics supply support in Namibia. As the country has entered its infancy petroleum exploration, the need for offshore supply support in Namibia is essential. Currently, supply is dependent significantly on South African, Angola and over sees stockpiles to support the drilling activities ongoing in petroleum exploration.

The petroleum exploration and discovery in Namibia is growing and the need for offshore logistics supply support is gaining momentum.

There is currently a severe shortage of bulk offshore petroleum support logistics warehouses handling chemicals storage facilities in the SADC region. The establishment of the KAESO OILFIELD SERVICES (PTY) LTD chemical handling and storage facility for petroleum exploration will be one of the largest in Namibia. The chemicals will be transported to the storage site either via the road should it be received via Walvis Bay, or direct via the port of Luderitz. For offshore supply, the transportation will be via the port of Luderitz to the drill ships.

Additional to these motivations, environmentally speaking, the warehouse storage is temporary since the chemicals are stored for a specific client and constant shipped to the drill rig in batches.

In conclusion, the demand for offshore supply support to the current petroleum exploration activities in Namibia is rapidly advancing. In order to benefit from the current exploration activities in Namibia , there is need to encourage the auxiliary services to be sourced locally , since this may provides a direct benefit to the country in terms of employment, tax and skills transfer.

In terms of contribution to the GDP in a country that has been for so long dominated by metalliferous mining other than petroleum. This kind of growth in petroleum industry and evident fundamental shift in balance of economics has

inspired KAESO OILFIELD SERVICES (PTY) LTD to expand the line of business focusing especially on customers who require chemical handling and storage logistics support for offshore drilling in Namibia to make use of its facilities in Lüderitz. KAESO OILFIELD SERVICES (PTY) LTD will be able to meet its demand and increase client base through marketing campaign and customer awareness, as petroleum exploration activities increase.

1.2 Potential Direct Benefits:

- Direct capital investment;
- Stimulation of skills transfer: Due to the nature of their operations, KAESO OILFIELD SERVICES (PTY) LTD has no other option but to implement a training programme for all staff. Training programmes will be advanced and staff will permanently benefit from these training programmes. Many of the training programmes will be targeting specifically semi-skilled Namibian workers.
- Stimulation of economic development (e.g. supply and handling various offshore petroleum support base in Luderitz. Chemical handling and storage services, long term offshore support etc.).
- Security of handling and storage of chemicals: the new KAESO OILFIELD SERVICES (PTY) LTD hazardous chemicals at Luderitz, aims to avert risks associated with volatile international and regional offshore logistics support to companies involved in exploration and production activities. If Namibia's economic growth targets (Vision 2030) are to be met, then development of the petroleum industry must never be in short of its auxiliary support services, or compromised. It is therefore in national interest for the country to support a project of this nature as soon as possible. With this establishment at Luderitz, it is essential to note that Namibia is to secure the auxiliary offshore support to petroleum exploration and production chemical handling and storage storage for most of the current active petroleum exploration activities ongoing.
- Job creation: A number of 15 (fifteen) persons will be employed initially to get the warehousing and handling to the operational phase. Approximately 100 new jobs will be created for the long term. Some of the jobs will go to persons living in Lüderitz. Given the unemployment rate of 28% for the Karas Region some years back, this in itself is regarded as a significant benefit to the socio-economic situation in the region.

1.3 Potential Indirect Benefits:

More competitive conditions that could lower costs of chemical handling and storage;

- Expansion of trade and industrial activity in the town of Ludertz;
- Inducement of additional investments;
- Creation of new long-term employment opportunities at the chemical warehousing storage facility;
- General enhancement of the health conditions and quality of life in the town of Lüderitz.
- Of significance is the prospect of diversification of the Lüderitz economy, which is presentlymainly focused on fishing and port related industry.

2 SCOPE

The scope of the EIA is to determine the potential environmental impacts emanating from construction, operations and possible decommissioning of the proposed bulk hazardous chemical storage facility. Relevant environmental data is to be compiled by making use of secondary data, from reconnaissance site visits and from various meetings with stakeholders. Potential environmental impacts and associated social impacts will be identified and addressed in this report. A Risk Based Assessment is included in addition to the impact assessment and this is included in the EIA report. An Environmental Management Plan has been created and has been added to the Assessment Report.

The aims and objectives of this EIA report is to:

1. Provide sufficient information to determine whether the proposed project will result in significant adverse impacts;
2. Identify a range of management actions which could mitigate the potential adverse impacts to acceptable levels;
3. Comply with Namibia's Environmental Assessment Policy and Environmental Management and Assessment Act, and
4. Provide sufficient information to the Ministry of Environment & Tourism and Ministry of Mines and Energy to make an informed decision regarding the proposed development;
5. Present and incorporate comments made by Interested and Affected Parties during Public Participation meetings.

3 METHODOLOGY

The following methods were used to investigate the potential impacts on the social and natural environment due to the construction and operation of the bulk hazardous chemical storage facility:

1. Baseline information about the site and its surroundings was obtained from existing secondary information as well as from a reconnaissance site visit.
2. As part of the scoping process to determine potential environmental impacts, Interested and Affected Parties (I&APs) were consulted and their views, comments and opinions are put forward in this report.

Fig 1, Location Map for Proposed Kaeso Oil in Lüderitz

Fig 2 Location Map for Proposed Kaeso Oil in Lüderitz

4 ADMINISTRATIVE, LEGAL AND POLICY REQUIREMENTS

To protect the environment and achieve sustainable development, all projects, plans, programmes and policies (PPPPs) deemed to have adverse impacts on the environment require an EIA according to the Namibian legislation. The following legislation governs the EIA process in Namibia, pertaining to the proposed development. Additional legislation is listed which is required for bulk hazardous chemical storage, shipping and distribution in smaller batches. These pertain to the health and safety of the social and ecological aspects of our environment.

4.1 The Namibian Constitution

Article 95 of Namibia's constitution provides that:

"The State shall actively promote and maintain the welfare of the people by adopting, inter alia,policies aimed at the following:

(l) management of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future; in particular the Government shall provide measures against the dumping or recycling of foreign nuclear and toxic waste on Namibian territory."

This article recommends that a relatively high level of environmental protection is called for in respect of pollution control and waste management.

4.2 Environmental Management Act of Namibia (2007)

The Environmental Management Act of Namibia (2007) requires that all projects, policies, programmes, and plans that have detrimental effect on the environment must be accompanied by an EIA. The Environmental Assessment Procedure is depicted in Figure 3.

It further provides a guideline list of all activities requiring an impact assessment. The proposed development is listed as a project requiring an impact assessment as per the following points in thepolicy:

1. Transportation of hazardous substances & radioactive waste.
2. Storage facilities for chemical products.
3. Industrial installation for bulk storage of fuels.

The Act provides a broad definition to the term "*environment*" - 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. *NOTE*: this definition of "environment" was used throughout this report.

Cumulative impacts associated with proposed developments must be included as well as public consultation. The Act further requires all major industries and mines to prepare waste management plans and present these to the local authorities for approval.

Apart from the requirements of the Environmental Management Act, the following sustainability principles needs to be taken into consideration, particularly to achieve proper waste management and pollution control:

4.2.1 Cradle to Grave Responsibility

This principle provides that those who manufacture potentially harmful products should be liable for their safe production, use and disposal and that those who initiate potentially polluting activities should be liable for their commissioning, operation and decommissioning.

4.2.2 Precautionary Principle

There are numerous versions of the precautionary principle. At its simplest it provides that if there is any doubt about the effects of a potentially polluting activity, a cautious approach should be adopted.

4.2.3 The Polluter Pays Principle

A person who generates waste or causes pollution should, in theory, pay the full costs of its treatment or of the harm, which it causes to the environment.

4.2.4 Public Participation and Access to Information

In the context of environmental management, citizens should have access to information and the right to participate in decision-making.

4.3 Petroleum Products and Energy Act of Namibia (Act No. 13 of 1990)

The Act makes provision for impact assessment for new proposed fuel facilities and petroleum products known to have detrimental effects on the environment.

4.4 Pollution Control and Waste Management Bill (guideline only)

Of particular reference to the above, the stated project, Parts 2, 7 and 8 apply.

Part 2 provides that no person shall discharge or cause to be discharged any pollutant to the air from a process except under and in accordance with the provisions of an air pollution licence issued under section 23.

Part 2 also further provides for procedures to be followed in licence application, fees to be paid and required terms of conditions for air pollution licences.

Part 7 states that any person who sells, stores, transports or uses any hazardous substances or products containing hazardous substances shall notify the competent authority, in accordance with sub-section (2), of the presence and quantity of those substances.

The competent authority for the purposes of section 74 shall maintain a register of substances notified in accordance with that section and the register shall be maintained in accordance with the provisions.

Part 8 provides for emergency preparedness by the person handling hazardous substances, through emergency response plans.

4.5 Atmospheric Pollution Prevention Ordinance of Namibia (No. 11 of 1976)

Part 2 of the Ordinance governs the control of noxious or offensive gases. The Ordinance prohibits anyone from carrying on a scheduled process without a registration certificate in a controlled area. The registration certificate must be issued if it can be demonstrated that the best practical means are being adopted for preventing or reducing the escape into the atmosphere of noxious or offensive gases produced by the scheduled process.

4.6 Hazardous Substances Ordinance (No. 14 of 1974)

The Ordinance applies to the manufacture, sale, use, disposal and dumping of hazardous substances, as well as their import and export and is administered by the Minister of Health and Social Welfare. Its primary purpose is to prevent hazardous substances from causing injury, ill- health or the death of human beings.

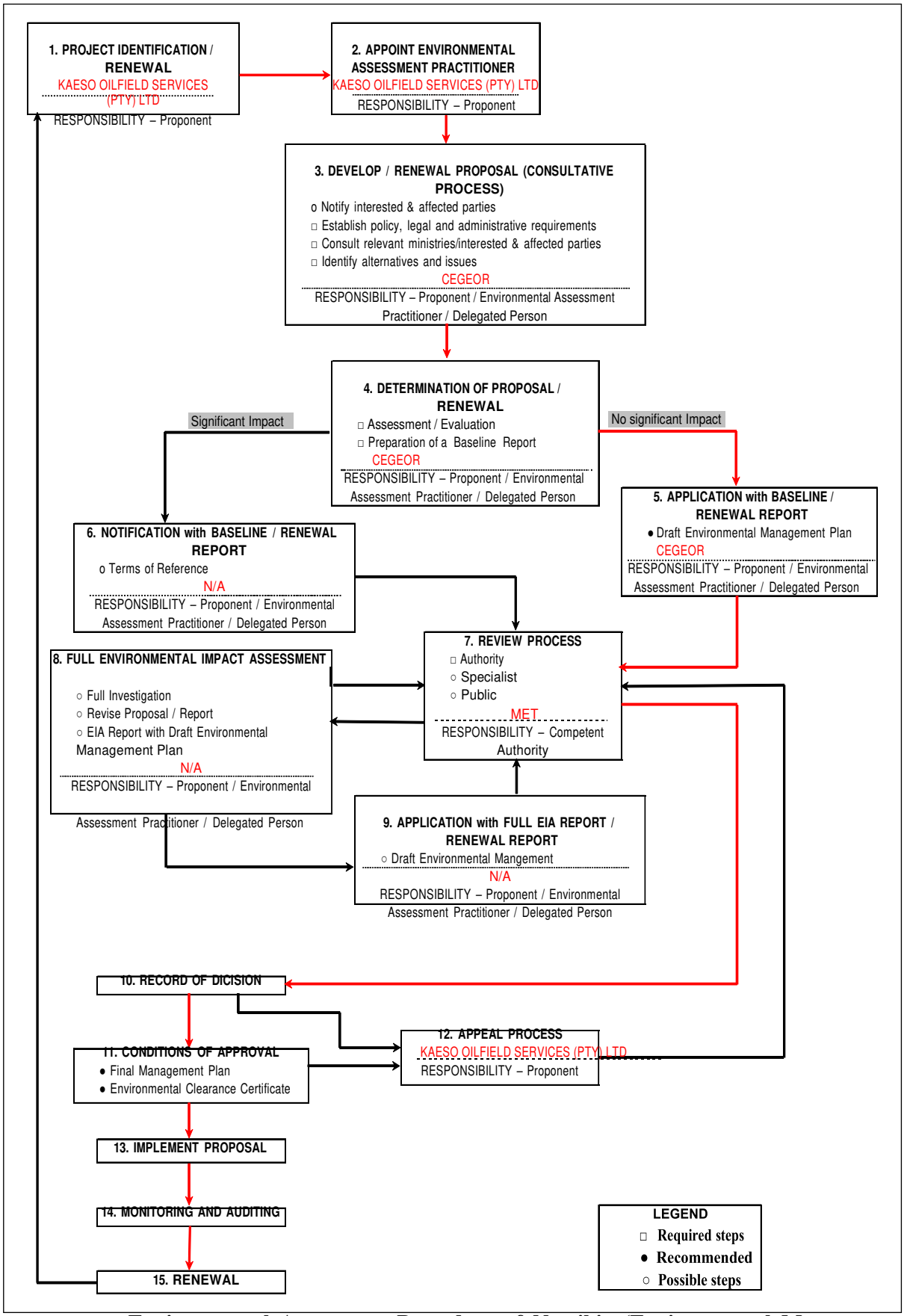

Figure 3. **Environmental Assessment Procedure of Namibia (Environmental Management Act of Namibia (2007))**

4.7 Namibian Ports Authority Act (Act No. 2 of 1994)

The Regulations promulgated under the Namibian Ports Authority Act (Act No. 2 of 1994) crucially codify the applicability of the International Maritime Dangerous Goods (IMDG) Code and numerous aspects of the International Safety Guide on Ships and in Terminals. The Namibian Port Regulations of 2001 (GN No. 117 of 2001) are relevant in so far as the regulations control the nature of and manner in which activities may be undertaken within any Namibian Port. The Regulations importantly stipulate that the handling of all dangerous goods in Namibian Portsmust be in accordance with the IMDG Code. The Regulations also comprehensively regulate howflammable liquid bulk cargoes must be managed within a Namibian Port. Refer to Appendix A.

4.8 Municipality of Lüderitz (Environmental By-laws, Guidelines and Regulations)

Environmental Impact Assessment procedure guidelines, Draft Structure Plans of the Municipalityof Lüderitz and the Integrated Environmental Policy of Lüderitz do not exist. It is assumed that any such Environmental guidelines and regulations are taken from the national Acts, policies and guidelines.

4.9 Relevant International Standards, Codes, Treaties, Guidelines andConventions for Chemicals

4.9.1 International Maritime Dangerous Goods Code (IMDG)(2006)

The handling of dangerous goods is stipulated in this document. The code regulates the transport of dangerous goods in packaged form across the sea. From the 1st January 2004, this code became mandatory, in terms of chapter 7 of the Safety of Life at Sea (SOLAS) Convention under the auspices of the International Maritime Organisation (IMO). Namibia ratified SOLAS on 27 February 2001. The IMDG code is revised and republished every two years, and is based on the recommendations published by the United Nations Committee of Experts on the Transport of Dangerous Goods. See Appendix A on page 51 for applicable details.

4.9.2 International Codes for the Carrying of Bulk Chemicals

Part 10 of the Namibian Port Authority Act Regulations extensively regulates how flammable liquid bulk cargoes are to be transported, handled and transferred in Namibian ports. Chemicals used in drilling fluids are listed in the IMDG Dangerous Goods List, inter alia:

Category E gases. (see part 7 of IMDG Code)
Gases that must be kept clear of living

organisms.

Various bulk liquids chemicals have associated hazards due to their inherent chemical properties. Many of these may have serious potential fire or corrosive hazards. Due to these inherent risks, together with the volumes of chemicals stored and handled, such bulk chemicals are generally supposed to be handled at purpose-built terminals, situated away from the main port facilities.

Internationally recognised guidelines and procedures for handling bulk chemicals are regulated by:

- International Safety Guide for Chemicals Tankers & Terminals
- Safety Guide for Terminals Handling Ships hazardous chemicals in Bulk

These International Codes are specifically intended to regulate the carrying of bulk chemicals with the objective of ensuring safety at sea and at terminals. Although these codes regulate extensively the manner in which chemicals must be carried and handled at terminals, the regulations outlined more fully in Appendix A on page 51 are particularly pertinent for the purposes of this assessment and should be incorporated into the EMP.

4.9.3 South African National Standards (SANS) and Codes of Practice

The South African National Standards (SANS) and Codes of Practice relating to all Hazardous Chemicals, that is also required by the Namibian Ministry of Mines and Energy. KAESO OILFIELD SERVICES (PTY) LTD has incorporated in its design of the proposed hazardous chemicals storage, the prevailing SANS standards. The SABS 0228" the Code of Practice for the Identification and Classification of Dangerous Substances and Goods, SABS 0228, published by the South African Bureau of Standards (SABS); on chemical storage facilities), The Emergency Response Guidebook (2008) must be read in conjunction with SABS 0228 (Emergency Response Guides for transporting dangerous goods). The latter references must be incorporated into the Emergency Response Plan that is required for the operational manuals. Additional relevant standards are referred to in Appendix A.

4.9.4 National Fire Protection Association Code 58 – USA

KAESO OILFIELD SERVICES (PTY) LTD has stated that this code holds priority with regards to safety and that all other safety measures will be subservient to the NFPA. This code is most widely used and

internationally acknowledged Hazardous Chemical Storage standard in the industry. The standard forms the backbone of many of the recognized International Standards operating throughout the world including South African National Standards of which Namibia prescribe to.

5 DEVELOPMENT AND RELATED ACTIVITIES

5.1 Proposed infrastructure for bulk hazardous chemical Storage Facility

The development will entail the construction of the chemical storage at Erf 522. Three (3) warehouse of 200m^2 each will be used to store the various type of Hazardous chemicals. The open air cemented storage slab area will cover an area of 2100m^2, see Figure 4 for a schematic site layout.

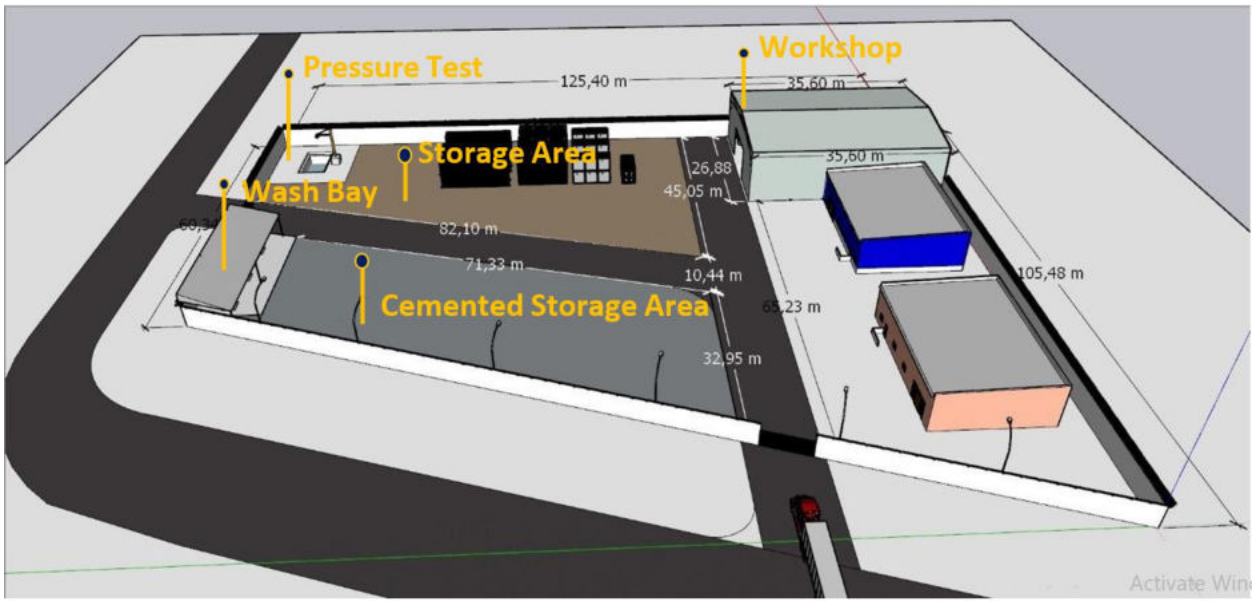

Figure 4, The layout of the buildings on efr 5222

The hazardous chemicals stored for clients include the following but not limited:

- Rheology modifiers
- Biocides
- Emulsifiers
- Lubricants
- Corrosion inhibitors
- Foamers
- Dispersants
- Clay controlling agents
- Bentonite modifiers

5.2 Proposed hazardous chemical Offloading Sites

The considered offloading of chemicals from the supply vessels, namely, along the existing main quay see Figure 4.

5.2.1 *Main Quay*

The depth of the harbour at Lüderitz for offload vessel is approximately 8m, which is sufficient for the chemical vessel to anchor and offload its cargo. Kaeso Oilfield Services (pty) Ltd have many years'experience in the field of chemical handling.

6 ENVIRONMENTAL CHARACTERISTICS

This section lists the most important environmental characteristics of the study area and provides a statement on the potential environmental impacts on each. The relevant national, regional and international regulations and standards for the hazadeous chemical Industry have been consulted for the baseline assessment and subsequent impact assessment to incorporate all required and pertinent issues in the investigation.

6.1 Locality and Surrounding Land Use

The project site (26°38'45"S; 15°09'28"E) is in the industrial area of Lüderitz. The site is currently surrounded by industrial land to the northeast and commercial and residential to the southeast. Theshape of the land portion is roughly triangular. on the western side of the harbour at the western end of Hafen Street.

6.2 Climate

Lüderitz is located along the southern part of the Namibian coastline along the arid Namib Desert. The arid conditions are a result of dry descending air and upwelling of the cold Benguela Current. Lüderitz is subject to occasional winter rainfall. (EEU 2000)

Namibia is situated within an anti-cyclone belt of the Southern Hemisphere. Winds generated from the high-pressure cell over the Atlantic Ocean blow from a southerly direction when they reach the Namibian coastline. As the Namibian interior is warm (particularly in summer), localised low-pressure systems are created which draws the cold southerly winds towards the inland desert areas. These winds manifest themselves in the form of strong prevailing southwesterly winds, which range from an average of 6m/s during winter months to as high as 18m/s during the summer. Winds near Lüderitz display two main trends; high velocity andfrequency south to south-southeasterly winds in summer and high velocity, low frequency east to northeasterly winds during winter. During winter, the east winds generated over the hot Namib Desert have a strong effect on temperature, resulting in temperature in the upper 30's degrees Celsius and tend to transport plenty of sand (EEU 2000).

Thick fog or low stratus clouds are a regular occurrence in Lüderitz. This is due to the influence ofthe Benguela Current and forms the major source of water for the succulent and lichen flora in the Namib Desert. A summary of wind speed and direction for Lüderitz is given in Figures 5 & 6.

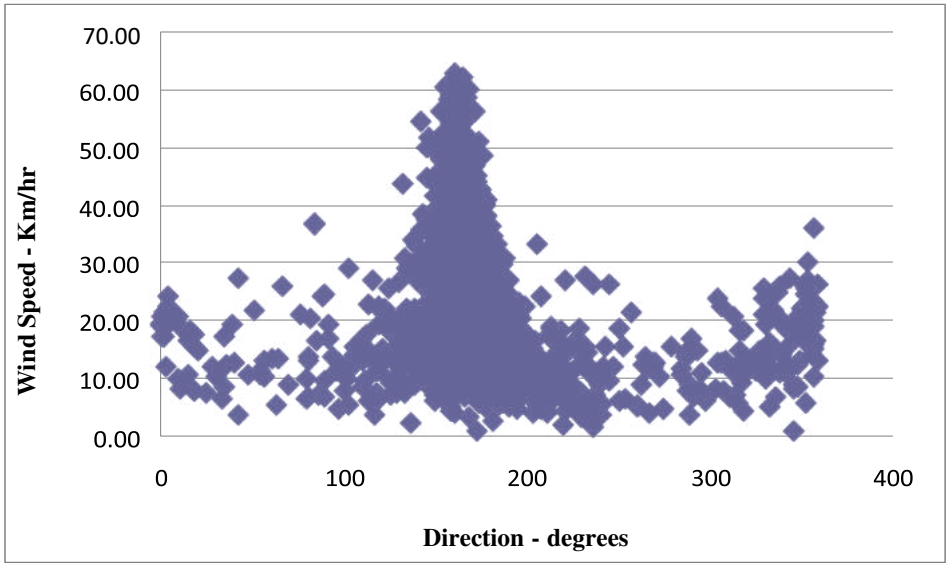

Figure 5. Wind Direction versus Wind Speed (QuikSTAT)

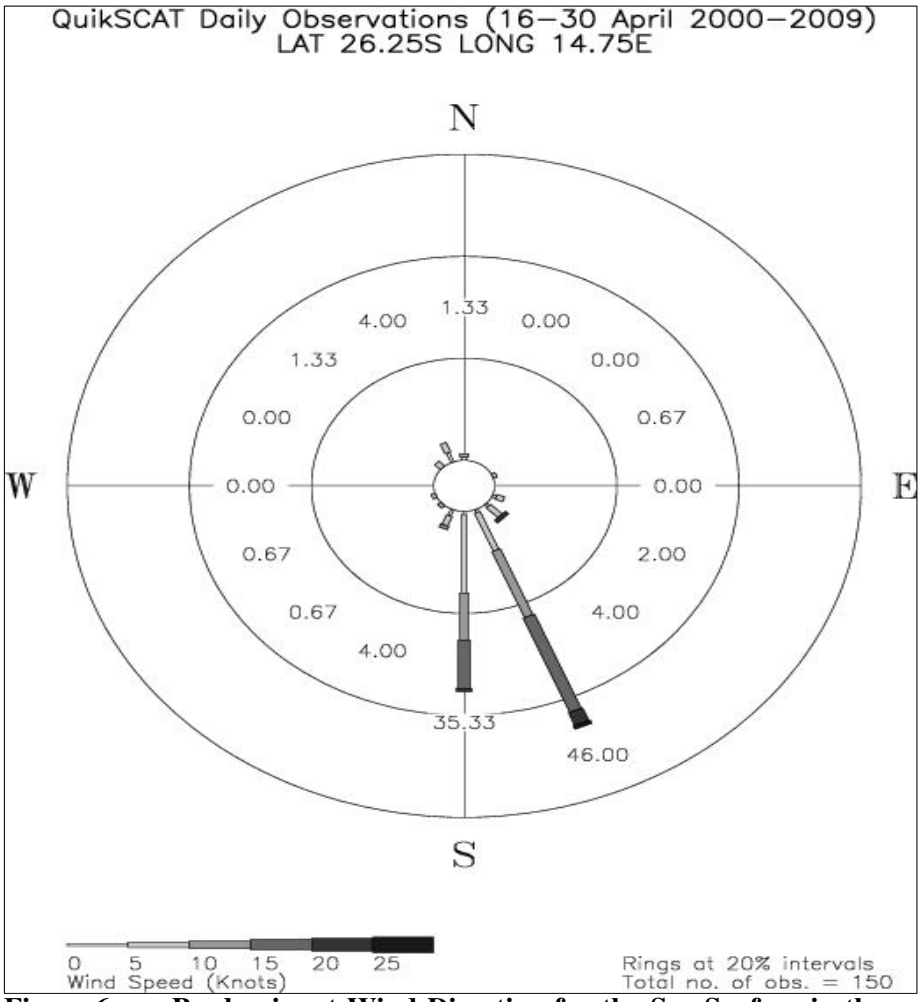

Figure 6. Predominant Wind Direction for the Sea Surface in the area NW of Lüderitz from 2000 to 2009 for the 2nd half of April (QuikSTAT)

Table 1. Summary of Climate Data

Average annual rainfall (mm/a)	0-50
Variation in annual rainfall (%)	80-90
Average annual evaporation (mm/a)	2400-2600
Water deficit (mm/a)	1701-1900
Average annual temperatures (°C)	<16

6.3 Corrosion Environment

Lüderitz is located in a very corrosive environment, which may be attributed to the frequent salt- laden fog, periodic winds and abundance of aggressive salts (dominantly Sodium Chloride (NaCl) and sulphates) in the soil. The periodic release of hydrogen sulphide (H_2S) from the ocean is expected to contribute to corrosion.

The combination of high moisture and salt content of the surface soil can lead to rapid deterioration of subsurface metal and concrete structures. Chemical weathering of concrete structures due to the abundant salts in the soil is a concern.

Consulting with KAESO OILFIELD SERVICES (PTY) LTD the following points make it clear that these impacts will be minimized.

- Metal structures will be covered with a non-corrosive substance.
- distance between concrete to be reinforced to prevent corrosion

6.4 Topography and Surface Water

The landscape is classified as being in the Namib plain, an area with sand-rifts and prominent inselbergs. No noteworthy river is present within a kilometre from the site. Local drainage takes place to the west and northwest towards the only surface water body, the Atlantic Ocean. The Atlantic Ocean (lagoon and harbour) is the only surface water body near the site, with thesewerage ponds and its outflow lake as an artificial water body, located 5km northeast. The topography of the site is generally flat with a local gentle slope in a westerly direction (towards thelagoon)

6.5 Geology and Hydrogeology

The site generally has a relative thin soil/stone cover (10 to 20cm) which was brought in from another area to cover the existing ground. The sand and stone surface was laid down between 2003and 2004 before which oil drums were stored in the area. The true depth of the multiple soil layers is unknown. A baseline analysis must be done prior to construction to know exact conditions ofthe subsurface materials.

Subsurface geology consists of the Namaqua Metamorphic Complex. The Namaqua Metamorphic Complex here consists mainly of pre- to syntectonic biotite-rich augen gneiss. Groundwater flow would be mostly along fractures, faults (secondary porosity) and other geological structurespresent within the formations as well as through primary porosity in the unconsolidated top cover. No potable groundwater source is known of in the vicinity of the site. Groundwater is expected to be saline and originating from the Atlantic Ocean. There are no known boreholes within a 5km radius of the site. This area does not fall within

a Water Control Area.

6.6 Lüderitz's Water Supply

Lüderitz derives all of its water from the Namwater water supply scheme Koichab, approximately 100km east of Lüderitz. The Koichab water supply scheme consists of about 10 production boreholes, supplying groundwater from the alluvial of an old paleo-channel. Future groundwater development will focus mainly around the existing infrastructure at the Koichab water supply scheme, as it is considered to be the only known source with a sustainable yield of potable water.

6.7 Fauna and Flora

The proposed site is located within an urban set-up where the ground was backfilled during previous land use activities. The habitat for fauna is therefore fragmented and is expected to degrade consequently. There is little indigenous fauna or flora present at the site. The project area is located within the Succulent Karoo biome, with Succulent steppe type vegetation. The vegetation structure type is classified as dwarf shrub land, with a medium diversity of higher plants. The site itself has no vegetation, save for a number of invasive plants along the periphery. No terrestrial wildlife apart from birds has been observed along the shoreline of the study area. Oystercatchers were observed along the shoreline during a site visit on the 10th October 2022.

In light of the facts about the area's fauna summarised in Appendix B, there is a tremendous opportunity for KAESO OILFIELD SERVICES (PTY) LTD to give impetus to the conservation efforts of the organisations working in the area around Lüderitz. This can be done through assisting these organisations financially thereby bringing greater awareness of their efforts and helping them especially in the realm of research and education.

Fig 7, showing vegetation cover over the Erf 522

Table 2 and **Table 3** below indicate the fauna and flora found in the biome in which Lüderitz is situated. It is unlikely that many of the species listed for this Biome occur in the vicinity of the proposed hazardous chemical storage facility.

Table 2. General Flora Data (Atlas of Namibia)

Biome	Succulent Karoo
Vegetation type	Succulent steppe
Vegetation structure type	Dwarf shrubland
Diversity of higher plants highest	Medium (Diversity rank = 4 [1 to 7 representing to lowest diversity])
Number of plant species	150 - 300
Percentage tree cover	<0.1
Tree height (m)	2-5
Percentage shrub cover	<0.1
Shrub height (m)	1-2
Percentage dwarf shrub cover	0.1-1
Dwarf shrub height (m)	<0.5
Percentage grass cover	<0.1
Grass height (m)	<0.5
Dominant plant species 1	Zygophyllum decumbens
Dominant plant species 2	Rhigozum trichotomum

Table 4. General Fauna Data (Atlas of Namibia)

Mammal Diversity	16 - 30 Species
Rodent Diversity	4 - 7 Species
Bird Diversity	51 - 80 Species
Reptile Diversity	31 - 40 Species
Snake Diversity	15 - 19 Species
Lizard Diversity	24 - 27 Species
Frog Diversity	1 - 3 Species
Termite Diversity	1 - 6 Genera
Scorpion Diversity	6 - 9 Species

6.8 Socio-Economic Status Quo

This section provides an overview of socio-economic characteristics of the study area. It provides regional and local information on the, economic activities, population dynamics, vulnerability, andsocial services currently available in the area.

6.8.1 Regional Context

The proposed hazardous chemicals storage facility is situated in the Karas Region of Namibia for which the total population of 2011 is estimated to be 77,421 (39 407males and 38 014 females) (NPC 2012. 92.6% (NIDS 2011) of the population of the Karas Region over 15years of age is literate[1] while the estimated unemployment rate is 32%.

The Karas Region is an average urbanised area for Namibia – the 2011 Census shows that 54% of its population live in urban areas. People are mostly settled at the coastal towns of Lüderitz and Oranjemund, and the inland town of Keetmanshoop. This is presumably due to the employment opportunities found there. Other smaller towns exist to either serve thefarming or mining in the region.

6.8.2 Local Context

Economic Activities

Lüderitz, the principal port of the Karas Region, and second in Namibia, is an import/export facility for processed fish, bait, mining products and fuel. Mining products exports are on the rise with the present growth in the zinc industry.

The area is linked to Namibia's air and road network, making its port well situated to service Zambia, Zimbabwe, Botswana, Southern Angola and South Africa. The rail network link has been revamped and fully operational.

The fishing industry is a major employer of low skilled workers on a permanent and seasonal basis. The total employment of this sector in Lüderitz compared to the total Namibian workforce is not known currently.

[1] The census considers this figure to be overestimated because no literacy tests were administered

The major constraints of industrial development are the lack of sufficient water supply, thelack of a large enough local market and the excessive focus on the fishing industry. Most industries that exist at the coast are either secondary or tertiary suppliers to the fishingindustry. More recently the mining industry is using the harbour to export zinc.

Industrial activities in Lüderitz are linked to port-related activities. More and more demand is,and will be, generated to obtain industrial and commercial land in close proximity to the port (as is the general nature of harbour towns). Most industries that are dependent on the port- related activities need to limit operational costs by being located as close as possible to the port itself. KAESO OILFIELD SERVICES (PTY) LTD is no exception. However, the safety of the transfer of hazardous Chemicals to the storage facility warrants the close proximity to the habour.

Tourism has become a more recent point of focus and much has been done to drive this sector of the economy. It is debatable whether this focus has brought much to the Town in terms of contributing greatly to its economic development.

Demographics

The current data available for Lüdertiz as the census of 2011 published estimated population of the town for 2011 as 12,537 people.

6.8.3 Employment Creation Structure for Karas Region and Further a Field

KAESO OILFIELD SERVICES (PTY) LTD with help of is a main company KAESO ENERGY SERVICES in Angola handle , store and distribute the chemicals to its clients offshore during the drilling activities. Hence, establishment of Lüderitz Chemicals storage will create more than 50 jobs in the at its peak operations.

6.8.4 **Table 5.** KAESO OILFIELDS SEVICES proposed employment structures

POSITION	NUMBER OF PERSONEL
Board of Directors	6
Managing Director	1
General Manager	1
Operation Managing	1
Logistic Manager	1
Finance Manager	1
Health and Safety Manager & Assistant	1
Accountant	1
Ware house Manager and Assistants	2
Labour	2
Driver and delivery driver	2
Dispatch Officers	1
Security	2
Receptionist	1
Cleaners	2

6.8.5 Livelihoods

Economic activities in Karas Region are limited and livelihoods are heavily dependent on the fishing, farming and mining industry. The livelihoods of the local community are likely to be positively impacted therefore predicted to be better than before KAESO OILFIELD SERVICES (PTY) LTDcommences its operation in that area.

6.8.6 Procurement

Local businesses are to benefit from the envisaged construction and operational activities. KAESO OILFIELD SERVICES (PTY) LTDand/or its sub-contractors might need to procure services from these businesses e.g. cleaning services, security services, domestic waste removal etc.

6.8.7 Tourism

Lüderitz attracts a number of Tourists from all over the world. The tourist attractions to Lüderitz are mainly the Kolmanskop Ghost Town, rich biodiversity (particularly the bird life and specialised plant life) and the port. Tourism activities do contribute to the livelihoods of people but to what extent is unsure.

Excessive waste, dust, noise and vibrations can have negative impacts on the tourism industry in the area, as it can become a nuisance to tourists. Mitigation measures will be put in place to reduce these impacts.

6.8.8 In - Migration

Due to enhanced employment opportunities that could be created by the envisaged project, some in-migration of job seekers to Lüderitz can be expected. Depending on the amount of in-migration, local areas may start experiencing overcrowding, over use of infrastructure, local ethnical conflicts, increase of goods prices due to increased demand etc. KAESO OILFIELD SERVICES (PTY) LTDis committed to giving jobs to as many local people as is possible and is willing to commit to training programs to meet the demand for competent and skilled staff. This will hopefully reduce the urbanisation, which so often expected from increased development in urban areas.

6.8.9 HIV & Prostitution

Namibia has a high incidence of HIV/AIDS, which has a strong and adverse socio-economic impact on livelihoods of people. The HIV prevalence rate for the age group 15 to 24 is estimated at 5.8% for females and 2.3% for males for Namibia (The Human Development Report 2011).

The spending power of locals and expatriates working for KAESO OILFIELD SERVICES (PTY) LTD and/or itscontractors are likely to increase, and this might be a perfect opportunity for sex workers to explore. Migrant labourers from other regions and expatriates are normally vulnerable andmay use the services rendered by the sex workers.

6.8.10 Infrastructure & Increased Traffic

The traffic in the area is expected to increase and it might lead to heavy traffic during peak hours and a higher number of car accidents, see Figure 8. Pedestrians in that area may not be used to heavy traffic, and accidents may occur. Infrastructure like roads will be affected due to increased traffic. It is expected that the increase in traffic during the operational phase would mainly be road cargo carriers in case the chemicals are received via Walvis bay and a few small vehicles due to the added employment created in the area. KAESO OILFIELD SERVICES (PTY) LTD (PTY) LTD ' ultimategoal is to distribute to its clients via smaller vessels to the offshore drilling rigs via the port of Lüderitz. No alternate route out of the town exists. The road that bypasses the CBD is a dirt road and this poses a problem for regulations for tankers transporting hazardous chemicals goods as they may not use dirt roads.

7 STAKEHOLDER CONSULTATION

Consultation with the public forms an integral component of an EIA investigation and enables I&Aps *e.g.* neighbouring landowners, local authorities, environmental groups, civic associations and communities, to comment on the potential environmental impacts associated with the proposed development and to identify additional issues which they feel should be addressed in the EIA.

The public participation notices for the public meeting was advertised twice in the national papers:The Namibian as well as in Confidente weekly newspaper (prior to the meeting). The Town Council as the main administrator of the town was invited via email.

The meeting was held at the Benguela Community Hall, in Lüderitz at 10:00am to 12:30pm, on 10th October 2022, Monday. Views, comments and opinions expressed by I&APs were noted and incorporated into this report. A list of stakeholders and I&APs who attended the meetings is also presented. (attached Public meeting report in appendix D).

8 ASSESSMENT OF IMPACTS

The purpose of this section is to assess and identify the most pertinent environmental impacts and provides possible mitigation measures that are expected from the construction, operational and decommissioning activities of the fuel facilities. The following summarise some impacts identified, following the site reconnaissance visits and from comments received from I&APs.

- Surface water contamination
- Soil and ground water contamination
- Destruction of flora and displacement of fauna
- Visual impact
- Noise impacts
- Traffic impacts
- Impacts on air quality
- Economic impacts
- Cumulative impacts
- Health & Safety impacts
- Security impacts
- Heritage impacts

These identified impacts will be assessed and evaluated in different phases of the development. Mitigation measures are also proposed for different impacts. There are specific policies and guidelines that address environmental issues associated with the construction, operation and decommissioning of tanks and pumps for hazardous chemical storage facilities. The policies and guidelines were referred to in the legal section and Appendix A, C & D.

The following assessment methodology (Table 6) will be used to examine each impact identified.

Table 6. Criteria for Impact Evaluation (DEAT 2006)

Criteria	Description
Nature	Reviews the type of effect that the proposed activity will have on the relevant component of the environment and includes what will be affected and how?
Extent	Indicates whether the impact will be Site specific; Local (Lüderitz); Regional (limited to ~100 km radius around the site); National (limited to within the borders of Namibia); or International (extending beyond Namibia's borders).
Duration	Reviews the lifetime of the impact, as being Short (days, <1 month), Medium (months, <1 year), Long (years, <10 years), or Permanent (generations, or >10 years).
Intensity	Establishes whether the magnitude of the impact is destructive or innocuous and whether or not it exceeds set standards, and is described as **None** (no impact); **Low** (where natural/ social environmental functions and processes are negligibly affected); **Medium** (where the environment continues to function but in a noticeably modified manner); or **High** (where environmental functions and processes are altered such that they temporarily or permanently cease and/or exceed legal standards/requirements).
Probability	Considers the likelihood of the impact occurring and is described as Improbable (low likelihood), Probable (distinct possibility), Highly probable (most likely) or Definite (impact will occur regardless of prevention measures).
Significance	**Low** (where natural, cultural and social and economic functions and processes are not affected). In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means of achieving this benefit are likely to be easier, cheaper, more effective and less time-consuming; **Medium** (where the affected environment is altered but natural, cultural and social functions and processes can continue); **High** (where the affected environment is altered to the extent that natural, cultural, social and economic functions and processes will temporarily or permanently cease). In the case of adverse impacts, there is no possible mitigation that could offset the impact, or mitigation is difficult, expensive, time consuming or a combination of these. In the case of beneficial impacts, the impact is of a Substantial order within the bounds of impacts that could occur.
Degree of Confidence in	Is based on the availability of specialist knowledge and other information.

8.1 General Socio-economic Impact Evaluation

There are a few concerns that could reduce or counteract the benefits related to the project, asfollows:

- Increased spread of HIV/AIDS particularly during construction.
- Increased influx to Lüderitz as people come to search for job opportunities during construction and operation.
- Reduced property values.
- Increased informal settlement and associated problems.

In order to harness the benefits and curb the potential problems for the Lüderitz community andthe Region, the following are recommended:

Devise a project-specific recruitment policy for the construction and operation phases of theProject, which includes the following principles:

KAESO OILFIELD SERVICES (PTY) LTD will give preference first to people of Lüderitz, then to people from thesub-region, then to people from the Region.

- Preference to be given to people with families established in the area.
- Otherwise the company will assist families to relocate to Lüderitz if necessary.
- The practice of single men and women working at the site, but families residing elsewhere should be discouraged.
- Employees to be encouraged to live a life free of alcohol & drug abuse, violence and sexual immorality. HIV/AIDS awareness raising and counselling to be provided.
- The above principles should be prescribed for all contractors and sub-contractors involved and implemented during operation. All contractors should submit details of how these issues are addressed.

Tables 7 to 14 address these socio economic impacts, which are expected to have varying influences during the construction and operational phases of the development.

Table 7. Socio-Economic Impact - Skills, Technology & Development

Impact	Enhanced skills transfer and technology transfer to Namibia and subsequent promotion of economic development
Nature	People need skills to perform their jobs. The technology to do something is often not found in Namibia. Development of people and technology are key to economic development
Type of impact	**Positive**
Extent	**Local** (Skills upliftment limited to developing Lüderitz); National (Technology to benefit whole country in the long term)
Duration	**Long** (<10 years)
Intensity	**Low** (where natural/ social environmental functions and processes are negligibly affected);
Probability	Probable skills and technology transfer (distinct possibility); Economic development is highly probable (most likely)

Table 8. Socio-Economic Impact - HIV / AIDS, In-migration, Informal Settlements & Property Prices

Impact	Increased spread of HIV/ AIDS; Increased influx to Lüderitz; Increased informal settlement and associated problems; Reduced property values
Nature	New Developments attract people to the town who seek work. This in turn can increase the extent of informal settlements and its associated problems. The increased trucking and distribution of goods from Lüderitz could contribute to the spread of HIV / AIDS. It is possible that these can affect property prices in the area depending on the residential site.
Type of impact	**Negative**
Extent	HIV / AIDS and In-migration into Lüderitz affects the whole Nation. The growing informal settlement affects the local community. Reduced property prices affects individual properties and is site specific.
Duration	All of these aspects have a long (<10 years) term impact
Intensity	**Medium** (where the environment continues to function but in a noticeably modified manner) for all aspects save for the informal settlement which would be **Low** (where natural/ social environmental functions and processes are negligibly affected);
Probability	**Probable** (distinct possibility),
Significance without mitigation	**Medium** (where the affected environment is altered but natural, cultural and social functions and processes can continue);
Mitigation	The implementation of an educational program on HIV / AIDS for all the staff of KAESO OILFIELD SERVICES (PTY) LTDin particular the truck drivers is imperative. Restricted employment for Lüderitz dwellers only should be practiced. Deviations from this practice should be justified appropriately. Training of local people should be considered from the start. These measures will reduce the influx of newcomers to the town and thereby reduce growth in the informal settlement and maintain property prices.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

Table 9. Socio-Economic Impacts – Employment

Impact	Employment & industrialisation
Nature	The proposed development hopes to become the hub. The proposed development promises employment to inhabitants of Lüderitz.
Type of impact	**Positive**
Extent	Employment is promised to local inhabitants; A secure supply of fuel for National, International (extending beyond Namibia's borders) needs.
Duration	The company is planning for the long (years, <10 years) term if not permanently as per the longevity of the petroleum exploration activities.
Intensity	**Medium** (where the environment continues to function but in a noticeably modified manner). In a positive sense, development will improve the quality of life of the people benefiting directly (employees) and indirectly (end users)
Probability	A definite security of fuel supply will ensue. Employment is highly probable if the project goes ahead.

8.2 Construction Phase

Potential impacts on the environment and their mitigation measures during construction of the hazardous chemical storage facility are found in tables 16 to 25.

Table 10. Construction Phase Impact - Traffic Pollution

Impact	**Construction Phase Impact – Traffic Pollution**
Nature	The site is located within the Harbour & Industrial area. Construction related activities are expected to have some impact on the movement of traffic into the construction area and where the pipeline is being laid
Type of impact	**Negative**
Extent	Site specific.
Duration	**Medium** (months, <1 year)
Intensity	**Medium** (where the environment continues to function but in a noticeably modified manner)
Probability	Considers the likelihood of the impact occurring and is described as: Definite (impact will occur regardless of prevention measures)
Significance without mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Mitigation	Heavy construction vehicles are to frequent the site when offloading construction materials or the storage tanks. The responsible contractor must liaise with the relevant traffic department to ensure that traffic flow along the affected route is not disrupted. Speed reduction along Street mustbe enforced, especially near access point to premises along the road. A narrow entrance to the building site exists. Barricading of roadways, paths and open areas that are normally used by vehicles and pedestrians might be needed on a temporary basis when the pipeline is being laid, particularly when it must pass under the road towardsthe storage facility site.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

Table 11. Construction Phase Impact – Health, Safety & Security

Impact	**Health, Safety and Security**
Nature	During construction, earthmoving equipment will be used on site and where the pipeline will be laid. This increases the possibility of injuries and the responsible contractor must ensure that all staff members are briefed about the potential risks of injuries on site.
Type of impact	**Negative**
Extent	**Site specific**
Duration	**Medium** (months, <1 year)
Intensity	**Medium** (where the environment continues to function but in a noticeably modified manner)
Probability	Considers the likelihood of the impact occurring and is described as: Probable (distinct possibility)
Significance without	**Medium** (where the affected environment is altered but natural, cultural and social functions and processes can continue);
mitigation Mitigation	The contractor must be advised to ensure that adequate emergency facilities, including first aid kits, are available on site. All Health and Safety standards specified in the Labour Act should be complied with. Should a construction camp be necessary, it should be located in such a way that it does not pose a risk to the public. For safety and security reasons it is recommended that the entire site be fenced-off and security personnel be employed to safeguard the premises and avert criminal activities.The Contractor should be obliged to adhere to the following: ♦ Adhere to Health and Safety Regulations pertaining to personal protective clothing, first aid kits being available on site, warning signs, etc.; ♦ In consultation with the Lüderitz Traffic Department devise and submit a traffic management programme for sections of the roads to be closed or traffic diverted if necessary during the construction of the pipeline; ♦ Employ security personnel to prevent the unauthorised entry of the construction site; and ♦ Equipment that will be locked away on site (camp) must be placed in a way that does not encourage criminal activities.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	Established norms for safe and secure work practice have proven to be very effective.

Table 12. Construction Phase Impact - Dust Pollution

Impact	**Dust Pollution**
Nature	Dust will be generated during the construction phase and might be aggravated during periods of strong winds. This occurs regularly in Lüderitz
Type of impact	**Negative**
Extent	**Site specific** - will most probably pose a nuisance to personnel related to the construction of the facility and to neighbouring properties.
Duration	**Medium** (months, <1 year)
Intensity	**Low** (where natural/ social environmental functions and processes are negligibly affected);
Probability	Considers the likelihood of the impact occurring and is described as: Highly probable (most likely)
Significance without mitigation	**Medium** (where the affected environment is altered but natural, cultural and social functions and processes can continue);
Mitigation Significance	It is recommended that regular dust suppression be included in the construction phase, when dust becomes an issue.
after mitigation Degree of	**Low** (where natural, cultural and social and economic functions and processes are not affected).
confidence in predictions	**High**

Table 13. Construction Phase Impact - Noise Pollution

Impact	**Noise Pollution**
Nature	Noise pollution will exist due to heavy vehicles accessing the site with building materials. Cranes may be erected for placing the huge storage tanks into place. Cement mixing, drilling and a little excavating will be some additional activities.
Type of impact	**Negative**
Extent	**Site specific** – Construction activities will be restricted to the site and the path along which the pipeline will be laid. The pipeline to the quay could disturb other harbour activities.
Duration	**Medium** (months, <1 year)
Intensity	**Low** (where natural/ social environmental functions and processes are negligibly affected) – for onsite construction **Medium** (where the environment continues to function but in a noticeably modified manner) – for pipeline due to proximity to public in harbour area
Probability	Considers the likelihood of the impact occurring and is described as: Definite
Significance without mitigation	**Medium** (where the affected environment is altered but natural, cultural and social functions and processes can continue)
Mitigation	It is recommended that the construction and traffic be limited to normal working hours (08h00 to 17h00) and that weekends should rather be avoided. On site construction during these office hours; Pipeline might need to be laid during non-office times if it disturbs office time activities.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected). In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both.
Degree of confidence in predictions	**High**

Table 14. Construction Phase Impact - Waste Production

Impact	**Waste Production**
Nature	The ability of products and building rubble to act as a waste which must be cleaned up or removed off-site
Type of impact	**Negative**
Extent	**Site specific**
Duration	**Medium** (months, <1 year),
Intensity	**Low** (where natural/ social environmental functions and processes are negligibly affected)
Probability	**Definite** (impact will occur regardless of prevention measures).
Significance without mitigation	**Medium** (where the affected environment is altered but natural, cultural and social functions and processes can continue);
Mitigation	The facility will produce waste during construction in the form of building rubble or any other waste as a result of spillage or leakage from cleaning and painting materials. Due to the nature of some hazardous materials they should be disposed of in an appropriate way at the Town Councils official dump site. See the Material Safety Data Sheets available from suppliers if the user is not sure how to dispose of the substance.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

Table 15. Construction Phase Impact - Groundwater / Surface Water Contamination

Impact	**Groundwater / Surface Water Contamination**
Nature	Porous surface substrate can allow unwanted hazardous and ecologically detrimental substances to seep down to the water table, which in this case is seawater. The surface substrate is a topping of mixed sand and small stones. Bedrock close to the sea level appears to have been artificially covered by ground fill.
	Type of impact Negative
Extent	**Local** (limited to Lüderitz Bay Harbour)
Duration	**Long** (years, <10 years)
Intensity	**Medium** (where the environment continues to function but in a noticeably modified manner)
Probability	Considers the likelihood of the impact occurring and is described as: Probable (distinct possibility)
Significance without mitigation	**Medium** (where the affected environment is altered but natural, cultural and social functions and processes can continue)
Mitigation	The close proximity to the marine ecosystem dictates that all precautions are to be taken to prevent contamination of the soil as this could enter the ecosystem. Leakages from construction 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 (i.e. the sea) and may create an impact on underground utilities (i.e. fresh water supply to buildings, sewerage system). Pollutants in the soil and buildingrubble must be transported away from the site to the approved, appropriately classified waste disposal site in Lüderitz.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

Table 16. Construction Phase Impact: Heritage Impact

Impact	**Heritage Impact**
Nature	Buildings and other sites of significance for historical purposes must be reviewed for their age and uniqueness so that the construction of the proposed facility has no impact on such heritage sites.
Type of impact	**Negative**
Extent	**Site specific**
Duration	**Medium** (months, <1 year)
Intensity	**Low** (where natural/ social environmental functions and processes are negligibly affected).
Probability	Considers the likelihood of the impact occurring and is described as Improbable (low likelihood).
Significance without mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Mitigation	A building of unknown age is located at the entrance of the site might be the only building of concern. The narrow passage on to the site might pose a problem for the storage tanks that might be delivered by road to the site. Care must be taken not to damage the building.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

Table 17. Construction Phase Impact - Ecological Impact

Impact	Ecological Impact
Nature	The site was previously developed, thus no conservation worthy vegetation is situated at the proposed facility location. Limited impact on the flora can be expected, as no vegetation will be removed for the construction of the facilities. A few sea birds can be expected along the rocky coastline along the
	western boundary.
Type of impact	Negative Site specific
Extent	**Medium** (months, <1 year).
Duration Intensity	**Low** (where natural/ social environmental functions and processes are negligibly affected)
Probability	Considers the likelihood of the impact occurring and is described as Improbable (low likelihood).
Significance without	**Low** (where natural, cultural and social and economic functions and processes are not affected).
mitigation Mitigation	A security boundary fence which is planned for the whole site will on the western boundary reduce the impact that the construction activities and workers will have on the tidal zone along the site's boundary. Oyster catchers were observed on the coastal rocks during the site visit.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

Table 18. Construction Phase Impact - Visual Impact

Impact	Visual Impact
Nature	This is an impact that affects the aesthetic appearance
Type of impact	**Negative**
Extent	Site specific and along path of pipeline
Duration	**Medium** (months, <1 year),
Intensity	**Low** (where natural/ social environmental functions and processes are negligibly affected).
Probability	Considers the likelihood of the impact occurring and is described as: Definite (impact will occur regardless of prevention measures).
Significance without mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected). In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means of achieving this benefit are likely to be easier, cheaper,more effective and less time-consuming.
Mitigation	Visual impact could pose one of the most significant impacts. Visual impacts could be limited through keeping all construction areas clean and orderly at all times. Good housekeeping also reduces the risk of injuries.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

Table 19. Construction Phase Impact - Cumulative Impact

Impact	Cumulative Impact
Nature	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.
Type of impact	**Negative**
Extent	**Site specific**
Duration	**Medium** (months, <1 year)
Intensity	**Medium** (where the environment continues to function but in a noticeably modified manner).
Probability	**Definite** (impact will occur regardless of prevention measures).
Significance without mitigation	**Medium** (where the affected environment is altered but natural, cultural and social functions and processes can continue).
Mitigation	Possible cumulative impacts associated with the construction phase include increase in traffic frequenting the site and along the Street. Therefore anincrease in emissions from these vehicles will be experienced, decreasing the air quality around the proposed establishment and along the Street.Wear and tear on the Street, coupled with increased risk of road traffic incidences. These impacts will however be short lived.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

As depicted in the tables above, impacts are expected to be low to medium, mostly short livedand site specific. An Environmental Management Plan (EMP) will ensure that the impacts of the construction work is minimised and includes measures to reduce the identified impacts during construction of the facilities while ensuring that vehicular and pedestrian traffic are suitably protected to avoid accidents and injuries. It is further advised that traffic signs (and barricades if necessary) be installed along feeders gravel Street to ensure public safety. All surfaces should be fully reinstated and stabilized after the installations of the storage tanks. It should also be noted that paving activity associated with the construction, may increase surface water flow during the rainyseasons and may cause localised flooding around the site. To avoid the risk of flooding, storm water management plans must be in place so that uncontaminated runoff can enter the marine ecosystem with the least impact on the facilities.

The appointed contractor should be made aware of the content and environmental requirements of this report so as to plan the construction phase accordingly. Little wastewater is expected during the construction.

8.3 Operational Phase

During the operation phase of the hazardous chemical storage facility, chemical products used for offshore drilling activities will be offloaded fromships and transported via road to the storage warehouses at erf 522. Specific impacts identified, associated with the operational phase are summarised in the followingtables 20 to 30:

Table 20. Operational Phase Impact - Traffic

Impact	**Traffic Pollution**
Nature	The site is located within the Harbour & Industrial area. Assessment of traffic to and from the site is assessed.
Type of impact	**Negative**
Extent	**Local** (site and town)
Duration	**Long** (months, <10 year) or for as long as the facility is in operation o drilling activities cease.
Intensity	**Medium** (where the environment continues to function but in a noticeably modified manner)
Probability	Considers the likelihood of the impact occurring and is described as: Definite (impact will occur regardless of prevention measures)
Significance without mitigation	**Medium** (where the affected environment is altered but natural, cultural and social functions and processes can continue)
Mitigation	At maximum envisaged The facility can accommodate 2 (two) trucks on site (4 for offloading. No truck stop exists in Lüderitz and citizens are concerned about associated hygiene problems that persist as a result from truckers using side streets for parking and overnight stays before offloading or leaving town. KAESO OILFIELD SERVICES (PTY) LTDcould address the issue pertaining to their trucks and drivers by offering amenities for truckers off site before and after loading of the chemicals especially in the event of them having to overnight in Lüderitz. Unless otherwise, KAESO OILFIELD SERVICES (PTY) LTDwould use rail for transporting of chemicals from Walvisbay port to as am alternative.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

Table 21. Operational Phase Impact - Fire and Explosion Hazard

Impact	**Fire and Explosion Hazard**
Nature	Hydrocarbons are volatile under certain conditions and their vapours in specific concentrations are flammable. If precautions are not taken to prevent their ignition, fire and subsequent safety risks may arise.
Type of impact	**Negative**
Extent	Site specific and possibly Local (limited to radius of 900m in case of BLEVE) which would affect Lüderitz CBD and Harbour
Duration	**Long** (years, <10 years). That is, the risk exists for as long as the bulk storage facility is in existence at this site. A BLEVE event itself would be of short duration.
Intensity	**High** (where environmental functions and processes are altered such that they temporarily or permanently cease and/or exceed legal standards/requirements). This is in the case of a BLEVE event only. Otherwise a medium intensity is predicted.
Probability	Considers the likelihood of the impact occurring and is described as Improbable (low likelihood)
Significance without mitigation	**High** (where the affected environment is altered to the extent that natural, cultural, social and economic functions and processes will temporarily or permanently cease).
Mitigation	Various international occupational health and safety performances should be consulted for specific regulations. These have already been referred to in a the legal section and Appendix A, C & D. It is very important to take public safety into account when locating hazadeous chemical storage facilities, as the public can be at risk from potential leak vapour emissions and fires. Risks from these can be minimized through implementation of buffer zones. Different types of chemicals may be located within specified distance from each other in the facilities. KAESO OILFIELD SERVICES (PTY) LTD would have no control on the future placement of facilities around their proposed bulk hazardous chemical storage facility. All chemical storage and handling facilities in Namibia must however comply with

	strict safety distances as prescribed by SANS. SANS is **adopted by the Ministry of Mines and Energy as the national standard for petroleum exploration**. The KAESO OILFIELD SERVICES (PTY) LTDfacility exceeds the API & SANS safety distances. If the setting-out of the site and the safety distances to the nearest adjacent property are adhered to, then any development can be safely built on the neighbouring property. It is specifically appropriate to comply with these standards, as KAESO OILFIELD SERVICES (PTY) LTD would have no control on the future placement of facilities around the proposed facility. Although Namibian legislation only requires that the SANS standards with regard to barrier distances be implemented, the more stringent standards for hazardous chemical storage of the National Fire Protection Association of America (NFPA) will be adhered to for the project. It must further be assured that sufficient water is available for fire fighting purposes and additional specific fire retardants are onsite. In addition to this, all personnel have to be sensitised about responsible fire protection measures and good housekeeping such as the removal of flammable materials including rubbish, dry vegetation, and hydrocarbon-soaked soil from the vicinity of the chemical storage facility. Regular inspections should be carried out to inspect and test fire fighting equipment and pollution control materials at the chemical storage facility. All fire precautions and fire control at the hazardous chemical storage facility must be in accordance with SANS, or better. A holistic fire protection and prevention planis needed. See the EMP for the role that NAMPORT must play with regards to this. Experience has shown that the best chance to rapidly put out a major fire is in the first 5 minutes. It is important to recognise that a responsive fire prevention plan does not solely include the availability of fire fighting equipment, but more importantly, it involves premeditated measures and activities to timeously prevent, curb and avoid conditions that may result in fires. An integrated fire prevention plan should be drafted before “start-up” of the facilities.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

Table 22. Operational Phase Impact - Security

Impact	**Security**
Nature	Access to site by unauthorised persons with the intent to steal product or equipment.
Type of impact	Negative
Extent	Site specific and at offloading quay area
Duration	**Long** (months, <10 year). That is for as long as the facility is in operation.
Intensity	**Low** (where natural/ social environmental functions and processes are negligibly affected)
Probability	Considers the likelihood of the impact occurring and is described as: **Highly probable** (most likely)
Significance without mitigation	**High** (where the affected environment is altered to the extent that natural, cultural, social and economic functions and processes will temporarily or permanently cease)
Mitigation	Strict security that prevents unauthorised entry. Patrolling perimeter fence.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

Table 23. Operational Phase Impact - Health & Safety

Impact	**Health & Safety**
Nature	During operational times all procedures for offloading, storage and uploading are subject to risks to human beings. These risks are assessed in terms of the predicted impact if realised.
Type of impact	**Negative**
Extent	Site specific and at offloading quay area
Duration	**Long** (months, <10 year). That is for as long as the facility is in operation.
Intensity	**Low** (where natural/ social environmental functions and processes are negligibly affected)
Probability	Considers the likelihood of the impact occurring and is described as: **Highly probable** (most likely)
Significance without mitigation	**Significance after mitigationDegree of confidence in predictions**
Mitigation	

Medium (where the affected environment is altered but natural, cultural and social functions and processes can continue)

The operations of a chemical storage facility can cause serious health and safety risks to workers on site. Occupational exposures are normally related to the dermal contact with chemicals and inhalation of chemical vapours during handling of such products. For this reason adequate measures must be brought in place to ensure safety of staff on site, and includes: (See Appendix A & D)

- Proper training of operators;
- First aid treatment;
- Medical assistance;
- Emergency treatment;
- Prevention of inhalation of fumes (chemicals);
- 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 material safety data sheets become available;
- 24 hour security surveillance

Low (where natural, cultural and social and economic functions and processes are not affected).

High

Table 24. Operational Phase Impact - Air Quality

Impact	**Air Quality**
Nature	Vapors from chemicals which are detrimental to living organisms are assessed under this section.
Type of impact	**Negative**
Extent	**Local** (limited to Lüderitz)
Duration	**Long** (years, <10 years)
Intensity	**Medium** (where the environment continues to function but in a noticeably modified manner)
Probability	**Highly probable** (most likely)

Significance without mitigation	**Medium** (where the affected environment is altered but natural, cultural and social functions and processes can continue)
Mitigation	In terms of air quality, hydrocarbon vapours will not normally be released during delivery due to complete containment of chemicals.
Significance after mitigation	**Low** (where natural, cultural, social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

Table 25. Operational Phase Impact - Noise Pollution

Impact	**Noise Pollution**
Nature	Noise pollution will exist due to heavy vehicles accessing the site to transport Chemicals from the site.
Type of impact	**Negative**
Extent	**Local** – Offloading of hazadeous chemicals at the quay to the Bulk chemical Storage warehouses will take place on specific demand by clients conducting offshore drilling. Loading of chemicals into road trucks will be restricted to the site and trucks will travel through the urban area and then on to the port area .
Duration	**Long** (years, <10 years)
Intensity	**Low** (where natural/ social environmental functions and processes are negligibly affected) – 6 trucks per day at full delivery rate to the ship.
Probability	Considers the likelihood of the impact occurring and is described as: Definite
Significance without mitigation	**Medium** (where the affected environment is altered but natural, cultural and social functions and processes can continue)
Mitigation	It is recommended that the road transport tarucks loading and associated traffic be limited to normal working hours (08h00 to 17h00) and that weekends should rather be avoided.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected). In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both.
Degree of confidence in predictions	**High**

Table 26. Operational Phase Impact - Waste Production

Impact	**Waste Production**
Nature	The ability of a product to act as a waste which must be cleaned up
Type of impact	**Negative**
Extent	Site specific
Duration	**Long** (years, <10 years). That is for as long as the drilling activities are ongoing offshore Namibia.
Intensity	**Low** (where natural/ social environmental functions and processes are negligibly affected)
Probability	**Definite** (impact will occur regardless of prevention measures).
Significance without mitigation	**Medium** (where the affected environment is altered but natural, cultural and social functions and processes can continue);
Mitigation	The facility will not produce waste directly as a result of spillage or leak due to the nature of the hazardous material. See the Material Safety Data Sheet in Appendix D.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

Table 27. Operational Phase Impact - Groundwater Contamination

Impact	**Groundwater Contamination**
Nature	Porous surface substrate can allow unwanted hazardous and ecologically detrimental substances to seep down to the water table, which in this case is the subsurface intruded seawater. The surface substrate is a topping of mixed sand and small stones. Bedrock close to the sea level appears to have been artificially covered by ground fill.
Type of impact	**Negative**
Extent	**Site specific**
Duration	**Long** (years, <10 years). That is for as long as the drilling activities are ongoing offshore Namibia.
Intensity	**Low** (where natural/ social environmental functions and processes are negligibly affected)
Probability	**Improbable** (low likelihood)
Significance without mitigation	**Medium** (where the affected environment is altered but natural, cultural and social functions and processes can continue)
Mitigation	Chemical spillages during offloading /loading of chemicals should be mitigated by ensuring that surfaces are sealed for example with interlocks.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

Table 28. Operational Phase Impact - Ecological Impact

Impact	Ecological Impact
Nature	The site was previously developed, thus no conservation worthy vegetation is situated at the proposed facility location. Limited impact on the flora can be expected, as no vegetation will be removed for the construction of the facilities. A few sea birds can be expected along the rocky coastline along the western boundary.
Type of impact	**Negative**
Extent	**Site specific**
Duration	**Long** (months, <10 year).
Intensity	**Low** (where natural/ social environmental functions and processes are negligibly affected)
Probability	Considers the likelihood of the impact occurring and is described as Improbable (low likelihood).
Significance without mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Mitigation	There is also no defined bird flight path in the vicinity of the proposed chemical storage facility. The shoreline will be fenced off and birds using the tidal zone will continue to have access to this area. Less access by humans and probable predators (i.e. cats and dogs) from the landside will take place due to the erection of fencing. The fencing is a security and safety measure.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

Table 29. Operational Phase Impact - Visual Impact

Impact	Visual Impact
Nature	This is an impact that affects the aesthetic appearance
Type of impact	**Negative**
Extent	Site specific and along path of pipeline
Duration	**Long** (months, <10 year) or until decommissioning.
Intensity	**Medium** (where the environment continues to function but in a noticeably modified manner)
Probability	Considers the likelihood of the impact occurring and is described as: Definite (impact will occur regardless of prevention measures).
Significance without mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Mitigation	The height of the bunded walls constructed on the facility will be 8m high and will cause little change to the landscape compared that cover the storage facility and will blend better into the natural environment.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

Table 30 Operational Phase Impact - Cumulative Impact

Impact	**Cumulative Impact**
Nature	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.
Type of impact	**Negative**
Extent	**Local** (limited to Lüderitz)
Duration	**Medium** (months, <1 year)
Intensity	**Medium** (where the environment continues to function but in a noticeably modified manner).
Probability	**Definite** (impact will occur regardless of prevention measures).
Significance without mitigation	**Medium** (where the affected environment is altered but natural, cultural and social functions and processes can continue).
Mitigation	Possible cumulative impacts associated with the operational phase include increase in traffic frequenting the site and along the section of road near the fuel depots. Therefore increase in emissions from these vehicles, decreasingthe air quality around the proposed establishment. Wear and tear on the road and increased risk of road traffic incidences could increase. Other companies are using the roads to access the town and harbour and a few members of the public are concerned that the additional road tankers that will frequent thetown will have a cumulative impact on the town, in particular the road quality, obstructions along main and side streets when parked and health impactsthrough lack of garbage and ablution amenities.
Significance after mitigation	**Low** (where natural, cultural and social and economic functions and processes are not affected).
Degree of confidence in predictions	**High**

Handling of Bulk Hazardous Chemical Products – The handling of bulk hazardous chemical product during operation also deserves consideration and regulations related to receiving bulk chemical cargo from sea vessels should be adhered to at all times. Staff of the proposed hazardous chemical storage facility should at all times be aware of the precautions associated with the handling of hazardous chemical as described in the relevant Material Safety Data Sheets (Appendix c). Regulations with regard to the handling of hazardous chemical delivered by sea vessels include:all regulations in the International Safety Guide for chemical Tankers and Terminals, as well as those regulations required by the local fire authorities. No marine off-loading procedures or off-loading equipment will be changed as part of this project. KAESO OILFIELD SERVICES (PTY) LTD has 2 options for offloading the hazardous chemicals. Either via the sea by vessels or direct by road to the storage facility. ***Heritage Impacts*** – There are no known heritage areas or artefacts of note to be impacted by the operational phase.

8.4 Decommissioning Phase

The impacts associated with this phase will be similar to that of the construction phase. These impacts will include noise, possible fires and explosions. Guidelines for tank removal must be followed to reduce the risk of chemical spillage and groundwater contamination. Rubble and waste will be created, as structures are dismantled. These should be contained and disposed of at an approved waste facility and not dumped in the surrounding areas. The Environmental Management Plan for this phase will have to be reviewed at the time of decommissioning to cater for changes made to the development.

9 ALTERNATIVES TO THE PROPOSED HZARDOUS CHEMICAL STORAGE AT WALVIS BAY

9.1 Walvis Bay

The port of walvis bay is an option, for bulk hazardous chemical storage. But due to limited availability of land close to the harbor made it difficult to pursue the business there.

9.2 No Development Alternative

If the proposed development does not take place then KAESO OILFIELD SERVICES (PTY) LTD would not be able to successfully carry out its goal to ensure hazardous chemical storage warehousing for offshore drilling activities. KAESO OILFIELD SERVICES (PTY) LTD will need a marine based hazardous chemical import facility to store the imported hazardous chemical. Without this development the supply of hazardous chemical to offshore petroleum drilling activities would be dependent on the supply of South African Depots and Angola. The No-development alternative is thus not considered to be viable.

10 ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan (EMP) provides management options to ensure impacts of the proposed development are minimised. An EMP is a tool used to take pro-active action by addressing potential problems before they occur. This should limit the corrective measures needed, although additional mitigation measures might be included if necessary. The EMP acts as a stand-alone document, which can be used during the various phases (planning, construction, operational and decommissioning) of the proposed hazardous chemical storage facility. All contractors and sub-contractors taking part in the construction of the facility should be made aware of the contents of the EMP, so as to plan the relevant activities accordingly in an environmentally sound manner. An EMP for the construction and operational phases of the proposed hazardous chemical storage facility has been developed and is available as a separate document.

The objectives of the EMP are:

- to include all components of the development;
- to prescribe the best practicable control methods to lessen the environmental impacts associatedwith the construction and operation of the development;
- to monitor and audit the performance of construction and operational personnel in applying suchcontrols; and

- to ensure that appropriate environmental training is provided to responsible construction andoperational personnel.

Once the facility has been constructed, it is highly recommended that KAESO OILFIELD SERVICES (PTY) LTD implement an ISO 14001(or other) Environmental Management System (EMS). An EMS is an internationally recognized and certified management system that will ensure on going incorporation of environmental constraints. At the heart of an ISO 14001 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 would need to include 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 theeffectiveness of the EMS.
- The Environmental Management Plan is attached.

11 CONCLUSIONS

In general, the proposed hazardous chemical storage facility would pose limited environmental and social risks that could be mitigated provided the required measures are followed strictly and that the technical abilities needed are brought to bear on this proposed project. The proposed hazardous chemical storage facility wouldcontribute to the economy of Lüderitz and the Region by creating jobs and diversifying the economic activity.

The site is generally suitable for the proposed hazardous chemical storage facility. All environmental risks can be minimised and managed through implementing preventative measures and sound management systems. It is recommended that environmental performance be monitored regularly to ensure compliance and that corrective measures be taken if necessary. It is also recommended that this information be made available to the community on a regular basis.

Fire prevention should be adequate, as specified by the standards and codes of practice listed in Appendix A.of this assessment. Health and safety regulations should be adhered to in accordance with the Regulations pertaining to Health and Safety.

The Environmental Management Plan should be used as an on-site reference document during all phases (Planning, Construction, Operation and Decommissioning) of the proposed hazardous chemical storage facility, and auditing should take place in order to determine compliance with the EMP. Parties responsible for transgression of the EMP should be held responsiblefor any rehabilitation that may need to be undertaken.

With future expansion of the proposed hazardous chemical storage facility, compliance with environmental, health and safety issues must again be checked and improved where necessary during an EIA.

Any polluted soil or groundwater encountered during the construction process must be reported to the relevant authorities and the contaminated soil and or groundwater must then be disposed of in an applicable manner.

CEGEOR

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EAP

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13 **APPENDIX A:** HAZARDOUS GOOD (INCLUDING CHEMICALS)

13.1 International Maritime Dangerous Goods Code

The primary requirements of the IMDG Code stipulate that all packaged dangerous goods must be: (Moolla & Currie 2007)

- Classified in terms of the UN system of classification;
- Declared;
- Packaged in appropriate UN approved packaging;
- Labelled; and
- Packed onto a cargo transport unit where appropriate.

It is the shipper's responsibility to classify the goods and arrange for them to be packaged in appropriate UN approved packaging, labelled with the requisite hazard warning signs.

The Hazard Warning signs may be in the form of marks, placards, labels or signs. The IMDG Code specifies how many labels, placards or signs are to be attached. Diamond-shaped labels and placards identify hazards by colour and symbol. The design for each class is different including the two classes into which Chemicals fall. Within these two classes there are further subdivisions.

The marine pollutant mark, elevated temperature and fumigation warning sign also needs to be affixed where relevant.

All packaged dangerous goods for transport by sea must be declared in a dangerous goods transport document signed on behalf of the shipper. Where relevant, this needs to be accompaniedby a container or vehicle packaging certificate.

The following minimum information must be included in the declaration:

- UN Number
- Class and, where applicable the division
- Proper shipping name
- Packaging group
- Total quantity of dangerous goods
- Number and kind of packages
- Specific reference to empty, portable tanks not cleaned, packages, packaging anddangerous goods
- Possible, subsidiary hazards not conveyed by the Proper Shipping Name.
- Any further information that may be required by NAMPORT

The above information is required in order for port and shipping companies to arrange for the safe handling, stowage and segregation at the terminal and on board the ship. Shipments may not be allowed to proceed into the maritime transportation chain without such information being adequately provided. KAESO OILFIELD SERVICES will receive hazardous chemicals from clients for onshore storage. The nominated vessels will be suitable to transport hazardous chemicals and are suitable for berthing at the Lüderitz Bay Harbour.

14 APPENDIX B: IMPORTANT FAUNA AND RELEVANT CONSERVATION STATUS

In light of the following facts about the area's fauna there is a tremendous opportunity for KAESO OILFIELD SERVICES (PTY) LTDto give impetus to the conservation efforts of the organisations in the area around Lüderitz. This can be done through assisting these organisations financially thereby bringing greater awareness of their efforts especially in the realm of research and education.

14.1 Site description

The Lüderitz Bay Island complex consists of three coastal islands all falling within one kilometre of the shore: Halifax Island (3 ha), Penguin Island (36 ha) and Seal Island (44 ha). The rocky shoreline including Lüderitz fishing harbour is also included within this Important Bird Area (IBA). Halifax Island is located at the south end of Guano Bay near Diaz Point, a promontory at the western entrance of Lüderitz Bay and one of the first landfalls of Portuguese explorers in the 1400's. The other two islands are to the east of Halifax, within Lüderitz Bay. The whole area lies within the intense upwelling cell off the Lüderitz coastline and this adds to the high marine productivity of the area, explaining the large number of seabirds here. The islands hold some abandoned guano-scrapers buildings which are now used by penguins for nest sites. They support no terrestrial vegetation. (Simmons, Barnes, Jarvis & Robertson 1999)

14.2 Birds

This island complex regularly supports over 10 000 seabirds. Halifax Island is an important coastal seabird breeding island in Namibia, supporting over 2 000 seabirds including substantial numbers of breeding African Penguin (400 pairs), Crowned Cormorant (50 pairs) and Swift Tern (800 pairs). Penguin and Seal Islands are mostly used for roosting, however Bank (60 pairs), Crowned (80 pairs), Cape (2 000 pairs) and Whitebreasted Cormorants (20 pairs) all breed on Penguin Island. This island also holds large numbers of African Black Oystercatcher, which probably breed, and roosting Damara Terns. Seal Island holds 80 pairs, or 3%, of the world population of Crowned Cormorants, and 400 pairs of Kelp Gull which are known to predate cormorant eggs when disturbance occurs. On the adjacent mainland, the harbour supports dense nesting populations of Hartlaub's Gull and Swift Tern. In 1994, at least 2 470 pairs of Swift Terns(40 % of the southern African population) nested successfully there and on the rocky promontory called Shark Island. The shoreline here is completely rocky and the Lüderitz peninsula alone holds about 14 000 shorebirds. At 30 birds/km it is locally rich but supports a lower linear densitythan shores farther north in central Namibia. (Simmons et al 1999)

Ramsar designation progress is as follows: Areas within 16 Important Bird Areas qualify currently as Ramsar Sites in the Republic of Namibia. Designation coverage is complete within three of these and partial (with need of expansion) in one. However, 28 (75%) of the suitableIBAs in Namibia have no Ramsar designation as yet. Lüderitz Bay Islands fall in the latter category although they fully comply with criteria 2,4,5,6 of the Ramsar Convention for the classification of wetlands. Lüderitz harbour is situated within the 5km radius of these islands. See section 14.5 & 14.6 below for Ramsar criteria.

14.3 Other threatened/endemic wildlife

Killer Whales, many Heaviside's Dolphin and the rarer Humpback, Minke and Southern Right Whales all occur. Dusky and common Bottle nosed Dolphins are also seen. (Simmons et al 1999)

14.4 Conservation issues

Previously these islands were more populated by breeding birds than at present: their proximity to the mainland suggests they were heavily exploited by man probably even before the precipitous decline of the African Penguin in the 19th and 20th centuries. Onshore, harbour pollution appears minimal but disturbance to breeding gulls and terns in the harbour itself by humans, dogs and cats has been severe. Although attempts to control these impacts have met with some success, disturbance will inevitably increase as the harbour is renovated. (Simmons et al 1999)

Table 37. Breeding Birds on the Islands of the Lüderitz Bay Harbour

(data from Bird Life International 2001 – updated from earlier data Simmons et al 1999)	**Breeding (pairs)**	**Total numbers**
Globally endangered species		
African Penguin	330 - 471	800 – 1 500
Bank Cormorant	60	200
Globally near-threatened species		
Crowned Cormorant	50 - 160	160 - 350
African Black Oystercatcher	5 – 10	200 - 400
Least Concern		
Kelp Gull	500 - 800	1 200 – 2 000
Hartlaub's Gull	200 – 400	1 500
Swift Tern	800 – 2 470 (max)	6 000 (max)

max Absolute maximum

The following Ramsar Criteria and Definitions are useful for assessing the area in general in light of the preceding discussion of fauna and conservation status.

14.5 The Ramsar Criteria for Identifying Wetlands of International Importance.

The Criteria for Identifying Wetlands of International Importance as adopted by the 4th, 6th, and 7th Meetings of the Conference of the Contracting Parties to the Convention on Wetlands(Ramsar, Iran, 1971) to guide implementation of Article 2.1 on designation of Ramsar sites.

Group A of the Criteria: Sites containing representative, rare or unique wetland types.

Criterion 1:

A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

Group B of the Criteria: Sites of international importance for conserving biological diversity.

Criteria based on species and ecological communities

Criterion 2:

A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.

Criterion 3:

A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.

Criterion 4:

A wetland should be considered internationally important if it supports plant and or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

Specific criteria based on water birds.

Criterion 5:

A wetland should be considered internationally important if it regularly supports 20,000 or more water birds.

Criterion 6:

A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of water bird.

Specific criteria based on fish

Criterion 7:

A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, speciesinteractions and/or populations that are representative of wetland benefits and or values and thereby contributes to global biological diversity.

Criterion 8:

A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

14.6 The Ramsar Convention definition of "wetland" and classification system for wetland type

14.6.1 Definition

Under the Convention on Wetlands (Ramsar, Iran, 1971) "wetlands" are defined by Articles 1.1 and 2.1 as shown below:

Article 1.1:

"For the purpose of this Convention wetlands are areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres."

Article 2.1 provides that wetlands:

"may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands".

14.6.2 Ramsar Classification System for Wetland Type

The codes are based upon the Ramsar Classification System for Wetland Type as approved by Recommendation 4.7 and amended by Resolution VI.5 of the Conference of the Contracting Parties. The categories listed herein are intended to provide only a very broad framework to aid rapid identification of the main wetland habitats represented at each site.

Marine/Coastal Wetlands

A Permanent shallow marine waters in most cases less than six metres deep at low tide; includes sea bays and straits.

B Marine subtidal aquatic beds; includes kelp beds, sea-grass beds, tropical marine meadows.

C Coral reefs.
D Rocky marine shores; includes rocky offshore islands, sea cliffs.
E Sand, shingle or pebble shores; includes sand bars, spits and sandy islets; includes dunesystems and humid dune slacks.
F Estuarine waters; permanent water of estuaries and estuarine systems of deltas.
G Intertidal mud, sand or salt flats.
H Intertidal marshes; includes salt marshes, salt meadows, saltings, raised salt marshes; includes tidal brackish and freshwater marshes.
I Intertidal forested wetlands; includes mangrove swamps, nipah swamps and tidal freshwater swamp forests.
J Coastal brackish/saline lagoons; brackish to saline lagoons with at least one relatively narrow connection to the sea.
K Coastal freshwater lagoons; includes freshwater delta lagoons.
Zk(a) Karst and other subterranean hydrological systems, marine/coastal

Inland Wetlands
L Permanent inland deltas.
M Permanent rivers/streams/creeks; includes waterfalls.
N Seasonal intermittent irregular rivers/streams/creeks.
O Permanent freshwater lakes (over 8 ha); includes large oxbow lakes.
P Seasonal intermittent freshwater lakes (over 8 ha); includes floodplain lakes.
Q Permanent saline/brackish/alkaline lakes.
R Seasonal/intermittent saline/brackish/alkaline lakes and flats.
Sp Permanent saline/brackish/alkaline marshes/pools.
Ss Seasonal/intermittent saline/brackish/alkaline marshes/pools.
Tp Permanent freshwater marshes/pools; ponds (below 8 ha), marshes and swamps on inorganic soils with emergent vegetation water-logged for at least most of the growing season.
Ts Seasonal/intermittent freshwater marshes/pools on inorganic soils; includes sloughs, potholes, seasonally flooded meadows, sedge marshes.
U Non-forested peat lands; includes shrub or open bogs, swamps, fens.
Va Alpine wetlands; includes alpine meadows, temporary waters from snowmelt.

Table 38. Delivery Vessel (Ship) Related Operational Risk, Probability of Occurrence and the Proposed Risk Mitigation Measures

Operational Risk Source	Cause	Assessment Probability Of Occurrence	Risk Mitigation Measures
Delivery Vessel (ship)	(a) Unseaworthy ship (b) Incompetent crew	**Low**	i. Port to only permit vessels complying hazardous chemicals International Marine Forum's (OCIMF) Ship InspectionReport Programme (SIRE) on berthing. ii. Rigorous application of a Port State Control programme
	(c) Collision while at anchor	**Low**	i. Designated safe anchorage ii. Issue local navigation warning iii. Monitoring by active Vessel Traffic service (VTS) iv. Safety zone around ship
	(d) Collision or grounding while transiting the channel inbound or outbound or while manoeuvring off from berth	**Low**	i. Declare safety zone around ship while it is in the channel ii. Compulsory pilotage iii. Monitoring by active VTS
	(e) Repairs and hot work while in port limits	**Low**	i. Not permitted while in port limits

Table 39. Cargo Works Related Operational Risks, Probability of Occurrence and Proposed Risk Mitigation Measures

Operational Risk Source	Cause	Assessment Probability Of Occurrence	Risk Mitigation Measures
Cargo Work	a. Spillage loading or offloading of cargo	**Moderate**	i. Compliance procedures ii. Trained (stevedores) jetty staff
	b. During cargo offload; spillage on deck; Failure of cargo;	**Moderate**	i. Tug and pilot on immediate standby ii. Quay fire fighting adequate iii. Fire fighting response on immediate standby iv. Clear lines of communication between terminal and ship
	c. Chemicals leaking	**Low**	i. Not permitted while ship is in port limits ii. Closed loop cargo discharge
	d. Fire on ship	**Low**	i. Not permitted at all while ship is in port limits
	e. Repairs and hot work	**Moderate**	i. Rigid compliance with safety procedures. ii. Application and monitoring of chemical manual check lists. iii. Adequate fire fighting appliances iv. Properly trained and sufficient staff v. Quick reaction time.
	f. Weather or lightning strike	**Low**	i. Not permitted and safe distances for hot work not on ship or quay – properly enforced
		Low	i. Proper procedures requiring handling of hazard chemicals when certain weather parameters are exceeded.

Table 40. The Berth Related Operational Risk, Probability of Occurrence and the Proposed Risk Mitigation Measures

Operational Risk Source	Cause	Assessment Probability Of Occurrence	Risk Mitigation Measures
The Berth	(a) Offloading vessel struck by a passing vessel	**Low**	i. Port to only permit vessels complying with berth
	ii. Proper docking	**Low**	i. Static electricity earthing protection to be provided for vessel.
	iii. Oflloading safety appliances	**Low**	i. Adequate fire fighting appliances. ii. Properly trained and sufficient fire staff. iii. Quick reaction time
	iv. Proximity of ship repair facilities	**Medium**	i. High safety standards applied in repair facilities. ii. Compliance with the safety distances

Table 41. Pipeline Related Operational Risk, Probability of Occurrence and the Proposed Risk Mitigation Measures.

Operational Risk Source	Cause	Assessment Probability Of Occurrence	Risk Mitigation Measures
Pipeline	(a) Leak of sealed chemicals	**Low**	i. Regular check and monitoring of sealed containers. ii. Regular inspections. iii. Safe distance from ship repair facilities
	(b) Damage	**Moderate**	i. Ban on lifting damaged seal of chemicals

Table 42. Cargo Terminal Related Operational Risk, Probability of Occurrences and Proposed Risk Mitigation Measures

Operational Risk Source	Cause	Assessment (Probability Of Occurrence)	Risk Mitigation Measures
Cargo Terminal	(a) Leak	**High**	i. Rigid compliance with safety procedures. ii. Strategically placed air quality analyzer monitors. iii. Regular monitoring of seals. iv. Safe distance from ship repair facilities. v. Licences to operate from municipality
	(b) Leak during transfer to road truck causing spillage	**Medium – High**	i. Rigid compliance with safety procedures ii. Performance audits
	(c) Leak during offloading at warehouse may cause spillage	**Low**	i. Not permitted at this terminal

APPENDIX C: SAFETY IN THE USE & HANDLING OF HAZARDOUS CHEMICALS

Use And Handling Of Hazardous Chemicals

In this part, we will consider the hazards, precautions, and emergency procedures pertinent to the safe use and handling of chemicals. There are two categories to bear in mind: chemical hazards and physical hazards..

Labels And Material Safety Data Sheets

Precautionary labels for chemicals typically present information in four parts, usually in the order described here. First is a Signal Word: “Danger”, “Warning”, or “Caution”. Only one of the three should be used on a label. “Danger” is the strongest of the three and is used when the contents present a potential for serious foreseeable harm. “Caution” is restricted to chemicals that are foreseeably the least potentially harmful. “Warning” is for chemicals intermediate in their potential to cause foreseeable harm. One or more Statements of Hazard follow the Signal Word.

These are succinct descriptions of the major foreseeable way or ways in which the chemical could cause harm. Examples include “Flammable”, “Harmful if Inhaled”, “Causes Severe Burns”, “Poison” (with or without a skull and crossbones graphic), and “May Cause Irritation”. Chemicals that exhibit two or more hazards are labelled with a corresponding number of Statements of Hazard. Next on the label are one or more Precautionary Measures, as appropriate. These are brief descriptions of actions to be undertaken or avoided and which, if heeded, will prevent the corresponding hazard(s) that are described by the Statements of Hazard from causing harm. Examples include “Keep Away from Heat, Sparks, and Flame”, “Use with Adequate Ventilation”, “Do Not Get in Eyes”, and “Avoid Breathing Dust”. Usually, but not always, First Aid or other information will appear on a label below, or off to the side of, the Precautionary Measures.

Typical First Aid information includes instructions such as how to induce vomiting or to not induce vomiting if that is the case. Advice to wash off the skin or flush the eyes if the victim has been exposed to a corrosive chemical, how to extinguish a fire involving a chemical, and what to do if

an excessive amount has been inhaled are also included. Typically, MSDSs contain similar information, but in more detail, and frequently in a different order from that used for labels. Usually, MSDSs are not written for the layperson; they require interpretation by persons familiar with the technical terms used. Often, an overemphasis is placed on the toxic characteristics of the subject chemical.

There may also be vague or insufficient information regarding other hazards that the subject chemical presents. MSDSs vary widely in quality and reliability.

Chemical Hazards

The hazards presented by any chemical depend upon the properties of that chemical. Each chemical is different from all others because it has properties that are different. So, it follows that each chemical presents different hazards.

But to use a chemical properly, first we must know the hazards of that chemical; second, we must know and apply the appropriate precautionary measures that will reduce the probability of harm from those hazards; and third, we must know and be prepared to carry out the necessary emergency measures (should our precautions fail) that will minimize the harm, just in case. It would seem that these requirements are formidable. How can I know that much about each of the many chemicals my students and I will use in the lab— to say nothing of teaching all this to the students? Fortunately, there is a practical answer: classification.

Chemicals present only four classes of chemical hazards: • Flammability • Corrosivity • Toxicity • Reactivity The following sections describe each of these hazards separately. Keep in mind that any single chemical may simultaneously present more than one hazard. A few chemicals also possess physical hazards, which are discussed later. But before attending to these hazards, there is one all-important precautionary measure that requires the first-place mention in any discussion of chemical

l hazards: eye protection.

Eye Protection

Always, when hazardous chemicals are used or handled, when glassware is used or handled, when flames are involved, all persons present, whether or not they are doing the handling or using, must wear eye protection. Ordinary spectacles do not provide protection from chemical splashes; even spectacles with so-called hardened lenses do not provide this kind of protection.

Similarly, contact lenses alone are not considered to offer sufficient protection when used without safety goggles. Only safety goggles (also known as chemical splash goggles) as described below and marked with the code “Z87” provide the kind of protection that is needed. The Z87 code refers to a voluntary standard promulgated by the American National Standards Institute called ANSI Z87. This standard describes several different kinds of eye and face protection, all of which can be purchased from suppliers and bear the Z87 code marking. For example, a type of eye protection that is often and incorrectly worn as protection in a chemical environment is the type usually called “safety glasses”.

These are similar in appearance to ordinary spectacles and could be used in a chemical environment only if it were certain that the only hazard would be from flying fragments, not splashing liquids. In the ANSI standard, these are classified as types A, B, C, and D; the latter three have side-shields that offer partial protection against flying fragments approaching from the side. Type A only protects against a direct frontal flying fragment. None of the four, not A, B, C, or D, offer sufficient protection against splashes of liquids.

All four, however, if they conform to the ANSI standard, is marked Z87. There are two types of “safety goggles”, types G and H, with no ventilation and with indirect ventilation, respectively. Only these two types are suitable for eye protection where chemicals are used and handled. Both types G and H are equipped with flexible edging so that they fit against the skin and thus protect from both flying fragments and flying splashes of liquid from all directions. Make sure that the type G or H safety goggles you and your students use are marked “Z87”.

Flammability

The first chemical hazard to be discussed is flammability. Although one chemical may indeed be more flammable, say, than another,3 the precautions and emergency treatment depend principally upon flammability itself, not the degree of flammability. A flammable chemical (obviously) will burn. Other terms that convey the same hazard potential information include “extremely flammable” and “combustible”. Keep in mind that the vapours of flammables, if ignited when mixed with air in suitable proportions (ranging from 1% to more than 50% [by volume] in some cases) can explode.

Flammable solids sublime; hence, their vapours are just as hazardous as the vapours from a flammable liquid. For example, glacial acetic acid (solid or liquid, depending on the temperature) is a flammable chemical as defined here. Keep in mind also that the vapours of most flammables are denser than air and can travel 10, 20, or 30 feet, or even further.

The travelling vapours mix with air as they move. Consequently, a source of ignition can be several tens of feet away from the flammable liquid and still cause a fire or explosion by igniting the vapor trail that has traveled from the flammable liquid to the ignition source Precautionary measures include the enforced absence of ignition sources, such as lighted burners, hot plates, other hot surfaces (a lighted incandescent light bulb), and sources of sparks (electrical sparks, static charge sparks, and friction sparks). Keep containers closed when not actually in use.

Ensure that the air movement in the storage warehouse is sufficient to keep the concentration of the flammable vapour in the air well below 1%. Minimize the quantities available— usually, 100 mL is more than ample for lab use. If more is necessary, provide it in separate containers, 100 mL maximum in each container. Store flammables in an approved flammable liquid storage cabinet, preferably in safety cans. Use fabric, not plastic, tape to tape glass vessels (test tubes, flasks, beakers) beforehand if they are to contain flammable gases or vapours.

Otherwise, when handled by students or used by teachers in demonstrations of an exploding gas or vapour, there can be flying glass shards from the ignition of the air-gas mixture. Even with the necessary taping, conduct such demonstrations only behind a sturdy shield that will confine flying fragments. Ask your local fire department to review your procurement, receiving, storing, handling,

dispensing, use, and disposal of flammables and to make recommendations for improving safety.

Make certain in advance that the safety shower is working and that students know how to use it. Ensure beforehand that fully charged fire extinguishers are available that you (not the students) know how to operate, that there has been a recent, successful fire drill, that the fire alarm system is operating, that all persons know what the fire alarm bell sounds like, and what to do when it sounds.

workers should be taught the “stop, drop, and roll” technique to be used if their clothes catch on fire elsewhere and in the laboratory taught to walk calmly to and use the safety shower to extinguish clothes that are on fire. A drill to practice these exercises is recommended

Corrosivity

A corrosive chemical either destroys living tissue or causes a permanent change in such tissue through chemical action. (A chemical that corrodes iron, for example, wet salt [sodium chloride], is not corrosive under this definition—which pertains to chemical safety. Sulfuric acid will corrode iron but is also a corrosive in this safety context.) Corrosives can destroy both skin and tissues underneath the skin; corrosives destroy eyes, the respiratory system, and any other living tissue.

Corrosive effects include impaired sight or permanent blindness, severe disfigurement, permanent severe breathing difficulties, even death. Usual precautionary measures include preventing contact with skin, eyes, and the respiratory tract. Wear both safety goggles and a face shield. The face shield should be a full-face shield, large enough, and curved, to protect the whole face, neck, and ears; it, too, should bear the Z87 code mark.

Wear gloves made of a material known to be impervious to the corrosive being handled. Be sure the gloves are free of corrosive contaminant on the inside before wearing. If it is likely that bare arms will be splashed, wear sleeve gauntlets made of the same material as the gloves. Use a lab apron, made of a material known to be impervious, large enough, and sufficiently full-tailored to protect the clothing.

- The apron should be tied so as to protect the lower neck/upper chest and be long enough to protect the calf of the leg. Never wear shoes with open toes, or with woven leather strips, or other gaps over the toes, or with cloth-covered toes in the laboratory.
- Always store corrosives below eye level.
- After handling corrosive chemicals, always wash thoroughly using plenty of water. Promptly flush splashes of corrosives off the skin with copious flowing water for at least 15 minutes.If splashed on clothing, the clothing must be removed while under a safety shower. Do not remove the clothing and then get under the shower.

While under the shower, remove all clothing, including shoes, socks, wristwatch and strap, and other jewelry5 if they are splashed with corrosives (this is no time for modesty). Stay under the shower for at least 15 minutes while someone else calls a doctor. (It helps if the water is tepid, not cold.) Make certain in advance that the safety shower is working and that students know how to use it. A splash of a corrosive chemical in the eye is a very serious matter. Get the victim to an eyewash fountain within 30 seconds maximum, preferably even sooner.

The eyewash fountain must be capable of delivering a gentle but copious flow of fresh water (preferably tepid) for at least 15 minutes to both eyes. (Most portable eyewash devices cannot meet this requirement.) Ensure in advance that safety showers and eyewash fountains are working and that students know how to use them. While the victim is flushing the eyes for at least 15 minutes, someone else should call the doctor for further instructions. (Is the doctor's phone number already posted by the telephone?)

The victim should hold both eyelids open with thumb and forefinger and roll the eyeballs up, down, left and right, continuously, so as to work the flushing water around to the back of the eyeball and wash any chemical away from the optic nerve. If the chemical destroys a portion of the optic nerve, permanent blindness ensues.

If instead, the chemical destroys a portion of the front of the eye, the prognosis is less pessimistic. In all cases of contact with corrosives, take the victim to a physician for further evaluation and treatment. Irritants are chemicals similar to corrosives except that they do not destroy tissue by chemical action. Irritants cause inflammation, itching, and so on. The effects are usually reversible but may or may not be severe or long lasting; victims should be referred to a physician.

Finally, some chemicals are sensitizers. The first exposure does not usually cause any notable symptoms. The second, or perhaps the third or fourth or more, exposure does cause symptoms because the victim has been sensitized by prior exposure(s). Poison ivy is an example of this kind of effect; some victims can be exposed several dozens of times before that next, and then often quite serious, exposure incident. From the above, it would seem that the use of corrosive chemicals in grades 7–12 should be severely limited or perhaps not used at all.

Corrosive chemicals are potentially seriously harmful. There is no need for their use in pre-high school laboratory work. At that level, purchase and use diluted solutions of the strong acids and bases.6 Other corrosives such as elemental bromine are not needed at all. On the other hand, high school students can use corrosives if the precautions described above are followed.

Toxicity

Broadly speaking, there are two different toxic effects, chronic and acute. A chronic toxic effect is noted only after repeated exposures or after a single, long exposure. Commonly known chronic toxic effects include cancer and reproductive malfunctions. Acute toxic effects occur promptly upon exposure, or within a short time—a few hours at most.

Methyl and ethyl alcohol are examples. Both exhibit the same acute toxic effect: inebriation. Ethyl alcohol exhibits a chronic effect: cirrhosis of the liver. Methyl alcohol exhibits two additional acute toxic effects: blindness and death.

To understand this, consider the “dose-response” phenomenon, a characteristic of all toxins, both acute and chronic: the greater the dose, the more severe the response to the toxin. Thus, a very small amount of methyl alcohol inebriates, a bit more causes blindness, yet a bit more is fatal. All toxic substances share this characteristic; exposure to a larger amount of the toxin is worse than exposure to a smaller amount; an exposure of longer duration has a greater toxic effect than the exposure of a shorter duration.

One precautionary measure for toxins is now obvious: Minimize the exposure. Use the smallest amount of a toxin that is suitable for the purposes of an experiment. Minimize the time an experimenter will work with a toxin. Work with toxins only in a fume hood that is known to be operating properly.

Toxic chemicals can enter the body in five different ways, called “routes of exposure”. The first route of exposure to be discussed is inhalation. 1. Inhalation. It is commonly thought that if you cannot smell a toxin, then you are not being exposed unduly. This is true for some odoriferous toxins and false for others; there is no way to tell which is which. It is especially incorrect to think that the more offensive the odour, the more toxic the substance.

The safe procedure is to keep the concentration of the toxic vapour well below the “threshold limit

value" (TLV). Not all toxins have been assigned a TLV value. TLVs for toxic chemicals, if a value has been assigned, are given in the MSDS for those chemicals. Note that TLV values pertain to fully grown adults. Younger persons may be more susceptible to toxic exposure than fully grown adults. Therefore, in laboratory work for students in grades 7–12, it is particularly important to ensure that vapour and dust concentrations of toxins are maintained well below established TLV values.

Fortunately, there are many chemicals used for laboratory work in grades 7–12 for which this need not be a concern because their TLV values are sufficiently high so that their expected air concentrations are well below their TLV values. Under certain circumstances, your employer is required to measure the concentrations of toxins in the air you breathe and to provide you, the teacher–employee, both with the results of the measurement and with consultation by a physician or other health practitioner, all at no expense to you.7 No similar requirements have been promulgated for the protection of students or other nonemployees.

The preceding discussion has emphasized inhalation. The other four routes are 2. Injection, for example, by a cut from contaminated, broken glassware or sharp knife. 3. Absorption through intact skin, for example, phenol splashed on the skin—which can be fatal if not promptly flushed off. 4. Ingestion, for example, swallowing a toxic solution. 5. Via other body orifices, such as the ear canal and the eyeball socket. Our eyes are a bit loose in their sockets.

Vapors, mists and fine dust can enter the body via this route. In addition to minimizing the exposure by using the least amount necessary for the shortest possible period of time, precautionary measures for toxins include barriers, cleanliness, and avoidance. Thus, one avoidance precaution is, simply, good ventilation throughout the laboratory as well as the use of fume hoods. Wearing impervious gloves is an example of a barrier precaution.

Cleanliness includes good housekeeping practices, such as minimizing dust from solid toxins, the mist from liquid toxins, prompt spill cleanup, and probably most important of all, thorough washing of hands and arms and scrubbing under fingernails as a habitual practice before leaving the laboratory. Further precautions involve your awareness of the most likely symptoms of toxic overexposure: headache, nausea, and dizziness. Whenever you experience any of these three while you or someone else nearby is working with a toxic chemical, get to fresh air immediately and do not return until the symptom has disappeared.

If on your return the symptom recurs, leave immediately and call a physician; it is likely that you have been overexposed. However, the absence of these or other symptoms does not necessarily indicate no exposure. In advance, read the MSDSs for the chemicals you and your students will be handling. Consult with a local physician in advance, advising him or her of the toxic chemicals used in the lab and ensure that the physician will be prepared in advance to treat victims of toxic exposures. For each toxic chemical, after reading the MSDS:

1. Evaluate the toxic risk posed to your students in their use, with precautions, of the chemical;
2. Evaluate the educational benefit to be gained if the chemical is used, with precautions, by your students; and
3. Based on the balance between risk and benefit, decide whether or not to use the chemical.

And, if you decide to use a particular chemical, be sure that you know

- whether or not, in case of ingestion, vomiting should or should not be induced,
- the symptoms of exposure to that chemical, and
- if applicable, the recommended procedure in case of unconsciousness.

Reactivity

Next, reactive hazards. Container labels do not always describe the fact that a chemical is self-reactive, for example, that it will spontaneously explode, or that if mechanically disturbed it could explode. Nor do labels always state that a chemical, if mixed with certain other chemicals, will react rapidly and release a large amount of energy. For reactivity information, refer to the MSDS for a chemical; if applicable, that information should be described in the MSDS.

Precautionary measures for self-reactive chemicals include, of course, not providing students with any such chemicals. These include picric acid, wet or dry ,picric acid can detonate when mechanically disturbed). Peroxide formers are similarly hazardous. They include metallic potassium, diethyl ether, and other ethers such as dioxane and tetrahydrofuran; their peroxides are explosively unstable when mechanically disturbed. The other reactive hazard is reactive incompatibility.

Even dilute acid is reactively incompatible with the dilute base. Other combinations include oxidizing agents and reducing agents—chlorates and powdered metal, to cite one example. There are other kinds of incompatible pairs. For this, the MSDS is the usual information source.

Precautionary measures include providing reactively incompatible pairs to students only when that provision is deliberately determined by the teacher— and even then providing very small quantities, and only under direct supervision. Precautionary measures also, and emphatically, include proper storage practices. Incompatible pairs are kept separate from each other in the storage area. Above all else, never store chemicals in alphabetical order by name.

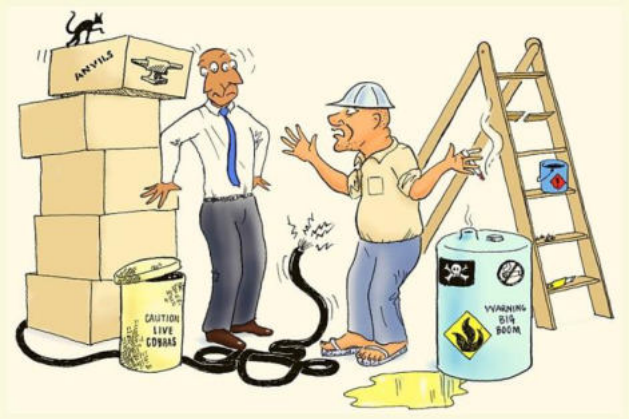
Alphabetical storage leads inevitably to adjacent positions for several pairs of incompatibles.8 Chemicals that are incompatible with common fire-fighting media—water, carbon dioxide—should be stored under conditions that minimize the possibility of reactions should it be necessary to fight

a fire in the storage area. Refer to the MSDS for information on this incompatibility.

Some of the commercial suppliers of laboratory chemicals for schools have incorporated the use of colour-coded labels with different colours, or alternating stripes of colour, or both, on the label to indicate the manner of storage. Each different colour or stripe code signifies a separate storage space; only chemicals with the same colour or the same stripe coding are compatible with each other and therefore may be stored with other similarly coded chemicals.

When this storage protocol is followed, incompatible chemicals are well separated from each other. Unfortunately, different laboratory chemical suppliers use different colour codes. When storing chemicals from different suppliers, be aware that a chemical coded with a green stripe, say, from supplier X may or may not be compatible with a green stripe-coded chemical from supplier Q. Consult both suppliers'MSDSs for clarification

Physical Hazards



The last hazard category, physical hazards. Some physical hazards are associated with chemicals, some with objects, and some with people. A physical hazard that once was quite common among teachers of chemistry was their tendency to accept donations of chemicals from well-meaning donors. An example of a physical hazard that is associated with some chemicals is slipperiness. Concentrated sulfuric acid is very slippery.

Appendix D : Public Meeting