EXPANSION OF LIQUID OXYGEN (LOX) AND DIESEL STORAGE AT THE AIR PRODUCTS FACILITY LOCATED WITHIN THE COEGA SPECIAL ECONOMIC ZONE, PORT ELIZABETH, EASTERN CAPE PROVINCE

ENVIRONMENTAL MANAGEMENT PROGRAMME

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PROJECT DETAILS

Title	:	Environmental Management Programme: Expansion of Liquid Oxygen (LOX) and diesel storage at the Air Products facility located within the Coega Special Economic Zone, Port Elizabeth, Eastern Cape Province
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DEFINITIONS AND TERMINOLOGY

The following definitions and terminology may be applicable to this project and may occur in the report below:

Alien species: A species that is not indigenous to the area or out of its natural distribution range.

Alternatives: Alternatives are different means of meeting the general purpose and need of a proposed activity. Alternatives may include location or site alternatives, activity alternatives, process or technology alternatives, temporal alternatives or the 'do nothing' alternative.

Ambient sound level: The reading on an integrating impulse sound level meter taken at a measuring point in the absence of any alleged disturbing noise at the end of a total period of at least 10 minutes after such meter was put into operation.

Assessment: The process of collecting, organising, analysing, interpreting and communicating information which is relevant.

Biological diversity: The variables among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes they belong to.

Commence: The start of any physical activity, including site preparation and any other activity on site furtherance of a listed activity or specified activity, but does not include any activity required for the purposes of an investigation or feasibility study as long as such investigation or feasibility study does not constitute a listed activity or specified activity.

Construction: Construction means the building, erection or establishment of a facility, structure or infrastructure that is necessary for the undertaking of a listed or specified activity as per Regulations GNR 327, 325 and 324 of December 2014 (as amended April 2017). Construction begins with any activity which requires Environmental Authorisation.

Cumulative impacts: The impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

Decommissioning: To take out of active service permanently or dismantle partly or wholly, or closure of a facility to the extent that it cannot be readily re-commissioned. This usually occurs at the end of the life of a facility.

Direct impacts: Impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity (e.g. noise generated by blasting operations on the site of the activity). These impacts are usually associated with the construction, operation, or maintenance of an activity and are generally obvious and quantifiable.

Disturbing noise: A noise level that exceeds the ambient sound level measured continuously at the same measuring point by 7 dB or more.

'Do nothing' alternative: The 'do nothing' alternative is the option of not undertaking the proposed activity or any of its alternatives. The 'do nothing' alternative also provides the baseline against which the impacts of other alternatives should be compared.

Ecosystem: A dynamic system of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.

Endangered species: Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included here are taxa whose numbers of individuals have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

Environment: the surroundings within which humans exist and that is made up of:

i. The land, water and atmosphere of the earth;
ii. Micro-organisms, plant and animal life;
iii. Any part or combination of (i) and (ii) and the interrelationships among and between them; and
iv. The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

Environmental Authorisation (EA): means the authorisation issued by a competent authority (Department of Environmental Affairs) of a listed activity or specified activity in terms of the National Environmental Management Act (No 107 of 1998) and the EIA Regulations promulgated under the Act.

Environmental Assessment Practitioner (EAP): An individual responsible for the planning, management and coordinating of environmental management plan or any other appropriate environmental instruments introduced by legislation.

Environmental Control Officer (ECO): An individual appointed by the Owner prior to the commencement of any authorised activities, responsible for monitoring, reviewing and verifying compliance by the Contractor with the environmental specifications of the EMPr and the conditions of the Environmental Authorisation.

Environmental Officer (EO): The Environmental Officer (EO), employed by the Contractor, is responsible for managing the day-to-day on-site implementation of this EMPr, and for the compilation of regular (usually weekly) Monitoring Reports. The EO must act as liaison and advisor on all environmental and related issues and ensure that any complaints received from the public are duly recorded and forwarded to the Site Manager and Contractor.

Environmental impact: An action or series of actions that have an effect on the environment.

Environmental impact assessment: Environmental Impact Assessment, as defined in the NEMA EIA Regulations, is a systematic process of identifying, assessing and reporting environmental impacts associated with an activity.

Environmental management: Ensuring that environmental concerns are included in all stages of development, so that development is sustainable and does not exceed the carrying capacity of the environment.

Environmental management programme: A plan that organises and co-ordinates mitigation, rehabilitation and monitoring measures in order to guide the implementation of a project or facility and its ongoing maintenance after implementation.

Habitat: The place in which a species or ecological community occurs naturally.

Hazardous waste: Any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment.

Incident: An unplanned occurrence that has caused, or has the potential to cause, environmental damage.

Indigenous: All biological organisms that occurred naturally within the study area prior to 1800.

Indirect impacts: Indirect or induced changes that may occur because of the activity (e.g. increased traffic and emissions in the vicinity of the plant due to increased Air Products trucks to due increase in storage capacity at the site). These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place because of the activity.

Interested and affected party: Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups, and the public.

Method Statement: a written submission by the Contractor in response to the environmental specification or a request by the Site Manager, setting out the plant, materials, labour and method the Contractor proposes using to conduct an activity, in such detail that the Site Manager is able to assess whether the Contractor's proposal is in accordance with the Specifications and/or will produce results in accordance with the Specifications.

Pre-construction: The period prior to the commencement of construction, which may include activities which do not require Environmental Authorisation (e.g. geotechnical surveys).

Pollution: A change in the environment caused by substances (radio-active or other waves, noise, odours, dust or heat emitted from any activity, including the storage or treatment or waste or substances.

Rare species: Taxa with small world populations that are not at present Endangered or Vulnerable, but are at risk as some unexpected threat could easily cause a critical decline. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range. This category was termed Critically Rare by Hall and Veldhuis (1985) to distinguish it from the more generally used word "rare."

Red Data Species: Species listed in terms of the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species, and/or in terms of the South African Red Data list. In terms of the South African Red Data list, species are classified as being extinct, endangered, vulnerable, rare, indeterminate, insufficiently known or not threatened (see other definitions within this glossary).

Significant impact: An impact that by its magnitude, duration, intensity, or probability of occurrence may have a notable effect on one or more aspects of the environment.

Vulnerable species: A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

Waste: Any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be re-used, recycled or recovered and includes all wastes as defined in Schedule 3 to the Waste Amendment Act (as amended on June 2014); or any other substance, material or object that is not included in Schedule 3 that may be defined as a waste by the Minister.

ABBREVIATIONS

The following abbreviations may be applicable to this project and may occur in the report below:

AIA	Archaeological Impact Assessment
BGIS	Biodiversity Geographic Information System
CDC	Coega Development Corporation
CDSM	Chief Directorate Surveys and Mapping
CEMP	Construction Environmental Management Plan
DEA	Department of Environmental Affairs
DMR	Department of Minerals and Energy
EAP	Environmental Impact Practitioner
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
I&APs	Interested and Affected Parties
NEMA	National Environmental Management Act
NEMAA	National Environmental Management Amendment Act
NEMBA	National Environmental Management: Biodiversity Act
NHRA	National Heritage Resources Act
NSBA	National Spatial Biodiversity Assessment
NWA	National Water Act
PM	Post Meridiem; "Afternoon"
SANBI	South Africa National Biodiversity Institute
SANS	South Africa National Standards
SDF	Spatial Development Framework

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APPENDICES:

CHAPTER 1: INTRODUCTION

This Environmental Management Programme (EMPr) has been compiled for the expansion of Liquid Oxygen (LOX) storage; the addition of diesel storage and associated infrastructure at the Air Products Coega facility located within the Coega Special Economic Zone (SEZ), Zone 3. The expansion of liquid oxygen storage consists of either a) the addition of 1x 127,3 m^3 double walled, vacuum jacketed vertical tank or b) the replacement of the existing tank 72,7 m^3 with a 200 m^3 LOX tank; and the installation of a 1 x 23 m^3 aboveground composite diesel storage tank on Erf 228, within Zone 3 of the Coega SEZ, on the existing Air Products Coega Plant site. The existing site is approximately 1.3ha in extent and falls under the jurisdiction of the Nelson Mandela Bay Metropolitan Municipality.

This EMPr has been developed on the basis of the findings of the Basic Assessment (BA), and must be implemented through controlling construction, operation and decommissioning activities that could have a detrimental effect on the environment, and through avoiding or minimising potential impacts. This EMPr is applicable to all employees and contractors working on the pre-construction, construction, and operation and maintenance phases of the development. The document must be adhered to and updated as relevant throughout the project life cycle. This document fulfils the requirement of the EIA Regulations, 2014 (as amended) and forms part of the BA Report for the project.

In terms of the Duty of Care provision in S28(1) of NEMA, the project proponent must ensure that reasonable measures are taken throughout the life cycle of this project to ensure that any pollution or degradation of the environment associated with this project is avoided, halted or minimised. In terms of NEMA, it has become the legal duty of a project proponent to consider a project holistically, and to consider the cumulative effect of a variety of impacts. While no permitting or licensing requirements arise directly by virtue of the expansion of the Liquid Oxygen and diesel storage, this Section of the Act will be applicable throughout the life cycle of the project.

CHAPTER 2: PROJECT DETAILS

APSA first broke ground at the Coega Special Economic Zone (SEZ), Zone 3, in 2013 and was the first of its kind in the region. The purpose of the company's investment in the SEZ was to bring local stability to the sector, counter-acting the practice of gas being trucked into the region practice of gas being trucked into the region.

The APSA site in the Coega SEZ features the latest available air separation technology designed for maximum product output capacity and energy efficiency (see **Figure 2.2.** for Air Separation process). Liquid Oxygen (LOX) and Liquid Nitrogen (LIN) are currently handled and stored at the site for use in the air separation process. APSA is proposing to increase the current LOX storage capacity at this site. The LOX storage capacity will be expanded by an additional 127,3 m^3 to a total of 200 m^3 either through the addition of a new 127,3 m^3 tank, or the replacement of the existing 72,7m^3 tank with a 200m^3 tank. In addition, APSA intends to add 23 000 litres (23 m^3) of above ground diesel storage facility at the site for use for the Air Products trucks that are based in Port Elizabeth.

The design and layout of the LOX tanks are as per APSA standards for the storage of cryogenic liquids. The 127,3 m^3 LOX tank will either be located adjacent to the existing LOX and Nitrogen tanks or replace the existing 72,7 m^3 LOX tank with a 200 m^3 tank as the loading bays and infrastructure are already in place.

The design of the 23 m^3 aboveground diesel tank is as per the standard of the fuel supplier (Engen). The standard aboveground composite tank will also consist of standard bund wall designs, spill slab, spill separator, 1 pump, 2 hoses and shut off valve. The layout of the diesel tank and infrastructure within the site is dependent on the location of the intended diesel tank based on the results of the Major Hazard Installation Risk Assessment. One location was determined to be feasible by APSA for the siting of the diesel tank (Location 1) within the site and has been assessed accordingly within the Major Hazard Installation Risk Assessment Report (refer to Appendix D of the Basic Assessment report) for the Qualitative evaluation of the proposed diesel locations. Based on the Major Hazard Installation Risk Assessment report the following alternatives of the LOX and diesel storage locations are proposed:

Addition of 127,3 m^3 LOX tank adjacent to existing LOX tank and diesel tank storage located at location 1 as per MHI report (Preferred Alternative- A1): Loading bays and infrastructure for additional LOX tank already in place and the diesel tank placement was deemed relatively distant from neighbouring properties and to be located a minimum of 15,2 metres away from the Main Air Compressor as per Air Products standards.

Replacement of existing 72,7 m^3 LOX tank with 200 m^3 LOX Diesel Tank location Number 1 as per MHI report (Alternative 2- A2): Loading bays and infrastructure for already in place for existing LOX tank and the diesel tank placement was deemed relatively distant from neighbouring properties and to be located a minimum of 15,2 metres away from the Main Air Compressor as per Air Products standards.

As the proposed expansion of Liquid Oxygen and Diesel storage will take place within the existing site and within Zone 3 of the Coega SEZ, the changes will take place within a brownfields site.

The existing operations consist of storage of and handling of Liquid Oxygen (LOX) and Liquid Nitrogen (LIN) at the site for use in the air separation process. The initial development and operation of facilities for the storage and handling of cryogenic substances (liquid oxygen) in above ground double walled, vacuum

jacketed storage tanks was below the threshold of 80 m^3 for storage of dangerous good. The current storage of liquid gases and petroleum at the site consists of the following capacities:

Cryogenic substance	Existing capacity (m^3)
Liquid Oxygen (LOX)	72,7
Liquid Nitrogen (LIN)	356
Diesel	0

As per the above table the storage capacity did not exceed GN R. 327, Activity No. 14 for storage of dangerous good (LOX and diesel) and other activities as per National Environmental Management Act (NEMA), Act 107 of 1998 (as amended) during the Air Products inception in 2013.

Air Products South Africa (Pty) Ltd now intends to increase their storage capacity of Liquid Oxygen at and include aboveground diesel storage at the site to supply their trucks travelling long distances. This proposed increased storage of Liquid Oxygen (LOX) and diesel combined with the existing storage of Liquid Oxygen will result in the total storage capacity that exceeds 80 m^3 of dangerous goods thereby triggering Listing Notice 1 of GN R.327, Activities 14, 51 and Activity No. 67. The expansion of storage facilities at the Air Products Coega plant is in line with the current operations at the site and forms part of the larger existing operations at the site.

Table 2.1: Location of proposed expansion of liquid oxygen and diesel storage tanks within the existing Air Products Coega plant site.

Province	Eastern Cape Province
Municipality	Nelson Mandela Bay Metropolitan Municipality
Ward number(s)	Ward 60
Nearest town(s)	The project site is located near the Motherwell Township, ~1km, east of the project site. The town of Port Elizabeth is located ~22 km south of the project site.
Farm name(s) and number(s)	Erf 228
SG 21 Digit Code	Surveyor-General Database » C07600230000022800000
Current Zoning	Light general Industrial
Site Coordinates	33° 47'36.65"S 25° 37'37.21"E

The expansion is proposed to include the following infrastructure:

- 1 x 127,3 m^3 LOX double walled vacuum jacketed vertical storage tank or replacement of existing 72,7m^3 tank with a 200m^3 tank;
- 1 x 23 m^3 composite aboveground diesel storage tank with fibre glass lining;
- 1 x standard pump, 2 hoses and shut off valves;
- Spill slab;
- 9,6 m x 6,4 m (57,15 m^3) bund wall with drainage system in compliance with SANS 10131:2004 or SANS 10089 – 1:2008;

» Separator pit (oil separator) with 6000 litre capacity (57,15 m^3) in line with SANS 10400 P (Sewer and Drainage) Edition 3.

Table 2.2 provides the details of the technology proposed for the proposed expansion of liquid oxygen and diesel storage tanks and the associated infrastructure.

Table 2.2: Details of the proposed liquid oxygen and diesel storage tanks and associated infrastructure

Component	Description / Dimensions
LOX storage tank	Capacity: additional 127,3 m^3 LOX tank **or** 200m^3 replacement tank
Aboveground diesel tank	Capacity: ~23 m^3 Pumps: x1 pump; 2 hoses; shut off valves
Bund Wall	9,6 m x 6,4 m bund wall with drainage system in compliance with SANS 10131:2004 or SANS 10089 – 1:2008
Spill slab	Impermeable concrete surface upon which vehicles will park when refuelling.
Separator pit	Separator pit (oil separator) with 6000 litre capacity in line with SANS 10400 P (Sewer and Drainage) Edition 3.
Internal access	Existing internal access roads are present within the site; no new accesses will be created.
Site access	Existing access to the site will be used on the north western side of the Air Products site, off Intsimbi Road
Services required	» Refuse material disposal - all refuse material generated from the proposed project will be collected by EnviroServ Waste Management that is contracted to the Air Products Coega site and will be disposed of at a licensed waste disposal site off site. This service will be arranged with EnviroServ Waste Management when required. » Refuelling of the above ground diesel tank will be conducted as per the internal agreement of supply between Engen and Air Products (Pty) Ltd..

The Coega Special Economic Zone (SEZ) is developed and managed by the Coega Development Corporation (CDC) and aimed at driving local and foreign direct investments in port orientated industries. Industries that are designated within different zones have undergone the relevant environmental assessments based on the activities being undertaken and impacts on the surrounding environment. Considering the sheer number of industries and operations at the SEZ, there have been several basic assessments, environmental impact assessments, specialist studies and management plans that have been conducted and implemented for the SEZ.

Air Products South Africa (Pty) Ltd (APSA) is a world-leading company with over 50 years of operation. The company's core Industrial Gases business provides atmospheric and process gases and related equipment to manufacturing markets, including refining and petrochemical, metals, electronics, and food and beverage. APSA first broke ground at the Coega Special Economic Zone (SEZ), Zone 3, in 2013 and was the first of its kind in the region. The purpose of the company's investment in the SEZ was to bring local stability to the sector, counter-acting the practice of gas being trucked into the region.

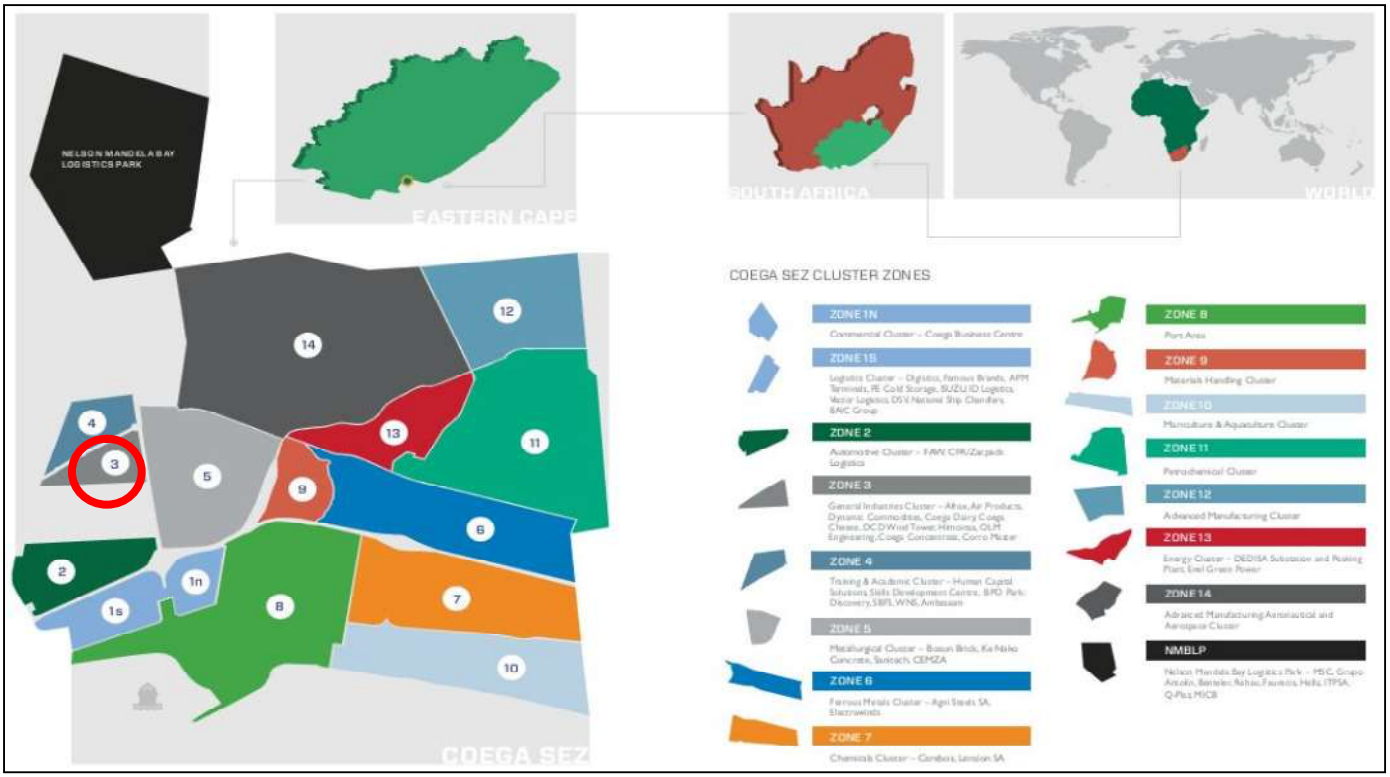

Figure 2.1: Zone Map for the Coega Strategic Economic Zone (SEZ)

The APSA site in the Coega SEZ features the latest available air separation technology designed for maximum product output capacity and energy efficiency. Liquid Oxygen (LOX) and Liquid Nitrogen (LIN) are currently handled and stored at the site for use in the air separation process. Refer to **Figure 2.2**. for a brief summary of the air separation process.

The APSA project site is located within the Coega Special Economic Zone (SEZ), Zone 3, amongst other existing industries such as Afrox, Coega Dairy, Famous Brands, Dynamic Commodities, Himoin SA and Ambsaam. Zone 3 is designated for light general industrial development and can therefore be considered a brownfields site.

Air Products is committed to providing a safe environment for its employees other tenants within the SEZ, in this regard APSA will undertake monthly water quality monitoring to ensure that the quality of outflow entering the stormwater system complies with the General Limit Values of the National Water Act (No. 36 of 1998). In order to ensure the safety of the neighbouring tenants APSA will be installing a 1,5m high firewall between the diesel tank and the property boundary of Dynamic Commodities as an alternative mitigating measure to ensure compliance to the SANS 10131 requirements.

Diesel is a class II product and is required to be heated to release its volatiles. Due to the hydrocarbon vapours likely being present only in trace amounts, the inventory of hydrocarbon vapour available for fire or explosion would be limited and therefore the effects would unlikely result in a major release, but rather on equipment damage.

It is anticipated that exhaust emissions from APSA tankers refuelling will remain the same as per the daily emissions as there will be no change to the fleet size and considering that the tankers currently operate from the Air Products site.

The Nelson Mandela Bay Fire Department will only issue the Flammable Liquid Licence to Air Products if they are satisfied with the installation and that it has met the SANS standards and local by-laws.

There is no land sterilisation of the properties adjacent to the Air Products site as a result of the planned installation LOX and diesel storage tanks at the planned locations.

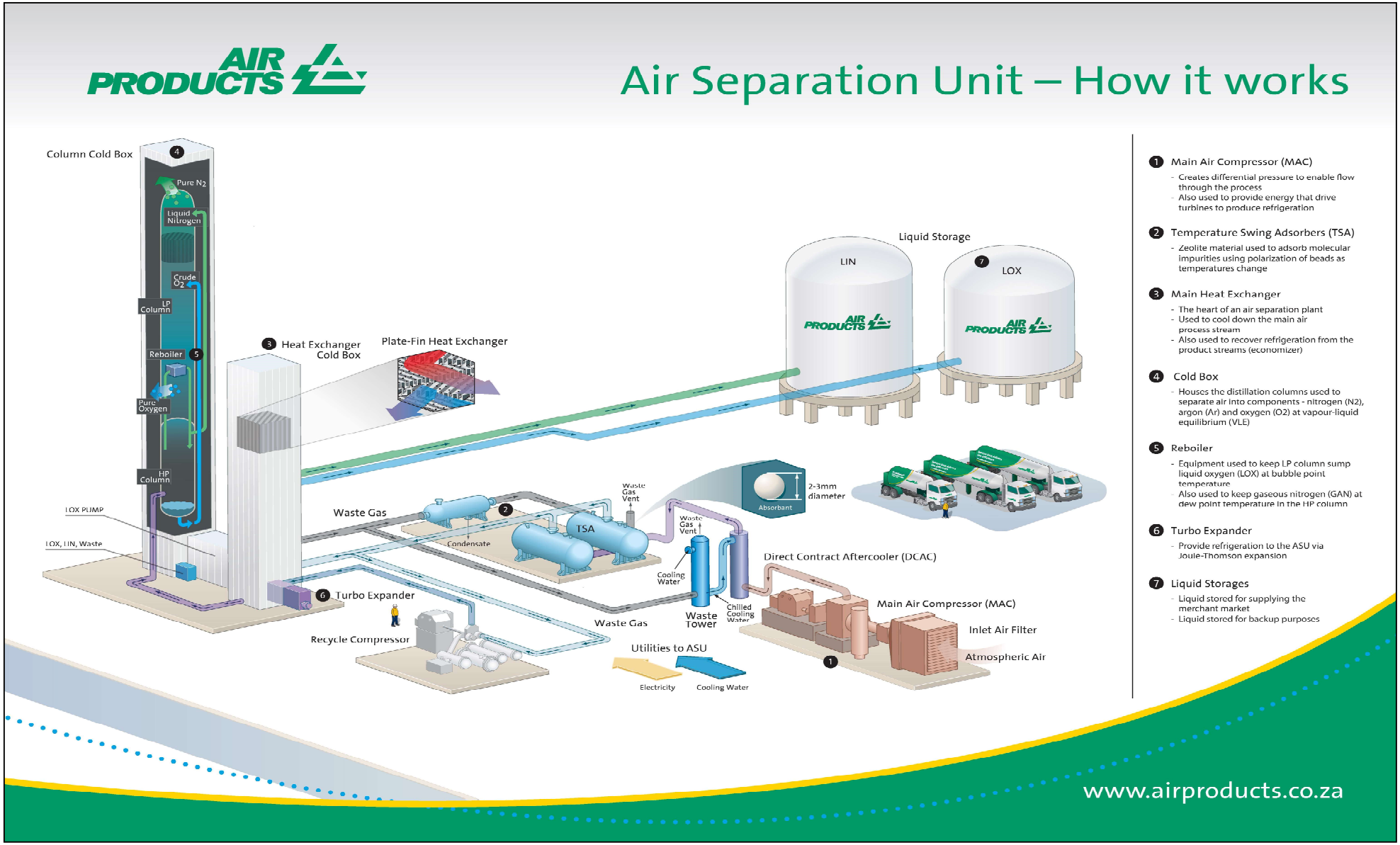

Figure 2.2: Air Separation – How it works (Air Products (Pty) Ltd; 2019)

APSA currently supplies customers in the Eastern Cape region with supply also going as far as from Port Elizabeth to Cape Town in the Western Cape. APSA currently uses approximately 5 trucks that transport and supply cryogenic substances to customers. It is not anticipated that more trucks will be added due to the proposed expansion. The addition of trucks is dependent on the demand for the product and will be determined a part of the strategic plan going forward.

Figure 1.3: Preferred Layout of Air Products Coega Site for proposed addition of LOX tank in red and location of replacement LOX tank at existing LOX tank (Alternative 2) circled in red and Diesel Storage highlighted in red.

2.1 Activities and Components Associated with the development

The following pre-construction, construction, operation and decommissioning activities will be associated with the project:

Pre-Construction Surveys:

Prior to initiating construction, the following studies/surveys s will be required to be undertaken including, but not limited to:

» A Risk Assessment – The Major Hazard Installation (MHI) Regulations require that a risk assessment be carried out when hazardous materials are used, handled, processed or stored.

Construction Phase:

The construction phase will be up to 3 months. The following activities will be undertaken during the construction phase:

» The construction phase will include the transportation of the required equipment and building material to the project site. Typical civil engineering construction equipment will need to be brought to the site (e.g. trucks, graders, compaction equipment, cement trucks, etc.).
» As the site is existing and currently operational, no vegetation clearing will take place, site preparation will include the clearance of paved surfaces for the installation of the new aboveground tanks and associated infrastructure.
» Laydown and storage areas will be required for the typical construction equipment. Once the required equipment has been transported to site, a dedicated equipment construction camp and laydown area will be established within the site.
» Construction of the spill slab, bunding and installation of the separator pit.
» Installation of the aboveground vertical double walled vacuum jacketed LOX tank;
» Installation of the aboveground composite diesel tank;
» Once construction is completed and all construction equipment is removed, the site must be rehabilitated where practical and reasonable.

A local contractor will be appointed for the construction phase of the expansion activities. Employment opportunities will need to comply with the Labour Agreement as provided by the CDC due to the locality of the expansion within the SEZ. The Compilation Document for the Construction Management Plan: Preparation and Incorporation of Specifications into Tender and Contract Information (Report No: CDC/SHE/4233/SHESD 4.4.6.0.4) must be in considered and incorporated within the formulation and procurement procedures associated with the construction phase of the project, all contractors must be made aware and carry out the conditions associated with the document as relevant to the project.

Operation Phase

The proposed additional liquid oxygen (LOX) and diesel tanks and associated infrastructure will be designed for a future life of the operation. The Air Products Coega plant is expected to produce approximately 110 tonnes of liquid nitrogen and oxygen per day in line with market demand. Employment opportunities during the operational phase will consist of up to 4 additional opportunities. The Air Products plant and associated infrastructure will require maintenance, this will be undertaken as part of the quarterly scheduled maintenance conducted or the annual shut down. Aspects concerning the diesel storage tank maintenance will be undertaken by Engen during scheduled inspections.

Decommissioning

Depending on the continued economic viability of the project following an operation period of 30 years, the project will either be decommissioned or the operation phase will be extended. However, if the decision is made to decommission the project, the following activities will form part of the project scope:

» Site preparation activities will include confirming the integrity of the access to the site to accommodate the required decommissioning infrastructure.

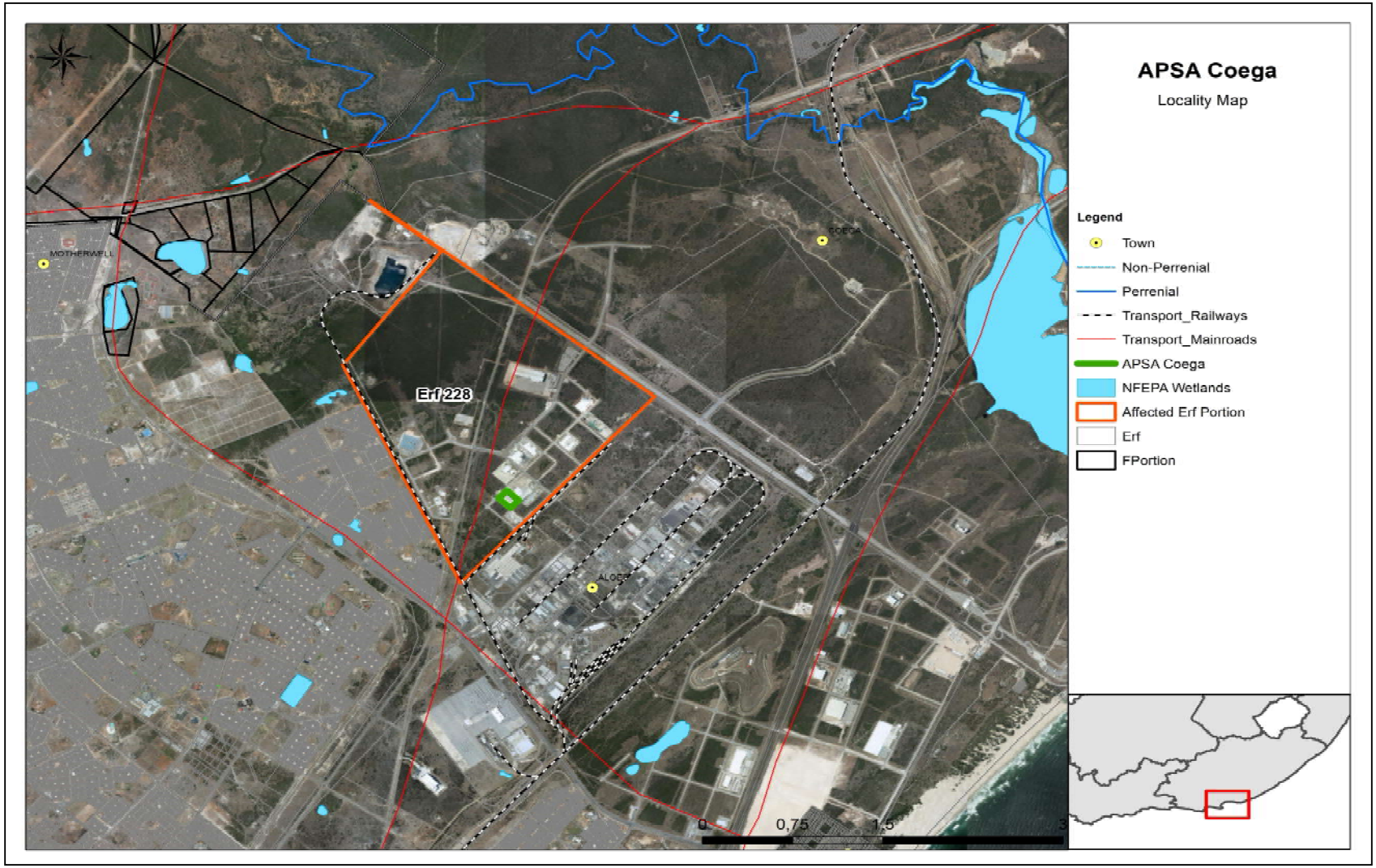

Figure 2.4: Locality map indicating the location of the existing Air Products site within Coega, Eastern Cape

2.2 Findings of the Basic Assessment (BA)

This section provides a summary of the environmental assessment and conclusions drawn for the development of the project at the existing Air Products South Africa Coega site, and which will be expanded in response to the supply demand for liquid oxygen within the Coega, Port Elizabeth and Cape Town regions. In doing so, it draws on the information gathered as part of the Basic Assessment process and the knowledge gained by the environmental consultant during the course of the process, and presents an informed opinion of the environmental impacts associated with the proposed project. The following conclusions can be drawn from the Basic Assessment:

Noise:

Noise generated from construction activities will have little impact on the surrounding businesses due to the nature of area zoned for light and medium general industrial activities. As construction activities will take place during the day when ambient noise conditions are louder the noise generated from construction is anticipated to be minimal. Construction noise is anticipated is to be short term and local in extent, as construction is anticipated to be completed within 3 months of commencement.

Noise is created from the machinery that is operational 24 hours a day in the existing facility and will not increase following the addition of the LOX will increase the ambient noise levels in the immediate vicinity. The plant design has already taken into consideration the positioning of noise generating equipment to reduce the noise levels at the boundaries and Air Products have also implemented soundproofing of the structures housing noise generating equipment, with no additional mitigation measures proposed.
The significance of the impact resulting from construction activities is rated as low (negative) for the proposed development as the site is classified as industrial with very low baseline noise levels and it is not near any residential areas. With the implementation of mitigation measures the impact can be minimised further.

Socio-Economic Impacts

The project will result in direct investment into the economy, consisting of capital expenditure, including engineering, procurement and construction; additionally, local contractors will be appointed for the construction phase of the activity. Employment opportunities must comply with the Labour Agreement as provided by the CDC due to the locality of the expansion within the SEZ.

It is anticipated that the expansion will result in approximately 3 new job opportunities during the operational phase. Although the intensity of the impact is low due to the small number of jobs required for the operation of the plant, the period of the impact (up to 50 years) and the one local contractor being appointed for the construction period results in the impact were rated as a low (negative). No mitigation measures are required.

Waste Management Impacts

As minimal general waste is anticipated to be generated during the 3-month construction phase and considering that the operational site currently has an agreement with EnviroServ Waste Management for

the collection and disposal of waste the impact rating for the construction phase was anticipated to low (negative).
No further waste management impact as a result of the additional storage tanks were anticipated for the operational phase of the project.

Traffic Impacts

Traffic impacts during the construction phase of the activity is deemed to be low (-ve) due to the short construction timeframe (3 months). It is not anticipated that the construction phase will lead to traffic congestion in the area as the vehicles will be concentrated near Neptune, Cable and Intsimbi Road close to the site. It is not anticipated that construction traffic will exceed vehicle carrying capacity in the vicinity of the site. No mitigation measures are proposed due to the short construction timeframes.

As the site is located with the SEZ it is anticipated that the design of the road infrastructure as well as the road network was done in accordance with required specifications to handle the anticipated carrying capacity of the developed area on completion of the SEZ. The other developments should not interfere with the operations of Air Products located in Zone 3 of the SEZ, which is designated the Air Products plant as the plant can be reached from two directions, minimising the chance of congestion.
Based on the above the significance of this negative impact on the congestion at the intersections, as well as wear and tear of the infrastructure, is rated as low negative) due to the long-term operation of the plant, as such no mitigation measures are proposed.

Health and Safety Risks (Risk of accidents in relation to the storage of a dangerous goods)

The entire existing plant is currently fenced off; meaning any lawful access to the plant will only be gained by authorisation with adherence to safety protocol. The Air Products, storage tanks and associated machinery are to be manufactured according to the relevant safety standards. The plant is provided with safety-related monitoring and protection equipment. As a result, dangerous conditions such as excessive pressures, too high or too low temperatures, and accumulation of critical materials or leakages can be prevented. Additionally, the products are stored in double shelled storage tanks so that in the case of any external incidents, if the external shell is punctured the internal shell will remain intact.
There are management measures that will be implemented that are inherent in all the companies associated air separation plants, these include (but are not limited to):

1. An emergency response procedure is available for the site and will be updated to include all future planned installations;
2. The plant is currently equipped with lights, escape routes from the systems are to be clearly marked and updated following the new installations;
3. Regular maintenance of the machines are carried out at the plant on a quarterly basis).
4. Re-fuelling of diesel is to be undertaken more than 15,2m away from the main air compressor within the site.

From the measures currently in place for the safety impacts for operational phase of the project were deemed as low (negative) as the expansion activities are a continuation of operations currently taking

place at the site and Air Products have a number or policies and procedures in place that must be followed by all personnel.

Contamination of soil

There the risk of diesel spills when filling up trucks at the filling point as well as leaks from the storage tanks. However; the area where the filling of trucks is to take place will be constructed out of an impermeable concrete slab and bunded area, and the above ground storage tanks, as well as equipment that could potentially result in spills or leaks, are to be positioned within defined areas so as to contain any leaks or spills that may occur.
The significance of this impact is rated as a low (negative) which can be minimised with the implementation of mitigation measures

Cumulative Impacts:

Overall, the expansion activities for the Air Products Coega plant will not lead to a whole-scale change of the area due to the current zoning and land-use surrounding the site. The expansion of storage facilities will also not add to the current impacts of the existing Air Products plant and other businesses/industries in the area. The cumulative affect of the surrounding developments on the safety is considered low due to the safety procedures that are currently in place at the site. The cumulative effects of noise impacts are rated as low as the anticipated noise levels are not anticipated to exceed the current levels due to the nature of the activity being undertaken (expansion of storage facilities for existing operations). Therefore, the expansion of storage facilities for LOX and diesel is considered appropriate within the existing Air Products site without any significant cumulative impacts expected. The cumulative impacts both within and outside of the boundaries of the existing Air Products plant are considered to be of **low significance**, based on the impact being considered. Therefore, the expansion of storage facilities activity is considered appropriate and acceptable within the proposed location.

Conclusion:

Based on the findings of the impact assessment undertaken, in terms of environmental constraints and opportunities identified through the Basic Assessment process, no environmental fatal flaws were identified to be associated with the expansion of storage facilities within the Air Products Coega plant. The findings of the impacts for Alternative A1 (addition of an existing LOX tank) and Alternative A2 (replacement of the existing LOX tank) were found to be similar unless otherwise highlighted within the basic assessment. Therefore the mitigation measures proposed within this EMPr are applicable to both Alternative A1 and A2 unless otherwise specified.

The development of the project will result in positive impacts and negative impacts. Impacts are expected to be **low** after the implementation of appropriate mitigation measures. It is recommended that the proposed project be implemented to provide a reliable supply of cryogenic gases to customers requiring a trucked supply from the Eastern Cape to the Western Cape. Considering the information available at this planning stage in the project cycle, the confidence in the environmental assessment undertaken is regarded as acceptable. A Google Earth image of the site and proposed locations of the LOX storage tank and Diesel storage tank has been included as **Figure 2.5** below.

Figure 2.5. Google Image of proposed locations of the LOX and diesel storage tanks.

CHAPTER 3: PURPOSE AND OBJECTIVES OF THE EMPR

An Environmental Management Programme (EMPr) is defined as "an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation and decommissioning of a project are prevented or mitigated, and that the positive benefits of the projects are enhanced". The objective of this EMPr is to provide consistent information and guidance for implementing the management and monitoring measures established in the permitting process and help achieve environmental policy goals. The purpose of an EMPr is to help ensure continuous improvement of environmental performance, reducing negative impacts and enhancing positive effects during the construction and operation of the facility. An effective EMPr is concerned with both the immediate outcome as well as the long-term impacts of the project.

The EMPr provides specific environmental guidance for the construction and operation phases of a project and is intended to manage and mitigate construction and operation activities so that unnecessary or preventable environmental impacts do not result. These impacts range from those incurred during start up (site clearing and site establishment) through to those incurred during the construction activities themselves (erosion, noise, dust) to those incurred during site rehabilitation (soil stabilisation, re-vegetation) and operation. The EMPr also defines monitoring requirements in order to ensure that the specified objectives are met.

This EMPr is applicable to all employees and contractors working on the pre-construction, construction, and operation and maintenance phases of the development. The document will be adhered to and updated as relevant throughout the project life cycle.

This EMPr has been compiled in accordance with Appendix 4 of the EIA Regulations, 2014 (as amended) (refer to Table 3.3). This is a dynamic document and will be further developed in terms of specific requirements listed in any authorisations issued for the development and/or as the project develops. The EMPr has been developed as a set of environmental specifications (i.e. principles of environmental management), which are appropriately contextualised to provide clear guidance in terms of the on-site implementation of these specifications (i.e. on-site contextualisation is provided through the inclusion of various monitoring and implementation tools).

The EMPr has the following objectives:

- Outline mitigation measures and environmental specifications which are required to be implemented for the planning, construction, rehabilitation and operation phases of the project in order to minimise the extent of environmental impacts, and to manage environmental impacts associated with the expansion of Liquid Oxygen and Diesel storage facilities at the Air Products facility located within the Coega Special Economic Zone (SEZ).
- Ensure that the construction and operation phases do not result in undue or reasonably avoidable adverse environmental impacts and ensure that any potential environmental benefits are enhanced.
- Identify entities who will be responsible for the implementation of the measures and outline functions and responsibilities.
- Propose mechanisms and frequency for monitoring compliance and prevent long-term or permanent environmental degradation.
- Facilitate appropriate and proactive responses to unforeseen events or changes in project implementation that were not considered in the BA process.

The mitigation measures identified within the BA process are systematically addressed in the EMPr, ensuring the minimisation of adverse environmental impacts to an acceptable level.

Air Products South Africa (Pty) Ltd must ensure that the implementation of the project complies with the requirements of all environmental authorisations, permits, and obligations emanating from relevant environmental legislation. This obligation is partly met through the development and the implementation of this EMPr, and through its integration into the relevant contract documentation provided to parties responsible for construction and/or operation activities on the site. The adequacy and efficacy of implementation is to be monitored by an independent Environmental Control Officer (ECO). Since this EMPr is part of the BA process for the expansion of LOX and diesel storage facilities at Air Products Coega, Zone 3, it is important that this document be read in conjunction with the BA Report compiled for this project. This will contextualise the EMPr and enable a thorough understanding of its role and purpose in the integrated environmental management process. Should there be a conflict of interpretation between this EMPr and the Environmental Authorisation, the stipulations in the Environmental Authorisation shall prevail over that of the EMPr, unless otherwise agreed by the authorities in writing. Similarly, any provisions in legislation overrule any provisions or interpretations within this EMPr.

This EMPr shall be binding on all the parties involved in the planning, construction and operational phases of the project, and shall be enforceable at all levels of contract and operational management within the project. The document must be adhered to and updated as relevant throughout the project life cycle.

3.1. Contents of this Environmental Management Programme (EMPr)

This Environmental Management Programme (EMPr) has been prepared as part of the BA process being conducted in support of the application for Environmental Authorisation (EA) for the expansion of Liquid Oxygen and Diesel storage facilities at the Air Products facility located within the Coega Special Economic Zone (SEZ). This EMPr has been prepared in accordance with the requirements as contained in Appendix 4 of the 2014 EIA Regulations, as amended (GNR 326). It provides recommended management and mitigation measures with which to minimise impacts and enhance benefits associated with the project.

An overview of the contents of this EMPr, as prescribed by Appendix 4 of the 2014 EIA Regulations (GNR 326), and where the corresponding information can be found within this EMPr is provided in **Table 3.1**.

Table 3.1: Summary of where the requirements of Appendix 4 of the 2014 NEMA EIA Regulations (GNR 326) are provided in this EMPr.

Requirement	Location in this EMPr
(1) An EMPr must comply with section 24N of the Act and include – (a) Details of – (i) The EAP who prepared the EMPr. (ii) The expertise of that EAP to prepare an EMPr, including a curriculum vitae.	Chapter 3 Appendix D
(b) A detailed description of the aspects of the activity that are covered by the EMPr as identified by the project description.	Chapter 2
(c) A map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the existing site	Chapter 2 Figure 2.5 Appendix A
(d) A description of the impact management outcomes, including management	

Requirement	Location in this EMPr
statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development including –	
(i) Planning and design.	Chapter 5
(ii) Pre-construction activities.	Chapter 5
(iii) Construction activities.	Chapter 6
(iv) Rehabilitation of the environment after construction and where applicable post closure.	Chapter 7
(v) Where relevant, operation activities.	Chapter 8
(f) A description of proposed impact management actions, identifying the manner in which the impact management outcomes contemplated in paragraph (d) will be achieved, and must, where applicable, include actions to – (i) Avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation. (ii) Comply with any prescribed environmental management standards or practices. (iii) Comply with any applicable provisions of the Act regarding closure, where applicable. (iv) Comply with any provisions of the Act regarding financial provision for rehabilitation, where applicable.	Chapters 5 - 8
(g) The method of monitoring the implementation of the impact management actions contemplated in paragraph (f).	Chapters 5 - 8
(h) The frequency of monitoring the implementation of the impact management actions contemplated in paragraph (f).	Chapters 5 - 8
(i) An indication of the persons who will be responsible for the implementation of the impact management actions.	Chapters 5 - 8
(j) The time periods within which the impact management actions contemplated in paragraph (f) must be implemented.	Chapters 5 - 8
(k) The mechanism for monitoring compliance with the impact management actions contemplated in paragraph (f).	Chapters 5 - 8
(l) A program for reporting on compliance, taking into account the requirements as prescribed by the Regulations.	Chapters 6
(m) An environmental awareness plan describing the manner in which – (i) The applicant intends to inform his or her employees of any environmental risk which may result from their work. (ii) Risks must be dealt with in order to avoid pollution or the degradation of the environment.	Chapter 6
(n) Any specific information that may be required by the competent authority.	None have been received to date
(2) Where a government notice gazetted by the Minister provides for a generic EMPr, such generic EMPr as indicated in such notice will apply.	N/A

3.2. Project Team

In accordance with Regulation 12 of the 2014 EIA Regulations (GNR 326) the applicant appointed Savannah Environmental (Pty) Ltd as the independent environmental consultants responsible for managing the application for EA and the supporting BA process. The application for EA and the BA

process, is being managed in accordance with the requirements of NEMA, the 2014 EIA Regulations (GNR 326), and all other relevant applicable legislation.

3.3.1 Details and Expertise of the Environmental Assessment Practitioner (EAP)

Savannah Environmental is a leading provider of integrated environmental and social consulting, advisory and management services with considerable experience in the fields of environmental assessment and management. The company is wholly woman-owned (51% black woman-owned) and is rated as a Level 2 Broad-based Black Economic Empowerment (B-BBEE) Contributor. Savannah Environmental's team have been actively involved in undertaking environmental studies over the past 12 years, for a wide variety of projects throughout South Africa, including those associated with electricity generation and infrastructure development.

Jo-Anne Thomas and Arlene Singh are the EAPs responsible for preparing this EMPr. An overview of their expertise to prepare the EMPr is provided below, and copies of their curricula vitae (CVs) detailing the Savannah Environmental team's expertise and relevant experience are provided in **Appendix F** to this EMPr.

» **Jo-Anne Thomas** is a Director at Savannah Environmental (Pty) Ltd and the registered EAP for the EIA for this project. Jo-Anne holds a Master of Science Degree in Botany (M.Sc. Botany) from the University of the Witwatersrand, and is registered as a Professional Natural Scientist (400024/2000) with the South African Council for Natural Scientific Professions (SACNASP) and the Environmental Assessment Practitioners Association of South Africa (EAPASA). She has over 20 years of experience in the field of environmental assessment and management, and the management of large environmental assessment and management projects. During this time she has managed and coordinated a multitude of large-scale infrastructure EIAs, and is also well versed in the management and leadership of teams of specialist consultants, and dynamic stakeholders. Jo-Anne has been responsible for providing technical input for projects in the environmental management field, specialising in Strategic Environmental Advice, EIA studies, environmental permitting, public participation, EMPs and EMPrs, environmental policy, strategy and guideline formulation, and integrated environmental management (IEM). Her responsibilities for environmental studies include project management, review and integration of specialist studies, identification and assessment of potential negative environmental impacts and benefits, and the identification of mitigation measures, and compilation of reports in accordance with applicable environmental legislation.

» **Arlene Singh** is an Environmental Consultant at Savannah Environmental. Arlene has a Bachelor of Science Honours Degree in Environmental Management (B.Sc. Honours) and more than 6 years of experience in the environmental field. Her key focus is on environmental impact assessments, public participation, environmental management plans and programmes, as well as environmental compliance auditing for a variety of environmental projects.

Savannah Environmental's team have been actively involved in undertaking environmental studies over the past 13 years, for a wide variety of projects throughout South Africa, including those associated with infrastructure development, and therefore have extensive knowledge and experience in EIAs and environmental management, having managed and drafted EMPrs for numerous other infrastructure development projects throughout South Africa.

2.4.2 Details of the Specialist Consultants

Specialist contributions were in the form of Major Hazard Risk Assessments conducted for the site in 2015 by ISHECON and 2019 by MMrisk.

CHAPTER 4: STRUCTURE OF THIS EMPR

The first three chapters provide background to the EMPr and the project, while the chapters which follow consider the following:

- Planning and design (pre-construction) activities;
- Construction activities;
- Operation activities; and
- Decommissioning activities.

These chapters set out the procedures necessary for the project owner, to minimise environmental impacts and achieve environmental compliance. For each of the phases of implementation, an overarching environmental **goal** is stated. In order to meet this goal, a number of **objectives** are listed. The EMPr has been structured in table format in order to show the links between the goals for each phase and their associated objectives, activities/risk sources, mitigation actions, monitoring requirements and performance indicators. A specific EMPr table has been established for each environmental objective. The information provided within the EMPr table for each objective is illustrated below:

OBJECTIVE: Description of the objective, which is necessary to meet the overall goals; which take into account the findings of the BA specialist studies

Project Component/s	List of project components affecting the objective i.e.: » LOX storage tank; » Diesel storage tank;
Potential Impact	» Brief description of potential environmental impact if objective is not met.
Activity/Risk Source	» Description of activities which could affect achieving the objective.
Mitigation: Target/Objective	» Description of the target and/or desired outcomes of mitigation.

Mitigation: Action/Control	**Responsibility**	**Timeframe**
List specific action(s) required to meet the mitigation target/objective described above.	Who is responsible for the measures?	Periods for implementation.

Performance Indicator	Description of key indicator(s) that track progress/indicate the effectiveness of the EMPr.
Monitoring	Mechanisms for monitoring compliance; the key monitoring actions required to check whether the objectives are being achieved, taking into consideration responsibility, frequency, methods, and reporting.

The objectives and EMPr tables are required to be reviewed and possibly modified whenever changes, such as the following, occur:

- Planned activities change (i.e. in terms of the components and/or layout of the development);
- Modification to or addition to environmental objectives and targets;

- Additional or unforeseen environmental impacts are identified and additional measures are required to be included in the EMPr to prevent deterioration or further deterioration of the environment.
- Relevant legal or other requirements are changed or introduced; and
- Significant progress has been made on achieving an objective or target such that it should be re-examined to determine if it is still relevant, should be modified, etc.

CHAPTER 5: PLANNING AND DESIGN MANAGEMENT PROGRAMME

Overall Goal: undertake the pre-construction (planning and design) phase in a way that:

- Ensures that the design of the development responds to identified environmental constraints and opportunities.
- Ensures that pre-construction activities are undertaken in accordance with all relevant legislative requirements.
- Ensures that adequate regard has been taken of any landowner and community concerns and that these are appropriately addressed through design and planning (where appropriate).
- Ensures that the best environmental options are selected for the tank locations within the site, including consideration of the access roads.
- Enables the construction activities to be undertaken without significant disruption to other land uses and activities in the area.

In order to meet this goal, the following objectives have been identified, together with necessary actions and monitoring requirements.

5.1 Objectives

OBJECTIVE 1: Ensure the facility design responds to environmental constraints and opportunities

The project is located within Erf 228 of the existing Air Products Coega Plant located within Zone 3 of the Coega Special Economic Zone (SEZ) (referred to as the project site) located 1km west of the Motherwell Township. The town of Port Elizabeth is located 22 km south of the project site.

The proposed development site is considered to be a brownfields site as it is located within the existing Air Products site located within Zone 3 of the SEZ. Zone 3 has been designated for light general industrial activities. The existing site is currently surrounded by other industries.

Project component/s	» LOX storage tank » Diesel storage tank;
Potential Impact	» Increased risk of fire and damage to property as a result
Activity/risk source	» Location of the proposed diesel and LOX storage tanks
Mitigation: Target/Objective	» The design of the development responds to the identified environmental constraints and opportunities. » Minimisation of nuisance impacts (including noise and dust).

Mitigation: Action/control	Responsibility	Timeframe
Plan and conduct pre-construction activities in an environmentally acceptable manner.	Developer Contractor	Pre-construction
Plan the placement of laydown areas, construction equipment camps and temporary construction equipment camps in order to minimise disturbance within the site.	Developer	Pre-construction

Mitigation: Action/control	Responsibility	Timeframe
Fourteen (14) days written notice must be given to the Department that the activity will commence. The notification must include a date on which the activity will commence as well as the reference number.	Developer	Pre-construction
ECO to be appointed prior to the commencement of any authorised activities. Once appointed the name and contact details of the ECO must be submitted to the Director: Compliance Monitoring at the DEDEAT.	Developer	Pre-construction
Reduce the construction period as far as possible through careful planning and productive implementation of resources.	Developer Contractor	Pre-construction
Only the existing access to the site must be used to ensure safe entry and exit.	Developer Contractor	Design
Ensure that designs for the spill separator are to be connected to and discharged into the storm water only and no other municipal infrastructure based on agreement with Nelson Mandela Bay Metropolitan Municipality and the Coega Development Corporation.	Developer Contractor	Design
Planning of diesel tank location to be greater than or at least 15,2m away from the Main Air Compressor, as per the approved layout plan.	Developer Contractor	Design
Laydown areas and turning areas must be located in areas that are located away from the current plant but within the Air Products site to avoid degradation of adjacent properties. The EO must identify such areas.	Developer EO	Project planning
A local procurement policy must be adopted to maximise the benefit to the local economy.	Developer	Pre-construction
A comprehensive employee induction programme must be developed and utilised to cover land access protocols, fire management and road safety.	Contractor	Pre-construction
As a minimum, ongoing training should include: » Explanation of the importance of complying with the EMPr; » Explanation of the importance of complying with the Environmental Authorisation; » Discussion of the potential environmental impacts of construction activities; » Employees' roles and responsibilities, including emergency preparedness (this should be combined with this induction, but presented by the contractors Health and Safety Representative); » Explanation of the mitigation measures that must be implemented when carrying out activities; and » Explanation of the specifics of this EMPr and its specification (no-go areas, etc.).	Contractor EO	Pre-construction Construction Operation
The terms of this EMPr and the Environmental Authorisation to be included in all tender documentation and Contractors contracts.	Developer Contractor	Tender process
Where applicable, any tender documentation which may be prepared for the project is to stipulate the use of local labour as far as possible.	Developer Contractor	Tender process

Performance Indicator	» No complaints from surrounding tenants » The design meets the objectives and does not degrade the surrounding environment » Design and layouts respond to the mitigation measures and recommendations in the BA Report » The contractor must keep records of all environmental training sessions, including names, dates and the information presented. Details of the environmental induction must be included in the environmental control reports
Monitoring	» Ensure that the design implemented meets the objectives and mitigation measures in the BA Report through review of the design by the Project Manager, and the ECO prior to the commencement of activity » Records of training are kept on site

CHAPTER 6: CONSTRUCTION MANAGEMENT PROGRAMME

Overall Goal: Undertake the construction phase in a way that:

» Ensures that construction activities are properly managed in respect of environmental aspects and impacts.
» Enables construction activities to be undertaken without significant disruption to other land uses and activities in the area, in particular concerning noise impacts, waste management, soil degradation and health and safety risks, and effects on other tenants.

6.1 Institutional Arrangements: Roles and Responsibilities for the Construction Phase

As the proponent, Air Products (the Developer) must ensure that the project complies with the requirements of all environmental authorisations and permits, and obligations emanating from other relevant environmental legislation. This obligation is partly met through the development of the EMPr, and the implementation of the EMPr through its integration into the contract documentation. The Developer will retain various key roles and responsibilities during the construction phase.

OBJECTIVE 1: Establish clear reporting, communication, and responsibilities in relation to overall implementation of the EMPr

Formal responsibilities are necessary to ensure that key procedures are executed. Specific responsibilities of the Technical Director/Manager; Site Manager; Safety, Health and Environment Representative; Environmental Control Officer (ECO) and Contractor for the construction phase of this project are as detailed below. Formal responsibilities are necessary to ensure that key procedures are executed. **Figure 6.1** provides an organogram indicating the organisational structure for the implementation of the EMPr.

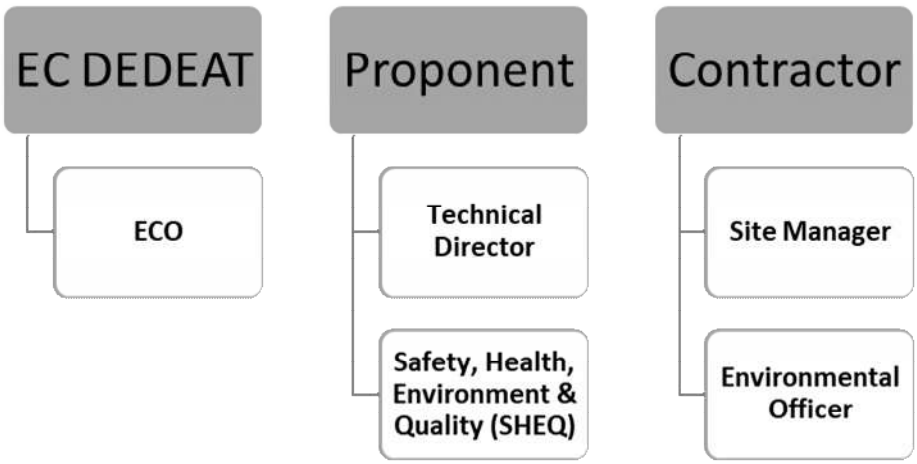

Figure 6.1: Organisational structure for the implementation of the EMPr

Technical Director will:

- Ensure all specifications and legal constraints specifically with regards to the environment are highlighted to the Contractor(s) so that they are aware of these.
- Ensure that the Developer and its Contractor(s) are made aware of all stipulations within the EMPr.
- Ensure that the EMPr is correctly implemented throughout the project by means of site inspections and meetings. This will be documented as part of the site meeting minutes through input from the independent ECO.
- Be fully conversant with the BA for the project, the EMPr, the conditions of the Environmental Authorisation, and all relevant environmental legislation.
- Be fully knowledgeable with the contents of all relevant licences and permits.

Site Manager (The Contractors' on-site Representative) will:

- Be fully knowledgeable with the contents of the BA.
- Be fully knowledgeable with the contents and conditions of the Environmental Authorisation.
- Be fully knowledgeable with the contents of the EMPr.
- Be fully knowledgeable with the contents of all relevant environmental legislation, and ensure compliance with these.
- Have overall responsibility of the EMPr and its implementation.
- Conduct audits to ensure compliance to the EMPr.
- Ensure there is communication with the Technical Director, the ECO, the Internal Environmental Officer and relevant discipline engineers on matters concerning the environment.
- Be fully knowledgeable with the contents of all relevant licences and permits.
- Ensure that no actions are taken which will harm or may indirectly cause harm to the environment, and take steps to prevent pollution on the site.
- Confine activities to the demarcated construction site.

An independent **Environmental Control Officer (ECO)** must be appointed by the project proponent prior to the commencement of any authorised activities. The ECO will be responsible for monitoring, reviewing and verifying compliance by the Contractor with the environmental specifications of the EMPr and the conditions of the Environmental Authorisation. Accordingly, the ECO will:

- Be fully knowledgeable with the contents of the BA.
- Be fully knowledgeable with the contents and the conditions of the Environmental Authorisation.
- Be fully knowledgeable, maintain, update and review the EMPr.
- Be fully knowledgeable of all the licences and permits issued for the site.
- Be fully knowledgeable with the contents of all relevant environmental legislation, and ensure compliance with them.
- Provide environmental induction training to contractors on site prior to commencing of construction activities (this can also be undertaken by the EO).
- Ensure that the contents of this document are communicated to the Contractor site staff and that the Site Manager and Contractor are constantly made aware of the contents through discussion.
- Ensure that the compliance of the EMPr, EA and the legislation is monitored through regular and comprehensive inspection of the site and surrounding areas.

- Compilation of the Environmental Audit Report, six months after completion of construction or at a frequency in compliance with the Environmental Authorisation. Reports should be submitted to the relevant authority, the Project Proponent and the CDC.
- Monitoring and verification must be implemented to ensure that environmental impacts are kept to a minimum, as far as possible.
- Ensure that the Site Manager has input into the review and acceptance of construction methods and method statements.
- Keep record of all activities on site, problems identified, transgressions noted and a task schedule of tasks undertaken by the ECO. Reports should be submitted to the relevant authority on a monthly basis.
- Ensure that the compilation of progress reports for submission to the Technical Director, with input from the Site Manager, takes place on a regular basis, including a final post-construction audit.
- Ensure that there is communication with the Site Manager regarding the monitoring of the site.
- Attendance of contractors site meetings.
- ECO site inspections to be undertaken once a month to ensure compliance with the EMPr. The duration of these visits may be increased or decreased at the discretion of the ECO in consultation with the Engineers Representative.
- Submit independent reports to the DEDEAT and other regulating authorities regarding compliance with the requirements of the EMPr, EA and other environmental permits.

As a general mitigation strategy, the Environmental Control Officer (ECO) should be present for the site preparation and initial clearing activities to facilitate environmental induction with construction staff and supervise site clearing activities (i.e. during site establishment, and excavation of foundations). Thereafter, monthly site compliance inspections would probably be sufficient, which must be increased if required.

Contractor's Environmental Officer: The Contractor's Environmental Officer (EO), employed by the Contractor, is responsible for managing the day-to-day on-site implementation of this EMPr, and for the compilation of regular (usually weekly) Monitoring Reports. In addition, the EO must act as liaison and advisor on all environmental and related issues and ensure that any complaints received from the public are duly recorded and forwarded to the Site Manager and Contractor. Given the low sensitivity of the site, this role could be combined with the Health and Safety Officer (i.e. a Safety, Health and Environment (SHE) Officer could be appointed).

The Contractor's Environmental Officer should:

- Be well versed in environmental matters.
- Understand the relevant environmental legislation and processes and the implementation thereof.
- Understand the hierarchy of Environmental Compliance Reporting, and the implications of Non-Compliance.
- Know the background of the project and understand the implementation programme.
- Be able to resolve conflicts and make recommendations on site in terms of the requirements of this Specification.
- Keep accurate and detailed records of all EMPr-related activities on site. The EO shall keep a daily diary for monitoring the site specific activities as per project schedule.
- As a general mitigation strategy, the EO should supervise any flora relocation and faunal rescue activities that may need to take place during the site clearing (i.e. during site establishment, and excavation of foundations) and therefore needs the relevant training/ experience. The EO will have overall responsibility for day-to day environmental management and implementation of mitigations.

- The EO is responsible for reporting to the ECO on the day-to-day on-site implementation of this EMPr and other Project Permits/Authorisations.
- Ensure or otherwise train and induct all contractor's employees prior to commencement of any works.
- Ensure that there is daily communication with the Site Manager regarding the monitoring of the site.
- Compilation of Weekly and Monthly Monitoring Reports to be submitted to the ECO and Site Manager.
- In addition, the EO/ Environmental Representative must act as project liaison and advisor on all environmental and related issues and ensure that any complaints received from the public are duly recorded and forwarded to the Site Manager, ECO and Contractor(s).

Contractors and Service Providers: It is important that Contractors are aware of the responsibilities in terms of the relevant environmental legislation and the contents of this EMPr. The Contractor must appoint an Internal Environmental Officer (EO) who will be responsible for informing contractor employees and sub-contractors of their environmental obligations in terms of the environmental specifications, and for ensuring that employees are adequately experienced and properly trained in order to execute the works in a manner that will minimise environmental impacts. The Internal Environmental Officer and Contractor's obligations in this regard include the following:

- Must be fully knowledgeable on all environmental features of the construction site and the surrounding environment.
- Be fully knowledgeable with the contents and the conditions of the Environmental Authorisation.
- Be fully knowledgeable with the contents with the EMPr.
- Be fully knowledgeable of all the licences and permits issued for the site.
- Ensure a copy of the Environmental Authorisation and EMPr is easily accessible to all on-site staff members.
- Ensure contractor employees are familiar with the requirements of this EMPr and the environmental specifications as they apply to the construction of the proposed facility.
- Ensure that prior to commencing any site works, all contractor employees and sub-contractors must have attended environmental awareness training included in the induction training which must provide staff with an appreciation of the project's environmental requirements, and how they are to be implemented.
- Ensure that any complaints received from the public are duly recorded and forwarded to the Site Manager and Contractor.
- Manage the day-to-day on-site implementation of this EMPr, and the compilation of regular (usually weekly) Monitoring Reports.
- Keep record of all activities on site, problems identified, transgressions noted and a task schedule of tasks undertaken, including those of the Independent ECO.
- Inform staff of the environmental issues as deemed necessary by the Independent ECO.

All contractors (including sub-contractors and staff) and service providers are ultimately responsible for:

- Ensuring adherence to the environmental management specifications.
- Ensuring that all applicable Method Statements are submitted to the Site Manager (and ECO) for approval before any work is undertaken.
- Ensuring that any instructions issued by the Site Manager on the advice of the ECO are adhered to.
- Ensuring that a report is tabled at each site meeting, which will document all incidents that have occurred during the period before the site meeting.
- Ensuring that a register is kept in the site office, which lists all transgressions issued by the ECO.

- Ensuring that a register of all public complaints is maintained.
- Ensuring that all employees, including those of sub-contractors, receive training before the commencement of construction in order for the sub-contractors to constructively contribute towards the successful implementation of the EMPr (i.e. ensure their staff are appropriately trained on the environmental obligations).

6.2. Objectives

In order to meet the overall goal for construction, the following objectives, actions, and monitoring requirements have been identified.

OBJECTIVE 1: Minimise impacts related to inappropriate construction activities

On-going communication with surrounding tenants is important to maintain during the construction and operation phases of the development. Any issues and concerns raised should be addressed as far as possible in as short a timeframe as possible.

Project component/s	» LOX storage tank; » Diesel storage tank;
Potential Impact	» Hazards to landowners and the public » Visual impact of general construction activities,
Activity/risk source	» Movement of construction vehicles in the area and on-site.
Mitigation: Target/Objective	» To secure the site against unauthorised entry. » To protect members of the public/landowners/residents. » Minimal visual intrusion by construction activities outside of the immediate construction work areas.

Mitigation: Action/control	Responsibility	Timeframe
Establish and maintain appropriately bunded areas for storage of hazardous materials (i.e. fuel to be required during construction).	Contractor	Site establishment
Visual impacts must be reduced during construction through minimising areas of surface disturbance, using dust suppression techniques.	Contractor	Site establishment, and duration of construction
Adequate protective measures must be implemented to prevent unauthorised access to the working area and the internal access routes. The development (including the development footprint and contractor's equipment camp) must also be secured and fenced and clearly demarcated.	Contractor	Site establishment, and duration of construction
Establish the necessary ablution facilities with chemical toilets and provide adequate sanitation facilities and ablutions for construction workers so that the surrounding environment is not polluted (at least one sanitary facility for each sex and for every 30 workers as per the 2014 Construction Regulations; Section 30(1) (b)) at appropriate locations on site). The facilities must be placed within the construction area.	Contractor	Site establishment, and duration of construction
Supply adequate waste collection bins at site where construction is	Contractor	Site establishment,

Mitigation: Action/control	Responsibility	Timeframe
being undertaken. Separate bins should be provided for general and hazardous waste. As far as possible, provision should be made for separation of waste for recycling.		and duration of construction

Performance Indicator	» Site is secure and there is no unauthorised entry. » No members of the public injured as a result of construction activities. » Appropriate and adequate waste management and sanitation facilities provided at construction site.
Monitoring	» Secure the site against unauthorised entry. » An incident reporting system should be used to record non-conformances to the EMP. » SHE to monitor all construction areas on a continuous basis until all construction is completed. Non-conformances must be immediately reported to the site manager. » Monitoring of vegetation clearing during construction (by contractor as part of construction contract).

OBJECTIVE 2: Appropriate management of the construction site and construction workers

Project component/s	» LOX storage tank; » Diesel storage tank
Potential Impact	» Impacts on areas immediately outside the site due to inadequate sanitation and waste removal facilities. » Pollution of the areas immediately outside the site due to inadequate or inappropriate facilities or procedures.
Activity/risk source	Access to and from the equipment storage area/s. » Contractors not aware of the requirements of the EMPr, leading to unnecessary impacts on the surrounding environment.
Mitigation: Target/Objective	» Educate all workers of the dangers associated with a construction site » Secure the site against unauthorised entry » Ensure adequate sanitation facilities and waste management practices » Ensure appropriate management of actions by on-site personnel in order to minimise impacts to the surrounding environment

Mitigation: Action/control	Responsibility	Timeframe
In order to minimise impacts on the open fields surrounding the site, contractors must be required to adopt a certain Code of Conduct and commit to restricting construction activities to areas within the development footprint. Contractors and their sub-contractors must be familiar with the conditions of the Environmental Authorisation, the BA Report, and this EMPr, as well as the requirements of all relevant environmental legislation.	Contractor	Construction phase
Contact details of emergency services should be prominently displayed on site.	Contractor	Construction phase
Conduct training and safety induction amongst workers.	Contractor	Construction phase
A local employment policy should be adopted to maximise opportunities made available to the local labour force.	Contractor	Construction phase

Mitigation: Action/control	Responsibility	Timeframe
All litter must be deposited in a clearly marked, closed, weather and animal-proof disposal bin in the construction area. Particular attention needs to be paid to food waste.	Contractor	Duration of contract
Ensure compliance with all national, regional and local legislation with regard to the storage, handling and disposal of hydrocarbons, chemicals, solvents and any other harmful and hazardous substances and materials.	Contractor Owner	During and post construction.
Keep a record of all hazardous substances stored on site. Clearly label all the containers storing hazardous waste.	Contractor	During and post construction.
Ensure waste containers are maintained and emptied as and when required.	Contractor	Duration of construction
Ensure ablution facilities are maintained and emptied as and when required.	Contractor	Duration of construction

Performance Indicator	» No injuries or incidents on the construction site » Ablution and waste removal facilities are in a good working order and do not pollute the environment due to mismanagement » No complaints regarding contractor behaviour or habits » Appropriate and adequate waste management and sanitation facilities provided at construction site » Appropriate training of all staff is undertaken prior to them commencing work on the construction site » Code of Conduct drafted before commencement of construction phase
Monitoring	» An incident reporting system to record non-conformances to the EMPr » Observation and supervision of Contractor practices throughout construction phase by the ECO » Complaints must be investigated and, if appropriate, acted upon » An incident reporting system will be used to record non-conformances to the EMP

OBJECTIVE 3: Minimisation of development footprint and soil degradation.

The soil on site may be impacted in terms of:

» Uncontrolled run-off relating to construction activity (excessive wetting, uncontrolled discharge, etc.) which will also lead to accelerated erosion;
» Accidental spillages;
» Erosion from rainwater;

Project component/s	» LOX storage tank; » Diesel storage tank
Potential Impact	» Soil contamination from accidental spillages. » Increased run-off over the site.
Activity/risk source	» Removal of paving, excavation, stockpiling, compaction, and pollution of soil. » All constructional activities that disturb the soil below surface, such as levelling. » The construction and installation of aboveground LOX and diesel tanks and associated

	infrastructure which will cover soil surfaces. » Rainfall - water erosion of disturbed areas. » Chemical contamination of the soil by vehicles and machinery. » Storage of materials required for construction.
Mitigation: Target/Objective	» Ensure effective soil clean up should there be a spill. » Minimise soil degradation (mixing, wetting, compaction, etc.). » Maintain and monitor the site.

Mitigation: Action/control	**Responsibility**	**Timeframe**
Erosion control measures: Run-off attenuation on slopes (sandbags, logs), silt fences, storm water catch-pits, shade nets, gabions or temporary mulching over denuded area as required.	EO and Contractor	Site establishment and duration of contract
Monitor the site for erosion problems and identify areas where additional intervention such as additional revegetation or erosion control such as silt traps may be necessary.	Contractor	Construction
Soil stockpiles must be dampened with dust suppressant or equivalent to prevent erosion by wind.	Contractor	Construction
Any erosion problems within the development area as a result of the construction activities observed must be rectified immediately and monitored thereafter to ensure that they do not re-occur.	EO and Contractor	Construction Operation
The gravel access roads within the site and other disturbed areas (laydown areas) should be regularly monitored for erosion occurrences and must receive follow-up monitoring by the EO to assess the success of the remediation.	EO and Contractor	Construction Rehabilitation
No soil is to be stripped from areas within the site that the contractor does not require for construction works.	EO and Contractor	Construction

Performance Indicator	» Limited soil erosion around site. » No activity in restricted areas. » No disturbance outside of designated work areas. » Minimised clearing of existing/natural vegetation.
Monitoring	» Supervision of all clearing and earthworks. » Limited level of soil erosion around the site. » An incident register and non-conformance must be used to record incidents and non-conformances to the EMPr. » On-going visual assessment of compliance with erosion prevention by Contractor and ECO. » Monitor visual signs of erosion such as the formation of gullies after rainstorms and the presence of dust emissions during wind storms. » Any signs of soil erosion on site should be documented (including photographic evidence and coordinates of the problem areas) and submitted to the management team of the project. » Monitor compliance of construction workers to restrict construction work to the clearly defined limits of the construction site to keep footprint as small as possible. Monitoring to be undertaken by the ECO.

OBJECTIVE 4: Appropriate stormwater management

Project component/s	» Alteration of areas into hard surfaces impacting on the local hydrological regime of the area.
Potential Impact	» Poor stormwater management and alteration of the hydrological regime.
Activity/risk source	» Placement of hard engineered surfaces.
Mitigation: Target/Objective	» Reduce the potential increase in surface flow velocities and the impact on localised drainage systems.

Mitigation: Action/control	Responsibility	Timeframe
Any storm water within the site must be handled in a suitable manner, i.e. clean and dirty water streams around the plant and install stilling basins to capture large volumes of run-off, shade nets, or gabions trapping sediments and reduce flow velocities.	Contractor and Engineers	Construction
All roads and other hardened surfaces must have runoff control features which redirect water flow and dissipate any energy in the water which may pose an erosion risk.	Contractor	Construction
Storm water control systems must be implemented to reduce erosion on the project site.	Contractor	Construction
Contractors must comply with the requirements of the Integrated Stormwater Master Plan (Appendix C)	Contractor	Construction

Performance Indicator	» No impacts due to runoff » Minimise erosion as far as possible
Monitoring	» Appropriate storm water management system in place

OBJECTIVE 5: Protection of heritage resources

Project component/s	» LOX storage tank; » Diesel storage tank
Potential Impact	» Heritage objects or artefacts found on site are inappropriately managed or destroyed.
Activity/risk source	» Site preparation and earthworks. » Foundations or installation of infrastructure. » Mobile construction equipment movement on site.
Mitigation: Target/Objective	» To ensure that any heritage objects found on site are treated appropriately and in accordance with the relevant legislation.

Mitigation: Action/control	Responsibility	Timeframe
A chance find procedure must be developed and implemented in the event that archaeological or palaeontological resources are found.	Contractor Heritage specialist	Pre-construction Construction
In the event that fossils resources are discovered during excavations, immediately stop excavation in the vicinity of the potential material. Mark (flag) the position and also spoil material that may contain fossils. Inform the site foreman and the EO. EO to inform the developer, the	Contractor and EO	Construction

Mitigation: Action/control	Responsibility	Timeframe
developer contacts the standby archaeologist and/or palaeontologist. EO to describe the occurrence and provide images by email.		

Performance Indicator	» No disturbance outside of designated work areas. » All heritage items located are dealt with as per the legislative guidelines.
Monitoring	» Observation of excavation activities by the EO throughout construction phase. » Supervision of all clearing and earthworks. » Due care taken during earthworks and disturbance of land by all staff and any heritage objects found reported. » Appropriate permits obtained from SAHRA prior to the disturbance or destruction of heritage sites (if required). » An incident reporting system will be used to record non-conformances to the EMPr.

OBJECTIVE 6: Appropriate handling and management of waste

Activities resulting from the construction phase could lead to impacts resulting from waste management and materials handling. Good supervision of the waste management programme on site is critical for the minimisation of impacts.

Project component/s	» LOX storage tank; » Diesel storage tank
Potential Impact	» Risk to environment due to poor waste management practices » Inefficient use of resources resulting in excessive waste generation.
Activity/risk source	» Spoil material from excavation, earthworks and site preparation » Hydrocarbon use and storage » Other construction wastes
Mitigation: Target/Objective	» To comply with waste management legislation » To minimise production of waste » To ensure appropriate waste handling, storage and disposal » To avoid environmental harm from waste disposal

Mitigation: Action/control	Responsibility	Timeframe
Dispose of all solid waste collected at an appropriately registered waste disposal site. The disposal of waste shall be in accordance with all relevant legislation.	Contractor	Duration of Contract
Construction contractors must provide specific waste management plans to deal with all waste streams should this not already be available as part of the Air Products procedures.	Contractor	Pre-construction
Specific areas must be designated on-site for the temporary management of various waste streams, i.e. general refuse, construction waste (wood and metal scrap) and contaminated waste. Location of such areas must seek to minimise the potential for impact on the surrounding environment, including prevention of contaminated runoff, seepage and vermin control.	Contractor	Duration of contract

Mitigation: Action/control	Responsibility	Timeframe
Disposal of waste must be in accordance with relevant legislative requirements, including the use of licensed contractors.	Contractor	Duration of contract
Hydrocarbon waste must be contained and stored in sealed containers within an appropriately bunded area.	Contractor	Duration of contract
Implement an integrated waste management approach that is based on waste minimisation and incorporates reduction, recycling, re-use and disposal where appropriate. Where solid waste is disposed of, such disposal shall only occur at a landfill licensed in terms of section 20(b) of the National Environmental Management Waste Act, 2008 (Act 59 of 2008).	Contractor	Duration of construction
Under no circumstances may waste be burnt on site.	Contractor	Duration of construction
Waste and surplus dangerous goods must be kept to a minimum and must be transported by approved waste transporters to sites designated for their disposal.	Contractor	Duration of contract
Documentation (waste manifest) must be maintained detailing the quantity, nature and fate of any regulated waste. Waste disposal records must be available for review at any time.	Contractor	Duration of contract
Waste disposal at the construction site must be avoided by separating and trucking out of waste.	Contractor	Duration of contract
SABS approved spill kits to be available on site and easily accessible.	Contractor	Duration of contract
All rubble, spoil and solid concrete waste must be disposed of at a suitable registered waste site unless CDC or the Competent Authority issues a contrary instruction.	Contractor	Duration of contract

Performance Indicator	» No complaints received regarding waste on site or indiscriminate dumping » Internal site audits ensuring that waste segregation, recycling and reuse is occurring appropriately » Provision of all appropriate waste manifests for all waste streams
Monitoring	» Observation and supervision of waste management practices throughout construction phase » Waste collection to be monitored on a regular basis » Waste documentation completed » An incident reporting system will be used to record non-conformances to the EMP

OBJECTIVE 7: Appropriate handling and storage of chemicals, hazardous substances

The construction phase may involve the storage and handling of a variety of chemicals including adhesives, abrasives, oils and lubricants, paints and solvents.

Project component/s	» Laydown areas. » Temporary hydrocarbon and chemical storage areas. » Proximity to Air Products existing plant and storage tanks

Potential Impact	» Generation of contaminated wastes from used chemical containers. » Soil pollution.
Activity/risk source	» Vehicles associated with site preparation and earthworks. » Hydrocarbon spills by vehicles and machinery during levelling, vegetation clearance and transport of workers, materials and equipment and fuel storage tanks. » Accidental spills of hazardous chemicals. » Pollution from concrete mixing.
Mitigation: Target/Objective	» To ensure that the storage and handling of chemicals and hydrocarbons on-site does not cause pollution to the environment or harm to persons. » To ensure that the storage and maintenance of machinery on-site does not cause pollution of the environment or harm to persons. » Prevent and contain hydrocarbon leaks. » Undertake proper waste management. » Ensure access to the plant and existing storage areas are monitored and access controlled at all times. » Store hazardous chemicals safely in a bunded area.

Mitigation: Action/control	Responsibility	Timeframe
Any liquids stored on site, including admixtures, fuels and lubricants, should be stored in accordance with applicable legislation.	Contractor	Pre-construction and implement for duration of Contract
Spill kits must be made available on-site for the clean-up of spills and leaks of contaminants. These must be located in appropriate areas on site and must be maintained in an operational condition throughout the construction period.	Contractor	Duration of contract
Losses of fuel and lubricants from the oil sumps and steering racks of parked vehicles and equipment must be contained using a drip tray with plastic sheeting filled with absorbent material when not parked on hard standing.	Contractor	Construction Operation
Ensure compliance with all national, regional and local legislation with regard to the storage, handling and disposal of hydrocarbons, chemicals, solvents and any other harmful and hazardous substances and materials. The onus is on the Contractor to identify and interpret the applicable legislation. Hazardous waste to be disposed of at a registered landfill site.	Contractor	During and post construction.
Establish an appropriate Hazardous Stores which is in accordance with the Hazardous Substance Amendment Act, No. 53 of 1992. This should include but not be limited to: » Designated area; » All applicable safety signage; » Firefighting equipment; » Enclosed by an impermeable bund; » Protected from the elements, » Lockable; » Ventilated; and » Has adequate capacity to contain 110% of the largest container contents.	Contractor	Pre-construction and implement for duration of Contract
In the event of a major spill or leak of contaminants, the relevant administering authority and Air Products South Africa (Pty) Ltd must be immediately notified as per the notification of emergencies/incidents.	Contractor	Duration of contract

Mitigation: Action/control	Responsibility	Timeframe
Spilled concrete must be cleaned up as soon as possible and disposed of at a suitably licensed waste disposal site.	Contractor	Duration of contract
Accidental spillage of potentially contaminating liquids and solids must be cleaned up immediately in line with procedures by trained staff with the appropriate equipment.	Contractor	Duration of contract
Any contaminated/polluted soil removed from the site must be disposed of at a licensed hazardous waste disposal facility.	Contractor	Duration of contract
Any storage and disposal permits/approvals which may be required must be obtained, and the conditions attached to such permits and approvals must be compiled with.	Contractor	Duration of contract
Transport of all hazardous substances must be in accordance with the relevant legislation and regulations.	Contractor	Duration of contract
High level maintenance must be undertaken on all vehicles and construction machinery at a designated place off site to prevent hydrocarbon spills.	Contractor	Duration of contract
Monitoring of the existing plant and storage tanks must be undertaken regularly during the installation of the LOX tank to ensure the integrity of the other tanks and plant infrastructure is not compromised.	Contractor	Duration of contract
All stored fuels to be maintained within a bund and on a sealed surface as per the requirements of SABS 089:1999 Part 1.	Contractor	Duration of contract
Fuel storage areas must be inspected regularly to ensure bund stability, integrity, and function.	Contractor	Duration of contract
Construction machinery must be stored in an appropriately sealed area.	Contractor	Duration of contract
An effective monitoring system must be put in place to detect any leakage or spillage of all hazardous substances during their transportation, handling, installation and storage.	Contractor	Construction
Precautions must be in place to limit the possibility of oil and other toxic liquids from entering the soil or clean storm water system.	Contractor	Construction

Performance Indicator	» No chemical spills outside of designated storage areas. » No water or soil contamination by spills. » No complaints received regarding waste on site or indiscriminate dumping. » Safe storage of hazardous chemicals. » Proper waste management.
Monitoring	» Observation and supervision of chemical storage and handling practices and vehicle maintenance throughout construction phase. » A complaints register must be maintained, in which any complaints from the community will be logged. » An incident reporting system will be used to record non-conformances to the EMPr. » On-going visual assessment to detect polluted areas and the application of clean-up and preventative procedures. » Monitor hydrocarbon spills from vehicles and machinery during construction continuously and record volume and nature of spill, location and clean-up actions.

	» Monitor maintenance of drains and intercept drains weekly. » Analyse soil samples for pollution in areas of known spills or where a breach of containment is evident when it occurs. » Records of accidental spills and clean-up procedures and the results thereof must be audited on an annual basis by the ECO. » Records of all incidents that caused chemical pollution must be kept and a summary of the results must be reported to management annually.

OBJECTIVE 8: Minimise impacts related to transportation of equipment and materials to site

Heavy and light-duty vehicles will be transporting goods, personnel and building materials for the duration of the construction phase. Vehicles would make use of the R102, Cable, Neptune Roads as well as the Intsimbi road closer to the site.

Project Component/s	» SEZ road network (Cable, Neptune and Intsimbi roads) & R102
Potential Impact	» Increase in disruption to traffic
Activities/Risk Sources	» Increase in traffic and movement of vehicles.
Mitigation: Target/Objective	» Minimise impact of traffic associated with the construction of the development on local traffic volume, local communities, existing infrastructure, property owners and road users. » To ensure all vehicles are roadworthy and all materials/equipment are transported appropriately and within any imposed permit/licence conditions

Mitigation: Action/Control	Responsibility	Timeframe
All vehicles must be roadworthy and drivers must be qualified, obey traffic rules, follow speed limits and be made aware of the potential noise, dust and road safety issues.	Contractor	Construction
All relevant permits for abnormal loads must be applied for from the relevant authority.	Contractor (or appointed transportation contractor)	Pre-construction
Only designated access routes must be used	Contractor	Construction
The contractor must take all reasonable measures to ensure the safety of the public in the surrounding area. Where the public could be exposed to danger by any of the works or site activities, the contractor must, as appropriate, provide suitable flagmen, barriers and/or warning signs in English, Afrikaans and any other relevant local languages, all to the approval of the Site Manager.	Contractor	Duration of contract
Appropriate signage must be erected warning road users of construction traffic entering and exiting the construction site.	Contractor	Duration of contract

Performance Indicator	» Vehicles are roadworthy, inspected regularly and speed limits are adhered to. » Provision of traffic warning signs

Monitoring	» An incident reporting system will be used to record non-conformances to the EMPr.

6.3. Detailing Method Statements

OBJECTIVE 9: Ensure all construction activities are undertaken with the appropriate level of environmental awareness to minimise environmental risk

The environmental specifications are required to be underpinned by a series of Method Statements, within which the Contractors and Service Providers are required to outline how any identified environmental risks will practically be mitigated and managed for the duration of the contract, and how specifications within this EMPr will be met. That is, the Contractor will be required to describe how specified requirements will be achieved through the submission of written Method Statements to the Site Manager and ECO.

A Method Statement is defined as "a written submission by the Contractor in response to the environmental specification or a request by the Site Manager, setting out the plant, materials, labour and method the Contractor proposes using to conduct an activity, in such detail that the Site Manager is able to assess whether the Contractor's proposal is in accordance with the Specifications and/or will produce results in accordance with the Specifications". The Method Statement must cover applicable details with regard to:

- Details of the responsible person/s;
- Construction procedures;
- Materials and equipment to be used;
- Getting the equipment to and from site;
- How the equipment/material will be moved while on-site;
- How and where material will be stored
- The containment (or action to be taken if containment is not possible) of leaks or spills of any liquid or material that may occur;
- Timing and location of activities;
- Compliance/non-compliance with the Specifications; and
- Any other information deemed necessary by the Site Manager.

Method Statements must be compiled for all activities which affect any aspect of the environment and should be applied consistently to all activities. Specific areas to be addressed through method statements (pre, during and post construction) may include:

- Site establishment (which explains all activities from induction training to offloading, construction sequence for site establishment and the different amenities to be established etc., including a site camp plan indicating all of these).
- Preparation of the site (i.e. removal of paving, concrete, compacting soils and removing of waste).
- Erosion control.
- Ablution facilities (placement, maintenance, management and servicing).
- Solid Waste Management:
  - Description of the waste storage facilities (on site and accumulative).

- Placement of waste stored (on site and accumulative).
- Management and collection of waste process.
- Recycle, re-use and removal process and procedure.

» Dust and noise pollution:
- Describe the necessary measures to ensure that noise from construction activities is maintained within lawfully acceptable levels.

» Procedure to control dust at all times on the site, access roads and spoil sites (dust control shall be sufficient so as not to have significant impacts in terms of the biophysical and social environments).
» Hazardous substance storage (ensure compliance with all national, regional and local legislation with regard to the storage of oils, fuels, lubricants, solvents, wood treatments, bitumen, cement, pesticides and any other harmful and hazardous substances and materials. South African National Standards apply).
- Prevention protocol of accidental contamination of soil at storage and handling areas.

» Fire prevention and management measures on site.
» Incident and accident reporting protocol.

The Contractor may not commence the activity covered by the Method Statement until it has been approved by the Site Manager (with input from the ECO), except in the case of emergency activities and then only with the consent of the Site Manager. Approval of the Method Statement will not absolve the Contractor from their obligations or responsibilities in terms of their contract. Failure to submit a method statement may result in suspension of the activity concerned until such time as a method statement has been submitted and approved.

6.4. Awareness and Competence: Construction Phase of the storage facilities and associated infrastructure

OBJECTIVE 10: To ensure all construction personnel have the appropriate level of environmental awareness and competence to ensure continued environmental due diligence and on-going minimisation of environmental harm

To achieve effective environmental management, it is important that Contractors are aware of the responsibilities in terms of the relevant environmental legislation and the contents of this EMPr. The ECO is responsible for monitoring compliance pre, during and post construction. The Contractor is responsible for informing employees and sub-contractors of their environmental obligations in terms of the environmental specifications, and for ensuring that employees are adequately experienced and properly trained in order to execute the works in a manner that will minimise environmental impacts. The Contractors obligations in this regard include the following:

» All Employees must have a basic understanding of the key environmental features of the construction site and the surrounding environment. This includes the discussion/explanation of site environmental matters during toolbox talks.
» The content and requirements of Method Statements are to be clearly explained to all plant operators and general workers. All staff acting in a supervisory capacity is to have copies of the relevant Method Statements and be aware of the content thereof.
» Ensuring that a copy of the EMPr is readily available on-site, and that all senior site staff is aware of the location and have access to the document. Senior site staff will be familiar with the requirements of

the EMPr and the environmental specifications as they apply to the expansion of LOX storage facilities and addition aboveground diesel storage at the Air Products Coega facility.

- Ensuring that, prior to commencing any site works, all employees and sub-contractors have attended an Environmental Awareness Training session. The training session must provide the site staff with an appreciation of the project's environmental requirements, and how they are to be implemented.
  - Records must be kept of those that have completed the relevant training.
  - Training should be done either in a written or verbal format but must be appropriate for the receiving audience.
- All sub-contractors must have a copy of the EMPr and sign a declaration/ acknowledgement that they are aware and familiar with the contents and requirements of the EMPr and that they will conduct work in such a manner as to ensure compliance with the requirements of the EMPr.
- Contractors and main sub-contractors should have a basic training in the identification of archaeological sites/objects, and protected flora and fauna that may be encountered on the site.
- Awareness of any other environmental matters, which are deemed to be necessary by the ECO.
- Ensuring that employee information posters, outlining the environmental "do's" and "don'ts" (as per the environmental awareness training course) are erected at prominent locations throughout the site.

Therefore, prior to the commencement of construction activities on site and before any person commences with work on site thereafter, adequate environmental awareness and responsibility are to be appropriately presented to all staff present onsite, clearly describing their obligations towards environmental controls and methodologies in terms of this EMPr. This training and awareness will be achieved in the following ways:

6.4.1 Environmental Awareness and Induction Training

The EO, in consultation with the contractor, shall ensure that all construction workers receive an induction presentation, as well as on-going environmental education and awareness, on the importance and implications of the EMPr and the environmental requirements it prescribes. The presentation shall be conducted, as far as is possible, in the employees' language of choice. The contractor should provide a translator from their staff for the purpose of translating should this be necessary.

As a minimum, induction training should include:

- Explanation of the importance of complying with the EMPr;
- Explanation of the importance of complying with the Environmental Authorisation;
- Discussion of the potential environmental impacts of construction activities;
- Employees' roles and responsibilities, including emergency preparedness (this should be combined with this induction, but presented by the contractor's Health and Safety Representative);
- Explanation of the mitigation measures that must be implemented when carrying out their activities; and
- Explanation of the specifics of this EMPr and its specification.

Environmental Awareness Training must take the form of an on-site talk and demonstration by the EO/ECO before the commencement of site establishment and construction on site. The education/awareness programme should be aimed at all levels of management and construction workers within the contractor team. A record of attendance of this training must be maintained by the EO/ECO on site. Proof of awareness training should be kept on record. Environmental induction training must be presented to all

persons who are to work on the site – be it for short or long durations; Contractor's or Engineer's staff; administrative or site staff; sub-contractors or visitors to site.

This induction training should be undertaken by the Contractor's Environmental Officer and should include discussing the developer's environmental policy and values, the function of the EMPr and Contract Specifications and the importance and reasons for compliance to these. The induction training must highlight overall do's and don'ts on site and clarify the repercussions of not complying with these. The non-conformance reporting system must be explained during the induction as well. Opportunity for questions and clarifications must form part of this training. A record of attendance of this training must be maintained by the EO/ECO on site.

6.4.2 Toolbox Talks

Toolbox talks should be held on a scheduled and regular basis (at least twice a month) where foremen, environmental and safety representatives of different components of the works and sub-consultants hold talks relating to environmental practices and safety awareness on site. These talks should also include discussions on possible common incidents occurring on site and ones recommended by the onsite EO and the prevention of reoccurrence thereof. Records of attendance and the awareness talk subject must be kept on file.

6.5. Monitoring Programme: Construction Phase

OBJECTIVE 11: To monitor the performance of the control strategies employed against environmental objectives and standards

A monitoring programme must be in place not only to ensure conformance with the EMPr, but also to monitor any environmental issues and impacts which have not been accounted for in the EMPr that are or could result in significant environmental impacts for which corrective action is required. The period and frequency of monitoring will be stipulated by the Environmental Authorisation (once issued). Where this is not clearly dictated, the Developer will determine and stipulate the period and frequency of monitoring required in consultation with relevant stakeholders and authorities. The Technical Director/ Project Manager will ensure that the monitoring is conducted and reported.

The aim of the monitoring and auditing process would be to monitor the implementation of the specified environmental specifications, in order to:

- Monitor and audit compliance with the prescriptive and procedural terms of the environmental specifications
- Ensure adequate and appropriate interventions to address non-compliance
- Ensure adequate and appropriate interventions to address environmental degradation
- Ensure appropriate and adequate record keeping related to environmental compliance
- Determine the effectiveness of the environmental specifications and recommend the requisite changes and updates based on audit outcomes, in order to enhance the efficacy of environmental management on site
- Aid communication and feedback to authorities and stakeholders

All documentation e.g. audit/monitoring/compliance reports and notifications, required to be submitted to the EC DEDEAT in terms of the Environmental Authorisation, must be submitted to the Director: Compliance Monitoring of the Department.

Records relating to monitoring and auditing must be kept on site and made available for inspection to any relevant and competent authority in respect of this development.

6.5.1. Non-Conformance Reports

All supervisory staff including Foremen, Engineers, and the ECO must be provided the means to be able to submit non-conformance reports to the Site Manager. Non-conformance reports will describe, in detail, the cause, nature and effects of any environmental non-conformance by the Contractor.

The non-conformance report will be updated on completion of the corrective measures indicated on the finding sheet. The report must indicate that the remediation measures have been implemented timeously and that the non-conformance can be closed-out to the satisfaction of the Site Manager and ECO.

6.5.2. Monitoring Reports

A monitoring report must be compiled by the ECO on a monthly basis and must be submitted to the Director: Compliance Monitoring at DEDEAT for their records. This report should include details of the activities undertaken in the reporting period, any non-conformances or incidents recorded, corrective action required, and details of those non-conformances or incidents which have been closed out. The contractor must ensure that all waste manifests are provided to the ECO on a monthly basis in order to inform and update the DEDEAT regarding waste related activities.

6.5.3. Audit Reports

The holder of the Environmental Authorisation must, for the period during which the Environmental Authorisation and EMPr remain valid, ensure that project compliance with the conditions of the Environmental Authorisation and the EMPr are audited, and that the audit reports are submitted to the Director: Compliance Monitoring of the DEDEAT.

An environmental internal audit must be conducted and submitted every 3 months and an external audit must be conducted once a year. An annual audit report must be compiled and submitted to DEDEAT until the completion of the construction and rehabilitation. This report must be compiled in accordance with Appendix 7 of the EIA Regulations, 2014, as amended, and indicate the date of the audit, the name of the auditor and the outcome of the audit in terms of compliance with the environmental authorisation conditions and the requirements of the EMPr.

6.5.4. Final Audit Report

A final environmental audit report must be compiled by an independent auditor and be submitted to DEDEAT upon completion of the construction and rehabilitation activities. The report must be submitted within 30 days of completion of rehabilitation activities. This report must indicate the date of the audit, the name of the auditor and the outcome of the audit in terms of compliance with the environmental authorisation conditions and the requirements of the EMPr.

CHAPTER 7: MANAGEMENT PROGRAMME: REHABILITATION

Overall Goal: Undertake the rehabilitation measures in a way that:

» Ensures rehabilitation of disturbed areas following the execution of the works, such that residual environmental impacts are remediated or curtailed.

7.1. Objectives

In order to meet this goal, the following objective, actions and monitoring requirements are relevant:

OBJECTIVE 1: **Ensure appropriate rehabilitation of disturbed areas such that residual environmental impacts are remediated or curtailed**

Areas requiring rehabilitation will include all areas disturbed during the construction phase and that are not required for regular operation and maintenance operations. Rehabilitation should be undertaken in an area as soon as possible after the completion of construction activities within that area.

Project Component/s	» Construction camps. » Laydown areas. » All areas disturbed by construction activities.
Potential Impact	» Environmental integrity of the site undermined resulting in reduced visual aesthetics, erosion and increased runoff, and the requirement for on-going management intervention.
Activity/Risk Source	» Temporary construction areas » Other disturbed areas/footprints
Mitigation: Target/Objective	» Ensure and encourage site rehabilitation of disturbed areas. » Ensure that the site is appropriately rehabilitated following the execution of the works, such that residual environmental impacts (including erosion) are remediated or curtailed.

Mitigation: Action/Control	Responsibility	Timeframe
All temporary facilities, equipment, and waste materials must be removed from site as soon as construction is completed.	Contractor	Following execution of the works
All temporary fencing and danger tape must be removed once the construction phase has been completed.	Contractor	Following completion of construction activities in an area
The area that previously housed the construction equipment camp is to be checked for spills of substances such as oil, paint, etc. and these must be cleaned up.	Contractor	Following completion of construction activities in an area
No planting or importing any listed invasive alien plant species (all Category 1a, 1b and 2 invasive species) to the site for landscaping, rehabilitation or any other purpose must be undertaken.	Contractor	Following completion of construction activities in an area
All hardened surfaces within the construction equipment camp area should be ripped, all imported materials removed, and	Contractor	Following completion of construction activities in

Mitigation: Action/Control	Responsibility	Timeframe
the area shall be top soiled and re-vegetated.		an area

Performance Indicator	» All portions of the site, including construction equipment camp and working areas, cleared of equipment. » Topsoil replaced on all areas and stabilised where practicable or required after construction and temporally utilised areas. » Completed site free of erosion and alien invasive plants.
Monitoring	» On-going inspection of rehabilitated areas in order to determine effectiveness of rehabilitation measures implemented during the operational lifespan of the development.

CHAPTER 8: OPERATION MANAGEMENT PROGRAMME

Overall Goal: To ensure that the operation of the LOX and diesel storage tanks dos not have unforeseen impacts on the environment and to ensure that all impacts are monitored, and the necessary corrective action taken in all cases. In order to address this goal, it is necessary to operate the entire Air Products Coega plant in a way that:

» Ensures that operation activities are properly managed in respect of environmental aspects and impacts

An environmental manager must ensure the implementation of the operational EMPr.

8.1. Objectives

In order to meet this goal, the following objectives have been identified, together with necessary actions and monitoring requirements.

OBJECTIVE 1: Establish clear reporting, communication, and responsibilities in relation to the overall implementation of the EMPr during operation

Formal responsibilities are necessary to ensure that key procedures are executed. Specific responsibilities of the Operations Manager, and Environmental Manager for the operation phase of this project are detailed below.

The **Operations Manager** will:

» Ensure that adequate resources (human, financial, technology) are made available and appropriately managed for the successful implementation of the operational EMPr.
» Conduct annual basis reviews of the EMPr to evaluate its effectiveness.
» Take appropriate action as a result of findings and recommendations in management reviews and audits.
» Provide forums to communicate matters regarding environmental management.

The **SHEQ Manager** will:

» Manage and report on the development's environmental performance.
» Maintain a register of all known environmental impacts and manage the monitoring thereof.
» Conduct internal environmental audits and co-ordinate external environmental audits.
» Liaise with statutory bodies such as the DEDEAT on environmental performance and other issues.
» Conduct environmental training and awareness for the employees who operate and maintain the development.
» Compile environmental policies and procedures.
» Liaise with interested and affected parties on environmental issues of common concern.

The Technical/SHEQ Manager must provide fourteen (14) days written notification to the GDARD that the operation phase will commence.

OBJECTIVE 2: Minimise soil degradation and erosion

The soil on site may be impacted in terms of:

- *Soil degradation including erosion* - by wind and water and subsequent deposition elsewhere is of a concern across the entire site.
- *Uncontrolled run-off* - relating to construction activity (excessive wetting, uncontrolled discharge, etc.) will also lead to accelerated erosion and possible sedimentation of drainage systems outside of the project site during operation.
- *Degradation* - of the natural soil profile due to pollution.

Project component/s	» Existing project infrastructure
Potential Impact	» Soil degradation. » Soil erosion. » Increased water run-off, soil degradation due to water erosion and sediment generation » Impact on the surrounding landscape due to alien plant invasion, erosion or poor management of the development.
Activity/risk source	» Poor rehabilitation of cleared areas. » Complete denudation of the soil. » Rainfall - water erosion of disturbed areas. » Wind erosion of disturbed areas.
Mitigation: Target/Objective	» Minimise soil degradation (removal, mixing, wetting, compaction, pollution, etc.). » Minimise erosion. » Minimise dust pollution.

Mitigation: Action/control	**Responsibility**	**Timeframe**
Existing roads must be maintained to ensure limited erosion and impact on areas adjacent to roadways.	O&M Contractor	Operation
Regular monitoring for erosion post-construction to ensure that no erosion problems have developed as a result of the past disturbance.	O&M Contractor	Operation
Alien plants must be removed from the site through appropriate methods such as hand pulling, application of chemicals, cutting etc., on a regular basis during operation. Removal must occur prior to plants developing seeds.	O&M Contractor	Operation

Performance Indicator	» No erosion problems within the site or from access roads. » No alien species within the site. » Maintenance of a ground cover of that resist erosion.
Monitoring	» Records of erosion problems and mitigation actions taken with photographs.

OBJECTIVE 3: Ensure the implementation of an appropriate fire management plan and general management measures during the operation phase

The following below can be used as a guide for appropriate fire management (also refer to **Appendix C**):

Project component/s	» Operation and maintenance of the development
Potential Impact	» Fires can pose a personal safety risk to surrounding businesses and industries, and their infrastructure.
Activity/risk source	» The presence of operation and maintenance personnel and their activities on the site can increase the risk of fires.
Mitigation: Target/Objective	» To avoid and or minimise the potential risk of fires on surrounding industries and their infrastructure. » The fire risk on site is a point of discussion that must take place as part of the environmental induction training prior to commencement of construction.

Mitigation: Action/control	Responsibility	Timeframe
Provide adequate firefighting equipment on site and establish a fire-fighting management plan during operation (refer to Appendix C).	O&M Contractor	Operation
Cigarette butts may not be thrown in the open fields adjacent to the site but must be disposed of correctly. Designated smoking areas must be established with suitable receptacles for disposal.	SHEQ Manager	Operation
Contact details of emergency services should be prominently displayed on site.	O&M Contractor	Operation
Contractors must ensure that basic firefighting equipment is available on site as per the specifications defined by the health and safety representative / consultant.	SHEQ Manager	Operation
The contractor must also comply with the requirements of the Occupational Health and Safety Act with regards to fire protection.	SHEQ Manager	Operation
Ensure that all personnel are aware of the emergency policies and procedures in place from Air Products.	O&M Contractor	Operation
Air Products to provide training to all personnel on the safety and emergency procedures implemented at the site.	O&M Contractor	Operation

Performance Indicator	» Firefighting equipment provided before the operation phase commences. » Appropriate fire breaks in place.
Monitoring	» The O&M operator must monitor indicators listed above to ensure that they have been met.

OBJECTIVE 4: Appropriate handling and management of general waste and hazardous waste

The main wastes expected to be generated by the operation and maintenance activities includes general solid waste and hazardous waste such as oily rags and grease.

Project component/s	» Operation and maintenance of the development
Potential Impact	» Litter or contamination of the site through poor waste management practices.

Activity/risk source	» Daily office activities » Maintenance by external contractors on site
Mitigation: Target/Objective	» Comply with waste management legislation. » Ensure appropriate waste disposal. » Avoid environmental harm from waste disposal.

Mitigation: Action/control	Responsibility	Timeframe
All structures and/or components replaced during maintenance activities must be appropriately disposed of at an appropriately licensed waste disposal site or sold to a recycling merchant for recycling.	O&M Contractor	Operation
All waste must be suitably contained. Loose waste and organic waste must be kept in enclosed weather proof containers with lids that are not accessible to scavengers. Containers must be stable so as not to be blown or knocked over.	O&M Contractor	Operation
All operational areas shall be provided with suitable waste containers. No litter or uncontained refuse must be allowed anywhere at any-time.	O&M Contractor	Operation
Disposal of waste must be in accordance with relevant legislative requirements, including the use of licensed contractors.	O&M Contractor	Operation
Hazardous waste mustl be stored in suitable separate, labelled, enclosed, stable (to wind and collision impacts), weatherproof and scavenger proof containers and shall be disposed of at an appropriate licensed hazardous waste site. Disposal records shall be kept for a minimum of 1 year.	O&M Contractor	Operation
Liquid waste and hazardous waste containers must be placed in a bundled area capable of containing spills and leaks	O&M Contractor	Operation
Used oil and grease must be taken to an approved oil recycling company for recycling.	O&M Contractor	Operation

Performance Indicator	» No complaints received regarding waste on site, littering or indiscriminate dumping.
Monitoring	» Waste collection must be monitored on a regular basis. » An incidents/complaints register must be maintained, in which any complaints from the community must be logged. » Complaints must be investigated and, if appropriate, acted upon.

OBJECTIVE 5: Appropriate handling and management of hazardous substances, hazardous waste and dangerous goods

As per the activities of the site i.e. handling and storage of diesel and LOX, are classified as dangerous goods.

Project component/s	» Operation and maintenance of the development
Potential Impact	» Contamination of soil because of poor materials management.
Activity/risk source	» Generators » Diesel refuelling » Maintenance vehicles
Mitigation: Target/Objective	» Comply with waste management legislation. » Ensure appropriate waste disposal. » Avoid environmental harm from waste disposal. » Ensure appropriate storage of chemicals, dangerous goods and hazardous substances.

Mitigation: Action/control	Responsibility	Timeframe
Suitable procedures and preventative measures must be in place if it is necessary for portable equipment (e.g. generators, lawnmowers) to be re-fuelled on site. As a minimum, drip trays must be used, a suitable leak-proof method of re-fuelling employed and a fire extinguisher and spill kit must be available	Owner O&M Contractor	Operation and maintenance
All structures and/or components replaced during maintenance activities must be appropriately disposed of at an appropriately licensed waste disposal site or sold to a recycling merchant for recycling.	O&M Contractor	Operation
Disposal of waste must be in accordance with relevant legislative requirements, including the use of licensed contractors.	O&M Contractor	Operation
Hazardous waste (including hydrocarbons) and general waste must be stored and disposed of separately.	O&M Contractor	Operation
A vehicle leaking hydrocarbons within the site must be immediately repaired or removed from the site or to a designated servicing area.	O&M Contractor	Operation
Re-fuelling must only take place in designated locations designed for the purpose to ensure no contamination of the environment. Suitable procedures and equipment shall be in place to prevent and deal with spills and emergencies (e.g. fire).	O&M Contractor	Operation
Re-fuelling must only be undertaken by trained personnel	O&M Contractor	Operation

Performance Indicator	» No complaints received regarding waste on site, littering or indiscriminate dumping. » No contamination of soil.
Monitoring	» Waste collection must be monitored on a regular basis. » An incidents/complaints register must be maintained, in which any complaints from the community must be logged. » Complaints must be investigated and, if appropriate, acted upon.

OBJECTIVE 6: Stormwater management

Project component/s	» Above ground diesel storage tank » Separator pit.
Potential Impact	» Potential of hydrocarbons discharging into the stormwater system.
Activity/risk source	» Separator Pit.
Mitigation: Target/Objective	» Implement water quality monitoring and regular maintenance of the separator tank.

Mitigation: Action/control	Responsibility	Timeframe
Test the water quality of stormwater leaving the separator pit monthly to ensure that outflow complies with the General Limits Values of the National Water Act (No. 36 of 1998).	O&M Contractor	Operation
Maintain the separator pit on a monthly basis to ensure blockages are prevented.	O&M Contractor r	Operation
Collect the contents of the separator pit drain box for disposal at an appropriate waste disposal site, and safe disposal receipts must be kept onsite for auditing purposes.	O&M Contractor	Operation

Performance Indicator	» No impacts to stormwater leaving the site
Monitoring	» Appropriate stormwater monitoring and maintenance in place.

CHAPTER 9: DECOMMISSIONING MANAGEMENT PROGRAMME

The operational phase of the expansion of storage facilities and associated infrastructure at the Air Products are designed for a 50 year period. It is most likely that decommissioning activities of the infrastructure of the development would comprise the disassembly or replacement of infrastructure with more appropriate technology/infrastructure available at that time.

» ***Site Preparation***
Site preparation activities will include confirming the integrity of the access to the site to accommodate the required equipment, preparation of the site (e.g. laydown areas, construction platform) and the mobilisation of construction equipment.

» ***Disassemble and Remove Infrastructure***
Disassembled components will be reused, recycled, or disposed of in accordance with regulatory requirements.

9.1. Objectives

In decommissioning the development, Air Products South Africa (Pty) Ltd must ensure that:

» Prior to decommissioning, objectives and mitigation measures will need to be updated to ensure legal compliance with the relevant legislation.
» All structures, foundations and sealed areas are demolished, removed and waste material disposed of at an appropriately licensed waste disposal site or as required by the relevant legislation.

The general specifications of Chapter 6 (Construction) are also relevant to the project and must be adhered to.

APPENDIX A:
LAYOUT MAP


Additional LOX Storage Tank- Option 1
Replacement of Existing LOX tank- Option 2
Proposed Diesel Storage Tank
© 2019 AfriGIS (Pty) Ltd.
© 2019 Google
Google Earth
2004
33°47'35.04" S 25°37'43.94" E elev 58 m eye alt 351 m

APPENDIX B:
FIRE MANAGEMENT AND EMERGENCY PREPAREDNESS AND RESPONSE PLAN

EMERGENCY PLAN

AIR PRODUCTS SOUTH AFRICA (PTY) LTD

COEGA FACILITY

ASU

Bumba Road, Coega IDZ, Zone 3

GPS Coordinates: S33o47'35.0"
E025o37'36.0

EMERGENCY TELEPHONE NUMBERS	
EMERGENCY SERVICES - POLICE	**10111**
EMERGENCY SERVICES – AMBULANCE	**10177**
EMERGENCY SERVICES – FIRE	**041 585 1555**
SITE/FACILITY MANAGER:	**JP VAN WYK**
SITE EMERGENCY COORDINATOR:	**VINCENT NTULI**
AIR PRODUCTS EMERGENCY RESPONSE CENTER:	**0800 650 315**

Full lists of emergency numbers are given in Section 1

REV: 04

DATE: 08-2019

APPROVED BY:

Role	Name	Signature	Date
Site Manager / 16(2)	**JP van Wyk**		**21/08/2019**
Site Emergency Coordinator	**V Ntuli**		**21/08/2019**

CHANGE LOG

Rev	Rev	Author(s)	Description of Revision
	4	V Ntuli	Add new security contacts

NOTE:

No set of guidelines can cover all situations. There is no substitute for sound judgment and common sense.

These guidelines are intended to aid the user by providing general instructions and listing communication channels, support agencies and corrective measures that are commonly available.

For all Emergency Situations the basic principles to be followed are;

- **SOUND** the alarm.
- **CONTACT** the Emergency Coordinator.
- **ASSESS** the risk.
- **CONTROL** the situation.
- **MITIGATE** the situation.

WARNING

- *Personnel are not permitted to approach a hazardous area for emergency response unless they are trained emergency responders, equipped with proper protective equipment, operate within the limits of the site emergency plan, and back up support is available*
- *Emergency Responders may proceed only if safe to do so without putting yourself or other plant personnel at risk*
- *DO NOT approach a leak unless the oxygen content in the area is confirmed to be between 19.5% and 23.5%, or the appropriate PPE and back up support is available*
- *DO NOT enter an oxygen enriched atmosphere (greater than 23.5% oxygen)*
- *DO NOT enter atmospheres that are greater than 40% LEL*

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CONTENTS

SECTION 1 : EMERGENCY INFORMATION & TELEPHONE LISTINGS

1.1 SITE INFORMATION – LOCATION, OPERATING HOURS, NUMBER OF EMPLOYEES

Location

Physical Address:	Bumba Road, Coega IDZ, Zone 3, Port Elizabeth, 6100
Postal Address:	Bumba Road, Coega IDZ, Zone 3, Port Elizabeth, 6100
Tel No:	041 405 9605
GPS Coordinates:	S33o47'35.0" E025o37'36.0
Directions / Nearest Intersection:	N2 off-ramp to Neptune Road, Coega IDZ, Zone 3

Access / entrances for emergency vehicles

GATE 1	M17
GATE 2	Neptune Road
GATE 3	
GATE 4	

Site operating Hours

	DAY	NIGHT
WEEKDAY	08H00 – 16H30	16H30 – 08H00
WEEKEND	06H00 – 18H00	18H00 – 06H00
PUBLIC HOLIDAY	06H00 – 18H00	18H00 – 06H00

Number of people on site

	Employees	TES personnel	Other personnel
DAY SHIFT 08h00 - 16h30	9	0	2
NIGHT SHIFT 16h30 – 08h00			2
WEEKEND DAY SHIFT 08h00 - 16h30			2
WEEKEND NIGHT SHIFT 16h30 – 08h00			2

1.2 TELEPHONE LISTINGS – EXTERNAL EMERGENCY CONTACTS

Emergency Services

	Name	Contact details
Fire Dept:	Nelson Mandela Bay Metro	041 585 1555
Site Doctor:		
Hospital:	Dora Nginza Hospital	041 406 4111
	Netcare Greenacres Hospital	041 390 7000/7070
	Mercantile Private Hospital	041 401 2700
	Livingstone Hospital	041 405 9111
	Provincial Hospital	041 392 3911
	Life St George's Hospital	041 392 6111
Ambulance		10 177
Ambulance	Gardmed	041 373 6777
	Net care 911	086 091 1000
Police:	Mount Road, North End	041 394 6326
	Swartkops SAPS	041 408 8331
	Motherwell SAPS	041 4076408
Police Flying Squad		10111
Security:	Coega Gate House	041 403 0603
Security:	Air Products	041 405 9612
Vehicle Recovery:	AA Emergency Breakdown	083 843 22 or 083 THEAA
Spill Response:	Spill Tech	0861 00 0366

Utilities

	Name	Contact details
Electricity:	Nelson Mandela Bay Metro	041 374 4434
Water:	Coega IDZ	041 360 7811

Government Dept

	Name	Contact details
Dept of Labour:	Port Elizabeth, Govan Mbeki Street	041 506 5000
Environmental Affairs:	Nelson Mandela Bay Metro	041 505 4451

1.3 TELEPHONE LISTINGS - AIR PRODUCTS EMERGENCY CONTACTS

Corporate

CRISIS MANAGEMENT OFFICER:	MAROPENG BAHULA	**079 898 5886**
AIR PRODUCTS EMERGENCY RESPONSE CENTER:		**0800 650 315**

Site Specific

Role	Name	Contact details
SITE MANAGER:	JP VAN WYK	**041 402 9916**
SITE EMERGENCY COORDINATOR:	VINCENT NTULI	**041 405 9608**

1.4 TELEPHONE LISTINGS - FACILITY NEIGHBOURS & AFFECTED PARTIES

Neighbouring Companies:

Company Name	Contact Person	Contact Tel No.
AFROX	Andile Qwase	041 405 9643
Dynamic Commodities	Control Room	041 405 9888
Coega Dairy	Johan Schlebusch	041 405 0000
Famous Brands	Johan Schlebusch	041 405 0000

Pipeline Customers:

Company Name	Contact Person	Contact Tel No.
None		

Temporary Employment Services (with people on site)

Company Name	Contact Person	Contact Tel No.

Independent Contractors (with people on site)

Company Name	Contact Person	Contact Tel No.
Supercare	Jason Swanepoel	081 016 7339 / 041 365 1117
Stallion Security Services	Xolile Tshem	082 3256342

SECTION 2 : EMERGENCY ACTION PLAN OVERVIEW

2.1 PURPOSE

The procedures are to provide a plan of action to control potential emergencies which may arise at this facility. Actions under these procedures are to be directed at:

- minimizing personal injury;
- limiting property damage;
- and minimizing interruption of operations.

2.2 SCOPE

This Site Emergency plan is applicable to the Air Products South Africa,

COEGA FACILITY

This Emergency Plan covers potential types of site emergencies or off-site emergencies which could impact site operations, personnel, facilities and/or the surrounding community.

Specific emergency plans are available to deal with off-site emergencies which do not impact the site operations.

Although operations and maintenance employees are trained and knowledgeable of the hazards of the chemicals they work with daily, and, are expected to respond to incidental spills in the areas in which they work (as defined in Section 5) assistance may be required from other facilities or external resources.

2.3 RELATED DOCUMENTS

The following documents shall be maintained to be use in conjunction with this plan;

- Safety Data Sheet File
- Site Emergency Shut-down Procedures / Work Instructions
- Customer ER Plan (where site is situated within customer premises)
- MHI Risk Assessment

2.4 DEFINITIONS

EMERGENCY: Any abnormal event which may threaten to affect operations within and outside the Facility perimeters or which may require assistance from third parties to control shall be considered to be an emergency for which control procedures and instructions shall be devised.

Such events include but are not limited to: fires and explosions, uncontrollable spills and emissions, medical emergencies, workplace violence, and natural disasters.

CRISIS: An unstable or crucial time or state of affairs in which a decisive change is pending, especially with the distinct possibility of an undesirable outcome.

Examples include public disaster, fatality(ies), interruption of public activity (closure of highway, damage to public structures, etc.), involvement of emergency personnel and regional, national, or international news media.

2.5 RESPONSIBILITY AND AUTHORITY

2.5.1 Facility Manager / Appointed 16(2): has the overall responsibility and authority to ensure the implementation and compliance with this procedure.

The Facility Manager is responsible for;

- Generating and maintaining an up-to-date written emergency action plan for the facility.
- Ensuring the emergency plan is available and communicated to all employees
- Identifying and appointing suitable persons to take control of certain functions during an emergency to minimise the effect of the emergency situation, e.g. fire teams, first-aid teams, evacuation marshals, etc.
- Identifying and appointing suitable persons to ensure all monitoring, detection, alarms and ER equipment is available and maintained in good working condition.

In the event of an emergency, the Facility Manager or his/her designee shall be the Emergency Coordinator.

2.5.2 Department Managers/Supervisors: are responsible to ensure that all employees are trained according to this procedure.

2.5.3 Employees: are responsible to adhere to the relevant sections of this procedure, and to raise the alarm in the event of an emergency.

- The employee first becoming aware of a potential emergency shall report immediately to the Emergency Coordinator.
- Employees shall respond to emergency situations only to the extent they have been trained to do so. A description of the training is described in this section under "TRAINING AND DRILLS".

2.6 ER TEAM ROLES

2.6.1 Site Emergency Coordinator (SEC)

The Site Emergency Coordinator is the senior Air Products representative who is in charge of Crisis or Emergency Operations at the site. The SEC leads the Incident Management Team (IMT) and, as needed, works directly with the Crisis Management Officer to coordinate crisis control activities. The Emergency Coordinator uses the information in *Attachment E2* to guide his/her actions

The Emergency Coordinator will normally make determinations to request the fire department, rescue units, police, or other outside Emergency Services as needed.

The Emergency Coordinator is also responsible for:

- The decision to evacuate the site.
- The coordination of a personnel count, including visitors.
- The notification of surrounding neighbours and businesses.
- The decision to return to the site (in coordination with outside Emergency Services).

During an emergency, the Emergency Coordinator shall designate a person to staff a phone in order to maintain necessary communications.

The Emergency Coordinator will assign personnel to tend the main plant entrance(s) to send Emergency Response Services to the desired area and keep unnecessary personnel from entering.

The Emergency Coordinator is responsible for accounting for all employees, visitors and contractors personally or through a designee, after an evacuation by having everyone on site report to a predetermined designated assembly area and conducting a head count.

The Emergency Coordinator will activate the Crisis Management System when the emergency involves serious injury or fatality, the assistance of outside Emergency Services or extensive news media coverage. Activation is accomplished by calling the Air Products Crisis Management Officer on **079 898 5886**. When Crisis Management is activated refer to *Attachment E4, "Crisis Management Checklist"*.

NB: *In the absence of the Emergency Coordinator (e.g. during off hours), the senior person available at the facility shall act as the Emergency Coordinator. The acting Emergency Coordinator shall remain in that capacity until relieved by the Emergency Coordinator (or more senior person)*

2.6.2 Emergency Response Team

Appointed ER Team members are identified in *Attachments C1-C3*

Full details of their duties and responsibilities are defined in their letters of appointment, Attachments C4 – C7

Roles;

- **Area Emergency Marshals:** Take control of the emergency evacuation of personnel and control the ER activities in their area of responsibility.
- **Fire Fighters:** control or extinguish minor / early stage fires using portable fire extinguishers. Advanced Fire-fighters may also use fire hoses.
- **First Aiders:** tend to injured employees until emergency medical services arrive.
- **Hazardous Materials Technicians:** respond to releases or potential releases of hazardous materials for the purpose of protecting nearby persons, the environment, or property. Respond **only defensively, to control the release from a safe distance**, to keep it from spreading and to prevent exposures

2.6.3 Security

The Site Security personnel shall assist the Site Emergency Controller to ;

- Keep access / entrances open and clear
- Control access of personnel / visitors – prohibit entrance/exit of vehicles or people (unless permission is given by the Emergency Controller)
- Direct Emergency services to correct area
- Provide PPE to Emergency Services

2.7 EMERGENCY EVACUATION PROCEDURE

2.7.1 Reporting Emergencies

Employees on site first identifying an emergency or potential emergency (e.g., fire, explosion, chemical leak/spill, medical, workplace violence, or natural disaster) shall activate the appropriate alarm (manual pull box, public address system, plant intercom, etc.) as specified below to notify the Emergency Coordinator or the Senior Person on site.

2.7.2 Alarm System(s)

The location of alarms is indicated on the Site Plan

The alarm system is used to notify people on site that an emergency exists and what their immediate response should be. In addition, to the extent possible, it should identify the type of emergency condition (fire, explosion, chemical spill/release, medical) and the location of the emergency.

The alarm system(s) at this site for notifying people on site of an emergency are:

	TYPE OF ALARM	RESPONSE ACTION
1.	Fire Alarm	Gather at emergency assembly point
2.		

The alarm system is tested routinely at the following times :

Quarterly

2.7.3 Emergency Evacuation and Assembly Areas

Emergency escape routes have been posted in each work area, and all employees have been trained in the correct procedures to follow.

The emergency evacuation assembly areas will be located at the following locations:

Primary Location: **Next to the Guard house**

Secondary Location *:

'Safe Haven' **

** The secondary location shall be used as an assembly point **only** if the primary location is involved in an emergency or access to it is blocked.*

*** The 'safe haven' is a room which can be sealed in case escape routes are inaccessible due to gas release*

Employees shall view any windsocks at the site noting wind direction and proceed to the location which is upwind when appropriate.

The escape routes and assembly locations, in addition to being posted in the work area, can be found in *Attachments A1 & A2*

In the event of an emergency evacuation, the Emergency Coordinator shall ensure that the following items are taken to the assembly area:

- The Visitor's Log sheets and Employee Roster
- A cellular phone or 2-way radio, when available.

2.7.4 Emergency Control Centre (ECC)

The Emergency Response shall be coordinated from the Emergency Control Centre (ECC).

Primary Location: **Guard House**

Secondary Location*:

* *In case the primary location is involved in an emergency or access to it is blocked.*

The following items must be available at the ECC:

- A current copy of this Site Emergency Action Plan.
- The Safety Data Sheet file.

2.7.5 Actions to be Taken When The Alarm Sounds

Employees : Offices	Evacuate the building through the nearest emergency exit If you are not in your own office do not return to your department but evacuate through the nearest emergency exit Proceed to the Emergency assembly Point Assemble with your department to facilitate roll call
Employees (and contractors) : operations & maintenance	Stop work and ensure that the equipment and area is safe. Proceed to the emergency assembly point. Some employees may need to remain on site to shut down operations before evacuating (refer 2.7.9) *NB: Following the emergency the permit to work will have to be reissued. The previous permit will now be invalid*.
Operators of motor vehicles or motorised equipment	Immediately move your vehicle out of the road so as not to obstruct emergency vehicles. Turn off your vehicle and walk to the nearest emergency assembly point.
Visitors and contractors	Visitors are the responsibility of the person being visited. They must be assisted to the nearest emergency exit and escorted to the assembly point Contractors must evacuate to the assembly point as instructed during the induction process
First Aiders	Collect first aid bag Collect the first aiders **hard hat (plant first aiders) or bib (office first aiders)** for identification**.** Report to the Emergency Co-ordinator / designated assembly point for further instructions after Roll Call has been taken
Fire Team	Collect the fire team **PPE** (will also serve as identification) Report to the Emergency Co-ordinator for further instructions after Roll Call has been taken

Area Emergency Marshal(s)	Ensure all personnel in their area have evacuated ('sweep' the area) and equipment is safe (shut-down where required). Report to the Emergency Co-ordinator for further instructions after Roll Call has been taken
Site Emergency Co-ordinator	Determine the type of emergency Co-ordinate the Fire Team Leaders and Area Emergency Marshals to locate emergency i.e. fire etc. Contact Emergency services if required Liaise with Emergency Services and Armed Response Report on emergency and action to Management

2.7.6 Personnel Accountability after Evacuation

The Emergency Coordinator, or designee, shall conduct a head count.

Rosters shall be maintained listing normal personnel present during each shift from which a head count can be made. See *Attachment E3 "Employee Roster".*

- Everyone must be accounted for by name.
- Missing persons shall be reported to the Emergency Coordinator.

Visitor and Employee Log sheets shall be used to account for visitors and employees visiting from other facilities.

2.7.7 Rescue, Fire Fighting and Medical Duties

Emergency Response Team Members must assemble at the initial assembly points. The respective Team leaders will discuss an emergency action plan with the Emergency Response Co-ordinators.

Teams will then execute the action plan if and only if it is safe to do so. The Team leaders have the right to refuse his teams response if he feels an area is too dangerous

Attachment C1 lists individuals at the site who have been trained and certified in First Aid and CPR, who may voluntarily tend to injured employees until Emergency Medical Services arrive.

Attachment C2 lists individuals who have been trained and certified in Fire Fighting.

2.7.8 Emergencies Involving Releases or Spill of Hazardous Materials

The Facility Hazardous Chemical Substances Program and SDSs identify the hazardous substances on site, the quantities in which they are stored, the consequences of an uncontrolled release, the types of releases that could require an emergency response and what is considered an incidental release.

Refer *Attachment D "Major Hazardous Chemical List"*

Only trained First Responders / Hazardous Materials Technicians *(see Attachment C3)* shall respond to releases or spills of hazardous materials. Refer Section 5.

2.7.9 Procedures for Employees Who Remain to Perform Critical Plant Operations Before They Evacuate

Emergency operations and plant shutdown procedures are included in the Site Emergency Shut-down Procedures / Work Instructions File.

2.8 PRE-EMERGENCY PLANNING AND COORDINATION WITH OUTSIDE PARTIES

The Emergency Coordinator has identified outside agencies that the site may utilise (e.g., fire department, police, emergency medical services, spill response) to control the emergency.

These agencies have been notified and invited to review this emergency response plan. Emergency contact phone numbers are maintained in this plan.

2.9 EMERGENCY EQUIPMENT

The equipment available at this site for use in the event of emergencies is identified in *Attachments B1-B4*.

2.10 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment required to be worn when responding to specific emergencies is identified in Emergency Response Awareness training, the Facility PPE Hazard Assessment, JSA's and appropriate SDS.

2.11 COMMUNICATION WITH MEDIA AND EXTERNAL 3RD PARTIES (INCLUDING VIA SOCIAL MEDIA)

Only nominated personnel who have been trained are permitted to communicate with media or external 3rd Parties during and after the incident. No unauthorised personnel may post any information or pictures on any Social media.

Any personnel approached by media / 3rd parties for comment shall refer them to the Corporate or Site Communications Spokesperson.

Corporate Communications Spokesperson(s)	**ARTHI GOVENDER**	**082 447 2609**
Site Communications Spokesperson(s)	**JP VAN WYK**	**082 788 0112**

2.12 TAKING AND DISTRIBUTION OF PHOTOGRAPHS

Only ER Team members, investigation teams and the Marketing Dept are permitted to take photographs during and after the event unless specifically requested by the Site Emergency Coordinator (SEC).

All photographs taken shall be given to the SEC. No photographs may be distributed internally or externally without the permission of the SEC.

2.13 PRESERVATION AND COLLECTION OF EVIDENCE FOR INCIDENT INVESTIGATION

Care shall be taking during and after the emergency situation to preserve evidence which will be required for the incident investigation.

No person may disturb the site or remove any article or substance involved in the incident unless required to prevent a further incident, remove the injured or dead or to rescue persons from danger.

After the incident the area shall be cordoned off and not disturbed without the consent of the SEC or, in the case of a fatality, loss of limb or part of a limb, the Department of Labour Inspector

2.14 CRITIQUE OF RESPONSE AND FOLLOW-UP

At the conclusion of an emergency response (or routine training drill), a critique of the event will be conducted. The critique will involve personnel pertinent to the response and will include recommendations for improvement in the various areas of the emergency response, if needed. The critique will be documented and recommendations followed until complete.

2.15 TRAINING AND DRILLS

Site Emergency Action Plan training requirements are defined in the Global EHS Standard 25-020802.

All personnel employed at the facility will receive instructions and will participate in training drills to assure familiarity with emergency procedures and to develop proficiency in carrying out their specific emergency procedure assignments

2.16 EMERGENCY RESPONSE PLAN COMMUNICATION

Hard, controlled copies of the Site Emergency Plan and Guidelines (including Attachments) shall be available at the following locations;

- Emergency Control Centre
- Security
- Reception
- Site Emergency Controller
- Area Emergency Marshal(s)
- Fire Team Leader
- SHEQ Coordinator
- Plant Control rooms

A copy shall be given to the local Fire / Emergency Services for review and approval.

A Distribution list and document Transmittal notices shall be used to track distribution to ensure updates are communicated effectively.

Electronic copies of the Site Emergency Plan and Guidelines and Attachments shall be emailed to the Corporate Risk Manager.

"In Case of Emergency" flyers (*Attachment E8) s*hall be posted on notice boards and key locations on the site.

SECTION 3 : SITE ACTIVITIES & POTENTIAL EMERGENCIES

3.1 NATURE OF ACTIVITIES

This plant is manufacturing liquid oxygen and liquid nitrogen, and distribution to Bulk customers.

3.2 HISTORY OF INCIDENTS

To date there have been no incidents on site.

3.3 SPECIFIC AREA INFORMATION

Important features / landmarks

Key information of adjacent premises / activities

None of the surrounding businesses pose any significant risk to Air Product Coega Facility.

3.3 POSSIBLE TYPES OF EMERGENCY & CONSEQUENCES

Type of Emergency	Consequence								
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Fire									
- General / Structural	X	X	X	X	X	X		X	
- Electrical Equipment	X		X	X					
- Oxygen fed fires	X	X	X	X					
- Flammable Gas	X	X	X	X	X		X	X	
Medical Emergencies									
- Injuries / Illness	X								
Security									
- Threats & Harassing Phone Calls	X		X	X	X				X
- Physical Threats	X								
- Unlawful Acts – Intruders / Vandalism	X		X	X	X		X		
- Bomb Threats	X		X	X	X				X
Emergencies Caused By Neighbours / Customers /Third Parties With Impact									
- Train derailments									
- Neighbour emergency									
Natural Disasters									
- High Winds	X	X	X	X					
- Earthquakes and Aftershocks	X		X	X					
- Severe Rainstorms, Floods, Hail, Lightning	X		X	X					
- Power Outage				X					
Hazardous Materials Release/Spill									
- Flammable Gas	X	X		X		X			
- Asphyxiant Gas	X					X			
- Toxic Gas -									
- Cryogenic Liquid	X	X	X	X		X			
- Hazardous Chemical -	X	X	X	X		X			
- Flammable Liquid Spill – Diesel	X	X	X	X		X			
- Pipeline - ?									
Other									
- Pressure release / high pressure equipment ruptures #	X		X	X	X	X	X	X	X
- Vehicle Accident#	X	X	X			X			

pressure releases/high pressure equipment ruptures/vehicle accidents may result in Hazardous materials releases and/or fires as well as possible flying, falling or uncontrolled moving objects

Consequence Legend

A Harm to Air Products employees, contractors, and the public
B Harm to environment
C Damage to Air Products property and third party
D Loss to process
E Adverse publicity
F Presence of hazardous substances and materials
G Effect on the community
H Difficulty to resume business activity after the incident
I Effect on customers

SECTION 4 : SPECIFIC EMERGENCY ACTION GUIDELINES

4.1 FIRES

Facility Fires – General / Structural

In the event of a **MAJOR** fire, which could be detrimental to personnel safety or result in damage to equipment or structures located within the facility?

- All plant personnel must evacuate to the designated safe haven or assembly area.
- The Emergency Coordinator
    - shall determine when the Fire Department needs to be notified
    - shall, in conjunction with local emergency responders, determine when facility neighbours need to be notified or evacuated

In the event of a **MINOR (EARLY STAGE)** fire i.e. a fire which can be controlled or extinguished by portable fire extinguishers without the need for protective clothing or breathing apparatus

- Personnel who have portable fire extinguisher training may attempt to extinguish the fire after assessing the risk
    - Think before you act.
    - Fires may require electrical equipment to be isolated.
    - Burning materials may give off toxic fumes.
    - Make sure you have a means of egress / escape.
    - Always alert others of the fire before attempting any action.
    - Proceed only if safe to do so without putting yourself and plant personnel at risk.
- If unable to readily extinguish or control the fire, **STOP**. If you have not already done so, **ACTIVATE** the fire alarm and evacuate.
- **NO ATTEMPT** shall be made to extinguish large fires.
- **DO NOT ENTER** any structure, if the fire is beyond your control.

Guidelines for specific types of fire

Facility Fires Involving Electrical Equipment

- Burning materials may give off toxic fumes.
- Lighting or other important electrical functions in the vicinity of the fire may be lost, when the electrical power is shut off.
- Shut off the electrical power to the area from a safe distance.
- Keep a safe distance from any energized or conductive materials such as loose wire, metal rods or beams, or spilled liquids.
- Use an extinguisher that is suitable for the condition.
    - For small fires in cable insulation, windings, or other similar equipment, either carbon dioxide or Halon extinguishers are effective and safe since the extinguishing materials are non conductors. NEVER USE WATER.
- Oil switches, oil-filled transformers, and other electrical equipment containing oil involve the additional hazard of an oil fire. Oil has a relatively high flash point, but it may be heated and ignited by excessive current or an electric arc. Use carbon dioxide, Halon or dry chemical extinguishers for this type of fire. These extinguishers can be used without danger of shock to the operator even if electrical power cannot be shut off. NEVER USE WATER.

Flammable or Combustible Liquid Fires

- If possible, shut or block off the fuel source before attempting to fight the fire – Do so only if the source can be safely reached.
- Use carbon dioxide or dry chemical fire extinguishers.
- Secondary fires involving wood, paper, rubber, etc., should be controlled by soaking with water, providing no exposure to electrical elements exists.

***Special Precautions* to trained fire-fighters**.

- If fuel source is highly volatile, use fire fighting foam or take precautions to suppress flammable vapours to prevent re-ignition (possible with explosive force.)
- If fuel has low volatility, such as oil, cooling with water fog or breaking the combustion reaction with dry chemicals is effective.
- In the case of larger and more intense fires, chemical extinguishers should be used in combination with foam. Foam use should be limited to amounts necessary to smother the fire.
- Water must be used with caution. Addition of water will float most hydrocarbons and cause the fuel to spread increasing the intensity of the fire. Water may be used to cool adjacent equipment if the runoff does not spread the fire. Water fog may reduce the fire intensity, but the runoff may have environmental impacts.

Oxygen-Fed Fires

- Oxygen is non-flammable, but vigorously accelerates combustion. It causes objects to ignite more easily and burn more quickly than normal.
- Normally non-combustible materials, including those used for fireproofing, may burn quickly in an oxygen-rich atmosphere.
- If possible, shut off the source of oxygen before attempting to fight the fire – Do so only if the source can be safely reached.
- Only attempt to extinguish the flames if the oxygen source is shut off and if the resulting fire is small.
- Fight the fire according to the material involved.
    - For wood, rubbish, and textile fires use water and foam.
    - For oil, solvent, grease, and paint fires, use dry chemical powder, carbon dioxide, or foam.
    - For electrical fires use carbon dioxide or dry chemical powder.

***Special Precautions* to trained fire-fighters**.

- Use water to combat the fire directly and to cool and protect nearby combustible objects.
- If the fire is near a cryogenic liquid storage tank, water may be applied to the shell to keep it cool. The water must NEVER contact the diverter valve, relief devices, or outer vessel relief plate. The cold temperature of the cryogenic liquid could freeze the water and inhibit the proper functioning of these safety devices, and a tank rupture could result.

Flammable Gas Fires

- If nearby equipment is not threatened by the fire and the source of the gas cannot be safely turned off, it is often best to allow the fire to burn until the gas is consumed.
- If a flammable gas fire is extinguished before the gas flow is turned off, an explosive mixture of flammable gas and air may be formed. Make sure there is adequate ventilation to dissipate the gas.
- Even with protective equipment, emergency personnel should never enter an area where flammable gases may have accumulated.
- If possible, stop the flow of gas before extinguishing the fire – Do so only if the source can be safely reached.
- Water spray can be used to cool and protect adjacent combustible equipment or materials.
- Fight secondary fires according to the material involved.
    - For wood, rubbish, and textile fires use water and foam.
    - For oil, solvent, grease, and paint fires use dry chemical powder, carbon dioxide, or foam.
    - For electrical fires use carbon dioxide or dry chemical powder.
- Cylinders in fires
    - Cylinders in or near fires must be cooled by the use of a water stream to prevent heat and pressure build-up and possible rupture of cylinders.

***Special Precautions* to trained fire-fighters**

- If the fire is near a cryogenic liquid storage tank, water may be applied to the shell to keep it cool. The water must NEVER contact the diverter valve, relief devices, or outer vessel relief plate. The cold temperature of the cryogenic liquid could freeze the water and inhibit the proper functioning of these safety devices, and a tank rupture could result.
- HYDROGEN can burn with an almost invisible flame, and often can only be detected visually by heat waves. If entering an area where a suspected hydrogen fire may exist, always approach the area with caution.
- ACETYLENE cylinders. Use extreme caution when fighting a fire involving acetylene cylinders. Do not approach the fire. Spray water from a safe distance. *Refer Acetylene Cylinders in Fires*

Acetylene Cylinders in Fires

NB: Acetylene in cylinders can become unstable when exposed to heat. Container failure due to internal decomposition has been known to occur hours after the heat source was removed.

- Immediately evacuate – follow the normal procedures.
    - The main risk once the area is evacuated is missile style objects should the cylinder explode so a minimum radius of 50m should be evacuated, and personnel should shelter behind solid objects, not standing in front of windows etc
- Contact the fire brigade, advising that there are acetylene cylinders involved.
- If it is safe to do so, spray water onto cylinder, but take care to shelter behind a solid structure (not a light breeze block wall or any structure containing fuel) in case cylinder explodes. The use of a monitor is recommended, and once established personnel should withdraw outside of the evacuation zone.
    - When the Fire Brigade arrive, advise them of the location of the cylinders, and if known the quantities and products involved.
- Acetylene cylinders shall be kept cool by application of water for a minimum of 24 hours (preferably longer). This can be achieved in a number of ways (spray from a fire hose, immersion in water bath etc.).
- If possible leave the cylinders in situ, however if it is impractical or competent authorities (fire brigades) require it to be moved to a more suitable position for long term cooling then the following methodology is acceptable
    - Cool the cylinder from a safe location for a minimum of 2 hours – fire hose
    - From a safe location examine the cylinder to check if it is uniformly cold. This can be done using;
        - a thermal camera – pause the cooling long enough for the water to substantially dry from the cylinder – 5 minutes and examine
        - the 'wetting test' – pause water application and observe the cylinder for signs of steam rising from its surface, or, if no steam is observed, check to see if the wetted cylinder surface dries out quickly or remains wetted.
    - If steam is seen or the surface dries out quickly, recommence cooling.
    - If the cylinder is uniformly cold approach the cylinder and confirm results by hand. If cool it is permissible to relocate the cylinder – with care

      ** It is NOT appropriate to approach the cylinder to undertake the initial check by hand.*
    - If any of the checks indicate the cylinder is not uniformly cool – continue to cool for another 1 hour before checking again

      ** Care is important as the cylinder is still potentially dangerous.
- Other precautions shall include
    - Do not allow the cylinder to drop from height, or in other ways be exposed to knocks & bumps.
    - Continue to check for warm spots on regular basis
    - If mechanical transport is involved it shall be done slowly and the cylinder shall be completely secured.

4.2 MEDICAL EMERGENCIES AND PERSONNEL INJURY

- In the event of injury or sudden illness due to an accident or natural causes, immediately notify your supervisor or the Emergency Coordinator.
- Apply First Aid or CPR only if you are trained and certified.
- The Emergency Coordinator shall determine if outside Emergency Services are required.
- In the event of a fatality or serious personal injury, the Emergency Coordinator must immediately notify his/her line manager. If within 5 minutes, the line manager cannot be contacted, the Emergency Coordinator shall activate the Crisis Management System by calling the Air Products Crisis Management Officer on **079 898 5886**.

4.3 SECURITY THREATS & EVENTS

Threats and Harassing Phone Calls

- A threat is a telephone call, email, letter, note, etc. which conveys an overt threat of harm or damage to Company personnel or property.
- A harassing phone call is a telephone call which implies threat, impedes production, or is intended to annoy by means of its timing, frequency, or objectionable or obscene language.
- When a threat or harassing phone call is received:
  - Obtain as much information about the call and the caller as possible. Use the *Threats and Harassing Phone Calls Checklist, Attachment E1*, to document the information.
  - Notify Site Management immediately and evaluate the threat.
  - If Site Management cannot be reached, notify Vincent Ntuli on 041 405 9608. Explain the situation and request assistance.

Physical Threats, Threatening Behaviour, or Acts of Violence against Employees

- IMMEDIATE THREATS
  - If a situation arises that you feel is an **immediate** threat, i.e. the situation could result in bodily harm to one or all parties involved, deal with it calmly. Do not retaliate, use common sense and remove yourself from the area.
  - Contact the security resources (local police, etc.) for the site as necessary.
  - Contact Site Management.
  - After the situation is resolved, Site Management shall contact Vincent Ntuli on 041 405 9608/072 316 8745 for follow-up action.
- PERCEIVED THREATS
  - If a situation arises that you feel is a **perceived** threat, i.e. the situation has the potential to escalate over time if no action is taken, report it to Site Management.
  - Site Management shall contact Vincent Ntuli on 041 405 9608/072 316 8745 to assess the situation.
- **In the case of strike action**
  - Engage additional security and warn local police of pending or immediate threat.
  - Lock / barricade gates.
  - Keep everybody out of line of sight of the protestors (preferably inside buildings).
  - Contact Air Products delivery vehicles and personnel to warn them not to approach the site until it is clear.

Unlawful Acts

- INTRUDERS:
  - Do not attempt to confront the intruder yourself.
  - Contact the security resources (local police, etc.) for the site.
  - Contact Site Management.
  - Use phones as discreetly as possible to summon help.
- VANDALISM:
  - If vandals are discovered in the act:
  - Contact the security resources (local police, etc.) for the site. Air Products personnel **will not** assume the role of police.
  - Contact Site Management.
- If vandalism is discovered:
  - Report it immediately to Site Management.
  - Secure the area.
  - Site Management will evaluate if the damage constitutes a hazard to personnel or plant operation.
  - Site Management will notify the security resources (local police, etc.) for the site.

Bomb Threats

- When a bomb threat is received:
  - Obtain as much information about the call and the caller as possible. Use the *Threats and Harassing Phone Calls Checklist, Attachment E1*, to document the information.
  - Notify and evacuate any areas of the plant that may be **immediately** threatened.
  - Notify Site Management immediately and evaluate the bomb threat. Determine if the facility should be shut down and evacuated.
  - Notify the local police.
  - If Site Management cannot be reached, notify Vincent Ntuli on 041 405 9608. Explain the situation and request assistance.
  - If Site Management cannot be reached, notify *Vincent Ntuli on 041 405 9608/ 072 316 8745 as per ER matrix*. Explain the situation and request assistance
- Bomb Threat - Plant Evacuation:
  - If the bomb threat is indefinite regarding the time period; or no time is offered; immediate defensive action is required. Evacuate the plant and proceed to the designated assembly area.
  - Leave the Main Gate open.
  - Take a head count to ensure all site personnel and visitors have left the site and are accounted for.
  - Do not use two-way radios for communication. The bomb triggering device could use radio frequencies to set it off.
  - After evacuation, contact the local police and Line Management. Any further action and decision to return to the site will be determined by Site Management and local police.
- Bomb Threat - Plant Shutdown:
  - The decision to perform an Emergency or Normal Shutdown of the plant must be made by Site Management.
  - Follow the Site Work Instruction Manual for appropriate Emergency and Normal Shutdown procedures for the plant.
- Bomb Threat - Search:
  - Whenever possible, search procedures must be accomplished by professionals, i.e. bomb squads or rescue teams that are affiliated with the local police or fire departments.

    NOTE: THE REMOVAL AND/OR DISARMING OF A BOMB OR EXPLOSIVE DEVICE MUST BE LEFT TO EXPERTS IN EXPLOSIVE ORDNANCE DISPOSAL
  - If requested to assist in a search, a minimum number of people familiar with the site and the equipment are to be utilized on a voluntary basis.
  - All Air Products personnel involved in a search must realize their mission is only to search and report suspicious objects, **NOT** to move, jar, or touch the object or anything attached to it.

4.4 EMERGENCIES CAUSED BY NEIGHBOURING FACILITIES, CUSTOMERS, OR THIRD PARTIES WITH ON SITE IMPACT.

Train Derailments / Runaway Vehicles (Depending on Surrounding Traffic and Road Conditions)

- The Emergency Coordinator shall;
  - determine appropriate action to be taken based on nature and severity of the incident eg. evacuation, emergency shut-down of plant
  - determine if the ER Team should assist while waiting for emergency services – ***only if safe to do so***
  - ensure local emergency services have clear access to the incident site
  - notify emergency services of the hazards related to the site, products and process
  - communicate with local emergency services to assist where possible
  - notify the Corporate Crisis Management Officer on **079 898 5886**
- All Employees must evacuate to the emergency assembly point and must not interfere with the duties of the emergency services. Once personnel have been accounted for it may be preferable to move them indoors or to an area away from the incident site.
- Employees may not communicate with any media or external 3rd Parties and may **not distribute any information or pictures to 3rd Parties or post on any Social media.**

Emergency Response due to Emergency on Neighbouring Site / Customer Site (if Air Products Facility Located on Customer Site)

- The Emergency Coordinator shall;
  - Communicate with Neighbour / Customer Emergency Controller
  - Determine appropriate action to be taken eg. evacuation, emergency shut-down of plant
  - Comply with Customer Emergency Procedure / Instructions (if applicable)

4.5 NATURAL DISASTERS

Severe Weather Conditions

This guideline lists the precautions to be taken in the event severe weather conditions including high winds, rainstorms, or floods, hail and/or lightning (hurricane, tornado, wind storm) are suspected in the area.

- Have disaster supplies on hand including flashlights and extra batteries, portable, battery-operated radio and extra batteries, first aid kit and manual.
- Plan and practice alternative evacuation routes and assembly points (shelter) as the primary ones may not be suitable in adverse weather conditions.
- The Emergency Coordinator shall make the decision to shut down the facility and evacuate.
- Consider shutting down all power except as needed for emergency services.

High Winds

- Secure loose materials together, if they are stored outside. Bind groups of cylinders together.
- Seek shelter in a basement under something sturdy, like a workbench. If there is no basement, seek shelter in a small interior room in the middle of the building, like a closet or a bathroom. Always stay away from outside walls, windows or glass enclosures.

Severe Rainstorms/Floods

- If the plant is located in a frequently flooded area (flood plain) or is susceptible to flash flooding plan ahead by stockpiling emergency building materials. This can include plywood sheets, plastic sheeting, shovels, and sandbags.
- If possible relocate any loose equipment and material to higher ground.
    - Move all ground-stored cylinders onto elevated docks and secure.
    - Move all vehicles to higher ground.
    - Lock and secure valuables (files, vaults) and move to upper floors if possible.
- Evacuation should be by the safest routes to high ground. Evacuation is much simpler and safer before the flood waters become too deep.
    - Avoid walking through any flood waters. If it is moving swiftly, even water 15 cms deep can sweep you off your feet.
    - Cars can be easily swept away in just 60 cms of moving water. If flood waters rise around a car, it should be abandoned.

Hail Storms

- Seek shelter indoors or undercover and stay away from windows or glass enclosures.
- Stay inside until the hail stops - Do not go outside for any reason. Large hail can cause serious or even fatal injuries.
- Stay out of culverts and lowland areas that may suddenly fill with water.

Lightning

- During thunderstorms no place outside is safe. If you can hear thunder, lightning is close enough to strike. Stop what you are doing and seek safety in a substantial building or a hard-topped metal vehicle.
- Stay off and away from
    - anything tall or high, including rooftops, scaffolding, utility poles and ladders.
    - large equipment such as bulldozers, cranes, backhoes, track loaders and tractors
    - materials or surfaces that can conduct electricity, including metal scaffolding, metal equipment, utility lines, water, water pipes and plumbing
    - areas with explosives / flammable materials
- To avoid the danger of electrocution from lightning, avoid using phones and electrical appliances during a severe storm
- Seeking shelter under trees should be a last resort. It is common during severe storms for trees to lose branches. Also, large isolated trees attract lightning.
- AFTER THE EVENT:
    - Account for all personnel.
    - Enter the site only when it is safe to do so to secure the area and assess damage.
    - Rescue shall be left to trained and equipped personnel. However, if the immediate rescue of a person is needed, the buddy system shall be used. Injured personnel shall be administered first aid as needed in accordance with Section 4, "Specific Emergency Action Guidelines - Medical Emergencies".
    - Product releases resulting from the event shall be handled as per Section 5, "Hazardous Materials Emergency Response Guidelines".
    - Fires or explosions resulting from the event shall be handled as per Section 4, "Specific Emergency Action Guidelines - Fires".

Power Outage

This guideline lists the precautions to be taken in the event of a power outage.

While power outages are rarely life-threatening, they can pose safety hazards.

- Where specific site procedures are in place for a power failure these need to be followed.
- Move to a lighted area, if it can be done safely. Otherwise, stay where you are until help arrives and gives you a safe escort out of the area.
- Notify Supervision at this time, if they do not already know of the power outage.
- Never touch downed power lines, even if they are not sparking. The lines may be dead at first, but they can re-energize automatically.
- Treat all equipment as live.
- UNDER THE DIRECTION OF THE EMERGENCY COORDINATOR:
    - Turn off equipment that might be sensitive to voltage variation such as, computers, and microprocessor-based controllers and alarms to avoid damaging them.
    - Shut down equipment that may otherwise start up automatically when the power is restored.
    - Follow plant operating procedures for securing equipment and bringing equipment back on line when the power is restored.

SECTION 5: HAZARDOUS MATERIALS (HAZMAT) EMERGENCY RESPONSE PLAN & GUIDELINES

5.1 HAZARDOUS MATERIAL EMERGENCY RESPONSE

This facility **does not** have a HAZMAT trained Emergency Response Team.

Employees in their local area will respond to only incidental releases of hazardous materials.

An incidental release is one in which the substance can be absorbed, neutralized, or otherwise controlled at the time of the release by employees in the immediate release area, or by maintenance personnel, and there is no potential safety or health hazard (e.g. fire, explosion, or chemical exposure).

This response to incidental releases may include the following:

- Closing of local and remote operated shut off valves,
- wearing appropriate personal protective equipment as needed,
- containment of small leaks/spills
- prevention of personnel exposure through area isolation.

At this facility, all personnel are trained to, at a minimum, the "HAZWOPER" first responder awareness level, as well as specific operating procedures in order to perform functions listed above.

All releases shall be reported to the Emergency Coordinator or Senior Person on site.

If, during the course of a response to an incidental release of hazardous substance, the release escalates beyond an incidental release, then the employees conducting the response shall cease and the Emergency Coordinator shall activate the alarm system notifying employees to evacuate and call for local Emergency Services.

If the release has off site impact potential, the Emergency Coordinator in collaboration with local Emergency Services must consider notifying surrounding neighbours and businesses.

5.2 DECONTAMINATION

Exposure, First Aid, and decontamination requirements for specific chemicals on site are addressed in the appropriate SDSs in the site's HAZCOM binder.

5.3 CYLINDER LEAKS

- Do not handle leaking cylinders without supervision.
- Determine the source of the leak.
    - Most leaks occur at the valve in top of the cylinder. Areas that may be involved are the valve threads, valve stem and packing, valve outlet, or pressure relief device.
- **NEVER** attempt to repair a leak at the valve threads or pressure relief device.

Guidelines for INCIDENTAL leaks involving flammables, atmospheric inerts, or oxidants.

- If a leak develops in a cylinder containing flammables, atmospheric inerts, or oxidants, make sure there is adequate ventilation to dissipate the gas.
- Keep mobile phones and non IS portable radios away from the source of the leak.
- Move the cylinder to an isolated area (away from combustibles materials if the cylinder involves flammable or oxidizing gases).
- If the leaking cylinder is in a poorly ventilated area, monitor for oxygen deficient atmosphere (and flammable atmosphere if its a flammable gas) before attempting to move the cylinder.
- If the leaking cylinder is still connected to a fill manifold, valve off the remaining cylinders and slowly vent down the leaker through the manifold vent, before attempting any repairs.
- Atmospheric inerts that have been moved outdoors can be vented down by securing the cylinder, opening the valve and discharging the gas at a moderate rate, before attempting any repairs.
- If the leak cannot be safely stopped or controlled, or if the leak escalates beyond an incidental leak contact the Air Products Emergency Response Center at **0800 650 315** or Vincent Ntuli on 041 405 9608.

Guidelines for ANY leaks involving corrosives or toxics.

- Leaks involving corrosive or toxic gas must be evaluated and handled only under the direct supervision of an Air Products Emergency Response Coordinator.
- Evacuate and secure the affected area. Observe any wind socks at the site for the likely direction of fumes or vapours.
- Contact The Air Products Emergency Response Center at **0800 650 315**.
- The Emergency Response Coordinator will determine if the leak can be handled by plant personnel or if a trained Emergency Response team must be dispatched.
- If applicable, emergency response equipment is shown on *Attachment B4*.

5.4 FLAMMABLE GAS RELEASE

Hydrogen, Methane, Ethylene, Synthesis / Natural Gas / Sasgas

- Determine the approximate location of the release (once the release site is located, move away from the source).
- All nonessential personnel shall go to the designated assembly area that is away from and upwind of the release. Observe any windsocks at the site, noting wind direction.
    - Secure the area from vehicular traffic.

  WARNING *- Proceed only if safe to do so without putting yourself or other plant personnel at risk! Plant personnel must never attempt to approach a leak unless the flammable gas concentration is confirmed to be < 10% of the LEL, and the appropriate PPE and back up support is available. Plant personnel are not permitted or trained to enter a hazardous area for emergency response to a major release.*
- **MITIGATE** the situation.
    - If necessary, shut down the affected part of the plant and depressurize the system. See *Attachment A4, "Plant Main Emergency Shut Offs".*
    - In some cases, it may be necessary to start a nitrogen purge on the equipment.
    - Eliminate all ignition sources.
    - If available and necessary, set up fire monitors to establish a water spray to disperse the gas and to keep non-electrical equipment such as pneumatic control systems and instrument air lines cool.
    - If unable to secure the leak, **STOP**. Activate the evacuation alarm and evacuate.

5.5 TOXIC GAS RELEASE

Ammonia

N/A

5.6 CRYOGENIC LIQUID SPILLS

General Guidelines for All Cryogenic Liquid Spills

- **CONTACT** the Emergency Coordinator.
  - The Emergency Coordinator must make a determination as soon as possible as to whether the release has off site potential, i.e., obscuring vision, asphyxiation, fire and energy release.
  - If it is determined that the release does have off site potential, then contact the local Emergency Services.
  - The Emergency Coordinator in conjunction with local Emergency Services shall determine if facility neighbours need to be notified or evacuated.
- **ASSESS** the risk.
  - All cryogenic liquids produce large volumes of gas when they vaporise.
  - Cryogenic liquids will flow and result in accumulation of potentially hazardous atmospheres in low points and drains.
  - Contact with cryogenic liquids or their vapours can cause severe frostbite.
  - A plant evacuation may be necessary, if there is a risk of explosion or a risk of high or low oxygen concentrations depending on the product.
  - A hazardous atmosphere can exist well beyond the visible vapour cloud. Keep well clear of the vapours and direct others to do likewise.
- **CONTROL** the situation.
  - Secure the area from both non-essential personnel and all vehicular traffic.
  - If the vapour cloud is obscuring a neighbouring road, then, provided manpower is available, personnel should be stationed on both sides of the vapour cloud, and well clear of it, to stop traffic. This control should be passed on to the police or fire service as soon as possible.
  - Shut down any air conditioning or ventilating systems that may draw vapours or gas from spills or gas releases into buildings.
  - Carbon steel will be brittle and subject to impact or stress breakage if cooled to cryogenic temperatures. Keep critical lines, structures or vessels warm with water. Stand clear of any structural work that may be subject to collapse.
- **MITIGATE** the situation.
  - If possible, shut off the source of the cryogenic liquid. Whenever possible, accomplish this with a remotely operated valve**. (Do not subject yourself to any unreasonable hazard i.e., high oxygen, combustible or asphyxiating atmospheres, or cryogenic liquid exposure.)** Emergency Stop Buttons, emergency shut off valves, and electrical switches are shown on *Attachment A4*.
  - For minor releases of cryogenic liquids, water can be used to vaporise the liquid, if the source cannot be shut off. Be aware that depending on wind and weather conditions, the resulting expanding vapour cloud can jeopardize plant personnel, equipment, and possibly third parties.
  - Major releases should be vaporised only with the support of local emergency services, and after facility neighbours have been notified.

Liquid Oxygen (LOX) Spill Guidelines

(to be used in addition to the general guidelines)

WARNING – Do Not enter atmospheres that are greater than 23.5% Oxygen

- LOX Emergency Stop Buttons, emergency shut off valves, and electrical switches are shown on *Attachment A4.*
- Although the vapour cloud reveals the presence of a leak, the oxygen-rich area usually extends beyond its boundaries and may exist significantly downwind. Always approach an oxygen leak from upwind. Analyze the air to determine the perimeter of the area with an oxygen content over 23.5%. Keep all personnel outside of this area and shut off all sources of ignition such as electrical equipment, open flames, and machinery.
- If anyone has been exposed to an oxygen-rich area, do not get near any sources of high heat or open flame for at least 30 minutes. Open your clothes and pat them down to ventilate. Change your clothes, if possible. ***DO NOT SMOKE*** *until clothes have been ventilated for at least 30 minutes or changed*.
- Block all vehicular traffic from entering the area.
- Shut down the plant if the control room or other enclosed areas are susceptible to oxygen rich atmospheres. If it is already saturated with oxygen vapours, do not attempt to shut down. Evacuate the area and do not operate any equipment which may provide a source of ignition.
- If vapour clouds drift toward the air intake of instrument or main air compressors, shut them down immediately.
- If vapour clouds drift toward the cooling tower, the fans shall be shut down. Keep the water pumps operating. This may then require shutting down the facility depending on the load, ambient temperature, and the time necessary to keep the fans off.
- If the LOX reaches an asphalt surface or oil-soaked concrete, do not allow any movement, personnel or vehicular, on the affected area for at least 30 minutes after the frost disappears. In cases of large spills penetrating into the ground, this can take days.
- Use drawings and reference material to understand the hydraulics of system and know what is driving the leak. (Examples, tank leak stop head pressure using PIC, loading line leak stop pump, etc.)
- Use drawings to locate pipe spools and understand how they are run/located in box, duct work, or annulus of tanks. (Example, tank leak could be bottom drain, top fill, seal loops, etc.)
- Use existing flow sheets to see if any "injection" points are available upstream of leak. Use taps, drains, and other connections as a location to inject water, or CO2 into piping upstream of leak to freeze pipe or use air, N2, O2 injection to break seal or siphon effects in piping.
- Using fire water to make an ice dam by wetting of leak location to ice over area to seal leak.

Liquid Nitrogen (LIN) and Liquid Argon (LAR) Spill Guidelines

(to be used in addition to the general guidelines)

- LIN and LAR Emergency Stop Buttons, emergency shut off valves, and electrical switches are shown on *Attachment A4*.
- Keep out of, and well away from, the vapour clouds. Although the cloud usually extends beyond the oxygen-deficient area, do not assume that it is a boundary. Atmospheric conditions may cause variations. Approach any areas of suspected oxygen-deficiency from upwind.
- The cold vapours may settle in low-lying areas and cause localized areas of oxygen-deficiency.
- If it is necessary to enter a suspect area, first analyze the oxygen content of the air.

  If the oxygen content is below 19.5%, only HAZMAT trained emergency response teams with the appropriate PPE and back up support are permitted to enter the area.
- If vapours are suspected of having penetrated a building, evacuate the building. Keep ventilators operating on any equipment which withdraws air from the building.
- Equipment can be left running if cold vapours or liquids do not affect any structural members of machinery or piping, and the general operation of the plant is stable.

Liquid Helium (LHe) Spill Guidelines

(to be used in addition to the general guidelines)

N/A

Liquid Carbon Dioxide (LCO_2) Spill Guidelines

(to be used in addition to the general guidelines)

N/A

5.7 OTHER HAZARDOUS CHEMICALS SPILLS

General Guidelines for All Spills (Fuel, Diesel, Oil and Process / Maintenance Chemicals)

Note:

- *Chemicals are listed in Attachment D "Major Hazardous Chemical List"*
- *Refer to Safety Data Sheets for full details*
- *Ensure the appropriate PPE and spill kits are available to handle spills*

- **ASSESS** the risk.
  - The risks presented by the spill should be assessed the moment a spill is discovered.
  - A major spill may require plant employees to evacuate and a response be made by outside services that are equipped and trained to handle major releases.

  WARNING - Proceed only if safe to do so without putting yourself or other plant personnel at risk! Plant personnel must never attempt to approach a major spill (uncontrolled). Plant personnel are not permitted or trained to enter a hazardous area for emergency response to a major spill.
- **CONTROL** the release.
  - Secure the source of the spill.
  - Seal off all drains in the path of the spill.
  - Prevent the spill from spreading to any soil or water sources or from leaving facility using absorbent materials, booms, outside contractors, etc.
- **REPORT** the release.
  - Report all releases to Site Management / Site Emergency Controller.
  - Site Management shall contact the Site SHEQ Coordinator in the event of any release or spill. The Site SHEQ Coordinator will assist in determining if a specific situation warrants reporting and in making the actual reports.
- **CLEAN UP** the impacted area.
  - Cleanup should begin as soon as possible.
  - The Site SHEQ Coordinator will contact a local spill response contractor to arrange for proper clean up and disposal of spilled materials.
  - Spill cleanup contractors must not be allowed to dispose of spill residue until an approved or acceptable disposal facility has been identified.

5.9 PIPELINE ACCIDENT

Onsite

N/A

Off-site – refer Pipeline ER plan

N/A

SECTION 6 : ATTACHMENTS INDEX

A SITE PLOT PLANS

A1 Evacuation Assembly Locations
A2 Emergency Exits and Escape Routes
A3 Emergency Equipment Locations
A4 Plant Main Emergency Shut-Offs
A5 Hazardous Chemical Substances Storage Areas

B EMERGENCY EQUIPMENT

B1 Control Room
B2 Fire fighting equipment
B3 First Aid equipment

C ER TEAM INFORMATION

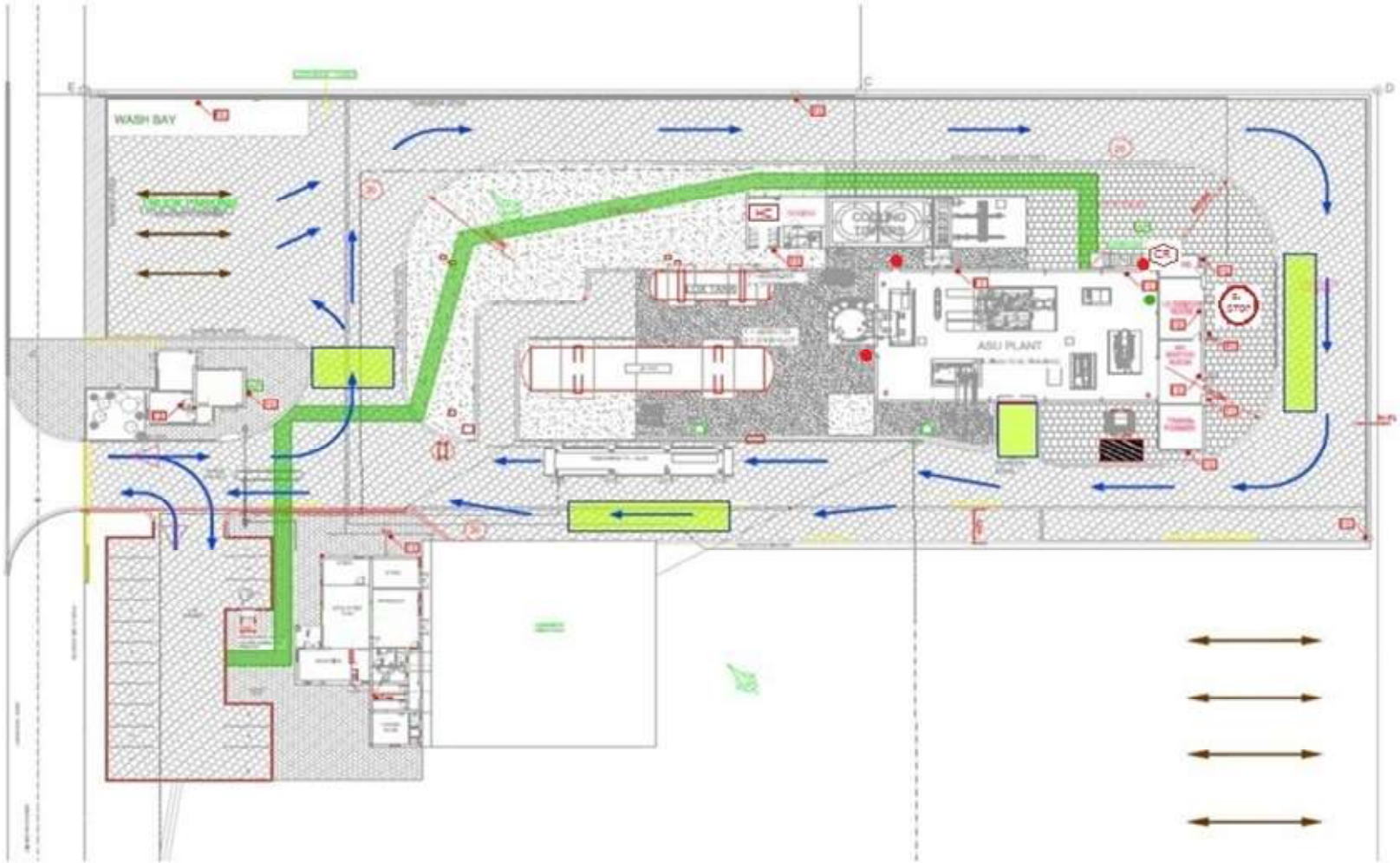
C1 Organogram/List: First Aiders Team
C2 Organogram/List: Fire-fighters Team
C3 Appointment Letter: Site Emergency Coordinator
C4 Appointment Letter: Area Emergency Marshal
C5 Appointment Letter: Fire Fighter
C6 Appointment Letter: First Aider

D MAJOR HAZARDOUS CHEMICAL LIST

E CHECKLISTS / TEMPLATES / FORMS

E1 Threats and Harassing Phone Calls Checklist (including Bomb Threat)
E2 Site Emergency Coordinator Checklist
E3 Employee Roster
E4 "In Case of Emergency" information

EMERGENCY SITE PLAN: COEGA



EMERGENCY PLAN

EMERGENCY REPONSE TEAMS: Coega Facility

SITE EMERGENCY LEADERSHIP:

SITE EMERGENCY COORDINATOR:

Vincent Ntuli

AREA EMERGENCY MARSHAL:

None

FIRST AIDERS:

- **Sigqibo Mbiyozo**
- **Sinethemba Dzena**
- **Vincent Ntuli**
-

FIRE FIGHTERS:

- **Sigqibo Mbiyozo**
- **Sinethemba Dzena**
- **Vincent Ntuli**
- **Stuart Conyngham**
-

HAZARDOUS MATERIALS TECHNICIANS:

None

-

Refer to Site ER Plan & Guidelines for full procedure

EMERGENCY PLAN

IN CASE OF EMERGENCY: Coega Facility

EMERGENCY SITUATIONS

Such events include but are not limited to: fires and explosions, uncontrollable spills and emissions, medical emergencies, workplace violence, and natural disasters.

BASIC STEPS TO FOLLOW IN AN EMERGENCY ARE:

- **SOUND** the alarm : *situated in the Control room*
- **CONTACT** the Emergency Coordinator and or Emergency Services

EVACUATION RULES: ALL EMPLOYEES / CONTRACTORS / VISITORS:

- When you hear the alarm **EVACUATE** through the nearest emergency exit and proceed directly to the Emergency Assembly point situated *at the Main Gate Guard House*
- Ensure visitors / Contractors are escorted to the assembly point
- Stay calm and participate in roll call
- Remain in the assembly point until the all clear signal has been given

EMERGENCY RESPONSE TEAMS:

- Report to the Emergency Coordinator for further instructions after roll call
- Following guidelines in the Emergency Plan **ASSESS** the risk, **CONTROL** and **MITIGATE** the situation

Note: Employees shall respond to emergency situations only if they have been trained to do so

EMERGENCY TELEPHONE NUMBERS:

SITE MANAGER/ 16(2):	**JP VAN WYK**	**082 788 0112**
SITE EMERGENCY COORDINATOR:	**VINCENT NTULI**	**072 316 8745**
EVACUATION CONTROLLER:	**VINCENT NTULI**	**072 316 8745**
CRISIS MANAGEMENT OFFICER:	**MAROPENG BAHULA**	**079 898 5886**
AIR PRODUCTS EMERGENCY RESPONSE CENTER:		**0800 650 315**
FIRE DEPARTMENT:	**10177 /**	**041 585 1555**
POLICE:	**10111 /**	**041 394 6326**
NET – CARE:		**082 911**

Refer to Site ER Plan & Guidelines for full procedure

EMERGENCY PLAN

THREATS & HARASSING PHONE CALLS CHECKLIST (including Bomb Threats)

** This checklist should be kept readily available at all phones that can accept incoming calls*

CALL DETAILS

Telephone Number at which call was received	Date	Time of Call

YOUR DETAILS

Name: _____

Position: _____

Location: _____ **Telephone No.:** _____

EXACT WORDING OF THREAT / MESSAGE

_____

_____

_____

_____

_____

_____

_____

_____

_____

LISTEN--DO NOT INTERRUPT!!
AFTER CALLER STOPS VOLUNTEERING INFORMATION, ASK THE FOLLOWING QUESTIONS:

Bomb threats;

1. When is the bomb going to explode?
2. Where is the bomb right now?
3. What does the bomb look like?
4. What kind of bomb is it?
5. What will cause the bomb to explode?
6. Did you place the bomb?

All threats;

7. What is the reason for the threat?
8. What is your address?
9. What is your name?

RECORD THE FOLLOWING INFORMATION:

Sex of Caller: _____ **Age:** _____ **Length of Call:** _____

CALLER'S VOICE (check the appropriate descriptors):

☐ Calm	☐ Nasal	☐ Soft	☐ Distinct
☐ Angry	☐ Stutter	☐ Loud	☐ Ragged
☐ Excited	☐ Lisp	☐ Laughter	☐ Cracking Voice
☐ Slow	☐ Rasp	☐ Crying	☐ Clearing Throat
☐ Rapid	☐ Deep	☐ Normal	☐ Accent
☐ Deep Breathing	☐ Slurred	☐ Whispered	☐ Disguised

☐ Familiar--If familiar, who does it sound like? _____

CALLER'S LANGUAGE (check the appropriate descriptors):

☐ Well-spoken(educated)	☐ Incoherent	☐ Foul
☐ Irrational	☐ Taped	☐ Threat Read

BACKGROUND SOUNDS (check the appropriate descriptors):

☐ Street Noises	☐ Animal Noises	☐ Long Distance	☐ Voices
☐ House Noises	☐ Office Machinery	☐ Local	☐ Music
☐ Bar Noises	☐ PA System	☐ Booth	☐ Radio
☐ Motor	☐ Static	☐ Clear	☐ TV
☐ Factory			

☐ Other: _____

WHO WAS NOTIFIED (check the appropriate boxes):

☐ Site Management	☐ Line Management	☐ Security
☐ Police	☐ Fire	☐ Medical
☐ Customer	☐ Other: _____	

ACTION TAKEN (check the appropriate boxes):

☐ Evacuation	☐ Normal Shutdown	☐ Emergency Shutdown

☐ Other: _____

Remarks:

_____

_____

_____

_____

EMPLOYEE ROSTER & EVACUATION ACCOUNTING LIST

FACLITY / SITE: Coega Facility EVACUATION DATE: _____

AREA/DEPT: All ROLL CALL BY: _____

EMPLOYEE NAME	JOB TITLE	Evacuation Accounted For
Vincent Ntuli	Plant Supervisor	
Sigqibo Mbiyozo	Process Controller	
Sinethemba Dzena	Process Controller	
Neliswa Kenene	Office Administrator	
Stuart Conyngham	Technician	
Buhle Hlabingwe	General Dutyman	
Brendan Oelofse	TES – Bulk Driver	
Sisasenkosi Belebana	TES – Bulk Driver	
Mxolisi Cacela	TES – Bulk Driver	
Leslie April	TES – Bulk Driver	
Bonginkosi Nomandla	TES – Bulk Driver	
Bongeka Hlazo	Ind. Contractor – Cleaner	
	Ind. Contractor – Security	
	Ind. Contractor – Security	

APPENDIX C:
CDC INTEGRATED STORMWATER MASTER PLAN (2008)

COEGA
DEVELOPMENT CORPORATION

INTEGRATED STORMWATER MASTERPLAN

FINAL REPORT

Project Number: J27139

Date: 03 MARCH 2008

ARCUS GIBB
CONSULTING • DESIGN • MANAGEMENT

EXECUTIVE SUMMARY

Integrated Stormwater management refers to a holistic approach that brings together all the aspects that have influence on stormwater in an area, in this case the area being western Coega IDZ. Integrated Stormwater Masterplan is then meant to address the questions of how the ecological values of streams and receiving waters can be protected or enhanced, and how drainage-related problems could be prevented, while the land is being developed at the same time.

During the process of updating ISWMP for western Coega IDZ, the components of interest were rainfall for Coega IDZ, Coega River floodline, minor and major drainage systems, water quality, current stormwater design criteria and guidelines and stormwater environmental impact assessment.

Rainfall intensities graphs for Western IDZ were developed using the current Port Elizabeth graphs and rainfall data generated by Schultz and Smithers (2003). These new intensity graphs for Coega are on average five percent lesser than Port Elizabeth graphs and according to Schultz and Smithers (2003) Mean Annual Precipitation for Coega is 427 mm which is smaller than 611 mm for Port Elizabeth airport.

For Coega River floodline, Geographical Information System (GIS) programme (Manifold) was used to map the catchment area. The total area was found to be 498 km². This value was earlier obtained by ARUP (2003) while SSI (2005) obtained 497 km². Peak flows for 50 and 100 year floods were estimated using Standard Design Flood (SDF) method as recommended by SANRAL and were checked using Unit hydrograph method. The peak flood values obtained were also similar to the ones obtained previously by ARUP (2003) and SSI (2005). HEC-RAS model was used to model Coega River.

Minor and major drainage systems from the previous Masterplan were based on the return period of 2 year and 100 year design floods. This concept was again reviewed and the recommended design period based on the SANRAL (2006) drainage manual (2006) were suggested.

Stormwater design criteria and guidelines were developed and are based on the CSIR manual (Red book) and SANRAL drainage manual (2006). For modelling, the set criteria from ARUP (2003) were adopted. Previous ISWMP requirements for tenants and operator of IDZ were also reviewed and adopted.

For water quality a chart was developed which is based on the stormwater polluting potential of each land use. The map is developed to indicate how each land development impacts on the quality of water. Best Management Practices developed by SRK (2006) for flood and erosion control were also reviewed and added under water quality section.

Spill Contingency Management Plan within the IDZ makes the last section in this Masterplan and summarise the protocols and responsibility of tenants and on Site Emergency Service during the contingency incident.

The use of most recent studies and technology in developing this Masterplan will make this document a valuable document for supporting the application for DWAF licensing and furthermore for overall stormwater management of the IDZ.

INTEGRATED STORMWATER MASTERPLAN
FINAL REPORT

CONTENTS

1 BACKGROUND

ARCUS GIBB is submitting this final report as part of the deliverables for the development of an Integrated Stormwater Masterplan (ISWMP) for the Coega Industrial Development Zones (IDZ), west of the Coega River, Contract No. CDC 206/06. ARCUS GIBB was appointed on 4 May 2007 for the update of the ISWMP project. The project is situated 20 kilometres to the north east of Port Elizabeth and covers approximately 1200 hectares of which 6500 hectares forms the Core Development Area (CDA).

The Coega Development Corporation (Pty) Ltd (CDC) is the legally responsible organisation for the promotion, development and management of the entire IDZ. In accordance with the good management practices and support of the requirements of the Record of Decision (ROD) for the change of land use of the Core Development Area issued by the Department of Environmental Affairs and Tourism (DEAT) on 27 May 2002 (ref. 03/2/4, A24/29/3/20/7), CDC has developed an Integrated Storm Water Management Plan.

The CDC intends to update the existing Integrated Stormwater Management Plan (ISWMP) for the Coega IDZ. The establishment of infrastructure in this part of the Coega IDZ requires a Stormwater Management Plan that will benefit the detail infrastructure designs of Zones 1,2,3,4, and 5. The update of the ISWMP report is aimed at providing the Department of Water and Forestry (DWAF) with a technical supporting document for the CDC's applications for water use licences.

1.1 Stormwater Masterplan Scope of Work

The CDC is facilitating the development of a number of infrastructure projects within the Coega IDZ using private sector consulting firms. In IDZ context, watercourses (whether natural rivers or constructed canals) serve the important function of draining stormwater runoff from both developed and undeveloped land as well as providing natural habitats. Inundation of floodplains is both natural and desirable where it can occur without risk to human life or damage to property and infrastructure.

It is in general more cost effective in the longer term, to develop in locations that are intrinsically safe from flooding rather than retrospectively engaging in flood defence works to protect developments in locations that are not intrinsically safe from flooding.

The CDC Request for Proposal (CDC 200/06, January 2007) rightly identifies that there are several locations in the IDZ study area where stormwater runoff may present problems due to excessive concentrations.

The Terms of Reference (ToR) for this project state that the ISWMP must:

- Provide an updated ISWMP that will provide DWAF with technical support documentation for the CDC's applications for water use licences.
- Provide a broad framework plan for stormwater management by suggesting acceptable standards for overall stormwater management.
- Provide a design basis for the proposed storm-water management at the IDZ with respect to water quality and quantity.

- Devise ways to regulate and monitor how the quality and quantity of storm water will be managed by construction contractors, tenants, and CDC as the operator of the IDZ.
- Minimise disturbance to the hydrological and hydro geological regimes of the Coega River catchment by ensuring the control of storm water runoff and associated releases to the environment.
- Provide detailed information about the environmental setting of the IDZ with particular emphasis on water resources
- Review the CDC's Integrated Stormwater Masterplan and incorporates all changes implemented during the construction phase of the Coega Development Area.

Guided by the stated project duration of 5 months, ARCUS GIBB has used a Task Programme included in **Appendix A**.

1.2 Overview of the sections

This document is structured as follows:

Section 1 gives an outline of the general background, the scope of works and general characteristics of Coega catchment area

Section 2 is the literature review and discusses mainly those sections of the previous Masterplans which needs to be reviewed and updated

Section 3 discusses the rainfall analysis which has been done as part of updating the previous ISWMP

Section 4 focuses on new estimates of Coega River floodlines

Section 5 discusses the stormwater drainage and storage review

Section 6 outlines suggested stormwater design criteria for Western Coega IDZ

Section 7 focuses on water quality and the Best Management Practices for erosion and flood control.

Section 8 discusses the environmental impacts assessment specification and stormwater impact assessment.

Section 9 discusses the spill contingency management plan for Coega IDZ

1.3 Locality and Catchment Characteristics

1.3.1 Geography

The Coega Industrial Development Zone (IDZ) is located approximately 20 km northeast of the Port Elizabeth city centre and occupies 120 km² on relatively flat terrain. The locality plan for the Coega is shown in **Figure 1.1** below. With the exception of some dune-covered areas near the shores of Algoa Bay, most of the IDZ drains to the Coega River which intersects the site in its lower reaches. The Coega River rises in the Great Winterhoek Mountains to the northwest of Uitenhage and discharges into the Indian Ocean where it forms a temporary open/closed estuary next to the Port of Ngqura. The Coega River can be considered an intermittently flowing or ephemeral river that is driven by rainfall events. Over long periods of insufficient rainfall the river consists of small vegetation-choked puddles in the middle and upper reaches and series of large pools towards the estuary. During dry seasons any connectivity between areas of standing water occurs as hyporheic (subsurface) flow. The Coega River is classified as moderately modified in the upper reaches owing to water abstraction for farming activities and negative impacts by alien invasive plants. The lower reaches of the river are regarded as critically modified as it has been extensively modified through canalisation, commercial saltworks and the port structures.

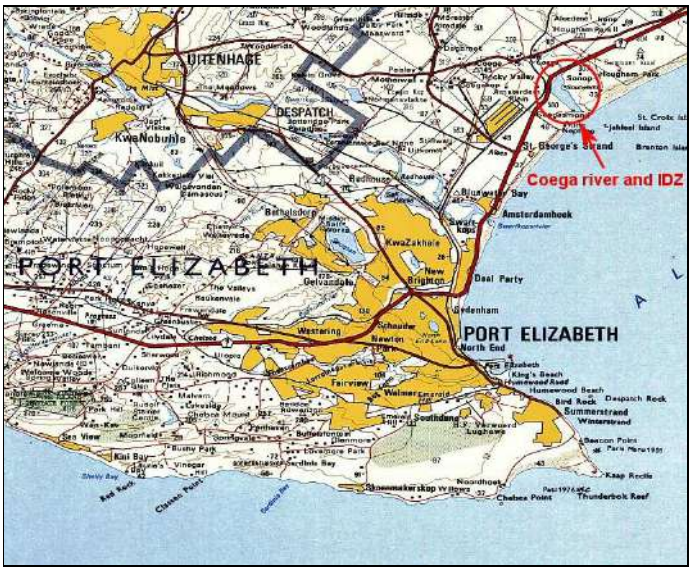


Figure 1.1: The locality plan for the Coega IDZ

1.3.2 Geomorphology

The IDZ is situated on a coastal platform that descends towards the sea in a series of gentle steps orientated parallel to the existing coastline. This platform has been incised by the Coega River, which flows towards the sea across the western and southwestern parts of the IDZ. Coega Kop, inliers of Table Mountain sandstone rising to 145 m, is a prominent hill in the northwest of the IDZ.

The ground surface in the northern part of the IDZ is generally flat, with the

northernmost corner and north-eastern edge having undulating topography sloping down to the Sundays River. The southern and central part of the IDZ is traversed by linear, palaeo-beach ridges and troughs running parallel to the present coastline. These features were formed by an episodically receding sea level. A coastal dune ridge of substantial proportions is present along the shore.

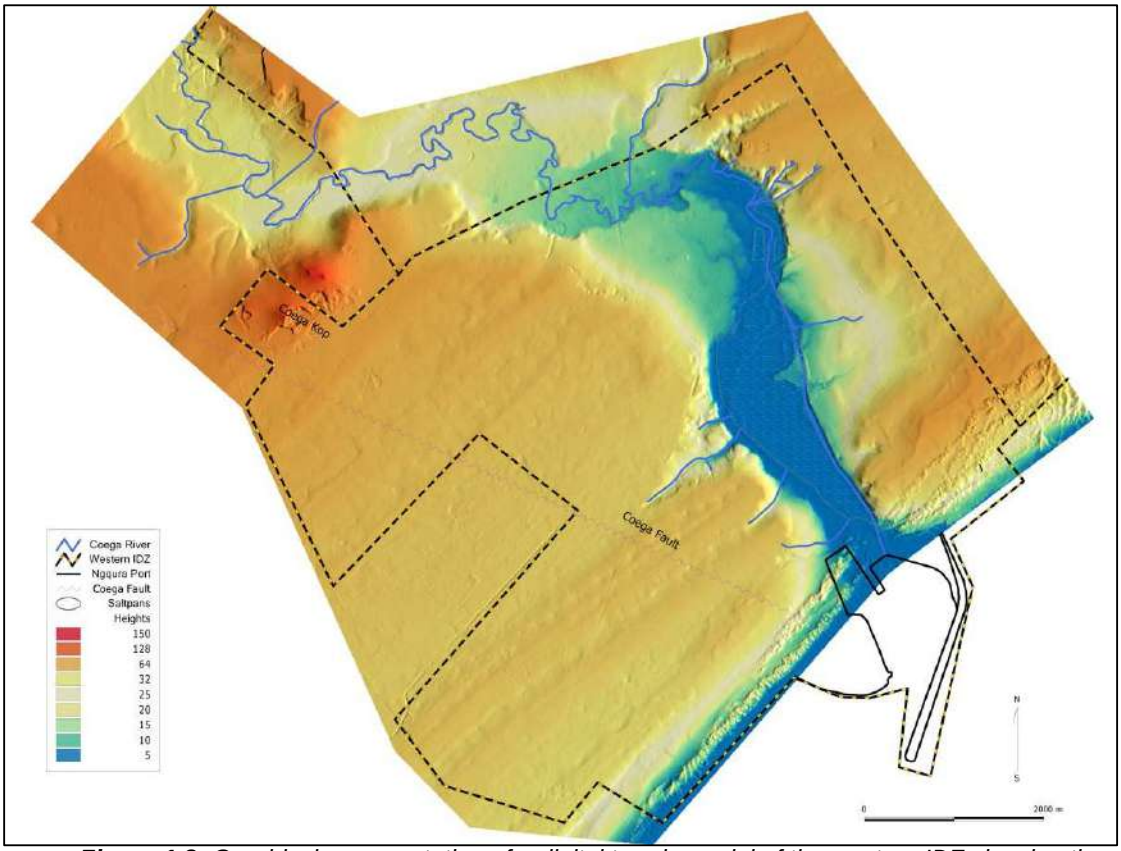


Figure 1.2: *Graphical representation of a digital terrain model of the western IDZ showing the general topography of the study area.*

1.3.3 Geological Setting

Most of the Coega IDZ is underlain at depths of 100 – 300 m by hard, quartzitic sandstones of the Table Mountain Group. The overlying Cretaceous Sundays River and Kirkwood Formations of the Uitenhage Group dip north-east at 20^{o}. These formations vary in thickness from ±10 m in the vicinity of Coega Kop to >800 m in the centre of the Algoa basin. Both formations show low groundwater permeability and form an effective aquiclude. The Tertiary marine deposits of Alexandria Formation occur as a 10 m thick capping over the Cretaceous rock types. Calcium carbonate shell fragments and quartz-sand gravels commonly occur in the Alexandria Formation. Weathering and dissolution of the calcareous Alexandria Formation has led to the formation of small-scale sinkhole (doline) structures, especially on the western side of the Coega River. Quaternary alluvial sediments are found in the river valley on the eastern side.

An important geological feature in the area is the northwest-southeast trending Coega Fault. This fault traverses the south-western corner of the IDZ and

intersects the coastline at about 1 km southwest of the Coega River mouth. The fault is considered to be seismically inactive at present.

1.3.4 Groundwater

Owing to the local geology surface water infiltration is limited. The presence of the low permeability Alexandria Formation and the clays of the Sunday River and Kirkwood Formations restrict the vertical infiltration of rainwater. Following a rain event rapid run-off towards the Coega River takes place. The quartzitic sandstones of the Table Mountain Group form part of the productive semi-confined Coega Ridge Aquifer. In the aquifer the flow is predominantly eastwards. The Coega Ridge Aquifer forms part of the Uitenhage Artesian Basin, which is protected by legislation from over-exploitation and contamination. The aquifer is naturally protected from pollutants by the thick cover of impermeable Cretaceous clays.

1.3.5 Climate

As the Coega IDZ is located in the transition between southern temperate and subtropical bioclimatic zones it receives rainfall throughout the year. Precipitation shows a bimodal pattern with peaks in autumn and spring. The mean annual precipitation is 427 mm. At least in summer, evaporation exceeds rainfall by such a large margin that salt making is a viable industry of this area. Winds reflect the seasonal variation of the atmospheric circulation systems and the influence of coastal lows. Westerly to south-westerly winds are the most prevalent, but during the summer months, easterly to south-easterly winds are almost as frequent (Stone, 1988).

1.3.6 Vegetation

The Nelson Mandela Bay Municipality is an area of convergence of five of South Africa's seven biomes, namely the Fynbos, Subtropical Thicket, Forest, Nama Karoo, and Grassland biomes, which give rise to a high diversity of vegetation types. Owing to the low rainfall, succulent vegetation dominates the study area. This dense, spiny vegetation biome unique to the region is known as the Subtropical Transitional Thicket. The inland parts are assigned to the Sundays Valley Thicket, while a second broad habitat unit, the Algoa Dune Thicket, is found on the aeolianite and calcareous soils next to the sea.

1.3.7 Fauna

The present fauna is depauperate owing to severe impacts from previous human activity, which has led to loss of animal habitat as a consequence of the loss of indigenous vegetation. Local extinctions of large mammals have occurred. Sixty-three small or medium-sized mammals are expected to occur, although their available habitat is rapidly shrinking as new tenants move into the IDZ. Over 150 bird species are resident or visitors to the study area. The most diverse avifauna is associated with the remaining patches of intact indigenous vegetation. Specialised avifauna is found along the seashore and at the salt pans. As regards the lower vertebrates approximately 17 amphibians and 63 reptiles are expected to occur in the Coega IDZ according to previous environmental impact

studies (CES 1997). While none of the amphibians are threatened internationally, 18 reptile species are of conservation concern by being rare, endemic, Vulnerable or Endangered. A further four reptile species occur at the edge of their distribution limits.

Conservation measures were introduced for three rare butterflies (the Wineland Blue *Lepidochrysops bacchus*, and the small coppers *Aloeides clarki* and *Poecilmitis pyroeis*) to halt their impending extinctions, but it is uncertain if these measures will prove to be sufficient.

Certain environmentally sensitive areas in the IDZ have been set aside and incorporated into the Open Space System.

2 LITERATURE REVIEW

2.1 Introduction

In order to evaluate and quantify the extent of the update requirements for the ISWMP a literature review was conducted. This process has been an ongoing process so as to ensure that all relevant information which has an impact on the quality of the ISWMP was being incorporated. As part of the literature review process, a number of documents were requested from CDC by ARCUS GIBB and were reviewed. A detailed list of the documents that were reviewed including, among others, Stormwater Masterplan (2003) is attached in **Appendix B**.

2.2 Catchment Characteristics

Integrated Management could be defined as the holistic approach that brings the technical, social, and economical and environment knowledge together to make a system that works in harmony with each component without compromising anyone part of the system.

In line with the theme of Integrated Stormwater Management, the literature review process was subdivided into the following sections:

- Rainfall Data Analysis
- Flood Line Analysis
- Stormwater Drainage System and Design
- Water Quality Monitoring
- Current Developments and Land Use
- Planned Control Measures and Existing Available Guidelines
- Department of Water Affairs and Forestry (DWAF)‘s requirement.

2.3 Rainfall Data Analysis

From the list of the documents that was reviewed, rainfall data is discussed mostly in Appendix A of the Integrated Storm Water Management report No CDC/SHE/0252/05 ARUP (2003). in this document, the rainfall patterns of Coega area are referenced with the ones from Port Elizabeth airport. The calculations made from this document suggest that Intensity-Duration-Frequency (IDF) rainfall curves from Port Elizabeth airport are representative of the Coega vicinity. This statement is later refuted by the study carried out by SRK (2006) for CDC.

SRK (2006)’s report on “Coega IDZ Soil and Water Quality” Report No 329730/3, states that rainfall data for the Port Elizabeth airport station is not an accurate reflection of the rainfall in the Coega catchment. It is furthermore mentioned that the Port Elizabeth airport (which is close to the coast) is in a different catchment zone from Coega, which is said to be situated 50 km inland in the north- westerly direction from the Port Elizabeth airport.

2.4 Floodline Analysis

The computation of floodline is mainly dependant on the following parameters:

- Rainfall input data
- Catchment land use
- Catchment size
- River roughness coefficients (Manning's values dependant on the river bed conditions in terms of stone size and vegetation cover on the main channel and floodplain banks).

The first Coega River floodline was modelled by Gibb Africa (1997) using 5-m contours. In the modelling of this river, the catchment area was taken as 565 km² (this value was cited from a Water Research Commission report no 298/5.1/94). The method that was used to estimate the peak floods was the Regional Maximum Flood (RMF) based on Kovacs. For the river modelling the outlet control was taken as a gap in the dunes 600 m from the sea with a bed level at 2 m and a 200 m wide channel discharging as a broad crest weir. The cross sections were taken between the mouth and a distance of 10km upstream; using the 1: 10 000 scale orthophotomaps. The values used for Manning's 'n' varied between 0.02 for sandy lagoon bed to 0.045 for the floodplain areas with scattered bush.

In 2003, ARUP was appointed to update the Stormwater Masterplan which included reviewing Gibb Africa (1997) floodlines. ARUP (2003) delineated Coega River catchment area from 1:250 000 scale plans and measured 498 km². The difference in catchment areas between Gibb Africa (1997) and ARUP (2003) was explained by the fact that the first estimate referenced by Gibb Africa included the local dune areas and the area near the mouth which discharge directly into the sea. ARUP (2003) used rational, unit hydrograph, MIPI, the TR137 and Standard Design Flood (SDF) methods to estimate the peak discharge in Coega River. For modelling, the Highest Astronomical Tide (HAT) was taken as the outlet control with a starting water level of +3.5m (1.094m masl). The cross sections were abstracted from Digital Terrain Model (DTM). The model was then run / developed using Hydrologic Engineering Centre River Analysis System (HEC-RAS) backwater programme.

The latest update of Coega River floodline was done by SSI (2005). This time the catchment area up to the harbour area was estimated to be 497 km² though it was not explained how it was estimated. SSI (2005) used SDF and RMF methods to estimate the peak flows in Coega. For the modelling boundary conditions, the outlet control was taken as HAT, wind set-up from onshore winds, hydrostatic set-up from a low-pressure storm system and prediction of sea level rise in the future. The total level from these conditions gave a depth of 2.54m. The cross-sections were also taken from DTM and the Manning's 'n' values used ranged from 0.025 to 0.108. The model was again run using the HEC-RAS backwater programme.

2.5 Stormwater Drainage System and Design

2.5.1 Stormwater Drainage System

Coega IDZ, as mentioned earlier, is characterised by a flat plateau area, with poorly developed drainage, intersected by deep formed river channels. The main drainage

paths are the Coega River, which bisects the site, the Swartkops River to the Southwest of the IDZ, and the Sundays River to the northeast.

Gibb Africa (1997) stated that, where clearly defined river channels occur within the development, it is vital to keep them on their existing alignment and just provide adequate drainage servitudes along them. Gibb Africa (1997) report also stated that it is not feasible to drain any part of Coega IDZ into Sundays River, but rather into Coega River or Swartkops River. Gibb Africa further stated that the development will require artificial drainage systems that will connect most of the development to the river channels.

Maxplan et al (2001) gave Coega IDZ drainage system the same description given by Gibb Africa (1997) and further explained that the natural and man-made depressions characterise the low-lying area on the south of Coega IDZ. *Maxplan et al* (2001) also mentioned that the runoff that drains into these areas flows into these depressions and little runoff escape into Coega and Swartkops rivers due to the large sizes of these depressions. The northern portion of IDZ is said to be characterised by less regular depressions hence large quantities of runoff escape to Coega River and Swartkops River.

In the previous ISWMP's by Gibb Africa (1997 and 1999) and *Maxplan et a*l (2001), the use and calculations of attenuation ponds are discussed. *Maxplan et al* (2001) and CDC had also agreed that individual developers of large sites should be required to attenuate stormwater within their developments. The purpose of these detention storages is to avoid excessively large culverts and channels and to reduce peak to manageable levels. In the latest ISWMP by ARUP (2003) the use of these attenuation ponds suggested earlier was discussed as not being very practical due to the topographical nature of the IDZ. Furthermore, it is discouraged in that the implementation of some of these ponds might require substantial structural measures. ARUP (2003) stated that major floods in Coega IDZ can be controlled by certain roads, park strips without putting the attenuation ponds in place. The use of attenuation ponds is later implemented by different consultants in individual zones of the development. Africon (2004) commented on the statement of impracticality of using the attenuation ponds in Coega IDZ, and stated that ARUP (2003) stormwater Masterplan is a general overview for the entire IDZ area and includes various aspects which are site specific and should not be applied globally across the entire development area.

2.5.2 Stormwater Drainage Design

As mentioned above Gibb Africa (1997) stated that Coega IDZ would further require artificial drainage systems to support the already existing natural drainage systems. For bulk stormwater drains (major drainage) Gibb Africa suggested a design capacity of 1: 50 years. *Maxplan et al* (2001) defined major drainage system as all natural watercourses and major artificial conduits (including roads, large open channels, closed infrastructure and stormwater detention ponds) which could be utilised during severe storms. The minor drainages are defined as drainage systems that are provided for the convenience of the community and required that runoff should be moved rapidly form the area being drained.

From the Integrated Stormwater Management Plan by ARUP (2003), a 2-year recurrence interval was adopted as a criterion for the minor system drainage design and the 100-year recurrence interval as the design for the major system. These design criteria were adopted from the previous Integrated Stormwater Masterplan of 1999 by Gibb Africa.

2.6 Water Quality Monitoring

The previous ISWMPs discuss the stormwater quality of Coega IDZ briefly. ISWMP of 2001 states that heavy industrial areas, the metallic industry cluster and bulk mineral storage area will yield highly polluted stormwater. From ISWMP (2001), it is proposed that this dirty stormwater be retained in lined dams and then be treated prior to discharge into the stormwater system by the responsible polluters themselves. It is also recommended that a portion of clean stormwater (that is the stormwater which was not directly in contact with industrial works) be used to dilute the dirty stormwater prior to discharge into Coega River. *Maxplan et al* (2001) further recommended that all the stormwater which is being discharged into the harbour via Coega River should be treated by way of silt traps and trash racks. The stormwater from Motherwell would require to be treated to reduce pollution in IDZ. *Maxplan et al* (2001) recommend the use of an artificial wetland which could be placed at Motherwell stormwater outfall.

ARUP (2003) focused mainly on the quantities of stormwater that could be produced in the IDZ. However ARUP (2003) indicate that the following items should be taken into consideration:

- Quality of runoff from general industrialised areas
- Quality of runoff specifically from Pechiney site
- Possibility of storing runoff, especially the so-called “first flush”
- The extent to which DWAF water quality standards be met with and without on-site storage or other handling measures
- Impact of the development of the IDZ on the aquatic environment with regard to a likely degradation in water quality.

2.7 Current Development and Land use

Coega River catchment is generally used for agricultural purpose. Intensive agriculture occurs to a limited extent along the Coega River. Within Coega IDZ and around the development, the following land use could be seen:

- The saltworks within Coega River Estuary
- Brick making works in the vicinity of Coega village
- Coega village
- A recreational area behind the dunes at St. George’s Strand and Joorst Park
- Aldo Scribante race track
- The Markman Industrial Township
- Regional cemetery of Motherwell and Coega
- Truck stop near N2/MR 450 interchanges.

2.8 Planned Control Measures and Existing Guidelines

Maxplan et al (2001) proposed the following documents as a basis for the detail design criteria and standards for Coega IDZ:

- Guidelines for the Provision of Engineering Services and Amenities in Residential Townships (red book)
- Guidelines for Urban Stormwater Management, draft UTG4.

Furthermore *Maxplan et al* (2001) report proposed that all the design works should comply with Nelson Mandela Bay Municipality (NMBM) standard detailing.

ISWMP of 2003 provided a summary of the baseline environmental, requirements for tenants and the IDZ operator.

Africon, Izizwe and Nzuza (2004) produced a document named 'Design Standards Report' (Revision No.3) of 18 October 2004. This report relates to the design standards to be used for municipal services design in Coega Zone 1. This document is based on the Nelson Mandela Bay Municipality (NMBM) standard detailing and ISWMP of 2003. The standard details were as prescribed by NMBM based on the City of Engineers' Department Standard Details of Water, Sewerage, Roads and Stormwater and Transport divisions (January 2003) revised edition.

SRK (2006) conducted a Phase 2 Study on Generic Guidelines and Best Management Practices (BMPs) for Flood and Erosion Control and produced a Report No. 350137/2 under contract CDC/11/04 in January 2006. This report states that there are very limited guidelines and specifications available for planning and design regarding energy dissipaters, spillways and inlet works and litter and sediment traps. There are comprehensive guidelines and specifications for construction stage and fairly comprehensive guidelines and specifications for operational stage except in the case energy dissipaters, litter and sediment traps.

2.9 DWAF's Requirements

ISWMP (2003), states that Department of Water Affairs and Forestry (DWAF) proposed to define stormwater from known pollution risk areas as being potentially polluting. For this reason, it requires a water licence in terms of Section 21 of the National Water Act of 1998. Stormwater from areas considered as low risk pollution level would not require to be licensed but DWAF would want to be assured that it is managed. DWAF is responsible for controlling releases to rivers and estuaries in terms of the National Water Act of 1998; however the requirements for discharge to sea are less stringent than those for the river. It is also stated in the ARUP (2003) report that the provision of control of discharges to sea was supposed to have been the responsibility of the Marine Coastal Management Unit (MCM) but at the time MCM lacked the procedure to issue such licences hence the responsibility was transferred to DWAF under section 21 (f) of the Water Act. The DWAF application forms together with the procedures need to be obtained from the DWAF representative. Previously the stormwater required two water use forms namely Form F and Form G, which relate to the discharge of potentially polluted stormwater and to the disposal of waste or water containing waste respectively.

3 RAINFALL ANALYSIS

3.1 Introduction

In the previous works that have been done in Coega IDZ, rainfall data that has been used was for Port Elizabeth Airport gauge. Port Elizabeth Airport is approximately 22 km south of Coega hence rainfall data for Port Elizabeth might not be a true representation of rainfall in Coega.

In this section synthetic data developed by Smithers and Schulze (2003) were used to develop the Intensity Duration Frequency (IDF) curves for Coega IDZ and Port Elizabeth. The curves produced by synthetic data were compared to the Port Elizabeth Airport Intensity Duration Frequency curves developed from historical data as a calibration process.

3.2 Coega Rainfall Station

South African Weather Services has established a rainfall station (referred to as Climate station number 0035288 9) in November 2003 around Coega IDZ to establish the actual rainfall falling within the development. This station is located at the following coordinates. Data from this station was found to be insufficient to use at this stage as it only dates back to 2004.

Latitude	Longitude	Altitude
33.8040	25.668	46 m

3.3 Sourcing Data

The rainfall data was obtained from South African Weather Services for Port Elizabeth Airport gauge and Coega station. From Port Elizabeth Airport Gauge daily rainfall was available. The current Stormwater Masterplan also has the Intensity-Duration Frequency (IDF) curves for Port Elizabeth Airport gauge, which were adopted for use in Coega.

Following the collection of the above-mentioned data, synthetic rainfall depth for Coega and Port Elizabeth Airport were estimated using a computer programme developed by Smithers and Schulze (2003). The depths were estimated for durations of 5, 10, 15, 30, 45, 60 and 90 minutes with the recurrence period of 2, 10, 20, 50 and 100 years. This programme estimates three values, which are the lower, the upper and the design limit. The upper limit values were used in this study.

To develop the programme that estimates the rainfall depth for short durations in South Africa, Smithers and Schulze (2003) adopted a regionalised index storm-based frequency analysis using L-moments. Seventy-eight homogeneous rainfall regions in South Africa were identified using daily rainfall data from 1789 stations, which had at least 40 years of records. They also found that the general extreme value (GEV)

probability distribution as the most suitable distribution to estimate one day rainfall value for South Africa. More details on this programme can be found on Water Research Commission Report number 811/1/00, ISBN 1 86845 6501.

3.4 Methodology

The initial step was to confirm the synthetic rainfall depth estimated using the computer programme. The assumption was made here that the currently adopted IDF curves of Port Elizabeth Airport were derived using the natural (historical) data. Using the rainfall depth estimated by the programme, the synthetic IDF curves for Port Elizabeth Airport were derived and compared with the existing IDF curves to check any differences.

The next step was to derive the synthetic IDF curves for Coega, which were then compared with the synthetic IDF curves of Port Elizabeth Airport for calibration purposes.

To compare the rain intensity curves of Port Elizabeth airport and Coega, analysis of covariance (ANCOVA) was also employed. The same statistical tool was employed to compare natural data to synthetic (computer generated) data. The confidence limit was set at 5% due to the small data set.

3.5 Results

3.5.1 IDF curves for Port Elizabeth (Natural versus Synthetic)

(a) 2 years recurrence interval

In estimating the rainfall intensity from the current IDF curves the following expression was used:

$$i = 441/ (10 + t)^{0.704}$$

Where:

i = Rainfall Intensity (mm/hr)
t = Duration of the storm (minutes)

When the natural IDF curves was compared with the synthetic IDF curves, the natural values appeared to be smaller than the synthetic values for durations of less than 10 minutes thereafter they became greater than the synthetic values. On average the ratio of the synthetic data to that of the natural data is 0.968. When raising the values of the natural IDF by an average power value of 0.989, the values of synthetic IDF graphs could be estimated. **Appendix C** shows the intensity plots against duration for both synthetic and existing IDF curves for Port Elizabeth.

$$I_{synthetic} = I^{k}_{natural}$$

Where by: k = Power value

I = Rainfall intensity

(b) 10 years recurrence interval

In estimating the rainfall intensity from the current IDF curves the following expression was used.

$i = 694/ (8 + t)^{0.678}$

Where *i* and *t* are defined as mentioned above.

The results from the 10 years comparison are similar to the 2 year return period mentioned above except that the average ratio of the synthetic to natural is 0.988 and if natural values are raised to an average power value of 0.996 will yield the values of the synthetic IDF. Figure 3.1 shows the plot of these IDF curves for Port Elizabeth.

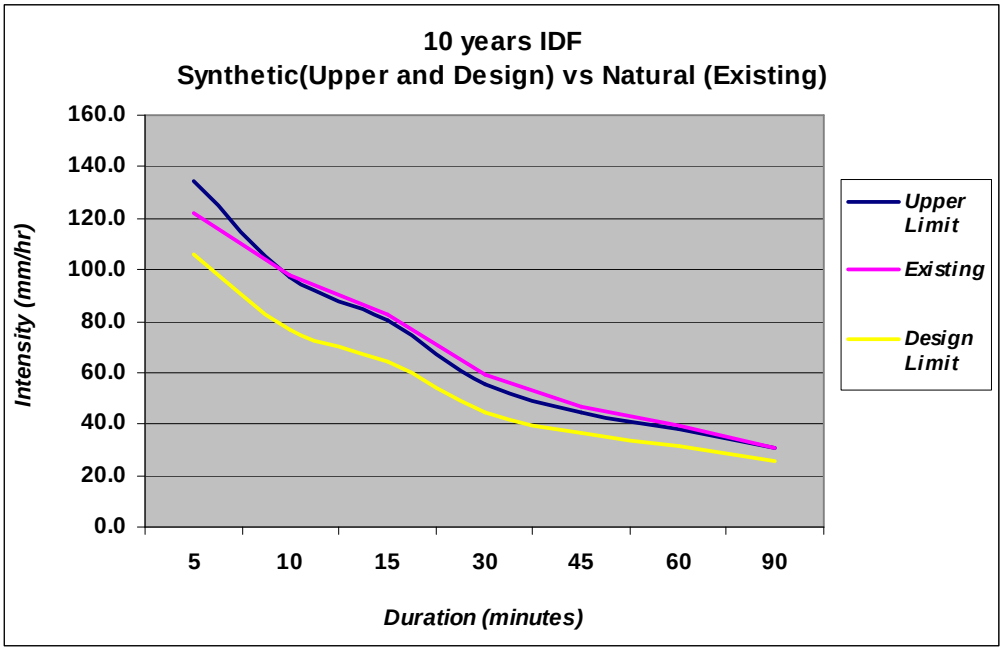


Figure 3.1: Intensity Duration Frequency curves of Port Elizabeth Airport

(c) 20 years recurrence interval

In estimating the rainfall intensity from the current IDF curves the following expression was used:

$i = 880/ (8 + t)^{0.694}$

The natural IDF values are again smaller than those of the synthetic IDF curve values for durations less than 10 minutes and thereafter they became greater than the synthetic values. On average the ratio of the synthetic data to that of the natural data is 1.010. When raising the values of the natural IDF by an average power value of 1.002, the values of synthetic graphs could be estimated.

(d) 50 years recurrence interval

In estimating the rainfall intensity from the current IDF curves the following expression was used.

$i = 859/ (7 + t)^{0.643}$

The natural IDF curve values are smaller throughout the plot though the difference between the natural and synthetic gets smaller after 30 minutes. On average the ratio of the synthetic data to that of the natural data is 1.068. When raising the values of the natural IDF by an average power value of 1.014, the values of synthetic graphs could be estimated. Table 3.1 below shows the values for 50 years return period for Synthetic and Natural IDF curve.

Table 3.1: Values of Synthetic and Natural IDF for 50 years

Duration (Minutes)	Synthetic Intensity (mm/hr)	Existing intensity (mm/hr)	Power value (k)	Syn :Natu
5	208.80	173.81	1.036	1.201
10	151.20	138.94	1.017	1.088
15	125.20	117.71	1.011	1.064
30	86.20	84.26	1.005	1.023
45	69.20	67.70	1.005	1.022
60	59.20	57.52	1.007	1.029
90	47.53	45.34	1.012	1.048
120	40.70	38.13	1.017	1.067

(e) 100 years recurrence interval

In estimating the rainfall intensity from the current IDF curves the following expression was used:

$i = 800/ (4 + t)^{0.606}$

The natural IDF curve values are smaller throughout the plot though the difference between the natural and synthetic gets to be smaller after 30 minutes. On average the ratio of the synthetic data to that of the natural data is 1.085. When raising the values of the natural IDF by an average power value of 1.023, the values of synthetic graphs could be estimated. Table 3.2 below shows the values for 100 years. Figure 3.2 shows the plotted 100-year intensity-duration curves.

Table 3.2: Values of Synthetic and Natural IDF for 100 years

Duration (Minutes)	Synthetic Intensity (mm/hr)	Existing Intensity (mm/hr)	Power value (k)	Syn:Natu
5	247.20	211.26	1.029	1.170
10	179.40	161.64	1.020	1.110
15	148.40	134.33	1.020	1.105
30	102.20	94.41	1.017	1.083
45	82.00	75.65	1.019	1.084
60	70.20	64.35	1.021	1.091
90	56.40	50.98	1.026	1.106
120	48.25	43.10	1.030	1.119

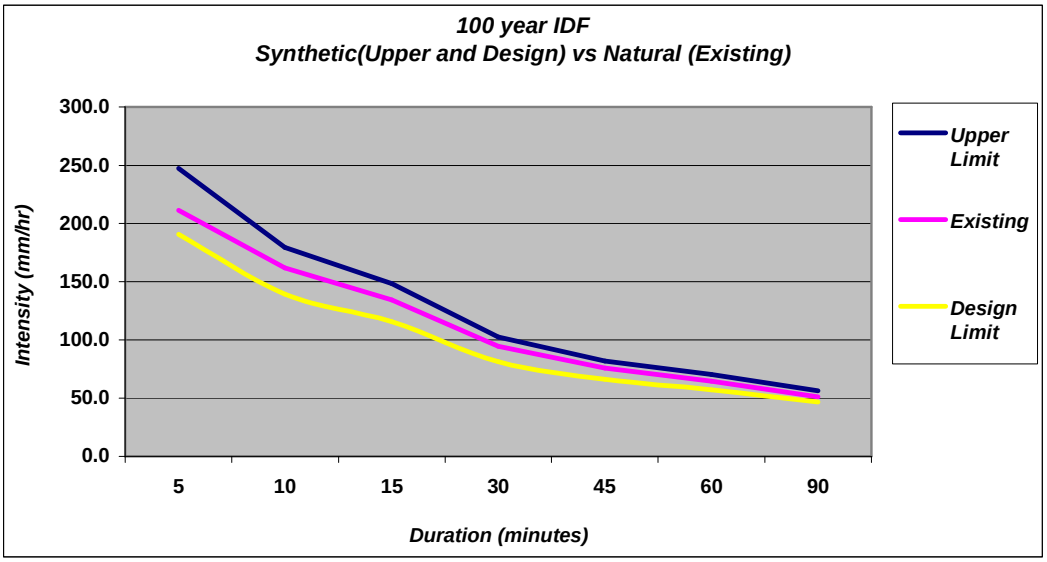


Figure 3.2: 100 year intensity Duration Curves.

(f) Statistical Results

The statistic analysis results indicate that there is no significant difference between the rates of change of intensities from the two sources used. There is also no significant difference in the magnitude of intensity throughout the event. Table 3.3 and 3.4 below indicates results of the analysis.

Table 3.3: Slope Port Elizabeth natural versus synthetic

Return Period	F	P	Degree of freedom (v_1)	Degree of freedom (v_2)
2	0.00	0.952	1	10
10	0.00	0.981	1	10
20	0.00	0.986	1	10
50	0.04	0.710	1	10
100	0.05	0.824	1	10

Table 3.4: Elevations Port Elizabeth (natural versus synthetic)

Return Period	F	P	Degree of freedom (v_1)	Degree of freedom (v_2)
2	0.00	0.979	1	11
10	0.00	0.967	1	11
20	0.01	0.907	1	11
50	0.14	0.710	1	11
100	0.22	0.642	1	11

3.5.2 Coega IDF curves versus Port Elizabeth IDF curves (Synthetic versus Synthetic)

$I_{Coega\ synthetic} = I^{k}_{PE\ synthetic}$

Where: k = power value
I = Rainfall intensity

(a) 2 years return period

The two synthetic graphs are very similar. Intensities during the first 10 minutes are very similar and with slight variation after 10 minutes. The maximum difference between Port Elizabeth and Coega is 1.4 mm/hr. To estimate the values for Coega, Port Elizabeth values could be raised with an average power value of 0.988 and the average ratio of Port Elizabeth to Coega is 1.039. The approximate expression for the synthetic IDF curve for Coega is:

$i = 384/ (10 + t)^{0.688}$

The graphs indicating the IDF curves of Coega versus IDF curves of Port Elizabeth are in **Appendix C**.

(b) 10 years return period

The two synthetic graphs are again very similar. Intensities during the first 10 minutes are very similar and differ with slight variation after 10 minutes. The maximum difference is slightly higher than for 2 years return period and is 2.40 mm/hr. To estimate the values for Coega, Port Elizabeth values could be raised with and average power value of 0.99 and the average ratio of Port Elizabeth to Coega is 1.039 (similar to 2 years return period). The approximate expression for the synthetic IDF curve for Coega is:

$i = 633/ (8 + t)^{0.668}$

Figure 3.3 below shows the 10 years IDF curves for Coega and Port Elizabeth.

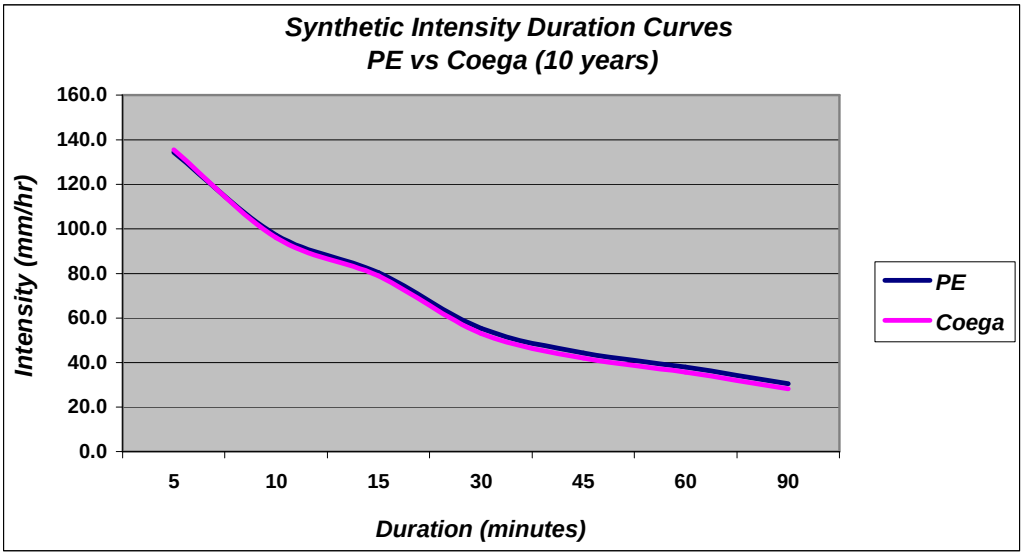


Figure 3.3: 10 years IDF curves for Coega and Port Elizabeth.

(c) 20 years return period

These synthetic graphs behave similarly to the abovementioned graphs. The maximum difference in this case is 3 mm/hr. To estimate the values for Coega, Port Elizabeth values could again be raised with an average power value of 0.99 and the average ratio of Port Elizabeth to Coega is 1.038. The approximate expression for the synthetic IDF curve for Coega is:

$i = 833/(8 + t)^{0.688}$

(d) 50 years return period

50 years synthetic graphs behave similarly to the abovementioned graphs. The maximum difference between Port Elizabeth and Coega in this case is 3.73 mm/hr. To estimate the values for Coega, Port Elizabeth values could again be raised with an average power value of 0.99 and the average ratio of Port Elizabeth to Coega is 1.038 (similar to the 20 years return period). The approximate expression for the synthetic IDF curve for Coega is:

$i = 881/(7 + t)^{0.645}$

(e) 100 years return period

50 years return period graphs behave similar to the abovementioned graphs. The maximum difference between Port Elizabeth and Coega in this case is 4.40 mm/hr. To estimate the values for Coega, Port Elizabeth values could again be raised with and average power value of 0.99 and the average ratio of Port Elizabeth to Coega is 1.038 (similar to the 20 and 50 years return period). The approximate expression for the synthetic IDF curve for Coega is:

$i = 870/(4 + t)^{0.614}$

(f) Statistical Results

The statistic analysis results again indicate that the rates of change of intensities for Port Elizabeth and Coega are the same and that there is no statistical significant difference in the rate of change in intensity between the two Intensity Duration curves. There is also no significant difference in the magnitude of intensity throughout the event. Table 3.5 and 3.6 below indicates results of the analysis.

Table 3.5: Slope Port Elizabeth versus Coega (synthetic data)

Return Period	F	P	Degree of freedom (v_1)	Degree of freedom (v_2)
2	0.01	0.933	1	10
10	0.00	0.948	1	10
20	0.01	0.936	1	10
50	0.01	0.939	1	10
100	0.01	0.943	1	10

Table 3.6: Elevations Port Elizabeth versus Coega (synthetic data)

Return Period	F	P	Degree of freedom (v_1)	Degree of freedom (v_2)
2	0.02	0.896	1	11
10	0.02	0.889	1	11
20	0.02	0.897	1	11
50	0.02	0.897	1	11
100	0.01	0.943	1	11

3.5.3 Approximate Coega Intensity Duration Frequency curves expressions.

The rates of change of intensities between Port Elizabeth airport and Coega IDZ are the same; there is no statistical significant difference in the rate of change in intensity between these places.

There is also no significant difference in the magnitude of intensity throughout the event. Table 3.7 and 3.8 below shows the results of the statistic analysis between Port Elizabeth and Coega.

Table 3.7: Slope Port Elizabeth (natural data) versus Coega (estimated)

Return Period	F	P	Degree of freedom (v_1)	Degree of freedom (v_2)
2	0.04	0.850	1	10
10	0.03	0.863	1	10
20	0.03	0.863	1	10
50	0.04	0.855	1	10
100	0.03	0.865	1	10

Table 3.8: slope Port Elizabeth (natural data) versus Coega (estimated)

Return Period	F	P	Degree of freedom (v_1)	Degree of freedom (v_2)
2	0.18	0.681	1	11
10	0.15	0.703	1	11
20	0.14	0.714	1	11
50	0.18	0.681	1	11
100	0.14	0.717	1	11

However, from the data and statistics analysis done, the following expression are assumed to be representative of the actual Intensity Duration Frequency curves for Coega.

$I_{2years} = 410/ (10 + t)^{0.696}$

$I_{10years} = 650/ (8 + t)^{0.672}$

$I_{20years} = 822/ (8 + t)^{0.687}$

$I_{50years} = 802/ (7 + t)^{0.637}$

$I_{100years} = 747/ (4 + t)^{0.600}$

The plots of these equations against the currently used Intensity Duration Frequency curves can be seen in **Appendix C**.

3.6 Conclusion

It can be seen from the plots of the estimated IDF curves for Coega and IDF curves from Port Elizabeth airport that there is a good correlation in rainfall intensity between these two places. It could also be seen that the intensities at Port Elizabeth are slightly higher than at Coega (all within 5 percent). This could be used to confirm the claim made by local residents that rainfall in the Coega vicinity is less than that experienced further to the southwest in the city. The Mean Annual Precipitations estimated by Smithers and Schulze (2003) programme are 611 mm and 427mm for Port Elizabeth and Coega respectively.

The use of Port Elizabeth IDF curves on Coega will yield slightly higher design values. The following expressions are recommended for Coega IDZ.

$1 \text{ in } 2 \text{ year} = 410/ (10 + t)^{0.696}$

$1 \text{ in } 100 \text{ year} = 747/ (4 + t)^{0.600}$

4 FLOODLINE ANALYSIS

4.1 Aim of the Study

The aim of this study was to check whether there could be any changes in discharge flows of the Coega River, which could probably result in change in the floodline of the river.

4.2 Current Situation

Coega River catchment has an elongated rectangular shape measuring approximately 565 km² (estimated using the GIS software Manifold®). Approximately 67 km² of this is the sand dunes and the area around the river mouth that discharges directly into the sea.

Some facts relating to this catchment and the Coega River are summarised below.

Total Catchment area:	565.096 km²
Catchment area discharging into Coega River:	498 km²
Catchment shape:	Rectangular approximately 45 km long and typically 12 – 13 km wide.
Main Stream Length:	Approximately 57.87 km
Highest Point upstream:	395 m ASL
River Outlet:	Indian Ocean

4.3 Rainfall data

Rainfall records for Coega IDZ that were obtainable from South African Weather Service (SAWS) date back to 2003.

The recommended rainfall Intensity Duration Frequency (IDF) curves for Coega are given in the previous section (Section 3) above. From this section above, 1 in 2 year, 1 in 50 year and 1 in 100 year intensities could be estimated from the following expressions.

$I_{2years} = 410/ (10 + t)^{0.696}$

$I_{50years} = 802/ (7 + t)^{0.637}$

$I_{100years} = 747/ (4 + t)^{0.600}$

Where; I = rainfall intensity (mm/hr) and t = storm duration (minutes)

The upper Coega River catchment may have rainfall referenced to Uitenhage rainfall stations with records being available from SAWS.

4.4 Design Flood Estimation

4.4.1 Aim

The aim of the flood estimation was to determine the peak discharges associated with various return periods along Coega River. The peak discharge values were then used as input to the hydraulic modelling component, which computed the corresponding water levels for the various return period events, thus defining the floodlines.

4.4.2 Methodology

Probable Maximum Flood (PMF) method and Standard Design Flood (SDF) method were used to determine the peak flows that could be expected in Coega River and results were compared with the results from SSI (2005).

(a) PMF method

In this method, in order to estimate the peak flow, the catchment area was used as a whole rather than as sub-catchments. The initial procedure was the estimation of catchment index (CI) using the following expression,

$CI = L\ L_C\ S^{-0.5}$

Where: L = Length of the longest watercourse (km)
L_C = Distance from the centroid of the catchment to the outlet (km)
S = Average Slope

Following the estimation of the catchment index, the catchment lag was estimated. This parameter is determined from the physical characteristic and vegetation cover of the catchment. The following equation was used to estimate the lag time.

$T_L = C_t\ (L\ L_C\ S^{-0.5})^{0.36}$

Where: T_L = Catchment Lag
C_t = Lag coefficient

The next step was to estimate the duration of the storm likely to create the maximum flood peaks at 20, 50 and 100-year recurrence interval. Figure C.2 attached in Annexure A was used to check the corresponding rainfall depth associated with recurrence interval 20, 50 and 100-year and durations 2, 4, 6, 8 and 12 hours. This was followed by the estimation of the storm reduction factor. A dimensionless one-hour unitgraph suitable for Paapenkuils River catchment was then selected from HRU1/72 report. The conventional unitgraph method was used to convert the dimensionless unitgraph into one-hour unitgraph for 2, 4, 6, 8, 10 and 12-hour unitgraphs. The peaks and the times when they occur were observed.

(b) SDF method

SDF method is a simple, robust method which encourages one to use engineering factors of safety to accommodate uncertainties in the hydrological analyses, rather than investigate, evaluate and apply alternative hydrological procedures.

The method is based on historical data that sufficiently define the flood frequency relationships. The river flow and rainfall records used for the development and calibration of the method are sufficiently long and extensive to provide stable values for required parameters and rainfall intensity.

SDF method is described in detail on the Drainage manual (2006) by SANRAL.

4.4.3 Results

The effective catchment area of Coega River up to the harbour was estimated as 498 km². Table 4.1 below shows the estimated peaks obtained using the PMF method.

Table 4.1: Probable Maximum Flood (PMF) Method Peak Flood Estimates.

Coega Flows (PMF method)			
Recurrence period	20 years	50 years	100 years
Peak flows (m³/s)	520	668	890

Table 4.2: The inputs to the SDF method are as follows.

Drainage Basin	20
Catchment Area (A)	498km²
Length Longest Watercourse (L)	58km
Elevation at 10% of L	15m
Elevation at 85% of L	335m
1085 Slope (S)	7.36m/km
Time of Concentration (t)	10.0hours
	601minutes
Area Reduction Factor (ARF)	88.4%

Table 4.3: The results from this method are as follows.

Recurrence Interval	**2**	**10**	**20**	**50**	**100**	**200**
Point Precipitation Depth ($P_{t,T}$)	*31.4*	*69.2*	*85.5*	*107.1*	*123.4*	*139.7*
Average Rainfall Over Catchment	*27.7*	*61.2*	*75.6*	*94.6*	*109.0*	*123.4*
Intensity (I_T)	*2.8*	*6.1*	*7.5*	*9.4*	*10.9*	*12.3*
Runoff Coefficient (C_T)	*0.10*	*0.37*	*0.45*	*0.54*	*0.60*	*0.65*
Peak Discharge (Q_T, m^3/s)	**38**	**317**	**472**	**706**	**904**	**1 115**

see SDF Users Manual, WJR Alexander, March,2002

These results do not differ much from the previous results obtained by SSI (2005). The input of data in SDF method used by SSI were as follows

Drainage basin	20
Catchment area	497 km²
Main channel length	67 km
Elevation at 10%	15 m
Elevation at 85%	335 m
10/85 slope	6.4 m/km
Runoff coefficient (C)	0.55 for 50 year and 0.60 for 100 year

Effective rainfall intensity 9.2 mm/hr for 50 year and 10.9 mm/ hr for 100 year

Manong and Associates/Ninham Shand Joint Venture cited by SSI (2005) reported that 610m³/s and 850m³/s for 50-year and 100-year floods, respectively, could be expected at the MR435 Bridge five kilometres upstream of the river mouth. At MR435 Bridge the catchment area of Coega River is 403 km² according to Manong and Associates/Ninham Shand Joint Venture (2003).

4.5 Hydraulic Modelling

4.5.1 General

Having defined the probable peak flows that could be expected in the Coega River, the next exercise was to perform a hydraulic analysis of the peak water levels in the river. The exercise of estimating the peak water level was done through the creation of a river model. This hydraulics analysis provides information on the flow regime in the river, including depths, velocities as well as delineating the floodplain area.

4.5.2 Methodology

The process of identifying the floodline of Coega River was done through performing one-dimensional steady flow hydraulic calculations.

The Hydrologic Engineering Centre River Analysis System (HEC-RAS) computer program was used to perform the hydraulic analyses. The inputs to this program are:

- **Steady flow data**
- **River geometric data** (this include the bridges and culvert in the river that is being modelled).

The baseline model used in this study was adopted from SSI (2005).

4.5.3 Steady-Flow Data

The higher values, which were estimated from Standard Design Flood (SDF) method, were used in the modelling.

4.5.4 Geometric Data

SSI (2005) applied the cross-sections that were cut from the digital terrain model that was supplied by CDC at approximately 100 m to 400 m intervals (depending on the topography of the floodplain) to create the geometric model. Levees, weirs and ineffective flow areas were used in the model where appropriate to model features such as the levees and embankments at the salt works.

To estimate Manning's roughness, SSI (2005) used the method given by Arcement and Schneider (undated). The obtained values were calibrated with those estimated using the photographs of Coega River and its floodplain and the representative photographs given by Arcement and Schneider (undated), Barnes (1967) and Chow (1973), and tabulated values given by Chow (1973). SSI used the value of 0.033 – 0.050 for the channel roughness and 0.025 – 0.108 for the floodplain.

4.5.5 Results

The calculated flows at the mouth of Coega River are 706 m³/s and 904 m³/s for 50 and 100 year flood respectively. SSI (2005) estimated 692 m³/s and 901 m³/s for 50 and 100 years respectively. These values are very comparable, with the ones estimated by SSI (2005) being 98.02% and 99.67% for 50- and 100 year floods respectively to those estimated by ARCUS GIBB. This means that the flows upstream would be in the same magnitude; hence the values estimated by SSI (2005) are adopted.

The section of Coega River upstream of the Coega IDZ will experience very little development if any in the future so the values estimated just upstream of the development will remain relevant for a long time. Furthermore, as discussed by ARUP (2003), the proportion of Coega IDZ area to the overall catchment area is small, so even after the complete development of the Coega IDZ; the increase into the peak discharge of Coega River will not significantly change the current floodline position.

Another important factor is the time of concentration of the IDZ to that of the total catchment by the time the peak of entire catchment reaches the IDZ (distance of approximately 40 km), the peak of the IDZ will have already passed through to the sea (main stream length of approximately 10 km).

5 STORMWATER DRAINAGE AND STORAGE REVIEW

5.1 Design Criteria

The previous Stormwater Masterplan by ARUP (2003) adopted the design criteria of 2-year return period for minor stormwater drainage and 100-year return period for major drainage systems. These design criteria were first introduced by Gibb Africa (1999).

Design criteria of 2-year return period and 50-year were adopted in the design of minor and major stormwater drainages respectively in all the zones. This is in line with the 'Guidelines for Human Settlement Planning and Design' manual by CSIR (2003).

The Intensity Duration Frequency (IDF) curves from Port Elizabeth airport were used as a baseline for the design. However in the future, the use of IDF curves given in Section 3 of this document is recommended, as the values from Port Elizabeth airport are slightly higher (although within five percent).

5.2 Drainage Design Methodology

5.2.1 Modelling Approach and Minor System Design

Different approaches and methods were used in the design of the minor stormwater in different development zones. Drawing Number **J27139 – 7231/CDC001/0** shows the different positions of zones of the western IDZ.

Zone 1

Standard design method adopted in this zone was in accordance with 'Guidelines for Human Settlement Planning and Design' manual. Minimum pipe slope of open channel through public open spaces was taken as 1:500, while the maximum and minimum velocities were taken as 3 m/s and 0.9 m/s, respectively. Modelling was done by Civil Designer software and the following parameters were used.

Depression storage (pre-wetting) for pervious areas	4 mm
Depression storage (pre-wetting) for impervious areas	1 mm
Overland roughness coefficient for pervious areas (n)	0.03
Soil Type	Type B
Antecedent moisture conditions for 2-year event	(0 – 12.5 mm)
Antecedent moisture conditions for 50-year event	(12.5 – 25 mm)
Routing Method	Continuity
Friction loss formula	Manning
Manhole conditions	Invert

Rainfall input parameters used in the modelling were adopted from the previous Stormwater Masterplan ARUP (2003) except storm duration for pipe design which was taken at one minute steps up to 60 minutes.

Zone 2

The minor system was designed using HYDROSIM V and the input parameters used were adopted from the previous Stormwater Masterplan ARUP (2003). Both 75D and 100D concrete pipes were proposed for use in the minor system. The design in the north-western side was conducted for 50-year flood since the natural ground levels are undulated, hence the roads that would have to act as overflow channels have many sags and crest within this area that will result in stormwater of 50-year return period being land locked.

Zone 3 and 4

In these two zones Iliso (2005) used HYDROSIM to model the stormwater drainage. The allowable percentage development coverage that was adopted was in the order of 80 percent. The impervious for industrial development was varied between 80% and 94%. The infiltration rates of 45 mm/hr to 15 mm/hr were adopted for Horton infiltration equation.

Zone 5

The minor drainage system design in this zone was carried out as per the design in the previous Masterplan ARUP (2003) except in the south-eastern side. The design in this side was carried out for 50-year storm because Alumina rd has sags and crest that will result in stormwater of 50-year return period being land locked.

5.2.2 Major System Analysis

Zone 1

The road network and drainage will form the major drainage system and will be designed to handle 50-year storm events. Low points and depression will be used as natural escape routes for floods larger than 50-year flood and retention ponds are designed to retain 50-year floods where no direct sea outlets are possible. Drawing Number **J27139 – 7231/CDC002-1/0** in **Appendix E** shows the positions of the pipes and pond in zone 1.

Zone 2

Where peak flows for 50-year flood were greater than the capacity of the existing culverts, attenuation ponds are proposed. Attenuation ponds will have litter traps, head walls and 450 mm diameter outlet pipe placed at the pond floor level. Overflow spillway structures will be constructed on the attenuation pond which is in the southern corner of the zone. Drawing Number **J27139 – 7231/CDC002-2/0** in **Appendix E** shows the positions of the pipes and pond in zone 2.

Zone 3 and 4

Proposed attenuation ponds in zone 4 were designed to attenuate 2-year return floods when this zone is fully developed. The ponding system in zone 3 is interlinked to attenuate all stormwater from zone 3 and 4 and to discharge into Markman canal. It is assumed that the major system will follow the same route as the minor and the roadways would act as overflow channels to accommodate the flow rates exceeding the pipe capacities. Drawing Number **J27139 – 7231/CDC002-3/0** in **Appendix E** shows the positions of the pipes and pond in zone 3 and 4.

Zone 5

The major systems are designed to accommodate runoff resulting from 50-year flood. The major system consists of mainly the roads and open channels mainly on the boundary of the ALCAN site to drain storms with return period greater than 2-year but not exceeding 50-year floods. Drawing Number **J27139 – 7231/CDC002-4/0** in **Appendix E** shows the positions of the pipes and pond in zone 1.

5.3 Analysis and Results

Zone 1

This zone is primarily for Light industries (Business centre and warehouses) and therefore minimal contaminated stormwater discharge is expected. The velocities in the channel will be kept low to aid settling of suspended solids. The use of natural vegetation, gabions and armourflex in the lining of the channel will be encouraged as these linings increase the infiltrations. Erosion control measures will be implemented especially in the proximity of Butterfly Valley where soils are regarded as erodable.

Drawing Number **J27139 – 7231/CDC002/0** indicates the position of the proposed attenuation ponds for this zone. The open space areas should be grassed and landscaped in a manner that creates a useable and pleasant space that provide an escape route and channel for major floods.

Zone 2

Stormwater draining to the north western boundary of the zone towards the existing railway line is landlocked and can only be drained using a wide open channel drain with slope varying from 1:770 to 1:1000. This proposed open channel will discharge into a pipe at Neptune Interchange. The remainder of the zone could be discharged through the minor system into the major system including attenuation ponds and through existing culverts and one new culvert.

According to BKS, MDC and MSBA (2004) and Mazizi Msutu and Associates (2007) some parts of stormwater runoff from this zone may discharge into the Markman canal (see Drawing Number **J27139 – 7231/CDC004/0**). This stormwater will go through four culverts (three are already existing and one is proposed) which goes under the railway line.

The majority of the minor pipes will be installed at an invert level of approximately 1,5 – 2,0 m below the final road level. On the cambered roads catchpits will be installed on both sides of the roads with road cross drainage pipes consisting of 450 mm diameter pipe.

Zone 3 and 4

The runoff contributing to zone 3 from zone 4 will be conveyed through a pipe crossing under MR435 road. The attenuation pond placed in zone 4 is meant to reduce the flow from this zone, hence reducing the size of the pipe crossing to zone 3.

These zones are generally flat which results in flat gradients. This flat surface gradients lead to deep excavations of pipes. All pipes sizes are determined for the 2-year floods. The pipe sizes for zone 3 range from 450 mm diameter to 1800 mm diameter.

Zone 5

Stormwater from zone 5 will be discharged through existing as well as proposed new culverts. These discharge points are indicated on Drawing Number **J27139 – 7231/CDC004/0**.

The north side of zone 5, which is approximately 21% of the zone, drains towards the north and discharges through three new culverts and one existing culvert.

The analysis done indicated that the existing stormwater reticulation installed in Alumina Road and 3A road has been designed for 50-year flood.

The majority of the minor pipes will be installed at an invert level of approximately 1,5 – 2,0 m below the final road level. On the cambered roads catchpits will be installed on both sides of the roads with road cross drainage pipes consisting of 450 mm diameter pipe.

5.4 Storage and Attenuation Ponds

The provision of the detention storage is an effective means of attenuating flood peaks. The whole objective of flood attenuation is to reduce the peak flow of the developed area to equivalent peak flow of the same area in its undeveloped state. Flood attenuation does not mean reducing the peak storm of the development to 2-year flood. This flood attenuation then caps the impact on the development on the downstream.

The design of the attenuation ponds has been done in all zones in order to reduce the chances of flooding and in other zones to reduce the use of excessively high downstream pipe dimensions. Drawing Number **J27139 – 7231/CDC002/0** shows the layout of these ponds.

Zone 1

In zone 1 development creating large storage areas purely for the purpose of attenuation is neither practical nor feasible in certain cases.

Attenuation therefore has only been considered in areas where the outflow is down environmentally sensitive areas, namely Butterfly Valley and the adjacent valley towards the Coega River. This attenuation already reduces the flows to the two-year flow, thereby reducing the chance of erosion due to high flows.

The ponds have been sized on the attenuation of 50 year to 2-year event outfall. The required volumes for these ponds are:
Pond A: 13000 m^3
Pond B1: 8300 m^3
Pond B2: 8150 m^3

The ponds have been positioned in the existing low points on the site in order to minimise excavations required. The ponds will have 1:3 side slopes to provide a more aesthetically pleasing environment.

Zone 2

Attenuation ponds were provided where peak flows of 50 year floods exceed the existing culverts capacities. Six attenuation pond and two evaporation ponds are required for zone 2. All the ponds are placed in the open spaces except one that is situated in the Electronic/Technical zone in the south-eastern corner. The summary of the pond sizes is as follows:

Pond 1:	36500 m^3
Pond 3:	2220 m^3
Pond 4:	11400 m^3
Pond 7:	19300 m^3
Pond 8:	32500 m^3
Pond 10:	3500 m^3
Evaporation Pond 1	2500 m^3
Evaporation Pond 2	1900 m^3

The evaporation ponds will have spillway facilities draining with open channel to roads discharging to other discharge points.

Zone 3 and 4

The proposed stormwater detention ponds in zone 3 are intended to attenuate the runoff from zone 3 and 4. The stormwater run off from zone 3 and 4 will be conveyed through a pipe culvert system into the respective detention ponds and will ultimately be discharged into Markman canal.

To accommodate the 1:50 year flows it is planned that detention ponds with a combined storage capacity of 8 200 m^3 will be provided in Zone 4. In Zone 3 two detention ponds have been constructed with capacities of 3 000 m^3 and 22 000 m^3, and in the Markman Industria an existing stormwater pond has been enlarged to provide a detention pond with a capacity of 45 000 m^3. The latter pond will combine the various piped flows from Zone 3 and will discharge them into an existing manhole on Ranger Road in the north-western portion of the Markman Industria. (Iliso, 2007)

Zone 5

Approximately 45 000 m^3 of stormwater will be attenuated for 50 year flood in the south-eastern corner of the zone.

ALCAN will attenuate their first flush runoff up to 2-year flood by means of a wet pond system. Stormwater runoff exceeding the 2-year flood will be discharged into the attenuation pond through a box culvert adequately sized for 100-year flood.

5.5 Analysis and Results

- For future developments in Coega IDZ the minor and the major stormwater drainage should be designed to 2 -5 year and 50 -100 year peak floods respectively. This proposed standard is in accordance with the South African Road drainage manual.
- All the floods that happen within the development should be routed to the pre development flows and not to 2-year peak floods. The attenuation ponds provided in each zone should have the minimum capacity to attenuate the 50-year post development into 50-year predevelopment peak flow.
- The Best Management Principles layout in Section 7 and the ISWMP requirements discussed in Section 6 should be adhered to in areas.

5.6 Recommendations

- For future developments in Coega IDZ, the minor and the major stormwater drainage should be designed to 2 year and 50 year peak floods respectively. This standard agrees with the one mentioned by the Guidelines for Human Settlement Planning and Design manual and the South African Road drainage manual
- All the floods that happen within the development should be routed to the pre development flows and not to 2-year peak floods. The attenuation ponds provided in each zone should have the minimum capacity to attenuate the 50-year post development into 50-year peak flow
- The Best Management Principles should be adhered to in areas that are likely to experience excessive erosion.
- Stormwater measuring weir and notches are proposed at the discharge points of all the drainage systems.

6 STORMWATER DESIGN CRITERIA

6.1 Introduction

Stormwater can result in damage to property, loss of income and loss of life. It needs careful planning at the earliest stage to minimize its impact on the environment. The best way to manage the stormwater is to have the developer, landowners, businesses and public involved. Stormwater management makes up the most important part of the hydrology and water quality of the area in question.

Coega IDZ is going through a continuous development period. This means the best stormwater management should be developed for planning, construction stage (which will be continuous) and for operation stage.

The set stormwater design criteria for Coega are meant for sustainable development of Coega, and should be adhered to at all times in order to mitigate the effects of floods, erosion and thus pollution. Table 6.1 and 6.2 show the ISWMP requirements for tenants and Coega IDZ operator adopted from the previous Masterplan. This adoption however excludes requirement of the general management (under Requirements for Operator) reference O1 of Table 5.2 of the previous ISWMP, the sections that states that “release of stormwater into natural environment should be at 1:2 year flood discharge rate”. This is not going to be economical when there is 1:100 year flood. The proposal also excludes the requirement of the design of system; reference O6, first part which suggests that CDC should design major stormwater system to attenuate the 1:100 year recurrence interval flood peak to a 1:2 year interval level. This is not economically practical as large attenuation ponds would be required. ARCUS GIBB in Table 6.2 below (Requirements for Operator) changes the first statement on reference O1 to “release stormwater into the natural environment at pre development discharge rate” and the second statement from reference O6, to state that “CDC will design the major stormwater system to attenuate 1:100 year post development flood peaks into 1:100 year pre-development flood peaks”. ARCUS GIBB further changes the statement in reference O1 which states that CDC will have secondary detention ponds to contain 1:100 year rainfall incident, and change the statement to “CDC will have secondary detention ponds to contain a 1:100 year flood peak where 20 year flood exceed 150 m^3/s and a secondary detention ponds to contain 1:50 year flood peak where 20 year flood is 20 m^3/s or less.

Table 6.1: ISWMP Requirements for tenants

Type of requirement	Ref.	Requirement
General	T1	For major sites (as determined by the Safety, Health and environmental (SHEQ Project Manager), the tenants will be required to develop a documented water management strategy which will include storm water management criteria.
Design of System	T2	Tenants must attenuate 1:2 year recurrence interval storm event unless otherwise agreed with the SHEQ Project Manager. Attenuation for recurrence interval of up to 1:5 years may be required in certain circumstances (as determined by the CDC) and in these cases a 0.8 m freeboard might also be introduced.
	T3	Should the storm water storage facility have a volume greater than 50 000 m^3 and a height of greater than 5 m, the tenant must have the facility registered in terms of Chapter 12 of the National Water Act (Dam Safety).
	T4	Areas that could potentially give rise to polluted storm water runoff must be kept as small as possible and kept separate from areas with low potential pollution risk.
	T5	If the tenant or SHEQ Project Manager determines by a process of risk assessment that a drainage area is considered potentially polluting due to the activities taking place within that area, then the first flush storm water volume must be captured for full containment and reuse. Any volumes greater than the first flush need to be managed as indicated above. For the purpose of this requirement, the first flush volume should be determined.
	T6	Any potential polluted storm water storage facility with a volume greater than 1000 m^3 may require a Section 21b water use licence from DWAF. It is the tenant's responsibility to ensure that the necessary approvals are obtained/ complied with.
	T7	Minor storm water systems on each site must be designed by the tenants to prevent sedimentation or erosion.
	T8	The storm water attenuation on ponds must be fitted with return pump system to facilitate recycling/reuse of the collected storm water.
	T9	Should servicing or refuelling need to take place on site, they must take place in a designated appropriately bunded site agreed upon by the SHEQ Project Manager (ROD# 71). Storm water runoff from this bunded area must drain to a grit and oil separator and preferably be released into the sewage or industrial effluent drainage system.
	T10	All material storage facilities must comply with relevant national, provincial and local legislation and must be designed to minimise the risks of Spillage (particularly into the storm water system or bare oil), dispersal or damage to materials (ROD# 67 and 68). Relevant legislation and guidelines include but are not restricted to: · Hazardous Substances Act 15 of 1973 · Occupational Health and Safety Act 85 of 1993 · Minimum Requirements for Handling, Classification and Disposal of Hazardous Wastes (DWAF, 1998); · SABS 089 – 1 The petroleum industry – Part 1: The Handling, storage, and distribution of petroleum products · SABS 0263 The warehousing of dangerous goods – Enclosed storage areas and covered and uncovered outdoor storage yards. · National Environmental Management act 1999

Type of requirement	Ref.	Requirement
Design of System continued	T11	Bunding of any substances considered to pose a risk to the storm water management system must ensure that a volume equal to 110% of the largest storage vessel within the bund can be contained. All fill points should be located within the bunded area. The bund must have no drainage outlets but should be fitted with a pump system to remove any spills or contaminated rainwater. Where the material has potential corrosive or reactive properties, appropriate sealants should be used to protect the bund. These requirements must be met unless agreed otherwise in writing with the SHE Manager.
	T12	If the tenant is releasing storm water into an unlined section of the major storm water system, then appropriate energy dissipation measures must be provided to minimise erosion and scouring.
	T13	Tenants should carry out regular risk assessments (at least every two years) to ensure that potentially hazardous materials are appropriately stored, labelled and handled.
Materials handling	T14	ROD# 58 states that the appropriate materials and equipment to deal with spills of any materials used must be kept on site. Any material or equipment used must be well maintained (at least yearly) and strategically placed at accessible locations which are clearly marked with durable notices explaining their use.
	T15	In the event of a spill the SHEQ Project Manager must be notified. Any spills should be cleared and the contaminated soil/sludge disposed of in an appropriate manner at a licensed hazardous waste disposal site. All equipment that leaks onto the ground must be repaired or removed immediately.
	T16	The use of such materials and the management of spills must be included in environmental awareness training.
	T17	High risk areas, such as filling points, shall have clear warning signs indicating possible dangers or risks and what to do in case of an accident (ROD# 67).
	T18	All tenants must ensure that their staff and any contractors receive appropriate environmental awareness training. If necessary, the SHEQ Project Manager can provide assistance on the scope of this training.
	T19	No chemicals, hydrocarbons (e.g. oil and lubricants), process effluent, factory wash water, paints, cement, grit or other potentially polluting substances will be allowed to enter the storm water system.
Storm water releases	T20	No tenants shall commit an act which may cause pollution of any nature to enter the storm water drainage system unless specifically authorised in writing by the SHEQ Project Manager.
	T21	Storm water discharges should comply with the standards imposed by the SHEQ Project Manager for a specific site. These standards will take into account the standards imposed on the CDC by DWAF, the volume of dilution available in a particular system.
	T22	All tenants must monitor storm water quality and quantity leaving their site in accordance with a monitoring protocol to be documented and agreed with the SHEQ Project Manager. Monitoring must take place weekly during the rainy season. If the site is considered by SHEQ Project Manager to have a high pollution risk, the monitoring should be increased to daily and continuous monitoring for certain key determinands may be required.
	T23	An accredited laboratory, with the necessary quality assurance, should carry out the analysis of the samples and should have quality control measures in place (blanks, standards, duplicates, cation-anion balances etc).

Type of requirement	Ref.	Requirement
Storm water releases continues	T24	Should monitoring indicate actual or potential non-conformance the tenant must: · Notify the SHEQ Project Manager; · Identify the source of the actual/possible non-conformance; · Remedy the situation; · Take the necessary actions to ensure that recurrences do not occur; · Keep record of incident, its root cause and the remedial and preventative action taken
	T25	Gardens should use, as far as possible drought tolerant indigenous species. If irrigation is required, storm water or other recycled water (if approved in terms of the National Water Act) should be used in preference to potable water.
Storm water use	T26	Landscaping should use underground or drip irrigation systems to reduce loss by wind evaporation (ROD #48).
	T27	All water, including storm water, should be used optimally to ensure that no wastage of water occurs.
	T28	Each tenant must have a procedure for the regular inspection, cleaning and maintenance of the minor storm water system on their site. This must include checking that any sumps, oil traps, silt traps, collection ponds and attenuation dams are kept clear of debris. Signs of erosion and scouring should also be checked. Any possible problems should be rectified immediately.
Maintenance of storm water system	T29	The levels in the attenuation ponds shall be kept as low as possible to maximise on the possible containment in case of an emergency or during periods of high rainfall.
	T30	Areas of hard standing shall be regularly kept clean by regular washing (into a recyclable system) or sweeping
	T31	Particulate matter collected in the storm water system must be stipulated in the waste inventory and disposal addressed in the site specific waste management plan.
	T32	Each tenant must ensure that alien invasive species are kept out of the storm water system by means of an eradication plan (ROD #33). This will entail the implementation of weed control through manual and mechanical means. Any use of herbicides must be cleared with the Provincial Department of Agriculture and the Environmental Manager.
	T33	No tenant may release any substance or undertake any activity, or allow such release or activity to take place, which might damage the storm water drainage system either within its own site or within IDZ.
	T34	Each tenant must have a procedure for the inspection of storage facilities, transport facilities (conveyors, pipelines etc) and transfer points to ensure that no leakages, spillages or other losses have occurred. If problem are identified they must be remedied immediately and any potential pollution cleaned up.
	T35	Should a tenant receive a written notification of actions required in respect of any maintenance, clean up or rehabilitation of the storm water system, they must take action within the stipulated time frame.
Non-conformance	T36	Any non-conformance with this plan or any notification issued by the IDZ Operator may entail the liability of a spot fine. Such fine must be paid unless reasonable grounds for appeal can be provided in writing with in 14 days of issuing of the spot fine or notification.

Type of requirement	Ref.	Requirement
	T37	Each tenant must prepare emergency plans to address identified environmental emergency risks specific to their site. These must be approved by the SHEQ Project Manager. Where hazardous materials are used on site this should include control of major spills and handling of potentially polluted fire water (in the event of a fire).
Emergency preparedness	T38	For sites that are considered to have a high potential risk of pollution, a number of additional measures may be required by SHEQ Project Manager. These include: ·Additional sumps in the storm water system which would be fitted with shut off valves to enable containment of spills; ·Use of impermeable areas such as roads, parking areas or yards as temporary storm water/ containment lagoons by construction of low bunding with controlled outlets; · Remote sensing equipment fitted with alarms to notify of sudden changes in levels or quality; · Remote closure devices that respond automatically to elevated pollutant levels; · A diesel stand by pump may be required to ensure that spills can be pumped away from the storm water system as soon as possible.

Table 6.2: ISWMP Requirements for Operator

Type of activity	Ref.	Commitment	Responsible person	Due date or frequency
General management	O1	CDC aims to minimize the pollution of the water by implementing a DWAF approved ISWMP (as covered by this document) and ensuring that all tenants adhere to the principles contained in the plan – current principles (which are to be reviewed every 5 years) are: · Prevent storm water pollution by good management of areas considered to have a high pollution risk; · Tenants will have initial detention ponds to capture the site specific run-off; · CDC will have secondary detention ponds to contain a 1:100 year flood peak where 20 year flood exceed 150 m^3/s and a secondary detention ponds to contain 1:50 year flood peak where 20 year flood is 20 m^3/s or less; · Reuse and recycle captured storm water as far as possible; · Release storm water into the natural environment at equivalent of predevelopment discharge rate (unless motivated otherwise due to site specific circumstances).	SHEQ Project Manager	Ongoing
	O2	CDC will charge for the quality of water discharged – the charge rate will be dependant on: · The extent to which the BPEO has been implemented to manage storm water; · The extent to which the storm water exceeds the DWAF guidelines given in CDC's licence; · Ensuring that all significant discharge points contain continuous volumetric and quality monitoring systems at the cost of the organisations discharging water to the system.	SHEQ Project Manager	Ongoing
	O3	As a key stakeholder in the Coega catchment, the IDZ will participate in the establishment of the Catchment Management Agency. Once established, the IDZ will continue to participate as a key stakeholder.	SHEQ Project Manager	Ongoing
	O4	The SHE Manager will ensure tenants are informed of the specific catchment management guidelines as determined by DWAF's Reserve Determination. Any review of the ISWMP will take into consideration these guidelines.	SHEQ Project Manager	Ongoing
	O5	The ISWMP requirements will be reviewed regularly to ensure that the requirements are applicable, achievable and effective. Any changes to the requirements will be reported to construction contractors, tenants and DWAF.	SHEQ Project Manager	Every two years
Design of System	O6	The CDC will design the major storm water system to attenuate the post development 1:100 year recurrence interval flood peaks to predevelopment 1:100 year recurrence interval level. Where this is not possible written motivation will be prepared. It is expected that the minimum pipe diameter for the major system will be 600mm. This may be reduced to 525mm where slopes greater than 1:150 can be achieved.	Engineering Manager	During Design of system

Type of activity	Ref.	Commitment	Responsible person	Due date or frequency
Design of System continues	O7	As far practicable, the CDC will maximise the infiltration of storm water along major system by use of ponds or wetlands.	Engineering Manager	During Design of system
	O8	All potential polluting facilities will be located outside of the 1:100 year floodline.	Engineering Manager	During Design of system
	O9	All attenuation ponds will be designed to contain silt or will have silt traps associated with the pond to trap particulate matter. As far as possible, silt traps will be constructed in twos so that one pond can be cleared while the other is in use. All such facilities will be fitted with a manually operated shut off valve so that in the event of a major spill upstream of the pond, the potential contaminant can be contained. Access to the ponds/traps will be designed so that honey suckers can gain access for the removal of polluted material, if necessary.	Engineering Manager	During Design of system
	O10	Litter traps will be located at regular intervals and the strategic points along the major storm water system to collect larger material. Litter prohibition signs will be placed at regular intervals, particularly in open space areas.	Engineering Manager	During Design of system
	O11	Runoff from undeveloped land will be kept separate and away from potentially contaminated areas and will be allowed to drain to the nearest natural water course.	Engineering Manager	During Design of system
	O12	All release points into the natural environment will have appropriately designed energy dissipaters to minimise the risk of scouring and erosion.	Engineering Manager	During Design of system
	O13	The Storm Water Model (ARUP, 2003) will be updated and reviewed every 5 years to determine if the input criteria and predicted results are still appropriate. Any significant changes will feed into the review of this ISWMP.	Engineering Manager	Every 5 Years
Maintenance	O14	Inspections of the storm water system, release points and the receiving water courses will be carried out to assess levels of erosion, litter and alien invasive weeds. If problem areas are identified, the maintenance crew will be dispatched to rectify the situation as soon as practicable.	SHEQ Project Manager	Every six months once IDZ operational
	O15	Before construction of the storm water system is complete and as part of the detailed design procedure, CDC will develop a documented maintenance procedure in terms of its EMS which indicates how the major storm water system will be kept clear of blockages and in a fit state to ensure the passage of storm water. The system will be implemented as soon the system is operational. Key aspects of the procedure include: · Maintaining access to silt traps, shut off valves and litter collection points; · Measurement of silt levels and determination of de-silting frequency; · Weed control in accordance with ROD #33	Engineering Manager	Before construction of storm water system
	O16	The weed control program (ROD #33) will be extended to the Coega River catchment impacted and disposal upon by the IDZ as part of ongoing rehabilitation.	Zone Operations Manager	Ongoing

Type of activity	Ref.	Commitment	Responsible person	Due date or frequency
	O17	Particulate matter collected in the storm water system will be stipulated in the waste inventory and disposal addresses in CDC's waste management plan	Zone Operations Manager	Ongoing
	O18	Litter collection along the storm water management system, within open spaces and in the catchment of the Coega River impacted upon by the IDZ will be implemented.	Zone Operations Manager	Once IDZ operational
Monitoring	O19	The CDC will ensure that samples of both storm water releases and the receiving environments (surface and ground water) are taken on a regular basis.	SHEQ Project Manager	As indicated in table
	O20	Samples will be taken in accordance with the sampling protocol provided. Should the sampling protocol be changed, the sampler and laboratory will be provided with the copy of the new protocol.	SHEQ Project Manager	Ongoing
	O21	To ensure consistency in analysis and the verification and validation of water quality data, an accredited laboratory, with the necessary quality assurance, should carry out the analysis of samples and should have quality control measures in place (blanks, standards, duplicates, cation-anion balances etc).	SHEQ Project Manager	Ongoing
	O22	Data from the monitoring programme will be stored electronically. Trend analysis and load calculations will be carried out to assist in the identification of any future problems.	SHEQ Project Manager	Quarterly
	O23	Should monitoring of the storm water release indicate non-compliance with the DWAF licence conditions, CDC will immediately notify the Regional Director of DWAF by fax. CDC will then: a) Identify the source of the contamination; b) Identify, and if necessary implement, measures for the prevention of this contamination (both short and long term); c) Determine, and if necessary implement, any remediation measures; and d) Keep record of the incident and the actions taken	SHEQ Project Manager r	On identification of non-compliance
Compliance assessment and enforcement	O24	The CDC will carry out *ad hoc* audits of both contractors and tenants. With respect to storm water management, CDC will check to see that the requirements stipulated above and in the site specific licences/ permits/ authorisation are being complied with.	SHEQ Project Manager	As necessary
	O25	For each new tenant, the requirements given in Table 5.1 must be reviewed in light of the proposed operation to determine what hydrological and pollution control measures need to be implemented. The tenant must be informed in writing of any requirements in addition to those given above along with a motivation of why the additional requirements are needed.	SHEQ Project Manager	Upon tenant application
	O26	If necessary, site specific requirements in addition to those given above, will be imposed to minimise any risk to the storm water system.	SHEQ Project Manager	On determination of new tenant application

Type of activity	Ref.	Commitment	Responsible person	Due date or frequency
	O27	The CDC may issue a written notice indicating an area of known or suspected non-conformance. The notice must stipulate what action must be taken and in what time period. The penalty for non-compliance with notice must be clearly stated as must any opportunity for appeal. The notice must be delivered to the tenant's registered office or business premises.	SHEQ Project Manager	As necessary
	O28	CDC will issue spot fines for non-conformance (ROD #25) of the plan laid out in Table 5.1 or any written notice issued in accordance with the above commitment. The fine must be issued in accordance with procedure CDC SHE\4223\EWI 4.4.6.4, Clause 5.3.	SHEQ Project Manager	As necessary
	O29	If spot fine payment or compliance with the application does not take place, CDC may cut off services or restrict releases of storm water.	SHEQ Project Manager	As necessary
Emergency preparedness	O30	CDC will set up a centralised emergency centre for the IDZ to deal with issues such as fire, flooding etc. Emergency procedures will be drawn up to address the various possible emergency situations that could arise. With respect to storm water management the following procedures will have relevance:· Flood management;· Fire (handling of potentially polluted water);· Serious spills of hazardous materials;	Zone Operations Manager	1st September 2003 and reviewed annually

6.2 Acceptable Design Standards

The following documents are recommended for Coega IDZ as the supporting documents to be used for designs:

- Human Settlement Planning and Design by CSIR (2000)
- Drainage Manual by SANRAL (2006)
- Standard Infrastructure Details by NMBM (2007)

6.3 Hydrology

6.3.1 Rainfall Intensity

The amount of rainfall that the Coega Catchment receives determines the amount of runoff that could be expected in Coega IDZ area. In the previous works, rainfall patterns of Port Elizabeth airport were used for all the design works in Coega IDZ. The values from Port Elizabeth airport are slightly higher than the values of rainfall received in Coega and these two places are not within the same catchment area. Smithers and Schulze (2003) have estimated the Mean Annual Precipitation (MAP) of Coega to be 427 mm. This MAP is smaller than the MAP of Port Elizabeth which is approximately 611 mm. The recommended rainfall Intensity-Duration-Frequency (IDF) curves for Coega can be found in section 3 above.

6.3.2 Recurrence Intervals for Major and Minor Stormwater Drainage

Coega stormwater drainage should be able to handle infrequent severe storms (major storms) and frequent minor storms. According to CSIR (2000), the typical formal drainage system should be able to handle the minor storms and during the major storms should support the major drainage system in handling the unusual storm. The minor systems will be installed by relevant tenants on each property and will feed into the major systems.

Designing the major stormwater drainage, CSIR (2000) recommend return period of 50 years and 2 – 5 years for minor stormwater drainages. SANRAL (2006) uses the peak flood calculated for a flood with a return period of 20 years as a basis for the selection of the appropriate design return period (recurrence interval). For major drainages, 50-year recurrence interval is used where 20-year flood is less than $20m^3/s$ and 2-year recurrence interval is recommended for minor systems. In cases where 20-year peak flood is more than $150m^3/s$, 100-year and 5-year are recommended for major and minor systems respectively. CSIR and SANRAL standards are very similar; however SANRAL should be adopted for Coega IDZ.

National Water Act cited by CSIR (2000) requires a 100-year recurrence interval floodline on residential development.

6.3.3 Attenuation and Storage

Attenuation ponds are provided in all the zones to reduce the peaks of the floods. The aim of the attenuation ponds should be to reduce the peak of the storm occurring of

post development back to the peak of the pre-development flood. This may mitigate the downstream flooding as a result of the development. As mentioned above, attenuating the storm of 100-year flood into 2 year or 5 year is not economically practical as this might require a large space for the attenuation ponds.

The best practice for IDZ would then be to have all the attenuation ponds, being constructed to attenuate a storm of 50-100-year post development into 50- 100year pre development peak. The selection of the return period should be based on section 6.3.2 above.

6.3.4 Pipes

Although CSIR (2000) recommends minimum pipe diameters of 300mm and 375mm in the ervens and road reserves respectively, minimum pipe size of 450mm diameter and class D with a minimum slope of 1:250 for minor drainages is suggested for the development. The recommended minimum pipe cover is 600 mm around the ervens and 750 mm else where in the development. CSIR (2000) recommend minimum pipe velocity of 0.9 m/s in order to prevent siltations, this velocity should be adopted for Coega IDZ.

6.3.5 Open Channels

Concrete should be used to line the bases of the channel where the sides are grass lined. Armorflex and hyson cells should be preferred over concrete lining due to costs and environmental issue. SANRAL (2006) recommends maximum sides slope of 1:3 and minimum channel bed slope of 1:500; these values should be adopted for Coega IDZ. The recommended minimum and maximum velocities in the channels should be 0.9 m/s and 3.0 m/s respectively.

The recommended design capacity for all major open channels in the development should be 1 in 50 years.

6.4 Design for Erosion and Sediments control

6.4.1 Introduction

When land is disturbed for any reason, soil erosion becomes a problem. The main cause of soil erosion around the coastal areas is rainfall, wind and runoff. Sedimentation on the other hand, is the process of deposition of the eroded soil particles.

6.4.2 Soil Stabilisation

Stabilisation is a key factor in reducing the erosion potential of rainfall or stormwater discharged over unprotected area. This is achieved by forcing the water particles to infiltrate into the soil hence reducing the sediment carrying capacity of the surface runoff.

During construction, if the construction activities are taking a large area, staging the project and matching the existing land contours will help minimise the disturbed area. Once construction activities are complete, the disturbed areas must be permanently stabilised. In areas that will not be re-disturbed for a long time, temporary seeding and mulching can be used as a stabilisation measure.

Proposed Best Management Practices recommended for erosion and flood control can be found the next section (7).

6.5 Best Management Practices (BMPs)

Stormwater Management involves the effective handling of the quantity and quality of runoff water being discharged into a land or water area. Effective management requires that possible pollution conditions of stormwater be addressed adequately as these impact water bodies downstream. Also, erosion and sedimentation assert a detrimental impact on the existing drainage as the deposited silt and soil particles render the drainage incapable of operating at original designed level. Best Management Practices (BMPs) are then suggested to reduce or to possibly eliminate the detrimental impacts resulting from uncontrolled erosion and sedimentation from the land upstream.

The proposed BMPs applicable to Coega IDZ are tabulated in Section 7 from Table 7.6 to 7.11.

6.6 Summary of Stormwater Design Criteria

Table 6.3 below summaries the proposed design criteria for Coega IDZ.

Parameter	Criteria		
Rainfall	MAP = 427mm - $I_{2years} = 410/(10 + t)^{0.696}$ - $I_{10years} = 650/(8 + t)^{0.672}$ - $I_{20years} = 822/(8 + t)^{0.687}$ - $I_{50years} = 802/(7 + t)^{0.637}$ - $I_{100years} = 747/(4 + t)^{0.600}$		
Recurrence Interval	**Floods for 20yrs**	**Minor Drainage**	**Major Drainage**
	20 m³/s or less	2 year design period	50 year design period
	150 m³/s	5 year design period	100 year design period
Attenuation & Storage	- All ponds should be able to attenuate 50 year post development flood into 50 year predevelopment flood		
Pipes	- Minimum pipes of 450 mm, class D for minor drainage - Minimum pipe slope of 1:250 - Minimum pipe cover of 600 mm around ervens and 700 mm else where - Minimum pipe velocity of 0.9 m/s		
Open Channels	- Maximum side slope of 1:3 - Minimum channel slope of 1:500 - Minimum velocity of 0.9 m/s - Maximum velocity of 3 m/s		
Modelling	- Depression storage (pre-wetting) for pervious areas 4 mm - Depression storage (pre-wetting) for impervious areas 1 mm - Overland roughness coefficient for pervious areas (n) 0.03 - Soil Type Type B - Antecedent moisture conditions for 2-year event (0 – 12.5 mm) - Antecedent moisture conditions for 50-year event (12.5 – 25 mm) - Routing Method Continuity - Friction loss formula Manning - Manhole conditions Invert		

7 COEGA WATER QUALITY

7.1 Monitoring Network

SRK was appointed in 2000 to design and implement a water quality monitoring programme within Coega IDZ. The programme focused on the flow volume, water quality and pollutant concentration in the surface and groundwater environments of the Coega River. In 2001-2002, surface monitoring activities included monitoring at 6 locations for pH, EC, temp, TDS, major ions, nitrates, bacteria and heavy metals 6 times per annum and Diesel Range Organics (DRO) analysis which was to be done once a year (SRK, 2002).

The 6 sampling locations which are all within Coega River were as follows;

Names	**X**	**Y**	**Z (mamsl)**
SW-DS	3737330	-62540	10
SW-1	3736572	-61807	18
SW-2	3736944	-60060	18
SW-3	3737097	-57326	28
SW-4	3734948	-55547	40
SW-US	3735314	-54990	45

In 2003 SRK expanded its monitoring network to include surface water from Motherwell (Motherwell canal). The Gully sampling was included in 2004, culvert A sampling point adjacent to N2 was also included in 2005 to monitor baseline water quality conditions of stormwater discharge and further culvert B sampling was added in 2006. Culvert B will be used in the future (SRK, 2006).

The locations of these new sampling stations are as follows;

Names	**S°**	**E°**
Motherwell Canal	33.7609	25.6001
Gully	33.7849	25.6705
Culvert A	33.7833	25.6692
Culvert B	33.7941	25.6728

Groundwater was also monitored in 8 locations. Monitoring was done 6 times per annum for pH, EC, temp, TDS, major ions, nitrates, bacteria and heavy metals and once a year for DRO.

The monitoring boreholes are located as follows:

Names	**X**	**Y**	**Z (mamsl)**	**Z (mbs)**
CM-1	3736890	-61334	15	9
CM-2	3736964	-59882	20	15
CM-3	3736975	-57611	30	15
CM-4	3735114	-55361	40	15
CBM-1	3737225	-62212	20	7
CBM-3	3736800	-61750	25	9
CBM-14	3737300	-60987	15	8
BH 302/42/1	3738450	-57900	90	40

Table 7.1 summaries the sampling location discussed.

Table 7.1: Water Quality monitoring locations

Type of monitoring	Location	Frequency	Parameters to be assessed*
Compliance assessment with DWAF licensed storm water released points	Any outlets where DWAF and CDC determine a water use licence is required.	Continuously	pH, EC, dissolved oxygen
		Weekly during rainy season	pH, EC, TDS, TSS, Total hardness, Total alkalinity, major cations (Ca, Mg, Na and K) an anions (CI, SO4 and F), nutrients (COD, Nitrate, nitrite as N) and ammonia as N), dissolved metals by ICP, total hydrocarbons, total coliforms and faecal coliforms
Other storm water points	Other storm water release points	Monthly during rainy season	pH, EC, TDS, TSS, Total hardness, Total alkalinity, major cations (Ca, Mg, Na and K) an anions (CI, SO4 and F), nutrients (COD, Nitrate, nitrite as N) and ammonia as N), dissolved metals by ICP, total hydrocarbons, total coliforms and faecal coliforms
	Ad hoc sampling in the major storm water system	As necessary	pH, EC, dissolved oxygen using hand held meter**
Receiving surface waters	SW 3 and SW-DS	Samples taken on *ad hoc* basis after typical rainfall events (at least 6 samples per year)	pH, EC, dissolved oxygen using hand held meter**
		Quarterly	pH, EC, TDS, TSS, Total hardness, Total alkalinity, major cations (Ca, Mg, Na and K) an anions (CI, SO4 and F), nutrients (COD, Nitrate, nitrite as N) and ammonia as N), dissolved metals by ICP, total hydrocarbons, total coliforms and faecal coliforms
	SW-US, SW 1, SW 2 and SW 4	Six Monthly unless problem identified	pH, EC, TDS, TSS, Total hardness, Total alkalinity, major cations (Ca, Mg, Na and K) an anions (CI, SO4 and F), nutrients (COD, Nitrate, nitrite as N) and ammonia as N), dissolved metals by ICP, total hydrocarbons, total coliforms and faecal coliforms
Ground Water	BH 302/42/1, CBM - 1, CBM - 3, CBM - 14, CM - 1, CM 2, CM 3 and CM 4	Six Monthly unless problem identified	pH, EC, TDS, TSS, Total hardness, Total alkalinity, major cations (Ca, Mg, Na and K) an anions (CI, SO4 and F), nutrients (COD, Nitrate, nitrite as N) and ammonia as N), dissolved metals by ICP, total hydrocarbons, total coliforms and faecal coliforms

*Additional parameters may be added should new developments indicate potential parameters of concern. The frequency of analysis and location of sampling will be determined by SHE Manager.

7.2 Water Quality Measuring Criteria

According to SRK (2002 and 2003), DWAF has requested that water quality database collected in Coega should be compared with the General Limits, the SANS 241 Maximum Limit for Drinking Water and the South African Water Quality Guidelines for Agricultural and Industrial Use. Once a representative database is established it then becomes the water quality guideline for reference purpose and in environmental impact assessment.

The following tables (Table 7.2 and 7.3) outline SANS 241 drinking water specification as it appears on "Drinking Water Quality Management Guide for Water Services Authorities'' (2005).

Table 7.2: Microbiological Safety Requirements

1	2	3	4	5
Determinand	**Unit**	**Allowable compliance contribution[a]**		
		95% of samples, min.	**4% of samples max.**	**1% of samples, max.**
		Upper limits		
E.coli[b] or Thermotolerant	count/100ml	Not detected	Not detected	1
(faecal) coliform bacteria[c]	count/100ml	Not detected	1	10

[a] The allowable compliance contribution shall be at least 95% to the limits indicated in column 3, with a maximum of 4% and 1%, respectively, to the limits indicated in column 4 and column 5. The objective of disinfection should, nevertheless, be to attain 100% compliance to the limits indicated in column 3.
[b] Definitive, preferred indicator of faecal pollution.
[c] Indicator of unacceptable microbial water quality, could be tested instead of E. coli but is not the preferred indicator of faecal pollution. Also provides information on treatment efficiency and aftergrowth in distribution networks.

Table 7.3: Physical, Organoleptic and Chemical Requirements

1	2	3	4	5
Determinand	**Unit**	**Class I (recommended operational limit)**	**Class II (max. allowable for limited duration)**	**Class II water consumption period,[a] max.**
Physical and organoleptic requirements				
Colour (aesthetic)	mg/l Pt	<20	20 - 50	No limit[b]
Conductivity at 25°C (aesthetic)	mS/m	<150	150 - 370	7 years
Dissolved solids (aesthetic)	mg/l	<1000	1000 - 2400	7 years
Odour (aesthetic)	TON	<5	5 – 10	No limit[b]
pH value at 25°C (aesthetic /operational)	pH units	5,0 – 9.5	4,0 - 10,0	No limit[c]
Taste (aesthetic)	FTN	<5	5 - 10	No limit
Turbidity (aesthetic/ operational/ indirect	NTU	<1	1 – 5	No limit[d]

1	2	3	4	5
Determinand	**Unit**	**Class I (recommended operational limit)**	**Class II (max. allowable for limited duration)**	**Class II water consumption period,[a] max.**
health)				
Chemical requirements – marco-determinand				
Ammonia as N (operational)	mg/l	<1,0	1,0 – 2,0	No limit[d]
Calcium as Ca (aesthetic/ operational)	mg/l	<150	150 – 300	7 years
Chloride as Cl^- (aesthetic)	mg/l	<200	200 – 600	7 years
Fluoride as F^- (health)	mg/l	<1,0	1,0 – 1,5	1 year
Magnesium as Mg (aesthetic/health)	mg/l	<70	70 – 100	7 years
(Nitrate and nitrite) as N (health)	mg/l	<10	10 – 20	7 years
Potassium as K (operational/ health)	mg/l	<50	50 – 100	7 years
Sodium as Na (aesthetic/ health)	mg/l	<200	200 – 400	7 years
Sulfate as SO_4^- (health)	mg/l	<400	400 – 600	7 years
Zinc as Zn (aesthetic/ health)	mg/l	<5,0	5,0 – 10	1 year
Chemical requirements – mirco-determinand				
Aluminium as Al (health)	µg/l	<300	300 – 500	1 year
Antimony as Sb (health)	µg/l	<10	10 – 50	1 year
Arsenic as As (health)	µg/l	<10	10 – 50	1 year
Cadmium as Cd (health)	µg/l	<5	5 – 10	6 months
Total Chromium as Cr (health)	µg/l	<100	100 – 500	3 months
Cobalt as Co (health)	µg/l	<500	500 – 1000	1 year
Copper as Cu (health)	µg/l	<1000	1000 – 2000	1 year
Cyanide (recoverable) as CN^- (health)	µg/l	<50	50 – 70	1 week
Iron as Fe (aesthetic/ operational)	µg/l	<200	200 – 2000	7 years[b]
Lead as Pb (health)	µg/l	<20	20 – 50	3 months
Manganese as Mn (aesthetic)	µg/l	<100	100 1000	7 years
Mercury as Hg (health)	µg/l	<1	1 – 5	3 months
Nickel as Ni (health)	µg/l	<150	150 – 350	1 year
Selenium as Se (health)	µg/l	<20	20 – 50	1 year
Vanadium as V (health)	µg/l	<200	200 – 500	1 year
Chemical requirements – organic determinand				

1	2	3	4	5
Determinand	**Unit**	**Class I (recommended operational limit)**	**Class II (max. allowable for limited duration)**	**Class II water consumption period,[a] max.**
Dissolved organic carbon as C (aesthetic/ health)	mg/l	<10	10 – 20	3 months[e]
Total trihalomethanes (health)	µg/l	<200	200 – 300	10 years[f]
Phenols (aesthetic/ health)	µg/l	<10	10 - 70	No limit[b]

[a] The limits for the consumption of class II water are based on the consumption of 2 L of water per day by a person of mass 70 kg over a period of 70 years. Column 4 and 5 shall be applied together.
[b] limits given are based on the aesthetic aspects.
[C] No primary health effect – low pH values can result in structural problems in the distribution system.
[d] These values can indicate process efficiency and risks associated with pathogens.
[e] When dissolved organic carbon is deemed of natural origin, the consumption period can be extended.
[f] This is a suggested value because trihalomethanes have not been proven to have any effect on human health.

7.3 Surface Water Quality Monitoring Results

In 2000-2001 the highest flow rates that were measured in Coega River were in the range of 0.001-0.003 m³/sec and due to these low flows, only 4 locations were sampled (SW-1, SW-2, SW-3 and SW-US). The results were as follows

- Electrical Conductivity (EC) of the surface water had increased from <300 mS/m to maximum of 9970 mS/m from May 2001. This was measured after a significant rainfall period (September 2001), and the results indicated that stormwater flushed out the salts which had accumulated during the dry period. In November 2001 lower EC values were measured ranging from 62 mS/m upstream (SW-US) to 96 mS/m near the coast (SW-DS).

- Highest Sodium (19859 mg/l) and chloride (37264 mg/l) were measured at SW-DS after September 2001. The inland SW-3 showed Sodium concentration of 1911 mg/l and chloride concentration of 2823 mg/l. In November 2001, lower concentrations were measured for both sodium and chloride (ranging between 80 mg/l to 107 mg/l for Sodium and 140 to 217 mg/l for Chloride).

- *E .Coli* count varied between 10, 000 to 20, 000 counts/ ml in samples from SW-1, SW-2 and SW-US exceeding the SABS 241 Maximum Limit for drinking water of 10, 000 counts/ml.

In 2003, physical parameters of surface water were still behaving as in 2002 while concentrations of major ions were on average below the SABS 241 Maximum Limit. *E .Coli* concentrations varied between 141 to 3100 counts/ 100ml in the samples, which also falls within the SABS 241 Maximum Limit for

drinking water. DRO level were below the laboratory detection limit in all the samples.

According to SRK (2002 and 2003) the results of the testing indicate that salinity is dependent on Coega River flow frequency, volume and distance from the coast and all the samples have similar composition to seawater. Furthermore SRK (2002 and 2003), state that rainfall dilutes the concentrations of Coega surface water without affecting Na/Cl signature of Coega river water.

The results of 2005-2006 showed the following parameters exceed the 90th percentile:

- SW-1: pH and carbonate alkalinity
- SW-2: Total Alkalinity, bicarbonate alkalinity and carbonate hardness
- SW-3: pH, total Alkalinity, carbonate hardness, non-carbonate hardness, total hardness and calcium
- SW-US: Carbonate alkalinity

In Motherwell canal (SW-MWC) Electrical Conductivity, chemical oxygen demand, fluoride and boron parameters exceeded the SANS 241 Maximum Limit for Drinking Water. In Gully, the surface water samples had no parameters that are greater than SANS 241 Maximum Limit.

7.4 Groundwater Quality Monitoring Results

According to SRK (2002 and 2003), groundwater is encountered at an average depth of 3 to 7m below surface or just above the contact between the permeable sands and the underlying low permeability clays. The results of monitoring in 2001-2003 are as follows:

Physical parameters: In 2002, across all the monitoring areas, groundwater had a pH of 7-8 and temperature of approximately 20°C. The salinity increased towards the sea rising from an average value of 722 mS/m (CM-4) to 2473 mS/m (CM-1). Salinity of the groundwater in the riverbed varied between 1540 mS/m and 9270 mS/m. In 2003, pH was found to be 6.6 -7.9 with the temperature still around 20°C. Salinity at CM-4 as 745 mS/m and at CM1 as 3148 mS/m. The salinity in the riverbed varied between 1267 mS/m and 1649 mS/m. According to SRK (2002 and 2003), these high values possibly indicate the Coega River's function as a groundwater discharge feature, where evapo-transpiration concentrates the salts in the soil moisture.

Major ion chemistry: In 2002, TDS varied between 4696 mg/l (upstream) and 20620 mg/l (downstream) and this groundwater has been characterised by a consistent Na/Cl signature. This composition is confirmed by samples collected from the 3 shallow boreholes (CBM-1, CBM-3 and CBM-14). Water sampled from deep borehole (BH 302/42/1) is also characterised by Na/Cl composition but has reduced TDS value (approximately 600mg/l). In 2003, TDS varied between 4212 mg/l (upstream) and 34040 mg/l (downstream).

Trace Metal: Coega groundwater has higher concentrations of all trace metals than the surface water samples. The highest concentrations (in particular Fe, Hg, Pb and Mn) were measured in samples collected near the coast.

Contaminant indicators: In 2002, the up gradient groundwater samples showed a high total bacterial count (>1 000000 counts/ml) and E.Coli count of 3200 counts/100ml in CM-4. The highest nitrate concentration was 28mg/l and DOC was 85mg/l at CM-2, indicating the possible effect of soil eutrofication within Coega area. In 2003, the up gradient groundwater samples showed a total bacterial count of 5800 counts/ml and E.Coli count of <100 count/100ml. Nitrate and nitrite concentration was 67mg/l in CM-2.

In 2003, groundwater levels fell by 0.5 to 1.0m during the low rainfall period. From the groundwater samples taken it became visible that groundwater quality was not affected by the fluctuation in water level. The Na/Cl signature and the presence of trace metal concentrations are probably due to the occurrence of connate water soil-water interaction rather than industrial pollution; however the relatively high bacterial count and nitrate concentrations may be related to agricultural activities.

7.5 Development of Compliance Limit

Comparing the results obtained by SRK up to 2006 with the SANS 241 it becomes obvious that Coega water cannot be suitable for use in domestic, agriculture and industrial use. The high salinity of Coega water makes it difficult or even impossible to compare with any available water quality guidelines. The comparison of effluent with 90 percentile of SRK results as recommended by DWAF is then adopted in this ISWMP. Since a representative data has been established, this 90 percentile becomes a water quality guideline for reference purposes and environmental impact assessment. Table 7.4 below shows the 90 percentile limits for effluent discharge set based of the results from location SW-3 taken in July 2006.

Table 7.4: Recommended interim effluent compliance limits

Parameter (mg/l unless otherwise stated)	90 percentile	Proposed Compliance limit
pH	7.6	5.5 – 9.5
Electrical Conductivity (mS/m)	918	1000
Total Dissolved Solids	5371	No Standard
Dissolved oxygen	Not Determined	No Standard
Sodium	1233	1250
Ammonia as N	2.9	3
Nitrate/ Nitrite as N	0.05	0.05 – 0.1
Fluoride	1.4	1.5
Arsenic	Not Determined	Not Determined
Boron	1.8	2
Cadmium	Not Determined	Not Determined
Total Chromium	Less than 0.001	0.05
Sulphate	460	500
Iron	0.003	0.05-0.1
Lead	0.005	0.05 – 0.01
Manganese	Less than 0.001	0.01 – 0.05
Mercury	Less than 0.001	0.001 – 0.005
Selenium	Not Determined	Not Determined

Parameter (mg/l unless otherwise stated)	90 percentile	Proposed Compliance limit
Zinc	0.0023	0.005 – 0.01
Cyanides as CN	Not Determined	Not Determined
Phenols	Not Determined	Not Determined
Soaps/ oils or grease	Not Determined	Not Determined
Chemical Oxygen Demand (COD)	117	120 – 140
Dissolved Organic Carbon	21	25 – 30
Faecal Coliforms per 100 ml	21 (total bacterial count)	30 – 50
E.Coli per 100 ml	Not Detected	No Standard
Total Bacterial count	585	No Standard

7.6 Western Coega IDZ Surface Water Quality

Coega IDZ zones 1 to 4 are basically for light industrial use hence no heavily polluted stormwater could be expected at full development. In zone 5, the metal precinct is proposed hence the stormwater quality might be highly polluted.

In these zones non-stormwater discharges that could be expected to be mixed with stormwater are;

- Landscape irrigation
- Discharge from potable water sources
- Foundation drains
- Lawn watering
- Discharge from fire fighting

This non-stormwater could be allowed to join the stormwater system; however its pollution potential should not be disregarded. All dischargers should be obligated to reduce pollutant discharges to the maximum extent practicable.

Coega IDZ operations and maintenance programs in these zones should be effective and adequate. The employees and contractors should be trained so that they can prevent or reduce pollutant runoff from the Coega IDZ operations.

In areas where land is available the use of wetlands to treat stormwater would play an important role. These wetlands could be designed to accommodate stormwater peaks in a manner that dissipates energy to the extent that floating and suspended materials are allowed to settle in quiescent areas or can be filtered by wetland vegetation. The internal wetland design should attempt to minimize or mitigate preferential flow paths and allow for maximum contact with the wetland surfaces while water is retained within the system.

7.6.1 Release into Coega River

Some parts of zone 1 and most of zone 5 discharge their stormwater into Coega River. Stormwater quality from zone 1 is expected not to be of poor quality or highly polluted because of the nature of the development proposed for zone 1. Stormwater discharge from zone 1 hence is not expected to have a negative impact on the existing water quality of Coega River.

Metal precincts have been proposed for zone 5 hence the stormwater quality might be highly polluted. One of the major steps in reducing the amount of highly polluted stormwater from getting into the river could be by making the sure that there is adequate knowledge of public drainage systems within the development zone. This knowledge should be in the form of maps showing the major and minor drainage pipes and outfalls. The tenants that produce illicit non-stormwater should retain it in lined dams within their properties and treat it before it can be released.

7.6.2 Release into Markman Canal

ARUP (2003) and Iliso (2005) proposed that Zone 3 and 4 stormwater be discharged into Markman canal. BKS, MDC and MSBA (2005) have also indicated that some part of zone 2 will discharge stormwater into Markman canal. The quality of stormwater from these zones is not expected to be of poor quality because these zones are meant for light industries.

7.6.3 Coega IDZ Surface Water Quality Chart

The proposed land uses and zone labelling has changed from the original land use as per the Stormwater Masterplan of ARUP (2003). Each land use suggested for IDZ will have an impact on floods, erosion and siltation, safety, health and the environment. From the report by SRK (2006), it was observed that Metallurgical, automotive precincts and tank farm will have the highest total impact. Based on this observation it is seen that it is of utmost importance to include appropriate control measures to minimise the impact of the proposed landuse on flooding, erosion, siltation and the environment. Table 7.5 below, shows the proposed Land-use and relative impacts of each class.

Table 7.5: Proposed Land-use and Relative Impact

Landuse Category	Sub Class	Potential Impact Score			Total Score
		Flooding	Erosion/ Siltation	Health, Safety & Environment	
2.7.1 Commercial	Office parks, admin centre	✓✓	✓	✓	4
	Training/academic precinct	✓	✓	✓	3
2.7.2 Industrial	General industrial precinct	✓✓	✓✓	✓✓	6
	Electronic/tech precinct	✓✓	✓✓	✓✓	6
	Metallurgical precinct	✓✓	✓✓	✓✓✓	7
	Automotive precinct	✓✓✓	✓✓	✓✓	7
	Service centres	✓✓	✓	✓	4

Source: SRK (2006) Phase 2 Report

Note:
Potential Impact Weighting
✓: Low Impact (1)
✓✓: Medium Impact (2)
✓✓✓: High Impact (3)

Floods result in more waste materials and substance that are toxic which might not be high enough above the ground being carried into the stormwater systems. High erosion rates mean stormwater will have a high content of organic contents and soil particles which reduces the quality of stormwater. A general statement can be made to say increase in floods and soil erosion is proportional to decrease in stormwater quality.

Based on Table 7.5 above, a ranking of development areas which are likely to produce polluted stormwater is proposed. Areas which score a total of 4 could be considered to have stormwater which is less polluted, areas scoring total of 6 could be considered to produce moderately polluted stormwater whereas areas scoring 7 and above could be consider producing a highly polluted stormwater. From this ranking Drawing Number **J27139 – 7231/CDC005/0** shows the proposed labelling in the western Coega IDZ.

The observation from the table mentioned above, is that high percentage of the western IDZ will be contributing to deteriorating the quality of stormwater in Coega IDZ. The major focus in the western IDZ should be on zone 5 which has a total score of 7. More surface water monitoring stations should be enforced in this zone and all the stormwater coming out this zone should be treated or diluted before being allowed to flow into Coega River. In other zones excluding zone 5, stormwater quality can be improved when the stormwater passes through the attenuation ponds, where the velocity of flow will be decrease hence causing the carried solid material to settle in the attenuation ponds.

Having identified that quality of stormwater from the Western Coega IDZ can be affected by flooding and erosion; the Best Management Practices (BMPs) in Table 7.6 to 7.11 below are suggested for flood and erosion control during the Planning and design Stage, Construction Stage and Operational stage. The BMPs can be divided into two main categories which are: structural BMPs and Non-structural BMPs. The structural type (S) includes physical/structural measures for the control of water quantity and quality in an urban environment. Non-structural type (SN) includes non-structural measures such as policy documents, guidelines, contracts between various parties for the upkeep and maintenance of the structural BMPs.

Table 7.6 Proposed BMPs for Flood Control: Planning and Design Stage

Control Measure Category	Control Measure Type	Proposed BMPs				
		BMP Code	BMP Description	BMP Type (S, NS)	Planning	Finance
Urban development & road drainage	Public open space (P.O.S.)	BMP/F/P1	• Incorporate buffer strips and flood control measures (detention, retention ponds) in P.O.S. • Define P.O.S. along natural low lying areas based on 100-year floodplain. • Join P.O.S. to form networks and natural drainage corridors. • No development allowed within the 50-year floodplain and all development floor levels to be above the 100-year flood level.	S & NS	CDC	CDC
	Development layout	BMP/F/P2	• Reduce paving areas. • Reduce directly connected impervious areas. • Direct runoff to a treatment point (e.g. local silt, effluent trap.	S & NS	CDC	Developer
	Local development runoff quantity (minor drainage system)	BMP/F/P3	• Attenuate up to 2 to 5 year storm event. • Contain first flush from contaminated areas. • Attenuation ponds fitted with return pump system. • Clean and “dirty” water runoff separated on site. • All overflow systems to divert flow into natural drainage corridors.	S	CDC	Tenants

Control Measure Category	Control Measure Type	Proposed BMPs				
		BMP Code	**BMP Description**	**BMP Type (S, NS)**	**Planning**	**Finance**
Urban development & road drainage continue	Road drainage	BMP/F/P4	• Where practical an alternative crossfall road to be constructed needing no or limited underground drainage system. • Road network plus underground system to handle up to 5-10 year storm events. • 100 Year excess flow to be handled by overflow (natural drainage corridors or canal) systems.	S	CDC	CDC/Tenants
	Parking areas.	BMP/F/P5	• Parking areas to be used as temporary storage facility (100 year storm event) • Parking areas to drain into P.O.S. areas.	S	CDC	Developer
	Pipe networks	BMP/F/P6	• In flat gradient areas sufficient access manholes implemented for cleaning (grad 1:300 or flatter) • Pipe network joints well sealed especially in sandy areas.	S	CDC (major system Tenants (minor system)	CDC (major system) Tenants (minor system)
	Energy dissipaters	BMP/F/P7	• Energy dissipating structures to be implemented at all outlet works and/or in areas with concentrated flows	S	CDC (major system Tenants (minor system)	CDC (major system) Tenants (minor system)
	Road crossing culverts/bridge	BMP/F/P8	• Culvert gradient sufficient to ensure flow velocity > 1.5m/s for 1:2 year storm event • Inlet and outlet works protected against erosion	S	CDC	CDC
Stormwater containment structures	Primary (on-site) detention pond	BMP/F/F9	• Implement for attenuation only (up to 2 to 5 year event) on site • Provide upstream silt pond with easy ramp access for cleaning	S	Tenants	Tenants/ CDC

Control Measure Category	Control Measure Type	Proposed BMPs				
		BMP Code	**BMP Description**	**BMP Type (S, NS)**	**Planning**	**Finance**
Stormwater containment structures continue	Primary (on-site) retention pond	BMP/F/P10	• Implement for attenuation and possible treatment of polluted water on site. • Define area of artificial reeds • Provide upstream silt pond.	S	Tenants	Tenants
	Secondary (major) drainage system detention / retention ponds.	BMP/F/P11	• Implement in low lying areas and/or at naturally draining corridors (attenuate post development to pre-development event, with minimum attenuation pond being able to attenuate 50 year event) • Provide upstream silt pond and debris trap • Implement retention pond with artificial wetland in potentially polluted drainage systems.	S	CDC	CDC
Open canals	Compound canals	BMP/F/P12	• Canals to be designed to have a low flow section for a 2-5 year event and an overflow section to handle up to the 50/100 year event.(Based on the criteria mentioned above in section 6.3.2.	S	CDC (major system Tenants (minor system)	CDC (major system) Tenants (minor system)
Debris traps	Primary (minor) on site trap	BMP/F/P13	• Debris traps to be implemented on sites with a litter potential. • Trap to be positioned upstream of any control structure to prevent blockages. • Trap to handle up to al least a 1:1 year storm event without flooding debris screen.	S	Tenant	Tenant
	Secondary (major) gross pollutant trap	BMP/F/P14	• Debris trap to be implemented upstream of sensitive water bodies to prevent blockage. • Trap to handle up to at least a 1:2 year storm event without flooding debris screen.	S	CDC	CDC

Table 7.7: Proposed BMPs for Flood Control: Construction Stage

Control Measure Category	Control Measure Type	Proposed BMPs				
		BMP Code	• BMP Description	BMP Type (S, NS)	Planning	Finance
Urban development & road drainage.	Road construction & drainage.	BMP/F/C1	• Road layer works prevented from excessive flooding by temporary diversion trenches or embankments. • Temporary diversions to handle at least up a 1:5 year storm event.	S	CDC (major roads) Tenants (minor on site roads)	CDC (major roads) Tenants (minor on site roads)
	Pipe network & trenches	BMP/F/C2	• All trenching to be protected against flooding by temporary diversion trench or embankment.	S	CDC (major system) Tenants (minor)	CDC (major system) Tenants (minor)
	Culvert/bridge crossing	BMP/F/C3	• Sufficient flow area allowed during construction to handle up to at least a 1:5 year storm event.	S	CDC (major system) Tenants (minor)	CDC (major system) Tenants (minor)
Stormwater containment	On-site detention and retention ponds	BMP/F/C4	• Sufficient flow area allowed during construction to handle up to at least a 1:5 year storm event.	S	CDC/Tenants	Tenants
	Major drainage system detention/retention ponds	BMP/F/C5	• Sufficient flow area allowed during construction to handle up to al least a 1:20 year storm event.	S	CDC	CDC
Open canals	Minor canals	BMP/F/C6	• No obstructions to be in place for flow of water. To handle at least a 1:5 year storm event.	S	Tenants	Tenants
	Major canals		• No obstructions to be in place for flow of water. To handle at least a 1:20 year storm event.	S	CDC	CDC
Debris & Silt Traps.	Minor on site trap	BMP/F/C7	• Trap not to cause any obstruction to flows up to at least a 1:5 year event	S	Tenants	Tenants
	Major gross pollutant trap	BMP/F/C8	• Trap not to cause any obstruction to flow up to at least a 1:20 year event.	S	CDC	CDC

Table 7.8: Proposed BMPs for Flood Control: Operational Stage

Control Measure Category	Control Measure Type	Proposed BMPs					
		BMP Code	BMP Description	BMP Type (S, NS)	Responsible Organisation		
					Planning	Finance	Maintenance
Urban development & road drainage.	Public open space natural drainage corridors.	BMP/F/01	• All corridors to be maintained on a regular basis to ensure no obstructions to flow of water. • Vegetation to be maintained such that flood water levels are not increased. • Excessive deposition of silt (excess of 0.5m depth) to be removed along corridors, especially before rain season and after significant rainfall)	NS	CDC	CDC	CDC
	Secondary (major) drainage network.	BMP/F/02	• All drainage network elements to be frequently monitored and obstructions removed from canals, road crossings, especially before rainy season.	NS	CDC	CDC	CDC
	Secondary (major) energy dissipaters, culverts, bridge crossings.	BMP/F/03	• All energy dissipaters to be cleaned regularly, especially before rainy season. • Ensure that no obstructions to flows are present causing upstream flooding.	NS	CDC/SANRAL	CDC/SANRAL	CDC/SANRAL
	Primary (minor) drainage network	BMP/F/04	• All drainage network elements (Pipes, kerb inlets, civil inlets) to be frequently monitored and obstructions removed especially before rainy season and after significant rainfall.	NS	CDC/Tenants	Tenants	Tenants

Control Measure Category	Control Measure Type	Proposed BMPs					
		BMP Code	BMP Description	BMP Type (S, NS)	Responsible Organisation		
					Planning	Finance	Maintenance
Stormwater containment structures	On-site (primary) detention/retention pond.	BMP/F/05	• Ponds frequently monitored and obstructions (debris) to inlet/outlet works, spillways removed. • If any pollutants are present, these need to be removed immediately.	NS	CDC	Tenants	Tenants
	Major drainage system (secondary) detention/retention pond.	BMP/F/06	• Ponds frequently monitored and obstructions (debris) to inlet/outlet work spillways removed. • If any pollutants are present, these need to be removed immediately.		CDC	CDC	CDC

Table 7.9: Proposed BMPs for Erosion Control: Planning and Design Stage

Control Measure Category	Control Measure Type	Proposed BMPs			
		BMP Code	BMP Description	BMP Type (S, NS)	Planning
Urban Development and Road Signage.	Public open space (P.O.S.)	BMP/E/P1	• Erosion/siltation to be controlled along flat gradients (slopes less than 1:500) by base flow channels with a flow capacity of 1:2-1:5 year storm event • Natural and indigenous vegetation cover to be enhanced.	S, NS	CDC
	Develop layout	BMP/E/P2	• Reduce paving areas • Reduce directly connected impervious areas. • Direct runoff to a treatment point (e.g. local silt, effluent trap.	S	CDC/Tenant
	Local development runoff quantity (minor system)	BMP/E/P3	• All flows to be dispersed by energy dissipaters before leaving the tenants site and entering major drainage systems. • Energy dissipaters to handle up to at least a 1:10 year storm event. • Energy dissipaters designed to enable easy silt removal manually or mechanically.	S	CDC/Tenant
	Road drainage.	BMP/E/P4	• Road pavements and side drains to be protected by grassing and/or liners (Armorflex, renos etc.) to prevent side erosion. • Liners to be used where design flow velocity is in excess of 1.5m/s.	S	CDC/SANRAL
	Parking areas	BMP/E/P5	• All parking area drainage exit points to have energy dissipaters (1:10 year minimum capacity)	S	CDC
	Primary (on-site) energy dissipater	BMP/E/P6	• All energy dissipaters designed to allow for silt deposition in a lined area with easy access to remove silt manually or mechanically	S	CDC

Control Measure Category	Control Measure Type	Proposed BMPs			
		BMP Code	**BMP Description**	**BMP Type (S, NS)**	**Planning**
Urban Development and Road Signage continue	Road crossing culverts/bridges.	BMP/E/P7	• All inlet / outlet works protected against erosion. • Protection works to extend up to natural/major drainage system.	S	CDC/SANRAL
	Embankment protection.	BMP/E/P8	• Steep embankment (slope 1:1.5 and steeper) protection to be gabions, Reno mattresses or grouted stone pitching. • Medium embankment (slope 1:1.5 to 1:2) protection to be combination of vegetation covers and above liners. • Shallow embankment (slope 1:2 and less) protection to be vegetation covers.	S	CDC/SANRAL
Stormwater containment structures	On-site (primary) detention/retention ponds	BMP/E/P9	• All ponds to have an upstream silt deposition area which is lined and has easy access for removal of silt.	S	CDC/Tenants
	Major drainage system (secondary) Detention/retention ponds.	BMP/E/P10	• All ponds to have an upstream silt deposition area which is lined and has easy access for removal of silt.	S	CDC
Open canals	Compound canals	BMP/E/P11	• Where practical possible canals to have a low flow section and overflow section. • In steep gradient canals max velocity limit to about 3-4 m/s and canals lined (Armoflex, Reno Mattresses, graded stone pitching) • In shallow gradient canals min velocity to be not less than 1 m/s and canals lined with a flexible liner for removal of silt deposits. • Access ramps provided for removal of silt deposits.	S	CDC

Control Measure Category	Control Measure Type	Proposed BMPs			
		BMP Code	BMP Description	BMP Type (S, NS)	Planning
Debris & silt traps.	Minor (primary) on site traps.	BMP/E/P12	• Both traps to make provision to store at least one month estimated silt load at the trap. • Access to silt deposition area to be via ramps (slope 1:3 or flatter) • All overflow sections and spillways to be erosion protected for up to a 1:50 year flood event.	S	CDC/Tenants
	Major (secondary) grass pollutant traps.	BMP/E/P13	• Both traps to make provision to store at least one month's estimated silt load at the trap. • Access to silt deposition area to be via ramps (slope 1:3 or flatter) • All overflow sections and spillways to be erosion protected for up to a 1:100 year flood event.	S	CDC

Table 7.10: Proposed BMPs for Erosion Control: Construction Stage

Control Measure Category	Control Measure Type	Proposed BMPs		
		BMP Code	BMP Description	BMP Type (S, NS)
Urban development & road drainage.	Road construction & drainage.	BMP/E/E1	• Road layer works prevented from excessive erosion by temporary diversion trenches or embankments. • No concentrated flow points allowed onto road area.	S
	Pipe network & trenches	BMP/E/E2	• All trenching to be protected against erosion by temporary diversion trenches or embankments.	S
	Culvert/bridge crossing.	BMP/E/E3	• All concentrated flows channeled away from the works by temporary diversion trenches or embankments.	S
	Kerb & drop inlets	BMP/E/E4	• In areas with high silt loads new kerb and drop inlets to be protected by temporary gravel filters.	S
Stormwater containment structures	On-site (primary) detention/retention ponds.	BMP/E/E5	• All concentrated flows diverted away from site via diversion trenches or embankments. • In flat areas use of hay bales also to be considered.	S
	Major drainage system (secondary) detention/retention ponds.	BMP/E/E6	• All concentrated flows diverted away from site via diversion trenches or embankments. • In flat areas use of hay bales also to be considered.	S
Open canals.	Minor (primary) canals.	BMP/E/E7	• All concentrated flows diverted away from the canal via temporary diversion trenches or embankments. • Flow velocity in canal reduced via temporary check dams. • Steep sides to be protected by soil savers (BioMac or similar approved.	S

Control Measure Category	Control Measure Type	Proposed BMPs	Control Measure Category	Control Measure Type
Open canals continue.	Major (secondary) canals	BMP/E/E8	• All concentrated flows diverted away from the canal via temporary diversion trenches or embankments. • Flow velocity in canal reduced via temporary check dams. • Steep sides to be protected by soil savers (BioMac or similar approved)	S
	Major (secondary) canals	BMP/E/E8	• All concentrated flows diverted away from the canal via temporary diversion trenches or embankments. • Flow velocity in canal reduced via temporary check dams • Steep sides to be protected by soil savers (Biomac or similar approved).	S
Embankments	Road/rail embankment	BMP/E/E9	• All concentrated flows diverted away from the embankment via temporary diversion trenches or embankments. • Steep sides to be protected by soil savers (Biomac or similar approved)	S
Debris and silt traps.	Minor on-site (primary) trap	BMP/E/E10	• All concentrated flows diverted away from the embankment via temporary diversion trenches or embankments. • In high debris or silt areas the use of temporary sediment traps to be considered until the works are completed.	S
	Major (secondary) grass pollutant trap.	BMP/E/E11	• All concentrated flows diverted away from the embankment via temporary diversion trenches or embankments. • In high debris or silt areas the use of temporary sediment traps to be considered until the works are completed.	S

Table 7.11: Proposed BMPs for Erosion Control: Operational Stage

Control Measure Category	Control Measure Type	Proposed BMPs				
		BMP Code	BMP Description	BMP Type (S, NS)	Responsible Organisation	
					Planning	Maintenance
Urban Development & road drainage.	Public open space & natural drainage corridors.	BMP/E/E01	• Drainage areas to be regularly monitored to identify and erosion gullies or silt deposition. • Any erosion gullies to be repaired and excessive silt to be removed (excess of 0.5 m depth)	NS, S	CDC	CDC
	Major (secondary) Drainage network	BMP/E/E02	• All drainage network elements to be frequently monitored. • Silt deposits not to obstruct more than 15-20% of flow area.	NS/S	CDC	CDC
	Major (secondary) energy dissipaters, culverts, bridge crossings	BMP/E/E03	• All drainage network elements to be frequently monitored. • Silt deposits not to obstruct more than 15-20% of flow area.	NS/S	CDC	CDC/SANRAL
	Minor (primary) drainage network	BMP/E/E04	• All drainage network elements (pipes, kerb inlets, grid inlets) to be frequently monitored. • Silt deposits not to obstruct more than 15-20% of flow area.	NS, S	CDC/Tenants	Tenants

Control Measure Category	Control Measure Type	Proposed BMPs				
		BMP Code	BMP Description	BMP Type (S, NS)	Responsible Organisation	
					Planning	Maintenance
Stormwater containment structures	On-site (primary) detention / retention ponds.	BMP/E/E05	• Ponds frequently monitored (mostly during rainy season) • Any erosion gullies to be repaired. • Silt deposits to be removed after heavy rainfall and if silting is in excess of 80% of storage volume.	NS, S	CDC/Tenants	Tenants
	Major drainage system (secondary) detention / retention ponds.	BMP/E/E06	• Ponds frequently monitored (mostly during rainy season) • Any erosion gullies to be repaired. • Silt deposits to be removed after heavy rainfall and if silting is in excess of 80% of storage capacity.	NS, S	CDC	CDC
Open canals	Minor (primary) canals.	BMP/E/E07	• Canals to be regularly monitored to identify any erosion gullies or silt deposition. • Any erosion gullies to be repaired and excessive silt to be removed (excess of 0.5m depth).	NS, S	CDC/ Tenants	Tenants
	Major (secondary) canals	BMP/E/E08	• Canals to be regularly monitored to identify any erosion gullies or silt deposition. • Any erosion gullies to be repaired and excessive silt to be removed (excess of 0.5m depth). •	NS, S	CDC	CDC

Control Measure Category	Control Measure Type	Proposed BMPs				
		BMP Code	BMP Description	BMP Type (S, NS)	Responsible Organisation	
					Planning	Maintenance
Embankments	Road/rail embankment.	BMP/E/E09	• Embankment monitored regularly to identify excessive erosion gullies. • Erosion gullies repaired and temporary protection measures put in place if erosion gully is 0.3m or more.	NS, S	CDC	CDC
Debris and silt traps	Minor on-site (primary) trap	BMP/E/E010	• Structure monitored regularly. • Silt and debris removed after heavy rainfall and if debris / silt is in excess of 80% of storage volume.	NS, S	CDC	Tenant
	Major (secondary) trap	BMP/E/E011	• Structure monitored regularly. • Silt and debris removed after heavy rainfall and if debris/silt is in excess of 80% of storage volume.	NS, S	CDC	CDC

8 COEGA ENVIRONMENTAL IMPACT ASSESSMENT

8.1 Standard Environment Specification

As part of this study, ARCUS GIBB reviewed Standard Environmental Specification for Construction (SES) of March 2005 and adopted the document. Within this report, some of the important information mentioned includes the following:

8.1.1 Stockpiling

If the stockpile material is in danger of being washed or blow away the Contractor shall spray it with Dustex or cover it with a suitable material such as Hessian or plastic.

8.1.2 Solid Waste Management

No on-site burning, burying or dumping of any waste materials, litter or refuse shall occur. The Contractor shall provide vermin and weatherproof bins with lids. Bins shall not be allowed to become overfull and shall be emptied at least one a day.

8.1.3 Hazardous Substance

If potentially hazardous substances are to be stored or used on Site, the Contractor shall submit a Method Statement to the Engineer detailing the substances / materials to be used, together with the transport, storage, handling and disposal procedures for the substances.

8.1.4 Contaminated Water

Potential pollutants of any kind and in any form shall be kept, stored, and used in such a manner that any escape can be contained and that the water table is not endangered. Water containing such pollutants as chemicals, washing detergents, sewerage, fuels, paints and solvents and hydrocarbons shall be contained and discharged into an impermeable storage facility for removal from the site or for recycling. This particularly applies to runoff from fuel depots/ workshops/ truck washing areas. The Contractor may direct contaminated water into a sewerage main, provided that authorisation has been obtained from the local authority and that the Engineer has provided written permission for this action.

Wash down areas shall be placed and constructed in such a manner so as to ensure that the surrounding areas are not polluted.

8.1.5 Cement and Concrete Batching

Batching areas shall not be located within 150m of the Coega River. All wastewater shall be passed through a concrete wastewater settlement system. The water from this system shall not be allowed to flow into any water course but must permeate through the ground before it reaches any such water course.

8.1.6 Fuel and Oil

Fuel storage area must be at least 100m away from any major drainage system. Tanks on site shall not be linked or joined via any pipe work, but shall remain as separate entities. The tanks shall be situated on a smooth impermeable base with a bund. Tanks and bunded areas shall be covered to prevent the bunded area from filling up with rain water.

8.1.7 Ablution Facilities

Washing, whether of the person or of personal effects, and acts of excretion and urination are strictly prohibited other that at the facilities provided. The Contractor shall provide the necessary ablution facilities.

Discharge into the environment and burial of waste is strictly prohibited. The Contractor shall ensure that no spillage occurs when the toilets are cleaned or emptied and that the contents are removed from the Site.

8.1.8 Workshop and Equipment Maintenance

No maintenance may take place within 50m of drainage system.

8.1.9 Dust Control

The Contractor shall be responsible for the continued control of dust arising from his operations. The Contractor shall inform the Engineer 48 hours in advance of anticipated unavoidable dust generating activities.

8.1.10 Contractor's SHE Officer and Assistance

The Contractor shall appoint a Contractor's SHE Officer who shall be responsible for undertaking a daily site inspection to monitor compliance with this SES and any relevant Project Specification. The Contractor will also appoint reliable staff, which will assist and report to the Contractor's SHE Officer.

8.1.11 Stormwater Management

Natural run-off must be diverted to stormwater drains where these are available. The Contractor shall take appropriate measures to prevent sand, silt and silt-laden waters from entering stormwater drains, or any surface water course. The Contractor shall take reasonable measures to control the erosive effects of stormwater runoff particularly where excavation and construction activities form temporary channels. Suitable energy breaking devices, cut-off drains, diversions and retention ponds shall be employed to ensure that storm water runoff from the Site is dissipated and does not exceed the capacity of the surrounding stormwater system and excessive suspended solids are settled before they enter the stormwater system or any surface water course.

8.1.12 Erosion and Sedimentation Control

The Contractor shall take all reasonable measures to limit erosion and sedimentation due to construction activities.

8.2 Environmental Impact Assessment for Stormwater Drainage

Mazizi Msutu and Associates (2007) did the environmental assessment on the drainage discharge from zone 1 and 2 and this was submitted to CDC on as a report titled “Basic Environmental Assessment for Stormwater Discharge from Zone 1 & 2 of the Coega IDZ, Eastern Cape Province”. From this report the following impacts (tabulated below) as a result of construction and operations phases were recorded, with recommended mitigation measures. However, during the preparation of this document, reports similar to the one prepared for zone 1 & 2 were not available for the other zones; hence the environmental impact assessment for zone 3, 4 and 5 is not discussed in this document.

9 SPILL CONTINGENCY MANAGEMENT PLAN (SCMP)

This chapter summarises the suggested Coega Development Cooperation Spill Contingency Management Plan.

9.1 Purpose

The purpose of a SCMP is to document the specific requirements, protocols, responsibilities and materials necessary for Coega IDZ tenants to conduct an emergency spill response during the critical first few hours of an incident on any property within Coega IDZ limits.

9.2 Agency Roles

Police and Fire personnel typically are the first responders of the spill incident, thus have the primary responsibility to form an incident command system (i.e., organisational structure for interagency cooperation and coordination) and to assign incident commander (i.e., individual in overall command of initial response activities) to coordinate response efforts. On Site Emergency Services personnel within Coega IDZ will provide concurrent assistance by helping contain off-site runoff of spill contaminants from entering the stormwater drainage system to help prevent environmental damage. Emergency notification to all required agencies is to be given at the earliest opportunity.

Following the initial response to a spill incident, the responsible party (or on Site Emergency Services if the responsible party is unavailable or unresponsive) assumes control of the incident. Actions following the initial response (typically within hours of the incident) will be conducted under the oversight of on Site Emergency Services and other agencies, as appropriate.

9.3 CDC's Emergency Centre

CDC's emergency centre will be responsible for first response for fire, trauma and spill management within Coega IDZ. It will be equipped with all the spill containment, cleanup and diversion material that can be used during any emergency. With its on Site Emergency Services, it will take control of any incident on behalf of Coega Development Cooperation (CDC). CDC's emergency centre will have satellite spill management centres in strategic locations within the IDZ as the need are identified and will all be linked to the main station.

The emergency call centre contact person and numbers are as follows:

Contact Person: Jackie Fort (Operations Manager)
Telephone: +27 (0) 41 403 0439
Fax: +27 (0) 41 403 0527
Cell: +27 (0) 82 464 7785

9.4 Emergency Notification

The following organisations will be notified immediately upon discovery of a release of any hazardous substance to the environment where the quantities are greater than on Site Emergency Services can handle:

- Police if there is an immediate threat to life or property
- Nelson Mandela Bay Municipality Disaster Management Unit (in South End)
- Identify and notify the party responsible for the spill of their legal obligation to take immediate responsibility and action
- General maintenance and operations section to report a spill entering storm drainage systems or creeks.

Notification of spill should be made by anyone who first discovers a spill. However, the party responsible for a spill is required to notify on Site Emergency Services.

9.5 Observations to make upon encountering a spill

In making any observations of the spill incident assess the situation from a safe distance and check for the following:

- Effect on people, animals and the environment
- Distance and direction of the spill to stormwater drains and streams
- Distance and direction of nearby property
- Signs of a released or discharged substance, including unusual or pungent odours

Actions that can be taken by the first responder prior to arrival of police and maintenance and operation personnel is to determine whether the spill has entered or may enter stormwater drainage system and or creeks. Begin spill containment efforts as soon as possible.

9.6 Actions in Response to Notification

- **Tenants/Operator within Coega IDZ**

  - Implement the facility-specific emergency response plan
  - Notify CDC

- Contact the maintenance and operation section or spill removal contractors
- Initiate or join the Incident Command System.

- **Coega Development Cooperation**

  - Implement all the contingency management procedures
  - Notify DWAF and DEAT (only if on Site Emergency Services cannot manage the spill)
  - Initiate or join the Incident Command System
  - Use stormwater drainage maps to identify the stormwater drainage systems that may be impacted by the spill.

9.7 Actions during a Spill Response

All responders to spills are to use the SCMP as a resource to locate the information, individuals, and resources that may be needed as part of the response action.

- **Communications** – The incident commander is in overall command of the response efforts, and is to issue communications according to the set incident management system. The incident commander must establish a communication plan shortly after arrival.
- **Spill response assistance and resources** – Contact and consult emergency response personnel to assist in the response effort.
- **Spill response equipment and containment methods** – Spill response equipment should be available at on Site Emergency Services centre.
- **Stormwater drainage maps** – Consult drainage maps to identify locations where spill runoff can be contained in manholes, ditches or culverts.
- **Potential spill sources** – Determine if the property has hazardous materials on site, or has a history of contaminant spills.
- **Health and Safety** – Ensure that spill responders are adequately trained in emergency response, wear protective equipment, restrict their movements to established work zones and follow decontamination procedures.
- **Cleanup and Removal** – Cleanup and removal of contaminants may be initiated immediately, depending on the nature and severity of the spill.
- **Leaving the scene** – Before leaving the scene, ensure that response actions are completely transferred to anther agency or contractor.
- **Incident Reporting** – Submit all required reporting forms and reports to CDC.

9.8 Actions Following Initial Spill Response

Following the initial actions of the spill response, responsible tenant will assume the role of Incident Commander, and will initiate cleanup and remedial actions.

At this point, it is assumed that the threat to public safety has been mitigated and that the spill has been at least temporarily contained.

- **Tenants/Operator within Coega IDZ**

  - Ensure that cleanup actions are being addressed
  - Initiate enforcement actions if a code violation caused the spill
  - Initiate the cost reimbursement process to recoup CDC labour and material costs
  - Contact a critique of how your organisation responded, and determine if improvements to the facility's preparedness are necessary and
  - Revise the facility's emergency response plan, if needed, to improve spill prevention and preparedness.

- **Coega Development Cooperation**

  - Contact a critique of how CDC has responded, and determine if improvements to CDC's preparedness are necessary
  - Use lessons learned from the spill event and the information in the SCMP to identify ways to improve CDC's preparedness and
  - Revise CDC's spill prevention and preparedness plans, as needed.

10 SUMMARY AND CONCLUSIONS

10.1 Summary

Integrated Stormwater management refers to a holistic approach that brings together all the aspects that have influence on stormwater in an area, in this case the area being western Coega IDZ. Integrated Stormwater Masterplan is then meant to address the questions of how the ecological values of streams and receiving waters can be protected or enhanced, and how drainage-related problems could be prevented, while the land is being developed at the same time.

During the process of updating ISWMP for western Coega IDZ, the components of interest were rainfall for Coega IDZ, Coega River floodline, minor and major drainage systems, water quality, current stormwater design criteria and guidelines and stormwater environmental impact assessment.

Rainfall intensities graphs for Western IDZ were developed using the current Port Elizabeth graphs and rainfall data generated by Schultz and Smithers (2003). These new intensity graphs for Coega are on average five percent lesser than Port Elizabeth graphs and according to Schultz and Smithers (2003) Mean Annual Precipitation for Coega is 427 mm which is smaller than 611 mm for Port Elizabeth airport.

For Coega River floodline, Geographical Information System (GIS) programme (Manifold) was used to map the catchment area. The total area was found to be 498 km². This value was earlier obtained by ARUP (2003) while SSI (2005) obtained 497 km². Peak flows for 50 and 100 year floods were estimated using Standard Design Flood (SDF) method as recommended by SANRAL and were checked using Unit hydrograph method. The peak flood values obtained were also similar to the ones obtained previously by ARUP (2003) and SSI (2005). HEC-RAS model was used to model Coega River.

Minor and major drainage systems from the previous Masterplan were based on the return period of 2 year and 100 year design floods. This concept was again reviewed and the recommended design period based on the SANRAL (2006) drainage manual (2006) were suggested.

Stormwater design criteria and guidelines were developed and are based on the CSIR manual (Red book) and SANRAL drainage manual (2006). For modelling, the set criteria from ARUP (2003) were adopted. Previous ISWMP requirements for tenants and operator of IDZ were also reviewed and adopted.

For water quality a chart was developed which is based on the stormwater polluting potential of each land use. The map is developed to indicate how each land development impacts on the quality of water. Best Management Practices developed by SRK (2006) for flood and erosion control were also reviewed and added under water quality section.

Under environmental section, Standard Environmental Specification for Construction (SES) of 2005 was reviewed and adopted.

Spill Contingency Management Plan within the IDZ makes the last section in this Masterplan and summarise the protocols and responsibility of tenants and on Site Emergency Service during the contingency incident.

The use of most recent studies and technology in developing this Masterplan will make this document a valuable document for supporting the application for DWAF licensing and furthermore for overall stormwater management of the IDZ.

10.2 Conclusion

The literature review has been conducted; ARUP (2003) Masterplan has been updated and the key issues addressed include the following;

- Rainfall Analysis (intensity data). The results show that rainfall intensities in Coega IDZ are slightly less than rainfall intensities in Port Elizabeth airport and the MAP for Coega is 427 mm whereas for Port Elizabeth is 611 mm. This could be used to confirm the claim made by local residents that rainfall in the Coega vicinity is less than that experienced further to the southwest in the city. In conclusion, results from this study should be adopted,

- Floodline Analysis. The results don't differ from the one estimated by SSI (2005) with the 100 year flood estimates being 99.7% close to each other. The important observation is the time of concentration; average length of Coega River catchment is quite long, such that by the time the peak flow as a result of the total catchment reaches the outlet, the peak from the IDZ will have already reached the sea. This time lag is advantageous because the IDZ will not experience a very high peak flow which would result if the peak flow of the upstream and IDZ were to coincide. In conclusion, the floodline produced by SSI (2005) could be adopted for Coega IDZ,

- Stormwater Drainage and Storage. For future developments minimum design periods for minor and major drainages should be 2 year and 50 year peak floods respectively and the Best Management Practices proposed Section 7 should be adhered to.

- Water Design Criteria. All the stormwater design should be in accordance with Section 6.6, where further clarity is required, reference should be the SANRAL's drainage manual (2006) and Human Settlement Planning and Design by CSIR (2000).

- Water quality in other zones excluding zone 5, can improve as the stormwater passes through the attenuation ponds, because the velocity of flow will be decrease hence causing the carried solid material to settle in the attenuation ponds. Where sufficient water quality data has been collected, the 90 percentile water quality criteria should be adopted as a stormwater discharge criteria. In the future, surface water monitoring location is suggested along the proposed St. Georges Strand stormwater outlet.

- Environment. Similar studies to the one done by Mazizi Msutu & Associate (2007) should be conducted for the other zones. The recommended environmental impact mitigation for zone 1 and 2 outlet should be adhered to.

This document has addressed all the issues as stated in the ToR.

11 LIST OF REFERENCES

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APPENDIX A
ISWMP TASK PROGRAMME

APPENDIX B
LIST OF REVIEWED DOCUMENTS

APPENDIX C
RAINFALL ANALYSIS ANNEXURES

APPENDIX D
FLOODLINE ANALYSIS ANNEXURES

APPENDIX E
DRAWINGS

APPENDIX F
DOCUMENT CONTROL SHEET

DOCUMENT CONTROL SHEET (FORM IP180/B)

ARCUS GIBB
CONSULTING • DESIGN • MANAGEMENT

CLIENT : COEGA DEVELOPMENT COOPERATION

PROJECT : INTEGRATED STORMWATER MASTERPLAN

PROJECT No : J27139

TITLE : INTEGRATED STORMWATER MASTERPLAN FINAL REPORT

	Prepared by	Reviewed by	Approved by
ORIGINAL	NAME **R LEKONYANA**	NAME **N MKWANANZI**	NAME **N KLAGES**
DATE **14 NOVEMBER 2007**	SIGNATURE	SIGNATURE	SIGNATURE

REVISION 1	NAME	NAME	NAME
03 MARCH 2008	SIGNATURE 	SIGNATURE 	SIGNATURE

REVISION 2	NAME	NAME	NAME
	SIGNATURE	SIGNATURE	SIGNATURE

REVISION	NAME	NAME	NAME
DATE	SIGNATURE	SIGNATURE	SIGNATURE

ARCUS GIBB (Pty) Ltd

Website : www.arcusgibb.co.za

REVIEW STATEMENT (FORM IP180/A)

ARCUS GIBB
CONSULTING • DESIGN • MANAGEMENT

1. Preparer to enter the details of the project and document to which this form applies, and to sign and date the form. (*PL to enter source details where document was prepared externally.)

Preparer /(Source*): R.LEKONYANA_____ Date:03 March 2008_____

DOCUMENT TITLE	**INTEGRATED STORMWATER MASTERPLAN FINAL REPORT**	**DOCUMENT No & VERSION**	**Rev 1**
PROJECT	**UPDATING OF INTEGRATED STORMWATER MASTERPLAN**	**PROJECT No**	**J27139**

2. Use the following checklist as guidance to assist in a systematic appraisal of the document.

No	TECHNICAL ASPECTS REVIEWED	EDITORIAL ASPECTS REVIEWED
1.	Description of task brief?	Project Title, Job No and Workcode?
2.	Appropriateness of preparer's skill/level?	Table of Contents, Pagination?
3.	Adequacy and appropriateness of References? (Regulations, Codes, Standards etc)	Appendices, cross references?
4.	Accuracy of results?	Document number and version identifier?
5.	Adequacy of assumptions?	Style, Spelling, English?
6.	Adequacy of argument or analysis?	Image, Font, Appearance?
7.	Appropriateness of recommendations?	Tables, Figures and Diagrams?
8.	Compliance with task brief?	
9.	Health, Safety and Environmental impact?	
10.	Other aspects?	

3. Reviewers must decide whether the document is fit for delivery in its current form or whether corrections/deletions/additions or other alterations are required. Mark required changes in the text of the document. Return the document to the preparer, or proceed to step 4.

4. Reviewers please sign and date the following statement when satisfied with the quality of the document.

   I/We have reviewed this document against the requirements of the task specification. My/Our review comments and reservations have been resolved to my/our satisfaction. This document is presentable and technically fit for delivery to the client.

Task Reviewer **N Mkwananzi** Date:_____

APPENDIX D:
PROJECT TEAM CV'S

savannah environmental

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Woodlands Drive, Woodmead
Johannesburg, South Africa

Email: joanne@savannahsa.com
Tel: +27 (11) 656 3237

CURRICULUM VITAE OF JO-ANNE THOMAS

Profession:	Environmental Management and Compliance Consultant; Environmental Assessment Practitioner
Specialisation:	Environmental Management; Strategic environmental advice; Environmental compliance advice & monitoring; Environmental Impact Assessments; Policy, strategy & guideline formulation; Project Management; General Ecology
Work experience:	Twenty one (21) years in the environmental field

VOCATIONAL EXPERIENCE

Provide technical input for projects in the environmental management field, specialising in Strategic Environmental Advice, Environmental Impact Assessment studies, environmental auditing and monitoring, environmental permitting, public participation, Environmental Management Plans and Programmes, environmental policy, strategy and guideline formulation, and integrated environmental management. Key focus on integration of the specialist environmental studies and findings into larger engineering-based projects, strategic assessment, and providing practical and achievable environmental management solutions and mitigation measures. Responsibilities for environmental studies include project management (including client and authority liaison and management of specialist teams); review and manipulation of data; identification and assessment of potential negative environmental impacts and benefits; review of specialist studies; and the identification of mitigation measures. Compilation of the reports for environmental studies is in accordance with all relevant environmental legislation.

Undertaking of numerous environmental management studies has resulted in a good working knowledge of environmental legislation and policy requirements. Recent projects have been undertaken for both the public- and private-sector, including compliance advice and monitoring, electricity generation and transmission projects, various types of linear developments (such as National Road, local roads and power lines), waste management projects (landfills), mining rights and permits, policy, strategy and guideline development, as well as general environmental planning, development and management.

SKILLS BASE AND CORE COMPETENCIES

- Project management for a range of projects
- Identification and assessment of potential negative environmental impacts and benefits through the review and manipulation of data and specialist studies
- Identification of practical and achievable mitigation and management measures and the development of appropriate management plans
- Compilation of environmental reports in accordance with relevant environmental legislative requirements
- External and peer review of environmental reports & compliance advice and monitoring
- Formulation of environmental policies, strategies and guidelines
- Strategic and regional assessments; pre-feasibility & site selection
- Public participation processes for a variety of projects
- Strategic environmental advice to a wide variety of clients both in the public and private sectors
- Working knowledge of environmental planning processes, policies, regulatory frameworks and legislation

EDUCATION AND PROFESSIONAL STATUS

Degrees:

- B.Sc Earth Sciences, University of the Witwatersrand, Johannesburg (1993)
- B.Sc Honours in Botany, University of the Witwatersrand, Johannesburg (1994)
- M.Sc in Botany, University of the Witwatersrand, Johannesburg (1996)

Short Courses:

- Environmental Impact Assessment, Potchefstroom University (1998)
- Environmental Law, Morgan University (2001)
- Environmental Legislation, IMBEWU (2017)
- Mining Legislation, Cameron Cross & Associates (2013)
- Environmental and Social Risk Management (ESRM), International Finance Corporation (2018)

Professional Society Affiliations:

- Registered with the South African Council for Natural Scientific Professions as a Professional Natural Scientist: Environmental Scientist (400024/00)
- Registered with the International Associated for Impact Assessment South Africa (IAIAsa): 5601
- Member of the South African Wind Energy Association (SAWEA)

EMPLOYMENT

Date	Company	Roles and Responsibilities
January 2006 - Current	Savannah Environmental (Pty) Ltd	Director Project manager Independent specialist environmental consultant, Environmental Assessment Practitioner (EAP) and advisor.
1997 – 2005	Bohlweki Environmental (Pty) Ltd	Senior Environmental Scientist at. Environmental Management and Project Management
January – July 1997	Sutherland High School, Pretoria	Junior Science Teacher

PROJECT EXPERIENCE

Project experience includes large infrastructure projects, including electricity generation and transmission, wastewater treatment facilities, mining and prospecting activities, property development, and national roads, as well as strategy and guidelines development.

RENEWABLE POWER GENERATION PROJECTS: PHOTOVOLTAIC SOLAR ENERGY FACILITIES

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Christiana PV 2 SEF, North West	Solar Reserve South Africa	Project Manager & EAP
De Aar PV facility, Northern Cape	iNca Energy	Project Manager & EAP
Everest SEF near Hennenman, Free State	FRV Energy South Africa	Project Manager & EAP
Graafwater PV SEF, Western Cape	iNca Energy	Project Manager & EAP
Grootkop SEF near Allanridge, Free State	FRV Energy South Africa	Project Manager & EAP
Hertzogville PV 2 SEF with 2 phases, Free State	SunCorp / Solar Reserve	Project Manager & EAP
Karoshoek CPV facility on site 2 as part of the larger Karoshoek Solar Valley Development East of Upington, Northern Cape	FG Emvelo	Project Manager & EAP

Project Name & Location	Client Name	Role
Kgabalatsane SEF North-East for Brits, North West	Built Environment African Energy Services	Project Manager & EAP
Kleinbegin PV SEF West of Groblershoop, Northern Cape	MedEnergy Global	Project Manager & EAP
Lethabo Power Station PV Installation, Free State	Eskom Holdings SoC Limited	Project Manager & EAP
Majuba Power Station PV Installation, Mpumalanga	Eskom Holdings SoC Limited	Project Manager & EAP
Merapi PV SEF Phase 1 – 4 South-East of Excelsior, Free State	SolaireDirect Southern Africa	Project Manager & EAP
Sannaspos Solar Park, Free State	SolaireDirect Southern Africa	Project Manager & EAP
Ofir-Zx PV Plant near Keimoes, Northern Cape	S28 Degrees Energy	Project Manager & EAP
Oryx SEF near Virginia, Free State	FRV Energy South Africa	Project Manager & EAP
Project Blue SEF North of Kleinsee, Northern Cape	WWK Development	Project Manager & EAP
S-Kol PV Plant near Keimoes, Northern Cape	S28 Degrees Energy	Project Manager & EAP
Sonnenberg PV Plant near Keimoes, Northern Cape	S28 Degrees Energy	Project Manager & EAP
Tutuka Power Station PV Installation, Mpumalanga	Eskom Transmission	Project Manager & EAP
Two PV sites within the Northern Cape	MedEnergy Global	Project Manager & EAP
Two PV sites within the Western & Northern Cape	iNca Energy	Project Manager & EAP
Upington PV SEF, Northern Cape	MedEnergy Global	Project Manager & EAP
Vredendal PV facility, Western Cape	iNca Energy	Project Manager & EAP
Waterberg PV plant, Limpopo	Thupela Energy	Project Manager & EAP
Watershed Phase I & II SEF near Litchtenburg, North West	FRV Energy South Africa	Project Manager & EAP
Alldays PV & CPV SEF Phase 1, Limpopo	BioTherm Energy	Project Manager & EAP
Hyperion PV Solar Development 1, 2, 3, 4, 5 & 6	Building Energy	Project Manager & EAP

Basic Assessments

Project Name & Location	Client Name	Role
Aberdeen PV SEF, Eastern Cape	BioTherm Energy	Project Manager & EAP
Christiana PV 1 SEF on Hartebeestpan Farm, North-West	Solar Reserve South Africa	Project Manager & EAP
Heuningspruit PV1 & PV 2 facilities near Koppies, Free State	Sun Mechanics	Project Manager & EAP
Kakamas PV Facility, Northern Cape	iNca Energy	Project Manager & EAP
Kakamas II PV Facility, Northern Cape	iNca Energy	Project Manager & EAP
Machadodorp 1 PV SEF, Mpumalanga	Solar To Benefit Africa	Project Manager & EAP
PV site within the Northern Cape	iNca Energy	Project Manager & EAP
PV sites within 4 ACSA airports within South Africa, National	Airports Company South Africa (ACSA)	Project Manager & EAP
RustMo1 PV Plant near Buffelspoort, North West	Momentous Energy	Project Manager & EAP
RustMo2 PV Plant near Buffelspoort, North West	Momentous Energy	Project Manager & EAP
RustMo3 PV Plant near Buffelspoort, North West	Momentous Energy	Project Manager & EAP
RustMo4 PV Plant near Buffelspoort, North West	Momentous Energy	Project Manager & EAP
Sannaspos PV SEF Phase 2 near Bloemfontein, Free State	SolaireDirect Southern Africa	Project Manager & EAP
Solar Park Expansion within the Rooiwal Power Station, Gauteng	AFRKO Energy	Project Manager & EAP
Steynsrus SEF, Free State	SunCorp	Project Manager & EAP

Project Name & Location	Client Name	Role
Sirius Solar PV Project Three and Sirius Solar PV Project Four (BA in terms of REDZ regulations), Northern Cape	SOLA Future Energy	Project Manager & EAP

Screening Studies

Project Name & Location	Client Name	Role
Allemans Fontein SEF near Noupoort, Northern Cape	Fusion Energy	Project Manager & EAP
Amandel SEF near Thabazimbi, Limpopo	iNca Energy	Project Manager & EAP
Arola/Doornplaat SEF near Ventersdorp, North West	FRV & iNca Energy	Project Manager & EAP
Bloemfontein Airport PV Installation, Free State	The Power Company	Project Manager & EAP
Brakspruit SEF near Klerksorp, North West	FRV & iNca Energy	Project Manager & EAP
Carolus Poort SEF near Noupoort, Northern Cape	Fusion Energy	Project Manager & EAP
Damfontein SEF near Noupoort, Northern Cape	Fusion Energy	Project Manager & EAP
Everest SEF near Welkom, Free State	FRV & iNca Energy	Project Manager & EAP
Gillmer SEF near Noupoort, Northern Cape	Fusion Energy	Project Manager & EAP
Grootkop SEF near Allansridge, Free State	FRV & iNca Energy	Project Manager & EAP
Heuningspruit PV1 & PV 2 near Koppies, Free State	Cronimat	Project Manager & EAP
Kimberley Airport PV Installation, Northern Cape	The Power Company	Project Manager & EAP
Kolonnade Mall Rooftop PV Installation in Tshwane, Gauteng	Momentous Energy	Project Manager & EAP
Loskop SEF near Groblersdal, Limpopo	S&P Power Unit	Project Manager & EAP
Marble SEF near Marble Hall, Limpopo	S&P Power Unit	Project Manager & EAP
Morgenson PV1 SEF South-West of Windsorton, Northern Cape	Solar Reserve South Africa	Project Manager & EAP
OR Tambo Airport PV Installation, Gauteng	The Power Company	Project Manager & EAP
Oryx SEF near Virginia, Free State	FRV & iNca Energy	Project Manager & EAP
Rhino SEF near Vaalwater, Limpopo	S&P Power Unit	Project Manager & EAP
Rustmo2 PV Plant near Buffelspoort, North West	Momentous Energy	Project Manager & EAP
Spitskop SEF near Northam, Limpopo	FRV & iNca Energy	Project Manager & EAP
Steynsrus PV, Free State	Suncorp	Project Manager & EAP
Tabor SEF near Polokwane, Limpopo	FRV & iNca Energy	Project Manager & EAP
UpingtonAirport PV Installation, Northern Cape	The Power Company	Project Manager & EAP
Valeria SEF near Hartebeestpoort Dam, North West	Solar to Benefit Africa	Project Manager & EAP
Watershed SEF near Lichtenburg, North West	FRV & iNca Energy	Project Manager & EAP
Witkop SEF near Polokwane, Limpopo	FRV & iNca Energy	Project Manager & EAP
Woodmead Retail Park Rooftop PV Installation, Gauteng	Momentous Energy	Project Manager & EAP

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
ECO and bi-monthly auditing for the construction of the Adams Solar PV Project Two South of Hotazel, Northern Cape	Enel Green Power	Project Manager
ECO for the construction of the Kathu PV Facility, Northern Cape	REISA	Project Manager
ECO and bi-monthly auditing for the construction of the Pulida PV Facility, Free State	Enel Green Power	Project Manager
ECO for the construction of the RustMo1 SEF, North West	Momentous Energy	Project Manager
ECO for the construction of the Sishen SEF, Northern	Windfall 59 Properties	Project Manager

Project Name & Location	Client Name	Role
Cape		
ECO for the construction of the Upington Airport PV Facility, Northern Cape	Sublanary Trading	Project Manager
Quarterly compliance monitoring of compliance with all environmental licenses for the operation activities at the Kathu PV facility, Northern Cape	REISA	Project Manager
ECO for the construction of the Konkoonsies II PV SEF and associated infrastructure, Northern Cape	BioTherm Energy	Project Manager
ECO for the construction of the Aggeneys PV SEF and associated infrastructure, Northern Cape	BioTherm Energy	Project Manager

Compliance Advice and ESAP Reporting

Project Name & Location	Client Name	Role
Aggeneys Solar Farm, Northern Cape	BioTherm Energy	Environmental Advisor
Airies II PV Facility SW of Kenhardt, Northern Cape	BioTherm Energy	Environmental Advisor
Kalahari SEF Phase II in Kathu, Northern Cape	Engie	Environmental Advisor
Kathu PV Facility, Northern Cape	Building Energy	Environmental Advisor
Kenhardt PV Facility, Northern Cape	BioTherm Energy	Environmental Advisor
Kleinbegin PV SEF West of Groblershoop, Northern Cape	MedEnergy	Environmental Advisor
Konkoonises II SEF near Pofadder, Northern Cape	BioTherm Energy	Environmental Advisor
Konkoonsies Solar Farm, Northern Cape	BioTherm Energy	Environmental Advisor
Lephalale SEF, Limpopo	Exxaro	Environmental Advisor
Pixley ka Seme PV Park, South-East of De Aar, Northern Cape	African Clean Energy Developments (ACED)	Environmental Advisor
RustMo1 PV Plant near Buffelspoort, North West	Momentous Energy	Environmental Advisor
Scuitdrift 1 SEF & Scuitdrift 2 SEF, Limpopo	Building Energy	Environmental Advisor
Sirius PV Plants, Northern Cape	Aurora Power Solutions	Environmental Advisor
Upington Airport PV Power Project, Northern Cape	Sublunary Trading	Environmental Advisor
Upington SEF, Northern Cape	Abengoa Solar	Environmental Advisor
Ofir-ZX PV SEF near Keimoes, Northern Cape	Networx S28 Energy	Environmental Advisor
Steynsrus PV1 & PV2 SEF's, Northern Cape	Cronimet Power Solutions	Environmental Advisor
Heuningspruit PV SEF, Northern Cape	Cronimet Power Solutions	Environmental Advisor

Due Diligence Reporting

Project Name & Location	Client Name	Role
5 PV SEF projects in Lephalale, Limpopo	iNca Energy	Environmental Advisor
Prieska PV Plant, Northern Cape	SunEdison Energy India	Environmental Advisor
Sirius Phase One PV Facility near Upington, Northern Cape	Aurora Power Solutions	Environmental Advisor

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
Biodiversity Permit & WULA for the Aggeneys SEF near Aggeneys, Northern Cape	BioTherm Energy	Project Manager & EAP
Biodiversity Permit for the Konkoonises II SEF near Pofadder, Northern Cape	BioTherm Energy	Project Manager & EAP
Biodiversity Permitting for the Lephalale SEF, Limpopo	Exxaro Resources	Project Manager & EAP

Project Name & Location	Client Name	Role
Environmental Permitting for the Kleinbegin PV SEF West of Groblershoop, Northern Cape	MedEnergy	Project Manager & EAP
Environmental Permitting for the Upington SEF, Northern Cape	Abengoa Solar	Project Manager & EAP
Environmental Permitting for the Kathu PV Facility, Northern Cape	Building Energy	Project Manager & EAP
Environmental Permitting for the Konkoonsies Solar Farm, Northern Cape	BioTherm Energy	Project Manager & EAP
Environmental Permitting for the Lephalale SEF, Limpopo	Exxaro Resources	Project Manager & EAP
Environmental Permitting for the Scuitdrift 1 SEF & Scuitdrift 2 SEF, Limpopo	Building Energy	Project Manager & EAP
Environmental Permitting for the Sirius PV Plant, Northern Cape	Aurora Power Solutions	Project Manager & EAP
Environmental Permitting for the Steynsrus PV1 & PV2 SEF's, Northern Cape	Cronimet Power Solutions	Project Manager & EAP
Environmental Permitting for the Heuningspruit PV SEF, Northern Cape	Cronimet Power Solutions	Project Manager & EAP
Permits for the Kleinbegin and UAP PV Plants, Northern Cape	MedEnergy Global	Project Manager & EAP
S53 Application for Arriesfontein Solar Park Phase 1 – 3 near Danielskuil, Northern Cape	Solar Reserve / SunCorp	Project Manager & EAP
S53 Application for Hertzogville PV1 & PV 2 SEFs, Free State	Solar Reserve / SunCorp	Project Manager & EAP
S53 Application for the Bloemfontein Airport PV Facility, Free State	Sublunary Trading	Project Manager & EAP
S53 Application for the Kimberley Airport PV Facility, Northern Cape	Sublunary Trading	Project Manager & EAP
S53 Application for the Project Blue SEF, Northern Cape	WWK Developments	Project Manager & EAP
S53 Application for the Upington Airport PV Facility, Free State	Sublunary Trading	Project Manager & EAP
WULA for the Kalahari SEF Phase II in Kathu, Northern Cape	Engie	Project Manager & EAP
Environmental Permitting for the Steynsrus PV1 & PV2 SEF's, Northern Cape	Cronimet Power Solutions	Project Manager & EAP
Environmental Permitting for the Heuningspruit PV SEF, Northern Cape	Cronimet Power Solutions	Project Manager & EAP

RENEWABLE POWER GENERATION PROJECTS: CONCENTRATED SOLAR FACILITIES (CSP)

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Ilanga CSP 2, 3, 4, 5, 7 & 9 Facilities near Upington, Northern Cape	Emvelo Holdings	Project Manager & EAP
Ilanga CSP near Upington, Northern Cape	Ilangethu Energy	Project Manager & EAP
Ilanga Tower 1 Facility near Upington, Northern Cape	Emvelo Holdings	Project Manager & EAP

Project Name & Location	Client Name	Role
Karoshoek CPVPD 1-4 facilities on site 2 as part of the larger Karoshoek Solar Valley Development East of Upington, Northern Cape	FG Emvelo	Project Manager & EAP
Karoshoek CSP facilities on sites 1.4; 4 & 5 as part of the larger Karoshoek Solar Valley Development East of Upington, Northern Cape	FG Emvelo	Project Manager & EAP
Karoshoek Linear Fresnel 1 Facility on site 1.1 as part of the larger Karoshoek Solar Valley Development East of Upington, Northern Cape	FG Emvelo	Project Manager & EAP

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
ECO for the construction of the !Khi CSP Facility, Northern Cape	Abengoa Solar	Project Manager
ECO for the construction of the Ilanga CSP 1 Facility near Upington, Northern Cape	Karoshoek Solar One	Project Manager
ECO for the construction of the folar Park, Northern Cape	Kathu Solar	Project Manager
ECO for the construction of the KaXu! CSP Facility, Northern Cape	Abengoa Solar	Project Manager
Internal audit of compliance with the conditions of the IWUL issued to the Karoshoek Solar One CSP Facility, Northern Cape	Karoshoek Solar One	Project Manager

Screening Studies

Project Name & Location	Client Name	Role
Upington CSP (Tower) Plant near Kanoneiland, Northern Cape	iNca Energy and FRV	Project Manager & EAP

Compliance Advice and ESAP reporting

Project Name & Location	Client Name	Role
Ilanga CSP Facility near Upington, Northern Cape	Ilangethu Energy	Environmental Advisor
Ilangalethu CSP 2, Northern Cape	FG Emvelo	Environmental Advisor
Kathu CSP Facility, Northern Cape	GDF Suez	Environmental Advisor
Lephalale SEF, Limpopo	Cennergi	Environmental Advisor
Solis I CSP Facility, Northern Cape	Brightsource	Environmental Advisor

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
Environmental Permitting for the Ilanga CSP Facility near Upington, Northern Cape	Ilangethu Energy	Project Manager & EAP
Environmental Permitting for the Kathu CSP, Northern Cape	GDF Suez	Project Manager & EAP
WULA for the Solis I CSP Facility, Northern Cape	Brightsource	Project Manager & EAP

RENEWABLE POWER GENERATION PROJECTS: WIND ENERGY FACILITIES

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Sere WEF, Western Cape	Eskom Holdings SoC Limited	EAP

Project Name & Location	Client Name	Role
Aberdeen WEF, Eastern Cape	Eskom Holdings SoC Limited	Project Manager & EAP
Amakhala Emoyeni WEF, Eastern Cape	Windlab Developments	Project Manager & EAP
EXXARO West Coast WEF, Western Cape	EXXARO Resources	Project Manager & EAP
Goereesoe Wind Farm near Swellendam, Western Cape	iNca Energy	Project Manager & EAP
Hartneest WEF, Western Cape	Juwi Renewable Energies	Project Manager & EAP
Hopefield WEF, Western Cape	Umoya Energy	EAP
Kleinsee WEF, Northern Cape	Eskom Holdings SoC Limited	Project Manager & EAP
Klipheuwel/Dassiesfontein WEF within the Overberg area, Western Cape	BioTherm Energy	Project Manager & EAP
Moorreesburg WEF, Western Cape	iNca Energy	Project Manager & EAP
Oyster Bay WEF, Eastern Cape	Renewable Energy Resources Southern Africa	Project Manager & EAP
Project Blue WEF, Northern Cape	Windy World	Project Manager & EAP
Rheboksfontein WEF, Western Cape	Moyeng Energy	Project Manager & EAP
Spitskop East WEF near Riebeeck East, Eastern Cape	Renewable Energy Resources Southern Africa	Project Manager & EAP
Suurplaat WEF, Western Cape	Moyeng Energy	Project Manager & EAP
Swellendam WEF, Western Cape	IE Swellendam	Project Manager & EAP
Tsitsikamma WEF, Eastern Cape	Exxarro	Project Manager & EAP
West Coast One WEF, Western Cape	Moyeng Energy	Project Manager & EAP

Basic Assessments

Project Name & Location	Client Name	Role
Amakhala Emoyeni Wind Monitoring Masts, Eastern Cape	Windlab Developments	Project Manager & EAP
Beaufort West Wind Monitoring Masts, Western Cape	Umoya Energy	Project Manager & EAP
Hopefield Community Wind Farm near Hopefield, Western Cape	Umoya Energy	Project Manager & EAP
Koekenaap Wind Monitoring Masts, Western Cape	EXXARO Resources	Project Manager & EAP
Koingnaas WEF, Northern Cape	Just Palm Tree Power	Project Manager & EAP
Laingsburg Area Wind Monitoring Masts, Western Cape	Umoya Energy	Project Manager & EAP
Overberg Area Wind Monitoring Masts, Western Cape	BioTherm Energy	Project Manager & EAP
Oyster Bay Wind Monitoring Masts, Eastern Cape	Renewable Energy Systems Southern Africa (RES)	Project Manager & EAP

Screening Studies

Project Name & Location	Client Name	Role
Albertinia WEF, Western Cape	BioTherm Energy	Project Manager & EAP
Koingnaas WEF, Northern Cape	Just Pal Tree Power	Project Manager & EAP
Napier Region WEF Developments, Western Cape	BioTherm Energy	Project Manager & EAP
Tsitsikamma WEF, Eastern Cape	Exxarro Resources	Project Manager & EAP
Various WEFs within an identified area in the Overberg area, Western Cape	BioTherm Energy	Project Manager & EAP
Various WEFs within an identified area on the West Coast, Western Cape	Investec Bank Limited	Project Manager & EAP
Various WEFs within an identified area on the West Coast, Western Cape	Eskom Holdings Limited	Project Manager & EAP

Project Name & Location	Client Name	Role
Various WEFs within the Western Cape	Western Cape Department of Environmental Affairs and Development Planning	Project Manager & EAP
Velddrift WEF, Western Cape	VentuSA Energy	Project Manager & EAP
Wind 1000 Project	Thabo Consulting on behalf of Eskom Holdings	Project Manager & EAP
Wittekleibosch, Snylip & Doriskraal WEFs, Eastern Cape	Exxarro Resources	Project Manager & EAP

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
ECO for the construction of the West Coast One WEF, Western Cape	Aurora Wind Power	Project Manager
ECO for the construction of the Gouda WEF, Western Cape	Blue Falcon	Project Manager
EO for the Dassiesklip Wind Energy Facility, Western Cape	Group 5	Project Manager
Quarterly compliance monitoring of compliance with all environmental licenses for the operation activities at the Gouda Wind Energy facility near Gouda, Western Cape	Blue Falcon	Project Manager
Annual auditing of compliance with all environmental licenses for the operation activities at the West Coast One Wind Energy facility near Vredenburg, Western Cape	Aurora Wind Power	Project Manager
External environmental and social audit for the Amakhala Wind Farm, Eastern Cape	Cennergi	Project Manager
External environmental and social audit for the Tsitsikamma Wind Farm, Eastern Cape	Cennergi	Project Manager
ECO for the construction of the Excelsior Wind Farm and associated infrastructure, Northern Cape	BioTherm Energy	Project Manager
External compliance audit of the Dassiesklip Wind Energy Facility, Western Cape	BioTherm Energy	Project Manager

Compliance Advice

Project Name & Location	Client Name	Role
Amakhala Phase 1 WEF, Eastern Cape	Cennergi	Environmental Advisor
Dassiesfontein WEF within the Overberg area, Western Cape	BioTherm Energy	Environmental Advisor
Excelsior Wind Farm, Western Cape	BioTherm Energy	Environmental Advisor
Great Karoo Wind Farm, Northern Cape	African Clean Energy Developments (ACED)	Environmental Advisor
Hopefield Community WEF, Western Cape	African Clean Energy Developments (ACED)	Environmental Advisor
Rheboksfontein WEF, Western Cape	Moyeng Energy	Environmental Advisor
Tiqua WEF, Western Cape	Cennergi	Environmental Advisor
Tsitsikamma WEF, Eastern Cape	Cennergi	Environmental Advisor
West Coast One WEF, Western Cape	Moyeng Energy	Environmental Advisor

Due Diligence Reporting

Project Name & Location	Client Name	Role
Witteberg WEF, Western Cape	EDPR Renewables	Environmental Advisor
IPD Vredenburg WEF within the Saldanha Bay area, Western Cape	IL&FS Energy Development Company	Environmental Advisor

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
Biodiversity Permitting for the Power Line between the Tsitikamma Community WEF & the Diep River Substation, Eastern Cape	Cennergi	Project Manager & EAP
Biodiversity Permitting for the West Coast One WEF, Western Cape	Aurora Wind Power	Project Manager & EAP
Environmental Permitting for the Excelsior WEF, Western Cape	BioTherm Energy	Project Manager & EAP
Plant Permits & WULA for the Tsitsikamma Community WEF, Eastern Cape	Cennergi	Project Manager & EAP
S24G and WULA for the Rectification for the commencement of unlawful activities on Ruimsig AH in Honeydew, Gauteng	Hossam Soror	Project Manager & EAP
S24G Application for the Rheboksfontein WEF, Western Cape	Ormonde - Theo Basson	Project Manager & EAP
S53 Application & WULA for Suurplaat and Gemini WEFs, Northern Cape	Engie	Project Manager & EAP
S53 Application for the Hopefield Community Wind Farm near Hopefield, Western Cape	Umoya Energy	Project Manager & EAP
S53 Application for the Project Blue WEF, Northern Cape	WWK Developments	Project Manager & EAP
S53 for the Oyster Bay WEF, Eastern Cape	RES	Project Manager & EAP
WULA for the Great Karoo Wind Farm, Northern Cape	African Clean Energy Developments (ACED)	Project Manager & EAP

CONVENTIONAL POWER GENERATION PROJECTS (COAL)

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Mutsho Power Station near Makhado, Limpopo	Mutsho Consortium	Project Manager & EAP
Coal-fired Power Station near Ogies, Mpumalanga	Ruukki SA	Project Manager & EAP
Thabametsi IPP Coal-fired Power Station, near Lephalale, Limpopo	Axia	Project Manager & EAP
Transalloys Coal-fired Power Station, Mpumalanga	Transalloys	Project Manager & EAP
Tshivasho IPP Coal-fired Power Station (with WML), near Lephalale, Limpopo	Cennergi	Project Manager & EAP
Umbani Coal-fired Power Station, near Kriel, Mpumalanga	ISS Global Mining	Project Manager & EAP
Waterberg IPP Coal-Fired Power Station near Lephalale, Limpopo	Exxaro Resources	Project Manager & EAP

Basic Assessments

Project Name & Location	Client Name	Role
Coal Stockyard on Medupi Ash Dump Site, Limpopo	Eskom Holdings	Project Manager & EAP

Project Name & Location	Client Name	Role
Biomass Co-Firing Demonstration Facility at Arnot Power Station East of Middleburg, Mpumlanaga	Eskom Holdings	Project Manager & EAP

Screening Studies

Project Name & Location	Client Name	Role
Baseload Power Station near Lephalale, Limpopo	Cennergi	Project Manager & EAP
Coal-Fired Power Plant near Delmas, Mpumalanga	Exxaro Resources	Project Manager & EAP
Makhado Power Station, Limpopo	Mutsho Consortium, Limpopo	Project Manager & EAP

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
ECO for the Camden Power Station, Mpumalanga	Eskom Holdings	Project Manager

Compliance Advice

Project Name & Location	Client Name	Role
Thabametsi IPP Coal-fired Power Station, near Lephalale, Limpopo	Axia	Environmental Advisor

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
Permit application for the Thabametsi Bulk Water Pipeline, near Lephalale, Limpopo	Axia	Project Manager & EAP
S53 & WULA for the Waterberg IPP Coal-Fired Power Station near Lephalale, Limpopo	Exxaro Resources	Project Manager & EAP
S53 Application for the Tshivasho Coal-fired Power Station near Lephalale, Limpopo	Cennergi	Project Manager & EAP

CONVENTIONAL POWER GENERATION PROJECTS (GAS)

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Ankerlig OCGT to CCGT Conversion project &400 kV transmission power line between Ankerlig and the Omega Substation, Western Cape	Eskom Holdings SoC Limited	Project Manager & EAP
Gourikwa OCGT to CCGT Conversion project & 400 kV transmission power line between Gourikwa & Proteus Substation, Western Cape	Eskom Holdings SoC Limited	Project Manager & EAP
Richards Bay Gas to Power Combined Cycle Power Station, KwaZulu-Natal	Eskom Holdings SoC Limited	Project Manager & EAP
Richards Bay Gas to Power Plant, KwaZulu-Natal	Richards Bay Gas	Project Manager & EAP
Decommissioning & Recommissioning of 3 Gas Turbine Units at Acacia Power Station & 1 Gas Turbine Unit at Port Rex Power Station to the existing Ankerlig Power Station in Atlantis Industria, Western Cape	Eskom Holdings	Project Manager & EAP
Two 132kV Chickadee Lines to the new Zonnebloem Switching Station, Mpumalanga	Eskom Holdings	Project Manager & EAP

Screening Studies

Project Name & Location	Client Name	Role
Fatal Flaw Analysis for 3 area identified for the establishment of a 500MW CCGT Power Station	Globeleq Advisors Limited	Project Manager & EAP
Richards Bay Gas to Power Combined Cycle Power Station, KwaZulu-Natal	Eskom Holdings SoC Limited	Project Manager & EAP

GRID INFRASTRUCTURE PROJECTS

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Aggeneis-Oranjemond Transmission Line & Substation Upgrade, Northern Cape	Eskom Transmission	Project Manager & EAP
Ankerlig-Omega Transmission Power Lines, Western Cape	Eskom Transmission	Project Manager & EAP
Karoshoek Grid Integration project as part of the Karoshoek Solar Valley Development East of Upington, Northern Cape	FG Emvelo	Project Manager & EAP
Koeberg-Omega Transmission Power Lines,, Western Cape	Eskom Transmission	Project Manager & EAP
Koeberg-Stikland Transmission Power Lines, Western Cape	Eskom Transmission	Project Manager & EAP
Kyalami Strengthening Project, Gauteng	Eskom Transmission	Project Manager & EAP
Mokopane Integration Project, Limpopo	Eskom Transmission	Project Manager & EAP
Saldanha Bay Strengthening Project, Western Cape	Eskom Transmission	Project Manager & EAP
Steelpoort Integration Project, Limpopo	Eskom Transmission	Project Manager & EAP
Transmission Lines from the Koeberg-2 Nuclear Power Station site, Western Cape	Eskom Transmission	Project Manager & EAP
Tshwane Strengthening Project, Phase 1, Gauteng	Eskom Transmission	Project Manager & EAP

Basic Assessments

Project Name & Location	Client Name	Role
Dassenberg-Koeberg Power Line Deviation from the Koeberg to the Ankerlig Power Station, Western Cape	Eskom Holdings	Project Manager & EAP
Golden Valley II WEF Power Line & Substation near Cookhouse, Eastern Cape	BioTherm Energy	Project Manager & EAP
Golden Valley WEF Power Line near Cookhouse, Eastern Cape	BioTherm Energy	Project Manager & EAP
Karoshoek Grid Integration project as part of the Karoshoek Solar Valley Development East of Upington, Northern Cape	FG Emvelo	Project Manager & EAP
Konkoonsies II PV SEF Power Line to the Paulputs Substation near Pofadder, Northern Cape	BioTherm Energy	Project Manager & EAP
Perdekraal West WEF Powerline to the Eskom Kappa Substation, Westnern Cape	BioTherm Energy	Project Manager & EAP
Rheboksfontein WEF Powerline to the Aurora Substation, Western Cape	Moyeng Energy	Project Manager & EAP
Soetwater Switching Station near Sutherland, Northern Cape	African Clean Energy Developments (ACED)	Project Manager & EAP

Solis Power I Power Line & Switchyard Station near Upington, Northern Cape	Brightsource	Project Manager & EAP
Stormwater Canal System for the Ilanga CSP near Upington, Northern Cape	Karoshoek Solar One	Project Manager & EAP
Tsitsikamma Community WEF Powerline to the Diep River Substation, Eastern Cape	Eskom Holdings	Project Manager & EAP

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
ECO for the construction of the Ferrum-Mookodi Transmission Line, Northern Cape and North West	Trans-Africa Projects on behalf of Eskom	Project Manager
EO for the construction of the Gamma-Kappa Section A Transmission Line, Western Cape	Trans-Africa Projects on behalf of Eskom	Project Manager
EO for the construction of the Gamma-Kappa Section B Transmission Line, Western Cape	Trans-Africa Projects on behalf of Eskom	Project Manager
EO for the construction of the Hydra IPP Integration project, Northern Cape	Trans-Africa Projects on behalf of Eskom	Project Manager
EO for the construction of the Kappa-Sterrekus Section C Transmission Line, Western Cape	Trans-Africa Projects on behalf of Eskom	Project Manager
EO for the construction of the Namaqualand Strengthening project in Port Nolloth, Western Cape	Trans-Africa Projects on behalf of Eskom	Project Manager
ECO for the construction of the Neptune Substation Soil Erosion Mitigation Project, Eastern Cape	Eskom	Project Manager
ECO for the construction of the Ilanga-Gordonia 132kV power line, Northern Cape	Karoshoek Solar One	Project Manager

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
Environmental Permitting and WULA for the Rockdale B Substation & Loop in Power Lines,	Eskom Holdings	Project Manager & EAP
Environmental Permitting and WULA for the Steelpoort Integration project, Limpopo	Eskom Holdings	Project Manager & EAP
Environmental Permitting for Solis CSP near Upington, Northern Cape	Brightsource	Project Manager & EAP

MINING SECTOR PROJECTS

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Elitheni Coal Mine near Indwe, Eastern Cape	Elitheni Coal	Project Manager & EAP
Groot Letaba River Development Project Borrow Pits	liso	Project Manager & EAP
Grootegeluk Coal Mine for coal transportation infrastructure between the mine and Medupi Power Station (EMPr amendment) , Limpopo	Eskom Holdings	Project Manager & EAP
Waterberg Coal Mine (EMPr amendment), Limpopo	Seskoko Resources	Project Manager & EAP
Aluminium Plant WML & AEL, Gauteng	GfE-MIR Alloys & Minerals	Project Manager & EAP

Basic Assessments

Project Name & Location	Client Name	Role
Rare Earth Separation Plant in Vredendal, Western Cape	Rareco	Project Manager & EAP

Decommissioning and Demolition of Kilns 5 & 6 at the Slurry Plant, Kwa-Zulu Natal	PPC	Project Manager & EAP

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
ECO for the construction of the Duhva Mine Water Recovery Project, Mpumalanga	Eskom Holdings SoC Limited	Project Manager
External compliance audit of Palesa Coal Mine's Integrated Water Use License (IWUL), near KwaMhlanga, Mpumalanga	HCI Coal	Project Manager
External compliance audit of Palesa Coal Mine's Waste Management License (WML) and EMP, near KwaMhlanga, Mpumalanga	HCI Coal	Project Manager
External compliance audit of Mbali Coal Mine's Integrated Water Use License (IWUL), near Ogies, Mpumalanga	HCI Coal	Project Manager
Independent External Compliance Audit of Water Use License (WUL) for the Tronox Namakwa Sands (TNS) Mining Operations (Brand se Baai), Western Cape	Tronox Namakwa Sands	Project Manager
Independent External Compliance Audit of Water Use License (WUL) for the Tronox Namakwa Sands (TNS) Mineral Separation Plant (MSP), Western Cape	Tronox Namakwa Sands	Project Manager
Independent External Compliance Audit of Water Use License (WUL) for the Tronox Namakwa Sands (TNS) Smelter Operations (Saldanha), Western Cape	Tronox Namakwa Sands	Project Manager
Compliance Auditing of the Waste Management Licence for the PetroSA Landfill Site at the GTL Refinery, Western Cape	PetroSA	Project Manager

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
Waste Licence Application for the Rare Earth Separation Plant in Vredendal, Western Cape	Rareco	Project Manager & EAP
WULA for the Expansion of the Landfill site at Exxaro's Namakwa Sands Mineral Separation Plant, Western Cape	Exxaro Resources	Project Manager & EAP
S24G & WML for an Aluminium Plant, Gauteng	GfE-MIR Alloys & Minerals	Project Manager & EAP

INFRASTRUCTURE DEVELOPMENT PROJECTS (BRIDGES, PIPELINES, ROADS, WATER RESOURCES, STORAGE, ETC)

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	Client Name	Role
Bridge across the Ngotwane River, on the border of South Africa and Botswana	Eskom Holdings	Project Manager & EAP
Chemical Storage Tanks, Metallurgical Plant Upgrade & Backfill Plant upgrade at South Deep Gold Mine, near Westornaria, Gauteng	Goldfields	Project Manager & EAP
Expansion of the existing Welgedacht Water Care Works, Gauteng	ERWAT	Project Manager & EAP

Project Name & Location	Client Name	Role
Golden Valley WEF Access Road near Cookhouse, Eastern Cape	BioTherm Energy	Project Manager & EAP
Great Fish River Wind Farm Access Roads and Watercourse Crossings near Cookhouse, Eastern Cape	African Clean Energy Developments (ACED)	Project Manager & EAP
Ilanga CSP Facility Watercourse Crossings near Upington, Northern Cape	Karoshoek Solar one	Project Manager & EAP
Modification of the existing Hartebeestfontein Water Care Works, Gautng	ERWAT	Project Manager & EAP
N10 Road Realignment for the Ilanga CSP Facility, East of Upington, Northern Cape	SANRAL	Project Manager & EAP
Nxuba (Bedford) Wind Farm Watercourse Crossings near Cookhouse, Eastern Cape	African Clean Energy Developments (ACED)	Project Manager & EAP
Pollution Control Dams at the Medupi Power Station Ash Dump & Coal Stockyard, Limpopo	Eskom	Project Manager & EAP
Qoboshane borrow pits (EMPr only), Eastern Cape	Emalahleni Local Municipality	Project Manager & EAP
Tsitsikamma Community WEF Watercourse Crossings, Eastern Cape	Cennergi	Project Manager & EAP
Clayville Central Steam Plant, Gauteng	Bellmall Energy	Project Manager & EAP
Msenge Emoyeni Wind Farm Watercourse Crossings and Roads, Eastern Cape	Windlab	Project Manager & EAP

Basic Assessments

Project Name & Location	Client Name	Role
Harmony Gold WWTW at Doornkop Mine, Gauteng	Harmony Doornkop Plant	Project Manager & EAP
Ofir-ZX Watercourse Crossing for the Solar PV Facility, near Keimoes, Northern Cape	Networx S28 Energy	Project Manager & EAP
Qoboshane bridge & access roads, Eastern Cape	Emalahleni Local Municipality	Project Manager & EAP
Relocation of the Assay Laboratory near Carletonville, Gauteng	Sibanye Gold	Project Manager & EAP
Richards Bay Harbour Staging Area, KwaZulu-Natal	Eskom Holdings	Project Manager & EAP
S-Kol Watercourse Crossing for the Solar PV Facility, East of Keimoes, Northern Cape	Networx S28 Energy	Project Manager & EAP
Sonnenberg Watercourse Crossing for the Solar PV Facility, West Keimoes, Northern Cape	Networx S28 Energy	Project Manager & EAP
Kruisvallei Hydroelectric Power Generation Scheme, Free State	Building Energy	Project Manager & EAP
Masetjaba Water Reservoir, Pump Station and Bulk Supply Pipeline near Nigel, Gauteng	Naidu Consulting Engineers	Project Manager & EAP
Access Road for the Dwarsug Wind Farm, Northern Cape Province	South Africa Mainsteam Renewable Power	Project Manager & EAP
Upgrade of the Cooling Water Treatment Facility at the Kriel Power Station, Mpumalanga	Eskom	Project Manager & EAP

Screening Studies

Project Name & Location	Client Name	Role
Roodepoort Open Space Optimisation Programme (OSOP) Precinct, Gauteng	TIMAC Engineering Projects	Project Manager & EAP
Vegetable Oil Plant and Associated Pipeline, Kwa-Zulu Natal	Wilmar Oils and Fats Africa	Project Manager & EAP

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
ECO and bi-monthly auditing for the construction of the Olifants River Water Resources Development Project (ORWRDP) Phase 2A: De Hoop Dam, R555 realignment and housing infrastructure	Department of Water and Sanitation	Project Manager Auditor
ECO for the Rehabilitation of the Blaaupan & Storm Water Channel, Gauteng	Airports Company of South Africa (ACSA)	Project Manager
Due Diligence reporting for the Better Fuel Pyrolysis Facility, Gauteng	Better Fuels	Project Manager
ECO for the Construction of the Water Pipeline from Kendal Power Station to Kendal Pump Station, Mpumalanga	Transnet	Project Manager
ECO for the Replacement of Low-Level Bridge, Demolition and Removal of Artificial Pong, and Reinforcement the Banks of the Crocodile River at the Construction at Walter Sisulu National Botanical Gardens, Gauteng Province	South African National Biodiversity Institute (SANBI)	Project Manager
External Compliance Audit of the Air Emission Licence (AEL) for a depot in Bloemfontein, Free State Province and in Tzaneen, Mpumalanga Province	PetroSA	Project Manager

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	Client Name	Role
WULA for the Izubulo Private Nature Reserve, Limpopo	Kjell Bismeyer, Jann Bader, Laurence Saad	Project Manager & EAP
WULA for the Masodini Private Game Lode, Limpopo	Masodini Private Game Lodge	Environmental Advisor
WULA for the Ezulwini Private Nature Reserve, Limpopo	Ezulwini Investments	Project Manager & EAP
WULA for the Masodini Private Game Lode, Limpopo	Masodini Private Game Lodge	Project Manager & EAP
WULA for the N10 Realignment at the Ilanga SEF, Northern Cape	Karoshoek Solar One	Project Manager & EAP
WULA for the Kruisvallei Hydroelectric Power Generation Scheme, Free State	Building Energy	Project Manager & EAP
S24G and WULA for the Ilegal construction of structures within a watercourse on EFF 24 Ruimsig Agricultural Holdings, Gauteng	Sorror Language Services	Project Manager & EAP

HOUSING AND URBAN PROJECTS

Basic Assessments

Project Name & Location	Client Name	Role
Postmasburg Housing Development, Northern Cape	Transnet	Project Manager & EAP

Compliance Advice and reporting

Project Name & Location	Client Name	Role
Kampi ya Thude at the Olifants West Game Reserve, Limpopo	Nick Elliot	Environmental Advisor

Project Name & Location	Client Name	Role
External Compliance Audit of WUL for the Johannesburg Country Club, Gauteng	Johannesburg Country Club	Project Manager

Environmental Compliance, Auditing and ECO

Project Name & Location	Client Name	Role
Due Diligence Audit for the Due Diligence Audit Report, Gauteng	Delta BEC (on behalf of Johannesburg Development Agency (JDA))	Project Manager

ENVIRONMENTAL MANAGEMENT TOOLS

Project Name & Location	Client Name	Role
Development of the 3rd Edition Environmental Implementation Plan (EIP)	Gauteng Department of Agriculture and Rural Development (GDARD)	Project Manager & EAP
Development of Provincial Guidelines on 4x4 routes, Western Cape	Western Cape Department of Environmental Affairs and Development Planning	EAP
Compilation of Construction and Operation EMP for the Braamhoek Transmission Integration Project, Kwazulu-Natal	Eskom Holdings	Project Manager & EAP
Compilation of EMP for the Wholesale Trade of Petroleum Products, Gauteng	Munaca Technologies	Project Manager & EAP
Operational Environmental Management Programme (OEMP) for Medupi Power Station, Limpopo	Eskom Holdings	Project Manager & EAP
Operational Environmental Management Programme (OEMP) for the Dube TradePort Site Wide Precinct	Dube TradePort Corporation	Project Manager & EAP
Operational Environmental Management Programme (OEMP) for the Kusile Power Station, Mpumalanga	Eskom Holdings	Project Manager & EAP
Review of Basic Assessment Process for the Wittekleibosch Wind Monitoring Mast, Eastern Cape	Exxaro Resources	Project Manager & EAP
Revision of the EMPr for the Sirius Solar PV	Aurora Power Solutions	Project Manager & EAP
State of the Environment (SoE) for Emalahleni Local Municipality, Mpumalanga	Simo Consulting on behalf of Emalahleni Local Municipality	Project Manager & EAP
Aspects and Impacts Register for Salberg Concrete Products operations	Salberg Concrete Products	EAP
First State of Waste Report for South Africa	Golder on behalf of the Department of Environmental Affairs	Project Manager & EAP
Responsibilities Matrix and Gap Analysis for the Kruisvallei Hydroelectric Power Generation Scheme, Free State Province	Building Energy	Project Manager
Responsibilities Matrix and Gap Analysis for the Roggeveld Wind Farm, Northern & Western Cape Provinces	Building Energy	Project Manager

PROJECTS OUTSIDE OF SOUTH AFRICA

Project Name & Location	Client Name	Role
Advisory Services for the Zizabona Transmission Project, Zambia, Zimbabwe, Botswana & Namibia	PHD Capital	Advisor
EIA for the Semonkong WEF, Lesotho	MOSCET	Project Manager & EAP
EMP for the Kuvaninga Energia Gas Fired Power Project, Mozambique	ADC (Pty) Ltd	Project Manager & EAP
Environmental Screening Report for the SEF near Thabana Morena, Lesotho	Building Energy	EAP
EPBs for the Kawambwa, Mansa, Mwense and Nchelenge SEFs in Luapula Province, Zambia	Building Energy	Project Manager & EAP
ESG Due Diligence for the Hilton Garden Inn Development in Windhoek, Namibia	Vatange Capital	Project Manager
Mandahill Mall Rooftop PV SEF EPB, Lusaka, Zambia	Building Energy	Project Manager & EAP
Monthly ECO for the PV Power Plant for the Mocuba Power Station	Scatec	Project Manager

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Jo-Anne Thomas

Registration Number: 400024/00

is registered as a

Professional Natural Scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following fields(s) of practice (Schedule 1 of the Act)

Environmental Science

Effective **17 February 2000** Expires **31 March 2020**

Chairperson

Chief Executive Officer

Scan this code to view online version of this certificate

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Woodlands Drive, Woodmead
Johannesburg, South Africa

Email: arlene@savannahsa.com
Tel: +27 (11) 656 3237

CURRICULUM VITAE OF ARLENE SINGH

Profession : Environmental Assessment Practitioner (EAP)

Specialisation: Environmental Assessments, report writing, report reviewing, development of project proposals for procuring new projects and project administration.

Work Experience: 5 years' experience in Environmental Assessments and 1 year in Sustainability Consulting.

VOCATIONAL EXPERIENCE

Professional execution of consulting services for projects in the environmental management field, specialising in Environmental Impact Assessment studies, environmental permitting, public participation, compilation of Environmental Management Plans and Programmes, environmental policy, and integrated environmental management. Responsibilities include report writing, project management, review of specialist studies and the identification and assessment of potential negative environmental impacts and benefits. Compilation of the reports for environmental studies is in accordance with all relevant environmental legislation.

Experience in conducting environmental impact assessments for infrastructure development projects (roads, stormwater, pipelines), Mixed Use Developments and Section 24G Applications for complex projects. She has extensive experience in managing and monitoring ECO functions and compliance on relevant projects. She has gained the ability to conduct sustainability assurance audits for non-financial environmental KPI's through her experience with listed mining corporations.

SKILLS BASE AND CORE COMPETENCIES

- Compilation of environmental impact assessment reports and environmental management programmes in accordance with relevant environmental legislative requirements;
- Identification and assessment of potential negative environmental impacts and benefits through the review of specialist studies;
- Key experience in the assessment of impacts associated with complex Section 24G Applications.
- Review of environmental impact assessment reports, impacts matrices and environmental management programme reports;
- Conducting of ECO audits, managing ECO staff, review of ECO reports and liaison with the client;
- Review of Carbon Footprint Analysis report and provision of recommendations for industry;
- Developing Business Development Plans, action plans and carrying out Business Development initiatives;
- Compilation of Integrated Reports in line with King IV;
- Conducting Mining Permit Applications with the DMR and the associated Basic Assessment process in line with the MPRDA;
- Extensive experience in compilation and submission of Tenders and Proposals;

EDUCATION AND PROFESSIONAL STATUS

Degrees:

- B.Sc. (Hons.) Environmental Management (2016), University of South Africa (UNISA);
- B.Sc. Environmental Science (2012), University of Kwa-Zulu Natal, Westville

Short Courses:

- Official DWS Section 21 (c) and (i) Water Use Authorisation Course (2018)- Dr Wietsche Roets, Specialist Scientist: (In Stream Water Use);
- SMME Green Building Face to Face Workshop (2018)- GBCSA hosted by JP Morgan;
- ArcGISBasic 10,3 (2016)- Esri South Africa

Professional Society Affiliations:

- IAIAsa- Member
- South African Council for Natural Scientific Professionals - Candidate Natural Scientist: Environmental Scientist) – Reg No. 118872

Other Relevant Skills:

- Compiling and submission of invoices on projects;
- Registration of Waste Management Facilities on GWIS

EMPLOYMENT

Date	Company	Roles and Responsibilities
08 April 2019- Current:	Savannah Environmental (Pty) Ltd	Environmental Assessment Practitioner <u>Tasks include</u>: *Compilation of Environmental Impact Assessment (EIA) reports; Basic Assessment (BA) reports and Environmental Management Programmes; Environmental Screening reports; Co-ordination of the public participation process; Project management; project proposals and tenders; Client liaison and Marketing; Process EIA Applications.*
01 January 2016- 05 April 2019	Triplo4 Sustainable Solutions (Pty) Ltd	Environmental Consultant/Gauteng Office Manager <u>Tasks included:</u> *Review of Basic Assessment reports, Environmental Management Programme reports, Impact Matrices. Review of Environmental Control Officer functions, report and planning of site visits. Compiling Waste Management License Applications and Section 24G Application with reports for review by company Director. Review of specialist reports. Compilation of tenders, proposals and fee proposals. Co-ordinate public participation processes. Liaison with clients,*

Date	Company	Roles and Responsibilities
		stakeholders and competent authorities. Business Development, Integrated reporting. Strategy, policy and procedure development. Planning of staff on engagements and Invoicing of clients.
01 October 2014 – 31 December 2015	PricewaterHouse Coopers (PwC)	Sustainability Consultant 2 <u>*Tasks included:*</u> *Non-financial auditing of Environmental KPI's (Primary water, Total Waste, Total Electricity, Total CDP Calc, Scope 1, 2 and 3 emissions, Total CSI spend, Total Environmental incidents and Total Rock waste generated) for listed mining companies. Role included, testing of controls, applications of audit standards and guidelines, preparation and conclusions of audit papers and files, reporting to management and preparation of audit reports.*
01 January 2013- 30 September 2014	Triplo4 Sustainable Solutions (Pty) Ltd	Junior Environmental Consultant <u>*Tasks included:*</u> *Conducting Environmental Control Officer audits and drafting of ECO reports for review. Drafting of Basic Assessment (BA) reports, Environmental Management Programme reports for review by Environmental Consultant. Conducting public participation by liaison with competent authorities and stakeholders. Assisting with compiling of Basic Assessment documents.*

PROJECT EXPERIENCE

Arlene has experience in conducting environmental impact assessments for infrastructure development projects (roads, stormwater, pipelines), Mixed Use Developments and Section 24G Applications for complex projects. She has extensive experience in managing and monitoring ECO functions and compliance on relevant projects. She has gained the ability to conduct sustainability assurance audits for non-financial environmental KPI's through her experience with listed mining corporations.

<u>MINING SECTOR PROJECTS</u>

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	*Client Name*	*Role*
Yzermyn Coal Mine EMPr, Piet Retief, Mpumalanga	*Atha Group*	*EAP*

Basic Assessments

Project Name & Location	*Client Name*	*Role*
Shaya Quarry Basic Assessment process, Empangeni, Kwazulu-Natal	*Mbavuza Minerals*	*Project Manager*

Umvoti River Sand Mining Basic Assessment process, Kwazulu-Natal	*Izimbiwe Minerals Pty Ltd*	*Project Manager*

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	***Client Name***	***Role***
Shaya Quarry Mining Permit Application, Empangeni, Kwazulu-Natal	*Mbavuza Minerals*	*Project Manager*
Umvoti River Sand Mining Mining Permit Application, Kwazulu-Natal	*Izimbiwe Minerals Pty Ltd*	*Project Manager*
Newark Quarry, Ilembe Municipality, Kwazulu-Natal	*iLembe Concrete Pty Ltd*	*Junior EAP*

INFRASTRUCTURE DEVELOPMENT PROJECTS (BRIDGES, PIPELINES, ROADS, WATER RESOURCES, STORAGE, ETC)

Basic Assessments

Project Name & Location	***Client Name***	***Role***
Replacement of Nseleni Bridge- Empangeni, Kwazulu-Natal	*RHDHV*	*EAP*
Construction of the 60ML Ntuzuma Reservoir, Ntuzuma, Kwazulu-Natal	*eThekwini Metropolitan Municipality*	*Project Manager*
Upgrade of the Nyathikazi box culvert, Darnell, Kwazulu- Natal	*KwaDukuza Municipality*	*Junior EAP*
Upgrade and Expansion Provincial Main Road D887, Kwazulu-Natal	*RHDHV*	*Junior EAP*

Environmental Compliance, Auditing and ECO

Project Name & Location	***Client Name***	***Role***
ECO Monitoring for Construction of Offtake 1 Reservoir, KwaDukuza, Kwazulu-Natal	*KwaDukuza Municipality*	*Project Manager*
ECO Monitoring for Construction of Offtake 6A2, 6D, 8C, 8D, 9, 11D Pipelines, KwaDukuza, Kwazulu-Natal	*KwaDukuza Municipality*	*Project Manager*
ECO Monitoring for the Construction of the Jozini RCWSS Phase 1A, Jozini, Kwazulu-Natal	*RHDHV*	*ECO (1 year), Project Manager*
ECO Monitoring for the Greytown BWSS, Greytown, Kwazulu-Natal	*RHDHV*	*Project Manager*
ECO Monitoring for the Kranskop Water Supply Scheme, Kranskop, Kwazulu-Natal	*RHDHV*	*ECO*
ECO Monitoring for the Zulti South Access Road, Richards Bay, Kwazulu-Natal	*RHDHV*	*Project Manager*

Compliance Advice and ESAP reporting

Project Name & Location	***Client Name***	***Role***
Ethafeni Cemetery Environmental Assessment Report, KwaDukuza, Kwazulu-Natal	*KwaDukuza Municipality*	*EAP*

Environmental Permitting, S53, Water Use Licence (WUL), Waste Management Licence (WML) & Other Applications

Project Name & Location	***Client Name***	***Role***
General Authorisation for the Replacement of the Nseleni Bridge, Empangeni, Kwzulu-Natal	*RHDHV*	*EAP*

HOUSING AND URBAN PROJECTS

Environmental Impact Assessments and Environmental Management Programmes

Project Name & Location	***Client Name***	***Role***
Ethafeni Precinct Project Section 24G Application- Groutvill , Kwazulu- Natal.	*KwaDukuza Municipality*	*Project Manager/Lead Consultant*
Environmental Management Programme report Brettenwood Residential Development, Kwazulu-Natal.	*Brettenwood Coastal Estate*	*EAP*
Environmental Management Programme report for CTM Ballito, Ballito, Kwazulu-Natal	*CTM*	*EAP*

Basic Assessments

Project Name & Location	***Client Name***	***Role***
Upgrade of residential dwelling on Colwyn Drive, Salt Rock, Kwazulu-Natal	*Mike Graham*	*Junior EAP*
Ethafeni Precinct Project Basic Assessment, Groutville, Kwazulu-Natal	*KwaDukuza Municipality*	*Project Manager*
105 Nkwazi Drive Single Residential House Basic Assessment, Zinkwazi, Kwazulu-Natal	*Ituwiz Pty Ltd*	*Project Manager*

Environmental Compliance, Auditing and ECO

Project Name & Location	***Client Name***	***Role***
88 Compensation ECO Audits – Ballito, Kwazulu-Natal	*Imali Corp*	*Environmental Control Officer (ECO)*
Oceans Umhlanga Hotel & Residential Development, Umhlanga, Kwazulu-Natal	*Edison Property Group*	*Project Manager*
Inoxa Cookware Factory Warehouse, Woodmead Estate, Shakaskraal, Kwazulu-Natal	*Shree Property*	*Project Manager*
Woodmead Estate Warehousing, Gauteng	*Shree Property*	*Project Manager*
Ridgeside Commercial Development, Umhlanga, Kwazulu-Natal	*Shree Property*	*Project Manager*
Construction of Jozini Shopping Centre, Jozini, Kwazulu-Natal	*GK Projects*	*ECO*
Birdhaven Residential Development, Ballito, Kwazulu-Natal	*Mike Graham Trust*	*ECO*
Foxhill Church and Residential Development, Ballito, Kwazulu-Natal	*M&C Janigh Trust*	*ECO*
Beema Bamboo Plantation Site (Bamboo to Energy project, Kwazulu-Natal	*Green Grid Energy*	*ECO*

OTHER PROJECTS

Environmental Compliance, Auditing and ECO

Project Name & Location	***Client Name***	***Role***
Beema Bamboo Plantation Site (Bamboo to Energy project, Kwazulu-Natal	*Green Grid Energy*	*ECO*
Mkondeni Medical Waste External Waste Management License Audit , Pietermaritzburg	*Ecocyle Waste Solutions*	*Auditor*
Dube Tradeport External Audit, eThekwini	*Dube Tradeport Corporation*	*Junior Auditor*

Carbon Footprint Analysis

Project Name & Location	***Client Name***	***Role***
Carbon footprint analysis of Newcastle and Sasolburg Plants, (Kwazulu Natal & North West	*Karbochem Pty Ltd*	*EAP*
Measure Carbon Emissions and provide updated baseline that would enable DTPC to quantify, monitor and assess carbon footprint and its climate change impact for DTPC, eThekwini	*Dube Tradeport Corporation*	*Junior EAP*

Waste Management

Project Name & Location	***Client Name***	***Role***
Waste Classification Assessment for Karbochem Newcastle facility , Kwazulu-Natal	*Karbochem Pty Ltd*	*EAP*
Waste Management Licenses for Wadeville & Rosslyn Waste Management Facilities, Gauteng.	*Planet Care Pty Ltd*	*EAP*

Compliance Advice and ESAP reporting

Project Name & Location	***Client Name***	***Role***
Environmental Opinion and Enquiry for the Rosslyn Tyre Pyrolysis Plant, Gauteng	*Cosmic Energy*	*EAP*

Non-Financial Auditing

KPI'S Audited	***Client Name & Location***	***Role***
Total Primary Water Use, Total Electricity Used, Total Waste Generated, Scope 1, 2 & 3 Emissions and Total Number of Environmental Incidents.	*Anglo Platinum (South Africa)*	*Sustainability Consultant*
Total Primary Water Use, Total Waste Generate and Total Number of Environmental Incidents.	*De Beers (Namibia)*	*Sustainability Consultant*
Scope 1, 2 & 3 Emissions, Total Electricity Purchased, Total Primary Water Used.	*Harmony Gold (South Africa)*	*Sustainability Consultant*
Scope 1, 2 & 3 Emissions, Total Electricity Purchased, Total Primary Water Used and Total Rock Waste Generated.	*Exxaro (South Africa, Papua New Guinea)*	*Sustainability Consultant*
Total Corporate Social Investment fund spend by Barclays Group	*Barclays Group*	*Sustainability Consultant*
Audit Environmental and Social Risk Finance Projects -Equator Principles	*MTN (South Africa & Nigeria)*	*Sustainability Consultant*

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Arlene Singh

Registration number: 118872

is registered as a

Candidate Natural Scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following fields(s) of practice (Schedule 1 of the Act)

Environmental Science

Effective **06 June 2018**

Expires **31 March 2020**

Botha

President

Executive Director