



FOSKOR RICHARDS BAY

UPGRADE OF THE PRIMARY AND SECONDARY POLLUTION CONTROL DAMS

SPECIFICATIONS

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FOSKOR RICHARDS BAY

UPGRADE OF THE PRIMARY AND SECONDARY POLLUTION CONTROL DAMS

SPECIFICATIONS

C3.1 DESCRIPTION OF THE WORKS

C3.1.1 Employer’s objective

The employer’s objective is to upgrade the primary and secondary pollution control dams located South of the Foskor plant, Richards Bay. The works will also include the construction and/or upgrade of pumpstations and appurtenant works.

C3.1.2 Labour-intensive works

Labour-intensive works comprise the activities described in SANS 1921-5, Earthworks activities which are to be performed by hand, and its associated specification data.

C3.1.3 Overview of the works

This contract comprises the upgrade of the 4,000m³ Primary and 16,000m³ Secondary pollution control dams with class A liner design to meet regulatory requirements. The works include the construction of overflow weirs, stormwater channels and pumpstations with appurtenant pipework.

C3.1.4 Location of the works

The works would be isolated to the detached fenced property South of Foskor where the pollution control dams are located and immediate surrounding areas where specific works is required. For contractual purposes the boundary of the “SITE” is indicated on drawing no. R21-097-00-003.

Reference area	Coordinates	
Foskor Pollution Control Dams	28°46'41.66"S	32° 1'59.72"E

C3.2 EMPLOYER’S AGENTING

C3.2.1 Design services and activity matrix

Responsibilities for the design and activity matrix can briefly be classified as follows:

- Final design for fixed works : Employer’s Agent
- Design for temporary works : Contractor
- Supply of As-built information : Contractor
- Preparation of as-built drawings : Employer’s Agent

C3.2.2 Employers design

The employers design is depicted on the tender drawings, and provides for detailed design of all of the fixed works. The drawings will be issued as construction drawings upon the award of the contract.

C3.2.3 Contractors design

The contractor to note the sandy conditions of the soil on site and the risk of collapse of trenches. The contractor to allow for the design of shoring as temporary works so as to safeguard his employees. The design will be deemed to be incorporated into the rates tendered.

The contractor to incorporate into the rates tendered for excavation for the dewatering of excavations.

The contractor, at the outset of the contract, to satisfy the Employer's Agent as to the construction methodology to be followed, in particular with regards to the de-silting and construction of the pollution control dams and the management of effluent water and stormwater throughout construction, and will not proceed until this has officially been approved. Approval thereof will however not transfer the responsibility for safe working practice from the contractor, who will remain responsible thereof.

C3.2.4 Drawings

The following drawings are included in volume two and comprise of tender drawings:

DRG NO:	DESCRIPTION
R21-097-00-001	COVER PAGE, LOCALITY AND DRAWING LIST
R21-097-00-002	GENERAL ARRANGEMENT OF PRIMARY & SECONDARY DAMS
R21-097-00-003	GENERAL LAYOUT PLAN
R21-097-00-200	PRIMARY DAM OVERFLOW STRUCTURE LAYOUT AND DETAILS
R21-097-00-201	SECONDARY DAM OVERFLOW STRUCTURE LAYOUT AND DETAILS
R21-097-00-202	SECONDARY DAM OVERFLOW STRUCTURE SECTIONS
R21-097-00-203	TYPICAL DETAILS – STORMWATER CHANNELS AND SAW-CUT DETAIL
R21-097-00-204	SECONDARY DAM PUMPSTATION LAYOUT AND SECTIONS
R21-097-00-205	ABSTRACTION PIPELINE ANCHOR BLOCKS
R21-097-00-206	PRIMARY DAM INLET PIPES RC ANCHOR BLOCK CONCRETE AND REINFORCEMENT
R21-097-00-207	TYPICAL DETAILS – PUMPSTATION REINFORCED CONCRETE SLAB
R21-097-00-208	TYPICAL DETAILS – ANCHOR TRENCH AND ROAD
R21-097-00-210	LEACHATE AND SUB-SOIL LAYOUT OF DAMS
R21-097-00-211	TYPICAL DETAILS – EMBANKMENT TYPICAL SECTIONS AND DETAILS
R21-097-00-212	TYPICAL DETAILS – DAM LINER AND ANCHOR TRENCH DETAILS
R21-097-00-213	TYPICAL DETAILS – LEAKAGECOLLECTION SUMP LAYOUT, SECTION AND DETAILS
R21-097-00-214	TYPICAL DETAILS – LEAKAGE DRAINAGE AND DETECTION LINER CONFIGURATIONS
R21-097-00-215	TYPICAL DETAILS – DAM LEAKAGE AND SUMP PUMP SLEEVE SECTIONS AND DETAILS
R21-097-00-216	TYPICAL DETAILS – DAM RETURN WATER SYSTEM SECTIONS AND DETAILS
R21-097-00-350	TYPICAL DETAIL – PIPE TRENCHES
R21-097-00-351	TYPICAL DETAIL – THRUST BLOCK
R21-097-00-352	TYPICAL DETAIL – ISOLATION VALVE AND CHAMBER DETAILS FOR VALVES FROM 75mmØ – 160mmØ
R21-097-00-353	TYPICAL DETAIL – ISOLATION VALVE AND CHAMBER DETAILS FOR VALVES FROM 200mmØ – 315mmØ
R21-097-00-354	TYPICAL DETAIL – FABRICATED FITTINGS
R21-097-00-355	TYPICAL DETAIL – NON-RETURN VALVE AND CHAMBER DETAILS FOR VALVES 160mmØ
R21-097-00-356	TYPICAL DETAIL – NON-RETURN VALVE AND CHAMBER DETAILS FOR VALVES 250mmØ
R21-097-00-357	TYPICAL DETAIL – NON-RETURN VALVE AND CHAMBER DETAILS FOR VALVES 300mmØ
R21-097-00-358	TYPICAL DETAIL – NON-RETURN VALVE AND CHAMBER DETAILS FOR VALVES 450mmØ
R21-097-00-700	GENERAL NOTES

C3.2.5 As-built drawings and information

All information in possession of the contractor that is required by the Employer's Agent in order to complete the as-built drawings and to prepare a completion report for the employer must be submitted to the Employer's Agents before a Certificate of Practical Completion will be issued for the works.

C3.3 PROCUREMENT

C3.3.1 Sub-contracting

As required by Clause 4.4.4 of the Conditions of Contract, the contractor shall be responsible for all work carried out by sub-contractors (whether nominated by the employer or selected by the contractor) on his behalf. The Employer's Agent will not liaise directly with any sub-contractor, nor will he become involved in any problems and / or disputes related to payments, programming, workmanship etc, unless provided for in the Conditions of Contract. Such problems and / or disputes shall remain the sole concern of the contractor and his sub-contractors.

C3.4 CONSTRUCTION

C3.4.1 Project Specifications

STATUS

The Project Specification, consisting of two parts, forms an integral part of the contract and supplements the Standard Specifications.

Part A contains a general description of the works, the site and the requirements to be met.

Part B contains variations, amendments and additions to the Standardized Specifications and, if applicable, the Particular Specifications.

In the event of any discrepancy between a part or parts of the Standardized or Particular Specifications and the Project Specification, the Project Specification shall take precedence. In the event of a discrepancy between the Specifications, (including the Project Specifications) and the drawings and / or the Bill of Quantities, the discrepancy shall be resolved by the Employer's Agent before the execution of the work under the relevant item.

The standard specifications which form part of this contract have been written to cover all phases of work normally required, and they may therefore cover items not applicable to this particular contract.

PROJECT SPECIFICATION

PART A: THE WORKS

PS1 DESCRIPTION OF SITE AND ACCESS

Access to the site of the works can be obtained from the W Central Arterial together with existing dedicated roads.

The contractor must evaluate the availability of access to the areas, evaluate construction space and location together with any other aspect that may influence his construction activities and or method and allow for it in his tendered rates.

PS2 NATURE OF GROUND CONDITIONS

Geology and Sub-soils

The area is underlain by Quaternary-age recently redistributed sediments. The recently redistributed sediments (Qs) are anticipated to comprise complex sequences of unconsolidated Quaternary-age aeolian, alluvial or estuarine/lacustrine sediments, that, in the project area, extend to depths in excess of 10m below existing ground levels.

The provision of data regarding the nature of the ground by the Employer's Agent does not relieve the Contractor of his responsibility in terms of the General Conditions of Contract, to satisfy himself as to the condition on the site and the possible variation there from due to seasonal effects.

PS3 DETAILS OF CONTRACT

The Contractor will be responsible for carrying out all work under the contract in accordance with the drawings, specification and schedule of quantities.

The drawings, specifications and schedule of quantities define the scope of this contract and indicate all work to be done. They may be supplemented by additional drawings to supply information regarding details of construction and exact lines, levels and depths.

The Contractor is to co-ordinate all his operations and activities, including those of the Sub-Contractors, with the Employer and Employer's Agent.

The description of the works is not necessarily complete and shall not limit the work to be carried out by the contractor in respect of this contract.

The scope of works for the sections can be summarised as follows:

Scope of works

The contract is for the supply of all labour, plant and materials to complete the works which in brief comprises the following:

GENERAL

- Site establishment and removal of establishment on completion.
- Complying with relevant health and safety regulations.
- Management and supervision of contract.

INCEPTION

- De-silt primary and secondary pollution control dams.
- Decommission existing pumpstations.
- Excavation and removing existing pipelines.
- Fabricate existing secondary dam pumpstation platform.
- Install new pumps, pipelines and associated electrical for Secondary dam pumpstation.

PRIMARY DAM

- Demolish and dispose dam concrete surface layer.
- Demolish existing reinforced concrete inlet structure.
- Excavate in all material to designed depths.
- Excavate anchor trenches.
- Import natural gravels, place in layers and compact.
- Construct reinforced concrete subsoil / leakage detection sump.
- Install liner barrier system including the installation of required subsoil drainage and leakage detection pipelines.
- Install leakage detection and subsoil drainage abstraction pipeline.
- Import and install Geocells, including the import of concrete and placing within geocells.
- Excavate and import material for the construction of perimeter access road for the construction of gravel access road.
- Construct bases and anchor blocks for the installation of Primary dam pumpstations, including the installation of suction and discharge pipelines, and all electrical installations.
- Construct concrete inlet structure.

SECONDARY DAM

- Excavate in all material to designed depths.
- Modify existing reinforced concrete inlet structure.
- Excavate anchor trenches.
- Import natural gravels, place in layers and compact.
- Construct reinforced concrete subsoil / leakage detection sump.
- Install liner barrier system including the installation of required subsoil drainage and leakage detection pipelines.
- Install leakage detection and subsoil drainage abstraction pipeline.
- Import and install Geocells, including the import of concrete and placing within geocells.
- Excavate and import material for the construction of perimeter access road for the construction of gravel access road.
- Construct base and anchor blocks for the installation of Secondary dam pumpstation, including the installation of suction and discharge pipelines, and all electrical installations.
- Construct reinforced concrete overflow weir from Primary dam to Secondary dam.
- Construct Secondary dam overflow weir and channel.

FINISHES

- Construct reinforced concrete entrance ramps to Primary and Secondary dams.
- Demolish existing concrete channels leading to Secondary dam.
- Construct concrete v-drains and channels leading to Secondary dam.
- Construct reinforced concrete floor slab between Primary and Secondary dam.
- Test and commission pumpstations.

INCLUDED WORK:

This contract provides for:

The maintenance of records and accurate measurements of the works for certification by the Employer's Agent.

The compilation of as-built drawings on completion of the works.

The supply and application of all safety equipment and clothing applicable to the works.

The supply of all plant, equipment, materials, transport, labour, incidentals, fuels etc. and supervision to carry out the works.

The removal of all redundant material, rubble and spoil to the designated Municipal dump area, or other designated area as directed.

The construction and testing.

Transportation and delivery to the designated site in and in the vicinity of the site as required in terms of scope of works.

Supervision of erection of the contract works, i.e. offloading from transport, safe storage, handling to situation, installing, setting to work, testing, maintaining prior to the practical completion date and all other work incidental thereto.

PS4 STANDARDS

PS4.1 Applicable national and international standards

All construction work must be undertaken in accordance with the Standard Specifications for Civil Engineering Construction SANS 1200 and or SANS 2001 family of standards for construction works.

Aforementioned, together with the amendments as indicated in Part A: Project Specifications, Part B: Variations and additions to the Standard Specifications, of this document.

Although not bound in nor issued with the Document, the following Sections of the Standardized Specifications shall form part of this Contract:

STANDARDIZED SPECIFICATIONS APPLICABLE TO THIS CONTRACT

SANS 1200

SANS 1200A	GENERAL
SANS 1200AD	GENERAL (SMALL DAMS)
SANS 1200C	SITE CLEARANCE
SANS 1200DA	EARTHWORKS (SMALL WORKS)
SANS 1200DB	EARTHWORKS (PIPE TRENCHES)
SANS 1200DE	SMALL EARTH DAMS
SANS 1200DK	GABIONS AND PITCHING
SANS 1200DM	EARTHWORKS (ROADS, SUBGRADE)
SANS 1200GA	CONCRETE (SMALL WORKS)
SANS 1200L	MEDIUM-PRESSURE PIPELINES
SANS 1200LB	BEDDING (PIPES)
SANS 1200LE	STORMWATER DRAINAGE
SANS 1200ME	SUBBASE

SOIL AND GRAVEL

SANS 1083	AGGREGATE
ASTM D2488	VISUAL-METHOD SOIL CLASSIFICATION
TRH 14	SOIL CLASSIFICATION
SANS 3001-GR30	MOISTURE-DENSITY
SANS 3001-AG1	PARTICLE SIZE
SANS 3001-GR10	ATTERBERG LIMITS
SANS 3001-NG5	NUCLEAR MOISTURE/DENSITY1
SANS 3001-GR 40	CALIFORNIA BEARING RATIO (CBR)
ASTM D3080	SHEAR BOX TEST
SANS 3001-GR20	MOISTURE CONTENT
SANS 3001-GR35	SAND REPLACEMENT TEST
ASTM D5084-90 /	HYDRAULIC CONDUCTIVITY
ASTM D2488	
ASTM D6391-11	FIELD-SCALE INFILTRATION TEST & PERMEABILITY EVALUATION
ASTM D3385 /	PERMEABILITY
ASTM D5093	

POLYETHYLENE PIPE – PHYSICAL PROPERTIES

ISO 1183	DENSITY
ISO 1133	MELT FLOW INDEX (190°C/21.6KG)
ISO 1133	MELT FLOW INDEX (190°C/5KG)
ISO 306	VICAT SOFTENING POINT (5KG)
ISO 3146-85	CRYSTALLINE MELTING RANGE
ISO 1628-3	VISCOSITY NUMBER

POLYETHYLENE PIPE – MECHANICAL PROPERTIES

ISO 868	SHORE D, HARDNESS
ISO 527	TENSILE @ YIELD
ISO 527	ULTIMATE TENSILE
ISO 527	ULTIMATE ELONGATION
ISO 527	ELASTIC MODULUS
ISO 178	FLEXURAL STRESS (3.5% DEFLECTION)
ISO 4427	DESIGN STRESS
ISO 179	NOTCHED IMPACT (CHARPY) CAN 23°C
ISO 179	NOTCHED IMPACT (CHARPY) CAN -30°C
ISO 10837	THERMAL STABILITY (OIT,210°C)
ISO 6964	CARBON BLACK CONTENT

CONCRETE

SANS 50197-1	CEMENT: OPC, RHC
SANS 50197-1	CEMENT: PBFC
SANS 50197-1	CEMENT: PC15, RHPC15
SANS 50197-1	CEMENT: GBFS
SANS 1083	AGGREGATE
SANS 5836	DRYING SHRINKAGE OF AGGREGATES
SANS 6085	DRYING SHRINKAGE OF CONCRETE
SANS 1083	AGGREGATE SIZE
SANS 5850-1	SULPHATE CONTENT: AGGREGATES
SANS 5865	DRILLING CORES
SANS 10100	PART 2 EVALUATE CORES
SANS 10100	PART 2 LOAD TESTS
BS - 8007: 1997	CODE OF PRACTICE FOR THE DESIGN OF CONCRETE S TRUCTURES FOR RETAINING AQUEOUS LIQUIDS
SANS 5861-2	SAMPLING FRESH MIXED
SANS 5861-3	MAKING AND CURING TEST SPECIMENS
SANS 5862-1	SLUMP TEST
SANS 5863	COMPRESSIVE STRENGTH (7,28 DAYS) - MORE IF REQUIRED.
SANS 5865	COMPRESSIVE STRENGTH OF CORES
SANS 667	PRECAST CONCRETE PIPES
SANS 986	PORTAL AND RECTANGULAR PRECAST CULVERTS UNITS

GEOMEMBRANE

SANS 1526	THERMOPLASTICS SHEETING FOR USE AS A GEOMEMBRANE
GRI-GM13	TEST METHODS, TEST PROPERTIES AND TESTING FREQUENCY FOR HIGH DENSITY POLYETHYLENE (HDPE) SMOOTH AND TEXTURED GEOMEMBRANES
SANS 10409	CODE OF PRACTICE FOR THE DESIGN, SELECTION AND INSTALLATION OF GEOMEMBRANES
GRI-GM17	TEST METHODS, TEST PROPERTIES AND TESTING FREQUENCY FOR LINEAR LOW-DENSITY POLYETHYLENE (LLDPE) SMOOTH AND TEXTURED GEOMEMBRANES
GRI-GM14	SELECTING VARIABLE INTERVALS FOR TAKING GEOMEMBRANE DESTRUCTIVE SEAM SAMPLES USING THE METHOD OF ATTRIBUTES

GRI-GM19	SEAM STRENGTH AND RELATED PROPERTIES OF THERMALLY BONDED POLYOLEFIN GEOMEMBRANES
ASTM D1505	DENSITY
ASTM D5199 /	THICKNESS
ASTM D5994	
ASTM D6639	TENSILE STRENGTH AND ELONGATION AT BREAK
ASTM D1603	CARBON BLACK CONTENT, % (RANGE)
ASTM D5596	CARBON BLACK DISPERSION
ASTM D5397	STRESS CRACK RESISTANCE (SP-NCTL)
ASTM D3895	STANDARD OXIDATIVE INDUCTION TIME (OIT)
ASTM D5885	HIGH PRESSURE OXIDATIVE INDUCTION TIME (HP- OIT)
ASTM D7238	UV RESISTANCE
ASTM D5321	INTERFACE SHEAR STRENGTH

COMPOUND HDPE RESIN PROPERTIES

ASTM D1505	DENSITY, G/CM3, (MIN)
ASTM D 1238	MELT FLOW INDEX

GEOTEXTILE

GRI-GT12(A)	TEST METHODS AND PROPERTIES FOR NONWOVEN GEOTEXTILES USED AS PROTECTION (OR CUSHIONING) MATERIALS
GRI-GT13(A)	TEST METHODS AND PROPERTIES FOR GEOTEXTILES USED AS SEPARATION BETWEEN SUBGRADE SOIL AND AGGREGATE
ASTM D4354	PRACTICE FOR SAMPLING OF GEOSYNTHETICS FOR TESTING
ASTM D4355	TEST METHOD FOR DETERIORATION OF GEOTEXTILES FROM EXPOSURE TO ULTRAVIOLET LIGHT AND WATER (XENON-ARC TYPE APPARATUS)
ASTM D4439	TERMINOLOGY FOR GEOSYNTHETICS
ASTM D4533	TEST METHOD FOR TRAPEZOIDAL TEARING STRENGTH OF GEOTEXTILES
ASTM D4632	TEST METHOD FOR GRAB BREAKING LOAD AND ELONGATION OF GEOTEXTILES
ASTM D4759	PRACTICE FOR DETERMINING THE SPECIFICATION CONFORMANCE OF GEOSYNTHETICS
ASTM D4833	TEST METHOD FOR INDEX PUNCTURE RESISTANCE OF GEOTEXTILES, GEOMEMBRANES AND RELATED PRODUCTS
ASTM D4873	GUIDE FOR IDENTIFICATION, STORAGE AND HANDLING OF GEOSYNTHETICS
ASTM D5261	TEST METHOD FOR MEASURING MASS PER UNIT AREA OF GEOTEXTILES
ASTM D5494	TEST METHOD FOR THE DETERMINATION OF PYRAMID PUNCTURE RESISTANCE OF UNPROTECTED AND PROTECTED GEOMEMBRANES
ASTM D6241	TEST METHOD FOR STATIC PUNCTURE STRENGTH OF GEOTEXTILES AND GEOTEXTILE RELATED PRODUCTS USING A 50-MM PROBE
ASTM D4491	TEST METHOD FOR WATER PERMEABILITY OF GEOTEXTILE BY PERMITTIVITY
ASTM D4751	TEST METHOD FOR DETERMINING APPARENT OPENING SIZE OF A GEOTEXTILE

GEOSYNTHETIC CLAY LINER

ASTM D 5993	MASS PER UNIT AREA
ASTM D 5887	INDEX FLUX

GEOCELLS

SANS 10221	MASS PER PANEL
SANS 10221	PARENT PRODUCT (THICKNESS)
SANS 10221	TENSILE STRENGTH

ELECTRONIC LEAK LOCATION

ASTM D6747-15	STANDARD GUIDE FOR SELECTION OF TECHNIQUES FOR ELECTRICAL DETECTION OF LEAKS IN GEOMEMBRANES
ASTM D7953-14	STANDARD PRACTICE FOR ELECTRICAL LEAK LOCATION ON EXPOSED GEOMEMBRANES USING THE ARC TESTING METHOD
ASTM D7002-16	STANDARD PRACTICE FOR LEAK LOCATION ON EXPOSED GEOMEMBRANES USING THE WATER PUDDLE SYSTEM
ASTM D7703-16	STANDARD PRACTICE FOR ELECTRICAL LEAK LOCATION ON EXPOSED GEOMEMBRANES USING THE WATER LANCE SYSTEM
ASTM D7909-14	STANDARD GUIDE FOR PLACEMENT OF BLIND ACTUAL LEAKS DURING ELECTRICAL LEAK LOCATION SURVEYS OF GEOMEMBRANES
ASTM D7007	STANDARD PRACTICES FOR ELECTRICAL METHODS FOR LOCATING LEAKS IN GEOMEMBRANES COVERED WITH WATER OR EARTH MATERIALS
ASTM D4439-18	TERMINOLOGY FOR GEOSYNTHETICS
ASTM D8265 – 19	STANDARD PRACTICES FOR ELECTRICAL METHODS FOR MAPPING LEAKS IN INSTALLED GEOMEMBRANES

ROADS

TMH 1	STANDARD METHODS OF TESTING ROAD CONSTRUCTION MATERIALS
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PS4.2 Particular/generic specifications

As well as the Variations and additions to the Standard Specifications' contained in Part B of Section 1: Project Specifications, of this document, the following Particular Specifications as contained in Section 1, are applicable and is attached hereto as separate documentation.

Part PN	OCCUPATIONAL HEALTH AND SAFETY SPECIFICATIONS
Part PO	BASELINE RISK ASSESSMENT

PS5 PLANT AND MATERIALS

PS5.1 Plant and materials provided by the employer

No free issue materials to be installed or use of plant will be provided by the employer.

PS5.2 Materials and samples

Contractor to undertake and submit testing of quality of Material together with strength tests required on representative samples of the materials to be used. Tests must be done in accordance with the relevant standard specifications.

The contractor, when using materials that are required to comply with any standard specification, shall, if so ordered, furnish the employer with certificates showing that the materials do so comply.

Where so specified, materials shall bear the official mark of the appropriate authority. Samples ordered or specified shall be delivered to the Employer's office on the site free of charge.

Where proprietary products have been specified, similar products may be used subject to the prior written approval of the employer.

Unless otherwise specified, all proprietary materials shall be used and placed in strict accordance with the relevant manufacturer's current published instructions.

Unless anything to the contrary is specified, all manufactured articles or materials supplied by the contractor for the permanent works shall be unused.

Earth, stone, gravel, sand, and all other materials excavated or present on the site or within the road reserve, or in borrow areas shall not become the property of the contractor, but will be at his disposal only in so far as they are approved for use on the contract.

Existing structures on the site shall remain the property of the employer and except as and to the extent required elsewhere in the contract, shall not be interfered with by the contractor in any way.

Materials to be included in the works shall not be damaged in any way and, should they be damaged on delivery or by the contractor during handling, transportation, storage, installation or testing they shall be replaced by the contractor at his own expense.

All places where materials are being manufactured or obtained for use in the works, and all the processes in their entirety connected therewith shall be open to inspection by the Employer (or other persons authorised by the Employer) at all reasonable times, and the employer shall be at liberty to suspend any portion of work which is not being executed in conformity with these specifications".

The contractor shall satisfy himself that any quarry selected for use provides the necessary mined material in accordance with the specification.

PS6 CONSTRUCTION EQUIPMENT

PS6.1 Requirements of equipment

The Contractor shall ensure that any equipment, plant, and machinery used on site is safe for use. The necessary requirements as stipulated by the OHS Act 85/1993 and Construction Regulations (2014) shall apply. The Contractor shall ensure that operators are competent and that certificates are kept on site in the health & safety file. All relevant Contractors must ensure the same.

PS6.2 Equipment provided by the employer

No equipment will be provided by the employer.

PS7 EXISTING SERVICES

PS7.1 Known services

Some known existing services exists within the site, the location of these services will be located by the Contractor.

These known services/infrastructures are indicated on the tender drawing in the table below.

Drawing no.	Description
R21-097-00-003	General Layout Plan

The Contractor shall take due care not to damage these services/infrastructures, unless instructed to do so by the client or the client's representative and is required to protect the services in their existing positions.

Not all as-built drawings were available for underground services and thus have not all been accounted for. It can however reasonably be expected that more underground services could be in existence. Foskor is to confirm the existence of these services prior to the commencement of the works on site. It is thus of utmost importance that the Contractor liaise with the Employer to expose and prove all known services in the vicinity of the works to avoid injuries, costly repairs and downtime. Measures to protect services need to be established once the position, depths and cover to services have been established.

Works required to deviate/relocate and or to possibly protect the existing services will be measured separately, provisional amounts have been allowed for in the Bill of Quantities.

PS7.2 Damage to services

Any cost of repairs, replacement and/or installation of the stations and equipment resulting from the contractor's negligence or unauthorised action shall be to the contractor's account.

PS8 SITE ESTABLISHMENT

PS8.1 Services provided by the employer

PS8.1.1 Contractor's camp site

An appropriate lay down area will be made available by Foskor.

See PS9.1

PS8.1.2 Electricity

The Employer will make available, at the employers cost, a 220V, electrical supply connection point should this be required.

The Contractor has to supply and install his own distribution system, which is subject to the Engineer's approval.

Any temporary power requirements will need to be provided by the Contractor.

The Contractor is also responsible for the maintenance of his electrical distribution system.

PS8.1.3 Water

The Employer will make available at the employers cost water for construction purposes.

See PS9.3

PS9 FACILITIES PROVIDED BY THE CONTRACTOR

PS9.1 Contractor's camp site

See PS8.1.1

The standard of the Contractor's camp, offices, ablution, and other facilities must comply with the requirements of Foskor. Details of the above shall also be submitted to the Employer for approval.

The Contractor is to fully familiarise himself with all regulations for the employment, transport, and accommodation of labour on site.

PS9.2 Electricity

See PS8.1.2

The Contractor must supply and install his own distribution system, which is subject to the Employers approval.

Any temporary power requirements will need to be provided by the Contractor.

The Contractor is also responsible for the maintenance of his electrical distribution system.

PS9.3 Water

The Employer will make available at the employers cost water for construction purposes.

The Contractor will be responsible for the transportation and distribution of water during construction.

The Contractor shall further make his own arrangements regarding the possible storage of water where required.

PS9.4 Sanitary arrangements

The Contractor will make available sanitary services for the duration of the project.

PS9.5 Fire protection

The Contractor shall provide adequate fire fighting equipment in his working area.

The type, capacity, location, and number of items of fire fighting equipment shall be to the satisfaction of the Employer's Safety Manager. The Contractor shall also ensure that his employees are trained in the operation of the equipment.

PS9.6 Refuse and waste

Separate waste disposal facilities are required for dry/wet concrete; bricks; general rubble and general domestic refuse such as paper, tins, plastics, and glass.

The Contractor will make arrangements with a waste disposal company for the removal of waste at regular intervals.

PS9.7 Accommodation and transport

The Employer will not provide any accommodation for the Contractors employees.

No accommodation for employees is to be provided on the Construction site or the Contractors lay-down area.

Transport of contractor's local employees to the Construction Site or lay-down area will be the responsibility of the Contractor.

PS9.8 Security

The Contractor is responsible for the security related to the Construction Site and the Contractors lay-down area.

The Employer is not liable for losses of the Contractor's or his Subcontractor's plant, equipment, or materials from his designated working area.

The Contractor is to set up an appropriate system to secure the Construction Site and the Contractors lay-down area to manage and control all incoming and outgoing personnel, visitors, and traffic. The Contractor is to provide details of what he proposes in this regard and the Contractors authority includes the right to search any person or vehicle before entry or exit and to refuse entrance to Site to any person not meeting security requirements.

Any breach of security must be reported to the Employer immediately.

PS9.9 Safety and First Aid

All site facilities must conform to the Occupational Health and Safety Act (Act No 85 of 1993). The Contractor shall provide first aid facilities complying with the requirements of this Act for his employees as well as the employees of his Sub-contractors and/ or visitors on site.

PS9.10 Storage facilities

The Contractor is responsible for ensuring that all equipment and materials required under his Contract are delivered to his working area and for the receipt, offloading and storage of the delivered goods.

PS9.11 Laboratory facilities

Although it shall not be a requirement of this Contract that the Contractor supply and maintain a testing laboratory on site, the proposed off-site commercial laboratory to be used shall be approved by the Employer prior to any testing for this Contract being conducted therein.

The Contractor shall provide and allow for his own facilities, operations, and procedures for the testing of materials and the process control testing of materials and workmanship in order to ensure compliance with the requirements of the specifications. The Employer will only carry out control testing. Laboratory facilities and testing apparatus can either be provided on the Site of Works or the Contractor may make use of a private laboratory to be approved by the Employer.

The Employer will not consider any claims related to delays to the Works due to test results being awaited. It is in the Contractor's own interest to ensure that samples and/or the necessary facilities are provided timeously.

Should the Contractor decide to use an outside or private laboratory, the tendered amount shall include for the Contractor's overheads, profit and all costs associated with the use of the outside laboratory (including transport of samples). Curing of the samples is the responsibility of the Contractor.

PS9.12 Vehicles and equipment

"Construction Plant" includes all types of plant including but not limited to, cranes, excavators, road vehicles, and all lifting equipment.

The Principal Contractor shall ensure that all such plant complies with the requirements of the OHS Act 85/1993 and Construction Regulations (2014). The Principal Contractor and all relevant Contractors shall inspect and keep records of inspections of the construction plant used on site. Only authorized/competent persons are to use machinery under proper supervision. Appropriate PPE and clothing must be always provided and maintained in good condition.

PS9.13 Hired plant and machinery

The Principal Contractor shall ensure that any hired plant and machinery used on site is safe for use and in accordance with Foskor specifications. The necessary requirements as stipulated by the OHS Act 85/1993 and Construction Regulations (2014) shall apply. The Principal Contractor shall ensure that operators hired with machinery are competent and that certificates are kept on site in the health & safety file. All relevant Contractors and subcontractors must ensure the same.

PS9.14 Advertising rights

The Contractor shall not publish, or cause to be published, any papers, articles or information relating to this project, nor permit any advertising mentioning the subject of this Contract, nor display, or permit to be displayed, any advertisements on the Site, or elsewhere, in connection with this Contract, without the prior permission, in writing, of the Employer. The Contractor shall be responsible for the observance of this Clause by his employees and by his Sub-Contractors.

PS10 SITE USAGE

Refer to site layout plan. The usage to be limited to the execution of the contract and shall be the immediate area where the works are to be constructed.

PS11 WATER FOR CONSTRUCTION PURPOSES

Refer to PS6.3. It is expected that water will be obtained from a tap located in the vicinity of the works.

PS12 SURVEY CONTROL AND SETTING OUT OF THE WORKS

Benchmarks for setting out the proposed works will be shown to the Contractor on official handing over of the site. The Contractor shall be responsible for setting out of the works.

The Contractor, on official handing over of the site, will be responsible to appoint a land surveyor to install beacons and confirm levels provided so that the platform design quantities can be verified by the Engineer. The Contractor will be responsible for any cost that may arise for instance to replace control, or any property beacons damaged by the Contractor during construction.

PS13 CONSTRUCTION IN CONFINED AREAS

It may be necessary for the Contractor to work within confined areas. Except where provided for in the Specifications and the Bill of Quantities, no additional payment will be made for work done in restricted areas. In certain places the width of the fill material may reduce to as little as zero and the working space may be confined. The method of construction in these confined areas will depend largely on the Contractor's constructional plant.

However, the Contractor shall note that measurement and payment shall be in accordance with the specified cross-sections and dimensions irrespective of the method used for achieving these cross-sections and dimensions, and that the tendered rates and amounts shall include full compensation for all special equipment and construction methods and for all difficulties encountered during working in confined areas and narrow widths, and at or around obstructions, and that no extra payment will be made nor will any claim for additional payment be considered in such cases.

PS14 MANAGEMENT

PS14.1 Applicable standards

Refer to PS4.

PS14.2 Particular/generic specifications

As well as the 'Part B: Variations and additions to the Standard Specifications' contained in Part B of Section 1: Project Specifications, of this document, the following Particular Specifications are applicable to this Contract and is provided in separate documentation to this contract.

Part PN OCCUPATIONAL HEALTH AND SAFETY SPECIFICATIONS
Part PO BASELINE RISK ASSESSMENT

PS14.3 Planning and programming

A detailed programme is required within 2 days after appointment of the Contractor. The programme shall not be in the form of a bar chart only but shall clearly show the anticipated quantities of work to be performed, together with the way the listed plant is to be used, as well as the anticipated earnings for the various sections of work.

Failure to comply with these requirements will entitle the Project Manager to use a programme based on his own assumptions for the purpose of evaluating claims for extension of time or additional payments.

If, during the progress of work, the quantities of work performed per week fall below those shown on the programme, or if the sequence of operations is altered, or if the programme is deviated from in any other way, the Contractor shall, within 2 days of having been notified by the Employer, submit a revised programme and network.

If the programme must be revised by reason of the Contractor falling behind his programme, he shall produce a revised programme showing how he intends to regain lost time in order to ensure completion of the Works within the time for completion. Any proposal to increase the tempo of work must be accompanied by positive steps to increase production by providing more labour and plant on site, or by using the available labour and plant in a more efficient manner.

Failure on the part of the Contractor to submit the programme or to work according to the programme or revised programme shall be sufficient reason for the Project Manager to take steps as provided in the Conditions of Contract.

The approval by the Employer of any programme shall have no contractual significance other than the Project Manager being satisfied if the work is carried out according to such programme and that the Contractor undertakes to carry out the work in accordance with the programme.

It shall not limit the right of the Project Manager to instruct to vary the programme if required by circumstances.

Tenderers shall, with their tenders, submit to the Project Manager a preliminary programme in the form of a bar chart indicating for each portion of the works, the proposed order and rate of progress of the various construction activities. The programme shall be consistent with the construction period tendered to complete the contract.

The successful tenderer shall be required to take cognisance when preparing the construction program and shall note the following:

The programme shall be in the form of a bar chart (Gantt chart) or any other time-activity form acceptable to the Project Manager, and shall clearly show:

- (i) The proposed rate of progress to complete the works within the required period as tendered, showing the various activities, their durations and proposed resourcing levels (major plant and labour) for each element of the works. Sufficient detail shall be provided to enable the Project Manager to be able to gauge construction progress. All activities, including establishment on site, trimming, and finishing and the completion of all minor ancillary works are to be included in the programme.
- (ii) The sequence of activities and any dependencies (time or resource related) between them.
- (iii) The critical path activities.
- (iv) Key dates with respect to work to be carried out, or information, etc., to be provided, by others.
- (v) Other information specifically required by the Project Manager.

In drawing up the programme the contractor shall make allowance for the following:

- a) The Contractor should compile a preliminary construction programme that caters for, but is not limited to the following items **and is to be submitted together with the RFQ submission:**
 - (i) All special non-working days defined in the Appendix to tender.
 - (ii) The expected delays defined in Section 1: Scope of Works Part A, PS 11.6.18: Extension of time resulting from inclement weather.
 - (iii) Known physical conditions or artificial obstructions.
 - (iv) Occupational, Health & Safety approvals.

- (v) The accommodation and safeguarding of public traffic.
- b) Restrictions on the supply of material from commercial sources.
 - (vi) Allowance should be made to accommodate sub-contractors working on the site.
 - (vii) Environmental requirements as per Specification.
 - (viii) Geotechnical aspects which could have an impact on the works.
 - (ix) On site access as per own requirements and construction methodology.
 - (x) Critical aspects which could have an impact on the works.

The following details shall be submitted together with the programme:

- (i) The number of working hours per day, working days per week (7h30-16h30 Mon – Thu, 7h30 – 13h30 Fri), assumed holiday or shut down periods on which the programme is based. (Where applicable)
- (ii) The overall labour and major plant resource levels and production rates on which the programme is based.
- (ii) A budget forecast of the value of completed work, excluding CPA and contingencies but including VAT, month by month, for the full contract period.

These additional items shall also be revised when any revision is made to the programme.

Failure to comply with these requirements entitles the Project Manager to use a programme based on his own assumptions to evaluate claims for extension of time for completion of the works, or for additional compensation.

Minor revisions to the approved programme may be introduced from time to time by mutual agreement between the Contractor and the Project Manager. Should the Project Manager believe that a major revision of the programme is required, the Contractor will be notified in writing and an updated programme shall be submitted within one week of receipt of such notification.

It should be noted that it is in the Contractor's interest to provide a comprehensive programme giving as much information as possible about the times allowed for the various activities as well as resource or other limitations affecting the programme, since the approved programme may be used to evaluate any claims in terms of the Conditions of Contract for extension of time.

The Contractor shall submit to the Employer, at least three working days before each weekly site meeting, copies of the following:

- (i) The contract programme with progress charts and programme graphs updated to reflect the actual progress to date.
- (ii) A summary of progress on site over the 2 weeks preceding the site meeting. The report shall be in the form of a detailed narrative to the contract programme.
- (iii) Details of activities running late, indicating what steps have been or will be taken to ensure that the work is completed within the specified time.
- (iv) A report on all labour, plant, and materials on site.
- (v) All other appendices to the bi-weekly site meeting minutes, as required by the Employer.”

c) Programme revisions

The programme will be reviewed at the bi-weekly site meetings at which the contractor shall provide sufficient detail that will allow the comparison of completed work per activity against the original approved programme. The contractor shall indicate what resources and programme changes he intends to implement to remedy any activity that has fallen behind. The Project Manager may demand from the contractor a major revision of the programme. Such a revision shall be submitted for approval within seven days of the demand.

PS14.4 Sequence of the works

The Contractor is at liberty to plan the sequence of the work based on achieving the shortest possible construction period.

PS14.5 Software application for programming

Microsoft Projects will be the software platform used for preparing and providing the programme in accordance with the requirements as set out.

PS14.6 Methods and procedures

PS14.6.1 Contractors' areas and housekeeping

Before moving onto Site, the Contractor shall indicate how he intends to utilise the Construction site and Contractors lay-down area and indicate this on a plan. The Contractor shall indicate proposed locations of offices, ablutions and toilets, stores, car park, equipment park, for the Employer's approval.

All persons on Site are expected to contribute towards keeping the Site orderly and tidy. Rubbish, such as cartons, papers, tins and bottles shall be suitably disposed of.

The Contractor and his Subcontractors shall only store waste material, rubbish, spoil, etc. at places and in a manner designated by the Employer.

Rubble and waste construction materials may not be buried or burnt.

The Contractor shall ensure that his working area and that of his Sub-contractors are kept neat, tidy and clean at all times.

If the Contractor fails to maintain satisfactory standards of housekeeping to the reasonable satisfaction of the Employer, then the Employer may undertake this work with other resources and back-charge the cost to the Contractor.

The Contractor's work is not completed until he has tidied and cleaned his working area to the reasonable satisfaction of the Employer.

PS14.6.2 Access

The professional team shall have the right to enter at any reasonable time, any part of the Contractor's working area or offices.

PS14.6.3 Hours of work

Foskor operates 24 hours a day, Monday to Sunday.

Although the Site will be accessible 24 hours a day, the Contractor is required to define his standard working hours, which must comply, with statutory requirements.

The Contractor is reminded that every employee shall take at least 24 hour continuous rest in any period of seven days.

Requests for working outside these agreed hours shall be made to the Employer at least 24 hours in advance in the prescribed format.

The Contractor shall ensure that adequate supervision is provided outside normal working hours.

PS14.6.4 Restricted areas

It is not foreseen that any areas of the site will be restricted unless so ordered by the contractor for some reason. Notices of these areas will be issued by the Contractor in writing. All personnel are expected to observe the conditions laid down in these notices.

The Contractor's employees must follow the defined roads and walkways when coming to or leaving their normal workplace. Taking short cuts through other sections of the Works or other sections of the Plant is not permitted.

PS14.6.5 Emergency procedures and safety

The Contractor will prepare issue procedures for warnings of emergency, evacuation/invacuation arrangements, communication arrangements and responsibilities for action in an emergency.

The Contractor shall submit a list of names and telephone numbers of persons to be contacted in case of accident or emergency outside normal working hours.

PS14.6.6 Access to and within the site

Access to the site of the works can be obtained from the W Central Arterial together with existing dedicated roads. Final access arrangements to be clarified at the tender briefing meeting.

PS14.6.7 Possible areas for stockpiling or spoiling of material

Construction materials may be temporarily stockpiled within the area of works or on other locations as agreed with the Employer.

All spoil material from excavations shall be hauled to and disposed of off-site as directed by the Employer, all other building rubble and waste to be disposed at the Municipal Refuse Site, Empangeni.

PS14.6.8 Dust control

The Contractor shall apply water using a water tanker at regular intervals to access and construction roads where dust is causing a nuisance. The application rate should be sufficient to keep the routes dust free during the movement of construction equipment.

PS14.6.9 Delivery of material

The Contractor shall ensure that all material delivery and removal vehicles carrying loose material are suitably covered to prevent the loss of material. The rates tendered shall include for suitable covers including for sub-contractors supplying or removing materials.

PS14.6.10 Borrow pits and spoil areas

All spoil material shall be hauled to and disposed of at the designated Local Municipality Refuse Site.

Any spoil sites other than the Municipal Refuse Site shall be determined on site in conjunction with the Employer.

The Contractor shall be permitted to use only those spoil areas approved by the Employer.

PS14.6.11 Maintenance

The Contractor shall be responsible for maintenance of the works until project handover.

PS14.6.12 Finishing and tidying

On no account must rubble and spoil materials, other materials, equipment, or unfinished operations be allowed to accumulate in such a manner as to unnecessarily impede the activities of other Contractors or Authorities.

Finishing and tidying must not simply be left until the end of the construction period. The defects liability period in respect of the Works shall commence on the date on which the works is accepted by the Employer as being completed, i.e., fully commissioned, including finishing and tidying.

On completion of the contract, the Contractor shall ensure that all materials used in the construction of the temporary site office, workshop and storage yard are removed from site.

Waste materials such as construction debris and soil contaminated with oil and fuel are to be disposed of at the solid waste disposal site used by the Local Municipality. Prior to the handover of the Site to the Employer, the Contractor and the Employer will conduct a post construction audit to determine if any additional measures are to be taken. The Completion Certificate will only be issued after this stage.

PS14.6.13 Security regulations

PS14.6.13.1 General

All personnel on the Construction Site or Contractors lay-down area must possess an identification card supplied by the Contractor. Particulars that are to be reflected on the identification card include at least the surname and initials of the employee together with an identity number, occupation and a recent photograph.

Only persons with legitimate business on the Construction Site or Contractors lay-down area and in possession of positive identification will be allowed access to these areas.

PS14.6.13.2 Vehicles

Contractors' and visitors' cars are not allowed within the Construction Site area. Cars must be parked in the car park at the Construction lay-down area.

A limited number of Contractor vehicles will be allowed entry to the Construction Site and suitable vehicle entry discs should be issued by the Contractor at the discretion of the Employer on receipt of an application signed by the Contractor.

No motorcycles, two wheel or four-wheel types will be allowed on the Site.

PS14.6.13.3 Visitors

Visitors are subject to all rules of identification, safety and discipline and if occasional must be accompanied by a host who has undergone formal Safety induction for the Construction Site. Regular visitors can apply for a permanent identification card but are then obliged to attend the Construction Site Safety induction program. A visitor is regarded to be a "regular" visitor if he/she visits the Construction Site once or more per week.

Visitors must be provided with, or provide their own, mandatory Personal Protective Equipment.

PS14.6.13.4 Recruiting

No recruiting of personnel will be allowed at the Construction Site or Contractors lay-down area.

PS14.6.13.5 Unauthorised persons

The contractor shall always keep unauthorised persons from the works. Under no circumstances may the contractor's personnel be accommodated on the site.

PS14.6.13.6 Loss of /or damage to plant or property

Any Contractor's employees found causing wilful damage to any plant or property on the Site, belonging to the Employer, the professional team or other Contractor, shall be removed from Site and such damage made good at the Contractor's expense.

PS14.6.14 Site Instruction Book

The Contractor shall supply, at his own expense an A4 size triplicate book which shall be kept in the site office. All correspondence between the employer's representatives and Contractor's site staff shall be entered into this book, and each entry signed and dated by both parties. It shall be available from the first day of the contract and at all times be accessible to the employer's representatives.

The original shall be issued to the Contractor, the first copy is to be forwarded to the office of the employer's representative's and the second copy shall remain in the book.

Employer's representative's version of the entries that have been lost will be assumed correct and binding. If the Contractor should lose the book, it will be considered a grave offence on his part. In such case the Employer's representative's version of the entries that have been lost will be assumed correct and binding.

PS14.6.15 Daily records

A site diary is to be compiled jointly by the contractor's and the employer's representative on site and is to be signed and agreed by both parties. The original signed copy is to be retained by the employer's representative.

The contractor is to keep daily records of people and equipment on site in a format to be agreed by the employer's representative and provide copies to the employer's representative when requested.

PS14.6.16 Recording of weather

The contractor shall erect a rain gauge and record the rainfall daily. This information together with other details of the prevailing weather conditions shall be recorded in the daily site diary.

PS14.6.17 Extension of time for completion

PS14.6.17.1 Climatic records and claims for extension of time arising from climatic conditions

The Contractor shall record all rainy and windy periods during the execution of the Works. The recordings shall be submitted to the Employer's Representative on a weekly basis, together with a statement recording the Contractor's opinion of the effect on the progress of the Works and on his construction program of any climatic conditions which he may consider to be abnormal and/or to constitute a reason for an extension of the time for Completion of the Works.

Claims for an extension of Time for Completion due to climatic condition whether it may be an initial or final claim in accordance with the Foskor Conditions of Contract, shall be submitted to the Employer's Representative on a weekly basis, in order that such claims may be investigated at the time.

Should the Contractor wish to invoke or submit a claim for extension of time for the completion of the Works due to the Works being delayed by reason of climatic conditions he shall do so in writing giving, inter alia, the following details:

- (1) (a) The periods and time work or the works was stopped and proceeded with.
- (b) A report on resources on site, active and/or in readiness, at the time of the alleged delay or disruption,

The reports shall be certified by the Employer's representative.

- (2) The reasons construction could not or cannot (as the case may be) proceed or commence, with reference to the approved construction program activities and an identification of the crucial path activity affected.
- (3) The circumstances surrounding any instruction by a third party to stop work due to inclement weather such as Industrial Council Officers, etc.

Only when works shall have been completed in terms of the Conditions of Contract shall the extension of time for completion resulting from climatic conditions, if any, be finalized by the Employer.

PS14.6.17.2 Principles and method for granting extension of time resulting from climatic conditions

“Normal climatic conditions” shall not be deemed to constitute “circumstance of any kind” in terms of the Conditions of Contract.

Extension of time resulting from “adverse climatic conditions” of the Conditions of Contract shall be determined in accordance with a critical path method as follows:

A delay caused by “adverse climatic conditions” will be regarded as an actual delay only if, in the opinion of the Employer, the execution of an item or items of work on the critical path of the construction program of the Contractor cannot be proceeded or commenced on. Delays on working days only (based on an ordinary working week having 45 working hours and an ordinary working day having 9 working hours) will be taken into consideration for the determination of an extension of time, but the Contractor shall make provision in his construction program for expected delays cause by “normal climatic conditions” for which he will not receive any extension of time.

The Employer shall consider extension of time due to abnormal climatic conditions over the full period of construction up to the authorized Due Completion date, i.e. including any extension thereof, which may have been granted.

Extension of time for parts of a month shall be determined by pro rata values of the expected delays in his construction program.

Although the overall effect of delays resulting from climatic conditions can only be finalized at the conclusion of the construction period, extension of time (when applicable) shall be granted at regular intervals throughout the construction period to enable the Contractor to re-program the works, provided that claims for extension of time for completion have been properly submitted by the Contractor.

PS14.6.18 Weather conditions

Rainfall station : Richards Bay

Average annual rainfall : 1,228 mm

Average number of days per year with rainfall exceeding:

Nn : Average number of days in the calendar month concerned on which a rainfall of **10mm** or more is recorded in terms of existing rainfall data

Rn : Average rainfall for the calendar month in mm deduced from existing rainfall data.

MONTH	Nn	Rn	MONTH	Nn	Rn
January	4	172	July	2	60
February	4	167	August	2	65
March	3	107	September	3	77
April	3	109	October	3	105
May	2	109	November	3	114
June	2	57	December	3	86

PS14.7 Quality plans and control

The Contractor shall maintain an effective quality system, which meets the ISO 9000 Series or equivalent standard, to ensure and demonstrate that material or services provided conform to the specified requirements.

The Contractor shall be required to submit his detailed quality assurance system to the Employer for approval. Any specialist sub-contractor/supplier shall be required to submit his detailed quality assurance system to the Employer for approval, prior to the supply of any materials.

The contractor shall submit the quality assurance system he proposes using to the Employer, for his approval, within ONE week prior to the site handover. Once accepted by the Employer the contractor shall not deviate from it unless written notification of proposed changes has similarly been submitted and approved. The system shall record the lines and levels of responsibility and indicate the method by which testing procedures will be conducted.

PS14.8 Accommodation of traffic

PS14.8.1 Safety of the travelling public

All works fall within the boundaries of the site and will not affect the public.

PS14.8.2 Safety of the Foskor employees and road users

The safety of the Foskor employees and road users are of utmost importance and every effort must be made to ensure that all road signs, barricades, delineators, flagmen and speed controls are maintained and effective and that courtesy is always extended to all users whenever this is required.

PS14.9 Other contractors on site

In addition to the work undertaken by the Contractor, other works (services) could be undertaken by other contractors during the same period.

The Contractors shall liaise with one another and so organise their operations in such a manner that will permit the Works in their entirety to proceed without delay and without damage to the works.

No separate payment will be made for liaising and general planning and co-ordination of construction activities.

PS14.10 Management of the environment

Respect for the environment is important for this contract. The environmental control of the site shall be governed by sound Environmental Management Practices, which should provide inter alia for:

- (a) The Contractor must allow for the satisfactory combating of dust and noise nuisance throughout the contract length during construction.
- (b) The Contractor must make provision for the prevention of excessive erosion and siltation throughout the Contract. Should excessive erosion and/or siltation take place on site or surrounding area as a direct result of the Contractor's construction activities it will be the Contractor's responsibility to make good the erosion/siltation to the satisfaction of the landowner and the Engineer, all at the cost of the Contractor.
- (c) No littering by construction workers shall be allowed. A refuse control system shall be established for the collection and removal of refuse to the satisfaction of the Engineer and Foskor.
- (d) Adequate provision shall be made for temporary toilet requirements in construction areas. Use of the veld for this purpose shall not, under any circumstances be allowed.

- (e) Streams, rivers and dams shall be protected from direct or indirect spillage of pollutants, such as effluent, refuse, garbage, cement, concrete, sewage, chemicals, fuels, oils, aggregate tailings, wash water, organic materials and bituminous products. In the event of spillage, prompt action shall be taken to clear the affected area. Emergency measures in the event of spillage must be set out and the responsible person made aware of the required action.
- (f) Bituminous and/or other hazardous products shall not be spoiled on site and may only be disposed of in licensed authorised disposal facilities.
- (g) Control of invader species of plants.
- (h) Clearing shall be limited to the site, which shall be sited in consultation with the Engineer and Foskor.

PS14.11 Site meetings and procedures

Over and above the requirement of monthly site meetings, weekly technical meetings will be held.

The meetings will be held to discuss technical issues and monitor progress.

The contractor shall keep on site a set of minutes of all site meetings, daily records of resources (people and equipment employed), a site memoranda book, a complete set of the latest contract working drawings and a copy of the procurement document and make these available at all reasonable times to all persons concerned with the contract.

PS14.12 Management meetings

The contractor will be required to hold management meetings with site management staff and sub-contractors on a weekly basis and to be held on Mondays at a time convenient to all concerned, to discuss planning, co-ordination and scheduling of tasks planned for the week ahead also to discuss health and safety amongst other things. A brief description of activities and works planned for the week will be provided to the Project Manager every Monday.

PS14.13 Guarantees

Contractor to provide a guarantee in accordance with the Condition of Contract in the prescribed format and to the sum as stipulated.

PS14.14 Insurance provided by the employer

Insurance of "The Works"

The Employer will **not** insure the Works and the Contractor will be responsible for insurance of the works in terms of the Conditions of Contract.

PS14.15 Payment certificates

Payment certificates to be submitted by the contractor to the Employer by the 20th of each month. The Employer will verify and approve the certificate. The target date for submission of payment certificates to the employer will be the 25th of each month. There could be financial cut off dates for payment submission to Foskor and these need to be established and confirmed prior to first payment submission. The Employer is to make payment within 30 days after submission of an approved invoice.

Details of measurements, proof of payment for items contained in provisional sums, proof of ownership of materials on site and documentation pertaining to contract price adjustment and special materials, are required as substantiation of claims for payment.

PS14.16 Electronic payments

Payments of approved payment claims will be made electronically upon submission of the contractor's banking details.

PS15 HEALTH AND SAFETY

Health and safety requirements and procedures.

PS15.1 General statements

It is a requirement of this contract that the Contractor shall provide a safe and healthy working environment and to direct all his activities in such a manner that his employees and any other persons, who may be directly affected by his activities, are not exposed to hazards to their health and safety.

To this end the Contractor shall assume full responsibility to conform to all the provisions of the Occupational Health and Safety Act No 85 and Amendment Act No 181 of 1993, and the OHS Act 1993 Construction Regulations 2014 issued in 2014 by the Department of Labour.

For the purpose of this contract the Contractor is required to confirm his status as mandatory and employer in his own right for the execution of the contract by entering into an agreement with the Employer in terms of the Occupational Health and Safety Act in the form as included in Section 7, Form 7.2.

PS15.2 Health and Safety Specifications and Plans

- (a) Employer's Health and Safety Specification
- (b) Tenderer's Health and Safety Plan

The Tenderer shall submit with his tender his own documented Health and Safety Plan he proposes to implement for the execution of the work under the contract. His Health and Safety Plan must at least cover the following:

- (i) a proper risk assessment of the works, risk items, work methods and procedures in terms of Regulations 7 to 28;
- (ii) pro-active identification of potential hazards and unsafe working conditions;
- (iii) provision of a safe working environment and equipment;
- (iv) statements of methods to ensure the health and safety of subcontractors, employees and visitors to the site, including safety training in hazards and risk areas (*Regulation 5*);
- (v) monitoring health and safety on the site of works on a regular basis, and keeping of records and registers as provided for in the Construction Regulations;
- (vi) details of the Construction Supervisor, the Construction Safety Officers and other competent persons he intends to appoint for the construction works in terms of Regulation 6 and other applicable regulations; and
- (vii) details of methods to ensure that his Health and Safety Plan is carried out effectively in accordance with the Construction Regulations 2014.

The Contractor's Health and Safety Plan will be subject to approval by the Employer, or amendment if necessary, before commencement of construction work. The Contractor will not be allowed to commence work, or his work will be suspended if he had already commenced work, before he has obtained the Employer's written approval of his Health and Safety Plan.

Time lost due to delayed commencement or suspension of the work as a result of the Contractor's failure to obtain approval for his safety plan, shall not be used as a reason to claim for extension of time or standing time and related costs.

PS15.3 Cost of compliance with the OHS Act Construction Regulations

The rates and prices tendered by the Contractor shall be deemed to include all costs for conforming to the requirements of the Act, the Construction Regulations and the Employer's Health and Safety Specification as applicable to this contract.

Should the Contractor fail to comply with the provisions of the Construction Regulations, he will be liable for penalties as provided in the Construction Regulations and in the Employer's Health and Safety Specification.

PART B: VARIATIONS AND ADDITIONS TO THE STANDARDIZED SPECIFICATIONS

In certain clauses in the Standard Specifications, allowance is made for a choice to be specified in the Project Specifications between alternative materials or methods of construction and for additional requirements to be specified to suit a particular contract. Details of such alternatives or additional requirements applicable to this contract are contained in this part of the Project Specifications. It also contains the necessary additional specifications required for this contract.

The clauses and payment items dealt with in this part of the Project Specifications are prefixed "PS" and numbered sequentially. The number corresponding to the relevant clause or item number in the Standard Specifications is given in parenthesis.

New clauses and payment items not covered by clauses or items in the Standard Specifications have also been included here.

Additional specifications where applicable are prefixed "P" and numbered alphabetically.

PART B: VARIATIONS AND ADDITIONS TO THE STANDARDIZED SPECIFICATIONS

SUB-CLAUSE REFERENCE

The sub-clause in brackets refers to the sub-clause in particular in the standardised specifications of SANS 1200.

PSA GENERAL

PSA3 MATERIALS

PSA3.1 QUALITY

Substitute the second sentence of the first paragraph of A 3.1 with the following:

"Where applicable and/or where specified, materials shall comply with the relevant SANS specifications.

Substitute the second paragraph with the following:

The Contractor is responsible for the cost of all testing to ascertain that the materials do comply with the specified minimum requirements of the relative materials and no additional payment will be made for such testing.

The Contractor shall conduct all quality control tests in the shortest possible time and shall submit to the Engineer authenticated copies of all quality control tests conducted within 24 hours of completing the tests and shall deliver samples of all materials to the Engineer for check testing. The frequency, number and volume of samples will be determined by the Engineer."

The Contractor shall inform the Employer of any control testing to be done at least 48 hours before such tests are required and must allow in his program for the time necessary for the tests and the processing of the results thereof.

The Employer will take samples from stockpiles or from construction material on site. Samples shall not be delivered direct to the Employer's office.

The Contractor shall be responsible for the cost of failed test samples and control testing.

PSA3.3 ORDERING OF MATERIALS

Add the following additional Clause:

“The quantities set out in the Schedule of Quantities have been carefully determined from calculations based on data available at the time and should therefore be considered to be only approximate quantities.

The liability shall rest entirely and solely with the Contractor to determine before ordering, the required types and quantities of the various materials required for the completion of the Works in accordance with the specifications and the Drawings issued to the Contractor for construction purposes.

Any reliance placed by the Contractor on the estimated quantities stated in the Schedule of Quantities issued for tendering purposes, or measurements made by the Contractor from the drawings issued for tendering purposes, shall be entirely at the Contractor's risk, and the Employer accepts no liability whatsoever in respect of materials ordered by the Contractor on the basis of tender documents.”

PSA3.4 SOURCES OF MATERIALS

Add the following additional Clause:

“Granular materials requirements shall be met from the following sources:

- | | | |
|------------------------|---|------------------------------|
| a) Natural Gravel (G5) | : | Approved commercial sources. |
| b) Natural Gravel (G7) | : | Approved commercial sources. |
| c) Natural Gravel (G9) | : | Approved commercial sources. |
| d) Natural 19mm stone | : | Approved commercial sources. |

The Contractor shall ensure that:

- i) Classification of all materials have been delivered to the Engineer for approval prior them being utilized for construction of the works.
- ii) Written approval of the source is obtained prior to commencement of construction.
- iii) That the quality and consistency of the materials are routinely checked, in accordance with the specifications, and the test results are submitted to the Engineer within 24 hours of completion of the tests, which are to be conducted in the minimum time period applicable to the test in question.

Any out of specification materials incorporated into the works shall be removed and replaced or modified, as instructed by the Engineer, at the Contractor's cost and the Contractor shall also bear the cost of any testing or investigations arising out of the use of materials not complying to the specifications.

No overhaul shall be payable on materials from designated and/or commercial sources.”

PSA5 CONSTRUCTION

PSA5.1 SURVEY

PSA5.1.1 Setting out of the works

Substitute the first sentence in A5.1.1 with the following:

“Setting out of the works is the sole responsibility of the Contractor and shall be done from survey beacons identified by the Employer. The Contractor shall, within one (1) week after the site has been handed over to him, confirm himself that the survey beacons are correct. Any discrepancy shall immediately be reported in writing to the Employer. Any costs or subsequent costs arising from discrepancies which had not been reported to the Employer within the aforementioned period shall be the sole responsibility of the Contractor. A grid of final terrace levels over the site of the works will be issued to the Contractor once the levels have been taken (and pegs installed) by the Contractor and issued to the Engineer. It is the Contractors responsibility to preserve all setting out pegs based on this information as given for the duration of the contract.

Setting out of the works will not be measured and paid for directly, and compensation for the work involved in setting out shall be deemed to be covered by the rates and process tendered and paid for the various items of work included under the contract.”

PSA5.1.3 Survey beacons

Add the following additional Clause:

“The Contractor shall take care not to disturb any of the installed site boundary beacons. Permanent benchmarks and survey base line beacons will be provided under the Contractor’s contract. The Contractor shall still ensure that they are protected at all times.

The Contractor shall establish any additional temporary benchmarks he deems necessary and shall be responsible for setting out all work from the survey base lines.

The Contractor shall make available all survey data relating to setting out of the works if requested by the Engineer.”

PSA5.4 PROTECTION OF OVERHEAD AND UNDERGROUND SERVICES

Add the following paragraph:

“The Contractor shall as soon as possible after handing over of the site, commence with the detection of existing services, continue with it without interruption and finalize it at least 3 days before excavation starts at that particular section.”

PSA5.5 DEALING WITH WATER ON WORKS

The Contractor’s attention is specifically drawn to the requirements of sub-clause 5.5 in that adequate measures are to be implemented at all times to ensure that the works are kept dry for their proper execution. This will entail, but not necessarily be restricted to, any or all of the following measures:

- a) Ensuring that at all times, the site is graded such that surface water can drain and no standing water remains on the site.
- b) Ensuring temporary measures are put in place to accommodate stormwater and/or ground water accumulation in the Primary and Secondary dams so the works are maintained dry during construction activities.

PSA5.6 POLLUTION

Add the following at the end of the sub-clause:

“The location of this Project within an existing production facility requires greater emphasis on dust and silt pollution control. The Contractor is referred to the relevant clauses in this regard under the different sections of SANS 1200:

SANS	1200	A5.6	Pollution
SANS	1200	D5.1.3	Stormwater
SANS	1200	D5.1.4	Nuisance
SANS	1200	D5.2.2.3	Spoil.”

PSA6.1 DEGREES OF ACCURACY

Add the following paragraph:

“Degree of Accuracy II as specified, shall apply to all work under this Contract, except where specified otherwise on the drawings for a particular section of the Works.”

PSA7 TESTING

PSA7.1 PRINCIPLES

PSA7.1.1 Checking

Add the following paragraphs:

“Every completed section of the Works shall be subject to check testing by the Contractor. Once the contractor is satisfied with the standard of his works, the Employer must be requested by the Contractor to perform acceptance testing for the particular section. The Contractor shall provide the Employer with the results of his check testing indicating that the work is to specification.

Failure by the Contractor to notify the Employer or to provide the required test results may be grounds for withholding of payment for the associated work and for all subsequent work which would be affected by the failure of the Work to be tested.

The Employer will be under no obligation to the Contractor to perform the tests. If the Employer elects not to perform an acceptance test after notification by the contractor, he will issue the Contractor with a written instruction to proceed with the relevant works without the acceptance test being performed.

Nothing contained in this clause will relieve the Contractor of his responsibilities under the specification, or in any way limit the tests that the Employer may call for or perform in terms of the specification.

The contractor shall be responsible for the execution of all compaction tests, where necessary. The contractor may use his own laboratory, if approved, or an approved independent laboratory for the execution of the abovementioned tests.

All quality control tests to ensure that work is done according to specifications will be for the contractor's account. It is assumed that these costs are included in the rates of items that are subjected to quality control tests.

All tests' results shall as soon as available immediately be given to the Employer for approval.”

PSA7.2 APPROVED LABORATORIES

Add the following paragraph:

“A laboratory approved by the Employer shall do the acceptance testing. The Employer requires forty-eight hours' notice from the contractor to perform the relevant acceptance test. Failure by the Contractor to notify the Employer or to provide the required information or, where specified, to perform the required test, may be grounds for withholding of payment for the associated work and for all subsequent work which would be affected by the failure of the work to be tested.”

In addition to approval by the Employer, the laboratory should have SANS approval for the testing to be carried out.

All acceptance testing by the Employer shall be paid for by the contractor.

The costs of such tests that meet the specification requirements will be reimbursed to the Contractor in the monthly payment certified.

A provisional Sum has been provided in the Schedule of Quantities to allow for the cost of such testing.

The contractor shall make due allowance for testing procedures in his construction programme.

PSA7.4 STATISTICAL ANALYSIS OF CONTROL TESTS

Substitute A7.4 with the following:

“Test results shall not be evaluated by statistical methods. All results shall comply with the specified minimum requirements of the materials concerned. Full and complete test results are to be made available to both the Engineer and Foskor.”

PSA8.1.2 PRELIMINARY AND GENERAL ITEMS OR SECTION

Replace the definitions for fixed charge, time-related charge and value-related charge with the following :-

“Fixed Charge : A charge that is not subject to adjustment on account of variation in the value of the Contract amount or the Contract time for completion.

Time-related Charge : A charge, the amount of which is varied in accordance with the time for completion of the work as adjusted in accordance with the provisions of the Contract.

Value-related Charge: A charge, the amount of which is varied pro rata the final value of the measured work executed and valued in accordance with the provisions of the Contract.”

PSA8.1.2.2 TENDERED SUMS

Replace the contents of this sub-clause with the following:-

“The Contractor’s tendered sums under items PSA8.2 and PSA8.3 shall collectively cover all charges for:-

- Risks, costs and obligations in terms of the General Conditions of Contract and of this Standardised Specifications, except to the extent that provision is made in these Project Specifications to cover compensation for any of these items of work.
- Head-office and site overheads and supervision, including the Liaison Officer where required in terms of the Project Specifications.
- Profit and financing costs
- Expenses of a general nature not specifically related to any item or items of permanent or temporary work
- Providing facilities on Site for the Contractor’s personnel, including offices, storage facilities, workshops, ablutions, for providing services such as water, electricity, sewerage, sewerage and rubbish disposal, for access roads and all other facilities required, as well as for the maintenance and removal of completion of the Works of these facilities and the cleaning up of the camp site on completion of the works.
- Dealing with water.
- Providing facilities for the Employer’s Agent and his staff as specified in SANS 1200 AB and in these Project Specifications.

PSA8.3.3 As-built drawings (additional obligation)

The Contractor is to provide, on prints supplied by the Employer, co-ordinate values in addition to cover levels and invert for all manholes (where relevant), catchpits or other stormwater structures, platform levels, constructed during the course of the contract. This information must be certified as a true and correct reflection of the finished works. The price tendered for carrying out such work shall be inclusive of all costs, albeit indirect or direct to the Contractor. The survey needs to be carried out by a suitably qualified Surveyor.

No additional payment shall be made for this service and all costs related thereto shall be deemed to be included in the scheduled item in the Bill of Quantities.

PSA8.8.4 Existing Services

Add the following to A8.8.4:

“Where the Contractor is responsible for the cost of repairs carried out by the Employer or others, the costs will be recovered by means of a deduction from the Contractor’s monthly payment certificate. The Employer will attend to the payment of monies due to others.”

PSC SITE CLEARANCE

PSC3 MATERIAL

PSC3.1 DISPOSAL OF MATERIAL

Substitute the first sentence of C3.1 with the following:

“Material obtained from excavations and spillage on site shall be disposed of at the municipal dump site or an appropriate dump site located by the Contractor and approved by the Employer.”

PSC5.6 CONSERVATION OF TOPSOIL

Add the following:

“All topsoil shall be stockpiled and maintained on the site for re-use. The temporary stockpiles will be within the free haul distance which is set at 0.5km.”

PSC5.9 DUST CONTROL

Add the following new sub-clause:

“The Contractor shall be responsible for controlling dust and shall be liable for all claims arising from dust nuisance.”

PSC8.2.5 TAKE DOWN EXISTING FENCES

Add the following to the heading of C8.2.5:

“AND REINSTATE WHERE INDICATED”

Substitute the first sentence of C8.2.5 with the following:

“The rate shall cover the cost of carefully taking down the fences and reinstalling where indicated by the Employer. The quantity specified shall include for both removal and reinstallation.

The existing property perimeter fences are to be protected at all times and any damage to this will be for the contractors account.

PSD EARTHWORKS

PSD3 MATERIAL

PSD3.1 CLASSIFICATION FOR EXCAVATION

Machine excavation

Notwithstanding Clause 3.1 of SANS 1200D, no classification will be made for either intermediate or boulder excavation. The classification for excavation will be as follows:

- 1.1 Rock excavation : All material that cannot be removed otherwise than using compressors and jack hammers, or alternatively by blasting.
- 1.2 Soft excavation : All material that is not classified as rock excavation
Payment for rock excavation will only be approved if the Employer has classified the excavation as such in writing before commencement of the excavation under Clause 1.1 above.

PSD3.2 CLASSIFICATION FOR PLACING PURPOSES

PSD3.2.1 Material suitable for embankments and terraces material to be G5 quality natural gravel.

PSD3.3 SELECTION

PSD3.3.1 General

Any imported material in platform areas that do not comply with the minimum requirements for the respective layers, shall be removed and replaced with suitable material.

The Contractor shall deal in such a way with materials from all excavations for the removal of unsuitable material to ensure that usable material is not contaminated with unsuitable material. If usable material is contaminated, such contaminated material shall be removed and replaced with suitable material, all at the Contractor's expense. No additional payment shall be made in respect of this, and all relevant costs shall be deemed to be included in the tendered rates.

All unsuitable material shall be removed prior to importing fill material to such areas.

PSD5 CONSTRUCTION

PSD5.1 PRECAUTIONS

PSD5.1.2 Existing Services

PSD5.1.2.2 Detection, location, and exposure

Add the following paragraph:

"If existing services are not shown on the drawings but the existence thereof can be reasonably expected, the Contractor shall, in conjunction with all relevant Foskor representatives determine the exact depth and location of such services before the commencement of construction."

After locating the exact position of services, whether indicated on the drawings or not such services shall be deemed to be known services and the Contractor shall be liable for all costs and subsequent costs arising from the damage thereof as a result of the Contractor's activities. These services must also be indicated on the "As Built" drawings.

PSD5.1.2.3 Protection of Cables

Substitute “estimated position” in the second sentence of D5.1.2.3 with “actual or exposed position.”

PSD5.1.2.4 Negligence

Where a service is damaged due to the Contractor’s negligence, he should bear the full costs of repairs to the service. These repairs will be carried out by the relevant authority, or at their decision, by the Contractor to the satisfaction of the relevant authority.

PSD5.1.3 Stormwater and Groundwater

Add the following to clause:

“The Contractor shall properly deal with and dispose of water to ensure that the Works are kept sufficiently dry for their proper execution.

Under no circumstances will any claim be entertained for dewatering, or waterlogged conditions. The Contractor will control all surface and sub-surface water during construction, and the cost of such, will be deemed to be included in the rates tendered for excavations.”

It must be noted that groundwater at the site can be encountered at depths as shallow as 0.6m to 1.4m below the existing ground level. The elevation of groundwater seepage is influenced by the rainfall and during the wet season the elevation of the perched water table can rise particularly after prolonged heavy storm events. The contractor can expect groundwater when excavating for the pollution control dams and the contractor must make provision to take the necessary temporary precautions to direct groundwater and/or stormwater away from his excavations.

PSD5.1.4 Nuisance

PSD5.1.4.1 Dust nuisance

Add the following paragraphs:

“The Contractor is responsible for dust control and is liable for all claims that may result from dust nuisance on all parts of the site and at all times from the date of handing over of the site to the completion date of the contract. No payment regarding the above-mentioned will be made and all costs shall be deemed to be covered by tendered rates.”

The Contractor shall take the necessary precautions to prevent dust/sand blowing onto or into the existing factory facilities during the construction period.

Where necessary, stabilization deemed will be specified, but during construction the Contractor will be responsible for keeping the sand damp to prevent wind erosion. Provision for keeping soil damp must be included in the Contractor’s tender rates for the control of pollution under the Preliminary and General section.

PSD5.1.6 Road Traffic Control

Add the following paragraphs:

- a) Sufficient road signs must be erected in such a way that road users will be warned in time of works, e.g. At the closing of a street sufficient signs to direct traffic must be erected at the preceding intersection.
- b) Bypasses and/or road signs shall be provided and/or erected at all locations where the free flow of traffic is obstructed and shall be approved by the Employer before the commencement of construction. Where main roads are crossed, detours and temporary traffic signs must be provided.

- c) Danger tape must be put up between drums and tied around the drums.
- d) Drums may not be filled with stones. The spacing of drums must be in such a way (maximum 5 m) that they are visible from all directions.
- e) Sufficient safety measures must be utilized for pedestrians.”

PSD5.2 METHODS AND PROCEDURES

PSD5.2.1 Site Preparation

PSD5.2.1.2 Conservation of topsoil

Add the following paragraph:

“Removal of topsoil shall only occur in areas as approved, in writing, by the Employer. The topsoil shall be conserved for use elsewhere.”

PSD5.2.2 Excavation

PSD5.2.2.3 Disposal

Substitute the second sentence of this clause with the following paragraph:

“All surplus and unsuitable material shall be disposed of as directed by the Employer.”

PSD5.2.3 Placing and Compaction

The minimum compaction requirement of fill Cohesive soil. G7 Gravel/soils to be compacted to a minimum of 93% of MOD AASHTO density. G5 Gravel/soils to be compacted to a minimum of 96% of MOD AASHTO density. Non-cohesive soil to 100% of MOD AASHTO density.

PSD5.2.5 Transport for earthworks

PSD5.2.5.1 Free haul

Add the following paragraph:

“The movement of cut material will be taken as free haul, with no additional payment for loading, handling Haulage and placement in the final position.

The free-haul distance applicable will be 0.5km.”

PSD5.2.5.2 Overhaul

PSD5.2.5.2.1 Limited overhaul

No allowance will be made for limited overhaul.

PSD5.2.5.2.2 Long overhaul

No allowance will be made for long overhaul.

PSD5.1.7 Fencing

Add the following new sub-clause:

“The existing property perimeter fences are to be protected at all times and any damage to this will be for the contractors account.”

PSD6 TOLERANCES

PSD6.1 POSITION, DIMENSIONS, LEVELS, ETC

Add the following paragraph:

“Degree of Accuracy II shall apply.”

PSD7.4 QUALITY CONTROL PLAN

The Contractor shall be responsible for all quality control on the project.

It is a requirement of the contractor to provide the Engineer within 14 days of contract award a detailed Quality Control Plan for prior approval before construction commences. The Quality Plan should include a responsibility matrix for each construction activity showing and identifying all actions, processes, frequencies and test types required.

The above should also include all hold, witness, surveillance, approval, testing and verification points required.

PSD7.5 SOIL TESTING ON SITE

All soil testing shall be carried out in accordance with TMH1 and only by an accredited soil testing laboratory.

Quality tests must be conducted on all the materials that are to be used for the earthworks and or layerworks and these test results must be submitted to the Engineer for prior approval before the materials can be used.

During construction, quality tests shall be carried out by the contractor in accordance with the test frequencies stated in the table below and these tests will be deemed to be included in the contractor’s rates for each item priced in the bill of quantities.

ACCEPTANCE QUALITY CONTROL: MINIMUM SAMPLING FREQUENCIES

COMPONENT	PROPERTY	QUANTITY PER TEST (MAX)	LOT SIZE (MAX)	SAMPLES PER LOT (MIN)
Embankments - Rockfill		Not tested	Too coarse	
Embankments - soils and gravel	Indicator	10,000m ³	Completed layer	4
	Relative compaction	2,000m ³		4
	CBR	10,000m ³		4
Cuttings & natural formation: Soils & gravels in top 150mm below bottom of selected subgrade	Indicator	2,500m ²	Section	4
	Relative compaction	2,500m ²	Section	4
	CBR	10,000m ²	Section	2
Subbase & selected subgrade (unstabilised)	Indicator	2,500m ²	Section	4
	Relative compaction	2,500m ²	Section	6
	CBR	5,000m ²	Section	2
Subbase & selected subgrade (stabilised)	Indicator	2,500m ²	Section	4
	Relative compaction	2,500m ²	Section	6
	UCS & ITS (each)	2,500m ²	Section	4
	Stabiliser content	500m ²	Section	20
Base (crushed stone & natural gravels)	Indicator	2,500m ²	Section	4
	Relative compaction	2,500m ²	Section	6
	CBR (only natural gravels)	5,000m ³	Section	2
	ACV (only crushed stone)	5,000m ²	Stockpile	4
Aggregates for concrete	Grading	250m ³	Stockpile	4
	.5 Organic Impurities	250m ³	Stockpile	4
	ACV	5,000m ³	Stockpile	4

PSD7.7 TESTING OF BORROW PIT AND COMMERCIAL SOURCES

PSD7.7.1 General

Samples should be tested in accordance with the TMH1 Manual, except where otherwise prescribed. The frequency of sampling and testing required is described in paragraphs above.

Borrow materials are evaluated by means of indicator and strength tests and the wet-dry durability test. The determination of the sand equivalent can also be useful.

The strength tests normally used are the CBR, the UCS and the ITS test.

The CBR test is used to determine the strength of unstabilised gravel, and also the strength of materials stabilised mainly for modification. By the latter is meant stabilisation to reduce the plasticity of the material and not so much to increase the strength.

The UCS, ITS and wet-dry durability tests are used where stabilisation is applied mainly to improve the strength of the material, i.e. where cementation is desired.

Aggregate for crushed stone is evaluated by means of the 10 FACT and ACV tests, Ethylene Glycol weathering test, indicator tests and the determination of pH and soluble salt content.

PSD7.7.2 Strength and durability tests on borrow pit samples

The type of strength test used on stabilised samples is determined by the type of stabilisation envisaged, namely cementation or modification as described in PSD 7.7.1.

PSD7.7.2.1 UCS Tests

Stabilisation tests are carried out on samples for, sub-base and base but not crushed stone for base.

For cement, stabilisation tests are carried out with any of CEM1, CEM 11 or CEM 111 cement.

The stabilisation agent or agents tested depend on the material concerned and the most economical or the locally available agents. Tests should be carried out using more than one stabilising agent in order to determine which one reacts best with the material concerned.

It is advisable to discuss in advance with the Client the stabilising agent/s to be used before extensive testing is carried out.

The strength tests and wet-dry durability of samples stabilised for cementation are determined to TMH1 tests. On each sample to be stabilised, the CBR of the unstabilised material and the strength tests of the stabilised material must be executed according to TMH1 methods or other methods required by the Client. TMH1 methods A7, A8, A9, A14, A 16T and a modified version of A 19 are applicable.

The Mod. AASHTO moisture/density relation of both stabilised and unstabilised materials must be determined before strength tests are carried out. The compaction moisture content for the strength tests must be within 0,3 of the optimum moisture content.

The apparatus must be in good order and according to the TMH1 requirements.

- (a) Three briquettes at Mod. AASHTO compaction
- (b) Three briquettes at NRB compaction
- (c) Three briquettes at Proctor compaction

Preparation of material and compaction of Briquettes shall be according to TMH 1 method A16T.

The average compressive strength at each compactive effort is determined and plotted vs compaction graphically.

PSD7.7.2.2 CBR testing for modification

In the case of samples to be stabilised for modification, the CBR of the unstabilised and stabilised material must be determined.

The compaction moisture content for the CBR determination must be within 0,3 of the optimum moisture content. Three different compactive efforts are applied as described in TMH1 method A8.

Samples stabilised with lime for modification are compacted 24 hours after the lime has been mixed in. After compaction the samples are cured for 7 days and then soaked for 4 days before the CBR is determined.

PSD7.7.2.3 Wet-dry durability test

On one sample of each sub-base and base borrow pit and in doubtful cases the wet-dry durability test should be carried out on stabilised samples, particularly where materials comply with strength but not all other requirements. The test is done in accordance with a modified TMH1 method A19.

PSD7.7.2.4 Initial lime consumption test

The test can be used for weathered basic igneous rocks and for materials where the strengths normally obtained from similar materials are not attained. The test gives an indication of the presence of an abnormally high content of matter deleterious to the stabilising agent. This reaction can be confirmed by the wet-dry durability test.

PSD8 MEASUREMENT AND PAYMENT

PSD8.2 COMPUTATION OF QUANTITIES

PSD8.2.1 Bulk earthworks quantities shall be measured from cross sections based on the survey of the total site. The contractor is at liberty to verify these levels by taking his own on-site measurements.

Should there be any discrepancy on these levels, the Contractor shall immediately notify the Employer before construction commences.

PSDB EARTHWORKS (PIPE TRENCHES)

PSDB4.2 CONTROL OF WATER

Add the following paragraph:

“The Contractor will control all surface and sub-surface water during construction, and the cost of such, will be deemed to be included in the bid rates for excavations.”

PSDB5.1.2 Stormwater, Seepage and Dewatering of Excavations

PSDB5.1.2.1 Throughout the works

Add the following paragraph:

“Under no circumstances will any claim be entertained for dewatering, or waterlogged conditions. The Contractor will control all surface and sub-surface water during construction, and the cost of such, will be deemed to be included in the rates tendered for excavations.”

PSDB5.4 Excavation

The length of open trenches at any time shall by no means exceed 200m in length per service. Should this happen, the Employer’s Agent shall have the right to intervene and stop the excavation process until such time as may be deemed necessary for the pipe laying team and backfilling team to meet the prescribed open trench lengths. The Contractor must ensure that all excavation is progressive and that sections are not passed over without discretion from the Employer’s Agent.

The minimum trench width will be in accordance with the trench detail drawing. Minimum cover to be 1 000mm under roads and in road reserves, while a minimum cover of 600mm will be accepted elsewhere.

Excavation for pipe trenches in all materials by means of machine or hand excavation should allow for collapsing and saturated soil conditions. The Contractor shall properly deal with and dispose of water to ensure that the Works are kept sufficiently dry for their proper execution. Allowance for the above should be made and will be deemed inclusive in the bid rates for excavations.

PSDB5.6 BACKFILLING

PSDB5.6.9 OVER EXCAVATIONS

Add the following new sub-clause:

All over excavations will be backfilled to prescribed levels with granular material and compacted to 93% mod. AASHTO at the Contractors own expense.

PSDB5.7 COMPACTION

PSDB5.7.1 Areas not subject to Traffic loads

The minimum compaction requirement of Cohesive soil will be 93% of mod AASHTO density.

PSDB5.7.2 Areas subject to Traffic loads

The minimum compaction requirement of Cohesive soil will be 95% of mod AASHTO density.

PSDB5.7.3 Excessive water conditions

Sub-soil drainage to be installed in accordance with specific details and layout drawing provided.

PSGA CONCRETE (SMALL WORKS)

PSGA5.4 CONCRETE

PSGA5.4.1 Quality

PSGA5.4.1.5 Strength concrete

The required strength concrete for each section of the works is as follows:

- Concrete v-drain and trapezoidal channel: 25MPa, maximum nominal size of coarse aggregate 19mm.
- Kerb channel, access ramps and walkways 30m MPA - 19mm.
- Concrete for headwalls: 30MPa, maximum nominal size of coarse aggregate 19mm.

PSGA5.4.1.6 Ready mixed concrete

Should the contractor decide to use ready mixed concrete, the Contractor shall take test cubes of each batch delivered to site, regardless of any samples that may have been taken by the concrete supplier at the batching plant.

PSGA6 TOLERANCES

PSGA6.6.1 General

Concrete surfaces must have the following finishes:

- All visible concrete : Grade I accuracy with smooth homogeneous surface
- Inside of structures : Grade II accuracy with smooth surface
- Rest of concrete : Grade III accuracy

All edges to be chamfered.

PSGA8 MEASUREMENT AND PAYMENT

PSGA8.6 MANUFACTURE (OR SUPPLY) AND ERECT PRECAST ELEMENTS

PSGA8.6.1 The rates shall cover the cost of the supply of all material, plant, and labor for the installation of precast concrete elements to design and is inclusive of special finishes, curing, transport, handling on site, positioning or building in or fixing, and grouting.

PSL MEDIUM PRESSURE PIPELINES (SANS 1200L)

PSL3 MATERIALS

As indicated on drawings and to comply with SANS ISO 4427 incorporating AS 4130 (INT).

PSL3.1 All flanges shall be drilled according to SANS 1123 table 1600/3 except flanges which have no holes or if otherwise specified on the drawings or in the Schedule of Quantities.

Before leaving the factory the pipes shall be hydraulically tested in accordance with SANS 719 and a test certificate shall be provided.

Where plain ends are specified the external welds of the pipe shall be ground flush for a distance of 150 mm from the end. The pipes shall be sufficiently round to ensure that flexible couplings can fit onto the ends.

PSL3.7 Other Types of Pipes

PSL3.7.1 uPVC Pipes

uPVC Pipes and fittings shall be fitted with spigot and socket rubber ring joints and shall comply with the relevant requirements of SANS 966 Part 1. The class of pipes will be as indicated on the drawings and schedule of quantities.

Where uPVC bends are specified, they shall have a minimum pressure rating of 16 bar irrespective of the rating of the pipe to which they are attached.

PSL3.7.2 Polyethylene Pipes

All HDPE piping on this contract shall be manufactured to the latest SANS ISO 4427 specification in an ISO 9002 listed factory belonging to a company which is a member of SAPPMA. Pipes from manufacturers who are non-SAPPMA members will not be accepted. Random samples will be taken to check the MFI and OIT index of the material.

All HDPE pipes will comply with SANS ISO 4427 (1996) PE80 of Class as indicated on the drawings.

The contractor will be required to submit proof of the above prior to bringing any pipe material to site. The Employer's Agent may also call for certificates of compliance to be submitted to substantiate the origins of raw material used in the manufacture of pipes.

PSL3.8 Jointing Materials

PSL3.8.2 Flexible Couplings

HDPE compression fittings, including both coupling and thread, shall be rated as being suitable for operational pressures of 12,5 bar and shall be manufactured of the following materials:

- Body: Virgin polypropylene in master batch UV, high stability copolymer (PP-B) with UV protection.
- Seal: Nitrile rubber (NBR).
- Bush ring: Polypropylene, high stability copolymer (PP-B) with UV protection.
- Clamping ring: Acetalic resin (POM).
- Body nut: Polypropylene, high stability copolymer (PP-B) with UV protection.

Clamp saddles must comply with the following minimum specification:

- They must have a pressure rating of minimum 16 bar.
- The parallel thread may not exceed 2" BSP.
- They must be reinforced with stainless steel reinforcing ring.
- They must have a minimum of 4 x galvanized steel bolts.

PSL3.8.3 Flanges and Accessories

Unless otherwise indicated on the drawings or Schedule of Quantities, dimensions and drilling of flanges shall be in accordance with the requirements of SANS 1123 Table 2600/3 pr 2500/3 as specified. All flanges shall be true angles to the axis of the pipe fittings and shall be drilled with bolt holes off centre.

Flanges for normal working pressure up to 2500 kPa shall be flat-faced with full-faced gaskets. All gaskets shall be of the “Klinker” type.

Nuts and bolts for flanges shall comply with SANS 135 or SANS 136 as applicable.

All bolts, nuts and washers shall be mild steel, hot dip, galvanised in accordance with SANS ISO 1461.

The length of each bolt shall be such that after tightening at least one thread in addition to the thread run out and not more than the bolt diameter shall project. The threaded portion of the bolts shall be clear of the shear plane.

All nuts and studs shall be fitted with two, steel, flat washers under each bolt head and under the nut.

Any bolts not complying with this requirement shall be removed and replaced at the expense of the Contractor.

PSL3.9 Corrosion Protection (Sub-Clause 3.9)**PSL3.9.1 General**

All new valves are to be epoxy coated internally and out. Coating may be either by an approved solvent based epoxy system or an approved fusion bonded epoxy system as specified below:

Contractors will be required to submit details of their proposed suppliers, coating specification and the coating system to be applied, to the Employer’s Agent for approval, before ordering the valves.

a) Solvent Based Epoxy Coating System

The epoxy shall be of the type Carboline 891 ;Plascogard KSIR 88; Sigmaguard EHB; AEBECOTE 330 or similar approved.

The dry film thickness (D.F.T) shall be as follows:

- Coating: 350 microns ± 50 microns; and
- Lining: 250 microns ± 50 microns

The applied coating and lining shall comply with the requirements of Table 1 below.

TABLE 1

No	Property	Requirements	Test Method	Frequency
1	Visual	The lining shall be smooth, free from excessive runs, sags, orange peel, occlusion or other visible defects.	Use an experienced observer.	Each Valve
2	Coating Thickness	Minimum: 200 microns Maximum: 500 microns	SANS Method 141	Minimum 6 readings/ Valves per batch
3	Electrical Insulation Defects	Nil defects when tested at 90 Volts 2 Megaohms	SANS Method 1217 – Section 8:12	One Valve per batch

4	Degree of Cure	No softening or discolouration	20 double rubs with cotton wool swab soaked in MEK	One valve per batch
5	Adhesion	Destructive testing not recommended		

b) Fusion Bonded Epoxy Powder Coating System

The Epoxy coating shall be a fusion bonded epoxy powder coating of the type Interpon PCL 331, Vedoc V VPC 2001 or similar approved.

TABLE 2

No	Property	Requirements	Test Method	Frequency
1	Visual	Smooth glossy or semi glossy finish, free from excessive runs, sags, orange peel, occlusion or other visible defects	Use an experienced observer	Each Valve
2	Coating Thickness	Min. 200 max. 500 microns	SANS Method 141	Minimum 6 readings/valve
3	Electrical Insulation Defects	Nil defects at 3500 Volts. For conditions for repair see Clause 3.3	SANS 1217 section 8.12.2	One Valve per batch
4	Impact Resistance	No defects at 2 joules	SANS 1217 section 8.7	Random 5% of Valves
5	Degree of cure : Dynamic Test	No softening or discolouration	20 double rubs with cotton wool swab soaked in MEK	One Valve per batch

The cured fusion bonded epoxy powder coating shall meet the requirements specified in Table 2 above.

Where extended spindles are used these shall be galvanised.

PSL3.9.6 Protection Against Corrosive Soils

External protection to all steel and ductile iron pipes, fittings and joints against corrosive soils shall be by means of an approved petroleum impregnated tape packing and prime coat applied to at least 150mm above final ground level and wrapped in an adhesive plastic tape.

Flanges, VJ couplings, short/long collar couplings or other steel based or cast iron mechanical couplings shall be protected by priming with "Denso S105" paste or similar approved before encasing the nuts and bolts and the filling of all voids with "Densofil" cork filled mastic or similar approved to give an approved, smoothed and free from voids. For external, buried joints only, the entire wrapping shall be covered with "Densotherm" bitumen outer wrap or similar approved. Internal joints shall not require the outer wrap.

Contractor is to allow for the associated cost in the tendered rates.

PSL3.10 Valves

PSL3.10.1 General

Lifting lugs are to be fitted to all valves that have a mass in excess of 100kg, to be hot dip galvanized to SANS 1461.

PSL3.10.2 Resilient seal gate valves

Resilient seal gate valves (RSV) shall comply with SANS 664 (latest amendment) with classes and flange drillings as detailed or scheduled elsewhere. Where plain ended valves are required, the ends shall be suitable for the type of pipe specified. The valves shall be designed for droptight closure over the full range of pressures from zero to maximum working pressure.

The typical application of resilient seal valves is for valves in “normally open” locations (e.g. air valves, isolating valves, in-line valves < 250NB where the maximum differential pressure across the valve is not likely to exceed 16 Bar under normal operating conditions.

All valves shall be clockwise closing when viewed from above.

In addition to the above, the valves will comply with the following:

a) General

Gate valves shall be double flanged and be resilient seated and shall be on the non-rising spindle type.

The valves shall be capable of sealing drip tight bi-directionally over the full range of pressures from zero to maximum working pressure.

b) Gate design

The gate shall be fully rubber encapsulated inside and out to ensure drip tight sealing and to avoid corrosion and shall be provided with a 10 year replacement warrantee. The gate shall further have a drain hole, preventing stagnant water or impurities from collecting.

c) Gate and body design

The gate shall have optimally placed guides of wear resistant plastic so as to reduce the torques as well as to reduce wear between the rubber and the coating on the body. The bore of the body shall be straight through design in order to allow cleaning with a badger.

d) Valve bonnet

The valve shall utilize 3 independent bonnet seals which shall include a set of stem steel embedded in non-corrosive material, a back seal to prevent leakage when changing seals and a wiper ring to protect against debris entering the valve.

Two friction washers (size 50mm to 200mm) and thrust ball bearings (250mm to 600mm) shall be incorporated to ensure smooth spindle operation as well as to reduce opening and closing torques.

e) Spindle

Spindles shall be made of stainless steel. The stem threads shall be rolled to maintain steel structure and increase strength and to ensure smooth thread edges and consequently a low operating torque.

f) Body and assembly

The rubber bonnet gasket shall fit in the recess in the valve bonnet preventing blow out of the seal under surge conditions. The bonnet bolts shall pass through the gasket and be sunk into the bonnet and be sealed for corrosion protection.

An edge protecting ring shall permanently be fitted around the body of the bonnet joint in order to protect the coating during transportation and installation. The body of the valve shall be fusion bonded epoxy coated to a minimum D.F.T. of 250 microns.

Unless otherwise specified caps for key operation will be required for buried valves and hand wheels on valves situated in accessible chambers. Extension spindles and brackets shall be provided where detailed and hand wheels shall be clearly marked with direction of opening.

PSL3.10.3 Wedge gate valves

Gate valves shall comply with the requirements of SANS 664 (latest amendment) with classes and ends as elsewhere specified.

The typical application for wedge gate seal valves is for valves in “normally closed” locations (eg scour valves) and for valves in the normally open position (eg in-line valves <250NB) where the maximum differential pressure across the valve is likely to exceed 16 Bar under normal operating conditions.

Channel-guides and shoes shall be fitted to valves falling within the following pressure and size ranges:

PRESSURE	VALVE SIZE
Class 10	600mm and above
Class 16	350mm and above
Class 25	350mm and above
Class 40	All sizes
Class 100	All sizes

The spindles shall be of the non-rising type and shall be manufactured of solid stainless steel.

All valves shall be clockwise closing when viewed from above.

Gearing shall be chosen to limit the total effort at the hand wheel or valve key to 400 Newtons.

The valves shall be capable of being easily operated by one man against the maximum unbalanced pressure and the total effort required to operate the valve shall not exceed 400 Newtons (i.e. a simultaneous push-pull of 200 Newtons each) on the ends of tee key 900mm long resulting in a maximum torque of 180Nm.

In order to comply with the above requirements it has been found that the following are normally necessary for larger sizes of valves:

- a) Class 16 (PN 16) valves in sizes 80mm, 150mm and 300mm should be fitted with ball thrust collars; and
- b) Class 25 (PN 25) valves in size 80mm, 150mm should be fitted with either ball thrust collars or spur gears, while 250mm and 300mm sizes should be fitted with ball thrust collars and 3 to 1 gears.
- c) Class 40 (PN 40) valves in sizes 80mm, 150mm and 200mm should be fitted with either ball thrust collars or spur gears, while 250mm and 300mm sizes should be fitted with ball thrust collars and 3 to 1 gears.

While other forms of anti-friction devices may be acceptable it is the Contractor’s responsibility to ensure that the required torque is not exceeded.

Unless otherwise specified buried valves shall be provided with caps for key operation and valves in chambers with hand wheels.

The valves shall be provided with Type B (Gunmetal) trim with pinned seat rings. The gate shall be full length. The body of the valve shall be epoxy coated to a minimum D. F. T. of 250 microns inside and out.

The gland packing shall be of the "Maxmech Style M57", Chesterton 1724" or similar approved.

The valves are to be drop tight at working pressure.

Each valve so supplied shall be provided with a pressure test certificate.

PSL3.10.4 Butterfly valves

These shall be solid body cast iron type for bolting to flanges and shall be of perfect closure. The valves shall be fitted with gearbox operated hand wheels or ratchet locating hand-levers, stainless steel shafts and discs and natural rubber or neoprene seals and shaft seals.

The valves shall conform to the requirements of BS 5155:1984. The class of valve shall be as specified. Specifications and test certificates shall be provided.

PSL3.10.5 Air release valves

Air valves shall be the double purpose air release valves / vacuum break type.

The air release and vacuum break valve shall be of a compact single chamber design with solid cylindrical High Density Polyethylene control floats housed in a tubular stainless steel or corrosion protected body with epoxy powder coated cast iron, or s/steel ends secured by means of stainless steel tie rods.

Ball type air valves are not acceptable.

The valve shall have an integral surge alleviation mechanism which shall operate automatically to limit transient pressure rise or shock induced by closure due to high velocity air discharge or the subsequent rejoining of separated water columns. The limitation of pressure rise must be achieved by deceleration of approaching water prior to valve closure. Relief mechanisms that act subsequent to valve closure cannot reach in the low millisecond time span required and are therefore unacceptable.

Large orifice sealing shall be effected by the flat face of the control float seating against a nitrile rubber 'O' Ring housed in a dovetail groove circumferentially surrounding the large orifice. Discharge of pressurized air shall be controlled by the seating and unseating of a small orifice on a natural rubber seal affixed to the control float.

The intake / discharge orifice area shall be equal to the nominal size of the valve i.e., and 150mm (6") valve shall have a 150mm (6") intake / discharge orifice.

The valve construction shall be proportioned with regard to material strength characteristics, so that deformation, leaking or damage of any kind does not occur by submission to twice the designated working pressure.

The valve design shall incorporate an over pressure safety feature that will fail without an explosive effect, such as normally the case when highly compressed air is released suddenly. This feature shall consist of easily replaceable components such as gaskets, seals or the like.

PSL3.11 Manholes and Surface Boxes

PSL3.11.5 Manhole covers and frames

Covers and frames as well as locking bars shall be as shown on the drawings.

PSL5 CONSTRUCTION

PSL5.1 Laying

PSL5.1.1 General

The laying of pipes and ancillary fittings shall be performed only by a qualified person who is registered as an artisan in the plumbing, pipe fitting, or drain laying trade or who is qualified by reason of having attended and passed the course on pipe laying of the Civil Employer's Agenting Industry Training Board. The Contractor will be expected to provide proof of this requirement.

PSL5.1.4.2 Pipe laid radii

Add the following paragraphs:

"Where rigid pipes have been indicated as being laid to radii the maximum deflection angle at any flexible coupling may be no more than 50% of that permissible deflection as specified by the manufacturer for that diameter and class coupling.

Where uPVC pipes have been indicated as being laid with radii to accommodate changes in grade or horizontal alignment these radii must be taken up over a minimum of 3 pipe lengths for deflection angle less than 9° and one extra pipe length per 3° thereafter."

PSL5.2 Jointing Methods (Sub-clause 5.2)

Add the following paragraphs:

PSL5.2.5 Flexible couplings

"At all positions where steel pipes or specials are cast into a concrete structure in an underground position the first joint outside the structure and a joint 1m from the structure shall be made by using a Viking-Johnson or similar approved flexible coupling unless otherwise specified.

At flexible couplings the pipe ends shall be at least 10mm apart to accommodate any pipe expansion.

In all isolating, reflux and scour valve chambers at least one pipe/valve connection shall be made by means of a Viking-Johnson or similar approved flexible flange adapter coupling to facilitate the removal of the valve from the line. The coupling shall be an equivalent class to the valve or higher."

PSL5.5 Thrust blocks

Thrust blocks will be required at all changes of direction, reducers, end caps, tees and where otherwise directed by the Employer's Agent.

The Contractor may not backfill any thrust block until it has been approved by the Employer's Agent in writing. If there are any doubts regarding the suitability of the insitu materials at any location, the Contractor shall obtain a ruling from the Employer's Agent prior to casting the thrust blocks.

Standard drawings will be issued for anchor blocks in the expected soil conditions. The size may however vary depending on the condition of the soil encountered at each position. Should adverse soil conditions be encountered, it is the responsibility of the Contractor to notify the Employer's Agent. The Employer's Agent will then issue an instruction regarding the size of the anchor block. All anchor blocks to be cured for a minimum of three days before pressuring the pipeline.

The rate for blocks includes for all costs to shutter the blocks so that a neat product is produced.

Sandbags and other means of shuttering will not be permitted.

PSL5.11 Location

All pipelines shall be laid according to layout drawings and final positions to be confirmed by Employer's Agent on site.

PSL7 TESTING

PSL7.1 General

All pipes after completion and before scouring shall be tested to 1,25 x rated working pressure of pipes.

All tests must be carried out in the presence of the Employer's Agent.

The availability of water for testing will be the responsibility of the contractor and the associated costs are deemed to be included in the tender rates.

Backfilling of all pipelines should be carried out in two phases:

Phase 1 involves partial backfilling to 300mm above the pipeline before pressure testing.

Partial backfilling should leave the joints totally exposed and rise at least 300mm above pipes.

Mechanical shovels may not be used for placing the partial backfilling in the trench.

Phase 2 involves completion of backfilling after pressure testing.

Interconnections with existing water lines and reticulation must be backfilled after associated disconnection and interconnections have been made.

PSL8 MEASUREMENT AND PAYMENT

PSL8.2.1 Supply, Lay and Bed Pipes Complete with Couplings

Add the following paragraph:

"The rate shall include the cost for the receipt of the pipes upon delivery, inspection, off loading, stacking and storage thereof, the subsequent loading, transporting to construction site and off-loading.

The rate for laying shall be deemed to include for connecting pipes to existing pipes where necessary.

The rate for testing of pipelines and appurtenances shall be deemed to include for the supply and loan of temporary valves, end caps, blank flanges, isolating-type devices, buffer beams or anything else the Contractor considers necessary to complete a successful test."

PSL8.2.15 Special wrapping in corrosive soils

The rate for wrapping of steel pipes and specials as set out in PSL3.9.6 shall be deemed to include for the packing with bitumen based mastic and external encasing protection of joints and couplings as well as the outer protective wrap.

PSLE STORMWATER DRAINAGE

PSLE3 MATERIALS

PSLE3.4 MANHOLES, CATCHPITS AND ACCESSORIES

PSLE3.4.6 Subsoil Drainage

The requirements for subsoil drainage will specifically be issued by the Engineer. This is to be constructed in accordance with the details indicated consisting of single graded stone wrapped on both sides into a M80 "GEOPIPE" drainage pipe. (The excavation and backfilling required for this drainage will be deemed inclusive in the rate tendered therefore).

PSLE3.4.6 Concrete Channels

Concrete trapezoidal and v-drain channels are to be constructed as per detail. All concrete to be class 30/19 with construction joints and expansion joint as per drawing.

PSLE6.4 INVERT LEVELS

The permissible deviation of the invert level from the designated level shall be ± 10 mm.

PSM ROADS (GENERAL)

PSM3 Materials

PSM3.1 Quality

The quality of the material to be utilized for the various layers must be equal to or better than the standardized specifications, or those published in TRH14: Guidelines for Road Construction Material as published by the Department of Transport.

Where a discrepancy between the standardized specification and TRH14 exists, the most stringent specification will prevail.

PSM7 Testing

PSM7.4 Compaction Control (Additional Requirements)

Unless otherwise instructed by the Engineer, the following compaction requirements must be complied with:

LAYER	MATERIAL	COMPACTION DENSITY
Base Course	Imported gravel G2	102% mod AASHTO
Sub-base C4	Imported gravel G5	97% mod AASHTO
Selected layer - Upper	Imported gravel G7	93% mod AASHTO
Selected layer - Lower	Insitu/imported gravel G9	93% mod AASHTO for cohesive soil and 100% for non- cohesive soil
Road Bed	Insitu G9	93% mod AASHTO for cohesive soil and 100% for non- cohesive soil
Fill	Insitu G9	93% mod AASHTO for cohesive soil and 100% for non- cohesive soil
Imported fill	Insitu G9	93% mod AASHTO for cohesive soil and 100% for non- cohesive soil

PSME SUBBASE

PSME3 Materials

PSME3.2.1 Subbase material

Add the following:

The minimum Indirect Tensile Strength ITS-200kPa (SABITA Manual 14 1193)

PSME3.3 STABILIZING AGENT

PSME3.3.1 Type of cement

The Contractor shall only use ordinary Portland cement.

Cement type CEM 11, Strength Class 42,5R

PSME5 CONSTRUCTION

PSME5.8 Cutting of Subbase Layer (Additional clause)

Prior to constructing the subbase layer, all services crossing the roads shall be installed. Under no circumstances will the subbase layer be cut to accommodate any services.

PART C: PARTICULAR SPECIFICATIONS

PA	Pumps
PB	Electrical equipment
PC	Valves and pipework accessories
PD	Galvanising
PE	Brickwork
PF	Management plan for the construction phase
PG	Labour Intensive Specifications
PH	Desilting Specification
PI	Geomembranes
PJ	Cusped Drains and Drainage Geocomposites
PK	Geotextiles
PL	Geosynthetic Clay Liner
PM	Geocells
PN	Occupational Health and safety Specification (OHSA 1993 Safety Specifications)
PO	Baseline Risk Assessment
PP	Construction Quality Assurance Plan

PA: PUMPS

PA1 Installation of pumps

The following information must be supplied:

- a) On acceptance of Tender
 - Installation requirements
 - Panel wire diagram and equipment details
- b) On commissioning
 - Operation and maintenance manual (3 off)
 - List of spare parts

PA2 Operation and Maintenance Manual

The Tenderer shall hand over the Engineer three sets of the Operation and Maintenance Manual for the installation not later than one month after commissioning of the installation. These Manuals are a prerequisite for the final take-over of the Plant.

The Operation and Maintenance Manual will be printed on durable paper and will consist of two parts.

The first part will contain sections on:

- a) Brief description of the plant installation.
- b) Concise operating instructions.
- c) Routine maintenance instructions.
- d) Precautionary measures, elementary trouble location, rectifying measures and emergency actions.

The second part will contain sections on:

- a) Detailed information on equipment.
- b) List of spare parts including names and addresses of suppliers.
- c) All technical information of the installations.
- d) Detail and ratings of motors.
- e) Layout drawings showing pipe runs.
- f) Drilling for all equipment.

Operating conditions of pumps

Pump Station: P1	
1. Installation	Above ground
2. Pumping main	150mm Ø HDPE pipe
3. Length of main	Approximately 200m
4. Discharge rate	80m ³ /h minimum
5. Control	A new control system must be installed to control the pump
6. Static (Hs)	4m
7. Suction line	100mm Ø steel pipe

Pump Station: P2	
1. Installation	Above ground
2. Pumping main	150mm Ø HDPE pipe
3. Length of main	Approximately 20m connected to 300mm Ø HDPE pipe.
4. Discharge rate	120m ³ /h minimum
5. Control	A new control system must be installed to control the pump
6. Static (Hs)	1.75m
7. Suction line	150mm Ø steel pipe

Pump Station: S1	
1. Installation	Above ground
2. Pumping main	150mm Ø HDPE pipe
3. Length of main	Approximately 100m connected to 500mm Ø PE pipe.
4. Discharge rate	80m ³ /h minimum
5. Control	A new control system must be installed to control the pump
6. Static (Hs)	1.85m
7. Suction line	150mm Ø steel pipe

Pump Station: S2	
1. Installation	Above ground
2. Pumping main	250mm Ø HDPE pipe
3. Length of main	Approximately 40m connected to 500mm Ø PE pipe.
4. Discharge rate	500m ³ /h minimum
5. Control	A new control system must be installed to control the pump
6. Static (Hs)	2.08m
7. Suction line	300mm Ø steel pipe with bellmouth

Pump Station: S3	
1. Installation	Above ground
2. Pumping main	250mm Ø HDPE pipe
3. Length of main	Approximately 40m connected to 300mm Ø HDPE pipe.
4. Discharge rate	500m ³ /h minimum
5. Control	A new control system must be installed to control the pump
6. Static (Hs)	2.08m
7. Suction line	300mm Ø steel pipe with bellmouth

Installation of pumps

The following information must be supplied:

- a) **On acceptance of Tender**
 - Panel wiring diagram and equipment details
- b) **On Commissioning**
 - Operation and maintenance manual (3 off)
 - List of spare parts
 - Electrical compliance certificate

PA3

Operational requirements on the pumping system

General

Briefly pump station comprises a single pump and motor combination, MCC panel with a level control through ultrasonic sensor. The pump installations will be designed to run automatically. In short, the operation of the systems is foreseen as follows:

Operating instructions

- The main isolator switch on the control panel is to be on at all times unless maintenance work or other emergency necessitates shutdown.
- AC Voltmeter should read approximately 400 Volt.
- Pump switch should be in Auto. The pump should operate automatically.
- Pumps must start up sequentially and never simultaneously.

Switch off level (level at or below “stop” level)

If the liquid level is below the stop level the “Pump Stopped” lamps and “Low Level” lamp should be on. The pumps will not operate in Manual or Auto with the level below switch off level.

Duty level (level above operating level)

Water level at which pump will operate until “stop” level is reached.

High level alarm (Top level)

Should the water level rise to this level the High Level Alarm will come on – this must be responded to urgently as the dam will overflow if left un-attendant.

Pump trip lights

Should one of these come on it indicates the relevant pump has tripped on overload – the pump must be removed, checked for blockages, faults or other problem and replaced prior to re-setting the overload.

Ammeters & Watt Meters

An ammeter (A) and kilo-Watt (kW) meter must be provided for each pump to indicate the electric motor load whilst in operation.

PA4

Control panels & Switchboards

The Contractor must design, install and commission the complete control panels. The design is to be approved by the Engineer prior to commencement of manufacturing. The control panel enclosure must conform to the specification PA6 ELECTRICAL WORK, must be manufactured of 3CR12 stainless steel or GRP, must be weather proof and must have, in addition to the necessary equipment for operation of the system, the following instrumentation:

Description: Switchgear / Control Panel mounted on dedicated galvanized steel stands positioned no further than 2m from the pump. The Pumps will be controlled via an ultrasonic level sensor. Pump motor sizes are specified as follows:

P1: 1 x 7.5 kW; 400 V pump – ZEST/WEG W20 IE1 IP55
P2: 1 x 15 kW; 400 V pump – ZEST/WEG W20 IE1 IP55
S1: 1 x 22 kW; 400 V pump – ZEST/WEG W20 IE1 IP55
S2: 1 x 75 kW; 400 V pump – ZEST/WEG W20 IE1 IP55
S3: 1 x 75 kW; 400 V pump – ZEST/WEG W20 IE1 IP55

Enclosure: Stand Mounted, IP54, 3Cr12 Steel, Lockable Outer Door with 4 Inner Sections, Epoxy or Powder coated electric orange.
Generator Supply panel to be powder coated red

- Section Layout:** Top Right – Power: Circuit Breaker, Volt Meter, Power Protection Relay
Top Left – Control: Common Pump Controls, Auxiliary Equipment
Bottom Left – Pump 1: Controls, VFD and associated equipment
- Section Doors:** **Power:**
Door Interlocked Lockable Isolator
Analog Volt Meter with fuses and selector switch for 1-p and 3-p power
Warning Signs
- Control & Auxiliary:**
Three-Way Selector Switch for Siren / Strobe Light – Siren / Strobe / Siren & Strobe
Accept Button for Alarm Siren / Strobe
Lamp Test Button
Two-Way Selector Switch for Day / Night Relay – Auto / Manual
Emergency Stop Button
All indication/alarm Lamps shall be LED
- Pumps:**
Door Interlocked Lockable Isolator per Pump
Digital Ammeter per Pump
Analog Running Hour Meter per Pump
Three-Way Selector Switch per Pump – Auto / Off / Manual
Run Lamp
Stop Lamp
Over-Load Lamp
Under-Load Lamp
Thermal Trip Lamp
Fault Lamp (for any other fault)
Start Button per Pump (with “Hold-In” ability for Manual Mode)
Stop Button per Pump (for Manual Mode but also switched off by low level)
Reset Button per Pump (For All Faults)
All indication/alarm Lamps shall be LED
- Control:** 12V Transformer / Power Supply for Control Power
Control Circuit Breaker
Fuses
“Flip-flop” Cycle Relay
Strobe Light and 50m Audible Siren / Buzzer
Day / Night Switch Relay (to control operation of external light)
- Pump Protection:** Thermal Protection Relays
Over- / Under-Load protection with 60 Second Delay-On Timer
Pump Protection Relay for moisture
- Power Protection:** Phase Angle / Failure / Reversal
Over- / Under-Voltage Protection
Surge Arrestors
Earth Leakage Relay
- Level Control:** Ultrasonic Level transmitter (NIVELCO EasyTREK or similar) with high level alarm
- Auxiliary:** Standalone DB with 63A, 30mA Earth Leakage including circuit breaker
2 x 16A MCB for socket outlets
1 x 16A MCB: Spare
1 x 10A MCB for photocell
1 x 10A MCB for lighting circuits
1x Spare 10A MCB (for future use)
10A Royce Thomson Photocell to be fitted on outside wall.

Mains Supply: Mains Incomer supply to be confirmed by Foskor
Incomer:
P1: MCCB Type C: 63 A,
P2: MCCB Type C: 80 A,
S1: MCCB Type C: 80 A,
S2: MCCB Type C: 80 A,
S3: MCCB Type C: 80 A,

Space for meter, ELSTER A1700 programmable electronic meter (check meter)

Current transformers incl test blocks and voltage fuses/MCBs to be confirmed by an approved electrical contractor.

P1: 75/5
P2: 100/5
S1: 100/5,
S2: 100/5
S3: 100/5

3 x Maximum demand indicators
Volt meter with selector switch

PA5 Commissioning

After the pump has been tested successfully the contractor must commission the pump units.

A licensed electrical sub-contractor must perform all the electrical connections and relevant testing and the issuing of an electrical certificate of compliance (CoC). The Contractor to make all arrangements with the Engineer to obtain approval and the energizing of the connection. Only Electrical Contractors registered with the ECA shall be eligible to undertake all electrical installation works and certification. Proof of such registration must be provided to the Engineer before commencement of installation works.

PA6 Electrical installation

Technical Specification

The contractor should fully familiarise himself with these documents prior to quoting.

All low voltage switchgear and control gear assemblies are to comply with SANS 1473 Part 1 1989/IEC 439 – 1 1985. All electrical installations shall comply strictly with SANS 10142 Part 1 latest edition. An Electrical Certificate of Compliance, in accordance with the OSH Act, will be required for all Electrical Works.

Cabling

All cabling shall be appropriate 4 or 2 core PVC insulated steel wire armoured PVC sheathed copper cable with an earth continuity conductor (ECC), 600/1000 rated complying to SANS 1507-3. The motor supply cable shall be sized according to the pump motor and include an earth continuity conductor cable complying with the provisions of Table 6.28 in SANS 10142. The cable to the pressure switch shall be as above, but the core size shall be 2,5 mm². Acceptable voltage drop for determining cable size shall be 5% or alternatively as specified by the pump manufacturer, but not greater than 5%.

PA7 Pumping Equipment

7.1 Scope

This specification covers the supply, delivery, transport, handling, storage, erection, installation, commissioning, testing, adjustment, handing over in complete working order and upholding during the Defects Liability Period of pumping equipment complete with associated pipe work up to the limits specified in the Project Specification.

It shall however not include for any civil works in connection with the pump station, for foundations, building in of pipe work, grouting and for the electrical control board or power supply to the motor.

Any civil works required for the building in of pumping equipment, shall be carried out under the supervision of the pumping equipment contractor who will be completely responsible for the correct setting up of the equipment and the safe-guarding of the same against damage. The contractor shall also ensure, in liaison with the electrical contractor, that the power supply to the motor is correct and motor running at correct speed and direction.

7.2 Materials

7.2.1 General

All materials used shall be the best of their respective kinds and shall be suitable for working at the pressures and temperatures involved under all working conditions, without distortion or deterioration or the setting up of undue stresses in any part and without impairing the efficiency or reliability of the plant and the strength of its component parts. No welding, burning, filling or plugging of defective castings will be permitted without the Engineer's approval in writing.

Where corrosion of metal may be expected, the Contractor shall supply materials which are resistant to corrosion. Any equipment or material showing signs of corrosion, tuberculation or pitting before the expiry of the Maintenance Period shall be replaced by the Contractor. The tendered price will be held to include the cost of all painting or other surface treatment which is not separately specified or scheduled but which is nevertheless necessary for the protection of surfaces against corrosion.

7.2.2 Structural steelwork

All structural steelwork shall comply with the requirements of SANS 1200 H.

7.2.3 Pipe work and valves

All pipe work in pump stations shall be of flanged cast iron or steel complying with the requirements of the relevant SANS or BS Specifications as may be applicable.

Valves and pipe work accessories shall be of cast iron and shall comply with the relevant Particular Specification.

Isolation valves shall be double flanged cast iron standard waterworks pattern gate valves with non-rising spindle complying with SANS 664 and clockwise closing directions.

Check valves shall be double flanged cast iron single door valves with gunmetal trims complying with SANS 144. The valves shall close without the aid of springs or external counter weights. Flanges shall be cast iron and shall comply in all respects with SANS 1123 for the class specified in the Project Specification. Flange faces shall be machined flat i.e. without a raised joint face. Puddle flanges shall have the same dimensions as standard flanges but shall be left undrilled. Rubber insertion rings shall be of the full face type and shall comply with the requirements of BS 3063.

7.3 Pumps

7.3.1 General

The pumps shall be of maker's standard and approved design, capable of doing the duty required at a speed preferably not exceeding 2 000 rpm and shall be so balanced that there will be no end thrust when the pump is new or after wear has taken place, or alternatively suitable heavy duty thrust bearings must be provided. The pump casing shall be of high grade cast iron or stainless steel. Impellers and guides shall be made of high grade cast iron or stainless steel and the shaft of high tensile steel with suitable renewable protecting sleeves, the diameter being sufficient to withstand and transmit without whip and with ample margin of safety all torsional and bending stresses to which it may be subjected. Shaft sleeves shall be of bronze and renewable. Bearings are to be of ample bearing area, dustproof and with suitable provision for continuous lubrication.

The pumps offered are preferably to be of the self-regulating type, the power characteristic curve being such that with increase in the rate of delivery beyond a certain figure, the power demand shall decrease, thereby ensuring that the motor shall not be overloaded in the event of a large reduction in pumping head, due to a burst occurring in the rising main or any other such contingency. Performance particulars and characteristic curves shall be submitted at the time of tendering. The electric motors shall in all cases be sized to cope with the maximum power requirements of the associated pumps.

The pumps and motors shall be capable of efficient operation over the whole range indicated by the system head curves.

7.3.2 Pumpstation

Each pump and motor shall be mounted on a common base plate of rigid construction provided with suitable openings for pouring in grout and with all necessary holding down bolts for securing to the foundations. Before dispatch, the motor of each pumping set shall be mounted in proper alignment with the pump on the common base plate. Concrete work of the foundations shall be finished off approximately 20 mm below the underside of the base plate. During erection of the pump and motor, the Contractor shall set up each unit to exact line or level by means of steel wedges before grouting the base plate and holding down bolts with a non-shrink grout.

Each pump shall be supplied with a pressure gauge on the delivery side of the pump as well as on the suction side.

Self-priming pumps:

Consideration shall be given to the intended service, in which occasionally debris will lodge between the pump suction check valve and seat. The result is not only in loss of the suction leg, but also in the siphoning of the liquid from the pump casing to the approximate centerline of the impeller. Such occurrence shall be considered normal with proper installation of air release line free to atmosphere.

In consideration of such occurrence and of the unattended operation anticipated, each pump shall be designed as to retain adequate liquid in the pump casing to insure unattended automatic re-priming while operating at its rated speed in a completely open system without suction check valves and with a dry suction leg.

Openings and passages of the pump shall be large enough to permit the passage of a sphere 76 mm in diameter. Pump volute or casing shall contain no openings, such as recirculation ports, of a lesser diameter than sphere sizes specified. Screens or any internal devices that create a maintenance nuisance or interfere with priming and performance of the pump shall not be permitted.

NO SPECIAL TOOLS SHALL BE REQUIRED FOR REPLACEMENT OF ANY COMPONENTS WITHIN THE PUMP.

Re-prime performance:

Each pump must be capable of a re-prime of 6m, while operating at the selected speed and the selected impeller diameter. Re-prime lift is defined as the static height of pump suction centerline above liquid that the pump casing after a delivering pump is shut down with the suction check valve removed.

Additional standards under which re-prime tests shall be run are:

1. Piping shall incorporate a discharge check valve downstream from the pump.
2. A 3 m length of 25 mm pipe shall be installed between pump and discharge check valve. This line shall be open to atmosphere at all times to duplicate the air displacement rate of a typical pump station fitted with an air release valve.
3. No restrictions shall be present in pump or suction piping which could serve to restrict the rate of siphon drop of the suction leg. Suction pipe configuration for re-prime test shall incorporate a minimum horizontal run of 600 mm and one 90° elbow.
4. Impeller shall be set at the clearances recommended by the Manufacturer in the pump service manual.
5. Re-prime lift repeatability shall be demonstrated by five sequential re-prime cycles.
6. Liquid to be used for re-prime test shall be water.

Upon request from the engineer, certified re-prime test data prepared by pump Manufacturer and certified by a registered professional engineer shall be submitted to the engineer for approval.

Suction check valve:

Pump shall incorporate a neoprene suction check valve that can be removed or installed through a removable cover plate opening without disturbing the suction piping. Sole function of the check valve shall be to eliminate re-priming with each start / stop cycle. Pumps requiring suction check valves to perform will not be acceptable.

Pump casing:

Casings shall be made from Gray iron No. 30 and able to withstand a maximum operating pressure of 793 kPa. Casings shall incorporate mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance. A filler port of 90 mm in diameter (minimum) shall be supplied for ease of filling the pump casing. A casing drains of at least 1 – ¼ in NPT shall be provided to insure complete and rapid draining.

Cover Plate:

Pumps must be equipped with a four point attachment lightweight removable cover plate. It must allow complete access to the pump interior to permit the clearance of blockages and to provide simple access for service and repair without disturbing suction or discharge piping. It must be fitted with an additional O-ring at the inner bore to provide added sealing between the vacuum and pressure chambers and a tapered inlet for hydraulically enhanced entrance into the eye of the impeller.

Replacement of the wear plate, impeller, and mechanical seal shall be possible through the removable cover plate if necessary. On pumps 250 mm or larger, replacement of these items shall be accomplished by removal of the suction gooseneck. In consideration of safety, a pressure relief valve made of brass shall be fitted to the pump casing as a standard component. The cover plate shall be fitted with an “easy-grip” handle to facilitate ease of handling and pusher bolt capability to facilitate removal. Once the cover plate has been removed the design must ensure that the clearance between the impeller and the wear plate is not altered and does not need to be reset after the cover plate is re-installed.

Wear Plate:

Pumps shall be fitted with a replaceable wear plate made from Carbon Steel No. 1015. The design must ensure that the impeller / wear plate clearance adjustment can be carried out BOTH from the cover plate side making use of SHIMLESS locking collars and adjusting screws AND if necessary by adding or removing shims between the rotating assembly and volute casing.

Rotating assembly:

The complete rotating assembly, which includes the bearing housing, bearings, shaft, mechanical seal, seal plate and impeller, shall be removed as a unit without disturbing the pump volute or suction and discharge pipe. Means shall be provided for external adjustment of the impeller to the wear plate. Pusher bolt facility and cap screws shall be supplied to facilitate ease of removal. The design must allow for the fitting of double lip seals, which provide an atmospheric path for purposes of protecting the bearings when the mechanical seal has failed. Complete Super-T rotating assemblies must be interchangeable with all Classic-T units.

Two independent clear sight gauges shall be fitted for purposes of monitoring the condition and levels of the oil for the Bearings and Mechanical seal.

Seal:

Pumps shall be fitted with oil-lubricated, double floating, self-aligning mechanical seals capable of withstanding temperatures of up to 71° C. The rotating and stationary seal faces shall be made from tungsten titanium carbide (or silicon carbide when specified). The cages and springs from 18-8 stainless steel and fluorocarbon elastomers from DuPont Viton.

Each seal face must be ground to produce a flatness tolerance not to exceed three light bands, as measured by an optical flat and monochromatic light. To insure seal faces are in full contact at all times, stationary seal shall be double floating and self-aligning during periods of shock loads that will cause deflection, vibration, and axial or radial movements of the pump shaft.

Mechanical seal shall be installed within removable seal plate housing and lubricated from an independent oil filled reservoir. A clear sight gauge will be fitted to provide easy monitoring of the seal oil level and condition without removing any screws. A vent system will be in place in case of overfilling or pressure. An atmospheric vent between the mechanical and seal chamber and the bearing chamber shall form part of the pump protection.

Shaft bearings:

The pump shaft bearings shall be anti-friction or ball or tapered roller bearings of ample size and proper design to withstand all radial and thrust loads that can be reasonably expected during the normal operation of the pump. Bearings shall be lubricated from a dedicated oil reservoir. Pump designs, which use the same oil reservoir to lubricate both the shaft bearings and the mechanical seal, shall not be acceptable. A clear sight gauge will be provided for easy monitoring of the oil level and condition.

Manufacturer:

The specification and project drawings depict equipment and materials manufactured by the Gorman-Rupp Company which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. The bidder shall prepare his bid based on the specified equipment for the purposes of determining a competitive bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.

At time of tender the bidder may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be of proven superiority in both construction quality and performance to that specified in the engineer's tender document. This must be further supported by a list of current users of the proposed equipment in similar installations.

In the event the engineer allows approval of equipment substitution, the bidder shall, at his own expense, make all resulting changes to the structure, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance.

It will be assumed that if the cost to the purchaser is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.

Manufacturer Warranty:

Pumps shall carry the standard manufacturers "5 year" limited warranty.

7.3.2.1 Submersible pumps

Submersible pumps shall be supplied with handling gear of approved non-corrodible material to extract the pumps from the abstraction pipe sleeves.

7.4 Installation

Concrete work of the foundations shall be finished to approximately 20 mm below the underside of the base plate. During erection of the pump and motor, the Contractor shall set each unit exactly to line or level by means of steel wedges whereafter the holding down bolts (if applicable) are grouted in and the empty space inside the base plate is filled with grout.

Bends and branches shall not cause cavitating flow conditions and the layout of the pipe work shall be such as to facilitate dismantling and inspection. The pipes are to be properly supported and so arranged that all stresses created in the pipeline by static and dynamic forces, including recoil shock, will be taken up by suitable anchors.

All suction pipe work shall be provided with a flexible coupling in a convenient position downstream of the gate valve to facilitate removal and reinstallation of a pump. Any reducers used on suction pipe work shall have level soffits (as installed).

Reflux valves on delivery mains of sludge pumps shall only be used in a horizontal position and shall be accessible for maintenance purposes.

Individual suction pipes shall be supplied for each pump. Suction pipe velocity shall not exceed 1,0 metre per second under normal operating conditions.

Delivery pipe work and valves shall have the same nominal diameter as the rising main unless otherwise indicated on the drawings.

Where reducers are used on the delivery from pumps they shall be installed directly downstream of the pumps.

7.5 Painting and corrosion protection

Pipe work in wet wells (internal and external)	System I
Pipe work and valves in valve chambers (internal)	System I
Pipe work and valves in valve chambers (external)	System I finished off with one coat bituminous aluminum paint

Bolts not built into concrete	System B
Motors, base plates, gearbox casings	System A
Galvanized mild steel grating	System E

7.6 Testing and commissioning

Each pump shall be tested individually and where pumps are to operate in parallel they shall also be treated as such. The rate of delivery during testing shall be determined by cutting off the inflow to the sump and timing the drop in water level therein. The pumping head shall be determined as the measured static head plus the calculated friction loss in the system or alternatively by the use of temporary pressure gauges provided by the Contractor.

During the tests, the values of voltage, current drawn by the motor and power factor shall be noted and recorded.

The test results shall be compared with the tendered pump characteristics and the following tolerances will be allowed:

- Delivery rate : - 0 % to + 10 %
- Overall efficiency : - 5 %

In the event of the pumps failing to achieve the tendered performance in regard to discharge or efficiency within the tolerance allowed, then the Employer shall have the right to reject the pumps, to recover all monies paid to the Contractor under the Contractor for such pumps and to confiscate the surety by way of agreed and liquidated damages, whereupon the Contractor at his own expense shall remove all rejected plant when ordered to do so by the Engineer.

Control boards, electric motors and other electrical equipment shall be tested as specified in the applicable Particular Specification.

PB: ELECTRICAL EQUIPMENT

PB1 Scope

This specification covers the supply, delivery, installation and upholding during the Defects Liability Period of electrical equipment. All electrical requirements are to be confirmed by an approved electrical contractor or electrical engineer and need to meet all equipment specifications.

PB2 Equipment specification

2.1 Cables

Low voltage cables shall be for service in a 3 phase 50 Hz system and shall be PVC insulated, PVC sheathed, steel wire armoured, PVC covered with ECC, 600 / 1000 volt rated, complying with the requirements of SANS 1507-3.

The following auxiliary cable sizes shall be used:

- a. Socket outlet circuits: 2.5mm² cu, 1-core house wire incl earth
- b. Lighting circuits: 1.5mm² cu, 1-core house wire incl earth
- c. Control circuits: 2.5mm² cu, 1-core panel wiring

2.2 Starters

Starters shall be suitable for manual as well as automatic operation and shall comply with the requirements of BS 587. For motors up to and including 7,5 kW the starters shall be of the direct-on-line (DOL) type while for motors for more than 7,5 kW, but less than 30 kW the starters shall be of the star-delta type. Variable Frequency Drives are required for motors larger than 30 kW.

DOL and Star-Delta starters shall be of the air-break contactor type provided with adjustable magnetic or thermal overload trip relays with adjustable time lags in each phase, under-voltage release mechanism and protection against single phasing. The motors will not be started more than 15 times per hour.

The starters shall be provided with an isolating switch mechanically interlocked with the door of the housing, cable entry glands and an ammeter on one of the phases except in the case of starters for motors of 1 kW and lower for which ammeters are not required.

Contactors may not hum or chatter in service and the contacts may not bounce on closing.

All VFDs shall be supplied with communication cables and software where applicable. All VFDs shall be programmed according to the intended application before or during commissioning.

2.3 Busbars

Control boards shall be provided with one set of solid, copper busbars in the top section extending over the entire length of the board. The earth bar shall be located in the bottom section of the panel.

Busbars shall comply with the requirements of SANS 1195.

Busbars shall be rigidly supported at suitable intervals to prevent undue damage resulting under short circuit conditions. Ceramic or other approved busbar insulators shall be used. The busbars shall be arranged horizontally with the longer sides of the cross-sections in the vertical plane.

Busbars shall be clearly and indelibly marked red, yellow and blue for the three phases and black for neutral.

Connections to busbars shall be effected by means of cable lugs and suitably sized high tensile stainless steel bolts and nuts with stainless steel cup washers or lock washers.

2.4 Isolators

All isolators shall be of the "load-breaking" and "fault making" type and shall comply with the requirements of SANS 152 where applicable.

2.5 Fused switches

All fused switches shall be of the "load-breaking" and "fault making" type complying with BS 5419 where applicable and fitted with HRC cartridge fused links to BSS 88.

2.6 Moulded case circuit breakers

All moulded case circuit breakers shall comply with the requirements of SANS 156 Specification.

These circuit breakers shall be fitted with copper terminal collector bars where more than one cable core has to be terminated on the same terminal.

MCCB terminals shall be appropriately specified to accommodate the receiving cable lug size.

Each individual motor control shall be protected using Motor Protection Circuit Breakers: MPCBs.

Mains supply MCCBs shall be type C.

2.7 Current transformers

All current transformers shall be of the air insulated type complying in all respects with the requirements laid down in BS 3938.

The Contractor shall carefully select the ratio, burden and accuracy class to suit its specific application in accordance with the recommendations and requirements of BS 3938.

2.8 Indicating instruments

All indicating instruments shall comply with the requirements laid down in BS 89: Part 1 for instruments of a 2,5 Accuracy Class with exception of the kWh meters which shall comply with BS 37: Part 4. All indicating instruments shall have 100 mm square dials.

VOLTMETERS shall be of the flush panel mounting type having a square dial approximately 100 x 100 mm and shall have a quadrant type scale. The scale shall be calibrated to suit the supply voltage. Phase selector switches shall be fitted.

AMMETERS shall be flush panel mounting type having a square dial approximately 100 x 100 mm and shall have a quadrant scale. The scale shall be calibrated to suit the equipment served. Phase selector switches shall be fitted. The meters shall be able to withstand overcurrents resulting under starting conditions and the full load current of the relevant motor shall be clearly marked in red on the face of the meter.

KILOWATT-HOUR energy meters shall be of the three phase 4 wire electronic LCD display type preferable ELSTER, and shall be mounted behind the panel of the distribution board with a transparent window in the front panel opposite the dial of the meter. The meter shall be of the integrating type. The current rating of the meter shall be suitable for the maximum requirements. Where a whole current type of meter is not supplied, a suitable current transformer shall be supplied with the meter.

The MAINS input supply panel that shall feed the entire electrical system shall be equipped with an ELSTER A1700 programmable energy and demand meter that will be used for check metering. Suitably sized 5A CTs shall be provided to drive the meter. All CT cores shall be wired through an appropriate test block while voltage signals shall be protected through either fuses or MCBs.

The power factor meters shall indicate between 0,7 lagging to 0,7 leading.

The running hour meters shall have cyclometer dials indicating up to 5 digits and two decimals.

All indicating instruments shall be mounted behind and shall protrude through the front panels of the boards.

All instrument and meter wiring shall be minimum 2.5 mm² copper panel wiring. No panel wiring shall be spliced. All panel wiring shall be colour coded and numbered.

2.9 Phase selector switch

A four position rotary type phase selector switch shall be mounted directly below the relevant instrument, in such a way that only the selector knob and indicator plate are on the panel, and the switch itself is behind the panel.

The selector knob shall consist of bakelite, and shall have an arrow engraved on it, indicating the switch position.

The switch shall have a positively driven switching mechanism.

The indicator plate shall consist of bakelite and shall have the positions for the three phases and "OFF", engraved on it in 5 mm high lettering.

2.10 Power factor correction capacitors and low voltage motors

Each of these capacitors shall be of the outdoor switchboard mounting 50 Hz three phase self-contained type with a dead casing and shall fully comply with the requirements laid down in BS 1650.

Each capacitor unit shall be of carefully selected rating to correct the power factor of its associated motor to 0,95 lagging at full load and should not exceed a value which compensates for 85 % of the no-load magnetizing current.

The dielectric shall consist of plastic film and low-loss paper situated between aluminium foil and impregnated with a synthetic liquid agent with scavenger additive.

The capacitor losses shall not exceed 1 watt / kVAr.

Each of these capacitor units shall be provided with discharge resistors and a fuse for each winding element which will disconnect the affected element in event of a dielectric breakdown.

2.11 Earth leakage protection units

The earth leakage protection units shall be rated as follows:

- (a) For motor and motor control circuits: 250 mA.
- (b) For plug socket circuits: 30 mA.

2.12 Labels

All labels shall be of the laminated or screwed-on reverse engraved perspex type using stainless steel or brass screws. Labels shall be in white letters on a black background in both official languages. Small wiring shall be identified by means of a numbered ferrule of an approved type on each end of each wire.

2.13 Level switches

Level control through ultrasonic level transmitter integrated into MCC with multichannel process controller by Nivelco Process Control or similar approved.

2.14 Cable racking

All cables and earth conductors shall be installed on appropriate galvanised or aluminium cable racks/ladders which shall be attached to cable duct trenches, walls, roofing or floors where required.

All cable rack/ladder splicing and attachments shall be bonded together using 10mm² copper PVC single core earth cable.

2.15 Control Boards

2.15.1 General

All boards shall be of waterproof construction and shall require access from the front only.

All control boards shall be subdivided into separate compartments for each incoming or outgoing circuit other than minor services and control circuits with suitable barriers and interlocking to prevent accidental access to live parts.

Unless otherwise specified in the Project Specification every control board shall provide for future connections to a single centralized indicator system for the Works as a whole.

All control boards for motors shall, for each motor served, be equipped with:

- (a) Thermal over current protection
- (b) Wiring for anti-condensation heaters
- (c) Wiring for thermistors (if specified for relevant motor)

2.15.2 Switch/Control Boards for outside erection

These boards shall be constructed of 3CR12 stainless steel or glass fibre. Door hinges, knobs and handle shall be constructed of chromium plated brass.

The boards and doors shall be weather and waterproof.

2.16 Electric motors

Electric motors shall be of the totally enclosed fan cooled type suitable for operation on the electric supply, at the altitude and at the ambient temperature specified in the Project Specification. Motor performance shall comply with BS 2613. The motors will not be started more than 15 times per hour and shall furthermore be rated for continuous operation at full load. Full load speed shall not be in excess of 2 000 rpm unless approved by the Engineer and the rated power shall be the nearest standard rating to the maximum power requirement of the associated equipment, but not less than 10 % in excess thereof.

Motor frames shall be of metric dimensions complying with the requirements of SANS 948 and shall be of the totally enclosed fan cooled type suitable for internal or external use, as the case may be, provided with suitable terminal boxes and glands. Insulating materials for weather and water protected dry well motors shall comply with the requirements of BS 2757 and shall be of Class E quality. Outdoor and submersible motors shall be insulated to Class F standard. Motors and terminal boxes are to be enclosed to IP 55 of SANS 948.

All motors shall be equipped with anti-condensation heaters. Bearings of motors shall be pre-lubricated sealed roller and / or ball bearings. All bearings shall be manufactured in the Republic of South Africa.

All motors with a rating of 25 kW and more shall be protected with thermistors installed in the stator windings.

All motors shall be statically and dynamically balanced to comply with the requirements of SANS 948.

The maximum starting current of these motors under locked rotor conditions with specified voltage applied to the motor terminals shall not exceed six times normal full load current for DOL starting.

The motors shall be suitably rated for 15 starts per hour at the specified ambient temperature and altitude.

2.17 Socket outlets and Lighting

Socket outlets:

All socket outlets shall be double 16A switched CBi or equivalent

2 x Outlets for each pump station

Gate Light:

1 x Beka LEDLume-midi 144W LED luminaire or equivalent mounted on a 5m galvanised steel pole with a 15° outreach spigot facing towards the pump station interior. This light to be supplied from a 2.5mm² 2 core PVC SWA cable

Lighting Note: Conventional fluorescent, CFL, HPMV, HPS, etc lamps and fittings will not be accepted.

PB3 Installation

Switch/Control boards shall be installed, plumb and fixed in position.

Where switchboards are installed outside, all fixing bolts shall be of stainless steel.

Concrete foundation for switchboards and motors must be constructed by the main contractor to the requirements of the design and equipment sub-contractor.

Fixing of equipment shall be the responsibility of the equipment sub-contractor.

Where bolts or base plates are to be grouted with concrete, the work shall be carried out by main contractor.

PB4 Painting and corrosion protection

Control boards shall be treated to SANS 064 after manufacture and shall be finished in baked enamel in the colour scheme ordered by the Engineer.

Should the board be scratched or dented during erection, the Engineer shall have the right to order that the board be replaced.

PB5 Testing and commissioning

5.1 Tests at manufacturer's works

5.1.1 Switchgear/Control boards

Each panel shall be subjected to the following tests in the manufacturer's works after manufacture and before delivery to site:

- (a) A thorough inspection shall be carried out to ensure compliance with the Specifications and approved drawings and wiring diagrams and to ascertain that all connections are properly made.
- (b) A full operating voltage test on all primary connections to check the insulation between phases mutually and between each phase and earth.
- (c) The polarities and ratios of all potential and current transformers shall be checked.
- (d) Primary and secondary inspection tests shall be carried out on all switching, protection, metering, interlocking and indication circuits.

The manufacturer shall submit copies of test certificates giving details of conditions and results of tests carried out to the Engineer.

The Contractor shall make provision in his bill for the witnessing of Factory Acceptance Testing (FAT) by the Engineer. This shall include air travel between Richards Bay and the place of manufacture, any vehicle hire and accommodation if required.

5.1.2 Electric motors

If the motors do not carry the SANS mark, performance and efficiency tests shall be carried out to prove the guaranteed information submitted with the successful tender.

All motors shall be subjected to routine tests as prescribed in Appendix D to SANS 948.

The manufacturer shall submit to the Engineer two certified copies of the test certificates reflecting the conditions and results of the tests carried out on each motor.

5.2 Tests on site after installation but prior to commissioning of the equipment

5.2.1 Control board

- (a) Check all components to ensure that they are free from dust and protective packing material.
- (b) Check the operation of all components liable to damage in transit such as meters and protection relays.
- (c) The insulation of all primary circuits between phases mutually and between each phase and earth shall be measured.
- (d) All fused links shall be checked for electrical continuity.
- (e) All control supplies shall be checked.

All adjustable protection devices shall then be set and the boards and panels commissioned all in consultation with and to the instructions of the Engineer.

5.2.2 Electric motors

- (a) Ensure that the bearings are properly lubricated.

- (b) Ensure that all power and earth connections are properly made.
- (c) Check all ventilation openings for obstruction.
- (d) Measure the insulation resistance between phases mutually and between each phase and earth to ensure that the windings are dry.
- (e) Spin the motor by briefly switching the supply on to check the correctness of the direction of rotation.
- (f) Check whether the motor runs smooth and how long it takes to accelerate up to maximum speed.
- (g) Check on the noise level the vibration and temperatures of motor and bearings.

PB6 Motor protection systems

6.1 General

Unless otherwise specified protection shall be as indicated below:

TYPE OF PROTECTION	APPLICATION
Thermal Overcurrent	All motors
Magnetic Overcurrent	As short-circuit protection only when coupled to circuit-breakers
Thermistor Temperature Protection	All motors with rating excess of 25 kW
Anti-Single-Phasing	All three-phase motors with HRC fuse protection
Earth fault	Only when condensation can occur in motors eg. standby or direct coupled cooling pump motors or outdoor motors.
Reverse Phasing	All circuits supplying centrifugal compressors or reciprocating compressors or circuits where reverse phasing can cause damage
Undervoltage	As specified.
Temperature protection mechanisms	Statormatic starters, resistor starters

6.2 Overcurrent protection

Overcurrent protection of motors shall be provided in accordance with the requirements of BS 587. Overcurrent protection shall comprise thermal trip mechanisms or relays which are coupled to contactors, hand operated starters or circuit breakers. HRC fuses shall not be regarded as overcurrent protection.

In the cases where overcurrent protection forms an integral part of the starter, the protection shall comprise a temperature compensated bi-metal thermal element which is directly heated by separate heating elements in each phase and which is coupled in series with the load. The overcurrent protection shall be adjustable over a range of 75 % to 120 % of the full load current of the motor.

Motors subjected to frequent starting and stopping duties or to inching may be protected against overcurrent with magnetic overcurrent protection with a time delay provided the motor is suitable of this method of operation.

Magnetic overcurrent tripping devices shall not trip starting contactors but shall be coupled to circuit-breakers with suitable breaking capacities.

Adequate protection shall be provided against extended overloads, but, unnecessary tripping during starting shall be prevented. For this condition short-circuiting of the overcurrent protection, increased overcurrent settings or connection of the overcurrent protection to the delta circuit only in start-delta starters is not acceptable.

6.3 Anti-single-phasing protection

Anti-single-phasing shall form an inherent part of the overcurrent protection unit in the case of integral motor starters.

Protection methods which rely on the overcurrent only which may occur during single-phase conditions are not acceptable.

6.4 Short circuit protection

Refer to Project Specification for requirements of short-circuit protection.

6.5 Thermistor protection

Thermistor protection shall be provided as specified under the Quality Specification for motors.

Thermistor control units shall where possible be integrated with the motor starter.

Thermistor protection shall not be used in lieu of overcurrent protection.

6.6 Reverse-phasing protection

Reverse-phasing protection shall be provided as stipulated under Clause PMF-2 and on all bi-directional motors where specified.

The sensing of reverse phasing shall be done at the outgoing terminals of the motor supply.

6.7 Combination and electronic motor protection units and relays

Programmable microprocessor based motor protection units that incorporate all the overcurrent, anti-single phasing, short circuit, thermistor and reverse phasing protection functions amongst other protection and control features would be a preferred option to individual units.

All units and relays shall be mounted in withdrawable panel-mounted enclosures.

Motor protection relays shall not be connected to current transformers used for metering purposes.

All protection relays shall be provided with test terminal blocks of the "CHAMBERLAIN & HOOKHAM" type or equal for the testing of relays, CT's, etc.

Communication cabling and software shall be provided with all programmable microprocessor based units.

6.8 Control components

The Contractor shall submit performance data on all sensing and control devices supplied and installed under this contract to the engineer for approval with his tender.

The devices shall all be suitable for operation at voltages determined by the Control System TE 380/230 V or control voltage.

Switching devices shall provide for both normally open and normally closed switching configuration for each required operation. The switching contacts shall be a silver to silver or other approved type with a minimum continuous operating current of 6A at the chosen voltage.

Sensing and control devices shall be protected against ingress to at least IP54 to the external environment. All mounting accessories and cable entry / exit points shall be designed to retain the specified rating once equipment is installed and connected.

PB7 Earthing

The Contractor shall install a local earth mat for the entire facility.

The earth mat shall consist of a minimum of 4 x 2.4m earth electrodes (2 x 1.2m coupled together) driven into the outside ground to provide a total earth resistance of less than 1 ohm. Should the minimum earth resistance not be attainable, additional rods shall be installed in a crow's foot configuration until 1 ohm is achieved. The Contractor shall provide the Engineer with the earth test results report.

The earth electrodes and conductor shall be buried at a depth of more than 500mm from ground level.

The earth electrodes shall be connected together using 70 mm² copper single core PVC cable. The earth mat shall be connected to a local earth bar which shall be installed within the cable trench located in the switchgear room. All switchboards, cable racks, electrical machinery, including the standby generator system shall be connected to this earth bar point.

PB8 Measurement and payment

No separate payment will be made for electrical installations and the work shall be deemed to have been included in the rates tendered for the corresponding main equipment.

PC: VALVES AND PIPEWORK ACCESSORIES

PC1 Scope

This specification covers the supply, delivery, installation and upholding during the Defects Liability Period of valves and pipework accessories in installations.

PC2 Materials

Valves shall be constructed of cast iron, brass, bronze or stainless steel and shall be suitable for operating under the pressures and temperatures of the lines in which they are to be installed.

Cast iron valves shall be manufactured from material conforming to BS 1452 GR 14 or ASTM A 126-61T and shall be of the Waterworks Pattern.

Brass and bronze valves shall be of the corrosion and dezincification resistant (C.R.) type shall be stamped as such and shall have stainless steel trims. Bronze valves shall be manufactured from material conforming to BS 1400 LG 2-C or ASTM B62.

Stainless steel screwed and socketed and stainless steel flanged valves shall be manufactured of AISI grades 304 or 316 stainless steel. Stainless steel buttwelded valves shall be manufactured from grades 304L or 316L stainless steel.

Handwheel nuts shall be of grade 304 or 316 stainless steel.

All stainless steel products shall be manufactured from material conforming to SANS 965 for the specified grade stainless steel. Unless otherwise shown on the Drawings, the surface finishes of stainless steel products shall conform to type 2B of BS 1449 Part 2.

PC3 General requirements

All valves and pipework accessories of one type supplied under one contract, shall be of the same manufacturer and supported by a well established SA organization.

Unless otherwise specified, all valves shall be of the same nominal diameter as the pipe in which they are to be installed. Cast iron valves shall not be installed in hot-water lines.

All valves shall be clockwise closing with a clear forged arrow or a brass or bronze nameplate on the handwheel indicating clearly the directions of opening and closing.

Unless prior approval has been obtained, dissimilar materials shall not be allowed to come in contact with each other but shall be properly insulated from each other by means of nylon or teflon spacers or washers.

3.1 Flanges

All flanges shall be of cast iron, galvanized mild steel or grade 304 L or 316 L stainless steel and unless otherwise specified, shall be of a pressure class of not less than 1600 kPa.

Flange drilling and flange and bolt sizes shall conform to the requirements of SANS 1123. Flange drilling orientation shall match the requirements of flanges of specials, fittings and valves.

Flanges shall have flat machined joint faces.

Rubber insertion rings shall comply with the requirements of BS 3063 and shall be of the reinforced full face type.

Each flanged pipe section or fitting shall be supplied with one complete set steel bolts, nuts and washers and one reinforced rubber insertion ring, all as specified.

The bolt lengths shall be compatible with the flange, washer and insertion ring thicknesses to ensure that after the flanges have been connected and the bolts tightened, no bolt protrudes more than three threads from a nut and no bolt is short of the end of a nut.

3.2 Bolts, nuts and washers

Bolts, nuts and washers used in conjunction with cast iron or galvanized mild steel pipework shall be hot dipped galvanized. All other bolts nuts and washers shall be of stainless steel. Washers used on pipework shall be of the spring-loaded anti-vibration type. All bolts and nuts shall be hexagon ISO metric conforming to the requirements of SABS 135.

Bolts shall project not more than three threads and no bolt shall be short of the end of a nut.

3.3 Screw threads

All screw threads shall be standard ISO-7/1 pipe thread. Jointing tape shall be PTFE grade 3M. Tape shall be applied to male ends of fittings.

3.4 Flexible joints

Flexible joints and flexible flange adaptors shall be manufactured from cast iron, bronze or stainless steel. Bolts nuts and washers shall be of stainless steel and gasket and sealing and wedge rings shall be suitable for the specified pressures and temperatures of the pipelines in which they are to be installed.

PC4 Type of Valves

4.1 Shut-off, sluice and drain valves

Only gate valves shall be used for this purpose.

The construction of gate valves shall be of the inside screw, screwed or bolted bonnet, solid tapered wedge disc, non-rising stem and hand wheel type.

Gate valves up to 50 mm diameter shall be of bronze or stainless steel with standard threaded connections and bonnet. Stems shall be of copper alloy or stainless steel and discs of bronze or stainless steel.

Gate valves of 65 to 80 mm diameter shall be of cast iron, stainless steel, bronze or brass to SABS 776 with screwed bonnets and flanged ends. Stems shall be of brass, bronze or stainless steel and discs shall be of bronze or stainless steel.

Valves of 100 mm diameter and larger shall be of cast iron or stainless steel with flanged ends and bolted bonnets. Stems shall be of brass, bronze or stainless steel and discs shall be of solid cast iron with bronze seat rings on body and disc. Trim shall be bronze.

Gate valves shall be provided with back-seating on stems to facilitate repacking under pressure.

Mild steel handwheels shall be treated against corrosion as specified.

4.2 Isolation, throttling and balancing valves

Gate, ball or butterfly valves may be used for temporary isolating pipeline sections. Only ball or butterfly valves shall be used for throttling or balancing. Gate, ball or butterfly valves may be used for temporary isolating pipeline sections.

4.2.1 Ball valves

All ball valves shall be constructed of cast iron, bronze or stainless steel.

Carbon steel handles shall be treated against corrosion as specified.

Ball valves larger than 50 mm diameter shall be flanged.

4.2.2 Butterfly valves

Butterfly valves shall have cast iron, bronze or stainless steel bodies with internal rubber lining and flanged ends, or wafer type fitting between flanges.

The valves shall be fitted with hand lever position indication and locking mechanism.

4.3 Non-return valves

Non-return valves shall be manufactured from cast iron, bronze or stainless steel and shall be of the non-clog ball types. Discs shall be of bronze or stainless steel, balls shall be of stainless steel and seats shall be elastic. The valves shall be of the non-slam type.

Valves up to 50 mm diameter shall be screwed and socketed and valves larger than 50 mm shall be flanged.

4.4 Float valves

Float valves up to 40 mm diameter shall have bronze valve bodies and working parts, screwed connections and shall be suitable to close against the system pressure.

Float valves of 50 mm diameter and larger shall have cast iron, bronze or stainless steel bodies with flanged ends and bronze seat rings.

4.5 Air valves

Air valves shall either be of the small diameter single orifice type or the automatic air vent type with integral stop valve and shall be manufactured of cast iron, bronze or stainless steel. Balls shall be of stainless steel.

The inlet diameter shall not be less than 10 mm and each air valve shall be equipped with a brass or stainless steel isolation valve. The valve shall be fitted with a standard screwed end.

4.6 Pressure gauges

Pressure gauges shall be of the Bourdon type with a 100 mm minimum gauge dial diameter and shall be manufactured from stainless steel.

Each gauge shall be provided with a cock and syphon tube.

The gauge shall be of the heavy duty type with adjustable zero point and shall be calibrated in SI units.

4.7 In-line flow meters

Flow meters shall be of the stainless steel orifice plate type, fitting between flanges.

The screwed take-off connections shall be provided with check valves.

A differential pressure gauge matching the orifice plates complete with tubes, shut-off cocks, air vents and carrying case shall be supplied for the flow meters. The differential pressure gauge shall be calibrated to give a direct rate of flow reading in SI units.

In addition graphs or charts on which the flow quantities are plotted against pressure differential across the flow meter, shall be supplied.

PC5

Installation

All valves and accessories shall be installed with removable and connections or unions for servicing or replacing the valve.

All valves and handwheels shall be easily accessible.

Reflux valves shall only be installed in horizontal lines.

PD: GALVANISING**PD1 Galvanising**

- 1.1 All hot dip galvanizing shall be executed in accordance with the SABS No 763 (as amended) specification for Hot Dip (Galvanised) Zinc Coatings, with particular reference to the following requirements.
- 1.2 All hot dipped galvanizing shall be of the heavy duty grade.
- 1.3 Mild steel plate and sections shall be of good commercial quality, or higher grades, best suited for galvanizing. The material shall be free from slag or coarse laminations, fine fissures and rolled-in impurities.
- 1.4 Castings shall be sound, dense and clean and free from distortion, porosity, carbon and slag enclosures, blow-holes and other injurious conditions.
- 1.5 Folded, rivetted or similarly jointed metal constructions are not acceptable.
- 1.6 Welding flux shall be chipped away and all welds wire brushed before galvanizing.
- 1.7 The surfaces to be galvanized shall be free from paint, oil, grease and similar impurities.
- 1.8 All exposed surfaces including welds shall be thoroughly sand blasted prior to galvanizing.
- 1.9 The Engineer shall have the right to inspect all steel components before galvanizing, and to reject or ask for remedial treatment of any material which is considered to be unsuitable. This applies particularly to welds.
- 1.10 The galvanized coating shall be smooth, adherent, continuous and free from black spots or flux stains.
- 1.11 Globular extra heavy deposits of zinc which interfere with the intended use of the material shall not be acceptable. Excessively protuberant lumps and nodules shall be removed by hot wiping or by the skillful application of mechanical means.
- 1.12 However, there shall remain a sufficient minimum thickness of unbroken zinc coating. Flaws on small parts and working surfaces shall be repaired only by stripping and re-dipping. The zinc bath shall contain not less than 98,5 % pure zinc.
- 1.13 The deposits required from galvanized coatings shall be as follows:

MATERIAL THICKNESS	COATING GRAMS PER m²	THICKNESS IN MICRON
5mm and over	735	105
5mm to 2mm	560	80
2mm to 1,25mm	385	55
Bolts and nuts	315 - 385	45 - 55

PD2 Protection of unpainted surfaces**2.1 Bright machined parts**

All bright machined parts shall have a protective treatment applied by the manufacturer before dispatch and this treatment shall be kept intact up to the time of handover unless it has to be removed for installation. If the surface is exposed after installation a further protective coating shall be applied in accordance with the manufacturer's requirements.

2.2 Non-ferrous

All exposed copper piping shall be cleaned down, degreased and all adhering materials cleaned off without damage to the installation. Where indicated on drawings or described elsewhere in this specification, exposed copper piping and sanitary fittings (chromium plated) shall be degreased, cleaned down and polished without damage to the installation.

PD3 Repair of paintwork

Areas where the paint coating has been damaged during transportation, erection or by any means whatsoever, shall be repaired as follows:

Rust spots shall be removed by means of a wire brush or emery paper and the surrounding paint which is still intact shall be feathered for a distance of 50 mm beyond the damaged area. Spot priming shall consist of all the coats previously applied, and shall overlap the damaged area by 20 mm.

PD4 Testing of paintwork

Paint dry film thickness shall be measured using a non-destructive thickness gauge such as the "Mikrotest" or equivalent.

The Employer may subject complete paintwork to specialist inspection, the findings of such inspection being binding on the Contractor. The cost of the inspection will be borne by the Employer but the cost of any remedial work resulting from the inspection must be borne by the Contractor.

PD5 Measurement and Payment

No separate payment will be made for painting and corrosion protection and the cost of this work shall be deemed to have been included in the prices tendered for the equipment.

PE: BRICKWORK

PE1 General

Brick work to comply with the "Specification of materials and methods to be used" as published by the Department of Public Works.

The following applicable extracts of the specification are given:

PE2 Lime

Lime shall be hydrated bedding mortar lime complying with the requirements of SABS Specification 523.

PE3 Cement

Cement shall be Portland cement complying with the requirements of SANS 471 or PC 15 complying with the requirements of SABS 831.

PE4 Sand

Sand shall comply with the requirements of SANS Specification 1090, unless specialist advice is obtained.

PE5 Works mortar tests

5.1 Sampling

The frequency of sampling will be decided by the Representative / Agent. Sufficient mortar shall be taken from each of the points of laying to prepare a composite sample to make a set of three mortar cubes.

5.2 Moulding

Cube moulds with a nominal size of 100mm, that comply with SANS 863 must be used.

Fill each mould with mortar in three equal layers and compact each layer by means of a tamper.

The tamper must be made of hard wood with a flat tamping surface with nominal dimensions of 50 x 25 mm and shaped to provide a round stem of approximately 25 mm diameter and long enough to afford sufficient hard grip. Immerse the tamper in water for 15 minutes before use.

Each layer of mortar must be compacted by means of 8 evenly spaced pressing strokes of the tamper. After the final layer has been tamped, the excess mortar must be struck off level with the top edges of the moulds.

5.3 Curing

Cover the test cubes (in their moulds) with an impervious sheet followed by wet matting, sacks or similar material, and store them in a place free from vibration, excessive draughts and direct sunlight.

After 24 hours mark each cube so that it can be identified. After 48 hours the cubes must be removed from their moulds and placed in water in a curing tank at 22° - 25°C for a minimum period of 7 days before they are transferred to the testing laboratory. Ensure that loss of moisture is prevented during transportation and that they are well protected against damage.

5.4 Testing of cubes

The testing of all mortar cubes will be done by the Contractor on instructions of the Engineer or by an approved laboratory in accordance with SABS STM 868.

PE6 Cement Mortar

Cement mortar shall be composed of 6 parts (by volume) of sand and 1 part (by volume) of cement. The material shall be mixed dry until of uniform colour and the water added and the mixture turned over until the ingredients are thoroughly incorporated. Cement mortar shall be produced in such quantities as can be used before commencing to set as no cement mortar that has once commenced to set shall be used in any way.

Care shall be taken in mixing cement mortar to remove from the mixing machine or platform any old mortar that has already set as much mortar may not be incorporated into any new batch.

PF: MANAGEMENT PLAN FOR THE CONSTRUCTION PHASE

PF1 Construction Phase Management Programme

The management criteria, objectives and actions are organized in this document according to generic groups of activities that are similar in nature. In reality, some of these may vary with different activities and environmental aspects.

1.1 Site Establishment and Method Statements

The Engineers Representative and Contractor shall discuss, and plan the site layout and establishment in detail, including the production of a sketch plan showing the construction site layout designed to avoid the impacts discussed further on. This plan must be approved by the Engineers Representative prior to construction commencing. Thereafter, the Contractor shall provide all method statements detailing the construction programme, methods and associated plant. These details must be approved before construction commences. Any changes to a proposed method that could have significant environmental consequences shall be agreed upon with the Engineers Representative first, before proceeding with the change.

1.2 Transport of Materials, Equipment and Staff to Site

This section covers the issues associated with the transport of construction material, equipment and staff to and from the site. The aim of this section is to ensure that the transport activities associated with the project do not impact significantly on the environment and the surrounding properties.

- Access to the construction sites will be via existing roads. The contractor will monitor the condition of the road in the vicinity of the construction areas and should the road be damaged due to construction activities, the road will be repaired within two days of detection/complaint/notification.
- Equipment lay-down areas and material storage areas must be discussed and agreed to with Foskor and specified in the Site Establishment Plan.
- Lay-down and material storage areas must be located away from the banks of rivers and wetlands to avoid any contaminated stormwater runoff from entering the rivers and wetlands. In addition, stormwater diversion berms or cut-off trenches must be constructed around the lay down areas.
- All potentially hazardous materials i.e. fuels, oils and chemicals, will be stored in an acceptable manner. In addition, all hazardous material storage areas will be bunded, with a minimum of sand bags.
- In the event of a spill of construction material, either hazardous or non-hazardous, the material must be contained in an area as small as possible. The spill material must then be removed and disposed of in a legally acceptable manner. In the event of hazardous material spillage and cleanup, a safe disposal certificate will be required. In the event of a spill the Engineer must be notified immediately.
- Drivers will reduce speed and exercise caution due to site operations in the vicinity of the construction site.
- The majority of the construction will take place adjacent to existing railway. The contractor must ensure that the railway adjacent to construction areas are kept clear at all times and not blocked by construction vehicles or equipment. Should a railway closure be required during the contract this must be discussed with Foskor.

1.3 Excavation and Storage

This section deals with the earthworks to be undertaken during the construction period. The aim of this section is to ensure that the area of impact due to construction is minimized and all material excavated during construction is stockpiled in an appropriate manner.

- The area of disturbance for the laying of pipes should be limited to 3m.
- Material excavated must be stockpiled in designated storage areas as specified in the Site Establishment Plan. Material excavated for the laying of the pipelines must be stockpiled in the following manner.
- The topsoil (top 30mm of the soil) must be excavated and stockpiled separately.
- The subsoil excavated and stockpiled adjacent to the trench.
- The stockpiles must be positioned away from the banks of rivers, streams and wetlands to prevent soil-laden run-off from draining directly into the watercourses. Long-term stockpiles must be stabilized to at least a 1:4 slope that are not longer than 20m.
- Any blasting or jackhammer operation will be limited to times when air movement is minimal and site operating hours (at present no blasting is anticipated, however it may be necessary in areas with rocky substrates).
- The flow of water in any river must not be stopped during construction. Any activity requiring a temporary stoppage in the flow of water must be discussed in detail at the preliminary site meeting and a detailed method statement provided. Under normal construction conditions the water must be diverted around the construction site.
- Material that is excavated may either be used in final site rehabilitation or must be disposed at a suitable spoil area. The Contractor, in consultation with the Site Engineer, will identify a suitable spoil area.

1.4 Construction

This section deals with the construction and associated activities on the site. The aim of this section is to manage all possible impacts that may arise during construction.

- All activities for construction e.g. concrete production will be located away from river banks and wetlands with cut-off trenches or stormwater diversion berms constructed to ensure that any contaminated run-off does not drain directly into rivers.
- Water required for construction activities may **NOT** be obtained from the adjacent river, adjacent wetland or pollution control dam.
- All waste i.e. construction and general, generated by activities on the site will be disposed of in a waste disposal area to be designated in the Site Establishment Plan. The area is to be equipped with suitable containers i.e. skips or bins, of sufficient capacity. The contents of the skips/bins will be disposed of at a permitted waste disposal facility when they have reached capacity.
- No fires whatsoever will be allowed on site.
- The Contractor will provide temporary ablution facilities i.e. chemical toilets, for construction workers for the duration of the contract. These toilets must be located away from the river and wetland. Workers must be warned that severe penalties will be imposed if they do not utilize the facilities provided.
- The construction site is to be kept neat and tidy i.e. good housekeeping practices to be implemented.

1.5 Site Rehabilitation and Re-vegetation

This section deals with the site rehabilitation and re-vegetation after construction is complete.

- On completion of construction, all unused material and waste must be removed from the site.
- All erosion protection and prevention measures must be implemented as per the design requirements.
- All excavated material not utilized during the rehabilitation process must be disposed of at an appropriate spoil site.
- Disturbed area where construction or related activities have occurred will be re-vegetated, where appropriate. These areas will be ripped and scarified before rehabilitation commences. The following grassing specification must be used during the re-vegetation of the site:
 - fertilizer - Standard 2:3:3 (N:P:K) fertilizer shall be used
 - Rate of Application – 200kg/hectare
 - grass seed mix - *Eragrostis tef* (Teff) (5kg/ha)
 - *Eragrostis curvula* (Weeping lovegrass) (10kg/ha)
 - *Chloris gayana* (Rhodes grass) (10kg/ha)
 - *Digitaria eriantha* (Smuts fingergrass) (5kg/ha)
 - irrigation - 25mm of irrigation per day until 60% ground cover achieved
- The seeding method recommended for re-vegetation is hand broadcasting, due to the small area to be re-vegetated. No trees or shrubs will be replaced during the re-vegetation process.
- All alien invasive plant species in the vicinity of the site must be removed prior to reinstatement and re-vegetation of the site. This will assist in the establishment of the new vegetation.
- The progress of the re-vegetation must be monitored on a regular (monthly) basis until at least 85% cover is achieved with no areas in excess of 0.04m² remaining un-vegetated.

1.6 Working Hours

The construction site is located within an industrial zone, therefore all activities in the areas will be limited to between 07h00 and 17h00 during weekdays. Any work to be undertaken on weekends will be subject to the standard conditions laid down in the contract document. These working hours will be strictly enforced and no loitering of Contractor's staff will be allowed after hours, except any security personnel appointed by the Contractor.

1.7 Complaints

- *Within 24 hours* the Contractor will report to the Project Manager the occurrence or detection of any incident at the site, or incidental to the operation of the site which has the potential to cause, or has caused water pollution of the environment, health risks or nuisance conditions or which is a contravention of the authorization conditions.
- *Within 7 working days* (or a shorter period of time) from the occurrence or detection of any incident, an action plan will be submitted, with a detailed time schedule giving measures taken to:

- Correct the impacts of the incident;
- Prevent the incident from causing any further impacts; and
- Prevent a recurrence of a similar incident.

An incident report and complaints register is to be kept and made available to the site engineer.

1.8 Compliance with Environmental Specification

The contractor is deemed not to have complied with the Environmental Specifications if:

- Within the boundaries of the site, site extensions and access roads there is evidence of contravention of clauses;
- Environmental damage occurs due to negligence;
- The contractor fails to comply with corrective or other instructions issued by the Project Manager or Clerk of Works within a specified time period;

Application of a penalty clause will apply for incidents of non-compliance. The penalty imposed will be per incident. Unless otherwise stated in the project specification, the penalties imposed per incident or violation will be as follows:

Incident/ Violation	Penalty
Failure to stockpile material correctly	R 1 000
Pollution of water bodies	R 3 000
Failure to control stormwater runoff	R 1 500
Failure to provide adequate sanitation	R 3 000
Unauthorized removal / clearing of vegetation	R 10 000
Failure to provide adequate waste disposal facilities and services	R 5 000
Failure to reinstate disturbed areas within specified time period	R 3 000
Failure to rehabilitate disturbed areas within 3 months of completion	R 5 000
Any other contravention of the environmental specification	R 1 000

PG: LABOUR INTENSIVE SPECIFICATIONS

PG1 Generic labour intensive specification

1.1 Scope

This specification establishes general requirements for activities which are to be executed by hand involving the following:

- a) trenches having a depth of less than 1.5 meters
- b) storm water drainage
- c) low-volume roads and sidewalks

1.2 Precedence

Where this specification is in conflict with any other standard or specification referred to in the Scope of Works to this Contract, the requirements of this specification shall prevail.

1.3 Hand excavateable material

Hand excavateable material is material:

a) granular materials:

- i) whose consistency when profiled may in terms of table 1 below be classified as very loose, loose, medium dense, or dense; or
- ii) where the material is a gravel having a maximum particle size of 10mm and contains no cobbles or isolated boulders, no more than 15 blows of a dynamic cone penetrometer is required to penetrate 100mm;

b) cohesive materials:

- i) whose consistency when profiled may in terms of table 1 be classified as very soft, soft, firm, stiff and stiff / very stiff; or
- ii) where the material is a gravel having a maximum particle size of 10mm and contains no cobbles or isolated boulders, no more than 8 blows of a dynamic cone penetrometer is required to penetrate 100mm;

Note:

- 1) A boulder, a cobble and gravel is material with a particle size greater than 200mm, between 60 and 200mm.
- 2) A dynamic cone penetrometer is an instrument used to measure the in situ shear resistance of a soil comprising a drop weight of approximately 10kg which falls through a height of 400mm and drives a cone having a maximum diameter of 20mm (cone angle of 60° with respect to the horizontal) into the material being used.

Table 1: Consistency of materials when profiled

GRANULAR MATERIALS		COHESIVE MATERIALS	
CONSISTENCY	DESCRIPTION	CONSISTENCY	DESCRIPTION
Very loose	Crumbles very easily when scraped with a geological pick.	Very soft	Geological pick head can easily be pushed in as far as the shaft of the handle.
Loose	Small resistance to penetration by sharp end of a geological pick.	Soft	Easily dented by thumb; sharp end of a geological pick can be pushed in 30-40 mm; can be moulded by fingers with some pressure.
Medium dense	Considerable resistance to penetration by sharp end of a geological pick.	Firm	Indented by thumb with effort; sharp end of geological pick can be pushed in upto 10 mm; very difficult to mould with fingers; can just be penetrated with an ordinary hand spade.
Dense	Very high resistance to penetration by the sharp end of geological pick; requires many blows for excavation.	Stiff	Can be indented by thumb-nail; slight indentation produced by pushing geological pick point into soil; cannot be moulded by fingers.
Very dense	High resistance to repeated blows of a geological pick.	Very stiff	Indented by thumb-nail with difficulty; slight indentation produced by blow of a geological pick point.

1.4 **Compaction of backfilling to trenches (areas not subject to traffic)**

Backfilling to trenches shall be placed in layers of thickness (before compaction) not exceeding 100mm. Each layer shall be compacted using hand stampers:

- a) to 93% MOD AASHTO density;
- b) such that in excess of 5 blows of a dynamic cone penetrometer (DCP) is required to penetrate 100 mm of the backfill, provided that backfill does not comprise more than 10% gravel of size less than 10mm and contains no isolated boulders, or
- c) such that the density of the compacted trench backfill is not less than that of the surrounding undisturbed soil when tested comparatively with a DCP.

1.5 **Excavation**

The excavation of any material which presents the possibility of danger or injury to workers shall not be excavated by hand.

1.6 **Clearing and grubbing**

Grass and small bushes shall be cleared by hand.

1.7 **Grassing**

All grassing shall be undertaken by sprigging, sodding, or seeding by hand.

PH: DESILTING SPECIFICATIONS

PH1 Desilting Specifications

1.1 Introduction

The desilting of the dams is required to reinstate the capacity of dams and also to allow for the draining of the dams and the installation of new liners to meet Class A liner specifications as required by the Waste Act.

The silt and water are considered hazardous with a low pH of 0,7 – 1,4. All desilting operations must be done in strict accordance with the safety and operational requirements of Foskor as specified elsewhere in this document.

1.2 Methodology

Silt within the dams have a high moisture content which complicates mechanical removal and loading when compared to dry product.

The methodology for the removal of the silt from both dams must be determined by the contractor and detail submitted with the tender. The flow of effluent water from the Foskor factory to the dams will not be stopped and the management of the effluent water discharging into the dams must be determined by the contractor and a detailed methodology submitted with the tender. The methodology must allow for the removal of the silt in the following manner:

- The existing pump facilities can deliver the silt to the Gypsum Disposal Pipeline. The total dam volume is 4 000 m³ for the Primary Dam and 16 000 m³ for the Secondary Dam. It is expected that the particle size in the Primary Dam will be 100 – 1 000 µm. The silt volume is 1 200 m³ and the available dilution water 1 000 – 1 500 m³. For the Secondary Dam, the silt content is 1 700 m³ and the dilution water 10 000 – 12 000 m³. It is anticipated that the Primary Dam will be desilted first with dilution water available from the Secondary Dam.

Spillages of the dam water or silt will not be acceptable and must be avoided. Any such spillage must be cleaned immediately to the satisfaction of Foskor.

It will be the contractor's responsibility to ensure that the existing pumpstations (pump, motor, DB board, etc) are in functional and safe working condition to perform the desilting, for the entire duration of the desilting process.

The Method Statement must be accepted by Foskor and include an Environmental Management Plan for the desilting process. The acceptance of the Method Statement will not relieve the contractor from any of its obligations to remove the sludge in a safe manner without damage to persons, infrastructure or the environment.

The following are guidelines for the removal of the silt that will be considered, but the contractor is not limited to it:

- a. Removal of the silt by suction pumping to the Gypsum pipeline utilising existing fixed pump facilities. The silt in the dams to be agitated by means of mechanical equipment and pumped to the Gypsum pipeline. Sufficient water must be available in the dams to ensure the silt is diluted. The sludge pumped from the dams must have a SG of < 1.2. It is recommended that an inline slurry density meter or total suspended solids meter be installed on the pumped pipeline leading to the Gypsum pipeline. The slurry density meter must be linked to a valve actuator. The valve actuator must manage two control valves. The one control valve must manage the flow of slurry to the Gypsum pipeline and the other must allow for the discharge of slurry back into the dam when the slurry density meter measures a SG of < 1.2. The silt removal process must limit removal of the existing overburden liner in Dam 2.

The silt removal and handling procedures are measured in the Bill of Quantities and the rates entered must be fully inclusive of the equipment, labour, water, material, monitoring, etc to manage, remove and deposit the silt as specified.

Alternative methods to remove the sludge will be considered and can be proposed provided the criteria regarding damage, efficiency and pollution are met.

The contractor to indicate detail of the following in his tender:

- Equipment to be used.
- Power and any other assistance required from Foskor.
- Detailed activity schedule and time implications.

Sufficient access to the site for equipment should be available, but the contractor must evaluate the site and access conditions and allow for it in his tender rate.

PI: GEOMEMBRANES

PI1 General

This Specification for the supply and installation of the geomembrane liners is based on the SANS 10409 Code of Practice for the Design, Selection and Installation of Geomembranes.

PI2 Scope

This specification covers the work involved in the geomembrane component of the geocomposite liner system for the lining of the Foskor Dams. It covers the supply of all materials, and the installation and testing of the liners.

PI3 Supporting Specifications

The publications below and in PS GM 10 in Section 0 form part of this specification to the extent referenced. Where a particular publication is referred to, that publication shall, unless otherwise stated, be the edition in effect 30 (thirty) days prior to the date of issue of this specification. Any contradictions between publications shall be submitted to the Engineer for decision.

- SANS 1526 (2015) – Thermoplastics sheeting for use as a geomembrane.
- SANS 10409 (2020) – Design, selection and installation of geomembranes.
- GRI Standard GM13 (Rev 16 - 2021) - Standard Specification for Test Properties, Test Frequencies and Recommended Warranties for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes.
- GRI Standard GM14 (Rev 1 - 2013) – Selecting variable intervals for taking geomembrane destructive seam samples using the method of attributes.
- GRI Standard GM19a (Rev 10 – 2021) - Standard Specification for Seam Strength and Related properties of Thermally Bonded Polyolefin Geomembranes.
- GRI Standard GM29 (2013) - Field Integrity Evaluation of Geomembrane Seams (and Sheet) Using Destructive and/or Non-destructive testing.

This specification contains clauses that are generally applicable to the manufacture, supply and installation of geomembrane liners.

PI4 Materials

4.1 Geomembrane Liners

The geomembrane liner materials shall comply with the requirements of SANS Specification 1526 (2003) for Geomembranes. It shall consist of a Pure High Density Polyethylene (HDPE) incorporating an evenly dispersed carbon black content as well as time proven Ultra Violet stabilisers and anti-oxidants. Reprocessed or reground materials shall not be used.

The geomembrane liner is to have a nominal thickness of either 2.0 mm or 1.5 mm as specified on the drawings and shall either be textured or smooth as specified in the drawings with a minimum asperity height of 0.4 mm for the textured geomembranes.

The HDPE material supplied for the geomembrane liners shall comply with the minimum property specifications as contained in GRI-GM13 Table 1(b) “High Density Polyethylene (HDPE) Geomembrane (Smooth)” (SI Metric Units).

4.2 Materials Certification

The Contractor shall submit documented certification that the geomembrane liner materials supplied, comply with the aforementioned specifications. This documentation for each roll to be delivered shall be submitted to the Engineer for approval prior to shipment of any materials to site.

4.3 Materials General

The geomembrane liners are to be supplied to site in panels no less than 6.5 m wide to minimize the number of site welds required. If necessary, factory controlled welding is to be carried out to attain the required minimum width.

The purpose of the liner is to create a barrier against seepage of contaminated water from Foskor and its leachate into the clean ground water below the facility. The physical and chemical characteristics of the geomembranes and their jointing systems must be such that the integrity of the geomembranes is maintained during construction of the Foskor Dams, and shall have at least a hundred year service life. As such, the geomembranes shall be resistant to degradation as a result of the temperature and chemical characteristics of stored product, sunlight, ultra violet rays, ozone, airborne pollution and weathering.

PI5 Packaging, Transportation, Unloading and Storage

The products shall be packaged, transported, unloaded and stored in accordance with the Manufacturer's instructions.

5.1 Labelling, Packaging and Transportation

The rolls of geomembrane shall be packaged so as to protect them from mechanical damage during transportation and handling. The geomembrane rolls must be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging is to be carefully removed without damaging the geomembrane.

Geomembrane rolls shall each be labelled on the surface of the package. Labels should be resistant to fading and moisture degradation such that they are legible at the time of installation. Labelling should include the Manufacturer's name, product identification, roll number, batch/lot number, roll dimensions and weight of the roll.

5.2 Unloading

Before off-loading on site, the contractor must ensure that the off-loading equipment is adequate for handling the geomembrane rolls without any risk of damaging them. The area where the geomembrane is to be off-loaded and stored must have a smooth well-drained surface, free of rocks or any other protrusions, which may damage the material. No special covering is necessary for geomembranes.

After off-loading, the contractor shall conduct a surface observation of all rolls for defects and for damage. This inspection shall be conducted without unrolling rolls unless defects or damages are found or suspected. The contractor shall inform the Engineer and the manufacturer of any defects or damages. Repairs shall be made subject to approval by the Engineer; otherwise, damaged rolls shall be replaced at the contractor's cost.

5.3 Storage

A designated storage area shall be established in a location such that on-site transportation and handling are minimised. The storage area should be protected from theft, vandalism, passage of vehicles, and be adjacent to the area to be lined. The geomembrane rolls shall be stored lying flat and continuously supported.

PI6 Plant

The Contractor shall provide all tools necessary to ensure a high level of workmanship.

PI7 Construction

7.1 Installation

The geomembrane installation shall generally be carried out in accordance with the requirements of SANS 10409 (2005) "Design, selection and installation of geomembranes", and the requirements of this project specification.

The Contractor shall submit with his tender a detailed proposal on the methods he proposes to use for installation of the geomembrane products. Some of the aspects to be covered include:

- Placement of the geomembrane without disturbance or causing to the layer being installed or any underlying layers.
- Equipment and procedures used to place the geomembrane.
- Placing of geotextile, geocells or other cover material in accordance with the Designs, on top of the protection geotextiles without damaging or disturbing the geotextile or underlying geomembrane lining.

Immediately prior to installation of the geomembrane lining, the subgrade surface shall be inspected by the Engineer, the Contractor and the Lining Sub-Contractor, to confirm that it is in a condition to safely accept the geomembrane on top of it. The Lining Sub-Contractor shall sign acceptance of the surface condition of the subgrade.

- The area to be lined must be free of all protrusions, stones, roots, vegetation and other materials, which may be detrimental to the performance of the liner. On the surface to be lined, a maximum particle size of 6 mm diameter is permissible.
- The final surface layer shall be left smooth and dense and finished levels shall be correct to within + 30 mm as measured under a 3 m long straight edge.

At the time of installation, each field panel or portion of a roll of geomembrane shall be given an "identification code". Field panels are to be located in a manner consistent with the specification and best suited to the design layout. A floor plan clearly showing the intended layout of the geomembrane, including orientation of panels and positions of seams should be submitted to the Engineer prior to installation commencing. Field panels are to be placed one at a time, and each field panel is to be seamed immediately after placement to the adjoining panel (in order to minimise the number of unseamed panels). The Lining Sub-Contractor shall record the identification code, location and date of installation of each geomembrane field panel.

Installation and seaming shall not take place in wet weather or in the presence of excessive moisture, blowing dust, or strong winds.

During installation, the Lining Sub-Contractor shall ensure the following:

- Any equipment used shall not damage the geomembrane by handling, trafficking, excessive heat, leakage of hydrocarbons (e.g.: diesel, petrol, etc.), or other means.
- The prepared surface has not deteriorated since the acceptance inspection and is still acceptable immediately prior to placement of the geomembrane.
- Any geosynthetic elements immediately underlying the geomembrane are clean and free of debris.
- All personnel working on the geomembrane shall not smoke, wear damaging shoes, or engage in any activities, which could damage the geomembrane.

- The method used to unroll the panels must not cause crimps in the geomembrane and must not damage the supporting soil surface.
- The method used to place the panels shall minimise wrinkles (especially differential wrinkles between adjacent panels).
- Adequate temporary loading and/or anchoring (e.g.: sand bags, tyres), which will not damage the geomembrane, must be placed to prevent uplift by wind.

Each geosynthetic and geomembrane layer shall be inspected for damage after placement, prior to seaming. Damaged areas shall be marked, removed and repaired in accordance with the specifications. The locations of repaired sections shall be recorded in the quality control documentation.

7.2 Seaming

In general, field seams should be oriented parallel to the line of maximum slope. In corners and odd-shaped geometric locations, the number of seams should be minimised. No horizontal seams should be less than 1.5 m from the toe of the slope or areas of potential stress concentrations, unless otherwise authorised. When full roll lengths do not extend past the toe of the slope, panel ends may be seamed provided the panel is cut at an angle greater than 45 degrees.

A seam numbering system compatible with the panel numbering system shall be established.

Seaming of field panels shall be carried out by means of a continuous heat extrusion welding process, or an electric double wedge fusion welding process, to produce a totally homogeneous seam.

The extrusion welding apparatus shall be equipped with gauges giving the temperature at the nozzle and extruder barrel. The fusion welding apparatus must be automated device, which produces a double seam with an enclosed space for pressure testing. The fusion welding apparatus must also be fitted with gauges giving the applicable temperatures.

Prior to seaming, the seam area is to be clean and free of moisture, dust dirt, debris of any kind, and foreign material. Seaming shall not take place in excessively high temperatures where the air pressure channels begin to close, or where passing welds are unobtainable. Similarly, no seaming shall be attempted at ambient temperatures below 0°C. In all cases, the geomembrane shall be dry and protected from the wind.

Trial seams shall be made on fragment pieces of geomembrane liner to verify that seaming conditions are adequate. Such trial seams shall be made at the beginning of each seaming period for each seaming apparatus used. Trial seams shall be made under the same conditions as the actual seams. The trial seam shall be approximately 1 m long by 300 mm wide, with the seam centred lengthwise.

Field seams shall be made by overlapping adjacent sheets at least 75 mm for hot wedge fusion welding and 30 mm for extrusion welding. Seams must be aligned with the fewest possible number of wrinkles and "fish mouths". Where wrinkles or "fish mouths" are unavoidable, they shall be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut wrinkles or "fish mouths" shall be seamed and any portion where the overlap is inadequate shall be patched with an oval or round patch of the same geomembrane, extending a minimum of 150 mm beyond the cut in all directions. All seaming shall be performed through the anchor trench.

For hot wedge fusion welding on wet or damp subgrade (such as pre-hydrated GCL), a protective layer of plastic may be required to be placed directly below the overlapped membranes being seamed.

7.3 Anchorage

The outer edges of the geomembrane liners are to be anchored in the same anchor trench at the top (and bottom in specified cases) of the slope, together with the other components of the lining system, as shown on the drawings. The front edge of the trench is to be rounded, so as to prevent stress concentrations on the geomembranes.

The geomembranes are to be placed in the trench such that they cover the entire trench floor, but do not extend up the rear trench wall.

The anchorage trench is to be backfilled and compacted in layers not exceeding 150 mm thick with selected material or with cement stabilised soil as specified on the drawings. To minimise material bridging at the toe of the slope and the formation of wrinkles, backfilling of the anchor trench should be carried out during the cool of the morning or extended period of overcast skies. Care must be taken during backfilling of anchor trenches to prevent any damage to the geosynthetic lining components.

7.4 Penetrations

Where pipes penetrate the geomembrane liner, a purpose-made “pipe boot” made from the same material as the geomembrane shall be welded to the geomembrane, and the area of the geomembrane within the “pipe boot” cut out. Where the pipe composition is the same as the geomembrane (e.g.: HDPE), the “pipe boot” sleeve is to be welded directly to the pipe, if space permits. For dissimilar materials, the “pipe boot” sleeve should be fastened to the pipe by mechanical means and sealant applied between the pipe and sleeve.

7.5 Placement on Top of Geomembranes

The Contractor is to provide a detailed method statement for placement of any cover/protection onto the Geomembrane such as soil or filled geocells. The method statement should take into account the following:

- Placement of a cover layer, which may be soil and/or similar approved material.
- Equipment allowance on top of soil cover layer.
- Sequencing of cover layer placement to follow similar schedule to that of the liner panel placement.
- Management of wrinkles/folds during cover layer placement.

The commencement of cover/protection layer placement shall not proceed prior to the approval of the method statement by the Engineer in writing.

Placement of subsequent geosynthetic layers, drainage media or soil on top of installed geomembrane liners shall not take place until all destructive and non-destructive testing has been completed and the geomembrane accepted.

Placement of material over the geomembrane shall be performed so as to minimise wrinkles. If a wrinkle forms, every effort shall be made to walk the wrinkle out prior to placement of material over the geomembrane. Minor folding over of wrinkles is acceptable, provided that an even transition occurs at the tail of the wrinkle. If excessive stress points are created at the tail of a wrinkle, the wrinkle should be cut out and repaired as specified.

Material placed on top of the geomembrane liner should be back-dumped on the liner, rather than being pushed across the liner, in an effort to reduce the formation of wrinkles. This is done by using a front-end loader to place the material ahead of it being spread over the liner.

PI8 Tolerances

The required tolerances are as per the supporting specifications listed under PS GM 2 under Section PS GM2.

PI9 Testing and Construction Quality Control

9.1 Construction Quality Control

The Contractor shall supply with his tender, a Construction Quality Assurance / Control Plan, which clearly indicates documentation ensuring compliance with the necessary material specifications, and control points requiring quality control checking during construction/installation. As a minimum, the Construction Quality Control Plan shall include the following:

- Method statement for liner installation at each area/facility.
- Project Quality Plan for each area that lists every activity with its associated work instruction/procedure, records, inspection requirements and signature requirements.
- All quality inspection sheets to be used.

It is strongly recommended that the Contractor use a digital cloud based software program for daily uploading of all CQC information for review/approval by the Engineer and/or the Employer.

9.2 Materials Conformance Tests

When instructed by the Engineer at the commencement of the liner installation, the Contractor shall take samples of the geomembranes for conformance testing. Six samples, each 300 mm x 300 mm, are to be taken across the entire width of a roll of each geomembrane type, not including the first 1.5 m. The samples are to be marked with the machine direction, roll number on the sample, and date the sample was obtained. The samples are then to be sent to an accredited Geosynthetics testing laboratory where the following conformance tests are to be performed (according to the relevant ASTM standard test method):

- Density - ASTM D1505
- Thickness - ASTM D5199
- Tensile Strength and Elongation at break - ASTM D6639
- Stress Crack Resistance (SP-NCTL) - ASTM D5397
- Standard Oxidative Induction Time (OIT) - ASTM D3895
- High Pressure Oxidative Induction Time (HP-OIT) - ASTM D5885

The thickness of the liner sheet shall be tested before laying as verified by thickness conformance profiles as supplied by the manufacturers. The thickness of geomembrane liner shall be a minimum nominal thickness, as measured in accordance with SANS 1526 (2003) Specification test method.

9.3 Trial Seam Testing

To ensure proper setting and calibration of welding equipment, a trial seam weld approximately 2 m in length shall be run each day on material not forming part of the main geomembrane before welding on the main geomembrane commences.

Three specimens, each, 25 mm wide, must be taken from the trial weld seam and tested by the Contractor using a field tensiometer. All three specimens shall meet the criteria for film tearing bond (FTB), i.e.: the geomembrane must fail before the weld seam.

9.4 Vacuum Testing

This test creates a vacuum on one side of the joint. If a vacuum of minus 75 kPa can be maintained for three (3) minutes, the joint shall be considered effective. This test must be done where three sheets are lapped or where patching is done on straight runs at a rate of one test per 5 linear metres of welding.

9.5 Electric Double Wedge Testing

Electric Double Wedge Testing is tested non-destructively by inflating the space between the two wedge welds and maintaining a certain pressure for a predetermined period of time. All double wedge welded seams are to be tested.

9.6 Peel Test

This test determines the effectiveness of the weld by peeling the weld apart at a rate of 50 mm/min on a strip 25 mm wide cut perpendicular to the joint direction.

An increasing force is applied to the two strips of membrane forming the joint. If one of the strips break prior to full separation across the weld, it is considered acceptable. If the weld separates, the weld is considered unacceptable.

9.7 Spark Testing

If non-destructive spark testing will be performed on the seam, a wire is embedded in the weld during the extrusion process. Spark testing shall be carried out on all extrusion-welded seams in accordance with the test method specified in ASTM D6365 "Standard Practice for the Non-destructive Testing of Geomembrane Seams using the Spark Test". All extrusion-welded seams are to be spark tested.

PI10 Measurement and Payment

10.1 Supply

Supply HDPE geomembrane liner including all jointing, trimming laps, anchoring and wastage (m²) (specify geomembrane thickness).

This item includes the cost of all plant, labour, materials, customs requirements, shipment and transport to the Foskor site, off-loading and storage at the permanent storage site as indicated by the Engineer and according to specifications or as detailed on the contract drawings.

10.2 Install

Install HDPE geomembrane liner including all jointing, trimming laps, anchoring and wastage (m²) (specify geomembrane thickness).

This item includes the cost of all plant, labour and materials required for the transporting from the permanent storage area to the position of installation, panel cutting, panel deployment, seaming, testing and any repairs required and any activity forming part of the installation for the geomembrane liner as detailed on the contract drawings.

This item also includes the cost of all plant, labour and materials required for the anchorage of the geomembranes according to the contract drawing details (excavation and backfilling measured elsewhere).

10.3 Extra Over

Extra over PS GM 8.2 for working lining around pipes, openings etc. not exceeding 355 mm diameter (No.)

This item shall be an extra over rate for items PS GM 8.2 and includes full compensation for the extra work involved to work and fix the geomembranes around pipes and openings etc.

PI11 Other Applicable Geomembranes Standards

- American Society for Testing and Materials (ASTM):
- ASTM D638 – Standard Test Method for Tensile Properties of Plastics.
- ASTM D792 – Standard Test Method for Specific Gravity and Density of Plastics by Displacement.
- ASTM D1004 – Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
- ASTM D1603 – Test Method for Carbon Black in Olefin Plastics.
- ASTM D5886-95 – Standard Guide for Selection of Test Methods to Determine Rate of Fluid Permeation Through Geomembranes for Specific Applications.
- ASTM D5199-98 – Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
- ASTM D4833-88(1996) e1 – Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.
- ASTM D5397 – Standard Test Method for Single Point Notched Load Test for Geomembranes.
- ASTM D3895 – Standard Test Method for Determining the Minimum Oxidative Induction Time of Geomembranes.

PJ: CUSPATED DRAINS AND DRAINAGE GEOCOMPOSITES

PJ1 Scope

This is a particular specification and covers the supply and installation of cuspated drainage cores (sheets) and drainage geocomposites to be installed in the liner system of the Foskor Dams.

PJ2 Interpretations

2.1 Supporting Specifications

The following supporting specifications, standards and guidelines shall, inter alia, form part of the contract document together with this Particular Specification:

- ASTM D4439 – Terminology for Geosynthetics.
- ASTM D4759 – Practice for Determining the Specification Conformance of Geosynthetics.
- ASTM D4833 – Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.
- ASTM D6241 – Test Method for Static Puncture Strength of Geotextiles and Geotextile Related Products Using a 50-mm Probe.
- ASTM D638 – Standard Test Method for Tensile Properties of Plastics.
- ASTM D792 – Standard Test Method for Specific Gravity and Density of Plastics by Displacement.
- ASTM D1238 – Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
- ASTM D1603 – Test Method for Carbon Black in Olefin Plastics.
- ASTM D1621-04a – Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
- ASTM D7361-07 – Standard Test Method for Accelerated Compressive Creep of Geosynthetic Materials Based on Time-Temperature Superposition Using the Stepped Isothermal Method.
- Geocomposites ASTM D5885-06 – Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry.

2.2 Application

This specification contains clauses that are generally applicable to the manufacture, supply and installation of cuspated drains and drainage geocomposites.

PJ3 Materials

3.1 Properties of Geosynthetic Cuspated Drainage Core (GCDC)

The geosynthetic cuspated drainage core to be used in the leakage drainage and detection layer within the geocomposite lining system for the Foskor Dams shall be a product conforming to the properties and parameters provided below as approved by the Engineer.

It shall consist of a Pure High Density Polyethylene (HDPE) incorporating an evenly dispersed carbon black content as well as time proven Ultra Violet stabilisers and anti-oxidants. Reprocessed or reground materials shall not be used. Specifically, the GCDC shall have the following components and properties:

- The unit mass of the GCDC shall be approximately 700 g/m².
- The overall core thickness (uncompressed) shall not be less than 4.3 mm.
- The thickness under 200 kPa at 10 000 hrs shall not be less than 3.5 mm.
- The compressive yield strength shall not be less than 900 kPa.
- The uncompressed cusp height shall not be less than 3.5 mm.
- The in-plane water flow at 200 kPa vertical pressure shall not be less than 0.38 l/m.s at a hydraulic gradient of 1.0.
- Carbon black shall be between 0.8 and 2.5%.

3.2 Materials Certification

The Contractor shall submit documented certification that the cusped drain and drainage geocomposite materials supplied comply with the aforementioned specifications. This documentation shall be submitted prior to any installation of the products on site.

3.3 Materials General

The cusped drain and drainage geocomposite products are to be supplied to site in panels no less than 3.7 m wide to minimize the number of site joints required.

The purpose of the cusped drain between the first and second and the second and third geomembrane layers placed within the Foskor Dams lining is to drain away any leakage through the primary and secondary geomembranes and prevent a build-up of hydraulic head on the secondary and tertiary geomembranes respectively.

The purpose of the Drainage Geocomposite layer above the geomembrane liner on the facility side slopes is to intercept and drain away any seepage that may occur through the topsoil layer, and so prevent any potential erosion.

The physical and chemical characteristics of the drainage geocomposite products and their jointing systems must be such that the integrity of the drainage systems is maintained throughout the life of the plant and after closure. As such the drainage geocomposite products shall be resistant to degradation as a result of the temperature (nominal) and chemical characteristics of the seepage, sunlight, ultra violet rays, ozone, airborne pollution and weathering.

PJ4 Packaging, Transportation, Unloading and Storage

The cusped drain and drainage geocomposite products shall be packaged, transported, unloaded and stored in accordance with the manufacturers' instructions.

4.1 Labelling, Packaging and Transportation

The rolls of cusped drain and drainage geocomposite products shall be packaged so as to protect them from mechanical damage during transportation and handling. The product rolls must be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging is to be carefully removed without damaging the product.

Rolls shall each be labelled on the surface of the package. Labels should be resistant to fading and moisture degradation such that they are legible at the time of installation. Labelling should include the Manufacturer's name, product identification, roll number, batch/lot number, roll dimensions and weight of the roll.

4.2 Unloading

Before off-loading on site, the Contractor must ensure that the off-loading equipment is adequate for handling the cusped drain rolls without any risk of damaging them. The area where the cusped drain and drainage geocomposite products are to be off-loaded and stored must have a smooth well-drained surface, free of rocks or any other protrusions, which may damage the product.

After off-loading, the Contractor shall conduct a surface observation of all rolls for defects and for damage. This inspection shall be conducted without unrolling rolls unless defects or damages are found or suspected. The Contractor shall inform the engineer and the manufacturer of any defects or damages. Repairs shall be made subject to approval by the Engineer; otherwise, damaged rolls shall be replaced at the Contractor's cost.

4.3 Storage

A designated storage area shall be established in a location such that on-site transportation and handling are minimised. The storage area should be protected from theft, vandalism, passage of vehicles, and be adjacent to the area to be lined. The drainage geocomposite and cusped drain rolls shall be stored lying flat and continuously supported. The drainage geocomposite rolls must be covered to protect them from ultraviolet exposure until they are installed and covered with topsoil or backfill. No special covering is necessary for cusped drains.

PJ5 Construction

5.1 Installation

Leakage Drainage and Leak Detection Layers

The Contractor shall submit with his tender a detailed proposal on the methods he proposes to use for installation of the cusped drain and geocomposite drainage products. Some of the aspects to be covered include:

- Placement of the cusped drain and drainage geocomposite without disturbance or damage to underlying layers and linings.
- Equipment and procedures used to place the cusped drain and drainage geocomposite.
- Placing of the relevant material on top of the cusped drain and drainage geocomposite in the Foskop Dams without damaging or disturbing the underlying geosynthetic drains or geomembrane lining.

Field panels are to be located in a manner consistent with the specification and best suited to the design layout. Field panels are to be placed one at a time, and each field panel is to be seamed immediately after placement to the adjoining panel (in order to minimise the number of unseamed panels). The Contractor shall record the identification code, location and date of installation of each cusped drain and drainage geocomposite field panel.

Installation and seaming shall not take place in wet weather or in the presence of excessive moisture, blowing dust, or strong winds.

During installation, the Contractor shall ensure the following:

- Any equipment used shall not damage the geomembrane or cusped drain by handling, trafficking, excessive heat, leakage of hydrocarbons (e.g.: diesel, petrol, etc.), or other means.
- The prepared surface has not deteriorated since the acceptance inspection and is still acceptable immediately prior to placement of the cusped drain.
- Any geomembrane liner immediately underlying the cusped drain and drainage geocomposite is clean and free of debris.
- All personnel working on the cusped drains or drainage geocomposites shall not smoke, wear damaging shoes, or engage in any activities which could damage any of the geosynthetic components.
- The method used to unroll the panels must not cause crimps in the cusped drain or drainage geocomposites, and must not damage the underlying geomembrane.
- The method used to place the panels shall minimise wrinkles (especially differential wrinkles between adjacent panels).
- Adequate temporary loading and/or anchoring (e.g.: sand bags, tyres), which will not damage the cusped drain, must be placed to prevent uplift by wind.

Each geomembrane, cusped drain and drainage geocomposite layer shall be inspected for damage after placement, prior to seaming. Damaged areas shall be marked, removed and repaired in accordance with the Specifications. The locations of repaired sections shall be recorded in the quality control documentation.

Rolls shall be laid flat on the installed underlying geomembrane liner without folds or wrinkles, with a standard overlap or seam as specified by the manufacturer in both longitudinal and transverse directions. The orientation of the placed cusped drains should be such that the cusps are facing upwards.

No vehicular traffic shall be allowed on the installed lining and walking on the liners must be kept to an absolute minimum. Acceptable installation therefore may be accomplished such that the cusped drain or drainage geocomposite is rolled out by hand.

Care must be taken to minimise the extent to which the cusped drain and drainage geocomposite is dragged across the geomembrane liner in order to avoid damage to the cusped drain and the underlying geomembrane, and to prevent the formation of folds in the underlying liner.

5.2 Anchorage

The outer edge of the cusped drain and drain drainage geocomposite is to be anchored in the same anchor trench at the top (and bottom where specified) of the slope, together with the other components of the lining system, as shown on the design drawings. The front edge of the trench is to be rounded, so as to prevent stress concentrations on the cusped drain or drainage geocomposite.

In the anchor trench of the Foskop Dams, the second cusped drain and the bottom (third) geomembrane is to be placed in the trench such that it covers the entire trench floor, but does not extend up the rear trench wall unless shown otherwise in the drawings. The first cusped drain along with the first and second geomembranes are to be placed in the trench such that they are 150 mm above the bottom of the trench placed on the backfilled and compacted layers and do not extend up the rear wall unless shown otherwise on the drawings.

The anchor trench is to be backfilled and compacted in layers not exceeding 150 mm thick, with selected material or with cement stabilised soil, as specified in the drawings.

5.3 Seaming

In general, field seams should be oriented parallel to the line of maximum slope. In corners and odd-shaped geometric locations, the number of seams should be minimised. No horizontal seams should be less than 1.5 m from the toe of the slope or areas of potential stress concentrations, unless otherwise authorised. When full roll lengths do not extend past the toe of the slope, panel ends may be seamed provided the panel is cut at an angle greater than 45 degrees.

Seaming of cusped drain field panels shall be carried out by means of overlapping the two adjoining sheets by at least 50 mm and interlocking the cusps of the two sheets into one another. If deemed necessary by site conditions, the seams shall then be stitch-welded at 500 mm centres by means of a heat extrusion welding process. The extrusion welding apparatus shall be equipped with gauges giving the temperature at the nozzle and extruder barrel. Seaming of drainage geocomposite field panels shall be carried out by means of butting the two adjoining sheets of drainage geocomposites and heat bonding the geotextiles seam overlaps.

Prior to seaming, the seam area is to be clean and free of moisture, dust, dirt, debris of any kind, and foreign material. Seaming shall not take place in excessively high temperatures or at ambient temperatures below 0°C. In all cases, the cusped drain sheets and drainage geocomposite shall be dry and protected from the wind.

5.4 Installation around Penetrations and Structures

The cusped drain shall be cut away to fit neatly around penetrations and structures through the liner system. No welding or sealing of the cusped drain or drainage geocomposites is required around penetrations and structures through the lining system.

5.5 Damage Repair

Any repairs shall be in accordance with the manufacturer's instructions and subject to approval by the engineer.

PJ6 Tolerances

The tolerances required in the supporting specifications shall apply.

PJ7 Testing

The Contractor shall supply with his tender, a Construction Quality Assurance/Control Plan that clearly indicates documentation ensuring compliance with the necessary material specifications, and control points requiring quality control checking during construction/installation.

PJ8 Measurement and Payment

8.1 Supply Cusped Drain

- Description of Type:
 - (Position and area indicated) – Unit: m².
 - Etc. for other positions and areas.
- Etc. for other types.

Separate items will be scheduled for different structures or areas to be lined.

The unit of measurement will be square metres of lined surface. No additional area shall be measured as overlaps and/or wastage. Similarly, no additional payment will be made for cutting drainage geocomposite or cusped drain around penetrations and structures.

This item includes full compensation for procuring, custom costs, shipping, transporting material to Foskor site permanent storage. The cost for materials including cutting and wasting shall be included in the tendered price.

This item also includes the cost of all plant, labour and materials required for the anchorage and seaming of the drainage geocomposite or cusped drain in an earth trench as detailed on the contract drawing details (excavation and backfilling measured elsewhere).

8.2 Install Drainage Cusped Drain

- Description of Type:
 - (Position and area indicated) – Unit: m².
 - Etc. for other positions and areas.
- Etc. for other types.

Separate items will be scheduled for different structures or areas to be lined.

The unit of measurement will be square metres of lined surface. No additional area shall be measured as overlaps and/or wastage. Similarly, no additional payment will be made for cutting drainage geocomposite or cusped drain around penetrations and structures.

This item includes full compensation for transporting material from permanent storage area to position of installation, deploying, cutting and wasting and bending up against structures over filler blocks, and preparing ends for fixing to structures and for all labour incidentals required for the installation or application of the drainage geocomposite or cusped drain, complete as per manufacturer's specifications.

This item also includes the cost of all plant, labour and materials required for the anchorage and seaming of the drainage geocomposite or cusped drain in an earth trench as detailed on the contract drawing details (excavation and backfilling measured elsewhere).

PK: GEOTEXTILES

PK1 Scope

This is a particular specification and covers the supply and installation of protection, separation and filter geotextiles to be installed as part of the lining systems and around the subsoil drainage in the Foskor Dams and covers the supply and installation of the various protection geotextiles.

PK2 Interpretations

2.1 Supporting Specifications

The following supporting specifications, standards and guidelines shall, inter alia, form part of the contract document together with this Particular Specification:

- GRI Test Method GT12(a) (2016) – Test Methods and Properties for Nonwoven Geotextiles Used as Protection (or Cushioning) Materials.
- GRI Test Method GT13(a) (2017) – Test Methods and Properties for Nonwoven Geotextiles Used as Separation Between Subgrade soils and Aggregate.
- ASTM D4354 – Practice for Sampling of Geosynthetics for Testing.
- ASTM D4355 – Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
- ASTM D4439 – Terminology for Geosynthetics.
- ASTM D4533 – Test Method for Trapezoidal Tearing Strength of Geotextiles.
- ASTM D4632 – Test Method for Grab Breaking Load and Elongation of Geotextiles.
- ASTM D4759 – Practice for Determining the Specification Conformance of Geosynthetics.
- ASTM D4833 – Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.
- ASTM D4873 – Guide for Identification, Storage and Handling of Geosynthetics.
- ASTM D5261 – Test Method for Measuring Mass per Unit Area of Geotextiles.
- ASTM D5494 – Test Method for the Determination of Pyramid Puncture Resistance of Unprotected and Protected Geomembranes.
- ASTM D6241 – Test Method for Static Puncture Strength of Geotextiles and Geotextile Related Products Using a 50-mm Probe.
- AASHTO M288-00 – Geotextile Specification for Highway Applications.

2.2 Application

This specification contains clauses that are generally applicable to the manufacture, supply and installation of protection geotextiles.

PK3 Materials**3.1 Properties of Geotextiles**

The geotextiles to be used for protection, separation and filtration as well as a combination of these within composite liner system of the Foskor Dams shall be a nonwoven polyester geotextile and where classified as Type A, Type B and Type C based on their respective functions. The properties of each of the geotextiles to be used within the design are as follows:

Table 1: Mechanical and Hydraulic Properties of Specified Geotextiles

Property Description	Type A Geotextile	Type B Geotextile	Type C Geotextile
Thickness under 2kPa (mm)	6.4	4.4	1.6
Tensile strength - weaker direction (kN/m)	56	40	11.5
Tensile strength - elongation (%)	50-70	50-70	50-70
Static puncture strength – CBR (kN)	11.7	7.1	2.2
Puncture resistance – Max diameter of hole (mm)	3	8	25
Trapezoidal tear strength – weaker direction (N)	2100	1200	375
Grab strength – weaker direction (N)	4700	2500	730
Grab strength – elongation (%)	50-80	50-80	50-80
UV stability	70% strength retained after 1000 hrs		
Normal through flow @ 50mm head (l/s/m ²)	20	45	125
In-plane through flow – flow rate/ m width (l/hr)	130	75	35
Permeability @ 50mm head (m/s)	2.5x10 ⁻³	4.x10 ⁻³	4.x10 ⁻³
Pore size (µm)	<75	114	155

The Contractor shall submit to the Engineer a technical data sheet of the geotextiles he intends to use for the various types of geotextiles required on site. The Engineer shall provide approval of each of the geotextiles in writing before the Contractor procures the geotextiles.

3.2 Materials Certification

The Contractor shall submit documented certification that the geotextile materials supplied comply with the aforementioned specifications. This documentation shall be submitted prior to any installation of the products on site.

3.3 Materials General

The geotextiles are to be supplied to site in panels no less than 5.0 m wide to minimize the number of site joints required.

The purpose of the protection geotextile layer is to protect the underlying geomembrane liner from mechanical damage during and after construction.

The physical and chemical characteristics of the protection geotextile must be such that the integrity of the geotextile is maintained throughout the life of the facility/plant. As such the geotextile shall be resistant to degradation as a result of the temperature (nominal) and chemical characteristics of the seepage, sunlight, ultra violet rays, ozone, airborne pollution and weathering.

PK4 Packaging, Transportation, Unloading and Storage

The geotextile shall be packaged, transported, unloaded and stored in accordance with the Manufacturer's instructions.

4.1 Labelling, Packaging and Transportation

The rolls of geotextile shall be packaged so as to protect them from mechanical damage during transportation and handling. The geotextile rolls must be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging is to be carefully removed without damaging the product.

Geotextile rolls shall each be labelled on the surface of the package. Labels should be resistant to fading and moisture degradation such that they are legible at the time of installation. Labelling should include the Manufacturer's name, product identification, roll number, batch/lot number, roll dimensions and weight of the roll.

4.2 Unloading

Before off-loading on site, the Contractor must ensure that the off-loading equipment is adequate for handling the geotextile rolls without any risk of damaging them. The area where the geotextile rolls are to be off-loaded and stored must have a smooth well-drained surface, free of rocks or any other protrusions, which may damage the product.

After off-loading, the Contractor shall conduct a surface observation of all rolls for defects and for damage. This inspection shall be conducted without unrolling rolls unless defects or damages are found or suspected. The Contractor shall inform the Engineer and the manufacturer of any defects or damages. Repairs shall be made subject to approval by the Engineer; otherwise, damaged rolls shall be replaced at the Contractor's cost.

4.3 Storage

A designated storage area shall be established in a location such that on-site transportation and handling are minimised. The storage area should be protected from theft, vandalism, passage of vehicles, and be adjacent to the area to be lined.

The geotextile rolls shall be stored lying flat and continuously supported. The geotextile rolls must be covered to protect them from ultraviolet exposure until they are installed and covered with either the geomembrane, topsoil or relevant cover in accordance with the designs.

PK5 Construction

5.1 Installation

The Contractor shall submit with his tender a detailed proposal on the methods he proposes to use for installation of the geotextile products. Some of the aspects to be covered include:

- Placement of the protection geotextiles without disturbance or damage to underlying layers and linings.
- Equipment and procedures used to place the protection geotextiles.
- Placing of geomembrane, topsoil, geocells or other cover material in accordance with the Designs, on top of the protection geotextiles without damaging or disturbing the geotextile or underlying geomembrane lining.

When the geotextile is to be placed directly beneath a geomembrane as a protection layer, the subgrade surface to receive the geotextile shall meet the requirements for geomembrane installation as outlined in PI7. Immediately prior to installation of the geotextile, the underlying surface or geomembrane shall be inspected by the Engineer, the Contractor and the Lining Sub-Contractor, to confirm that it is in a condition to safely accept the geotextile on top of it. The Lining Sub-Contractor shall sign acceptance of the surface condition of the subgrade. This subgrade surface condition shall also be applicable to the subsurface trench faces and basin geomembranes, which are to be lined with geotextile prior to backfilling.

Field panels are to be placed one at a time, and each field panel is to be seamed immediately after placement to the adjoining panel (in order to minimise the number of unseamed panels). Installation and seaming shall not take place in wet weather or in the presence of blowing dust, or strong winds.

During installation, the Contractor shall ensure the following:

- Any equipment used shall not damage any of the liner components by handling, trafficking, excessive heat, leakage of hydrocarbons (e.g.: diesel, petrol, etc.), or other means.
- Any geomembrane liner immediately underlying the protection geotextile is clean and free of debris.
- All personnel working on the geomembrane, drainage geocomposite, cusped drain or geotextile shall not smoke, wear damaging shoes, or engage in any activities which could damage any of the geosynthetic components.
- The method used to unroll the panels must not cause crimps in the geotextile, and must not damage the underlying geomembrane.
- The method used to place the panels shall minimise wrinkles (especially differential wrinkles between adjacent panels).
- Adequate temporary loading and/or anchoring (e.g.: sand bags, tyres), which will not damage the geotextile, must be placed to prevent uplift by wind.

Each geomembrane and protection geotextile layer shall be inspected for damage after placement, prior to seaming. Damaged areas shall be marked, removed and repaired in accordance with the specifications. The locations of repaired sections shall be recorded in the quality control documentation.

Rolls shall be laid flat on the installed underlying geomembrane liner without folds or wrinkles, with a minimum overlap of 150 mm in both longitudinal and transverse directions.

No vehicular traffic shall be allowed on the installed lining and walking on the liners must be kept to an absolute minimum. Acceptable installation therefore may be accomplished such that the geotextile is unrolled in front of backward moving equipment. If the installation equipment causes rutting of the sub-grade, the sub-grade must be restored to its original accepted condition before placement continues.

Care must be taken to minimise the extent to which the geotextile is dragged across the underlying geomembrane liner in order to avoid damage to the geotextile and/or the underlying geomembrane, and to prevent the formation of folds in the underlying liner.

5.2 Anchorage

The outer edge of the protection geotextile is to be anchored in the same anchor trench at the top and/or bottom of the slope, together with the other components of the lining system, as shown on the drawings. The front edge of the trench is to be rounded, so as to prevent stress concentrations on the liner components. The geotextile is to be placed in the trench such that it covers the entire trench floor, but does not extend up the rear trench wall. The anchorage trench is to be backfilled and compacted in layers not exceeding 150 mm thick, with selected material or with cement-stabilised soil.

5.3 Seaming

In general, field seams should be oriented parallel to the line of maximum slope. In corners and odd-shaped geometric locations, the number of seams should be minimised. No horizontal seams should be less than 1.5 m from the toe of the slope or areas of potential stress concentrations, unless otherwise authorised. When full roll lengths do not extend past the toe of the slope, panel ends may be seamed provided the panel is cut at an angle greater than 45 degrees.

Seaming of field panels shall be carried out by means of overlapping the two adjoining sheets of geotextile by a minimum of 150 mm and heat bonding the geotextiles together.

Prior to seaming, the seam area is to be clean and free of moisture, dust, dirt, debris of any kind, and foreign material. Seaming shall not take place in excessively high temperatures or at ambient temperatures below 0°C. In all cases, the geotextile sheets shall be dry and protected from the wind.

5.4 Installation around Penetrations and Structures

The geotextile shall be cut away to fit neatly around penetrations and structures through the liner system. No welding or sealing of the geotextile is required around penetrations and structures through the lining system, however, protection to the underlying geomembrane should be maintained as far as possible.

5.5 Damage Repair

Any repairs shall be in accordance with the manufacturer's instructions and subject to approval by the engineer. Typically, geotextiles are to be repaired by applying patches, with a minimum of 300 mm overlaps in all directions around the damaged area and heat bonded.

PK6 Tolerances

The tolerances required in the supporting specifications shall apply.

PK7 Testing

The Contractor shall supply with his tender, a Construction Quality Assurance/Control Plan which clearly indicates documentation ensuring compliance with the necessary material specifications, and control points requiring quality control checking during construction/installation.

PK8 Measurement and Payment

8.1 Supply Geotextile

- Description of Type:
 - (Position and area indicated) – Unit: m².
 - Etc. for other positions and areas.
- Etc. for other types.

Separate items will be scheduled for different structures or areas to be lined.

The unit of measurement will be square metres of lined surface. No additional area shall be measured as overlaps and/or wastage. Similarly, no additional payment will be made for cutting protection geotextile around penetrations and structures.

This item includes full compensation for procuring, custom costs, shipping, transporting material to Foskor site permanent storage. The cost for materials including cutting and wasting shall be included in the tendered price.

This item also includes the cost of all plant, labour and materials required for the anchorage and seaming of the geotextiles.

8.2

Install Geotextile

- Description of Type:
 - (Position and area indicated) – Unit: m².
 - Etc. for other positions and areas.
- Etc. for other types.

Separate items will be scheduled for different structures or areas to be lined.

The unit of measurement will be square metres of lined surface. No additional area shall be measured as overlaps and/or wastage. Similarly, no additional payment will be made for cutting protection geotextile around penetrations and structures.

This item includes full compensation for transporting material from permanent storage area to position of installation, deploying, cutting and wasting and bending up against structures over filler blocks, and preparing ends for fixing to structures and for all labour incidentals required for the installation or application of the protection geotextile, complete as per manufacturer's specifications.

This item also includes the cost of all plant, labour and materials required for the anchorage and seaming of the geotextiles.

PL: GEOSYNTHETIC CLAY LINER

PL1 Scope

This is a particular specification and covers the supply and installation of geosynthetic clay liner to be installed as the secondary protection layer below the lining system of the new Foskor Dams.

PL2 Interpretations

2.1 Supporting Specifications

The following supporting specifications, standards and guidelines shall, inter alia, form part of the contract document together with this Particular Specification:

- ASTM D 4354 Practice for Sampling of Geosynthetics for Testing.
- ASTM D 4833 Test Method for Index Puncture of Geomembranes and Related Products.
- ASTM D 4439 Terminology for Geosynthetics.
- ASTM D 4632 Test Method for Grab Breaking Load and Elongation of Geotextiles.
- ASTM D 4759 Practice for Determining the Specification Conformance of Geosynthetics.
- ASTM D 5261 Test Method for Measuring Mass per Unit Area of Geotextiles.
- D5887 Standard Test Method for Measurement of Index Flux through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter.
- ASTM D 5888 Standard Guide for Storage and Handling of Geosynthetic Clay Liners.
- ASTM D 5889 Practice for Quality Control of Geosynthetic Clay Liners.
- ASTM D5890 Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners.
- ASTM D5891 Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners.
- ASTM D5993 Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners.
- ASTM D 6072 Standard Practice for Obtaining Samples of Geosynthetic Clay Liners.
- ASTM D 6102 Standard Guide for Installation of Geosynthetic Clay Liners.
- ASTM D 6141 Guide for Screening the Clay Portion of a GCL for Chemical Compatibility to Liquids.
- ASTM D6243 Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method.
- ASTM D 6495 Guide for Acceptance Testing Requirements for Geosynthetic Clay Liners.

- ASTM D6496 Standard Test Method for Determining the Average Bonding Peel Strength between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners.
- ASTM D 6766 Test Method for Evaluation of Hydraulic Properties of Geosynthetic Clay Liners Permeated with Potentially Incompatible Liquids.
- ASTM D6768 Standard Test Method for Tensile Strength of Geosynthetic Clay Liners.
- ASTM D 6496 Test Method for Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners.
- GRI GCL3 (Rev 5 – 2019) Specification for Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners (GCLs).
- ISO 10318 Geosynthetics – Terms and Definitions.
- ISO 12236 Test Method for Geosynthetics Static Puncture Test (CBR Test).

2.2 Application

This specification contains clauses that are generally applicable to the manufacture, supply and installation of the geosynthetic clay liner.

PL3 Materials

3.1 Properties of Geosynthetic Clay Liner

The geosynthetic clay liner to be used as a secondary protection layer below the liner system of the Foskop Dams shall be a reinforced geosynthetic clay liner or an equivalent product as approved by the Engineer. Specifically, the geosynthetic clay liner shall have the following components and properties:

- The unit mass of the Geosynthetic clay liner bentonite shall be a minimum of 4 000 g/m².
- The cover geotextile to be a polypropylene non-woven 200 g/m².
- The carrier geotextile to be a polypropylene slit film 110 g/m².
- GCL mass shall be a minimum of 4310 g/m².
- Bentonite minimum swell index: 24ml/2g.
- Grab strength 600N.
- CBR Burst 1500N, minimum 15% elongation.
- Hydraulic conductivity (maximum): 1.85×10^{-11} m/s.

3.2 Materials Certification

The Contractor shall submit documented certification that the geosynthetic clay liner materials supplied comply with the aforementioned specifications. This documentation shall be submitted prior to any installation of the products on site.

3.3 Materials General

The geosynthetic clay liner is to be supplied to site in panels no less than 5.0 m wide to minimize the number of site joints required.

The purpose of the geosynthetic clay liner is to provide a secondary layer of protection against seepage below the geomembrane liner in the Foskor Dams.

The physical and chemical characteristics of the geosynthetic clay liner must be such that the integrity of the geosynthetic clay liner is maintained throughout the life of the facility/plant. As such the geosynthetic clay liner shall be resistant to degradation as a result of the temperature (nominal) and chemical characteristics of the seepage, sunlight, ultra violet rays, ozone, airborne pollution and weathering.

PL4 Packaging, Transportation, Unloading and Storage

The geosynthetic clay liner shall be packaged, transported, unloaded and stored in accordance with the Manufacturer's instructions.

4.1 Labelling, Packaging and Transportation

The rolls of geosynthetic clay liner shall be packaged so as to protect them from mechanical damage during transportation and handling. The geosynthetic clay liner rolls must be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging is to be carefully removed without damaging the product.

Geosynthetic clay liner rolls shall each be labelled on the surface of the package. Labels should be resistant to fading and moisture degradation such that they are legible at the time of installation. Labelling should include the Manufacturer's name, product identification, roll number, batch/lot number, roll dimensions and weight of the roll.

4.2 Unloading

Before off-loading on site, the Contractor must ensure that the off-loading equipment is adequate for handling the geosynthetic clay liner rolls without any risk of damaging them. The area where the geosynthetic clay liner rolls are to be off-loaded and stored must have a smooth well-drained surface, free of rocks or any other protrusions, which may damage the product.

After off-loading, the Contractor shall conduct a surface observation of all rolls for defects and for damage. This inspection shall be conducted without unrolling rolls unless defects or damages are found or suspected. The Contractor shall inform the Engineer and the manufacturer of any defects or damages. Repairs shall be made subject to approval by the Engineer; otherwise, damaged rolls shall be replaced at the Contractor's cost.

4.3 Storage

A designated storage area shall be established in a location such that on-site transportation and handling are minimised. The storage area should be protected from theft, vandalism, passage of vehicles, and be adjacent to the area to be lined. All GCL rolls shall be stockpiled and maintained dry in a well-drained flat location area away from high-traffic areas but sufficiently close to the active work area to minimize handling. Rolls shall not be stacked on uneven or discontinuous surfaces, in order to prevent bending, deformation, and damage to the GCL or cause difficulty inserting the carpet spike or core pipe.

GCL shall not be stored more than three rolls high, or limited to the height at which installation personnel may safely manoeuvre the handling apparatus, whichever is lowest. Stacks or tiers of rolls must be situated in a manner that prevents sliding or rolling by chocking the bottom layer of the rolls. An additional tarpaulin or plastic sheet shall be used over the stacked rolls to provide extra protection for GCL material stored outdoors.

Bagged bentonite material shall be stored in a dry location free from the influences of weather conditions, standing water, UV radiation, chemicals, excessive heat, vandalism and animals. Bags shall be stored on pallets or other suitably dry surfaces that will prevent pre-hydration.

PL5 Construction

5.1 Installation

The Contractor shall submit with his tender a detailed proposal on the methods he proposes to use for installation of the geosynthetic clay liner products. Some of the aspects to be covered include:

- Placement of the geosynthetic clay liner without disturbance or damage to underlying prepared sub-base surface.
- Equipment and procedures used to place the geosynthetic clay liner.
- Placing of geomembrane, topsoil, geocells or other cover material in accordance with the designs, on top of the geosynthetic clay liner without damaging or disturbing the geosynthetic clay liner or underlying prepared sub-base.

When the geosynthetic clay liner is to be placed directly beneath a geomembrane as a secondary protection layer, the subgrade surface to receive the geosynthetic clay layer shall meet the requirements for geomembrane installation as outlined in PI7.

Immediately prior to installation of the geosynthetic clay liner, the subgrade surface shall be inspected by the Engineer, the Contractor and the Lining Sub-Contractor, to confirm that it is in a condition to safely accept the geosynthetic clay liner on top of it. The Lining Sub-Contractor shall sign acceptance of the surface condition of the subgrade.

Field panels are to be placed one at a time, and each field panel is to be seamed immediately after placement to the adjoining panel (in order to minimise the number of unseamed panels). Installation and seaming shall not take place in wet weather or in the presence of blowing dust, or strong winds.

During installation, the Contractor shall ensure the following:

- Any equipment used shall not damage any of the liner components by handling, trafficking, excessive heat, leakage of hydrocarbons (e.g.: diesel, petrol, etc.), or other means.
- The prepared surface to receive the geosynthetic clay liner has been approved.
- All personnel working on the geomembrane, drainage geocomposite, cusped drain, geotextile or geosynthetic clay liner shall not smoke, wear damaging shoes, or engage in any activities which could damage any of the geosynthetic components.
- The method used to unroll the panels must not cause crimps in the geosynthetic clay liner, and must not damage the underlying prepared surface.
- The rolls shall not be unrolled in an uncontrolled manner, the Contractor shall have control of roll at all times during the placement of geosynthetic clay liner roll.
- The method used to place the panels shall minimise wrinkles (especially differential wrinkles between adjacent panels).
- Adequate temporary loading and/or anchoring (e.g., sand bags, tyres), which will not damage the geosynthetic clay liner, must be placed to prevent uplift by wind.

Each geomembrane and geosynthetic clay liner layer shall be inspected for damage after placement, prior to seaming. Damaged areas shall be marked, removed and repaired in accordance with the manufacturer's specifications. The locations of repaired sections shall be recorded in the quality control documentation.

Rolls shall be laid flat on the underlying prepared surface without folds or wrinkles, with a minimum overlap of 150 mm in both longitudinal and transverse directions.

No vehicular traffic shall be allowed on the installed lining and walking on the liners must be kept to an absolute minimum. Acceptable installation therefore may be accomplished such that the geosynthetic clay liner is unrolled in front of backward moving equipment. If the installation equipment causes rutting of the sub-grade, the sub-grade must be restored to its original accepted condition before placement continues.

Care must be taken to minimise the extent to which the geosynthetic clay liner is dragged across the underlying prepared surface in order to avoid damage to the geosynthetic clay liner and/or the underlying prepared surface.

5.2 Anchorage

The outer edge of the geosynthetic clay liner is to be anchored in the same anchor trench(s) at the top and/or bottom of the slope, together with the other components of the lining system, as shown on the drawings. The front edge of the trench is to be rounded, so as to prevent stress concentrations on the liner components.

The geosynthetic clay liner is to be placed in the trench such that it covers the entire trench floor, but does not extend up the rear trench wall. The anchorage trench is to be backfilled and compacted in layers not exceeding 150mm thick, with selected material or with cement-stabilised soil.

5.3 Seaming

GCL seams shall be used where called for on the design drawings, shown on the approved panel layout, or as directed by the Engineer. The seam shall be created by overlapping adjacent edges and enhancing the seam as recommended by the manufacturer, or as instructed by the Engineer. GCL shall not be heat bonded to other geosynthetics.

The overlap zone shall be kept clean and shall not be contaminated with loose soil or other debris. There shall be no folds in the overlap zone and no traffic or walking shall occur on the completed seam.

5.4 Overlap

Adjacent panels shall be overlapped with the sufficient material, unless otherwise specified by the manufacturer; the minimum dimension of the longitudinal overlap must be 150 mm. The overlap for end-of-roll seams must be a minimum of 600 mm. Seams at the end of panels must be constructed such that they are shingled in the direction of the grade, to prevent the potential for runoff water to enter the overlap zone. Non-self-sealing end overlap areas shall be treated with bentonite paste in accordance with manufacturer's instructions.

Rolls may be cut to length with a carpet knife or electric cutter. Disturbance of overlap areas during placement of upper layers must be avoided.

5.5 Installation Around Penetrations and Structures

The GCL shall be sealed around penetrations and structures in accordance with the manufacturer's recommendations, as shown on the design drawings, or as instructed by the Engineer.

5.6 Damage Repair

Agreement on the appropriate repair method shall be reached between the Contractor and the Engineer. Repairs shall be undertaken using one or a combination of the following methods:

Patching

Patching shall be used to repair holes, cuts or tears, insufficient overlap, bridging, GCL material defects, and to remove hard objects underneath the GCL. Patching shall comprise installing a new piece of GCL of the same material type and thickness extending at least 300 mm beyond the affected area in each direction. Patches on slopes steeper than 1V:6H shall be minimized, and in this case, the location and size of such a patch shall be approved by the Engineer. In addition to bentonite augmentation around the edge of patches on slopes steeper than 1V:6H the patch shall be temporarily secured with construction adhesive so that it is not displaced during cover placement. Smaller patches may be tucked under the damaged area to limit patch movement.

No patches shall overlap. If this is required to make a repair, the entire area, including all previous patches in the near vicinity, shall be covered with a single large patch. Deviations from this requirement shall be approved by the Engineer.

Cuts or tears that are less than 25 percent of the roll width may be repaired by patching. Cuts or tears longer than 25 percent of the roll width shall be cut out and replaced with a new piece of GCL for the full width of the roll and seamed to the existing GCL. In this case, the location of such seam shall be approved by the Engineer.

Replacement

GCL material exposed to hydrocarbon fuels, chemicals, pesticides, non-compatible leachates, or other harmful liquids, or subjected to premature unconfined hydration shall be rejected and replaced.

PL6 Tolerances

The tolerances required in the supporting specifications shall apply.

PL7 Testing

The Contractor shall supply with his tender, a Construction Quality Assurance/Control Plan which clearly indicates documentation ensuring compliance with the necessary material specifications, and control points requiring quality control checking during construction/installation.

PL8 Measurement and Payment

8.1 Supply Geosynthetic Clay Liner

- Description of Type:
 - (Position and area indicated) – Unit: m².
 - Etc. for other positions and areas.
- Etc. for other types.

Separate items will be scheduled for different structures or areas to be lined.

The unit of measurement will be square metres of lined surface. No additional area shall be measured as overlaps and/or wastage. Similarly, no additional payment will be made for cutting around penetrations and structures.

This item includes full compensation for procuring, custom costs, shipping, transporting material to Foskor site permanent storage. The cost for materials including cutting and wasting shall be included in the tendered price.

This item also includes the cost of all plant, labour and materials required for the anchorage and seaming of the geosynthetic clay liner as detailed on the contract drawing details.

8.2 Install Geosynthetic Clay Liner

- Description of Type:
 - (Position and area indicated) – Unit: m2.
 - Etc. for other positions and areas.
- Etc. for other types.

Separate items will be scheduled for different structures or areas to be lined.

The unit of measurement will be square metres of lined surface. No additional area shall be measured as overlaps and/or wastage. Similarly, no additional payment will be made for cutting geosynthetic clay liner around penetrations and structures.

This item includes full compensation for transporting material from permanent storage area to position of installation, deploying, cutting and wasting and bending up against structures over filler blocks, and preparing ends for fixing to structures and for all labour incidentals required for the installation or application of the geosynthetic clay liner, complete as per manufacturer's specifications.

This item also includes the cost of all plant, labour and materials required for the anchorage and seaming of the geosynthetic clay liner as detailed on the contract drawing details.

PM: GEOCELLS

PM1 Scope

This is a particular specification and covers the supply and installation of protection geocells to be installed as the protection and leachate drainage layer above the geocomposite lining systems a Foskor Dams, as shown on the construction drawings and described by the contract specifications.

PM2 Interpretations

2.1 Supporting Specifications

The following supporting specifications, standards and guidelines shall, inter alia, form part of the contract document together with this Particular Specification:

- GRI Standard GS-13 – Guide for Geomembrane-related Geocell Seam Strength and its Efficiency with respect to the Perforated Sheet Strength
- GRI Standard GS-14 – Test Method for the Average Wall Thickness of a Geomembrane-related Geocell by Indirect Measurement
- GRI Standard GS-15 – Test Methods, Test Properties and Testing Frequency for Geocells Made From High Density Polyethylene (HDPE) Strips
- ASTM D4354 Practice for Sampling of Geosynthetics for Testing
- ASTM D4439 Terminology for Geosynthetics
- ASTM D4759 Practice for Determining the Specification Conformance of Geosynthetics
- ASTM D4873 Guide for Identification, Storage and Handling of Geosynthetics

2.2 Application

This specification contains clauses that are generally applicable to the manufacture, supply and installation of geocells to be placed over installed geocomposite liners.

PM3 Materials

3.1 Properties of Geocells

The geocells to be used as a protection and leachate drainage layer above the installed liner system in the Foskor Dams shall be “Multicell HD Geocell SW712-100” as supplied by Kaytech.

The geocell system shall consist of an assembly of plastic sheet strips connected in series, using full-depth fusion welded seams aligned perpendicular to the longitudinal axis of the strips. When expanded, the interconnected strips form the walls of a flexible, three dimensional cellular confinement structure into which the specified infill materials can be placed.

The geocells shall be manufactured from virgin, non-thermally degraded high density polyethylene (HDPE) or similar polyolefin material. Specifically, the geocells shall have the following components and properties:

- The polymer shall have a minimum density of 0.935 g/cm³, tested per ASTM D1505;
- The polymer shall have a minimum environmental stress crack resistance (ESCR) of 4 000 hours, tested as per ASTM D1693;

- The nominal sheet thickness shall be not less than 1.25 mm (+/-5%), as measured per ASTM D5199. Thickness shall be determined in the flat, before any surface texturing or other surface disruption.
- The carbon black content shall be not less than 2% by mass, and shall be homogeneously distributed throughout the material.
- The geocell material shall exhibit a High Pressure Oxidative Induction Test (HPOIT) result of at least 400 minutes, or a Standard Oxidative Induction Test (OIT) result of at least 100 minutes.
- Cell seam strength shall be uniform over the full depth of the cell. Minimum seam peel strength shall be 12 kN/m.
- The geocell walls shall be perforated not more than 15% of the total wall area.

3.2 Materials Certification

The Contractor shall submit documented certification that the geocell materials supplied comply with the aforementioned specifications. This documentation shall be submitted prior to any installation of the products on site.

3.3 Materials general

The purpose of the geocells is to contain a protective and drainage layer of granular material on top of the installed geocomposite liner in the dams, so as to protect the liner from the effects of heat, ultraviolet exposure and mechanical damage, whilst at the same time providing a layer of granular material to act as a leachate drainage layer.

The physical and chemical characteristics of the geocells must be such that the integrity of the geocells is maintained throughout the operational life of the facilities at Foskor. As such the geocells shall be resistant to degradation as a result of the temperature (nominal) and chemical characteristics of the leachate, sunlight, ultra violet rays, ozone, airborne pollution and weathering.

The geocells shall be 100 mm deep as shown on the construction drawings. The plan area of the expanded individual cells shall be approximately 1 206 cm², ie the cell size should be approximately 508 mm x 475 mm.

PM4 Packaging, Transportation, Unloading and Storage

The geocells shall be packaged, transported, unloaded and stored in accordance with the manufacturers' instructions.

4.1 Packaging and Transportation

The geocells shall be packaged flat so as to protect them from mechanical damage during transportation and handling. The geocell packages must be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging is to be carefully removed without damaging the product.

4.2 Unloading

Before off-loading on site, the Contractor must ensure that the off-loading equipment is adequate for handling the geocell packages without any risk of damaging them. The area where the geocell packages rolls are to be off-loaded and stored must have a smooth well-drained surface, free of rocks or any other protrusions which may damage the product.

After off-loading, the Contractor shall conduct a surface observation of all geocell packages for defects and for damage. This inspection shall be conducted without opening the packages unless defects or damages are found or suspected. The Contractor shall inform the engineer and the manufacturer of any defects or damages. Repairs shall be made subject to approval by the Engineer, otherwise damaged rolls shall be replaced at the Contractor's cost.

4.3 Storage

A designated storage area shall be established in a location such that on-site transportation and handling are minimised. The storage area should be protected from theft, vandalism, passage of vehicles, and be adjacent to the area to be lined. The geocell packages shall be stored laying flat and continuously supported.

PM5 Construction

5.1 Installation

The Contractor shall submit with his tender a detailed proposal on the methods he proposes to use for installation of the geocell protection layers. Some of the aspects to be covered include:

- A floor plan clearly showing the intended layout of the geocells, including orientation of strips, and positions of joints.
- Placement, expansion and securing the geocells without disturbance or damage to underlying liner system.
- Equipment and procedures used to place the geocells.
- Filling of the installed geocells with concrete without damaging or disturbing the underlying geomembrane lining.

Field panels are to be placed one at a time, and each field panel is to be joined after placement to the adjoining panel. Installation and jointing shall not take place in the presence of strong winds.

During installation, the Contractor shall ensure the following:

- Any equipment used shall not damage any of the liner components by handling, trafficking, excessive heat, leakage of hydrocarbons (e.g. diesel, petrol, etc.), or other means.
- Any geomembrane liner with its protection geotextile underlying the geocells must be clean and free of debris.
- All personnel working on the GCL, geomembrane, drainage geocomposite, geotextile or geocells shall not smoke, wear damaging shoes, or engage in any activities which could damage any of the geosynthetic components.
- The method used to expand and deploy the geocell the panels must not cause crimps in the geocells, and must not damage the underlying geomembrane.
- Adequate temporary loading and/or anchoring (e.g., sand bags, tyres), which will not damage the geocells, must be placed to prevent uplift by wind.

Geocell panels shall be opened and expanded uniformly into position over the underlying geotextile and geomembrane liner. The orientation of the expanded panels shall be such that the panel is expanded longitudinally down the slope. Accommodation of non-linear alignments may require non-uniform expansion of individual geocell sections in order form tapered or curved elements. When properly expanded, the individual cells of each geocell section shall measure approximately 508 mm wide x 475 mm long in the direction of the geocell expansion.

Expanded panels shall be held in position with a temporary frame placed on top of the installed liner and held in position by means of sand bags or a similar method. Under no circumstances can pegs be driven through the liner into the subgrade.

The edges of adjacent geocell panels shall be inter-leafed or butt-jointed according to which side wall profiles abut. In all cases, the upper surfaces of adjoining geocell panels shall be flush at the joint. Welded edge seams shall be flush and aligned when stapling. The longitudinal centre lines of abutting external cells should be aligned and stapled at the cell wall contact point. Adjoining panels shall be stapled together in accordance with the manufacturer's instructions.

Care must be taken to minimise the extent to which the geocell panels are dragged across the underlying geotextile and geomembrane liner in order to avoid damage to the geotextile and/or the underlying geomembrane, and to prevent the formation of folds in the underlying liner.

5.2 Anchorage

The outer edge of the geocells is to be anchored in the same anchor trench at the top of the slope, together with the other components of the lining system, as shown on the drawings. The front edge of the trench is to be rounded, so as to prevent stress concentrations on the liner components. The liner anchor trench is to be partially backfilled to surface along the inner edge and sloping back at approximately 45° towards the outer edge. The geocell panels are to be placed in the trench on this sloping backfill and the anchor trench must then be backfilled to surface with cement stabilised soil. Galvanised J – Hooks are to be installed for every individual geocell cell in the anchor trench as per the manufacturer's instructions and Engineering drawings.

5.3 Installation around penetrations and structures

The geocells shall be cut away to fit neatly around penetrations and structures through the liner system. No welding or sealing of the geocells is required around penetrations and structures through the lining system. All voids to be filled with concrete to ensure a water-tight seal at penetrations and structures.

5.4 Filling of Geocells

As each area of geocells has been properly installed and secured in position, filling with class 30/19 concrete can be carried out. Infilling shall commence from the crest and must then proceed over the filled geocell panels inwards towards the toe line and dam base. The fill material should not be dropped from a height above 1 m, and shall be spread and finished off slightly above the top of the geocell panel walls.

The concrete mix design must be approved by the Engineer.

5.5 Damage repair

Any repairs shall be in accordance with the manufacturer's instructions and subject to approval by the engineer.

PM6 Tolerances

The tolerances required in the supporting specifications shall apply.

PM7 Testing

The Contractor shall supply with his tender, a Construction Quality Assurance/Control Plan which clearly indicates documentation ensuring compliance with the necessary material specifications, and control points requiring quality control checking during construction/installation.

PM8 Measurement and Payment

8.1 Supply and Instal Geocells

- Description of type and depth:
 - (Position and area indicated) - Unit: m².
 - Etc for other positions and areas
- Etc for other types and depths

Separate items will be scheduled for different structures or areas to be lined.

The unit of measurement will be the net square metres of geocells installed. No additional area shall be measured as overlaps and/or wastage. Similarly, no additional payment will be made for cutting geocell panels around penetrations and structures.

This item includes full compensation for procuring, furnishing and placing or application of materials including cutting and wasting and bending up against structures over filler blocks, and preparing ends for fixing to structures and for all labour incidentals required for the installation or application of the geocells, complete as per manufacturer's specifications.

8.2 Anchoring of Geocells in Anchor Trench

- Anchorage of geocells according to detail in anchor trench together with other liner components (excavation and backfilling measured elsewhere) – Unit : m

This item includes the cost of all plant, labour and materials required for the anchorage of the protection geotextile in an earth trench as detailed on the contract drawings.

PN: OCCUPATIONAL HEALTH AND SAFETY SPECIFICATION



**OCCUPATION
HEALTH AND SAFETY
SPECIFICATION**

Specifically Designed

FOSKOR RICHARDSBAY

For The

**Upgrade of The Primary and
Secondary Pollution Control
Dams**

Prepared By: *C & M Safety Consultants*

Date Prepared: 19 May 2023

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OCCUPATIONAL HEALTH AND SAFETY SPECIFICATION
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Task Completion Form

Annexure B:

Principal Responsible Persons

Annexure C:

Other requirements

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Acceptance Letter

(Please acknowledge and return to - C & M Safety Consultants)

1. INTRODUCTION:

1.1. Duties of Client

The Construction Regulations require that the Client prepare a suitable, sufficiently documented and coherent site-specific Health and Safety Specification for the intended construction work.

1.2. Purpose of the Construction Health and Safety Specification

To assist in achieving compliance with the Occupational Health and Safety Act No. 85 of 1993 and Regulations in order to prevent incidents and injuries. The Construction specification shall act as basis for the drafting of the Construction Health and Safety Plan of the Principal contractor. This specification in no way release Contractors from compliance with the relevant legal requirements. Should there be any contradiction between this document and the Act, the Act must take preference. Similarly, where this document is silent on a specific health & safety requirement, the Act must be used as the minimum requirement. Should the Contractor be in doubt about the precise meaning of any item set out in this document, the Client must be contacted in order that the correct meaning may be decided.

The Construction Specification sets out the requirements to be followed by the Principal Contractor and Sub-contractors so that the health and safety of all persons potentially at risk may receive the same priority as other facets of the project i.e., cost, program, environment etc.

Principal Contractors must take cognizance of the fact that they must make adequate provision for the cost of health and safety measures on their tender documents. The Principal Contractor in turn must ensure that potential Sub-contractors submitting tenders to perform construction work for the Principal Contractor have made sufficient provision for the cost of health and safety measures.

1.3. Implementation of the Construction Health and Safety Specification

The Principal Contractor once having drawn up the required Health and Safety Plan based on the Client's Health and Safety Specification must submit the plan to the C & M Safety Consultants for approval prior to commencement of work. The Principal Contractor must apply the approved plan from the date of commencement of the construction work on site and for the duration of the construction project. The Health and Safety plan must be reviewed and updated by the Principal Contractor as work progresses. The C & M Safety Consultants appointed representing the Client on behalf of safety will conduct periodic health and safety audits at least once every 30 days on the Principal Contractor to ensure compliance with the Specification. The Principal Contractor shall forward a copy of this specification to all Sub-Contractors at their bidding stage so that they can in turn prepare health and safety plans relating to their operations.

2. CONSTRUCTION HEALTH AND SAFETY SPECIFICATION

2.1. Scope of Work.

Inception:

1. Site establishment
2. Dewatering both dams – pumping to effluent line
 - a. Desilt around dam 2 pumpstation end.
 - b. Install submersible pump in dam 1 that will pump to the suction end of dam 2/

3. Desilting both dams
 - a. Excavate with front end loaders and bobcats that load into skips.
 - b. Skips transported and off load silt at Foskor Gypsum disposal site.
4. Fabricate dam 2 pumpstation platform by demolishing concrete section and constructing opening in wall as per DWG. R21-097-00-204.
5. Install pumps S2 and S3 with DB board.
 - a. Install pump and motor combination with frame on existing structure as per DWG. R21-097-00-204.
 - b. Install new switchgear for ear pump including the installation of ultrasonic level transmitters.
6. Install pipeline from pump S2 to effluent pipeline and install pipeline from pump S3 to Gypsum pipeline.
 - a. Install T-piece on effluent pipeline and Gypsum pipeline with reducers.
 - b. Install isolation valve and non-return valves on discharge pipes with valve chambers.
7. Install T-piece on effluent pipeline and Gypsum pipeline with reducers for the connection of pipes from pump S1 and pump P2. Install isolation valves and non-return valves on discharge pipes with valve chambers for later connection.
8. Install non-return valve on effluent pipeline with valve chambers.
9. Install non-return valve on gypsum pipeline with valve chamber.
10. Break into reinforced concrete sump and connect discharge pipe section from P1.
 - a. Install isolate valve and non-return valve on discharge pipe with valve chamber.
11. Decommission and dismantle existing pumpstation South of the dams and remove existing pipelines.

Dam 1:

1. Expose pipelines discharging into primary dam and connect to new diversion pipelines that discharge into dam 2.
2. Decommission and dismantle existing dam 1 pumpstation and remove pipelines.
3. Demolish dam 1 concrete surface layer.
4. Demolish existing dam 1 pump base.
5. Demolish reinforced concrete culvert inlet structure into dam 1 from dam 2.
6. Excavate in all material for dam 1 to require depths.
7. Rip and recompact in-situ material for dam 1.
8. Excavate anchor trenches around dam 1.
9. Import G9 natural gravel, place and compact for dam 1.
10. Import G5 natural gravel, place and compact for dam 1.
11. Construct reinforced concrete subsoil / leakage detection sump.
12. Install sub-soil drainage pipeline including the placement of 19mm stone and wrapping in geotextile.
13. Install sub-soil drainage abstraction pipeline.
14. Import G5 natural gravel, place and compact for dam 1 above subsoil drainage.
15. Import and install GCL.
16. Import and install Tertiary liner geomembrane.
17. Import and install geotextile.
18. Import and install cusped drainage sheet.
19. Install leakage detection pipeline including the placement of 19mm stone.
20. Install leakage detection abstraction pipeline.
21. Import and install Geotextile.

22. Import and install Secondary liner geomembrane.
23. Import and install geotextile.
24. Install leakage detection pipeline including the placement of 19mm stone.
25. Install leakage detection abstraction pipeline.
26. Import and install geotextile.
27. Import and install Primary liner geomembrane.
28. Import and install Geotextile.
29. Import and install geocells.
30. Import and pour concrete into geocells.
31. Excavate for the construction of gravel access road.
32. Install hydraulic barrier discharge pipeline to dam 1.
 - a. Install isolation valve on discharge pipe with valve chamber.
33. Rip and recompact in-situ material for access road.
34. Import G9 natural gravel, place and compact for under road.
35. Import G7 natural gravel, place and compact for under road.
36. Import G5 natural gravel, stabilize to C4, place and compact for road surface.
37. Install pipelines underground between dams for pump P1 and pump S1.
38. Construct cover slabs with covers for the three abstraction pipelines.
39. Construct reinforced concrete pump base for Pump P1 and pump P2.
40. Install suction pipelines for pump P1 and including concrete anchor blocks.
41. Install pump P1 with DB board.
 - a. Install pump and motor combination with frame on new concrete base.
 - b. Install new switchgear for pump including the installation of ultrasonic level transmitters.
42. Install pump P2 with DB board.
 - a. Install pump and motor combination with frame on new concrete base.
 - b. Install new switchgear for pump including the installation of ultrasonic level transmitters.
43. Construct inlet structure for inlet pipes.

Dam 2:

1. Expose pipelines discharging into secondary dam and connect to new diversion pipelines that discharge into dam 1.
2. Install submersible pump in dam 2 inlet structure that will pump to dam 1.
3. Demolish inlet structure section leading to dam 1 from dam 2.
4. Excavate all material for dam 2 to required depths.
5. Remove and discard existing concrete railway sleepers.
6. Rip and recompact in-situ material for dam 2.
7. Excavate anchor trenches around dam 2.
8. Import G9 natural gravel, place and compact for dam 2.
9. Import G5 natural gravel, place and compact for dam 2.
10. Construct reinforced concrete subsoil / leakage detection sump.
11. Install sub-soil drainage pipeline including the placement of 19mm stone and wrapping in geotextile.
12. Install sub-soil drainage abstraction pipeline.
13. Import G5 natural gravel, place and compact for dam 2 above subsoil drainage.
14. Import and install GCL.
15. Import and install Tertiary liner geomembrane.
16. Import and install Geotextile.
17. Import and install suspected drainage sheet.

18. Install leakage detection pipeline including the placement of 19mm stone.
19. Install leakage detection abstraction pipeline.
20. Import and install Geotextile.
21. Import and install Secondary liner geomembrane.
22. Import and install Geotextile.
23. Install leakage detection pipeline including the placement of 19mm stone.
24. Install leakage detection abstraction pipeline.
25. Import and install Geotextile.
26. Import and install Primary liner geomembrane.
27. Import and install Geotextile.
28. Import and install Geocells.
29. Import and pour concrete geocells.
30. Reposition existing boundary fence.
31. Excavate for the construction of gravel access road.
32. Rip and recompact in-situ material for access road.
33. Import G9 natural gravel, place and compact for under road.
34. Import G7 natural gravel, place and compact for under road.
35. Import G5 natural gravel, stabilize to C4, place and compact for road surface.
36. Construct cover slabs with covers for the three abstraction pipelines.
37. Construct reinforced concrete pump base for pump S1.
38. Install suction pipelines for pump S1 including concrete anchor blocks.
39. Install pump S1 with DB board.
 - a. Install pump and motor combination with frame on new concrete base.
 - b. Install new switchgear for pump including the installation of ultrasound level transmitters
40. Construct reinforced concrete overflow weir from dam 1 to dam 2.
41. Construct reinforced concrete overflow weir for dam 2.
42. Excavate all in material for construction of dam 2 overflow channel.
43. Rip and recompact in-situ material for dam 2 overflow channel.
44. Construct gabion and reno matters overflow channel for dam 2.
45. Construct reinforced concrete road access over overflow channel.

Finishes:

1. Construct reinforced concrete vehicle entrance ramps for dam 1 and dam 2.
2. Demolish existing concrete channels leading to dam 2.
3. Excavate all material for v-drain North of dam 1.
4. Rip and recompact in-situ material for v-drain North of dam 1.
5. Import G5 natural gravel, place and compact for v-drain North of dam 1.
6. Construct concrete v-drain North of dam 1 leading to dam 2.
7. Excavate all material for concrete trapezoidal channel North of dam 2.
8. Rip and recompact in-situ material for trapezoidal channel North of dam 2.
9. Import G5 natural gravel, place and compact for trapezoidal channel North of dam 2.
10. Construct concrete trapezoidal channel North of dam 2 leading to dam 2.
11. Excavate all material for v-drains leading to concrete trapezoidal channel.
12. Rip and recompact in-situ material for v-drains leading to concrete trapezoidal channel.
13. Import G5 natural gravel, place and compact for v-drains leading to concrete trapezoidal channel.
14. Construct concrete v-drains leading to concrete trapezoidal channel.

15. Cast reinforced concrete floor slab between dam 1 and dam 2.

2.2. Foskor Safety File Index

Contractor Name: Ilifa Consulting Engineers		Date:		
Project Name: Primary / Secondary Dam		Mr Chris Busch		
Item	Element	Yes	No	N/A
1	Preliminary Requirements			
1.1	Proof of Foskor Induction			
1.2	Proof of Plant specific induction			
1.3	Have all persons on site been badged			
1.4	Copy of the OHS Act available on file			
2	Appointments			
Have the following appointments been made? Please provide proof of competency for each appointment as applicable below				
2.1	Sign 37.2 agreement with the company COVID Compliance			
2.2	Chief Executive Officer 16.1			
2.3	Employer Representative / Subordinate Manager / Manager 16.2			
2.4	Construction Manager CR 8.1 with CV			
2.5	Construction Supervisor CR 8.7			
2.6	Assistant Construction Supervisor CR 8.8			
2.7	First Aider GSR 3.4 with proof of valid certificate			
2.8	Health and Safety Representative 17.1 with proof of valid certificate			
2.9	Safety Committee Chairperson 19.3			
2.10	Safety Committee Members 19.1			
2.11	Person Responsible for Machinery / Engineer GMR 2.1			
2.12	Master Installation Electricians EIR 11.2 with proof of valid certificate			
2.13	Portable Electrical Equipment Inspector CR 24 I			
2.14	Ladder Inspector GSR 13.A			
2.15	Lifting Machinery Inspector DMR 18.6 with proof of valid certificate			
2.16	Lifting Tackle Inspector DMR 18.6 with proof of valid certificate			
2.17	Scaffolding Supervisor CR 16.1 with proof of valid certificate			
2.18	Excavation Supervisor CR 13.1			
2.19	Stacking and storage Supervisor GSR 8			
2.20	Fall Protection Planner CR 10.1 with proof of valid certificate			
2.21	Accident / Incident Investigation GAR 9.2 with proof of valid certificate			
2.22	Risk Assessor Appointment CR 9.1 with proof of training			
3	Registers and Monthly Inspections			
Are the following registers available and up to date?				
3.1	Portable Electrical Registers available and up to date? (Three monthly check)			
3.2	Portable Electrical Equipment Inspected and Tagged by Foskor Electrical Department			
3.3	Lifting Machinery Register including load test certificates			
3.4	Lifting Tackle Register including load test certificates			
3.5	Ladder Register			
3.6	Scaffolding Register			
3.7	List of vehicles with driver's name and proof of valid and applicable license			

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3.8	Equipment Calibration Certificates			
3.9	Pneumatic register			
3.10	Safety Harness Register – Proof of training			
3.11	Fire Equipment Register			
3.12	Hand Tool Register			
3.13	Excavation Inspectors Register			
3.14	PPE Register (with signatures of employees as proof of issue)			
3.15	Vehicle daily inspection register			
3.16	Gas cylinder register			
4	Administration			
	Are the following documents in place?			
4.1	SHREQ Policy / Mission Statement			
4.2	HIV / AIDS Policy			
4.3	Drug and Alcohol Policy			
4.4	Smoking Policy			
4.5	Vehicle Policy			
4.6	PPE Policy			
4.7	SHREQ Integrated Management Plan			
4.8	Method Statement			
4.9	Baseline Risk Assessment including proof of communication			
4.10	Fall Protection Plan			
4.11	Safe Working Procedures (Provide proof of training)			
4.12	Site list of contracts and emergency telephone numbers with designation			
4.13	Valid Letter of Good Standing in terms of section 80 of the COIDA Act			
4.14	Contractors Public Liability Insurance			
4.15	Company and site organogram			
4.16	Emergency evacuation procedure (follow Foskor Procedure)			
4.17	Contractors Internal Audit Procedure & Audit Criteria & Reporting			
4.18	Notification of Construction Work to Department of Labour			
4.19	Deviation / Near Miss Reports / Incident Reports			
4.20	Names of Contractor employees working on this job & Copy of their ID Book & COF – Including employee name list			
4.21	Toolbox talks (provide proof)			
4.22	Accident / Incident Reports Annexure 1, WCL 1, WCL 2, Incident Reporting Procedure			
5	Health and Safety Representatives			
5.1	Proof of Health and Safety Representative election / appointment			
5.2	Proof SHE Representative training			
5.3	Proof of the SHE Representative appointment as Health and Safety Committee members			
5.4	Proof of Health and Safety Committee meeting minutes			
5.5	Proof of monthly inspections conducted and signed			
	Personal Protective Equipment			
6.1	Proof of employees trained in the use of their PPE			
6.2	Proof of Supervisor PPE inspection			
6.3	Proof of inventory of PPE stock on site in the event of an emergency			
7	First Aid Facilities			
7.1	Proof of First Aid Box with checklist			

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7.2	Proof of First Aid Boxes supplied and equipped in accordance with GSR 3			
8	<i>Fire Fighting Equipment</i>			
8.1	Proof of valid fire fighting equipment checklists and test certificate			
9	<i>Environment System</i>			
9.1	Proof of Waste types being generated			
9.2	Safety Data Sheets applicable to this work and proof of communication			
9.3	Proof of Environmental Risks register			
9.4	Proof of Spillage Control Procedure			

2.3. Interpretations

2.3.1. Application:

This specification is a compliance document drawn up in terms of South African legislation and is therefore binding. It must be read in conjunction with relevant legislation as noted previously.

2.3.2. Definitions:

The definitions as listed in the Occupational Health and Safety Act No. 85 of 1993 and Regulations shall apply.

2.4. Administrative and General Legal Requirements

2.4.1. Application for Construction Work Permit:

A client who intends to have construction work carried out, must at least 30 days before that work is to be carried out apply to the provincial director in writing for a construction work permit to perform construction work if the intended construction work will:

- a) Exceed 365 days;
- b) Will involve more than 3600 person days of construction work; or
- c) The work contract is of a value exceeding Sixty (60) million rand or Construction Industry Development Board (CIBD) grading level 7,8 or 9.

Once the permit is obtained by the C & M Safety Consultants, the Principal Contractor to ensure that a notice board separate from the site information board is conspicuously displayed at the main entrance of the site as per conditions of the permit, with the following information:

- a) Client details
- b) Project details
- c) Permit number
- d) Principal Contractor's name
- e) Construction Manager's name with contact details
- f) Client Agent's name with contact details

The Site information board lettering to be a minimum of 60mm in size.

Failing to comply with the above requirements may lead to the Provincial Director to prohibit all construction work. The cost implications will be for the Principal Contractor's account.

2.4.2. Health and Safety File

The Principal Contractor must prior to performing any construction work, submit the Health and Safety File required as per Regulation 7(1)(b) of the Construction Regulations to the Client or the Client's appointed Agent for evaluation and approval. No construction work may commence until the file is approved in writing in total or with conditions if any, by the Client or the Client's appointed Agent.

Note: the file must be in a hardcopy format; no electronic submission will be accepted.

2.4.3. Assignment of Contractor's Responsible Persons to Supervise Health and Safety on site

The Contractor shall submit supervisory appointments as well as any relevant appointments in writing (as stipulated by the OHS Act and Construction Regulations), prior to commencement of work. Proof of competency and Curriculum Vitae must be included.

The Contractor must appoint a Construction Manager as per Construction Regulation 8(1)

In the absence of the appointed Construction Manager CR 8(1) from the site, the appointed Assistant Construction Manager CR 8(2) must assume full responsibility and be fulltime on site. In the case where there is more than one appointed Assistant Construction Managers CR 8(2), a specific Assistant Construction Manager CR 8(2) must be nominated to assume full responsibility in the absence of the appointed Construction Manager CR 8(1) and be fulltime on site. Should both be absent from the site, the work may not continue and must be stopped.

The Construction Manager CR 8(1) must ensure that a detailed shutdown procedure is in place for the builders' holiday over the December/January period, pay weekends or any extended period where no personnel will be on site and make it available to the Client and all relevant Sub-contractors.

It is the duty of the Chief Executive Officer 16(1) or the Assistant to the Chief Executive Officer 16(2) to Appoint all relevant responsible persons as per the Occupational Health and Safety Act and Regulations on the project unless the Construction Manager 8(1) has been mandated to appoint responsible persons as per the Occupational Health and Safety Act and Regulation.

On completion of the project, the principal contractor must provide proof that all appointments made available on the Health and Safety file have been cancelled in the form of a written letter by the Responsible Person in this regard placed in the Health and Safety file.

See Annexure B

All appointments must be originals; no photo copies or altered appointments will be accepted.

A Curriculum Vitae to be attached for all persons appointed.

2.4.4. Competency of Contractor's Appointed Competent persons

Contractor's competent persons for the various risk management portfolios shall fulfill the criteria as stipulated under the definition of Competent in accordance with the

Construction Regulations (2014). Proof of competence for the various appointments must be included.

2.4.5. OHS Act and Regulations

The Principal Contractor and all Sub-contractors shall ensure that a copy of the OHS Act and relevant Regulations is kept on site and available on request to any person engaged on any activity on site.

2.4.6. Compensation for Occupational Injuries and Diseases Act 130 of 1993 (COIDA)

The Principal Contractor shall submit a Letter of Good Standing with its Compensation insurer to the Client as proof of registration. Sub-contractors shall submit proof of their own registration to the Principal Contractor before they commence work on site. No work may start if the relevant valid Letter of Good Standing is not in place.

2.4.7. Occupational Health and Safety Policy

The Principal Contractor and all Sub-contractors shall submit a Health and Safety Policy signed by their Chief Executive Officer. The Policy must outline objectives and how they will be achieved and implemented by the Principal Contractor / Sub-Contractor.

2.4.8. Health and Safety Organogram

The Principal Contractor and all Sub-contractors shall submit an organogram outlining the Health and Safety Site Management structure on site. In cases where appointments have not yet been made, the organogram shall reflect the intended positions. The organogram must be updated when there are any changes in the Site Management structure.

2.4.9. Risk Assessments

The Principal Contractor shall cause a hazard identification to be performed by a competent person before the commencement of construction work and the assessed risks shall form part of the construction phase health and safety plan submitted for approval by the Client. The Risk Assessments must be listed as per the activities as indicated on the Construction Program.

The risk assessments must include:

- a) An index must be prepared with the list of hazards identified, as well as potentially hazardous tasks.
- b) Documented risk assessments must be prepared based on the listed hazards and all risk assessments must be listed on a register available on file.
- c) A set of safe working procedures (method statements) to eliminate, reduce and / or control the risks assessed, must be available and linked to the risk assessment.
- d) A monitoring and review procedure of the risk assessment as the risks change.
- e) **NO GENERIC RISK ASSESSMENTS WILL BE ACCEPTED;** risk assessments must be specific to the work on site and must be so recorded on the risk assessment document.
- f) The Competency Certificates of the Risk Assessor must be available on file. The Risk Assessor must be fulltime on site to monitor the risks and update the

documentation. A competent person with the relevant experience of the task to be performed must be part of the assessment team. The Construction Manager CR 8(1) who is ultimately responsible for safety on the project will approve the risk assessments. If the Risk Assessor is found not to be on site, work will be stopped and standing time will be for the Contractors' account. **NO RISK ASSESSMENTS = NO WORK.**

The Principal Contractor shall ensure that all Sub-contractors are informed, instructed and trained by a competent person regarding any hazards, risks and related safe work procedures before any work commences and thereafter at regular intervals as the risk changes and as new risks develop. Proof of this must be kept for inspection by the Client or Client's appointed Agent.

The Principal Contractor shall be responsible for ensuring that all persons who could be negatively affected by its operations are informed and trained according to the hazards and risks and are conversant with the safe work procedures, control measures and other related rules. A toolbox talk strategy is then to be implemented.

All Sub-contractors need to provide competency certificates of their Risk Assessor, Accident Investigator and First Aider. Where work at heights take place, the Sub-Contractor must ensure Compliance with the requirements as set out in the Construction Regulations.

2.4.10. Health and Safety Officer / Health and Safety Consultant

A Contractor must after consultation with the Client and having considered the size of the project, the degree of danger likely to be encountered or the accumulation of hazards or risks on site, appoint a full time or part time Construction Health and Safety Officer / Health and Safety Consultant in writing to assist in the control of all health and safety related aspects on site.

No contractor may appoint a Construction Health and Safety Officer / Health and Safety Consultant to assist in the control of health and safety related aspects on the site unless he or she is reasonable satisfied that the Construction Health and Safety Officer / Health and Safety Consultant that he or she intends to appoint is registered with the SACPCMP (The South African Council for Project and Construction Management Professions), a statutory body approved by the Chief inspector and has the necessary competencies and resources to assist the contractor.

If the Contractor appoints a Safety Consultant who is an employer in his own rite, the Consultant appointed must submit proof of Company Registration, Professional Indemnity Insurance (PI) and valid Letter of Good Standing.

Failing to produce the above the Consultant will not be allowed on site.

2.4.11. Health and Safety Representative (s)

The Principal Contractor and all Contractors shall ensure that Health and Safety Representative(s) are appointed with consultation of the workforce on site and trained to carry out their functions. The appointment must be in writing. The Health and Safety

Representative shall carry out regular inspections, keep records and report all findings to the Responsible person forthwith and at health and safety meetings.

2.4.12. Health and Safety Committee

The Principal Contractor shall ensure that project health and safety meetings are held monthly and minutes are kept on record. Meetings must be arranged and chaired by the Principal Contractor's responsible person. All Contractors' responsible persons and Health and Safety Representatives shall attend the monthly health and safety meetings. Sub-contractors shall also have their own internal health and safety committee in accordance with the OHS Act No. 85 of 1993 and minutes of their meetings shall be forwarded to the Principal Contractor on a monthly basis. Where the Sub-contractor does not have a Safety Committee they will form part of the Principal Contractors' health and safety meetings.

2.4.13. Health and Safety Training

2.4.13.1. Training

The Principal Contractor shall ensure that all his employees are adequately trained and experienced to perform their work and are further trained on the Health and Safety aspects relating to the work and that they understand the hazards associated with such work being carried out on the premises. The Principal Contractor will ensure that the staff of appointed Sub-contractors is competent to do the work. This training will not form part of a toolbox talk or DSTI (Daily Safety Task Instruction).

2.4.13.2. Induction

The Principal Contractor shall ensure that all site personnel undergo a risk-specific health and safety induction session before starting work. A record of attendance shall be kept in the health and safety file. A suitable venue must be made available to house this training.

2.4.13.3. Awareness

The Principal Contractor shall ensure that on site periodic safety talks take place at least **once a week**. These talks should deal with risks relevant to the construction work at hand. A record of attendance shall be kept in the health and safety file. All Contractors have to comply with this minimum requirement. At least one of the Toolbox Talks shall be on any environmental related issue.

2.4.13.4. Competency

All competent persons shall have the knowledge, experience, training and qualifications specific to the work they have been appointed to supervise, control and carry out. This will have to be assessed on regular basis e.g., periodic audits by the Client, progress meetings etc. The Principal Contractor is responsible to ensure that competent Sub-contractors are appointed to carry out construction work. Proof of their competency must be on their site safety file.

2.4.13.5. Rules of Conduct

Principal Contractors, their Sub-contractors and all employees under their control including any visitor brought onto site must adhere to the following Rules of Conduct on site:

YOU MAY NOT:

- Partake, possess or sell drugs or alcoholic beverages on site. Any employee or visitor whose action and demeanor show symptoms of possible narcosis or drunkenness shall be removed from site
- Indulge in practical jokes, horseplay, fighting or gambling
- Destroy or tamper with safety devices, symbolic signs or wilfully and unnecessarily discharge fire extinguishers
- Bring onto site or have in your possession a firearm or lethal weapon
- Assault, intimidate or abuse any other person
- Operate construction equipment (vehicles or plant) without the necessary training or authorization
- Display insubordination toward any supervisor, foreman or Manager in respect to carrying out of properly issued instructions or order for health and safety reasons
- Enter any area where you have no business unless authorized to do so by the person in charge
- Negligently, carelessly or wilfully cause damage to property of others
- Refuse to give evidence or deliberately make false statements during investigations
- Wear any loose clothing or items that may be caught up in moving machinery.
- Wear any hoodies covering your head to such an extent that it obscures your view to the side.
- Wear phone or radio headsets or any other headset that will prevent you from hearing any instruction, alarms or moving plant or vehicles on site.
- Drive on site with a vehicle without the hazard lights on and where equipped, with yellow rotating lights on.
- Go on site unless you wear a safety reflective vest.

2.4.14. General Record Keeping

The Principal Contractor and all Sub-contractors shall keep and maintain Health and Safety records to demonstrate compliance with this Specification document, with the OHS Act No. 85 of 1993 and Regulations. The Principal Contractor shall ensure that all records of incidents / accidents, training, inspections, audits etc. are kept in the health a safety file in the site office. The Principal Contractor must ensure that Sub-contractors open their own health and safety file, maintains the file and makes it available on request for auditing.

2.4.14.1. Inspection of equipment and tools

The following items of equipment must be regularly inspected, maintained and appropriate records kept:

- First Aid dressing registers
- Fire equipment
- Lifting equipment
- Portable Electrical equipment
- Stacking and Storage inspections
- Pressure Vessels
- Ladders
- Excavations
- Construction Vehicles and Mobile Plant
- Hand tools
- Hazardous Chemical Substances
- Confined space entry
- Blasting
- Traffic Accommodation

2.4.15. Health and Safety Audits, Monitoring and Reporting

The Client or the Client's appointed agent shall conduct monthly health and safety audits including a full audit of physical site activities as well as the administration of health and safety management. The Principal Contractor is obligated to conduct similar audits on all Sub-contractors appointed by them.

Detailed reports of the audit findings and results shall be reported on at all levels of project management meetings / forums. Copies of the Client audit reports shall be kept in the Project Health and Safety File while the Principal Contractor's audit reports shall be kept in their file and a copy forwarded to the Client. Sub-contractors have to audit their Sub-contractors and keep records of these audits in their health and safety files and it must be available on request.

Copies of the monthly audits to be sent to the Client's Health and Safety Agent.

2.4.16. Emergency Procedures and include Foskor Emergency Procedures

The Principal Contractor shall submit a detailed Emergency Procedure for approval by the Client prior to the commencement of work on site. The procedure shall detail the response plan including the following key elements:

1. List of key competent personnel
2. Details of emergency services
3. Actions or steps to be taken in the event of the specific type of emergencies
4. Information on hazardous materials / situations

Emergency procedure(s) shall include, but shall not be limited to fire, spills, accidents to employees, use of hazardous substances, bomb threats, major accidents / incidents etc. In the case of elevated work and water environments where construction work is done over or in close proximity to water, a rescue procedure is to be included.

The Principal Contractor shall advise the Client in writing forthwith of any emergencies, together with a record of actions taken. A contact list of all service providers (Fire

department, Ambulance, Police, Medical and Hospital etc.) must be maintained and available to site personnel.

The Principal Contractor must develop a **Site Emergency Plan** detailing tasks for the appointment of the firefighting team, first aid and the emergency coordinating team. In addition to which, mustering points must be identified and depicted by the use of the appropriate symbolic signage (SANS Approved). The Emergency Plan must be approved by in consultation with the Client, or the Client's appointed Agent. Should the early warning fire alarm system not be integrated, each zone / area must, by definition be accommodated in the site Evacuation Plan (ref. Regulation 9 – Environmental Regulations of the OHS Act No. 85 of 1993)

The Construction Manager must conduct an emergency identification exercise and establish what emergencies could possibly develop and to incorporate any changes in the working environment. He / she must then develop a detailed contingency plan and emergency procedure, taking into account any emergency plans that may already be in place. The Contractors must hold regular practice drills of the contingency plans and emergency procedures to test them and to familiarize employees with them.

The Principal Contractor must appoint a competent person to act as Emergency Controller / Coordinator.

An emergency situation which is likely to require outside emergency assistance, may attract mass circulation written media or electronic media attention and can be harmful to the Client's reputation. No person may comment on the incident on site without prior approval of the Client.

2.4.17. First Aid Boxes and First Aid Equipment

The Principal Contractor and all Sub-contractors shall appoint in writing First Aider(s). The appointed First Aider(s) are to be trained by an accredited training provider. Valid competency certificates are to be kept on site. The Principal Contractor shall provide on-site first aid facilities, including first aid boxes adequately stocked at all times. All Sub-contractors with more than 5 employees shall supply their own first aid box. Sub – Contractors with more than 10 employees shall have a trained, certified first aider on site at all times.

2.4.18. Accident / Incident Reporting and Investigation

The Principal Contractor shall appoint in writing a competent accident/incident investigator on site.

Injuries are to be categorized into first aid, medical, disabling and fatal or near misses. The Principal Contractor must stipulate in its construction phase health and safety plan how it will handle each of these categories. When reporting injuries to the Client, these categories shall be used. All reportable Incidents must be in compliance with Section 24 and General Administration Regulations 8 & 9. The Principal Contractor shall investigate all injuries with a report being forwarded to the Client forthwith. The Principal Contractor must report all injuries to the Client during the same day.

In the case of incidents where a person dies, becomes unconscious, suffers the loss of a limb or part of a limb or is otherwise injured or becomes ill to such a degree that he is

likely either to die or suffer a permanent physical defect or likely to be unable for a period of at least 14 days either to work or to continue with the activity for which he or she was employed or is usually employed, report this immediately verbally or by phone to the Client or the Client's appointed Agent as soon as it comes to his or her notice. The same requirement as above applies to persons other than employees involved in incidents on site. In all cases the investigation report is to follow not later than seven (7) days after the incident.

Annexure 1 forms must also be completed.

2.4.19. Hazards and Potential Hazardous Situations

The Principal Contractor shall immediately notify all Sub-contractors as well as the Client of any hazards or potentially hazardous situations that may arise during performance of construction activities.

2.4.20. Personal Protective Equipment (PPE) and Clothing – See Attachment F.

The Principal Contractor shall ensure that all workers are issued free of charge as per General Safety Regulation 2(2) and wear hard hats, safe footwear and overalls or any other Personal Protective Equipment that may be required due to the nature of the work. The Principal Contractor and all Sub-contractors shall make provisions and keep adequate quantities of SANS approved PPE on site at all times. The Principal Contractor shall clearly outline procedures to be taken when PPE or Clothing is:

1. Lost or Stolen
2. Worn out or damaged

The above procedure applies to Sub-contractors and their contractors, as they are all Employers in their own right.

The Principal Contractor and Sub-contractor is to train all employees on how to use PPE on site. Training records of these sessions should be kept on file.

Employees must sign for all PPE issued to them.

2.4.21. Occupation Health and Safety Signage

The Contractor shall provide adequate on-site Occupational Health and Safety signage, including but not limited to: *No unauthorized entry, report to site office, beware of deep excavations, speed limit restrictions, construction vehicles* etc. Signage shall be posted up at all entrances to the site as well as on site in strategic locations e.g., access routes, entrances and other potential risk areas / operations.

2.4.22. Permits (Authorisation Permits)

Permits may be included in the following:

1. Excavations
2. Blasting
3. Confined Space entry

2.4.23. Fall Protection

The Principal Contractor must designate a competent person to be responsible for the preparation of a fall protection plan, the implementation of the plan and amended where and when necessary and maintained as required and ensure continued adherence to the fall protection plan. C & M Safety Consultants appointed as the Client Safety Agent must approve the Fall Protection plan prior to construction work requiring a fall protection plan commence on a site.

A Risk Assessment will be required for all work carried out from a fall risk position and the procedures and methods used to address all the risks identified per location.

All employees working at heights must have a valid medical certificate of fitness issued by an occupational health practitioner in the form of Annexure 3.

All employees who will be required to work on heights must be in possession of a competency certificate as per Health and Welfare Seta Unit Standard: 120362 & 229994 or similar training for working at heights and such employees must be identified.

A rescue plan detailing the necessary procedure, personnel and suitable equipment required to affect a rescue of a person in the event of a fall incident to ensure that the rescue procedure is implemented immediately following the incident.

The Principal Contractor must ensure that a Construction Manager appointed under Regulation 8(1) is in possession of the most recently updated version of the fall protection plan.

2.4.24. Contractors and their Sub-contractors

The Principal Contractor shall ensure that all Sub-contractors under its control comply with this Occupational Health and Safety Specification, the OHS Act No. 85 of 1993 and Regulations and all other relevant legislation that may relate to the activities directly or indirectly. The Sub-contractor, when appointing other Contractors as “Sub-contractors” shall *mutatis mutandis* ensure compliance.

It is the responsibility of the Principal Contractor to ensure that the appointed Sub-contractor(s) must comply with the Occupational Health and Safety Act No.85 of 1993 and Regulations before they may commence with work on site.

The Principal Contractor need to evaluate the Sub-contractors’ documentation and after approval, place on the file a record of the approval.

2.4.25. Safety and Security

The Principal Contractor shall ensure that all persons under their control and the Sub-contractors shall comply with the security operations, security requirements, including stop and search procedures if required.

Special permission may need to be obtained for after hours and / or weekend / public holiday access.

The Principal Contractor and Sub-contractors’ employees shall enter and leave the premises only through the main gate(s) and / or checkpoint(s) designated by the Principal Contractor. The Principal Contractor shall ensure that employees and Sub-

contractors observe the security rules at all times and shall not permit any person who is not directly associated with the work from entering the premises.

All the Principal Contractor's and Sub-contractors' employees will be issued with a company identification card which must be displayed on his / her person at all times whilst on duty or on the premises.

Should any of the employees of the Principal Contractor or Sub-contractors:

- Tamper or otherwise interfere with the Principal Contractor's or Sub-contractors equipment, plant or other assets
- Steal, or otherwise engage in acts of dishonesty
- Appears to be under the influence of alcohol and drugs
- Ignore any security, safety or occupational health rule, or engage in unsafe conduct;

Then the Principal Contractor, Sub-contractors, Client or Client's Safety Agent shall have the right to immediately remove such a person or have him / her withdrawn from the premises, and if appropriate, charge at law such relevant offence(s).

The Principal Contractor and Sub-contractor and their employees shall not enter any area of the premises that is not directly associated with the work. The Principal Contractor and Sub-contractors shall ensure that all materials, machinery plant and equipment brought by them onto the premises are recorded at the main gate(s) and / or checkpoint(s). A failure to do this may result in refusal by the Principal Contractor to allow the materials, machinery or equipment to be removed from the premises.

The Principal Contractor acknowledges that its employees and the employees of the Sub-contractors and vehicles may be subject to search at any time and that the Principal Contractor shall ensure that employees co-operate fully with such arrangements.

2.4.26. Medicals

All employees employed by the Principal Contractor and the Sub-contractors that will work on the project must be declared fit to do the work. The Medical Certificate of fitness as prescribed in the Construction Regulation 7(8) must be done through an Occupational Health Practitioner. Proof of the valid medical certificate of fitness in the form of Annexure 3 must be available in the Health and Safety File. Failing to submit the medical certificate on the prescribed form will result in work not to commence / or be temporarily suspended. No photo copies of medicals will be accepted unless certified by a commissioner of oath.

2.4.27. Use of Nuclear Soil Density Gauges

The use of Nuclear Soil Density Gauges must be in compliance with the requirements of the Hazardous Substances Act No. 15 of 1973 as amended by Section 4 of the Hazardous Substances Amended Act, 1992 relating to Group iv Hazardous Substances and the Regulations Relating to Group iv Hazardous Substances.

The user must be in possession of a valid written authority to possess radioactive nuclides issued by the Director-General: National Health.

A Radiation Protection Officer and Acting Radiation Protection Officer must be appointed in writing.

Gauges containing radioactive nuclides transported on site to be in approved transport containers marked “Radioactive” and the required symbolic warning of radiation signs displayed and must be lockable.

Internal rules compiled in compliance with Regulation 7 of the Regulations relating to Group iv Hazardous Substances must at least address the following items; Medicals carried out by an Occupational Medical Practitioner, risk assessments, safe working procedures, transportation of gauges, requirements pertaining to the area where the work will be carried out, emergency response in case of accidental damage to the unit, equipment checklist and a list of emergency contact numbers.

The holder of the Authority to possess radioactive nuclides must ensure compliance with all additional conditions as stipulated on the written authority to possess radioactive nuclides. This normally requires in addition to any other conditions that the area of work be demarcated and the warning of radiation signs displayed, a red flag mounted on a yellow and Black striped pole placed adjacent to each nuclear soil density gauge so as to be clearly visible to all operators of vehicles or earth moving equipment and access to the area must be controlled.

In addition to any other documentation required as per the specification, the following must be on file and made available to the Client or the Client’s appointed Agent for approval. In the case where the user of the Nuclear Soil Density Gauges is a Sub-contractor to the Principal Contractor, the file to be made available to the Principal Contractor for approval before any nuclear soil density gauges are brought on site;

- Valid written authority to possess radioactive nuclides specific to the type of work to be performed on site issued by the Directorate: Radiation Control.
- Appointments of the Radiation Protection Officer and the Acting Radiation Protection Officer.
- Competency training records of the Radiation protection Officer and the Acting Radiation Protection Officer and all operators of the nuclear soil density gauges used on site.
- Valid Medical Certificates issued by an Occupational Medical Practitioner (OMP) for all the above.
- Record of the latest annual leak test carried out specific to each nuclear soil density gauge used on site.
- Internal Rules compiled.
- Risk assessment and Safe Working procedure pertaining to the specific task to be done on site.
- Applicable checklists.
- Copies of the Hazardous Substances Act No. 15 of 1973; Hazardous Substances Amendment Act, 1992 and the Regulations Relating to Group iv Hazardous Substances.

2.5. Physical Requirements on site

2.5.1. Site Establishment

The establishing of the site by the positioning of the offices, storage areas, parking area, hygiene facilities or any other facilities must be such that it ensures easy access of persons and vehicles. The electrical cabling must preferably be buried underground and the distribution boards if any, be placed on firm level ground out of the way of any traffic movement to prevent tripping hazards and electric shock should the equipment be damaged. A Certificate of Compliance for the electrical installations must be available and includes all hired prefabricated offices, container offices etc. with electricity installations for which Certificates of Compliance must be provided by the company supplying it.

The ablution and dining facilities must be in compliance with the requirements of the Facilities Regulations. Sufficient and the correct type of fire equipment must be available and placed where it is easily accessible for use should a fire occur. All the required signage must be identified and put up. The site camp area must be fenced off to control access to the site.

2.5.2. Laydown areas

Properly planned Laydown areas for the receipt, storage and partial assembly of the project equipment and materials to be installed or constructed to be identified.

The following need to be considered when establishing the Laydown areas:

- Access to the areas for the type of mobile plant or construction vehicles that will be loading or unloading materials and equipment.
- Stability and slope of the surface on which the items will be laid down.
- Sufficient space for the movement of vehicles and workers carrying out certain tasks.
- Sufficient space for safe stacking and storage.
- Proximity to overhead electric power lines.
- Location of adjacent property or services so as not to cause any damage or disruptions.
- Not restricting the access to other buildings or public parking areas.
- Demarcation where required.
- Safety of the public and workers.
- Availability of firefighting equipment.
- Access to laydown areas to be fenced off and controlled where required.
- Lighting if any work is going to be carried out in the area at night.

2.5.3. Excavations, Shoring, Dewatering or Drainage

The Principal Contractor and any relevant Sub-contractors shall make provisions in their tender for shoring, dewatering or drainage of any excavation as per this specification.

The Contractor shall make sure that:

- a) All excavations are inspected before every shift and after every shift, occurrence of rain, or change to the excavation / shoring and record thereof is kept on file.
- b) Photographs of excavations be taken daily and kept on the file.
- c) Any accumulation of water inside an excavation must be removed
- d) Safe Work Procedures have been communicated to the workers
- e) The Safe Work Procedures are enforced and maintained by the Contractor's responsible persons at all times
- f) The requirements as per Regulation 13 of the Construction Regulations are adhered to as stipulated below;

Excavation work

- 1) A contractor shall ensure that all excavation work is carried out under the supervision of a competent person who has been appointed in writing
- 2) A contractor shall evaluate as far as is reasonably practicable, the stability of the ground before the excavation work begins
- 3) Every contractor who performs excavation work shall:
 - a. Take suitable and sufficient steps in order to prevent, as far as reasonably practicable, any person from being buried or trapped by a fall or dislodgement of material in an excavation
 - b. Not require or permit any person to work in an excavation which has not been adequately shored or braced. Provided that shoring and bracing may not be necessary where:
 - i. The sides of the excavation are sloped to at least the maximum angle of repose measured relative to the horizontal plane or
 - ii. Such excavation is in stable material. Provided that:
 - a) Permission being given in writing by the appointed competent person contemplated in Sub Regulation (1) upon evaluation by him or her of the site conditions, and
 - b) Where any uncertainty pertaining to the stability of the soil still exists, the decision from a professional engineer or a professional technologist competent in excavations, shall be decisive and such a decision shall be noted in writing and signed by both the competent person contemplated in Sub Regulation (1) and the professional engineer or technologist as the case may be
 - c) Take steps to ensure that the shoring or bracing contemplated in paragraph (b) is designed and constructed in such a manner rendering it strong enough to support the slides of the excavation in question
 - d) Ensure that no load, material, plant or equipment is placed or moved near the edge of any excavation where it is likely to cause it to collapse and thereby endangering the safety of any person, unless precautions such as the provision of sufficient and suitable shoring or bracing are taken to prevent the sides from collapsing
 - e) Ensure that where the stability of an adjoining building, structure or road is likely to be affected by the making of an excavation, the steps are taken that may be necessary to ensure the stability of such building, structure or road and the safety of persons

- f) Cause convenient and safe means of access to be provided to every excavation in which persons are required to work and such access shall not be further than 6 metres from the point where any worker within the excavation is working.
- g) Ascertain as far as reasonably practicable the location and nature of electricity, water, gas or other similar services which may in any way be affected by the work to be performed, and shall before the commencement of the steps that may be necessary to render the circumstances safe for all persons involved:
- h) Cause every excavation, including all bracing and shoring, to be inspected:
 - i. Daily, prior to each shift
 - ii. After an unexpected fall of ground
 - iii. After substantial damage to supports, and
 - iv. After rain
 - v. After every blasting operationBy the competent person contemplated in Sub Regulation 1, in order to pronounce the safety of the excavation to ensure the safety of persons, and those results are to be recorded in a register kept on site and made available to an inspector, client, client's agent, contractor or employee upon request
- i) Cause every excavation which is accessible to the public or which is adjacent to public roads or thoroughfares, or whereby the safety of persons may be endangered as is practicable, to be -
 - i. Adequately protected by a barrier or fence of at least one (1) metre in height and as close to the excavation as is practicable, and
 - ii. Provide with warning illuminants or any other clearly visible boundary indicators at night or when visibility is poor
- j) Ensure that all precautionary measures as stipulated for confined spaces as determined in the General Safety Regulations promulgated by Government Notice R 1031 of May 1986, as amended, are complied with when entering any excavation and
- k) Cause warning signs to be positioned next to an excavation within which persons are working or carrying out inspections or tests.

2.5.4. Stacking of Material

The Principal Contractor and other relevant Sub-contractors shall ensure that there is an appointed stacking supervisor and all materials and equipment is stacked and stored safely.

2.5.5. Speed Restrictions and Protection

The Principal Contractor shall ensure that all persons in its employment, all Sub-contractors, and all those that are visiting the site are aware and comply with the site speed restriction of **30kph**. Separate vehicle and pedestrian access routes shall be provided, maintained, controlled and enforced.

2.5.6. Hazardous Chemical Substances (HCS)

The Principal Contractor and other relevant Sub-contractors shall provide the necessary training and information regarding the use, transport, and storage of HCS. The Principal Contractor shall ensure that the use, transport, and storage of HCS are carried out as prescribed by the HCS Regulations. The Contractor shall ensure that all hazardous chemicals on site have a Material Safety Data Sheet (MSDS) on site and the users are made aware of the hazards and precautions that need to be taken when using the chemicals. The First Aiders must be made aware of the MSDS and how to treat HCS incidents appropriately.

Flammable substances must be stored separately away from other materials and in a well-ventilated area (appropriate cross ventilation). A competent person should be appointed to be in control of this portfolio. The necessary safety signage should be positioned near and around the cordoned off areas. Fire extinguishers should also be placed not closer than five (5) meters from the area but not further than 20 meters away from the storage area.

2.5.7. Water Environments

A contractor must ensure that where construction work is done over or in close proximity to water, provision is made for: -

- a) Preventing persons from falling into water and
- b) The rescuing of persons in danger of drowning.

A contractor must ensure that where a person is swimming or exposed to the risk of drowning by falling into the water, the person is provided with and wears a lifejacket.

A documented rescue procedure must be included in the emergency procedures.

2.5.8. Confined Space Entry

“Confined Space” means an enclosed, restricted or limited space in which, because of its construction, location or contents, or any work activity carried on therein, a hazardous substance may accumulate or an oxygen-deficient atmosphere may occur and includes any chamber, tunnel, pipe, pit, sewer, container, valve, pump, sump or similar construction, equipment, machinery or object in which a dangerous liquid or a dangerous concentration of gas, vapour, dust or fumes may be present.

A method statement and risk assessment addressing all aspects of confined space entry specific to every task to be carried out must be available e.g., permit to entry, evaluating, testing and ongoing monitoring of air quality, entry procedure, rescue procedure, personal protective equipment requirements etc. Proof of training on method statement, risk assessment and relevant procedures given to all persons involved with the confined space entry must be available on file on site.

All entry into confined spaces must be in accordance to the requirements of General Safety Regulation 5; Work in confined spaces.

The certificate of competency of the person evaluating and testing the air inside a confined space and pronouncing it safe for entry including the required certification in

writing that it is safe to do so and the valid calibration certificate of the testing equipment must be available on file.

2.5.9. Blasting

The principal contractor who will be required to make use of a selected sub-contractor responsible for the blasting on the construction site must ensure that the selected sub-contractor comply with the Explosives Regulations as set out in the Occupational Health and Safety Act and Regulation No. 85 of 1993 and the Explosives Act, 2003.

The Blasting Contractor must have a valid licence for explosive workplaces as defined in Regulation 4(1) of the explosive regulations. The Blasting Contractor must have a valid blasting permit and a continuous transport permit for explosives applicable to the specific site where the blasting will be carried out, issued by the South African Police Services. The Blasting Contractor must be in possession of a written permission (permit) issued by or under the authority of the Chief Inspector of occupational health and safety to use explosives for blasting purposes. The Blasting Contractor must also inform the Provincial Director not less than 24 hours prior to the blasting taking (preferably 3 days on request from the local Department of Labour) to allow them enough time to process the documentation and issue in writing permission for the blasting to take place.

A full-time Competent and Certificated Explosives Manager must be appointed in writing in terms of Regulation 12(1) of the Explosives Regulations of the OHS Act to ensure compliance with the blasting operation. Suitably qualified and experienced Supervisor(s) shall be appointed in terms of Regulation 12(3). All blasting operations must be carried out by a competent Blaster in possession of a valid certificate as a Blaster appointed in writing for the class of operation to be carried out. Trained Flagmen equipped with red flags and two-way radios patrolling on foot are to warn and prevent unauthorised entrance to the blasting site.

Neighbours to the site must be informed of the blasting operation in writing and record thereof to be available. On the day of the blast, all persons on site that will be in the vicinity of the blast area must be informed of the intention to blast. The siren must be sounded before the blast is carried out. The Blaster is to ensure all people and equipment is safe before blasting.

All explosives brought on site to carry out the blasting must be under the control of the Blaster. No person shall convey or cause or permit any other person to convey explosives in any vehicle unless such vehicle is of a design and construction approved in writing for that purpose by the Chief Inspector. All vehicles transporting explosives must be equipped with a fire extinguisher suitable for the purpose of extinguishing the type of fire that may occur.

No preparation of blasting is to take place when there is lightning in the vicinity. No charges are to be fired if the visibility is poor because of mist, smoke, rain etc. or during high winds.

All drilling operations must be carried out under the supervision of a competent Supervisor appointed in writing and proof of competency to be available. All drill operators must have received appropriate training, certified competent and in possession of proof of competency and is authorised in writing to operate the drill. Proof of training and appointments must be available on file on site. The drilling area must be barricaded and access to the area must be controlled. All drilling personnel must be issued with the required personal protective equipment pertaining to the drilling

operation. A daily check on the drill using a checklist must be carried out and record thereof to be available.

Daily safe task instructions (DSTI^s) must be carried out before any drilling or blasting work commences and record thereof to be available.

In addition to any other documentation required as per the specification, the following must be on file and made available to the Client, the Client's agent or the Principal Contractor for approval before any drilling and blasting operations may commence on site:

- The documented blasting procedure.
- The documented drilling procedure.
- The documented charging up procedure.
- The documented transporting of explosives on site procedure.
- The documented cleaning of the area before / prior to blasting procedure.
- The documented misfired blast holes / surface cut-offs procedure.
- The documented destruction of old or damaged blasting explosives procedure.
- Risk assessments carried out pertaining to all above activities.
- Training of all personnel on the relevant procedures and Risk Assessments pertaining to their individual tasks.

2.5.10. Public and Site Visitor Health and Safety

The Principal Contractor shall ensure that every person working on or visiting the site, as well as the public in general, shall be made aware of the dangers likely to arise from site activities, including the precautions to be taken to avoid or minimize those dangers. Appropriate health and safety notices and signs shall be posted up, but shall not be the only measure taken.

The Principal Contractor have a duty in terms of the OHS Act No.85 of 1993 to do all that is reasonably practicable to prevent members of the public and site visitors from being affected by the construction activities. The Principal Contractor must ensure that construction sites in build-up areas adjacent to a public way are suitable and sufficiently fenced off and provided with controlled access points to prevent the entry of unauthorized persons.

Site visitors must be briefed on the hazards and risks that they may be exposed to and what measures are in place or should be taken to control these hazards and risks. A record of these "inductions" must be kept on site in accordance with the Construction Regulations.

Any building material or sand that may wash into the road must be cleared by the Principal Contractor immediately.

2.5.11. Night Work

The Principal Contractor must ensure that adequate lighting is provided to allow for work to be carried out safely. Lighting must be in compliance with the requirements of the Environmental Regulations for Workplaces of the Occupational Health and Safety Act.

If any construction work will be taking place at night it will be the responsibility of the Principal Contractor to ensure a full-time competent supervisor is on site to supervise all construction work and health and safety matters.

2.5.12. Transport of Workers

The Principal Contractor and Sub-contractors shall ensure:

1. Transportation of persons together with goods or tools is prohibited unless there is an appropriate area or section to store the tools and equipment provided separate from the employees.
2. No person rides or is permitted to ride on a construction vehicle or mobile plant otherwise than in a safe place provided thereon for that purpose.
3. Workers shall not be permitted to stand on the back of the vehicle or sit on top of the sides of the bins of the transporting vehicle.
4. Vehicles to be used for the purpose of transporting employees to have seats firmly secured and adequate for the number of employees to be carried.
5. All construction vehicles or mobile plant traveling, working or operating on public roads to comply with the requirements of the National Road Traffic Act, 1996.

2.5.13. Severe Weather Plan

When high wind creates a hazard to the workers or work being performed i.e., instability in elevated areas, limited visibility due to dust or particles in the air, unmanageable materials etc. Supervision must stop work activities; re-assign work area, properly store and secure material which might blow away or cause injury or damage.

Should lightning be present, workers must be removed from open areas, high structures or any open elevated areas and instructed to take cover inside vehicles or buildings where possible.

2.5.14. Traffic Management

The Construction of the earthworks will inevitably result in a temporary increase in traffic Flow, as personnel, materials and equipment have to be transported to and from the site. Careful planning of the routes, the location of the construction areas and storage areas together with the timing of the transportation are considered to be the key to the minimization to traffic disturbance, the impact on the local residents and for the efficient delivery of materials and equipment. Authority and responsibility will be delegated to the **Site Safety Officer and the Construction Manager** for determining the Traffic Control.

2.6. Operational Plant, Machinery and Equipment

2.6.1. Construction Vehicles and Mobile Plant

“Construction Vehicle” means a vehicle used as a means of conveyance for transporting persons or material or persons and material, on and off the construction site for the purpose of performing construction work.

“Mobile Plant” means any machinery, appliance or other similar device that is able to move independently and is used for the purpose of performing construction work on a construction site.

The Principal Contractor shall ensure that all such plant complies with the requirements of the OHS Act No. 85 of 1993 and Construction Regulations. The Principal Contractor and all relevant Sub-contractors shall inspect and keep records of inspections of the construction vehicles and mobile plant used on site. Only authorized / competent persons appointed in writing are to use construction vehicles and mobile plant under proper supervision. Appropriate PPE and clothing must be provided and maintained in good condition at all times. Proof of medical fitness certificates as per the requirement of the Construction Regulations must be available for inspection by the Client.

Vehicles shall not enter the site with:

- Defective exhaust systems
- Serious oil or fuel leaks
- Unsafe bodywork or loads
- Non-standard equipment fitted
- Improperly seated passengers
- Any obvious mechanical defects

All construction vehicles and mobile plant shall be operated in accordance with good safety practices so as to protect the safety of the operator and other workers or persons in the area. All construction vehicles and mobile plant shall be equipped with an acoustic warning device which can be activated by the operator and also be equipped with an automatic acoustic reversing alarm. A procedure for the control of the ignition keys of the construction vehicles and mobile plant to prevent unauthorized operation thereof must be available on file.

2.6.2. Vessels under Pressure, Gas Bottles

The Principal Contractor and all relevant Sub-contractors shall comply with the Vessels under Pressure Regulations, including:

1. Providing competency and awareness training to the operators;
2. Providing the required PPE;
3. Inspect equipment regularly and keep records of inspections;
4. Providing appropriate firefighting equipment (Fire Extinguishers) on hand;
5. Pressure vessels including hired in mobile compressors must have a valid inspection and test certificate issued by an Approved Inspection Authority holding an approval certificate from the Chief Inspector verifying that the pressure vessel has been pressure tested and that the inspection has taken place within 36 months;
6. A Manufacturer's plate must be securely fitted in a conspicuous place to the shell of every pressure vessel.
7. The following signs must be prominently displayed at the flammable gas bottle storage facility:
 - i. No Smoking Sign
 - ii. No Open Flam Sign
 - iii. No unauthorized Entry
 - iv. Firefighting Equipment Location Signs

2.6.3. Fire Extinguishers and Firefighting Equipment

The Principal Contractor and relevant Sub-contractors shall provide adequate, regularly serviced firefighting equipment located at strategic points on site specific to the classes of fire likely to occur. The appropriate notices and signs must be posted up as required. A Fire risk survey must be conducted by a competent person; proof of survey must be kept in the Site Health and Safety File.

The Principal Contractor and Sub-contractors are to ensure that a fire equipment inspector is appointed to inspect their specific equipment on site.

2.6.4. Hired Plant and Machinery

The Principal Contractor shall ensure that any hired plant and machinery used on site is safe for use. The necessary requirements as stipulated by the OHS Act No.85 of 1993 and Construction Regulations shall apply. The Principal Contractor shall ensure that operators hired with machinery are competent and that certificates are kept on site in the health and safety file. All relevant Sub-contractors must ensure the same.

The Principal Contractor is to ensure that a Mandatary Agreement [Section 37(2)] and the Sub-contractor's appointment as per Construction Regulation 7(1)(c)(v) with all hired plant is signed. Hired Plant Contractors must also submit their Letter of Good Standing to the Principal Contractor.

The following criteria should be adhered to when considering Hired plant and machinery:

- Hired plant must be checked for safety compliance prior to it being accepted and brought on site;
- Should the hired plant be accompanied by an operator, then the Principal Contractor / Sub-contractor must ensure that the competency and medical fitness of the operator be verified. It is also their responsibility to ensure that the operator undergoes the required Site Safety Induction;
- The Principal Contractor / Sub-contractor shall ensure that the operators of the hired plant attend the planned Safety talks in conjunction with the Principal Contractor's / Sub-contractors' staff;
- The Principal Contractor / Sub-contractor shall ensure that all operators are equipped
- with the required PPE before commencing with work on site.

2.6.5. Ladders and Ladder Work

The Principal Contractor shall ensure that all ladders are inspected monthly, are in good safe working order, are the correct height for the task, extend at least one (1) metre above the landing, fastened and secured, and placed at a safe angle. Records of inspections must be kept in a register on site. Sub-contractors using their own ladders must ensure the same. Ladders shall not be used as horizontal walkways or as scaffolding. Tools or equipment must be carried in suitable slung containers or hoisted up to the working position.

The Principal Contractor and Sub-contractors shall ensure that a Ladder inspector is appointed in writing.

2.6.6. Temporary Works

Temporary works Section 12 of the Construction Regulations

A contractor must:

- Appoint a temporary works designer in writing to design, inspect and approve the erected temporary works on site before use. (Can be three individual persons each appointed for a different function)
- Ensure that all temporary works operations are carried out under the supervision of a competent person who has been appointed in writing for that purpose.
- All temporary works structures are adequately erected, supported, braced and maintained by a competent person so that they are capable of supporting all anticipated vertical and lateral loads that may be applied to them, and that no loads are imposed onto the structure that the structure is not designed to withstand.
- All temporary works structures are done with close reference to the structural design drawings, and where any uncertainty exists the structural designer should be consulted.
- Detailed activity specific drawings pertaining to the design of the temporary works structures are kept on the site and are available on request to an inspector, other contractors, the client, the client agent or any other employee.
- All persons required to erect, move or dismantle temporary works structures are provided with adequate training and instruction to perform those operations safely.
- All equipment used in temporary works structures are carefully examined and checked for suitability by a competent person before being used.
- All temporary works structures are inspected by a competent person immediately before, during and after the placement of concrete after inclement weather or any other imposed load and at least on a daily basis until the temporary works structure has been removed and the results have been recorded in a register and made available on site.
- No person may cast concrete until authorization in writing has been given by the competent person.
- If, after erection any temporary works structures are found to be damaged or weakened to such a degree that its integrity is affected, it is safely removed or reinforced immediately.
- Adequate precautionary measures are taken in order to secure any deck panels against displacement and prevent any person from slipping on temporary works due to the application of release agents.
- As far as is reasonably practicable the health of any person is not affected through the use of solvents or oils or any other similar substances.
- Upon casting concrete, the temporary works structure is left in place until the concrete has acquired sufficient strength to safely support its own weight and any imposed load, and is not removed until authorization in writing has been given.
- The foundation conditions are suitable to withstand the loads caused by the temporary works structure and any imposed load in accordance with the temporary works design.

- Provisions are made for safe access by means of secured ladders or staircase for all work to be carried out.
- A temporary works drawing or any other relevant document includes construction sequences and methods statements.
- The temporary works designer has been issued with the latest revision of any relevant structural design drawing.
- A temporary works design and drawing is used only for its intended purpose and for a specific portion of a construction site.
- The temporary works design drawing is approved by the temporary works designer before the erection of any of any temporary works.
- No contractor may use a temporary works design and drawing for any other than its intended purpose.

Deviations found may result in the activity being stopped by the Client, Client Agent / Inspector, until such time as compliance is achieved. Standing time will be against the Contractor for not Complying with section 12 of the Construction Regulations.

2.6.7. Lifting Machines, Hand Powered Lifting Devices & Lifting Tackle

The Principal Contractor and all contractors shall ensure lifting machines (includes Lift Trucks, Mobile Elevated Work Platforms and cranes), hand-powered lifting devices and lifting tackle are inspected and tested in accordance with the Driven Machinery Regulations 2015. There must be competent lifting machines, hand-powered lifting devices and lifting tackle inspectors who must inspect the equipment daily or before use, taking into account that:

1. All lifting machines, hand-powered lifting devices and lifting tackle have a safe working load clearly indicated
2. Regular inspections and servicing are carried out
3. Records are kept of inspections and of service certificates
4. There is proper supervision in terms of guiding the loads that includes a trained banks man to direct lifting operations and check lifting tackle.
5. The operators are competent as well as physically and psychologically fit to work and is in possession of a medical certificate of fitness issued by an Occupational Health Practitioner which must be available on site
6. Rigging of loads to be done in accordance with acceptable safe work practices. Proof of competency training to carry out rigging to be available on file.
7. Annual load tests certificates for lifting machines by an LME / LMI in place
8. The Operators are certified to operate the specific machine (valid certificates to be on site)

2.6.8. General Machinery

The Principal Contractor and relevant Sub-contractors shall ensure compliance with the Driven Machinery Regulations, which includes inspecting machinery regularly, appointing a competent person to inspect and ensure maintenance, issuing PPE or clothing and training those who use machinery.

2.6.9. Electrical Installations and Machinery

The Principal Contractor and relevant Sub-contractors shall ensure compliance with the Electrical Installation Regulations 2009, the Electrical Machinery Regulations 2011 and Construction Regulation 24 of the Occupational Health and Safety Act and Regulations (Act 85 of 1993). All electrical connections and installations must be performed under the supervision of an appropriately qualified Registered Person as defined in the Electrical Installation Regulations pertaining to the category of electrical installations carried out, who has been appointed in writing. All Temporary Supplies may only be connected once the necessary permissions have been obtained and must be performed under the supervision of an appropriately qualified electrician.

The Temporary Supply must be inspected periodically but at least once per week by a competent person and the inspection findings recorded in a register kept on the construction site. A copy of the certificate of compliance where applicable, must be kept in the health & safety file.

A certificate of compliance must be obtained from the supplier and be available on site for all hired containers or site offices equipped with electricity.

Every person authorized to use a particular electric machine must be trained in the safe use thereof and be fully aware of the dangers attached thereto and be conversant with the precautionary measures to be taken or observed to obviate such dangers. The authorized operator or user must carry out a daily inspection using a relevant checklist prior to use and the inspection findings recorded in a register kept on site.

The correct Personal Protective Equipment to operate such machinery must be identified and issued to the respective operators / users of the machinery and training in the correct use of such PPE must be given. PPE must be regularly inspected to ensure it is in a good condition

2.6.10. Portable Electrical Tools

The Principal Contractor and relevant Sub-contractors shall ensure that the use and storage of all portable electrical tools are in compliance with the relevant legislation. The Principal Contractor and relevant Sub-subcontractors shall ensure that all electrical, tools, electrical distribution boards, extension leads and plugs are kept in safe working order. Regular inspections and Safety talks must be conducted to make workers aware of the dangers and control measures to be implemented e.g., personal protection equipment, guards etc.

The Principal Contractor and relevant Sub-contractors shall consider the following:

1. A competent person undertakes routine inspections using a checklist and records are kept on file
2. Only authorized trained persons use the tools
3. The Safe Working Procedures apply
4. Awareness training is carried out and compliance is enforced at all times
5. PPE and clothing are provided and maintained
6. Each power tool must be clearly marked for identification purposes.
7. Portable Power tool inspector must be appointed in writing.

2.7. Occupational Health

2.7.1. Occupational Hygiene

Exposure of workers to occupational health hazards and risk is very common in any work environment, especially in construction. Occupational exposure is a major problem and all Principal Contractors must ensure proper health and hygiene measures are put in place to prevent exposure to these hazards. Prevent inhalation, ingestion, and absorption of any hazardous substances and high noise level exposure. Site specific health risks can be cementing dust, wet cement, wood-dust, noise etc.

2.7.2. Welfare Facilities

The Principal Contractor must supply sufficient toilets (1 toilet per 30 workers), showers (1 shower for every 15 workers), changing facilities, hand wash facilities, soap, toilet paper and hand drying material must be provided. Waste bins must be strategically placed and emptied regularly. Safe, clean storage areas must be provided for workers to store personal belongings and personal protective equipment. Workers should not be exposed to hazardous materials / substances while eating and must be provided with sheltered eating areas.

2.7.3. Alcohol and Drugs Policy

A written Alcohol and Drugs policy must be available on file and all employees must be trained on the contents thereof. No alcohol or drugs will be allowed on site. No person may be under the influence of alcohol or any other drugs while on the construction site. Any person on prescription drugs must inform his / her superior, who shall in turn report this to the Principal Contractor forthwith. Any person suffering from any illness / condition that may have a negative effect on his / her safety performance must report this to his / her superior, who shall in turn report this to the Principal Contractor forthwith. Any person suspected of being under the influence of alcohol or other drugs must be sent home immediately, to report back the next day for a preliminary inquiry. A full disciplinary procedure must be followed by the Principal Contractor or Sub-contractor concerned and a copy of the disciplinary action must be forwarded to the Principal Contractor for his records.

Document Prepared by:

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19 May 2023

ANNEXURE A:

OCCUPATIONAL HEALTH AND SAFETY SPECIFICATION
Foskor Richardsbay – Upgrade of The Primary and Secondary Pollution Control Dams

The Principal Contractor and Sub-contractors must submit proof of compliance with Annexure A of this Construction Health and Safety Specification (HSS), with the Construction Health and Safety Plan, where applicable.

HSS Item no:	Requirement	OHS Act Requirement	Submission Date
2.3.1	Application for construction work permit	Annexure 1 (Construction Regulation 3(2))	Before commencement of work on site
2.3.2	Assignment of Responsible Persons to supervise Construction work	All relevant appointments as per OHS Act 85/1993 and Construction Regulations	Before commencement of work on site
2.3.3	Competency Certificates of Responsible Persons	Client requirements and OHS Act 85/1993	Together with the Health & Safety Plan
2.3.4	Compensation for Occupational Injuries and Disease Act (COIDA) 130 of 1993	COIDA Requirement	Together with the Health & Safety Plan
2.3.5	Occupational Health and Safety Policy	OHS Act 85 of 1993	Together with the Health & Safety Plan
2.3.6	Health and Safety Organogram	Client Requirements	Together with the Health & Safety Plan
2.3.7	Initial Hazard Identification and Risk Assessment based on the Client's Assessment	Construction Regulation 9	Together with the Health & Safety Plan
2.3.8	Health and Safety Representative	OHS Act 85 of 1993	Submit as soon as there are more than 20 employees on site
2.3.9	Valid Medical Certificate of Fitness in the form of Annexure 3	Construction Regulation 7(8)	Before employee commence to work

ANNEXURE B:

OCCUPATIONAL HEALTH AND SAFETY SPECIFICATION
Foskor Richardsbay – Upgrade of The Primary and Secondary Pollution Control Dams

The Principal Contractor shall make the following appointments according to the initial assessment (further appointments could become necessary as Project progresses)

Appointment	OHS Act Reference	Requirement
CEO Assignee	Section 16(2)	A competent person to assist with the on-site H & S overall responsibility – Contractor's Responsible Persons
Construction Manager	CR 8.1	A competent person to supervise and be responsible for the health & safety related issues on site. The person is appointed to assist the CEO with their overall duties
Assistant Construction Manager	CR 8.2	A competent person to assist with the daily supervision of construction or building work. The person assists the Construction Work Supervisor
Health and Safety Officer	CR 8.5	A competent person to assist with the on-site H & S overall responsibility – Contractor's Responsible Persons
Construction Supervisor	CR 8.7	A competent person responsible for construction activities and ensuring Occupational Health and Safety Compliance.
Assisting Construction Supervisor	CR 8.8.	A competent person responsible for construction activities and ensuring Occupational Health and Safety Compliance.
Health & Safety Representative(s)	Section 17	A competent person(s) to inspect H&S in reference to plant, machinery and Health and Safety of persons in the workplace
Health & Safety Committee Member(s)	Section 19	A competent person(s) representing the employer to assist with the onsite Health & Safety matters
Incident Investigator	GAR 9	A competent person to investigate incidents / accidents on site and could be: <ul style="list-style-type: none"> • The employer • H & S Representative • Designated person • Member of the H&S Committee
Risk Assessment Coordinator	CR 9	A competent person to coordinate all risk assessments on behalf of the Principal Contractor. The same applies to Sub-contractors
Fall Protection Coordinator	CR 10	A competent person to prepare and amend the Fall Protection Plan
First Aiders	GSR 3	A qualified person to address all on site first aid cases
Lifting machine & equipment inspector	DMR 18	A competent person to inspect lifting machines, equipment and tackle
Scaffolding Inspector	SANS 10085 CR 16	A competent person to inspect scaffolding before the use, and every time after bad weather etc.
Scaffolding Erector	SANS 10085 CR 16	A competent person to erect scaffolding

Appointment	OHS Act	Requirement
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OCCUPATIONAL HEALTH AND SAFETY SPECIFICATION
Foskor Richardsbay – Upgrade of The Primary and Secondary Pollution Control Dams

	Reference	
Scaffolding Supervisor	SANS 10085 CR 16	A competent person to supervise scaffolding
Ladder Inspector	GSR 13(a)	A competent person to inspect ladders daily and ensure they are safe for use, keeping monthly records
Stacking Supervisor	CR 28	A competent person to supervise all stacking and storage operations
Firefighting Equipment Inspector	CR 29	A competent person to inspect firefighting equipment

ANNEXURE C:

The Principal Contractor shall comply, but not be limited to the following requirements, report on these items to the Client at progress meetings or at least monthly, whichever is sooner

What	When	Output
Induction Training	Every worker – before they commence with work onsite	Attendance Registers
Awareness Training (Toolbox Talks)	At least weekly	Attendance Registers
Health & Safety Reports	Monthly	Reports covering: <ul style="list-style-type: none"> • Incidents, Accidents & Investigations • Non conformances by employees & contractors • Internal & External HS Audits reports
Emergency Procedures	Continuous Evaluation of Procedure	Table the procedure in writing as well as Contact numbers
Risk Assessments	Updated and signed off at least monthly	Documented Risk Assessments
Safe Work Procedures	Drawn up before workers are exposed to new risks	Documented set of Safe Work Procedures/ Method Statements updated and signed off
General Inspections	Weekly & Daily	Report OHS Act compliance: <ul style="list-style-type: none"> • Scaffolding • Excavations • Formwork & Support work • Explosive Actuated Fastening Devices
General Inspections	Monthly	<ul style="list-style-type: none"> • Firefighting equipment • Portable Electrical Equipment • Ladders • Lifting Equipment / slings
List of contractors	List to be updated weekly	Table list, number of workers and Company contact numbers
Workman's Compensation	Continuous	Table a list of contractors' Workman's Compensation proof of good standing
Construction Site Rules & Section 37(2) – Mandatory Agreement	Continuous	Table a report of signed and up to date Mandatories.

ANNEXURE 4

ACCEPTANCE OF DOCUMENT.

Health and Safety Specification.

Contractor Representative

I as the Contractor Representative for the Project.....hereby state that I have read the Health and Safety specification and understands it. I further state that I am responsible for the project and will ensure that all the requirements set out in the Occupational Health and Safety Act in particular the Construction Regulations will be adhered to by all on site and coming on to site.

Project Information:

Project Location:

Expected Commencement date:

Expected Completion date:

Responsible Person:

Responsible Person Contact Details:

Name: Date:

Signature:

Note: This page must be completed and a copy to be send to C & M Safety Consultants (cmssc@saol.com) before work start. If a Construction Manager CR 8(1) has not been assigned to the mentioned project as yet, the Chief Executive Officer Section 16(1) or the Assigned Assistant to the Chief Executive Officer Section 16(2) must sign this letter.



CODE OF PRACTICE RICHARDS BAY

Procedure No.	COP 164
Revision	11
Pages	1 of 66

COP 164 – EMERGENCY PLANNING

DEKRA	7.1/ 7.2	9001	N/A	14001	8.2	45001	8.6	3000	7.0	16001	5.6
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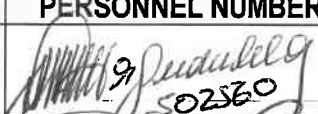

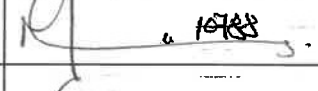

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REVISION SHEET

REVISION NUMBER	SUBJECT OF REVISION	PAGE NUMBER	EFFECTIVE DATE
0	This document replaces procedure SHE 3.1	All	APR'03
1	Emergency Numbers update	49	MAY '04
2	Annexure 11 – Environmental Updated Government Services Number	46-47	JUNE '05
3.	General and changes on Annexure 12 (Emergency Contact Numbers) New Foskor logo	All	NOV '07
4	New Blood spill procedure Updated contact Numbers	49 50	OCT '08
5	Update Contact numbers and add Gas room numbers	50 - 55	JAN '09
6	Updated contact Numbers	50 - 54	November 2013
7	General Review and Re-numbering	All	April 2015
8	General Review: <ul style="list-style-type: none"> • Storm water dam overflow emergency planning • Annexure 16 and 17 	51	
9	Alignment to the new standards	All	31 August 2017
10	General review of the procedure	All	05 June 2018
11	Alignment to ISO 45001 standards	All	17 January 2020

ENDORSEMENT

	DESIGNATION	DATE	SIGNATURE & PERSONNEL NUMBER
COMPILED BY	SUPERINTENDENT EMERGENCY AND SECURITY	10/03/2020	 502560
CHECKED BY	SENIOR MANAGER SHREQ	10/03/2020	 503460
CHECKED BY	GENERAL MANAGER ACID DIVISION	11/03/2020	 10788
APPROVED BY	VICE PRESIDENT ACID DIVISION	16/03/2020	 503402

1. PURPOSE

The purpose of this procedure is to define the response plan in terms of which emergency situations will be managed at Foskor and to comply with the provision of Management of Emergency Preparedness in Foskor Richards Bay site including Railyard Operations

2. SCOPE

The identification of possible risks which could lead to emergencies and the consequent development of contingency plans were based on past experience in Foskor Richards Bay including The Port Phosphoric Acid storage tanks at the Transnet Port Authorities. In the light of this experience the following emergencies were identified:

1. Fires and explosion
2. Ammonia gas leaks
3. SO₂/ SO₃ Leaks/Emission
4. Bomb Threats
5. Injury/Trauma/Trauma Struck by a train
6. Pipeline tank failures: Effluent & Acid
7. Hazardous waste spillage
8. Export pipe and Port Storage tanks failure
9. Storm water dam overflow
10. Sulphuric/Phosphoric acid leak – Railyard
11. Loco/Tanker derailment and Collision – Train and Road Tanker
12. Evacuation plan

It is the intention of Foskor, Richards Bay to provide an effective and efficient means for all employees to handle an emergency, which may occur on the premises.

To ensure the safety & Health of personnel and protection of the environment by developing contingency plans for the handling of emergency situations.

This Code of Practice is applicable to all Foskor-Richards Bay employees, contractors and visitors.

3. REFERENCES

1. Disaster Management Act (Act No 57 of 2002)
2. National Environmental Management Act (Act No 107 of 1998)
3. Occupational Health and Safety Act, 1993 (Act No. 85 of 1993)
4. Fire Brigade Services Act No 99 of 1987
5. Railway Safety Management Part 1: General SANS 3000-1:2016

4. DEFINITIONS & ABBREVIATIONS

4.1 Emergency Situations - Any deterioration in conditions or acts unplanned positioning of plant equipment or events which could lead to uncontrolled hazardous emissions, major process interruptions, material loss, damage, destruction, fire, injury or fatalities or major uncontrolled spills

4.2 Emergency Occurrence – Any sudden occurrence/ event causing or threatening injury or disease, death damage to property, infrastructure or the environment, or disruption to the community, which exceeds the ability of the effected instance to cope with using its own resources.

4.3 Emergency Personnel - Any person selected and appointed as Emergency co-ordinator (E.Co), Proto team Leader (PL), Emergency Area Warden (EAW) or Proto team Member (PM). These are personnel who will be trained and appointed to respond to any emergency situation or occurrence.

4.4 Emergency Co-ordinator - Person appointed in a full-time capacity by Foskor Richards Bay, to command all emergency situations and personnel in the event of an emergency situation arising.

4.5 Security Supervisor - The security supervisor, on duty at time of the incident, and appointed to assist the emergency co-ordinator in any emergency situation.

4.6 Emergency Area Warden (Production Shift Supervisor) - Any person responsible for a specific area, appointed to assist the Emergency Co-ordinator in any emergency situation.

4.7 Proto team leader - Any person appointed to direct the activities of the Proto team members at the scene of emergency situation or occurrence.

4.8 Proto team Member - Any person appointed to perform firefighting and first aid activities, at the scene of an emergency.

4.9 Disaster – An occurrence which may cause widespread destruction and distress or a catastrophe.

4.10 Emergency drill - Any emergency situation or occurrence, which has been simulated, for the purpose of training emergency personnel and maintaining awareness amongst other personnel in general.

4.11 Pre-contact phase - This refers to the planning stage where an infrastructure is created which will facilitate the handling of emergencies that may occur.

4.12 Contact phase - This is the stage where an incident has occurred, and action is being taken to resolve or alleviate the situation. This phase embodies all actions taken during an emergency.

4.13 Post-contact phase - This phase refers to the actions that are required after an emergency has occurred in order to ensure that normal functions are resumed. This phase includes investigations and corrective actions.

4.14 Emergency Preparedness Plan – Individual and coordinated actions required by management at Foskor Richards Bay to respond to an emergency situation, aimed at the containment of the consequences and include warning, mobilization, security, fire fighting, trauma care, employee assistance, media liaison and stand down arrangements

4.15 Emergency control centre - This is the nerve centre from which all emergencies are to be managed and will be established in the Security Boardroom.

During Normal working Hours:

The following personnel must within 3 minutes of the alarm move to the ECC only provided that it is safe to do so, in order to co-ordinate the emergency response

- GM Operations
- GM Logistics/Materials Handling Process
- GM Sales and Marketing
- Manager Sulphuric Operations
- Manager Sulphuric Maintenance

- Manager Granulation/Laboratory
- Manager Granulation/ Materials Handling Maintenance
- Manager SHREQ
- Security Manager
- Electrical Engineer
- Proto Team Support

After Hours/ Weekend

- Stand by Manager
- Security Supervisor
- Process Coordinator
- Electrical?
- Proto Team Support
- Any of the above support managers if available & is asked to come to site.

Abbreviations

a) ARV	Antiretroviral
b) B.A. SET	Breathing Apparatus Set
c) C.E. O	Chief Executive Officer
d) COID	Compensation for Occupational Injuries and Diseases
e) DAEA	Department of Agriculture and Environmental Affairs
f) DEA	Department of Environmental Affairs
g) DoL	Department of Labour
h) DWA	Department of Water Affairs
i) E.A. W	Emergency Area Warden
j) E.C.C	Emergency Control Centre
k) E.Co	Emergency Co-ordinator
l) EAP	Employee Assistant Practitioner
m) ERG	Emergency Response Guide
n) HIV	Human immunodeficiency virus
o) P.P. E	Personal Protective Equipment
p) P.T.	Proto Team
q) P.T. L	Proto team Leader
r) P.T.M	Proto team Member
s) PEP	Post-exposure prophylaxis (PEP)
t) PTA	Post Traumatic Stress Syndrome
u) S.S.	Security Supervisor
v) SAPS	South African Police Services
w) SO ₂	Sulphur dioxide
x) SO ₃	Sulphur Trioxide
y) TFR	Transnet freight rail

5. RESPONSIBILITY, ACCOUNTABILITY, AUTHORIZATION

Foskor Richards Bay Management is responsible for formulating, developing, implementing and maintaining effective emergency action plans based on the top identified emergency preparedness risks as covered in this Code of Practice

5.1 The Emergency Co-ordinator is responsible for:

- The overall management of the plan.

- Taking command of all emergency incidents
- Liaising with emergency Departments (uMhlathuze fire and Disaster management)
- Co-ordinating all emergency related functions.
- Reporting on all emergencies.
- Selecting the required number of emergency personnel as well as alternative emergency personnel.
- Reviewing emergency personnel bi-annually.
- Maintaining reports on all drills, practices and competitions.
- Arranging planning sessions with emergency personnel and other relevant personnel when deemed necessary.
- Ensuring that emergency personnel attend medical examinations, training sessions, drills and competitions.
- Issuing and controlling the use and maintenance of personal protective equipment.
- Maintaining discipline and general order amongst emergency personnel.
- Issuing such schedules to emergency personnel.
- Maintaining all fire fighting and emergency equipment.
- Arranging emergency drills.
- Liaising with the local emergency services regarding matters such as training, inspections and competitions.
- Taking command of all emergency incidents
- Liaising with management.
- Decision making.

5.2 The Security Supervisor is responsible for:

- Assisting with the responsibilities assigned to the emergency co-ordinator under sec. 5.1
- Manning the emergency control room.
- Ensuring communication with the action group at all times.
- Liaising with all relevant external services.
- Ensuring that the emergency gas alarm is tested each Friday at 10h00.
- Recording all communication.
- Taking command of all security functions during the emergency

5.3 The Emergency Area Warden (Shift Supervisor)

- Assisting with responsibilities assigned to the Emergency Co-ordinator (Eco) under section 5.1
- Take charge of incidents in his area of responsibility until ECo arrives
- Control and maintain emergency equipment in his area of responsibility
- Perform and co-ordinate emergency procedure as per emergency plan for his area
- Responsible for reporting of all emergency incidents to Emergency Co-ordinator

5.4 The Crisis Communicator

A senior manager or delegate to be appointed, by the C.E.O, to assume responsibility for all communication in the event of an emergency. Such person to be trained in communication and to assume the following responsibility:

- Liaising with the press
- Controlling all communication

5.5 Electrical/Instrumentation Engineer

The Electrical/Instrumentation Engineer is responsible for checking and maintaining all alarms in accordance with the plan.

Ensure that the emergency alarm tests are done every Friday at 10:00 am

5.6 Works Emergency Controller (SHREQ Manager)

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The SHREQ Manager for Foskor Richards Bay shall appoint responsible team to assist him in the development and implementation of an integrated emergency planning programme

5.7 EAP – Employee Assistance Practitioner

Employee Assistant Practitioner is responsible for counselling of all employees who are affected during any major or traumatic emergency.

6. MINIMUM REQUIREMENT FOR THE EMERGENCY CONTROL CENTRE

The Emergency Control Centre is provided with the following minimum facility:

- 6.1. Table and chairs for minimum of 10 persons in a conference room
- 6.2. Two telephone lines
- 6.3. Two computers
- 6.4. CCTV screen
- 6.5. South African National Anthem display
- 6.6. Overhead projector with keyboard and mouse plus computer tower
- 6.7. Wall clock
- 6.8. Foskor drawings and picture display

7. REPORTING OF INCIDENT

In the event of an incident that constitutes danger to the safety or health of people or plant or the environment or which has caused injuries to people or damage to plant or any hazardous situation that arises out of the process of production, it must be immediately reported to the Security Control Room. Refer to Annexure 15

The Emergency Information card must be displayed in all notice boards and offices to ensure all employees are familiar with information needed in an emergency when making a call to the security control room

Any incident that happens outside Foskor Richards Bay premises on the road and within City of uMhlathu areas will be requested to respond by SHREQ Manager's instruction.

The external areas that are under Foskor Richards Bay Responsibility

- 7.1 Gypsum dam
- 7.2 The Port Storage Tanks including export pipeline
- 7.3 Alton Building 1906 erf. including Truck Staging area

Ammonia storage tanks and offloading bay gas releases will automatically activate an emergency alarm

8. PROCEDURE

8.1 SELECTION, APPOINTMENT AND TRAINING OF EMERGENCY PERSONNEL

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8.1.1 APPOINTMENT OF EMERGENCY CONTROLLER AND AREA WARDENS

- The Manager: SHREQ shall, for each shift, appoint an Area warden.
- The original appointment shall be handed to the appointee.
- A copy of the appointment shall be kept by the Quality Administrator.

9. SELECTION OF EMERGENCY PERSONNEL

- The Emergency Co-ordinator will evaluate the performance of all aspiring emergency personnel, as well as any applications that are submitted by other personnel.
- The number of emergency personnel required for selection will be according to Annexure 3
- The Emergency Co-ordinator shall arrange for a medical examination of selected persons at the clinic.
- Selection shall be terminated if the person is to be a member of the action group and is declared medically unfit.
- The medical status shall be recorded on each person's record form as per Annexure 4

10. BASIC TRAINING

- The Emergency Co-ordinator shall ensure, in conjunction with the SHREQ Trainer, that all selected emergency personnel attend all required training courses.
- Emergency personnel, who do not pass the required basic courses, shall be notified of such by the Emergency Co-ordinator.
- A copy of all certificates issued shall be kept by the Training Centre as well as in the in the Emergency Coordinators Office.

11. APPOINTMENT OF EMERGENCY PERSONNEL

- On successful completion of the required basic training/on site basic training the Manager SHREQ shall appoint the person as a member of the "Emergency Personnel Team" as per Annexure 6
- The original appointment shall be presented to the candidate.
- A copy is to be filed in the Quality Administrators Office.

12. ALTERNATIVE EMERGENCY PERSONNEL

- The Emergency Area Warden on each shift shall ensure that the correct numbers of emergency personnel are available. In order to achieve this, alternative personnel shall be selected, trained and appointed to replace emergency team members who are absent.
- All appointed alternatives shall be reviewed, at least annually, by the Emergency Co-ordinator.
- Alternative personnel shall be appointed in accordance with section 11 above.
- These appointments shall be made by the Manager SHREQ.

13. TRAINING PROGRAM

- The Emergency Co-ordinator shall at the beginning of each year develop a training programme, in conjunction with the Training Department and relevant external organizations.
- Such training programme must be issued to all emergency personnel.
- The Emergency Co-ordinator will discuss these programmes with all personnel as well as alternatives. He will also make arrangements to facilitate their attendance.
- The Emergency Co-ordinator shall ensure that training times are adhered to and that a record of attendance is kept as per Annexure 4

14. GENERAL ADMINISTRATION

- Competitions must be arranged and organised by the Emergency Co-ordinator, in conjunction with the Umhlathuze Fire and Rescue Service.
- The Emergency Co-ordinator shall keep a record of all such competitions.
- A record of each drill or practice carried out, shall be kept at the Emergency co-ordinator as per annexure 8.9

- The Emergency Area Wardens shall report all problems such as lack of equipment to the, Emergency Co-ordinator who will in turn ensure that the problem is addressed.

15. REQUIREMENTS

15.1 Documentation

Emergency personnel listed

A list of all emergency personnel will be kept on file in the emergency control centre & security will be updated by the Emergency Co-ordinator whenever necessary.

15.2 Emergency external services

A list of all external emergency services and their contact numbers will be available in the emergency control centre as well as the security control room. These lists are to be updated by the Emergency Co-ordinator whenever necessary.

15.3 Evacuation and emergency procedures

A copy of the evacuation plan, as well as contact and post contact phases for all emergencies must be accessible to all employees on the company's premises. All personnel are to be conversant with these procedures.

15.4 Company structure

A copy of the company structure will also be prominently displayed in the emergency control centre, which will allow the Emergency Co-ordinator to convey information to relevant personnel as well as referring certain decisions to the responsible person.

15.5 Emergency Ammonia/SO₂/SO₃ Alarm

a. Emergency gas alarm

The emergency gas alarm indicates that there is a leakage, or uncontrolled release of Ammonia, SO₂ or SO₃ and one must evacuate to the nearest emergency gas escape room. This evacuation is done by radio and telephone communication to the affected area.

This alarm is a continuous loud, wailing alarm that can be activated at the following points:

- MAP control room
- Granulation control room.
- Phos acid control room.
- Sulphuric acid control room.
- Rail Weighbridge Control Room

b. Fire alarm

Fire alarms are installed in each section and at present fires are reported by means of our extensive radio system and a central control panel in the security control room.

The emergency alarm must comply with the standards and requirements as set out in COP 109 – Emergency alarms and be tested accordingly.

c. Fire Suppression System

Only two gas suppression detection system linked to the central control room which are IT server room and Drawing offices and the rest are localised alarms as per area.

16. EMERGENCY GAS ESCAPE ROOMS

See attached list

17. EMERGENCY CONTINGENCY PLANS (ANNEXURE11)

- Fires and explosions (10.1)
- Ammonia gas leaks (10.3)
- SO₂/SO₃ emissions (10.4)
- Bomb threats (10.5)
- Trauma (10.6)
- Hazardous waste (10.7)
- Acid leak/Spillage Export pipeline and The Port Storage tanks (10.8)
- Evacuation plan (10.9)
- Evacuation of disabled persons (10.10)
- Environmental Acid Spillage including storm water dam overflow and others (10.11)
- Blood Spill (10.12)
-

18. EMERGENCY TELEPHONE NUMBERS

Foskor emergency number is 035 902 3299 / 3116 / 3114 Cell phone: 083 252 7222
Refer to Annexure 15

19. RECORDS

DESCRIPTION	RESP	LOCATION	FILE NAME:/INDEX	RETENTION TIME (MINIMUM)
Emergency co-ordinator appointment form.	E Co	ESR Office	COP 164.2	5 Years
Emergency team organisation chart.	E Co	ESR Office	COP 164.3	5 Years
Emergency personnel appointment.	E Co	ESR Office	COP 164.6	2 Years
Emergency drill Practice report	E CO	ESR Office	COP 164.8	5 Years

20. Annexure 1 - EMERGENCY CO-ORDINATOR APPOINTMENT

DATE:

NAME:

INTERNAL ADDRESS:

EMERGENCY CO-ORDINATOR APPOINTMENT

Dear

In terms of company policy COP 164 for the appointment, training and control of emergency personnel, you are hereby appointed as an emergency co-coordinator to perform the below mentioned functions during your normal working hours, standby period or when specifically required.

You will be responsible for all functions as defined in section 9.2. of the above-mentioned policy. You will ensure that you are acquainted with company policy COP 164 which is the emergency plan, and perform all functions delegated to you by this plan.

Your appointment is effective as of and shall remain in effect unless a notice to the contrary is issued.

.....
Khumbulani Buthelezi
MANAGER: SHREQ

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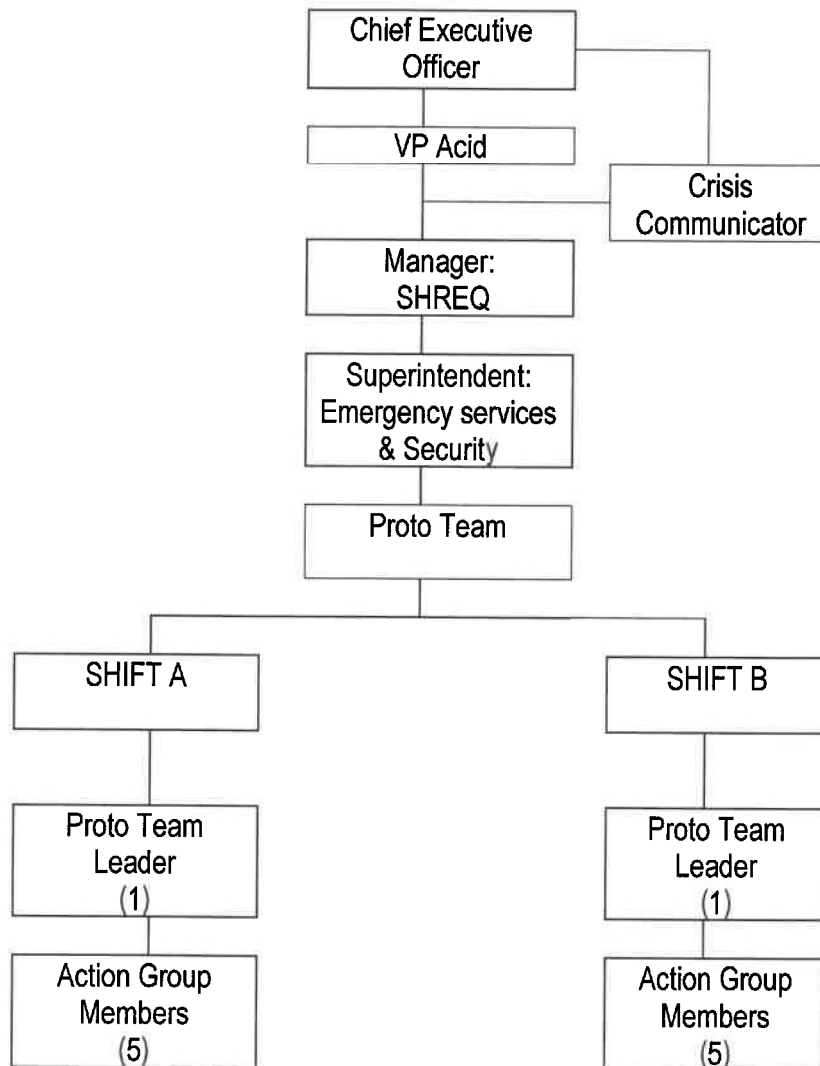
I do hereby acknowledge that I have read and understand my duties and responsibilities and undertake to carry out these duties to the best of my ability.

.....
SIGNATURE

.....
DATE

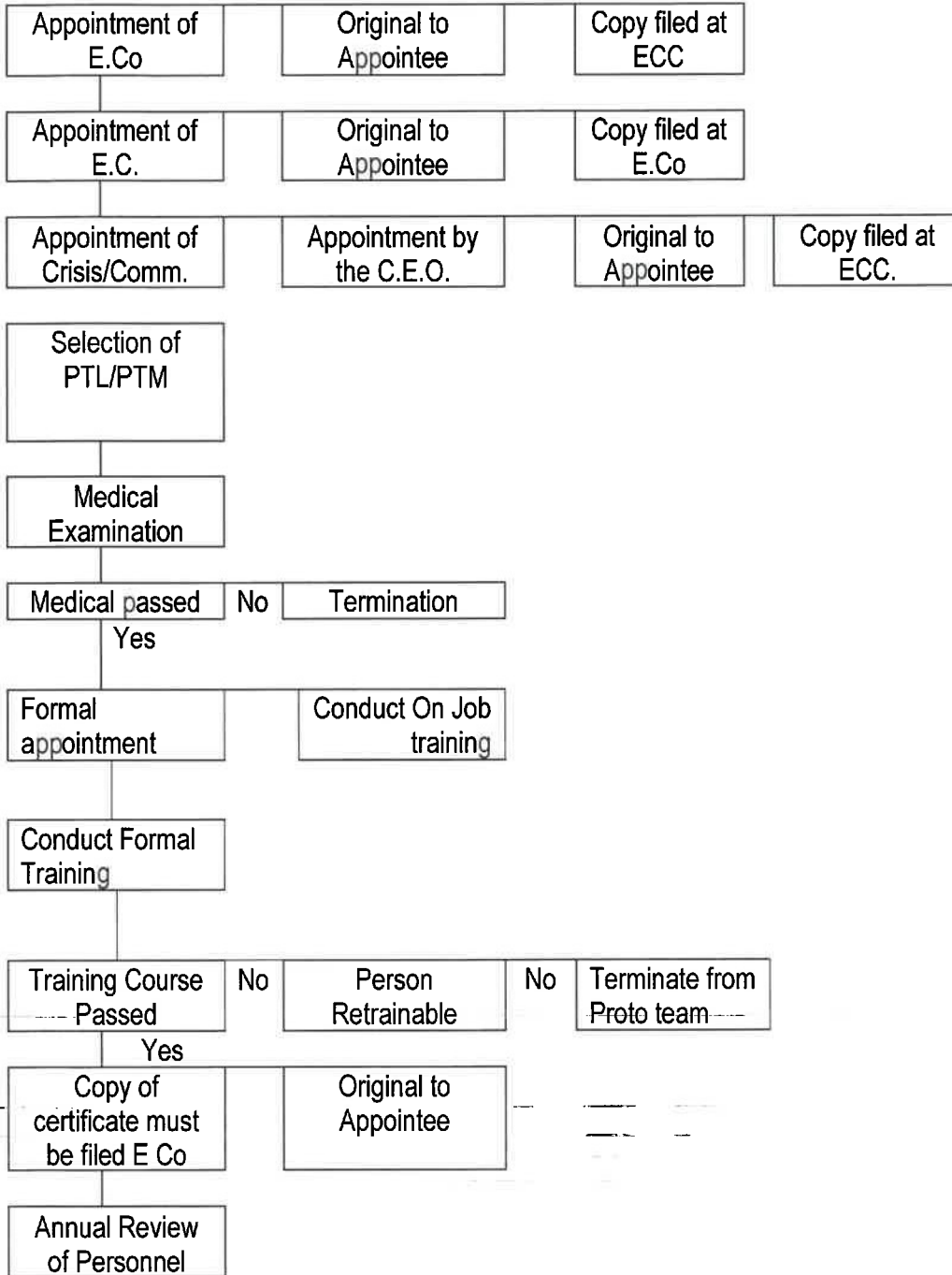
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21. Annexure 2 - EMERGENCY TEAM ORGANISATION CHART



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22. Annexure 3 - FLOWCHART



23. Annexure 4 - EMERGENCY PERSONNEL RECORD FORM

NAME		COMPANY NO.	
SECTION		SHIFT	

DESIGNATION (Tick where applicable)

EMERGENCY CO-ORDINATOR	<input type="checkbox"/>	M I Magudulela	<input type="checkbox"/>
PROTO TEAM MEMBER	<input type="checkbox"/>	ACTION GROUP MEMBER	<input type="checkbox"/>

MEDICAL EXAMINATION

Certified medically suitable for participation in physical activities required during training and emergencies.

YES NO SURGERY

PERSONAL PROTECTIVE EQUIPMENT ISSUES

ITEM	DATE	DATE	DATE

I accept responsibility for the care and maintenance of the above equipment.

SIGNATURE:

DATE:

FORMAL TRAINING RECEIVED

TRAINING MODULE	Yes	No
First Aid (Level 1)		
First Aid (Level 2) and (3)		
Hazmat Operational and Awareness level		
Advance Fire Fighting		
Rope rescue 1/Rope access		

ON THE JOB TRAINING

BA Training		
Fire Engine Operation		
Fire Extinguisher Training		
Hazmat On Job Training Annexure 10(3), 10(4), 10(7) and 10(8)		
Radiation training		
First Aid training Annexure 10(6) and 10(12)		

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24. Annexure 5 - APPOINTMENT AS PROTO TEAM MEMBER

(Environment Regulation 9(1)) and (General Safety Regulation 2)

I _____ having been appointed in terms of Section 16(2) of the Occupational Health and Safety Act (85 of 1993) as the Subordinate Manager. SHREQ hereby appoint you as Proto Team Member for the Company.

The following will be your Duties and Responsibilities

1. To follow all instructions given by the Fire and Emergency Coordinator (Eco.)
2. Ensure that you are familiar with the operation of the firefighting and emergency equipment in the company.
3. Ensure that you are familiar with all emergency procedures and regulations of the company. (COP 164)
4. Assist to ensure that all fire and emergency equipment is clearly indicated and unobstructed.
5. Ensure attendance at all emergency training and fire drills organized by the company.
6. Attend to all emergencies during normal working hours and after hours while on standby.
7. Do standby duties every second week for emergencies in the company.
8. Assist to ensure that all employees are familiar with sounds of fire alarm, gas alarm and back-up emergency alarms.
9. Assist to ensure that all emergency exits, and assembly points are clearly identified and obstruction free, with all keys to emergency exits available at the doors.
10. Assist to ensure that all fire procedure notices displayed on boards are up to date.
11. Regularly check condition of emergency and firefighting equipment, reporting to the Fire and Emergency coordinator any that is damaged or in bad condition.

This appointment is valid from _____ to until otherwise indicated in writing.

Your area of responsibility is **throughout the company**

Person to report to **Emergency Coordinator Proto Team Leader**

Manager SHREQ

DATE

Please confirm your acceptance of this appointment by completing the following:

ACCEPTANCE

I, _____ understand the implications of this appointment as detailed above and confirm my acceptance.

SIGNATURE

DATE

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25. Annexure 6 – PROTO TEAM TRAINING MATRIX

TRAINING MATRIX (TICKED ON APPLICABLE BOX)

SUBJECT COURSE	TEAM LEADERS	PROTO TEAM MEMBERS
First Aid level 1	X	X
First Aid Level 2 and 3	X	X
Basic Ambulance Assistance	X	
Basic Fall Arrest Technician	X	X
Rope Access Technician	X	X
Hazmat Awareness level	X	X
Hazmat operational level	X	X
Advance fire fighting	X	X

.....
EMERGENCY CO-ORDINATOR

.....
TRAINING CO-ORDINATOR

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26. Annexure 7 - EMERGENCY DRILL/PRACTICE REPORT

DATE		DAY/NIGHT	
TIME OF			
ALARM TIME		ALL CLEAR TIME	

Nature of emergency responded to:

.....

UNITS RESPONDING	YES	NO	TIME
Production group involved, Name:			
Proto team			
UMhlatuze Fire department			
Bay Hospital			
S.A. Police			
Disaster Management			
NETCARE or NPA Ambulance Service			
Other			

Was evacuation necessary	Gas Rooms	Yes	No	Emergency Assembly Point
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COMMENTS	
..... Emergency Co-coordinator	1. Copy to Emergency Co-coordinator 2. Report any problems to the Emergency Co-coordinator

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27. Annexure 8 - COMMUNICATION

During any emergency, the success depends on the communication channels established between different sections and organizations. For the successful implementation of the Foskor Emergency Plan the following guidelines will ascertain proper communication channels and improve effectiveness of the overall plan

Employees

All emergencies discovered by employees / Contractors must be reported to supervision and security without delay.

Plant control room personnel are to remain at their control stations in order to maintain communication between the Emergency Control Center and the plant.

Security

On receiving an emergency call from any organization or employee contractor the following communication channels must be followed as per criteria for specific Emergencies

Contact the Emergency Coordinator

Activate the proto team and immediately notify uMhlathuze Fire & Rescue services.

Inform outside contacts on request from authorized persons

Notify all surrounding companies of the emergency, as indicated on the emergency plan

Emergency coordinator

On receiving the emergency call he/she is responsible for liaison with outside companies, direct internal emergency procedures and to inform management about the status and progress. He/she is to communicate with the internal proto and emergency teams. He/she takes charge of the Emergency Control Centre until released by more senior management and communicate/ liaise with uMhlathuze fire and disaster management

Proto team leader

Responsible for communication between proto team and Emergency Control Centre for major incidents, or emergency co-coordinator in case of minor incidents. Responsible for communication between outside companies and Foskor on incident scene.

Foskor Clinic

Responsible for communication with all outside medical emergency services, company doctors and private doctors where necessary. Report to Emergency Control Centre or management on all casualties treated by Foskor clinic or outside medical facilities. Responsible for reporting all incidents to the relevant governing bodies e.g. COID

Crisis communicator

Only the CEO or his designate is allowed to communicate with the media. All statements and reports from the Emergency Control Centre or Foskor will therefore be done through the Crisis communicator.

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Foskor SHREQ Department / Responsible Manager /Supervisor

Responsible for communication with the relevant governmental departments, and local authority related to the specific incident, e.g.

Department of Water affairs
Department of Labor
Richards Bay Clean Air Association
Department of Environmental Affairs -National
Department of Agriculture and Environment Affairs –Regional
City of uMhlatuze - Environmental Office – Local
UThungulu District Municipality-District

Internal Communication

All departments or organizations are responsible for their own internal communication. All communication of any emergencies on site between different organizations, must channelled through the Emergency Control Centre. Communication will also be done through the internal gas room intercom system

General

For effective communication between different organizations a representative of each organization must be present in the Emergency Control Centre. All communication at the scene of the emergency to be recorded. No person is allowed to give any information regarding the incident to the media but should channel it to the Crisis communicator.

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28. Annexure 9 - TRAINING REQUIREMENTS FOR EMERGENCY PERSONNEL

PERSONNEL	REQUIREMENTS
Emergency Co-ordinator	<ol style="list-style-type: none"> 1. Must be conversant with all plant layouts and activities. 2. Crisis communication. 3. Conversant with existing emergency plans. 4. Possess decision making skills 5. Conversant with the harmful substances, which may be released into the environment either as a primary cause or as a consequence of the emergency. 6. Storage locations of harmful substances.
Security Supervisor / Officers	<ol style="list-style-type: none"> 1. Knowledge of all existing emergency plans 2. Have a good knowledge of the factory layout. 3. Training in communication and reporting skills. 4. Be trained in first aid.
Proto team	<ol style="list-style-type: none"> 1. Conversant with all contingency plans. 2. Training in fire fighting and first-aid. 3. This training to be coordinated by the emergency co-ordinator and safety officers. 4. Refresher training to be scheduled. 5. Practice drills to be carried out on a monthly basis
Employees	<ol style="list-style-type: none"> 1. To have a good knowledge of all emergency procedures. 2. This is to be achieved by: <ul style="list-style-type: none"> - Regular evacuation drills - Memos - Posters - Newsletters 3. To undergo a basic course in first-aid and basic fire fighting. 4. To be conversant with contingency plans: <ul style="list-style-type: none"> - Have copies available in each department for reference

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29. Annexure 10 (1) - CONTINGENCY PLANS FIRES AND EXPLOSIONS

Contact Phase	
PERSONNEL	ACTIONS
Employees / Contractors	<ol style="list-style-type: none"> 1. Contact security/ Foskor responsible person 2. Note the location and the extent of the fire 3. Make the area safe 4. Control fire with available equipment 5. Do not risk lives 6. Wait for Proto team to arrive 7. Do not re-enter affected area 8. Control room personnel to remain at control stations in order to maintain communication
Security	<ol style="list-style-type: none"> 1. Log the fire report 2. Notify Proto team and the emergency coordinator 3. Notify uMhlathuze Fire and Rescue services 4. Log and relay all Proto team assessments to the co-ordinator 5. Ensure that all access routes are clear 6. Maintain communication 7. Restrict access to affected area
Emergency Co-ordinator	<ol style="list-style-type: none"> 1. Establish Emergency control centre when necessary 2. Take command of control centre 3. Direct all the emergency personnel 4. Inform the fire department if situation escalates/or uncontrolled call them out if required so 5. Inform management 6. Liaise with management regarding decisions
Proto Team Leader	<ol style="list-style-type: none"> 1. Equip members 2. Proceed to the scene 3. Set up a control point at the scene 4. Assess situation 5. Report findings to the Emergency Co-ordinator 6. Request assistance if it is required 7. Prioritise actions – indicate area safe 8. Monitor situation 9. Evacuate
Proto Team Member	<ol style="list-style-type: none"> 1. Get to the scene 2. Secure the area 3. Restrict access to the area 4. Treat casualties 5. Commence fire fighting activities 6. Search area for people who may be trapped 7. Assist the fire department if required.
Security Supervisor	<ol style="list-style-type: none"> 1. Report to the control centre or maintain

PERSONNEL	ACTIONS
<p>Outside contacts</p> <p>Crisis communicator</p> <p>Foskor Clinic</p> <p>Foskor SHREQ Department</p> <p>EAP</p>	<p>communication with the control centre</p> <p>2 Ensure that all perimeters are secured, and access routes are not obstructed</p> <p>3 Assist with and monitor evacuation</p> <p>4 Report to the control centre or maintain communication with the control centre</p> <p>5 Establish roadblocks, redirect public traffic and direct emergency services on public roads</p> <p>uMhlatuze Fire and Rescue services:</p> <p>1. Proceed to scene.</p> <p>2. Senior member reports to control centre.</p> <p>3. Take charge of scene, liaise with action group /Eco.</p> <p>1. Only the C.E.O. or his designate to communicate with media.</p> <p>2. Issue and update standard brief.</p> <p>3. Standard brief available in ECC.</p> <p>4. Ensure that all communication is properly recorded.</p> <p>1. Attend to all casualties, stabilise and transfer to Bay Hospital when necessary</p> <p>2. Liaise with Company Doctors and external medical facilities</p> <p>1. Report to Department of Environmental Affairs</p> <p>2. Report to Department of Labour.</p> <p>3. Report incident to Department of Agriculture and Environmental Affairs.</p> <p>4. Notify The City of Uthmaniyana Community services department of incident</p> <p>5. Report incident to Department of Labour.</p> <p>1. Report to Foskor Clinic</p> <p>2. Receive list of employees to be counselled</p> <p>3. Refer to outside experience psychologist if needed</p> <p>4. Report back to Foskor Crisis Management</p>
RAILYARD AREA	
	<p>Rail tanker if involved the following must be done</p> <p>1. Transnet freight rail must be notified</p> <p>2. Transnet Freight Rail must respond to the scene if a tanker is involved</p> <p>3. Rail tankers to be moved away from the scene</p>

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30. Annexure 10 (2) Post-Contact Phase for Fires

PERSONNEL	ACTIONS
Personnel Employee/ Contractor	<ol style="list-style-type: none"> 1. Receive the all clear signal 2. Return to their normal duties 3. Do not interfere with the scene
Security	<ol style="list-style-type: none"> 1. Inform all areas of the all clear 2. Supply the Emergency Co-ordinator with all relevant records and information 3. Follow up on all casualties 4. Arrange transport for the required standby maintenance personnel 5. Compile an action report 6. Attend de-briefing session
Emergency Co-ordinator	<ol style="list-style-type: none"> 1. Inform management of the all clear 2. Pursue all the action reports 3. Compile a detailed management report 4. De-brief all the emergency personnel 5. Provide security officer with all relevant info 6. Liaise with UMhlathuze Fire and Disaster 7. Notify TFR of the all clear
Proto Team Leader	<ol style="list-style-type: none"> 1. Monitor recovery of all equipment 2. Check equipment 3. Compile an action report 4. Attend de-brief 5. Refer expended and any damaged equipment to the emergency co-ordinator
Proto Team Member	<ol style="list-style-type: none"> 1. Recover and check all the expended equipment 2. Clean and store P.P.E 3. Refer all used equipment to the P.T. Leader 4. Remain in attendance until de-briefed by the Emergency Co-ordinator
Security Supervisor	<ol style="list-style-type: none"> 1. Attend de-brief 2. Gather all the necessary information 3. Photograph the scene 4. attend investigation, in conjunction with the safety officer 5. Prepare report for loss control purposes
Business Units	<ol style="list-style-type: none"> 1. Assess damage 2. Assist with the investigation 3. Arrange for the required maintenance 4. Arrange for any additional personnel required

PERSONNEL	ACTIONS
Crisis Communicator	<ol style="list-style-type: none"> 1 Draft official post incident statement for the media 2 Brief all senior personnel i.e. Supervisor level and higher on the incident 3 Ensure that all affected premises in the area are informed as to the outcome of the incident 4 Ensure that all queries are responded to 5 Secure all recordings of communication. (Tape, written, notes and actions)
Foskor Clinic	<ol style="list-style-type: none"> 1. Attend debriefs. 2. Provide detailed report to management on all casualties treated. 3. Report all incidents to relevant governing bodies e.g. COID
SHREQ	<ol style="list-style-type: none"> 1 Contact relevant authority DOL, DAEA, DEA, DWA, uThungulu municipality, SAPS 2 Prepare necessary report for Authorities
EAP	<ol style="list-style-type: none"> 1. Attend debriefs 2. Provide detail counselling report to management 3. Report to clinic on who must be reported to C.O.I.D. 4. For PTS Syndrome
RAILYARD AREA	
	<ol style="list-style-type: none"> 1... TFR make up their equipment if dispatched. 3. Involved in a post-mortem 4.

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31. Annexure 10 (3) - AMMONIA GAS LEAKS

Contact Phase for Ammonia Gas Leaks

PERSONNEL	ACTIONS
Employees/ Contractors	<ol style="list-style-type: none"> 1. Person discovering the gas leak to inform Security immediately 2. In the event of a major gas leak the gas alarm is to be sounded 3. Ammonia alarms linked to gas alarms automatically 4. Upon the sounding of the gas alarm, all employees are to proceed to the gas escape rooms and perform the gas escape room procedure. (within 2/3 min)
Emergency Co-ordinator	<ol style="list-style-type: none"> 1. Take control of E.C.C. 2. Inform uMhlatuze Fire and Rescue services 3. Inform management 4. Determine wind direction and affected area, also areas with the potential of being affected. 5. Direct all the emergency responses 6. Phone affected surrounding companies. See emergency numbers. 7. Brief outside contacts 8. Co-ordinate all actions and decisions. 9. Place medical personnel on standby. 10. Bay Hospital to be informed of the leak, to be prepared for emergencies arriving at hospital. 11. Notify TFR of the incident and request assistance
Proto Team Leader	<ol style="list-style-type: none"> 1. Equip the Proto Team 2. Isolate the affected area 3. Assess situation 4. Set up forward command post 5. Control emergency responses at the scene 6. Brief outside contracts. 7. Check on evacuation. 8. Search for casualties.
Proto Team Member	<ol style="list-style-type: none"> 1. Set up command post 2. Attempt to contain the leak 3. Restrict access to the area 4. Place a fine water spray over the leak 5. Search for and treat all casualties 6. Assist outside contacts 7. Do not place any lives in danger
Outside Contacts	<p><u>uMhlatuze Fire and Rescue Services</u></p> <ol style="list-style-type: none"> 1 Senior member to report to E.C.C- 2 To be briefed by ECo 3 Disaster management plan to be activated when necessary. 4 Inform all surrounding companies

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PERSONNEL	ACTIONS
<p>Security</p> <p>Crisis Communicator</p> <p>Foskor Clinic</p> <p>Foskor SHREQ Department</p>	<p>Hospital</p> <p>1. To treat all gas victims.</p> <p>Ambulance services</p> <p>1. Ambulances to assist with conveying victims.</p> <p>1. Report to the control centre or maintain communication with the control centre</p> <p>2. Ensure that all perimeters are secured, and access routes are not obstructed</p> <p>3. Assist with and monitor evacuation</p> <p>4. Establish roadblocks, redirect public traffic and direct emergency services on public roads</p> <p>1. Only the CEO or appointed designate is to communicate with the media</p> <p>2. All queries are to be logged and responded to</p> <p>3. Issue a standard brief and ensure that this brief is regularly updated</p> <p>4. All communication to be recorded.</p> <p>1. Inform Bay Hospital of incident and put them on standby</p> <p>2. Attend to all casualties, stabilise and transfer to Bay Hospital when necessary</p> <p>3. Liaise with Company Doctors and external medical facilities</p> <p>1 Report to Department of Environmental Affairs.</p> <p>2 Report to Department of Labour.</p> <p>3 Report incident to Department of Agriculture and Environmental Affairs.</p> <p>4 Notify the City of UMhlatuze Community services department of incident</p> <p>5 Report incident to Department of Labour.</p>
RAILYARD AREA	
<p>Transnet Freight Rail</p> <p>Material handling</p>	<p>1. Assist with isolation if leak on tanker valve</p> <p>2. Connect equipment for decanting to other tanker if necessary</p> <p>3.</p> <p>1. Move other tankers away from the scene if safe to do so</p> <p>2. Stop operation</p> <p>3. Barricade area</p> <p>4.</p>

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Post Contact Phase for Ammonia Gas Leaks

PERSONNEL	ACTIONS
Employee Recovery	<ol style="list-style-type: none"> 1. Receive all clear from the emergency personnel 2. Close compressed air 3. De-brief by senior person in gas escape room 4. Resume normal functions
Security supervisor	<ol style="list-style-type: none"> 1. Supply the ECo with all recorded info. 2. Arrange transport for the required maintenance personnel 3. Follow up on all casualties 4. Complete detailed incident log 5. Attend de-brief
Emergency Co-ordinator	<ol style="list-style-type: none"> 1 Issue all clear 2 Inform management 3 Liaise with Disaster Management coordinator 4 De-brief all the emergency personnel 5 Assist with the investigation into the cause of the incident 6 Compile a detailed report of all action taken
Proto Team Leader	<ol style="list-style-type: none"> 1. Monitor the recovery of all equipment 2. Refer expended equipment to the Emergency co-ordinator 3. Draft an action report 4. Attend de-brief
Proto Team Member	<ol style="list-style-type: none"> 1. Recover equipment 2. Check and clean equipment 3. Report defects to the P.T. Leader 4. Store all P.P.E. 5. Search the affected area 6. Attend de-brief 7. Resume normal functions 8. To ensure that all B A set bottles are re-filled
Safety Officer	<ol style="list-style-type: none"> 1 Attend de-brief 2 Collect all records 3 Photograph the scene 4 Investigate the cause of the incident 5 Prepare a report on all the findings
Business Unit	<ol style="list-style-type: none"> 1. Assess nature of damage caused 2. Determine the maintenance requirements 3. Arrange for extra personnel if it is required 4. Resume production as soon as possible

PERSONNEL	ACTIONS
Crisis Communicator	<ol style="list-style-type: none"> 1. Attend de-brief 2. Issue official company statement to the media 3. Ensure that all queries are responded to 4. Secure all recordings of communication.
Foskor Clinic	<ol style="list-style-type: none"> 1. Attend debriefing session. 2. Provide detailed report to management on all casualties treated. 3. Report all incidents to relevant governing bodies e.g. C.O.I.D
TFR	<ol style="list-style-type: none"> 1. Make up equipment 2. Debriefing 3. Return to their workstation - Transnet
EAP	<ol style="list-style-type: none"> 1. Attend debriefing 2. Provide detail counselling report to management 3. Report to clinic on who must be reported to C.O.I.D. 4. For PTS Syndrome

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32. Annexure 10 (4) - SULPHUR DIOXIDE / TRIOXIDE
Contact Phase for Sulphur Dioxide/Trioxide

PERSONNEL	ACTIONS
Immediate Employees	<ol style="list-style-type: none"> 1. H₂SO₄ plant personnel to first make sure that the plant causing the emission is shut down and that air flow and sulphur burning is stopped. If SO₂ emission is caused by sulphur fire the fire fighting procedure to be activated to stop any further formation of SO₂/SO₃. 2. Active gas alarm. 3. Check the wind direction. 4. Go to nearest gas escape room. 5. Contact security 6. Do not re-enter affected area. 7. Follow gas escape room procedures. 8. Remain there until rescued or all clear is sounded. 9. Control room personnel to remain at the control stations in order to maintain communication.
Gas Escape Room Procedure	Refer to COP 105 Annexure A and B
Security	<ol style="list-style-type: none"> 1. Receive report of gas leak. 2. Inform Umhlatuze Fire and Rescue services. 3. Perform gas escape room procedure 4. Notify co-ordinator, Action Group and Proto team 5. Monitor gas room evacuation. 6. Relay Proto Team assessment to co-ordinator. 7. Maintain communication with the affected area. 8. Ensure access routes are clear. 9. Establish roadblocks, redirect public traffic and direct emergency services on public roads and into plant.
Emergency Co-ordinator	<ol style="list-style-type: none"> 1. Take control of E.C.C. 2. Update Umhlatuze Fire and Rescue services on situation. 3. Inform Management. 4. Determine wind direction and affected area, also areas with the potential of being affected. 5. Direct all the emergency responses. 6. Brief outside contacts - Fire Brigade/Civil. 7. Co-ordinate all actions and decisions. 8. Place medical personnel on standby. 9. Notify TFR to be alert in case they are coming with rolling stock
Proto Team Leader	<ol style="list-style-type: none"> 1. Equip the Proto Team. 2. Isolate the affected area. 3. Assess situation. 4. Set up forward command post. 5. Control emergency responses at the scene. 6. Maintain communication with the E.C.C. 7. Check on evacuation.

PERSONNEL	ACTIONS
Proto Team Member	<ol style="list-style-type: none"> 8. Search for casualties. 1. Set up command post. 2. Attempt to contain the leak. 3. Restrict access to the area. 4. Search for and treat all casualties. 5. Assist outside contacts. 6. Do not place any lives in danger
Outside Contacts	<p>Umhlatuze Fire and Rescue services</p> <ol style="list-style-type: none"> 1. Senior member to report to the E.C.C. 2. To be briefed by E.Co 3. Take charge of scene and liaise with action group. 4. Disaster Management plan will be activated if it is required. 5. Inform CTC, Silva cell and Billion Hillside etc. <p>Hospital / Ambulance Services</p> <ol style="list-style-type: none"> 1. To treat all gas victims. 2. To assist with conveying victims.
Crisis Communicator	<ol style="list-style-type: none"> 1. Only appointed personnel are to communicate with the media. 2. All queries are to be logged and responded to. 3. He must issue a standard brief and ensure that this brief is regularly updated. 4. All communication to be recorded.
Foskor Clinic	<ol style="list-style-type: none"> 1. Attend to all casualties, stabilise and transfer to Bay Hospital when Necessary 2. Liaise with Company Doctors and external medical facilities. 3. The company doctors must treat all community members affected. 4. The company doctors will schedule follow up examinations for those affected. 5. Foskor Clinic will provide treatment. (Provide all outside facilities e.g. Bay Hospital Silva cell, Billiton with emergency protocol treatment.
Foskor Environmental Department	<ol style="list-style-type: none"> 1. Report to Department of Environmental Affairs and Tourism. 2. Report to Department of Labour. 3. Report to Richards Bay Clean Air Association
EAP	<ol style="list-style-type: none"> 1. Liaise with clinic 2. Obtain list of employees who must be counselled 3. Severe cases of PTA must be reported to COID and be Referred to outside Psychologist for counselling

Post-Contact Phase for SO₂/SO₃

PERSONNEL	ACTIONS
Employee Recovery	<ol style="list-style-type: none"> 1. Receive all clear from the emergency personnel. 2. Close compressed air. 3. De-brief by senior person in gas room. 4. Resume normal functions.
Security Supervisor	<ol style="list-style-type: none"> 1. Supply the E.Co with all recorded info. 2. Arrange transport for the required standby maintenance Personnel recorded. 3. Follow up on all casualties. 4. Complete detailed incident log. 5. Attend de-brief.
Emergency Co-ordinator	<ol style="list-style-type: none"> 1. Issue all clear. 2. Inform Management. 3. De-brief all the emergency personnel. 4. Liaise with the civil defence 5. Assist with the investigation into the cause of the incident. 6. Compile a detailed report of all action taken. 7. Notify TFR all clear
Proto Team Leader	<ol style="list-style-type: none"> 1. Monitor the recovery of all equipment. 2. Refer expended equipment to the Emergency Co-ordinator. 3. Draft an action report. 4. Attend de-brief.
Proto Team Member	<ol style="list-style-type: none"> 1. Recover equipment. 2. Check and clean equipment. 3. Report defects to the P.T.Leader 4. Store all P.P.E. 5. Search the affected area. 6. Attend de-brief 7. Resume normal functions.
Safety Officer	<ol style="list-style-type: none"> 1. Attend de-brief. 2. Collect all records. 3. Photograph the scene. 4. Investigate the cause of the incident. 5. Prepare a report on all the findings.
Business Unit	<ol style="list-style-type: none"> 1. Assess nature of danger caused. 2. Determine the maintenance requirements. 3. Arrange for extra personnel if it is required. 4. Resume production as soon as possible.
Crisis Communicator	<ol style="list-style-type: none"> 1. Attend de-brief. 2. Issue official company statement to the media. 3. Ensure that all queries are responded to. 4. Secure all recordings of communication.
EAP	<ol style="list-style-type: none"> 1. Liaise with clinic 2. Obtain list of employees who must be counselled 3. Severe cases of PTA must be reported to COID and be Referred to

PERSONNEL	ACTIONS
	outside Psychologist for counselling

33. Annexure 10 (5) - BOMB THREATS

Contact Phase for Bomb Threats

PERSONNEL	ACTIONS
Personnel	<ol style="list-style-type: none"> 1. Complete bomb threat checklist 2. Remain calm 3. Notify security (not per radio) 4. Notify supervisor 5. Evacuate 6. Perform superficial search of area 7. Report suspicious items to the area warden 8. Report to the nearest evacuation point 9. Remain there
Security	<ol style="list-style-type: none"> 1. Receive notice of bomb threat. 2. Inform the S.A.P.S. 3. Notify all the relevant area wardens 4. Notify the Emergency Co-ordinator 5. Activate Proto team as well as Umhlatuze Fire and Rescue services to be on standby at security 6. Check attendance register against evacuation report 7. Ensure access routes are kept clear 8. Restrict access to affected area by demarcating area +/- 2-3 meters wide 9. Activate evacuation alarm
Emergency Co-ordinator	<ol style="list-style-type: none"> 1. Assess bomb threat checklist 2. Note any suspicious items reported 3. Notify security office. 4. Inform management 5. Monitor evacuation 6. Direct outside contacts 7. Notify TFR
Proto Team	<ol style="list-style-type: none"> 1. Assemble at the security office 2. To be on standby in the event of an explosion 3. Assist with access control – demarcation +/- 2-3 meters 4. Assist Fire Department if it is required 5. Do not enter the affected area unless requested by S.A.P.S. and informed that it is safe
Area Warden	<ol style="list-style-type: none"> 1. Sound fire alarm 2. Control evacuation 3. Ensure that all visitors are safely evacuated and accounted for 4. Report any injury to the Clinic and ECo 5. Note all personnel evacuated and inform the ECo.

PERSONNEL	ACTIONS
<p>Security Officer</p> <p>Outside Contacts</p> <p>Crisis Communicator</p> <p>EAP</p>	<p>6. Keep all employees calm</p> <p>1. Report to the ECC 2. Liaise with the S.A. Police services and Emergency services 3. Assess bomb threat checklist 4. Ensure that the area has been made safe 5. Monitor situation and inform S.A.P. and Umhlatuze Fire and Rescue services of all known risk areas</p> <p>S.A. Police Service</p> <p>1. Respond immediately 2. Notify the bomb disposal experts 3. Check the area 4. Cordon off the affected area 5. Keep the E.C.C. informed of any findings</p> <p>UMhlatuze Fire and Rescue services</p> <p>1. Respond immediately and ensure that area has been evacuated and barricaded off. 2. Liaise with ECo.</p> <p>Ambulance services</p> <p>1. To be on standby in the event of an explosion</p> <p>1. No impromptu statement to be made to the media 2. Crisis communicator to be kept informed 3. No statement to be made without police authorisation 4. Record all communication.</p> <p>1. If only a threat all employees affected must be counselled as a group by EAP Counsellor 2. Keep employees calm do group counselling if possible</p>
RAILYARD AREA	
<p>TFR</p> <p>SAPS</p> <p>Material handling Supervisor</p>	<p>1. Stop operation to Foskor during the incident</p> <p>1. Take over the incident in search of the bomb</p> <p>1. Stop operation in the railyard 2.</p>

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Post Contact Phase for Bomb Threats

PERSONNEL	ACTIONS
Security Supervisor	<ol style="list-style-type: none"> 1. Provide all the relevant information to Emergency co-ordinator 2. Inform area wardens that the evacuation can be terminated 3. Attend de-brief
Emergency Co-ordinator	<ol style="list-style-type: none"> 1. Provide security officer with a report pertaining to the incident 2. Co-ordinate all personnel requirements to resume production 3. De-brief emergency personnel 4. Inform management 5. Notify TFR all clear
Security Officer	<ol style="list-style-type: none"> 1. Liaise with the S.A.P.S. regarding the investigation 2. Compile a report on the incident for management 3. Investigate the risk and implement corrective systems
Proto Team	<ol style="list-style-type: none"> 1. Demarcate area 2. Check, clean and replace any equipment utilised 3. Resume normal duties 4. Do not touch until Police declare area safe
Outside Contacts	<p>S.A. Police service</p> <ol style="list-style-type: none"> 1. To give the all clear 2. To proceed with an investigation 3. To supply security supervisor with the results of the investigation
Area wardens	<ol style="list-style-type: none"> 1. To inform personnel that the incident has been resolved 2. To direct personnel back to their workstations 3. To resume normal duty
Crisis communicator	<ol style="list-style-type: none"> 1. The C.E.O or delegate to release an official statement to the media 2. To ensure that all queries are responded to 3. To ensure that the families of personnel are informed as to the situation. 4. Secure all recordings of information and communication.
Foskor Clinic	<ol style="list-style-type: none"> 1. Attend debriefing session 2. Provide detailed report to management on all casualties treated. 3. Report all incidents to relevant governing bodies e.g. COID
EAP	<ol style="list-style-type: none"> 1. Attend debrief 2. Provide detailed report on all casualties treated after treatment by clinic staff 3. All PTS syndrome must be reported to COID as per instruction.

34. Annexure 10 (6) - TRAUMA

Contact Phase for Trauma:
Minor Injury

PERSONNEL	ACTIONS
Personnel	<ol style="list-style-type: none"> 1. Ensure that the area is made safe 2. Contact the supervisor, security and clinic 3. Keep the casualty calm and comfortable 4. Attempt to stop any seriously visible bleeding 5. Notify the first aider on shift
Security Supervisor	<ol style="list-style-type: none"> 1. Provide transport for the casualty if requested 2. Maintain communication with the first aider 3. Notify the safety officer as well as the clinic sister if required 4. Ensure that the clinic is accessible 5. Log all reports and action taken
First Aider	<ol style="list-style-type: none"> 1. Get to the scene as soon as possible 2. Assess the situation 3. Ensure that the area has been made safe 4. Treat the casualty at the scene 5. Stabilise the persons condition 6. Request transport and assistance from Security supervisor as may be required
Supervisor	<ol style="list-style-type: none"> 1. Ensure that an incident form is completed 2. Commence investigation
Foskor Clinic	<ol style="list-style-type: none"> 1. Attend to injures according to set protocols and depending on the <u>nature of injury</u>. 2. Refer injuries to Bay hospital if of serious nature 3. Liaise with external medical facilities.
EAP	<ol style="list-style-type: none"> 1. Attend debrief 2. Provide detailed report on all casualties treated after treatment by clinic staff 3. All PTS syndrome must be reported to COID as per Instruction.

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**Contact Phase for Trauma:
 Serious Injury / Fatality / Person knocked by a train**

PERSONNEL	ACTIONS
Personnel	<ol style="list-style-type: none"> 1. Make the area safe/Demarcate whole area in case of fatality 2. Ensure that the casualty is comfortable 3. Contact supervisor, security and clinic 4. Do not move the casualty 5. Wait for the first aider to arrive 6. Stop operation if incident occurred in railyard area
Security supervisor	<ol style="list-style-type: none"> 1. Receive notification of the injury 2. Inform the first aider on duty 3. Note the first aiders assessment 4. Inform Proto Team, ECo. and relevant outside contacts as required 5. Note the Proto Team assessment 6. Ensure free access 7. Inform the safety officer
First Aider	<ol style="list-style-type: none"> 1. Proceed to the scene 2. Assess the situation 3. Check for life threatening conditions 4. Report to the Security supervisor and request any assistance if required 5. Treat and stabilise casualty only if not fatal
Emergency Co-ordinator	<ol style="list-style-type: none"> 1. Note the Proto Team assessment 2. Inform management 3. Direct all emergency responses 4. Liaise with all external services 5. Keep the crisis communicator informed 6. Log all reports and external enquiries 7. Inform TFR about the details of the incident 8. Stop operation in the railyard until all clear
Proto Team	<ol style="list-style-type: none"> 1. To get to the scene as soon as possible 2. Assess the situation 3. Inform Security supervisor and request assistance if required 4. Assist the first aider 5. Note all actions taken 6. Assist the external emergency services 7. Condone area off
Outside Contacts	<p>Ambulance Services</p> <ol style="list-style-type: none"> 1. Report to the E.C.C. or scene of accident, as directed 2. Note the location of casualty. 3. Treat the casualty. 4. Transport casualty to hospital as advised by the doctor

PERSONNEL	ACTIONS
<p>Crisis communicator</p> <p>Foskor Clinic</p>	<ol style="list-style-type: none"> 5. All acid burns must first be decontaminated at Foskor clinic before transferred to hospital. 6. Fatal injuries can only be removed after police complete their investigation. 7. Only TOP MANAGEMENT can convey the death report to the family <p>Hospital</p> <ol style="list-style-type: none"> 1. To be on standby to admit casualties 2. To assist with transport if requested <ol style="list-style-type: none"> 1. Obtain the facts from the emergency co-ordinator. 2. Issue a standard crisis brief. 3. Liaise with the media. 4. Liaise with the families of casualties. 5. Record all communication. 6. In case of fatality, SAPS will be called out immediately <ol style="list-style-type: none"> 1. Attend to injures according to set protocols and depending on the nature of injury 2. Refer injuries to Bay hospital if of serious nature 3. Liaise with external medical facilities.
RAILYARD AREA	
<p>Transnet Freight Rail</p> <p>Material handling Supervisor</p> <p>Department of Labour</p> <p>SAPS</p>	<ol style="list-style-type: none"> 1. Stop operation if should bring/remove rolling stock into/from Foskor 2. To be informed about the magnitude of an incident to change operation schedules <ol style="list-style-type: none"> 1. Stop production operation 2. Ensure proper information is conveyed to the Crisis communicator <ol style="list-style-type: none"> 1. If there is a fatality, the body will not be moved until Department of labour and SAPS arrive at the scene <ol style="list-style-type: none"> 1. Only there is a fatality the SAPS will take over in conjunction with Department of Labour

Ensure the following is done in case of Fatality






1. Ensure that the area is safe, demarcate area immediately and do not move anything even the body. If it is unsafe, appointed emergency employees must first ensure that their boots are marked around with masking tape so that the police can identify their shoe prints, they can then only be made scene safe but the body must remain untouched if possible.
2. The local police must be informed, and they must then respond immediately to conduct their investigation with the Safety Officer and Emergency Coordinator.
3. The doctor must be called and respond immediately to declare the worker 'Deceased'
4. Only then the body can be removed either by police or funeral parlour
5. Report fatality immediately by fax, email and post to all the necessary authorities.

6. Top Management to inform the family in person of the death of an employee.

Triage

Triage is the process of determining the priority of patient's treatments based on the severity of their condition.

1. Ideally CODE GREEN should be sent to a big area like the club and the companies' first aiders should be able to handle all green cases.

	CODE RED	PRIORITY 1- RESUSCITATION – TIME LIMIT - IMMEDIATELY
	CODE ORANJE	PRIORITY 2 – BLEEDING, FRACTURES – TIME LIMIT – 10 MIN
	CODE YELLOW	PRIORITY 3 - URGENT – TIME LIMIT – 30 MIN
	CODE GREEN	PRIORITY 4 (MINOR – FIRST AIDERS HANDLE – TIME LIMIT 120MIN
	CODE BLUE	DO NOT RESUSCITATE – FATAL – CLOSE PATIENT – AND GO ON TO RED CODE.

Critical Information

GENERAL

- The first 10 minutes of any trauma are vital to the casualty's chances of recovery.
- It is thus essential that emergency personnel get to the scene as soon as possible
- These personnel must be correctly trained to recognise any life-threatening conditions and to apply first aid accordingly.
- Each first aider has access to a trauma bag on his shift. This bag must be collected at security when he comes on shift and must be handed in at the end of each shift.

Post-Contact Phase for Trauma

PERSONNEL	ACTIONS
Employee Recovery	<ol style="list-style-type: none"> 1. Receive all clear from the emergency personnel. 2. De-brief 3. Resume normal functions.
Security Supervisor	<ol style="list-style-type: none"> 1. Supply the E.Co with all recorded info. 2. Follow up on all casualties. 3. Complete detailed incident log. 4. Attend de-brief.
Emergency Co-ordinator	<ol style="list-style-type: none"> 1. Issue all clear. 2. Inform Management. 3. De-brief all the emergency personnel. 4. Liaise with the Crisis communicator 5. Assist with the investigation into the cause of the incident. 6. Compile a detailed report of all action taken. 7. Notify TFR all clear
Proto Team Leader	<ol style="list-style-type: none"> 1. Monitor the recovery of all equipment. 2. Refer expended equipment to the Emergency Co-ordinator. 3. Draft an action report. 4. Attend de-brief.
Proto Team Member	<ol style="list-style-type: none"> 1. Recover equipment. 2. Check and clean equipment. 3. Report defects to the P.T.Leader 4. Inspect and search the affected area for any suspicious matter. 5. Attend de-brief 6. Resume normal functions
Safety Officer	<ol style="list-style-type: none"> 1. Attend de-brief. 2. Collect all records. 3. Photograph the scene. 4. Investigate the cause of the incident. 5. Prepare a report on all the findings.
Material Handling Supervisor	<ol style="list-style-type: none"> 1. Assess nature of danger caused. 2. Determine the maintenance requirements if needed. 3. Arrange for extra personnel if it is required. 4. Resume production as soon as possible.
Crisis Communicator	<ol style="list-style-type: none"> 1. Attend de-brief. 2. Issue official company statement to the media. 3. Ensure that all queries are responded to. 4. Secure all recordings of communication.
EAP	<ol style="list-style-type: none"> 1. Liaise with clinic 2. Obtain list of employees who must be counselled 3. Severe cases of PTA must be reported to COID and be Referred to outside Psychologist for counselling

**35. Annexure 10 (7) (Contact Phase for Hazardous Waste:
Environmental impact**

PERSONNEL	ACTIONS
Employees/ Contractors	<ol style="list-style-type: none"> 3. Person discovering the waste spill to inform Security immediately
Security Control Room	<ol style="list-style-type: none"> 1. Security Control room will notify the Waste Supervisor, Proto Team, Emergency Co-ordinator. 2. Log all information about the scene, especially the type of waste spilled.
Emergency Co-ordinator	<ol style="list-style-type: none"> 1. Inform UMhlathuze Fire and Rescue services, Traffic Department if Incident occurred outside Foskor premises. 2. Inform management 3. Direct all the emergency responses 4. Phone affected surrounding companies. See emergency numbers. 5. Brief outside contacts 6. Co-ordinate all actions and decisions.
Waste Supervisor	<ol style="list-style-type: none"> 1. Assess the nature of the spill. 2. Only Asbestos would be an Asbestos Certified Body will be called in to handle the spillage. 3. Verify if an outside contact must be called to assist
Proto Team Leader	<ol style="list-style-type: none"> 1. Equip the Proto Team 2. Isolate the affected area 3. Assess situation 4. Set up forward command post 5. Control emergency responses at the scene. 6. Search for casualties.
Proto Team Member	<ol style="list-style-type: none"> 1. Set up command post 2. Attempt to protect environment 3. Restrict access to the area 4. Search for and treat all casualties 5. Assist outside contacts 6. Do not place any person lives in danger

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Post-Contact Phase for Hazardous Waste

PERSONNEL	ACTIONS
Security Control Room	<ol style="list-style-type: none"> 1. All clear must be communicated to all 2. Log all information about the scene
Emergency Co-ordinator	<ol style="list-style-type: none"> 1. Inform UMhlatuze Fire and Rescue services that it is all clear. 2. Update management 3. Direct all the emergency responses. 4. Brief outside contacts 5. De-brief all the emergency personnel
Waste Supervisor	<ol style="list-style-type: none"> 1. De-brief all the emergency personnel 2. Inform DEA, and Compile Section 30 Environmental Report if applicable. 3. Log on an Incident on Isometrix. 4. Report to Environmental Engineer if rehabilitation of soil is needed
Proto Team Leader	<ol style="list-style-type: none"> 1. Clear the affected area 2. Make up equipment used 3. Make an inventory of the equipment used 4. Brief outside contracts. 5. Do not place any person lives in danger
Proto Team Member	<ol style="list-style-type: none"> 1. Make up and clean equipment used 2. Clear the affected area 3. Do not place any person lives in danger

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36. Annexure 10(8) Contact Phase for Acid leak/Spillage Export Pipeline and Port Storage Tanks failure:

The following people should be informed

Contact Security Control Room immediately. Furthermore contact:

During Normal working hours

- Phosphoric Acid Plant Manager
- Materials Handling Manager
- Environmental Engineer
- Security Supervisor
- Process Coordinator
- Process supervisor
- Port personnel (if the failure is in the Port area)

After Hours/ Weekend

- Stand by Manager
- Security Supervisor
- Process Coordinator
- SHREQ Standby
- Proto Team Support
- Port personnel (if the failure is in the Port area)

PERSONNEL	ACTIONS
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<p>Employees/ Contractors/Port Authorities</p> <p>Security Control Room</p> <p>Emergency Co-ordinator</p>	<ol style="list-style-type: none"> 1. Person discovering the leak or spillage to inform Foskop Security Control Room immediately 1. Security Control room call out the Proto Team and Emergency Co-ordinator. 2. Environmental engineer and SHREQ Standby must be called out immediately 3. Inform SHREQ Manager about the incident 4. Log all information about the scene 1. Take command of control centre 2. Direct all the emergency personnel 3. Inform the fire department if situation escalates/or uncontrolled call them out if required 4. Inform management 5. Liaise with management regarding decisions 6. Establish Emergency control centre when necessary
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PERSONNEL	ACTIONS
<p>Port Emergency Services and Security</p>	<ol style="list-style-type: none"> 1. Cordon area off 2. Notify and Evacuate at the radius of 50 meters from hot zone. Refer to ERG(Emergency Guide Book) 3. Secure area on incident 4. Close off drains nearby the leak without touching the product 5. Use appropriate PPE 6. Wait for Foskop Emergency Services to take over the Scene
<p>Environmental Engineer</p>	<ol style="list-style-type: none"> 1. Ensure security notified of the incident 2. Take samples of the affected areas for analysis 3. Inform the Local Municipality, Provincial DEA and National DEA 4. Inform SAPS depending on the incident
<p>Material Handling Supervisor</p>	<ol style="list-style-type: none"> 1. Drain all product on the line if the leak is on the export line 2. Organise stripping tanker for the product on the export pipe 3. Organise lime to be used to neutralise acid spill 4. Stop operation 5. Pump acid to sump/tank
<p>Proto Team Leader</p>	<ol style="list-style-type: none"> 1. Ensure proper PPE is used and worn 2. Isolate the affected area 3. Assess situation 4. Set up forward command post 5. Control emergency responses at the scene. 6. Search for casualties.

PERSONNEL	ACTIONS
Proto Team Member	7. Ensure that all drains are blocked 8. Contain the spillage and prevent spreading 1. Set up command post 2. Control/coordinate cleaning up operation 3. Attempt to protect environment 4. Restrict access to the area 5. Search for and treat all casualties 6. Assist outside contacts 7. Do not place any person lives in danger 8. Use lime to neutralise acid
RAILYARD AREA – Rail tanker acid leak/Pipe leak	
Transnet Freight Rail	1. Assist with source isolation of the leak 2. Decant product to another tanker 3. Neutralise acid spill with lime 4. Stop operation to Foskor unless its contingency planned 5.

Post-Contact Phase for Export pipe and Port Storage Tanks

PERSONNEL	ACTIONS
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PERSONNEL	ACTIONS
Security Control Room	<ol style="list-style-type: none"> 1. All clear must be communicated to all 2. Log all information about the scene
Emergency Co-ordinator	<ol style="list-style-type: none"> 1. Inform UMhlatuze Fire and Rescue services that it is all clear. 2. Update management 3. Direct all the emergency responses. 4. Brief outside contacts 5. De-brief all the emergency personnel
Environmental Engineer	<ol style="list-style-type: none"> 1 De-brief all the emergency personnel 2 Inform DEA, and Comp Section 30 Environmental Report. Log on an Incident on Isometrix. 3 Report to Environmental Engineer if rehabilitation of soil is needed
Proto Team Leader	<ol style="list-style-type: none"> 1 Clear the affected area 2 Make up equipment used 3 Make an inventory of the equipment used 4 Brief outside contracts. 5 Do not place any person lives in danger
Proto Team Member	<ol style="list-style-type: none"> 1 Make up and clean equipment used 2 Clear the affected area 3 Do not place any person lives in danger 4 Cleaning up of the area and equipment 5
RAILYARD AREA – Rail tanker acid leak/Pipe leak	
Transnet Freight Rail	<ol style="list-style-type: none"> 1. Make up equipment 2. Cleaning up the area 3.

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37. Annexure (10)9 – Contact phase Loco/tanker derailment/collision

PERSONNEL	ACTIONS
Employees/ Contractors	<ol style="list-style-type: none"> 4. The Loco driver must ensure loco is kept stationery 5. Do not move the loco
Material Handling Supervisor	<ol style="list-style-type: none"> 1. Notify Security Control Room 2. Cordon area off 3. Notify Supt, Material Handling 4. Evacuate all persons from the affected area
Security Control Room	<ol style="list-style-type: none"> 1. Notify TFR and request assistance 2. Call Proto team 3. Call Foskor Manager on standby 4. Call for the SHREQ Standby
Emergency Co-ordinator	<ol style="list-style-type: none"> 1. Notify SHREQ Manager about the incident 2. Direct all emergency responses 3. Liaise with all external services 4. Keep the crisis communicator informed 5. Log all reports and external enquiries
Proto Team Leader/Member	<ol style="list-style-type: none"> 1 Equip the Proto Team 2 Assist TFR with isolation of the affected area 3 Assess situation 4 Set up forward command post 5 Control emergency responses at the scene 6. Brief internal contacts. 6 Check on evacuation. 7 Search for casualties.
Transnet Freight Rail Team	<ol style="list-style-type: none"> 1. Salvage derailling loco/tanker 2. Usage of proper tools and machine

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Post Contact Phase for Loco/tanker derailment/Collision

PERSONNEL	ACTIONS
Security Control Room	<ol style="list-style-type: none"> 1. Receive all clear from the emergency personnel 2. Close compressed air 3. De-brief by senior person in gas escape room 4. Resume normal functions
Security supervisor	<ol style="list-style-type: none"> 1. Supply the ECo with all recorded info. 2. Arrange transport for the required maintenance personnel 3. Follow up on all casualties 4. Complete detailed incident log 5. Attend de-brief
Emergency Co-ordinator/Supt: Material Handling	<ol style="list-style-type: none"> 1. Issue all clear 2. Inform management 3. Liaise with Disaster Management coordinator 4. De-brief all the emergency personnel 5. Assist with the investigation into the cause of the incident 6. Compile a detailed report of all action taken 7. Ambulance services will be called out for any injuries
Proto Team Leader	<ol style="list-style-type: none"> 1. Monitor the recovery of all equipment 2. Refer expended equipment to the Emergency co-ordinator 3. Draft an action report 4. Attend de-brief
Proto Team Member	<ol style="list-style-type: none"> 1. Recover equipment 2. Check and clean equipment 3. Report defects to the P.T. Leader 4. Store all P.P.E. 5. Search the affected area 6. Attend de-briefing session 7. Resume normal functions 8. To ensure that all B A set bottles are re-filled
Transnet Freight Rail	<ol style="list-style-type: none"> 1. De-Briefing 2. Issue all clear collectively
Safety Officer	<ol style="list-style-type: none"> 1. Attend de-briefing session 2. Collect all records 3. Photograph the scene 4. Investigate the cause of the incident 5. Prepare a report on all the findings
Business Unit	<ol style="list-style-type: none"> 1. Assess nature of damage caused 2. Determine the maintenance requirements 3. Arrange for extra personnel if it is required

PERSONNEL	ACTIONS
Crisis Communicator	<ol style="list-style-type: none"> 4. Resume production as soon as possible <ol style="list-style-type: none"> 1. Attend de-brief 2. Issue official company statement to the media 3. Ensure that all queries are responded to 4. Secure all recordings of communication.
Foskor Clinic	<ol style="list-style-type: none"> 1. Attend debriefing session. 2. Provide detailed report to management on all casualties treated. 3. Report all incidents to relevant governing bodies e.g. COID

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38. Annexure 10 (9) - EVACUATION PLAN
This evacuation plan is not applicable to an ammonia or SO₂/SO₃ gas leak

1. PURPOSE

The purpose of this plan is to provide a procedure, whereby all personnel and visitors, on Foskor, Richards Bay property, can be accounted for and located in a safe area, in the event of an emergency.

2. SCOPE

The evacuation plan is applicable to all Foskor Richards Bay personnel, as well as any visitors or contractors who enter the premises.

3. OBJECTIVE

The objectives of this plan are:

1. To create a standard orderly procedure whereby evacuation can take place.
2. To ensure that all personnel are evacuated.
3. To ensure personnel safety.

4. PROCEDURE

General

- a) The most senior person will assume responsibility as area warden for the evacuation point located in his area.
- b) Evacuation will take place when the alarm is sounded, or on instruction from either the area warden or the emergency co-ordinator.
- c) All employees must endeavour to remain calm.
- d) Do not run.
- e) Adhere to the area warden's instructions.

5. RESPONSIBILITY

Area Wardens

- a) To ensure that all personnel are evacuated from the affected area.
- b) Inform the emergency co-ordinator of successful evacuation or any problems experienced.
- c) Report any missing employees to the emergency co-ordinator.
- d) Ensure that the evacuation instructions are clear.
- e) To manage the evacuation points as well as any instructions given by the emergency co-ordinator.

Employees

- a) To evacuate, via the shortest and safest route, to the designated point in their area.
- b) To superficially search their work area whilst evacuating.
- c) To report any suspicious articles to the area warden if the evacuation is related to a bomb threat.
- d) To remain calm, if receiving a telephonic bomb threat, and to complete the checklist accurately.
- e) To adhere to all instructions given by the area warden.

- f) To remain at the evacuation point until otherwise informed.
- f) Ensure that all visitors are accounted for and evacuated.
- g) Close all doors and windows while evacuating in case of fire.
- h) Open all doors and windows in case of bomb threats.

Security Supervisor

- a) To log all evacuation reports received from the area wardens
- b) To compare these reports with the day's attendance report.
- c) To direct emergency personnel to areas where employees are reported missing or injured.
- d) To liaise closely with the emergency co-ordinator.
- e) To maintain communication with the various evacuation points.

EMERGENCY ASSEMBLY POINTS

The following points have been defined and demarcated as emergency assembly points.

1. The visitors parking in front of the main administrative building.
2. The parking area near Lab samples door north of the Garage.
3. The open area east of the granulation workshop.
4. The open area between the sulphur and rock stores.
5. The road outside the road weighbridge.
6. The area at the bus terminal near boom gates
7. Sulphuric lay down area
8. South gate near salvage yard
9. Outside area near technical Building
10. Contractors yard near Fabrication workshop
11. Back of the new Procurement building
12. Near materials Handling maintenance workshop
13. Area near Projects including Rail weighbridge

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39. Annexure 10 (10) - EVACUATION OF DISABLED PERSONS

GENERAL PROCEDURES

In the event of an emergency, everyone including disabled persons should observe the following procedures for evacuation:

1. All able-bodied persons shall move toward the nearest marked exit corridor and/or stairway. DO NOT USE AN ELEVATOR.
2. Disabled persons should seek refuge near the closest exit stairway and request assistance from others. Do not obstruct the stairway or door leading to the stairway. If the location becomes unsafe, move to different exit stairway and call for help until rescued.
3. Able-bodied persons should assist in the evacuation of the disabled. That assistance may be in the form of the following:
 - a. Be familiar with the disabled persons who are routinely in your area.
 - b. Ask disabled person if he or she needs help. Do not move the person unless they have given you permission
 - c. Inform hearing impaired/deaf persons that they should evacuate.
 - d. Assist visually impaired/blind persons to an exit stairway.
 - e. Assist persons in wheelchairs to a location close to an exit stairway.
 - f. Inform Security of disabled persons located inside the building that you are unable to evacuate safely.
 - g. In the extreme case where you must physically evacuate a disabled person, you should ask that person how to safely carry/assist them.

If any employee receives disabled visitors, it is his responsibility to ensure that the disabled person is evacuated to a safe area in case of an emergency.

IF YOU ARE DISABLED

It is suggested that disabled persons prepare for emergencies ahead of time by learning the locations of exit corridors and exit stairways, by planning an escape route, and by showing a co-worker how to assist him/her in case of an emergency. In addition, disabled persons who cannot speak loudly should carry a whistle or have some other means for attracting the attention of other.

All exit corridors and stairways are marked with exit signs. These are the safest areas during an emergency. Rescue personnel will first check all exit stairways for trapped persons. Be aware of persons in your area who could assist you

SPECIAL NEEDS

Visually impaired persons

In an emergency, tell the person the nature of the emergency and offer to guide him/her. As you walk, tell the person where you are and advise of any obstacles. When you have reached safety, orient the person to where he/she is and ask if any further assistance is needed.

Hearing impaired persons

Persons with impaired hearing may not perceive emergency alarms and an alternative warning technique is required. Warning methods include writing a note about the emergency and evacuation route or turning the light switch on and off. Then indicate through gestures or writing what is happening and what to do.

Persons using crutches, canes or walkers

Ask if the person needs assistance to evacuate.

Offer to guide him/her to the emergency exit.

If necessary, carrying options include using a two-person lock arm position or having the person sit in a sturdy chair, preferably one with arms and drag the chair out of the building.

Move person up or down stairs only if necessary, for life safety.

Persons in wheelchairs

Wheelchairs may have parts not intended for lifting. Batteries or life support equipment may be connected. Lifting the person could be harmful. Ask the person how you can help. Determine if the person wants to be removed from the chair. Determine if the person wants to be carried down a flight of stairs; forward or backward. Ask what type of assistance he/she will need after evacuation. Move person up or down stairs only if necessary, for life safety.

NOTE: It is suggested that the wheelchair occupant or person with mobility impairment prepare for emergency situations ahead of time

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40. Annexure 10 (11) – ENVIRONMENTAL

The responsible Shift Supervisor / Engineer must generate an incident report when a spillage has occurred.

Please note that all the necessary PPE is to be worn whilst addressing any acid or liquid / effluent spillage.

The steps listed below are to be followed for a large spill that is spills greater than 500 litres. If a spill is smaller than 500 litres the responsible Shift Supervisor is to use his/her discretion as to whether the Proto Team or Environment needs to be called out. However, the Environmental section needs to be informed of all spills.

ACID OR LIQUID / EFFLUENT SPILLAGES:

If there's an acid or liquid / effluent spill within a bund that could result in the overflow of the bund area the following steps are to be followed:

1. The responsible person in that area is to close all valves feeding the bund area pump or isolate the line immediately.
2. The responsible person mentioned above is to inform the necessary plant/s to stop their pump/feeding the bund area.
3. The responsible person is to cordon off the area with barrier tape. A distance of two (2) meters from the affected area is to be cordoned off with barrier tape; this is provided the spillage is within the bund area.
4. The responsible person is to report the spillage to his/her Supervisor.
5. The informed Supervisor will in turn inform the Proto Team and the Environmental Section or Environmental Standby of the spillage via security.
6. Because the spillage has occurred in a bund area **do not** add lime to neutralize until steps 7 and 8 have been followed.
7. The responsible maintenance section is to arrange for a submersible pump to pump the acid into the mobile 2500 litres tanker, if the sump cannot be emptied into the process. This step is to be taken immediately and not left for the following shift.
8. The responsible maintenance section is to empty the tanker into the applicable sump, i.e. Sulphuric acid spillage to be emptied into the sulphuric acid sump and a phosphoric acid spillage to be emptied into the phosphoric acid sump. Please note that before effluent spillages are disposed of the Environmental Section or Environmental Standby is to be consulted with regarding best disposal method.
9. Responsible Supervisor to arrange that remaining acid in bund area is to be neutralized with lime.
10. Neutralized acid is to be picked up manually and placed into bags.
11. Responsible Shift Supervisor to make arrangements for disposal at a suitable landfill site after consultation with the Integrated Waste Management Supervisor.
12. Responsible Supervisor to wash remaining lime in bund area with water.

13. Follow steps 7 and 8 above.

If there's an acid or liquid / effluent spill that occurs outside the bund area the following steps are to be followed:

14. The responsible person in that area is to close all valves at the area immediately.
15. The responsible person is to inform the necessary plant/s to stop their pump or isolate the line immediately.
16. Responsible person to cordon off the area with barrier tape. A distance of five (5) meters from the affected area is to be cordoned off with barrier tape. Responsible person to not allow any vehicular or pedestrian traffic through the spillage.
17. The responsible person is to report the spillage to his/her Supervisor.
18. The informed Supervisor will in turn inform the Proto Team and the Environmental Section or Environmental Standby of the spillage via security.
19. Responsible Supervisor or designated person is to cordon off the area making a lime bag bund wall around the spillage. The bund wall is to be three (3) meters from the spillage. Signage indicating that an acid spill has occurred is to be displayed. If a spillage of liquid / effluent has occurred a pay loader is to be used to erect bund walls to contain the spillage.
20. The responsible Supervisor to arrange that acid is to be neutralized with lime. Please note that before effluent spillages are disposed of the Environmental Section or Environmental Standby is to be consulted with regarding best disposal method.
21. Neutralized acid and all acid contaminated soil is to be picked up manually and placed into bags.
22. Responsible Supervisor to make arrangements for disposal at a suitable landfill site after consultation with the Integrated Waste Management Supervisor.

If storm water drains are near the spillage, and the possibility exists that the acid could enter the storm water drains, two bags of lime are to be emptied into each drain.

Each Department is to have lime bags readily available in the case of an acid spillage. The reason for this is so that lime is available immediately in the case of an acid spillage and whilst these lime bags are being utilized an order for more lime bags can be placed at the stores. Acid spill signage is also to be kept by each Department.

STORMWATER DAM OVERFLOW:

If there's a stormwater dam overflow the following steps are to be followed:

Contact Security Control Room immediately

Also, the following personnel should be informed/ contacted

During Normal working hours

- Phosphoric Acid Plant Manager
- Materials Handling Manager
- Environmental Engineer
- Security Supervisor
- Process Coordinator
- Process supervisor

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After Hours/ Weekend

- Stand by Manager
- Security Supervisor
- Process Coordinator
- SHREQ Standby
- Proto Team Support

The Prototeam must ensure:

- The spill should be contained to minimise further contamination to the surrounding areas
- To prevent further movement of the effluent, a barrier/ berm should be built with clean sand
- The spill should be neutralised with lime/ soda ash
- The area should be cleaned taking all the contaminated material back to the plant for safe disposal

Environmental Engineer:

- Contact the regulatory authorities if spill is not contained and enters the receiving environment
- Co-ordinate regulatory authorities meeting and the NEMA S30 Report

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41. Annexure 10 (12) - BLOOD SPILL PROCEDURE

Special procedure to be implemented for dealing with exposure to blood and body fluids spills. -(HIV contamination)

- Do not attempt to clean up spills of blood or body fluid if you have open wounds on your hands.
- Ensure to use latex gloves when cleaning up blood or body fluids spills on site. Ensure that your gloves are in good order – No tears.
- Be careful if cleaning up blood or body fluid from machinery parts with sharp areas.
- For exposed body fluid or blood spills on floors – soak up in JIK for 10 mins and cover it then with sand.
- Sand and other material used must be shoveled into a “RED” bag in spillage pack in the first aid box in your area, or from the clinic.
- Walls and other surfaces should be wiped down with JIK (BLEACH).
- All cleaning material (cloths, mops and brooms) must be placed in RED BAGS for Medicals hazardous Waste - can be collected from the clinic.
- All contaminated blood/body fluid's waste products – sand, mops, cloths etc. must be taken to the clinic in the RED bags. The clinic will clean and dispose of as per Waste Procedure.

EMERGENCY FIRST AID PROCEDURE AFTER ACCIDENTAL EXPOSURE TO BLOOD OR BODY FLUIDS

1. Report or transport employee to Foskor Clinic for medical assistance.
2. In case of an eye splash wash the eye out with gently running water from the inside out
3. In case of blood on your skin or a sore wash the skin or site with soap and running water.
4. Immediately get medical assistance
5. The doctor or the nurse will immediately request your permission to do HIV test to determine your current HIV STATUS after pre counselling and post counselling shall be conducted.
6. If the person is HIV negative, he/she will be immediately placed on ARV's starter packs.
7. The exposed person needs to take the ARV'S within 72 hours/within 2 hours is the optimum time to start per ARV'S.
8. The person must take PEP ARV'S for total of 28 days
9. The doctor will advise the person of how to take the treatment depending on the nature of exposure.

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Emergency Services/Medical Services/Other Services

Umhlathuze Fire Rescue Service – Deputy Director	A. Vumba	035-907 5724 083 661 9911	035-797-3313 035-797 3911
Umhlathuze Fire Rescue Services-Chief Fire Officer	OM Ramaboea	035-907 5731	083661 3045
Umhlathuze Traffic Derp	Mbongiseni Ndlovu	035-907 5272	035-7973313/5504 035-772 5503
Umhlathuze Municipality Umhlathuze Water Umhlathuze Electricity	Dolf Marais	035-907 5000 035-902 1000 035-907 5566	035-797 3313
SAPS		10111	10111
Bay Hospital	Reception	035-7806111	035-7806111 035-9012475/2777
Netcare Ambulance	Devan Govender	082911	082911 082821 4281
Provincial Ambulance	Lucky Sibisi	086 100 2326	086 1002626
Disaster Management	Robert Mnguni	035-907 5728 073 742 6548	035-7973313 035-7973911
Company Doctors	Dr M Baleta Dr Watson Dr Cloete	035-753 3684	082 550 7432 082 8709079
Hazardous Waste			
DCLM	Strini	087 351 3384	079 871 9310
Certified Asbestos Agent	Oram	083 3202176	083 3202178
Radioactive Waste	Enviroserv Roonie/Jessica	035- 751 1763	082 312 7616

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Outside Companies

Organisation	Contact Person	Tel. No.	After Hours
Eskom		086 003 7566	086 003 7566
South 32 Bayside Aluminium	Security Control Reception	035-908 9111 035-908 8111	035-908 9111
Portnet Risk Control Portnet Emergency	Bongani Ndaba	035-905 3335	0837080830
TWK(CTC)	Reception/Control Dave Conrad Braan Myburg	035-797 3303 082 959 5897 071 682 5937	035-753 2504 082 959 5897
Silvacell	Control Room Production Manager	035-902 2074 082 8504905	035-902 2074
Mondi Security Mondi Fire	Control Room/ Thokozani E Briks	035-902 2110 072 1086 5995	035-902 2110
KUSSASA	Corrie Lotz SHREQ Christo Coetzee	035-7979092 035- 797 9092	083 310 8511 083 463 9333
SHINCEL Production Supervisor	Gerrie Pretorius Percy Naidoo Ryno Martin Andy Kruger	035 -797 5126 078 201 7270 076 199 1111 071 22 35033	074 886 2198
Grindrod	Sonto Mgobhozi SHE Manager	035 797 9092	

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Government organisations

Organization	Contact Person	Tel No	After Hours No
LOCAL MUNICIPALITY			
Thungulu	Air emission	035- 7972500	035 - 797 3313/4
DEPARTMENT OF ECONOMIC DEVELOPMENT TOURISM AND ENVIRONMENTAL			
Main Office Richards Bay			
Mrs Mkhwanazi	Environmental	035-780 6700	
William Mngoma	Air and water emissions	083 454 5556	083 454 5556
DEPARTMENT OF WATER AFFAIRS AND SANITATION			
Main Office Durban	Water contamination	031 - 336 2700	-
DEPARTMENT OF AGRICULTURE AND FORESTRY			
Local Area Ngwelezane			
Agriculture	Sanele Kunene	035-7942381	
Forestry (Mtuba)		035- 7806818	
		035 5504387	
RICHARDS BAY CLEAN AIR ASSOCIATION			
Francois Nel	Air emissions		072 321 5061
Sandy Caminga	Clean Air	035 - 786 0076	083 515 2384

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Foskor Management Team

Position	Tel. No	After Hours No.
Chief Executive Officer	011- 347 0601	083 449 9263
GM Human Resources		082 8072926
Manager Human Capital	035-902 3392	072 807 6305
Vice President Acid: Foskor Richards Bay	035-9023139 035-902 3232	063 253 2070
General Manager: Operation	035-902 3280	083 783 1667
Manager: Sulphuric Acid	035-902 3183	072 590 8012
Manager : Phosphoric Acid	035-902 3292	083 633 9541
Manager Projects	035-902 3240	082 376 7140
Manager: Maintenance and Engineering Service	035-902 3075	082 700 7413
Manager: Technical Service	035-902 3086	084 774 0074
Manager: Finance	035-902 3391	083 7926296
Manager :IS Facilities	035- 902 3377	082 462 8418
Manager: Procurement	035- 902 3021	
Manager: SHREQ	035-902 3244	082 777 2412 5003
Manager: FGAS Group Manager Divisional Manager	011- 3470625 035- 9023026	083 2603771
Engineer: Electrical and Instrumentation	035- 902 3327	082 92 44392
Engineer: Phos Acid Concentration	035- 902 3342 035- 903342	08371 77944
Manager :Phos R&F	035-9023124	060 439 8514
Engineer: Environment	035- 9023025	082 866 8553
Supt: Safety	035-902 3368	083 696 5484
Supt: Environment &Quality	035- 902 3159/3360	0733161200
Site Manager: Security	035- 9023181	073 5390 7751

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Important Foskor Departments

Department	Tel No.	After Hours	Speed Dial
Emergency Services Proto Team	035- 9023350	083 626 7906	5013
	035-9023102	083 7886889	5509
	035-9023350	0810333364	5705
Security	035-9023181	073 539 0751	
	035-9023114	0860367567	
	3116/3299	0832527222	
Clinic	035-9023146	0744155505	
	035-9023287		
Safety Department	035-9023368	083 696 5484	5501
	035-9023263	082486 1093	5503
	035-9023285	083 783 1726	5504
Environmental Department	035-9023025	082 866 8553	
Occupational Hygienist and Radiation Specialist	035- 9023372	0725610711	
	035- 9023064	0735152955	
Phos Control Room	035-9023120		
Sulphuric Control Room	035-902 3173		
	035-902 3174		
Granulation Control Room	035-9023 215		5544
Employee Assistance Practitioner	035-902 3220	083 294 4475	

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42. Annexure 12 – GAS ESCAPE ROOMS

Number	Location	Tel
G1	Phosphoric Acid Control Room	3120/ Intercom
G2	Filtration Workshop	3179/ Intercom
G3	M.A.P Control	3236/ Intercom
G4	Sulphuric Acid Control Room	3157/3136/ Intercom
G5	Main Lab	3252/ Intercom
G6	Training Centre	3137/ Intercom
G7	Main Workshop	3152/ Intercom
G8	Fabrication Workshop	3210/ Intercom
G9	Main Store	3184/ Intercom
G10	Emergency Control Centre Security	3114/3116/3299 Intercom
G11	Main Building	Intercom
G12	Bagging Plant	Vacant
G13	Granulation Workshop	3305/ Intercom
G14	Granulation Control Room	3215/ Intercom
G15	Material Handling Workshop	3303/ Intercom
G16	HR Department	3134/Intercom
G17	Canteen	3150/Intercom
G18	CTC	Vacant
G19	Concentration Tea Room	3293/ Intercom
G20	Technical Department	Intercom
G21	South Gate Induction Room	3053/
G22	Clinix	3146/ Intercom
G23	Material Handling Rail Weighbridge	3227/333/3254/Intercom
G24	Sulphuric Maintenance W/Shop	3131/ Intercom
G25	Standby Rooms	Intercom
G26	Concentration Workshop- Movable-Responsible Person Process Engineer with assigned key	
G27	Sulphur Store	
G28	Sasol gas line	
G29	Old store Receiving	3245/ Intercom
G30	Phos Rock Store/ Cooling Tower area	
G31	Used by Isandiso	
G32	Sulphur Store West	
G33	Phos Rock / Sulphur store	
G34	South Gate New Building/ Salvage yard	Intercom
G35	The Club	3079/ Intercom
G36	Old Procurement	Intercom
G37	CCTV	3015
G38	PR Board room	Intercom
G39		

43. ANNEXUR
E 13
ACTION
CHECKLIST
TA
44. ND
ROLLCALL
LIST
DURING
GAS
RELEASE/
DRILL

GAS ROOM NUMBER	EMERGENCY AREA WARDEN
DATE OF EXERCISE/EMERGENCY	RESPONSIBLE PERSON
TIME OF EXERCISE/EMERGENCY	TIME ALL CLEAR

ACTION CHECKLIST

ACTION/ITEM	YES	NO

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Have All Air conditioners Been Left On? Only Split Unit To Be Left On		
Have All Windows, Doors, Openings Been Sealed?		
Have The Compressed Air Cylinders Been Opened?		
Has The Senior Person/Emergency Area Warden Taken Control?		
Has The Senior Person Inspected His Area To Determine Extent Of Hazard ?		
Has The Evacuation Been Reported To The Emergency Control Centre (3114, 3116 3299)?		

ROLLCALL LIST

Name and Surname	Co. Number	Signature	Name and Surname	Co. Number	Signature
1.			17.		
2.			18.		
3.			19.		
4.			20.		
5.			21.		
6.			22.		
7.			23.		
8.			24.		
9.			25.		
10.			26.		
11.			27.		
12.			28.		
13.			29.		
14.			30.		
15.			31.		
16.			32.		

Original copy must remain in the Gas Room and a copy must be sent to Emergency Services and Security

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45. Annexure 14 - TELEPHONIC BOMB THREAT CHECKLIST

On receipt of a telephonic bomb threat note the following:

Time : _____ Date : _____

Ask the caller the following questions:

- Exactly where the bomb is or as close as possible to the area
- What does it look like?
- When will it explode? (Time limit)
- Why was it placed?
- When and where was it placed?
- Why Foskor (Pty) Limited

Mark with X

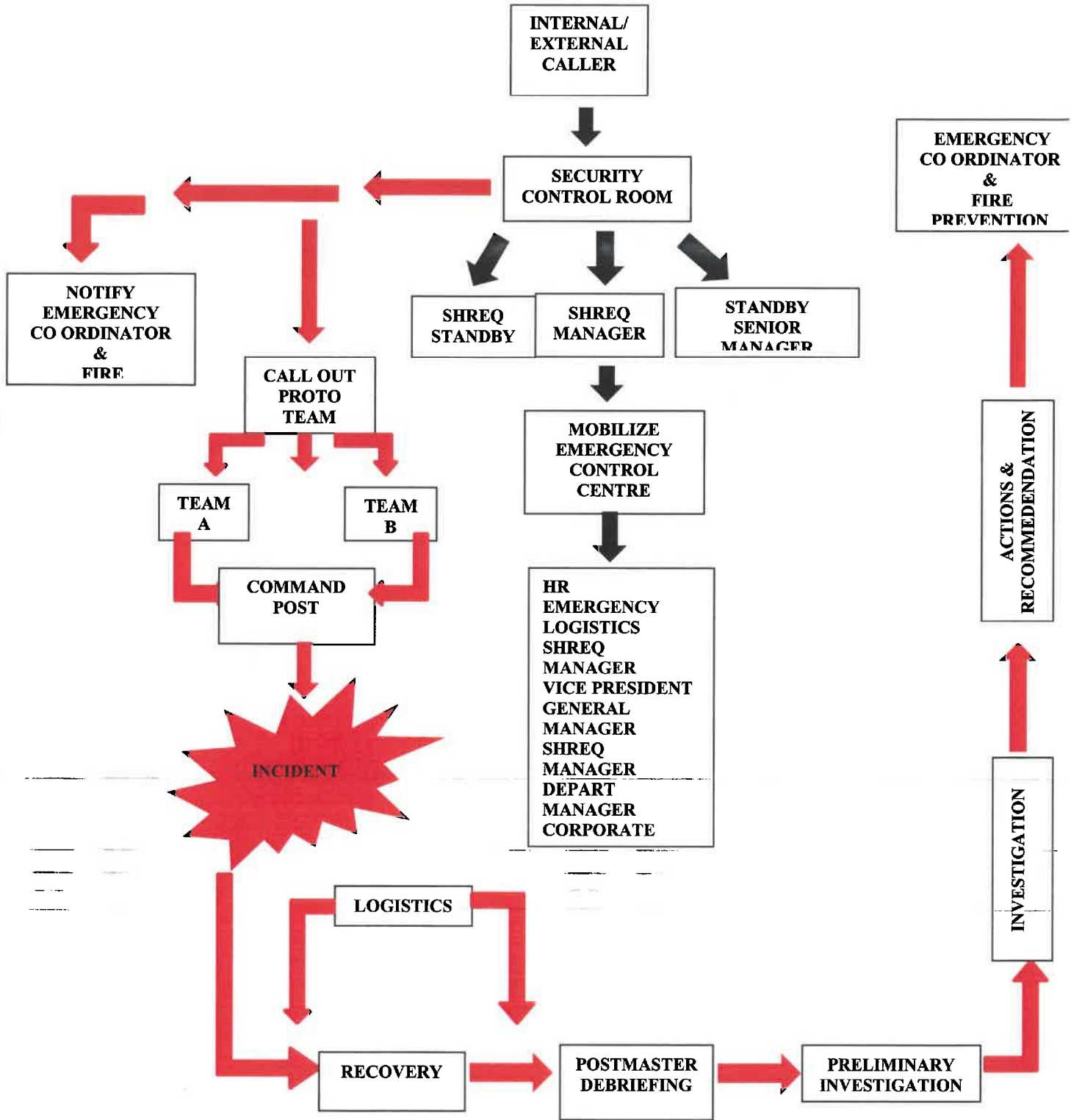
ORIGIN	CALLER	CHARACTERISTICS OF SPEECH
Call Box	Male	Language
Internal Phone	Female	Accented
External Phone	Young	Slurred
	Old	Other
	Foreign	
MANNER: Hesitant		BACK.NOISE: Traffic
Confident		Other people
Hysterical		Machinery
Aggrieved		Music
		—Other—



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Annexure 17. EMERGENCY RESPONSE CHART



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Annexure 18: SAFETY SHOWER CHECKLIST

SAFETY SHOWER CHECKLIST

NAME:		CO NUMBER:				SIGNATURE:								
DATE:														
Shower Number	Shower location	Identification #1 A Demarcation; B Number; C Signage; D Main Valve				Eye wash fountain A Nozzle; B Bowl; C Ball valve			Identification #2 A Nozzle; B Platform; C Footvalve; D Framework				Works order number	Comments
		A	B	C	D	A	B	C	A	B	C	D		

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**CODE OF PRACTICE
RICHARDS BAY**

Procedure No.	COP 159
Revision	6
Pages	1 of 4

COP 159 – EMERGENCY ALARM SYSTEM

DEKRA	7.5	9001	N/A	14001	8.2	45001	8.6	3000	N/A	16001	N/A
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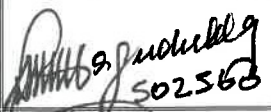


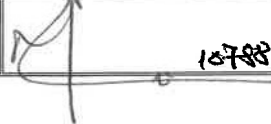
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REVISION SHEET

REVISION NUMBER	SUBJECT OF REVISION	PAGE NUMBER	EFFECTIVE DATE
1	Revision - Procedure	All	2004/03/01
2	General revision	All	2008/08/20
3	General revision	2	2012/10/31
4	Re-Numbering	4	2016/10/01
5	Alignment to the new standards	All	2017/08/31
6	Alignment to ISO 45001	All	2020/01/21

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ENDORSEMENT

	DESIGNATION	DATE	SIGNATURE & PERSONNEL NUMBER
REVIEWED BY	SUPERINTENDENT EMERGENCY AND SECURITY	21/01/2020	 502568
CHECKED BY	SENIOR SHREQ MANAGER	21/01/2020	 503460
CHECKED BY	GENERAL MANAGER ACID DIVISION	22/01/2020	 10788
APPROVED BY	VICE PRESIDENT ACID DIVISION	24/01/2020	 10788

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1. SCOPE

To provide an independent alarm system for specific emergencies, which is unique in the sense that it is used for a specific emergency only.

2. RESPONSIBILITY, ACCOUNTABILITY, AUTHORIZATION

Sensitive installations are practically secured with a person / worker in the area with a two-way radio. In case of emergency notify and acquire assistance through the Security Control Office by radio or telephone (3114 / 3116 / 3299). The Supervisor and or SHE-Rep must ensure that the alarms and back-up alarms in their areas are inspected regularly and are in a good working condition. Security and the specific control rooms are to ensure that Emergency gas alarms are tested on the set times.

3. DEFINITIONS & ABBREVIATIONS

None to be specified.

4. PROCEDURE

4.1 FIRE ALARM

Offices and certain complexes are provided with automatic fire alarm systems. If a fire or any emergency is of extended nature, the area alarm will be activated automatically or manually to warn personnel in that area and to enable them to evacuate the area. This alarm will also be activated via the network at security. Telephone or radio communication is used to obtain assistance from other parties to assist in cases where the fire or emergency cannot be controlled by existing equipment or teams. If the fire alarm in your area is activated the following procedure must be followed.

- If fire exists evacuate affected area or building immediately as per COP 164
- If no fire – silence bells and buzzer on fire panel
- **Do not reset panel**
- Contact security immediately, who will then contact the responsible persons e.g. (Proto team, Fire dept etc.)
- Investigate area to determine source of the alarm, if no fire condition exist.
- Do not activate any manual call point if there is no fire condition, these activation points are for remote manual activation of the fire alarm in case of emergencies, and not for resetting the alarms.

4.2 EMERGENCY GAS ALARM

In case of gas emergencies Granulation control room, MAP room, Sulphuric control room, Phosphoric control room or Rail weighbridge, depending on where the emergency exist, will activate the Emergency gas alarm. On activation of this alarm the emergency procedures must be implemented immediately. (See COP 164)

4.3 KNOWLEDGE OF ALARM SYSTEMS

Regular training and fire drills are done to improve people's reaction time and knowledge of the alarm system and evacuation procedure in their area. The Emergency gas alarm is tested every Thursday at 10:00 and a gas escape drill carried out on the first Thursday day of every month. Fire alarms will be tested bi-annually with a fire evacuation drill.

4.4 STAND-BY ALARM

A hand operated portable alarm is available at Security. In case of power failures or the electrical alarms that is out of order, Security must be contacted and instructed to activate the manual alarm immediately.

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4.5 GUIDELINES FOR TESTING, INSPECTIONS AND AUDITS

4.5.1 Fire alarm

- Sound of alarm is unique
- Can be heard in specific areas
- Tested internally according to set procedure bi-annually.
- Serviced and tested by external party once every 3 months.

4.5.2 Back-up Alarm

- Back-up alarm independent of main electricity supply
- Tested at regular scheduled intervals and deviations addressed

4.5.3 Emergency Gas Alarm

The following procedure must be followed every Thursday for testing of the Emergency gas alarm

- The Security control room Supervisor reminds all control rooms at 09:50 that the alarm must be activated at 10:00
- The Security Supervisor must log into the occurrence book the name of the person on duty in the specific control room that he has informed of the alarm test.
- The person at Sulphuric control room must activate the alarm at 10:00
- After the alarm has stopped, Phosphoric control room activate the alarm.
- Thereafter Granulation control room and MAP control room must activate their alarms respectively.
- The rail weighbridge must also be tested in the same way as the other alarms.
- All alarms are fitted with a relay that is set to enable the alarm to sound for a predetermined time.
- **NB: NOBODY MUST PLAY OR PRESS THE ALARM MORE THAN ONCE**
- The Emergency gas alarm must only be tested at exactly **10:00 and not 10:05**
- Any deviation or non-activation of the alarms must be reported to the Emergency co-ordinator immediately.

4.5.4 Interested and affected parties have sound knowledge of alarm

- Interested and affected parties correctly identify alarm and know what action to take
- Emergency team's reaction time monitored

4.6 OTHER COMMUNICATION SYSTEM

- Other means of communication will be introduced when required as determine by risk

5. RECORDS

DESCRIPTION	RESP	LOCATION	FILE NAME:/INDEX	RETENTION TIME (MINIMUM)





6. REFERENCES

SANS SANS 10400 Part T / 1186

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Emergency response information

Please report all emergencies to 035 902 3299/3116 or alternatively 086 036 75 67

Fire	Medical/Injury	Gas releases	Chemicals spillages
			
<p>Call Foskor Emergency number 035 902 3299/3116</p> <p>Provide the following information to the Control Room Attendant:</p> <ol style="list-style-type: none"> Your name Your contacts details Location of fire Nature and extent of fire 	<p>Call Foskor Emergency number 035 902 3299/3116</p> <p>Provide the following information to the Control Room Attendant:</p> <ol style="list-style-type: none"> Your name Your contacts details Location of incident and send a person to give direction at the main road Severity of injury 	<p>Upon hearing the Site Emergency Alarm, put on escape respirator, walk briskly crosswind to the nearest Gas Room</p> <p>Close all the windows and doors</p> <p>Isolate all equipment and potential ignition sources were possible</p> <p>Follow the instruction of the Emergency Area Warden</p>	<p>Call Foskor Emergency number 035-9023299/3116</p> <p>Provide the following information to the Control Room Attendant:</p> <ol style="list-style-type: none"> Your name Your contacts details Location of the incident Nature/severity of incident Name of chemical (if known)
<p>First assess and then attempt to extinguish the fire without endangering yourself and others</p>	<p>Trained First Aider to administer treatment and reassure the person.</p> <p>Send someone to meet the ambulance personnel.</p> <p>Escort the ambulance to the injured person.</p> <p>Never leave injured person unattended.</p> <p>Avoid overcrowding around the injured person</p>	<p>Remains calm, be patient and listen for status announcements on intercom</p> <p>Assist when requested by the Emergency Area Warden</p> <p>Wait for the all clear announcement</p>	<p>Put on escape respirator to avoid inhalation of or contact with the substance</p> <p>Minor spillages: Isolate the leak if possible wearing proper PPE, When leak isolated, add absorbent agent to the waste product.</p> <p>Major Spillages: Where possible take steps to contain the leaking, wearing proper PPE, Await proto team When leak isolated, add absorbent agent to the waste product</p>
<p>Evacuate the building by following escape route and close doors and windows as you go.</p> <p>Remain calm and do not run</p> <p>Report to the emergency assembly point and participate in the roll call.</p> <p>Ensure that all the emergency equipment utilized during the emergency is returned to a state of readiness</p>	<p>Ensure that all emergency equipment that was utilized during the emergency is returned to a state of readiness.</p> <p>Emergency gathering room/Gas Room number: <i>Insert wording</i></p>	<p>Ensure that all emergency equipment that was utilized during the emergency is returned to a state of readiness.</p> <p>Emergency gathering room/Gas Room number: <i>Insert wording</i></p>	<p>Assist the emergency services with Incident Control Actions</p> <p>Ensure that all emergency equipment that was utilized during the emergency is returned to a state of readiness</p> <p>Safety officer: <i>Insert wording</i></p>
<p>Emergency assembly point: <i>Insert wording</i></p>	<p>Emergency assembly point: <i>Insert wording</i></p>	<p>Emergency gathering room/Gas Room number: <i>Insert wording</i></p>	<p>Safety officer: <i>Insert wording</i></p>

Annexure 16 EMERGENCY PLANNING

IMMEDIATE EMPLOYEES, SUPERVISOR AND ENGINEERS

STEPS	BOMB THREATS	FIRE AND EXPLOSIONS	GAS LEAKS	TRAUMA/ACCIDENTS	HIGH GAS EMISSIONS	PIPELINE FAILURES INTERNAL	PIPELINE FAILURE EXTERNAL	EXTENDED POWER FAILURES	DAM OVERFLOW	HAZARDOUS SUBSTANCES LEAKS
1	On receiving the call complete bomb threat Checklist in full	Person discovering the fire to inform Security immediately	Person discovering the gas leak to inform plant control room immediately	Person discovering the incident to inform Security and Clinic Immediately	If high alarm on DCS panel is activated, contact shift supervisor and engineer immediately	Person discovering the incident to inform Security immediately	Person discovering the incident to inform Foskor Security immediately	Phos acid Engineer to ensure that Mhlathuze Water have been notified of the situation	Person discovering the incident to inform Security	Person discovering the incident to inform Security immediately
2	Remain calm	Note the location and the extent of the fire and activate local fire alarm	In the event of a Major gas leak the main gas alarm must be sounded	Contact the Supervisor and inform him of the incident	Stop plant immediately and check wind direction and stack appearance	Person discovering the incident. → close all valves and isolate the line immediately or inform the necessary supervisor of the incident	Person discovering the incident to close all valves immediately or inform the necessary supervisor of the incident	Phos acid Engineer to ensure that the storm water dam level is closely monitored and that the Environmental section are kept abreast of the situation	Person discovering the incident to inform necessary supervisor immediately – (Gypsum dam= Materials handling) – (Storm Water dam = Phos Acid)	Person discovering the incident to close all valves and isolate the line immediately or inform the necessary supervisor of the incident
3	Notify Security per telephone (not per radio)	Safeguard the area and evacuate immediate employees not assisting in emergency procedures to allocated assembly point	If in H ₂ SO ₄ plant- the personnel first make sure that the plant is shut down and air flow and Sulphur burning is stopped	Ensure that the area is made safe	Notify Security immediately	Ensure that the area is made safe by cordoning off the area with barrier tape and traffic cones if spillage is on road	Ensure that the area is made safe by cordoning off the area with barrier tape and traffic cones if spillage is on road.	Material Handling Superintendent to ensure that lime is dosed at the stilling basin, samples of the stilling basin overflow is taken every half hour and that the Environmental section is notified	Supervisor to follow the dam overflow procedure	Ensure that the area is made safe by cordoning off the area with barrier tape and traffic cones if spillage is on road
4	Notify Supervisor per telephone (not per radio)	Dedicated employees to control fire with available equipment	If SO ₂ emission is caused by a Sulphur fire the Fire and explosion procedure must be followed	Notify First Aider on shift	Notify Environmental officer and request surveillance of possible affected areas	If the spillage has occurred in a bund are do not add lime to neutralize	If the spillage has occurred in a bund area do not add lime to neutralize	All Supervisors & Engineers to ensure that the levels of all sumps and cooling towers are closely monitored. If overflows do occur all acidic overflows to be neutralised with	Supervisor and or Engineer to neutralize overflow with lime and samples to taken every half hour for analysis	If the spillage has occurred within a bunded area do not add lime to neutralize

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5	Evacuate area and open all doors and windows	Assist proto team when they arrive	Upon sounding of the gas alarm, all employees are to check the wind direction and proceed to nearest gas escape room	First Aider to perform first aid to injured persons if and when necessary	Notify Emergency coordinator	If the spillage has occurred outside a bind area add lime to neutralize the spillage	If the spillage has occurred outside a bind area add lime to neutralize the spillage	lime	If the spillage has occurred outside a bind area add lime to neutralize the spillage
6	Perform superficial search of building whilst evacuating	Control room personnel to remain at control stations to maintain communication	Perform the gas escape room procedure and follow all instructions from the responsible person	Serious injuries – keep casualties calm and comfortable until medical help arrive. Minor injuries – transport to clinic		Responsible maintenance section to follow detailed spillage procedure	Responsible role-players to follow detailed spillage procedure		Responsible role-players to follow detailed spillage procedure
7	Report all suspicious items to the Area warden/safety Rep	Do not re-enter affected area	Remain in gas escape rooms until rescued by the Proto team or the all clear is sounded			Responsible supervisor to inform all affected external parties of the situation	Responsible supervisor to inform all affected external parties of the situation		Responsible supervisor to inform all affected external parties of the situation
8	Assemble at the safest allocated assembly point	Do not risk lives	Control room personnel to remain at control stations to maintain communication			Sasol Gas = Sulphuric Buoyant/Dense Line = UMHiatuze Hillside water = Phos Acid	Responsible maintenance section to follow detailed spillage procedure		Responsible maintenance section to follow detailed spillage procedure
9	Remain there until instructed to return to your work station		Do not re-enter affected area						

ACTIONS AFTER THE EMERGENCY/POST CONTACT PHASE

STEPS	BOMB THREATS	FIRE AND EXPLOSIONS	GAS LEAKS	TRAUMA / ACCIDENTS	HIGH GAS EMISSIONS	PIPELINE FAILURES INTERNAL	PIPELINE FAILURE EXTERNAL	EXTENDED POWER FAILURE	DAM OVERFLOW	HAZARDOUS SUBSTANCES LEAKS
1	Provide all the relevant information to Emergency coordinator	Receive the all clear signal	Receive all clear from the person in charge of the gas escape room	Return to your workstation and resume normal duties	Return to your workstation and resume normal duties	If effluent spillages need to be disposed of the Environmental Section/Standby is to be consulted with regarding best disposal method	If effluent spillages need to be disposed of the Environmental Section/Standby is to be consulted with regarding best disposal method	All panels, UPS and systems to be reset after power are restored	If contaminated soil needs to be disposed of the Environmental/Standby is to be consulted with regards to the best disposal methods	If Hazardous substances need to be disposed of, the environmental /Standby is to be consulted with regards to the best disposal methods
2	Attend de-brief	Attend de-brief	Close compressed air	Refill first aid kit at Clinic Immediately after the incident	Shift supervisor and Engineer to follow the detailed procedure on high emissions	Investigation to be initiated immediately & report submitted to Environmental section	Replenish all material and equipment used on incident			
3	Return to your workstation and resume normal duties	Return to your workstation and resume normal duties	De-briefed by person in charge of gas escape room		Investigation to be initiated immediately & report submitted to Environmental section					
4	Do not interfere with the scene and evidence	Do not interfere with the scene and evidence	Return to your workstation and resume normal duties							
5			Person in charge of Gas escape room to ensure that all used emergency equipment are repaired or replaced immediately							

EMERGENCY TELEPHONE NUMBERS FOR SECURITY 3114 - 3116 - 3299 - 0860 367567

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**WRITTEN AGREEMENT ON
OCCUPATIONAL HEALTH AND SAFETY**

In accordance with the provisions of Section 37(2) of the Occupational Health
and Safety Act 85 of 1993

Entered into and between

FOSKOR LTD (PTY)
(Hereafter referred to as "the Employer")

And

.....
(Hereafter referred to as "the Mandatary")

.....
(COID Registration Number)

WHEREAS the Employer has entered into a contract and / or Purchase Order with the Mandatary, in terms of which the Mandatary is to perform certain work and services for and on behalf of the Employer, subject to the terms and conditions as contained in such contract and / or Purchase Order.

The parties concerned have agreed that in respect of performance of the work the Mandatary shall be responsible for the full compliance with the Occupational Health and Safety Act 85 of 1993 and its regulations. The Employer and Mandatary accordingly enter into this agreement in terms of section 37(2) of the OHS Act, the terms and conditions of which are set out hereunder.

1. DEFINITIONS

- 1.1 Expressions which denote:
 - 1.1.1 Any gender shall include the other genders;
 - 1.1.2 A natural person shall include a juristic person and vice versa;
 - 1.1.3 The singular shall include the plural and vice versa;
- 1.2 **Agreement** shall mean this document containing its terms and conditions as applicable to the parties thereto;
- 1.3 **Employer** shall mean the party as described on the cover page of this document;
- 1.4 **Employees** shall mean all Employees, servants, contractors, sub-contractors, agents, invitees and the like of the **Mandatary**;
- 1.5 **Chief Executive Officer** shall mean such responsible person as is nominated by the Mandatary, pursuant to the provisions of clause 4 hereunder;
- 1.6 **Mandatary** shall mean the party as described on the face of this document;
- 1.7 **OHS Act** shall mean the Occupational Health and Safety Act 85 of 1993, as amended, together with all regulations thereto;
- 1.8 **Premises** shall mean all such Premises of the Employer, where the Mandatary and the Employees perform work or render a service for and on behalf of the Employer;

2. WARRANTY OF COMPLIANCE

- 2.1 In terms of this Agreement the Mandatary warrants that he/she has familiarized himself/herself with the working environment and that he/she agrees to the arrangements and procedures, as prescribed by the Employer, and as provided for in terms of Section 37(2) of the OHS Act, for the purposes of compliance with the OHS Act.
- 2.2 The Mandatary acknowledges that this Agreement constitutes an agreement in terms of Section 37(2) of the OHS Act, whereby all responsibility for health and safety matters relating to the work that the Mandatary and the Employees are to perform on the Premises shall be the obligation of the Mandatary.
- 2.3 The Mandatary further warrants that he/she and/or the Employees undertake to maintain all necessary compliance with the OHS Act. Without derogating from the generality of the above, or from the provisions of this Agreement, the Mandatary shall ensure that the clauses as hereunder described are at all times adhered to by himself /herself and the Employees.

- 2.4 The Mandatary hereby undertakes to ensure that the health and safety of any other person on the Premises is not endangered by the conduct and/or activities of the Employees whilst they are on the Premises.
- 2.5 Notwithstanding the above, the Mandatary confirms that it is familiar with and will comply with the Foskor 10 Safety Rules to Live By, a copy of which is available on request, Induction
- 2.6 The Mandatary shall also ensure that it complies with all relevant Labour Legislation including the Basic Conditions of Employment Act, the Labour Relations Act and any specific wage determinations specific to your business activity.

3. MANDATARY AN EMPLOYER

The Mandatary shall be deemed to be an employer in his own right whilst on the Employer's Premises. In terms of Section 16(1) of the OHS Act, the Mandatary shall accordingly ensure that the requirements of the OHS Act are complied with by himself /herself and/or his/her Chief Executive Officer.

4. APPOINTMENTS AND TRAINING

- 4.1 The Mandatary shall appoint competent persons as per Section 16(2) of the OHS Act. Any such appointed person shall be trained on any occupational health and safety matter, and the OHS Act provisions pertinent to the work that is to be performed under their responsibility. Copies of any appointments made by the Mandatary shall be made available to the Employer upon the Employer's request.
- 4.2 The Mandatary warrants that he has familiarized himself/herself with the hazards associated with the work being carried out on the premises. The Mandatary shall further ensure that the Employees are trained on the health and safety aspects relating to the work and that they understand the hazards associated with such work being carried out on the Premises. Without derogating from the foregoing, the Mandatary shall, in particular, ensure that all his users or operators of any materials, machinery or equipment are properly trained in the use of such materials, machinery or equipment.
- 4.3 Notwithstanding the provisions of the above, the Mandatary shall ensure that he/she; his/her appointed responsible persons and Employees are at all times familiar with the provisions of the OHS Act, and that they comply with the provisions.

5. SUPERVISION, DISCIPLINE AND REPORTING

- 5.1 The Mandatary shall ensure that where applicable all work performed on the Premises is done under strict supervision and that no unsafe or unhealthy work practices are permitted. Discipline regarding health and safety matters shall be strictly enforced against any of his Employees regarding non-compliance by such Employee with any health and safety matter.
- 5.2 The Mandatary shall further ensure that the Employees report to him/her all unsafe or unhealthy work situations immediately after they become aware of the same, and that he in turn immediately reports these in writing, to the Employer.

6. ACCESS TO THE OHS-ACT

The Mandatary shall ensure that he/she has an updated copy of the OHS Act available at all times, and that this is accessible to his appointed responsible persons and Employees, save that the parties may make arrangements for the Mandatary and his responsible appointed persons to have access to the Employer's copies of the said Act.

7. CO-OPERATION

7.1 The Mandatary and/or its responsible persons and Employees shall provide full co-operation and information if and when the Employer or his representative inquires into occupational health and safety issues concerning the Mandatary. It is hereby recorded that the Employer and his representative shall at all times be entitled to make such inquiry.

7.2 Without derogating from the generality of the above, the Mandatary and his/her responsible persons shall make available to the Employer and his representative, on request, all and any checklists and inspection registers required to be kept by him/her in respect of any of his materials, machinery or equipment.

8. WORK PROCEDURES

8.1 The Mandatary shall ensure that he/she has safe work practices and procedures in place.

8.2 The Mandatary may have regard to and apply any applicable procedures, guidelines and other documentation previously used by the Employer as a basis for prescribing the safe work procedures and practices for the Employees, however, the Mandatary shall, at all times, be responsible for ensuring compliance with the OHS Act, including ensuring that it has adequate safe work procedures in place. The Mandatary shall ensure that the Employees are made conversant and comply with the content of the safe work procedures and practices.

8.3 The Mandatary shall ensure that the Employees, prior to the obtaining of such a permit, do not perform work for which a permit is required.

9. HEALTH AND SAFETY MEETINGS

If required in terms of the OHS Act, the Mandatary shall establish his/her own health and safety committee(s), and ensure that the Employees, being the committee members, hold health and safety meetings as often as may be required, and at least once every 3 (three) months. The Mandatary may, if he/she wishes to do so, send a representative to any health and safety committee meetings held by the Employer.

10. COMPENSATION REGISTRATION

The Mandatary shall ensure that he/she has a valid registration with the Compensation Commissioner, as required in terms of the Compensation for Occupational Injuries and Diseases Act 130 of 1993, and that all payments owing to the Commissioner are discharged. The Mandatary shall further ensure that the cover shall remain in force whilst any such Employee is present on the Premises.

11. MEDICAL EXAMINATIONS

The Mandatary shall ensure that all the Employees undergo routine medical examinations where these are necessary in terms of the working environment and that they are medically fit for the purposes of the work they are to perform.

12. INCIDENT REPORTING AND INVESTIGATION

- 12.1 All incidents referred to in Section 24 of the OHS Act shall be reported by the Mandatary to the Department of Labour and to the Employer. The Employer shall further be provided with copies of any written documentation relating to any incident.
- 12.2 The Employer retains an interest in the notification of any incident as described, above, as well as in any formal investigation and/or inquiry conducted in terms of Section 32 of the OHS Act into such incident.

13. SUB-CONTRACTORS

- 13.1 The Mandatary shall notify the Employer of any sub-contractor he/she may wish to engage to perform work on the Premises. It is hereby recorded that all the terms and provisions contained in this clause shall be equally binding upon the sub-contractor prior to the sub-contractor commencing with the work. Without derogating from the generality of this paragraph:
 - 13.1.1 The Mandatary shall ensure that training as discussed in paragraph 4, above, is provided, prior to the sub-contractor commencing work on the Premises.
 - 13.1.2 The Mandatary shall ensure where applicable that work performed by the sub-contractor is done under strict supervision and discipline, as described in paragraph 5, above.
 - 13.1.3 The Mandatary shall inform the Employer of any health and safety hazard and/or issue that the sub-contractor may have brought to his attention.
 - 13.1.4 The Mandatary shall inform the Employer of any difficulty encountered with regard to compliance by the sub-contractor to any health and safety instruction, procedure and/or legal provision applicable to the work the sub-contractor performs on the Premises.

14. SECURITY AND ACCESS

- 14.1 The Mandatary and its Employees shall only access and exit the Premises through the main gate(s) and/or checkpoint(s) designated by the Employer. The Mandatary shall ensure that the Employees observe the security rules of the Employer at all times and shall not permit any person who is not directly associated with the work from entering the Premises.
- 14.2 The Mandatary and the Employees shall not enter into any area of the Premises which is not directly associated with the work.
- 14.3 The Mandatary shall ensure that all materials, machinery or equipment brought by it onto the Premises are registered at the main gate (and/or checkpoint)

A failure to do this may result in a refusal by the Employer to allow the materials, machinery or equipment to be removed from the Premises.

- 14.4 The Mandatary shall submit to the Employer, for approval, all the names of each proposed Employee prior to such Employee entering the Premises.

15. COVID -19

15.1 The Contractor will assess all hazards & risks associated with the Covid-19 Virus and then put in place the necessary / required controls.

15.2 The Contractor will comply specifically but not exclusively with the most recent versions of the Occupational Health and Safety Act, Hazardous Biological Agents Regulations, the Disaster Management Act and its regulations, Department of Health directives, notices & guidelines, Department of Employment & Labour directives, notices & guidelines, etc. in relation to the Covid-19 pandemic. The contractor will also comply with all Company specific Covid-19 rules and requirements.

15.3 The Contractor will designate a Compliance Officer who will ensure full compliance with the aforementioned legislation

15.4 The Contractor must appoint a manager to address employees or workplace concerns regarding Covid-19 matters.

15.5 The Contractor will have records available of compliance regarding Covid-19 at site. This plan will include risk assessment and all its controls. Said records will remain accessible whilst the contractor is at site.

15.6 The Contractor will implement screening and testing protocols. The contractor will immediately in writing inform the Foskor Appointed Compliance Officer on Foskor site if contractor's employee tests positive or is suspected to be positive for the Covid-19 virus.

The Contractor will comply with vulnerable and age protocols / directives / regulations

16. FIRE PRECAUTIONS AND FACILITIES

16.1 The Mandatary shall ensure that an adequate supply of fire protection and first aid facilities is provided for the work to be performed on the Premises. The parties may mutually make arrangements for the provision of such facilities, subject to such arrangements being recorded in writing by the parties thereto.

16.2 The Mandatary shall further ensure that the Employees are familiar with fire precautions at the Premises, which include fire alarm signals and emergency exits and those precautions, are adhered to.

17. HYGIENE AND CLEANLINESS

The Mandatary shall ensure that the area where the work is performed is at all times maintained to reasonably practicable levels of hygiene and that they maintain the surrounding area of the work site to a reasonably practicable level of cleanliness. In this regard, no loose materials shall be left lying unnecessarily, and the work site shall be cleared of waste materials regularly and on completion of any work performed by the Mandatary and the Employees.

18. NO NUISANCE

The Mandatary shall ensure that neither he/she nor the Employees undertake any activity which may cause environmental impairment, nor constitute any form of nuisance to the Employer and/or his surroundings.

19. INTOXICATION NOT ALLOWED

No intoxicating substance of any form shall be allowed on the Premises. Any person suspected of being intoxicated shall not be allowed on the site, save that any person required to take medication shall notify the relevant responsible person thereof, as well as the potential side effects of the medication.

20. PERSONAL PROTECTIVE EQUIPMENT

The Mandatary shall ensure that his/her responsible persons and the Employees are provided with adequate personal protective equipment (PPE) for the work they may perform, and in accordance with the requirements of General Safety Regulation 2(1) of the OHS Act. The Mandatary shall further ensure that his responsible persons and the Employees wear the PPE issued to them at all relevant times.

21. PLANT, MACHINERY AND EQUIPMENT

21.1 The Mandatary shall ensure that all the plant, machinery, equipment and/or vehicles he/she may wish to utilize on the Premises is/are at all times of sound order and fit for the purpose for which it is intended, and that it complies with the requirements of Section 10 of the OHS Act.

21.2 In accordance with the provisions of Section 10(4) of the OHS Act, the Mandatary hereby assumes the liability, for taking the necessary steps to ensure that any article or substance that is erected or installed at the Premises, or manufactured, sold or supplied to or for the Employer, and which the Mandatary uses at work complies with all the prescribed requirements and will be safe and without risks to health when properly used.

22. NO USAGE OF THE EMPLOYER'S EQUIPMENT

The Mandatary hereby acknowledges that the Employees shall not be permitted to use any materials, machinery or equipment of the Employer unless the prior written consent of the Employer has been obtained, in which case, the Mandatary shall ensure that only those persons authorized to make use of the same, have access thereto.

23. TRANSPORT

22.1 The Mandatary shall ensure that all road vehicles used on the Premises are in a roadworthy condition, are licensed and insured. All drivers shall have relevant valid driving licences and no vehicle shall carry passengers unless it is specifically designed to do so. All drivers shall adhere to the speed limits and road signs on the Premises.

22.2 In the event that any hazardous substances are to be transported on the Premises, the Mandatary shall ensure that the requirements of the Hazardous Chemical Substances Act 15 of 1973 are complied with at all times.

24. INDEMNITY BY MANDATARY

Notwithstanding the provisions of this Agreement, or any other contractual relationship as between the Employer and the Mandatary:

- 24.1 The Employer shall not be responsible for any loss, damage, injury or death, howsoever caused, to the Mandatary or to the Employees, and the Mandatary hereby indemnifies the Employer and holds the Employer harmless against all and any claims, losses, demands, liability, costs and expenses of whatsoever nature, which the Employer may, at any time sustain or incur arising out of the circumstances referred to herein; provided that such loss, damage, injury or death is not caused by the willful action or omission or gross negligence of the Employer.
- 24.2 The Mandatary hereby assumes liability for any loss or damage which is caused by the Mandatary's negligence, or through the negligence of any of the Employees, and the Mandatary hereby indemnifies the Employer for such loss or damage, whether caused by the Mandatary's breach of any of the terms of this Agreement, or by delict.
- 24.3 The Mandatary in pursuance of clause 23 undertakes to ensure that he carries the appropriate insurance cover, including third party public liability cover, the details of which shall be furnished to the Employer on demand by the Employer.

25. CLARIFICATION

In the event that the Mandatary requires clarification of any of the terms or provisions of this Agreement, it should contact the appropriate and designated representative of the Employer, whose clarification in terms hereof must be in writing.

26. DURATION OF AGREEMENT

This Agreement shall remain in force for any work performed by the Mandatary and / or any of the Employees for the Employer.

27. HEADINGS

The headings as contained in this Agreement are for reference purposes only, and shall not be construed as having any interpretative value in them, nor any indication as to the meaning of the contents of the paragraphs contained in this Agreement.

SIGNED AT Richards Bay ON THE ____ DAY OF _____ YEAR _____

Name: _____
PRINT NAME

Signature: _____
*For and on behalf of THE EMPLOYER
He being duly authorized*

SIGNED AT _____ ON THE ____ DAY OF _____ YEAR _____

Name: _____ Signature: _____
PRINT NAME *for and on behalf of THE MANDATARY*
He being duly authorised

NOTE:

Please ensure that each person signing for and on behalf of the Employer and the Mandatary initials all pages.

OCCUPATIONAL HEALTH & SAFETY MANUAL	FOSKOR RICHARDSBAY	Date Reviewed: 19 May 2023
Occupational Health and Safety Act (Act 85 of 1993)	HSE Documentation	Document No: DIV-HSE-001-00
APPOINTMENT:	Principal Contractor	
PROJECT:	Upgrade of The Primary and Secondary Pollution Control Dams	

OCCUPATIONAL HEALTH AND SAFETY ACT (85 of 1993)

APPOINTMENT OF A CR5.1(k) PRINCIPAL CONTRACTOR

DUTIES AND RESPONSIBILITIES:

You are to ensure that the Occupational Health & Safety Act 85 of 1993 and the regulations applicable are complied with in your area of responsibility.

You may assign junior/senior persons who report to you, with the duty to assist you in your functions in terms of **Section 16 and the Construction Regulations**. As they report to yourself, you are to give them all the necessary training, assistance, support, authority and power to carry out their responsibility for the implementation and sustainability of health and safety in terms of the Occupational Health & Safety Act 85 of 1993 and its regulations.

You shall provide these appointees with access to the Occupational Health and Safety Act as well as the organization's HSE program documentation and information as is necessary and where required.

You are charged with reporting on the following issues:

- Deviations and areas of non-compliance (which you cannot rectify) to _____ – Immediately.
- Submitting a monthly report to _____ – Monthly

The monthly report shall consist of the following information and shall be submitted in the approved format:

- Health and Safety Representative Inspections.
- Internal Inspections/Audits.
- Planned Task Observations.
- Task Analysis.
- Continuous Risk Assessments.
- Performance Measurement of Employees.
- Incidents (Near misses, Accidents, Illnesses, First Aid Treatments)
- Investigations
- Medicals (New employees, Scheduled medicals)
- Competency information (Drivers, First Aiders, Fire Fighters, HS Representatives etc)

Responsible Designation shall assume the responsibilities of this appointment in absentia of the appointee.

You are required to acknowledge your confirmation of training and your acceptance of the responsibilities and implications of this appointment. Please initial each statement if you agree with the content.

OCCUPATIONAL HEALTH & SAFETY MANUAL	FOSKOR RICHARDSBAY	Date Reviewed: 19 May 2023
Occupational Health and Safety Act (Act 85 of 1993)	HSE Documentation	Document No: DIV-HSE-001-00
APPOINTMENT:	Principal Contractor	
PROJECT:	Upgrade of The Primary and Secondary Pollution Control Dams	

APPOINTMENT

I, _____ (Name of Sec 16.1/16.2) of _____ (Company Name)

do hereby appoint you, _____ (Appointee Name) being a full-time employee, with

the duty of Principle Contractor for the following project/contract: _____ (Project Name)
for the duration of the project/contract or until you are relocated to another site/project or leave the employment of the company.

Your appointment will be valid from ____/____/____ to ____/____/____ or such other date as decided and documented in writing by the Sec 16.1/16.2.

You are reminded that you are required to be conversant with all relevant statutory provisions and regulations of the Occupational Health & Safety Act 85 of 1993 and the COID Act 130 of 1993.

Signature: _____

Date: _____

Designation: _____

ACCEPTANCE OF APPOINTMENT

I _____ (Name of appointee) hereby accept this appointment as Principle Contractor and confirm that I have the necessary competence required and that I am conversant with all the relevant statutory provisions of the Occupational Health & Safety Act (85 of 1993) with regard to carrying out construction work.

Signature: _____

Date: _____

Designation: _____

MEMORANDUM

From the office of: SHREQ

To:
All Richards Bay Employees
All Managers
All Supervisors
All Contractors

From : Pranil Singh
Safety Superintendent

Circular no: /2016

Take note that as from the 02 August 2016 , All contractor personnel found in any other PPE except for what is specified below will not be granted access onto Foskor site:

Garments:

BLUE Sweet Orr overall (80%Polyester 20% Viscose Rayon Acid repellent) – with company names either on front of jacket or back



OR

BLUE North Safety Acid /Flame overall (Flame retardant acid resistant anti-static ATPV 15.4CAL/CM2) with company names either on front of jacket or back

The escape respirator pack consists of: A double face piece,

- An ABEK Cartridge,
- Uvex Goggle – Uvex Ultra Vision Fire Red
- and a Pouch



Take note of the expiry date on Cartridges and ensure that it is changed accordingly.



Eye Protection: Uvex Carbon vision SV extreme clear with strap : Anti fog inside and anti-scratch coating outside

All contractor employees must ensure that they are in possession of the above specified PPE at all times when entering site and during execution of their tasks. Any employee found not in possession or is found with defective equipment in the opinion of an authorized Foskor official will be denied access onto site.

Note: This is for your SAFETY

Pranil Singh
Safety Superintendent

PO: BASELINE RISK ASSESSMENT



**OCCUPATIONAL HEALTH AND SAFETY
BASELINE RISK ASSESSMENT**

SPECIFICALLY DESIGNED FOR

FOSKOR RICHARDSBAY

FOR

**Upgrade of The Primary and
Secondary Pollution Control Dams**

**PREPARED BY: C&M SAFETY CONSULTANTS
DATE PREPARED: 19 May 2023**

BASELINE RISK ASSESSMENT
Foskor Richardsbay – Upgrade of The Primary and Secondary Pollution Control Dams

CLIENT:
Foskor Richardsbay

PROJECT LOCATION:
Upgrade of The Primary and Secondary Pollution Control Dams

SCOPE OF WORK:

Inception:

1. Site establishment
2. Dewatering both dams – pumping to effluent line
 - a. Desilt around dam 2 pumpstation end.
 - b. Install submersible pump in dam 1 that will pump to the suction end of dam 2/
3. Desilting both dams
 - a. Excavate with front end loaders and bobcats that load into skips.
 - b. Skips transported and off load silt at Foskor Gypsum disposal site.
4. Fabricate dam 2 pumpstation platform by demolishing concrete section and constructing opening in wall as per DWG. R21-097-00-204.
5. Install pumps S2 and S3 with DB board.
 - a. Install pump and motor combination with frame on existing structure as per DWG. R21-097-00-204.
 - b. Install new switchgear for ear pump including the installation of ultrasonic level transmitters.
6. Install pipeline from pump S2 to effluent pipeline and install pipeline from pump S3 to Gypsum pipeline.
 - a. Install T-piece on effluent pipeline and Gypsum pipeline with reducers.
 - b. Install isolation valve and non-return valves on discharge pipes with valve chambers.
7. Install T-piece on effluent pipeline and Gypsum pipeline with reducers for the connection of pipes from pump S1 and pump P2.
 - Install isolation valves and non-return valves on discharge pipes with valve chambers for later connection.
8. Install non-return valve on effluent pipeline with valve chambers.
9. Install non-return valve on gypsum pipeline with valve chamber.
10. Break into reinforced concrete sump and connect discharge pipe section from P1.
 - a. Install isolate valve and non-return valve on discharge pipe with valve chamber.
11. Decommission and dismantle existing pumpstation South of the dams and remove existing pipelines.

BASELINE RISK ASSESSMENT
Foskor Richardsbay – Upgrade of The Primary and Secondary Pollution Control Dams

Dam 1:

1. Expose pipelines discharging into primary dam and connect to new diversion pipelines that discharge into dam 2.
2. Decommission and dismantle existing dam 1 pumpstation and remove pipelines.
3. Demolish dam 1 concrete surface layer.
4. Demolish existing dam 1 pump base.
5. Demolish reinforced concrete culvert inlet structure into dam 1 from dam 2.
6. Excavate in all material for dam 1 to require depths.
7. Rip and recompact in-situ material for dam 1.
8. Excavate anchor trenches around dam 1.
9. Import G9 natural gravel, place and compact for dam 1.
10. Import G5 natural gravel, place and compact for dam 1.
11. Construct reinforced concrete subsoil / leakage detection sump.
12. Install sub-soil drainage pipeline including the placement of 19mm stone and wrapping in geotextile.
13. Install sub-soil drainage abstraction pipeline.
14. Import G5 natural gravel, place and compact for dam 1 above subsoil drainage.
15. Import and install GCL.
16. Import and install Tertiary liner geomembrane.
17. Import and install geotextile.
18. Import and install cusped drainage sheet.
19. Install leakage detection pipeline including the placement of 19mm stone.
20. Install leakage detection abstraction pipeline.
21. Import and install Geotextile.
22. Import and install Secondary liner geomembrane.
23. Import and install geotextile.
24. Install leakage detection pipeline including the placement of 19mm stone.
25. Install leakage detection abstraction pipeline.
26. Import and install geotextile.
27. Import and install Primary liner geomembrane.
28. Import and install Geotextile.
29. Import and install geocells.
30. Import and pour concrete into geocells.
31. Excavate for the construction of gravel access road.

BASELINE RISK ASSESSMENT

Foskor Richardsbay – Upgrade of The Primary and Secondary Pollution Control Dams

32. Install hydraulic barrier discharge pipeline to dam 1.
 - a. Install isolation valve on discharge pipe with valve chamber.
 33. Rip and recompact in-situ material for access road.
 34. Import G9 natural gravel, place and compact for under road.
 35. Import G7 natural gravel, place and compact for under road.
 36. Import G5 natural gravel, stabilize to C4, place and compact for road surface.
 37. Install pipelines underground between dams for pump P1 and pump S1.
 38. Construct cover slabs with covers for the three abstraction pipelines.
 39. Construct reinforced concrete pump base for Pump P1 and pump P2.
 40. Install suction pipelines for pump P1 and including concrete anchor blocks.
 41. Install pump P1 with DB board.
 - a. Install pump and motor combination with frame on new concrete base.
 - b. Install new switchgear for pump including the installation of ultrasonic level transmitters.
 42. Install pump P2 with DB bard.
 - a. Install pump and motor combination with frame on new concrete base.
 - b. Install new switchgear for pump including the installation of ultrasonic level transmitters.
 43. Construct inlet structure for inlet pipes.
- Dam 2:
1. Expose pipelines discharging into secondary dam and connect to new diversion pipelines that discharge into dam 1.
 2. Install submersible pump in dam 2 inlet structure that will pump to dam 1.
 3. Demolish inlet structure section leading to dam 1 from dam 2.
 4. Excavate all material for dam 2 to require depths.
 5. Remove and discard existing concrete railway sleepers.
 6. Rip and recompact in-situ material for dam 2.
 7. Excavate anchor trenches around dam 2.
 8. Import G9 natural gravel, place and compact for dam 2.
 9. Import G5 natural gravel, place and compact for dam 2.
 10. Construct reinforced concrete subsoil / leakage detection sump.
 11. Install sub-soil drainage pipeline including the placement of 19mm stone and wrapping in geotextile.
 12. Install sub-soil drainage abstraction pipeline.
 13. Import G5 natural gravel, place and compact for dam 2 above subsoil drainage.

BASELINE RISK ASSESSMENT

Foskor Richardsbay – Upgrade of The Primary and Secondary Pollution Control Dams

14. Import and install GCL.
15. Import and install Tertiary liner geomembrane.
16. Import and install Geotextile.
17. Import and install suspected drainage sheet.
18. Install leakage detection pipeline including the placement of 19mm stone.
19. Install leakage detection abstraction pipeline.
20. Import and install Geotextile.
21. Import and install Secondary liner geomembrane.
22. Import and install Geotextile.
23. Install leakage detection pipeline including the placement of 19mm stone.
24. Install leakage detection abstraction pipeline.
25. Import and install Geotextile.
26. Import and install Primary liner geomembrane.
27. Import and install Geotextile.
28. Import and install Geocells.
29. Import and pour concrete geocells.
30. Reposition existing boundary fence.
31. Excavate for the construction of gravel access road.
32. Rip and recompact in-situ material for access road.
33. Import G9 natural gravel, place and compact for under road.
34. Import G7 natural gravel, place and compact for under road.
35. Import G5 natural gravel, stabilize to C4, place and compact for road surface.
36. Construct cover slabs with covers for the three abstraction pipelines.
37. Construct reinforced concrete pump base for pump S1.
38. Install suction pipelines for pump S1 including concrete anchor blocks.
39. Install pump S1 with DB board.
 - a. Install pump and motor combination with frame on new concrete base.
 - b. Install new switchgear for pump including the installation of ultrasound level transmitters
40. Construct reinforced concrete overflow weir from dam 1 to dam 2.
41. Construct reinforced concrete overflow weir for dam 2.
42. Excavate all in material for construction of dam 2 overflow channel.
43. Rip and recompact in-situ material for dam 2 overflow channel.

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44. Construct gabion and reno matters overflow channel for dam 2.
45. Construct reinforced concrete road access over overflow channel.

Finishes:

1. Construct reinforced concrete vehicle entrance ramps for dam 1 and dam 2.
2. Demolish existing concrete channels leading to dam 2.
3. Excavate all material for v-drain North of dam 1.
4. Rip and recompact in-situ material for v-drain North of dam 1.
5. Import G5 natural gravel, place and compact for v-drain North of dam 1.
6. Construct concrete v-drain North of dam 1 leading to dam 2.
7. Excavate all material for concrete trapezoidal channel North of dam 2.
8. Rip and recompact in-situ material for trapezoidal channel North of dam 2.
9. Import G5 natural gravel, place and compact for trapezoidal channel North of dam 2.
10. Construct concrete trapezoidal channel North of dam 2 leading to dam 2.
11. Excavate all material for v-drains leading to concrete trapezoidal channel.
12. Rip and recompact in-situ material for v-drains leading to concrete trapezoidal channel.
13. Import G5 natural gravel, place and compact for v-drains leading to concrete trapezoidal channel.
14. Construct concrete v-drains leading to concrete trapezoidal channel.
15. Cast reinforced concrete floor slab between dam 1 and dam 2.

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RISK RATING CRITERIA

A	INJURY SEVERITY	B	FREQUENCY of OCCURENCE	RATING	
				RISK CLASSIFICATION	RISK VALUE
0	No injury	0	Has not occurred in last two years	LOW	0---6
2	Minor laceration, wound (first aid case)	2	Occurs very seldom	MEDIUM	6---16
4	More severe injury medical attention	4	Occurs occasionally	HIGH	16---32
8	Serious injuries, broken bones, amputation etc	8	Occurs often	CRITICAL	32---40
10	Loss of life / fatality	10	Could / has happened		
C					
POTENTIAL DAMAGE / LOSS					
D					
ENVIRONMENT					
0	No damage, minimal costs R10 – 100	0	No effect	Spillage, noise, water, dust / vapours/ fauna and flora	Supervision, training, certification, method/risk assessments, safe work procedures training, toolbox talks.
2	Minor damage, small costs R100 – 1000	2	Minor effect		
4	Med damage, stoppage (On site repair) medium cost R1000 – 5000	4	Serious effect (Short term)		
8	More serious damage // loss / delay < R5000 - +	8	Very serious effect (Long Term)		
10	Severe damage, long term stoppage, high costs	10	Catastrophic effect		
ACTION REQUIRED					
				LOW	Good instruction.
				MEDIUM	Change method, mitigate
				HIGH	Change method, mitigate
				CRITICAL	Change method, mitigate



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	POTENTIAL HAZARD	POSSIBLE RESULT	RISK EVALUATION					PREVENTATIVE MEASURES	CONTROLS
			A	B	C	D	R		
Site establishment	<ul style="list-style-type: none"> Poor positioning of offices, stores and parking areas. 	<ul style="list-style-type: none"> Restricted access to parking and delivery to storage areas can cause damage to transport, equipment and buildings. 	2	2	4	0	8	<ul style="list-style-type: none"> Access to be a main consideration when positioning offices and stores on site during planning stage; possible one way traffic movement to be introduced. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; directional signs and supervision.
	<ul style="list-style-type: none"> Incorrect installation of cables and distribution boards. 	<ul style="list-style-type: none"> Damage to exposed cables and loose wires; Electrical shock / Electrocutation of employees or non employees. 	10	2	8	0	20	<ul style="list-style-type: none"> All cables from distribution board to offices, stores and security to be underground; the distribution board is to stand on a firm level base and should be locked at all times; Electrical installations must be in compliance with the Electrical Installations Regulations 2009. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; constant reinforcement and inspections by an appointed competent person and findings recorded in a register kept on site.
	<ul style="list-style-type: none"> Installation of security fencing. 	<ul style="list-style-type: none"> Installation of fencing can result in lacerations and other minor injuries to the hands of the workers; Objects falling on feet of workers. 	2	2	2	0	6	<ul style="list-style-type: none"> Security fencing must be minimum height of 1.8m around site area together with two double gates; Employees must wear hand gloves and safety boots at all times. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; constant reinforcement and inspections by an appointed competent person and findings
	<ul style="list-style-type: none"> Fire Fighting Equipment not provided. 	<ul style="list-style-type: none"> Not having Fire Fighting Equipment available in case of a fire can result in loss of property. 	0	2	8	2	12	<ul style="list-style-type: none"> Fire fighting Services to be available during site establishment; Fire fighting equipment to be included on first order placed for contract. 	<ul style="list-style-type: none"> Site Agent to ensure that sufficient fully serviced fire fighting equipment to meet the fire risk is on site from the start up of the site establishment; training on use of fire fighting equipment; fire risk surveys; fire drills and scheduled inspections on fire equipment
	<ul style="list-style-type: none"> Not providing required hygiene facilities. 	<ul style="list-style-type: none"> Not having proper hygiene facilities available like clean drinking water, toilets, showers, changing facilities and sheltered eating 	4	2	4	2	12	<ul style="list-style-type: none"> Hygiene facilities to be available in compliance with the Facilities Regulation 2004 and must be within reasonable access of the site; clean hygienic and maintained facilities consisting of at least 1 shower for every 15 persons, 1 sanitary facility for each sex for every 30 workers, changing facilities 	<ul style="list-style-type: none"> Site Agent to ensure that sufficient fully maintained hygiene facilities are on site from the start of the site establishment; talks on hygiene; regular inspections carried out on the facilities.

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		for each sex; Sheltered eating areas.						
	areas will result in unhygienic conditions which can lead to Health issues and water pollution	10	2	0	0	12		
Site establishment	<ul style="list-style-type: none"> Not providing required First Aid facilities. 	10	2	0	0	<ul style="list-style-type: none"> To be in compliance with General Safety Regulations Regulation 3; First Aid box with minimum contents as listed on the Annexure pertaining to Regulation 3; Trained First aiders who is in possession of valid certificates of competency issued by a Person or Organisation approved by the Chief Inspector. 	<ul style="list-style-type: none"> Site Agent to ensure First aid facilities are on site from the start of the site establishment; sufficient First aid boxes to be available and regular inspections carried out on the contents thereof and replenished where required; first aiders to be trained and valid dates on certificates not expired. 	
Surveyor set out area to be cleared and grub with wooden survey pegs	<ul style="list-style-type: none"> Heat Exposure Environmental hazards 	4	4	2	0	10	<ul style="list-style-type: none"> Risk assessment training; Daily safe task instructions; Potable water available on site; Wearing of appropriate PPE Wearing of appropriate PPE; Daily safe task instructions; Trained First Aider on site; When possible snake / spider to be identified to assist medical personnel with treatment. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; DSTI's; Supervision. Detailed risk assessment and training on RA; DSTI's; Supervision. PPE Matrix and issue Registers
Static traffic management through the placement of signage	<ul style="list-style-type: none"> Signage not visible to oncoming traffic. Incorrect Signage. 	10	4	8	4	26	<ul style="list-style-type: none"> A traffic management plan needs to be drawn up before construction work affects the road, this will include a diagram which will indicate the legal required positioning of temporary road signs in relation to the activities on the road; Flashing lights need to be used during the night to ensure visibility; A Responsible person needs to be assigned to exercise control and ensure that the management plan is implemented; Consult Chapter 13 of the Road Traffic Signage manual. Consult local roads department regarding the correct signage to be used & attach correspondence & information to the plan. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; Supervision; Daily safe task instructions; Audits Detailed risk assessment and training on RA; Supervision; Daily safe task instructions; Audits



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ACTIVITY	POTENTIAL HAZARD	POSSIBLE RESULT	RISK EVALUATION					PREVENTATIVE MEASURES	CONTROLS
			A	B	C	D	R		
Operation of mobile plant & construction vehicles	<ul style="list-style-type: none"> Untrained operators operating mobile plant 	<ul style="list-style-type: none"> Causing accidents involving people, other mobile plant, existing structures, Spillages resulting in ground contamination. 	10	2	8	2	22	<ul style="list-style-type: none"> Only certified competent, medically fit and legally appointed employees may operate mobile plant & construction vehicles; Certificates of competency of the operators Must be filed in the safety file on site. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to operators; Certificates of competency of the operators on file.
	<ul style="list-style-type: none"> Sub standard condition of machinery 	<ul style="list-style-type: none"> Failure of machine parts could result in injury to the operator, other employees, damage to mobile machines, vehicles or structures. 	8	2	8	0	18	<ul style="list-style-type: none"> A supervisor of machinery needs to be appointed to ensure that all plant is maintained & records thereof kept; A planned maintenance schedule must be followed & operators must record daily inspections & report deviations immediately to the supervisor. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; Toolbox talks; Supervision; Constant reinforcement & specific instructions to operators; daily vehicle checklists.
	<ul style="list-style-type: none"> Overhead power lines 	<ul style="list-style-type: none"> Possible electrical shock and burns or electrocution of the operator and other workers; damage to power lines, plant & interruption of electrical supply causing delays resulting in financial losses. 	10	2	10	0	22	<ul style="list-style-type: none"> A risk assessment needs to be conducted prior to allowing operation of mobile plant/vehicles on site to identify exposure to overhead power lines; f power lines are present then a safe work procedure must be drawn up; Signage to be displayed & safe distances to be marked out for operators. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to operators.
Machine Excavations	<ul style="list-style-type: none"> Working in the wrong place. 	<ul style="list-style-type: none"> Striking of other underground services 	4	2	8	4	18	<ul style="list-style-type: none"> Trained competent person to do the layout & ensuring the correct location of all other services; permit system to be followed. 	<ul style="list-style-type: none"> Trained competent person does all the layout of the area & checking drawings & of other services in the area; Permit to be issued to carry out work.
	<ul style="list-style-type: none"> Striking unknown underground services. 	<ul style="list-style-type: none"> Severe injuries or damage to plant & equipment. Spillages resulting in ground contamination. 	4	2	8	4	18	<ul style="list-style-type: none"> Only trained competent licensed operators to operate machines; All operators to be appointed in writing. 	<ul style="list-style-type: none"> Trained competent operators appointed; Daily toolbox talks on ongoing operations.
	<ul style="list-style-type: none"> Workers being injured by moving machines. 	<ul style="list-style-type: none"> Severe injuries or Fatalities 	10	2	2	0	14	<ul style="list-style-type: none"> Banks man in place during mechanical operations; Only trained competent licensed operators to operate machines; All operators to be appointed in writing. 	<ul style="list-style-type: none"> Trained competent operators appointed; Daily toolbox talks on ongoing operations.



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ACTIVITY	POTENTIAL HAZARD	POSSIBLE RESULT	RISK EVALUATION				PREVENTATIVE MEASURES	CONTROLS	
			A	B	C	D			R
Machine Excavations	<ul style="list-style-type: none"> Un-roadworthy, unsafe machines being used. 	<ul style="list-style-type: none"> Failure of machine parts can result in injuries to operator, other employees, damage to mobile machines, vehicles or structures. 	8	2	8	0	18	<ul style="list-style-type: none"> A supervisor of machinery needs to be appointed to ensure that all plant is maintained & records kept thereof; A planned maintenance schedule must be followed & operators must record daily inspections & report deviations immediately to the supervisor. 	<ul style="list-style-type: none"> Risk assessment training; Toolbox talks; Supervision; Constant reinforcement & specific instructions to operators.
	<ul style="list-style-type: none"> Spoil is stacked too close to the edge of the excavation & causing it to collapse / fall back into the excavation. 	<ul style="list-style-type: none"> Lost time, damage and/or possible injury depending on the depth of the excavation. 	4	2	2	0	8	<ul style="list-style-type: none"> Ensure that the spoil removed is placed at least one meter from the edge of the excavation; ensure that there are no cracks in the side walls. 	<ul style="list-style-type: none"> As spoil is removed, it must be ensured that it is placed at least 1 meter from the edge of the excavation.
	<ul style="list-style-type: none"> Excavation collapsing 	<ul style="list-style-type: none"> Depending on depth, injuries or even fatalities; damage to machines. 	10	4	4	0	18	<ul style="list-style-type: none"> Ensure sides of excavation are stable, if unstable, the sides must be shored or cut back to prevent subsidence / collapse; Ladder access must be available for egress from the excavation within 6 metre of place of work. 	<ul style="list-style-type: none"> Regular inspection by competent trained person to ensure that the excavation is stable & safe.
	<ul style="list-style-type: none"> Improper barricading or warning signs to indicate location of an excavation 	<ul style="list-style-type: none"> Serious injuries, possible fatalities can occur if vehicle drivers are not aware of the excavation and drive into the excavation especially at night; other workers not aware of the excavation falling into the excavation. 	10	2	8	0	20	<ul style="list-style-type: none"> Ensure that barricades (barrier or fence) are put around the excavation at least 1 meter away from the edge, provide warning illuminants or any other clearly visible boundary indicators at night or when visibility is poor if accessible to the public, adjacent to public roads or through fares. 	<ul style="list-style-type: none"> Barricading is installed & maintained at all times; Explanation via toolbox talks why they are required & must be maintained.
	<ul style="list-style-type: none"> Unsafe work practises / conditions can occur if scheduled inspections are not carried out. 	<ul style="list-style-type: none"> Can result in injuries or even fatalities; damage to machines. 	8	2	8	0	18	<ul style="list-style-type: none"> Daily inspections are carried out & documented on a checklist by a competent trained person - Excavation Supervisor. 	<ul style="list-style-type: none"> Minimum of daily checks on all excavations to be carried out using a standard checklist; Inspection of excavation to be carried out by competent trained person.

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ACTIVITY	POTENTIAL HAZARD	POSSIBLE RESULT	RISK EVALUATION					PREVENTATIVE MEASURES	CONTROLS
			A	B	C	D	R		
Loading and Off loading of equipment	<ul style="list-style-type: none"> Overloading; damage to plant & equipment. Untrained / incompetent persons using the equipment; loads being dropped. 	<ul style="list-style-type: none"> Costs. Losses. Possible injuries to workers. Damage to material, equipment & plant; Injury to workers and/or plant. 	4	2	4	0	10	<ul style="list-style-type: none"> Competent person to ensure the correct type & capacity of transport is used. Only competent trained persons are permitted to operate the self contained crane; a Banks man / Rigger to be available at all times to co-ordinate & control the material being loaded or unloaded. 	<ul style="list-style-type: none"> Correct transport & in good condition. Ensure truck driver, crane operator & banks man are trained & are appointed as competent persons; Training certificates should be available. The banks man must use his whistle at all times when a suspended load is moving above workers to warn them. The checking of documentation & ensuring that work is carried out safely; do not permit sub-standard equipment to be used during lifting procedures; Lifting machines and lifting tackle to be visually inspected for damage before use.
	<ul style="list-style-type: none"> Substandard lifting machines and lifting tackle being used and falling when being used. 	<ul style="list-style-type: none"> Injury and/or damage to plant equipment. 	4	2	4	0	10	<ul style="list-style-type: none"> All lifting machines and lifting tackle are on register; have been tested & checked by a competent appointed person; Test certificates must be available for all lifting machines i.e. cranes, and lifting tackle, i.e. slings, shackles, block and tackle etc 	
	<ul style="list-style-type: none"> Unstable stacking and storage 	<ul style="list-style-type: none"> Collapsing stack and material falling off the stack can fall on employees resulting in multiple injuries; damaging of stored items. 	8	2	8	0	18	<ul style="list-style-type: none"> Competent person appointed in writing with the duty to supervise all stacking on site; Demarcated storage area; Stacking area must be stable and levelled to avoid material falling; Storage area must be kept neat and under control. 	<ul style="list-style-type: none"> Supervision by a competent person appointed in writing; Constant reinforcement; Toolbox talks.
Stacking and Storage	<ul style="list-style-type: none"> Stacking material of different sizes, shape and mass together 	<ul style="list-style-type: none"> Collapsing stack and material falling off the stack can fall on employees resulting in multiple injuries; damaging of stored equipment. 	8	2	8	0	18	<ul style="list-style-type: none"> Competent person appointed in writing with the duty to supervise all stacking on site; Demarcated storage area; Stacking area must be stable and levelled to avoid material falling; Storage area must be kept neat and under control; Material of the same size, shape / mass must be stacked and stored together to avoid the material falling. 	<ul style="list-style-type: none"> Supervision by a competent person appointed in writing; Constant reinforcement; Toolbox talks.
	<ul style="list-style-type: none"> Stacking exceeding 3m in height. 	<ul style="list-style-type: none"> It can cause material to fall and serious injuries and damage to 	8	2	8	0	18	<ul style="list-style-type: none"> Competent person appointed in writing with the duty to supervise all stacking on site; Demarcated storage area; 	<ul style="list-style-type: none"> Supervision by a competent person appointed in writing; Constant reinforcement; Toolbox

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							Stacking area must be stable and levelled to avoid material falling; Storage area must be kept neat and under control; Total height of stack must not exceed 3m to avoid material from falling onto the ground.	talks.
Hand Tools, Mechanical and Hydraulic operated tools.	<ul style="list-style-type: none"> Using tools which have the potential to cause injury. 	<ul style="list-style-type: none"> Possible injury if used incorrectly. 	4	2	4	0	10	<ul style="list-style-type: none"> Only trained competent persons to have access to the tools; Tools on register & checked on a regular basis; visually inspect tools for damage before use; Daily toolbox talks; PPE Register.
	<ul style="list-style-type: none"> Not being able to do the job properly due to insufficient or poor quality tools 	<ul style="list-style-type: none"> Substandard work; Possible damage to plant & equipment; delays in completing the job; Injuries due to tools failing. 	4	2	8	0	14	<ul style="list-style-type: none"> Standard for type and quality of tools used on site; Risk Assessments; Tools on register & checked on a regular basis; Daily toolbox talks; PPE Register.
Portable Electrical tools	<ul style="list-style-type: none"> Using portable electrical tools which have the potential to cause injury. 	<ul style="list-style-type: none"> Possible injury , electrical shock or electrocution if used incorrectly 	4	2	4	0	10	<ul style="list-style-type: none"> Only trained competent persons to have access to the portable electrical tools; Portable electrical tools on register & checked on a regular basis; visually inspect portable electrical tools for damage before use; Daily toolbox talk; PPE Register.
	<ul style="list-style-type: none"> Not being able to do the job properly due to insufficient or poor quality portable electrical tools. 	<ul style="list-style-type: none"> Substandard work; possible damage to plant & equipment; delays in completing the job; Injuries due to tools failing. 	4	2	8	0	14	<ul style="list-style-type: none"> Standard for type and quality of portable electrical tools used on site; Risk Assessments; Tools on register & checked on a regular basis; PPE Register.
	<ul style="list-style-type: none"> Unsafe portable electrical tools due to broken switches, damaged cables, plugs and missing machine guards. 	<ul style="list-style-type: none"> Possible injury, electrical shock or electrocution. 	10	8	4	0	22	<ul style="list-style-type: none"> Only trained competent persons to have access to the portable electrical tools; Portable electrical tools on register & checked on a regular basis; visually inspect portable electrical tools for damage before use; Daily toolbox talks; PPE Register.



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ACTIVITY	POTENTIAL HAZARD	POSSIBLE RESULT	A	B	C	D	R	PREVENTATIVE MEASURES	CONTROLS
Hazardous Chemicals & Flammable Liquids	<ul style="list-style-type: none"> Exposure to source of ignition; inhaling vapours / fumes; contact with the skin; accidental ingestion; Chemicals splashing into eyes; spillage of chemicals on ground and in water. 	<ul style="list-style-type: none"> Fire or explosion when ignited; respiratory irritation from fumes and vapours which can cause injuries to the respiratory system, dizziness, nausea & loss of consciousness if inhaled constantly. Irritation & possible skin disorders like Dermatitis, infection, allergy and poisoning when skin is exposed constantly to chemicals; low viscosity material if swallowed may enter the lungs and cause lung damage; eye injuries from chemicals splashing into the eyes; Ground and water pollution. 	4	2	8	2	16	<ul style="list-style-type: none"> Keep product away from high energy ignition sources, heat, sparks, pilot lights, static electricity & open flames; Explosion proof lighting and switches to be installed in storage area; Avoid contact with the skin by wearing gloves; Wear respirators if exposed to the inhalation of vapours or mists; Use in well ventilated area away from all ignition sources; no smoking or open flames in close proximity; firefighting equipment must be available at the point of storage & use; Store in banded area with suitable warning signs visible; Do not ingest the product; wear splash goggles when handling chemicals; Eye wash to be available; Workers trained on the correct use of personal protective equipment issued; Material Safety Data Sheets available for all Hazardous chemical substances; Spill kit to be available; Hazardous Chemical substances Co-ordinator to be appointed in writing. 	<ul style="list-style-type: none"> Detailed Risk Assessment; Training on MSDS sheets; Constant Supervision & Reinforcement of Preventative Action; PPE register; Daily toolbox talks.
	Bulk Diesel Storage	<ul style="list-style-type: none"> Sub-standard storage; spills & Delays. 	<ul style="list-style-type: none"> Ground and water pollution; ignition of fuel causing fire damage and possible burn injuries and delays in availability leaving machines standing and running at financial loss; fires from the local authorities. 	8	2	8	2	20	<ul style="list-style-type: none"> Obtain written approval from land owner where the tank will be positioned; Site plan and positioning of the Diesel tank along with the local fire departments approval after inspection needs to be supplied to the supplier before the installation can commence; Fire fighting equipment requirements information can be obtained from the fire department on their visit to site; The fuel supplier will then visit the site for approval before installation can commence.

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ACTIVITY	POTENTIAL HAZARD	POSSIBLE RESULT	RISK EVALUATION					PREVENTATIVE MEASURES	CONTROLS
			A	B	C	D	R		
Compaction of ground using a whacker	<ul style="list-style-type: none"> Not knowing how to operate whacker; Getting struck by uncontrolled whackers; Constant vibration on the body; Noise above 85 dBA; Defective whackers. 	<ul style="list-style-type: none"> Improper operation of the whacker can result in damage to materials, structures or vehicles; Hand-arm vibration Injuries; hearing loss. 	8	2	4	0	14	<ul style="list-style-type: none"> Only trained, competent & authorized employees may operate this machine; Do not work too close to other employees, valuable material or vehicles with the roller; Never leave machine unattended while in operation; Only operate when authorized to do so and when trained on the risks involved; Use drip tray when refuelling; Always wear hearing protection, safety boots and anti-vibration gloves; A fire extinguisher should be available in event of a fire; Report any defective machinery to the Supervisor & the Store man; Make sure that the stop / start buttons are in working condition; Workers trained on the correct use of personal protective equipment issued. 	<ul style="list-style-type: none"> Detailed Risk Assessment and workers trained on RA; Method statement and workers trained on content; Induction training; Daily Toolbox Talks; PPE register ; visually inspect Whacker for damage before use.
Delivery of bedding	<ul style="list-style-type: none"> Import material dump at wrong location. 	<ul style="list-style-type: none"> Environmental impact; cost 	0	4	4	4	12	<ul style="list-style-type: none"> Ensure that the manager and drivers of the service provider who deliver material for bedding have undergone induction training on the site safety requirements and that the location of the dump site has been pointed out to them; Delivery of bedding material to be done under supervision. 	<ul style="list-style-type: none"> Induction training of service provider employees; Supervision of deliveries.
Pipe laying	<ul style="list-style-type: none"> Rigger not competent, lifting pipe using TLB; TLB operator not competent; TLB defective; employees in trenches whilst pipe being lifted and lowered; positioning and assembling of pipes; improper use of PPE. 	<ul style="list-style-type: none"> Incorrect rigging can cause pipe to fall causing damage to pipe or serious injuries to workers in trench; injuries whilst positioning and assembling pipes; incompetent TLB operator unable to operate TLB properly can cause damage to TLB and pipes or injuries to operator or workers; defective TLB can cause damage to TLB and pipes or cause injuries to operator or workers should the brakes, 	8	2	8	0	16	<ul style="list-style-type: none"> Competent Rigger to be appointed in writing; Lifting tackle must be inspected before being used; TLB operator to be certified competent and appointed in writing; TLB must be in a good working order and inspected daily; No employees shall be in trenches whilst pipes are being lifted into place; Workers trained on the hazards and risks pertaining to the tasks to be performed; Workers trained on the correct use of personal protective equipment issued. 	<ul style="list-style-type: none"> Detailed Risk Assessment and workers trained on RA; Method statement in place and workers trained on content; Induction training; Competency records of Rigger and TLB operator on file; site supervision; toolbox talks and PPE registers; TLB daily checklist.



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ACTIVITY	POTENTIAL HAZARD	POSSIBLE RESULT	RISK EVALUATION					PREVENTATIVE MEASURES	CONTROLS
			A	B	C	D	R		
Using ladders for access	<ul style="list-style-type: none"> Defective ladders; ladders used by workers not trained in the safe use and maintenance of ladders; unsafe placing, climbing or securing of ladders; using the wrong ladder for the job; using ladders in unfavourable weather conditions; work done from a ladder. 	<p>hydraulic lifting cylinders etc. be defective and the operator lose control.</p> <ul style="list-style-type: none"> All potential hazards can result in serious injuries or Fatality. 	10	2	0	0	20	<ul style="list-style-type: none"> Only ladders in compliance with General Safety Regulation 13A of the Occupational Health and Safety Act may be used and used in the manner as set out in the regulation; No home made ladders are allowed on site; Only workers trained in the safe use and maintenance of ladders are allowed to use ladders; ladders must be numbered and listed in a register; ladders must be inspected on a scheduled basis by an appointed competent person who has the training and the knowledge on the safe use and maintenance of ladders in compliance with GSR 13A and the results of the findings recorded in the register; damaged ladders which cannot be repaired must be cut up and discarded; before using a ladder, the person trained in the use of ladders who is going to use the ladder, must inspect the ladder to ensure that it is safe to use; Ladders must not be used in inclement weather conditions; both hands to be used to climb the ladder; Carry tools in a tool bag that's secured to the waist; The ladder must always be secured when used, either by tying the top end of the ladder to the structure with a rope or being held in position by another person; The ladder must where possible, always protrude 900mm past the working platform; Where work is to be carried out whilst standing on a ladder, a safety harness must be used anchored to a point above the point of work; place a ladder so that its feed is a quarter of its own length from the object it is resting against; Only wooden ladders or ladders specifically constructed for the purpose should be used where there is a danger of coming into contact with electricity. 	<ul style="list-style-type: none"> Detailed Risk Assessment and workers trained on RA; Method statement in place and workers trained on content; induction training; Records of training on use of ladders; Only trained competent persons to have access to ladders; Ladder inspection registers; Strict supervision to ensure compliance;



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ACTIVITY	POTENTIAL HAZARD	POSSIBLE RESULT	RISK EVALUATION					PREVENTATIVE MEASURES	CONTROLS
			A	B	C	D	R		
Manual Handling	<ul style="list-style-type: none"> Lifting heavy loads i.e. bags of cement, heavy tools or equipment. 	<ul style="list-style-type: none"> Employees could injure their backs when picking up heavy loads on their own. 	4	2	0	0	8	<ul style="list-style-type: none"> Employees must never pick up anything that is too heavy for one person. If you battle to lift an item, get assistance from another colleague. Where possible use mechanical lifting equipment i.e. forklifts, cranes etc. to pick up heavy equipment. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees;
	<ul style="list-style-type: none"> Loads with sharp edges/corners 	<ul style="list-style-type: none"> Sharp edges and corners could cause lacerations to hands and other body parts 	2	2	4	0	8	<ul style="list-style-type: none"> Always inspect the load before you lift to check for sharp edges & corners. Always wear leather gloves when picking up equipment and materials so that your hands are protected. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees.
	<ul style="list-style-type: none"> Wrong posture when lifting/placing down items 	<ul style="list-style-type: none"> Employees that pick items up with their legs straight and back bent can sustain serious back & muscle injuries. 	4	2	2	0	8	<ul style="list-style-type: none"> Employees must ensure that they keep their back straight and bend their knees when they lift any load; this prevents strain on the lower back. Physical demonstrations should be given to all employees. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees.
Backfilling an excavation manually	<ul style="list-style-type: none"> Substandard access in and out of excavation 	<ul style="list-style-type: none"> Substandard access can cause employees not being able to escape when required; serious injuries or suffocation resulting in fatalities can occur when being buried or trapped by a fall or dislodgement of material. 	10	2	8	0	18	<ul style="list-style-type: none"> Permission to work to be given in writing by a competent person, Professional Engineer or Technologist competent in excavations; Supervision by a competent person appointed in writing; daily checks prior to the commencement of each shift by the appointed competent person and recorded in a register; ladders must be inspected on a scheduled basis by an appointed competent person who has the training and the knowledge on the safe use and maintenance of ladders in compliance with GSR 13A and the results of the findings recorded in the register; ladders may not be further than six meters from point of work; Employees must be trained how to use the ladder to get in and out of the excavation. 	<ul style="list-style-type: none"> Detailed Risk Assessment and workers trained on RA; Method statement and workers trained on content; Record of training on the use of the ladders; Daily Toolbox Talks; Supervision by an appointed competent person; Daily checks register carried out by the competent person appointed to supervise; ladder inspection register; Permission to work in writing; Emergency rescue plan.



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ACTIVITY	POTENTIAL HAZARD	POSSIBLE RESULT	A	B	C	D	R	PREVENTATIVE MEASURES	CONTROLS
Backfilling an excavation manually	<ul style="list-style-type: none"> Working where high temperatures, high humidity, direct sunlight and poor air circulation occurs, carrying out strenuous physical activities; Worker unacclimatized to working in such conditions. 	<ul style="list-style-type: none"> Heat exhaustion: Headaches, dizziness, fainting, irritability, confusion, upset stomach or vomiting. Heat Stress: Dry hot skin with no sweating, mental confusion, losing consciousness, seizures or convulsions. Heat stress can lead to death. 	10	4	4	0	18	<ul style="list-style-type: none"> Heat stress monitoring to be carried out; Standard procedure to be in place for working in areas where high temperatures, high humidity, direct sunlight and poor air circulation occurs, carrying out strenuous physical activities with the possibility of heat exhaustion or heat stress occurring; All persons working in such conditions must be trained on the contents of the procedure and to recognise the symptoms of heat exhaustion and heat stress, how to prevent it by drinking at least 600 ml of water every hour, taking regular breaks from the area, action to be taken when the symptoms are experienced or observed by moving the worker to a cool shaded place, provide water, fan to create air movement, cover the person with damp clothing to cool the body off and seeking medical assistance immediately; All persons working in such conditions must have medical certificate of fitness issued by a Occupational Health Practitioner (OHP) declaring that this person is fit to perform duties where high temperatures etc. occurs; Sufficient quantity of potable drinking water available; Supervision by a competent person appointed in writing. 	<ul style="list-style-type: none"> Detailed Risk Assessment and workers trained on RA; Method statement and workers trained on content; Record of heat stress monitoring carried out; Record of training on standard procedure for working in areas where high temperatures, high humidity, direct sunlight and poor air circulation occurs, carrying out strenuous physical activities with the possibility of heat exhaustion or heat stress occurring; Ensure availability of potable drinking water ; Daily Toolbox Talks; Supervision by an appointed competent person; Daily checks register carried out by the competent person appointed to supervise; Permission to work in writing; Emergency rescue plan.
	<ul style="list-style-type: none"> Fall or dislodgement of material from side of excavation. 	<ul style="list-style-type: none"> Serious injuries or suffocation resulting in fatalities can occur when being buried or trapped by a fall or dislodgement of material 	10	2	8	0	20	<ul style="list-style-type: none"> Permission to work to be given in writing by a competent person, Professional Engineer or Technologist competent in excavations; Supervision by a competent person appointed in writing; daily checks prior to the commencement of each shift by the appointed competent person and recorded in a register; Excavation to be adequately shored or braced unless sloped to at least maximum angle of repose measured relative to the horizontal plane; No load, material plant or equipment placed near the edge of excavations which can cause it to collapse; 	<ul style="list-style-type: none"> Detailed Risk Assessment and workers trained on RA; Method statement and workers trained on content; Daily Toolbox Talks; Supervision by an appointed competent person; Daily checks register carried out by the competent person appointed to supervise; Permission to work in writing; Emergency rescue plan.

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									warning signs to be positioned next to an excavation within which or where persons are working.	
Backfilling an excavation manually	<ul style="list-style-type: none"> Improper barricading or warning signs to indicate location of an excavation 	<ul style="list-style-type: none"> Serious injuries, possible fatalities can occur if vehicle drivers are not aware of the excavation and drive into the excavation especially at night, striking the workers; other workers not aware of the excavation falling into the excavation. 	10	2	8	0	20	<ul style="list-style-type: none"> Ensure that barricades (barrier or fence) are put around the excavation at least 1 meter away from the edge, provide warning illuminants or any other clearly visible boundary indicators at night or when visibility is poor if accessible to the public, adjacent to public roads or through fares; warning signs to be positioned next to an excavation within which or where persons are working; daily checks prior to the commencement of each shift by the appointed competent person and recorded in a register. 	<ul style="list-style-type: none"> Detailed Risk Assessment and workers trained on RA; Method statement and workers trained on content; Daily Toolbox Talks; Supervision by an appointed competent person; Daily checks register carried out by the competent person appointed to supervise; Permission to work in writing; Emergency rescue plan 	
Backfilling excavation with mobile plant	<ul style="list-style-type: none"> Untrained operators operating mobile plant Workers working in the vicinity of moving mobile plant. 	<ul style="list-style-type: none"> Causing accidents involving people, other mobile plant, existing structures, Spillages resulting in ground contamination. Workers struck by the moving mobile plant by coming to close to it or working behind it not being visible to the operator sustaining serious injuries or death. 	10	4	10	0	24	<ul style="list-style-type: none"> Only certified competent, medically fit and legally appointed employees may operate mobile plant & construction vehicles; Certificates of competency of the operators Must be filed in the safety file on site. All employees to wear reflective clothing. No employee should walk or work behind moving mobile plant. All mobile plant must be fitted with a reverse alarm; all persons walking on site must listen for the hooter; operators may never leave the mobile plant running unattended or with the key in the ignition. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to operators; Certificates of competency of the operators on file. Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to operators; Certificates of competency of the operators on file. 	
Manual Handling	<ul style="list-style-type: none"> Lifting heavy loads i.e. bags of cement, heavy tools or equipment. Loads with sharp edges/corners 	<ul style="list-style-type: none"> Employees could injure their backs when picking up heavy loads on their own Sharp edges and corners could cause lacerations to hands and other body parts 	4	2	2	0	8	<ul style="list-style-type: none"> Employees must never pick up anything that is too heavy for one person. If you battle to lift an item, get assistance from another colleague. Where possible use mechanical lifting equipment i.e. forklifts, cranes etc. to pick up heavy equipment. Always inspect the load before you lift to check for sharp edges & corners. Always wear leather gloves when picking up equipment and materials so that your hands are protected. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees; Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees. 	



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ACTIVITY	POTENTIAL HAZARD	POSSIBLE RESULT	RISK EVALUATION				PREVENTATIVE MEASURES	CONTROLS	
			A	B	C	D			R
Manual Handling	<ul style="list-style-type: none"> Wrong posture when lifting/placing down items 	<ul style="list-style-type: none"> Employees that pick items up with their legs straight and back bent can sustain serious back & muscle injuries. 	4	2	2	0	8	<ul style="list-style-type: none"> Employees must ensure that they keep their back straight and bend their knees when they lift any load; this prevents strain on the lower back. Physical demonstrations should be given to all employees. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees.
	<ul style="list-style-type: none"> Shutter panels. 	<ul style="list-style-type: none"> Incorrect lifting and placing of shutter panels can cause falling of material and damage to equipment or fatality 	10	2	8	0	20	<ul style="list-style-type: none"> Banks man to make use of guide ropes. Employees must stand well clear from the path of movement. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees.
	<ul style="list-style-type: none"> Support work beams. 	<ul style="list-style-type: none"> Dislodging of beams and collapsing of decking can cause items and workers falling from platforms resulting in injuries and damage to equipment. 	10	2	8	0	20	<ul style="list-style-type: none"> Support work beams to be checked before positioning of deck panel. Safety harness to be used. Safety harness inspector to be appointed. Competent person to be appointed to supervise formwork and support work. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees. Daily pre-inspection to be carried out. Monthly safety harness register to be completed.
Formwork and Shuttering	<ul style="list-style-type: none"> Poor housekeeping can result in material, tools, rubble and equipment falling onto workers below and workers tripping and falling. 	<ul style="list-style-type: none"> Can result in serious injuries and damage to property 	8	2	8	0	18	<ul style="list-style-type: none"> Maintain strict housekeeping practises; Throwing of materials, tools, etc, from heights is not allowed; planning and coordinating the removal of rubble. Keep working area clean. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees.
	<ul style="list-style-type: none"> Reinforcing cage not secured. 	<ul style="list-style-type: none"> Falling over of reinforcing cage can cause injury to workers and damage to equipment. 	8	2	8	0	18	<ul style="list-style-type: none"> Secure the reinforcing cage prior to placing of shutters. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees.
	<ul style="list-style-type: none"> Inadequate design, supporting and bracing 	<ul style="list-style-type: none"> Collapsing resulting in workers falling and can result in injuries or fatalities and damage to equipment. 	10	2	8	0	20	<ul style="list-style-type: none"> All formwork and support work structures must be adequately designed, erected, supported, braced and maintained so that they will be capable of supporting all anticipated vertical and lateral loads that may be applied to them. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; Supervisor to check if design, supporting and bracing are adequate at all times

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ACTIVITY	POTENTIAL HAZARD	POSSIBLE RESULT	RISK EVALUATION				R	PREVENTATIVE MEASURES	CONTROLS
			A	B	C	D			
Formwork and Shuttering	<ul style="list-style-type: none"> No structural designed drawings in place. 	<ul style="list-style-type: none"> Delay for starting work and finishing it in time. 	2	2	2	0	6	<ul style="list-style-type: none"> The designs of formwork and support work structures are done with close reference to the structure design drawings and where any uncertainty exists, the structural designer should be consulted. All drawings pertaining to the design of formwork and support work structure must be kept on the site and available on request by an inspector, contractor, client, client's agent or employees 	<ul style="list-style-type: none"> Supervisor to check if structural design drawings are in place before work commence on site.
	<ul style="list-style-type: none"> Unexamined equipment 	<ul style="list-style-type: none"> Serious injuries to workers cause by weakened equipment. 	8	2	8	0	18	<ul style="list-style-type: none"> All equipment used in the formwork or support work structure must be carefully examined and checked for suitability by a competent person, before being used. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA Toolbox talks. Supervisor to inspect all equipments used on daily basis.
Working at Heights & Elevated Positions	<ul style="list-style-type: none"> Not wearing safety harnesses / safety harnesses not secured; Taking an unsafe position whilst working on scaffolding. 	<ul style="list-style-type: none"> Severe injury or even death when falling from a height or scaffolding 	10	2	4	0	16	<ul style="list-style-type: none"> Training on the correct use of safety harnesses and fall arrest equipment; ensuring that trained competent persons are carrying out the work & understand the hazards of working at height; always use the 100% tie off method while moving around at height. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees. Daily pre-inspection to be carried out; training on the correct use of a safety harness and fall arrest equipment on file. Competent to do the job; Monthly safety harness register to be completed.
	<ul style="list-style-type: none"> Improper identification and issuing of Personal Protective Equipment requirements resulting in slipping and falling; improper head, hand and eye protection. 	<ul style="list-style-type: none"> Severe injuries or even death. 	10	2	4	0	16	<ul style="list-style-type: none"> Survey to be carried out to identify PPE requirements; issuing of correct PPE as identified i.e. safety shoes, hardhat, overall, gloves, safety glasses, safety harnesses with dual lanyards; Workers trained in the correct use of PPE issued; record of all training to be kept on file; record of PPE issued to be kept on file; safety harness inspector to be appointed. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Daily pre-inspection to be carried out; training on the correct use of a safety harness and fall arrest equipment on file; training on the correct use of PPE on file; record of PPE issued on file; Monthly safety harness register to be completed.
	<ul style="list-style-type: none"> Open edges on decks / platforms 	<ul style="list-style-type: none"> Employees could walk off or be accidentally bumped off an open 	10	2	4	0	16	<ul style="list-style-type: none"> Open edges are not allowed on site. All open edges that are created must immediately be barricaded with solid barricading & made 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant



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ACTIVITY	POTENTIAL HAZARD	POSSIBLE RESULT	RISK EVALUATION					PREVENTATIVE MEASURES	CONTROLS
			A	B	C	D	R		
Working at Heights & Elevated Positions on Scaffolding structures	Scaffold not properly boarded	<ul style="list-style-type: none"> Employees could fall through resulting in serious injuries or death. 	10	2	4	0	<u>16</u>	<ul style="list-style-type: none"> Scaffold platforms must at all times be fully boarded to ensure that employees do not fall through. 	reinforcement & specific instructions to employees. Daily pre-inspection to be Carried out.
	<ul style="list-style-type: none"> Scaffold has no handrails 	<ul style="list-style-type: none"> Fall off the scaffold resulting in serious injuries or death. 	10	2	4	0	<u>16</u>	<ul style="list-style-type: none"> Handrails must be fitted at knee & hip height at all times, if employees are required to work on an open edge then they need to wear a harness & attach it to the structure or life line. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees. Daily pre-inspection to be carried out. Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees. Daily pre-inspection to be carried out.
	<ul style="list-style-type: none"> Scaffold has no safe access. 	<ul style="list-style-type: none"> Fall from height resulting in serious injuries or death. 	10	2	4	0	<u>16</u>	<ul style="list-style-type: none"> Scaffolding must be fitted with safe access ladders / staircases at all times, if the scaffold does not have safe access then it may not be used. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees. Daily pre-inspection to be carried out.
Confined spaces.	<ul style="list-style-type: none"> Testing and air evaluation 	<ul style="list-style-type: none"> Lack of oxygen while testing and evaluating air can cause suffocation. 	10	2	8	4	<u>24</u>	<ul style="list-style-type: none"> A competent person must test and evaluate the air within and certify in writing after testing. Trained or competent person must use dragger instrument to measure the oxygen content. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees. Daily pre-inspection to be carried out.
	<ul style="list-style-type: none"> Lack of oxygen below 20% 	<ul style="list-style-type: none"> Lack of oxygen in the confined space can cause suffocation to employees. 	10	2	8	0	<u>20</u>	<ul style="list-style-type: none"> Employees to be evacuated immediately should the oxygen level drop below 20% 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees. Hourly pre-inspection to be carried out.



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	<ul style="list-style-type: none"> No ventilation. 	<ul style="list-style-type: none"> If there is no ventilation in confined space, harmful gasses can reduce oxygen which can lead to explosions and suffocation. 	10	2	8	0	<u>20</u>	<ul style="list-style-type: none"> Fans to be positioned to allow sufficient air flow and oxygen to the worker. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to employees. Hourly pre-inspection to be carried out
	<ul style="list-style-type: none"> Changing conditions. Accumulation of poisonous gases or the lack of oxygen 	<ul style="list-style-type: none"> The lack of oxygen can cause lung damage/severe injury or death. 	10	2	10	0	<u>22</u>	<ul style="list-style-type: none"> Supervisor to take readings continuously throughout the day to monitor the oxygen content to ensure a space breathing environment for the persons working. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to operators.
Confined spaces.	<ul style="list-style-type: none"> Not using self-contained breathing apparatus if oxygen level drops to less than 20%. 	<ul style="list-style-type: none"> Not using self-contained breathing apparatus if there is lack of oxygen in confined space can cause suffocation to employees. 	8	2	8	0	<u>20</u>	<ul style="list-style-type: none"> Employees to use self contained breathing apparatus or airline system if oxygen level drops to less than 20%. Employees need to be trained on the proper and safe method of using the apparatus. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to operators.
	<ul style="list-style-type: none"> No unauthorised persons allowed into confined space 	<ul style="list-style-type: none"> Untrained employees can cause serious injuries or death to themselves and other employees, because they are not familiar with confined space working procedures. 	10	4	8	0	<u>22</u>	<ul style="list-style-type: none"> No unauthorised personnel allowed in the working area. Working area outside the confined space must be barricaded to avoid unauthorised persons. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to operators.
Mobile Crane operation	<ul style="list-style-type: none"> No emergency breathing apparatus provided. 	<ul style="list-style-type: none"> Not receiving the required oxygen immediately after the incident can cause suffocation or death to an employee. 	10	4	8	0	<u>22</u>	<ul style="list-style-type: none"> A breathing apparatus set must be positioned outside in case of an emergency. Check oxygen content of apparatus before work starts. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific instructions to operators
	<ul style="list-style-type: none"> Overhead Power Lines 	<ul style="list-style-type: none"> Possible electrical shock and burns or electrocution of the operator and other 	10	4	10	0	<u>24</u>	<ul style="list-style-type: none"> A risk assessment needs to be conducted prior to allowing operation of mobile crane on site to identify exposure to overhead power lines; If power lines are present then a safe 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; Constant reinforcement & specific



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	<ul style="list-style-type: none"> Using lifting equipment that is not load tested and certified safe for use. 	<p>workers; damage to power lines, crane & interruption of electrical supply causing delays that result in financial losses.</p> <ul style="list-style-type: none"> Use of uncertified safe to use lifting equipment could result in failure whilst lifting causing the load to drop resulting in damage to property, delays and possible injuries or death. 	10	2	10	0	22	<p>work procedure must be drawn up; Signage to be displayed & safe distances to be marked out for operators.</p> <ul style="list-style-type: none"> All lifting equipment must be placed on a register for inspection purposes and must have a certificate of safe work load test. Inspectors need to be done every three months by an approved inspection authority and each item fitted with an ID tag. Employees may not be positioned under suspended loads, banksman must control. 	<p>instructions to operators.</p> <ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; constant reinforcement and specific instructions to operators; lifting equipment certification on file.
	<ul style="list-style-type: none"> Incorrect rigging by untrained persons. 	<ul style="list-style-type: none"> Incorrect rigging could result in failure whilst lifting causing the load to drop resulting in damage to property, delays and possible injuries or death. 	10	2	10	0	22	<ul style="list-style-type: none"> A trained rigger must be appointed to supervise or perform all rigging operations. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; toolbox talks; supervision; constant reinforcement and specific instructions to operators; Rigger competency certificate on file.
Housekeeping	<ul style="list-style-type: none"> Poor housekeeping and storage practises can result in various items lying around. 	<ul style="list-style-type: none"> Materials and paper lying around creates an unneat appearance; items lying around are tripping hazards and can cause employees to trip and fall resulting in injuries. 	4	2	2	0	8	<ul style="list-style-type: none"> Housekeeping must be based on a place for everything and everything in place; refuse bins must be available to place all waste in; redundant material or equipment must be sorted and stored in designated areas; all workstations must be kept tidy; all maintenance and repair work must be carried out in a tidy and safe manner; employees should be trained through risk assessments and toolbox talks to practise housekeeping on a daily basis; Regular inspections by Supervisors. 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; refuse bins in place; designated storage areas; Supervision, Constant reinforcement, Toolbox talks.
Housekeeping	<ul style="list-style-type: none"> Material lying around in work areas and in walkways. 	<ul style="list-style-type: none"> Can cause restriction of space on roadways resulting in vehicles striking items lying around or other vehicles causing 	4	2	8	0	16	<ul style="list-style-type: none"> Housekeeping must be based on a place for everything and everything in place; refuse bins must be available to place all waste in; redundant material or equipment must be sorted and stored in designated areas; all workstations must be kept tidy; all 	<ul style="list-style-type: none"> Detailed risk assessment and training on RA; refuse bins in place; designated storage areas; Supervision, Constant reinforcement, Toolbox talks.



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	damage to vehicles and equipment; items lying around in walkways are tripping hazards and can cause employees to trip and fall resulting in injuries.		maintenance and repair work must be carried out in a tidy and safe manner; employees should be trained through risk assessments and toolbox talks to practise housekeeping on a daily basis; Regular inspections by Supervisors.
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NOTE:

This information describes the type of work required in terms of this contract that will be accompanied by dangers, hazards and risks which the Contractor shall be required to identify, analyse, manage, monitor and review in terms of the Health and Safety Plan and Risk Assessments.

This information is neither prescriptive nor exhaustive, and is provided as a guideline to tenders in preparing their tender submissions and to the successful Contractor as a basis for the preparation of the Site Specific Risk Assessments, to be performed by the Contractor in terms of Construction Regulation 9.

Tenders shall make their own assessment of the dangers, hazards and risks that can be expected during the course of this contract, which may include dangers, hazards and risks not identified in the Baseline Risk Assessment, including those that may arise from specific methods of construction employed by the Contractor, and shall make due allowance in their tendered rates and prices for all costs related to complying with the provisions of the Act and Construction Regulations.

This information is given in good faith for the guidance of Tenderers, and no additional payment shall be made as a result of any inaccuracies, discrepancies or omissions contained therein.

This is a Baseline Risk Assessment and the responsibility remains with the Contractor to prepare project specific Risk Assessment as per Regulation 9.



PP: CONSTRUCTION QUALITY ASSURANCE PLAN



FOSKOR RICHARDS BAY

UPGRADE OF THE PRIMARY AND SECONDARY POLLUTION CONTROL DAMS

CONSTRUCTION QUALITY ASSURANCE PLAN

April 2023

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APPENDICES

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1.0 INTRODUCTION

This CQA Plan addresses the construction quality assurance procedures and monitoring requirements for the Foskor Richards Bay **Upgrade of the Primary and Secondary Pollution Control Dams portion** of the **works**. This plan has been developed to assure that the construction of the earthworks and geosynthetic components are in accordance with the **Project Specifications** and **Construction Drawings** and to demonstrate that the regulatory requirements for the construction are achieved.

This CQA Plan addresses the soil, concrete, pipe, geosynthetic and ancillary components of the project. The soil material, geosynthetic, and ancillary components may include drainage, leakage detection layers, subgrade, geosynthetic clay liner (GCL), geomembrane (GM), geotextile, geocells, drainage aggregate, geopipe and high-density polyethylene (HDPE) pipe, etc. where and if applicable. It should be emphasized that care and documentation are required in the placing soil and aggregate, and in the production and installation of the geosynthetic materials installed during construction. This CQA Plan outlines procedures to be followed for monitoring construction using these materials.

The objective of the CQA plan is to observe, verify and document, that proper materials, construction techniques, and procedures are followed by the **Contractor, Manufacturer** and **Installer** and provide the means for assuring that the project is constructed in accordance with the **Project Specifications**, permit conditions, applicable regulatory requirements, and **Construction Drawings** to meet the design intent.

The CQA protocols applicable to manufacturing, shipping, handling, and installing of materials are also included. However, this CQA Plan does not specifically address either installation specifications or construction specification of soils and geosynthetic materials as these requirements are addressed in the **Project Specifications** and **Construction Drawings**.

The main objective of this plan is to establish:

- Duties and responsibilities of parties responsible for the CQA Plan and **works**.
- Qualification requirements of the **CQA Monitor**.
- Provide guidance on the appropriate construction quality assurance procedures and verifications to be followed for the various components of the project.
- Establish quality assurance testing protocols.
- Establish guidelines for quality assurance documentation and document control measures.
- Inspection activities.
- Sampling procedures.
- Document control measures.
- Procedures for approving the materials used for construction.
- Methods for assuring compliance to **Project Specifications** and **Construction Drawings** during the **works**.
- Procedures for resolving issues that may occur concerning the design and construction.
- Documentation of construction and testing for submittal to the regulatory authority for their review.

The intent of the CQA Plan is to provide independent third-party verification and testing, to demonstrate that the **Contractor** and **Installer** have met their obligations in the supply and installation of components and materials according to the **Construction Drawings, Project Specifications**, and regulatory requirements. Construction must be in accordance with the approved **Project Specification** and **Construction Drawings**. This CQA Plan establishes the CQA monitoring, and testing program designed to ensure compliance with the **Project Specification** and **Construction Drawings**.

Quality Control is provided by the **Contractor, Manufacturer**, and **Installer** and refers only to their actions taken to ensure that materials and workmanship meet the requirements of the **Project Specification** and **Construction Drawings**.

2.0 ABBREVIATIONS AND DEFINITIONS

Contract:

The Contract will refer to the Construction Contract (NEC 3, FIDIC, JBCC, GCC or others) as signed between the Employer and the Contractor.

Contractor:

Will refer to the Civil Contractor with whom the Contract was signed and who is appointed for the earthworks portion of the Contract.

CQA:

Construction Quality Assurance – A planned and systematic pattern of means, and actions designed to assure adequate confidence that materials and/or services meet contractual and regulatory requirements and will perform satisfactorily in service. CQA refers to means and actions employed by the CQA Monitor to assure conformity of the project “works” with this CQA Plan, the Project Specification and Construction Drawings. CQA testing of aggregate, pipe, and geosynthetic components is provided by the CQA Monitor.

CQA Monitor:

The Construction Quality Assurance Monitor (CQA Monitor) is an independent person responsible for performing the CQA tasks outlined in this plan.

CQA Reviewer:

The Construction Quality Assurance Reviewer (CQA Reviewer) is an independent person responsible for overall review of the CQA tasks outlined in this CQA Plan.

CQC:

Construction Quality Control – Actions which provide a means to measure and regulate the characteristics of an item or service in relation to contractual and regulatory requirements. Construction Quality Control (CQC) refers to those actions taken by the Contractor, Manufacturer, and Installer to verify that the materials and the workmanship meet the requirements of this CQA Plan, the Project Specification and Construction Drawings. In the case of the geosynthetic components and piping of the works, CQC is provided by the Contractor, Manufacturer, and Installer.

CQC Monitor:

The Construction Quality Controller (CQC Monitor) is an independent person responsible for performing the CQC tasks as outlined in the Contractor Quality Control Plan.

Employers:

Employer refers specifically to *Foskor Richards Bay*.

Employer’s Representative:

Is the official representative of the Employer, appointed by the Employer. The Employer representative can act as a Construction Manager, Supervisor or Clerk of works.

Engineer:

The Engineer (or designated representative) appointed by the Employer is a company and its representatives which is responsible for the proper implementation of the Project Specification and Construction Drawings on the project. Professional Engineer registered with the Engineering Council of South Africa (ECSA)

Construction Drawings:

Issue for Construction (Construction Drawings) Drawings are the approved drawings as approved by the Engineer to be used in construction of the works.

Installer:

Refers to the Installation Contractor or Sub-Contractor of the Contractor responsible for the installation of the geosynthetic, pipes, etc. components to be used in construction of the works. But can also be the Installer of other products.

Manufacturer(s):

Refer to the Manufacturer responsible for production of the geosynthetic, pipes, etc. components outlined in this plan. But can also be other Manufacturer of other products.

Project Manager:

The Project Manager is the official representative of the Employer, appointed by the Employer, responsible for all construction activities including oversight and direction during construction. The Project Manager is also responsible for coordinating construction and CQA activities for the project. The Project Manager can delegate responsibilities to the Employer Representatives and should delegate such responsibilities in writing to all parties on the project.

Project Specifications:

The document/s forming part of the Contract in which the methods of executing the various items of work to be done, and the nature and quality of the materials to be supplied and includes technical schedules and drawings attached thereto as well as all samples and patterns are described.

Refer to Scope of Works, Project Specifications, South African National Standard (SANS 1200), American Standard Testing Methods (ASTM) where applicable, Construction Drawings and CQA Plan.

Resident Engineer(s):

The Resident Engineer(s) are representatives of the Engineer which reports solely and directly to the Engineer.

Scope of Works:

Shall mean the same as the work(s).

Surveyor:

Shall be defined as registered land Surveyor registered with South African Geomatics Council (SAGC) appointed by the Contractor to survey and certify the Levels, lines and grades of completed works.

Work(s):

Shall be defined as the required deliverable as stated in the Contract between the Contractor, Installer and Employer and will include the Project Specifications, South African National Standard (SANS 1200), American Standard Testing Methods (ASTM) where applicable, Construction Drawings and CQA Plan.

3.0 TECHNICAL DESIGN DRAWINGS AND SCOPE OF WORK

The CQA plan should be read in conjunction with the **Project Specifications, Construction Drawing**, South African National Standards (SANS), American Standard Testing Methods (ASTM), or any document stipulated in the **Contract** and supplied by the **Employer** during Tender and Construction of the project.

The requirements of the various components included in the **Project Specifications**, shall be read, and adhered to in the implementation of this CQA plan.

4.0 DESCRIPTION OF PARTIES TO CQA

The following section provides descriptions of the parties referred to in this CQA Plan including their responsibilities and qualifications. Specific qualified personnel will be chosen once the **work** has been approved and the scheduled is confirmed for the selected CQA project members. (The SANS 10409 standard specification as amended has particular reference).

4.1 Employer / Owner

In this CQA Plan, the **Employer** refers specifically to *Foskor Richards Bay* as the owner of the project and completed **works** and is the licence holder.

4.2 Employer's Representative

In this CQA Plan, the **Employer's Representative** is the official representative of the **Employer**, appointed and responsibilities delegated by the **Project Manager** in writing, for construction activities including oversight and direction during construction. The **Employer's Representative** is also responsible for co-ordinating construction and CQA activities for the project.

The **Employer's Representative** shall serve as delegated by the **Project Manager**.

4.3 Project Manager

The **Project Manager** is the official representative of the **Employer**, appointed by the **Employer** and is responsible for all construction activities at the facility, including oversight and construction management. The **Project Manager** is responsible for coordinating construction and quality assurance activities for the project as set out in the **Contract** and CQA Plan. The **Project Manager** shall be responsible for the resolution of all quality assurance issues that arise during the construction **work** and must be involved in any decisions that may affect future operations of the **Work**.

4.4 Engineer

In this CQA Plan, the **Engineer**, also referred to as the “Designer” or “Design Engineer”, refers to the appointed individual or consultancy firm responsible for the design and preparation of the **Project Specification** and **Construction Drawings**, appointment by the **Employer**. The **Engineer** may delegate some duties to the **Resident Engineer** (RE) on site, if appointed. The **Engineer** is responsible to delegate decision making responsibility for approving design and **Project Specification** changes, modifications, or classifications encountered during construction to the appointed **Resident Engineer**. The **Engineer** will be the Engineer-of-Record and will sign-off the final Construction Completion Report. The implementation and reporting of this CQA Plan shall be conducted under the direct supervision of an Engineering Council of South Africa (ECSA) registered professional civil engineer.

The **Resident Engineer(s)** is a representative of the **Engineer** which reports solely and directly to the **Engineer**. The Resident Engineer shall inspect, witness and verify day to day inspection requests for the **works** (earthworks, material compaction testing, material conformance testing, deployment and testing of geosynthetic materials, installation of pipes and drainage materials, placement and backfilling of pipelines, fixing of reinforcement, shuttering and pouring of concrete) as well as ensure any adherence to the **Project Specifications** and **Construction Drawings** of areas inspected in accordance with the **Project Specification** and **Construction Drawings**, to supply the **Engineer** with confidence that the facility has met the design intent prior to sign-off.

4.5 Construction Quality Assurance Monitor(s)

The **CQA Monitor** is appointed by the **Employer** or **Project Manager** which reports solely and directly to the **Engineer**. The **CQA Monitors** shall inspect, witness, and verify day to day inspection requests for the **works** (earthworks, material compaction testing, material conformance testing, deployment, and testing of geosynthetic materials, installation of perforated pipes and drainage materials, placement and backfilling of pipelines, fixing of reinforcement, shuttering and pouring of concrete) as well as ensure any adherence to the **Project Specifications** and **Construction Drawings** of areas inspected in terms of quality.

The **CQA Monitor** will be responsible for understanding this CQA Plan and shall conduct CQA testing, monitoring, documentation, and reporting as required by this CQA Plan.

In consultation with the **Engineer**, the **CQA Monitor** has the authority to stop any aspect of the **work** that is not in compliance with the **Project Specification** and **Construction Drawings**. **Work** may only resume once corrective action has been approved by the **Engineer** and the **CQA Monitor**. The specific responsibilities of the **CQA Monitor** include:

- Review the **Project Specifications**, **Construction Drawings**, and related guidance documents.
- Review all **Contractor / Installer** submittals and make appropriate comments.
- All earthworks and other civil related construction will be monitored against the **Project Specification** and **Construction Drawings**.
- Assure that any soil, civil, geosynthetic and pipe related testing equipment used, and tests performed are conducted according to **Project Specifications**.
- Monitor earthworks activities such as material removal and placement in designated areas, footprint preparations, bulk, selective and restricted excavations.
- Observe geosynthetics and pipe related material delivery, unloading, and storage and report any damage observed.

- Monitor geosynthetic and pipe material quality, pipe weld preparation and placement of pipes, backfilling of trenches and preparation of and construction of subsoil, leachate, and surface drains with associated infrastructure such as manholes and outlet structures.
- Observe, verify, and accept suitability of prepared subgrade prior to geosynthetic deployment.
- Monitor geosynthetic material placement, trial seam testing, non-destructive testing, seaming and repair operations, and destructive testing.
- Identify seam samples for CQA destructive testing.
- Assure that testing equipment used, and tests performed are conducted according to **Project Specification** and **Construction Drawings**.
- Observe and report test results to the **Engineer** or **Project Manager** as required.
- Report deficiencies to the **Engineer** or **Project Manager** that are not corrected to the satisfaction of the **CQA Monitor**, including design, **Project Specification** and **Construction Drawings** changes.
- Observe and verify that all **work** conducted is done according to the **Project Specification** and **Construction Drawings**. The **CQA Monitor** as appointed and stated in Table 1 shall carry out the full-time **CQA** inspections on site, under the guidance and supervision of the **Engineer** or **Project Manager**.

The implementation and reporting of this CQA Plan shall be conducted under the direct supervision of an Engineering Council of South Africa (ECSA) registered professional civil engineer.

4.6 Independent Construction Quality Assurance Reviewer

The Construction Quality Assurance Reviewer, also referred to as the “**CQA Reviewer**,” is an independent person responsible for overall review of the CQA tasks outlined in this CQA Plan. In consultation with the **Engineer**, the **CQA Reviewer**, has the authority to change CQA methodology where and when required to ensure the best possible CQA process. The **CQA Reviewer** is also responsible for final review of the Construction Completion Report.

The independent **CQA Reviewer** as appointed and stated in Table 1 is to ensure conformance to CQA related aspects.

The **CQA Reviewer** will be an Engineering Council of South Africa (ECSA) registered professional civil engineer.

4.7 Third-Party Controller

The third-party controller (as defined in SANS 10409: 2020) also referred to as the independent “**CQA Person**”, will be independent from the **Employer**, **Contractor**, **Manufacturer**, and **Installer** and will be a party appointed by the **Employer** to oversee the Quality of the geosynthetic manufacturing and installation. The **CQA Person** will report to the **Project Manager**.

The **CQA Person** is responsible for ensuring that the procedures of document management on site by the **Contractor**, **Installer** and **CQA Monitor** are followed and that independent laboratory tests are undertaken, and the results reflect compliance with SANS 1526 (2015) for HDPE geomembranes on the geomembrane and SANS 10409 (2020) for the installation along with other quality assurance records. The **CQA Person** shall keep records of the certified welding technicians (CWTs) certification.

4.8 Manufacturer(s)

The **Manufacturer(s)** is responsible for the production of finished material (geomembrane, geotextile, pipes, precast concrete elements, etc.) from appropriate raw materials. The **Manufacturer(s)** will be able to provide sufficient production capacity and qualified personnel to meet the demands of the project. Manufacturing quality standards should be adhered to as stated within the **Project Specification**. The **Manufacturer(s)** must be well established firms that meet the requirements identified in the **Project Specifications** and **Construction Drawings** as outlined in the CQA Plan.

Each **Manufacturer** must verify, prior to construction, that the **Manufacturer** can produce material that meets the requirements outlined in the **Project Specifications**. The **Manufacturer** is a supplier of materials and thus does not provide a service but a product and does not form part of the appointed parties.

The **Manufacturer** may not be aligned with the **Installer** as prescribed in the Competition Act, Act 89 of 1998.

4.9 Installer

The **Installer** appointed by the **Employer** or the installation sub-contracted by the **Contractor**, also referred to as the “**Installer**”, is responsible for the proper installation of the manufactured components, as outlined in the **Project Specification** and **Construction Drawings**. The **Installer** may be affiliated with the **Manufacturer**. The **Installer** during this project is listed in Table 1. In the CQA Plan the **Installer** refers specifically to the company employed by the **Contractor** or the **Employer** and approved by the **Project Manager**.

The **Installer** must meet the requirements outlined in the **Project Specification** and **Construction Drawings**.

The **Installer** must pre-qualify by meeting the requirements outlined in the **Project Specifications**. The **Installer** shall provide a qualified superintendent or foreman who will provide full-time technical guidance to the field crew. The superintendent will represent the **Installer** at all site meetings and will act as the spokesman for the **Installer** on the project. Welding technicians will be evaluated based on performance and prequalified prior to commencing any **work**. The master seamer will be certified as competent by the International Association of Geosynthetics Installers, the TRI (Austin, Texas) or equal approved independent oversight body. The **CQA Monitor** and **Engineer**, through the **Project Manager**, reserves the right to reject any welding technician whose performance is unsatisfactory.

The **Installer** will be responsible for storage, handling, deploying, anchoring, seaming, repairs, non-destructive testing, and destructive testing in accordance with the project plans, **Project Specification** and **Construction Drawings** and the **Installer’s** internal quality control program. It is the **Installer’s** responsibility to see that all submittals are received as outlined in the **Project Specification**, **Construction Drawings** and CQA Plan by the **CQA Monitor**.

The **Installer** will do independent testing by an accredited certified laboratory (TRI (Austin, Texas) or equal approved independent body) approved by the **Engineer** to prove to the **CQA Monitor** and **Engineer** that the **Manufacturer** materials confirm to the **Project Specification**, **Construction Drawings** and CQA Plan and will submit such prove prior to delivering the material to site.

Permanent anchoring of geosynthetics and backfilling of pipes is the **Contractors** responsibility and not the **Installers** responsibility.

The **Installer** may not be aligned with the **Manufacturer** as prescribed in the Competition Act, Act 89 of 1998.

4.10 Civil Contractor

The Civil **Contractor**, also referred to as the “**Contractor**”, is responsible for completion of the **works** as defined by **Contract** with the **Employer** and in accordance with the **Project Specification** and **Construction Drawings**, except for materials provided by the **Employer** or **Manufacturer** or **work** performed by the **Installer**, should they not be sub-contracted by the **Contractor**. In this CQA Plan, the **Contractor** during the project is listed in Table 1.

The **Contractor** refers to an independent party or parties, contracted by the **Employer**, to perform the **work** in accordance with the **Project Specification** and **Construction Drawings**. The **Contractor** is responsible for proper delivery and placement of earthwork components and other construction related **works** as well as any other Construction Quality Control procedures and testing that are required in accordance with the **Project Specification** and **Construction Drawings**. The **Contractor** shall have its own **CQC Monitors** on site conducting the appropriate testing in accordance with the **Project Specification**. Qualifications of the **Contractor** are specific to the **Contract**. The **Contractor** should have appropriate data and case histories demonstrating successful completion of similar **works** as specified within the **Project Specification** and **Construction Drawings**. The **Contractor** shall become contractually obligated to the **Employer**.

The **Contractor** will be responsible for setting out the **works** to the lines, grades and accuracy required for excavation, construction, and preparation and providing data or completing as-built drawings through a **Surveyor**.

The **Contractor** will be responsible to set-up his own soils laboratory onsite, to satisfy himself and the **CQC Monitor** on the quality of material used in construction and completion of the **works**. The **Contractor** will do sufficient testing to satisfy himself regarding the quality of the **works** regardless of the testing frequencies

specified in the **Project Specification** and CQA Plan and no approval by the **Engineer** or **CQA Monitor** of any material or plant and its operation, or any construction procedure to be used, will imply any relaxation of the requirements governing the quality of the materials or of the finished **work(s)**, or relieve the **Contractor** of his responsibilities under the **Contract**.

4.11 Independent CQA Laboratory

A third-party Independent CQA Laboratory (CQA Lab), approved by the **CQA Monitor** and **Engineer** will be responsible for performing the quality assurance soils and/or geosynthetics laboratory testing as specified in the **Project Specifications** and the CQA Plan.

The geosynthetics testing laboratory shall be accredited by the Geosynthetics Research Institute Laboratory Accreditation Program (GRI-LAP or similar). The CQA Lab shall not be affiliated with the **Contractor**, **Installer** or **Manufacturer** nor material suppliers.

4.12 Electronic Leak Location Specialist

An electric leak location survey (ELLS) or similar shall be undertaken by an independent person to confirm the competence of the geomembrane installation. The ELLS will be conducted after geomembrane installation for uncovered geomembrane or after placement of a liner protection layer and/or sacrificial layers for covered geomembrane installation and on completion of the **works**. The standard to be complied with for the ELLS on the final report submitted by the independent person will be ASTM D8265. The final Report from the ELLS person will form part of the Construction Completion Report.

4.13 Surveyor

The **Surveyor** is a party that is responsible for surveying, documenting, and verifying the location, levels and grades of all significant components of the **works**. The **Surveyor's work** is coordinated and employed by the **Contractor**. The **Surveyor** is responsible for generating and issuing as-built drawings of the construction of the **works**. The **Surveyor** will be a registered land **Surveyor** registered with South African Geomatics Council (SAGC). All **Surveys** submitted to the **Engineer and CQA Monitor** will be signed-off by the **Surveyor** to certify that the information is a direct representation of the installed/completed **works**.

4.14 Appointed Parties

The following parties are appointed by the **Employer** or **Project Manager** to conduct the construction and installation of the **Scope of Works** and is responsible for the Construction Quality Control and Assurance of the construction activities listed within the **Project Specifications**.

Table 1: Appointed Parties for The Works

PARTY DESCRIPTION	APPOINTED PARTY	DATE OF APPOINTMENT
Project Manager		
Engineer		
CQA Monitor		
Independent CQA Reviewer / Person		
Contractor		
Geomembrane Manufacturer		
Geotextile Manufacturer		
HDPE Pipe Manufacturer		

PARTY DESCRIPTION	APPOINTED PARTY	DATE OF APPOINTMENT
Geomembrane Installer		
Geotextile Installer		
HDPE Pipe Installer		
ELLS independent person		
CQA Laboratory		

5.0 LINES OF COMMUNICATION

The **CQA Monitor** will be capable of direct communication with the **Employer, Engineer, CQA Reviewer, Installer and Contractor** at all times. The **CQA Monitor** can only accept or decline test results and cannot suggest remedies if test results were unsatisfactory. Unsatisfactory test result can only be addressed by the **Engineer** or rework will be required that will be inspected by the **CQA Monitor**.

If there is disagreement among the **CQA Monitor, Project Manager, Installer, and/or Contractor** that cannot be resolved amongst themselves, the **Project Manager** will present the matter to the **Engineer** with related recommendations and the **Engineer** will decide the matter with such decision being final. If required, the **CQA Reviewer** can provide an opinion.

6.0 DEFICIENCIES AND RECTIFICATIONS

When deficiencies (items that do not meet project requirements) are discovered, the **CQA Monitor** will immediately determine the nature and extent of the problem and notify the **Installer and/or Contractor**. The **CQA Monitor** will also notify the **Engineer and Project Manager** who will provide corrective measures. If unsatisfactory test results identify a deficiency, additional tests will be performed to define the extent of the deficient area.

The **Installer and/or Contractor** will correct the deficiency to the satisfaction of the **Engineer and CQA Monitor**. If the **Installer and/or Contractor** are unable to correct the problem, the **CQA Monitor** will notify the **Project Manager** who will assist in the problem resolution. If the solution involves a design revision or alteration, the **Engineer** will be contacted together with the **CQA Reviewer** who will suggest the appropriate CQA conformance.

The corrected deficiency will be retested and/or approved by the **Engineer and CQA Monitor** before any additional related **work** is performed by the **Installer and/or Contractor** in the defective area. All retested and related documentation will be recorded by the **CQA Monitor and Engineer** and included in the final construction completion report.

Deficiency identification, rectification, and resolution Data Sheets, to be submitted with the weekly reports prepared by the **CQA Monitors**, describing special construction situations, will be cross-referenced with daily quality reports, specific observation logs, and testing data sheets and will include the following information, where available:

- A detailed description of the situation or deficiency.
- The location and probable cause of the situation or deficiency.
- How and when the situation or deficiency was found or located.
- Documentation of the response to the situation or deficiency.
- Measures taken to prevent a similar situation from occurring in the future.
- Signature of the **CQA Monitor**.

The **Project Manager** will be made aware of significant recurring non-conformance with the **works** or regarding the CQA Plan. The cause of the non-conformance will be determined and appropriate changes in procedures or a concession by the **Contractor** will be recommended. These changes or concessions will be submitted to the **Engineer** for approval. When this type of evaluation is made, the results will be documented and any revision

to procedures or the **Project Specification** and **Construction Drawings** will be approved by the **Project Manager**.

7.0 SITE AND PROJECT CONTROL

7.1 Project Coordination Meetings

Meetings of key project personnel are necessary to assure a high degree of quality during installation and to promote clear, open channels of communication. Therefore, project coordination meetings are an essential element in the success of the project. Several types of project coordination meetings are described below, including:

- Pre-construction meetings.
- Progress meetings.
- Planning meetings.
- Safety meetings.
- Environmental meeting.
- Quality and engineering meetings.

7.2 Pre-Construction Meeting

A pre-construction meeting will be held at the site prior to the start of construction and geosynthetic installation on the project. At a minimum, the pre-construction meeting will be attended by the **Project Manager, Engineer, CQA Monitor, CQA Reviewer, Installer** and **Contractor**, and others designated by the **Employer** shall attend this meeting. Specific items for discussion at the pre-construction meeting include the following:

- Appropriate modifications or clarifications to the CQA Plan.
- The **Construction Drawings** and **Project Specifications**.
- The responsibilities of each party.
- Lines of authority and communication.
- Methods for documenting and reporting, and for distributing documents and reports.
- Acceptance and rejection criteria.
- Protocols for testing.
- Protocols for handling deficiencies, repairs, and re-testing.
- The project schedule for all operations.
- Soil stockpiling locations, laydown areas and **Contractors / Installers** yard.
- Site security and safety protocol.

The **Project Manager** will conduct a site tour to observe the current site conditions and to review construction material and equipment storage locations. This meeting will be documented by the **Project Manager** and the draft minutes will be transmitted to all in attendance, within 2 working days of the meeting, to representatives of parties in attendance for review and comment. Corrections and/or comments to the draft minutes shall be made within 2 working days of receipt of the draft minutes to be incorporated in the final meeting minutes.

Should no comments be received within the allocated time, it will be concluded that no corrections and/or comments to the draft minutes is required and the **Project Manager** will issue the final meeting minutes, unless otherwise stated in the **Contract**.

For the installation of geomembrane, include component for geomembrane preconstruction meeting as defined in SANS 10409, Section 8.4.

7.3 Progress Meetings

Weekly progress meetings will be held between the **Project Manager, Engineer, CQA Monitor, CQA Reviewer, Installer** and **Contractor**, and others designated by the **Employer** shall attend this meeting. The **Project Manager** is responsible for organizing and conducting the progress meetings. The purpose of this meeting will be to:

- Review the previous weeks accomplishments and activities.
- Review upcoming scheduled **work** and project milestones.
- Discuss any problems or potential construction problems.
- Review the results and status of CQA field and laboratory testing.

This meeting will be documented by the **Project Manager** and the draft minutes will be transmitted to all in attendance, within 2 working days of the meeting, to representatives of parties in attendance for review and comment. Corrections and/or comments to the draft minutes shall be made within 2 working days of receipt of the draft minutes to be incorporated in the final meeting minutes.

Should no comments be received within the allocated time, it will be concluded that no corrections and/or comments to the draft minutes is required and the **Project Manager** will issue the final meeting minutes, unless otherwise stated in the **Contract**.

7.4 Planning Meetings

Planning meetings shall consist of weekly co-ordination meetings between the **Project Manager, Engineer, CQA Monitor, CQA Reviewer, Installer** and **Contractor** to ensure the **works** for the following week is discussed to ensure the **work** is conducted in a safe and prepared environment with the necessary approvals and acceptances in place. Any concerns with regards to the planned **work** should be raised and discussed during these meetings.

This meeting will be documented by the **Project Manager** and the draft minutes will be transmitted to all in attendance, within 2 working days of the meeting, to representatives of parties in attendance for review and comment. Corrections and/or comments to the draft minutes shall be made within 2 working days of receipt of the draft minutes to be incorporated in the final meeting minutes.

Should no comments be received within the allocated time, it will be concluded that no corrections and/or comments to the draft minutes is required and the **Project Manager** will issue the final meeting minutes, unless otherwise stated in the **Contract**.

7.5 Safety Meetings

Safety meetings shall consist of fortnightly meetings to discuss the health and safety incidents of the previous periods as well as identifying high risk **work** to be conducted for the following period. The meeting shall be attended by the **Project Manager, Engineer, CQA Monitor, CQA Reviewer, Installer** and **Contractor**

This meeting will be documented by the **Employers** Health and Safety Manager or representative and the draft minutes will be transmitted to all in attendance, within 2 working days of the meeting, to representatives of parties in attendance for review and comment. Corrections and/or comments to the draft minutes shall be made within 2 working days of receipt of the draft minutes to be incorporated in the final meeting minutes.

Should no comments be received within the allocated time, it will be concluded that no corrections and/or comments to the draft minutes is required and the **Employers** Health and Safety Manager or representative will issue the final meeting minutes, unless otherwise stated in the **Contract**.

7.6 Environmental Meetings

Environmental meetings shall consist of fortnightly meetings to discuss the Environmental issues regarding Water Use Licence (WUL) and Environmental Management Plan report (EMPr) of the previous periods as well as identifying noncompliance **work** to be concluded for the following period. The meeting shall be attended by the **Project Manager, Engineer, CQA Monitor, CQA Reviewer, Installer, Contractor** and Environmental Control Officer (ECO).

This meeting will be documented by the **Employers** Environmental Manager or representative and the draft minutes will be transmitted to all in attendance, within 2 working days of the meeting, to representatives of parties in attendance for review and comment. Corrections and/or comments to the draft minutes shall be made within 2 working days of receipt of the draft minutes to be incorporated in the final meeting minutes.

Should no comments be received within the allocated time, it will be concluded that no corrections and/or comments to the draft minutes is required and the **Employers** Environmental Manager or representative will issue the final meeting minutes, unless otherwise stated in the **Contract**.

7.7 Quality and Engineering Meeting

A special meeting will be held when and if a problem or deficiency is present or likely to occur regarding the **works**. The meeting will be attended by the **Project Manager, Engineer, CQA Monitor, CQA Reviewer, Installer** and **Contractor** and other parties as appropriate. The purpose of the meeting is to define and resolve the problem regarding quality of the **works** as follows:

- Define and discuss the problem or deficiency.
- Review alternative solutions.
- Select a suitable solution agreeable to all parties.
- Implement an action plan to resolve the problem or deficiency.

When deficiencies (items that do not the project requirements stated in the **Project Specifications**) are discovered, the **CQA Monitor** shall immediately determine the nature and extent of the problem and notify the **Contractor** or **Installer**. If unsatisfactory test results identify a deficiency, additional tests will be performed to define the extent of the deficient material or **works** area.

The **Contractor** or **Installer** shall correct the deficiency to the satisfaction of the **CQA Monitor**. If unable to correct the problem, the **CQA Monitor** will notify the **Engineer** who will assist during problem resolution. If the solution involves a design revision, the **Project Manager** and **Engineer** shall also be contacted. Design revisions can only be made by the **Engineer**.

The corrected deficiency shall be re-tested and/or approved before any additional related **work** is performed by the **Contractor** or **Installer**. Retest results shall be recorded by the **CQA Monitor** and included in the final Construction Completion Report documentation.

This meeting will be documented by the **Project Manager** and the draft minutes will be transmitted to all in attendance, within 2 working days of the meeting, to representatives of parties in attendance for review and comment. Corrections and/or comments to the draft minutes shall be made within 2 working days of receipt of the draft minutes to be incorporated in the final meeting minutes.

Should no comments be received within the allocated time, it will be concluded that no corrections and/or comments to the draft minutes is required and the **Project Manager** will issue the final meeting minutes, unless otherwise stated in the **Contract**.

8.0 DOCUMENTATION

8.1 General

An effective CQA Plan depends largely on recognition of all construction activities that should be monitored and on assigning responsibilities for the monitoring of each activity during all phases of construction and as a minimum shall comply with SANS 1200 and SANS 10409 as amended. This is most effectively accomplished and verified by the documentation of quality assurance activities. The **CQA Monitor** will document that quality assurance requirements have been addressed and satisfied.

During construction all documentation will be kept on-site and will be available for review by the **Project Manager, Engineer** and **CQA Monitor**.

The **CQA Monitor** will provide the **Project Manager** with signed descriptive remarks, data sheets, and logs to verify that monitoring activities have been carried out. The **CQA Monitor** will also maintain, at the job site, a complete file of **Project Specification** and **Construction Drawings**, a CQA Plan, checklists, test procedures, daily logs, and other relevant documents.

No Section of the barrier system may be covered up until the **CQA Monitor** and **Engineer** observes and approves the completed section of barrier system and assures that all CQA documentation has been completed.

8.2 Daily Record Keeping

Preparation of daily CQA records will be kept by the **CQA Monitors** this will consist of field notes, observation and testing data sheets, summary of the daily meeting with the **Contractor** and **Installer** and reporting on construction problems and resolutions. This information shall be submitted weekly along with a weekly summary to the **CQA Monitor**. Copies of all CQA documents will be maintained at the site and be available for review by the **Project Manager**. Daily records will include documentation of the observed activities during each day of activity. The daily records may include monitoring logs and testing data sheets. The records shall list all quality related items and will not be used seen as a construction report or used as a progress report. At a minimum, these logs and data sheets will include the following information:

8.2.1 Earthworks

- Date, project name, location, and weather data.
- A reduced-scale site plan, or full-scale plots, showing work areas and test locations
- Description of construction activity as well as reference to layer or elevation under consideration.
- Summary of survey or test result for the particular activity with actual results (Pass/Fail/Re-test), with location and elevations.
- Summary of survey or test results for the particular activity with the remediated action with results indicating conformance to the **Project Specification** and **Construction Drawings**.
- Off-site material received including conformance certification.
- Test equipment calibration, if applicable.
- Signature and initials of the **CQA Monitor**.

8.2.2 Concrete Works

- Date, project name, location, and weather data.
- A reduced-scale site plan, or full-scale plots, showing work areas and test locations.
- Description of concrete element under construction, type of test and/or inspection observed (slump test or shutter alignment etc.).
- Summary of survey or test results for the particular activity with actual results (Pass/Fail/Re-test).
- Summary of survey or test results for the particular activity with the remediated action with results indicating conformance to the **Project Specification** and **Construction Drawings**.
- Off-site material received including conformance certification.
- Test equipment calibration, if applicable.
- Signature and initials of the **CQA Monitor**.

8.2.3 Geosynthetics

- Date, project name, location, and weather data.
- A reduced-scale panel layout, or full-scale plots, showing work areas and test locations.
- Identification of panel or seam numbers.
- Detailing deployment areas.

- Numbering system identifying test or sample number.
- Location and identification of repairs and date of repair.
- Length and/or thickness measurements for geomembrane panels or seams.
- Welding machine temperatures and settings.
- Welding machine and technician identifications.
- Location of tests and test results (Pass/Fail/Re-test).
- Identification of testing technicians and time of tests.
- Off-site material received including conformance certification.
- Test equipment calibration, if applicable.
- Signature or initials of the **CQA Monitor**.

8.2.4 Pipes and Fittings

- Date, project name, location, and weather data.
- A reduced-scale site plan, or full-scale plots, showing work areas and test locations
- Description of location or chainage along the pipeline where inspection is observed.
- Description of test or inspection being observed (but weld, hydro-static test (Pass/Fail/Re-test), etc.) with location and elevations.
- Summary of survey information of the pipeline section being placed and inspected.
- Summary of survey or test result for the particular activity with actual results (Pass/Fail/Re-test).
- Survey or test results for the particular activity with the remediated action with results indicating conformance to the **Project Specification** and **Construction Drawings**.
- Identification of welding technicians and certification.
- Identification of testing technicians and time of tests.
- Off-site material received including conformance certification.
- Test equipment calibration, if applicable.
- Signature or initials of the **CQA Monitor**.

8.3 Construction Problems and Resolution Data Sheets

The **CQA Monitor** will keep a Construction Problems and Resolution Data Sheets, to be submitted with the weekly report prepared by the **CQA Monitor**, describing special construction situations, will be cross-referenced with daily record keeping documents and will include the following information, where available:

- A detailed description of the situation or deficiency.
- The location and probable cause of the situation or deficiency.
- How and when the situation or deficiency was found or located.
- Documentation of the response to the situation or deficiency.
- Measures taken to prevent a similar situation from occurring in the future.
- Signature of the **CQA Monitor** and the **Engineer** and a signature indicating concurrence by the **Project Manager**.

The **Project Manager** will be made aware of significant recurring nonconformance with the **Project Specification** and **Construction Drawings** and CQA Plan. The cause of the nonconformance will be determined and appropriate changes in procedures or **Project Specification** will be recommended. These changes will be submitted to the **Engineer** for approval. When this type of evaluation is made, the results will be documented and any revision to procedures or **Project Specification** will be approved by the **Project Manager** and **Engineer**.

A summary of supporting data sheets, along with final testing results and the **CQA Monitors** approval of the **work**, will be required upon completion of construction.

8.4 Quality Reports

The **CQA Monitor** shall write and submit reports as specified or requested on the quality of the construction activities on site. The reports shall list all quality related items and will not be used seen as a construction report or used as a progress report. The intent of the quality report is to inform the **Engineer** in advance of quality related issues.

8.5 Photographical Record Keeping and Documentation

The **CQA Monitor** will photograph and/or audio recorded (drone video or recording) all phases of construction, keep accurate records and submit these as part of the weekly or monthly quality reports. Photographs will be taken and documented by the **CQA Monitors** and **Engineer** to serve as a pictorial record of **Work** progress, problems, and mitigation activities. Photographs will be identified by separate photographic log by location, time, date, and name of person taking the photograph. A Camera that records the time and date will be used. These records will be presented to the **Project Manager** on a weekly basis. Photographic reporting data sheets, where used, will be cross-referenced with observation and testing data sheet(s), and/or construction problem and solution data sheet(s). Representative photographs will be included in the Construction Completion Report.

8.6 Design and/or Specification Changes

Design and/or **Project Specification** and **Construction Drawings** changes may be required during construction by the **Contractor** or **Installer**. In such cases, the **CQA Monitor**, or **Engineer** will notify the **Project Manager**. Design and/or **Project Specification** and/or **Construction Drawings** changes will be made with the written agreement of the **Engineer** and **Project Manager**, and regulatory authorities (if required) and will take the form of an addendum/concession to the **Project Specification** and **Construction Drawings** or an approval letter from the regulatory authorities responding on the request.

8.7 Construction Completion Report

During construction of the project, it is recommended that the **CQA Monitor** continuously compile the various sections of the Construction Completion Report as the information becomes available. The **Engineer** may request monthly reviews basis the progress of the report. The **Engineer** and the **CQA Monitor** shall submit to the **Employer** and the regulatory authority a Construction Completion Report at the completion of the project. This report shall certify that the **works** has been performed in compliance with the **Project Specification**, **Construction Drawings** and CQA Plan. The Construction Completion Report will acknowledge:

- Summary of construction activities.
- Observation and test data summary sheets, inclusive of a table reflecting statistical analyses i.e., for each test method on all materials the number of tests; minimum, maximum and mean values; standard deviation; number of non-compliances and rectification shall be included.
- Sampling, testing locations, and test results.
- Confirmation of interface shear strength parameters (peak and residual) using the actual geosynthetic materials supplied and installed on site.
- A description of significant construction problems and the resolution of these problems.
- Changes to the Project Drawings or Project Specifications and the justification for these changes.

- As-built drawings.
- A certification statement signed and certified by the **Engineer** and **CQA Monitor**, by whom the CQA activities were supervised, and **work** performed in responsible charge.

9.0 CONSTRUCTION QUALITY ASSURANCE

9.1 Scope of Work

Construction of the project's NEMWA 2013 compliant containment barrier system or specified earthworks must be in accordance with the approved **Construction Drawings** and **Project Specifications**. This CQA Plan establishes the CQA monitoring and testing program designed to ensure compliance with the **Construction Drawings** and **Project Specifications**. The earthwork quality assurance testing program consists of testing of soil and rock materials used during the excavation and the construction of the project's NEMWA 2013 compliant containment barrier system. Quality assurance testing and observation is required during excavation of subgrade, placement of the engineered fill, and construction of the liner system components for the project's NEMWA 2013 compliant containment barrier system.

The **works** to be performed shall consist of supplying tools, equipment, materials, supplies, manufactured articles, all labour, transportation for materials and labour and services, including essential communications and perform all operations required to fulfil the stipulated **works**. All materials, equipment and construction techniques shall be in accordance with the **Project Specification**, **Construction Drawings** and CQA Plan.

Where any materials, civil and mechanical equipment (pumps etc.) or construction technique relating to general civil engineering construction is not expressly indicated in the **Project Specifications** as required to complete the necessary and proper construction of the **works**, the **works** shall be in accordance with the South African National Standards (SANS 1200).

The types of geosynthetics used may include pipes, geomembrane, geotextiles, etc. These geosynthetics are defined in the **Project Specification**, **Construction Drawings** and CQA Plan. If any materials, equipment, or construction technique is not indicated in the **Project Specification**, **Construction Drawings** and CQA Plan, the **works** shall be in accordance with the South African National Standards (SANS), American Standard Testing Methods (ASTM) or the **Manufacturer** specifications and installation guidelines. Prior to and during construction, some of these geosynthetic materials shall be sampled and tested to determine whether they meet the **Project Specifications**. All tests shall be performed in an accredited geosynthetic laboratory approved by the **Engineer**.

The **Scope of Works** for the CQA Monitor includes monitoring of construction activities including the following but are not limited to:

- Site clearing and grubbing.
- Bulk earthworks of the project site.
- Subgrade preparation.
- Installation of compacted clay liner (CCL).
- Installation of geomembrane.
- Installation of drainage aggregates.
- Installation of pipes.
- Installation of geotextiles.
- Concrete works tie into liners.

9.2 Review Quality Control Submittals

Prior to commencement of construction, the **Engineer** shall have a meeting with the **Contractor** to confirm that the **Project Specifications** relating to the **works** are understood and that the **Contractor** can complete the **works** as per the **Contract**. Where required, any discrepancies shall be addressed by the **Engineer**. Quality control documentation and methodologies shall be reviewed by the **CQA Monitor** and **Engineer** and accepted by the **Engineer** prior to the commencement of any **works**.

Prior to geosynthetic installation, the **CQA Monitor**, and the **Engineer** shall review the **Installer's** quality control submittals to evaluate and confirm that these materials meet project requirements. The **CQA Monitor** and the **Engineer** shall review the QC submittals that are outlined in the **Project Specification, Construction Drawings** and CQA Plan and shall be accepted by the **Engineer**.

9.3 Construction Monitoring and Testing

The **CQA Monitor** will ensure that all **work** be observed and tested by the **Contractor** and **Installer** to verify that the **work** is in accordance with the **Project Specifications**. The **Engineer** shall review the work performed by the **CQA Monitor** and identify inadequate construction methodologies or materials which may adversely impact the performance of the **work**. The CQA Monitor may do visual observations and verification by using an independent survey for specific layers throughout the construction process to evaluate whether the materials are placed to the lines and grades as shown on the **Construction Drawings**.

The **CQA Monitor** and **Engineer** will give the **Project Manager** sufficient notice of anticipated completion of the construction components so that related CQA documentation may be reviewed and accepted without delay to the **Contractor** or **Installer**. Specific CQA observation and/or testing are required for the following:

- Engineered fill.
- Subgrade preparation including subsurface drainage aggregate and system.
- Compacted clay liner (CCL) or Geosynthetic clay liners (GCL).
- Anchor trench backfill.
- Soil protection layer.
- Leachate drainage gravels and systems.
- Operations soil layer or pioneering waste layer.

In addition to the above components, the **CQA Monitor** and Engineer will observe the construction of the aggregate base surfacing (geomembrane protection layer) and pipes for compliance with the **Construction Drawings** and **Project Specifications**.

9.4 Earthworks and Drainage Materials

9.4.1 Scope of Work

Earthworks in the **works** shall be done according to the **Project Specification, Construction Drawings** and CQA Plan.

The **CQA Monitor** shall ensure that quality control documentation from the **Contractor** is submitted for approval by the **Engineer** and should include **work** methodologies, inspection, and testing plans (ITP's), anticipated conformance testing and remedies on possible defects.

This section prescribes the CQA activities to be performed namely inspect, witness, verify and document whether the earthworks are constructed accordance with the **Project Specification, Construction Drawings** and CQA Plan. The earthworks activities to be monitored and accepted by the **CQA Monitors** and approved by the **Engineer**, shall include:

- Site clearance and topsoil stripping.
- PCD and Dirty Stockpile bulk excavation.
- Low permeable subgrade and compacted clay liner preparation.
- PCD and Dirty Stockpile bulk subsoil trench excavations.
- PCD and Dirty Stockpile bulk embankment construction.
- Subsoil and leachate collection drainage material and placement.
- PCD and Dirty Stockpile bulk anchor trench excavation and backfill.
- Clean and dirty water drain/channel excavation.

9.4.2 Conformance Testing

During construction, the **CQA Monitor** shall ensure that all the materials are tested to verify that the construction is in accordance with the **Project Specifications** and **Construction Drawings**. Testing shall be performed on all materials used in the construction to confirm that the materials meet the **Project Specifications** and **Construction Drawings**.

Materials testing will be performed for material qualification and material conformance. The two stages of testing are as follows:

- **Material Qualification tests:** These tests are used to evaluate the conformance of a proposed material source with the **Project Specification** for qualification of the source prior to construction.
- **Material Conformance tests:** These tests are used to evaluate the conformance of the particular batch of material from a qualified source to the **Project Specification** prior to installation of the material.

The **Contractor** will be responsible to submit material qualification test results to the **Project Manager** and the **CQA Monitor** for review. The appointed soils laboratory will perform the conformance testing and **CQC** testing. Material Testing will be conducted in general accordance with the current version of the corresponding South African National Standards (SNAS) test procedures or if not available the American Society of Testing and Materials (ASTM) testing procedures. The test methods indicated in Table 2 are those that will be used for this testing unless the test methods are updated or revised prior to construction. Revisions to the test methods will be reviewed and approved by the **Engineer** and the **CQA Manager** prior to their usage.

The **CQA Monitors** shall verify test results and request ad-hoc testing of materials for conformance before and during the construction activity is taking place. The minimum testing frequency shall be in accordance with the CQA Plan for earthworks is listed in Table 2. and **Project Specification**.

Table 2: Minimum Testing Frequency for Earthworks Materials

TEST DESIGNATION	APPLICABLE TEST METHOD	BULK ENGINEERED FILL (m ³)	ENGINEERED LAYER WORKS (m ³)	DRAINAGE AGGREGATE (m ³)	FOUNDATION OF DRAINS (m ³)
Visual-method soil classification	ASTM D2488	Continual during excavation and placement of soils			
Soil classification	TRH 14	2 000	2 000	Per structure	1 000
Particle size	SANS 3001-AG1	1 000	1 000	500	500
Atterberg limits	SANS 3001-GR 10	1 000	1 000	500	500
Moisture and density (nuclear)	SANS 3001-NG 5	1000 (Min 3 test per layer)	50 (Min 3 test per layer)	-	500 (Min 3 test per layer)
California bearing ratio (CBR)	SANS 3001-GR 40	4 000	4 000	-	2 000
Shear box test	ASTM D3080	10 000	10 000	-	-
Moisture-density relationship	SANS 3001-GR 30	5 000 (Min 1 test per soil type)	5 000 (Min 1 test per soil type)	-	1 000 (Min 1 test per layer)
Moisture Content	SANS 3001-GR 20	1 per 20 nuclear moisture tests	1 per 5 nuclear moisture tests	-	-
Sand replacement test	SANS 3001-GR 35	1 per 20 nuclear moisture tests	1 per 20 nuclear moisture tests	-	-
Hydraulic conductivity	ASTM D5084-90 ASTM D2488	3 000	1 500	-	-
Layer thickness	Surveyor	Per layer	Per layer	Per layer	Per layer

TEST DESIGNATION	APPLICABLE TEST METHOD	BULK ENGINEERED FILL (m ³)	ENGINEERED LAYER WORKS (m ³)	DRAINAGE AGGREGATE (m ³)	FOUNDATION OF DRAINS (m ³)
Side slopes (internal and external)	Surveyor	1 check per 20 m of linear chainage of the top crest	-	-	-
Permeability (Double Ring Infiltrometer)	ASTM D3385 / ASTM D5093	-	3 000	-	-
Aggregate crushing value (ACV)	SANS 3001-AG10 Aggregate Crushing Value	-	-	Per material	-
Flakiness index	SANS 5847: Flekiness Index	-	-	Per material	-

The testing frequencies specified in Table 2 shall be increased or decreased when the **CQA Monitor** determines that construction conditions (such as adverse weather, equipment breakdown, excessive lift thickness, improper soil type, improper moisture conditioning and compaction) warrant additional tests or visa versa tests. Tests shall be performed on an even grid to provide adequate testing coverage.

For large fills in small areas, the testing frequency shall be increased as necessary to ensure testing for each lift or layer of soil placed. Additional tests will be approved by the **Engineer** or **Project Manager** and directed by the **CQA Monitor**. The **Contractor** is advised to make allowance for additional testing.

9.4.3 Quality Control Submittals

Quality control testing shall be done by the **Contractor** as specified and to satisfy his obligations under the **Contract**. The results shall be submitted to the **CQA Monitor** for acceptance and to the **Engineer** for approval. Submittals include the following:

- Date, project name, location, and weather data, including high and low daily temperatures and precipitation (if any).
- Descriptions of ongoing construction **works** areas and equipment utilised by the **Contractor**.
- Summary of test results, along with material sample values used and if any new material samples were obtained, with locations and elevations.
- Identification, description and resolution of deficient test results, including conformance/non-conformance reports.
- Test equipment calibration certificates, if/where applicable.
- Note and summary of meetings held on-site with regards to material testing.
- Signature or initials of the **CQA Monitor** on all the **CQC** documentation.
- Record keeping in the form of physical and electronic copies.

9.4.4 Construction Monitoring and Testing

The **CQA Monitor** will observe and verify tests related to all earthworks and drainage construction materials to verify that the construction is in accordance with the **Project Specifications** and **Construction Drawings**. The **CQA Monitor** may identify inadequate construction methodologies or materials that may adversely impact the performance or intended design of the **works**.

The **CQA Monitor** will record visual observations and survey measurements (supplied by the **Contractor** inline with the information supplied on the **Construction Drawings** or as requested by the **CQA Monitor**) throughout

the construction process to ensure that the materials are placed to the minimum dimensions and specifications as shown on the **Project Specifications** and **Construction Drawings** or degree of accuracy and permissible deviation as specified in the **Project Specifications** or South African National Standards (SANS). The **Project Specifications** will take preference.

Construction Monitoring shall, as a minimum, include the following:

9.4.4.1 Site Clearance and Topsoil Striping

The **CQA Monitors** will observe and verify areas where site clearing, and topsoil stripping are conducted. The **CQA Monitor** shall monitor and verify that the vegetation is sufficiently cleared and grubbed, and by means of comparative surveys (supplied by the **Surveyor** and **Contractor**) confirm the specified depth of topsoil removed for the specific areas in question. Site clearance and topsoil stripping shall be done in accordance with the **Project Specifications** and **Construction Drawings**.

The **Contractor** will supply to the **CQA Monitor** on a weekly basis, a layout drawing of the topsoil stockpiles clearly indicating the stockpile name, surveyed volumes. The **CQA Monitors** shall observe and verify where topsoil is stockpiled.

The topsoil stockpiles will not be higher than 2m in height and will be maintained by the **Contractor** every six (6) monthly, by rotation the material on the stockpiles to ensure anaerobic conditions within the stockpile.

9.4.4.2 Bulk Excavation

CQA Monitors shall observe and verify bulk excavation activities on the project to verify that the area is excavated in accordance with the **Construction Drawings** and **Project Specifications**. As a minimum the **CQA Monitors** shall:

- Observe and verify bulk excavation levels by means of a pre and post excavation survey (supplied by the **Surveyor** and **Contractor**) of the areas in question to verify that the excavation depths and grades are in accordance with the **Project Specifications** and **Construction Drawings**, batter slopes will be inline with best practice guidelines and constructed by the **Contractor** to ensure a safe working area. Survey will be provided by the **Surveyor** and **Contractor** in line with the **Project Specifications** and **Construction Drawings** and supplied to the **CQA Monitor** within 24 hours of taking such survey.
- Observe and verify the placement, stockpiling and spoiling of the excavated material.
- Verify test results for material classification and suitability for use of excavated material in accordance with **Project Specifications** and **Construction Drawings**. Testing will be provided as per the testing frequency or as stipulated in the Quality Control Plan (QCP) (approved by the **CQA Monitor**) by the **Contractor** in line with the **Project Specifications** and **Construction Drawings**.

The **Contractor** will supply to the **CQA Monitor** on a weekly basis, a layout drawing of the stockpiles clearly indicating the stockpile name, surveyed volumes and perform CQC testing on the material stockpiled for classification, to provide evidence that the stockpiled material meets the **Project Specification**. The **Contractor** will supply a material balance monthly to the **CQA Monitor** and **Project Manager** indicating the available stockpile material volumes against his estimated required materials for project completion. The **CQA Monitors** shall observe and document where material is stockpiled.

The material stockpiles will be maintained by the **Contractor** daily, sides slopes sloped will be sloped at a minimum of 1:3 and access ramps will be sloped at a minimum of 1:10 to reduce the effect of erosion and siltation. Stormwater management and silt fences will be installed around the stockpiles to prevent transportation of silt and fines into water courses.

9.4.4.3 Subgrade Preparation

CQA Monitors shall observe and verify the subgrade preparation of the basin and side slopes to verify that the subgrade preparation is in accordance with the **Project Specifications** and **Construction Drawings**. As a minimum the **CQA Monitors** shall:

- Observe and verify that the Contractor obtain material from the approved excavation or borrow location.
- Observe and verify that prepared subgrade layers are constructed in number and thickness as specified on the **Project Specifications** and **Construction Drawings** and within tolerance.

- Observe and verify that the prepared subgrade surface meets the lines and grades shown on the **Construction Drawings** and that levels are in tolerance and in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that compaction and moisture test frequency and results are in accordance with the **Project Specifications** and **Construction Drawings**. Witness, verify that permeability test frequency and results are in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that the subgrade preparation is smooth, free of sharp rocks and debris as well as other undesirable materials ready to receive the geomembrane in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that all nuclear density holes for testing or holes created by survey pegs are filled with bentonite or the same soil as tested and compacted not to affect the performance of the layer works.
- Observe and verify that placement of the overlying materials does not damage, create large wrinkles, or induce excessive tensile stress in any underlying geosynthetic material.
- Approve the subgrade certification for hand over to the **Installer**.

Approval of the subgrade does not relieve the **Contractor** from his responsibilities to maintain the subgrade inline with the approved surface. After the subgrade has been accepted by the **Installer, Project Manager, Engineer** and **CQA Monitor**, it will be the **Installers** responsibility to indicate to the **CQA Monitor** any changes in the subgrade soil conditions or underlying geosynthetic conditions that may require repair work. If the **CQA Monitor** agree with the **Installer**, then the **CQA Monitor** will inform the **Project Manager** and **Contractor** to correct such areas as indicated. The **CQA Monitor** will observe and verify that the subgrade soil is repaired and approve the repaired area for continuation of installation. Only on approval by the **CQA Monitor** may geosynthetic material installation be allowed to continue.

At any time before or during installation of geosynthetic material installation, the **CQA Monitor** may indicate to the **Project Manager** and **Contractor**, locations that may not provide adequate support to the geomembrane. These areas will be rectified prior to subgrade handover or as indicated above.

If the geotechnical investigation or other constraint revealing inadequate suitable subgrade soil on site for the use of in the compacted clay liner (CCL) of a composite liner within a barriers system, the use of geosynthetic clay liner (GCL) or bentonite enriched soil liner (BESL) may be considered as a partial or total replacement of the CCL. Prior to considering the above-mentioned replacement the **Engineer** will take into consideration the effects of both cations and salts in the base soil and in the leachate on the sodium bentonite used in the GCL and BESL.

9.4.4.3.1 Test Pad Construction

A test pad is intended to establish methods, equipment, and procedures for attaining the specified properties, not to pre-qualify materials for the compacted clay liner. Once the methods and procedures have been verified by completing a successful test, the **Contractor** must use the same method and procedures to construct the compacted clay liner.

The below subgrade preparation considerations should be taken into consideration by the **Contractor** and allowed for in his rates.

- The test pad shall be in an area of the project agreed with the **Project Manager** and **CQA Monitor**.
- Preparation of the area shall be the same as for the construction area i.e., clearing and grubbing and stripping of topsoil and/or organic materials.
- The surface of the subgrade shall be proof rolled to detect soft zones and irregularities that may require removal and replacement and shaped to a slope of between 1% and 3%.
- Construction of the test pad shall only commence after the subgrade has been observe and verify by the **CQA Monitor**.

The test pad will be constructed by the **Contractor** as follows:

The test pad shall be constructed in a rectangular shape to a minimum plan area of fifty (50) meters by fifteen (15) meters. The test pad should consist of a minimum two (2) 150 mm thick compacted clay liner placed, processed, and compacted in accordance with the **Project Specifications**. It is recommended that a recycler

be used for the processing of clay material to ensure consistency in moisture conditioning and the proper blending of the layers.

The trail pad will supply the **Contractor** with the opportunity to investigate the amount of moisture and the compaction effort required to meet the **Project Specification**. It is recommended that the **Contractor** perform in lab permeability test on the material from stockpile he intends to use for the test pad prior to commencing with the test pad.

Only when the **CQA Monitor** and **Engineer** have determined that each lift meets the target dry density and moisture content requirements, shall the following lift be constructed. The completed compacted clay liner shall be sealed by rolling with appropriate equipment providing a smooth uniform surface and tested for permeability inline with Table 3 for a minimum continuous period of 40 hours. This will supply the **Contractor** with an indication on the duration for permeability testing that will be required during construction.

The **CQA Monitor** will observe and verify the borrow material and construction of each lift of the test pad and will ensure that construction is performed in accordance with the **Project Specifications** and CQA Plan. Monitoring and documentation will include:

- Weather conditions during construction.
- Equipment used in construction.
- Manner in which equipment was used.
- Soil type and USCS classification.
- Moisture content and dry density measurements for each lift.
- Approximate thickness of each uncompacted and compacted soil lift.
- Permeability test results.

Table 3: Test Pad Construction Testing Method and Frequency

TEST NAME	TEST METHOD	SUBGRADE	COMPACTED CLAY
Visual-method Soil Classification	ASTM D 2488	1 per Soil Type	Continuous
Moisture-density relationship	SANS 3001-GR30	1 Test	1 Test per Lift
Atterberg Limits	SANS 3001-GR10	N/A	1 Test per Lift
Moisture and density ⁱ (nuclear)	SANS 3001-NG5	3 Tests	4 Tests Per Lift ⁱ
Moisture Content	SANS 3001-GR20	1 Test	1 Tests Per Lift ⁱⁱ
Sand replacement	SANS 3001-GR35	N/A	1 Test per 20 Nuclear Density Tests
Hydraulic Conductivity	ASTM D5084 (5 psi)	N/A	2 Test per Lift ^{iii,iv}
Permeability (Double Ring Infiltrometer)	ASTM D3385	N/A	1 Test per 300mm layer

Notes to Table 3:

- i) Nuclear gauge tests for moisture content and dry density shall be performed at evenly spaced locations in a grid pattern within the footprint of the test pad. Acceptance will be based accordance with the **Project Specification**.
- ii) A correlation shall be developed between the moisture contents as determined by the nuclear gauge and conventional oven and/or microwave oven methods during construction of the test pad to facilitate construction testing and placement of compacted clay liner during full scale operations.
- iii) Upon completion of the test pad, samples shall be collected using 3-inch outside diameter thin-walled sampling tubes (Shelby tubes) in accordance with ASTM D1587 or by the block sampling technique in accordance with ASTM D4220, at the discretion of the **Engineer**.

Two samples in each lift shall be collected to represent the compacted clay liner. Samples should be collected outside of the future location of the field scale infiltration test.

- iv) The hydraulic conductivity evaluated in the laboratory (ASTM D5084) for the 3-inch diameter samples shall be correlated to the hydraulic conductivity evaluated in the field scale testing. Effective confining pressures of 5 psi (35 KPa) shall be applied during the test. The correlation is to provide a means for establishing criteria for laboratory and field testing of the full-scale (construction) compacted clay liner. In addition, in-situ hydraulic conductivity data is to provide information demonstrating the feasibility of constructing a compacted clay liner meeting the **Project Specifications**.

The interpretation of the test results shall focus on the feasibility of constructing a full-scale compacted clay liner in conformance with the project and regulatory requirements. A letter report summarizing the test results shall be issued by the Engineer to the CQA Monitor at the completion of the test pad testing program. This letter report shall also be included as a part of the final project CQA documentation.

9.4.4.4 Subsoil Trench Excavations

CQA Monitors shall observe and verify subsoil trench excavations to verify that the subsoil trench excavations are in accordance with the **Project Specifications** and **Construction Drawings**. The **CQA Monitor** as a minimum shall:

- Observe and verify that the subsoil excavations are in accordance with the lines, levels and grades provided in the **Construction Drawings** and **Project Specifications** and within tolerance.
- Observe and verify that compaction and moisture test frequency and results for trench bases are in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that the trench excavation is suitable for geotextile installation (if required) and confirm the overlap lengths in accordance with **Project Specifications** and CQA Plan.
- Observe and verify the stockpiling of excavated material in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that all material is in accordance with the **Project Specifications** and **Construction Drawings** are tested in line with the testing frequencies (Table 3).

9.4.4.5 Embankment and Earth Berm Construction

CQA Monitors shall observe and verify embankment construction for the PCD's as well as, diversion and contour berms to verify that the embankments and berms are constructed in accordance with the **Project Specifications** and **Construction Drawings**. The **CQA Monitor** as a minimum shall:

- Observe and verify that embankments are constructed to the lines, grades and levels specified within the **Project Specifications** and **Construction Drawings** and within tolerance.
- Observe and verify the removal of unsuitable material and suitable material on the footprint for areas in question to verify that the embankment footprint preparation is in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify the material classification of embankment materials and its conformance to the **Project Specifications** and **Construction Drawings**.
- Observe and verify that embankment layers are constructed in the specified thickness in accordance with the **Project Specifications** and **Construction Drawings**. Survey will be provided by the **Contractor** and **Surveyor** in line with the **Project Specifications** and **Construction Drawings** for each lift/layer constructed.
- Observe and verify that compaction and moisture test frequency and results are in accordance with the **Project Specifications** and **Construction Drawings**. Testing will be provided as per the testing frequency or as stipulated in the Quality Control Plan (QCP) (approved by the **CQA Monitor**) by the **Contractor** in line with the **Project Specifications** and **Construction Drawings** for each lift/layer constructed.
- Observe and verify that embankment upstream side slope surface preparation is in accordance with the **Project Specifications** and **Construction Drawings** ready to receive geomembranes.
- Approve the subgrade certification for hand over to the **Installer**.

- Observe and verify that embankment downstream side slope surface preparation is in accordance with the **Project Specifications** and **Construction Drawings** ready to receive topsoil and grassing.

Approval of the subgrade surface or topsoil surface does not relieve the **Contractor** from his responsibilities to maintain the surface inline with the approved surface, until geosynthetic material has been placed and signed-off or until vegetation has vested on the outer embankments.

9.4.4.6 Drainage Material and Drainage Layers

The **CQA Monitors** shall observe and verify the sourcing and placing of the drainage materials and layers. The drainage materials include any drainage material (graded filter sand, pea gravel, graded washed stone, etc.) The **CQA monitor** at a minimum shall:

- Review documentation of the material qualification test results provided by the **Contractor**.
- Verify that drainage material is constructed to the lines, grades and levels specified within the **Project Specifications** and **Construction Drawings** and within tolerance.
- Observe and verify the material classification testing of drainage material and its conformance to the **Project Specifications** and **Construction Drawings**.
- Observe and verify that that appropriate light ground pressure equipment is used and that such equipment avoids sharp turns.
- Observe and verify that drainage material layers are constructed in the specified thickness in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that drainage material layers installation does not cause damage to underlying geosynthetic material and is in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that drainage material layers are free from debris and other undesirable materials in accordance with the **Project Specifications** and **Construction Drawings** prior to the closing of the geotextile.
- Observe and verify that outlet pipe bedding, cradling and blanket layer thicknesses are in accordance with **Project Specifications** and **Construction Drawings**. Survey will be provided by the **Contractor** and **Surveyor** in line with the **Project Specifications** and **Construction Drawings** for each layer of backfill material.
- Observe and verify that outlet pipe bedding, cradling and blanket layer compaction and moisture content results are in accordance with the **Project Specifications** and **Construction Drawings**. Testing will be provided as per the testing frequency or as stipulated in the Quality Control Plan (QCP) (approved by the **CQA Monitor**) by the **Contractor** in line with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that outlet pipe backfill layer thicknesses are in accordance with **Project Specifications** and **Construction Drawings**. Survey will be provided by the **Contractor** and **Surveyor** in line with the **Project Specifications** and **Construction Drawings** for each layer of backfill material.
- Observe and verify that outlet pipe backfill compaction and moisture content results are in accordance with the **Project Specifications** and **Construction Drawings**. Testing will be provided as per the testing frequency or as stipulated in the Quality Control Plan (QCP) (approved by the **CQA Monitor**) by the **Contractor** in line with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that outlet pipe hydrostatic testing has been completed in accordance with **Project Specifications** and **Construction Drawings**.
- Observe and verify that pipes are clean and free from debris and other undesirable materials in accordance with the **Project Specifications** and **Construction Drawings**. The **Contractor** will allow for camera inspections to prove to the **CQA Monitor** that all pipes are clean once backfilling has been completed. The **CQA Monitor** will not allow rinsing or flushing out of perforated or drilled pipes under any circumstances.

9.4.4.7 *Anchor Trench Construction*

During construction, the **CQA Monitor** shall observe and verify the anchor trench excavations and backfilling methods are consistent with the requirements specified in the **Project Specifications** and **Construction Drawings**. The **CQA Monitor** as a minimum shall:

- Observe and verify that the final embankment level has been reached and within tolerance prior to allowing the excavation of the anchor trench.
- Observe and verify that the anchor trench excavations are in accordance with the lines, levels and grades provided in the **Project Specifications** and **Construction Drawings** and within tolerance.
- Observe and verify that the trench is free of sharp rocks, debris and other undesirable materials, particles are no larger than 3mm in its longest dimension and that the anchor trench corner that will be in contact with the geosynthetic material is rounded or protected in accordance with the **Project Specifications** and **Construction Drawings**, to avoid damage to the geosynthetic material.
- Observe and verify that anchor trench backfill layer thicknesses are in accordance with **Project Specifications** and **Construction Drawings**. Survey will be provided by the **Contractor** and **Surveyor** in accordance with the **Project Specifications** and **Construction Drawings** for each layer of backfill material.
- Observe and verify that anchor trench backfill compaction and moisture content results are in accordance with the **Project Specifications** and **Construction Drawings**. Testing will be provided as per the testing frequency or as stipulated in the Quality Control Plan (QCP) (approved by the **CQA Monitor**) by the **Contractor** in accordance with the **Project Specifications** and **Construction Drawings**.

9.4.4.8 *Channels / Drains*

The **CQA Monitor** shall observe and verify the construction of channels/drains. As part of the earthworks for the channels/drains the **CQA Monitor** shall as a minimum:

- Observe and verify that channels/drains are constructed in accordance with the lines, grades and levels specified within the **Project Specifications** and **Construction Drawings** and within tolerance.
- Observe and verify removal of unsuitable material on footprint for areas in question to verify that the channels/drains footprint preparation is in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that the channels/drains excavations are in accordance with the lines, levels and grades provided in the **Project Specifications** and **Construction Drawings** and in tolerance.
- Observe and verify that channel excavation base compaction and moisture content results are in accordance with **Project Specifications** and **Construction Drawings**. Survey and testing will be provided as per the testing frequency or as stipulated in the Quality Control Plan (QCP) (approved by the **CQA Monitor**) by the **Contractor** and **Surveyor** in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify replacement of unsuitable material with suitable material if required on the footprint areas in question to verify that the channel footprint preparation is in accordance with the **Project Specifications** and **Construction Drawings**.

9.4.4.9 *Road Construction*

The **CQA Monitor** shall observe and verify roads construction on the project. At a minimum the **CQA Monitor** shall:

- Observe and verify that the roads are constructed in accordance with the lines, grades and levels specified within the **Project Specifications** and **Construction Drawings** and within tolerance.
- Observe and verify removal of unsuitable material on the footprint for areas in question to verify that the road base preparation is in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify the material classification of road materials and its conformance to the **Project Specifications** and **Construction Drawings**.

- Observe and verify that road layers are constructed in the specified thickness in accordance with the **Project Specifications** and **Construction Drawings**. Survey and testing will be provided as per the testing frequency or as stipulated in the Quality Control Plan (QCP) (approved by the **CQA Monitor**) by the **Contractor** and **Surveyor** in accordance with the **Project Specifications** and **Construction Drawings**.

9.4.4.10 Cover Material Placement

The **CQA Monitor** shall observe and verify the construction of the cover material placed across the geosynthetic material on the project. At a minimum the **CQA Monitor** shall:

- Observe and verify that the cover material is constructed in accordance with the lines, grades and levels specified within the **Project Specifications** and **Construction Drawings** and within tolerance.
- Observe and verify that that appropriate light ground pressure equipment is used and that such equipment avoids sharp turns.
- Observe and verify removal of unsuitable material from the cover material for areas in question to verify that the material is in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify the material classification of cover materials and its conformance to the **Project Specifications** and **Construction Drawings**.
- Observe and verify that cover material placement does not cause damage to the underlying materials or geosynthetics.
- Observe and verify that cover material is constructed in the specified thickness in accordance with the **Project Specifications** and **Construction Drawings**. Survey and Testing will be provided as per the testing frequency or as stipulated in the Quality Control Plan (QCP) (approved by the **CQA Monitor**) by the **Contractor** and **Surveyor** in accordance with the **Project Specifications** and **Construction Drawings**.

9.5 Concrete

9.5.1 Scope of Work

Concrete **works** shall be done according to the **Project Specifications**.

This section prescribes the CQA activities to be performed to inspect, witness, verify and document whether the in-situ and precast concrete elements are constructed in accordance with the **Project Specifications** and **Construction Drawings**. The **CQA Monitor** shall ensure that quality control documentation from the **Contractor** is submitted for approval and should include **work** methodologies, anticipated conformance testing and remedies on possible defects.

The concrete activities to be monitored by the **CQA Monitors**, shall include:

- Observe and verify that all concrete and precast elements are installed in accordance with the lines and levels specified within the **Project Specifications** and **Construction Drawings** and within tolerance.
- Observe and verify that all concrete mix design is in accordance with the **Project Specifications** and **Construction Drawings Specifications** and has been approved by the **Engineer**.
- Observe and verify that all concrete slump is in accordance with the **Project Specifications** and **Construction Drawings** and within tolerance.
- Observe and verify that all joints have been prepared and constructed in accordance with the **Project Specifications** and **Construction Drawings** and within tolerance.
- Observe and verify that all feral holes, joint sealing, and concrete repair **work** has been prepared and constructed in accordance with the **Project Specifications** and **Construction Drawings** prior to backfilling.
- Observe and verify that all concrete test cubes are collected and tested in accordance with the **Project Specifications** and **Construction Drawings** and within tolerance.
- Observe and verify that curing and removal of shutter are in accordance with the **Project Specifications** and South African National Standards (SANS).

- Observe and verify that all concrete test machines are certified and calibrated and within tolerance.
- Observe and verify that all pre-cast concrete elements are in accordance with the South African National Standards (SANS) during off-site inspections and delivery to site.

9.5.2 Conformance Testing

Conformance testing shall be done by the **Contractor** as specified prior and during the construction. The results shall be submitted to the **CQA Monitor** for acceptance and to the **Engineer** for approval. The **CQA Monitor** shall ensure that the **Contractor** complies to the following minimum requirements or as specified in the **Project Specifications** and **Construction Drawings**:

- Mix designs have been approved for all concrete/ soilcrete strengths.
- Slump test of each load of concrete arriving onsite.
- Test results of compression strength of concrete cubs.
- Test cubes have been made, cured, stored and transported.
- Test equipment calibration certificates, if/where applicable.
- Test results for 7 days and 28 days strength meet the requirements.
- Signature or initials of the **CQA Monitor** on all the CQA documentation.

During construction, the **CQA Monitor** shall ensure that all concrete mix designs and all pre-cast concrete elements are inspected and tested to verify that the materials are in accordance with the **Project Specifications** and **Construction Drawings**. The **CQA Monitors** shall verify test results and request ad-hoc testing of materials for conformance before and during the construction activity. The minimum testing frequency shall be in accordance with the **Project Specifications** and Table 4.

Testing frequencies shall be increased when **CQA Monitors** determines that construction conditions (such as adverse weather, equipment breakdown, re-occurring material conformance failures, or any re-occurring construction deficiency) additional tests and allowance should be made by the **Contractor** for this. Additional tests shall be approved by the **Project Manager** and directed by the **CQA Monitor**.

Testing shall be performed on all materials used in the construction **works** to confirm that the materials meet the **Project Specifications**. The **CQA Monitor** shall request testing during and after final placement of the materials.

The **CQA Monitor** will observe and record that the **Contractor** collect concrete samples as specified in the Table 4 and that the average results obtained from the testing of three test cubes of concrete in accordance with SANS 5863.

Table 4: Concrete Test Methods and Frequencies

TEST NAME	TEST METHOD	FREQUENCY
Sampling fresh mixed	SANS 5861-2	per Truck / per Structure
Making and Curing Test Specimens	SANS 5861-3	per Truck / per Structure
Slump Test	SANS 5862-1	per Truck / per Structure
Compressive Strength (7,28 days) -more if required.	SANS 5863	per Truck / per Structure
Compressive Strength of Cores	SANS 5865	When required by CQA Monitor
Precast concrete pipes	SANS 667	1 per 50 Units
Portal and rectangular precast culverts Units	SANS 986	1 per 50 Units

If a defect is discovered in the concrete test results or visual defect by the **CQA Monitor**, the **CQA Monitor**, and **Engineer** will immediately determine the extent and nature of the defect. The **CQA Monitor** and **Engineer**

will determine the extent of the defect area by additional observation, review of records or by collecting samples inline with SANS 5865 for additional testing.

The **CQA Monitor** and the **Engineer** will document and notify the **Project Manager** and **Contractor** and schedule appropriate evaluation when the **work** defect is to be corrected.

The **Contractor** will correct the deficiencies to the satisfaction of the **CQA Monitor** and **Engineer**. Re-evaluation by the **CQA Monitor** and the **Engineer** shall continue until the defect has been corrected before any additional **work** is performed by the **Contractor** in the area of the deficiency. Should the **CQA Monitor**, and **Engineer** believe the deficiency can not be corrected after investigating, the **Engineer** will instruct the **Contractor** to demolish and rebuild the structure to the **Project Specification** to meet the design intent and will notify the **Project Manager** of such decision.

9.5.3 Quality Control Submissions

9.5.3.1 *Preconstruction*

Materials conformance testing will be done by at an accredited laboratory (approved by the **Engineer**) by the **Contractor** and the results submitted for approval by the **Engineer** and **CQA Monitor**. The **Contractor** will submit the following:

- Concrete:
 - Trail mix design.
 - Source of material.
 - Dates of testing.
 - Test results signed off by laboratory.
 - Copy of certification of laboratory.
- Specifications of sealant to be used for expansion joints.

9.5.3.2 *Construction*

All quality control documentation and procedures are to be reviewed by **Engineer** and **CQA Monitors** and accepted before any related **work** can commence.

Quality control testing shall be done by the **Contractor** as specified. The results shall be submitted to the **CQA Monitor** for acceptance and to the **Engineer** for approval. The **CQA Monitor** shall ensure that the **Contractor** complies to the following minimum requirements or as specified in the **Project Specifications** and **Construction Drawings**:

- Date, project name, location, and weather data, including high and low daily temperatures and precipitation (if any).
- Descriptions of ongoing construction **work** areas and equipment utilised by **Contractor**.
- Summary of test results, along with material sample values used and if any new material samples were obtained, with locations and elevations.
- Identification, description, and resolution of deficient test results, including conformance/non- conformance reports.
- Test equipment calibration certificates, if/where applicable.
- Note and summary of meetings held on-site with regards to material testing.
- Signature or initials of the **CQA Monitor** on all CQA documentation
- Record keeping in the form of physical and electronic copies.

9.5.4 Construction Monitoring

The **CQA Monitor** will observe and verify tests related to all concrete construction materials to verify that the construction is in accordance with the **Project Specifications** and **Construction Drawings**. The **CQA Monitor** shall identify inadequate construction methodologies or materials that may adversely impact the performance or intended design of the facilities being constructed.

The **CQA Monitor** will record visual observations and survey measurements (supplied by the **Contractor** and **Surveyor**) throughout the construction process to ensure that the materials are placed to the minimum dimensions and specifications on the **Construction Drawings** or degree of accuracy and permissible deviation as specified in the **Project Specifications** or South African National Standards (SANS). The **Project Specifications** will take preference. The **CQA Monitor** shall, as a minimum:

- Observe and verify that all materials and workmanship is in accordance with SANS 1200G, or any other referenced specification specified in the **Project Specifications** and **Construction Drawings**.
- Observe and verify, document date of arrival of cement on site.
- Observe and verify that cement is stored under cover and not in contact with floor or walls.
- Observe and verify that cement not stored for longer than eight (8) weeks.
- Observe and verify that Precast concrete pipes comply to the requirements of SANS 677
- Observe and verify that portal and rectangular precast concrete culvert units comply to the requirements of SANS 986
- Observe and verify that bulk cement stored in watertight silos.
- Observe and verify that aggregate of different sizes is stored separately.
- Observe and verify pre-concrete placement inspection that, blinding layers, reinforcing, and shuttering is in accordance with the **Project Specifications** and **Construction Drawings**. The **CQA Monitor** will observe any unsuitable preparations and verify that unsuitable preparations are rectified before the placement of concrete.
- Observe and verify that formwork is placed correctly and secured, free of debris and that joints are adequately prepared.
- Observe and verify that there is enough concrete to ensure that entire section is casted without the need to pour fresh concrete against uncompleted section from previous pour.
- Observe and verify that the reinforcement delivered to site is labelled and in accordance with the **Project Specifications** and **the Construction Drawings**.
- Observe and verify and observe that the reinforcement has been fixed and fastened as per the **Project Specifications** and **Construction Drawings**.
- Observe and verify that ferrule ties are placed correctly.
- Observe and verify that concrete is placed within forty-five (45) minutes on arriving on site.
- Observe and verify that sufficient vibration is done in accordance with the **Project Specifications**.
- Observe and verify that the shutters are properly supported, oiled, aligned vertically and horizontally with the appropriate cover between the reinforcing and shutters in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify the appropriate concrete mix designs for the respective structures in accordance with the **Project Specifications**.
- Observe and verify that joints are prepared and constructed in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify slump tests in accordance with the **Project Specifications**.
- Observe and verify stripping of formwork in accordance with the **Project Specifications**.
- Observe and verify that concrete is cured in accordance with the **Project Specifications**.

- Observe and verify concrete cube tests sampling and test results in accordance with the **Project Specifications**.
- Observe and verify that the subgrade is prepared in accordance with the **Project Specifications** and **Construction Drawings**.

9.5.4.1 Channels/Drains

The **CQA Monitor** shall observe and verify the construction of the concrete **works** for channels/drains. As a minimum the **CQA Monitor** shall:

- Observe and verify that all materials and workmanship is in accordance with SANS 1200G, or any other referenced specification specified in the **Project Specifications** and **Construction Drawings**.
- Observe and verify that excavation is clear and has no debris and is surveyed and tested in accordance with the **Construction Drawings** and **Project Specifications**.
- Observe and verify that shuttering lines, grades and levels are placed in accordance with the **Project Specifications** and **Construction Drawings** and in tolerance. Survey and testing will be provided as per the testing frequency or as stipulated in the Quality Control Plan (QCP) (approved by the **CQA Monitor**) by the **Contractor** and **Surveyor** in accordance with the **Project Specifications** and **Construction Drawings** and within tolerance.
- Observe and verify that the reinforcement is in accordance with the **Project Specifications** and **Construction Drawings** in the case of permanent channels.
- Observe and verify concrete slump and cube tests and results in accordance with the **Project Specifications** and **Construction Drawings**. Testing will be provided as per the testing frequency or as stipulated in the Quality Control Plan (QCP) (approved by the **CQA Monitor**) by the **Contractor** in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that surface finish is in accordance with **Project Specifications** and **Construction Drawings**.
- Observe and verify that joints are prepared and constructed in accordance with the **Project Specifications** and **Construction Drawings**.

9.5.4.2 Outlet Structures and Energy Dissipating Structure

The **CQA Monitor** shall observe and verify the construction of the concrete **works** for outlet structures and energy dissipating structure. As a minimum the **CQA Monitor** shall:

- Observe and verify that all materials and workmanship is in accordance with SANS 1200G, or any other referenced specification specified in the **Project Specifications** and **Construction Drawings**.
- Observe and verify that excavation is clear and has no debris and is surveyed and tested in accordance with the **Construction Drawings** and **Project Specifications**.
- Observe and verify that shuttering lines, grades and levels are placed in accordance with the **Project Specifications** and **Construction Drawings** and in tolerance. Survey and testing will be provided as per the testing frequency or as stipulated in the Quality Control Plan (QCP) (approved by the **CQA Monitor**) by the **Contractor** and **Surveyor** in accordance with the **Project Specifications** and **Construction Drawings** and within tolerance.
- Observe and verify that the reinforcement is in accordance with the **Project Specifications** and **Construction Drawings** in the case of permanent channels.
- Observe and verify concrete slump and cube tests and results in accordance with the **Project Specifications** and **Construction Drawings**. Testing will be provided as per the testing frequency or as stipulated in the Quality Control Plan (QCP) (approved by the **CQA Monitor**) by the **Contractor** in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that surface finish is in accordance with **Project Specifications** and **Construction Drawings**.

- Observe and verify that joints are prepared and constructed in accordance with the **Project Specifications** and **Construction Drawings**.

9.5.4.3 PCD Silt Traps, Access Ramps, Inlet and Outlet Structures

The **CQA Monitor** shall observe and verify the construction of the concrete **works** for the PCD's silt traps, PCD's side slopes and basin floor, PCD's inlet and outlet structures and PCD's access ramps (if any). As a minimum the **CQA Monitor** shall:

- Observe and verify that all materials and workmanship is in accordance with SANS 1200G, or any other referenced specification specified in the **Project Specifications** and **Construction Drawings**.
- Observe and verify that excavation is clear and has no debris and is surveyed and tested in accordance with the **Construction Drawings** and **Project Specifications**.
- Observe and verify that shuttering lines, grades and levels are placed in accordance with the **Project Specifications** and **Construction Drawings** and in tolerance. Survey and testing will be provided as per the testing frequency or as stipulated in the Quality Control Plan (QCP) (approved by the **CQA Monitor**) by the **Contractor** and **Surveyor** in accordance with the **Project Specifications** and **Construction Drawings** and within tolerance.
- Observe and verify that the reinforcement is in accordance with the **Project Specifications** and **Construction Drawings** in the case of permanent channels.
- Observe and verify concrete slump and cube tests and results in accordance with the **Project Specifications** and **Construction Drawings**. Testing will be provided as per the testing frequency or as stipulated in the Quality Control Plan (QCP) (approved by the **CQA Monitor**) by the **Contractor** in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that surface finish is in accordance with **Project Specifications** and **Construction Drawings**.
- Observe and verify that joints are prepared and constructed in accordance with the **Project Specifications** and **Construction Drawings**.

9.5.4.4 Dam Basin and Internal Side Slopes

The **CQA Monitor** shall observe, verify and document the construction of the concrete **works** for the dam and basin floor. As a minimum the **CQA Monitor** shall:

- Observe and verify that all materials and workmanship is in accordance with SANS 1200G, or any other referenced specification specified in the **Project Specifications** and **Construction Drawings**.
- Observe and verify that excavation is clear and has no debris and is surveyed and tested in accordance with the **Construction Drawings** and **Project Specifications**.
- Observe and verify that shuttering lines, grades and levels are placed in accordance with the **Project Specifications** and **Construction Drawings** and in tolerance. Survey and testing will be provided as per the testing frequency or as stipulated in the Quality Control Plan (QCP) (approved by the **CQA Monitor**) by the **Contractor** and **Surveyor** in accordance with the **Project Specifications** and **Construction Drawings** and within tolerance.
- Observe and verify that the reinforcement is in accordance with the **Project Specifications** and **Construction Drawings** in the case of permanent channels.
- Observe and verify concrete slump and cube tests and results in accordance with the **Project Specifications** and **Construction Drawings**. Testing will be provided as per the testing frequency or as stipulated in the Quality Control Plan (QCP) (approved by the **CQA Monitor**) by the **Contractor** in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that surface finish is in accordance with **Project Specifications** and **Construction Drawings**.

- Observe and verify that joints are prepared and constructed in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that the installation of the geocells and/or soilcrete are in accordance with the **Project Specifications** and do not in any way damage the underlying geosynthetics. Third party liner integrity survey will be done to ensure that no damage has been done to geomembrane regarding any cover material.
- Observe and verify that the filling of geocells is in accordance with the **Project Specifications** and do not in any way damage the underlying geosynthetics. Geocells will be filled from the lowest point moving upwards with the slope.

9.5.4.5 Precast Concrete Elements

The **CQA Monitor** shall observe and verify the construction of the civil **works** for the precast concrete elements. As a minimum the **CQA Monitor** shall:

- Observe and verify by means of off-site inspection that precast concrete elements are in accordance with the **Project Specifications** and **Construction Drawings** and South African National Standards.
- Observe and verify that Precast concrete pipes comply to the requirements of SANS 677
- Observe and verify that portal and rectangular precast concrete culvert units comply to the requirements of SANS 986.
- Observe and verify off-loading of precast concrete elements to site.
- Observe and verify on-site handling.
- Observe and verify that concrete base slab (in the case of rectangular culverts) is accepted and in accordance with the **Project Specifications** and **Construction Drawings** and South African National Standards.
- Observe and verify precast concrete elements are installed in accordance with the **Project Specifications** and **Construction Drawings** and South African National Standards.
- Observe and verify that the bedding layer has been installed and tested in accordance with the **Project Specifications** and **Construction Drawings**.

9.6 HDPE Pipelines and Fittings

9.6.1 Scope of Work

Pipe and fitting **works** shall be done according to the **Project Specifications**.

This section prescribes the CQA activities to be performed; to inspect, witness, verify and document that the HDPE pipes and their fittings are constructed in accordance with the **Project Specifications** and **Construction Drawings**. The HDPE pipes and their fittings activities to be monitored by the **CQA Monitors**, shall include:

- Corrugated perforated HDPE or HDPE drilled subsoil drainage pipeline and solid HDPE or corrugated HDPE subsoil drainage pipeline installation.

9.6.2 Conformance Testing

During construction, the **CQA Monitor** shall ensure that all the pipes are tested to verify that the material is in accordance with the **Project Specifications**. The **CQA Monitors** shall verify test results and request ad-hoc testing of materials for conformance before and during the construction activity is taking place. At a minimum one sample per batch per pipe size and strength will be tested to confirm compliance to the **Project Specifications**.

Testing frequencies should be increased when **CQA Monitors** determines that construction conditions (failed MQA results, re-occurring weld failures or any re-occurring deficiency) warrant additional tests. Additional tests shall be approved by the **Project Manager** and directed by the **CQA Monitor**.

Testing shall be performed on all materials used in the construction to confirm that the materials meet the **Project Specifications**. The **CQA Monitor** shall request testing during and after final placement of the materials, and the **Contractor** will allow for such test to be performed.

The Material used for manufacturing of polyethylene pipes and fittings will be tested for the following physical properties as per Table 5 and mechanical properties as per Table 6.

Table 5: Physical Properties Required for Polyethylene Pipes

PHYSICAL PROPERTIES	TEST METHOD	UNITS
Density	ISO 1183	g/cm ³
Melt flow index (190°C/21.6Kg)	ISO 1133	g/10 min
Melt flow index (190°C/5Kg)	ISO 1133	g/10 min
Vicat softening point (5Kg)	ISO 306	°C
Crystalline melting range	ISO 3146-85	°C
Viscosity number	ISO 1628-3	Cm ³ /g

Table 6: Mechanical Properties for Polyethylene Pipes

MECHANICAL PROPERTIES	TEST METHOD	UNITS
Shore D, Hardness	ISO 868	-
Tensile @ Yield	ISO 527	MPa
Ultimate Tensile	ISO 527	MPa
Ultimate Elongation	ISO 527	%
Elastic Modulus	ISO 527	MPa
Flexural Stress (3.5% deflection)	ISO 178	MPa
Design Stress	ISO 4427	MPa
Notched Impact (Charpy) can 23°C	ISO 179	KJ/m ²
Notched Impact (Charpy) can -30°C	ISO 179	KJ/m ²
Thermal stability (OIT,210°C)	ISO 10837	min
Carbon Black Content	ISO 6964	%

There shall be not evidence of splitting, holes, foreign inclusions, or other injurious defects. The pipe be uniform as commercially practical in colour, opacity, density and other properties. Pipes will be tested by the Contractor or Installer in accordance with ISO 9969:

- Flattening – Three specimens of pipe, a minimum of 300mm long, shall be flattened between parallel plates in a suitable press until the distance between the plates is 40 percent of the outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is completed within 2 to 5 minutes. Remove the load and examine the specimens for splitting cracking or breaking.
- Pipe Ring Stiffness Constant - The pipe ring stiffness constant shall be determined utilising procedures similar to those outlined in ISO 9969 in accordance with ISO 22138. The stiffness of HDPE pipe is defined in terms of the load, applied between parallel plats, which causes 1% reduction of pipe diameter. Test specimens shall be a minimum of two pipe diameter of 1.2m in length, whichever is less.

9.6.3 Quality Control Submissions

Quality control testing shall be done by the **Contractor** as specified. The results shall be submitted to the **CQA Monitor** for acceptance and to the **Engineer** for approval. Submittals include the following:

- Date, project name, location, and weather data, including high and low daily temperatures and precipitation (if any).
- Descriptions of ongoing construction **works** areas and equipment utilised by the **Contractor**.
- Summary of test results, along with material sample values used and if any new material samples were obtained, with locations and elevations.
- Identification, description and resolution of deficient test results, including conformance/non-conformance reports.
- Test equipment calibration certificates, if/where applicable.
- Note and summary of meetings held on-site with regards to material testing.
- Signature or initials of the **CQA Monitor** on all the CQA documentation.
- Record keeping in the form of physical and electronic copies.

9.6.4 Construction Monitoring

The **CQA Monitor** will observe and verify tests related to the above-mentioned pipeline installation activities to verify that the construction is in accordance with the **Project Specifications** and **Construction Drawings**. The **CQA Monitor** shall identify inadequate construction methodologies or materials that may adversely impact the performance or intended design of the facilities being constructed.

Care shall be taken during transportation of the pipes such that it will not be cut, kinked, or otherwise damaged. Ropes, fabric, or rubber-protected slings and straps will be used when handling pipes. Under no circumstances will pipes be dragged along the ground surface. Chains, cables, or hooks inserted into the pipe ends will not be allowed. Two slings spread apart will be used for lifting each length of pipe and to ensure equal distribution of the load. Pipes or fittings will not be dropped onto rocky or unprepared ground surfaces.

Pipes will be handled and stored in general accordance with the **Manufacturer** recommendation. The handling of jointed pipes will be in such a manner that the pipes are not damaged by dragging it over sharp and cutting objects. Slings for handling the pipes will not be positioned at joints. Sections of the pipes with deep cuts and gouges more than 10% of the wall thickness will be removed and the end of the pipes rejoined at the expense of the **Contractor**.

The **CQA Monitor** will record visual observations and survey measurements throughout the construction process to ensure that the materials are placed to the minimum dimensions and specifications as shown on the **Project Specifications** and **Construction Drawings** or degree of accuracy and permissible deviation as specified in the **Project Specifications** or South African National Standards (SANS). The **Project Specifications** will take preference. The **CQA Monitor** shall, as a minimum, include the following:

- Observe and verify pipe material and standard lengths delivered to site.
- Observe and verify the onloading, storing, transport, and offloading to specific locations on site.
- Observe and verify the welding, joining and/or fastening of pipe.
- Observe and verify the laying and backfilling of pipes.
- Observe and verify hydrostatic testing of pipes.
- Observe and verify that no rinsing or flushing out of perforated or drilled pipes occur.

9.6.4.1 *Perforated Corrugated HDPE / HDPE Corrugated Solid Subsoil Drainage Collection and Feeder Pipelines*

The **CQA Monitor** shall observe and verify the welding (where applicable) and installation of the subsoil drainage pipelines. The **CQA Monitor** shall as a minimum:

- Observe and verify pipe material, diameter and class conformance and review datasheets for the materials.
- Observe and verify that perforations in the pipe are in accordance with the **Project Specifications** and **Construction Drawings**.

- Observe, verify and document pipe welding, joining and/or fastening of pipe and obtain welding logs from the **Contractor** where applicable.
- Verify calibration certificates for welding machines and training certificates for welders (where applicable).
- Verify appointed HDPE welding inspector certification (where applicable).
- Observe and verify that pipelines are installed in accordance with lines and levels specified within the **Project Specifications** and **Construction Drawings** and within tolerance.
- Observe and verify hydrostatic testing in accordance with the **Project Specifications**.
- Observe and verify that no rinsing or flushing out of perforated or drilled pipes occur.

9.7 Geomembrane Construction Quality Assurance

9.7.1 Scope of Works

This section prescribes the CQA activities to be performed to inspect, observe and verify that the geomembrane activities are constructed accordance with the **Project Specification** and **Construction Drawings**. The geomembrane activities to be monitored by the **CQA Monitors** and **Engineer**, shall include:

- Material conformance and installation of geomembranes.
- Installation of pipe boot elements.
- Electronic Leak Location Survey requirements.

9.7.2 Conformance Testing

As part of Manufacturing Quality Assurance (MQA), the geomembrane specified within the **Project Specifications** and **Construction Drawings** shall be tested for conformance in accordance with the **Project Specifications** and **Construction Drawings**. During construction, the **CQA Monitor** shall ensure that all materials are tested to verify that the materials are in accordance with the **Project Specifications** and **Construction Drawings**. The **CQA Monitors** shall verify test results and request ad-hoc testing of materials for conformance before and during the construction activity is taking place. The minimum testing frequency shall be in accordance with the **Project Specifications** and **Construction Drawings**.

Testing frequencies should be increased when the **CQA Monitors** determines that construction conditions (MQA test failures, factory defects, or any re-occurring deficiency) warrant additional tests. Additional tests shall be approved by the **Project Manager** and directed by the **CQA Monitor**. The **Contractor** will allow for additional testing.

Prior to geomembrane installation, the **CQA Monitor** shall obtain samples of the geomembrane for conformance testing to confirm that these materials meet project requirements. One set of tests will be carried out at commencement, and as directed should the materials supplier change or if the material batch is changed. Six (6 No.) samples, each 300 mm x 300 mm, are to be taken across the entire width of a roll of each geomembrane type, not including the first 1.5 m. The samples are to be marked with the machine direction, roll number on the sample, and date the sample was obtained. The samples are then to be sent to an accredited geosynthetics testing laboratory where conformance tests as listed in Table 7 are to be performed (according to relevant ASTM standard test method). It is the responsibility of the **Installer** to ensure that the sample size is suitable for the testing that will be performed.

Table 7: ASTM Standard Test Methods for Conformance Testing

TEST NAME	TEST METHOD	FREQUENCY
Thickness, (Minimum Average), mm Lowest individual reading	ASTM D5994 / SANS 1526	100 000m ²
Asperity Height, mm	ASTM D7466	100 000m ²
Density, g/cm ³ , (min)	ASTM D1505/D792	100 000m ²
Tensile Properties (each direction)	ASTM D6693	100 000m ²

TEST NAME	TEST METHOD	FREQUENCY
- Strength at Break, N/mm - Strength at Yield, N/mm - Elongation at Break, % - Elongation at Yield, %		
Tear resistance	ASTM D1004	100 000m ²
Puncture resistance	ASTM D4833	100 000m ²
Carbon Black Content, % (Range)	ASTM D1603, mod	100 000m ²
Carbon Black Dispersion	ASTM D5596	100 000m ²
Standard Oxidation Induction Time (OIT)	ASTM D3895	100 000m ²
High Pressure Oxidation Induction Time (HP-OIT) (min avg)	ASTM D5885	100 000m ²
SP-NCTL Stress Crack Resistance	ASTM D5397, App	100 000m ²
Oven Aging at 85°C	ASTM D5721	100 000m ²
UV Resistance	ASTM D7238	100 000m ²
Interface Shear Strength	ASTM D5321	1 per project

All geomembrane and welding rods will be manufactured from a hexene or octene co-polymer. During installation all welding rods will be the same co-polymer as the geomembrane material. The base polymer supplied, combined with the master batch additives that make up the eventual geomembrane material, and must meet either the OIT or HP OIT standards.

The resin shall be new, first quality, compounded and manufactured specifically for producing geomembrane, and supplied by the same **Manufacturer**. The resin prior to the addition of carbon black shall be tested inline with Table 8.

Table 8: Compound HDPE Resin Properties

TEST NAME	TEST METHOD	FREQUENCY
Density, g/cm ³ , (min)	ASTM D1505 /D792	1 per Batch
Melt Flow Index	ASTM D 1238	1 per Batch
Using 2.16kg at 190°C		

Internal Quality Assurance testing will be carried out by the geomembrane **Manufacturer** to demonstrate that the incoming resin meets this the requirements. The resin shall be virgin material with no more than 10 percent rework. If rework is used, it shall be of the same formulation as the parent material. No post-consumer resin of any type shall be added to the formulation.

All conformance tests shall be performed in compliance with the specification requirements of GRI Test Method GM13 "Test methods, test properties and test frequency for smooth and textured geomembranes," Table 1(b) and Table 2(b) contained in GRI-GM13. The **Engineer** and the **CQA Monitor** shall review the test results and shall report any non-conformance to the **Employer** and the **Installer**.

9.7.3 Quality Control Submittals

Prior to geomembrane installation, the **CQA Monitor**, and the **Engineer** shall review the **Manufacture** and **Installer** quality control submittals to evaluate and confirm that these materials meet **Project Specifications** requirements. The **CQA Monitor** and the **Engineer** shall review the Quality Control submittals that are outlined in the **Project Specifications**. As a minimum the following will be reviewed by the **CQA Monitor** and the **Engineer**:

- Material Property Certification for resin batches.
 - Property data sheets, including at minimum, all specified properties, measured using testing methods indicated in the **Project Specification** and CQA Plan.

- Sampling procedures and results of testing.
- Testing equipment calibration certification.
- Geomembrane roll Material Quality Control (MQC) Certification.

Prior to shipment, the **Manufacturer** will provide the **CQA Monitor** and **Engineer** with MQC certification for every roll of geomembrane provided. The MQC certificate will be signed by a responsible party employed by the **Manufacturer**, such as the production manager. The MQC certification will include:

- Roll numbers and identification.
- Results of MQC tests – as a minimum, results will be given for thickness, specific gravity, carbon black content, carbon black dispersion, tensile properties, and puncture resistance evaluated in general accordance with the methods indicated in the **Project Specifications** or quality methods approved by the **CQA Monitor**.
- Conformance Testing
 - The **CQA Monitor** shall obtain conformance samples (at the manufacturing facility or site) at the specified frequency and forward them to the Geosynthetics CQA Laboratory for testing to monitor conformance to both the **Project Specification** and the list of properties certified by the **Manufacturer**. The test procedures will be as indicated in the **Project Specification**.
 - Samples will be taken across the width of the roll and will not include the first linear 1.5m of material. Unless otherwise specified, samples will be 1m long by the roll width. The **CQA Monitor** will mark the machine direction on the samples with an arrow along with the date and roll number. The required minimum sampling frequencies will be in accordance with the **Project Specifications**.
 - The **CQA Monitor** will examine results from laboratory conformance testing and will report any non-conformance to the **Project Manager** and the **Installer**. The procedures prescribed in the **Project Specification** will be followed in the event of a failing conformance test.

9.7.4 Construction Monitoring

The **CQA Monitors** shall observe and verify tests related to the above-mentioned installation activities to verify that the installation is in accordance with the **Project Specifications** and **Construction Drawings**. The **CQA Monitors** shall identify any inadequate construction methodologies or materials that may adversely impact the performance or intended design of the **works** being constructed.

The **CQA Monitor** shall record visual observations and survey measurements throughout the construction process to ensure that the materials are placed to the minimum dimensions specified in accordance with the **Project Specifications** and **Construction Drawings**.

During geomembrane installation, the **CQA Monitor** shall observe and verify deployment, trial seams, field seaming, non-destructive and destructive seam testing, and repairs to assess that the installation compliance with the **Project Specifications** and **Construction Drawings**. The scope of the CQA program has been established with the goal of 100% coverage of deployment and seaming, with 80% coverage of the **CQC** non-destructive testing, destructive testing, trial seams and repairs.

The supply and installation of the geomembrane will be in accordance with the **Project Specifications** and **Construction Drawings**.

The **CQA Monitor** shall observe and verify the geomembrane storage, handling, deployment, seaming testing, defect logging, repair, and retesting. At a minimum, the **CQA Monitor** shall:

- observe and verify MQC data for geomembrane rolls are in accordance with **Project Specifications** and **Construction Drawings**.
- Verify that all **Manufacturer** and **Installer** submittals are in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that storage areas for geomembranes are in accordance with the **Project Specifications** and **Construction Drawings** and **Manufacturer guidelines**.

- Observe and verify that handling of geomembrane rolls, and sheets are conducted in a responsible manner to prevent damage to the geomembrane in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that prepared subgrade is in accordance with **Project Specifications** and **Construction Drawings** and suitable to receive geomembrane panel deployment.
- observe and verify location of geomembrane panels in accordance with the approved panel layout plan.
- Verify that all geomembrane batches have been conformance tested in accordance with the **Project Specification** prior to installation.
- Observe and verify that geomembrane trial seam test results meet **Project Specifications**.
- Observe and verify that welding of geomembrane panel seams meets **Project Specifications**.
- Observe and verify that geomembrane seam destructive and non-destructive tests are in accordance with **Project Specifications**.
- Observe and verify that defects are logged and repaired in accordance with the **Project Specifications**.
- Observe and verify re-test results of defects in accordance with the **Project Specifications**.
- Sign-off all CQC documents submitted by the **Contractor** daily.
- Review and verify machine calibration certificates and Welder certificates.

9.7.4.1 Delivery

The **CQA Monitor** will observe and verify that the transportation and handling does not pose a risk of damage to the geomembrane. Upon delivery of the rolls of geomembrane, the **CQA Monitor** will document that the rolls are unloaded and stored on site as required by the **Project Specifications** or as directed by the **Manufacturer** or CQA plan. Damaged caused by unloading will be documented by the **CQA Monitor** and the damaged material will be cut from the roll and replaced by the **Installer** or **Contractor** at no additional cost to the **Employer**.

Offloading onsite will be done under controlled conditions by the means of a carpet spike, telehandler with spreader bar and slings or by means of crane or crane truck and slings. Only the **Manufacturer** slings designed for the purpose of handling geomembrane will be allowed to be wrapped around the geomembrane rolls for offloading.

Should any damage occur to the geomembrane after delivery the **Installer** will replace such geomembrane at his own cost.

9.7.4.2 Storage

The **CQA Monitor** will observe and verify the storage of geomembrane at the allocated storage area. An area dedicated solely to the storage of geomembrane will be made available by the **Project Manager** to the **Contractor** or the **Installer**. The **Installer** will be responsible for the storage of the geomembrane onsite. The **Project Manager** will provide a dedicated storage area to the **Contractor** or the **Installer** in a location (or several locations) such that onsite transportation and handling during installation is minimised to avoid potential damage to the geomembrane.

The storage area will be prepared in such a way that it complies to the **Project Specification** regarding subgrade preparation, with a minimum fall of 2% and a maximum fall of 4% to allow the rolls to be placed on an even surface directly on the in-situ material, unless otherwise specified by the **Manufacturer**, this will be supplied to the **CQA Monitor** in writing by the **Manufacturer** and **Installer** to certify that no damage will occur during storage. No storage on wooden pallets, blocks or any other supports will be allowed, unless certified by the **Manufacturer** as this does not distribute the loads equally nor provide continuous support along the roll length. The **CQA Monitor** and **Engineer** will sign-off acceptance of the storage area prior to any rolls being delivered to site by the **Installer**.

The following measures should be implemented for the storage area:

- Dedicated perimeter fence on the storage boundary.

- Dedicated gate for offloading and collection to site.
- Easy access for roll management and collection.
- Stormwater diversion berms and channels or a combination to prevent stormwater from the surrounding area to enter the storage area and erode the prepared surface.
- Dedicated security guard and tallyman to document entry to the storage area and the log rolls entering or leaving the storage area.
- Fire Management Plan and fire break along the perimeter of the storage area inline with the National Veld and Forestry Act (No:101) latest revision will apply. The area is to be denuded of vegetation to create a fire break, to prevent or create a fire.
- No open fires will be allowed in the storage area.
- Firefighting equipment will be installed at the storage area.
- No more than three rolls will be stacked on each other.
- Adequate space to allow storage of geomembrane and to prevent a shortage of material during installation.

9.7.4.3 Anchor Trench Termination

The **CQA Monitor** will observe and verify that the geomembrane termination in the anchor trench has been constructed in accordance with the **Project Specifications** and **Construction Drawings**. All geomembranes will be terminated at the back of the anchor trench and will not be allowed to extend upwards.

The anchor trenches will be dry, and no ponding of water will be allowed in anchor trenches. Should rain lead to ponding water, the water will be removed within 24 hours of it accumulating in the anchor trench. Anchor trench excavations will advance the installation by a maximum of 100m and will be backfilled within 24 hours of installation. Anchor trench backfill will be completed prior to the closure weld being performed on the geomembrane to avoid strain in the geomembrane material that might lead to trampolining.

9.7.4.4 Deployment

The **CQA Monitor** shall observe and verify that only the approved materials are used, each panel is given a unique panel number, no geomembrane is placed during unsuitable weather conditions as outlined in the **Project Specifications** and as approved by the **Project Manager**, the geomembrane is not damaged during installation, anchoring and weighting down is performed in accordance with the **Project Specifications**. All panels will be allowed to obtain the same material temperature prior to them being welded to together, this minimises the formation of wrinkles. All geomembrane panels should be overlapped in the direction of waterflow to avoid stain on the geomembrane seam. Installation of geomembrane should be start for the highest point and proceed downwards and to facilitate drainage in the event of precipitation. The **Installer** should take note of the wind direction and install his panels in such a way to minimise the effect of wind upliftment.

Geomembrane placement will not proceed unless otherwise authorised when the ambient temperature is below 5°C or above 45°C, unless the **Installer** demonstrates the capability of achieving acceptable results through the utilization of special seaming techniques and total tensile strain limitations are not exceeded, in addition wind speed will be monitored and it is recommended that installation only proceed with wind speeds below 20km/hr depending on prevailing wind direction. The **CQA Monitor** will document that the above-mentioned conditions are adhere to during installation. Installation will not be performed during any precipitation, in the presence of excessive moisture (e.g., fog, dew), and/or in an area of ponding water. Ponding water will be removed from the geomembrane within 24 hours until approval has been obtaining from the **Engineer** that the facility has been approved for storage of water.

The **CQA Monitor** shall observe and verify that the intended layout as approved by the **Engineer**, including the following:

- Orientation.
- Overlaps and seams are as intended.
- Subgrade or geosynthetics is free of deleterious materials prior to deployment.

- Anchoring is achieved as specified.
- Specified methods are used to minimise the wrinkles and protect underlying layers during cutting of materials.
- Deployment procedures are performed in accordance with the **Project Specifications**.

The **CQA Monitor** will observe and verify the following during deployment:

- Equipment used does not damage the geomembrane by handling, trafficking, excessive heat, leakage of hydrocarbons or other means.
- The surface underlying the geomembrane has not deteriorated since previous acceptance and is still acceptable immediately prior to geomembrane placement.
- Subgrade and geosynthetics underlying the geomembrane are clean and free of debris.
- Personnel working on the geomembrane do not smoke, wear damaging shoes, or engage in other activities which could damage the geomembrane.
- No sliding on or down geomembrane or sliding of sandbags over the geomembrane.
- A sacrificial geomembrane or geotextile will be installed in high pedestrian traffic areas.
- The method used to unroll the panels does not cause scratches, crimps in the geomembrane and does not damage the supporting subgrade. Under no circumstances will geomembrane rolls be allowed to freely roll downside slopes or steep basin slopes.
- The method used to place the panels to minimise wrinkles (especially differential wrinkles between adjacent panels).
- Adequate temporary loading and/or anchoring (e.g., sandbags), not likely to damage the geomembrane, has been placed to prevent uplift by wind (in case of high winds, continues loading, e.g., by adjacent sandbags, or temporary anchoring is recommended along the edges of panels to minimise risk of wind flow under the panels).

The **CQA Monitor** will inform the **Project Manager** and **Engineer** if the above conditions are not fulfilled. Damaged panels or portions of damaged panels that have been rejected will be marked and their removal from the **works** area recorded by the **CQA Monitor**.

9.7.4.5 Trial Seams

The **CQA Monitor** shall observe and verify that trial seaming is performed in accordance with the **Project Specifications**. As a minimum the **Installer** shall perform trial seams at the beginning of each day for every machine to be used for that day, as well as when seam welding machines have been switched off for a period of 30minutes and during tea and lunch breaks. Seaming operation shall not commence until the **CQA Monitor** has determined that the seaming process is meeting the **Project Specification** requirement and is approved by the **CQA Monitor**.

Prior to seaming operations no welding technicians or welding apparatus shall be allowed to perform field seaming operations until the technicians and equipment have successfully completed prequalification trial seam and trail seams and has been approved by the **CQA Monitor**.

Testing will include visual observation of a trial seam a minimum of 1 m long on the geomembrane material. The **Installer** will mark the trial seam with date, ambient temperature, geomembrane temperature, welding machine number, welding technician's initials, machine temperature, and speed. For extrusion welding, the Installer shall record the nozzle and extrusion settings and for fusion welding, the wedge temperature and machine speed shall be recorded. A 300 mm portion of each trial seam sample shall be archived by the CQA Monitor at the site. The **CQC Monitor** shall record the trial seam test results on a trial seam log form and supply it to the **CQA Monitor**.

When a welding apparatus arrives on the site for the first time, after repair, or after being removed from the site, it shall be prequalified in the presence of the **CQA Monitor** by performing three consecutive passing trial welds made according to the **Project Specification** for each geomembrane type and thickness to be welded by the apparatus. A new or returning welding technician may be prequalified using an existing welding apparatus, and a new, repaired, or returning welding apparatus may be prequalified by a qualified welding technician.

A record shall be maintained of each geomembrane type and thickness for which each welding technician and apparatus has prequalified, and a technician or apparatus shall not be used for seaming operations for which it has not been prequalified.

The **CQA Monitor** will as a minimum observe and verify:

- Observe and verify that trial seaming is performed in accordance with the **Project Specifications**.
- Observe and verify that each welding technician perform trial seams at the beginning of each day for every machine to be used for that day, or when it has been switched off for a period of 30minutes.
- Observe and verify that no seaming operations, no welding technicians or welding apparatus until the technicians and equipment have successfully completed prequalification trial seam and trail seams.
- Observe and verify that trial seam is performed at a minimum of 1 m long on the geomembrane material.
- Observe and verify all markings on the trail seams have been done.
- Archive a 300 mm portion of each trial seam sample.
- Observe and verify that all results are captured on the trial seam log form.

9.7.4.6 *Field Seaming*

The **CQA Monitor** shall observe and verify that only approved equipment and personnel perform welding, all welding is performed under suitable conditions as specified in the **Project Specifications**, specified overlaps are achieved, seams are oriented in accordance with the **Project Specification**, and that grinding techniques and extrudate meet the **Project Specification** for extrusion welding. The **CQC Monitor** shall record all field seaming on field seaming log forms and supply them to the **CQA Monitor** for verification.

Geomembrane field seaming will not proceed unless otherwise authorised when the ambient temperature is below 5°C or above 45°C, unless the **Installer** demonstrates the capability of achieving acceptable results through the utilization of special seaming techniques and total tensile strain limitations are not exceeded. If seaming operations are conducted at night, lighting equipment shall be sufficient to allow the Installer and CQA Monitor to perform their duties adequately and safely.

All field seaming technicians performing seaming operations will be qualified by prequalification seaming trial tests (refer to trial seaming) in accordance with the **Project Specification**. The master seamer will be GSI certified and will be responsible for direct supervision over less experienced seamers. The **Installer** will provide the **CQA Monitor** with a list of all field seaming technician and their experience records. These records will be reviewed by the **CQA Monitor** prior to prequalification trail seaming for acceptance.

The main seaming method will be the double fusion/ wedge welding and the secondary seaming method will be fillet/extrusion seaming. All fillet/extrusion seaming machines will be equipped with a gauge giving the temperature in the apparatus.

The **Installer** will provide documentation regarding the fillet/extrusion welding rod to the **CQA Monitor** and will certify that the extrusion welding rods are compliant with the **Project Specification**, and in comprises of the same resin as the geomembrane.

The **CQA Monitor** will as a minimum observe and verify:

- Apparatus temperatures, ambient temperatures, and geomembrane surface temperatures at appropriate intervals.
- The **Installer** maintain onsite, the number of spare operable seaming apparatus decided at the pre-construction meeting. As a minimum one spare machine for each field seaming operation, one space tensiometer, one spare air pressure test, one spare generator.
- Equipment used during the installation is not likely to damage the geomembrane.
- That fillet/extrusion is purged prior to beginning a seam until all heat-degraded extrudate has been removed from the barrel.
- That double fusion/ wedge welding apparatus is an automated vehicular-mounted devise, equipped with a gauge giving the applicable temperature and pressure.
- Electrical generator is placed on a smooth sacrificial layer such that no damage occurs to the geomembrane.

- A smooth insulation plate or sacrificial layer of fabric is placed beneath the hot welding apparatus after usage (geotextile may not be used for this purpose).
- The geomembrane is protected from damage in heavily trafficked areas.
- The seam area is clear and free of moisture, dust, dirt, debris, and foreign material.
- That seams are aligned with the fewest possible number of wrinkles and “fish mouths”
- That seaming only occurs during the temperature ranges as stated above.
- The panels of the geomembrane have a finished overlap of a minimum of 150mm for both fillet/extrusion and double fusion/ wedge welding, except if otherwise specified in the **Project Specifications**.
- That no solvent or adhesive bonding materials are used.
- The procedure used for temporarily bonding adjacent panels or patches does not damage the geomembrane.
- If seaming operations are carried out at night sufficient lighting will be provided.
- All double fusion/ wedge welding seams will extend to the outside edge of panels to be placed in the anchor trench.

The **CQA Monitor** shall observe and verify that the **CQC Monitor** document geomembrane seaming operations on a seaming log form. Seaming logs shall include, at a minimum:

- Seam identifications (typically associated with panels being joined).
- Seam starting time and date.
- Seam ending time and date.
- Seam length.
- Identification of person performing the seaming.
- Identifications of the seaming equipment.

9.7.4.7 Non-Destructive Seam Continuity Testing

The **CQA Monitor** shall observe and verify that the seams and repairs are non-destructively tested by **CQC Monitor** in accordance with the **Project Specifications**. If a seam cannot be tested, the **CQA Monitor** shall observe cap strip operations. The **CQA Monitor** shall verify that test equipment and gauges are functioning properly and that test procedures are in accordance with the **Project Specifications**. The **CQA Monitor** shall verify that the seams and repairs with failing test results are repaired and/or re-tested until passing results are achieved.

The **Installer** will non-destructively test field seams over their length using a vacuum box test unit, air pressure test (double fusion/ wedge seams only), or other methods stated in the **Project Specification** or approved by the **CQA Monitor**. Seam testing is a way of checking the continuity of seams and does not provide an indication of the seam strength. Continues testing will be carried out as the seaming **work** progresses, and not at the completion of all field seaming.

The **CQA Monitor** will as a minimum observe and verify and ensure that the **CQC Monitor** document:

- Continues testing.
- Record location, date, name of person conducting the test and the results of the test.
- Inform on required repairs.
- Observe and log all repairs and mark it on the geomembrane.
- Retest the repairs and indicate the result on the geomembrane and repair log sheet.

Where seams can not be non-destructively tested seams will be capped with the same geomembrane material and observed by the **CQA Monitor**. The seam number, date of observation, name of tester and outcome of the test or observation will be recorded by the **CQC Monitor** and observe and verify **CQA Monitor**.

9.7.4.7.1 Vacuum Box Testing

Vacuum box testing will be carried out on fillet/extrusion seams by using the equipment and procedures as specified in the **Project Specifications** or ASTM D4437 and ASTM D5641 if no specified in the **Project Specification**. Vacuum box testing will be observed and verified by the **CQA Monitor** and recorded by the **CQC Monitor**. The results of the test will be logged on the seaming log form or testing form by the **CQC Monitor** and observe and verify **CQA Monitor**. Results will include at a minimum:

- Person performing the test.
- Result of the test (pass/fail)
- Pressure used for testing.
- Test date.

Seams failing the vacuum box test shall be repaired in accordance with the **Project Specifications** or as directed in SANS 10409. Seam repairs will be observed by the **CQA Monitor** and logged by the **CQC Monitor** on the repair log form.

9.7.4.7.2 Air Pressure Testing

Air pressure testing will be carried out on double fusion/ wedge welding seams by using the equipment and procedures as specified in the **Project Specifications** or ASTM D5820 if no specified in the **Project Specification**. Air pressure testing will be observed by the **CQA Monitor** and recorded by the **CQC Monitor**. The results of the test will be logged on the seaming log form or testing form by the **CQC Monitor** and observe and verify **CQA Monitor**. Results will include at a minimum:

- Person performing the test.
- Result of the test (pass/fail).
- Pressure used for testing.
- Test date.

Seams failing the air pressure test shall be repaired in accordance with the **Project Specifications** or as directed in SANS 10409. Seam repairs will be observed by the **CQA Monitor** and logged by the **CQC Monitor** on the repair log form.

9.7.4.7.3 Spark Testing

Spark testing will be carried out on areas where vacuum box testing can not be performed by using the equipment and procedures as specified in the **Project Specifications** or ASTM D6565 if no specified in the **Project Specification**. Spark testing will be observed and verified by the **CQA Monitor** and recorded by the by the **CQC Monitor**. The results of the test will be logged on the seaming log form or testing form by the **CQC Monitor**. Results will include at a minimum:

- Person performing the test.
- Result of the test (pass/fail).
- Test date.

Seams failing the spark test shall be repaired in accordance with the **Project Specifications** or as directed in SANS 10409. Seam repairs will be observed by the **CQA Monitor** and logged by the **CQC Monitor** on the repair log form.

9.7.4.8 Destructive Seam Testing

The **Installer** shall obtain samples, at locations selected by the **CQA Monitor**, of the field seamed geomembrane approximately 600 mm long and 300 mm across the seam and centred over the seam as follows, unless otherwise stated in the **Project Specification**:

- A minimum of one sample per day.
- A minimum of one sample for each machine.
- A minimum of one sample every 150 m of seaming is required unless, in the opinion of the **CQA Monitor**, the seamer has demonstrated sufficient quality/experience to increase the seam sample interval. In no event shall the sampling interval exceed 300 m.
- A minimum of one sample for each representative working conditions (e.g., weather condition)
- Seams that appear suspect to the **CQA Monitor**.

The **CQA Monitor** shall witness the testing of destructive seam samples by the **CQC Monitor**. The **CQA Monitor** may request an additional 300x 300mm sample to be collected for testing at an independent third-party testing laboratory if he so wishes to verify the results obtained onsite, the **Installer** will allow for this in his rate. The **Installer** shall mark all samples with their roll and seam number, date, machine number, welding technician identification, extruder and nozzle/wedge temperature, and ambient air temperature.

The **Installer** shall test all destructive samples in compliance with the **Project Specifications** if not specified ASTM D6392 or ASTM D7747 shall apply.

The **Installer** shall be responsible for patching of all damages that were caused due to sampling for destructive testing in accordance with the **Project Specifications**. The **CQA Monitor** shall track failed tests as described in the **Project Specifications**. All destructive test results shall be recorded on the field destructive testing form by the **CQC Monitor**. The **CQA Monitor** will as a minimum observe and verify and ensure that the **CQC Monitor** document:

- Date of sample.
- Sample identification.
- Seam number.
- Machine number.
- Seamer information.
- Peel and shear results.
- Test result (Pass/Fail)
- Date to laboratory / packaging slip No.
- Lab test result (Pass/Fail).
- Comments.

The **Installer** shall repair destructive samples in the geomembrane within 30min of taking the sample.

The purpose of destructive seam testing is to evaluate seam strength. Seam strength testing will be done on both double fusion/ wedge seams and fillet/extrusion seams as the seaming **work** progresses, not at the completion of all field seaming. The **Installer** will not be notified in advance by the **CQA Monitor** on the location where seam samples will be taken.

The **CQA Monitor** will as a minimum observe and verify and ensure that the **CQC Monitor** document:

- Obtain destructive samples prior to the geomembrane being covered.
- Observe sample cutting and monitoring that corner are rounded.
- Assign a number to each sample and mark it accordingly.
- Record sample location on the panel layout drawing.
- Record the reasons for taking the sample at the location (routine samples, suspicious features, etc.)

Testing of destructive samples will be done by the **Installer** under the supervision of the **CQA Monitor**. Destructive sample testing will be done with the field tensiometer under the same site conditions as the production seam and not in a container or laboratory. The **CQA Monitor** destructive sample will be tested in a GSI certified laboratory or by making use of his own tensiometer onsite and results will be made available to the **Installer** as soon as possible. The specimen will not fail in peel and/or shear and shall meet the strength requirements as stated in the **Project Specifications** or GRI GM-19a or GRI GM-19b (latest revision to apply)

Seams failing the destructive test shall be retested using the method stated in SANS 10409 Sections 10.6.3.5 or in accordance with **Project Specifications**.

9.7.4.8.1 Double Fusion / Wedge Welding Samples

Test samples will be obtained at each location identified by the **CQA Monitor** for double fusion/ wedge welded seams. The sample shall consist of ten specimens, each cut approximately 25 mm wide by 200 mm long. These specimens shall be tested for peel and shear strength in the field by the **Installer** using a calibrated field tensiometer capable of quantitatively measuring peel and shear strengths. The **CQA Monitor** shall observe all field tests and record the test results.

If one or more specimens fail in either peel or shear, the **Installer** shall take additional test samples 3m from the point of the failed test in each direction and repeat the field test procedure. If these additional tests fail, then the procedure shall be repeated until the length of the poor-quality seam is established.

Sample shall be divided into three equal sections and distributed and tested as follows:

- One sample - **Installer** for their use.
- One sample - **CQA Monitor** for destructive testing (if required).
- One sample - **CQA Monitor** for site archives.

Each sample shall be subject to the following destructive tests at a GRI-LAP accredited CQA geosynthetics laboratory (or similar approved by **CQA Monitor**) or at the CQA Site Office and tested per ASTM D6392 with appropriate calibrated equipment:

- Seam shear strength (five tests).
- Seam peel strength (five tests).

9.7.4.8.2 Fusion / Extrusion Welding Samples

Test samples will be obtained at each location identified by the **CQA Monitor** for fusion/extrusion seams, one peel strength test refers to testing of both sides of the seam. A passing test must have all five passing tests for the shear test and peel test. Failed destructive tests shall be subject to additional testing until a passing area is found. The **Installer** shall take another test, from the same welder and machine prior to the failing test and repeat the field test procedure. If subsequent tests fail, then the procedure is repeated until the length of the poor-quality seam is established. Failed seams shall be tracked according to the welding apparatus and the machine operator.

9.7.4.9 Repairs

The **CQA Monitor** shall observe and verify that all repairs' materials, techniques, and procedures used for repairs are approved in advance and meet the requirements of the **Project Specifications**. The **CQA Monitor** shall verify that all defects and repairs are marked, recorded, repaired, tested, and wrinkles are addressed, prior to being covered by other material and that repairs are performed as specified, including proper patch size or dimension. No more than 1 repair per 25m² of installed geomembrane will be allowed, where this is witnessed by the **CQA Monitor**, the **Installer** replace the panel at his own cost.

The **CQA Monitor** will do a walk over of the completed installation and identify any defects, holes, blisters, undispersed raw materials, and signs of contamination by foreign matter. The **Installer** will clean the geomembrane prior to the inspection by the **CQA Monitor** by either, sweeping, air blowing, or washing the geomembrane as directed by the **CQA Monitor**.

Potential flawed locations, both in seam and non-seam areas, shall be non-destructively tested using the method stated above. Each location that fails the non-destructive testing will be marked by the **CQA Monitor** and repaired by the **Installer** and logged on the repair and patch log forms by the **CQC Monitor**. **Work** will not

proceed with any material that will cover locations which have been identified by the **CQA Monitor** and prior to obtaining passing test results. In such instances where material has been placed such material will be removed to the satisfaction of the **CQA Monitor** to complete his inspection and testing.

Several procedures exist for the repair of the areas that need to be repaired. The **Installer** will repair the geomembrane as directed by the **Project Specification** or as instructed by the **CQA Monitor**. The following will apply regarding repairs unless otherwise stated in the **Project Specification**:

- Patching – used to repair holes, tears undisputed raw materials and contamination by foreign matter.
- Gridding and re-welding – used to repair small sections of extrusion seaming less than 100mm.
- Spot welding – use to repair non-destructive holes, scratches less than 10% on the material thickness, pinholes when approved by the **CQA Monitor**.
- Capping – used to repair large lengths of failing seams when approved by the **CQA Monitor**.
- Replacement of panel – used in areas where more than one defect per 25m² is observed, or extensive scratching or defects are observed by the **CQA Monitor**.

Additional to the above the following will be satisfied by the **Installer**:

- Surfaces of the geomembrane to be repaired will be abraded no more than 20 minutes prior to the repair.
- Surfaces must be clean and dry at the time of the repair.
- All seaming equipment used in repairing procedures must be approved.
- The repair procedure, material and techniques will be approved by in advance by the **CQA Monitor** with input from the **Engineer**.
- Patches will extend at least 150mm beyond the edge of the defect, and all corners of patches and holes will be rounded with a radius of at least 75mm.
- The geomembrane below large caps should be appropriately cut to the satisfaction of the **CQA Monitor** to avoid water or gas collection between the two sheets.
- Patch perimeters will be marked out over the hole to be patched to ensure a minimum of 150mm overlap during heat bonding and fillet/extrusion welding.

The following monitoring and repair shall be done by the **CQA Monitor**:

- Panel containing repair and approximate location on panel.
- Approximate dimension of repair.
- Repair type, i.e., double fusion/ wedge welding or fillet/extrusion welding.
- Date of repair.
- Seamer making the repair.
- Results of repair non-destructive testing (Pass/Fail).

9.7.4.10 Large Wrinkles

When seaming of the geomembrane is completed (or when seaming of a large area of the geomembrane is completed) and prior to placing overlaying materials, the **CQA Monitor** will observe the geomembrane wrinkles. The **CQA Monitor** will indicate to the **Installer** which wrinkles should be cut and re-seamed. The seam produced will be tested like any other seam. No wrinkle larger than 200mm in length or 50mm in height will be left untreated and the **Installer** can repair these wrinkles in advance.

9.7.4.11 Liner system Acceptance

The **Installer** and the **Manufacturer** will retain all responsibilities for the geomembrane materials in the liner system until acceptance by the **Project Manager**, **CQA Monitor** and **Engineer**. The geomembrane liner system will be accepted when:

- The installation is finished.
- Verification of the adequacy of all seams and repairs, including associated testing is completed.
- All documentation of installation is completed including the **CQA Monitor** acceptance.
- Construction Completion Report, including “as-built drawing(s), signed by a professional **Engineer** registered with the Engineering Council of South Africa (ECSA) has been received by the **Project Manager**.
- A statement has been made in the Construction Completion Report that installation proceeded in general accordance with the **Project Specifications**, **Construction Drawings** and CQA plan.

9.7.4.12 Protection

The **CQA Monitor** shall observe and verify that all soil and ballast placed on top of the geomembrane are done in such a manner as to ensure that the geomembrane and underlying material are not damaged. Material will only be placed during the coolest parts of the day with ambient temperatures below 15°C to avoid wrinkle formation and entrapment of wrinkles. Wrinkles will be managed as described above.

9.7.4.13 Pipe boots

The **CQA Monitor** shall observe and verify the installation of the pipe boots. At a minimum, the **CQA Monitor** shall:

- Observe and verify pipe boot is installed as per the **Project Specifications** and **Construction Drawings**.
- All pipe boots have been tested in accordance with the **Project Specifications**.

9.7.4.14 Electric Leak Detection Survey

After the installation of geomembrane before material placement on bare liner and after the placement of the aggregate and/or soil cover layers top plateau of the geosynthetics, an Electric Leak Location Survey (ELLS) of the completed liner system shall be carried out by an independent certified ELLS company, according to latest editions of the following:

- ASTM D6747-15: Standard Guide for Selection of Techniques for Electrical Detection of Leaks in Geomembranes.
- ASTM D7002-16: Standard Practice for Leak Location on Exposed Geomembranes Using the Water Puddle System
- ASTM D7703-16: Standard Practice for Electrical Leak Location on Exposed Geomembranes Using the Water Lance System
- ASTM D7007: Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earth Materials
- ASTM D7909-14 Standard Guide for Placement of Blind Actual Leaks during Electrical Leak Location Surveys of Geomembranes
- ASTM D7953-14: Standard Practice for Electrical Leak Location on Exposed Geomembranes Using the Arc Testing Method
- ASTM D8265 – 19: Standard Practices for Electrical Methods for Mapping Leaks in Installed Geomembranes

The **CQA Monitor** shall observe and verify that the leak detection survey undertaken by the elected/approved independent certified company is in accordance with the **Project Specifications**. If there is a variation from the

Project Specifications, the **CQA Monitor** will immediately inform the **Project Manager** and **Engineer**. All defects will be corrected as per the above-mentioned procedures or as specified in the **Project Specification**.

9.7.4.15 Liner Interface Shear Testing

To verify the assumptions used in the facility stability analysis as informed by the design, it may be necessary to conduct liner interface shear testing using the actual liner materials installed on site. The **CQA Monitor** shall arrange for samples from each geosynthetic type, 600 mm x 600 mm are to be taken across the entire width of a roll of the geosynthetic material, not including the first 1.5 m.

The samples are to be marked with the machine direction, roll number on the sample, and date the sample was obtained. The samples are then to be sent to the approved geotechnical testing laboratory interface shear testing.

The geotechnical properties of the CCL material shall also be sent to an accredited geosynthetics testing laboratory for the laboratory staff to simulate the clay in the large shear box used for the interface shear testing. The **Engineer** shall coordinate the interface shear testing and rerun the stability analysis using the actual interface shear strength parameters obtained from the laboratory testing. The revised stability analysis results shall be included in the Construction Completion Report.

9.8 Geotextile

9.8.1 Scope of Works

This section prescribes the CQA activities to be performed to inspect, witness, verify and document that the geotextile activities are constructed accordance with the **Project Specification** and **Construction Drawings**. The geotextile activities to be monitored by the **CQA Monitors** and **Engineer**, shall include:

- Material conformance and installation of geotextile.
- Geotextile installation of filter geotextile.
- Geotextile installation of protection geotextile.

During geotextile installation, the **CQA Monitor** shall observe and verify deployment, overlaps, field seaming, and repairs to assess that the installation is in accordance with the **Project Specifications**.

All geotextile material will be protected against UV-degradation during storing and will not be exposed to direct sunlight for a period exceeding 15 days. The **CQA Monitor** may request the **Contractor** to replace any noncompliant material with new material at his own cost.

9.8.2 Conformance Testing

Prior to installation of the geotextile materials, the **Installer** will supply the **CQA Monitor** with the **Manufacturer** Quality Control (MQC) documents for review and approval by the **CQA Monitor** and **Engineer**.

The **Manufacturer** will provide the **Project Manager** and **CQA Monitor** with a written quality control certification signed by a responsible party employed by the **Manufacturer** that the material delivered have properties "minimum average roll value" which meet or exceed all property value guaranteed for each type of geotextile. The quality control certificate will include:

- Roll identification numbers.
- Results of MQC testing.

The **Manufacturer** will provide as a minimum, test results for the following unless additional results are requested by the **Project Specifications**:

- Mass per unit area.
- Grab strength.
- Tear strength.
- Puncture strength.

- Permittivity.
- Apparent opening size.

MQC testing shall be performed at a frequency listed in the **Project Specification** or as indicated in the CQA Plan. CQA testing on geotextile produced for the project shall be performed according to the test methods specified and frequencies presented in the below Table 9 and Table 10, unless otherwise instructed by the Engineer.

Table 9: Geotextile Conformance Testing Requirements for Protection or Cushioning Geotextile Material

TEST NAME	TEST METHOD	MINIMUM FREQUENCY
Mass per Unit Area	ASTM D5261 / ISO 09864	1 per site or 1 per supplied material
Tensile Properties		
Strength	ISO 10319	1 per site or 1 per supplied material
Strain at Max. Load	ISO 10319	1 per site or 1 per supplied material
Trapezoidal Tear Strength	ISO 13434	1 per site or 1 per supplied material
CBR Puncture (kN/mm)		
Max. Force	ISO 12236	1 per site or 1 per supplied material
Elongation at Max Force	ISO 12236	1 per site or 1 per supplied material
Installation		
UV Str. Ret. after 500 lt. HRS EXPOSURE	ASTM D7238	1 per site or 1 per supplied material
Joint Strength		1 per 50 000m ²
Strip Tensile	Strip Tensile Test	1 per 50 000m ²
Overlap	Measure	All Overlaps

Table 10: Geotextile Conformance Testing Requirements for Filter Geotextile Material

TEST NAME	TEST METHOD	MINIMUM FREQUENCY
Mass per Unit Area	ASTM D5261 / ISO 09864	1 per site or 1 per supplied material
Maximum Opening Size	ASTM D4751	1 per site or 1 per supplied material
Permittivity	ASTM D4491	1 per site or 1 per supplied material
Apparent Opening Size	ASTM D4751	1 per site or 1 per supplied material
Trapezoid Tear Strength	ASTM D 4533	1 per site or 1 per supplied material
CBR Puncture Strength	ASTM D 6241	1 per site or 1 per supplied material
Apparent Opening Size	ASTM D 4751	1 per site or 1 per supplied material
Ultraviolet Stability	ASTM D 7238	1 per site or 1 per supplied material
Overlap	Measure	All overlaps

As a minimum, for protection geotextiles, the material shall comply with GRI Test Method GT12 (a) (2012) – Test Methods and Properties for Nonwoven Geotextiles Used as Protection (or Cushioning) Materials. For separation geotextiles the material shall comply with GRI Test Method GT 13 (a) (2012) – Test Methods and Properties for Geotextiles Used as Separation Between Subgrade and Aggregate.

As a minimum the **CQA Monitor** shall independently confirm the mass per unit area and CBR puncture maximum force and elongation, and 3 in-field seam strength test results for cushion protection geotextiles, along

with the name of geotextile manufacturer, roll identification markings, type of polymer and filament and location of manufacturing plant. Similarly, as a minimum the **CQA Monitor** shall independently confirm the mass per unit area, CBR puncture strength and either the Apparent Opening Size or Gradient Ratio filter compatibility for separator and filter geotextile installations as required by the **Project Specifications**.

Sampling will be taken across the width of the roll and will not include the first 1.5 meters. Unless otherwise specified, samples will be 1 meter long by the roll width. The **CQA Monitor** will mark the machine direction on the samples with an arrow. Unless otherwise specified, samples will be taken at a rate as indicated in Table 9 for geotextile.

The **CQA Monitor** will examine results from laboratory conformance testing and will report non-conformances with the **Project Specification** and this CQA Plan to the **Project Manager**. Conformance testing will be allowed for by the **Installer** or **Contractor**.

The following will be applicable for rolls not conforming to the conformance testing conducted by the independent laboratory:

- The **Manufacturer** will replace every roll of geotextile that is in nonconformance with the **Project Specification** with a roll(s) that meet the **Project Specification**.
- The **Installer** will remove conformance samples for testing by the independent laboratory from the closest numerical rolls on both sides of the failing roll. These two samples must conform to the **Project Specifications**. If either of these rolls fail, the numerically closest rolls on the side of the failing sample must conform to the **Project Specification**. If any of these samples fail, every roll of geotextile on site from this lot and every subsequently delivered roll that is from the same lot must be tested by the independent laboratory for conformance to the **Project Specification**. This additional conformance testing will be at the cost of the **Manufacturer**.

The **CQA Monitor** will document actions taken in conjunction with conformance test failures.

9.8.3 Quality Control Submittals

Prior to geotextile installation, the **CQA Monitor**, and the **Engineer** shall review the **Installer's** quality control submittals to evaluate and confirm that these materials meet **Project Specifications** requirements. The **CQA Monitor** and the **Engineer** shall review the Quality Control submittals that are outlined in the **Project Specifications**.

The **CQA Monitor** will review the **Manufacturer** certifications to evaluate that the property values listed on the certification meet or exceed those specified for the particular type of geotextile and the measurements of properties by the **Manufacturer** are properly documented, test methods accepted, and the certification have been provided at the specified frequency identifying the rolls related to testing. Deviation will be reported to the **Project Manager**.

The **Manufacturer** will identify all rolls of geotextile with the following:

- Manufacturer name.
- Product identification.
- Lot number.
- Roll number.
- Roll dimension.
- Date of manufacturing.

The **CQA Monitor** will examine rolls upon delivery and deviation from the above requirements will be reported to the **Project Manager**.

As a minimum the following will be reviewed by the **CQA Monitor** and the **Engineer**:

- Material Property Certification.
 - Property data sheets, including at minimum, all specified properties, measured using testing methods indicated in the **Project Specification** and CQA Plan.

- Sampling procedures and results of testing.
- Testing equipment calibration certification.
- Geotextile roll Material Quality Control (MQC) Certification.

Prior to shipment, the **Manufacturer** will provide the **CQA Monitor** and **Engineer** with MQC certification for every roll of geotextile provided. The MQC certificate will be signed by a responsible party employed by the **Manufacturer**, such as the production manager. The MQC certification will include:

- Roll numbers and identification.
- Results of MQC tests – as a minimum, results will be given for Mass per unit area, grab strength, puncture resistance, permittivity and apparent opening size evaluated in general accordance with the methods indicated in the **Project Specifications** or quality methods approved by the **CQA Monitor**.

9.8.4 Construction Monitoring

The **CQA Monitors** shall observe and verify tests related to the above-mentioned installation activities to verify that the installation is in accordance with the **Project Specifications** and **Construction Drawings**. The **CQA Monitors** shall identify any inadequate construction methodologies or materials that may adversely impact the performance or intended design of the **works** being constructed.

The **CQA Monitor** shall record visual observations and survey measurements throughout the construction process to ensure that the materials are placed to the minimum dimensions specified in accordance with the **Project Specifications** and **Construction Drawings**.

During geotextile installation, the **CQA Monitor** shall observe and verify deployment, field seaming and repairs to assess that the installation compliance with the **Project Specifications** and **Construction Drawings**. The scope of the CQA program has been established with the goal of 100% coverage of deployment, overlapping and seaming (if required), with 80% coverage of the **CQC** repairs.

The supply and installation of the polyester geotextiles will be according to the specifications as stipulated in the **Project Specifications**

The **CQA Monitor** shall observe and verify the geotextile storage, handling, deployment, overlapping, defect logging and repair. The **CQA Monitor** will as a minimum observe and verify and ensure that the **CQC Monitor** document:

- Observe and verify MQC data for geotextile rolls are in accordance with **Project Specifications** and **Construction Drawings**.
- Observe and verify that storage areas for geotextiles are in accordance with the **Project Specifications** and **Construction Drawings** and **Manufacturer guidelines**.
- Observe and verify that geotextiles are placed and overlapped in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that defects are logged and repaired in accordance with the **Project Specifications** and **Construction Drawings**.

9.8.4.1 Delivery

The geotextile will be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damage or deleterious conditions. To that effect, geotextile rolls will be transported to site in relatively opaque and watertight wrapping.

Protective wrapping will be removed less than one hour prior to unrolling the geotextile. After the wrapping has been removed, a geotextile will not be exposed to sunlight for more than 15 days, except for UV protection geotextile, unless otherwise specified and guaranteed by the **Manufacturer**.

The **CQA Monitor** will observe rolls upon delivery at the site and deviation from the above requirements will be reported to the **Project Manager** and **Installer**.

9.8.4.2 Storage

The **CQA Monitor** will observe and verify the storage of geotextile at the allocated storage area. An area dedicated solely to the storage of geotextile will be made available by the **Project Manager** to the **Contractor** or the **Installer**. The **Installer** will be responsible for the storage of the geotextile onsite. The **Project Manager** will provide a dedicated storage area to the **Contractor** or the **Installer** in a location (or several locations) such that onsite transportation and handling during installation is minimised to avoid potential damage to the geotextile.

The storage area will be prepared in such a way that it complies to the **Project Specification** regarding subgrade preparation, with a minimum fall of 2% and a maximum fall of 4% to allow the rolls to be placed on wooden pallets or blocks to prevent contact with stormwater run-off. The **CQA Monitor** and **Engineer** will sign-off acceptance of the storage area prior to any rolls being delivered to site by the **Installer**.

The following measures should be implemented for the storage area:

- Dedicated perimeter fence on the storage boundary.
- Dedicated gate for offloading and collection to site.
- Easy access for roll management and collection.
- Stormwater diversion berms and channels or a combination to prevent stormwater from the surrounding area to enter the storage area and erode the prepared surface.
- Dedicated security guard and tallyman to document entry to the storage area and the log rolls entering or leaving the storage area.
- Fire Management Plan and fire break along the perimeter of the storage area inline with the National Veld and Forestry Act (No:101) latest revision will apply. The area is to be denuded of vegetation to create a fire break, to prevent or create a fire.
- No open fires will be allowed in the storage area.
- Firefighting equipment will be installed at the storage area.
- No more than three rolls will be stacked on each other.
- Adequate space to allow storage and to prevent a shortage of material during installation.
- All rolls will be wrapped in relatively opaque and watertight wrapping until one hour to unrolling the geotextile.

9.8.4.3 Deployment

The **Installer** will handle all geotextile in such a manner as to document they are not damaged in any way, and the following will be complied with:

- During wind all geotextiles will be sufficiently weighted down by the means of sandbags or equivalent ensuring that the geotextile is not damaged or contaminated in any way, until such time as it can be replaced with earth cover materials.
- Cutting of geotextile will be performed with hooked cutting blades approved by the **CQA Monitor**. The **Installer** will take all necessary measures to ensure no underlying materials is damaged during cutting operations.
- Care shall be taken by the **Installer** not to disturb or damage any underlying material during geotextile placement.
- During placement care shall be taken by the **Installer** to ensure the area where the geotextile is being placed in clean and smooth to prevent high strain zones and that no stone, excessive dust, or moisture is entrapped that may cause damage to the geotextile, this will include general clogging of drains or filters or impacting the subsequent seaming of the geotextile.
- The **CQA Monitor** will inspect the area with the **Installer** prior to and after the placement of the geotextile over the entire surface, to document that no potentially harmful foreign objects, such as needles are present.

- If required by the **CQA Monitor** the **Installer** shall use a metal detection device to ensure that no needles have been left in the geotextile material by the **Manufacturer**. The **Installer** will allow for this possibility in his costing.

Any non-conformances noted by the **CQA Monitor** will be documented and reported to the **Project Manager**.

The **CQA Monitor** shall verify that the intended layout as approved by the **Engineer**, including the following:

- Orientation.
- Overlaps and joints are as intended.
- In-situ, subgrade or geomembrane is free of deleterious materials prior to deployment.
- Anchoring is achieved as specified.
- Specified methods are used to minimise the wrinkles and protect underlying layers during cutting of materials.
- Relatively opaque and watertight wrapping will not be removed less than one hour prior to unrolling the geotextile.
- Unwrapped geotextile is not exposed to direct sunlight for a period of more than 15 days.
- Unwrapped geotextile is re-wrapped and stored in the storage area.
- Geotextile material contains no needles.
- Deployment procedures are performed in compliance with the **Project Specifications**.

9.8.4.4 Seams and Overlaps

All geotextiles will be continuously seamed (e.g., hot-air-gun welding or stitching etc.) in accordance with the **Project Specification**, if no mention is made on either method the **Installer** shall assume that all overlaps and closures should be hot-airgun welded and allow therefor in his rate. Geotextiles will be overlapped in accordance with the **Project Specification**, if no mention is made the **Installer** shall assume all overlaps to be a minimum of 300mm per geotextile sheet and side and will allow therefore in his rate.

No horizontal seaming will be allowed on side slopes, seams will therefor be along and not across the side slopes, exception is made on patching when approved by the **CQA Monitor** and the **Engineer** in writing.

The **CQA Monitor** shall verify the following:

- Sufficient overlap in accordance with the **Project Specification, Construction Drawings** or CQA plan.
- Specified seam procedures were followed in accordance with the **Project Specification, Construction Drawings** or CQA plan.
- Seams will be clear of any dust, moisture, and unwanted material.
- Seaming of field panels shall be done only under suitable conditions carried out by means of overlapping the two adjoining sheets of geotextile and hot-airgun welded or sewing the geotextiles together in accordance with the **Project Specification, Construction Drawings** or CQA plan.

9.8.4.5 Repairs

The **CQA Monitor** shall observe and verify that all repairs' materials, techniques, and procedures used for repairs are approved in advance and meet the requirements of the **Project Specifications**. The **CQA Monitor** shall verify that all defects and repairs are marked, recorded, repaired, tested, and wrinkles are addressed, prior to being covered by other material and that repairs are performed as specified, including proper patch size or dimension.

Holes or tears in the geotextile shall be documented and repairs observed by the **CQA Monitor** as follows:

- On Slopes – A patch made from the same geotextile will be double seamed into place as approved by the **CQA Monitor**. Should a tear exceed 10 percent of the width of the roll, the entire roll will be removed from the slope and replaced. Tears less than 10 percent of the width of the roll will be rounded at the ends with

a circular cut of minimum 75mm in diameter and patched with the same geotextile with a minimum overlap of 600mm that will be double seamed into place as approved by the **CQA Monitor**.

- Non-Slopes – a patch made from the same geotextile will be continuously seamed in place with a minimum overlap of 300mm unless specified otherwise in the **Project Specifications** or **Construction Drawings**.

The **Installer** and the **CQA Monitor** will ensure that all soil or other materials are removed from the tear, hole or opening prior to seaming the patch in place. The **CQA Monitor** will observe any repair, note any non-conformance with the requirements and report them to the **Project Manager**.

9.8.4.6 Protection / Cover

The **CQA Monitor** shall observe and verify that all materials placed on top or against the geotextile is done in such a manner as to ensure that the geotextile and underlying materials are not damaged. The **Contractor** will place all materials located on top or against the geotextile, in such a manner to ensure:

- No damage is done to the geotextile or underlying material.
- Minimal slippage of the geotextile on the underlying materials.
- No excess tensile stress is caused in the geotextile.

The **CQA Monitor** will document and report any non-conformance to the **Project Manager**.

9.9 Geosynthetic Clay Liner (GCL)

9.9.1 Scope of Work

This section prescribes the CQA activities to be performed to inspect, witness, verify and document that the geosynthetic clay liner (GCL) activities are constructed accordance with the **Project Specification** and **CONSTRUCTION Drawings**. The geosynthetic clay liner (GCL) to be monitored by the **CQA Monitors** and **Engineer**, shall include:

- Material conformance and installation of the geosynthetic clay liner (GCL).

During geosynthetic clay liner (GCL) installation, the **CQA Monitor** shall observe and document deployment, overlaps and repairs to assess that the installation is in accordance with the **Project Specifications**.

9.9.2 Conformance Testing

Prior to installation of the geosynthetic clay liner (GCL) materials, the **Installer** will supply the **CQA Monitor** with the **Manufacturer** Quality Control (MQC) documents for review and approval by the **CQA Monitor** and **Engineer**. The **Manufacturer** will supply the **CQA Monitor** and the **Engineer** with a list of guaranteed “minimum average roll value” properties, for the GCL to be delivered.

The **Manufacturer** will also supply the **CQA Monitor** and **Engineer** with a written quality control certification signed by a responsible party employed by the **Manufacturer** that the material delivered to the project have properties “minimum average roll value” which meet or exceed all property values guaranteed for the GCL.

The Quality control certificates will include:

- Roll identification numbers.
- Results of quality control testing.

The **Manufacturer** will provide, as a minimum, test results for the following unless stated otherwise in the **Project Specifications**:

- Mass per unit area.
- Index flux.

As a minimum, for GCL, the material shall comply with the test methods specified in Table 11, on GCL production for this project.

Table 11: GCL Conformance Testing Requirements

Test Name	Test Method	Minimum Frequency
Mass per Unit Area	ASTM D 5993	1 test per 100 000m ²
Moisture content (%) min	ASTM D5993	4 000m ²
Swelling index (ml/2g) min	ASTM D5890	50 Tons
Tensile strength, MD (kN/m)	ASTM D6768	20 000m ²
Peel strength (N/m) (min)	ASTM D6496	4 000m ²
GCL permeability (on pure bentonite not polymer modified) Permeability (m/s) max @35 Kpa	ASTM D6766	yearly
Component Durability Permeability (m/s) max @500 Kpa	ASTM D6766 mod.	yearly
Geotextile & reinforcing yarns (% strength retained)	ASTM D5721/ASTM D6768,	yearly
Overlap (mm)	GRI GCL3	all edges

The **CQA Monitor** will examine the **Manufacturer** certification to verify that the property value listed on the certifications meet or exceed those specified for GCL and the measurements of properties by the **Manufacturer** are properly documented, test methods acceptable and the certificates have been provided at the specified frequency properly identifying the rolls related to testing. Deviations will be reported to the **Project Manager**.

The **CQA Monitor** will sample the GCL either during production at the manufacturing facility or after delivery to the project site. The samples will be forwarded to an accredited laboratory for testing by the **Installer** to assess conformance to the **Project Specifications**. Results of the test will be sent from the accredited laboratory to the **CQA Monitor**. The test methods and minimum testing frequencies are indicated in Table 11.

Samples will be taken across the width of the roll and not include the first 1.5 meters if the sample is cut onsite. Unless otherwise specified samples will be 1 meter long by the roll width. The **CQA Monitor** will make the machine direction with an arrow and the **Manufacturer** roll number on each sample.

The **CQA Monitor** will examine results from the accredited laboratory conformance testing and will report non-conformances to the **Project Manager**. Conformance testing will be allowed for by the **Installer** or **Contractor**.

The following will be applicable for rolls not conforming to the conformance testing conducted by the independent laboratory:

- The **Manufacturer** will replace every roll of GCL that is in nonconformance with the **Project Specification** with a roll(s) that meet the **Project Specification**.
- The **Installer** will remove conformance samples for testing by the independent laboratory from the closest numerical rolls on both sides of the failing roll. These two samples must conform to the **Project Specifications**. If either of these rolls fail, the numerically closest rolls on the side of the failing sample must conform to the **Project Specification**. If any of these samples fail, every roll of GCL on site from this lot and every subsequently delivered roll that is from the same lot must be tested by the independent laboratory for conformance to the **Project Specification**. This additional conformance testing will be at the cost of the **Manufacturer**.

The **CQA Monitor** will document actions taken in conjunction with conformance test failures.

9.9.3 Quality Control Submittals

Prior to geosynthetic clay liner (GCL) installation, the **CQA Monitor**, and the **Engineer** shall review the **Installer's** quality control submittals and conformance test results to evaluate and confirm that these materials meet **Project Specifications** requirements. The **CQA Monitor** and the **Engineer** shall review the Quality Control submittals that are outlined in the **Project Specifications**.

The **Manufacturer** will identify all rolls of GCL with the following:

- Manufacturer name.
- Product identification.
- Lot number
- Roll number.
- Roll dimensions.

The **CQA Monitor** will examine rolls upon delivery and deviation from the above requirements will be reported to the **Project Manager**.

As a minimum the following will be reviewed by the **CQA Monitor** and the **Engineer**:

- Material Property Certification.
 - Property data sheets, including at minimum, all specified properties, measured using testing methods indicated in the **Project Specification** and CQA Plan.
 - Sampling procedures and results of testing.
- Testing equipment calibration certification.
- GCL roll Material Quality Control (MQC) Certification.

Prior to shipment, the **Manufacturer** will provide the **CQA Monitor** and **Engineer** with MQC certification for every roll of GCL provided. The MQC certificate will be signed by a responsible party employed by the **Manufacturer**, such as the production manager. The MQC certification will include:

- Roll numbers and identification.
- Results of MQC tests – as a minimum, results will be given for Mass per unit area, Index flux evaluated in general accordance with the methods indicated in the **Project Specifications** or quality methods approved by the **CQA Monitor**.

9.9.4 Construction Monitoring

During geosynthetic clay liner (GCL) installation, the **CQA Monitor** shall observe and verify deployment, overlaps, field seaming, and repairs to assess that the installation is in compliance with the **Project Specifications** and **CONSTRUCTION Drawings**. The scope of the CQA program has been established with the goal of 100% coverage of deployment, overlapping with 80% coverage of the **CQC** repairs.

The **CQA Monitor** shall verify that the subgrade is in accordance with The **Project Specifications** and **CONSTRUCTION Drawings** prior to deployment of the geosynthetic clay liner (GCL), anchoring is achieved as specified, specified methods are used to minimise wrinkles, and deployment procedures are performed in compliance with the **Project Specifications** and **CONSTRUCTION Drawings**.

The supply and installation of the geosynthetic clay liner (GCL) in accordance with **Project Specifications**.

The **CQA Monitor** shall observe, verify, and document the geosynthetic clay liner (GCL) storage, handling, deployment, overlapping, defect logging and repair. At a minimum, the **CQA Monitor** shall:

- Observe and verify MQC data for geosynthetic clay liner (GCL) are in accordance with **Project Specifications** and **CONSTRUCTION Drawings**.
- Observe and verify that storage areas for geosynthetic clay liner (GCL) are in accordance with the **Project Specifications** and **CONSTRUCTION** and **Manufacturer guidelines**.
- Observe and verify that geosynthetic clay liner (GCL) are placed and overlapped in accordance with the **Project Specifications** and **CONSTRUCTION Drawings**.
- Observe and verify that defects are logged and repaired in accordance with the **Project Specifications** and **CONSTRUCTION Drawings**. Delivery

The GCL will be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damage or deleterious conditions. To that effect, GCL rolls will be transported to site in relatively opaque and watertight wrapping.

Protective wrapping will be removed less than one hour prior to unrolling the GCL. After the wrapping has been removed, a GCL will not be exposed to sunlight for more than 15 days, unless otherwise specified and guaranteed by the **Manufacturer**.

The **CQA Monitor** will observe rolls upon delivery at the site and deviation from the above requirements will be reported to the **Project Manager** and **Installer**.

Upon delivery to the project site, the **CQA Monitor** will check the GCL rolls for defects (e.g., tears, holes) and for damage. The **CQA Monitor** will report any to the **Project Manager** and **Installer**:

- Any rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws.
- Any rolls which included minor repairable flaws.

The **CQA Monitor** will observe and verify that rolls delivered to site, roll numbers correspond to those on the approved **Manufacturer** quality control certificate of compliance.

9.9.4.1 Storage

The **CQA Monitor** will observe and verify the storage of GCL at the allocated storage area. An area dedicated solely to the storage of GCL will be made available by the **Project Manager** to the **Contractor** or the **Installer**. The **Installer** will be responsible for the storage of the GCL onsite. The **Project Manager** will provide a dedicated storage area to the **Contractor** or the **Installer** in a location (or several locations) such that onsite transportation and handling during installation is minimised to avoid potential damage to the GCL.

The storage area will be prepared in such a way that it complies to the **Project Specification** regarding subgrade preparation, with a minimum fall of 2% and a maximum fall of 4% to allow the rolls to be placed on wooden pallets or blocks to prevent contact with stormwater run-off. The **CQA Monitor** and **Engineer** will sign-off acceptance of the storage area prior to any rolls being delivered to site by the **Installer**.

The following measures should be implemented for the storage area:

- Dedicated perimeter fence on the storage boundary.
- Dedicated gate for offloading and collection to site.
- Easy access for roll management and collection.
- Stormwater diversion berms and channels or a combination to prevent stormwater from the surrounding area to enter the storage area and erode the prepared surface.
- Dedicated security guard and tallyman to document entry to the storage area and the log rolls entering or leaving the storage area.
- Fire Management Plan and fire break along the perimeter of the storage area inline with the National Veld and Forestry Act (No:101) latest revision will apply. The area is to be denuded of vegetation to create a fire break, to prevent or create a fire.
- No open fires will be allowed in the storage area.
- Firefighting equipment will be installed at the storage area.
- No more than three rolls will be stacked on each other.
- Adequate space to allow storage and to prevent a shortage of material during installation.
- All rolls will be wrapped in relatively opaque and watertight wrapping until one hour to unrolling the GCL.

9.9.4.2 Deployment

The **CQA Monitor** shall verify that the intended layout as approved, including orientation, overlaps and joints are as intended, that the subgrade is free of deleterious materials prior to deployment, anchoring is achieved

as specified, specified methods are used to minimise wrinkles and protect underlying layers during cutting of materials, and deployment procedures are performed in compliance with the **Project Specification**. The **CQA Monitor** shall verify that the geosynthetic clay liner (GCL) has not been hydrated prior or during installation dependent on the **Project Specification** and **CONSTRUCTION Drawings**.

The **CQA Monitor** will monitor and document that the GCL is installed in general accordance with the **Project Specification** and **CONSTRUCTION Drawings**. The **Installer** shall provide the **CQA Monitor** a certificate of subgrade acceptance prior to the installation of GCL as outlined in the **Project Specifications** and CQA Plan. The **CQA Monitor** will monitor and document the following regarding the GCL installation activities:

- Observe and verify that the GCL rolls are stored and handled in a manner which does not result in any damage to the GCL.
- Observe and verify that the GCL is not exposed to UV radiation for extended periods (more than 15days) of time without prior approval.
- Observe and verify that the GCL are seamed in general accordance with the **Project Specifications** and the **Manufacturer** recommendations.
- Observe and verify that the GCL is installed on an approved subgrade surface, free of debris, protrusions or uneven surfaces.
- Observe and verify that the GCL is hydrated prior to completion of the construction is so specified in the **Project Specifications**.
- Observe and verify that any damage to the GCL is repaired as outlined in the **Project Specifications**.
- Observe and verify that roll is unwrapped maximum one hour prior to unrolling the GCL.

The **CQA Monitor** will document and report non-conformances to the **Project Manager** and **Installer**.

9.9.4.3 Seams / Overlap

The **CQA Monitor** shall verify sufficient overlap at all seams and that the specified seam procedures were followed in compliance with the **Project Specification**. Seaming of field panels shall be done only under suitable conditions carried out by means of overlapping the two adjoining sheets of GCL and enhancing the seam as per the recommendation of the **Manufacturer**. GCL will not be heat bonded to other geosynthetics.

For the GCL, the **CQA Monitor** shall verify sufficient overlap and that the specified procedures were followed in compliance with the **Project Specification**.

All GCL will be continuously seamed in accordance with the **Project Specification**. GCL will be overlapped in accordance with the **Project Specification**, if no mention is made the **Installer** shall assume all overlaps to be a minimum of 300mm per GCL sheet and side and will allow therefore in his rate. All overlaps will be jointed by means of a bentonite clay mix to ensure proper binding and sealing of the overlaps inline with the **Project Specification** or **Manufacturer** installation guidelines. The entire 300mm overlap of the bottom GCL will be covered with the bentonite clay mix and the overlying GCL will be closed, and pressure rolled to create a tight bond between the top and bottom GCL. A 100mm (per sheet) wide layer of bentonite clay mix will then be coated over both sheets at the seam to create a tight seal. No wrinkles will be allowed at the seams.

No horizontal seaming will be allowed on side slopes, seams will therefor be along and not across the side slopes, exception is made on patching when approved by the **CQA Monitor** and the **Engineer** in writing.

The **CQA Monitor** shall observe and verify the following:

- Sufficient overlap in accordance with the **Project Specification**, **CONSTRUCTION Drawings** or CQA plan.
- Specified seam procedures were followed in accordance with the **Project Specification**, **CONSTRUCTION Drawings**, CQA plan and **Manufacturer** installation guidelines.
- Seams will be clear of any dust, moisture, and unwanted material.
- Seaming of field panels shall be done only under suitable conditions carried out by means of overlapping the two adjoining sheets of GCL and bonding the GCL together in accordance with the **Project Specification**, **CONSTRUCTION Drawings**, CQA plan and **Manufacturer** installation guidelines.

9.9.4.4 Repairs

The **CQA Monitor** shall observe and verify that all repairs' materials, techniques, and procedures used for repairs are approved in advance in accordance with the **Project Specifications**. The **CQA Monitor** shall verify that all defects and repairs are marked, recorded, repaired, tested, and wrinkles are addressed, prior to being covered by other material and that repairs are performed as specified, including proper patch size or dimension.

Holes or tears in the GCL shall be repairs and observe and verify by the **CQA Monitor** as follows:

- On Slopes – A patch made from the same GCL material will be overlapped by a minimum length of 600mm on all sides. The main GCL will be coated with a bentonite clay mix 600mm on all sides and the patch placed and pressure roller over the bentonite clay mix. The entire patch and 100mm on all sides of the patch will be coated with bentonite clay mix to ensure proper sealing of the joints. Should a tear exceed 10 percent of the width of the roll, the entire roll will be removed from the slope and replaced. Tears less than 10 percent of the width of the roll will be rounded at the ends with a circular cut of minimum 75mm in diameter and patched with the same GCL with a minimum overlap of 600mm that will be seamed into place as approved by the **CQA Monitor**.
- Non-Slopes – a patch made from the same GCL will be continuously seamed in place with a minimum overlap of 300mm unless specified otherwise in the **Project Specifications** or **CONSTRUCTION Drawings**.

The **Installer** and the **CQA Monitor** will ensure that all soil or other materials are removed from the tear, hole or opening prior to seaming the patch in place. The **CQA Monitor** will observe any repair, note any non-conformance with the requirements and report them to the **Project Manager**.

9.9.4.5 Protection

The **CQA Monitor** shall observe and verify that all materials placed on top of the installed geosynthetic clay liner (GCL), are done in such a manner as to ensure that the geosynthetic clay liner (GCL), and underlying materials are not damaged.

9.10 Geocell

9.10.1 Scope of Work

This section prescribes the CQA activities to be performed to inspect, witness, verify and document that the geocell activities are constructed accordance with the **Project Specification** and **Construction Drawings**. The geocells to be monitored by the **CQA Monitors** and **Engineer**, shall include:

- Material conformance and installation of the geocells.

During geocell installation, the **CQA Monitor** shall observe and document deployment, joining, anchoring and repairs to assess that the installation is in accordance with the **Project Specifications**.

9.10.2 Conformance Testing

Prior to installation of the geocell materials, the **Installer** will supply the **CQA Monitor** with the **Manufacturer** Quality Control (MQC) documents for review and approval by the **CQA Monitor** and **Engineer**. The **Manufacturer** will supply the **CQA Monitor** and the **Engineer** with a list of guaranteed "minimum average value" properties, for the geocells to be delivered.

The **Manufacturer** will also supply the **CQA Monitor** and **Engineer** with a written quality control certification signed by a responsible party employed by the **Manufacturer** that the material delivered to the project have properties "minimum average value" which meet or exceed all property values guaranteed for the geocells.

The Quality control certificates will include:

- Batch/Panel identification numbers.
- Results of quality control testing.

The **Manufacturer** will provide, as a minimum, test results for the following unless stated otherwise in the **Project Specifications**:

- Mass per panel.
- Parent product (Thickness).
- Tensile strength.
- Cell size.
- Panel size.
- Tendon strength (if applicable.)

As a minimum for geocells, the material shall comply with the test methods specified in Table 12, on geocell procured for this project.

Table 12: Geocell Conformance Testing Requirements

TEST NAME	TEST METHOD	MINIMUM FREQUENCY
Mass per panel	SANS 10221	1 test per batch
Parent product (Thickness)	SANS 10221	1 test per batch
Tensile Strength	SANS 10221	1 test per batch

The **CQA Monitor** will examine the **Manufacturer** certification to verify that the property value listed on the certifications meet or exceed those specified for geocells and the measurements of properties by the **Manufacturer** are properly documented, test methods acceptable and the certificates have been provided at the specified frequency properly identifying the panel related to testing. Deviations will be reported to the **Project Manager**.

The **CQA Monitor** will sample the geocell either during production at the manufacturing facility or after delivery to the project site. The samples will be forwarded to an accredited laboratory for testing by the **Installer** to assess conformance to the **Project Specifications**. Results of the test will be sent from the accredited laboratory to the **CQA Monitor**. The test methods and minimum testing frequencies are indicated in Table 12. Samples will be taken in accordance with SANS 10221, unless otherwise specified in the **Project**.

The **CQA Monitor** will examine results from the accredited laboratory conformance testing and will report non-conformances to the **Project Manager**. Conformance testing will be allowed for by the **Installer** or **Contractor**.

The following will be applicable for batches not conforming to the conformance testing conducted by the independent laboratory:

- The **Manufacturer** will replace every panel/batch of geocell that is in nonconformance with the **Project Specification** with a panel/batch that meet the **Project Specification**.
- The **Installer** will remove conformance samples for testing by the independent laboratory from the closest numerical panel/batch on both sides of the failing panel/batch. These two samples must conform to the **Project Specifications**. If either of these panel/batch fail, the numerically closest panel/batch on the side of the failing sample must conform to the **Project Specification**. If any of these samples fail, every panel/batch of geocell on site from this lot and every subsequently delivered roll that is from the same lot must be tested by the independent laboratory for conformance to the **Project Specification**. This additional conformance testing will be at the cost of the **Manufacturer**.

The **CQA Monitor** will document actions taken in conjunction with conformance test failures.

9.10.3 Quality Control Submittals

Prior to geocell installation, the **CQA Monitor**, and the **Engineer** shall review the **Installer's** quality control submittals and conformance test results to evaluate and confirm that these materials meet **Project Specifications** requirements. The **CQA Monitor** and the **Engineer** shall review the Quality Control submittals that are outlined in the **Project Specifications**.

The **Manufacturer** will identify all panel/batch of geocell with the following:

- Manufacturer name.
- Product identification.
- Lot number.
- Panel/batch number.
- Panel/batch dimensions.

The **CQA Monitor** will examine panel/batch upon delivery and deviation from the above requirements will be reported to the **Project Manager**.

As a minimum the following will be reviewed by the **CQA Monitor** and the **Engineer**:

- Material Property Certification.
 - Property data sheets, including at minimum, all specified properties, measured using testing methods indicated in the **Project Specification** and CQA Plan.
 - Sampling procedures and results of testing.
- Testing equipment calibration certification.
- Geocell panel/batch Material Quality Control (MQC) Certification.

Prior to shipment, the **Manufacturer** will provide the **CQA Monitor** and **Engineer** with MQC certification for every panel/batch of geocell provided. The MQC certificate will be signed by a responsible party employed by the **Manufacturer**, such as the production manager. The MQC certification will include:

- Panel/batch numbers and identification.
- Results of MQC tests – as a minimum, results will be given for mass per panel, thickness, tensile strength evaluated in general accordance with the methods indicated in the **Project Specifications** or quality methods approved by the **CQA Monitor**.

9.10.4 Construction Monitoring

During geocell installation, the **CQA Monitor** shall observe and verify deployment, joining, anchoring, tendon installation and repairs to assess that the installation is in accordance with the **Project Specifications** and **Construction Drawings**. The scope of the CQA program has been established with the goal of 100% coverage of deployment, joining and tendon installation and anchoring with 80% coverage of the **CQC** repairs.

The **CQA Monitor** shall verify that the subgrade and underlying geosynthetics is in accordance with the **Project Specifications** and **Construction Drawings** prior to deployment of the geocell, anchoring is achieved as specified, specified methods are used to minimise wrinkles, and deployment procedures are performed in compliance with the **Project Specifications** and **Construction Drawings**.

The supply and installation of the geocells will be according to the specifications as stipulated in the **Project Specifications**

The **CQA Monitor** shall observe and verify the geocell storage, handling, deployment, joining, anchoring, tendon installation and repair. At a minimum, the **CQA Monitor** shall:

- Observe and verify MQC data for geocells are in accordance with **Project Specifications** and **Construction Drawings**.
- Observe and verify that storage areas for geocell are in accordance with the **Project Specifications** and **Construction Drawings** and **Manufacturer guidelines**.
- Observe and verify that geocells are placed and joined in accordance with the **Project Specifications** and **Construction Drawings**.
- Observe and verify that defects are logged and repaired in accordance with the **Project Specifications** and **Construction Drawings**.

9.10.4.1 Delivery

The geocell will be protected from mud, dirt, dust, tearing, cutting or any other damage or deleterious conditions. Damaged panels/batches will be rejected and replaced.

The **CQA Monitor** will observe panels/batches upon delivery at the site and deviation from the above requirements will be reported to the **Project Manager** and **Installer**.

Upon delivery to the project site, the **CQA Monitor** will check the geocell panels/batches for defects (e.g., tears, cuts) and for damage. The **CQA Monitor** will report any to the **Project Manager** and **Installer**:

- Any panels/batches, or portions thereof, which should be rejected and removed from the site because they have severe flaws.
- Any panels/batches which included minor repairable flaws.

The **CQA Monitor** will observe and verify that panels/batches delivered to site, panels/batches numbers correspond to those on the approved **Manufacturer** quality control certificate of compliance.

9.10.4.2 Storage

The **CQA Monitor** will observe and verify the storage of geocells at the allocated storage area. An area dedicated solely to the storage of geocells will be made available by the **Project Manager** to the **Contractor** or the **Installer**. The **Installer** will be responsible for the storage of the geocells onsite. The **Project Manager** will provide a dedicated storage area to the **Contractor** or the **Installer** in a location (or several locations) such that onsite transportation and handling during installation is minimised to avoid potential damage to the geonet.

The storage area will be prepared in such a way that it complies to the **Project Specification** regarding subgrade preparation, with a minimum fall of 2% and a maximum fall of 4% to allow the panels/batches to be placed on wooden pallets or blocks to prevent damage. The **CQA Monitor** and **Engineer** will sign-off acceptance of the storage area prior to any panels/batches being delivered to site by the **Installer**.

The following measures should be implemented for the storage area:

- Dedicated perimeter fence on the storage boundary.
- Dedicated gate for offloading and collection to site.
- Easy access for roll management and collection.
- Stormwater diversion berms and channels or a combination to prevent stormwater from the surrounding area to enter the storage area and erode the prepared surface.
- Dedicated security guard and tallyman to document entry to the storage area and the log rolls entering or leaving the storage area.
- Fire Management Plan and fire break along the perimeter of the storage area inline with the National Veld and Forestry Act (No:101) latest revision will apply. The area is to be denuded of vegetation to create a fire break, to prevent or create a fire.
- No open fires will be allowed in the storage area.
- Firefighting equipment will be installed at the storage area.
- No more than three panels/batches will be stacked on each other.
- Adequate space to allow storage and to prevent a shortage of material during installation.

9.10.4.3 Deployment

The **CQA Monitor** shall verify that the intended layout as approved, including orientation and joints are as intended, that the subgrade or geosynthetics is free of deleterious materials prior to deployment, anchoring is achieved as specified, specified methods are used to minimise wrinkles and protect underlying layers during cutting of materials, and deployment procedures are performed in compliance with the **Project Specification**. The **CQA Monitor** shall verify that the geocell has not been damaged prior or during installation.

The **CQA Monitor** will observe and verify that the geocell is installed in accordance with the **Project Specification** and **Construction Drawings**. The **Installer** shall provide the **CQA Monitor** a certificate of acceptance prior to the installation of geocells as outlined in the **Project Specifications** and CQA Plan to ensure underlying geosynthetic **works** have been completed. The **CQA Monitor** will observe and verify the following regarding the geocell installation activities:

- Observe and verify that the geocell panels/batches are stored and handled in a manner which does not result in any damage to the geocell.
- Observe and verify that the geocell are joined in accordance with the **Project Specifications** and the **Manufacturer** recommendations.
- Observe and verify that the geocell is installed on an approved subgrade or geosynthetic surface, free of debris, protrusions, or uneven surfaces.
- Observe and verify that no dust, dirt or stones are entrapped in the geocells that might cause damage to the below geosynthetic material.
- Observe and verify that any damage to the geocell is repaired as outlined in the **Project Specifications**.
- Observe and verify that the joints are sufficiently secured with industrial staples to prevent the joints moving apart during filling or tensioning.
- Observe and verify that the geocells are sufficiently tensioned to prevent collapsing during filling or tensioning.
- Observe and verify that the tendons are correctly installed and secured prior to filling, and that tendons are tied to the sell wall or to a load displacement washer every three to six cells dependent on the **Project Specification**.
- Observe and verify that the fill material meets the **Project Specification** and that the geocells are not over filled (fill material should be 2-5cm higher to allow for settlement) or material is not dropped for a height higher than 1 meter.
- Observe and verify that the fill material is sufficiently vibrated or compacted, care should be taken on the below laying materials.

The **CQA Monitor** will document and report non-conformances to the **Project Manager** and **Installer**.

9.10.4.4 Joining

The **CQA Monitor** shall verify sufficient joining at all joints and that the specified joint procedures were followed in compliance with the **Project Specification** and **Manufacturer** guidelines. Joining of field panels shall be done only under suitable conditions carried out by means of industrial staples or recommendation of the **Manufacturer**. Geocells will not be heat bonded to other geosynthetics.

For the geocell, the **CQA Monitor** shall verify that the specified procedures were followed in compliance with the **Project Specification**.

All geocells will be joined in accordance with the **Project Specification**. No horizontal joining will be allowed on side slopes, joints will therefor be along and not across the side slopes, exception is made on patching when approved by the **CQA Monitor** and the **Engineer** in writing.

The **CQA Monitor** shall observe and verify the following:

- Sufficient joining in accordance with the **Project Specification**, **Construction Drawings** or CQA plan.
- Specified joining procedures were followed in accordance with the **Project Specification**, **Construction Drawings**, CQA plan and **Manufacturer** installation guidelines.
- Geocells will be clear of any unwanted material.
- Joining of field panels shall be done only under suitable conditions carried out by means of industrial staples in accordance with the **Project Specification**, **Construction Drawings**, CQA plan and **Manufacturer** installation guidelines.

9.10.4.5 Repairs

The **CQA Monitor** shall observe and verify that all repairs' materials, techniques, and procedures used for repairs are approved in advance and meet the requirements of the **Project Specifications**. The **CQA Monitor** shall verify that all defects and repairs are marked, recorded, repaired, tested, and wrinkles are addressed, prior to being covered by other material and that repairs are performed as specified, including proper patch size or dimension.

The **Installer** and the **CQA Monitor** will ensure that all soil or other materials are removed from the geocell opening prior to joining the repair in place. The **CQA Monitor** will observe any repair, note any non-conformance with the requirements and report them to the **Project Manager**.

9.11 Survey

9.11.1 Survey Control

Survey control will be performed by the **Surveyor** as needed or as requested by the **CQA Monitor** or **Engineer**. A permanent benchmark will be established for the site in a location convenient for daily tie-in. The vertical and horizontal control for this benchmark will be established within normal land surveying standards, by a certified land **Surveyor**.

9.11.2 Precision and Accuracy

A wide variety of survey equipment is available for the surveying requirements for this project. The **Surveyor** instruments used for the **works** should be sufficiently precise and accurate to meet the needs of the project. The **Surveyor** will supply to the **CQA Monitor**, **Engineer**, and **Project Manager** his calibration certification for all survey equipment onsite or intended to be used onsite prior to using such equipment for approval by the **Project manager**, **Engineer** and **CQA Monitor**. The **Surveyor** will have a copy of all calibration certificates filed onsite and will present such calibration certificates on request by the **CQA Monitor** or **Engineer**.

9.11.3 Lines and Grades

The following structures will be surveyed to verify and document the lines and grades achieved during construction of the project and will be supplied to the **CQA Monitor** according to the Setting Out Points (S.O.P) or chainages as indicated on the **Construction Drawings**, additional structures may be added by the **CQA Monitor** as he sees fit at no additional cost to the **Employer**:

- Embankment alignments.
- Embankment side slopes.
- Geomembrane panel layout, seam location, patches, and repairs.
- Pipe center line and invert levels.
- Channel and Drain center lines and invert levels.

The format of data submission from the **Surveyor** to the **CQA Monitor** can be changes at any time during the project by the **CQA Monitor** to ensure the **CQA Monitor** obtains the required information for validating construction activities and to perform checks and balances.

9.11.4 Frequency and Spacing

The **Surveyor** will supply to the **CQA Monitor** survey information as indicated on the **Construction Drawings** or as mentioned in the **Project Specifications** regarding SOP and chainages of all structures. The **Surveyor** will supply survey information regarding all layer **work** construction onsite to the **CQA Monitor** for review and approval prior to the **Contractor** or **Installer** commencing with the next layer or **works**. To avoid the **Contractor** or **Installer** form being delayed the **Surveyor** will supply the survey information within 24 hours of the layer or section being completed for verification and approval by the **CQA Monitor** or as specified in the **Project Specification** or **Contract**.

9.11.5 Documentation

Field survey notes will be retained by the **Surveyor**. The findings from the field survey should be documented on a set of Survey Record Drawings (“As-Built Drawings”) which shall be supplied to the **Project Manager, Engineer and CQA Monitor** in AutoCAD format or a suitable format as directed by the **Project Manager, Engineer and CQA Monitor**.

The information will be made available to the **Project Manager, Engineer and CQA Monitor** on completion of the section of the **works** and prior to handover for verification by the **Engineer and CQA Monitor**. “As-built” drawings will be at a scale not smaller than 1:1 000 scale. The accuracy of the surveying shall be sufficient to determine if the measurements are within the tolerances specified in the **Project Specifications**.

The required surveying of the barrier system elevations shall be carried out on a maximum 20 m square grid. Additional survey locations shall be recorded to define the following features in the barrier system: toe of slope, crest of slope, grade breaks, ridges and valleys, anchor trench, drainage system piping, perimeter drainage ditch, and position of barrier penetrations and instrumentation. The thickness of the geosynthetic barrier system components on the drawings shall be interpreted as negligible. Refer to the **Project Specifications** for details of the minimum requirements for surveys, as-build drawings, grades, lines, and levels.

10.0 CLOSING

The Construction Quality Assurance Plan as presented in the previous sections detail the roles and responsibilities of the interested parties along with the responsibilities and required documentation to ensure that the construction of the **works** conform to the design intent.

APPENDIX A

Parties Involved in the CQA Implementation

PARTY DESCRIPTION	APPOINTED PARTY	DATE OF APPOINTMENT
Project Manager		
Engineer		
CQA Monitor		
Independent CQA Reviewer / Person		
Contractor		
Geomembrane Manufacturer		
Geotextile Manufacturer		
HDPE Pipe Manufacturer		
Geomembrane Installer		
Geotextile Installer		
HDPE Pipe Installer		
ELLS independent person		
CQA Laboratory		

APPENDIX B

Design Parameters

1. SITE CONDITIONS

Surface Water

- The nearest water course: *Thulazihleka Pan into Ngodweni Canal*
- Shortest distance to the 1:100 year flood line: *2800 metres*
- Regional Rainfall: *1127 mm/annum*
- Regional evaporation: *1 770 mm/annum*
- 1:50 year 24hr duration storm event: *320.1 mm*

Groundwater

- Depth to groundwater:
The subsurface conditions across portions of the two PCDs consist of the following:
 - *From surface stretching a depth of between 1.1 m and 3.0 a slightly to moderately clayey sands with abundant gravels, fill material, cobbles and rubble.*
- Aquifer classification:
 - *Shallow and Deep aquifers both of high importance to local landowners.*

Geotechnical profile

- Depth to pebble marker: *2.5 m*
- Transported soil: *Estuarine Silty and Sandy clay*
- Residual soil: *Residual Sandstone Miocene*
- Depth to hard rock: *4.5 – 5 metres*
- Foundation rock description:
 - *The site is underlain by unconsolidated aeolian, alluvial or estuarine/lacustrine sediments.*
- Collapsible structures: *None.*
- Bearing capacity and consolidation: *Not given*
- Seismicity: *Low*

Topography

- Foskor occupies an area of approximately 40 Ha, and is located approximately 1,2km to the north of Richards Bay harbour. The site and neighbouring area is located on a gentle south east facing slope, which slopes down towards the Richards Bay harbour
- Minimum slope for waste containment facilities: 2%

2. MATERIALS PROPERTIES

Clay for barrier systems (Not available on site)

- PI: SP to 15%
- Standard proctor MDD: 1,928 kg/m³ and 1,927 kg/m³
- Optimum Moisture Content: 10.8% and 12.2%.
- Percentage clay:
- Maximum particle size:
- Permeability: 2.02×10^{-5} cm/s to 2.31×10^{-5} cm/s.
- Minimum shear strength:

Materials on Site

Description	Embankment Materials	Fill Materials	Foundation Materials
Sample Depth (m)	AH3 – 0 to 2.1 m AH4 – 0.6 m to 1.0 m	IP1 – 0 to 1.1 m IP3 – 0.5 m to 1.6 m	IP1 – 1.1 m to 4.0 m AH4 – 2.0 m to 2.3 m
Material (USCS)	SM to SP-SM	SM to SM-SC	SC to SM
Composition	Coarse sand 10% Coarse-fine sand 27% Medium-fine sand 38% Fine-fine sand 9% Silt and clay 16%	Coarse sand 17% Coarse-fine sand 24% Medium-fine sand 31% Fine-fine sand 10% Silt and clay 18%	Coarse sand 8% Coarse-fine sand 18% Medium-fine sand 32% Fine-fine sand 13% Silt and clay 29%
Atterberg Limits	PI – NP to SP LS – 0 to 2%	PI – NP to 5% LS – 0 to 3% LL – 21%	PI – SP to 15% LS – 6 to 7% LL – 32% to 35%

Geomembrane

- Indicator parameters:
compliance with SANS1526 (2015), with no protect specific deviations;
- Performance parameters:
≤ 3% total tensile strain

Liner Protection

Description of protection:

- 150mm of the base and side slopes of the PCDs is to be ripped, graded to falls and compacted to 95% Standard Proctor density at a moisture content between -2% to +2% of optimum moisture content.
- A herringbone system of subsurface below the base preparation layer. The subsoil drains will consist of 110 mm diameter slotted HDPE pipes set in a trench filled with 19mm washed stone and draining to a subsoil seepage monitoring sump.
- The compacted clay liner component to be replaced with a reinforced GCL that complies with GRI-GCL3 with a minimum sodium bentonite content of 4,000 g/m² at 0% moisture content.
- The tertiary geomembrane liner will be a 1.5 mm thick HDPE smooth geomembrane that complies with GRI-GM13.
- The secondary leakage detection layer separates the tertiary and secondary geomembrane and will consist of a 750 µm cusped drainage sheet that conforms to GRI-GS19.
- The secondary geomembrane liner will be a 1.5 mm thick HDPE smooth geomembrane that complies with GRI-GM13.
- The primary leakage detection layer separates the secondary and primary geomembrane and will consist of a 750 µm cusped drainage sheet that conforms to GRI-GS19.
- The primary geomembrane liner will be a smooth 2.0 mm thick HDPE geomembrane that complies with GRI-GM13.
- The liner protection geotextile will consist of a non-woven continuous filament needle-punched polyester material with a minimum unit mass of 1,000 g/m² that complies with GRI-GT12 (Type A geotextile).
- A 100 mm thick Multicell HD geocell filled with class 30/19 concrete.

3. SYSTEM PERFORMANCE CRITERIA

- Minimum factor of safety: 1.5
- Frequency of PCD overtopping:
Designed for 1:50 years storm event
- Action leakage rate:
 - It can be expected that between 2700 ℓ/ha/day and 3300 ℓ/ha/day will report from the primary leakage detection layer. For the two PCD this would result in the following volumes:
 - Primary dam with a footprint of 0.24 ha would report an expected 650 ℓ/day
 - Secondary dam with a footprint of 0.72 ha would report an expected 2400 ℓ/day
 - The estimated leakage rate through the primary seepage limiting system (the primary and secondary geomembranes) is expected to be 130 ℓ/ha/day. This is the expected volume that will report to the secondary leakage detection system (between the secondary geomembrane and the tertiary geomembrane).
 - Primary dam with a footprint of 0.24 ha would report an expected 35 ℓ/day
 - Secondary dam with a footprint of 0.72 ha would report an expected 95 ℓ/day

Strain limitation: Not applicable

- Elevated temperature and duration: *N/A*

APPENDIX C

Technical Standard Specifications

STANDARD SPECIFICATION	DESCRIPTION
LATEST REVISIONS AS AT 17 APRIL 2023 TO APPLY	
South African National Standards (SANS 1200)	
SANS 1200 A	General
SANS 1200 AD	General - Small Dams
SANS 1200 AH	General - Structures
SANS 1200 C	Site Clearance
SANS 1200 D	Earthworks
SANS 1200 DB	Earthworks (pipe trenches)
SANS 1200 DE	Small Earth Dams
SANS 1200 DK	Gabions and Pitching
SANS 1200 DM	Earthworks (Roads, subgrade)
SANS 1200 GA	Concrete (Small Works)
SANS 1200 L	Medium pressure pipelines
SANS 1200 LB	Bedding (Pipes)
SANS 1200 LE	Stormwater drainage
SANS 1200 M	Roads (General)
SANS 1200 ME	Subbase
SANS 1200 MF	Base
SANS 1200 MK	Kerbing and Channelling
Soil and Gravel	
SANS 1083	Aggregate
ASTM D2488	Visual-Method Soil Classification
TRH 14	Soil classification
SANS 3001-GR30	Moisture-Density
SANS 3001-AG1	Particle size
SANS 3001-GR10	Atterberg Limits
SANS 3001-NG5	Nuclear Moisture/Density ¹
SANS 3001-GR 40	California bearing ratio (CBR)

STANDARD SPECIFICATION	DESCRIPTION
LATEST REVISIONS AS AT 17 APRIL 2023 TO APPLY	
ASTM D3080	Shear box test
SANS 3001-GR20	Moisture Content
SANS 3001-GR35	Sand replacement test
ASTM D5084-90 / ASTM D2488	Hydraulic Conductivity
ASTM D6391-11	Field-Scale Infiltration Test & Permeability Evaluation
ASTM D3385 / ASTM D5093	Permeability
Polyethylene Pipe – Physical Properties	
ISO 1183	Density
ISO 1133	Melt flow index (190°C/21.6Kg)
ISO 1133	Melt flow index (190°C/5Kg)
ISO 306	Vicat softening point (5Kg)
ISO 3146-85	Crystalline melting range
ISO 1628-3	Viscosity number
Polyethylene Pipe – Mechanical Properties	
ISO 868	Shore D, Hardness
ISO 527	Tensile @ Yield
ISO 527	Ultimate Tensile
ISO 527	Ultimate Elongation
ISO 527	Elastic Modulus
ISO 178	Flexural Stress (3.5% deflection)
ISO 4427	Design Stress
ISO 179	Notched Impact (Charpy) can 23°C
ISO 179	Notched Impact (Charpy) can -30°C
ISO 10837	Thermal stability (OIT,210°C)
ISO 6964	Carbon Black Content
Concrete	
SANS 50197-1	Cement: OPC, RHC

STANDARD SPECIFICATION	DESCRIPTION
LATEST REVISIONS AS AT 17 APRIL 2023 TO APPLY	
SANS 50197-1	Cement: PBFC
SANS 50197-1	Cement: PC15, RHPC15
SANS 50197-1	Cement: GBFS
SANS 1083	Aggregate
SANS 5836	Drying shrinkage of aggregates
SANS 6085	Drying shrinkage of concrete
SANS 1083	Aggregate size
SANS 5850-1	Sulphate content: Aggregates
SANS 5865	Drilling cores
SANS 10100 Part 2	Evaluate cores
SANS 10100 Part 2	Load tests
BS – 8007: 1997	Code of Practice for the design of concrete Structures for Retaining Aqueous Liquids
SANS 5861-2	Sampling fresh mixed
SANS 5861-3	Making and Curing Test Specimens
SANS 5862-1	Slump Test
SANS 5863	Compressive Strength (7,28 days) -more if required.
SANS 5865	Compressive Strength of Cores
SANS 667	Precast concrete pipes
SANS 986	Portal and rectangular precast culverts Units
Geomembrane	
SANS 1526	Thermoplastics sheeting for use as a geomembrane
GRI-GM13	Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
SANS 10409	Code of Practice for the Design, Selection and Installation of Geomembranes
GRI-GM17	Test Methods, Test Properties and Testing Frequency for Linear Low-Density Polyethylene (LLDPE) Smooth and Textured Geomembranes

STANDARD SPECIFICATION	DESCRIPTION
LATEST REVISIONS AS AT 17 APRIL 2023 TO APPLY	
GRI-GM14	Selecting variable intervals for taking geomembrane destructive seam samples using the method of attributes
GRI-GM19	Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes
ASTM D1505	Density
ASTM D5199 / D5994	Thickness
ASTM D6639	Tensile strength and elongation at break
ASTM D1603	Carbon Black Content, % (Range)
ASTM D5596	Carbon Black Dispersion
ASTM D5397	Stress Crack Resistance (SP-NCTL)
ASTM D3895	Standard Oxidative Induction Time (OIT)
ASTM D5885	High Pressure Oxidative Induction Time (HP- OIT)
ASTM D7238	UV Resistance
ASTM D5321	Interface Shear Strength
Compound HDPE Resin Properties	
ASTM D1505	Density, g/cm ³ , (min)
ASTM D 1238	Melt Flow Index
Using 2.16kg at 190°C	
Geotextile	
GRI-GT12(a)	Test Methods and Properties for Nonwoven Geotextiles Used as Protection (or Cushioning) Materials
GRI-GT13(a)	Test Methods and Properties for Geotextiles Used as Separation Between Subgrade Soil and Aggregate
ASTM D4354	Practice for Sampling of Geosynthetics for Testing
ASTM D4355	Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D4439	Terminology for Geosynthetics
ASTM D4533	Test Method for Trapezoidal Tearing Strength of Geotextiles
ASTM D4632	Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D4759	Practice for Determining the Specification Conformance of Geosynthetics

STANDARD SPECIFICATION	DESCRIPTION
LATEST REVISIONS AS AT 17 APRIL 2023 TO APPLY	
ASTM D4833	Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
ASTM D4873	Guide for Identification, Storage and Handling of Geosynthetics
ASTM D5261	Test Method for Measuring Mass per Unit Area of Geotextiles
ASTM D5494	Test Method for the Determination of Pyramid Puncture Resistance of Unprotected and Protected Geomembranes
ASTM D6241	Test Method for Static Puncture Strength of Geotextiles and Geotextile Related Products Using a 50-mm Probe
ASTM D4491	Test Method for Water Permeability of Geotextile by Permittivity
ASTM D4751	Test Method for Determining Apparent Opening Size of a Geotextile
Geosynthetic Clay Liner	
ASTM D 5993	Mass per Unit Area
ASTM D 5887	Index Flux
Geocells	
SANS 10221	Mass per panel
SANS 10221	Parent product (Thickness)
SANS 10221	Tensile Strength
Electronic Leak Location	
ASTM D6747-15	Standard Guide for Selection of Techniques for Electrical Detection of Leaks in Geomembranes.
ASTM D7953-14	Standard Practice for Electrical Leak Location on Exposed Geomembranes Using the Arc Testing Method.
ASTM D7002-16	Standard Practice for Leak Location on Exposed Geomembranes Using the Water Puddle System.
ASTM D7703-16	Standard Practice for Electrical Leak Location on Exposed Geomembranes Using the Water Lance System
ASTM D7909-14	Standard Guide for Placement of Blind Actual Leaks during Electrical Leak Location Surveys of Geomembranes.
ASTM D7007	Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earth Materials.
ASTM D4439-18	Terminology for Geosynthetics.

STANDARD SPECIFICATION	DESCRIPTION
LATEST REVISIONS AS AT 17 APRIL 2023 TO APPLY	
ASTM D8265 – 19	Standard Practices for Electrical Methods for Mapping Leaks in Installed Geomembranes.

APPENDIX D

List of Drawings

DRAWING NO.	DRAWING TITLE	REV
R21-097-00-001	COVER PAGE, LOCALITY AND DRAWING LIST	B
R21-097-00-002	GENERAL ARRANGEMENT OF PRIMARY & SECONDARY DAMS	B
R21-097-00-003	GENERAL LAYOUT PLAN	B
R21-097-00-200	PRIMARY DAM OVERFLOW STRUCTURE LAYOUT AND DETAILS	B
R21-097-00-201	SECONDARY DAM OVERFLOW STRUCTURE LAYOUT AND DETAILS	B
R21-097-00-202	SECONDARY DAM OVERFLOW STRUCTURE SECTIONS	B
R21-097-00-203	TYPICAL DETAILS – STORMWATER AND ROAD	B
R21-097-00-204	SECONDARY DAM PUMPSTATION LAYOUT AND SECTIONS	B
R21-097-00-210	LEACHATE AND SUB-SOIL LAYOUT OF DAMS	B
R21-097-00-211	TYPICAL DETAILS - SHEET 1	B
R21-097-00-212	TYPICAL DETAILS - SHEET 2	B
R21-097-00-213	TYPICAL DETAILS - SHEET 3	B
R21-097-00-214	TYPICAL DETAILS - SHEET 4	B
R21-097-00-215	TYPICAL DETAILS - SHEET 5	B
R21-097-00-216	TYPICAL DETAILS - SHEET 6	B

APPENDIX E

Performance Parameter Reporting Summary Sheet

Performance parameter reporting summary sheet

CONSTRUCTION QUALITY ASSURANCE PLAN				RECORD OF MATERIAL CONTROL TEST							
Layers	PARAMETER	TEST METHOD	PERFORMANCE CRITERIA	MINIMUM FREQUENCY	Min	Max	AVERAGE VALUE	NUMBER OF TESTS	STANDARD DEVIATION	NUMBER OF FAILURES	Notes
Site Clearance & Topsoil Stripping	NGI Survey	Survey	Earthworks	At start of project							
	Stripping Depth	Survey	Clear vegetation and topsoils as required	Drone survey of entire site							
	Excavational depth	Survey	Remove all Black turf	Continuous survey depth to bottom of excavation (m)							
	Side slopes (internal and external)	Survey	Max of 200 mm (uncompacted)	1 check per 20 m of linear chainage of the top crest							
	Visual method soil classification	ASTM D2488	Clayey	Continual during excavation and placement of soils							
	Soil classification	TRH 14	See CCL Liner below								
	Particle size	SANS 3001-AG1	See CCL Liner below								
	Atterberg limits	SANS 3001-GR 10	See CCL Liner below								
	Moisture-density relationship	SANS 3001-GR 30:2015	See CCL Liner below								
	Hydraulic conductivity (Clay Material)	ASTM D5084-90	See CCL Liner below								
Dam Basin Preparation	Layer Thickness (Compacted)	Survey or Excavation and Measure	2 x 150 mm Layers	Visual Inspections with tape measure after completion of each layer							
	Visual method soil classification	ASTM D2488	Topsoil and fill removed	Continual during excavation and placement of soils							
	Density - All Materials	SANS 3001-GR 30	Determine Proctor Density	1 test per type of material							
	Moisture Content (OMC) - Clay	SANS 3001-GR 30	Determine OMC	1 test per type of material							
	Particle Size & Atterberg limits	SANS 3001-GR 1, 10	Maximum Size of 100 mm	1 test per type of material							
	Moisture and density (nuclear) - TSF	SANS 3001-NG 5	OMC 0% to +3% 95% STD Proctor MDD	1 Test per 800m ²							
	Sand Replacement - TSF	SANS 3001-GR 35	OMC 0% to +3% 95% STD Proctor MDD	1 Test per 2 500m ²							
	Moisture and density (nuclear) - RWD	SANS 3001-NG 5	OMC 0% to +3% 95% STD Proctor MDD	1 Test per 800m ²							
	Sand Replacement - RWD	SANS 3001-GR 35	OMC 0% to +3% 95% STD Proctor MDD	1 Test per 2 500m ²							
	Slopes	Survey	1% average - general slope of site	As required							

Layers	PARAMETER	TEST METHOD	PERFORMANCE CRITERIA	MINIMUM FREQUENCY	Min	Max	AVERAGE VALUE	NUMBER OF TESTS	STANDARD DEVIATION	NUMBER OF FAILURES	Notes
Subsoil System											
Subsoil Base	Excavational depth	Survey	To bottom of excavation	1 check per 20 m of linear chainage							
	Visual method soil classification	ASTM D2488		Continual during excavation and placement of soils							
	Soil classification	TRH 14		1 Test per 1 000m ²							
	Particle size	SANS 3001-GR 1	Maximum Size of 25 mm	1 Test per 500m ²							
	Alterberg limits	SANS 3001-GR 10		1 Test per 500m ² (Min 3 test per layer)							
	Moisture and density (nuclear)	SANS 3001-NG 5	OMC -2 to +2% 95% STD Proctor MDD	1 Test per 2 000m ³							
	California bearing ratio (CBR)	SANS 3001-GR 40		Continual during excavation and placement of soils							
	Visual method soil classification			Per Structure							
	Soil classification										
	Particle size - Sand	SANS 3001-GR 1	Maximum Size of 5 mm, Dust (<0.075) < 5%	1 Test per 500m ³							
Particle size - 6.7 mm Stone	SANS 3001-GR 1	Maximum Size of 9.5 mm, Dust (<0.075) < 2%, SANS 1083 Table 3	1 Test per 500m ³								
Particle size - 13 mm Stone	SANS 3001-GR 1	Maximum Size of 19 mm, Dust (<0.075) < 2%, SANS 1083 Table 3	1 Test per 500m ³								
Layer Thickness	Survey	Thickness according to design	Visual Inspections with tape measure after completion of each layer								
Average crushing value			Per Supplier								
Slope (Pipe Invert)	Survey	Sufficient to provide Minimum FoS of 10	1 check per 10 m of linear chainage								
Construction	DIN:4262-1E	Double wall plain pipe with white apex line	per batch								
Dimensions (OD, ID)	DIN:4262-1E	As per Specification	per batch								
Density	ISO 1183		per batch								
Melt flow index (190°C/21.8Kg)	ISO 1133		per batch								
Melt flow index (190°C/5Kg)	ISO 1133		per batch								
Vicat softening point (5Kg)	ISO 306		per batch								
Crystalline melting range	ISO 3146-85		per batch								
Viscosity number	ISO 16228-3		per batch								
Shore D, Hardness	ISO 868		per batch								
Tensile @ Yield	ISO 527		per batch								
Ultimate Tensile	ISO 527		per batch								
Ultimate Elongation	ISO 527		per batch								
Elastic Modulus	ISO 527		per batch								
Flexural Stress (3.5% deflection)	ISO 178		per batch								
Design Stress	ISO 4427		per batch								
Notched Impact (Charpy) can 23°C	ISO 179		per batch								
Notched Impact (Charpy) can -30°C	ISO 179		per batch								
Thermal stability (OIT, 210°C)	ISO 10837		per batch								
Carbon Black Content	ISO 6964		per batch								
Flattening	ISO 9969 in accordance with SANS ISO21138		3 Tests per batch								
Resistance to blows (impact)	DIN:4262-1E	Conditioning time of 3 hours @ 0deg C. Impact head of 50 mm diameter steel ball.	per batch								
Pipe Ring Stiffness	DIN:4262-1E	Compressive force applied by Tensometer @3% deflection	per batch								
Concrete Works											
Concrete Structures	Sampling fresh mixed	SANS 5661-2	As per Specification	per 10m ³ / per Structure							
	Making and Curing Test Specimens	SANS 5661-3	As per Specification	per 10m ³ / per Structure							
	Slump Test	SANS 5662-1	As per Specification	per 10m ³ / per Structure							
	Compressive Strength (7 <u>28</u> Days)	SANS 5663	As per Specification	per 10m ³ / per Structure							
Precast Concrete Elements	Compressive Strength of Cores	SANS 5665	As per Specification	When required by CQA Monitor							
	Precast concrete pipes	SANS 667	As per Specification	1 per 50 Units							
	Portal and rectangular precast culverts Units	SANS 986	As per Specification	1 per 50 Units							

Layers	PARAMETER	TEST METHOD	PERFORMANCE CRITERIA	MINIMUM FREQUENCY	Min	Max	AVERAGE VALUE	NUMBER OF TESTS	STANDARD DEVIATION	NUMBER OF FAILURES	Notes
	Thickness	ASTM D5994 / SANS 1526 :2015	2mm	100 000m ²							
	Asperity Height	ASTM D7466		100 000m ²							
	Asperity Height (mm) - Side A	ASTM D7466	0.4mm	100 000m ²							
	Asperity Height (mm) - Side B	ASTM D7466	0.4mm	100 000m ²							
	Density	ASTM D 1505/D792	0.940 g/cc	1 per site or 1 every 100 000m ²							
	Carbon Black Content	ASTM D 1603, mod.	2 - 3%	1 every 100 000 sqm							
	Carbon Black Dispersion	ASTM D 5586	Category 1 or 2	1 every 100 000 sqm							
	Rating - 1st field view										
	Rating - 2nd field view										
	Tensile Properties										
	MD Yield Strength		29kN/m	1 every 100 000 sqm							
	TD Yield Strength										
	MD Break Strength		21kN/m								
	TD Break Strength										
	MD Yield Elongation	ASTM D6693, 2 ipm strain rate	12%								
	TD Yield Elongation										
	MD Break Elongation		100%								
	TD Break Elongation										
	Puncture Resistance	ASTM D 4833	534 N	1 every 100 000 sqm							
	Tear Resistance	ASTM D 1004	249 N	1 every 100 000 sqm							
	MD Tear Strength		249 N								
	TD Tear Strength										
	Oxidative Induction Time	ASTM D 8117	100 mins	1 per site or 1 every 100 000 sqm							
	High Pressure Oxidative Induction Time	ASTM D 5885	400 mins	1 per site or 1 every 100 000 sqm							
	SP-NCTL Stress Crack Resistance	ASTM D 5397, App	500 hours	1 per site or 1 every 100 000 sqm							
	UV Resistance	ASTM D 7238									
	HFOIT (minutes) - Baseline	ASTM D 5885	50%	1 per site or 1 every 100 000 sqm							
	HFOIT (minutes) - After QUV Aging										
	Oven Aging	ASTM D 5721									
	OIT (minutes) - Baseline	ASTM D 3895		1 per site or 1 every 100 000 sqm							
	OIT (minutes) - After Oven Aging	ASTM D 3895	55%								
	HFOIT (minutes) - Baseline	ASTM D 5885	80%								
	HFOIT (minutes) - After Oven Aging	ASTM D 5885									

HDPE GM Properties

Layers	PARAMETER	TEST METHOD	PERFORMANCE CRITERIA	MINIMUM FREQUENCY	Min	Max	AVERAGE VALUE	NUMBER OF TESTS	STANDARD DEVIATION	NUMBER OF FAILURES	Notes
HDPE GM Properties	Tensile Properties										
	MD Yield Strength		22kN/m	1 every 100 000 sqm							
	TD Yield Strength										
	MD Break Strength		16kN/m								
	TD Break Strength	ASTM D6693, 2 ipm strain rate									
	MD Yield Elongation		12%								
	TD Yield Elongation										
	MD Break Elongation		100%								
	TD Break Elongation										
	Puncture Resistance										
		ASTM D 4833		400 N	1 every 100 000 sqm						
	Tear Resistance										
	MD Tear Strength	ASTM D 1004		187 N	1 every 100 000 sqm						
	TD Tear Strength			187 N							
	Oxidative Induction Time										
		ASTM D 8117		100 mins	1 per site or 1 every 100 000 sqm						
	High Pressure Oxidative Induction Time										
		ASTM D 5865		400 mins	1 per site or 1 every 100 000 sqm						
	SP-NCTL Steels Crack Resistance										
		ASTM D 5397, App		500 hours	1 per site or 1 every 100 000 sqm						
UV Resistance											
	ASTM D 7238		50%	1 per site or 1 every 100 000 sqm							
	ASTM D 5865										
HPOIT (minutes) - Baseline											
HPOIT (minutes) - After QUV Aging											
Oven Aging											
	ASTM D 5721			1 per site or 1 every 100 000 sqm							
	ASTM D 3895										
OIT (minutes) - Baseline											
OIT (minutes) - After Oven Aging			55%								
HPOIT (minutes) - Baseline											
HPOIT (minutes) - After Oven Aging			80%								
Seaming (Site Contractor)											
	GRI GM 14 & 19/Vacuum box/Spark Testing/Seam Pressure Test		Test	Test Every Seam							
Peel Tensile Test - Seaming (Site Contractor)											
Peel and Shear (ASTM)											
D6392/GRI GM 19/D4437/NFSD54/882 mod.)			90 % of parent material strength								
Interface Shear Strength											
	ASTM D5321			1 Test per site per material interface							
GM Cover Layer											
Soilcrete 5% Cement Fill	Compressive Strength of Cores	SANS 5865	As per Specification								
	Making and Curing Test Specimens (Grout mix)	SANS 5861-3	As per Specification	When required by CCA Monitor per Structure							
	Slump Test (Grout mix)	SANS 5862-1	As per Specification	per Structure							
	Compressive Strength (7, 28 days) -more if required. (Grout mix)	SANS 5863	As per Specification	per Structure							

Layers	PARAMETER	TEST METHOD	PERFORMANCE CRITERIA	MINIMUM FREQUENCY	Min	Max	AVERAGE VALUE	NUMBER OF TESTS	STANDARD DEVIATION	NUMBER OF FAILURES	Notes	
Filter Geotextile	Mass per Unit Area		Geotextile									
	Maximum Opening Size (o85)	ASTM D4751	max 0.423mm	1 per site or 1 per supplied material								
	Permittivity	ASTM D4491		1 per site or 1 per supplied material								
	Trapezoid Tear Strength	ASTM D 4533	0.8x1.2 kn	1 per site or 1 per supplied material								
	CBR Puncture Strength	ASTM D 6241	1.2 kn	1 per site or 1 per supplied material								
	Apparent Opening Size	ASTM D 4751	max 0.423mm	1 per site or 1 per supplied material								
	Ultraviolet Stability	ASTM D 7238	65%	1 per site or 1 per supplied material								
	Overlap	Inspection	Min of 300 mm	All Overlaps								
	(Protection or Cushioning Materials)	ISO 09864	350,400,600,800,1000,2000	1 per site or 1 per supplied material								
	Mass Unit Area (g/m ²)											
	Tensile Properties											
	Strength	ISO 10319	16,21,27,32,36,45	1 per site or 1 per supplied material								
	Strain at Max. Load	ISO 10319	50%	1 per site or 1 per supplied material								
	Trapezoidal Tear Strength	ISO 13434	0.42,0.51,0.66,0.89,0.96,1.32	1 per site or 1 per supplied material								
	CBR Puncture (kN/mm)											
Max. Force	ISO 12236	3,1,3,6,4,1,4,9,7,6,11,0	1 per site or 1 per supplied material									
Elongation at Max Force	ISO 12236	38	1 per site or 1 per supplied material									
UV Str. Ret. after 500 lt. HRS EXPOSURE	ASTM D7238	70%	1 per site or 1 per supplied material									
Joint Strength		90 % Strength of Parent Material	1 per 50 000m ²									
Strip Tensile Test		90 % of Parent Material	1 per 50 000m ²									
Overlap	Measure	Min of 300 mm	All Overlaps									
Mass per panel	SANS 10221	As per Specification or	1 test per batch									
Parent product (Thickness)	SANS 10221	As per Specification or	1 test per batch									
Tensile Strength	SANS 10221	As per Specification or	1 test per batch									
Geocell			Leachate Collection									
	Layer Thickness	Survey or Excavation and Measure	150 mm -200 mm per Design	1 Test per 10000m ²								
	Grading	SANS 3001-AG:2014-Sive analysis	38-53 mm with 2% less than fines	1 Test per 10 000m ²								
	Aggregate crushing value (ACV)	SANS 3001-AG:10 Aggregate Crushing										
	Flakiness index	SANS 5847 - Flakiness Index	Max 35%	1 Test per 10 000m ²								
	Crushing Strength	ASTM D2412	10 mm	Test Every Pipe Lengths								
	Orifice Size	Measure/Inspection		Min of 1 hole per meter								
	Slope	Survey	Min 2%	As per Detailed Design Drawings								
	ELLS - Electronic Leak Location Survey	Mapping of Leaks	ASTM D8265 – 19	all anomalies shall be noted and photo's taken of anomaly and repair	Per anomaly per facility							
		Exposed Geomembrane	ASTM D7953-14: Arc Testing Method or ASTM D7703-16: Water Lance Method or ASTM D7002-16: Water Puddle Method	No anomalies detected	Per facility							
		Covered Geomembrane	ASTM D7007: Dipole Method ASTM D8265 – 19: Section 9	No anomalies detected	Per facility							
		Reporting			Per facility							