

The tendered rate shall include full compensation for furnishing, procuring, placing and compacting concrete.

**CB.03.04 Precast concrete kerbing:**

(a) Supply and install (type indicated) ..... Unit: metre (m)

(b) Install only (type indicated) ..... Unit: metre (m)

The unit of measurement shall be the metre of precast kerbing complete as constructed, measured along the face of the kerb.

The tendered rate for CB.03.04(a) shall include full compensation for preparing of bedding, furnishing and installing all materials and supporting the kerb with in situ concrete, for backfilling behind kerbs, all complete as specified.

The tendered rate for CB.03.04(b) shall include full compensation for preparing of bedding, furnishing and installing all materials and reinstalling existing kerbing, all complete as specified.

**CB.03.05 Steel reinforcement:**

(a) Mild steel bars ..... Unit: ton (t)

(b) High-tensile steel bars ..... Unit: ton (t)

(c) Welded steel mesh ..... Unit: kilogram (kg)

The unit of measurement for steel bars shall be the ton of reinforcing, and kilogram of welded steel in place in accordance with the drawings or as authorised. Ties, stools and other steel used for positioning the reinforcing steel shall be measured as steel reinforcement.

The tendered rate shall include full compensation for supplying, delivering, cutting, bending, welding, trial weld joints, placing and fixing the steel reinforcement including all tying wire, spacers and waste.

**CB.03.06 Sealed joints in concrete lining open drains**

(type indicated) ..... Unit: metre (m)

The unit of measurement shall be the metre of completed joint of each size and type.

The tendered rate shall include full compensation for supplying all material and for all labour, tools, formwork and incidentals necessary for sealing the joint as shown on the drawings or specified in the Project Specifications.

**CB.03.07 Demolition and removal of damaged existing structures:**

(a) Plain concrete ..... Unit: cubic metre (m<sup>3</sup>)

(b) Reinforced concrete ..... Unit: cubic metre (m<sup>3</sup>)

The unit of measurement for CB.03.07(a) and (b) shall be the cubic metre of existing material demolished, determined from 70 % of the rated cubic metre capacity of the truck used to remove the material.

The tendered rates shall include full compensation for all labour, equipment and tools for removal of the damaged sections, trimming the bedding and for loading, transporting and disposing of the material from the site.

The reinstatement of damaged sections shall be paid for under the relevant items for constructing new structures.

**CB.03.08      Concrete side beams ..... Unit: cubic metre (m<sup>3</sup>)**

The unit of measurement shall be the cubic metre of concrete in side beams constructed as instructed.

The tendered rate shall include full compensation for furnishing all material and labour including formwork as necessary, placing concrete and shaping all surfaces and all excavations required.

**CB.03.09      Overhaul on material for haul in excess of 1,0 km:**

(a) Excavated material to spoil ..... Unit: cubic metre kilometer (m<sup>3</sup>-km)

(b) Existing structures demolished ..... Unit: cubic metre kilometer (m<sup>3</sup>-km)

The unit of measurement shall be the cubic metre of loose material hauled in excess of 1,0 km, measured according to the rated capacity of the truck used, multiplied by the average overhaul distance.

The tendered rate shall include full compensation for hauling the material in excess of the free-haul distance.

**CB.04            CLEANING OF CONCRETE DRAINS AND CHANNELS**

**CB.04.01      Removal and dispose of material from:**

(a) Drains and channels within the following invert width ranges:

(i)    Less than 1,0 m ..... Unit: metre (m)

(ii)   1,0 m up to and including 2,0 m ..... Unit: metre (m)

(iii)   Exceeding 2,0 m up to and including 3,0 m ..... Unit: metre (m)

(iv)   Exceeding 3,0 m ..... Unit: metre (m)

The unit of measurement shall be the metre of channel cleaned, measured once along the invert of the channel.

The tendered rates shall include full compensation for all labour and equipment required for removing the material from channels irrespective of the depth of silt and debris and for loading, off-loading and spreading when material removed is intended for spoiling at designated spoil sites. The tendered rates shall also include full compensation for the removal of vegetation in channels and growing over the edges of channels.

The tendered rates shall also include for transporting the excavated material to spoil sites.

Where material is disposed of adjacent to the channels, the tendered rate shall include full compensation for removing the material from the channels, irrespective of the depth of silt and debris, spoiling and spreading the material adjacent to the channel where it cannot be washed back in to the channel.

**CB.04.02**     **Overhaul of material hauled in excess of the free-haul distance of 1,0 km**..... Unit: cubic metre kilometer (m<sup>3</sup>-km)

The unit of measurement shall be the cubic metre of material hauled to spoil, the volume to be determined from the rated capacity of the truck multiplied by the average overhaul distance. All trucks shall be fully loaded to their rated capacity.

The tendered rate shall include full compensation for hauling the material the average overhaul distance to the designated spoil site.

**CB.05**     **CLEANING AND MAINTENANCE OF EXISTING EARTH CHANNELS**

**CB.05.01**     **Cleaning earth drains and channels** ..... Unit: cubic metre (m<sup>3</sup>)

The unit of measurement shall be the cubic metre of material cleaned out of the drain.

The tendered rate shall include full compensation for all labour and equipment required for removing the obstruction from drains, irrespective of depth of silt and debris and disposal of the excavated material as described.

**CB.05.02**     **Repairing of earth drains and channels** ..... Unit: cubic metre (m<sup>3</sup>)

The unit of measurement shall be the cubic metre of compacted material calculated from the dimensions measured in place.

The tendered rate shall include full compensation for trimming the eroded area to firm surrounding material, for procuring, transporting placing and compacting the backfill material.

**CB.05.03**     **Banks and dykes**..... Unit: cubic metre (m<sup>3</sup>)

The unit of measurement shall be the cubic metre of in place in banks or dykes, calculated in accordance with authorised dimensions.

The tendered rate shall include full compensation for procuring, transporting furnishing, placing, watering, compacting, shaping and trimming of material in the banks and dykes.

**CB.05.04**     **Cleaning of vegetation at inlet and outlet structures (5 m x 5 m)**..... Unit: square metre (m<sup>2</sup>)

The unit of measurement shall be the area measured in square metres, cleared of all vegetation blocking the inlet and outlet structures.

The tendered rate shall include for labour, clearing of vegetation, removing to spoil of vegetation and tools to complete the work to the approval of the Engineer.

**CB.05.05**     **Overhaul of material in excess of the free-haul distance of 1,0 km** ..... Unit: cubic metre kilometre (m<sup>3</sup>-km)

The unit of measurement shall be the cubic metre of imported material, nett volume of material compacted in place, multiplied by the average overhaul distance in excess of 1,0 km.

The tendered rate shall include full compensation for hauling the material the distance from the designated source in excess of 1,0 km.

**CB.06      REPAIR AND CONSTRUCTION TO EXISTING BRICKWORK INLETS**

**CB.06.01      Demolition and removal of existing structures ..... Unit: cubic metre (m<sup>3</sup>)**

The unit of measurement shall be the cubic metre of existing material demolished. The tendered rates shall include full compensation for all labour, equipment and slabs for the removal of the section, trimming the bedding and for loading, transporting and disposing of the material from the site.

**CB 06.02      Repair of brickwork inlet structures ..... Unit: number**

The unit of measurement shall be the number of inlet structures repaired.

The tendered rate shall include full compensation for furnishing all material and labour necessary for restoring the inlet structure to an as new state.

**CB.06.03      Reconstruction of brickwork inlet structures ..... Unit: number**

The unit of measurement shall be the number of inlet structures completely rebuilt.

The tendered rate shall include full compensation for furnishing all material and labour necessary for rebuilding the inlet structure to a complete state.

**CB.07      LOCKABLE GRID INLETS**

**CB.07.01      Provision of lockable grid inlets..... Unit: number**

The unit of measurement shall be the number of grid inlets fitted with a steel bar suitable for locking the inlet cover down.

The tendered rate shall include full compensation for all labour, equipment and tools, rust protection and any other function necessary for the secure installation of the bar.

**CB.07.02      Provision of padlocks..... Unit: number**

The unit of measurement shall be the number of padlocks provided for lockable grid inlets.

The tendered rate shall include purchasing and installation of all padlocks, as well as providing a full set of labelled keys to the User Client.

**CB.08      CLEANING OF PIPELINES**

The cleaning of pipelines will be measured and paid for under the payment items listed under CB.02 cleaning of prefabricated culverts. Pipelines and related structures will be regarded as pre-fabricated culverts and related structures for this purpose.

## **TECHNICAL SPECIFICATION**

### **CC FENCING AND GATES**

#### **CONTENTS**

CC 01	SCOPE
CC 02	STANDARD SPECIFICATIONS
CC 03	OPERATING AND MAINTENANCE MANUALS
CC 04	EXECUTION OF WORK
CC 05	QUALITY STANDARD
CC 06	MATERIALS
CC 07	MAINTENANCE
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#### **CC 01 SCOPE**

This specification covers the repair and maintenance of fencing and gates.

This specification shall form an integral part of the maintenance contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

Where a particular specification has been included in the documents to supplement Technical Specification CC: Fencing and gates, this technical specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence. The Contractor shall at all times adhere to this technical specification, unless otherwise specified in the applicable Particular Specification.

#### **CC 02 STANDARD SPECIFICATIONS**

##### **CC 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- SANS 935 - Hot-dip (galvanised) zinc coatings (other than on continuously zinc-coated sheet and wire) (1988)
- SANS 675 - Zinc-coated fencing wires (plain and barbed) (1993)
- SANS 1373 - Chain-link fencing and its wire accessories (1983)

##### **CC 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1993: Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

**CC 02.03**     **MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

**CC 02.04**     **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**CC 03**         **OPERATING AND MAINTENANCE MANUALS**

No operating and maintenance manuals will be developed for this section.

The Contractor shall use the Maintenance Control Plan (see SA Maintenance) to schedule routine preventative maintenance activities.

**CC 04**         **EXECUTION OF WORK**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

Any fencing work identified either by the Contractor or during inspection by the Engineer shall be carried out on the instruction of the Engineer.

The Contractor shall ensure that the necessary materials, skilled personnel, tools and equipment are available at all times to maintain the fences in a state of good repair.

The Engineer shall indicate where existing fences are to be moved to new locations, where new fences are to be erected, or where other repairs are necessary.

Whenever a part of the fence is taken down to repair/replace it, it will be replaced on the same day it has been taken down.

Unless otherwise instructed by the Engineer, similar type fencing material to that in the existing fence line shall be used where fences are to be repaired.

**CC 04.01**     **SCOPE OF WORK**

The scope of work has been divided into the following sections:

- (a) Perimeter fences at the various sites;
- (b) Residential fences of the residential areas;
- (c) Installation of a new security perimeter fence at the Port of Entry;
- (d) Other internal fences at the various sites.

**CC 04.02**      **CLEARING THE FENCE ROUTE**

The fence route shall be cleared over a width of at least 0,5 m on each side of the centre line of the fence and surface irregularities shall be levelled so that the fence will follow the general contour of the ground.

The bottom of the fence shall be located at a uniform distance above the ground line, but no more than 50 mm.

**CC 04.03**      **INSTALLATION OF POSTS AND STANDARDS**

Posts shall be accurately set in holes and be provided with concrete bases to the dimensions specified.

Holes shall be dug to their full specified depth.

Posts shall be firmly planted into the ground at the same spacing as the existing posts or as instructed by the Engineer. The spacing of posts between any two straining posts shall be uniform.

**CC 04.04**      **ERECTING FENCE WIRES**

All fencing wire shall be wired to the sides of posts in order to prevent the wires from being displaced or becoming loose. The wire shall be carefully strained and hung without sag, and with true alignment, care being exercised not to strain the wire so tightly that it will break or that end, corner, straining or gate posts will be pulled up.

Each strand of fencing wire shall be securely fastened in the correct position to each post with soft galvanised binding wire.

Splices in the fencing wire shall be permitted if made in the following manner using a splice tool. The end of each wire at the splice shall be carried at least 75 mm past the splice tool and wrapped snugly around the other wire for not less than six complete turns, the two separate wire ends being turned in opposite directions. After the splice tool is removed, the space left by it in the splice wire shall be closed by pulling the wire ends together. The unused ends of wire shall be cut close so as to leave a neat splice.

**CC 04.05**      **ERECTING DIAMOND MESH OR WIRE NETTING**

Wire netting or diamond mesh shall be stretched against the fence and properly secured to the fencing wire. The diamond mesh or wire netting shall be secured by means of soft binding wire at 1,2 m centres along the top and bottom wires and at 3 m centres along each of the other fencing wires unless otherwise specified.

**CC 04.06**      **CLOSING OPENINGS UNDER FENCES**

At ditches, drainage channels or other hollows where it is not possible to erect the fence so that it follows the general contour of the ground, the Contractor shall cover the openings with wire netting or diamond mesh fixed to the fence.

**CC 04.07**      **EXISTING FENCES**

Where a new fence joins an existing fence, whether in line or at an angle, the new fence shall be erected with a new straining post positioned at the terminal of the existing fence.

Existing fences that require to be taken down or moved to a new location shall be dismantled. Material not required for re-erection or declared unsuitable for re-use shall be neatly stacked at approved locations in accordance with the Engineer's instructions.

**CC 04.08**      **GATES**

Gates shall be hung on gate fittings in accordance with the requirements specified. The gates shall be so erected that they swing in a horizontal plane at right angles to the gateposts, clear of the ground in all positions.

Double swing gates shall not leave a gap of more than 25 mm between them when closed and other gates shall not be further than 25 mm from the gatepost when closed. The clearance below the gates shall not exceed 75 mm with the gates closed.

**CC 04.09**      **REPAIRS TO FENCES**

In the case of fences that require repairing, the Contractor shall use new material as may be required to re-erect the fence to the standard specified.

**CC 04.10**      **ERECTING NEW FENCING MATERIAL**

All new material used to replace old material shall be similar to the old material replaced unless new material is specified by the Engineer.

**CC 05**      **QUALITY STANDARD**

The completed fences shall be plumb, taut, true to line and ground contour, with all posts, standard and stays firmly set.

The Contractor shall, on completion of each section of fence, remove all cut-offs and other loose wire or netting so as not to create a hazard to grazing animals or a nuisance to the owners of the ground.

**CC 06**      **MATERIALS**

**CC 06.01**      **POSTS**

**CC 06.01.01**      **Steel posts**

New posts or posts that need to be replaced shall be of the same type and size as the existing posts. Tubular posts shall be galvanised in accordance with SANS 763 for Class B1 articles.

Tubular stays shall have a minimal bore of at least 60 mm and a wall thickness of at least 2,95 mm. These stays shall be galvanised as specified In SANS 763.



**CC 06.01.02 Wooden posts**

New posts or posts that need to be replaced shall be of the same type and size as the existing posts. Wooden posts shall be treated in accordance with SANS 457 (Hazard class H4 articles), or as specified and shall have a minimum diameter of 50 mm.

**CC 06.02 WIRE****CC 06.02.01 Barbed wire**

Barbed wire shall comply with the requirements of SANS 675 and shall be one or more of the following types:

- (a) High-tensile grade, oval shaped, single-strand wire, 3,15 mm x 2,50 mm (2,81 mm equivalent diameter), and fully galvanised;
- (b) High-tensile grade, oval shaped, single-strand wire, 2,80 mm x 1,90 mm (2,31 mm equivalent diameter), fully galvanised (first class coating). This wire shall not be used less than 500 mm above ground where there is danger of grass fires;
- (c) Mild-steel grade, double strand, unidirectional twist wire, each strand 2,50 mm diameter, for use at any height above ground. The wire shall be fully galvanised;
- (d) Barbs shall be manufactured from 2,0 mm galvanised wire and shall be spaced at not more than 152 mm.

**CC 06.02.02 Barbed tape coil**

The product shall be fully galvanised and of high-tensile grade.

**CC 06.02.03 Smooth wire**

Smooth wire shall comply with the requirements of SANS 675 and shall be of the types specified below:

- (a) Straining wire shall be 4,0 mm diameter and fully galvanised.
- (b) Fencing wire shall be high-tensile grade, 2,24 mm diameter wire fully galvanised.
- (c) Tying wire shall be 2,50 mm diameter, mild steel, galvanised wire for tying fencing wire to standards and droppers, and 1,60 mm diameter, mild steel, galvanised wire for tying netting and mesh wire to fencing wire.

**CC 06.03 DIAMOND MESH**

- (a) Diamond mesh (chain-link) fencing shall comply with the requirements of SANS 1373. The edge finish shall be both sides clinched or barbed.
- (b) The nominal diameter of the wire shall be 2,5 mm and the mesh size shall be 64 x 64 mm or 50 x 50 mm.
- (c) The wire shall be fully galvanised.

**CC 06.04**      **WELDED MESH**

Wire netting shall be fully galvanised with mild steel wire with a minimum diameter of 1,8 mm and 75 mm mesh.

**CC 06.05**      **RAZOR MESH**

Razor mesh shall be welded with reinforcing shoulders and blade strips 8 mm wide galvanised steel, on 2.5 mm dia. galvanised wire.

Standard diamond aperture size shall be 150 mm x 300 mm centre to centre.

High density diamond aperture size shall be 75 mm x 150 mm centre to centre.

Standard panel length shall be 6 m.

**CC 06.06**      **MANUFACTURING TOLERANCES FOR WIRE**

The actual diameter of wire supplied shall nowhere be less than the specified diameter by more than the following tolerances:

Specified diameter	Tolerance
1,00 - 1,8 mm	0,05 mm
2,00 - 2,8 mm	0,08 mm
3,15 - 4,0 mm	0,10 mm

**CC 06.07**      **GATES**

New gates or gates that need to be replaced shall be the same type and size as existing gates. Gates shall be galvanised in accordance with SANS 763 for class B1 articles.

**CC 07**      **MAINTENANCE**

This specification must be read in conjunction with Additional Specification: General Maintenance.

All components of the fencing and gates infrastructure shall be maintained during the maintenance phase of the Contract.

The scope of the maintenance work for the fencing and gates infrastructure comprises the following:

**Kosi Bay Port of Entry:**

- a) Maintenance of approximately 240 m of perimeter fence and gates around the operational area consisting of 1.8 m high (100 X 50mm wide) welded mesh with Y type tubular posts and a 700mm Ø barb tape coil, with a 2.5m wide fire break on both sides;
- b) Maintenance of approximately 180 m of perimeter fence and gates within the operational area consisting of 3,0 m high (100 X 50mm wide) welded mesh with Y type tubular posts and a 700mm Ø barb tape coil;

- c) Maintenance of approximately 5100 m of perimeter fence and gates for the pedestrian walk way of 3,0 m high (100 X 50mm wide) welded mesh with Y type tubular posts and a 700mm Ø barb tape coil;
- d) Maintenance of approximately 460 m of perimeter fence and gates for the waste water treatment works of 1.8 m high razor wire with 45o single overhang tubular posts and a 700mm flat wrap;
- e) Maintenance of approximately 1 200 m of perimeter fence and gates consisting of 1,8 m high diamond mesh with 45o angle barbed wire around residential area;
- f) Maintenance of approximately 1 200 m of perimeter fence and gates consisting of 1,2 m high diamond mesh around residential buildings.

The above description of the fencing and gates infrastructure to be maintained is not necessarily complete and shall not limit the maintenance work to be carried out by the Contractor under this contract.

Monthly maintenance responsibilities for each installation, including all units and components as specified, shall commence with access to the site. A difference shall be made in payment for the maintenance prior to and after practical completion of repair work.

Maintenance responsibilities of the completed installation shall commence upon the issue of a certificate of practical completion for repair work and shall continue for the remainder of the 36-month contract period.

Maintenance implies and shall include monthly routine preventative maintenance, corrective maintenance, as well as breakdown maintenance on all components of the specified installation. Maintenance shall include all repair work, replacing of components, fixing defects or any other actions or rectifying measures necessary for complete operation of the fencing installation, keeping the installation free of litter and any growth or any other element interfering with the function or integrity of the system.

Remuneration for maintenance of fencing will be deemed included in the monthly remuneration based on the point system, as tendered for maintenance of Installation: Fencing and Gates.

The following maintenance actions will be required under this contract::

- routine preventative maintenance
- corrective maintenance
- breakdown maintenance

These actions are defined in the Additional Specification SA – General Maintenance.

The maintenance schedules and frequency of maintenance activities shall be developed under the maintenance control plan which will be instituted by the Contractor. The Contractor's responsibility in this regard is specified in the Additional Specification SA – General Maintenance.

#### **SCOPE OF ROUTINE PREVENTIVE MAINTENANCE**

The routine maintenance work to be performed and executed shall include, but not be limited to the items listed below. These actions and findings shall be logged and reported on the relevant approved schedules and reports.

Monthly maintenance

- (a) Clearing the 2.5 m wide fence route.
- (b) Cleaning the 5 m wide fire break areas.
- (c) Inspect and report on the installation.
- (d) Inspect and repair any visible damages to the installation.
- (e) Corrosion protection on fencing, gates and tubular posts.
- (f) Inspect fence for tightness to straining wire and redress or repair if necessary.
- (g) Inspect tension of straining wires and repair if necessary.
- (h) Inspect gate hinges and repair or replace if necessary.

Annual maintenance

- (a) Paint all previously painted posts, stays, gates, and mesh fences
- (b) Tighten all straining wires
- (c) Tighten all straining bolts
- (d) Ensure alignment of all gates

**CC 08 MEASUREMENT AND PAYMENT**

**CC.01 CLEARING THE FENCE ROUTE:**

- CC.01.01 2.5 m wide strip ..... Unit: metre (m)
- CC.01.01 5 m wide strip ..... Unit: metre (m)

The unit of measurement for the clearing of the fence route shall be the metre of fence line measured along each fence line.

The tendered rate shall include full compensation for the clearing of the fence line as specified, including the removal of trees, stones, growth in the fences itself and other obstructions in the fence route and the disposal as directed of all material resulting from clearing operations.

- CC.01.02 Extra over CC.01.01 for cleaning the area between double fences and road shoulders in residential areas (up to 2.5 m wide) ..... Unit: square metre (m<sup>2</sup>)

The unit of measurement shall be the square metre of the area cleared between the two parallel fences of a double fence line, or between the edge of the road and the fence in residential areas. The measured area shall not include the 0,5m strips on the inside of each fence line of the double fence measured as part of CC.01.01

The tendered rate shall include full compensation for the clearing of the area as specified, including the removal of trees, stones and other obstructions and the disposal as directed of all material resulting from the clearing operations.

CC.02

**SUPPLY AND ERECTION OF NEW FENCING MATERIAL TO REPLACE OLD MATERIAL:**

- (a) Barbed wire ..... Unit: metre (m)
- (b) Smooth wire ..... Unit: metre (m)
- (c) Diamond mesh..... Unit: square metre (m<sup>2</sup>)
- (d) Barbed tape coil..... Unit: metre (m)
- (e) Posts ..... Unit: number
- (f) Gates ..... Unit: number
- (g) Y-standards..... Unit: number

The quantity of material used shall be determined by measuring the quantities of individual items of material installed in the completed fence. No linear measure of completed fence shall be applicable. Clearing of the fence line will be paid for under item CC.01.

The payment for the installation of the fencing material shall include for the removal of the existing fencing material including removal of concrete footings for fence posts.

The applicable units of measurement are as follows:

(a) Fencing wire

The unit of measurement shall be the metre of each type of fencing wire measured in place and between end posts. Binding wire and wire used for bracing and anchoring of posts shall not be measured for payment.

(b) Diamond mesh

The unit of measurement shall be the linear metre of diamond mesh replaced and the quantity shall be calculated using the prescribed length between straining posts or gate posts, or the length of strips for covering openings under fences, or the length used for the covering of gates.

(c) Posts

The unit of measurement shall be the number of posts, as follows:

All straining posts erected in accordance with the maximum specified spacing or such lesser spacing as authorised by the Engineer, all corner and gateposts authorised by the Engineer and all end posts. Gateposts for new gates shall not be measured for payment.

(d) Gates

The unit of measurement shall be the number of each type of gate repaired or replaced.

**CC.03      REPAIR OF FENCES..... Unit: metre (m)**

The unit of measurement shall be the metre of each type of existing fence repaired as instructed by the Engineer.

The tendered rate shall include full compensation for all overheads and transporting all labour, tools and materials from the Contractor's base to the point of repair.

The tendered rate shall also include full compensation for all labour, tools, binding and tying wire for repairing the fence.

The cost for procurement of materials needed shall be paid for under item CC.02.

**CC.04      REDRESS, TREAT AND PAINTING OF FENCE ..... Unit: metre (m)**

The unit of measurement for the redressing, treating and painting the fence line shall be the metre of fence line measured along each fence line.

The tendered rate shall include full compensation for performing minor repairs, treating the existing fence with an approved rust remover/inhibitor and then applying cold galvanising as specified by the Engineer.

**CC.05      TREATING AND PAINTING OF POSTS AND STANDARDS..... Unit: Number**

The unit of measurement shall be the number of posts and standards treated and painted along the fence line.

The tendered rate shall include full compensation for predetermining minor repairs, including sanding, treating the existing posts and standards with an approved rust remover/inhibited and then applying cold galvanising as specified by the Engineer.

**CC.06      REPAIR, RE-FIXING AND ALIGNING OF GATES ..... Unit: number**

The unit of measurement shall be the number of each type of existing gate repaired as instructed by the Engineer.

The tendered rate shall include full compensation for all overheads and transporting all labour, tools and materials from the Contractor's base to the point of repair.

The tendered rate shall also include full compensation for all labour, tools, binding and tying wire for repairing the fence.

The tendered rate shall also include full compensation replacement of hinges, bolts, catches, wheels and all other fixtures necessary to repair and refix gates into the original position including aligning the gate to ensure proper opening and closing of the gate.

## **TECHNICAL SPECIFICATION**

### **CE WATER DISTRIBUTION NETWORKS**

#### **CONTENTS**

CE 01	SCOPE
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CE 06	QUALITY ASSURANCE SYSTEM
CE 07	MAINTENANCE TO INSTALLATION SYSTEMS AND REPAIR WORK
CE 08	MEASUREMENT AND PAYMENT

#### **CE 01 SCOPE**

This specification covers the materials, equipment, methods, testing and work required for the repair and maintenance of existing water distribution networks. Such distribution networks may comprise:

- (a) Primary and secondary distribution pipelines
- (b) Irrigation pipe networks and sprinklers
- (c) Valves
- (d) Bulk water meters
- (e) Domestic water meters
- (f) Chambers
- (g) Pumping stations
- (h) Borehole installations
- (i) Reservoirs.

This specification shall form an integral part of the maintenance and servicing contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

The Contractor shall at all times adhere to this specification, unless otherwise specified in the Particular Specification.

#### **CE 02 STANDARD SPECIFICATIONS**

##### **CE 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- SANS 1200 D - Earthworks
- SANS 1200 DB - Earthworks (pipe trenches)
- SANS 1200 G - Concrete (structural)
- SANS 1200 L - Medium-pressure pipelines
- SANS 1200 LB - Bedding (pipes)

**CE 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1993: Construction Regulations, 2003 as promulgated in Government Gazette No 37305 of 04 April 2014 shall be adhered to.

**CE 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

**CE 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**CE 03 OPERATING AND MAINTENANCE MANUALS**

No operating and maintenance manuals will be developed for this section.

The contractor shall use the Maintenance Control Plan (see SA Maintenance) to schedule routine preventative maintenance activities.

**CE 04 EXECUTION OF REPAIR WORK**

**CE 04.01 GENERAL**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

At the start of the repair and maintenance Contract all the systems, installations and equipment shall be repaired as specified in the Particular Specification. This repair work shall include but not be limited to the specified Particular Specification details.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve.

All materials and equipment shall comply fully with the requirements as specified for each installation.

The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and particular specifications included in this document.



All new equipment, materials and systems shall be furnished with a written guarantee with a defects liability period of 12 months from date of completion of repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over if the satisfaction of the Engineer has been obtained.

Repair work items for the water distribution systems shall be categorised under the following headings:

- (a) Repair of existing pipelines
- (b) Cleaning of existing pipelines
- (c) Repair of fittings
- (d) Repair of existing structures.

**CE 04.02     REPAIR OF EXISTING PIPELINES**

This section covers the requirements for the repair of the water distribution pipelines for defects such as pipe breaks and leakage for distribution pipelines.

**CE 04.02.01     General**

Repair work to the water distribution system is detailed in the Particular Specification and may include but not be limited to the following:

- (a) Replacement of damaged, broken, leaking, corroded surface and underground pipework and fittings;
- (b) Replacement of damaged, broken and missing manhole covers and frames;
- (c) Repair work to damaged manholes;
- (d) Initial unblocking and clearing of all water distribution pipes and manholes;
- (e) Repair and upgrading of the water distribution system where necessary;
- (f) Introduction of additional connections to the water distribution system;
- (g) Removal of unauthorised connections;
- (h) Reinstatement and making good of walls, concrete, road surfaces, etc, to an approved acceptable level where any repair, upgrade and/or service work has been executed;
- (i) Video surveying of all underground drainage pipework to establish root ingress, damaged pipework, fat build-up, blockages, incorrect falls, sagging and as-built information. This survey shall be utilised to establish the extent of repair and upgrade work to be executed;
- (j) Test pipe system for leakage;
- (k) Repair, replace and service valves, which shall include new gaskets, gland packings, seals, bolt and nuts, etc;
- (l) Where valves do not close properly, all these valves shall be refurbished, descaled and if necessary replaced;

- (m) Repair, clean and service all strainers, including the replacement of strainer elements where corroded and installation of new gaskets;
- (n) Repair, service, test and readjust pressure-reducing valves. Pressure gauges are to be recalibrated and checked. Up and downstream pressures are to be logged. Downstream pressure has to be adjusted to an acceptable level, taking into account the allowable working pressure of the system and its components;
- (o) Repair, service and check the proper functioning of all non-return valves;
- (p) Repair, service, readjust and calibrate all safety and expansion relief valves;
- (q) Repair, service and clean out all air release valves and vacuum breakers;
- (r) Repair, service and log readings of water meters including cleaning of integral strainers;
- (s) Water storage tanks are to be emptied, cleaned out, repaired, sealed and put back into operation. Ball float and/or filling valves to these tanks are to be serviced and repaired where required;
- (t) Water pipes are to be sampled for corrosion and scaling. The Engineer will evaluate the actions to be followed if the outcome of this sampling requires attention;
- (u) Water supply has to be sampled and chemically analysed for the suitability to the systems and materials it serves;
- (v) Pressure test and sterilise repaired new installation and equipment;
- (w) Reinstatement and making good of walls, tiling, floors, concrete, finishes, holes, chases, surfaces, etc, to an acceptable level where repair, upgrade and/or service work have been executed.

**CE 04.02.02 Construction**

The Engineer will indicate the pipeline sections in need of repair and shall instruct the Contractor with regard to the repair work to be done.

(a) Excavation

The width of the excavation shall be sufficient to allow the proper laying, bedding and backfilling of the pipelines. The width of the excavation for each type and size of pipeline shall be as set out in SANS 1200 DB.

The depth of the excavation for each type and size of pipeline shall depend on site conditions and the amount by which the excavation is to exceed the proposed level of the invert of the pipeline and shall be sufficient to allow the type and thickness of bedding material instructed by the Engineer.

Where excavation is to be carried out through asphalt premix or concrete, the asphalt/concrete shall be cut neatly and vertically with approved sawing equipment before the asphalt/concrete is removed.

Cutting, breaking out and replacing of concrete pavements will be paid under Subclause CA.02.

Excavations shall extend such that, where possible cut in may be reduced by lifting adjacent pipes.

(b) Classification of excavation

All excavations shall be classified as follows for payment purposes:

(i) Hard material

Material which cannot be excavated except by drilling and blasting or with the use of pneumatic tools or mechanical breakers and boulders exceeding 0,10 m<sup>3</sup> shall be classified as hard material.

Where more than 40 % of any material (by volume) consists of boulders each exceeding 0,10 m<sup>3</sup> in size, the material shall be classified as hard material.

(ii) Soft material

All material not classified as hard material shall be classified as soft material.

Notwithstanding the above classification, all material excavated from previously constructed fills, subgrades and subbases shall be classified as soft material.

(c) Disposal of excavated material

Where excavated material does not comply with the requirements for backfilling material as specified or is surplus to backfilling requirements, such excavated material shall be removed from the site.

Material suitable for use in the works, however, shall be used as prescribed.

(d) Removal of damaged pipelines

Where indicated by the Engineer damaged sections of pipelines shall be completely removed and replaced.

(e) Pipe couplings

Repair sections will be joined, utilising existing pipe sockets and collars where possible.

Repair couplings shall be used with the approval of the Engineer.

(f) Laying of uPVC pipelines

New sections of uPVC pipelines shall be laid on a granular bed suitable for flexible pipelines as directed by the Engineer. The inside of the pipes shall be smooth and without any displacement and all pipes shall be laid true to line and level with a minimum slope of 2 % or as directed by the Engineer.

Refer to SANS 1200 LB: Bedding (pipes), for the specification on bedding.

(g) Laying of asbestos cement, concrete or galvanised mild steel pipelines

New sections of the pipelines shall be laid on class A or B bedding as directed by the Engineer. The inside of the pipes shall be smooth and without any displacement and

all pipes shall be laid true to line and level with a minimum slope of 2 % or as directed by the Engineer.

Refer to SANS 1200 LB: Bedding (pipes), for the specification on bedding.

(h) Rock foundation

Where rock, shale or hard material is encountered on the bottom of excavations a bed of fine material as required for class B bedding shall be placed before laying the pipe.

(i) Concrete encasement

Where instructed by the Engineer pipes shall be encased in concrete. All such encasing shall be done in accordance with the Engineer's instructions and sufficient allowance shall be made for movement joints.

(j) Extension of existing pipelines

Where existing pipelines require extension or where damaged sections are replaced the new sections shall be placed at the same grade and, where they join the existing service, at the same level as the existing pipeline.

Existing chambers or other structures which may obstruct any new work shall be demolished and removed. The demolition and reconstruction of new structures shall be paid for under the relevant sections in the specification.

(k) Construction in existing roads

Road crossings shall either be constructed utilising sufficient provision of bypass roads or utilising the half width of the road. At all times a through route shall be maintained for all traffic.

(l) Repairing of leaks

Where leaks occur at pipe sockets or collars the affected section shall be cut from the pipeline and repaired using repair couplings.

Where obvious leaks occur due to displaced sealing rubbers, the rubbers shall be replaced if the replacement can be done economically by lifting adjacent pipes.

(m) Replacement of pipes damaged by exposure to extensive ultraviolet light

Pipes damaged as a result of excessive exposure to sunlight shall be replaced where indicated by the Engineer.

**CE 04.02.03** Quality standard

Pipelines shall be laid at even gradients within the points of correction, to the satisfaction of the Engineer and the applicable specifications.

**CE 04.02.04** Materials

Materials and equipment to be used for repair items shall be suitable and/or adaptable to the existing installation and shall comply with the following:

(a) Supercast cast-iron pipes and fittings

Supercast cast iron pipes can be used for underground and above ground installations. Plain ended cast iron pipes and fittings shall be used, manufactured from 150, Grade A, grey iron in accordance with SANS 1034. Fittings and pipes shall be free of pinholes, blowholes, blemishes, flash and foundry sand and have a smooth bore. All pipes and fittings shall be sand blasted and coated on the inside and outside by submersion in a corrosion inhibiting oxide primer or bitumen paint.

The pipes and fittings shall be joined by means of stainless steel neoprene couplings as supplied by the manufacturer's of the pipe system. The coupling shall be installed according to the manufacturer's specification and is to be tightened with a torque wrench to a torque of 6,8 Nm.

(b) uPVC pipe and fittings under ground

uPVC pipes and fittings can be used for above ground installations.

For pipe sizes larger than 160 mm diameter, uPVC class 6 pressure pipe to SANS 966 shall be used with prefabricated uPVC bends and junctions. Prefabrication shall be done by means of hot-air welding of fittings to be covered with three layers of fibreglass reinforced lining over welded sections. The resin to be used shall be as specified by the manufacturer for usage with PVC. Bends shall be manufactured out of 3 to 4 sections per bend. Pipe joints shall be done by means of couplings fixed with solvent cement for PVC piping. This joint shall be reinforced with a fibreglass lining of three layers.

Piping is to be supported and bracketed with properly sized and designed brackets consisting of two half sections clamped over the pipe and hung with two hanger rods.

Pipes are to be pressure tested in sections as specified in this specification.

(c) Prefabricated galvanised steel piping and fittings above ground

The pipe to be used shall be plain-ended medium gauge uncoated pipe to SANS 62, galvanised to SANS 763 and shall be approved by the Galvanising Association of South Africa. All fittings are to be manufactured out of the same material, welded with flanged ends or rolled ends to fit clampon fittings. Fittings are only to be galvanised after manufacturing. All joints are to be either flanged or equipped with clampon couplings. All fittings and junction to be 45° sections.

The pipe system must be properly secured and bracketed at regular intervals with correctly sized and designed galvanised brackets.

Pipes are to be pressure tested in sections as specified in this specification.

(d) HDPE pipe and fittings

HDPE pipes and fittings can be used for underground and above ground installations where specified in accordance with SANS 8770:2008 only pipes manufactured using an extrusion process and tempered in a hot bath shall be used. Pipes shall be plain ended and only moulded HDPE bends and fittings shall be used. Jointing of pipes and fittings shall be done by butt welding, electro-sleeve couplings and/or flanged joints. Pipes and fittings shall only be installed by industry approved installers and the Contractor shall furnish a certificate to this effect. Pipes and fittings shall be installed strictly according to the manufacturer's application technique.

Pipes are to be pressure tested in sections as specified in this specification

(e) Galvanised steel pipe installations

- (i) All galvanised steel pipes shall be medium gauge mild steel screwed and socketed pipes to SANS 62 and shall be normalised and marked as such by the manufacturer. Pipes shall be hot-dipped galvanised to SANS 763 and shall be approved by the Galvanising Association of South Africa.
- (ii) All fittings shall be malleable cast-iron fittings to SANS 509 and galvanised to SANS 763 and shall be approved by the Galvanising Association of South Africa.
- (iii) All 80 diameter and larger pipes shall be joined with Class 16 flanged couplings to SANS 1123/1600. The bolts, nuts and spring washers to be used on these joints shall be cadmium plated.
- (iv) In pipe ducts and elsewhere pipes shall be fixed onto walls, soffits, etc, with approved type of supports, holderbats, clamps, etc. Brackets shall be designed to structurally support and fix the pipe system and shall have enough clearance from walls, soffits, etc, to insulate hot-water pipes and maintain equipment.
- (v) Pipes shall be supported according to the manufacturer's specifications with approved brackets at the following maximum intervals:

NORMAL SIZE (mm)	HORIZONTAL (mm)	VERTICAL (mm)
15 dia to 20 dia	1 200	1 830
32 dia to 40 dia	1 830	2 450
50 dia to 150 dia	2 450	3 050

- (vi) Pipes shall be installed in such a manner as to prevent airlocks. A minimum rise of 1:250 shall be maintained to high points, which shall be fitted with suitable air release valves.
  - (vii) All pipes shall be marked according to SANS 10140 or as specified by the Engineer. All surface pipes shall be painted.
  - (viii) Pipes shall be installed flush unless otherwise instructed by the Engineer.
  - (ix) Provision shall be made for thermal contraction and expansion.
  - (x) The type of pipe joint compound shall be approved by the Engineer and used sparingly with good quality hemp. For pipes larger than 80 mm diameter a jointing compound such as Epidermix 32 shall be used.
  - (xi) Any pipes buried shall have at least 900 mm cover and be coated and wrapped to SANS 11 17 and tested in the presence of the Engineer.
  - (xii) All exposed hot-water pipes shall be lagged as specified.
  - (xiii) All pipework and fittings shall be pressure tested and sterilised as specified.
  - (xiv) Valves shall be installed on all branch pipes and ball-o-stop valves on all connectors to basin pillar cocks, sink mixers, cistern type WCs and other fittings.
  - (xv) Approved type expansion bellows shall be installed where required for expansion and contraction to prevent excessive stain on fittings and pipe joints.
- (f) uPVC underground pipe installations
- (i) uPVC piping shall conform to SANS 966 with rubber ring type joints.
  - (ii) All bends shall be uPVC type fittings with rubber ring joints.
  - (iii) All other fittings such as T-pieces, reducers, flanges, etc, shall be bitumen-dipped cast iron rubber ring jointed fittings to SANS 546.
  - (iv) No solvent weld type fittings will be allowed.
  - (v) All cast iron fittings shall be coated and wrapped to SANS 1117.
  - (vi) All pipes shall be laid on a 100 mm sand-bedding cradle and covered with 300 mm sand before backfilling.
  - (vii) All backfilling shall be to the Engineer's specification and approval.

(viii) Pipe trenching and bedding shall be as follows:

AREA	MINIMUM COVER	BEDDING TYPE	MAIN FILL
Vehicle traffic	1 100		Soilcrete
Under surface bed	600		Soilcrete
Other areas	900		90% of modified AASHTO density

- (ix) All thrust blocks shall be cast between the pipe and the undisturbed trench material.
- (x) No concrete shall come into direct contact with the uPVC pipe. At the thrust blocks the bend shall be wrapped with Densopol 80 HT Tape or approved equivalent.
- (xi) DPE pipe connections to UPVC pipes up to 50 mm diameter can be done by means of SG iron manufactured saddles with the appropriate gaskets and cadmium-plated bolts and nuts.
- (xii) All pipe crossings under traffic areas shall be backfilled with soilcrete and compacted as specified.
- (xiii) All pipework shall be pressure tested with all joints uncovered, to the satisfaction of the Engineer.
- (xiv) Suitably sized air release valves built into valve chambers shall be installed at all high points of the pipeline.

(g) HDPe underground pipe installations

- (i) HDPe piping shall be Type 4 HDPe pipe to SANS 533.
- (ii) All fittings shall be of Plasson compression type, conforming to ISO/DIS 3458.
- (iii) All pipes shall be laid on a 100 mm sand bedding cradle and covered with 300 mm of sand of selected material.
- (iv) All backfilling shall be to the Engineer's specification and approval.
- (v) Pipe trenching and bedding shall be as follows:

AREA	MINIMUM COVER	BEDDING TYPE	MAIN FILL
Vehicle traffic	1 100		Soilcrete
Under surface bed	600		Soilcrete
Other areas	900		90% of modified AASHTO density

- (vi) No concrete shall come into direct contact with the HDPe pipe. At these points the fittings shall be wrapped with a Densopol 80 HT tape or approved equivalent.
- (vii) All pipe crossings under traffic areas shall be backfilled with soilcrete and compacted as specified.
- (viii) All pipework shall be pressure tested with all joints uncovered to the satisfaction of the Engineer.
- (ix) Suitably sized air release valves built into valve chambers shall be installed at all high points of the pipeline.

(h) Valves

- (i) Gate valves underground in valve chambers to connect to uPVC piping (65 mm NB and larger)

Gate valves are to be equipped with non-rising spindle, spherical graphite iron body to SANS 936 Grade 42, cast-iron nitrile butadine rubber-covered gate, stainless steel spindle, nitrile butadine rubber O-rings and seals, cast iron bonnet and gunmetal thrust collar to BS 1400 LG2.

The valve shall conform to SANS 664 and/or 665, and shall be capable of withstanding a working pressure of 1 600 kPa.

The valve shall be fitted with a square key spindle top to close the valve in a clockwise direction and socket ends to SANS 665 to fit into uPVC Class 12 pipe and installed to detail.

(ii) Gate valves underground in valve chamber to connect to HDPE piping

The gate valves shall be of the dezincified brass type with brass gate, brass body, non-rising spindle and BSP threaded socket ends. The valve shall conform to SANS 776 Class 125. The valve shall be able to withstand a working pressure of 1 600 kPa. The valve shall be fitted with a hand wheel on an extended spindle shaft of 700 mm to close in a clockwise direction and installed to detail.

(iii) Gate valves above ground for temperatures up to 40 °C to connect to steel piping (65 mm NB and larger)

Gate valves to be equipped with non-rising spindle, spherical graphite iron body to SANS 936 Grade 42, cast-iron nitrile butadine rubber-covered gate, stainless steel spindle, nitrile butadine rubber O-rings and seals, cast iron bonnet and gunmetal thrust collar to BS 1400 LG2.

The valve shall conform to SANS 664 and/or 665, and shall be capable of withstanding a working pressure of 1 600 kPa.

The valves shall be fitted with flanged ends to SANS 1123/1600, hand wheel to close the valve in a clockwise direction and installed in an upright position or side ways to a maximum 90° from upright.

(iv) Gate valves above ground for temperatures above 40 °C to connect to steel piping (65 mm NB and larger)

Gate valve shall be equipped with non-rising spindle, spherical graphite iron body to SANS 963 Grade 42, cast-iron gate, gunmetal seat and gate rings, high-tensile bronze spindle, cast-iron bonnet and gunmetal thrust collar to BS 1400 LG2. The valve shall conform to SANS 665 and shall be capable of withstanding a working pressure of 1 600 kPa and a temperature of 90 °C.

The valve shall be fitted with flanged ends to SANS 1123/1600, hand wheel to close the valve in a clockwise direction and installed in an upright position or sideways to a maximum 90° from upright.

(v) Gate valves above-ground to fit to copper pipes (65 mm NB and larger)

Gate valves shall be equipped with non-rising spindle, gunmetal bronze or dezincified brass body, gunmetal or dezincified brass gate, graphite asbestos packing in the gland.

The valve shall be fitted with a hand wheel to close in a clockwise direction and installed in an upright position or sideways to maximum 90° from upright.



The valve shall be equipped with flanges to SANS 1123/1600, hand wheel to close the valve in a clockwise direction and installed in an upright position or sideways to a maximum 90° from upright.

- (vi) Gate valves above-ground for temperatures up to 100 °C (up to 50 mm NB)

The gate valves shall be of the dezincified brass type with brass gate, brass body, non-rising spindle and BSP threaded socket ends. The valve shall conform to SANS 776-1965 Class 125.

The valve shall be able to withstand a working pressure of 1 600 kPa.

The valve shall be equipped with a hand wheel to close in a clockwise direction.

The valve shall be installed in an upright position or sideways to a maximum 90° from upright and shall be so placed with other fittings to be removable without cutting the pipework.

- (vii) Ball-O-Stop valves (15 mm diameter - 25 mm diameter)

This valve shall be a full-way ballcock type with BSP threaded ends. This valve shall conform to SANS 1056 Part 3, 1985, shall be rated for a test pressure of 2 000 kPa, and shall be chrome-finished where exposed.

- (viii) Angle regulating valves

This valve shall be a 15 mm diameter chromium-plated angle regulating valve with a 350 mm chromium-plated copper tube and cap nuts where required.

- (i) Strainers

- (i) Strainers for connection to steel or uPVC pipes (65 mm NB and larger)

These strainers shall be of the Y-type with cast iron body, stainless steel or bronze strainer element and shall be equipped with flanged ends to SANS 1123/1600. The whole size of the strainer element shall be maximum 1 mm diameter and be removable without dismantling of pipework. The strainer shall be suitable for a temperature of up to 90 °C at a 1 000 kPa pressure rating and installed with the element facing downwards or a maximum of 45° sideways.

- (ii) Strainers for connection to steel and copper pipes (up to 50 mm NB)

The strainers shall be of the Y-type with bronze or dezincified brass body, stainless steel strainer element and must be equipped with BSP threaded socket ends. The whole size of the strainer element shall be maximum 0,8 mm diameter. The strainer shall be suitable for a temperature of up to 90 °C at a pressure rating of 1 000 kPa and installed with the element facing downwards or a maximum of 45° sideways.

- (j) Non-return valves

- (i) Non-return valves for cold water (65 mm NB and larger)

The non-return valve shall be of the spring-loaded dual flap plate type fitted between two flanges (wafer).

The non-return valve shall be equipped with a cast-iron body, aluminium bronze plates, stainless steel springs and neoprene seals on the plates. The valves shall be suitable for a working pressure of 1 000 kPa.

- (ii) Non-return valves for hot water (up to 100 mm diameter) and cold water (up to 50 mm NB)

The non-return valve shall be of the spring-loaded piston type, with bronze or dezincified brass body, stainless steel spring and bronze disc with neoprene seal fitted with BSP threaded socket ends. The valve shall be suitable for a working pressure of 1 000 kPa and a temperature of up to 90 °C. All valves shall be installed as to be removable without extensive pipework removal.

(k) Air release valves and vacuum breakers

- (i) Double orifice double-acting air release valves with sizes from 50 mm NB to 200 mm NB

The air release valve shall be fitted with small and large orifice. The air release valve shall be fitted with a cast-iron or stainless steel body, stainless steel or fibreglass balls, integral shut-off valve and flanged ends to SANS 1123/1600. The valve shall be equipped with an anti-shock facility.

The valve shall be suitable for maximum pressure of 1 600 kPa.

- (ii) Single orifice air release valves for main water lines with sizes from 25 mm NB to 50 mm NB

The air release valve shall be fitted with a small orifice, cast-iron or stainless steel body, fibre glass or stainless steel ball float and BSP threaded inlet.

When the valve is installed a shut-off valve shall be installed on the inlet side. The valve shall be equipped with an anti-shock facility.

The valve shall be suitable for maximum pressure of 1 600 kPa.

- (iii) Single orifice double purpose air release valves for domestic water lines up to 15 mm NB

The air release valves shall be fitted with a stainless steel float, brass or cast steel body with an integral shut-off valve fitted.

The valve shall be capable to withstand a working pressure of 1 000 kPa at 110 °C.

- (iv) Vacuum breaker up to 40 mm diameter

The vacuum breakers shall be fitted with neoprene seal, spring-loaded disc in a dezincified brass or bronze body. The valve shall seal watertight and shall be designed to withstand a working pressure of 1 000 kPa and a temperature of 90 °C.

(l) Pressure-reducing valves

- (i) Combination pressure reducing stations

Where a high peak flow can occur as well as a small flow and the small flow is out of the range of the large pressure-reducing valve, a small pressure-reducing valve

shall be installed in parallel with the large pressure-reducing valve. The two pressure-reducing valves in parallel shall be set according to the manufacturer's specification.

(ii) Large pressure-reducing valves (65 mm NB and larger)

The pressure reducing valve shall be equipped with a cast iron body, neoprene-nylon reinforced diaphragm, bronze seal disc washer, stainless steel shaft and flanged ends. The valve shall be pilot operated and shall be designed to handle high flows at a minimum head loss.

The valve must be adjustable to handle a wide range of incoming pressure at a constant downstream pressure.

The valve shall be equipped with flanged ends to SANS 1123/1600.

(iii) Small pressure-reducing valves (15 mm NB - 50 mm NB)

The pressure-reducing valve shall be equipped with brass body, balanced single seat and integral strainer. The valve shall be able to handle a wide range of incoming pressure while the downstream pressure stays constant with maximum inlet pressure of 1 000 kPa and a maximum water temperature of 40 °C.

The valve shall be equipped with BSP male threaded brass union couplings.

(m) Water meters

(i) Combination water meters

Where high peak flow as well as a low flow can occur, and the low flow is out of the registration range of large water meter, a small diameter water meter shall be installed in parallel with the large water meter to cater for the low flows with integral automatic change-over valves. These valves shall be designed to have a minimum pressure drop at the operating point.

(ii) Water meters (50 mm NB and larger)

These water meters shall be of the dry type with all gears and transmission and roller counters in a dry head, and shall be equipped with flanged ends to SANS 1123, cast-iron body with high quality corrosion proof coating. The meter must be protected from magnetic fields and sealed to prevent tampering with adjustments. The meter must be able to work up to a pressure of 1600 kPa under a maximum water temperature of 40 °C. The scale of meter must be in cubic metre (m<sup>3</sup>) and equipped with needle indicators reading in litres. The accuracy of the meter shall be not less than 98 %.

The meters shall be installed with leading and trailing lengths of pipes to the manufacturer's specification.

(iii) Water meters (up to 50 mm NB)

The meter shall be of the volumetric rotary piston type with brass body equipped with union couplers. The meter reading must be in kilolitres. The meter shall have an accuracy of not less than 98 %. The meter must be able to operate up to a water pressure of 1000 kPa at a water temperature of 40 °C.

The meters shall be installed with leading and trailing lengths of pipes to the manufacturers specification.

**CE 04.03 FIRE WATER PIPED RETICULATION NETWORKS**

**CE 04.03.01 General**

Repair work to the fire water piped reticulation networks is detailed in the Particular Specification and shall include but not be limited to the work described below. This specification only covers the water piped reticulation for the fire water protection system, whereas the equipment to this installation, such as fire hydrants, hose reels and extinguishers, are covered and detailed in Technical Specification JC: Conventional Fire Fighting Equipment. This specification must be read in conjunction with the afore-mentioned specification.

Repair work to the fire water piped reticulation networks may include the following:

- (a) Replacement of damaged, broken, leaking, corroded above-ground and underground pipe work, fittings and equipment;
- (b) Repair, replace and service valves which shall include new gaskets, gland packings, seals, bolt and nuts, etc;
- (c) Where valves do not close properly, all these valves are to be refurbished, descaled and if necessary replaced;
- (d) Repair, service and check the proper functioning of all non-return valves and backflow preventers;
- (e) Repair, service, readjust and calibrate all pressure gauges;
- (f) Repair work to bracketing systems including fixing and repair of existing brackets and the introduction of additional brackets where required;
- (g) Report all related problems to fire fighting equipment to the Engineer;
- (h) Water storage tanks are to be emptied, cleaned out, repaired, sealed and put back into operation. Ball float or/and filling valves to these tanks are to be serviced and repaired where required;
- (i) Pressure test and sterilise repaired new installation and equipment;
- (j) Reinstatement and making good of walls, tiling, floors, concrete, finishes, holes, chases, surfaces, etc, to an acceptable level where any repair, upgrade and/or service work have been executed;
- (k) Record pressure readings on supply to installation.

**CE 04.03.02 Material and equipment specification for fire water piped reticulation networks**

Materials and equipment to be used for repair items shall be suitable and/or adaptable to the existing installation and shall comply with the relevant specification.

**CE 04.04**      **CLEANING OF PIPELINES**

The work under this section involves the removal of silt, debris and lime deposits from within the pipelines and the general cleaning in areas resulting from leakage.

**CE 04.04.01**    **Construction**

Prior to the cleaning of any pipeline sections, the Contractor shall arrange with the Engineer for an inspection of the pipe route. Based on the inspection, the Engineer will instruct the Contractor as to which sections of the network require cleaning.

Visual inspections utilising check circuit TV cameras will not be required unless deemed essential on large diameter pipelines.

Sections of the pipeline may be removed for a more detailed inspection. Such sections will be repaired as specified in Subclause CE 04.02. Sections will only be cut from the pipeline where specifically instructed by the Engineer.

The method to be applied for the cleaning of the pipelines will be chemical or mechanical and shall be followed by disinfection of the related section. The method to be applied for each section of the pipeline will be instructed by the Engineer.

Material removed from the pipelines shall be disposed of as instructed by the Engineer. The Contractor shall discuss the method proposed for the scouring of the pipelines where insufficient scour valves are present with the Engineer prior to implementation.

**CE 04.04.02**    **Quality standard**

Pipelines shall be cleaned such that head losses along the pipe route are negligible under simulated fire flow, when measured at convenient points along the route.

**CE 04.05**      **REPAIR OF FITTINGS**

**CE 04.05.01**    **Construction**

The Engineer will indicate the fittings that are to be repaired.

The repair of the following fittings may be required:

- (a) Gate valves
- (b) Fire hydrants
- (c) Viking Johnson couplings
- (d) Pressure-reducing valves
- (e) Ferrules
- (f) Domestic water meters
- (g) Bulk water meters
- (h) Stop-cocks
- (i) Tees
- (j) Bends
- (k) End caps
- (l) Saddles
- (m) Sprinklers.

**CE 04.06**      **REPAIR OF STRUCTURES**

The Engineer will indicate the structures that are to be repaired or cleaned from debris.

Damaged existing structures shall be demolished to the extent directed by the Engineer on site and the resulting debris and other debris spoiled at designated sites.

The reinstatement of damaged structures shall be carried out to the same standards prescribed for new construction.

**CE 05**      **TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK**

Except where otherwise provided in the Contract, the Contractor shall provide all labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out such tests. The Contractor shall make arrangements for such tests and he shall give at least 72 hours notice to the Engineer, in writing, prior to commencement of the test.

In the event of the plant or installation not passing the test, the Employer shall be at liberty to deduct from the Contract price all reasonable expenses incurred by the Employer or the Engineer attending the repeated test.

Whenever any installation or equipment is operated for testing or adjusting as provided for above, the Contractor shall operate the entire system for as long a period as may be required to prove satisfactory performance at all times in the occupied space served by that system for up to twenty-four hours a day continuously until the system is handed over.

The Contractor shall provide all labour and supervision required for such operation and the Employer may assign operating personnel as observers, but such observation time shall not be counted as instruction time.

After complete installation of the system all equipment shall be tested, adjusted and readjusted until it operates to the satisfaction and approval of the Engineer.

The Contractor shall submit certificates of tests carried out to prove the quality and proper functioning of all equipment and also certificates to be obtained from all relevant authorities and statutory bodies, etc.

**CE 06**      **QUALITY ASSURANCE SYSTEM**

The Contractor shall institute an approved quality assurance (QA) system which shall be submitted to the Employer or Engineer for approval. The records of this QA system shall be kept throughout the duration of the Contract and be submitted to the Engineer at regular intervals as required.

**CE 07      MAINTENANCE TO INSTALLATION SYSTEMS AND EQUIPMENT**

**CE 07.01      GENERAL**

This part of the Contract shall include routine preventative maintenance, corrective maintenance and breakdown maintenance as described in Additional Specification SA: General Maintenance.

The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification SA: General Maintenance, and as specified in the Particular Specification and this specification.

The said maintenance work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws and the manufacturer's specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be implemented by the Contractor.

All new equipment, components and materials supplied and installed under the maintenance Contract shall be furnished with the prescribed manufacturer's guarantees.

The maintenance work and items are categorised for each maintenance activity under the following headings:

- (a) Repair of water distribution pipelines (see table CE 07.02/1)
- (b) Cleaning of existing pipelines (see table CE 07.02/2)
- (c) Repair of fittings (see table CE 07.02/3)
- (d) Repair of existing structures (see table CE 07.02/4)
- (e) Fire water piped reticulation structures (see table CE 07.02/5).

The scope of the external water network and bulk water network is indicated in the drawings in the Contract.

**CE 07.02      ROUTINE PREVENTATIVE MAINTENANCE**

This routine maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance and the Particular Specification related to this work.

The routine maintenance work to be performed and executed shall include, but not be limited to the following items listed in the tables below under each heading.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

TABLE CE 07.02/1 REPAIR OF WATER DISTRIBUTION PIPELINES

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system	Monthly
2	Log all water meter readings	Monthly
3	Log all pressure gauge readings	Monthly
4	Check, inspect, report and repair leaks/replace rotten pipes where required	Monthly
5	Sample water supply and chemical analyses to be provided by approved company	Monthly
6	Bulk Water storage tanks to be emptied, cleaned out, inspected, repaired and resealed where necessary	Annually
8	Clean out all strainers	Monthly
9	Check, inspect, repair or replace all bracketing systems	Four-monthly
10	Paint repairs to piping, fittings and equipment	Annually

TABLE CE 07.02/2 CLEANING OF EXISTING PIPELINES

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system	Monthly
2	Remove silt, debris and loose lime deposits from within pipelines where required by scouring	Annually
3	Do general cleaning in areas where leakage has occurred	Six-monthly

TABLE CE 07.02/3 REPAIR OF FITTINGS

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Replace all valve gaskets, gland packings and seals	Annually
2	Check, inspect, service, repair and readjust all pressure reducing valves	Annually
3	Check, inspect and test operation of all valves on site	Four-monthly
4	Check, inspect, service, test and repair/replace all safety and expansion release valves	Six-monthly
5	Check, inspect, service, test and repair/replace all air release valves and vacuum breakers	Four-monthly
6	Check, service, repair or replace all ball float valves	Six-monthly
7	Check, inspect, test, service and repair/replace all non-return valves	Four-monthly

TABLE CE 07.02/4 REPAIR OF EXISTING STRUCTURES

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on all water distribution related structures	Monthly
2	Clean out structures of debris	Six-monthly



TABLE CE 07.02/5 FIRE WATER PIPED RETICULATION STRUCTURES

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system	Monthly
2	Report any failures/breakage of fire fighting equipment to the Engineer	Monthly
3	Log all pressure gauge readings	Monthly
4	Replace all valve gaskets, gland packings and seals	Annually
5	Clean out water storage tanks and reseal/repair if necessary	Annually
6	Check, inspect, service, repair/replace all non-return valves and backflow presenters	Four-monthly
7	Check, inspect, report and repair all leaks/replace rotten pipes where required	Monthly
8	Inspect, service, readjust and calibrate all pressure gauges	Four-monthly
9	Paint repairs to piping, fittings and equipment	Annually
10	Check, inspect, repair or replace all bracketing systems	Four-monthly

**CE 07.03 CORRECTIVE MAINTENANCE**

This corrective maintenance of the installations, systems and equipment to be done in accordance with Additional Specification SA: General Maintenance and the Particular Specification related to this work.

The Contractor shall inspect and check all equipment, materials, systems and installation for any pending breakdowns, maladjustments or anomalies of equipment.

The Contractor shall report and take actions to correct such deficiencies.

**CE 07.04 BREAKDOWN MAINTENANCE**

Breakdown maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance.

All breakdown problems experienced shall be acted upon within the time limitations allowed in the General Maintenance specification.

All breakdown maintenance shall be done in accordance with the related specifications, standards, regulations and codes.

The Contractor shall have access to the necessary spares, equipment and tools for the expected breakdowns.

**CE 08 MEASUREMENT AND PAYMENT****CE.01 WATER DISTRIBUTION PIPELINES****CE.01.01 Repair of existing pipelines ..... Unit: metre (m)**

The unit of measurement shall be per metre length of pipe replaced. In each case the Contractor shall agree on the length of pipe to be replaced and the method of coupling the pipes.

The tendered rate shall include full compensation for cleaning and grubbing, excavation, removal of existing pipeline, dealing with water logged conditions, provision of bedding and additional backfill, logging and backfilling of replacement pipeline, finishing, repair of kerbs, road surfaces, accommodation of traffic, excavation in all materials, removal of unsuitable material from the trench, disposal of surplus materials.

Separate items will be scheduled for house connections and distribution pipes.

The provision of the materials will be measured separately under CE 01.02.

**CE.01.02 Provision of materials**

(a) Pipelines ..... Unit: metre (m)

The unit of measurement shall be the metre of pipe replaced.

(b) Fittings ..... Unit: number

The unit of measurement shall be the number of fittings installed.

The tendered rates shall include full compensation for all transport to the place of installation, storage, labour costs.

Separate pay items shall be listed for the pipe materials and fittings per diameter and class.

**CE.01.03 Replacement of manhole covers, grid inlets and the like**

(a) SANS 558 Type 4 - covers, grids, etc, only:

- (i) Maximum dimension up to 300 mm ..... Unit: number
- (ii) Maximum dimension 301 mm - 600 mm ..... Unit: number
- (iii) Maximum dimension 601 mm - 900 mm ..... Unit: number
- (iv) Maximum dimension over 900 mm ..... Unit: number

(b) SANS 558 Type 4 - frames only for covers, grids, etc:

- (i) Maximum dimension up to 300 mm..... Unit: number
- (ii) Maximum dimension 301 mm - 600 mm ..... Unit: number
- (iii) Maximum dimension 601 mm - 900 mm ..... Unit: number
- (iv) Maximum dimension over 900 mm..... Unit: number

(c) SANS 558 Type 2A - covers, grids, etc, only:

- (i) Maximum dimension up to 300 mm..... Unit: number
- (ii) Maximum dimension 301 mm - 600 mm ..... Unit: number
- (iii) Maximum dimension 601 mm - 900 mm ..... Unit: number
- (iv) Maximum dimension over 900 mm..... Unit: number

(d) SANS 558 Type 2A - frames only for covers, grids, etc:

- (i) Maximum dimension up to 300 mm..... Unit: number
- (ii) Maximum dimension 301 mm - 600 mm ..... Unit: number
- (iii) Maximum dimension 601 mm - 900 mm ..... Unit: number
- (iv) Maximum dimension over 900 mm..... Unit: number

The unit of measurement shall be the number of covers or frames installed. The classification of the size of each cover or frame will be based on the nominal dimensions of the unit and not on the actual dimensions.

The tendered rates shall include full compensation for procuring, furnishing and placing the new covers, grids and/or frames. The tendered rates shall also include full compensation for removing and disposing of the damaged covers, grids and/or frames from the site.

**CE.01.04      Repair of corrosion protection**

Corrosion protection of pipes with diameters of:

- |                                    |                 |
|------------------------------------|-----------------|
| (a) <u>Up to 100 mm dia</u> .....  | Unit: metre (m) |
| (b) <u>101 to 200 mm dia</u> ..... | Unit: metre (m) |
| (c) <u>201 to 300 mm dia</u> ..... | Unit: metre (m) |
| (d) <u>301 to 400 mm dia</u> ..... | Unit: metre (m) |

The unit of measurement shall be meter length of pipe painted with corrosion protection in accordance with Specification LB: Corrosion protection.

The tendered rate shall include full compensation for preparation of pipe fittings, application of corrosion protection and curing of corrosion protection.

Separate items shall be scheduled for different types of pipework.

**CE.01.05      New Pipelines: Preparation and Finishing ..... Unit: metre (m)**

The unit of measurement shall be per metre length of pipe being replaced. In each case the Contractor shall agree on the length of pipe to be replaced.

The tendered rate shall include full compensation for cleaning and grubbing, all excavations to the specified depth, removal of existing pipeline, dealing with water logged conditions, provision of bedding and additional backfill, logging and backfilling of replacement pipeline, finishing, repair of kerbs, road surfaces, accommodation of traffic, excavation in all materials, removal of unsuitable material from the trench, disposal of surplus materials and pressure testing of the completed pipeline.

The provision of the pipeline materials will be measured separately under CE 01.02.

**CE.02      REPAIR OF FIRE WATER PIPE RETICULATION NETWORK**

Measurement and payment items from CE.01, CE.03, CE.04 and CE.05 will be utilised for work done on the external fire water pipe reticulation. Additional payment items for specialist fittings shall be paid under Specification JC.

**CE.03      CLEANING OF PIPELINE**

**CE.03.01      Cleaning of deposits in pipeline by mechanical means for pipes of diameters of:**

- |                                    |                 |
|------------------------------------|-----------------|
| (a) <u>Up to 100 mm dia</u> .....  | Unit: metre (m) |
| (b) <u>101 to 200 mm dia</u> ..... | Unit: metre (m) |
| (c) <u>201 to 300 mm dia</u> ..... | Unit: metre (m) |
| (d) <u>301 to 400 mm dia</u> ..... | Unit: metre (m) |

**CE.03.02      Scouring of pipeline to remove trapped debris for pipes of diameters of:**

- (a) Up to 100 mm dia ..... Unit: metre (m)
- (b) 101 to 200 mm dia..... Unit: metre (m)
- (c) 201 to 300 mm dia..... Unit: metre (m)
- (d) 301 to 400 mm dia..... Unit: metre (m)

The unit of measurement shall be metre length of pipe cleaned or scoured.

The unit rate of measurement for item CA.03.01 shall include full compensation for the emptying of the pipeline, cleaning, refilling and reporting on the condition of the pipe after cleaning. The rate shall also include the disposal of waste material in and appropriate manner.

The unit of measurement for item CA.03.02 shall include full compensation for the scouring of the pipeline and refurbishing of the pipeline. The unit of measurement shall be the total length of filled pipeline from which the water is scoured. The length shall be agreed with the Engineer prior to scouring.

The provision of additional scour points shall also be included in the rate.

**CE.04      REPAIR OF FITTINGS**

**CE.04.01      Servicing of valves ..... Unit: number**

The unit of measurement shall be the number of valves serviced.

The tendered rate shall include full compensation for cleaning, removing rust, scale or other solids from surfaces or moving parts, proper greasing of all moving parts, preparation for corrosion protection coating and painting of valves.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

**CE.04.02      Recondition valves ..... Unit: number**

The unit of measurement shall be the number of valves reconditioned.

The tendered rate shall include full compensation for dismantling, cleaning, removing rust, removing scale or other solids from surfaces and moving parts, replacing components such as hinges, spindles, hard wheels or gates, swing axles, swing gates, replacing or repair of seals, skimming of seal surfaces, proper greasing of all moving parts, preparation for corrosion protection, painting or any other action or cost necessitated to recondition a valve to a perfect functional drop tight condition.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

**CE.04.03      Decommission and remove valves ..... Unit: number**

The unit of measurement shall be the number of valves decommissioned and removed.

The tendered rate shall include full compensation for all labour and equipment required to decommission and remove valves, such as installation of temporary isolating valves or blank flanges, removal of unserviceable valves, loosening and removal of bolts and nuts, or any

other related action required. Excavation to exposed partially buried valves shall also be included in the rate.

Separate items will be scheduled in the Schedule of Quantities for different types and sizes of valves.

**CE.04.04**     **Repair of house connections**..... Unit: number

The unit of measurement shall be the number of house connections repaired.

The tendered rate shall exclude the provision of new fittings measured under CE. 01.02 but shall otherwise include full compensation for appurtenant fittings, excavation, backfilling and other necessary work to repair existing house connections.

All connections to the distribution pipelines, up to a diameter of 32 mm shall be measured as "house connections".

**CE.05**     **REPAIR OF STRUCTURES**

**CE.05.01**     **Demolition and removal of damaged existing structures**

- (a) Plain concrete ..... Unit: cubic metre (m<sup>3</sup>)
- (b) Reinforced concrete..... Unit: cubic metre (m<sup>3</sup>)
- (c) Brickwork ..... Unit: square metre (m<sup>2</sup>)
- (d) Precast concrete manhole sections..... Unit: number

The unit of measurement for CE.05.01(a) and (b) shall be the cubic metre of existing material demolished, determined from 70 % of the rated cubic metre capacity of the truck used to remove the material.

The unit of measurement for CE.05.01(c) and (d) shall be the square metre length of brickwork and the number of precast concrete manhole sections.

The tendered rates shall include full compensation for all labour, equipment and tools for removal of the damaged sections, trimming the bedding and for loading, transporting and disposing of the material. Excavation and backfill shall also be included for constructing the precast concrete manholes inclusive of all work required to complete the work as shown on the drawings.

The reinstatement of damaged sections shall be paid for under the relevant items for constructing new structures.

**CE.05.02**     **Cleaning of existing manholes, chambers and other structures** ..... Unit: cubic metre (m<sup>3</sup>)

The unit of measurement shall be the cubic metre of debris and other material to be disposed, removed from manholes, chambers and other structures.

The tendered rates shall include full compensation for all labour, equipment and tools for removal of the material, trimming the bedding and for loading, transporting and disposing of the material.

**CE.05.03**     **Overhaul on material for haul in excess of 1,0 km**

- (a) Excavated material to spoil..... Unit: cubic metre kilometre (m<sup>3</sup>-km)
- (b) Existing structures demolished..... Unit: cubic metre kilometre (m<sup>3</sup>-km)

The unit of measurement shall be the cubic metre of loose material hauled in excess of 1,0 km, measured according to the rated capacity of the truck used, multiplied by the average overhaul distance. All trucks shall be fully loaded to their rated capacity.

The tendered rate shall include full compensation for hauling the material in excess of the free-haul distance.

**CE.05.04 Repair of structures**

- (a) Brickwork ..... Unit: square metre (m<sup>2</sup>)
- (b) Concrete ..... Unit: cubic metre (m<sup>3</sup>)
- (c) Precast concrete manhole sections..... Unit: number

The unit of measurement shall be the cubic metre of brickwork or concrete constructed.

The tendered rate shall include full compensation for the provision of materials, transport, preparation and placing of foundations, labour and all other associated work to complete the work required.

Separate items will be scheduled for specific installations.

**CE.05.05 Marker posts..... Unit: number**

The unit of measurement shall be the number of marker posts installed.

The tendered rate shall include full compensation for the manufacture and installation complete as shown on the drawings.

**CE.05.06 Sample testing**

- (a) Extract sample to determine lime deposition, corrosion and general condition for pipes of:
  - (i) Up to 100 mm dia ..... Unit: number
  - (ii) 101 to 200 mm dia..... Unit: number
  - (iii) 201 to 300 mm dia ..... Unit: number
  - (iv) 301 to 400 mm dia..... Unit: number

The unit rate of measurement shall be the number of sample tests carried out.

The tendered rate shall include full compensation for cutting into pipe and extraction of sample, visual inspection and reporting on condition of pipe. The tendered rate shall also include full compensation for the appropriate disposal of the sample and for the repair of the section pipeline.

Compensation for provision of new pipes and fittings, shall be measured under CE 01.

**CE.05.07 New structures**

Precast concrete manhole sections..... Unit: number

The unit of measurement shall be the number of new pre-cast manholes constructed complete with precast top, manhole frame, cover and finishing.

The tendered rate shall include full compensation for the provision of materials, transport, preparation and placing of foundations, labour and all other associated work to complete the work required.

**CE.06      TESTS AND INSPECTIONS OF REPAIR WORK**

**CE.06.01      Pressure testing**

(a) Pressure test pipeline in sections of pipes with diameter of:

- (i) Up to 100 mm dia ..... Unit: metre (m)
- (ii) 101 to 200 mm dia..... Unit: metre (m)
- (iii) 201 to 300 mm dia..... Unit: metre (m)
- (iv) 301 to 400 mm dia..... Unit: metre (m)

The unit of measurement shall be the metre length of pipe tested.

The tendered rate shall include full compensation for isolation of test section, filling of section with water, testing for required duration and reporting on performance of pipes, the provision of any additional water shall also be included in the rate. The rate shall also include the provision of all equipment, labour and supervision necessary for the completion of the pressure test.

**CE.06.02      Provision of equipment for visual inspection of underground pipeline network ..... Unit: lump sum**

The tendered sum shall include full compensation for the provision of suitable equipment, such as torches, lights and mirrors, etc, to enable a basic visual inspection of the pipeline network.

**CE.06.03      CCTV inspection of underground pipework**

(a) Pipes of diameter:

- (i) Up to 300 mm dia ..... Unit: metre (m)
- (ii) 301 to 600 mm dia..... Unit: metre (m)

The unit of measurement shall be the metre length of pipe inspected.

The tendered rate shall include full compensation for all inter-pipe relocations required to conduct a thorough check of the pipework where indicated by the Engineer.

**CE.07      LOCATE AND CONNECT INTO THE EXISTING WATER NETWORK**

(a) Locate and connect into the existing water network pipeline ..... Unit: number

The tendered rate shall include the provision of all equipment, labour, fittings and material required to locate the existing water network pipeline, excavate and expose the existing pipe, blank off any unnecessary connections, and connect to the new pipeline.

**TECHNICAL SPECIFICATION****CF SEWERAGE NETWORKS****CONTENTS**

CF 01	SCOPE
CF 02	STANDARD SPECIFICATIONS
CF 03	OPERATING AND MAINTENANCE MANUALS
CF 04	EXECUTION OF REPAIR WORK
CF 05	TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK
CF 06	QUALITY ASSURANCE SYSTEM
CF 07	MAINTENANCE TO INSTALLATION SYSTEMS AND EQUIPMENT
CF 08	MEASUREMENT AND PAYMENT

**CF 01 SCOPE**

This specification covers all aspects regarding the general maintenance of sewerage networks which may include the following installations:

- (a) Sewer pipelines and manholes
- (b) Open sewerage channels
- (c) Conservancy tanks.

This specification shall form an integral part of the maintenance and servicing contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

**CF 02 STANDARD SPECIFICATIONS****CF 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- SANS 1200 D - Earthworks
- SANS 1200 DB - Earthworks (pipe trenches)
- SANS 1200 L - Medium-pressure pipelines
- SANS 1200 LB - Bedding (pipes)
- SANS 1200 LC - Cable ducts
- SANS 1200 LD - Sewers

**CF 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1998: Construction Regulations, 2004 as promulgated in Government Gazette No 37305 of 04 April 2014 shall be adhered to.



**CF 02.03**            **MANUFACTURER'S SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturer's specifications, instructions and codes of practice.

**CF 02.04**            **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**CF 03**                **OPERATING AND MAINTENANCE MANUALS**

No operating and maintenance manuals will be developed for this section.

The contractor shall use the Maintenance Control Plan (see SA Maintenance) to schedule routine preventative maintenance activities.

**CF 04**                **EXECUTION OF REPAIR WORK**

**CF 04.01**            **GENERAL**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

At the start of the repair and maintenance contract all the systems, installations and equipment shall be repaired as specified in the Particular Specification. This repair work shall include but not be limited to the details specified in the Particular Specification.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve.

All materials and equipment shall comply fully with the requirements as specified for each installation.

The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all Additional and Particular Specifications included in this document.

All repair work shall be executed within the approved period for repairs to be agreed at the start of the Contract period. All new equipment, materials and systems shall be furnished with a written guarantee with a defects liability period of twelve (12) months from date of completion of repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

**CF 04.02**      **REPAIR OF EXISTING PIPELINES AND STRUCTURES**

This section covers the work in connection with the construction of sewerage networks and associated sewerage structures such as manholes, cleaning eyes and the like. It also covers the removal and replacement of damaged and broken pipes and sewerage structures, as well as repairs to existing pipes and structures.

**CF 04.02.01**      **General**

Repair work to the soil and wastewater drainage system shall be detailed in the Particular Specification and may include the following:

- (a) Replacement of damaged, broken, leaking, corroded above-ground and underground pipework and fittings;
- (b) Replacement of damaged, broken and missing gully gratings, manhole covers and frames, cleaning eye covers, screws and bolts, inspection of eye covers, screws and bolts, end caps and vent cowls;
- (c) Repair work to damaged manholes, gullies, cleaning eyes, etc, including builder's work and benching;
- (d) Initial unblocking and cleaning of all drainage pipework, traps and gullies;
- (e) Repair of sewerage system where necessary;
- (f) Provision of additional connections to the sewerage system;
- (g) Reinstatement and making good of walls, concrete, road surfaces, etc, to an approved acceptable level where any repair and/or service work have been executed;
- (h) Video surveying of all underground drainage pipework to establish root ingress, damaged pipework, fat build-up, blockages, incorrect falls, sagging and as-built information. This survey shall be utilised to establish the extent of repair and upgrade work to be executed;
- (i) Test pipe system and equipment for leakage;
- (j) Sewerage pipes are to be sampled for corrosion and scaling. The Engineer will evaluate the actions to be followed if the outcome of this sampling requires attention;
- (k) Reinstatement and making good of walls, tiling, floors, concrete, finishes, holes, chases, surfaces, etc, to an acceptable level where repair and/or service work have been executed.

**CF 04.02.02**      **Construction**

The Engineer will indicate the location at which sections of pipeline are in need of repair after the appropriate surveys have been completed by the Contractor.

**(a)**      **Excavation**

The width of the excavation shall be sufficient to allow the proper laying, bedding and backfilling of the pipelines. The width of the excavation for each type and size of pipeline shall be as specified in SANS 1200 DB.

The depth of the excavation for each type and size of pipeline shall depend on site conditions and the amount by which the excavation is to exceed the proposed level of the invert of the pipeline and shall be sufficient to allow for the type and thickness of bedding material as instructed by the Engineer.

Where excavation is to be carried out through asphalt premix or concrete, the asphalt/concrete shall be cut neatly and vertically with approved sawing equipment before the asphalt/concrete is removed.

Excavations shall extend such that, where possible, cut in may be reduced by lifting adjacent pipes.

(b) Classification of excavation

All excavations shall be classified as follows for payment purposes:

(i) Hard material

Material which cannot be excavated except by drilling and blasting, or with the use of pneumatic tools or mechanical breakers and boulders exceeding 0,10 m<sup>3</sup> shall be classified as hard material.

Where more than 40 % of any material (by volume) consists of boulders each exceeding 0,10 m<sup>3</sup> in size, the material shall be classified as hard material.

(ii) Soft material

All material not classified as hard material shall be classified as soft material.

Notwithstanding the above classification, all material excavated from previously constructed fills, subgrades and subbases shall be classified as soft material.

(c) Disposal of excavated material

Where excavated material does not comply with the requirements for backfilling material as specified or is surplus to backfilling requirements, such excavated material shall be removed from the site.

Material suitable for use in the works, however, shall be used as prescribed.

(d) Removal of damaged pipelines

Where indicated by the Engineer damaged sections of pipelines shall be completely removed and replaced.

Excavation shall be carried out as described for new pipeline installation and the excavated material shall be, if suitable, preserved for backfilling. The damaged pipe materials shall be disposed of where instructed by the Engineer.

(e) Pipe couplings

Repair sections shall be joined utilising existing pipe sockets and collars where possible.

Repair couplings shall be used with the approval of the Engineer.

(f) Laying of vitrified clay pipes and fittings

New sections of vitrified clay pipes shall be laid on granular bed as directed by the Engineer. The inside of the pipes shall be smooth and without any displacement and all pipes shall be laid true to line and level with a minimum slope of 2 % or as directed by the Engineer.

(g) Rock foundation

Where rock, shale or hard material is encountered on the bottom of excavations a bed of fine material as required for class B bedding shall be placed before laying the pipe.

(h) Concrete encasement

Where instructed by the Engineer pipes shall be encased in concrete. All such encasing shall be done in accordance with the Engineer's instructions and sufficient allowance shall be made for movement joints.

(i) Extension of existing pipelines

Where existing pipelines require extension or where damaged sections are replaced the new sections shall be placed at the same grade and, where they join the existing service, at the same level as the existing pipeline.

Existing chambers or other structures which may obstruct any new work shall be demolished and removed. The demolition and reconstruction of new structures shall be paid for under the relevant sections in the specification.

(j) Construction in existing roads

Road crossings will either be constructed utilising sufficient provision of bypass roads, or they will be done utilising the half width of the road. At all times a through route shall be maintained for all traffic.

(k) Repairing of leaks

Where leaks occur at pipe sockets or collars the effected section will be cut from the pipeline and repaired using repair couplings.

Where obvious leaks occur due to displaced sealing rubbers they will be replaced if the replacement can be done economically by lifting adjacent pipes.

(l) Sewer manholes

All manhole cover frames shall be cast into the concrete cover slabs.

Manholes in trafficable areas shall be provided with heavy duty covers and frames and surrounded by concrete slabs.

(m) Steep sewers

Sewer pipes in the ground with a slope steeper than 1:5 and under surface beds shall be encased in concrete.

(n) External sewers

The sewer outside the boundary of the building complex shall be constructed strictly in accordance with the details and specifications of the Local Authority.

(o) As-built services

Existing drainage invert levels and positions are to be checked against invert levels given on the drawings before work commences. The Engineer must be informed immediately of any discrepancy.

The Contractor shall be responsible for the compilation of as-built plans of sewerage network, showing all pipes, pipe diameters, invert levels and associated structures.

All existing services are to be located and opened before the proposed work commences.

(p) Testing

The drainage system shall be tested according to the specifications laid down by the NBRI. This test shall be carried out in the presence and to the satisfaction and approval of the Engineer.

(q) Ingress of foreign material

During construction all pipe ends are to be suitably plugged to prevent any ingress of dirt, rubble, etc.

(r) CCTV surveys

Modern technology video surveying equipment and detection equipment shall be utilised to establish blockage problems and positions of such problems.

(s) Proximity to buildings

Any drainage pipe within the 45° range below building foundations shall be encased in concrete or soilcrete as specified.

(t) Repair to existing structures

Damaged existing structures shall be demolished to the extent directed by the Engineer on site and the resulting debris shall be spoiled at designated sites.

The reinstatement of damaged sections shall be carried out to the same standards prescribed for new construction and shall be paid for under the relevant items scheduled for new structures.

Provision shall be made for the reinstatement of existing damaged prefabricated concrete half round channels.

(u) Repair to existing channels

Existing channels shall be cleaned. Broken sections of lined channels shall be repaired. Such repair work shall comprise patching of concrete and replacement of precast sections.

**CF 04.02.03 Quality standard**

Pipelines shall be laid at even gradients to the satisfaction of the Engineer and the applicable specifications.

**CF 04.02.04 Materials**

Materials and equipment to be used for repair items shall be suitable and/or adaptable to the existing installation and shall comply with the following:

(a) Manhole covers

Manhole covers, etc, shall have covers and frames complying with SANS 558.

(b) Vitrified clay pipe and fittings

Vitrified clay pipe shall only be used for underground installations. The pipes and fitting shall strictly conform to SANS 559. The pipes and fittings shall have a minimum crushing strength of 45 kN/m.

The joining method to be used shall be polypropylene couplings with integral rubber seal similar or equal to Vitrosleeve in accordance with SANS EN 295: Vitrified clay pipes and fittings and pipe joints for drains and sewers, allowing up to 2,5° angular movement per joint and 5 mm line displacement per joint. The joint shall retain an affective water seal with respect to above conditions with a 6 m water head.

Pipes shall be cut using an approved pipe cutter and the end shall then be trimmed by means of a pipe trimmer to remove any sharp edges.

All fittings underground shall consist of vitrified clay and shall comply with SANS 559.

The piping system shall be tested according to the NBRI information sheet X/BOU 2-34.

**CF 04.02.05 Air test for sewer and drains**

The following air test as specified in the NBRI information sheet X/BOU 2-34 shall be applicable to all air tests on new sewers and drains installed under the repair Contract, and shall be executed by the Contractor and witnessed by the Engineer.

(a) Method of air testing

All openings in the pipeline are plugged by means of sewer testing plugs. The sewer plug at the lowest end of the pipeline is connected to an air supply hose, which is attached to a mechanically driven air blower, compressor or hand pump. Air is pumped into the pipeline at a pressure of approximately 375 mm water gauge. The pressure is held at this level for a period of two minutes to allow the air temperature to become constant. Subsequently the air supply is closed off and the time recorded for the air pressure to drop from 250 to 125 mm water gauge. If the recorded time is less than the value given in the table below, it means that the pipeline is leaking and does not comply with the required standards of tightness. The apparatus required for the air test is commercially available.

The following requirements have to be taken into account when performing the air test:

- (i) Air-permeable pipelines such as vitrified clay or asbestos cement should preferably be tested when moist or wet.
- (ii) The trench shall be partially backfilled before the test is carried out. This is required to stop possible temperature variations and to prevent damage to the pipeline during subsequent backfilling operations.
- (iii) The testing equipment shall be shielded from the direct rays of the sun.
- (iv) Flexible joints are recommended for sewer and drain pipelines. Good quality flexible joints are superior to cement caulked joints and they also provide the pipeline with flexibility to prevent cracking due to subsequent soil movement.
- (v) The test method is very sensitive to flaws in the pipeline, such as cracks or leaking joints. The actual positions of flaws along the pipeline can be determined by using the specialised equipment.
- (vi) If the pipeline is below the water table and subjected to external water pressure, the test method should be modified by the Engineer to ensure that the final pressure value is higher than that of the external water pressure acting on the lowest part of the installation.

The minimum times for pressure drop of 250 mm to 125 mm water gauge are given in table CF 04.02.05/1 below.

TABLE CF 04.02.05/1

PIPE DIAMETER (mm)	MINIMUM TIME (min - s)	CRITICAL LENGTH OF PIPELINE (m) (58 m <sup>2</sup> internal surface area)	MINIMUM TIME(s) FOR LONGER LENGTH (L) OF PIPELINE
100	1 to 58	184,6	0,640 L
150	2 to 57	123,1	1,439 L
200	3 to 56	92,3	2,559 L
225	4 to 26	82,1	3,239 L
250	4 to 55	73,8	3,998 L
300	5 to 54	61,5	5,757 L
375	7 to 23	49,2	8,996 L
450	8 to 51	41,0	12,954 L
525	10 to 20	35,2	17,632 L
600	11 to 49	30,8	23,030 L

#### CF 04.03

#### CLEANING OF SEWERAGE NETWORK

The work involved under this section is the removal of silt, debris and vegetation from within the pipelines and manholes and the general cleaning of areas where leakage has occurred. This can be done either mechanically or chemically according to the more appropriate method as specified by the Engineer.

**CF 04.03.01**      **Construction**

The Contractor shall arrange with the Engineer for an inspection of the pipe route before the cleaning of any pipeline sections is carried out. Based on the inspection, the Engineer will instruct the Contractor as to which sections of the network require cleaning.

Visual inspections utilising closed-circuit TV cameras will not be required unless deemed essential and will be specifically requested by the Engineer.

Sections of the pipeline may be removed for a more detailed inspection. Such sections shall be repaired as specified in Subclause CF 04.02.02. Sections shall only be cut from the pipeline where specifically instructed by the Engineer.

The method to be applied for the cleaning of the pipelines shall be chemical or mechanical. The method to be used for each section of the pipeline will be instructed by the Engineer.

Material removed from the pipes shall be disposed of as instructed by the Engineer.

Where insufficient scour values are present, the method for scouring of the pipelines shall be discussed and agreed with the Engineer prior to implementation.

**CF 04.04**      **REPAIR OF FITTINGS**

**CF 04.04.01**      **Construction**

The Engineer will indicate the fittings that are to be repaired, but these fittings shall not be limited to those specifically indicated by the Engineer.

Repair of the following fittings may be required:

- (a)    Cleaning eyes
- (b)    Permanent plug stoppers
- (c)    Channel sections.

**CF 05**      **TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK**

Except where otherwise provided in the Contract, the Contractor shall provide all labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out such tests. The Contractor shall make arrangements for such tests and he shall give at least 72 hours notice to the Engineer, in writing, prior to commencement of the test.

In the event of the plant or installation not passing the test, the Employer shall be at liberty to deduct from the Contract price all reasonable expenses incurred by the Employer or the Engineer attending the repeated test.

Whenever any installation or equipment is operated for testing or adjusting as provided for above, the Contractor shall operate the entire system for as long a period as may be required to prove satisfactory performance at all times in the occupied space served by that system for up to twenty-four hours a day continuously until the system is handed over.



The Contractor shall provide all labour and supervision required for such operation and the Employer may assign operating personnel as observers, but such observation time shall not be counted as instruction time.

After complete installation of the system all equipment shall be tested, adjusted and readjusted until it operates to the satisfaction and approval of the Engineer.

The Contractor shall submit certificates of tests carried out to prove the quality and proper functioning of all equipment and also certificates to be obtained from all relevant authorities and statutory bodies, etc.

## **CF 06**      **QUALITY ASSURANCE SYSTEM**

The Contractor shall institute an approved quality assurance (QA) system which shall be submitted to the Employer or Engineer for approval. The records of this QA system shall be kept throughout the duration of the Contract and submitted to the Engineer at regular intervals as required.

## **CF 07**      **MAINTENANCE TO INSTALLATION SYSTEMS AND EQUIPMENT**

### **CF 07.01**      **GENERAL**

This part of the Contract shall include routine preventative maintenance, corrective maintenance and breakdown maintenance, as described in Additional Specification SA: General Maintenance, for the specified installations described under the Clause CF 01 of this specification.

The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification SA: General Maintenance, and as specified in the Particular Specification and this specification.

The said maintenance work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws and the manufacturer's specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be implemented by the Contractor.

All new equipment, components and materials supplied and installed under the maintenance Contract shall be furnished with the prescribed manufacturer's guarantees.

The maintenance work and items are to be categorised for each maintenance activity under the following headings:

- (a) Sewerage network systems
- (b) Wastewater treatment systems.

### **CF 07.02**      **ROUTINE PREVENTATIVE MAINTENANCE**

The routine maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance and the Particular Specification related to this work.

The routine maintenance work to be performed and executed shall include, but not be limited to the items listed in table CF 07.02/1. The tendered rate shall include full compensation for all material, plant and labour required in order to perform such maintenance to the satisfaction of the engineer.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

TABLE CF 07.02/1 – SEWERAGE NETWORK SYSTEM

NO	ROUTINE PREVENTATIVE MAINTENANCE ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete installation	Monthly
2	Check, inspect, repair or replace all manhole covers and frames and builder's work to manholes	Four-monthly
3	Check, inspect and repair manhole benching.	Four-monthly
4	Check, inspect, repair or replace all inspection eye, end caps and cleaning eye covers	Four-monthly
5	Check, inspect, report and unblock any blockage that occurs	Monthly
6	Check, inspect, repair/replace and clean out all equipment traps	Monthly
7	Paint repairs to surface piping and equipment	Annually
8	Survey and resultant repairs and unblocking of all main sewer lines	At start of Contract
9	Check, inspect, repair/replace sewer pipes where necessary to maintain good working condition at all times	Four-monthly

#### CF 07.03

#### CORRECTIVE MAINTENANCE

This corrective maintenance of the installations, systems and equipment to be done in accordance with Additional Specification SA: General Maintenance and the Particular Specification related to this work.

The Contractor shall inspect and check all equipment, materials, systems and installation for any pending breakdowns, maladjustments or anomalies of equipment.

The Contractor shall report and take actions to correct such deficiencies.

#### CF 07.04

#### BREAKDOWN MAINTENANCE

Breakdown maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance.

All breakdown problems experienced shall be acted upon within the time limitations allowed in the General Maintenance documents.

All breakdown maintenance shall be done in accordance with the related specifications, standards, regulations and codes.

The Contractor shall have access to the necessary spares, equipment and tools for the expected breakdowns.

**CF 08 MEASUREMENT AND PAYMENT**

**CF.01 SEWERAGE NETWORKS**

**CF.01.01 Repair of existing pipelines ..... Unit: metre (m)**

The unit of measurement shall be per metre length of pipe replaced. In each case the Contractor shall agree on the length of pipe to be replaced and the method of coupling the pipes.

The tendered rate shall include full compensation for cleaning and grubbing, excavation, removal of existing pipeline, dealing with water logged conditions, provision of bedding and additional backfill, bedding and back filling of replacement pipeline, cutting to length, finishing, repair of kerbs, road surfaces, accommodation of traffic, excavation in all materials, removal of unsuitable material from the trench and disposal of surplus materials.

The tendered rate shall include full compensation for all material, plant and labour required to temporarily by-pass (if required) the pipe section being replaced.

The provision of the materials will be measured separately under CF. 01.02.

**CF.01.02 Provision of materials**

**(a) Pipelines ..... Unit: metre (m)**

The unit of measurement shall be the metre of pipe replaced.

**(b) Fittings ..... Unit: number**

The unit of measurement shall be the number of fittings installed.

The tendered rates shall include full compensation for all transport to the place of installation, storage, labour costs.

Separate pay items shall be listed for the pipe materials and fittings per diameter and class and for the class of bedding to be used.

**CF.01.03 Replacement of manhole covers, grid inlets and the like**

**(a) SANS 558 Type 4 - covers, grids, etc, only:**

- (i) Maximum dimension up to 300 mm ..... Unit: number
- (ii) Maximum dimension 301 mm - 600 mm ..... Unit: number
- (iii) Maximum dimension 601 mm - 900 mm ..... Unit: number
- (iv) Maximum dimension over 900 mm ..... Unit: number

**(b) SANS 558 Type 4 - frames only for covers, grids, etc:**

- (i) Maximum dimension up to 300 mm..... Unit: number
- (ii) Maximum dimension 301 mm - 600 mm ..... Unit: number
- (iii) Maximum dimension 601 mm - 900 mm ..... Unit: number
- (iv) Maximum dimension over 900 mm..... Unit: number

(c) SANS 558 Type 2A - covers, grids, etc. only:

- (i) Maximum dimension up to 300 mm..... Unit: number
- (ii) Maximum dimension 301 mm - 600 mm ..... Unit: number
- (iii) Maximum dimension 601 mm - 900 mm ..... Unit: number
- (iv) Maximum dimension over 900 mm..... Unit: number

(d) SANS 558 Type 2A - frames only for covers, grids, etc:

- (i) Maximum dimension up to 300 mm..... Unit: number
- (ii) Maximum dimension 301 mm - 600 mm ..... Unit: number
- (iii) Maximum dimension 601 mm - 900 mm ..... Unit: number
- (iv) Maximum dimension over 900 mm..... Unit: number

The unit of measurement shall be the number of covers or frames installed. The classification of the size of each cover or frame will be based on the nominal dimensions of the cover/unit and not on the actual dimensions.

The tendered rates shall include full compensation for procuring, furnishing and placing the new covers, grids and/or frames. The tendered rates shall also include full compensation for removing and disposing of the damaged covers, grids and/or frames from the site.

**CF.01.04 Manholes and inspection chambers**

**CF.01.04.01 Raising or lowering of existing manholes or inspection chambers of all types:**

- (a) Raise/lower 0 m up to and including 0,5 m ..... Unit: number
- (b) Raise/lower exceeding 0,5 m up to and including 1 m ..... Unit: number

The unit of measurement shall be the number of manholes/inspection chambers raised/lowered within the specified dimensions.

The tendered rates shall include full compensation for all excavation (including around structures), levelling, temporary timbering, shoring and strutting, for preparing the bottom of the excavation for the manhole beds, the disposal of material, dealing with subsurface or surface water, benching and for other operations necessary for completing the work as specified.

Payment shall distinguish between soft and hard material. The tendered rates shall include full compensation for transporting the excavated material from the site.

**CF.01.04.02 Breaking into existing sewer and building a new manhole**

(a) Pre-cast concrete manhole:

- (1) Depth exceeding 0,5 m up to and including 1,0 m..... Unit: number
- (2) Depth exceeding 1,0 m up to and including 1,5 m..... Unit: number
- (3) Depth exceeding 1,5 m up to 2,0 m Unit: number

The unit of measurement shall be the number of manholes constructed within the specified dimensions.

The tendered rate shall include full compensation for excavation, building a new manhole over the sewer, breaking into the existing sewer, building the channelization under wet conditions, ensuring the water tightness of the new connection, supplying all the necessary materials, removing surplus material, all labour and equipment required to make the connection, and liaison with the local authorities. Provision for manhole covers shall be made under CF 01.03 payment.

**CF.01.04.03 Connecting to existing sewer ..... Unit: sum**

The tendered sum shall include full compensation for excavation, making an opening in the existing manhole, installing new pipes in the new opening, for breaking out and modifying the channelization inside the manhole to suit the new pipe layout, ensuring the water tightness of the new connection, supplying all the necessary materials, removing surplus material and debris all labour and equipment required to make the connection, and liaison with the local authorities.

**CF.01.04.04 Repair of channels ..... Unit: metre (m)**

The unit of measurement shall be the length of channel section repaired.

The tendered rate shall include full compensation for cleaning, patching, repairing of existing channels, irrespective of diameter and position. The rate shall also include all necessary materials, equipment and labour required.

**CF.02 CLEANING OF SEWERAGE NETWORK**

**CF.02.01 Mechanical cleaning of sewer pipes and structures:**

- (a) Up to 150 mm ..... Unit: metre
- (b) 151 mm to 300 mm ..... Unit: metre
- (c) 301 mm to 450 mm ..... Unit: metre
- (d) More than 450 mm ..... Unit: metre

The unit of measurement shall be the metre of pipe cleaned, measured once along the soffit of the culvert. For multiple pipes each individual pipe shall be measured separately.

The tendered rates shall include full compensation for removing the material, for disposing of the material in an approved manner and ensuring that the material will not wash into drainage trenches.

**CF.02.02 Chemical cleaning of sewer pipes and structures:**

- (a) Up to and including 150 mm ..... Unit: metre
- (b) 151 mm to 300 mm ..... Unit: metre
- (c) 301 mm to 450 mm ..... Unit: metre
- (d) More than 450 mm ..... Unit: metre

The unit of measurement shall be the metre of pipe cleaned, measured once along the soffit of the culvert. For multiple pipes each individual pipe shall be measured separately.

The tendered rates shall include full compensation for supply of chemical agents, equipment, labour and the effective application of the cleaning process.

**CF.02.03**      **Provision of equipment for visual inspection of underground pipe networks** ..... Unit: lump sum

The tendered sum shall include full compensation for the provision of suitable equipment, such as TV surveillance equipment, torches, lights and mirrors, etc, to enable a thorough visual inspection of the pipe network.

**CF.02.04**      **Use of CCTV surveillance equipment** ..... Unit: metre (m)

The unit of measurement shall be the metre of pipe inspected.

The rate shall be fully inclusive of all associated equipment and interpipe moves and recording equipment.

**CF.02.05**      **Visual inspection of underground pipe network** ..... Unit: sum

The tendered sum shall include full compensation for all processes necessary to complete a thorough check of the sewer network including lifting and replacing manhole covers, using relevant equipment and any clearing necessary to allow the visual inspection to proceed.

**CF.02.06**      **Demolition and removal of damaged existing structures:**

(a)    Plain concrete ..... Unit: cubic metre (m<sup>3</sup>)

(b)    Reinforced concrete..... Unit: cubic metre (m<sup>3</sup>)

(c)    Kerbing and channelling ..... Unit: metre (m)

(d)    Pipework ..... Unit: metre (m)

The unit of measurement for CF.02.06(a) and (b) shall be the cubic metre of existing material demolished, determined from 70 % of the rates cubic metre capacity of the truck used to remove the material.

The unit of measurement for CF.02.06(c) and (d) shall be the metre length of kerbing and channelling or pipework removed.

The tendered rates shall include full compensation for all labour, equipment and tools for removal of the damaged sections, trimming the bedding and for loading, transporting and disposing of the material.

The reinstatement of damaged sections shall be paid for under the relevant items for constructing new structures.

**CF.03**      **TESTS AND INSPECTIONS**

(a)    Pressure testing of pipelines..... Unit: metre

The unit of measurement shall be the length of sewer pipeline tested.

(b)    Testing of manholes ..... Unit: number

The unit of measurement shall be the number of manholes tested after repair.

The tendered rates shall include full compensation for all labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out relevant tests as per SANS 1200. Submission of certificates from tests and equipment and any costs involved in obtaining such from relevant authorities shall also be included in the tendered sum.

## **TECHNICAL SPECIFICATION**

### **CG                    SOLID WASTE**

#### **CONTENTS**

CG 01	SCOPE
CG 02	STANDARD SPECIFICATIONS
CG 03	OPERATING AND MAINTENANCE MANUALS
CG 04	DETAIL OF REPAIR WORK
CG 05	MAINTENANCE
CG 06	MEASUREMENT AND PAYMENT

#### **CG 01                SCOPE**

This specification covers the requirements for maintenance work related to solid waste site and solid waste management.

Monthly maintenance responsibilities for Solid Waste (which forms part of installation A4, Fencing, Cleaning and Site Keeping) including all units and components as specified, shall commence with access to the site (site handover).

#### **CG 02                STANDARD SPECIFICATIONS**

##### **CG.02.01            GUIDELINES**

This specification shall be read in conjunction with the guidelines on solid waste and landfill sites as stipulated by DWAF which shall be deemed to form part of these specifications.

#### **CG 03                OPERATING AND MAINTENANCE MANUALS**

No operating and maintenance manuals will be developed for this section.

The contractor shall use the Maintenance Control Plan (see SA Maintenance) to schedule routine preventative maintenance activities.

#### **CG 04                DETAIL OF REPAIR WORK**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

Any work related to solid waste identified by the Contractor or during inspection by the Engineer shall be carried out on the instruction of the Engineer.

The Contractor shall ensure that the necessary materials, skilled personnel, tools and equipment are available at all times to perform his duties.



The work shall include the collection and removal of litter, rubble and other solid waste across the entire site.

Apart from informal dumps, the Contractor shall be responsible for removing all scattered waste in order to clean the entire site to a clean and healthy state. Collection of solid waste shall be performed under the guidance of the Engineer.

The Contractor shall transport solid waste collected across the entire site to a central container for removal to a disposal site off site. Removal of solid waste from the central container to a disposal site off site shall be the responsibility of the Contractor.

**CG 04.01**      **LITTER COLLECTION**

All litter and rubble shall be collected within the perimeter fences of the various Port of Entry and Border line bases (as reflected on the layout diagrams) and removed and disposed of as specified.

**CG 04.02**      **WASTE COLLECTION**

Waste bins shall be provided at each residential unit. Additional waste bins shall be provided at the offices and service buildings. The waste bins at all residential units shall be cleaned out on a weekly basis. Waste bins in public areas shall be cleaned out daily. The storage of the solid waste at the solid waste disposal area until such time as it is removed from site will be the responsibility of the Contractor in a skip at a central location within the site.

The disposal area shall be prepared and managed by the Contractor. The site shall be fenced-off (1,8 m high diamond mesh) and the entrance gate shall be locked at all times.

**CG 04.03**      **REMOVAL OF SOLID WASTE**

Removal of solid waste from the central solid waste container (skip) to a formal solid waste facility shall be the responsibility of the Contractor.

The existing waste disposal site shall be de-commissioned and backfilled. All waste located at the disposal site shall be relocated to the nearest off site waste disposal site. All waste collected at the Port of Entry shall be relocated to the nearest off site waste disposal site on a weekly basis.

**CG 05**      **MAINTENANCE**

This specification must be read in conjunction with Additional Specification SA: General Maintenance.

The whole of the site within the perimeter fences of the Kosi Bay Port of Entry (as reflected on the layout diagrams) shall be kept free of litter, rubble and other solid waste. Litter and rubble (solid waste) shall be collected, stored by the Contractor and removed from the site as frequently as necessary, but at least weekly by the Contractor.

Storage of the collected solid waste until such time as it is removed from site shall be the responsibility of the Contractor. Solid waste shall be removed from the residential units to the waste disposal site at least weekly. Solid waste shall be removed from the central solid waste container (skip) provided by the contractor as frequently as necessary, but at least weekly.

Removal of household solid waste to the municipal/approved dump site will still be carried out by the Contractor. The cleanliness of the site, excluding all areas included within residential fences, will be the responsibility of the Contractor.

Garden refuse are amongst the litter and rubble to be collected and disposed of by the Contractor.

Solid waste maintenance forms part of Installation A4. The tendered monthly payment for maintenance of Installation A4 as based on the point system and listed in the schedule of quantities, shall be deemed to include all labour, material, tools, equipment and transport required to continuously collect litter and rubble across the entire site, placing it in a central solid waste container (skip) provided by the contractor and removing it off-site to a formal solid waste facility at least weekly.

TABLE CG 05/1: SUMMARY OF MAINTENANCE RESPONSIBILITY

NO	ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Cleaning out of all waste bins in public areas	Daily
2	Cleaning out of all waste bins at residential units	Weekly
3	Collect litter, rubble and other waste across the entire site within the perimeter fences of the Port of Entry and place in central solid waste container (skip)	Continuously
4	Remove waste from skip to external approved waste disposal site	Weekly

**CG 06 MEASUREMENT AND PAYMENT**

**CG.01 DISPOSAL OF LITTER ..... Unit: cubic metre (m<sup>3</sup>)**

The unit of measurement shall be the cubic metre of litter, building rubble and other waste material removed from the site, irrespective of the type of material. The quantity shall be determined from 70 % of the rated cubic metre capacity of the truck used to remove the material.

Only litter, building rubble and other waste removed on instruction from the Engineer shall be measured for payment.

The tendered rates shall include full compensation for all labour, equipment and tools for collecting, loading, transporting and disposing of the material from the site to an approved dumping site, off site.

**CG.02 LEVELLING OF SITE ..... Unit: m<sup>2</sup>**

The unit of measurement shall be the surface area of the site to be graded.

The importation of additional material shall be paid under CG.03.

**CG.03 IMPORTATION OF FILL MATERIAL ..... Unit: m<sup>3</sup>**

The unit of measurement shall be cubic metres of fill measured as the transported volume. The rate shall be inclusive of excavation, transport and the distribution of the material at the disposal site.

**CG.04**                    **COVERING OF DUMPING SITE**

(a)    Lime cover ..... Unit: m<sup>2</sup>

The unit of measurement shall be the square metre of area covered with lime.

The tendered rate shall include provision of lime, spreading and finishing of the lime to a minimum depth of 20 mm.

(b)    Topsoil cover ..... Unit: m<sup>2</sup>

The unit of measurement shall be the square metre of area of topsoil placed.

The tendered rate shall include provision of topsoil, spreading and finishing of the material to a depth of 300 mm.

**CG.05**                    **SUPPLY OF WASTE BINS** ..... Unit: number

The unit of measurement shall be the number of waste bins supplied as described in the schedule of quantities.

The tendered rates shall include full compensation for the supply, transportation and placing of the waste bins.

**CG.06**                    **WASTE COLLECTION SKIP** ..... Unit: sum

The unit of measurement shall be a sum for the provision of a single skip at a central location within the site.

The tendered rate shall be fully inclusive of supply and installation of the skip to the site required including 1.8m high diamond fence around the skip with a lockable gate.

**CG.07**                    **OVERHAUL ON MATERIAL FOR HAUL**  
**IN EXCESS OF 1,0 km:** .....  
Unit: cubic metre per kilometre (m<sup>3</sup>-km)

The unit of measurement shall be the cubic metre of material hauled in excess of 1,0 km, measured according to the rated capacity of the truck used, multiplied by the average overhaul distance.

The tendered rate shall include full compensation for hauling the material in excess of the free-haul distance.

## TECHNICAL SPECIFICATION

### CI            PRESSED STEEL TANKS

#### CONTENTS

CI 01	SCOPE
CI 02	STANDARD SPECIFICATIONS
CI 03	OPERATING AND MAINTENANCE MANUALS
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CI 06	QUALITY ASSURANCE SYSTEM
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CI 08	MEASUREMENT AND PAYMENT

#### CI 01            SCOPE

This specification covers the materials, equipment, methods, testing and work required for the repair and maintenance of pressed steel tanks for the storage of potable water:

<b>Port of Entry</b>	<b>Elevated Tanks</b>
Kosi Bay	10 m <sup>3</sup> - 12 m high

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with portion 3: Additional Specifications included in this document.

Where a particular specification has been included in the documents to supplement Technical Specification CI: PRESSED STEEL TANKS, this technical specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence. The Contractor shall at all times adhere to this technical specification, unless otherwise specified in the applicable Particular Specification.

#### CI 02            STANDARD SPECIFICATIONS

##### CI 02.01            GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

CKS 114 - PRESSED STEEL SECTIONAL TANKS

##### CI 02.02            OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) shall be adhered to.

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1993: CONSTRUCTION REGULATIONS, 2003 as

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promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

**CI 02.03      MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

**CI 02.04      MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**CI 03      OPERATING AND MAINTENANCE MANUALS**

No operating and maintenance manuals will be required for pressed steel tanks.

**CI 04      EXECUTION OF REPAIR WORK**

**CI 04.01      GENERAL**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

At the start of the repair and maintenance Contract all the systems, installations and equipment shall be repaired as specified in the Specification. This repair work shall include but not be limited to the specified Specification details.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve.

All materials and equipment shall comply fully with the requirements as specified for each installation.

The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and particular specifications included in this document.

All new equipment, materials and systems shall be furnished with a written guarantee with a defects liability period of 12 months from date of completion of repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

**CI 04.02****REPAIR OF PRESSED STEEL PANEL RESERVOIRS**

Tanks shall be disassembled, cleaned, reconstructed, sealed and re-commissioned. All work shall be in compliance with the requirements of CKS 114 (Pressed steel sectional tanks).

- (a) The water level indicators located on the tanks shall be repaired to a perfect functional condition;
- (b) A COPON KSIR88 internal lining consisting of two coats with a total thickness of 275 micron shall be applied.
- (c) Sealing strips or sealing compound of a type suitable for an extremely hot, arid climate to be applied between the plate flanges. Sealing to be non-toxic and approved for use with drinking water;
- (d) All bolts, washers, nuts etc. used for the fastening of plate flanges and other components shall be discarded and new bolts, nuts, washers etc. supplied for the fastening of plate flanges etc.;
- (e) All external pipe connection points to the tank shall be flanged to SANS 1123 table 1600/3. All pipe work outside the tank, connecting to flanges as mentioned above, will be measured elsewhere;
- (f) The tank together with the stand, ladders, walkways, panels and all other components forming part of the tank and its accompanying stand shall be treated and painted in accordance with Technical Specification BJ (BJ 03.01 .03 Paint Specification for various components: (c) Metalwork; (2) Exterior: Previously painted metalwork).

All mild steel tank components, structural steel stand, walkway and ladders including bolts, nuts and washers shall be hot-dipped galvanized after manufacture to the requirements of SABS 763. This includes any pipe fittings, etc for connections.

The tanks shall be tested for watertightness after completion to the satisfaction of the Engineer and shall also be sterilized by the contractor after completion.

For all details of the tank, internal and external bracing, COPON lining, stand, walkway and ladders, written approval of the Engineer shall be obtained before manufacture. Workshop drawings shall be submitted to the Engineer timeously for his final approval of the concrete footings and the bending schedules.

All external pipe connection points supplied with tank shall be flanged to SABS 1123 table 1600/3, unless otherwise specified

**CI 04.03****LIGHTNING PROTECTION**

The reservoirs shall be protected from the effects of lightning by the installation of a lightning-protection system which complies with the requirements of SABS Code of Practice 03.

The Contractor shall obtain the services of a firm specialising in the supply and installation of such systems. The firm which shall be approved by the Engineer, shall timeously submit drawings of the system to the South African Bureau of Standards for approval, and work may commence only after the approved plan has been submitted to the Engineer.

**CI 04.04      STERILIZATION OF RESERVOIR**

Before the reservoir is sterilized, the pipelines serving the reservoir shall have been sterilized. The reservoir shall then be thoroughly cleaned out and washed down with clean water.

The roof and walls shall thereafter be thoroughly sprayed down, using pressurised equipment, and the floors shall be scrubbed with the solution specified in subclause 5.10 of SABS 1200 L.

On completion of the sterilization, the sterilizing solution shall be run to waste before the reservoir is filled for testing water tightness.

Should additional work be required to be done inside the reservoir after the water tightness tests has been completed, the reservoir shall be resterilized at the Contractor's expense.

**CI 04.05      TESTING FOR WATERTIGHTNESS**

Water for testing shall be provided by the contractor and he shall be responsible for providing all necessary equipment required for filling the reservoir.

The reservoir shall be filled with water at a uniform rate until the top water level has been reached. The water level will then be carefully noted and recorded by the Engineer in relation to a fixed bench-mark.

The level of the liquid surface shall be recorded at 24 hour intervals for a test period of 7 days. During this 7-day test period the total permissible drop in level, after allowing for evaporation, shall be determined by the Engineer.

In the event of appreciable leakage being evident at any stage of the filling or testing or in the event of the Engineer considering the final degree of watertightness to be unsatisfactory, the Contractor when ordered by the Engineer shall discontinue such filling or testing and shall, at his own expense, take approved steps immediately to rectify the leakage until a satisfactory test is obtained, which shall prove to the Engineer that watertightness has been obtained.

The costs of emptying the reservoir shall be borne by the Contractor. The water shall be discharged in a manner approved by the Engineer and shall be such that the Employer can utilise the water if he so desires.

The water shall not be used as a medium for additives to effect remedial work or to stop leaks.

The costs of retesting the structure for watertightness shall be borne by the Contractor.

**CI 04.06      ENGINEER'S CERTIFICATE**

The Contractor shall obtain a certificate from a registered professional engineer stating that the tank, stand, ladders, walkway and tank lining have all been designed and manufactured in accordance with accepted engineering standards. This certificate shall cover all the tanks installed under the contract, but shall also refer to each tank individually. No payment shall be made for any of the tanks until such time as when the certificate has been provided to the Engineer and the Engineer finds it to be legitimate and acceptable.

**CI 05 TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK**

Except where otherwise provided in the Contract, the Contractor shall provide all labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out such tests. The Contractor shall make arrangements for such tests and he shall give at least 72 hours notice to the Engineer, in writing, prior to commencement of the test.

In the event of the plant or installation not passing the test, the Employer shall be at liberty to deduct from the Contract price all reasonable expenses incurred by the Employer or the Engineer attending the repeated test.

Whenever any installation or equipment is operated for testing or adjusting as provided for above, the Contractor shall operate the entire system for as long a period as may be required to prove satisfactory performance at all times in the occupied space served by that system for up to twenty-four hours a day continuously until the system is handed over.

The Contractor shall provide all labour and supervision required for such operation and the Employer may assign operating personnel as observers, but such observation time shall not be counted as instruction time.

After complete installation of the system all equipment shall be tested, adjusted and readjusted until it operates to the satisfaction and approval of the Engineer.

The Contractor shall submit certificates of tests carried out to prove the quality and proper functioning of all equipment and also certificates to be obtained from all relevant authorities and statutory bodies, etc.

**CI 06 QUALITY ASSURANCE SYSTEM**

The Contractor shall institute an approved quality assurance (QA) system which shall be submitted to the Employer or Engineer for approval. The records of this QA system shall be kept throughout the duration of the Contract and submitted to the Engineer at regular intervals as required.

**CI 07 MAINTENANCE TO INSTALLATION SYSTEMS AND EQUIPMENT**

**CI 07.01 GENERAL**

This part of the Contract shall include routine preventative maintenance, corrective maintenance and breakdown maintenance, as described in Additional Specification SA: General Maintenance, for the specified installations described under the Clause CI 01 of this specification.

The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification SA: General Maintenance, and as specified in this specification.

The said maintenance work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws and the manufacturer's specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be implemented by the Contractor.



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All new equipment, components and materials supplied and installed under the maintenance Contract shall be furnished with the prescribed manufacturer's guarantees.

**CI 07.02      ROUTINE PREVENTATIVE MAINTENANCE**

The routine maintenance of the installations, systems and equipment shall be done in accordance with Additional Specification SA: General Maintenance and the Specification related to this work.

TABLE CI 07.01    MAINTENANCE OF PRESSED STEEL TANKS

NO	ROUTINE PREVENTATIVE MAINTENANCE OF PRESSED STEEL TANKS AND ANCILLARIES	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system.	Monthly
2	Check for and repair all leaks. Report leaks.	Monthly
3	Corrosion protection.	Bi-annually
4	Test lightning protection.	Annually
5	Clean and sterilise pressed steel tank	Bi-annually

**CI 08      MEASUREMENT AND PAYMENT**

**CI.01      Manufacture, supply and erection of a (specify size) kilolitre storage tank complete with (specify height) m high galvanized steel stand .....Unit: sum**

The tendered sum shall include full compensation for procuring and furnishing all materials, labour, equipment, transport, loading, off-loading, assembly and erection of the tank and stand, complete as scheduled with all pipework connections, level indicator, and accessories, stand, platform, walkway, handrailing ladders, holding down bolts, anchor bolts and grouting of base plates, as well as for all corrosion protection as specified, all in accordance with the specification, drawings and manufacturer's instructions.

Where the storage tank is erected on plinths or dwarf foundation walls and not on a steel stand, it shall be scheduled as such and the tendered rate shall include bearer beams as necessary and shown on the drawings.

Note:      Excavations, footings, plinths, dwarf foundation walls, etc, will be measured and paid for elsewhere, as well as external GMS pipework, specials and valves connecting to flanges.

**CI.02      Disassembling, repair, cleaning, painting, re-sealing, re-constructing and re-commissioning of a (specify size) kilo litre storage tank.....Unit: number**

The unit of measurement shall be the number of storage tanks disassembled, repaired, cleaned, painted, re-sealed, re-constructed and re-commissioned.

The tendered rate shall include full compensation for procuring and furnishing all materials, labour, equipment, transport, loading, off-loading, disassembly, assembly and erection of the tank, complete as scheduled with all pipe work connections, level indicator, and accessories, stand, platform, walkway, hand

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railing ladders, holding down bolts, anchor bolts and grouting of base plates, as well as for all corrosion protection, cleaning and painting as specified (Clause CI 04.02), all in accordance with the specification, drawings and manufacturer's instructions.

**CI.03**      **Lightning protection for (specify size) kilolitre storage tank.....Unit: sum**

The unit of measurement shall be the number of storage tanks for which lightning protection is provided.

The tendered sum shall include full compensation for obtaining SABS approval of the drawings, and for installing and testing the lightning-protection system on the structure as specified on the approved drawings.

**CI.04**      **Sterilization of (specify size) kilolitre storage tank ..... Unit: sum**

The unit of measurement shall be the number of storage tanks which are sterilized.

The tendered sum shall include full compensation for sterilizing the structure as specified in Clause CI 04.04.

**CI.05**      **Testing for water tightness (specify size) kilolitre storage tank.....Unit: sum**

The unit of measurement shall be the number of storage tanks tested for water tightness.

The tendered sum shall include full compensation for the provision of all labour, plant, materials and water for testing as necessary to carry out the test as specified. Only one test per tank shall be measured for payment, regardless of the number of tests carried out to determine water tightness as per Clause CI 04.05.

**CI.06**      **Engineer's certificate ..... Unit: sum**

The unit of measurement shall be the number of storage tanks for which an Engineer's certificate is obtained.

The tendered sum shall include full compensation for obtaining the certificate as specified in Clause CI 04.06 to the satisfaction of the Engineer. One certificate shall be obtained in respect of all the tanks supplied and installed under this contract."

**CI.07**      **Installation of 'LevelDex' hydraulic level control valve.....Unit: number**

The unit of measurement shall be the number of level control valves installed.

The tendered rate shall include full compensation for the provision of all labour, plant, materials, equipment and installation for installing a 'LevelDex' hydraulic, differential area level control valve. Size to be specified.

**CI.08**      **Dismantling and removal of existing tanks (description given).....Unit: sum**

The unit of measurement shall be a sum.

The tendered rate shall include full compensation for the provision of all labour, plant, materials and transport necessary to dismantle and remove the existing tanks and steel stands from site.

**CI.09**      **Supply, delivery and installation of a storage tank.....Unit: number**

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The unit of measurement shall be the number of storage tanks manufactured, delivered and installed.

The tendered rate shall include full compensation for procuring and furnishing all materials, labour, equipment, transport, loading, off-loading, assembly and erection of the tank, complete as scheduled with all pipe work connections, level indicator, and accessories, stand (including layerwork and concrete foundations), platform, walkway, hand railing ladders, holding down bolts, anchor bolts and grouting of base plates, as well as for all corrosion protection, cleaning and painting as specified (Clause CI 04.02), all in accordance with the specification, drawings and manufacturer's instructions.

**CI.10**      **Painting of storage tankstand**.....Unit: number

The unit of measurement shall be the number of storage tank structures painted.

The tendered rate shall include full compensation for procuring and furnishing all materials, tools, labour and equipment, corrosion protection, cleaning and painting as specified (Clause CI 04.02) of the steel tanks stand, including all pipe work, platform, walkway, hand railing, ladders, etc., all in accordance with the specification, drawings and engineer's instructions.

**CI.11**      **Disassembling and removal from site of a polyethelene tank and its steelstand**.....Unit: number

The unit of measurement shall be the number of polyethelene storage tanks and steel stands decommissioned, and removed from site.

The tendered rate shall include full compensation for all materials, labour, equipment and transport necessary for the disassembly, loading, off-loading, of the polyethelene tank and steel stand up to and including the dimensions listed in the schedule of quantities. The tendered rate includes the disassembling of all pipe work connections, level indicators, accessories, platforms, walkway, hand railing ladders, holding down bolts, anchor bolts base plates and the removal of all materials off site.

The size of the polyethelene storage tank and the height of the stand shall be specified in the Bill of Quantities.

**CI.12**      **Supply and installation of permanent fixed access ladder for a pressed steeltank on a steel stand**.....Unit : number

The unit of measurement shall be the number of access ladders supplied and installed on a pressed steel tank with dimensions up to and including the dimensions listed in the schedule of quantities.

The tendered rate shall include full compensation for the provision of all labour, materials and equipment necessary to provide, design and install a fixed ladder in accordance with SANS 10329 - The design and construction of sectional steel tanks for storage of liquids at or above ground level.

**CI.13**      **Testing of the earth installation of a pressed steel tank on a steel standby a specialist contractor** .....Unit: number

The tendered rate shall include full compensation for the testing of the earth installation of a pressed steel sectional tank for the dimensions listed in the schedule of quantities. The testing shall be done by a specialist contractor approved by the Engineer.

The size of the sectional steel tank and the height of the stand shall be specified in the Bill of Quantities.

**TECHNICAL SPECIFICATION****CJ SITE KEEPING AND CLEANING****CONTENTS**

CJ 01	SCOPE
CJ 02	STANDARD SPECIFICATIONS
CJ 03	EXECUTION OF REPAIR WORK
CJ 04	MAINTENANCE
CJ 05	MEASUREMENT AND PAYMENT

**CJ 01 SCOPE**

This specification covers the cleaning and site keeping of the facilities at the various installations. The scope of work has been divided into:

- Site keeping; and
- Cleaning of offices and support facilities

**CJ 01.01 SITE KEEPING**

The area where site keeping is to be performed is the area included within the perimeter fence of the applicable installation and all areas falling within fenced-in residential properties (See Table CJ 01.01). Site keeping will include removal of rubble, removal of weeds, shrubs and other objects and cutting of the grass.

**CJ 01.01.01 TABLE: OPEN AREAS**

TABLE CJ 01.01.01: AREAS

NO	LOCATION	AREA	DESCRIPTION
1	Kosi Bay Port of Entry Open Area (Site Keeping)	5 700 m <sup>2</sup>	All areas included within the perimeter fence and all areas falling within fenced in residential properties.
2	Residential Area (Site Keeping)	2500 m <sup>2</sup>	Open Areas

**CJ 01.02 CLEANING OF OFFICES AND SUPPORT FACILITIES**

All offices, ablutions and support buildings are to be cleaned and maintained in a sanitary condition at all times. Table CJ 01.02 indicates the facilities where cleaning are to be executed.

TABLE CJ 01.02: BUILDINGS

NO.	LOCATION	FLOOR AREA	DESCRIPTION
1	<b>Kosi bay Port of Entry</b>		
	<u>Office Buildings:</u> 1) One Building	100 m <sup>2</sup>	No of rooms: 4 100 m <sup>2</sup> floor tiles Exterior walls: Face Brick Interior walls: Plastered & Painted Face Brick 25 m <sup>2</sup> windows
	<u>Police Mobile Offices:</u> Two buildings	60 m <sup>2</sup>	No of rooms: 5 60 m <sup>2</sup> floor tiles Exterior walls: Steel Baked Enamel Interior walls: Wall Paper 10 m <sup>2</sup> windows
	<u>Agricultural Mobile Offices:</u> One Building	18 m <sup>2</sup>	No of rooms: 2 18 m <sup>2</sup> Floor sheeting Exterior walls: Steel Baked Enamel Interior walls: Steel Baked Enamel 4 m <sup>2</sup> windows
	<u>Generator &amp; Store rooms:</u> One Building	58 m <sup>2</sup>	No of rooms: 3 43 m <sup>2</sup> screed floor Exterior walls: Face Brick Interior walls: Plastered & Painted
1.5	<u>Ablution</u> One Building	40 m <sup>2</sup>	No of rooms: 2 40 m <sup>2</sup> tiled floor Walls: Face Brick 1.2 m <sup>2</sup> windows 25 Plumbing points 2 Drainage points

**CJ 01.03 ABLUTION EQUIPMENT AND CLEANING AGENTS**

All offices, ablutions and support buildings are equipped with sanitizing and ablu-tion equipment which must be maintained at all times. The following indicates the equipment that must be maintained in working order as well as providing of consumables such as toilet paper, hand-wash soap, air fresheners refills, sanitizer refills and plastic refuse bags for all waste bins and sanitary bins which will be the responsibility of the Contractor.

TABLE CJ 01.03: EQUIPMENT

	Hand Dryers (No)	Air Freshener	Toilet Roll Holders	She Bins	Soap Dis-pensers	Urinal Sanitizers	Paper Dispenser
QTY	2	2	10	5	5	3	4

**CJ 02 STANDARD SPECIFICATIONS**

**CJ 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof.

CODE	DESCRIPTION
CKS 285-1971	Dispensers for paper towels
CKS 340-1979	Plastic Refuse Bags (Disposable)
SANS 1344:2009	Medium duty solvent detergent
SABS 1868	Gel detergent cleaner (non-abrasive)
SANS 1887-1:2008	Tissue paper Part 1: General requirements
SANS 1887-2:2008	Tissue paper Part 2: Toilet paper
SANS 1887-4:2008	Tissue paper Part 4: Paper towels
SANS 1924:2007	Toilet soaps intended for use in dispensers
SANS 60335-1:2007	Household and similar electrical appliances -- Safety Part 1: General requirements
SANS 60335-2-67:2003	Household and similar electrical appliances – Safety Part 2-67: Particular requirements for floor treatment and floor cleaning machines, for industrial and commercial use

**CJ 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

The Contractor shall be required to comply with the Occupational Health and Safety Act 85 of 1993, Construction Regulations 2004 and related regulations. Non-compliance with these regulations, in any way whatsoever, will be adequate reason for suspending the Works.

**CJ 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturer's specifications, instructions and codes of practice.

**CJ 02.04**      **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**CJ 03**      **EXECUTION OF WORK**

**CJ 03.01**      **GENERAL**

The Contractor shall ensure that the necessary materials, skilled personnel, tools and equipment are available at all times to accommodate the site keeping and cleaning of the facilities.

The Contractor shall be responsible for cleaning ablution facilities as frequently as necessary to maintain them in a clean and healthy condition. The actions outlined serve only as a benchmark for the cleaning and maintaining of the facilities.

The ablution facilities and operational buildings will be kept clean during the operational periods of the Port of Entry as indicated below:

- (i) Kosi Bay Port of Entry is operational from 08:00 – 18:00.

Cleaning activities will include providing all cleaning agents and equipment necessary for cleaning.

Providing of consumables such as toilet paper, hand-wash soap, air fresheners refills, sanitizer refills and plastic refuse bags for all waste bins and sanitary bins will be the responsibility of the Contractor.

**CJ 03.02**      **ABLUTIONS**

Each ablution facility shall be equipped with the following equipment:

- 1) Hand Dryer
- 2) Stainless steel air freshener
- 3) Stainless steel toilet paper dispenser units
- 4) Stainless steel she bins
- 5) Stainless steel hand soap dispensers
- 6) Stainless steel sanitizer
- 7) Stainless steel paper towel dispenser
- 8) Stainless steel wall bin

**CJ 03.02.01**      **Hand Dryer**

The hand dryer unit shall comply with at least the following specifications:

- Blower Output: 450 Watt @ 20,000 rpm
- Air Heater Output: 900 W
- Air Flow Rate: 81 metres per second @ 100 mm from the air outlet nozzle
- Air Temperature: 55 °C @ 100 mm from the air outlet nozzle

The hand dryers units shall be of the wall mounted kind and shall be installed in accordance with the manufacturer's specifications.

**CJ 03.02.02 Air Freshener Doser**

The stainless steel air freshener dosing units shall be battery operated, wall mounted and lockable. The device shall possess an adjustable automatic timer between at least 5 to 30 minutes and the aerosol spray shall be metered.

**CJ 03.02.03 Toilet Paper Dispensing Unit**

The stainless steel toilet paper dispensing units shall be able to accommodate two standard size 500 sheet single-ply toilet paper rolls and shall be lockable. The device shall be wall mounted.

**CJ 03.02.04 She Bin**

One stainless steel she bin shall be supplied for each of the female ablutions. The she bins shall possess a self-closing lid and shall accommodate for plastic bag liners which can be removed and replaced with a new liner.

**CJ 03.02.05 Hand Soap Dispenser**

There shall be at least one stainless steel liquid hand soap dispenser per ablution. The liquid soap dispenser shall be of the wall mounted kind. The dispenser shall dispense a metered amount of liquid soap.

**CJ 03.02.06 Urinal Sanitiser Dispenser**

There shall be one stainless steel, battery operated, wall mounted, urinal sanitiser dispenser per urinal.

**CJ 03.02.07 Paper Towel Dispenser**

The paper towel dispenser shall comply with CKS 285-1971. The unit shall be a Type 2, closed dispenser designed to dispense paper towels in sheets.

There shall be at least one stainless steel wall mounted paper towel dispenser per ablution.

**CJ 03.02.08 Wall Bin**

There shall be one stainless steel wall bin per ablution. The wall bin shall possess a self-closing lid and shall accommodate for plastic bag liners which may be removed and replaced with a new liner. The device shall be wall mounted.

**CJ 04 MAINTENANCE**

**CJ 04.01 GENERAL**

The maintenance work to be performed under site keeping and cleaning shall be done strictly in accordance with Additional Specification SA: General Maintenance, and as specified in this specification.

Maintenance implies and shall include routine cleaning (which is the equivalent of routine preventative maintenance), routine preventative maintenance of site keeping and cleaning equipment, corrective cleaning (which is the equivalent of corrective maintenance), corrective maintenance of site keeping and cleaning equipment as well as breakdown maintenance of all site keeping and cleaning equipment.



The maintenance scope in terms of site keeping is set out in table CJ 01.01.01.

The maintenance scope in terms of cleaning is set out in table CJ 01.02

The maintenance scope in terms of equipment is set out in table CJ 01.03.

Monthly maintenance responsibilities for site keeping and cleaning of installations shall commence with access to the site. The maintenance schedules and frequency shall be developed under the maintenance control plan to be implemented by the Contractor.

Remuneration for maintenance of site keeping and cleaning will be deemed included in the tendered monthly payment for maintenance based on the point system, as described in Additional Specification SA: General Maintenance and in accordance with installation: A4: Cleaning and Site Keeping.

#### **CJ 04.02**      **ROUTINE PREVENTATIVE MAINTENANCE**

The tasks related to routine preventative maintenance work shall include but not be limited to the general actions listed in table CJ 04.02.01 and CJ 04.02.01 and CJ 04.02.03 below.

Please note that the operational times for the Port of Entry is from as follows

- (i) Kosi Bay Port of Entry is operational from 08:00 – 18:00.

TABLE CJ 04.02.01: SITE KEEPING

No	ROUTINE PREVENTATIVE MAINTENANCE TASKS	FREQUENCY
1.	Cleaning out of and supply of black refuse bags to all waste bins in public areas.	At least daily
2.	Watering of plants, shrubs, grass and trees	Weekly
3.	Removal of weeds	Weekly
4.	Clearing of weeds and grass along the edges of paved areas.	Weekly
5.	Cutting of grass. <i>No grass to exceed the length of 50 mm.</i>	Monthly
6.	Cutting of grass at residential units. <i>No grass to exceed the length of 30 mm.</i>	Weekly
7.	Restore lawns	Monthly
8.	Trimming of dense shrubs.	2 Monthly
9.	Fertilisation of lawns	Quarterly
10.	Fertilisation of flower beds and trees	Quarterly
11.	Removal of undesirable shrubs	Quarterly

No	ROUTINE PREVENTATIVE MAINTENANCE TASKS	FREQUENCY
12.	Trimming of trees where branches cause obstruction.	Quarterly
13.	Collecting of litter and foreign objects.	Continuous

TABLE CJ 04.02.02: CLEANING OF OFFICES AND SUPPORT FACILITIES

	ACTION	FREQUENCY
1.	Cleaning of floors in public areas and open plan offices	Daily (before opening of port of entry)
2.	Cleaning of counter tops and under counter shelves in public areas and open plan offices.	Daily (before opening of port of entry)
3.	Emptying of waste baskets in offices and service buildings	Daily
4.	Cleaning of office floors	Daily
5.	Vacuum carpets	Weekly
6.	Clean carpets	Six Monthly
7.	Washing of windows and dusting of window sills and ledges	Weekly
8.	Clean and polish all fittings	Weekly
9.	Washing of interior and exterior walls	Monthly
10.	Dusting of interior of the building to remove dust and spider webs	Weekly
8.	Clean and polish all vinyl floors	Monthly

TABLE CJ 04.02.03: CLEANING OF ABLUTION FACILITIES

	ACTION	FREQUENCY
1.	Cleaning and ensuring that the ablution facilities are in a sanitary condition	Continuous
2.	Washing and cleaning of floors	Daily
3.	Empty and clean all waste receptacles	Daily
4.	Clean all bowls, basins and urinals	Daily
5.	Clean and polish all fittings and mirrors	Daily
6.	Washing and cleaning out of the bins	Twice weekly

	ACTION	FREQUENCY
7.	Washing of windows and dusting of window sills, ledges, pipes and fittings	Weekly
8.	Washing of walls	Weekly
9.	Dusting of interior of the building to remove dust and spider webs	Weekly

**CJ 04.03**     **SITE KEEPING AND CLEANING EQUIPMENT**

All site keeping and cleaning equipment will be supplied by the Contractor and shall be maintained in a perfect working order for the duration of the Contract period. Remuneration for provision of cleaning equipment will be deemed included in the monthly tendered monthly payment for maintenance based on the point system, as described in Additional Specification SA: General Maintenance.

**CJ 04.03.01**     **Grass, Shrub and Tree Cutting Equipment**

Distinction will be made amongst 4 different types of grass, shrub and tree cutting equipment:

1. Light duty grass and shrub cutter (Weed Eater)

The light duty grass and shrub cutter shall be similar to a light duty Brushcutter and comply with the following:

Nylon or blade head;  
 Minimum displacement of 40.2 cm<sup>3</sup>;  
 Minimum power output of 1.6 kW; and  
 Length of 1.77 m.

2. Heavy duty shrub and tree cutter

The heavy duty shrub and tree cutter shall be similar to a heavy duty Brushcutter and comply with the following:

Blade head;  
 Minimum displacement of 51.7 cm<sup>3</sup>;  
 Minimum power output of 2.4 kW;  
 Length of 1.69 m.

3. Lawn mower for small lawns

The lawn mower for small lawns to be used at the residential areas shall comply with at least the following:

Walk behind 4 stroke petrol self propelled rotary mower;  
 Power output of 4 kW;  
 422 mm cutting width;  
 200 mm heavy duty sealed ball bearing wheels; and  
 54 litre polymer catcher with metal lining.

4. Lawn mower for large lawns

The lawn mower for large lawns shall comply with at least the following:

Walk behind 4 stroke petrol self propelled rotary mower;  
Power output of 12 kW;  
750 mm cutting width;  
Rubber wheels.

**CJ 04.03.02 Vacuum Cleaner**

Vacuum cleaners shall be wet and dry and comply with at least the following:

Tank capacity: 25 litre  
Cable length: 10 m  
Airflow rate: 56 litre per second

**CJ 04.03.03 Carpet Cleaner**

Carpet cleaners shall comply with at least the following:

Tank capacity fresh water: 40 litre  
Tank capacity dirty water: 25 litre  
Cable length: 10 m  
Suction motor: 2 x 1250 W;  
Airflow rate: 2 x 60 litre per second  
Pump delivery: 2.8 litre per minute @ 3 bar

Carpet cleaners shall be similar to Wetrok's Extravac 400.

**CJ 04.03.04 Mop and bucket system**

A two bucket mopping system shall be provided and be fitted with metal wringers. The mops provided shall be suitable for use with the buckets provided.

Mop and bucket systems shall be similar to Wetroks Socar L40.

**CJ 04.03.05 Window cleaning kit**

Window cleaners shall have a telescopic handle with a length of 0.5 to 3 m. It shall be possible to fit squeegees and brushes to the telescopic handle as required in order to clean windows. A bucket with capacity of at least 10 liter shall be provided that is suitable for use with the window cleaning kit.

**CJ 04.03.06 Sign boards**

Sign boards shall be yellow in colour, free standing and printed on both sides. It shall clearly indicate the dangerous situation.

**CJ 04.04 CONSUMABLES FOR SITE KEEPING AND CLEANING**

Provision of consumables will be the responsibility of the Contractor. Remuneration for provision of consumables will be deemed included in the monthly tendered monthly payment for maintenance based on the point system, as described in Additional Specification SA: General Maintenance.

**CJ 04.04.01 Refuse Bags**

Refuse bags shall comply with CKS 340-1979.

**CJ 04.04.02 Toilet Paper**

Toilet paper shall comply with SANS 1887 Part 1 & Part 2.

Toilet paper provided shall be single-ply, soft with a nominal number of 500 sheets per roll and a nominal outside diameter of 125 mm.

**CJ 04.04.03 Toilet soap for hand soap dispensers**

Toilet soap shall comply with SANS 1924:2007 – Toilet soaps intended for use in dispensers.

Toilet soap shall be Type 1, liquid toilet soap and shall be perfumed. The toilet soap shall be suitable for use in the hand soap dispensers provided.

**CJ 04.04.04 Biological detergent for urinal dispenser**

The urinal dispenser detergent may not contain any disinfectants. A biological detergent shall be used. The biological detergent shall have an EU ECO-LABEL accreditation and shall be endorsed by Indalo Yethu (South Africa's official environmental campaign)

The biological detergent shall be similar to nu flush from innu-science.

**CJ 04.04.05 Air freshener**

Air freshener shall be supplied that is suitable for use in the air freshener doser.

Air fresheners shall be similar to Technical Concepts Neutrally Metered Aerosols (available from Steiner Hygiene).

**CJ 04.04.06 SHE bin liners**

She bin liners shall be provided that is suitable for use in the she bins.

**CJ 04.04.07 Paper towels**

Paper towels shall comply with SANS 1887 Part 1 & Part 4.

Paper towels provided shall be supplied in packets of folded towels that can be dispensed from the supplied paper towel dispenser without sticking or other undue difficulty.

**CJ 04.04.08 Wall bin liners**

Wall bin liners shall be provided that is suitable for use in the wall bins.

**CJ 04.04.10 Biological detergents for cleaning of ablutions and public areas**

Disinfectants and Detergent-disinfectants shall not be allowed to clean ablutions and public areas. A biological detergent shall be used. The biological detergent shall have an EU ECO-LABEL accreditation and shall be endorsed by Indalo Yethu (South Africa's official environmental campaign)

The biological detergent shall be similar to nu kleen smell from innu-science.

**CJ 04.04.11 Medium duty solvent detergent**

Medium duty solvent detergents shall comply with SANS 1344:2009 Medium duty solvent detergent. It shall be used in cases where surfaces, walls and floors are soiled with oil, grease or similar soils.

A biological detergent may be used as an alternative where surfaces are soiled with oil, grease or similar soils. The biological detergent shall have an EU ECO-LABEL accreditation and shall be endorsed by Indalo Yethu (South Africa's official environmental campaign)

**CJ 04.04.12 Other**

Brooms, dusters and muslin cloths shall be seen as consumables.

The Contractor shall furthermore be responsible for the supply of batteries for all battery operated equipment, e.g. the urinal sanitizer and the air freshener dozer.

**CJ 04.05 SOLID WASTE MANAGEMENT**

All solid waste that is generated as a result of site keeping and cleaning shall be managed in accordance with specification CG Solid Waste.

**CJ 05 MEASUREMENT AND PAYMENT****CJ.05.01****HAND DRYERS**Unit  
No

The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.

**CJ.05.02****AIR FRESHENER DOSERS**Unit  
No

The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.

**CJ.05.03****TOILET PAPER DISPENSING UNITS**Unit  
No

The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.

**CJ.05.04****SHE BINS**Unit  
No

The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.

**CJ.05.05****HAND SOAP DISPENSER**Unit  
No

The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.

<b>CJ.05.06</b>	<b><u>URINAL SANITIZER</u></b>	<u>Unit</u> No
	The tendered rate shall include full compensation for the supply, delivery, labour and installation and commissioning of the urinal sanitizer. The unit shall be installed in accordance with the manufacturer's instructions.	
<b>CJ.05.07</b>	<b><u>PAPER TOWEL DISPENSER</u></b>	<u>Unit</u> No
	The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.	
<b>CJ.05.08</b>	<b><u>WALL BIN</u></b>	<u>Unit</u> No
	The tendered rate shall include full compensation for the supply, delivery, labour, installation and commissioning of the unit. The unit shall be installed in accordance with the manufacturer's instructions.	

**TECHNICAL SPECIFICATION****DA BOREHOLE PUMP SYSTEMS****CONTENTS**

DA 01	SCOPE
DA 02	STANDARD SPECIFICATIONS
DA 03	OPERATING AND MAINTENANCE MANUALS
DA 04	EXECUTION OF REPAIR WORK
DA 05	GENERAL SPECIFICATION FOR ELECTRIC MOTORS
DA 06	TESTING AND COMMISSIONING
DA 07	MAINTENANCE
DA 08	MEASUREMENT AND PAYMENT

**DA 01 SCOPE**

This specification covers the decommissioning, removal, repair and reconditioning, installation, testing, commissioning and maintenance of borehole pumping equipment, motor control devices and low-voltage cables. It also includes the pump testing of all boreholes to determine the borehole yield and optimum use of each borehole. The function of borehole pump systems shall be delivery of raw water at a specified flow rate and head to the required location.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

**DA 02 STANDARD SPECIFICATIONS****DA 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- BS 5316, Part 1 - Acceptance tests for centrifugal, mixed flow and axial pumps
- SANS 948 - Three-phase induction motors
- SANS 1222 - Enclosures for electrical equipment (classified according to the degree of protection that the enclosure provides)
- BS 4999 - General requirements for rotating electrical machines
- ISO 281/1 - Rolling bearings – dynamic load ratings and rating life.

**DA 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid in the latest edition of the Occupational Health and Safety Act of 1993: Construction Regulations, 2014 as promulgated in Government Gazette No 37305 of 04 April 2014 shall be adhered to.



**DA 02.03**      **MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

**DA 02.04**      **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**DA 03**      **OPERATING AND MAINTENANCE MANUALS**

The Contractor shall at the start of the Contract be given all available as-built information and operating and maintenance manuals.

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

**DA 04**      **EXECUTION OF REPAIR WORK**

**DA 04.01**      **GENERAL**

The Contractor shall investigate and inspect all areas of the installation to confirm the extent of the repair work required and shall report to the Engineer. The Engineer will thereafter demarcate any areas to be repaired and shall instruct the Contractor with regard to the repair work to be done.

At the start of the repair and maintenance contract all the systems, installations and equipment shall be repaired as specified in the Particular Specification. This repair work shall include but not be limited to the details specified in the Particular Specification.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve.

All materials and equipment shall comply fully with the requirements as specified for each installation.

The work required shall include, but not be limited to the following:

- (a) Removal of existing equipment;
- (b) Installation of temporary pumps;
- (c) Pump testing to determine safe yield;
- (d) Ground-water sampling;
- (e) Compilation of borehole recommendation report.

The said repair work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and particular specifications included in this document.

All new equipment, materials and systems shall be furnished with a written guarantee with a defects liability period of twelve (12) months from date of completion of repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

Repair work items for the borehole pump systems shall be categorised under the following headings:

- (a) Pump testing of boreholes
- (b) Repair of existing structures
- (c) Repair/replacement of electrical components.

**DA 04.02      CLASSIFICATION OF BOREHOLES**

The boreholes shall be inspected by the Contractor and the Engineer to confirm the classification of the boreholes in accordance with the guidelines below:

CLASS I	CLASS II	CLASS III	CLASS IV
Existing pump and motor in working order	Existing pump and motor require repair	Not equipped	Not equipped
Has connecting pipework	Has connecting pipework	Has connecting pipework	No connecting pipework
<b>REPAIR WORK</b>			
Routine maintenance	Repair pump and motor	Pump test Replace pump and motor	Abandon borehole

The above classification shall be used to determine the degree of repair work required.

**DA 04.03      PUMP TESTING OF BOREHOLES**

This section covers the requirements of the pump testing of the boreholes.

**DA 04.03.01      Construction**

It will be the responsibility of the Contractor to arrive on site with all equipment and materials required to complete the work without interruption.

The Contractor shall provide suitable plant to enable the installed pumping equipment to be removed and reinstalled. This includes the removal and reinstallation of motorised pumps and may also include the recovery of existing pumping equipment previously lowered into a borehole.

(a) Arrival-on-site actions

The Contractor shall firstly establish whether or not the borehole is equipped. If so, the Contractor will be required to:

- (1) Remove the equipment, taking care not to damage either the equipment or the installation,

- (2) inspect the equipment for defects, and
- (3) note down all particulars regarding the equipment and the installation.

The latter shall include but not be limited to the make and type of pump (and motor if motorised), the depth to which the pump was installed, the power rating of the motor and the diameter, length and quantity of pump column sections.

The Contractor shall next establish whether there are any other boreholes in the vicinity that need to be tested. Should this be the case, the following information shall be gathered and recorded for each borehole:

- (1) The straight-line distance (in metres) between each such borehole to be tested;
- (2) whether the borehole is equipped, open or sealed and, if equipped,
- (3) whether the installation is operational or not.

Depending on the degree of access available to such a borehole, the Contractor shall improve the access until it is adequate to reach the borehole and establish whether there is water in the borehole and if so, measure and record:

- (1) The depth to the ground-water rest level;
- (2) the height of the borehole collar above ground level, and
- (3) the depth of the borehole.

The final activities to be carried out prior to the actual installation of the test pump into the borehole to be tested shall comprise measuring and recording:

- (1) The diameter of the borehole;
- (2) the depth of the borehole as determined by means of a weighted line or plumb bob, and
- (3) the depth to the ground-water rest level in the borehole, with reference to a date level.

(b) Test pump installation

The conduit tube shall be attached and secured to the first section of pump column behind the pump element and the test pump installed to the required depth, attaching and securing the conduit tube to the riser main every 2 to 3 metre. If the pump installation depth has not been specified by the Engineer beforehand, then the depth must be determined on the basis of the guidelines provided in table DA 04.02.01/1.

The Contractor will be remunerated for the installation of a test pump per linear metre of depth installed at the rate tendered as set out in the Schedule of Quantities.

TABLE DA 04.02.01/1 GUIDELINES FOR TEST PUMP INSTALLATION DEPTH IF NOT SPECIFIED

DEPTH OF WATER IN BOREHOLE	TEST PUMP INSTALLATION DEPTH
Less than 5 m	Do not install the test pump
Between 5 m and 30 m	± 2 m above the bottom of the borehole
Between 30 m and 60 m	± 3 m above the bottom of the borehole
Between 60 m and 90 m	± 4 m above the bottom of the borehole
More than 90 m	± 5 m above the bottom of the borehole

NOTE:

1. Depth of water in borehole is calculated as the difference between the total depth of the borehole and the depth to the ground-water rest level as measured.
2. ± denotes a variation of not more than 0,5 m either way.

(c) Equipment set-up and pre-test actions

Where possible, the discharge pipe must be laid in a downhill direction from the borehole to be tested, provided this will take the pipe in the direction of or past another borehole located in the vicinity of the borehole to be tested. In such instances, lay the discharge pipe in a downhill direction that will take its furthest end as far as possible away from any other borehole in the vicinity.

In field situations where the terrain is extremely flat, the length of the discharge pipe shall be extended from 50 m to at least 300 m if any possibility exists that the discharged water may infiltrate to the ground-water resource within the radius of influence of the test. The dip meter should be inserted into the installed conduit tube and run down this tube to the bottom. Make sure that it passes freely down the full length of the tube. If the dip meter used is not graduated to an accuracy of 0,01 m, the position is to be marked on the dip meter cable indicating the depth to the ground-water rest level, and the end of the graduated tape attached at this position on the cable ensuring that the zero mark of the graduated tape corresponds exactly to this mark. Slowly lower the dip meter and graduated tape down the conduit tube, in the process securing the tape to the dip meter cable every 2 to 3 metre. Ensure that there is no slack between each point where the tape is secured to the dip meter cable. Also make sure that the dip meter cable and graduated tape combination passes freely along the full length of the conduit tube.

The Contractor will be remunerated for this work per set-up at the rate tendered for one such activity as set out in the Schedule of Quantities.

## (d)

Final pre-test measurements

The Contractor shall ensure that all the basic information required on the field data sheet is collected and recorded as completely as possible. The basic information data entry fields can be used as a checklist for information to be measured/collected and recorded. The Contractor shall not guess any information which has not been measured.

Payment for this work shall be incorporated into the payment for data recording as described below.

(e) Data recording

## (i) Discharge measurements

The measurement of discharge (yield or pumping rate) must be consistently accurate and reliable and shall be appropriate to meet this requirement. Where volumetric calculation methods are applied, time will be measured using a stopwatch and the container volume must be accurately known. The volumetrically measured yields recorded on the field data sheets shall be based on the average obtained from a set of three sequential measurements. Guidelines for the number and periodicity of discharge rate measurements for each type of test are given in table DA 04.02.01/2.

TABLE DA 04.02.01/2 NUMBER OF PERIODICITY OF DISCHARGE RATE MEASUREMENTS

TYPE OF TEST	DISCHARGE RATE MEASUREMENTS	
	NUMBER	PERIODICITY
Calibration test	2 per step	At $\pm 5$ and $\pm 10$ minutes into each step
Stepped discharge test	5 per step	At $\pm 5$ , $\pm 15$ , $\pm 30$ , $\pm 60$ and $\pm 90$ minutes into each step
Constant discharge test	See periodicity column	At $\pm 5$ , $\pm 15$ , $\pm 30$ , $\pm 60$ , $\pm 90$ and $\pm 120$ minutes into test and every 60 minutes thereafter for the full duration of pumping

## (ii) Water-level measurements

Rigid guidelines for the periodicity of water-level measurements for each type of test are given in table DA 04.02.01/3. This information can be found duplicated on the field data sheets which must be filled in as a record of all data collection activities carried out for a pumping test. The type of water-level measurement values required to be recorded on the field data sheets are the actual (or true) draw down values. These values represent measurements which reflect the depth of the water level below the ground-water rest level depth, ie which already take into account the ground-water rest level depth below the reference measuring point. It shall be noted that the more basic type of measurement which reports the depth of the dynamic water level as a distance below the reference measuring point, ie which combines the depth of the water level below the ground-water rest level depth and the depth of the ground-water rest level below the reference measuring point, gives only an apparent (or false) draw down value. All water-level measurements must be measured to an accuracy of at least 0,01 m (10 mm). The water-level data shall be plotted on the semi-logarithmic graph paper provided with each set of field data sheets. The plotting of the data shall be done as the test proceeds, ie each water-level measurement shall be plotted on the graph as soon as possible after measuring. The field data sheets and accompanying water-level graphs shall be shown to authorised supervisory personnel at request and shall be up-to-date at the time of such request.

## (iii) Other information

The Contractor shall also record any extraordinary observations made during the test. These may include:

- (1) Changes in the colour of the discharged water;
- (2) changes in the turbidity of the discharged water;
- (3) the presence of air in the discharged water, and
- (4) rainfall events which occur during a test.

Remuneration for all data collection and recording activities by the Contractor in the course of a pumping test shall be incorporated into an hourly rate as set out in the Schedule of Quantities.

TABLE DA 04.02.01/3 PERIODICITY (IN MINUTES) OF WATER-LEVEL MEASUREMENTS DURING PUMPING TESTS

CALIBRATION TEST	STEPPED DISCHARGE TEST	CONSTANT DISCHARGE TEST	RECOVERY TEST
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
7	7	7	7
9	9	9	9
12	12	12	12
15	15	15	15
	20	20	20
The above periodicity (measured in minutes after the start of each increased pumping rate) must be followed for each step of the calibration test	25	25	25
	30	30	30
	40	40	40
	50	50	50
	60	60	60
	70	70	70
	80	80	80
	90	90	90
	100	120	120
		150	150
	The above periodicity (measured in minutes after the start of each increased pumping rate) must be followed for each step of the stepped discharge test	180	180
		210	210
		240	240
		Every 60 minutes to end of pumping	Every 60 minutes to end of recovery

(f) Test pumping of boreholes

The Contractor may be required to test existing "older" boreholes which may or may not already be equipped with pumping installations.

Test pumping serves two primary objectives. The first of these is an assessment of the productive capacity (yield potential) of the borehole. The second objective addresses the productivity of the ground-water resource. These objectives are met by various types of borehole tests performed separately and often sequentially. These tests are identified as:

- (i) the slug test
- (ii) the calibration test
- (iii) the stepped discharge test
- (iv) the constant discharge test
- (v) the recovery test.

Factors determining which of these tests shall be performed include:

- The potential yield of the borehole, and
- the amount of water which it will be required to supply.

## (i) The slug test

The slug test provides a rapid means of assessing the potential yield of especially low yielding (less than 1 litre) boreholes (Vivier *et al*, 1995). The results may indicate whether it is feasible and warranted to perform other tests on the borehole. As with any of the other tests, a slug test can be executed in any borehole and not necessarily only newly drilled boreholes.

The test involves measuring the water-level response in a borehole to the rapid displacement of water therein. This displacement might cause either -

- (1) a rise in water level, as would result from the introduction of a slug below the rest water level, or
- (2) a drop in water level, as would be caused by the removal of a quantity of water from the borehole.

In instances where a slug is introduced, the water level will recede to its original level. The sudden removal of a quantity of water from the borehole will cause the water level to rise to its original level. The rate of recession or rise provides an indication of the yield of the borehole. In qualitative terms the more rapid this is, the higher the potential yield of the borehole.

## (ii) The calibration test

A calibration test requires that water be pumped from the borehole at three or more different rates over short (15 minutes) sequential periods. The response of the water level to each known pumping rate is measured and recorded. The calibration test provides a means of assessing the yield potential of borehole according to the magnitude of the water-level decline associated with each pumping rate. This information is used to select appropriate pumping rates at which to perform a stepped discharge test or a pumping rate at which to perform a constant discharge test.

(iii) The stepped discharge test

Also known as a step draw down test, this test is performed to assess the productivity of a borehole. It also serves to more clearly define the optimum yield at which the borehole can be subjected to constant discharge testing if required. The test involves pumping the borehole at three or more sequentially higher pumping rates, each maintained for an equal length of time, generally not less than 60 minutes and seldom longer than 120 minutes. A step length of 100 minutes is recommended. The magnitude of the water-level draw down in the borehole in response to each of these pumping rates must be measured and recorded in accordance with a prescribed time schedule. The actual pumping rate maintained during each "step" must also be measured and recorded. As a rule, the rate of water-level recovery for a period of time immediately following the period of pumping should also be monitored according to the same time schedule as during pumping.

(iv) The constant discharge test

A constant discharge test is performed to assess the productivity of the aquifer according to its response to the abstraction of water. This response can be analysed to provide information in regard to the hydraulic properties of the ground-water system and arrive at an optimum yield for the medium to long-term utilisation of the borehole. This test entails pumping the borehole at a single pumping rate which is kept constant for an extended period of time. The test duration shall not be less than 12 hours and, in some instances, might last up to 72 hours or more. The duration is generally determined by the importance which is attached to the borehole and ground-water resource not only in terms of its yield potential but also in terms of its intended application.

The pumping rate is set at a yield which it is considered the borehole and ground-water system will be able to maintain for the entire planned duration of the test and, in the process, utilising better than 70 per cent but not exhausting the available draw down. It is critical that the pumping rate during the entire duration of the test be kept as constant as possible. The draw down in water level in the borehole during the course of the test is again measured and recorded according to a prescribed time schedule. In the case of this type of test, it is imperative that water-level measurements be made during the recovery period following the end of pumping.

(v) The recovery test

This test provides an indication of the ability of a borehole and ground-water system to recover from the stress of abstraction. This ability can again be analysed to provide information with regard to the hydraulic properties of the ground-water system and arrive at an optimum yield for the medium to long-term utilisation of the borehole. Although referred to as a test, it rather represents a period of monitoring activity following a period of pumping. The rate at which the water level in the tested borehole (or any other borehole affected by the abstraction) recovers towards its starting level (the ground-water rest level before pumping started) is monitored in this period. The duration of this monitoring is generally equal to that of the preceding period of pumping unless the rate of recovery is sufficiently rapid so that the starting water level is reached in a shorter period of time.



(g) General approach and methodology

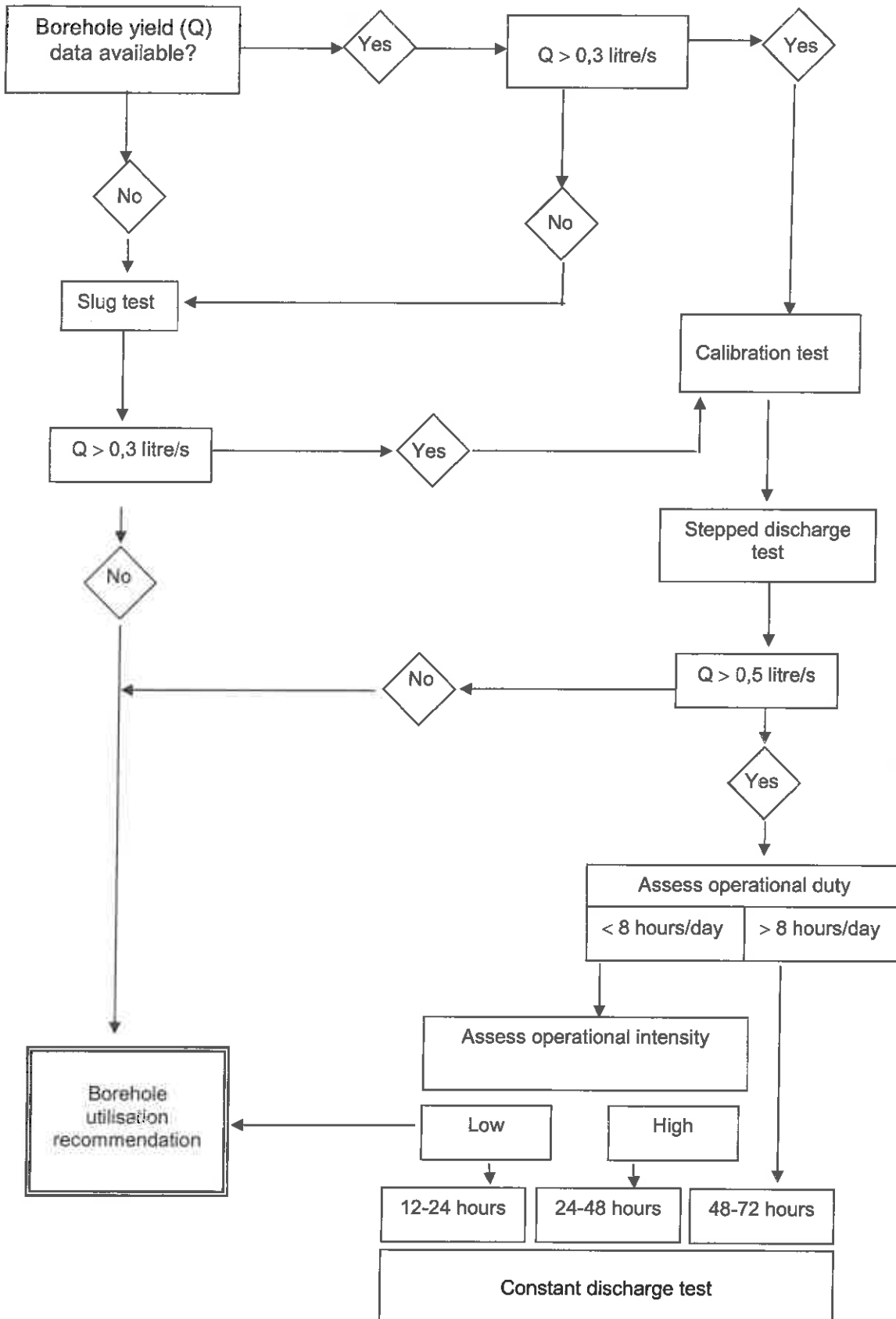
The Engineer will formulate a test pumping schedule for each borehole. The flow diagram presented overleaf provides an indication of the considerations which determine the scope of test pumping based on a logical decision-making process.

All project-related test pumping activities will also be carried out under the direct supervision of the Engineer. The execution of a pumping test in accordance with established scientific protocols must be undertaken by a suitably experienced and equipped testing contractor. The South African Bureau of Standards (SANS) is finalising a Standard Code of Practice titled *The test-pumping of water boreholes*. A draft of this Standard has been considered in the compilation of this document. It will be the task of the Engineer to evaluate and analyse the data, draw conclusions with regard to the productivity of the borehole and the aquifer, and make recommendations with regard to a suitable operating schedule for the borehole and the optimum exploitation of the ground-water resource.

Both the practical and analytical aspects of test pumping benefit greatly from prior information regarding the borehole and the aquifer which it taps into. This information is gleaned during the drilling and the construction of the borehole. It includes knowledge of:

- (1) The amount of water blown out of the borehole during drilling operations;
- (2) the depth(s) at which water was struck in the borehole;
- (3) the construction of the borehole in terms of the setting of especially perforated (slotted) casing, and
- (4) the nature of the rock formation at the depth(s) where water was struck.

This information will be communicated to the testing contractor by the Engineer prior to the testing of any borehole.



The Contractor shall keep a full record of the test pumping which is undertaken and submit the record on completion of the test. This record must include the following basic information:

- (1) The depth to water level before the start of testing;
- (2) the depth at which the test pump was installed;
- (3) the type, make and model of the test pump used;
- (4) the pumping rate as measured at regular intervals during the test, and
- (5) the water level in the borehole as measured according to a prescribed time schedule both during and after pumping.

The Contractor must be sufficiently well-equipped to gather this information with acceptable accuracy.

The rationale behind the flow diagram is explained as follows. A slug test should be performed on a borehole in instances where there is no prior indication of its possible yield. The result of the slug test will indicate whether additional test pumping is warranted. A slug test shall also be performed in instances where the possible yield of a borehole from prior information is indicated to be less than 0,3 litre/s. The result of the slug test will again indicate whether additional test pumping is warranted. In instances where the possible yield of a borehole from prior information is indicated to be equal to or greater than 0,3 litre/s, then a calibration test followed by a stepped discharge test shall be performed.

The result of the stepped discharge test will indicate whether further test pumping in the form of a constant discharge test is warranted or whether the borehole is judged to be sufficiently weak (potential production yield less than 0,5 litre/s) to make a utilisation recommendation without further testing. Should the result of the stepped discharge test indicate that a constant discharge is warranted, then the Engineer will need to make an assessment of the possible operational duty to which the borehole might be subjected.

The operational duty describes the number of hours per day for which the borehole must operate in order to meet the local water demand. By implication, the potential production yield of the borehole must be compared to the water demand. In qualitative terms, a lower yielding borehole would need to operate for a longer period per day to meet a given demand than a higher yielding borehole would need to. Further, the water demand is often too great for even a high yielding borehole pumping continuously to meet. The flow diagram indicates, however, that any borehole which reveals the potential to yield more than 0,5 litre/s and which will operate for a period in excess of 8 hours per day must be subjected to a constant discharge test of 48 to 72 hours duration. A borehole which does not fit this category requires an assessment of its possible operational intensity.

The operational intensity describes the yield at which a higher yielding borehole must operate in order to meet a water demand in a pumping period of eight hours or less per day. By implication, a high operational intensity requires the borehole to be pumped at a yield approaching its maximum, whereas a low operational intensity will place less stress on the borehole. These considerations will indicate whether a 24 to 48 hour or a 12 to 24 hour duration constant discharge test respectively will be performed.

The final step in the flow diagram requires the Engineer to make a borehole utilisation recommendation.

#### DA 04.02.02 Equipment and materials

This represents the test unit and all ancillary equipment and materials required to accurately and efficiently perform borehole testing. Details are provided below.

##### (a) Test unit

The test unit shall comprise a positive displacement (PD) type pump element and a pump head driven by a motor fitted with an accelerator, gearbox and clutch. The unit must be in good working order and capable of maintaining a minimum of 72 hours of continuous operation.

The unit must be capable of delivering water at a rate in excess of the expected maximum yield of the borehole to be tested. It may be acceptable under certain circumstances to employ a submersible pump for testing purposes. This must, however, be identified in the tender enquiry document. It is imperative that any submersible pump used for testing purposes be equipped with a non-return valve fitted at the bottom of the pump column (rising main).

##### (b) Discharge piping

Discharge piping comprises both the pipe (rising main or pump column) which brings the water to surface and the pipe (discharge hose) used to lead the pumped water away from the borehole being tested. The Contractor shall supply sufficient rising main to set the test pump at a depth of at least 100 m below the surface. It may, however, be required under certain circumstances to set the test pump at a greater depth in the borehole. Where necessary it shall be discussed with the Engineer prior to the installation of the test pump. The pump column must be of uniform diameter throughout. The Contractor shall also provide at least 50 m discharge piping. This must be free of leaks for its entire length. It may again, under certain circumstances, be required to discharge the pumped water at a point further away than 50 m (possibly in excess of 300 m) from the borehole being tested. In such instances, a similar procedure to that discussed above in regard to the rising main must be followed.

##### (c) Discharge measuring equipment/Instrumentation

This equipment/instrumentation must be adequate to accurately measure the pumping rate within the range of yields expected from successful project boreholes. If volumetric methods are used, a stopwatch for measuring time to an accuracy of at least one-tenth of a second is required. The full capacity of each container shall be determined accurately. The Contractor shall also ensure that a container stands level when used for discharge measurements. Guidelines regarding the use of different size containers for volumetric discharge rate measurements in specific yield ranges are given in table DA 04.02.02/1. Other acceptable instruments that may be used for discharge measuring are: (1) an orifice weir and (2) a flow meter. The use of these instruments is subject to various application criteria.

##### (i) Orifice weirs

These must be installed in a horizontal position at the end of the discharge pipe. The orifice plate opening must be sharp, clean, bevelled to 45 degrees and have a diameter less than 80 per cent of the diameter of the approach

tube to which it is fixed. The orifice plate must be vertical and centred on the end of the approach tube. There must be no leakage around the perimeter of the orifice plate mounting. The piezometer tube must not contain entrained air bubbles at the time of pressure head measurement. The latter measurement must be at least three times the diameter of the orifice.

TABLE DA 04.02.02/1 YIELD RANGE VERSUS CONTAINER SIZE FOR VOLUMETRIC MEASUREMENTS

YIELD RANGE	CONTAINER SIZE
Less than 2 litre/s	20 litre
2 litre/s to 5 litre/s	50 litre
5 litre/s to 20 litre/s	210 litre
20 litre/s to 30 litre/s	500 litre
30 litre/s to 50 litre/s	1000 litre
More than 50 litre/s	Other suitable methods

The orifice weir equipment must be calibrated for various combinations of approach tube and orifice diameters so that pressure head readings can be converted to accurate discharge measurements.

(ii) Flow meters

Flow meters must be calibrated and of similar diameter to that of the discharge pipe. The latter must be straight and of uniform diameter for a distance of four times the diameter of the pipe before the position of the meter. There must be no turbulent flow or entrained air in the discharge pipe before the meter. The discharged water must be free of solid material carried in suspension.

It is recognised that some water leakage will generally occur especially at the borehead during pumping. This is acceptable provided that: (1) such leakage does not interfere with any water-level monitoring and (2) the total amount of leakage to the end of the discharge pipeline does not exceed one per cent of the pumping rate as measured at the end of this pipeline.

(d) Water-level measuring equipment/instrumentation

The Contractor shall provide at least three water-level measuring devices which are each capable of providing an accuracy of at least 0,01 m (10 mm) and are of sufficient length to match the pump installation depth. If ungraduated electrical contact meters (dip meters) are used for this purpose, each such instrument must be equipped with a measuring tape of an acceptable length and approved standard and which is graduated to an accuracy of at least 0,01 m (10 mm). These instruments must be in good working order and number at least one spare for each two on site.

The Contractor shall further provide conduit tubing of sufficient length to match the pump installation depth. The diameter of this tube must be large enough (minimum 15 mm) to allow free movement of the dip meter probe and cable therein. The tubing must be made of material strong enough to withstand reasonable pressure on its sidewall which might cause a constriction. The tube must be open at its lower end to allow the free entrance of water into the tube. This is facilitated by perforating the

bottom section of the conduit tube sidewall. Precautions shall also be taken to prevent the dip meter probe from passing beyond the bottom end of the conduit tube and, as a result of entanglement, not able to be withdrawn.

(e) Other materials

No pumping test should commence without field data sheets on which to record all data and information relevant to the test pumping activities in an acceptable format. These can either be provided by the Contractor or the Engineer.

**DA 04.02.03**

**Ground-water sampling**

(a) Sampling for macro-element analysis

The Institute for Water Quality Studies of the DWAF, in conjunction with the Department of Health, commenced in May 1996 with the compilation of guidelines addressing all aspects of water sample collection aimed at routinely establishing the quality thereof for drinking purposes. Until such time as these guidelines become available, the following recommendations in this regard should be followed.

A water sample shall be collected from the end of the discharge pipeline no sooner than 15 minutes before the scheduled end of a pumping test, whether of a calibration, stepped discharge or constant discharge nature. This will ensure that a water sample is collected in case testing does not proceed to include either one or both of the latter two types of test. The standard amount of sample normally collected is in a clean, sterilised plastic bottle of capacity 240 millilitre or larger and equipped with a watertight screw-on cap. This is the standard issue sample bottle provided by the DWAF. Depending on the analysing laboratory's requirements, however, a sample of up to two litres in volume may have to be collected. The Engineer will advise on this matter in instances where the Contractor is required to collect samples, in which case the Engineer will provide ampoules containing preservative chemicals if required. All other materials such as sample bottles, tie-on labels and sample custody forms are to be provided by the Contractor. The mandatory sample custody form DW45 must be completed for each sample collected. Note that the code MACRO1 in Instruction 8 ("analyse for") of form DW45 defines the macro-element analysis.

(i) Sampling procedure

Wash hands thoroughly and rinse the sample bottle three times with the water to be sampled, ie the water being pumped from the borehole. Fill the bottle so that a space of five to ten millimetres is left at the top. Add the preservative as instructed in (ii).

(ii) Sample preservation

Gently tap the bottom of an ampoule of preservative on a firm surface so that all the chemical flows to below the constriction. Hold the ampoule firmly upright with thumbs placed either side of the constriction, flex off the neck, turn the ampoule upside down and place it in the bottle together with the broken-off neckpiece. Firmly screw on the cap of the sample bottle after rinsing it well with water from the borehole. Shake the capped sampled bottle well. **Caution shall be exercised when handling the preservative, since this chemical is poisonous.**

## (iii) Sample custody

Fill in the information requested on the tie-on label and attach this securely to the neck of the sample bottle. Place the sample bottle in a cooler or ice-box and keep it stored under chilled conditions. Complete the sample custody form (DWAF form DW45). The water sample and its custody form will be collected by the Engineer. The above procedures shall be adhered to and complied with to the satisfaction of the Engineer.

(b) Sampling for environmental isotope analysis

Use a new, clean, one-litre polyethylene bottle with watertight screw-on cap for routine stable (hydrogen and/or oxygen) isotope and tritium analysis. Take the same basic precautions as for macro-element analysis. Ensure that the water is as clean as possible, but do not filter or add anything. Turbidity does not matter. Rinse the bottle three times with the water to be sampled, fill till overflowing and tighten cap well. Turn bottle upside down and squeeze to test for tightness. Clearly label the bottle by waterproof marking pen on the bottle shoulder or tie-on label.

In special cases of confined to semi-confined (older) water, where tritium values < 0,5 TU are observed, or where it is specifically requested, samples for radiocarbon analysis may be required. Since this involves special procedures of field extraction of larger quantities of water, the Engineer shall contact experts in this field for the procedures and materials required.

This test shall only be conducted when requested by the Engineer.

The standards of isotopic measurement for hydrological applications are defined as follows:

## (i) Minimum detectable values

Tritium: 0,3 TU (tritium units)

Radiocarbon: 2 pMC (per cent modern carbon)

## (ii) Maximum analytical error

Tritium:  $\pm 0,3$  TU (0 - 3 TU); otherwise  $\pm 10$  %

Radiocarbon:  $\pm 2$  pMC (> 40 pMC);  $\pm 1$  pMC (< 40 pMC)

Oxygen-18:  $\delta^{18}O$ ;  $\pm 0,15$  ‰

Deuterium:  $\delta^2H$ ;  $\pm 1,5$  ‰

**DA 04.02.04****Aborted tests and breakdowns**

The Engineer may at any stage during the execution of a pumping test request the testing contractor to abort a test if, in the opinion of the Engineer, continuation of the test is not in the interests of the project. Factors which may contribute to such a decision by the Engineer are:

- Sufficient data having been collected for an adequate scientific evaluation thereof;
- the execution of the test not meeting project criteria and requirements (such as for constancy of yield, accuracy of yield measurements or accuracy of water-level measurements, sufficiency of discharge line length, etc), or
- a mechanical breakdown occurring during pumping which causes a test to be interrupted or aborted.

(a) Tests aborted due to sufficiency of data

The Engineer will fully motivate his decision to abort the test in a written statement to the User Client. In such instances, the testing contractor will be remunerated for the actual duration of testing (including recovery testing) at the hourly rates set out in the Schedule of Quantities.

(b) Tests aborted due to incorrect execution

The testing contractor will be required to remedy the cause(s) for an abort decision by the Engineer. The test shall be restarted, as if it were the first attempt, after the water-level has recovered to within five per cent of the pre-test rest water-level or the contractor is instructed thereto by the Engineer. The testing contractor shall not be entitled to remuneration for any test which is aborted under these circumstances irrespective of the time elapsed up to receipt of the instruction to abort.

(c) Tests aborted due to breakdowns

The following procedures are recommended when a mechanical breakdown occurs during pumping which causes a test to be interrupted or aborted.

(i) Calibration test

Start immediately with the measurement and recording of the water-level recovery rate according to the periodicity given in table DA 04.02.04/1. Irrespective of how long after the start of pumping the breakdown occurs or how rapidly the breakdown can be fixed, continue with water-level recovery measurements until the water level is within five per cent of the pre-test rest water level or, at the discretion of the Engineer, may be discontinued. Restart the calibration test as if it is the first attempt. The Testing Contractor shall not be entitled to remuneration for a calibration test which is aborted under such circumstances.

(ii) Stepped discharge test

Record the time of the breakdown and start immediately with the measurement and recording of the water level recovery according to the periodicity given in Table 4-9. If the breakdown occurs during the first or second steps of the test, continue with water-level recovery measurements until the water-level is within five per cent of the start rest water level and then restart the stepped discharge test as if it is the first attempt. If the breakdown occurs during the third step of the test, can be fixed and the pump restarted to produce the same yield (as before the breakdown) within five minutes of the breakdown occurring, continue with the test at this yield after measuring and recording the water level immediately before restarting the pump. Only one such breakdown event is allowed.



If a second breakdown occurs, proceed as described for a first step breakdown. If the breakdown occurs during the fourth or later step of the test, can be fixed and the pump restarted to produce the same yield (as before the breakdown) within five minutes of the breakdown occurring, continue with the test and complete it at this yield after measuring and recording the water level immediately before restarting the pump. If a breakdown at this stage can not be fixed within five minutes, continue with water-level recovery measurements as if the test has been fully completed. The Contractor shall not be entitled to remuneration for a stepped discharge test which is aborted: (1) within the first or second step, or (2) within the third step and can not be restarted within the time allowed for repair.

(iii) Constant discharge test

Note the time of the breakdown and start immediately with the measurement and recording of the water-level recovery according to the periodicity given in table DA 04.02.04/1. If the breakdown occurs within the first two hours after the start of pumping, continue with water-level recovery measurements until the water-level is within five per cent of the pre-test (start) rest water level and then restart the test. If the breakdown occurs later than two hours into the test, can be fixed and the pump restarted to produce the same yield as before the breakdown within the time periods (after the breakdown occurring) given in table DA 04.02.04/1, continue with the test at this yield after measuring and recording the water level immediately before restarting the pump.

If the breakdown can not be fixed and the pump started within one hour of the breakdown occurring, continue with water-level recovery measurements until the water level is within five per cent of the pre-test rest water level and then restart the constant discharge test as if it is the first attempt unless the following condition has been met. If the breakdown occurs after approximately 80 per cent of the planned duration of the constant discharge test has been successfully completed, continue with water-level recovery measurements as if the test has been fully completed. The allowable elapsed time (in hours) with regard to selected constant discharge test total durations in order for this specification to be acceptable is given in table DA 04.02.04/2.

TABLE DA 04.02.04/1 PERIOD ALLOWED FOR BREAKDOWN REPAIR AND CONTINUATION OF TESTING

TIME BREAKDOWN AFTER START OF TEST	PERIOD ALLOWED FOR REPAIR
2 hours to 4 hours	6 minutes
4 hours to 6 hours	12 minutes
6 hours to 8 hrs hours	18 minutes
8 hours to 10 hours	24 minutes
10 hours to 12 hours	30 minutes
12 hours to 14 hours	36 minutes
14 hours to 16 hours	42 minutes
16 hours to 18 hours	48 minutes
18 hours to 20 hours	54 minutes
Longer than 20 hrs	60 minutes

TABLE DA.04.02.04/2 PERIOD AFTER WHICH A CONSTANT DISCHARGE TEST MAY BE CONSIDERED COMPLETED IN THE EVENT OF A BREAKDOWN

CONSTANT DISCHARGE TEST DURATION	ALLOWABLE TIME ELAPSED TO BREAKDOWN
24 hours	20 hours (equivalent to 80 % of total time)
36 hours	30 hours (equivalent to 83 % of total time)
48 hours	38 hours (equivalent to 79 % of total time)
72 hours	60 hours (equivalent to 77 % of total time)

The Contractor shall not be entitled to remuneration for a constant discharge test which is aborted under circumstances which preclude its restart within the time allowable for repair and continuation. The contractor will, however, be entitled to remuneration for a constant discharge test which is aborted after approximately 80% of the planned duration of the constant discharge test (refer to table DA.04.02.04/2) has been successfully completed, payment being made for the actual duration of the test (including the recovery test) at the hourly rates set out in the Schedule of Quantities.

#### **DA 04.03 REPAIR OF EXISTING STRUCTURES**

This section covers the requirements for the repair of the associated structures at the borehole installation.

##### **DA 04.03.01 General**

The work required shall include but not be limited to the following:

- (a) Repair existing concrete base slabs around boreholes;
- (b) Cast concrete base slabs at boreholes without base slabs;
- (c) Clear around the borehole an area 20 m x 20 m.

##### **DA 04.03.02 Detail of work**

###### (a) Brickwork structures

Where instructed by the Engineer, existing minor brickwork buildings shall be renovated.

###### (b) Concrete base slabs

Where instructed by the Engineer, existing concrete base slabs shall be broken up and removed from existing boreholes.

Concrete base slabs shall be constructed as instructed by the Engineer.

###### (c) Clear area

An area of 20 m x 20 m shall be cleared of bushes, building rubble and other foreign matter as instructed by the Engineer. The area shall in addition be levelled.

**DA 04.04**      **REPAIR/REPLACEMENT OF ELECTRICAL AND MECHANICAL EQUIPMENT**

This section covers the requirements for the repair of the mechanical equipment associated with the boreholes.

The requirements for the repair of the electrical equipment associate with the boreholes are specified in Technical Specification GB: Electrical installation for mechanical and pumping equipment.

**DA 04.04.01**    **General**

The work required shall include but not be limited to the following:

- (a)    Reconditioning of MCC panel and housing
- (b)    Testing of electrical mechanical equipment
- (c)    Reconditioning of borehole pumping equipment
- (d)    Borehole information register
- (e)    Commissioning.

**DA 04.04.02**    **Detail of work**

(a)    Testing electrical and mechanical equipment

All electrical and mechanical equipment shall be inspected and tested at the start of the Contract to establish which items need to be repaired, reconditioned or replaced.

(b)    Borehole pumping equipment

The Contractor shall remove or extract the submersible pumps and inspect. Reconditioning or repair of pumps shall be carried out if necessary on the instruction of the Engineer. The difference between reconditioning and repair is defined in the payment items.

(c)    Borehole information register

A data register containing the following information shall be compiled during the repair contract and further developed during the maintenance contract:

- (i)    Borehole pumping equipment and maintenance tasks, records, etc
- (ii)   Borehole utilisation (rate of discharge and duration of discharge)
- (iii)   Borehole water-level.

(d)    Commissioning

All components at each borehole will be fully commissioned after reconditioning or replacement as described in Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

**DA 04.05**      **SUBMERSIBLE CENTRIFUGAL PUMPS**

This Specification covers the supply, delivery and installation of submersible centrifugal pumps. Testing and commissioning is covered in Clause DA 05 and in Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

**DA 04.05.01**    **General**

Centrifugal pumps supplied under this Contract shall be suitable for vertical installation in submerged conditions, shall consist of a submersible motor coupled directly to a multistage centrifugal pump and shall be suitable for pumping water for domestic use.

The details of the existing installation were unknown at the time of tender. Allowance has been made for the servicing of pumping equipment.

Should it become apparent during the servicing that components need to be replaced such as bearings, shafts, etc., a payment item for the reconditioning of the pumping equipment has been allowed. The "reconditioning" payment item will replace the "servicing" payment item in this event.

No orders shall be placed for any pumping equipment until the boreholes have been tested and the report submitted to the Engineer. The Engineer shall then provide the pump requirements to the Contractor for ordering of equipment.

Preference will be given to pumps of the self-regulating type and where the power consumption characteristic is such that with an increase in delivery to beyond a certain limit, the power consumption decreases, thereby ensuring that the motor is not overloaded in the event of a large reduction in pumping head.

Preference will be given to locally manufactured pumps and motors, with a reliable and efficient after sales service and readily available spares.

**DA 04.05.02**    **Depth of installation**

The most suitable depth of installation and safe pumping rate shall be confirmed by an experienced borehole contractor by virtue of the supplied borehole record, test and calculated information. All costs involved in confirming the most suitable depth of installation and safe pumping rate shall be deemed included in payment item DA.01.

**DA 04.05.03**    **Material**

All parts of the pump shall be manufactured from material most capable of withstanding wear. Full specification in this respect shall accompany the Tender and the Tenderer's advice in this respect will be considered.

**DA 04.05.04**    **Speed**

The pump shall have a rotational speed not exceeding 1 450 rpm. If a higher rotational speed is required, this shall be motivated in a covering letter or in the technical data sheets.

**DA 04.05.05**    **Design**

All working parts of the pumps shall be removable and serviceable and shall under no circumstances be integrated into the body of the pumps.

**DA 04.05.06 Turbine bowls**

Turbine bowls shall be manufactured from high-grade cast steel and shall be finished off smoothly before a high-quality corrosion protection system is applied. Grey Iron No 30 turbine bowls may be approved by the Engineer, or if so stated in the Project Specifications. The bowls shall be selected for a minimum of 2 500 kPa or 1,5 times the maximum discharge pressure, whichever is the greater. The casing, suction strainer, cable shield and all fastenings, nuts and bolts shall be manufactured from stainless steel.

**DA 04.05.07 Pump shaft**

The shaft shall be manufactured of stainless steel. Where the shaft passes through stuffing boxes it shall be fitted with renewable sleeves of high-quality, wear-resistant alloy.

The shaft shall be so designed that the running speed is well below the first critical speed, and the complete rotor shall be accurately balanced after assembly.

The rotating elements shall be accurately balanced statically and dynamically to eliminate noise and vibration when running.

**DA 04.05.08 Pump impellers**

Impellers shall be manufactured of stainless steel or bronze and shall be carefully bored and keyed. All parts inaccessible to machining shall have a smooth finish. Balancing of impellers shall not be done by means of drilling balancing holes, but rather by accurate and careful machining of impellers.

**DA 04.05.09 Seals and bearings**

Pumps shall be fitted with mechanical seals with sand deflectors. Pump bearings and thrust collars shall be bronze and shall be lubricated by the fluid handled. The pump and motor shall not be adversely affected by suspended sand concentrations of up to 25 g/m<sup>3</sup>.

**DA 04.05.10 Rising pipe**

The rising pipe shall have threaded or approved bolted couplings at a spacing of approximately 6 m intervals. The rising pipe shall have a minimum internal diameter of 50 mm and shall internally and externally be protected against corrosion by a fusion-bonded powder epoxy coating to a minimum thickness of 250 micron. All bolts used shall be stainless steel. The couplings shall not totally obstruct the borehole, but shall allow for sufficient clearance between the coupling and borehole casing to prevent any damage to the drop cable set and earth wire. The pump and rising pipe shall be centered in the borehole by means of approved centralisers at a preferred spacing of not more than 3 m. The centralisers shall be manufactured of an approved corrosion-resistant material and shall assist in eliminating any vibration that may occur in the borehole/rising pipe installation.

**DA 04.05.11 Borehole vents**

The borehole shall be adequately vented to prevent the build-up of pressure or vacuum. All borehole vent openings shall be piped watertight to the atmosphere outside of any enclosure and not less than 200 mm above any low ground level or the highest recorded flood level. Such vent openings shall be at least 12 mm in diameter. The terminal of the vent shall be suitably shielded and screened so as to prevent the entrance of foreign matter and insects.

**DA 04.05.12 Pump motor**

Unless otherwise specified, each pump shall be supplied complete with an electrical motor. Each electrical motor shall comply with the requirements as specified in Specification GB: Electrical installation for mechanical and pumping equipment and Clause DA 05 of this specification and Specification PF: Acceptance tests for pumps.

The depth setting shall be such that an up-flow of water past the motor is created. If insufficient up-flow of water past the motor is available, a suitable flow induced tube shall be fitted to the pump and motor to ensure sufficient cooling of the motor.

**DA 04.05.13 Base plate**

A suitable base plate shall be used to effectively close the top of the borehole to prevent any foreign matter from entering. The rising pipe shall be effectively bolted to the base plate. The base plate shall further be provided with the necessary openings for the drop cable site, earth wire and water-level monitoring device.

**DA 04.05.14 Accessories**

Over and above any reflux valves installed and specified above ground level, the pump shall be fitted with a non-slam type reflux valve situated at the pump outlet. The reflux valve shall be a matched component supplied and tested by the pump manufacturer for efficient and troublefree operation.

**DA 04.05.15 Pump technical details**

The pump shall be a currently catalogued product. Documentation shall include performance curves or selection tables, indicating flow, head, NPSH required, power absorbed, speed and efficiency for the expected range of operational conditions.

Performance curves and selection tables shall be based on a reproducible and certified test carried out in an approved laboratory. Certified detail selection shown on these performance curves or tables shall be submitted.

The flow rate at break-off point of the curve for the impeller selected shall be at least 1,5 times that of the maximum flow rate specified.

The head at zero delivery of the curve for the impeller selected shall be at least 1,2 times the operating head.

The efficiency of the pump shall not be less than 95 % of its maximum efficiency at the selected duty point. The efficiency of the pump at the selected duty point as stipulated in table DA 04.05.01/1 shall not be less than 75 %.

The possible percentage variation of data measured on Site by the supplied and/or installed instrumentation when compared with the catalogued performance data must be submitted.

All calculations for static and dynamic heads are to be based on an atmospheric pressure above mean sea level of approximately 1 410 m, which is the site elevation of the borehole site.

The pump shall be installed in accordance with the manufacturer's instructions and shall be maintained in "as new" condition at start up.

Details of the equipment shall include the following:

- (a) Operating, testing and commissioning instructions
- (b) Trouble analysis guide.

Full details of periodic and annual maintenance and service to be undertaken by the maintenance staff in accordance with a preventive maintenance programme shall be submitted.

The Contractor shall state in the technical data sheets the minimum selected service life for which the pump has been engineered and the components selected when operated under normal working conditions with optimum servicing and maintenance.

The minimum acceptable service life is 15 years with 8 500 operating hours per annum.

The Engineer reserves the right to call for -

- (a) Test certificates and reports from the manufacturer's quality control laboratory or an independent test laboratory such as SANS, and/or
- (b) site inspection, customer reports/references and user's interviews, and/or
- (c) full engineering, design and component selection details,

in order to check the correctness of the service life claimed.

#### **DA 04.06 SUBMERSIBLE PROGRESSING CAVITY PUMPS**

This Specification covers the supply, delivery and installation of belt-driven submersible progressing cavity pumps. Testing and commissioning is covered in Clause DA 05 and Additional Specification SC: General decommissioning, testing and commissioning procedures.

##### **DA 04.06.01 General**

The pumps supplied under this Contract shall be of the progressing cavity type with a stator and a rotor, similar to Mono, Orbit or approved equivalent pumps.

The pumps shall be belt-driven and suitable for vertical installation in submerged conditions and shall be suitable for pumping water for domestic use.

Preference will be given to locally manufactured pumps, with reliable and efficient after sales service and readily available spares.

##### **DA 04.06.02 Depth of installation**

The most suitable depth of installation and safe pumping rate if not required in the detail specification shall be confirmed by an experienced borehole contractor by virtue of the supplied borehole record, test and calculated information. All costs involved in confirming the most suitable depth of installation and safe pumping rate shall be deemed included in payment item DA.01.

**DA 04.06.03 Material**

The Contractor shall take cognisance of the operating environment and the properties of the pumped liquid when selecting the materials of manufacture for the pump components to ensure that the components are resistant to corrosion.

All parts of the pump shall be manufactured from material most capable of withstanding wear. Full specification in this respect shall accompany the Tender and the Tenderer's advice in this respect will be considered.

**DA 04.06.04 Pump speed**

The pump shall have a rotational speed not exceeding 1 500 rpm. If a higher rotational speed is required this shall be motivated in a covering letter or in the technical data sheets.

**DA 04.06.05 Design**

All working parts of the pumps shall be removable and serviceable and shall under no circumstances be integrated into the body of the pumps.

**DA 04.06.06 Pump shaft and rotor**

The pump shaft and rotor shall be manufactured from stainless steel.

The shaft shall be so designed that the running speed is well below the first critical speed.

The rising shaft shall be supported by a bobbin bearing every 1,5 metres.

The shaft supporting bearings shall be made of stainless steel with a vulcanised rubber outer sleeve and rubber linings with bushes of a synthetic material and shall be lubricated by the fluid handled.

**DA 04.06.07 Pump stator**

The stator of the pumps shall be manufactured from a suitable wear-resistant rubber and shall be formed by moulded-to-metal construction. The rubber shall be resistant to wear and heat caused by the occasional dry running of the pumps and the maximum permissible time span during which the pumps can run dry without any damage caused to the pumps, shall be indicated in the covering letter at tender stage.

**DA 04.06.08 Rising pipe**

The rising pipe shall withstand a 1 600 kPa working pressure.

The rising pipe shall have threaded or approved bolted couplings at a spacing of approximately 3 m intervals. The rising pipe shall have a minimum internal diameter of 50 mm and shall internally and externally be protected against corrosion by a fusion-bonded powder epoxy coating to a minimum thickness of 250 micron. All bolts used shall be stainless steel. The pump shaft shall run inside the rising pipe.

The pump and rising pipe shall be centred in the borehole by means of approved centralisers at a preferred spacing of not more than 6 m. The centralisers shall be manufactured of an approved corrosion-resistant material and shall assist in eliminating any vibration that may occur in the borehole/rising pipe installation.



**DA 04.06.09 Borehole vents**

The borehole shall be adequately vented to prevent the build-up of pressure or vacuum. All borehole vent openings shall be piped watertight to the atmosphere outside of any enclosure and not less than 200 mm above any low ground level or the highest recorded flood level. Such vent openings shall be at least 12 mm in diameter. The terminal of the vent shall be suitably shielded and screened so as to prevent the entrance of foreign matter and insects.

**DA 04.06.10 Pulley head and base plate**

A pulley head which includes the pulleys, shaft seals, bearings and pump delivery flange shall be mounted on a suitable base plate.

The pulley head and base plate shall effectively close the top of the borehole to prevent any foreign matter from entering.

The rising pipe shall be effectively bolted to the pulley head.

A double bearing configuration shall be installed where the shaft exits the pulley head frame. The bearing configuration shall consist of a lower thrust bearing and an upper sealed ball or roller locating bearing.

The pulley head shall be fitted with a stuffing box and shall have gland packings of adequate depths for sealing around the shaft, where the shaft exits the pump casing.

The gland packing shall be designed to permit high speed rotation without the possibility of seizing and charring the packing material or shaft. An automatic water seal shall be provided to prevent the entry of air into the pump.

**DA 04.06.11 Belt drives**

This clause only deals with V-belts, but full details of alternatives may be submitted to the Engineer for approval.

The Contractor shall install at least two belts per coupling.

The coupling (the belts, pulleys, shafts and keys) shall be selected such that it can safely transfer 200 % of the design starting torque and can operate up to a rotational speed of 150 % of the nominal duty speed.

The motor/engine and driven equipment shall be aligned and installed such that misalignment and stagger is within 60 % of the safe allowable limits specified by the supplier of the driving and/or driven equipment. Radial run-out on pulleys shall not be more than 1 % of the pulley diameter.

If the driving and driven pulleys are not in the same plane a maximum of a quarter twist turn between the driving and driven pulleys is allowed with a suitable belt length to prevent damage to the V-belts or pulleys.

Keys and keyways for load transfer to and from shafts shall comply with BS46 Part 1 and BS 4235 Part 2.

Suitable and accessible methods for adjusting the tension of the belts shall be provided.

The driving and driven pulleys and belts shall be enclosed in a single sturdy guard which allows visual inspection of the belt condition with the guard fitted. The guard shall be easily removable for belt maintenance.

Pulley sizes and ratios shall be selected such that operational belt speeds never exceed 25 m/s and are never less than 10 m/s.

The arc of contact on the small pulley shall be more than 120°. The pulley ratio shall not be less than 2,25:1, unless prior approval is obtained from the Engineer.

Belts shall be easily removed and installed for maintenance purposes and shall be to the approval of the Engineer.

The required belt tension to transfer the required load, including starting, shall not result in side thrusts in the prime mover and pump head pulley bearing which exceed 60 % of the manufacturer's specified maximum allowable side thrusts.

**DA 04.06.12 Accessories**

Each pump discharge line shall be fitted with the fittings and accessories as indicated by the Engineer.

Each pump shall be fitted with a suitably calibrated pressure relief valve fitted in the delivery pipework immediately downstream of the outlet flange.

Each pump shall be fitted with a non-slam type reflux valve situated at the pump outlet. The reflux valve shall be a matched component supplied and tested by the pump manufacturer for efficient and troublefree operation.

**DA 04.06.13 Pump efficiency**

The efficiency of the pumps shall not be less than 75 %. The normal operational efficiency of the pumps shall not be less than 3 % below the peak efficiency of the pumps.

**DA 04.06.14 Pump technical details and installation**

The pump shall be a currently catalogued product. Documentation shall include performance curves or selection tables, indicating flow, head, power absorbed, speed and efficiency for the expected range of operational conditions.

Performance curves and selection tables shall be based on a reproducible and certified test carried out in an approved laboratory. Certified detail selection shown on these performance curves or tables shall be submitted.

The Contractor shall state in the technical data sheets, the minimum selected service life for which the pump has been engineered and the components selected when operated under normal working conditions with optimum servicing and maintenance.

The minimum acceptable service life is 15 years with 8500 operating hours per annum.

The pumps required shall be determined by the Engineer after the borehole yield testing to ensure the optimum use of each borehole.

The Engineer or his representative reserves the right to call for -

- (a) Test certificates and reports from the manufacturer's quality control laboratory or an independent test laboratory such as SANS, and/or
- (b) site inspection, customer reports/references and user's interviews, and/or
- (c) full engineering, design and component selection details,

in order to check the correctness of the service life claimed.

The pump shall be installed in accordance with the manufacturer's instructions and shall be maintained in "as new" condition at start up.

Details of the equipment shall include the following:

- (a) Operating, testing and commissioning instructions
- (b) Trouble analysis guide.

Full details of periodic and annual maintenance and service to be undertaken by the maintenance staff in accordance with a preventive maintenance programme shall be submitted.

**DA 04.06.15 Prime mover**

The pump shall be belt-driven by either an electric motor or diesel engine as specified in the schedule of quantities.

The prime mover and the pump pulley head shall be mounted on separate base frames.

**DA 05 GENERAL SPECIFICATION FOR ELECTRIC MOTORS**

**DA 05.01 SCOPE, REFERENCE SPECIFICATIONS, STANDARDS AND CODES**

This specification covers all aspects related to electric motors that may be incorporated in any of the items of equipment to be supplied under the contract.

**DA 05.02 GENERAL REQUIREMENTS**

- (a) Electric motors shall be manufactured in South Africa and shall comply with the requirements of SANS 948.
- (b) Where imported motors are offered they shall be submitted to the South African Bureau of Standards to be tested in accordance with the requirements of SANS 948 and the Engineer shall be provided with the appropriate certificate obtained from the South African Bureau of Standards stating that such motors do comply, prior to the installation of the motors. However, where tests reveal that motors do not comply, it shall be the responsibility of the Contractor to supply alternative motors which comply with the requirements of SANS 948 and which are acceptable to the Engineer. Where imported motors are not normally kept in stock in South Africa, written proof shall be provided of the availability of replacement parts as well as the delivery period of the parts after placing the orders.
- (c) All motors shall be standard catalogue models and shall be readily available.

- (d) All motors shall, where possible, be from the same manufacturer and shall have the same interchangeable frames. Variations in type and size shall, where possible, be limited to prevent stocking a variety of special spares.

**DA 05.03 WORKING VOLTAGE AND SUPPLY SYSTEMS**

- (a) The motors shall be capable of operating within  $\pm 10\%$  of the nominal voltage supply without risk of damage. All motors shall be suitable for operating continuously at the specified 3-phase voltage under actual service conditions, including the  $\pm 10\%$  system voltage tolerance, without exceeding the specified temperature rise determined by the resistance on a basic full load heat run.
- (b) All motors shall be capable of operating continuously under actual service conditions at any supply frequency between 48 and 51 Hz together with any voltage between plus and minus 5 per cent of the nominal supply voltage.
- (c) The slip-in speed of any motor at 80 per cent of the nominal voltage at 50 Hz shall not exceed a percentage agreed on by the Engineer, and the motors shall be capable of operating at this voltage for a period of five minutes without deleterious heating.

**DA 05.04 TEMPERATURE RISE**

The temperature rise, as determined by resistance, of all motors, shall not exceed the following derated values:

Insulation class	E	B	F	H
Temperature rise (K)	50	60	80	100

**DA 05.05 EFFICIENCY AND POWER FACTOR**

- (a) The efficiency of all motors shall be guaranteed by the Contractor. Deviations from the guaranteed efficiency shall be within the limits specified in SANS 948.
- (b) The guaranteed efficiency of each size and rating of motor shall be as determined in accordance with BS 4999: Part 102. A basic test certificate of efficiency will be accepted for a motor of identical size and rating or a basic test of efficiency shall be conducted if no certificate is available.
- (c) The power factor of motors with a capacity of 20 kW or more shall not be less than 0,9 under all operating conditions.

**DA 05.06 VIBRATION**

- (a) Motors shall be statically and dynamically balanced.
- (b) All motors shall be checked for vibration without load, and at full rated voltage at the manufacturer's works, and the vibration amplitude as measured shall be in accordance with BS 4999: Part 142, quality grade 'Normal'.
- (c) The ratio of axial to radial vibration shall not exceed 0,5.

**DA 05.07 NOISE LEVEL**

Unless otherwise specified motors shall be of 'normal sound power', in compliance with BS 4999.

**DA 05.08      ENCLOSURE AND FRAME**

- (a) Each motor shall be protected to the degree required by its application, and its enclosure shall be designed for the system of cooling associated therewith.
- (b) Notwithstanding the requirements of DA 05.08 above, the minimum degree of protection shall be IP55 to SANS 1222 and, unless otherwise required, motors shall preferably be of the totally enclosed fan-cooled (TEFC) type.
- (c) All motors of the vertical-spindle type and exposed to the weather, shall be provided with a robust canopy of approved design.
- (d) Medium-length motors are preferred but short-length motors may be accepted where space is limited and written permission has been granted by the Engineer.

**DA 05.09      MOTOR TYPE**

Motors shall be of the squirrel-cage induction motor type. Slip-ring induction motors or other approved types will be considered if the Contractor is of the opinion that better results could be obtained by using such motors. Full electrical and mechanical details of each alternative shall be submitted with the tender documents.

**DA 05.10      RATING AND STARTING REQUIREMENTS**

- (a) Motors shall be adequately rated for the service for which they are intended, and due allowance shall be made for the temperature, altitude, climatic conditions and variations in the supply voltage. Motors shall, however, not exceed 120 % of the required capacity without prior approval having been obtained from the Engineer.
- (b) Not only shall motors be based on the full load requirements, but the motor capacity and starting characteristics shall be compatible with the requirements of the driven equipment.
- (c) Where motors are required to drive high inertia loads, the starting torque of the motor and the torque curve of the driven load shall be submitted to the Engineer for approval prior to manufacture. Such motors shall be capable of three starts per hour, with two consecutive starts from normal operating temperature, or more frequently if required by the Engineer.
- (d) Motors shall be of the continuously running duty class S1 unless otherwise specified in the detailed specification or if a more onerous duty is dictated by the drive requirement.
- (e) All squirrel-cage induction motors shall be suitable for direct-on-line starting at full voltage. Single-speed motors shall conform to BS 4999 part 41, Design B characteristics unless otherwise approved by or dictated by the drive requirements.
- (f) All motors shall be capable of starting its associated load with a minimum accelerating torque of not less than 5 per cent of full-load torque when the voltage at the motor terminals during starting is reduced to 80 per cent of the nominal value.
- (g) Unless otherwise approved, the -15 per cent tolerance on locked-rotor torque permitted by BS 4999: Part 69 will not be accepted and shall be limited to -10 per cent.
- (h) Documentation shall include performance curves to suit the expected working conditions.

**DA 05.11**      **BEARINGS**

- (a) All motors shall, wherever possible, be provided with prelubricated sealed bearings.
- (b) Regreasable bearings shall require only one lubrication per year. Grease lubrication of ball or roller bearings, where approved, shall be by means of hexagonal button-type grease nipples to BS 1486: Part 2, Nos. 21A or 21B (industrial type).
- (c) Grease-lubricated bearings shall have relief holes to ensure that the bearings have been correctly packed, which holes shall be positioned so that the excess grease can be easily removed. Cups shall be fitted to contain excess grease.
- (d) Bearings shall be protected against eddy currents and shall be capable of withstanding vibrations caused by unbalanced loads.
- (e) All bearings shall be designed for a life of 100 000 hours at B10 rating.

**DA 05.12**      **EARTHING**

All motors shall be provided with a machined or spot-faced boss tapped to receive a bolt of not less than 10 mm in diameter for earthing purposes, which is located on one side between the mounting feet.

**DA 05.13**      **HEATERS AND DRAINAGE**

Non-submersible motors which will be located out of doors or in a damp location such as in a drainage sump, shall be provided with suitable means of drainage to prevent the accumulation of water due to condensation. They shall also be fitted with anti-condensation heaters suitable for a 220V AC supply if considered advisable by the manufacturer.

Where specified in the project specifications, motors shall be supplied with anti-condensation heaters to keep the motor temperature at 23 °C when the motor is not operational to prevent moisture from condensing in the motor.

Heater terminal boxes shall be fitted on the motor frame and shall be of robust design, liberally sized and complete with suitable terminal block and mechanical cable gland or conduit entry.

**DA 05.14**      **TERMINAL ARRANGEMENTS**

- (a) The line connections of each motor shall be brought out to a terminal box located in an approved position. In the case of two-speed motors, separate terminal boxes shall be provided for each speed.
- (b) Terminal boxes shall be of the totally enclosed type designed to exclude the ingress of dust and moisture and sealed from the internal circuit of the motor, and shall be manufactured from sand-cast metal. The wall thickness of the terminal boxes and the dimension of the cable inlet shall be as specified in SANS 948. The terminal box shall be so designed that the cable entry may be made in any one of four positions placed at right angles to one another.
- (c) Terminal boxes shall be of ample size to allow the cable to be terminated in the box. Under no circumstances will the cable be allowed to be in contact with the inside of the box or lid.

- (d) Terminals shall be of a substantial design and shall be suited to receive cable lugs. Pinch-screw connections will not be accepted.
- (e) The terminal arrangement shall permit the motor to be disconnected from its supply cable without damaging the cable tails and shall allow the supply cable and motor windings to be tested separately.
- (f) The electrical clearance and creepage distances, with the correct cable terminations in position, shall comply with the requirements of BS 4999.
- (g) Terminal markings shall be clear and permanent and shall comply with BS 4999. Irrespective of the direction of rotation required on the site, the connections shall be such that, when the supply leads L1-L2-L3 are connected to the motor terminals U-V-W respectively, the motor shall rotate in a clockwise direction when viewed from the driving end.
- (h) Motors suited for only one-directional rotation, shall be clearly marked as such by an arrow fixed to the motor frame at the driving end.

#### **DA 05.15**      **MOTOR/LOAD COUPLING**

- (a) Motors shall be coupled direct to the equipment to be driven, by means of approved couplings. Vee-belt and chain drives shall be considered only if direct coupling of the motor to the equipment is impossible or impracticable. Motors driving vee-belt or chain drives shall be fitted with heavy-duty bearings suited to the full side thrust at 120 % of full load torque and short-term overloads of up to 250 % of the full load torques during starting. The stiffness of the rotor shaft shall be checked to ensure that resonance and fatigue do not occur.
- (b) Where applicable, the flanges of the motors and equipment shall be identical.
- (c) The precision tolerance class shall apply to all flange-mounted motors with regard to concentricity, perpendicularity and shaft run-out.

#### **DA 05.16**      **SUBMERSIBLE MOTORS**

The following additional requirements apply specifically to all submersible motors:

- (a) All submersible motors shall be suited for submersion up to a depth of 1,5 times the depth of submersion shown on the drawings for each application, or as specified in the project specifications.
- (b) All submersible motors shall have dynamically balanced rotors supported by maintenance-free, sealed-for-life ball bearings.
- (c) All motors shall be suitably coated to ensure the satisfactory operation of the motor under the specified class of service.
- (d) All terminal boxes shall be waterproof and suited for submersion up to the depth as specified for the motors.
- (e) An adequate length of waterproof cable, purpose-made for submerging, shall be supplied with each submersible motor. The coupling of this cable to the normal power-distribution cable, which usually is of the PVC type with steel-wire armour, shall be placed at least 1,0 m above the maximum water level by means of a purpose-made, weatherproof, outdoor junction box. The submerged cable shall be supported to

minimize any movement of the cable which results from turbulence caused by the operation of the equipment or the flow of the water.

- (f) Thermistor protection shall be provided for submersible motors.

**DA 05.17**      **ADDITIONAL REQUIREMENTS**

- (a) The rotation speed of motors shall not exceed 1 500 r/m unless approved otherwise by the Engineer.
- (b) Thermistor protection shall be provided for each winding of each motor.
- (c) The preferred class of insulation is Class F, derated in accordance with DA 05.16(d) above.

**DA 05.18**      **TECHNICAL DATA SHEETS**

Details of all individual electric machines and equipment requiring electrical energy shall be indicated on the 380 V motor and equipment schedule included in the technical data sheets.

**DA 06**      **TESTING AND COMMISSIONING**

**DA 06.01**      **TESTS TO BE PERFORMED**

- (a) All pumping equipment shall be subject to the commissioning tests as described in Additional Specification SC: General Decommissioning, Testing and Commissioning.
- (b) At least one of each type or size of pump supplied shall be subject to a delivery flow rate test. Flow rate or volumetric flow testing facilities will be supplied by others, unless otherwise specified in the detail specification.
- (c) The operating point of each pump shall be determined.
- (d) Efficiency tests will only be performed when specified in the detail specification.
- (e) NPSH tests will only be performed when specified in the detail specification.

**DA 06.02**      **PUMP OPERATING POINT**

During the day 1 commissioning tests the pump operating point shall be determined by observing the following:

- (a) Pump delivery and suction pressures, and
- (b) Electric motor power consumption.

If no efficiency tests are required in the detail specification then the motor power consumption shall be calculated from the voltage and current measurements obtained during the commissioning test.

The Contractor shall supply the necessary adaptors, fittings and pressure gauges to measure the suction and delivery pressures. If no gauge fittings exist on the suction side, then the suction pressure conditions will be calculated from the system properties.



**DA 06.03 FLOW RATE (DELIVERY), EFFICIENCY AND NPSH TESTS**

- (a) Testing will be done in accordance with BS 5316 Part 1, class C tests.
- (b) Power consumption of electric motors shall be as determined by the three-wattmeter method where efficiency tests are required in the detail specification.

**DA 06.04 TEST CONDITIONS**

- (a) All tests will be performed in situ.
- (b) The pumped medium or liquid specified as the process liquid in the detail specifications shall be utilised during the tests. The Contractor shall obtain from the pump manufacturer the test point for clean water corresponding to the specified duty point for the pumped liquid, in order to relate the measured performance to the pump supplier's curves which are based on water.

**DA 06.05 ADDITIONAL TESTS**

Additional tests may be specified in the detail specification.

**DA 07 MAINTENANCE**

All borehole pumping equipment and systems shall be serviced and repaired, following practical completion of the installation of which it forms part, to maintain it in perfect functional condition.

Maintenance to be carried out shall include routine preventative maintenance in accordance with the manufacturer's specification to be set out in the operating and maintenance manual, as well as unforeseen repair work or replacement.

The remuneration for monthly maintenance of borehole pumping equipment and systems shall be deemed included in the tendered rate for ten points of the installation of which the system forms part. Installations are specified in Additional Specification SA: General Maintenance.

The routine maintenance of the installations, systems and equipment shall include, but not be limited to the items listed in table DA 07/1 below:

**DA 07.01 TABLE DA 07/01 ROUTINE MAINTENANCE OF INSTALLATIONS, SYSTEMS AND EQUIPMENT**

NO	ITEM DESCRIPTION	MAINTENANCE FREQUENCY
1	Remove, inspect and service submersible pumps	Four-monthly
2	Clean filters/strainers	Monthly
2	Inspect and clean air release valves	Monthly
3	Check V-belts	Monthly
4	Measure rest water-level	Weekly
5	Check MCC panel	Monthly
6	Check electric motors	Monthly
7	Log and record water meter reading and water usage	Daily
8	Log and record amps, volts and hour meter readings	Daily

**DA 08 MEASUREMENT AND PAYMENT**

**DA.01 PUMP TESTING OF BOREHOLES** ..... Unit: number

The unit of measurement shall be the number of boreholes tested on the written instructions of the Engineer.

The tendered rate shall include full compensation for all labour, equipment and material required for the complete testing of the boreholes in accordance with the specification.

**DA.01.01 Extra over DA.01 for:**

(a) The removal of existing equipment..... Unit: number

The unit of measurement shall be the number of boreholes from which all the equipment is removed. The tendered rate shall include full compensation for the removal of existing operational pumps and motors and all associated pipework.

(b) Recovery of lost equipment..... Unit: number

The unit of measurement shall be the number of boreholes from which all the lost equipment is retrieved. The tendered rate shall cover the recovery of lost pumps and pipework for boreholes.

(c) Installation of temporary pumps ..... Unit: number

The unit of measurement shall be the number of temporary pumps installed and later retrieved. The tendered rate shall be fully inclusive of the pump and pipes required to effectively test the boreholes in accordance with the specifications.

(d) Ground-water sampling ..... Unit: number

The unit of measurement shall be the number of boreholes of which the water is sampled. The tendered rate shall be fully inclusive of the requirements of the specification irrespective of the number of samples taken from a borehole.

(e) Compilation of borehole report..... Unit: number

The unit of measurement shall be the number of boreholes regarding which approved reports is compiled. The tendered rate shall be fully inclusive of the work required to compile and produce six copies of each borehole recommendation report.

(f) Standing time ..... Unit: day

The unit of measurement shall be the number of days no work could be carried out. This will cover periods when the test pumping rig and crew or, if more than one rig and crew are fielded, when all rigs and crews are idle, waiting for decisions by the Engineer where those decisions or whose presence is required before the commencement or continuation of the work instructed. Under no circumstances will standing time be payable for any delays other than those incurred by the Engineer's decisions. Except only for abnormal weather conditions as provided for in PS14 of Portion 1 of the Project Specifications, no standing time will be payable due to inclement weather or prevention of access to a site by the Contractor due to inclement weather.

(g) Interhole moves..... Unit: number

The unit of measurement shall be the number of interhole moves made. The tendered rate shall include all labour and equipment costs incurred in moving plant, equipment and labour from one hole to another hole.

(h) Removal of existing pumping equipment ..... Unit: number

The unit of measurement shall be the number of boreholes from which equipment is removed prior to testing the borehole. The tendered rate shall cover the removal of existing pumping equipment from a borehole to be tested. Payment for removal up to an installed depth of 50 m shall be made at the unit rate tendered for in the Schedule of Quantities. Installed depths in excess of 50 m shall be remunerated for the first 50 m at the tendered unit rate and, for each full metre thereafter, at the rate per metre tendered in the Schedule of Quantities.

(i) Reinstallation of existing pumping equipment..... Unit: number

The unit of measurement shall be the number of boreholes in which removed equipment is re-installed. The tendered rate shall cover the reinstallation of existing pumping equipment in a borehole following test pumping of the borehole. Payment for installation up to a depth of 50 m shall be made at the unit rate tendered for in the Schedule of Quantities. Reinstallation depths in excess of 50 m shall be remunerated for the first 50 m at the tendered unit rate and, for each full metre thereafter, at the rate per metre tendered in the Schedule of Quantities.

The existing pumping equipment shall be reinstalled and left in working condition as it was found before removal unless the Contractor is instructed otherwise by the Engineer.

**DA.02      REPAIR OF EXISTING STRUCTURES**

**DA.02.01      Brickwork..... Unit: m<sup>2</sup>**

The unit of measurement shall be the area of brickwork repaired.

The tendered rate shall include full compensation for all labour, materials and equipment required for the complete repair of brickwork.

**DA.02.02      Concrete base slabs ..... Unit: m<sup>3</sup>**

The unit of measurement shall be the cubic metre of concrete used in the repair of base slab.

The tendered rate shall include full compensation for all labour, materials, and equipment required to carry out the work as well as fro all work carried out.

**DA.02.03      Clean around borehole..... Unit: number**

The unit of measurement shall be the number of boreholes around which the area is cleaned and levelled.

The tendered rate shall cover full compensation for the cleaning of an area 20 m x 20 m around each borehole.

**DA.02.04      Removal of concrete base slab ..... Unit: cubic metre (m<sup>3</sup>)**

The unit of measurement shall be the cubic metre volume of concrete broken out of the existing base slab.

The tendered rate shall include full compensation for the removal of the concrete inclusive of all tools, labour, removal of surplus material to a dump site and all other work required to satisfactorily complete the task.

**DA.02.05      Painting of exposed pipework ..... Unit: m**

The unit of measurement shall be the metre of pipework painted inside the pump house. The approximate diameter of the pipework is 100 mm.

The tendered rate shall include full compensation for the tools, labour, material, supply and delivery. The paintwork shall be conducted in accordance with Technical Specification BJ.

**DA.03      REPAIR/REPLACEMENT OF ELECTRICAL EQUIPMENT**

**DA.03.01      Detailed inspection and testing of components ..... Unit: number**

The unit of measurement shall be the number of boreholes for which a detailed inspection has been performed and all electrical and mechanical components tested.

The tendered rate shall include full compensation for testing all electrical and mechanical components for carrying out inspections and for all labour and equipment needed to carry out the work.

**DA.03.02      Commissioning ..... Unit: number**

The unit of measurement shall be the number of borehole installations commissioned.

The tendered rate shall include full compensation for all labour and equipment supplied and for the commissioning of each borehole installation.

**DA.03.03      Reconditioning of pumping equipment ..... Unit: number**

The unit of measurement shall be the number of pumps and motors reconditioned.

The tendered rates shall include full compensation for replacement of components and materials and for, tools, transport, site handling and labour necessary for the complete reconditioning of pumping equipment to conform to all the specifications in Subclause DA 04.06.14: Pump technical details and installation.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

**DA.03.04      Repair of pumping equipment ..... Unit: number**

The unit of measurement shall be the number of submersible pumps and motors repaired.

The tendered rate shall include full compensation for supply of an identification label, resetting the spacer between impeller and back plate and ensuring that impeller rotates freely, as well as cleaning and corrosion protection and installing a new hoisting chain.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

**DA.03.05     De-commissioning and removal of submersible pumping equipment ..... Unit: number**

The unit of measurement shall be the number of submersible pumps and motors de-commissioned and removed.

The tendered rates shall include full compensation for tools, transport, site handling and labour necessary for the complete de-commissioning and removal of pumping equipment.

**DA.03.06     Servicing of submersible borehole pumps ..... Unit: number**

The unit of measurement shall be the number of pumps serviced. The tendered rate shall include full compensation for servicing (including all consumables), cleaning, corrosion protection (including pump and motor base), adjusting, aligning, including disassembling and re-assembling. The tendered rate shall include all labour, tools, equipment and spare parts that form part of servicing as set out in the operating and maintenance manuals or as specified by the supplier.

**DA.04     SUBMERSIBLE CENTRIFUGAL PUMPS**

**DA.04.01     Supply and delivery of submersible borehole pumps:**

(a) (Pump description)..... Unit: number

(b) Etc for other pumps

The unit of measurement shall be the number of units supplied and delivered where each unit shall include one pump, one motor, one base plate, drop cable set, earth wire, flow inducer if required and all other accessories as specified.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, testing, delivery to site, storage, patent rights, etc, of all the equipment complete as specified in the Specifications.

**DA.04.02     Installation of submersible borehole pumps:**

(a) (Pump description)..... Unit: number

(b) Etc for other pumps

The unit of measurement shall be the number of units installed. Each unit shall include one pump with motor or engine, base plate and all other accessories as specified.

The tendered rates shall include full compensation for the installation of the units, the making good of all damaged corrosion protection areas, maintenance and for all other costs and actions that are necessary to provide a complete and efficiently working system.

Payment under this item may only be claimed after the relevant operating manuals have been handed over to the Engineer.

**DA.04.03     Supply, deliver and install rising pipe (diameter and pressure class indicated) ..... Unit: number**

The unit of measurement shall be the metre of rising pipe installed.

The tendered rate shall include full compensation for all labour, plant, transport and materials required to manufacture, supply and install the rising pipe, corrosion protection, fixing to the pump and base plate, including couplings, gaskets, nuts and bolts.

**DA.04.04 Remove existing equipment from borehole and store on site as directed by the Engineer:**

(a) (Equipment description)..... Unit: number

(b) Etc for other descriptions

The unit of measurement shall be the number of installations from which the equipment is removed.

The tendered rate shall include full compensation for the removal of the existing borehole equipment, providing a suitable storage facility, transporting the equipment to the storage facility and store the equipment for the period required.

**DA.05 SUBMERSIBLE PROGRESSING CAVITY PUMPS**

**DA.05.01 Supply and delivery of submersible progressing cavity pumping equipment:**

(a) Pump unit..... Unit: number

(b) Pulley head and base frame ..... Unit: number

(c) Rising pipe ..... Unit: m

(d) Rising pump shaft ..... Unit: m

The unit of measurement for subitem DA.05.01(a) shall be the number of submersible progressing cavity pump units supplied and delivered.

The unit of measurement for subitem DA.05.01(b) shall be the number of pulley heads including two complete sets of drive belts and their protective safety cages (sized to enclose the drive pulley heads of the motor or engine, suited to the particular installation) and a base frame for each pulley head supplied and delivered.

The unit of measurement for subitem DA 05.01(c) shall be the linear metre length of rising pipe supplied and delivered.

The unit of measurement for subitem DA.05.01(d) shall be the linear metre length of shaft supplied and delivered.

The tendered rates shall include full compensation for the manufacture, corrosion protection, predelivery testing, transport to site, off-loading and all handling of equipment which shall include the following:

- the pump unit
- pulley head and base frame
- rising pipework and centralisers
- rising shaft and locating bearings
- all accessories including valves, fittings, V-belts, fasteners and auxiliary materials to render a complete pump unit.

**DA.05.02 Installation of submersible progressing cavity pumping equipment:**

- (a) Pump unit ..... Unit : number
- (b) Pulley head and base frame ..... Unit : number
- (c) Rising pipe ..... Unit : m
- (d) Rising pump shaft ..... Unit : m

The unit of measurement for subitem DA.05.02(a) shall be the number of submersible progressing cavity pump units installed.

The unit of measurement for subitem DA.05.02(b) shall be the number of pulley heads including two complete sets of drive belts and a base frame for each pulley head installed.

The unit of measurement for subitem DA.05.02(c) shall be the linear metre length of rising pipe installed.

The unit of measurement for subitem DA.05.02(d) shall be the linear metre length of shaft installed.

The tendered rate shall include full compensation for the site handling and positioning and installation of the equipment including all labour and consumables required for a fully installed submersible progressing cavity pump.

Payment under this item may only be claimed after the relevant operating manuals have been handed over to the Engineer.

**DA.06 BOREHOLE STRUCTURES**

**DA.06.01 Clear area around borehole ..... Unit: square metre (m<sup>2</sup>)**

The unit of measurement shall be the square meter of area cleaned and levelled around the borehole.

**DA.06.02 Removal of concrete base slab ..... Unit: cubic metre (m<sup>3</sup>)**

The unit of measurement shall be the cubic metre volume of concrete broken out of the existing base slab.

The tendered rate shall include full compensation for the removal of the concrete inclusive of all equipment, labour, removal of surplus material to a dump site and all other work required to satisfactorily complete the task.

**DA.06.03 Laying of Concrete base slabs ..... Unit: cubic metre (m<sup>3</sup>)**

The unit of measurement shall be the cubic metre of concrete used for a new base slab or for the repair of a base slab.

The tendered rate shall include full compensation for all labour, materials, and equipment required to carry out the work, as well as cleaning of the construction area.

**DA.06.04**     **Brickwork**..... Unit: m<sup>2</sup>

The unit of measurement shall be the area of brickwork repaired.

The tendered rate shall include full compensation for all labour, materials and equipment required for the complete repair of brickwork. The tendered rate shall also include the cleaning of the construction area and the removal of surplus material from site.

**DA.06.05**     **Repair of existing steel cover**..... Unit: number

The unit of measurement shall be the number of steel covers repaired.

The tendered rate shall include full compensation for all labour, materials and equipment required for the complete repair required and repainting of the existing borehole steel cover. The tendered rate shall also include the cleaning of the construction area and the removal of surplus material from site.

**DA.06.06**     **Supply, Deliver and Install new borehole enclosure**..... Unit: number

The unit of measurement shall be the number of borehole enclosures installed.

The tendered rate shall include full compensation for all labour, materials and equipment required for the supply, delivery and installation of the new borehole enclosure complete as per the tender drawings. The tendered rate shall also include the cleaning of the construction area and the removal of surplus material from site.

**DA.06.07**     **Painting of exposed pipe work**..... Unit: m

The unit of measurement shall be the metre of pipe work painted. The approximate diameter of the pipe work is 100 mm.

The tendered rate shall include full compensation for the tools, labour, material, supply and delivery. The paintwork shall be conducted in accordance with Particular Specification BJ 03.01.03 (c).



**TECHNICAL SPECIFICATION****DB BOREHOLE DRILLING & EQUIPPING****CONTENTS**

DB 01	SCOPE
DB 02	STANDARD SPECIFICATIONS
DB 03	CONTRACTOR'S RESPONSIBILITY AND APPROACH
DB 04	DRILLING PROCEDURE
DB 05	MEASUREMENT AND PAYMENT

**DB 01 SCOPE**

This specification covers borehole drilling procedures, casing, backfilling, stabilising, protection and recording and reporting of related activities with the drilling of a borehole. The function of drilling of a borehole shall be supply of raw water to the facility at hand.

**DB 02 STANDARD SPECIFICATIONS****DB 02.01 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) shall be adhered to.

**DB 02.02 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

**DB 02.03 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**DB 02.03 DWAF GUIDELINES**

Minimum Standards and Guidelines for Groundwater Resource Development for the Community Water Supply and Sanitation Programme issued by the Department of Water Affairs and Forestry shall be adhered to unless otherwise specified.

**DB 03 CONTRACTOR'S RESPONSIBILITY AND APPROACH**

It is required that the drilling of any borehole be approached with due diligence and care on the part of the appointed drilling contractor. Specifically, it is required that the drilling of each borehole be approached on the premise that it will be successful and, as such, will serve the function of a raw water supply to the facility at hand. Under normal circumstances, the pre-drilling of a small diameter pilot borehole will not be allowed. Such an approach may only be considered with the approval of the Hydrogeological Consultant who shall be required to fully motivate such an approach to the Implementing Authority.

## DB . 2

The Drilling Contractor shall function under the direct supervision of the Hydrogeological Consultant. This by no means implies that the Drilling Contractor is absolved from any responsibility. All drilling activities shall, therefore, be approached through communication and discussion between the Hydrogeological Consultant and the contractor with a view to developing the most suitable and mutually acceptable finished product serving the best interests of the project.

Failure by the contractor to timeously render advice and input where required shall be regarded as a dereliction of duty. This responsibility extends to informing the Hydrogeological Consultant of serious reservations regarding any aspect of the work. The contractor shall also be required to maintain the aesthetic appearance of the site during drilling operations, including keeping the site neat, tidy and free of litter. The contractor shall ensure that safety standards are met and that the work site is kept free, as far as is possible, from vehicular and pedestrian traffic and from interested bystanders and onlookers not involved with the project.

The appointed Drilling Contractor shall carry the final responsibility for the finished water supply borehole and all actions and activities leading up thereto.

### **DB 04**                    **DRILLING PROCEDURE**

#### **DB 04.01**                **WORKMANSHIP & PERFORMANCE**

The standard of workmanship of the Drilling Contractor shall be subject to close scrutiny by the Hydrogeological Consultant. Although it cannot be expected of the contractor to complete a specified number of boreholes in a given time period, it is reasonable to expect that "favourable progress" be made under normal circumstances and drilling conditions. An indication of what might be regarded as "favourable progress" is considered to fall in the range of 50 to 100 m of drilling advancement per day taking into consideration interhole moves and setup time.

Although work-in-progress may be completed, the contractor shall under no circumstances vacate a site before the Hydrogeological Consultant has inspected the completed works and provided written approval that the work executed conforms to the requirements of this specification.

#### **DB 04.02**                **DRILLING TECHNIQUE**

The drilling technique to be employed for the project at hand is that of rotary air percussion drilling employing a down-the-hole (DTH) hammer.

Depending on site-specific circumstances other techniques might be employed including: (1) mud rotary drilling, (2) Odex drilling, (3) dual-tube reverse circulation and (4) cable tool percussion drilling. Instances where another drilling technique might be considered more appropriate and efficient shall be identified by the Hydrogeological Consultant during the project and the Contractor informed accordingly.

#### **DB 04.03**                **EQUIPMENT AND MATERIAL**

The equipment made available by the Drilling Contractor shall be in good working order. Equipment shall be maintained in good condition for the duration of the project. Routine servicing and preventative maintenance of all equipment required for the drilling procedure and other ancillary equipment shall form the responsibility of Contractor and shall be deemed as included in the tendered rates.

## DB . 3

The drilling equipment shall include a full air/foam pumping system. At the start of the project, the gauge diameter of the button drill bits to be employed with the rotary air percussion drilling technique shall conform closely to their manufactured gauge and shall also possess all of their tungsten carbide buttons.

The Hydrogeological Consultant shall discuss with the Drilling Contractor the retirement of a bit due to excessive wear or damage incurred during the course of the project. Further, it is imperative that the equipment be of a suitable size and capacity to deal, on occasion, with: (1) deep boreholes (up to 200 m), (2) larger than average borehole diameters (up to 254 mm), (3) large quantities of groundwater and (4) potentially onerous drilling conditions. Since this capability is provided in large measure by the air compressor, it is considered that a compressor having a capacity of at least 2400 kPa (24 bar) and a volume of at least 750 cfm is appropriate for most water borehole drilling applications and conditions using the rotary air percussion technique. In order to maintain the straightness of a borehole, the Hydrogeological Consultant may insist that the drilling contractor employ at least an overshot sleeve (drill collar) fitted to the pneumatic DTH hammer. Further precautions to ensure this aspect might include the use of a stabiliser rod immediately behind the bit/hammer/overshot combination. All materials to be used on the project should be new and meet project specifications.

Steel casing shall be: (1) of the seam-welded type, (2) round, (3) straight, (4) of uniform wall thickness and (5) have bevelled edges. Second-hand material such as steel casing recovered from an earlier borehole can be used provided that it has been refurbished to an acceptable condition. The Hydrogeological Consultant shall have the right to reject, with motivation, any material (including casing) that is deemed inappropriate, substandard or otherwise unsuitable for the project.

### DB 04.03

#### **BOREHOLE CONSTRUCTION**

This sections addressed certain basic borehole construction practices which will contribute to final acceptance of the successfully finished product.

### DB 04.03.01

#### **DRILLING DIAMETER**

Drilling of the water supply borehole shall commence at a diameter, which shall allow for the trouble free insertion of casing. Under normal circumstances, this entails drilling a 203 mm (8") or 216 mm (8½") diameter bore through the weathered overburden and any other potentially unstable near surface material. The bore shall penetrate at least three meters into fresh, more competent material before this horizon can be secured from potential collapse or wash-out by casing it off with nominal 165 mm (6½") or 152 mm (6") diameter steel casing. Thereafter, the bore is continued at 165 mm (or 152 mm) drilling diameter to its completion depth.

The presence of unstable rock formations (which are often also associated with groundwater-bearing horizons) at greater depths in the bore generally account for complications, which shall impact, on the abovementioned approach. The Drilling Contractor shall firstly attempt to penetrate through such horizons in order establish their vertical thickness. Such horizons often possess only a temporary instability and become "cleaned out" as drilling advances. In instances where such horizons remain unstable and severely hamper drilling progress, it will become necessary for the contractor to remove the surface casing and ream (widen) the borehole to a diameter of at least 203 mm (or 216

mm) to the depth of such unstable horizon. It will then be required to re-insert 165 mm (or 152 mm) nominal diameter casing to this depth and attempt to advance this casing through the unstable horizon.

In exceptional circumstances it may even be necessary to re-drill or ream the borehole to a diameter of 254 mm through unstable overburden material, insert nominal 203 mm (or 216 mm) diameter casing through this horizon and widen the borehole to 203 mm (or 216 mm) diameter below this depth to the unstable zone. Extremely onerous drilling conditions at depth might even warrant the commencement of drilling at a diameter of 305 mm or greater. This approach is often taken when aiming to maximise the exploitation of groundwater from a productive karst aquifer.

Information regarding the dimensions of the more commonly used button drill bits for rotary air percussion drilling is given in Table DB.1 together with casing diameters generally associated with each bit gauge.

<b>Table DB.1. Dimensions of commonly used button drillbit gauge diameters for use with the rotary air percussion drilling method</b>	
<b>BIT GAUGE DIAMETER</b>	<b>CASING INSIDE DIAMETER FOR DRILL-THROUGH PURPOSES</b>
127 mm (5 in.)	143 to 146 mm
152 mm (6 in.)	156 to 159 mm
165 mm (6½ in.)	168 to 171 mm
203 mm (8 in.)	207 to 212 mm
216 mm (8½ in.)	
254 mm (10 in.)	257 to 264 mm
305 mm (12 in.)	
<b>NOTE:</b>	
1. The bit gauge diameter is also given in the Imperial unit of inches (in.) since this unit is still in common use when referring to this parameter.	
2. Casing inside diameter varies according to wall thickness (refer Table DB.2).	

The information provided in Table DB.1 shows that each bit gauge passes comfortably through casing with a similar nominal diameter. For example, a 203 mm gauge bit can be used to extend the depth of a borehole already equipped with 207 to 212 mm inside diameter casing without having to reduce to the next smallest drilling diameter. Note also that a borehole drilled to a given diameter is able to accept casing having the next smallest diameter. For example, a 203 mm diameter borehole can be fitted with either 152 mm nominal inside diameter or preferably 165 mm nominal inside diameter steel casing.

In view of the foregoing, it is clear that the minimum final cased diameter of a successful raw water supply (for the extent of the facility at hand) borehole shall seldom be less than 152 mm nominal.

## DB 04.03.02

STEEL CASING

Steel casing may either be used in a temporary manner or form a permanent part of the borehole infrastructure. Its temporary use is indicated in instances where, for example, the borehole is unsuccessful or the need for it to remain in place becomes redundant. Under these circumstances it is also referred to as a pre-collar, surface casing, starter casing, outer casing or soil casing generally to be removed (recovered) on completion of drilling. It shall be left in place where the Hydrogeological Consultant is of the opinion that the unsuccessful borehole should be secured to serve a long-term groundwater monitoring purpose. In such instances, additional provision shall be made to protect the borehole against actions, which may compromise this function.

Steel casing shall be: (1) of the seam-welded type, (2) round, (3) straight, (4) of uniform wall thickness and (5) have bevelled edges. Secondhand material such as steel casing recovered from an earlier borehole can be used provided that it has been refurbished to an acceptable condition. The Hydrogeological Consultant shall have the right to reject, with motivation, any material (including casing) that is deemed inappropriate, substandard or otherwise unsuitable for the project.

More commonly, however, this casing constitutes the final casing with which a successful borehole is equipped. Its proper installation, therefore, is mandatory. It is installed from surface through unstable, unconsolidated or fractured materials usually occurring in the near surface. Under these circumstances, the function of steel casing includes one or more of: (1) supporting unstable materials against collapse into the borehole during drilling, (2) facilitating the installation or removal of other casing, (3) minimising the erosion and widening of the unstable upper portions of the borehole sidewall caused by the return flow established during drilling and/or the passage of drilling equipment/tools and (4) facilitating the placement of a sanitary seal and/or gravel pack or formation stabiliser.

In order to ensure as far as is possible that the annular space between this casing and the borehole sidewall remains open for the later emplacement of a sanitary seal, the circumferential entrance to this space shall be temporarily plugged. Hessian sacking packed around and lightly tamped into the surface entrance to this annular space can be used for this purpose. In instances where steel casing needs to be driven through unstable horizons (generally at greater depths in a borehole), it will be also be required that such casing be fitted with a casing shoe to protect the "mouth" of the casing from damage. Irrespective of the casing used to facilitate the drilling of the borehole, the final cased diameter of the finished product shall be sufficient for the borehole to easily accept a borehole pump. Since the outside diameter of the latter are generally in the order of 100 mm, it is required that the final cased diameter of the borehole not be less than 152 mm (6 in.) nominal where steel casing is used. Information on the dimensions of the more commonly used steel casing available locally is given in Table DB.2.

<b>Table DB.2.Dimensions of commonly used and locally available steel borehole casing</b>		
<b>OUTSIDE DIAMETER</b>	<b>WALL THICKNESS</b>	<b>INSIDE DIAMETER</b>
165 mm (6 in. nominal)	3.0 mm 4.0 mm 4.5 mm	159 mm 157 mm 156 mm
177 mm (6½ in. nominal)	3.0 mm 4.0 mm 4.5 mm	171 mm 169 mm 168 mm
219 mm (8 in. nominal)	3.5 mm 4.5 mm 6.0 mm	212 mm 210 mm 207 mm
273 mm (10 in. nominal)	4.5 mm 6.0 mm 8.0 mm	264 mm 261 mm 257 mm

**NOTES:**

1. The casing outside diameter dimensions are also given in the Imperial unit of inches (in.) since this unit is still in common use when referring to this parameter.
2. Use of the term "nominal" when referring to casing diameter provides a direct association with the gauge of the bit (Table DB.1) which most closely passes through it.

**DB 04.03.03      CASING SHOE**

This item is fitted (welded) to the bottom end (foot) of a casing string in order to protect the "mouth" of the casing from damage due to forcing the casing through unstable horizons. Its use is therefore only warranted (indeed mandatory) in instances where such conditions reveal themselves to require securement through the emplacement of casing.

**DB 04.03.04      uPVC CASING**

Also referred to as thermoplastic casing, the material generally comprises PVC (polyvinyl chloride) which, when treated to withstand ultraviolet radiation, is known as uPVC casing. Its application in the construction of water supply boreholes is specific, being used mainly in instances where security against the collapse of a borehole sidewall is required and where steel casing does not already offer such security. In such instances, the casing is inserted the entire length of the borehole and will certainly be perforated for some portion of its length.

The diameter of this casing will also necessarily be smaller than that of the steel casing used which, in most instances, will have a nominal diameter of 165 mm. In order not to compromise too severely on the minimum nominal diameter requirement of 152 mm for successfully completed water supply boreholes, the inside diameter of the uPVC casing shall not be less than 128 mm with a wall thickness of 6 mm. It is also common practice to leave the steel casing in place in order to provide protection for the uPVC casing. The decision to use uPVC casing in the final construction of a borehole shall be made by the Hydrogeological Consultant.

**DB 04.03.05**      **PERFORATED CASING**

For the purposes of this project perforated casing used shall be of a prefabricated type. As a general guideline, slots should be: (1) 300 mm in length, (2) 3 to 4 mm wide, (3) positioned in bands around the circumference of the casing, (4) spaced equally in each band, (5) each circumferential band of slots separated by 100 mm of plain pipe, (6) every second band of slots aligned with one another and (7) a 300 mm section of plain pipe left at both ends of the casing.

Bearing in mind that the number of slots forming each circumferential band depends not only on the casing diameter but also impact on the strength of the casing, it is suggested that the guidelines presented in Table DB.3 be adhered to in this regard.

<b>Table DB.3. Recommended number of slots per circumferential band for various steel casing diameters and associated percentage open area provided</b>		
<b>NOMINAL CASING DIAMETER</b>	<b>NUMBER OF SLOTS PER CIRCUMFERENTIAL BAND</b>	<b>PERCENTAGE OPEN AREA</b>
152 mm	6	3.0%
165 mm	8	3.7%
203 mm	10	3.7%

Also presented in this table (Table DB.3) is the approximate open area provided by the above slot pattern applied to each of the given casing diameters. In certain instances, however, it may be required to use more sophisticated and expensive slotted casing. Also known as screens, these include: (1) continuously wound wedge wire screens, (2) louvered screens or bridge-slotted screens and (3) screens pre-coated with gravel. The decision to use such screens shall again be made by the Hydrogeological Consultant after providing motivation to and gaining acceptance from the Implementing Authority.

**DB 04.03.06**      **RECOVERY OF STEEL CASING**

The contractor shall make every effort to recover, only on instruction from the Hydrogeological Consultant, steel casing from unsuccessful or abandoned boreholes. This casing can also be refurbished to an acceptable condition for re-use.

**DB 04.03.07**      **BOREHOLE STRAIGHTNESS**

The Drilling Contractor in the presence of the Hydrogeological Consultant shall perform the straightness test and its success (or failure) recorded by this party.

A borehole, which fails a straightness test, shall be deemed lost and it shall be required of the Drilling Contractor to drill a replacement borehole at own

expense. In the event that a straightness test is made before completion of the borehole, then the contractor shall be required to cease operations and facilitate access to the borehole for the duration of such activity.

**DB 04.03.08**      **BOREHOLE VERTICALITY**

The Hydrogeological Consultant in the presence of the Drilling Contractor shall perform the verticality test. The consultant shall therefore be required to provide the necessary equipment for conducting a verticality test. A borehole, which fails a verticality test, shall be deemed lost and it shall be required of the contractor to drill a replacement borehole at own expense. In the event that a verticality test is made before completion of the borehole, then the Drilling Contractor shall be required to cease operations and facilitate access to the borehole for the duration of such activity.

**DB 04.03.09**      **BACKFILLING**

This entails filling the annular space between the borehole sidewall and the outside of the casing with suitable material. The purpose of annular backfilling includes: (1) the provision of a base on which to found a sanitary seal and (2) the provision of support for the sidewalls of the borehole and the casing. In instances where casing has been seated at a comparatively shallow depth in fresh material below a weathered near-surface horizon, all of the drill cuttings removed from the borehole whilst drilling represents suitable material for this purpose. Annular backfilling with this material is not advisable in instances where this is not the case, such as for example where the casing extends to a substantial depth and comprises slotted/perforated sections or where the water-bearing horizon is shallow and open to the borehole via slotted/perforated casing. In these instances, it shall be required to insert a formation stabiliser into the annulus. The backfilling shall extend to within approximately 5 m of the ground surface.

**The Contractor shall allow for the cost of backfilling in the tendered rates.**

**DB 04.03.10**      **FORMATION STABILISER**

This comprises material, which is placed in the annulus between the borehole sidewall and perforated/slotted sections of casing to stabilise the formation against collapse and ingress into the borehole. The drill cuttings and spoils removed from the borehole is not suitable material for this purpose. The stabiliser shall comprise material which is: (1) well sorted, (2) well rounded, (3) low in calcareous content and (4) graded such that the smallest grain size is larger than the casing perforations/slots. The stabiliser material can either be placed by hand or through a tremie pipe. Excessive bridging of stabiliser material in the annulus can be prevented: (1) through the use of centralisers on the casing or (2) by washing it in with clean water. The formation stabiliser should extend some 10 m above the top of the uppermost perforated/slotted section of casing before the borehole is developed.

**The Contractor shall allow for the cost of formation stabilising in the tendered rates.**



**DB 04.03.11**      **CONCRETE COLLAR**

The Drilling Contractor shall construct a shallow circular concrete collar around each successfully completed borehole. This collar shall have dimensions and volume as specified by the Hydrogeological Consultant. The concrete mixture shall required strength of some 30 MPa after 28 days. A similar collar may need to be constructed, on request of the Hydrogeological Consultant, over unsuccessful or abandoned boreholes.

**The Contractor shall allow for the cost of the concrete collar in the tendered rates.**

**DB 04.03.12**      **UNSUCCESSFUL AND ABANDONED BOREHOLES**

A borehole shall be declared unsuccessful at the discretion of the Hydrogeological Consultant. The latter may also, at any time during the course of the work, order the abandonment of a borehole in progress.

In such instances, the Hydrogeological Consultant shall instruct the Drilling Contractor on further actions to be taken. These may include either: (1) the salvage of any casing from the borehole and (2) the plugging of the borehole or (3) the securement of the borehole for long term monitoring purposes, in which it case it shall be provided with a sanitary seal concrete collar protection and marking.

Plugging (or finishing) of an unsuccessful or abandoned borehole is aimed at removing any danger or hazard such boreholes may present to the environment, eg. as a conduit for the inflow of surface water into the groundwater regime or as a danger to traffic (whether human, stock or vehicular) in the immediate vicinity thereof. It shall also be required to cast a concrete collar over the infilled borehole.

The Drilling Contractor shall be remunerated for an unsuccessful or abandoned borehole on the basis of tendered rates in the Schedule of Rates for such of the following items as are relevant: (1) drilling per linear metre of depth for each relevant drilling diameter employed, (2) steel casing per linear metre thereof recovered, (3) backfilling, (4) a sanitary seal, (5) borehole protection and (6) borehole marking. Payment for any casing left behind in an unsuccessful or abandoned borehole will only be made, on the same basis as described in (2) above, on written certification by the Hydrogeological Consultant that the contractor has made every reasonable attempt in this regard.

**DB 04.03.13**      **LOST BOREHOLES**

A borehole shall be declared lost by the Hydrogeological Consultant in the event that it can not be completed satisfactorily due to factors such as: (1) the irrecoverable loss of drilling equipment, materials or tools therein, (2) accident to plant or heavy machinery, (3) failure to pass a straightness test and (4) failure to pass a verticality test. A decision in this regard shall be made after consultation with the Drilling Contractor, who shall have the considered option to either attempt remediation of the situation to the satisfaction of the Hydrogeological Consultant or, alternatively, declare the situation irretrievable.

No payment shall be made for any work done, materials used or time spent by the Drilling Contractor on a lost borehole. The cost of any materials recovered in a damaged state from a lost borehole shall be borne by the contractor.

A borehole, which is declared lost, shall be replaced with a new borehole to be constructed by the Drilling Contractor in the vicinity of the lost borehole and at a position indicated by the Hydrogeological Consultant. Payment for a new borehole constructed under these circumstances shall be made on the same basis as for any other successfully completed borehole. Materials recovered in good condition may, however, be re-used by the contractor.

**DB 04.03.14**      **SANITARY SEAL**

Every successful water supply borehole shall be provided with a sanitary seal. The seal shall consist of portland cement mixed to slurry with bentonite and water, which is free of oil and other organic matter. The bentonite and water should be thoroughly mixed in the ratio of 2 kg bentonite to 25 l water prior to adding and mixing in 50 kg (one bag) cement. The final grout seal shall extend to a depth of at least 5 m below ground surface, ie. founded on the backfilling. In such shallow applications, the slurry can be gravity-fed into the annulus through a small diameter tube (tremie pipe) extending to the depth of emplacement. The tremie pipe should be withdrawn slowly as the slurry fills up the annulus. There shall be no voids in the sanitary seal.

**The Contractor shall allow for the cost of the sanitary seal in the tendered rates.**

**DB 04.03.15**      **BOREHOLE DEVELOPMENT**

The Geohraulogist shall submit proof of sufficient borehole development procedures. This activity shall be concluded with the collection of a 1liter representative water sample obtained from the return flow during development.

**The Contractor shall allow for the cost of borehole development in the tendered rates.**

**DB 04.03.16**      **BOREHOLE DISINFECTION**

The Geohraulogist shall submit proof of sufficient borehole disinfection procedures.

Guideline volumes/weights of common compounds to be used for disinfection purposes under most normal circumstances can be derived from the information provided in Table DB.4.

**The Contractor shall allow for the cost of borehole disinfection in the tendered rates.**

**Table DB.4. Guideline volumes/weights of common sterilants to be used per unit volume of water for various borehole diameters**

		Sodium hypochlorite	Calcium hypochlorite	Chlorinated lime
	18 l	500 ml (2 cups)	26 g (¼ cup)	90 g (1 cup)
	21 l	600 ml (2½ cups)	30 g (½ cup)	105 g (1 cup)
	33 l	940 ml (4 cups)	47 g (½ cup)	165 g (1½ cups)
	51 l	1500 ml (6 cups)	73 g (¾ cup)	255 g (2½ cups)

**NOTES:**

1. No distinction is drawn between open and cased portions of a borehole since these differences are considered to have a negligible impact on calculated unit volumes.
2. The trade percentage of chlorine in the listed sterilants is taken to be:
  - 3.5 percent by volume (35 ml/l) for sodium hypochlorite,
  - 70 percent by weight (700 g/kg) for calcium hypochlorite, and
  - 20 percent by weight (200 g/kg) for chlorinated lime.

**EXAMPLE:**

A 100-metre deep borehole with a nominal diameter of 165 mm and with a rest water level standing at a depth of 25 m below surface will require  $75 \times 30 \text{ g} = 2,250 \text{ g}$  (2.25 kg), alternatively  $75 \times \frac{1}{2} \text{ cup} = 25 \text{ cups}$ , of calcium hypochlorite to achieve adequate disinfection. The same situation would require  $75 \times 600 \text{ ml} = 45,000 \text{ ml}$  (45 l) of sodium hypochlorite to achieve adequate disinfection.

**DB 04.03.17**

**BOREHOLE PROTECTION**

This entails sealing the borehole from the introduction of foreign material directly through the casing.

In order to provide the Hydrogeological Consultant with ready access to the borehole for water level measuring purposes, it is required that a small hole be drilled in the lid. This hole shall be furnished with a tamper-proof plug such as a "dead-end" threaded into a water pipe connector welded on the hole. The final diameter of the hole providing access to the borehole shall be sufficient to allow a "normal" dipmeter probe to pass through it. It is considered that a diameter of at least 10 mm and not more than 20 mm is suitable for this purpose.

**The Contractor shall allow for the cost of borehole protection in the tendered rates.**

**DB 04.03.18**      **BOREHOLE MARKING (IN THE FIELD)**

The activity itself represents marking the borehole by: (1) script-welding its assigned and unique identifying number onto the lid of the borehole and (2) planting a concrete block with dimensions of 200 mm x 200 mm x 200 mm (also bearing the number of the borehole) in the ground a distance of five metres to the north of the borehole.

It is the responsibility of the Hydrogeological Consultant to ensure that a borehole number is provided to the contractor for this purpose.

**The Contractor shall allow for the cost of borehole marking in the tendered rates.**

**DB 04.03.19**      **SITE FINISHING**

The activities associated with this task shall include the repair of construction scars on the work site resulting from drilling activities as well as the general cleanup of the site of waste materials, debris and oil spills. The latter shall be shoveled over and worked into the ground wherever possible.

**Site finishing shall be deemed as included in the tendered rates.**

**DB 04.04**      **DATA RECORDING AND REPORTING**

A detailed and accurate record of all information arising from the borehole drilling activity shall be recorded with care and diligence. The Drilling Contractor can collect much of this information. The Hydrogeological Consultant shall keep this current and available for inspection on request.

**The contractor shall include the cost of data recording and reporting in the tendered rates.**

It shall be the responsibility of the Hydrogeological Consultant to verify receipt of this information prior to certifying a claim by the Drilling Contractor in this regard. The following items of information represent the minimum number of parameters, which shall be monitored and recorded by the contractor:

- Penetration Rate
- Formation Sampling and Description
- Water Strike Depth
- Blow Yield
- Groundwater Rest Level

**DB 04.05**      **DOWN-THE-HOLE LOSS OF EQUIPMENT**

The Hydrogeological Consultant shall afford the contractor every opportunity and reasonable time to fish for lost equipment. The Drilling Contractor shall, in turn, keep the Hydrogeological Consultant informed of progress and the likelihood of success in this regard. The contractor shall have no claim against any other party for any losses incurred in this regard. The Hydrogeological Consultant shall finally decide on the fate of the borehole. It may either be declared successful or lost.

**DB 04.05.01**      **BOREHOLE DECLARED SUCCESSFUL**

Circumstances under which a borehole may be declared successful include: (1) the borehole has encountered significant water, (2) pumping equipment can be installed to an acceptable depth in the borehole and (3) the lost equipment does not pose a threat to the present and future quality of the groundwater. In the event that a borehole is declared successful despite the irrecoverable loss of drilling equipment, materials or tools therein, then the exact nature and position of the equipment lost in the borehole shall be recorded and appear in relevant project documentation. The Drilling Contractor shall be remunerated for a borehole declared successful under these circumstances on the same basis as for any other successfully completed borehole.

**DB 04.05.02**      **BOREHOLE DECLARED LOST**

Refer to paragraph DB 04.03.13.

**DB 04.06**      **BOREHOLE INFORMATION REQUIRED**

A detailed and accurate record of all information arising from the following activities shall be submitted by the Hydrogeological Consultant.

- Down-the-hole borehole measurement
- Borehole Construction Information
- Geological Information
- Hydrogeological Information
- Hydrochemical Information

**The Contractor shall allow for the cost of the information in the tendered rates.**

**DB 04.07**      **REHABILITATION OF EXISTING BOREHOLES**

The scope of this work may vary from the basic cleaning out and re-development of an existing borehole to the recovery of casing, the reaming and subsequent re-installation of casing. The nature of the rehabilitation required in each individual instance shall be identified prior to undertaking this activity since this shall indicate which equipment will most suitably complete the task.

The rehabilitation of an existing borehole shall be carried out under the supervision of the Hydrogeological Consultant. In any event, the execution of such work shall be subject to the same degree of data collection and record keeping as is required of a new borehole.

The Drilling Contractor shall be remunerated for this service on the basis of the rates tendered as per section DB 05. It shall be expected of the contractor to have assessed the potential technical risks involved with such work and, as a consequence, the contractor shall have no claim against any other party for the loss of equipment, materials or tools incurred in the course of such work.

**DB 04.08**            **FINAL ACCEPTANCE**

The Hydrogeological Consultant shall accept a successfully finished water supply borehole by issuing of a certificate of completion. At this stage, the Hydrogeological Consultant shall have established that all aspects pertaining to the work and the final product meet, at least, those of the various criteria and requirements set out above which have been imposed.

**DB 04.09**            **APPOINTMENT OF HYDROGEOLOGICAL CONSULTANT**

The Contractor shall be responsible for appointing a Hydrogeological Consultant for the purposes of this contract. The Hydrogeological Consultant shall be registered with the Department of Water Affairs and Forestry and shall be approved by the Engineer.

The Hydrogeological Consultant shall be responsible for the hydrogeological survey to site the borehole, oversee the drilling of the borehole and pump testing the borehole as well classification of the drinking water for domestic purposes.

**DB 05**                **MEASUREMENT AND PAYMENT**

**DB.01**                **DRILLING OF BOREHOLE** ..... Unit: m

The contractor shall be remunerated for drilling per linear metre of depth at the rate tendered for each relevant drilling diameter employed.

The tendered rate shall include full compensation for all labour, equipment and material required, recording and reporting for the complete drilling of the boreholes in accordance with the specification.

**DB.02**                **BOREHOLE CASING**

**DB.02.01**            **Steel Casing** ..... Unit: m

The unit of measurement for steel casing per linear metre thereof supplied, delivered and installed.

The tendered rate shall include full compensation for all labour, materials, transport, recording and reporting and equipment required for the complete installation of the casing.

**DB.02.02**            **Casing Shoe** ..... Unit: item

Remuneration shall be for each casing shoe supplied and installed.

The tendered rate shall include full compensation for all labour, materials, transport, recording and reporting and equipment required for the complete installation of the casing shoe.

**DB.02.03**            **uPVC Casing** ..... Unit: m

The unit of measurement for uPVC casing per linear metre thereof supplied, delivered and installed.

The tendered rate shall include full compensation for all labour, materials, transport, recording and reporting and equipment required for the complete installation of the casing.

**DB.02.04      Perforated Casing..... Unit: m**

The unit of measurement for perforated casing per linear metre thereof supplied, delivered and installed.

The tendered rate shall include full compensation for all labour, materials, transport, recording and reporting and equipment required for the complete installation of the casing.

**DB.03      RECOVERY OF STEEL CASING..... Unit: m**

Remuneration for the recovery of steel casing shall be per linear metre thereof salvaged from a borehole.

The tendered rate shall include full compensation for all labour, materials, transport, recording and reporting and equipment required for the recovery of steel casing.

**DB.04      APPOINTMENT OF HYDROGEOLOGICAL CONSULTANT**

(a) Appointment of Hydrogeological Consultant.....Unit: PC Sum

(b) Charge required by Contractor on subitem (a) above..... Unit: %

Remuneration for the appointment of a Hydrogeological Consultant shall be based on a Prime Cost Sum. The Prime Cost Sum provided under subitem (a) in the Schedule of Quantities will be expended in accordance with Subclause 48(2) of the General Conditions of Contract.

The tendered percentage under subitem (b) will be paid to the Contractor on the value of each payment made to the Hydrogeological Consultant.

**TECHNICAL SPECIFICATION****DC BOREHOLE SITING & DRILLING****CONTENTS**

DC 01	SCOPE
DC 02	STANDARD SPECIFICATIONS
DC 03	CONTRACTOR'S RESPONSIBILITY AND APPROACH
DC 04	DRILLING PROCEDURE
DC 05	MEASUREMENT AND PAYMENT

**DC 01 SCOPE**

This specification covers borehole drilling procedures, casing, backfilling, stabilising, protection and recording and reporting of related activities with the drilling of a borehole. The function of drilling of a borehole shall be supply of raw water to the facility at hand.

**DC 02 STANDARD SPECIFICATIONS****DC 02.01 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) shall be adhered to.

**DC 02.02 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

**DC 02.03 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**DC 02.03 DWAF GUIDELINES**

Minimum Standards and Guidelines for Groundwater Resource Development for the Community Water Supply and Sanitation Programme issued by the Department of Water Affairs and Forestry shall be adhered to unless otherwise specified.

**DC 03 CONTRACTOR'S RESPONSIBILITY AND APPROACH**

It is required that the drilling of any borehole be approached with due diligence and care on the part of the appointed drilling contractor. Specifically, it is required that the drilling of each borehole be approached on the premise that it will be successful and, as such, will serve the function of a raw water supply to the facility at hand. Under normal circumstances, the pre-drilling of a small diameter pilot borehole will not be allowed. Such an approach may only be considered with the approval of the Hydrogeological



Consultant who shall be required to fully motivate such an approach to the Implementing Authority.

The Drilling Contractor shall function under the direct supervision of the Hydrogeological Consultant. This by no means implies that the Drilling Contractor is absolved from any responsibility. All drilling activities shall, therefore, be approached through communication and discussion between the Hydrogeological Consultant and the contractor with a view to developing the most suitable and mutually acceptable finished product serving the best interests of the project.

Failure by the contractor to timeously render advice and input where required shall be regarded as a dereliction of duty. This responsibility extends to informing the Hydrogeological Consultant of serious reservations regarding any aspect of the work. The contractor shall also be required to maintain the aesthetic appearance of the site during drilling operations, including keeping the site neat, tidy and free of litter. The contractor shall ensure that safety standards are met and that the work site is kept free, as far as is possible, from vehicular and pedestrian traffic and from interested bystanders and onlookers not involved with the project.

The appointed Drilling Contractor shall carry the final responsibility for the finished water supply borehole and all actions and activities leading up thereto.

#### **DC 04 DRILLING PROCEDURE**

##### **DC 04.01 WORKMANSHIP & PERFORMANCE**

The standard of workmanship of the Drilling Contractor shall be subject to close scrutiny by the Hydrogeological Consultant. Although it cannot be expected of the contractor to complete a specified number of boreholes in a given time period, it is reasonable to expect that "favourable progress" be made under normal circumstances and drilling conditions. An indication of what might be regarded as "favourable progress" is considered to fall in the range of 50 to 100 m of drilling advancement per day taking into consideration interhole moves and setup time.

Although work-in-progress may be completed, the contractor shall under no circumstances vacate a site before the Hydrogeological Consultant has inspected the completed works and provided written approval that the work executed conforms to the requirements of this specification.

##### **DC 04.02 DRILLING TECHNIQUE**

The drilling technique to be employed for the project at hand is that of rotary air percussion drilling employing a down-the-hole (DTH) hammer.

Depending on site-specific circumstances other techniques might be employed including: (1) mud rotary drilling, (2) Odex drilling, (3) dual-tube reverse circulation and (4) cable tool percussion drilling. Instances where another drilling technique might be considered more appropriate and efficient shall be identified by the Hydrogeological Consultant during the project and the Contractor informed accordingly.

##### **DC 04.03 EQUIPMENT AND MATERIAL**

The equipment made available by the Drilling Contractor shall be in good working order. Equipment shall be maintained in good condition for the duration of the project. Routine servicing and preventative maintenance of all equipment required for the drilling

procedure and other ancillary equipment shall form the responsibility of Contractor and shall be deemed as included in the tendered rates.

The drilling equipment shall include a full air/foam pumping system. At the start of the project, the gauge diameter of the button drill bits to be employed with the rotary air percussion drilling technique shall conform closely to their manufactured gauge and shall also possess all of their tungsten carbide buttons.

The Hydrogeological Consultant shall discuss with the Drilling Contractor the retirement of a bit due to excessive wear or damage incurred during the course of the project. Further, it is imperative that the equipment be of a suitable size and capacity to deal, on occasion, with: (1) deep boreholes (up to 200 m), (2) larger than average borehole diameters (up to 254 mm), (3) large quantities of groundwater and (4) potentially onerous drilling conditions. Since this capability is provided in large measure by the air compressor, it is considered that a compressor having a capacity of at least 2400 kPa (24 bar) and a volume of at least 750 cfm is appropriate for most water borehole drilling applications and conditions using the rotary air percussion technique. In order to maintain the straightness of a borehole, the Hydrogeological Consultant may insist that the drilling contractor employ at least an overshot sleeve (drill collar) fitted to the pneumatic DTH hammer. Further precautions to ensure this aspect might include the use of a stabiliser rod immediately behind the bit/hammer/overshot combination. All materials to be used on the project should be new and meet project specifications.

Steel casing shall be: (1) of the seam-welded type, (2) round, (3) straight, (4) of uniform wall thickness and (5) have bevelled edges. Second-hand material such as steel casing recovered from an earlier borehole can be used provided that it has been refurbished to an acceptable condition. The Hydrogeological Consultant shall have the right to reject, with motivation, any material (including casing) that is deemed inappropriate, substandard or otherwise unsuitable for the project.

#### **DC 04.03**

#### **BOREHOLE CONSTRUCTION**

This sections addressed certain basic borehole construction practices which will contribute to final acceptance of the successfully finished product.

#### **DC 04.03.01**

#### **DRILLING DIAMETER**

Drilling of the water supply borehole shall commence at a diameter, which shall allow for the trouble free insertion of casing. Under normal circumstances, this entails drilling a 203 mm (8") or 216 mm (8½") diameter bore through the weathered overburden and any other potentially unstable near surface material. The bore shall penetrate at least three meters into fresh, more competent material before this horizon can be secured from potential collapse or wash-out by casing it off with nominal 165 mm (6½") or 152 mm (6") diameter steel casing. Thereafter, the bore is continued at 165 mm (or 152 mm) drilling diameter to its completion depth.

The presence of unstable rock formations (which are often also associated with groundwater-bearing horizons) at greater depths in the bore generally account for complications, which shall impact, on the abovementioned approach. The Drilling Contractor shall firstly attempt to penetrate through such horizons in order establish their vertical thickness. Such horizons often possess only a temporary instability and become "cleaned out" as drilling advances. In instances where such horizons remain unstable and severely hamper drilling progress, it will become necessary for the contractor to remove the surface casing and ream (widen) the borehole to a diameter of at least 203 mm (or 216 mm) to the depth of such unstable horizon. It will then be

required to re-insert 165 mm (or 152 mm) nominal diameter casing to this depth and attempt to advance this casing through the unstable horizon.

In exceptional circumstances it may even be necessary to re-drill or ream the borehole to a diameter of 254 mm through unstable overburden material, insert nominal 203 mm (or 216 mm) diameter casing through this horizon and widen the borehole to 203 mm (or 216 mm) diameter below this depth to the unstable zone. Extremely onerous drilling conditions at depth might even warrant the commencement of drilling at a diameter of 305 mm or greater. This approach is often taken when aiming to maximise the exploitation of groundwater from a productive karst aquifer.

Information regarding the dimensions of the more commonly used button drill bits for rotary air percussion drilling is given in Table DC.1 together with casing diameters generally associated with each bit gauge.

<b>Table DC.1. Dimensions of commonly used button drillbit gauge diameters for use with the rotary air percussion drilling method</b>	
<b>BIT GAUGE DIAMETER</b>	<b>CASING INSIDE DIAMETER FOR DRILL-THROUGH PURPOSES</b>
127 mm (5 in.)	143 to 146 mm
152 mm (6 in.)	156 to 159 mm
165 mm (6½ in.)	168 to 171 mm
203 mm (8 in.)	207 to 212 mm
216 mm (8½ in.)	
254 mm (10 in.)	257 to 264 mm
305 mm (12 in.)	
<b>NOTE:</b>	
1. The bit gauge diameter is also given in the Imperial unit of inches (in.) since this unit is still in common use when referring to this parameter.	
2. Casing inside diameter varies according to wall thickness (refer Table DC.2).	

The information provided in Table DC.1 shows that each bit gauge passes comfortably through casing with a similar nominal diameter. For example, a 203 mm gauge bit can be used to extend the depth of a borehole already equipped with 207 to 212 mm inside diameter casing without having to reduce to the next smallest drilling diameter. Note also that a borehole drilled to a given diameter is able to accept casing having the next smallest diameter. For example, a 203 mm diameter borehole can be fitted with either 152 mm nominal inside diameter or preferably 165 mm nominal inside diameter steel casing.

In view of the foregoing, it is clear that the minimum final cased diameter of a successful raw water supply (for the extent of the facility at hand) borehole shall seldom be less than 152 mm nominal.

## DC 04.03.02

**STEEL CASING**

Steel casing may either be used in a temporary manner or form a permanent part of the borehole infrastructure. Its temporary use is indicated in instances where, for example, the borehole is unsuccessful or the need for it to remain in place becomes redundant. Under these circumstances it is also referred to as a pre-collar, surface casing, starter casing, outer casing or soil casing generally to be removed (recovered) on completion of drilling. It shall be left in place where the Hydrogeological Consultant is of the opinion that the unsuccessful borehole should be secured to serve a long-term groundwater monitoring purpose. In such instances, additional provision shall be made to protect the borehole against actions, which may compromise this function.

Steel casing shall be: (1) of the seam-welded type, (2) round, (3) straight, (4) of uniform wall thickness and (5) have bevelled edges. Secondhand material such as steel casing recovered from an earlier borehole can be used provided that it has been refurbished to an acceptable condition. The Hydrogeological Consultant shall have the right to reject, with motivation, any material (including casing) that is deemed inappropriate, substandard or otherwise unsuitable for the project.

More commonly, however, this casing constitutes the final casing with which a successful borehole is equipped. Its proper installation, therefore, is mandatory. It is installed from surface through unstable, unconsolidated or fractured materials usually occurring in the near surface. Under these circumstances, the function of steel casing includes one or more of: (1) supporting unstable materials against collapse into the borehole during drilling, (2) facilitating the installation or removal of other casing, (3) minimising the erosion and widening of the unstable upper portions of the borehole sidewall caused by the return flow established during drilling and/or the passage of drilling equipment/tools and (4) facilitating the placement of a sanitary seal and/or gravel pack or formation stabiliser.

In order to ensure as far as is possible that the annular space between this casing and the borehole sidewall remains open for the later emplacement of a sanitary seal, the circumferential entrance to this space shall be temporarily plugged. Hessian sacking packed around and lightly tamped into the surface entrance to this annular space can be used for this purpose. In instances where steel casing needs to be driven through unstable horizons (generally at greater depths in a borehole), it will be also be required that such casing be fitted with a casing shoe to protect the "mouth" of the casing from damage. Irrespective of the casing used to facilitate the drilling of the borehole, the final cased diameter of the finished product shall be sufficient for the borehole to easily accept a borehole pump. Since the outside diameter of the latter are generally in the order of 100 mm, it is required that the final cased diameter of the borehole not be less than 152 mm (6 in.) nominal where steel casing is used. Information on the dimensions of the more commonly used steel casing available locally is given in Table DC.2.

<b>Table DC.2. Dimensions of commonly used and locally available steel borehole casing</b>		
<b>OUTSIDE DIAMETER</b>	<b>WALL THICKNESS</b>	<b>INSIDE DIAMETER</b>
165 mm (6 in. nominal)	3.0 mm	159 mm
	4.0 mm	157 mm
	4.5 mm	156 mm
177 mm (6½ in. nominal)	3.0 mm	171 mm
	4.0 mm	169 mm
	4.5 mm	168 mm
219 mm (8 in. nominal)	3.5 mm	212 mm
	4.5 mm	210 mm
	6.0 mm	207 mm
273 mm (10 in. nominal)	4.5 mm	264 mm
	6.0 mm	261 mm
	8.0 mm	257 mm

**NOTES:**

1. The casing outside diameter dimensions are also given in the Imperial unit of inches (in.) since this unit is still in common use when referring to this parameter.
2. Use of the term "nominal" when referring to casing diameter provides a direct association with the gauge of the bit (Table DC.1) which most closely passes through it.

**DC 04.03.03      CASING SHOE**

This item is fitted (welded) to the bottom end (foot) of a casing string in order to protect the "mouth" of the casing from damage due to forcing the casing through unstable horizons. Its use is therefore only warranted (indeed mandatory) in instances where such conditions reveal themselves to require securement through the emplacement of casing.

**DC 04.03.04      uPVC CASING**

Also referred to as thermoplastic casing, the material generally comprises PVC (polyvinyl chloride) which, when treated to withstand ultraviolet radiation, is known as uPVC casing. Its application in the construction of water supply boreholes is specific, being used mainly in instances where security against the collapse of a borehole sidewall is required and where steel casing does not already offer such security. In such instances, the casing is inserted the entire length of the borehole and will certainly be perforated for some portion of its length.

The diameter of this casing will also necessarily be smaller than that of the steel casing used which, in most instances, will have a nominal diameter of 165 mm. In order not to compromise too severely on the minimum nominal diameter requirement of 152 mm for successfully completed water supply boreholes, the inside diameter of the uPVC casing shall not be less than 128 mm with a wall thickness of 6 mm. It is also common practice to leave the steel casing in place in order to provide protection for the uPVC casing. The decision to use uPVC casing in the final construction of a borehole shall be made by the Hydrogeological Consultant.

## DC 04.03.05

**PERFORATED CASING**

For the purposes of this project, perforated casing used shall be of a prefabricated type. As a general guideline, slots should be: (1) 300 mm in length, (2) 3 to 4 mm wide, (3) positioned in bands around the circumference of the casing, (4) spaced equally in each band, (5) each circumferential band of slots separated by 100 mm of plain pipe, (6) every second band of slots aligned with one another and (7) a 300 mm section of plain pipe left at both ends of the casing.

Bearing in mind that the number of slots forming each circumferential band depends not only on the casing diameter but also impact on the strength of the casing, it is suggested that the guidelines presented in Table DC.3 be adhered to in this regard.

<b>Table DC.3.Recommended number of slots per circumferential band for various steel casing diameters and associated percentage open area provided</b>		
<b>NOMINAL CASING DIAMETER</b>	<b>NUMBER OF SLOTS PER CIRCUMFERENTIAL BAND</b>	<b>PERCENTAGE OPEN AREA</b>
152 mm	6	3.0%
165 mm	8	3.7%
203 mm	10	3.7%

Also presented in this table (Table DC.3) is the approximate open area provided by the above slot pattern applied to each of the given casing diameters. In certain instances, however, it may be required to use more sophisticated and expensive slotted casing. Also known as screens, these include: (1) continuously wound wedge wire screens, (2) louvered screens or bridge-slotted screens and (3) screens pre-coated with gravel. The decision to use such screens shall again be made by the Hydrogeological Consultant after providing motivation to and gaining acceptance from the Implementing Authority.

## DC 04.03.06

**RECOVERY OF STEEL CASING**

The contractor shall make every effort to recover, only on instruction from the Hydrogeological Consultant, steel casing from unsuccessful or abandoned boreholes. This casing can also be refurbished to an acceptable condition for re-use.

## DC 04.03.07

**BOREHOLE STRAIGHTNESS**

The Drilling Contractor in the presence of the Hydrogeological Consultant shall perform the straightness test and its success (or failure) recorded by this party.

A borehole, which fails a straightness test, shall be deemed lost and it shall be required of the Drilling Contractor to drill a replacement borehole at own expense. In the event that a straightness test is made before completion of the borehole, then the contractor shall be required to cease operations and facilitate access to the borehole for the duration of such activity.

**DC 04.03.08**      **BOREHOLE VERTICALITY**

The Hydrogeological Consultant in the presence of the Drilling Contractor shall perform the verticality test. The consultant shall therefore be required to provide the necessary equipment for conducting a verticality test. A borehole, which fails a verticality test, shall be deemed lost and it shall be required of the contractor to drill a replacement borehole at own expense. In the event that a verticality test is made before completion of the borehole, then the Drilling Contractor shall be required to cease operations and facilitate access to the borehole for the duration of such activity.

**DC 04.03.09**      **BACKFILLING**

This entails filling the annular space between the borehole sidewall and the outside of the casing with suitable material. The purpose of annular backfilling includes: (1) the provision of a base on which to found a sanitary seal and (2) the provision of support for the sidewalls of the borehole and the casing. In instances where casing has been seated at a comparatively shallow depth in fresh material below a weathered near-surface horizon, all of the drill cuttings removed from the borehole whilst drilling represents suitable material for this purpose. Annular backfilling with this material is not advisable in instances where this is not the case, such as for example where the casing extends to a substantial depth and comprises slotted/perforated sections or where the water-bearing horizon is shallow and open to the borehole via slotted/perforated casing. In these instances, it shall be required to insert a formation stabiliser into the annulus. The backfilling shall extend to within approximately 5 m of the ground surface.

**The Contractor shall allow for the cost of backfilling in the tendered rates.**

**DC 04.03.10**      **FORMATION STABILISER**

This comprises material, which is placed in the annulus between the borehole sidewall and perforated/slotted sections of casing to stabilise the formation against collapse and ingress into the borehole. The drill cuttings and spoils removed from the borehole is not suitable material for this purpose. The stabiliser shall comprise material which is: (1) well sorted, (2) well rounded, (3) low in calcareous content and (4) graded such that the smallest grain size is larger than the casing perforations/slots. The stabiliser material can either be placed by hand or through a tremie pipe. Excessive bridging of stabiliser material in the annulus can be prevented: (1) through the use of centralisers on the casing or (2) by washing it in with clean water. The formation stabiliser should extend some 10 m above the top of the uppermost perforated/slotted section of casing before the borehole is developed.

**The Contractor shall allow for the cost of formation stabilising in the tendered rates.**

**DC 04.03.11**      **CONCRETE COLLAR**

The Drilling Contractor shall construct a shallow circular concrete collar around each successfully completed borehole. This collar shall have dimensions and volume as specified by the Hydrogeological Consultant. The concrete mixture shall required strength of some 30 MPa after 28 days. A similar collar may need to be constructed, on request of the Hydrogeological Consultant, over unsuccessful or abandoned boreholes.

**The Contractor shall allow for the cost of the concrete collar in the tendered rates.**

**DC 04.03.12**      **UNSUCCESSFUL AND ABANDONED BOREHOLES**

A borehole shall be declared unsuccessful at the discretion of the Hydrogeological Consultant. The latter may also, at any time during the course of the work, order the abandonment of a borehole in progress.

In such instances, the Hydrogeological Consultant shall instruct the Drilling Contractor on further actions to be taken. These may include either: (1) the salvage of any casing from the borehole and (2) the plugging of the borehole or (3) the securing of the borehole for long term monitoring purposes, in which case it shall be provided with a sanitary seal concrete collar protection and marking.

Plugging (or finishing) of an unsuccessful or abandoned borehole is aimed at removing any danger or hazard such boreholes may present to the environment, eg. as a conduit for the inflow of surface water into the groundwater regime or as a danger to traffic (whether human, stock or vehicular) in the immediate vicinity thereof. It shall also be required to cast a concrete collar over the infilled borehole.

The Drilling Contractor shall be remunerated for an unsuccessful or abandoned borehole on the basis of tendered rates in the Schedule of Rates for such of the following items as are relevant: (1) drilling per linear metre of depth for each relevant drilling diameter employed, (2) steel casing per linear metre thereof recovered, (3) backfilling, (4) a sanitary seal, (5) borehole protection and (6) borehole marking. Payment for any casing left behind in an unsuccessful or abandoned borehole will only be made, on the same basis as described in (2) above, on written certification by the Hydrogeological Consultant that the contractor has made every reasonable attempt in this regard.

**DC 04.03.13**      **LOST BOREHOLES**

A borehole shall be declared lost by the Hydrogeological Consultant in the event that it can not be completed satisfactorily due to factors such as: (1) the irrecoverable loss of drilling equipment, materials or tools therein, (2) accident to plant or heavy machinery, (3) failure to pass a straightness test and (4) failure to pass a verticality test. A decision in this regard shall be made after consultation with the Drilling Contractor, who shall have the considered option to either attempt remediation of the situation to the satisfaction of the Hydrogeological Consultant or, alternatively, declare the situation irretrievable. No payment shall be made for any work done, materials used or time spent by the Drilling Contractor on a lost borehole. The cost of any materials recovered in a damaged state from a lost borehole shall be borne by the contractor.

A borehole, which is declared lost, shall be replaced with a new borehole to be constructed by the Drilling Contractor in the vicinity of the lost borehole and at a position indicated by the Hydrogeological Consultant. Payment for a new borehole constructed under these circumstances shall be made on the same basis as for any other successfully completed borehole. Materials recovered in good condition may, however, be re-used by the contractor.

**DC 04.03.14**      **SANITARY SEAL**

Every successful water supply borehole shall be provided with a sanitary seal. The seal shall consist of portland cement mixed to slurry with bentonite and water, which is free of oil and other organic matter. The bentonite and water should be thoroughly mixed in the ratio of 2 kg bentonite to 25 l water prior to adding and mixing in 50 kg (one bag) cement. The final grout seal shall extend to a depth of at least 5 m below ground surface, ie. founded on the backfilling. In such shallow applications, the slurry can be gravity-fed into the annulus through a small diameter tube (tremie pipe) extending to the



depth of emplacement. The tremie pipe should be withdrawn slowly as the slurry fills up the annulus. There shall be no voids in the sanitary seal.

The Contractor shall allow for the cost of the sanitary seal in the tendered rates.

**DC 04.03.15 BOREHOLE DEVELOPMENT**

The Geohraulogist shall submit proof of sufficient borehole development procedures. This activity shall be concluded with the collection of a 1liter representative water sample obtained from the return flow during development.

The Contractor shall allow for the cost of borehole development in the tendered rates.

**DC 04.03.16 BOREHOLE DISINFECTION**

The Geohraulogist shall submit proof of sufficient borehole disinfection procedures.

Guideline volumes/weights of common compounds to be used for disinfection purposes under most normal circumstances can be derived from the information provided in Table DC.4.

The Contractor shall allow for the cost of borehole disinfection in the tendered rates.

**Table DC.4.Guideline volumes/weights of common sterilants to be used per unit volume of water for various borehole diameters**

		Sodium hypochlorite	Calcium	Chlorinated lime
	18 l	500 ml (2 cups)	26 g (¼ cup)	90 g (1 cup)
	21 l	600 ml (2½ cups)	30 g (½ cup)	105 g (1 cup)
	33 l	940 ml (4 cups)	47 g (½ cup)	165 g (1½ cups)
	51 l	1500 ml (6 cups)	73 g (¾ cup)	255 g (2½ cups)

**NOTES:**

1. No distinction is drawn between open and cased portions of a borehole since these differences are considered to have a negligible impact on calculated unit volumes.
2. The trade percentage of chlorine in the listed sterilants is taken to be:
  - 3.5 percent by volume (35 ml/l) for sodium hypochlorite,
  - 70 percent by weight (700 g/kg) for calcium hypochlorite, and
  - 20 percent by weight (200 g/kg) for chlorinated lime.

**EXAMPLE:**

A 100-metre deep borehole with a nominal diameter of 165 mm and with a rest water level standing at a depth of 25 m below surface will require  $75 \times 30 \text{ g} = 2,250 \text{ g}$  (2.25 kg), alternatively  $75 \times \text{cup} = 25 \text{ cups}$ , of calcium hypochlorite to achieve adequate disinfection. The same situation would require  $75 \times 600 \text{ ml} = 45,000 \text{ ml}$  (45 l) of sodium hypochlorite to achieve adequate disinfection.

**DC 04.03.17      BOREHOLE PROTECTION**

This entails sealing the borehole from the introduction of foreign material directly through the casing.

In order to provide the Hydrogeological Consultant with ready access to the borehole for water level measuring purposes, it is required that a small hole be drilled in the lid. This hole shall be furnished with a tamper-proof plug such as a "dead-end" threaded into a water pipe connector welded on the hole. The final diameter of the hole providing access to the borehole shall be sufficient to allow a "normal" dipmeter probe to pass through it. It is considered that a diameter of at least 10 mm and not more than 20 mm is suitable for this purpose.

**The Contractor shall allow for the cost of borehole protection in the tendered rates.**

**DC 04.03.18      BOREHOLE MARKING (IN THE FIELD)**

The activity itself represents marking the borehole by: (1) script-welding its assigned and unique identifying number onto the lid of the borehole and (2) planting a concrete block with dimensions of 200 mm x 200 mm x 200 mm (also bearing the number of the borehole) in the ground a distance of five metres to the north of the borehole.

It is the responsibility of the Hydrogeological Consultant to ensure that a borehole number is provided to the contractor for this purpose.

**The Contractor shall allow for the cost of borehole marking in the tendered rates.**

**DC 04.03.19      SITE FINISHING**

The activities associated with this task shall include the repair of construction scars on the work site resulting from drilling activities as well as the general cleanup of the site of waste materials, debris and oil spills. The latter shall be shoveled over and worked into the ground wherever possible.

**Site finishing shall be deemed as included in the tendered rates.**

**DC 04.04      DATA RECORDING AND REPORTING**

A detailed and accurate record of all information arising from the borehole drilling activity shall be recorded with care and diligence. The Drilling Contractor can collect much of this information. The Hydrogeological Consultant shall keep this current and available for inspection on request.

**The contractor shall include the cost of data recording and reporting in the tendered rates.**

It shall be the responsibility of the Hydrogeological Consultant to verify receipt of this information prior to certifying a claim by the Drilling Contractor in this regard. The

following items of information represent the minimum number of parameters, which shall be monitored and recorded by the contractor:

- Penetration Rate
- Formation Sampling and Description
- Water Strike Depth
- Blow Yield
- Groundwater Rest Level

**DC 04.05**      **DOWN-THE-HOLE LOSS OF EQUIPMENT**

The Hydrogeological Consultant shall afford the contractor every opportunity and reasonable time to fish for lost equipment. The Drilling Contractor shall, in turn, keep the Hydrogeological Consultant informed of progress and the likelihood of success in this regard. The contractor shall have no claim against any other party for any losses incurred in this regard. The Hydrogeological Consultant shall finally decide on the fate of the borehole. It may either be declared successful or lost.

**DC 04.05.01**      **BOREHOLE DECLARED SUCCESSFUL**

Circumstances under which a borehole may be declared successful include: (1) the borehole has encountered significant water, (2) pumping equipment can be installed to an acceptable depth in the borehole and (3) the lost equipment does not pose a threat to the present and future quality of the groundwater. In the event that a borehole is declared successful despite the irrecoverable loss of drilling equipment, materials or tools therein, then the exact nature and position of the equipment lost in the borehole shall be recorded and appear in relevant project documentation. The Drilling Contractor shall be remunerated for a borehole declared successful under these circumstances on the same basis as for any other successfully completed borehole.

**DC 04.05.02**      **BOREHOLE DECLARED LOST**

Refer to paragraph DC 04.03.13.

**DC 04.06**      **BOREHOLE INFORMATION REQUIRED**

A detailed and accurate record of all information arising from the following activities shall be submitted by the Hydrogeological Consultant.

- Down-the-hole borehole measurement
- Borehole Construction Information
- Geological Information
- Hydrogeological Information
- Hydrochemical Information

**The Contractor shall allow for the cost of the information in the tendered rates.**

**DC 04.07**      **REHABILITATION OF EXISTING BOREHOLES**

The scope of this work may vary from the basic cleaning out and re-development of an existing borehole to the recovery of casing, the reaming and subsequent re-installation of casing. The nature of the rehabilitation required in each individual instance shall be identified prior to undertaking this activity since this shall indicate which equipment will most suitably complete the task.

The rehabilitation of an existing borehole shall be carried out under the supervision of the Hydrogeological Consultant. In any event, the execution of such work shall be

subject to the same degree of data collection and record keeping as is required of a new borehole.

The Drilling Contractor shall be remunerated for this service on the basis of the rates tendered as per section DC 05. It shall be expected of the contractor to have assessed the potential technical risks involved with such work and, as a consequence, the contractor shall have no claim against any other party for the loss of equipment, materials or tools incurred in the course of such work.

**DC 04.08**      **FINAL ACCEPTANCE**

The Hydrogeological Consultant shall accept a successfully finished water supply borehole by issuing of a certificate of completion. At this stage, the Hydrogeological Consultant shall have established that all aspects pertaining to the work and the final product meet, at least, those of the various criteria and requirements set out above which have been imposed.

**DC 04.09**      **APPOINTMENT OF HYDROGEOLOGICAL CONSULTANT**

The Contractor shall be responsible for appointing a Hydrogeological Consultant for the purposes of this contract. The Hydrogeological Consultant shall be registered with the Department of Water Affairs and Forestry and shall be approved by the Engineer.

The Hydrogeological Consultant shall be responsible for the hydrogeological survey to site the borehole, oversee the drilling of the borehole and pump testing the borehole as well classification of the drinking water for domestic purposes.

**DC 05**      **MEASUREMENT AND PAYMENT**

**DC.01**      **DRILLING OF BOREHOLE** ..... Unit: m

The contractor shall be remunerated for drilling per linear metre of depth at the rate tendered for each relevant drilling diameter employed.

The tendered rate shall include full compensation for all labour, equipment and material required, recording and reporting for the complete drilling of the boreholes in accordance with the specification.

**DC.02**      **BOREHOLE CASING**

**DC.02.01**      **Steel Casing** ..... Unit: m

The unit of measurement for steel casing per linear metre thereof supplied, delivered and installed.

The tendered rate shall include full compensation for all labour, materials, transport, recording and reporting and equipment required for the complete installation of the casing.

**DC.02.02**      **Casing Shoe** ..... Unit: item

Remuneration shall be for each casing shoe supplied and installed.

The tendered rate shall include full compensation for all labour, materials, transport, recording and reporting and equipment required for the complete installation of the casing shoe.

**DC.02.03**     uPVC Casing ..... Unit: m

The unit of measurement for uPVC casing per linear metre thereof supplied, delivered and installed.

The tendered rate shall include full compensation for all labour, materials, transport, recording and reporting and equipment required for the complete installation of the casing.

**DC.02.04**     Perforated Casing .... ..... Unit: m

The unit of measurement for perforated casing per linear metre thereof supplied, delivered and installed.

The tendered rate shall include full compensation for all labour, materials, transport, recording and reporting and equipment required for the complete installation of the casing.

**DC.03**     RECOVERY OF STEEL CASING ..... Unit: m

Remuneration for the recovery of steel casing shall be per linear metre thereof salvaged from a borehole.

The tendered rate shall include full compensation for all labour, materials, transport, recording and reporting and equipment required for the recovery of steel casing.

**DC.04**     APPOINTMENT OF HYDROGEOLOGICAL CONSULTANT

(a) Appointment of Hydrogeological Consultant ..... Unit: PC Sum

(b) Charge required by Contractor on subitem (a) above ..... Unit: %

Remuneration for the appointment of a Hydrogeological Consultant shall be based on a Prime Cost Sum. The Prime Cost Sum provided under subitem (a) in the Schedule of Quantities will be expended in accordance with Subclause 48(2) of the General Conditions of Contract.

The tendered percentage under subitem (b) will be paid to the Contractor on the value of each payment made to the Hydrogeological Consultant.

**DC.05**     REHABILITATION OF EXISTING BOREHOLES ..... Unit: m

The contractor shall be remunerated for rehabilitation of an existing borehole by by means of drilling per linear metre of depth at the rate tendered for each relevant drilling diameter employed.

The contractor shall also be remunerated for the basic cleaning out and re-development of an existing borehole to the recovery of casing, the reaming and subsequent re-installation of casing. The nature of the rehabilitation required in each individual instance shall be identified prior to undertaking this activity since this shall indicate which equipment will most suitably complete the task.

The tendered rate shall include full compensation for all labour, equipment and material required recording and reporting for the complete drilling of the boreholes in order to rehabilitate an existing borehole in accordance with the specification.

The rehabilitation of an existing borehole shall be carried out under the supervision of the Hydrogeological Consultant. In any event, the execution of such work shall be subject to the same degree of data collection and record keeping as is required of a new borehole.

It shall be expected of the contractor to have assessed the potential technical risks involved with such work and, as a consequence, the contractor shall have no claim against any other party for the loss of equipment, materials or tools incurred in the course of such work.

**TECHNICAL SPECIFICATION****DF POTABLE WATER DISINFECTION AND SEDIMENTATION UNITS****CONTENTS**

DF 01	SCOPE
DF 02	STANDARDS AND REQUIREMENTS
DF 03	DETAIL OF WORK
DF 04	MAINTENANCE
DF 05	MEASUREMENT AND PAYMENT

**DF 01 SCOPE**

This section covers the repair and maintenance of the equipment used to add chemicals as part of the treatment of the potable water at the water treatment works at Kosibay. The dosing equipment used to add flocculent to the raw water and the dosing equipment used to chlorinate treated water, before water is pumped to the pressure tower, are covered.

All additives (chemicals) to be added to raw water and treated water as part of the water treatment process *shall be supplied by others*. It shall *not* be the responsibility of the Contractor to supply, store, manage or add chemicals as part of the operation of the water treatment works whatsoever.

The Contractor shall be responsible for repair and maintenance of the equipment as specified. ***Operating of the water treatment works is performed by Department of Public Works' staff. Operating of the water treatment works does not form part of this contract.*** The Contractor shall be responsible for training of the departmental staff in the operating of the water treatment works (based on the operating and maintenance manuals), as specified elsewhere.

**DF 02 STANDARDS AND REQUIREMENTS****DF 02.01 STANDARD SPECIFICATIONS**

These specifications shall be read in conjunction with the following documents:

SABS 241:	Water for domestic supplies
SABS 295:	Calcium Hypochlorate

**DF 02.02 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with manufacturers specifications, instructions and codes of practice.

**DF 02.03 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health And Safety Act Of 1993 shall be adhered to.

**DF 03**      **DETAIL OF WORK**

The dosing equipment used to add flocculent to the raw water and the dosing equipment used to chlorinate treated water, before water is pumped to the pressure tower are all in a perfect working order at the time of this tender.

The Contractor shall be granted the opportunity to remove, service and reinstall the equipment as per the work measured in the schedule of quantities for repair work. Subsequent to the completion of the repair work as measured, the Contractor shall be responsible for the maintenance of the dosing equipment.

**DF 04**      **SERVICING OF EQUIPMENT**

The Contractor shall service the dosing equipment according to the specification that shall be provided in the Operating and Maintenance Manuals to be developed as part of this contract.

The Contractor shall set equipment to comply with the dosing rate as follows:

- The average flow rate of the raw water through the flocculation installation and of treated water through the chlorination installation shall be determined as accurate as possible
- Dosing rates shall be determined from the manufacturers of the dosing equipment and compared with that of the chemical suppliers (To be reflected in Operating and Maintenance manuals) after which the equipment shall be adjusted and tested to comply with the specification rates
- The actions and procedures for setting of dosing equipment rates shall be reflected in the Operating and Maintenance manuals.

**DF 05**      **MAINTENANCE**

The dosing equipment used to add flocculent to the raw water and the dosing equipment used to chlorinate treated water, before water is pumped to the pressure tower shall be maintained by the Contractor as soon as the repair work measured in the schedule of quantities has been completed.

Maintenance shall include all repair work, replacing of components, fixing leaks, routine settings (of dosing rates etc.), corrosion protection and all other actions necessary to maintain dosing equipment in a perfect functional condition.

Remuneration for maintenance of dosing equipment shall be deemed included in the tendered monthly rate, based on the point system, for the maintenance of installation G.

**DF 06**      **MEASUREMENT AND PAYMENT**

Item

**DF.01**      **DECOMMISSIONING AND REMOVAL OF DOSING EQUIPMENT ...** Unit: number

The unit of measurement shall be the number of dosing equipment units decommissioned and removed.



The tendered rates shall include full compensation for the removal, storage, safe keeping and all other actions required to be able to service the equipment. Separate items will be listed in the schedule of quantities for different sizes of equipment.

**DF.02**                    **SERVICE DOSING EQUIPMENT** ..... Unit: number

The unit of measurement shall be the number of dosing equipment units serviced.

The tendered rate shall include full compensation for cleaning, removing rust, removing dried sludge or other solids from surfaces and moving parts, proper greasing of all moving parts, preparation for corrosion protection (where applicable) coating (where applicable) and painting (where applicable) of dosing equipment units with its appurtenant material, and all other servicing actions as specified by the supplier. After servicing, the dosing equipment shall be in a perfect working order, adding additives at rates as specified in Operating and Maintenance manuals.

Separate items will be listed in the schedule of quantities for different types and sizes of equipment.

**DF.03**                    **INSTALLATION, TESTING AND COMMISSIONING OF DOSING EQUIPMENT** Unit: number

The unit of measurement shall be the number of dosing equipment units installed, commissioned and tested.

The tendered rates shall include full compensation for the installation and commissioning of the dosing equipment, to render the installation in a perfect working order, adding additives at rates as specified in the operating and maintenance manuals.

Separate items will be listed in the schedule of quantities for different sizes of equipment.

## TECHNICAL SPECIFICATION

### DH      OPERATION OF POTABLE WATER WORKS

#### CONTENTS

DH 01	SCOPE
DH 02	STANDARD SPECIFICATION AND REGULATIONS
DH 03	LEGAL AND GENERAL REQUIREMENTS
DH 04	GENERAL DESCRIPTION OF THE WORKS
DH 05	TECHNICAL DETAILS OF THE INSTALLATION
DH 06	DETAIL OF REPAIR WORK
DH 07	OPERATION
DH 08	MONITORING AND REPORTING
DH 09	MEASUREMENT AND PAYMENT

#### DH 01      SCOPE

Potable water works shall mean all units, components, equipment and materials, and their relation to each other, employed to enable reliable and effective water treatment.

This specification covers the operation of a bulk water supply system with borehole pump systems and equipment related to effective water treatment.

The Contractor shall manage and operate the water supply system in accordance with the prescriptions in this specification, the relevant operation and maintenance manuals and **Additional Specification SF**. Operation duties shall generally refer to all tasks and actions required for operating the process units and components of the water works typically found at remote DPW sites such as police stations, border posts, etc. These works shall include (among others):

##### 1. **Borehole(s):**

- One fully equipped production borehole(s): Duty (at least) and stand-by (where available).
- Monitoring borehole (where applicable).
- Water meter and isolating valves at each production borehole.
- Ground level tank/reservoir.
- Pump and rising main from boreholes to ground level tank/reservoir.
- Chlorination unit.
- Feed from ground level tank/reservoir to first user connection.

This specification covers requirements for potable water quality, as well as testing procedures and equipment to verify these requirements.

This specification shall form an integral part of the repair and maintenance contract document and shall be read in conjunction with Portion 3: Additional Specifications included in this document.

**DH 02      STANDARD SPECIFICATIONS AND REGULATIONS**

**DH 02.01      GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof.

- SANS 1200            -      Standardised specification for civil engineering construction
- SANS 5667-2        -      Water quality sampling, part 2: Guidance on sampling techniques
- SANS 241            -      South African Standard Specification for drinking water

**DH 02.02      OTHER SPECIFICATIONS**

The following Technical Specifications for repair and maintenance of water process units shall be read in conjunction with this specification and shall be deemed to form part thereof:

- CI    Pressed steel tanks
- CE    Water Distribution Networks
- DA    Borehole pump systems
- DB    Potable Water Filtration Systems
- DF    Potable Water Disinfection and Filtration Units
- SF    General Operation

**DH 02.03      ACTS, REGULATIONS AND STATUTORY REQUIREMENTS**

All relevant regulations and statutory requirements as laid down in the latest edition of the following acts shall be adhered to:

- Occupational Health and Safety Act, 1993 (No. 85 of 1993)
- National Water Act (No. 36 of 1998)
- Water Services Act (No. 108 of 1997)
- Environment Conservation Act (No. 73 of 1989)
- National Environmental Management Act (No. 107 of 1998)

**DH 02.04      MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

**DH 02.05      MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**DH 03      LEGAL AND GENERAL REQUIREMENTS**

**DH 03.01      DEFINITION OF WATER USE**

This specification covers the legal requirements for water use as regulated by the National Water Act (No. 36 of 1998). A large fraction of the activities performed by the Department of Public Works is covered by the general authorisations in terms of Section 39 of the Water Act. The following categories of water use are scheduled:

- Taking of water and storage of water (Section 2 (a) and (b)) of the Water Act.
- Engaging in a controlled activity, identified as such in Section 37 (1) of the Water Act. Irrigation of any land with waste or water containing waste generated through any industrial activity or by a water works (Section 21 (e) of the Water Act).
- Discharging of waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit, and disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generating process.
- Disposing of waste in a manner which may detrimentally impact a water resource (Section 28 of the Water Act).

**DH 03.02      REGISTRATION OF WATER USE**

According to the Water Act a water use must be registered with the Department of Water Affairs and Forestry (DWAF). The prescribed forms are available on DWAF's internet web site:

<http://www.dwaf.gov.za>

The application forms for registration or licensing of a water use are available on the above website. Forms DW 771 / DW 758 R1c.doc (updated version) – Licensing Part 1: Company, Business or Partnership, National or Provincial Government are applicable.

Parts 1, 3, 4 and 8 of these forms will be completed by the Department of Public Works. All other forms shall be completed and submitted by the Contractor.

These registration forms shall be completed by the Contractor and must be submitted to:

**The Director-General  
Department of Public Works  
Private Bag X65  
PRETORIA  
2001**

For attention of: **Deputy Director, Water Management**

Based on the information so provided, the Department of Water Affairs and Forestry may require the applicant to apply for a license for the relevant water or wastewater use.

**DH 03.03      LICENSING OF A WATER USE**

In general a water use must be licensed unless it is:

- Listed in Schedule 1 (See page 152 of Government Gazette No. 19182 dated 26 August 1998)

- An existing lawful use.
- Permissible under a general authorisation (See Government Gazette No. 20526 dated 8 October 1999)

The responsible authority can waive the need for a license.

If licensing is required, the Department of Public Works will appoint an independent consultant for the duty.

**DH 03.04**      **OPERATOR REGISTRATION AND CLASSIFICATION OF WATER CARE WORKS**

In the terms of Section 26 (f) of the Water Act (No. 36 of 1988) operators shall be registered with the Department of Water Affairs and Forestry. The Contractor shall be responsible for the registration of workers/operators in terms of this requirement (See Regulation R2834 dated 27 December 1985). The Engineer will classify the water care works for tendering purposes.

**DH 03.05**      **ENVIRONMENTAL IMPACT ASSESSMENT (EIA)**

In terms of Government Notices R1182 and R1183 of 5 September 1997, new water care works as well as upgrading of water care works are generally subject to Environmental Impact Assessment. The relevant procedures are described in a guideline document: EIA Regulations, Implementation of Sections 21, 22 and 26 of the Environment Conservation Act (No. 73 of 1989).

An independent consultant will generally be appointed to conduct such assessment. An EIA must be submitted to the Department of Environmental Affairs and Tourism for approval by means of a Record of Decision.

Under normal conditions, an EIA will not be required for repair of water care works.

**DH 03.06**      **ENVIRONMENTAL MANAGEMENT PLAN (EMP)**

An Environmental Management Plan (EMP) is required for all repair work that may generate waste (such as water treatment sludge) or that may detrimentally impact the environment during repair and operation of the water care works.

The Contractor shall prepare and submit an EMP to the Department of Public Works' project manager. His approval is not required, but the EMP should guide repair work so as to safeguard the environment from detrimental impact. The Contractor shall make provision in his tendered rates for all costs implied by the EMP.

**DH 04**      **GENERAL DESCRIPTION OF THE WATER SUPPLY SYSTEM**

**DH 04.01**      **KOSI BAY BULK WATER SUPPLY SYSTEM**

Water is pumped through a one borehole with the delivery indicated in table DH.05.01 to the elevated concrete ground reservoir.

One additional bore hole will also be connected to the elevated concrete ground reservoir indicated in table DH.05.01.

A chlorination system will be installed in the Contact that will allow for the chlorination of all the incoming water supply into the ground reservoir.

The complete bulk water system requires daily monitoring and operation in order to ensure effective reporting and supply of water to the operational and residential area.

## **DH 05 TECHNICAL DETAILS OF THE INSTALLATION**

### **DH 05.01 KOSI BAY PORT OF ENTRY: BOREHOLE PUMPS**

<b>QTY</b>	<b>Position</b>	<b>Pump Description</b>	<b>Pump and Motor Description</b>	<b>Pumping Medium</b>	<b>IN USE (YES/NO)</b>
1	BHP01	Mono Pump 110m deep borehole	0.8 l/s with 115m head for 24hours	Potable Water	YES

## **DH 06 DETAILS OF THE REPAIR WORK**

Additional bore holes will be connected to the bulk water supply and a new chlorination system will be installed.

## **DH 07 OPERATION**

### **DH 07.01 GENERAL**

Operation shall include all activities and all other actions or rectifying measures necessary for optimal operation of water care works.

Remuneration for operation of the complete water works shall be deemed included in at the tendered rate for monthly payment of operation of the works.

### **DH 07.02 PREPARATORY OPERATIONAL TASKS**

The preparatory tasks to be executed shall include, but shall not be limited to the items listed in the table below:

<b>DH 04.02</b>	<b>PREPARATORY OPERATIONAL TASKS</b>
01	Satisfy legal and general requirements.
02	Draft inventories of process units, components, materials, etc.
03	Draft process flow diagrams.
04	Derive from available information the design capacity and current load of the works.
05	Assess compliance with relevant design parameters to enable optimal operation of the plant according to its original functionality.
06	Draft plant-specific Operation and Maintenance manuals.
07	Institute required safety measures.
08	Draft template logbook.
09	Draft water balance of water and wastewater system.

### **DH 07.03 GENERAL OPERATION WORK**

General operation of the water care works shall be done in accordance with this specification, with Additional Specification SF: General Operations, and with the Particular Specification related to this work.

The general operation work to be performed and executed shall include, but shall not be limited to the items listed in the table below.

<b>DH 04.03</b>	<b>GENERAL OPERATION WORK</b>	<b>FREQUENCY</b>
<b>01</b>	General housekeeping: Keep site and treatment facilities in neat and acceptable condition.	Daily
<b>02</b>	Control access to the site.	Daily
<b>03</b>	Maintain safety conditions on site.	Daily
<b>04</b>	Log and report pollution events, power failures, extraordinary process phenomena, etc. Check auto-reset of power to mechanical equipment.	Event
<b>05</b>	Calibrate water meters to ensure accurate flow data.	Six-Monthly
<b>06</b>	Record operating hours (and kW-hours where applicable) of all mechanical equipment.	Daily
<b>07</b>	Check operation of all valves and sluices.	Monthly

#### **DH 07.04**

#### **OPERATION OF SPECIFIC PROCESSES AND UNITS**

Operation of specific processes, units and components of the water care works shall be done in accordance with this specification, with Additional Specification SF: General Operations, and with the Particular Specification related to this work.

The specific operation work to be performed and executed shall include, but shall not be limited to the items listed in the table below.

<b>DH 07.04.</b>	<b>OPERATION OF SPECIFIC PROCESSES AND UNITS</b>	<b>FREQUENCY</b>
<b>01</b>	<b>Boreholes and equipment</b>	
	<b>01</b> Check whether pump is operating.	Daily
	<b>02</b> Record operating hours.	Daily
	<b>03</b> Record pressure at borehole collar during operation.	Daily
	<b>04</b> Record borehole water levels at start and stop of pump.	Daily
	<b>05</b> Check operation of emergency stop switch.	Monthly
	<b>06</b> Record meter reading.	Daily
	<b>07</b> Record rainfall: Date, precipitation and duration per event.	Event
	<b>08</b> Monitor pollution risk (e.g. septic tank or fuel depot close to borehole).	3 Months
<b>02</b>	<b>Treated water tanks and reservoirs</b>	
	<b>01</b> Record water level in tank/reservoir.	Daily
	<b>02</b> Empty and clean tank/reservoir.	6 Months
<b>03</b>	<b>Chlorination</b>	
	<b>01</b> Check operation of chlorination facility.	Daily
	<b>02</b> Ensure chlorine-dosing proportional to flow rate.	Weekly
	<b>03</b> Measure residual chlorine concentration at outlet of contact tanks (generally the elevated storage tank).	Weekly
	<b>04</b> Ensure dosage concentration and dosing rates compatible with specification requirements.	Weekly
<b>04</b>	<b>On-site pipework</b>	
	<b>01</b> Flush pipework, tanks and geysers.	6 Months
	<b>02</b> Measure residual pressure in pipelines.	3 Months
<b>05</b>	<b>Submersible pumps</b>	
	<b>01</b> Check operation and correct switching of pumps.	Daily
	<b>02</b> Clean pump suction sumps/chambers.	Weekly
	<b>03</b> Check integrity of power supply and MCC	Monthly
<b>06</b>	<b>Power supply</b>	
	<b>01</b> Check operation of stand-by generator where applicable	Daily

## **DH 08 MONITORING AND REPORTING**

The contractor shall keep a written record of all measurements taken and analyses done for process control and for reporting to relevant authorities in terms of legal or project management requirements.

A logbook shall be kept for daily recording of failures, malfunctions, spills, pollution events, power failures and detail of corrective measures implemented.

The monitoring programme for the above measurements and analyses shall include, but shall not be limited to the items listed in the attached table.



**DH 09 MEASUREMENT AND PAYMENT**

**DH 09.01 REGISTRATION OF A WATER USE ..... Unit : Number**

The unit of measurement shall be the number of potable water and sewage treatment plants to be registered. Boreholes are registered as single units. Separate forms are necessary for individual properties, as it is registered at the Surveyor General under its own title deed number. Multiple boreholes on the same property can be registered on the same form by using a summary of the location of each borehole.

The tendered rates shall include full compensation to obtain all relevant information from different authorities (Surveyor General, for instance) to complete the forms. It shall also include full compensation to complete and dispatch the application form

**DH 09.02 ENVIRONMENTAL IMPACT ASSESSMENT (EIA):  
PRE-APPLICATION CONSULTATION, SUBMIT  
APPLICATION AND PLAN OF STUDY FOR  
SCOPING AND THE SCOPING REPORT ..... Unit : Number**

The unit of measurement shall be to perform the necessary tasks required by the relevant authorities to obtain authorisation for the proposed activity (or activities which may form any entity) up to the acceptance of and the issuing of Records of Decision. This can be performed by the contractor or if required, by the relevant authority, an independent consultant shall be appointed.

The unit of measurement shall be the number of scoping reports compiled by the contractor. The tendered rate shall include full compensation for performing the necessary tasks required by the relevant authorities to obtain authorisation for the proposed activity (or activities which may form an entity) up to the issuing of Record of Decision. Should it be required by the relevant authority that an independent consultant perform this duty such a consultant will be appointed for that purpose by the Department of Public Works.

**DH 09.03 ENVIRONMENTAL IMPACT ASSESSMENT:  
PLAN OF STUDY FOR ENVIRONMENTAL IMPACT  
REPORT ..... Unit : Number**

The unite of measurement shall be to do a full Environmental Assessment if it is required by the relevant authority for the proposed activity (or activities which may form an activity), after the scoping report has been reviewed and accepted. The Environmental Impact Assessment shall be conducted by an independent consultant.

The tendered rates shall include full compensation for all the necessary tasks required by the relevant authority to authorise the activity (activities).

**DH 09.04 ENVIRONMENTAL MANAGEMENT PLAN (EMP)  
DURING REPAIR AND OPERATION ..... Unit : Number**

The unit of measurement shall be number of EMP's compiled by the contractor. One EMP per site will be acceptable.

The tendered rates shall include full compensation for the compilation of an Environmental Management Plan, which will be executed during the repair, maintenance, and operation of a potable water installation and sewerage purification works.

**DH 09.05      REMUNERATION FOR OPERATIONAL RESPONSIBILITIES**

Remuneration for the monthly operation of an installation is determined by a ten point per month scoring system (refer to score card in Technical Specification SF: General Operation of an Installation). The scoring system includes but is not limited to the following operational parameters:

- Potable water quality control analysis by an approved authority
- quality monitoring programme
- operation of a site laboratory
- tests performed on site to evaluate component performance
- record keeping and reporting system
- supply of chemicals necessary for the operation of the plant
- operators and supervisors
- tools and equipment for operational needs
- compliance with the required standard (SANS 241 Class 0 or Class 1 ) .
- daily operation of the entire plant to its optimum capacity
- Keep site clean, cut/mow weeds and natural grass to a length not longer than 50mm, remove shrubs and small trees from pond walls.

**DH 09.06      SUPPLY AND DELIVERY OF REVERSE OSMOSIS MEMBRANE ELEMENTS AND PRESSURE VESSELS ..... Unit : Number**

The unit of measurement shall be number of elements and pressure vessels supplied and delivered.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing and test certificates, transport for delivery to site and off-loading including all handling of the equipment. The equipment shall include the following:

End caps, o-rings, connectors and all pipe work for the stages and arrays.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

**DH 09.07      INSTALLATION, TESTING AND COMMISSIONING OF REVERSE OSMOSIS ELEMENT AND PRESSURE VESSELS..... Unit : Number**

The unit of measurement shall be number of elements and pressure vessels, tested and commissioned.

The tendered rates shall include full compensation for the site handling and positioning of the equipment, including the fastening of the equipment in its designated position. The following shall also be included in the tendered rates:

- (a) Coupling of all required pipes flanges, including all required gaskets, nuts, bolts, o-rings, connectors and washers;
- (b) All required installation materials, labour and consumables to render a complete and working installation.

The tendered rates shall also include full compensation for all preliminary tests, delivery and efficiency tests if required and commissioning tests. Commissioning tests shall comply with the section dealing with testing and commissioning.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

**DH 09.08**    **SUPPLY OF CHEMICALS** ..... Unit : Litre

The unit of measurement shall be the volume of Chemicals supplied in litres.

The tendered rates shall include full compensation for all labour, transport and site handling for the chemicals delivery and storage of the chemicals.

Separate items for chemical reagents and solutions which are required will be listed in Schedule of Quantities.

DEPARTMENT OF PUBLIC WORKS

BORDER CONTROL – PORTS OF ENTRY

REPAIR, MAINTENANCE AND UPGRADING OF BUILDINGS, CIVIL INFRASTRUCTURE, ELECTRICAL INSTALLATIONS AND MECHANICAL EQUIPMENT

MONTHLY ANALYSIS REPORT- WATER PURIFICATION WORKS

MONTH	Conductivity (25°) mS/m	Dissolved Solids mg/l	pH (25°)	Turbidity NTU	Calcium (Ca) mg/l	Chloride (Cl) mg/l	Fluoride (F) mg/l	Magnesium (Mg) mg/l	Potassium (K) mg/l	Sodium (Na) mg/l	Sulfate (SO <sub>4</sub> ) mg/l	Nitrate (NO <sub>3</sub> -N) mg/l	Zinc (Zn) mg/l	*Aluminium (Al) µg/l	Copper (Cu) µg/l	Iron (Fe) µg/l	Manganese (Mn) µg/l	*Heterotrophic Plate Count count/m <sup>3</sup>	*Faecal Coliform Bacteria count/100 m <sup>3</sup>	*Total Coliform Bacteria count / 100m <sup>3</sup>	Total Hardness (CaCO <sub>3</sub> ) mg/l	YEAR	
JANUARY																							
FEBRUARY																							
MARCH																							
APRIL																							
MAY																							
JUNE																							
JULY																							
AUGUST																							
SEPTEMBER																							
OCTOBER																							
NOVEMBER																							
DECEMBER																							

\* Tests to be submitted on a Monthly Basis



**BORDER CONTROL – PORTS OF ENTRY**

REPAIR, MAINTENANCE AND UPGRADING OF BUILDINGS, CIVIL INFRASTRUCTURE, ELECTRICAL INSTALLATIONS AND MECHANICAL EQUIPMENT

**DAILY WATER CONSUMPTION REPORT IN k/?**

YEAR:				MONTH:			
DAY	A	B	C	D	E	D-E	
	RAW WATER METER READING	PRODUCT WATER METER READING	WASTE	BORE HOLE METER READING	ELVATED TANK METER READING	DIFFERENCE OF D AND E	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
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25							
26							
27							
28							
29							
30							
31							
TOT							



DEPARTMENT OF PUBLIC WORKS

BORDER CONTROL – PORTS OF ENTRY

36 MONTHS MAINTENANCE AND SERVICING OF BUILDINGS, CIVIL, MECHANICAL AND ELECTRICAL INFRASTRUCTURE AND INSTALLATIONS

**BORE HOLE PUMP READINGS**

YEAR:

MONTH:

Day	BOREHOLE 1: DELIVERY OF 1.2 ?/s for 12 HOURS						Comments
	Hour Reading	Hours worked	Amps	Water Meter Reading	m <sup>3</sup> Pumped	m <sup>3</sup> /h	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
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**TECHNICAL SPECIFICATION****DL CHLORINATION SYSTEMS FOR THE DISINFECTION OF DRINKING WATER AT REMOTE BOREHOLE INSTALLATIONS****CONTENTS**

DL 01	SCOPE
DL 02	STANDARD SPECIFICATIONS
DL 03	OPERATING AND MAINTENANCE MANUALS
DL 04	PROCUREMENT AND INSTALLATION OF CHLORINATION SYSTEMS
DL 05	TESTING AND COMMISSIONING
DL 06	OPERATION AND MAINTENANCE
DL 07	MEASUREMENT AND PAYMENT

**DL 01 SCOPE**

This specification states the requirements for all work related to the procurement, installation, testing, commissioning, operation and maintenance of chlorination equipment for the disinfection of drinking water at remote borehole installations. Chlorination equipment shall be provided as one of the following three technological systems, according to site-conditions and the relevant stipulations in this document:

- 1) Calcium hypochlorite dosing systems.
- 2) Sodium hypochlorite dosing systems.
- 3) Vacuum systems for gas chlorination.

Any on-site sodium hypochlorite generators, chlorine dioxide preparation systems or pressure systems for gas chlorination (direct chlorination) shall be deemed UNACCEPTABLE and are all excluded from the scope of this work.

**DL 02 STANDARD SPECIFICATIONS****DL 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- |            |   |
|------------|---|
| SANS 10298 | - Indirect small to medium-sized gas chlorination systems for the disinfection of water |
| SANS 241   | - Drinking water  |
| SANS 10306 | - The management of potable water in distribution systems                               |
| SANS 6052  | - Residual chlorine content of water  |

**DL 02.02**            **OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1993. Construction Regulations, 2004 as promulgated in the Government Gazette No 37305 shall be adhered to.

**DL 02.03**            **MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

**DL 02.04**            **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**DL 03**                **OPERATING AND MAINTENANCE MANUALS**

The Contractor shall be responsible for the compilation and production of operating and maintenance manuals including an inventory of all chlorination equipment.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals. The completion of operating and maintenance manuals shall be a requirement for practical completion.

**DL 04**                **PROCUREMENT AND INSTALLATION OF CHLORINATION SYSTEMS**

**DL 04.01**            **GENERAL**

Chlorine and hypochlorite are strong bleaching and oxidizing agents and pose a SUBSTANTIAL SAFETY RISK.

The Contractor shall submit proof to the Engineer to demonstrate his (or his subcontractor's) understanding, skill and experience in the assembly of chlorination systems

All chlorine dosing equipment shall be manually adjustable to set accurate dosing rates within the range of average daily flow rates specified. The concentration of chlorine at the point of dosing shall be between 1 – 5 mg/l, so that the free residual chlorine concentration shall be between 0.2 – 1.0 mg/l at the furthest point of use in the water distribution system.

The chlorination system shall be installed in such a way as to dose upstream of overhead tanks/ reservoirs to provide for contact time. Where more than one borehole is used for water supply, the dosing point shall be installed in a common rising main, upstream of the overhead tanks/ reservoirs.



## DL 04.02

**CALCIUM HYPOCHLORITE DOSING SYSTEM**

Calcium hypochlorite dosing shall be the system of choice for disinfection at small remote bore-hole water supply installations.

Calcium hypochlorite can be supplied as briquettes, chips or pellets. Chlorinators shall be designed to provide a consistently accurate dose of available chlorine to small water systems. Corrosion resistant plastics (polyethylene) shall be used in the product's construction.

All  $\text{Ca}(\text{ClO})_2$  supplied shall have a chlorine content of between 65 and 70% and an average moisture content of less than 4%. Calcium hypochlorite shall be properly packaged prevent contact with moisture and to ensure safety of handling. A shelf life of at least 3 months shall be maintained for supplied calcium hypochlorite.

The dosing plant uses a dry chemical product that is dissolved in water to make-up the required chlorine containing solution. When the chemical make-up tank is empty a specified mass of the chemical is added to the tank as it is filled with water to make up the required concentrate of chemicals in the solution.

The chemical solution used on this systems is 1,7% of Calcium Hypochlorite (\*1,13% Cl)

Note\*: Calcium Hypochlorite contains 68% chlorine

The principal of making up the chemical is to top up the tank once per week so that the tank is operating of the top half of the tank. This is done at the time of performing the weekly operational tasks. The level of the solution in the tank is used, as the indicator of how much chemical has to be added when performing the topping up task. If this is done, the concentrate of the chemical solution will stay constant.

The calcium component of the Calcium Hypochlorite will precipitate and cause a white settlement in the dosing tank. This settled white substance that accumulates at the bottom of the tank is not chlorine and needs to be cleaned out on a regular cycle as described in the three monthly procedures. The tank is used to its lowest operating level (15%) before executing the three monthly cleaning procedures. The make-up tanks are marked in 10% increments. The mass of chemical that has to be added at each increment is indicated in gram at each increment as in the following illustration as example using the main plaza markings.

**DL 04.03 SODIUM HYPOCHLORITE DOSING SYSTEM**

Sodium hypochlorite is a colourless, transparent liquid, which shall be dissolved in cold water to a concentration of between 8 – 10% for liquid dosing. Sodium hypochlorite shall be safely stored, located it in a cool, dark place, maintaining pH 11 or more and avoiding contact with copper or nickel.

The size of dosing tank shall be dimensioned such and kept at a maximum level to ensure that sodium hypochlorite ( $\text{NaOCl}$ ) does not break down to  $\text{NaCl}$  and  $\text{NaOH}$ .

A UV-stabilized polyethylene (PE) off-white or semitransparent dose tank is required, with a sintered drain-off connection and 4 lateral mounting places at the bottom on the tank shell. The dose tanks shall be optimized for stability and functionality.

The dosing apparatus shall be robust and shall not cause blockages. The dosing apparatus shall ensure absolutely precise dosing through a dosing process that is always strictly proportional to the quantity of water flowing through the main delivery pipe. This could be achieved through a flow meter in the dosing apparatus. The following special features shall be required:

- (i) adjustable dosing capacity that avoids over- or under-dosing
- (ii) automatic stop of an overload-proof synchronous motor under conditions of short-term pressure shocks, with automatic re-start when pressure drops to normal again
- (iii) a control LED that indicates pump strokes, with a second LED that flashes if the liquid level becomes too low causing the dose pump to switch off automatically; the empty indication is directly combined with the suction line for this purpose.

**DL 04.04****VACUUM GAS CHLORINATION SYSTEM**

Vacuum gas chlorination systems shall only be considered where average daily flow rates are more than 8 l/s (i.e. around 700 m<sup>3</sup>/d). The mean residence time of gas cylinders shall never be more than two months. Gas cylinders shall be mounted on mechanical balances.

Pressure systems feeding pressurized gaseous chlorine directly into the water supply system shall not be acceptable.

A dual system with two cylinders is required, including an automatic change-over device to switch between cylinders that shall be installed with a wall mounted manifold.

All chlorination equipment and ancillaries, the layout and installation, materials, operational safety measures and maintenance shall be strictly in accordance with SANS 10298.

**DL 04.05****SAFETY SIGNS AT CHLORINATION INSTALLATION**

Regardless of the type of chlorination system installed, warning signs shall be installed at the chlorination systems to be clearly visible. Warning signs shall also include all safety precautions for the operation and maintenance of chlorination systems, in accordance with the manufacturer's specifications and other relevant safety specifications and acts. A warning sign with first aid instructions shall also be installed at the chlorination system, specifying instructions for instances of skin exposure, eye exposure, inhalation exposure and swallowing, according to the manufacturer's specifications and SANS 10298.

**DL 05****TESTING AND COMMISSIONING**

After installation, the contractor shall evaluate the functioning of chlorination systems to ensure that there are no leaks and that the rate of dosing is set correctly.

**DL 06 DESCRIPTION OF INSTALLATION****DL 06.01****BULK WATER**

Water is pumped from multiple boreholes with borehole pumps and delivered into the elevated bulk storage tanks.

The boreholes are switched on and off to maintain a "full tank status". This manual does not cover details regarding the control of the boreholes.

An analysis of the borehole water indicated that the physical properties of the water were suitable for human consumption. The only treatment that the water requires is to dose it with a small quantity of chlorine so that any harmful bacteria and microorganisms that may enter the water can be destroyed.

A system was designed to dose chlorine at a rate of 0,5 to 2-mg/l. The object is to have a residual of chlorine left in the water so that by the time it reaches the user. The traceable presence of free chlorine should be between 0,2 to 0,5 mg/l. the dosing pump can be adjusted up or down to achieve the required residual.

The flow rate from the boreholes could vary depending on which of the boreholes are active and in which combination the boreholes are used. To maintain a constant dosing ratio (mg/l) the dosing facility has to be able to keep pace with possible fluctuations of flow from the boreholes.

"Proportionate to flow" takes place as follows:

- A water meter is used to measure the volume of water that is delivered from the boreholes to the storage tanks. This water meter is equipped with a sensor that gives one pulse for every 100L of water that has passed through the meter to the storage facility.
- A chemical dosing pump is used to dose a chlorine containing solution from the chemical make-up tank into the pipeline, before the water enters the storage tanks.
- The pulses from the water meter is received by an Alldos dosing pump with Etron electronics.
- Each pulse, as received from the water meter, is used to start the dosing pump and introduce a set volume of the chlorine containing solution into the pipeline to maintain the required chlorine-dosing ratio

The dosing pump can be set to manual mode in case of failure of the signal from the water meter.

## **DL 06.01**

### **WASTEWATER TREATMENT WORKS**

The wastewater treatment works consists of a 180kg Chip Dozer with a capacity capable of holding 180kg Calcium Hypochlorite chips Scientific Chips.

The maximum feed rate is 50kg chips per hour and the system is capable of handling a flow rate 40-4000 litre water per hour. Is also consists of a double rotameter system with a 2000 litre maximum flow per rotameter.

The system must be regularly cleaned to prevent build-up and blockages. The cleaning procedure will form part of the maintenance and operation requirements.

## **DL 07**

### **OPERATION AND MAINTENANCE**

#### **DL 07.01**

##### **GENERAL**

Maintenance shall be carried out according to an approved maintenance plan and operation and maintenance manual, which shall specify actions including routine

preventative maintenance according to the manufacturer's specifications, as well as unforeseen repair work, corrective maintenance and/or replacement of parts of the system.

**DL 07.02****OPERATION AND ROUTINE PREVENTATIVE MAINTENANCE**

The tasks related to the operation and routine preventative maintenance work shall include but not be limited to the GENERAL actions listed in table DL 06.02/1 below. SANS 241 shall be adhered to in the routine preventative maintenance of vacuum systems for gas chlorination.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

TABLE DL 07.02/1

NO	ROUTINE PREVENTATIVE MAINTENANCE OF CHLORINATION SYSTEMS AND ANCILLARIES	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system.	Daily
2	Clean complete installation thoroughly so that leaks would be obvious and clear when they occur.	Weekly
3	Check, service, repair and clean dosing apparatus from blockages.	Monthly
4	Corrosion protect all equipment and ancillaries.	Whenever necessary
5	Check for and repair all leaks. Report leaks.	Monthly
6	Check dosing rate and reset regulators if necessary.	Monthly
7	Measure residual chlorine in the drinking water system (DPD 4 or similar).	Weekly

**DL 07.03****OPERATION**

Operation of all chlorination systems shall include the supply of chemicals, including chlorine gas or sodium hypochlorite or calcium hypochlorite. The contractor shall supply chemicals to ensure that there is always enough supplied for a full month's requirement.

**DL 07.04****SAFETY PROCEDURES AND PRE-CAUTIONS**

SANS 10298 specifies operational safety in terms of general safety requirements, emergency action plans, personal protective equipment and handling of containers, which shall at all times be adhered to. Only personnel who are adequately trained shall be allowed to operate and maintain the chlorination systems.

**DL 07.05****REMUNERATION**

Remuneration for the monthly operation of chlorination systems, the supply of chlorine or hypochlorite as well as ALL maintenance activities related to chlorination systems shall be deemed included in the tendered rate for ten points of the installation of which the system forms part. Installations are specified in Additional Specification SA: General Maintenance.

**DL 08      MEASUREMENT AND PAYMENT****DL.01      SUPPLY AND DELIVERY OF CHLORINATION SYSTEMS ..... Unit: number**

The unit of measurement shall be the number of chlorination systems supplied and delivered, including all equipment and ancillaries deemed part of a functional system.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing and test certificates. Different systems as specified in this document shall be listed in the Schedule of Quantities, according to:

- i. Calcium hypochlorite dosing systems.
- ii. Sodium hypochlorite dosing systems.
- iii. Vacuum systems for gas chlorination.

Tendered rates shall include full compensation for all transport cost, including all handling of the equipment, loading and off-loading of chlorination systems.

Different systems shall be based on the daily average flow rate of the main water supply.

**DL.02      INSTALLATION, TESTING AND COMMISSIONING OF CHLORINATION SYSTEMS ..... Unit: number**

The unit of measurement shall be the number of chlorination systems installed, tested and commissioned.

The tendered rates shall include full compensation for the site handling and positioning of the chlorination equipment, including the fastening of the equipment in its designated position. The following shall also be included in the tendered rates:

- (a) Installation of all equipment, ancillaries and all other necessary appurtenances required to render a fully functional chlorination system;
- (b) Coupling of all required pipes flanges, including all required gaskets, nuts, bolts and washers;
- (c) Routing and fastening of all power cables, connecting of all electrical material and switchgear;
- (d) All required installation materials, labour and consumables to render a complete and working installation.

The tendered rates shall also include full compensation for all preliminary tests, delivery and efficiency tests if required and commissioning tests to ensure a leak-free system and the correct settings of regulators to ensure accurate dosing.

Separate items will be listed in the Schedule of Quantities for different types and sizes of systems, as specified under payment item DL.01.

**PARTICULAR SPECIFICATION**

**DN DOSING SYSTEMS FOR THE FLOCCULATION OF DRINKING WATER**

**CONTENTS**

DN 01	SCOPE
DN 02	STANDARD SPECIFICATIONS
DN 03	OPERATING AND MAINTENANCE MANUALS
DN 04	PROCUREMENT AND INSTALLATION OF DOSING SYSTEMS
DN 05	PROJECT SPECIFICATIONS
DN 06	TESTING AND COMMISSIONING
DN 07	OPERATION AND MAINTENANCE
DN 08	MEASUREMENT AND PAYMENT

**DN 01 SCOPE**

This specification states the requirements for all work related to the procurement, installation, testing, commissioning, operation and maintenance of dosing equipment for the coagulation and flocculation of drinking water at the water works at Kosibay Port of Entry.

**DN 02 STANDARD SPECIFICATIONS**

**DN 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- SANS 10298 - Indirect small to medium-sized gas chlorination systems for the disinfection of water
- SANS 241 - Drinking water
- SANS 10306 - The management of potable water in distribution systems
- SANS SM 1052 - Residual chlorine content of water

**DN 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1993: Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

DN. 2

**DN 02.03**      **MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND  
INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

**DN 02.04**      **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**DN 03**            **OPERATING AND MAINTENANCE MANUALS**

The Contractor shall be responsible for the compilation and production of operating and maintenance manuals including an inventory of all chemical dosing equipment.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals. The completion of operating and maintenance manuals shall be a requirement for practical completion

**DN 04**            **PROCUREMENT AND INSTALLATION OF DOSING SYSTEMS**

**DN 04.01**        **GENERAL**

The Contractor shall submit proof to the Engineer to demonstrate his (or his subcontractor's) understanding, skill and experience in the assembly of chemical dosing systems for water purification

All dosing equipment shall be manually adjustable to set accurate dosing rates within the range of average daily flow rates specified. The dosing range shall be between 1 - 200 mg/l.

The dosing system shall be installed in such a way as to dose at the start of the coagulation cascade to utilize the full potential of the mixing energy available.

**DN 04.02**        **COAGULATION/FLOCCULATION SYSTEM**

The dosing system required shall consist of the following components:

- 150 Litres dosing tank with electric stirrer, no 4.
- Extraction device and level indicator, no 4.
- Suction pulsation damper, no 4.
- Metering pumps, 35 l/ hour @ 10 bar working pressure, no 4.
- Overflow valve, no 2 .
- Pressure retention valve, no 2.
- Pulsation damper, no 2.

### DN.3

- Metering tube, no 2.
- Injection unit, no 2.
- 63mm dia uPVC class 16 pipe including wall brackets at 0,5 m clc, 90 degree bends  
and couplings, 10 m.

## **DN 05 PROJECT SPECIFICATION**

The raw water to be purified and reticulated as potable water to consumers residing at Kosibay Port of Entry is pumped from a borehole adjacent to the border. The raw water shall be treated to remove turbidity and colour and the final clarified and filtered drinking water shall be disinfected to achieve the statutory requirement for the physical, organoleptic, chemical and microbiological requirements in accordance with SANS 241-2006.

The purification process includes the following:

- Destabilisation of particles by introducing a coagulan/flocculent into a rapid mixing zone.
- Followed by flocculation in a slow mixing zone.
- Followed by clarification in sedimentation tanks
- Followed by filtration in dual media pressure filters
- Followed by disinfection by of the clean water with sodium hypochlorite.

### **DN 05.01 MATERIALS**

All materials used to assemble the dosing equipment shall be in accordance with the manufacturer's specification and within the prescribed working range specified

### **DN 05.02 SYSTEM COMPONENTS**

Notwithstanding the system components described in this specification or in the data sheets, the supplied system must be a complete working system, including dosing pumps, chemical containers for working solutions and chemical supply lines. Dosing tanks shall be installed in such a manner that it can be removed and cleaned before the new batch of working solutions are prepared.

The components of a typical dosing system shall include the following:

- Dosing tanks with electrical agitator for the preparation and dispensing of working solutions
- An extraction device and level indicator
- A suction pulsation damper



#### DN.4

- Dosing pumps( duty and standby)
- Overflow valve
- Pressure retention valve
- Pulsation damper (delivery side)
- Measuring tube
- Injection unit
- Valves and pressure gauges in dosing and flocculation/coagulation plumbing
- No- flow switches in dosing system
- Static mixers
- Coagulation and flocculation plumbing.

The final assembly of the dosing system shall be approved by the Engineer.

#### **PDN 05.03      ELECTRICAL POWER SUPPLY**

Electrical power supply at 220V, single phase, 50Hz will be made available in the dosing room as well as the chlorine store.

The Contractor shall co-ordinate the interfacing requirements of the Electrical Subcontractor and the relevant Mechanical Subcontractor.

#### **DN 05.04      CIVIL REQUIREMENTS**

The Contractor shall construct and install plinths, holding-down bolts, pipe ducts, excavate trenches and perform other civil construction work with due cognizance of the relevant Sub-contractor's requirements. Grouting of the bolts shall only be performed after setting up of the plant by the Contractor.

The Contractor shall be responsible for erecting, installing and fixing all pumps, pipe work and ancillary equipment.

#### **DN 06      TESTING AND COMMISSIONING**

After installation, the contractor shall evaluate the functioning of the dosing systems to ensure that there are no leaks and that the rate of dosing is set correctly.

#### **DN 07      OPERATION AND MAINTENANCE**

##### **DN 07.01      GENERAL**

Maintenance shall be carried out according to an approved maintenance plan and operation and maintenance manual, which shall specify actions including routine preventative maintenance according to the manufacturer's specifications, as well as unforeseen repair work, corrective maintenance and/or replacement of parts of the system.

DN.5

**DN 07.02      OPERATION AND ROUTINE PREVENTATIVE MAINTENANCE**

The tasks related to the operation and routine preventative maintenance work shall include but not be limited to the GENERAL actions listed in table DL 07.02/1 below. These actions and findings shall be logged and reported on the relevant approved schedules and reports.

TABLE POL 07.02/1

NO	ROUTINE PREVENTATIVE MAINTENANCE OF MAINTENANCE CHEMICAL DOSING SYSTEMS AND FREQUENCY ANCILLARIES	MAINTENANCE FREQUENCY
1	Visually inspect and report on complete system.	Daily
2	Clean complete installation thoroughly so that leaks would be obvious and clear when they occur.	Week
3	Check, service, repair and clean dosing room and apparatus	Monthly
4	Corrosion protect all equipment and ancillaries.	Whenever necessary
5	Check for and repair all leaks.	Monthly
6	Check dosing rate and reset regulators if necessary.	Monthly

**DN 07.03      OPERATION**

Operation of all chemical dosing systems shall include:

- The supply of water purification chemicals. The contractor shall supply chemicals to ensure that there is always enough supplied for a full month's requirement
- Record keeping of the turbidity readings of raw water as well as purified water
- The concentration of chemical working solutions
- The % settings on the dosing pumps
- The capacity of the dosing pump in use
- The actual volume of chemicals consumed
- Monthly analysis of the product water in terms of SANS 241: 2006
- Reporting in writing preferably electronically of the above.

**DN 07.04      REMUNERATION**

Remuneration for the monthly operation of chemical dosing systems, the supply of water purification chemicals as well as all maintenance and reporting activities related to chemical dosing systems shall be deemed included in the tendered rate for ten points of the installation of which the system forms part. Installations are specified in Additional Specification SA: General Maintenance.

**DN 08      MEASUREMENT AND PAYMENT**

**DN 08.01      SUPPLY AND DELIVERY OF CHEMICAL DOSING**

**EQUIPMENT .....Unit: number**

The unit of measurement shall be the number of chemical dosing equipment supplied and delivered, including all equipment and ancillaries deemed part of a functional system.

- The tendered rates shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing and test certificates.
- The tendered rate shall include all components as listed in DN 05.02 above

Tendered rates shall include full compensation for all transport cost, including all handling of the equipment, loading and off-loading of chemical dosing equipment.

**DN 08.02      INSTALLATION, TESTING AND COMMISSIONING OF CHEMICAL DOSING**

**EQUIPMENT .....Unit: number**

The unit of measurement shall be the number of chemical dosing equipment installed, tested and commissioned.

The tendered rates shall include full compensation for the site handling and positioning of the equipment, including the fastening of the equipment in its designated position. Dosing equipment shall be deemed as the full system inclusive of injection valves, dosing hose, power supply cable, make-up tanks, pulsation dampers, static mixers, no-flow switches, pressure gauges and strainers. The following shall also be included in the tendered rates:

- (a) Installation of all equipment, ancillaries and all other necessary appurtenances required to render a fully functional dosing system;
- (b) Coupling of all required pipes flanges, including all required gaskets, nuts, bolts and washers;
- (c) Routing and fastening of all power cables, connecting of all electrical material and switchgear;
- (d) All required installation materials, labour and consumables to render a complete and working installation.

The tendered rates shall also include full compensation for all preliminary tests, delivery and efficiency tests if required and commissioning tests to ensure a leak-free system and the correct settings of regulators to ensure accurate dosing.

**DN 08.03      SERVICING AND TESTING OF CHEMICAL DOSING EQUIPMENT**

**EQUIPMENT .....Unit: number/meter**

The unit of measurement shall be the number of dosing equipment serviced, tested and commissioned. The tendered rates shall include full compensation for the servicing, testing and commissioning, site handling and positioning of the dosing equipment, setting of

DN.7

the dosing rate including the fastening of the equipment in its designated position. Dosing equipment shall be deemed as the full system inclusive of injection valves, dosing hose, power supply cable, make-up tanks, pulsation dampers, static mixers, no-flow switches, pressure gauges and strainers.

**DN 08.04      DECOMMISSIONING AND REMOVAL OF CHEMICAL DOSING**

**EQUIPMENT**..... Unit: number/meter

The unit of measurement shall be the number of dosing pumps and associated equipment de-commissioned and removed.

The tendered rates shall include full compensation for all labour, machinery, tools, transport and site handling necessary for the decommissioning and removal of chemical dosing equipment. Dosing equipment shall be deemed as the full system inclusive of injection valves, dosing hose, power supply cable, make-up tanks, pulsation dampers, static mixers, no-flow switches, pressure gauges and strainers.

Separate items will be listed in Bill of Quantities for different types and sizes of equipment.

**DN 08.05      DECOMMISSIONING AND REPAIR/RECONDITIONING OF VALVES AND SLUICE GATES**.....Unit: number

The unit of measurement shall be the number of gate valves, flow control valves and sluice gates decommissioned and repaired or reconditioned.

The tendered rate shall include full compensation for replacement of components and materials for tools, transport, site handling and labour necessary for the complete decommissioning, dismantling, cleaning, repair or reconditioning of gate valves, flow control valves and sluice gates.

**DN 08.06      INSTALLATION, TESTING AND COMMISSIONING OF VALVES AND SLUICE**

**GATES**.....Unit: number

The unit of measurement shall be the number of gate valves, flow control valves and sluice gates installed, tested and commissioned.

The tendered rate shall include full compensation for the installation, testing, and commissioning making good all corrosion protected areas and for all other costs and actions necessary to obtain a complete working valve, control valve and sluice gate system as well as for materials, tools, transport, site handling and labour.

**PARTICULAR SPECIFICATION**

**DW**                      **SUPPLY OF WATER**

**CONTENTS**

PWS 01	SCOPE
PWS 02	STANDARD SPECIFICATIONS, REGULATIONS AND CODES OF PRACTICE
PWS 03	DETAIL OF WORK
PWS 04	PLANT: TRANSPORT
PWS 05	TESTING
PWS 06	PAYMENT ITEMS

**DW 01**                      **SCOPE**

Procure, deliver and discharge, into the storage container(s) at each facility, potable water complying with the specified quality standards.

**DW 02**                      **STANDARD SPECIFICATIONS, REGULATIONS AND CODES OF PRACTICE**

The supply of water is to be undertaken in compliance with the relevant specifications, regulations and/or codes of practice included in the following publications.

- SANS 241 of 2006 - South African Standard Specification for Drinking Water\*
- SANS 10252-2: 1993 – Code of Practice “Water Supply and Drainage for Buildings, Part 2: Drainage Installations for Buildings” – Annexure B – Septic Tank Systems\*
- National Water Act, Act No 36 of 1998\*\*
- Occupational Health and Safety Act, No 85 of 1993\*

**DW 03**                      **DETAIL OF WORK**

**DW 03.01**                      **PROCUREMENT OF WATER**

**DW 03.01.01**                      **Procurement of potable water**

Water of quality in compliance with the South African Standard Specification for Drinking Water, SANS 241: 2006 and volume to meet the facility requirements is to be procured on a legal basis from a source(s) identified by the Contractor. Written proof of purchase, quantity, quality and date(s) is to be provided with the Contractors application for payment for services provided under the Contract.

**DW 03.01.02**                      **Procurement of raw water**

Raw water is to be procured on a legal basis from a source(s) identified by the Contractor. Written proof of purchase, quantity, quality and date(s) is to be provided with the Contractors application for payment for services provided under the Contract.

**DW 03.02 DELIVERY OF WATER TO FACILITIES**

**DW 03.02.01 General**

The Contractor shall deliver the water to facilities on instruction from the Engineer within 24 hours.

**DW 03.02.02 Delivery of potable water**

The Contractor shall ensure that the water is not contaminated during delivery and upon discharge into the facility storage container(s) and must comply with the following macro- and micro-determinants and bacteriological limits:

MACRO- AND MICRO-DETERMINANTS	
1	2
Determined Mg/l	Class 1
Turbidity	1
Magnesium (as Mg)	70 max.
Sodium (as Na)	200 max.
Chloride (as Cl)	200 max.
Sulphate (as So <sub>4</sub> )	400 max.
Nitrate + nitrite (as N)	10 max.
Fluoride (as F)	1.0 max.
Zinc (as Zn)	1.0 max.
Aluminium (as Al)	0.3 max
pH	6.0 - 9.0
Conductivity	150 mS/m
Iron	0.2
Manganese	0.1

MICROBIOLOGICAL REQUIREMENTS				
1	2	3	4	5
		Allowable compliance contribution		
		95% of samples, min	4% of samples max	1% of samples max
		Upper limits		
Heterotrophic plate count	Count/ml	100	1000	10000
Total coliform bacteria	Count/100 ml	Not detected	10	100
Feacal coliform bacteria	Count/100 ml	Not detected	1	10

**DW 04 PLANT: TRANSPORT**

The Contractor shall ensure that the type, condition and capacity of the vehicle(s), including standby vehicles, to be used is sufficient to fulfil the obligations of the Contract. The transport operation shall be undertaken in compliance with relevant transport ordinances.

**DW 05                    TESTING**

The Contractor is responsible to ensure that tests required ensuring compliancy with the specifications and ordinaries relating to the quality of water, are undertaken at the frequency and in terms of procedures prescribed.

**DW 06                    PAYMENT ITEMS**

**DW 06.01                Supply units of 1000 litres (m<sup>3</sup>) of potable water from commercial sources on the instruction of the Engineer/Department's representatives ..... Unit: m<sup>3</sup>**

The unit of measurement shall be the number of cubic metres of potable water delivered to site within 24 hours from the time that the Engineer has logged an emergency breakdown call with the Call Centre.

The tendered rate shall include full compensation for the labour, materials and equipment needed to supply potable water into the elevated storage tank as directed by the engineer.

The tendered rate shall include, initial testing of water quality, value related as well as all time related preliminary and general charges, the operation and maintenance cost of the vehicle and the remuneration costs of the driver and workers. Separate items will be listed in the schedule of quantities for different rates of delivery.

**DW 06.02                Supply and delivery units of 1000 litres (m<sup>3</sup>) of potable water from existing sources within a 3km radius on the instruction of the Engineer/Department's representatives ..... Unit: m<sup>3</sup>**

The unit of measurement shall be the number of cubic metres of potable water delivered to site within 24 hours from the time that the Engineer has logged an emergency breakdown call with the Call Centre.

The tendered rate shall include full compensation for the labour, materials and equipment needed to supply and deliver potable water into the elevated storage tank as directed by the engineer.

The tendered rate shall include, initial testing of water quality, value related as well as all time related preliminary and general charges, the operation and maintenance cost of the vehicle and the remuneration costs of the driver and workers.

**DW 06.03                Supply units of 1000 litres (m<sup>3</sup>) of raw water on the instruction of the Engineer/Department's representatives ..... Unit: m<sup>3</sup>**

The unit of measurement shall be the number of cubic metres of raw water delivered to site.

The tendered rate shall include full compensation for the labour, materials and equipment needed to supply and deliver raw water into the raw storage tank or raw storage dams as directed by the engineer. It shall be possible to treat the raw water with the existing water treatment works on site to a standard that is in compliance with the South African Standard Specification for Drinking Water, SANS 241: 2006.

The tendered rate shall include, initial testing of water quality, value related as well as all time related preliminary and general charges, the operation and maintenance cost of the vehicle and the remuneration costs of the driver and workers. Separate items will be listed in the schedule of quantities for different rates of delivery.

**DW 06.04**

**Delivery of potable water from commercial sources on the instruction of the Engineer/Department's representatives..... Unit: km**

The unit of measurement shall be the number of kilometres travelled from the commercial source approved by the Engineer delivered to the storage tank.

The tendered rate shall include full compensation for the labour, materials and equipment needed to transport potable water into the elevated storage tank as directed by the engineer.

The tendered rate shall include, value related as well as all time related preliminary and general charges, the operation and maintenance cost of the vehicle and the remuneration costs of the driver and workers.



**TECHNICAL SPECIFICATION****EG SEPTIC TANK FACILITIES****CONTENTS**

EG 01	SCOPE
EG 02	STANDARD SPECIFICATIONS
EG 03	INFORMATION REQUIREMENTS FOR SEPTIC TANK SYSTEMS
EG 04	DETAIL OF REPAIR AND MAINTENANCE
EG 05	RESOURCES REQUIRED
EG 06	SOAK-AWAY PERCOLATION TEST
EG 07	MEASUREMENT AND PAYMENT

**EG 01 SCOPE**

Septic tanks (STs) are generally used as the most appropriate method of sewage disposal in rural/remote locations such as police stations. Typical problems experienced with ST facilities include:

- Inadequate capacity for the loads generated by their serviced populations, thus requiring too frequent emptying and consequent operation as conservancy tanks.
- Counter-sloping of feed sewers, causing blockages in these pipes.
- Inappropriate or broken inlet and/or outlet pipe-work (tee pieces).
- Top level of separation baffles too low, causing spillover of accumulated scum from primary to secondary compartment.
- Blocked connection between ST and disposal unit (mostly French drains – FDs).
- Blocked and/or overflowing FD, due to under-sized drain or retarded percolation.
- Uneven distribution of septic tank effluent into FD drain, caused by inappropriate slope and perforation of spreader pipe.
- Blockage of pipes and/or FDs by tree and grass roots.

**EG 02 STANDARD SPECIFICATIONS****EG 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

SABS 1200 - Standardized specification for civil engineering construction

**EG 02.02 OTHER SPECIFICATIONS**

LB - General corrosion protection

**EG 02.03**      **OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) shall be adhered to.

**EG 02.04**      **MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

**EG 02.05**      **MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**EG 03**            **INFORMATION REQUIREMENTS FOR SEPTIC TANK SYSTEMS**

The specifications in EG 03 are of a general nature and if not referred to in Clause EG 04: Detail of Repair and Maintenance, are not considered part of this Contract.

**EG 03.01**      **SPECIFIC INFORMATION REQUIREMENTS**

Specific information requirements re each ST facility include:

- Current and projected design population, incorporating appropriate design factors for domestic, public and institutional sanitation facilities (with/without detention cells).
- Dimensions and capacities of existing STs and FDs.
- ST emptying frequency and period since previous emptying event.
- Required ST and FD capacities.
- Integrity and serviceability of existing ST and FD structures and accessories (in/outlet fittings, baffle walls, rodding eyes on connecting pipes, etc.).
- Type and frequency of operational problems experienced, including resultant nuisance conditions.
- Contravention of applicable legal requirements.
- Availability and utilisation of groundwater (GW), its risk of pollution by the sanitation facility and precautions practised, such as chlorination of water supplied to users.
- Depth of GW table.
- Distance of separation between ST/FD and GW source.
- Other modes of water supply (with/without special treatment), such as Local Authority (LA) connection, surface source and carting from a remote source.

### EG 3

- Feasibility of connecting the water supply and/or sanitation facility to a LA-system.

#### EG 04 DETAIL OF REPAIR AND MAINTENANCE

##### EG 04.01 ALL INSTALLATIONS

The following general/repair and maintenance tasks shall be performed on all installations, whether specific problems are experienced, or not:

- Assess category in which the installation falls: Maintenance (no specific problems – largely applicable to FDs), Emergency repair and Repair (problematic cases – largely applicable to FDs), and/or Upgrading (applicable to STs or FDs, depending on design population). Measure internal length and width of tank, as well as depth from top of roof slab to top levels (TLs) of scum layer, supernatant layer and sludge layer, and to floor level (FL).
- Prepare temporary sludge disposal facility – the more appropriate of the following:
  - Drying bed/pond.
  - Direct on-site burial.
  - Carting to nearby sewage treatment works or domestic sanitary landfill site.
- Install permanent sewage by-pass facility consisting of a pre-fabricated tank of appropriate volume (c. 1m<sup>3</sup> for single dwelling, larger for communal facilities) parallel to the ST, with up- and downstream connecting pipes and plugs.
- Install rodding eyes for regular cleaning of connecting pipes, particularly those between the ST and FD.
- Using a stirrer, pump and/or bacterial aids, break up scum and sludge layers and suspend tank content to enable its pumping.
- Empty tank by means of pumping – retain seed sample for re-commissioning of tanks. Remove large settled objects, such as bricks, etc. Operate by-pass tank during emptying and re-commissioning of main tank.
- Clean connecting pipes and accessories, e.g. in/outlet tees. Remove tree and grass roots from pipes.
- Maintain acceptable aesthetic conditions re smells and spillages during the cleaning cycle.

##### EG 04.02 INSTALLATIONS REQUIRING EMERGENCY REPAIR, REPAIR AND/OR UPGRADING

Facilities in these categories shall, in most cases, be designed as if for new installations. Appropriate design guidelines are given in:

Water Institute of Southern Africa (1988). *Manual on the Design of Small Sewage Works*.

Summaries of preliminary designs shall be submitted to the Project Manager for conceptual approval. The services of a hydro-geologist may have to be employed, particularly where the accompanying water supply is fed from GW sources.

## EG . 4

In cases where the capacities of the ST and/or FD are inadequate for the flow to be treated, or where evidence of malfunctioning of the FD/disposal field is observed, the following tasks shall be carried out:

- Determine the design population/flow.
- In case of a single existing FD, install a duplicate FD and use it while the original FD is being refurbished. Thereafter, operate them alternately.
- In case of a disposal field (e.g. multiple FDs):
  - Dig an inspection hole close to the existing disposal field and characterise the soil profile to a depth of 1,2 to 1,5m below ground level.
  - Select the most feasible percolation layer and perform the prescribed percolation test in that layer.
  - Assess the percolation capacity of the existing FD/disposal field and, if necessary, the additional capacity required.
  - Increase the installed capacity of the FD/disposal field to at least 120% of its design capacity and operate the two halves of the system alternately.
- If the percolation zone of the FD/disposal field is perceived to be blocked, as evidenced by effluent seeping to the surface:
  - Remove the stone media from the drain, wash off accumulated biomass and allow the media to dry.
  - Strip a 100mm mantle of blocked soil from the sides and bottom of the drain and dispose of the spoil by on-site burial.
  - Return the stone media to the drain and replenish shortages.
- Pipework:
  - In either case (new or refurbished FD), install flow distribution pipe horizontally at correct level and with percolation holes located such that flow will be spread evenly over the length and width of the drain.
  - Install vertical inspection pipe (from floor level to 1m above ground level) to enable assessment of water level in drain.
- The ST site must at all times be maintained in a neat and acceptable condition.

### EG 04.03

Six monthly maintenance shall include the measurement and recording of sludge levels in the septic tank. Sludge removal shall be at frequencies as follows:

Population served:	10	-	30 persons	-	2 years
	50	-	200 persons	-	1 year
	200	-	500 persons	-	6 months
	Single Household	-		-	3 years

### EG 04.04

#### OTHER MEANS OF DISPOSAL OF ST EFFLUENT

Where geological conditions are such that ST effluent disposal by means of subsurface percolation is not feasible, the following alternative disposal methods may be considered:

- Evapo-transpiration beds, either as a stand-alone facility, or supplementary to a FD system.
- Reedbeds.
- Hydroponic systems.

## EG 05

**RESOURCES REQUIRED**

- Apparatus for measuring sludge and scum layers in STs.
- Apparatus for performing percolation tests.
- Excavator.
- Sludge pump.
- Stirrer/bacterial aids for breaking up of sludge and scum layers.
- Geo-hydrologist.

## EG 06

**SOAK-AWAY PERCOLATION TEST**

The percolation test has to be performed at the site of the soak-aways, the following procedure shall be followed:

Excavate a test hole to the floor of the trench of the soak-away (approximately 500mm in depth). The test hole shall be excavated large enough to allow a person to work on the floor of the excavation. The excavation shall be either shored to prevent collapsing of the walls, or the excavation shall be battered to prevent collapse.

At the floor of the excavation, a hole with a diameter of 300 mm  $\pm$  20 mm. The depth of the hole should be approximately 300 mm.

Now the 300 mm diameter hole must be filled with water and kept filled for 4 hours. The soil needs to be soaked.

After 4 hours of soaking, the hole is allowed to drain completely, where after the hole shall be filled with water to a depth of only 150 mm and the time noted. It is important to measure the actual depth of the water – if this differs from 150 mm.

As soon as the water has again soaked away, the time must be noted again. This time period, together with the original depth of water, is required to assess the percolation rate of the soil.

From the time it took to drain, the average time for the water to drop 10 mm is calculated. The table below is then used to determine the sidewall area of the trench. The trench bottom should be neglected since it gets clogged very rapidly.

<b>SOAK-AWAY PERCOLATION TEST</b>	
<b>Minutes to drop 10 mm</b>	<b>Rate of application (<math>\ell/m^2.d</math>)</b>
1	170
2	110
4	75
6	50
10	40
18	30
24	25
More than 24	Soil not suitable

**EG 07            MEASUREMENT AND PAYMENT**

**EG 07.01        MEASUREMENT AND PAYMENT FOR  
DESLUDGE AND GENERAL REPAIR  
OF SEPTIC TANKS ..... Unit : Number**

The unit of measurement shall be for the procedure described in EG 04.01 as well as for site specific requirements to achieve a clean and operational septic tank.

The tendered rate shall include full compensation for cleaning, excavation, installation, removing of obsolete material and rubble, dealing with water logged conditions, execution of the Environmental Measurement Plan during repair, provision of backfill and by-pass tanks and pipes and the disposal of sludge and surplus material. All labour shall also be included in the tendered rate.

**EG 07.02        MEASUREMENT AND PAYMENT FOR REHABILITATION  
OF FRENCH DRAIN SYSTEM ..... Unit : Number**

The unit of measurement shall be for the procedure described in EG 04.02 as well as for site specific requirements to achieve a clean and operational French Drain System.

The tendered rate shall include full compensation for the percolation test, the increased disposal field capacity, removal of stone media (if required), pipe work, rehabilitation of existing FD and installation of inspection pipes.

**EG 07.03        MEASUREMENT AND PAYMENT FOR ALIENATIVE  
METHODS TO AUGMENT THE SEPTIC TANK/  
FRENCH DRAIN TREATMENT ..... Unit : Number**

The unit of measurement shall be for the construction of the component to augment the ST/FD treatment system (see EG 04.04).

The tendered shall include the full compensation for the installation or construction of the system as approved by the Engineer.

**EG 07.04        SOAK-AWAY PERCOLATION TEST .....Unit: Number**

The unit of measurement shall be for the number of slump tests required.

The tendered rate shall include the full compensation for the excavation of the trench/ hole, materials, equipment, labour and any other requirements not mentioned here to complete the soak test.

**TECHNICAL SPECIFICATION****EJ WATER QUALITY TESTING****CONTENTS**

EJ 01	SCOPE
EJ 02	STANDARD SPECIFICATIONS
EJ 03	FLOW MEASUREMENT
EJ 04	DETAIL OF WORK
EJ 05	MEASUREMENT AND PAYMENT

**EJ 01 SCOPE**

This particular specification is applicable to the water quality testing by chemical analysis for both the sewage treatment works and the potable water purification works at Kosi Bay Port of Entry.

The specification covers requirements for sewage effluent standards as well as potable water standards. Testing procedures and equipment to verify these standards are also covered.

**EJ 02 STANDARD SPECIFICATIONS****EJ 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

SANS 5667-2	- Water quality sampling, part 2: Guidance on sampling techniques
SANS 5667-2	- Water quality sampling, part 10: Guidance on sampling of wastewater.
SANS 5011	- Water - pH value
SANS 5217	- Water - free and saline ammonia content
SANS 6048	- Water - chemical oxygen demand
SANS 6049	- Water - suspended solids content
SANS 6057	- Electrical conductivity of water
SANS 4831	- Microbiology: General guidance for the enumeration of coliforms: Most probable number technique
SANS 4833	- Microbiology: General guidance for the enumeration of coliforms: Colony count technique at 30 °C
SANS 241:2006	- Drinking water

**EJ 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1993: Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

**EJ 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

**EJ 02.04      MUNICIPAL REGULATIONS, LAWS AND BY-LAWS**

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**EJ 03      FLOW MEASUREMENT**

Flow rate shall be measured and recorded daily to populate a database of the following parameters:

- (a) Total flow
- (b) Maximum flow (peak flow)
- (c) Minimum flow (night flow).

**EJ 04      DETAIL OF WORK**

**EJ 04.01      GENERAL**

As part of the operational responsibilities on this project the Contractor shall regularly test wastewater and effluent quality as specified in the following clauses.

Operation shall include maintaining all testing equipment, including equipment not supplied as part of the Contract, in a clean and perfect functional condition.

**EJ 04.02      TEST LABORATORY**

The existing buildings shall be utilised as a site laboratory. Should the Contractor require more space, it shall be provided at his cost.

**EJ 04.03      TEST EQUIPMENT**

The contractor shall provide for the following analytical glassware and testing apparatus as part of this Contract:

- (a) Bench top pH, accurate and precise to at least 0,1 pH unit, including reference electrode and glass sensor or combination electrode;
- (b) Turbidity meter.
- (c) Electrical conductivity meter, with error not exceeding 1 % or 0,1 m S/m;
- (d) Magnetic stirrer with PTFE (Teflon) stirring bars;
- (e) 3 x 1 000 millilitre Imhoff cones with wooden rack;
- (f) 2 x 500 millilitre volumetric flasks;
- (g) 3 x pipettes (glass);
- (h) 5 x 500ml glass beakers
- (i) 2 x 1000ml plastic beakers
- (j) 3 X 1000 ml graduated measuring cylinders

**EJ 04.04      WASTE WATER AND POTABLE WATER QUALITY TESTING**

Waste water and potable water quality shall be tested within the first month after completion and commissioning of the sewage treatment plant and the water purification plant respectively.



See Operation Schedules for respective waste water treatment works.

**EJ 04.05**

**SEWAGE EFFLUENT QUALITY TESTS**

The final effluent of the sewage treatment plant shall comply with the general limit of the General Authorizations in terms of Section 39 of the Water Act, 1998 (Act No. 36 of 1998): DISCHARGE OF WASTE OR WATER CONTAINING WASTE INTO A WATER RESOURCE THROUGH A PIPE, CANAL, SEWER OR OTHER CONDUIT; AND DISPOSING IN ANY MANNER OF WATER WHICH CONTAINS WASTE FROM, OR WHICH HAS BEEN HEATED IN, ANY INDUSTRIAL OR POWER GENERATION PROCESS

The following analysis shall be performed by an approved authority on a monthly basis on the final effluent of the sewage works.

Faecal coliforms.(per 100ml)  
 Chemical Oxygen demand (mg/l)  
 pH  
 Ammonia as Nitrogen (mg/l)  
 Nitrate as nitrogen (mg/l)  
 Chlorine as free chlorine (mg/l)  
 Suspended solids (mg/l)  
 Electrical conductivity (mS/m)  
 Ortho-phosphate as phosphorus (mg/l)

Provision shall be made for the full analysis as published in table 3.1 of the GENERAL AUTHORIZATIONS once during the term of the contract.

The sample shall be taken at the outflow of the last maturation pond.

**EJ 04.06**

**MONITORING PROGRAMME FOR SEWAGE TREATMENT WORKS**

Regular measurement of the quantity and quality of wastewater final effluent shall be recorded according to the requirements of Government Notice no 1191: General Authorisations in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998), 8 October 1999. Licensed works shall be monitored in accordance with the license requirements.

The Contractor shall keep a written record and report electronically on a prescribed report form of all values for the duration of the Contract, of the following wastewater discharge and relative activities:

- (a) Quantity of wastewater final effluent discharged;
- (b) Quality of the wastewater final effluent discharged;
- (c) Detail of the monitoring programme;
- (d) Detail of failures and malfunctions in the discharge system and detail of measures taken.

**EJ 04.07**

**POTABLE WATER QUALITY TESTS**

An approved testing authority shall analyse the potable water on a monthly basis as per analysis schedule in particular specification PDH. Provision shall be made for a full Physical, organoleptic, and chemical requirements analysis once during the contract period. The sample shall be submitted to the testing authority according to prescription. The water distributed to consumers shall comply with the SANS 241:2006 Specification for the standards of drinking water. Only Class 1(recommended operational limit) water shall be distributed for human consumption.

The following analysis shall be performed by an approved authority on a monthly basis on the water delivered to the consumers.

MICROBIOLOGICAL ANALYSIS OF THE WATER IN ACCORDANCE WITH THE MICROBIOLOGICAL SAFETY REQUIREMENTS ACCORDING TO THE SANS 241:2006

The following analysis shall be performed by an approved authority on a monthly basis on the water delivered to the consumers.

Turbidity (NTU)  
Calcium as Ca (mg/l)  
Chloride as Cl<sup>-</sup> (mg/l)  
pH value  
Electrical conductivity  
Dissolved solids (mg/l)  
Sodium as Na (mg/l)  
Nitrate as N (mg/l)  
Magnesium as Mg (mg/l)  
Sulfate as SO<sub>4</sub><sup>=</sup> (mg/l)  
Aluminium as Al (µg/l)  
Iron as Fe (µg/l)  
Manganese as Mn (µg/l)  
Dissolved organic Carbon

**EJ 05**      **MEASUREMENT AND PAYMENT**

Remuneration for the monthly maintenance of the wastewater quality monitoring programme, maintenance of a site laboratory if necessary, laboratory equipment, testing to be performed on site during the maintenance phase as specified and record keeping system shall be deemed included in ten points for the maintenance of the installation of which wastewater quality control, measurement and testing form part.

Remuneration for all work and expenses related to water and wastewater quality tests by approved testing authorities in terms of SANS 10259 shall be paid to the Contractor as tendered for the number of tests including all water quality parameters as specified in EJ.

The Contractor shall be responsible for payment of testing authorities for any tests performed by them.





## TECHNICAL SPECIFICATIONS

### FD HEATING VENTILATION AND AIRCONDITIONING SYSTEMS

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#### FD 01 SCOPE

This specification covers the general maintenance and servicing of heating, ventilation and air-conditioning systems, which include the following:

- (a) Room air-conditioning units with air cooled condensers
- (b) Refrigeration pipework
- (c) Fans and attenuators
- (d) Electric motors
- (e) Air filters
- (f) Duct work
- (g) Air terminals
- (h) Noise and vibration
- (i) Painting and cleaning
- (k) Labelling and identification.

This specification shall form an integral part of the maintenance and servicing contract document, and shall be read in conjunction with the additional and particular specifications compiled as part of this document.

This specification shall act as a guideline to the Particular Specification and, in the event of any discrepancies between the Technical Specification and the Particular Specification, the latter shall take precedence.

The Contractor shall at all times adhere to this specification, unless otherwise specified in the Particular Specification.

**FD 02      STANDARD SPECIFICATIONS****FD 02.01      GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall deemed to form part thereof:

**FD 02.01.01      SANS and other specifications and codes**

- SANS 046      -      Copper tube manufacturing code of practice
- SANS 10400      -      The applications of building regulations
- SANS 10103      -      The measurement and rating of environmental noise with respect to annoyance and speech communication
- SANS 10139      -      The prevention, automatic detection and extinguishing of fire in buildings
- SANS 10140      -      Identification colour marketing
- SANS 10142      -      Code of practice for the wiring of premises
- SANS 10147      -      Refrigerating systems, including plants associated with air-conditioning systems
- SANS 10173      -      Installation, testing and balancing of duct work
- SANS 630      -      Decorative high-gloss enamel paint for interior and exterior
- SANS 763      -      General coating thickness
- SANS 1238      -      HVAC duct construction standards
- Act 103      -      National Building Regulations and Building Standard Act, 1977 (Act No 103 of 1977) as amended

**FD 02.01.02      Department of Public Works Specifications**

- PW 371      -      Specification of materials and methods to be used
- STS 1      -      Standard specification for air conditioning services
- STS 5      -      Standard Specification for electrical installations and equipment pertaining to mechanical installations

**FD 02.01.03      Occupational Health and Safety Act of 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1993: Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

**FD 02.01.04      Manufacturers' specifications, codes of practice and installation instructions**

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

**FD 02.01.05      Municipal regulations, laws and by-laws**

All municipal regulations, laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

**FD 03      VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS**

The following additional general specifications and requirements shall be read in conjunction with this specification and shall be adhered to unless otherwise specified in the Particular Specification.

**FD 03.01      GENERAL REPAIR AND INSTALLATION REQUIREMENTS**

- (a) All materials and equipment supplied and installed shall be of new high quality, design and manufactured to the relevant specifications, suitable for providing efficient, reliable and trouble-free service.
- (b) All work shall be executed in a first-class workman-like manner by qualified tradesmen.
- (c) All equipment, component parts, fittings and materials supplied and/or installed, shall conform in respect of quality, manufacture, test and performance to the requirements of the applicable current SANS specifications and codes, except where otherwise specified or approved by the Engineer in writing.
- (d) All materials and workmanship which, in the opinion of the Engineer, is inferior to that specified for the work will be condemned. All condemned material and workmanship shall be replaced or rectified as directed and approved by the Engineer.
- (e) The Contractor shall submit a detailed list of the equipment and material to be used to the Engineer for approval before placing orders or commencing installation.
- (f) All new equipment, materials and systems shall be installed and positioned such as to not impede on access routes, entrances and other services. The Contractor shall coordinate these items taking other services and equipment into account.
- (g) All control equipment and serviceable items shall be installed and positioned such that they will be accessible and maintainable.
- (h) The Contractor shall make sure that all safety regulations and measures are applied and enforced during the repair and construction periods to ensure the safety of the public and User Client.
- (i) Repair work shall be programmed in accordance with Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures, to ensure the shortest possible down-time of any service and the least inconvenience to the User Client and public. The Contractor shall make sure that the necessary notifications and notices are timeously put into place for these activities.

**FD 03.02      TESTING OF REFRIGERATION PIPING AND EQUIPMENT**

- (a) All new refrigerant pipe installations shall be thoroughly tested to be sure that they are absolutely tight. Nitrogen must be used to pressure test the system at 1,5 times the working pressure. A pressure-reducing valve must be used to set the test pressure. A leak test must be carried out on the entire system.
- (b) All new refrigerant pipe installations shall be vacuum pumped by means of a suitable vacuum pump. An absolute pressure of 2500 micron must be reached. Allow the system to stand under vacuum for a minimum of 12 hours. If no noticeable rise in pressure has taken place after 12 hours, the system may be charged.
- (c) The dryness of the refrigeration system shall be indicated by an approved moisture indicator.
- (d) Should moisture be present, the system shall be leak tested and the leak repaired. Should no leak be present, the system shall be flushed with dry nitrogen and vacuum pumped again as described above.
- (e) If the completed system complies with all the Specifications and passes the test and inspection, it can be approved and the Contractor may be instructed to recharge the system with the correct refrigerant and refrigerant charge.
- (f) Under no circumstances shall the refrigerant piping/installation be purged.

**FD 03.03      REFRIGERANTS**

- (a) No CFC refrigerant shall be used in new installations.
- (b) Equipment still running on CFC shall be maintained until such time that a leak occurs or the system has to be decanted. The system shall then be converted to a compatible HCFC or HFC as described in the Montreal Protocol and recommended by the compressor manufacturer.
- (c) Any CFC refrigerant that has to be discharged, shall be decanted by means of an approved reclaiming system, and not discharged to the atmosphere. Should the Contractor not comply with this requirement, full action shall be taken contractually and statutory against him.
- (d) Any refrigeration system not supplied with three-way service valves, shall be provided with Schreuder type service valves. These valves shall be installed on both suction and discharge lines of the compressors. Tap-o-line valves shall not be fitted or used on the systems.
- (e) In the event of an electrical motor burn-out in a hermetic or semi-hermetic compressor, a burn-out drier shall be used. Purging only is prohibited. The burn-out drier shall be installed and removed as per the manufacturer's instructions.
- (f) No synthetic components or solutions shall be used to repair leaks in refrigeration piping, on coils or evaporators. Only approved gas welding shall be used. Should the leak be of such nature that repair is not possible, the item should be replaced.

**FD 03.04      FANS AND ATTENUATORS****FD 03.04.01      General**

- (a) Requirements under this heading apply to fans that are not integral parts of complete units supplied by recognised suppliers. Selected fans shall be such that the operating point is as close as possible to maximum efficiency.
- (b) Fan motors selected must be capable of supplying not less than 10 % above the specified air quantity without overloading.
- (c) The system resistance must be calculated and the fan selected to meet the required static pressure, taking into consideration the site altitude, system air temperature and air density at which the system duty shall be met. The selection must be submitted to the Engineer for approval before ordering the equipment.
- (d) Belt drives shall be designed for a minimum overload of 25 % and not less than two matched belts may be used. Belts shall be selected and installed according to BS 790.
- (e) Pulleys shall be of the adjustable speed taper-lock type and shall be accurately keyed to the shafts and aligned before the system is put into operation.
- (f) Belt guards shall be supplied in accordance with Occupational Health and Safety Act, No 85 of 1993. The guards shall have an expanded metal front and shall allow oiling and the use of a tachometer without removal of the guard.
- (g) Bearings shall be selected for a minimum life expectancy of 200 000 hours at the given duty.
- (h) Lubrication points shall be readily accessible and shall be extended to the outside to permit lubrication without removal of the fan. Fan shafts shall be suitably protected from rust and corrosion.



**FD 03.04.02** **Axial flow fans**

- (a) Axial flow fans shall be in-line direct-driven type with the motor mounted inside the fan housing.
- (b) Fans shall be of the multi-bladed aerofoil type of a non-ferrous construction. The number of blades vary according to the application. The fans shall be provided with adjustable blade pitch indexed to permit field adjustment.
- (c) Fan casings shall be constructed of hot-dip galvanized mild steel with a minimum thickness of 3 mm and mild steel galvanized flanges on each side drilled for connections to matching flanges on ducting.

**FD 03.04.03** **Sound attenuators**

- (a) Sound attenuators shall be installed in the positions indicated on the drawings and shall be selected to provide the noise criteria levels as specified. All sound attenuators shall be products of an accredited manufacturer who publishes selection data on these products. Data shall be submitted to the Engineer for approval before ordering.
- (b) Metalwork shall be galvanized steel and acoustic insulation shall be non-combustible material, properly bonded and covered so as not to permit particles to be eroded by air moving over it.
- (c) Sound absorbing lining material shall have a density not less than 48 kg/m<sup>3</sup> and thickness of not less than 50 mm.

**FD 03.05** **CANOPIES AND GREASE ELIMINATORS**

- (a) Kitchen canopies shall be connected to the extract fan by means of cuts of which the joints and seams are of the welded or soldered construction and shall be watertight. Cleaning openings shall be provided at such intervals on the ducting that the inside of the ducting can be reached for cleaning purposes. The fan shall be provided with a cleaning access door, as well as a drain point at the bottom.
- (b) Fire dampers, operated with fusible links, shall be provided in each air outlet connection and shall form an integral part of the canopy construction.
- (c) Lights shall be fitted into the canopy by the manufacturer. Access to the tube for tube replacement shall be through the face of the fittings without the use of tools.
- (d) Grease filters shall contain a series of vertical baffles to change the direction of the air flow and efficiently divert grease particles out of the air stream by centrifugal action. Each filter bank shall contain a condensate trough and removable grease storage container.

**FD 03.06** **ELECTRIC MOTORS**

- (a) All electric motors shall be of one make, unless integral with the equipment, and shall not operate in excess of 1500 r/min unless previously approved by the Engineer for specific reasons. Motors, unless otherwise specified, shall be 380 volt, three-phase, 50 hertz for all sizes from and including 0,37 kW upwards. Smaller motors may be 220 volt, single-phase, 50 hertz.
- (b) All motors shall be totally enclosed, fan-cooled and have metric frame dimensions. Motors shall be quiet in operation to the full acceptance of the Engineer.
- (c) Three-phase motors shall all be squirrel cage induction type, special high torque motors being used on high inertia loads such as centrifugal fans, where otherwise excessively large motors, necessary to overcome driven equipment inertia, cause operation BHP to be less than 70 % of motor nameplate kW.

- (d) Starting methods for three-phase motors shall be as follows:
- |                     |   |  |
|---------------------|---|--|
| Motors up to 5,5 kW | - | DOL  |
| Above 5,5 kW        | - | Star-delta started, provided that the starting current does not exceed three times the full load amps. |
- (e) Single-phase motors shall be capacitor started, induction run type with built-in manual reset overload protection.
- (f) Nameplate rating of electric motors shall be at least 15 % larger than the required driven equipment brake drive losses duly accounted for, on motors below 15 kW. On larger motors a 10 % margin shall suffice.
- (g) All switch panels shall have a phase failure and low voltage protection with automatic reset adjustable to a maximum period of 10 minutes.

**FD 03.07****DUCT WORK**

- (a) This specification covers the air distribution system as shown on the drawings. Duct work shall be manufactured in accordance with the standard specification for air-conditioning duct work, SANS 1238. Duct work shall be erected in accordance with the code of practice for the installation, testing and balancing of duct work, SANS 0173.
- (b) Fittings such as elbows, parallel flow branches, branch connections, off-sets and transitions shall be manufactured and installed in accordance with the SMACNA standards.
- (c) All ducting shall be sufficiently airtight to ensure economical and quiet performance of the system, and joints shall be suitably sealed in accordance with the relevant SMACNA standard with suitable non-combustible filler compound.
- (d) The Contractor shall provide all hangers and supports which are to be hot-dip galvanized after fabrication to SANS 193. No explosive fasteners to the building structure shall be allowed, only approved expanding bolts or clamps are permissible.
- (e) The duct work shall be connected to the air terminals by means of flexible ducting. Flexible ducting shall be coated fibreglass fabric with a mineral base. Flexible ducting shall be installed with "easy" bends of not less than one duct diameter centre line and shall be supported to SMACNA specification to ensure that the ducting does not kink. The length of the flexible duct shall be kept to a minimum and shall not exceed lengths of 1200 mm.

**FD 03.08****AIR TERMINALS**

- (a) Air distribution shall be effected by means of the supply air grilles as indicated on the drawing. The finish of the grilles shall be epoxy powder-coated, the colour of which shall be advised and approved by the Engineer. Supply air grilles shall be of the double deflection type, consisting of two rows of individually adjustable aerofoil section vanes, front vanes horizontal rear vanes vertical, all vanes housed in a surrounding fixing flange with neat mitred joints in the corner.
- (b) Supply air grilles shall be of steel construction and shall be provided with burglar bars. The inner section will be only accessible from above and the face plate of the grille is fixed from above. No screws or fixing devices are accessible from below.
- (c) Supply grilles are supplied with a plenum box with spigot and connected to the spigot on the ducting by means of flexible ducting.
- (d) Transfer grilles shall be of steel construction and be provided with burglar bars. Standard door grilles may be installed with a burglar bar assembly in between.

**FD 03.09**      **AIR FILTERS****FD 03.09.01**    **General**

- (a) Provide and install air filters in the positions as indicated on the drawings.
- (b) Filters shall be standard products of a reputable manufacturer regularly engaged in the manufacture of the particular filter. The manufacturer shall submit evidence to the satisfaction of the Engineer that the filters have been tested by an independent authority and that they meet the minimum arrestance, efficiency and dust holding capacity.
- (c) Filters shall be tested in accordance with ASHRAE test standard 52 - 76.
- (d) A Megnahelic gauge calibrated from zero to 500 Pa shall be installed, connected with copper tubing to static pressure taps complete with isolating valves.

**FD 03.09.02**    **Primary filters**

- (a) Primary filters shall, unless otherwise stated, be washable on woven polyester material, pleated to provide an extended surface with a dust spot efficiency of minimum 40 % and an arrestance of 85 %.
- (b) Media shall be firmly held in place by rustproof wire screens to maintain pleat strength and spacing.
- (c) Media and support screens shall be continuously bonded into aluminium support.
- (d) Frames shall be folded to form a robust media support frame. The bonding between media and frame shall be continuous to prevent leakage.
- (e) Each filter shall be provided with a factory made holding frame, constructed of not less than 1,0 mm thick galvanized mild steel provided with suitable seals and quick release spring type clips to securely hold the filter cell in place without permitting leakage of air.
- (f) The holding frames of multiple cell filter banks shall be suitably joined and sealed so as to prevent leakage of air between the frames.

**FD 03.10**      **LABELLING AND IDENTIFICATION**

All equipment shall be labelled and identified using black Traffolite labels with 10 mm high white lettering on the labels. Labels will be secured using epoxy base glue.

The identification number used on these labels shall correspond with the equipment number on the complete inventory list.

**FD 03.11**      **NOISE AND VIBRATION**

- (a) Particular care shall be taken in the selection, application and installation of all equipment used to ensure that the equipment will operate below the required noise level for public areas of NC 35 and with the least vibration possible, all to the satisfaction of the Engineer.
- (b) Equipment shall be mounted on vibration isolators of the correct type and selection depending on deflection requirement and vibrating frequency.
- (c) Anti-vibration connections shall be used on duct work where it joins vibrating equipment such as fans and air-conditioning units.
- (d) Suitable sound attenuating devices shall be incorporated within the duct work to reduce airborne noise to acceptable levels as specified.

- (e) The subcontractor shall provide sound level data to the Engineer on the completion of the installation detailing the noise levels in NC level for each separate area. No measurement shall be taken closer than 1 metre from any outlet.

## FD 03.12

**PAINING AND CLEANING**

- (a) No untreated metal surfaces shall be allowed on the project. Items which are not galvanized or similarly protected against rust and corrosion shall be painted as detailed below. No equipment, hangers, brackets, etc, shall be delivered to site in unprotected condition; they shall be factory coated with an approved zinc-rich prime coat before being despatched.
- (b) Painting shall comprise the following consecutive processes. Thoroughly clean, descale and degrease all surfaces, apply one coat of approved zinc-rich primer and one coat of universal undercoat, and finish off with two coats of quality high-gloss enamel. Final finish shall be to the full approval of the Engineer.
- (c) Items with galvanized finish, such as cable trays, need not be painted but shall be properly cleaned with suitable galvanized iron cleaning fluid. Where galvanized finish is painted, it shall be primed with a calcium plumbate primer.
- (d) It is not a requirement to paint duct work, conduits or pipework installed in roof voids and shafts, where they are not visible, if they are galvanized. Items as mentioned above shall be properly cleaned and painted as specified above.
- (e) Visible sections of the inside of ducting through grilles shall be painted matt black after degreasing and priming as specified above.
- (f) Plant and equipment shall be painted with the relevant colour in accordance with SANS.

## FD 03.13

**SELF-CONTAINED AIR-CONDITIONING UNITS**

- (a) The self-contained packaged unit shall be a fully catalogued product and documentation shall include performance curves and selection tables.
- (b) Self-contained room air-conditioning units consist of unit casing, compressor, evaporator and fan, condenser and fan, refrigerant pipework with expansion device and the relevant controls. The condenser unit shall form an integral part of the unit or be separate for split applications.
- (c) Unit casings shall be of sheet metal construction with a baked enamel finish to give a corrosion resistance. Units shall be suitably insulated to ensure quiet operation.
- (d) Evaporator fans shall be of the double inlet centrifugal type with integral motor or belt-driven. The fan assembly shall be isolated from the unit by means of rubber mounts and the unit shall operate without vibration.
- (e) Condensate trays shall be manufactured of non-corrosive materials and shall be insulated and condensate shall be piped to the nearest drain point.
- (f) Washable WP 77 filters shall be provided and installed behind the inlet grille and shall be easily removable.
- (g) Compressors shall be of the hermetically sealed dome type with crankcase heaters and suitable vibration isolators.
- (h) Condenser coils shall be copper tubes with aluminium fins for inland use. Condenser fans shall be propeller fans or of the centrifugal type.
- (i) Refrigerant piping shall be installed and repaired as specified in FD 03.

**FD 04 AS-BUILT INFORMATION AND OPERATING AND MAINTENANCE MANUALS**

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals and system data sheets.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

The Contractor shall allow for the required equipment and facilities to establish the correct as-built information.

All information shall be recorded and reproduced in electronic format, as well as three sets of hard copies to be supplied to the Department.

Over and above what is specified in Additional Specification SB: Operating and Maintenance Manuals, the operating and maintenance manual to be compiled shall be structured to include at least the following:

- (a) System description  
Complete system description and the working of the plant.
- (b) Commissioning data  
Complete commissioning, test and inspection data of plant.
- (c) Operating data
  - (i) Plant running check list and frequency of servicing required;
  - (ii) Safety precautions to be implemented;
  - (iii) Manual and automatic operation;
  - (iv) Maintenance duties and logging required;
  - (v) Lubricating oils and service instructions;
  - (vi) Pre-start checklist for each system;
  - (vii) Starting and stopping procedures.
- (d) Mechanical equipment
  - (i) Description of all major items with the make, model number, names, addresses and telephone numbers of the suppliers, manufacturers or their agents;
  - (ii) Design capacities of all equipment, including selection parameters, selection curves, capacity tables, etc;
  - (iii) Manufacturers' brochures and pamphlets;
  - (iv) Schedule of spares with part numbers recommended to be held as stock.
- (e) Maintenance instructions
  - (i) Schedule of maintenance particulars, frequency of services and replacements;
  - (ii) Trouble-shooting guide;
  - (iii) Part number of all replacement items and spares;
  - (iv) Capacity curves of pumps, fans and compressors;
  - (v) Serial numbers of all items of equipment.
- (f) Electrical equipment
  - (i) Schedule of equipment, indicating manufacturer, type, model number, capacity and addresses and telephone numbers of suppliers;
  - (ii) Maintenance instructions;
  - (iii) Manufacturers' brochures and pamphlets;
  - (iv) Complete as-built circuit diagrams and diagrammatic representation of interconnections of all electrical equipment.

(g) Instrumentation and control

- (i) Description of each control system;
- (ii) Schedule of control equipment indicating manufacturer, type, model number, capacity and addresses and telephone numbers of suppliers;
- (iii) Maintenance instructions;
- (iv) Manufacturers' brochures and pamphlets.

(h) Drawings

- (i) Paper prints of all as-built mechanical and electrical drawings;
- (ii) Wiring diagrams framed behind glass shall be mounted adjacent to each relevant control panel.

**FD 05      LOGGING AND RECORDING PROCEDURES**

The Contractor shall under this repair and maintenance contract institute a logging and recording system as part of his maintenance control plan as defined in Additional Specification SA: General Maintenance. This shall consist of a log and record book which shall be utilised to log and record all operations, faults, system checks, breakdowns, maintenance visits, inspections, etc.

The logbook shall be kept in a safe place at the maintenance section and shall only be utilised by the boiler house supervisor, the Contractor and the Engineer. A copy of the monthly entries and recordings into this logbook shall be submitted by the Contractor together with this monthly report to the Engineer.

The logbook shall be structured to include at least the following:

- (i) Daily inspection and maintenance actions;
- (ii) Monthly inspection and maintenance actions;
- (iii) Six-monthly inspection and maintenance actions;
- (iv) Breakdown reports.

The Contractor shall also institute an attendance register, which shall be kept in a safe place at the maintenance section. This register shall be completed by all persons visiting the relevant plants, including:

- (a) Contractor and maintenance personnel;
- (b) Inspectors;
- (c) User Client and associates;
- (d) Engineer.

This register shall state the date, time-in, time-out, name, company and reason for visit. A copy of the register shall be submitted by the Contractor together with his monthly report.

On completion of repair work and/or the installation of new equipment the plant and equipment shall be put into operation after all tests and adjustments have been carried out to the satisfaction of the Engineer. Where new plant is installed the Contractor shall run and operate the system for a period of time specified by the Engineer and train the staff of the User Client to operate and maintain the system. This operation shall be done strictly in accordance with Clause SC 11 of the Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

Logging of the operation of the installations shall commence immediately upon start-up.

The Contractor shall submit a full commissioning report as per attached commissioning data sheet.

**FD 06 TESTS AND INSPECTIONS ON COMPLETION OF REPAIR WORK**

On completion of repair work the Contractor shall prior to recommissioning test the plant and its equipment. This operation shall be done strictly in accordance with Clause SC 08 of Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

Except where otherwise provided in the Contract, the Contractor shall provide labour, materials, power, fuel, accessories and properly calibrated and certified instruments necessary for carrying out such tests. Arrangements for these tests shall be made by the Contractor and he shall give at least 72 hours written notice to the Engineer before commencing the test. In the event of the plant or installation not passing the test, the Employer shall be at liberty to deduct from the Contract amount all reasonable expenses incurred by the Employer or the Engineer attending the repeated test.

Whenever any installation or equipment is to be operated for testing or adjusting as provided for above, the Contractor shall operate the entire system for as long a period as may be required to prove satisfactory performance at all times in the occupies space served by that system for up to twenty-four hours a day continuously until the certificate of practical completion of repair work is handed over.

The Contractor shall provide all labour and supervision required for such operation and the Department may assign staff as observers, but such observation time shall not be counted as instruction time.

After complete installation of the system all equipment shall be tested, adjusted and readjusted until it operates to the satisfaction and approval of the Engineer.

The Contractor shall submit certificates of tests carried out to prove the performance of all equipment, as well as certificates obtained from all the relevant authorities and statutory bodies, etc.

The Contractor shall only utilise Departmental approved inspection authorities for all inspections and tests to be conducted. This will be done and approved in writing among the relevant parties.

**FD 07 QUALITY ASSURANCE SYSTEM**

The Contractor shall institute an approved quality assurance (QA) system, which shall be submitted to the Engineer for his approval. The records of this QA system shall be kept throughout the duration of the Contract and be submitted to the Engineer at regular intervals as required.

**FD 08 COMMISSIONING AND RECOMMISSIONING OF PLANT AND INSTALLATION****FD 08.01 GENERAL**

On completion of repair work and/or the installation of new equipment the plant and equipment shall be put into operation after all tests and adjustments have been carried out to the satisfaction of the Engineer. Where new plant is installed the Contractor shall run and operate the system for a period of time as specified by the Engineer and train the staff of the User Client to operate and maintain the system. This operation shall be done strictly in accordance with Clause SC 11 of Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures.

Logging of the operation of the installations shall commence immediately upon start-up.

The Contractor shall submit a full commissioning report as per attached commissioning data sheet.

**FD 08.02      RECOMMISSIONING OF PLANT AND ANCILLARY EQUIPMENT**

On completion of repair work the Contractor shall recommission the plant and its equipment. This operation shall be done strictly in accordance with Clause SC 11 of Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures. This operation shall also be carried out strictly in accordance with the manufacturer's specification and shall be witnessed by the Engineer.

Recommissioning checks to be carried out shall be categorised under the following headings:

- (a) Mechanical checks
- (b) Electrical and control checks.

On completion of repair work the Contractor shall recommission the plant and its ancillary equipment. This operation shall be done strictly in accordance with the manufacturer's specification and shall be witnessed by the Engineer. This shall include but not be limited to the following:

- (a) All required recommissioning mechanical checks
  - (i) Check system for leaks;
  - (ii) Check rotation of all fans;
  - (iii) Check mountings of all equipment.
- (b) All required recommissioning electrical and control checks
  - (i) Check all wiring connections for tightness and repair any hot connections.
  - (ii) Check that all electrical equipment have been properly reconnected in accordance with the manufacturer's specification.
  - (iii) Perform and record all required electrical insulation tests on equipment.
  - (iv) Check and test all controls with main circuits isolated.
  - (v) Check all motor-driven equipment for correct rotational directions.
  - (vi) Check and test the operation of all indication and warning lights.
  - (vii) Check, set, record and readjust all equipment control and set points in accordance with manufacturer's specification.
  - (viii) Run all motor-driven equipment for a period to ensure free movement and correct operation, feed pumps only to be operated for a short interval to check rotation.

**FD 08.03      COMMISSIONING AND COMPLETION OF REPAIRS**

On completion of the recommissioning checks the Contractor shall proceed with the commissioning. This operation shall be done strictly in accordance with Clause SC 11.02 of Additional Specification SC: General Decommissioning, Testing and Commissioning Procedures. This operation shall also be carried out in accordance with the manufacturer's specification and shall include but not be limited to the following for the different types of equipment:

**FD 08.03.01      Self-contained air-conditioning unit**

- (a) Check evaporator and condenser pressures and superheat.
- (b) If the unit needs charging, find leak, decant, repair leak and recharge unit.
- (c) Check fans, fan speed control and fan motors.
- (d) Check entering and leaving air temperatures over evaporator coil.



- (e) Check operation of all safeties:
  - (i) LP cut-out pressure
  - (ii) HP cut-out pressure
  - (iii) Low on-coil thermostat
  - (iv) Set point of oil pressure safety
  - (v) Oil pressure trip.
- (f) Check anti-recycle timer.
- (g) Check all running amps of fans and compressors.
- (h) Check compressor unloading mechanism if applicable.
- (i) Complete commissioning data sheet.

#### **FD 09      GUARANTEE OF INSTALLATION AND EQUIPMENT**

The Contractor shall provide and obtain guarantees from the manufacturer(s) and/or supplier(s) to the effect that each piece of new equipment, supplied and installed under the repair contract, will comply with the required performance and will function as part of the complete system.

All new equipment, including the complete new installations and the systems as a whole, shall be guaranteed for a period of 12 (twelve) months commencing on the day of issue of a certificate of completion for repair work of the installation.

#### **FD 10      REPAIR WORK TO INSTALLATION SYSTEMS AND EQUIPMENT**

##### **FD 10.01      GENERAL**

At the start of the repair and maintenance contract all the systems, installations and equipment shall be repaired as specified in the Particular Specification. This repair work shall include but not be limited to the specified Particular Specification details.

All repair work shall be executed using approved materials and equipment suitable to the systems and/or installations they serve. The said repair work shall be executed in accordance with the relevant codes of practice, standard, regulations, municipal laws and by-laws, manufacturer's specifications and codes of practice and all additional and particular specifications included in this document.

The repair work items shall be listed in tabular form in the Particular Specification with all relevant details, such as capacity, size, manufacturer, model number, etc.

All repair work shall be executed within the approved period for repairs to be agreed at the start of the Contract period. All new equipment, materials and systems shall be furnished with a written guarantee of a defects liability period of 12 months from date of issue of a certificate for completion of the repair work. These guarantees shall be furnished in favour of the Department of Public Works. On completion of the required and specified repair work the systems, installations and equipment shall be commissioned and handed over to the satisfaction of the Engineer.

Repair work items shall be categorised for the following installations:

- (a) Self-contained air-conditioning units.

**FD 10.02      SELF-CONTAINED AIR-CONDITIONING UNITS**

- (a) Clean air intake screen.
- (b) Replace filters.
- (c) De-rust, neutralise and touch up paintwork.
- (d) Replace canvas collars.
- (e) Clean housing, ensure all panels are properly secured and door panels close properly.
- (f) Check setting and operation of all pressure switches, reset if required.
- (g) Check setting and operation of all safety switches, ie LP and HP switches, oil pressure switch.
- (h) Check setting and operation of thermostats.
- (i) Check timers and reset if required.
- (j) Check operation of seven-day timer.
- (k) Check running current of fans and compressor and settings and operation of overloads.
- (l) Check tightness of all electrical terminals.
- (m) Ensure operation of local and remote isolators.
- (n) Check condition of all cables and whether cables are neatly strapped and reposition and strap if required.
- (o) Ensure correct operation of emergency stop.
- (p) Carry out a leak test on all refrigeration piping and components inclusive of evaporator and condenser.
- (q) All leaks shall be repaired. Should a leak on a component be of such a nature that it cannot be repaired, the component shall be replaced. The procedure to follow is as set out in FD 03.
- (r) The superheat setting of the thermostatic expansion valve shall be checked and adjusted if required (setting approximately 8 °C).
- (s) The filter dryer shall be replaced.
- (t) Check compressor vibration mounts.
- (u) Test oil acidity.
- (v) Check refrigerant charge sight glass being clear or flashing.
- (w) Check moisture indication being dry.
- (x) Clean condensate tray and test drainage operation.
- (y) Clean evaporator and condenser blades and check unbalance.
- (z) Replace suction line insulation.
- (aa) Check all service valves for full operation, replace caps if missing.

**FD 11      MAINTENANCE TO INSTALATION AND EQUIPMENT****FD 11.01      GENERAL**

Monthly maintenance responsibilities for each installation including all units and components as specified, shall commence with commencement of the Contract. A difference shall be made in payment for the maintenance prior to and after practical completion of repair work.

Maintenance responsibilities of the completed installation shall commence upon the issue of a certificate of practical completion for repair work, and shall continue for the remainder of the 36-month contract period.

This part of the Contract shall include:

- (a) Routine preventative maintenance;
- (b) Corrective maintenance; and
- (c) Breakdown maintenance;
- (d) Cleaning of filters,

as defined in Additional Specification SA: General Maintenance, for the specified installations described under FD 01 of this specification.

The maintenance work to be performed and executed shall be done strictly in accordance with Additional Specification SA: General Maintenance, and as specified in Particular Specification PFD and this specification.

The said maintenance work shall be executed in accordance with the relevant codes of practice, statutory regulations, standards, regulations, municipal laws and by-laws and the manufacturers' specifications and codes of practice.

The maintenance schedules and frequency shall be developed under the maintenance control plan to be instituted by the Contractor, as specified in Additional Specification SA: General Maintenance.

All new equipment, components and materials supplied and installed under the maintenance contract shall be furnished with prescribed manufacturer's guarantees.

The maintenance work and items are to be categorized by the Contractor for each maintenance activity under the following headings:

- (a) Self-contained air-conditioning units.

The Contractor shall be remunerated monthly, based on his performance, for maintaining the complete installation in a perfect functional condition.

**FD 11.02      DEFINITION AND QUALIFICATION OF ACTIONS**

**FD 11.02.01    Daily maintenance actions**

Daily actions are the responsibility of the User Client. These checks are to be performed by staff responsible of the facility. The self-contained air-conditioning units and ventilation systems should run during working hours and/or continuously. The status of these systems can thus be monitored by observation on a daily routine.

- (a) Self-contained air-conditioning units:

- Does the unit perform and maintain temperature?
- Is the temperature in the areas concerned satisfactory?
- Is the condensate drain working properly?

These daily checks shall be logged at the facility, ie by the kitchen manager and the maintenance personnel.

**FD 11.02.02    Monthly maintenance actions**

TABLE FD 11.02.02/1: SELF-CONTAINED AIR-CONDITIONING UNIT

REFERENCE NUMBER	ACTION
S-1	Clean filters, replace if required
S-2	Inspect air intake and discharge for blockages
S-3	Check all refrigerant, drainage pipes for damaged and leaks
S-4	Check sightglass: clear or flash gas
S-5	Carry out visual inspection of condenser coil for blockages and correct operation of fans
S-6	Carry out visual inspection of evaporator coil for blockages and correct operation of supply fan
S-7	Check enclosure for damages
S-8	Check electric motor running temperatures
S-9	Check electric connections for tightness

S-10	Test thermostat and control operation
S-11	Clean condensate tray and test drainage for proper operation
S-12	Check cooling and heating cycle

Note: The monthly actions shall include the activities of the daily maintenance actions.

**FD 11.02.03 Biannual maintenance actions**

**TABLE FD 11.02.03/1: SELF-CONTAINED AIR-CONDITIONING UNITS**

REFERENCE NUMBER	ACTION
S-1	Clean filters, replace if required
S-2	Inspect air intake and discharge for blockages
S-3	Check all refrigerant, drainage pipes for damages and leaks
S-4	Check sight-glass: clear or flash gas
S-5	Carry out visual inspection of condenser coil for blockages and correct operation of fans
S-6	Carry out visual inspection of evaporator coil for blockages and correct operation of supply fan
S-7	Check enclosure for damages
S-8	Check electric motor running temperatures
S-9	Check electric connections for tightness
S-10	Test thermostat and control operation
S-11	Clean condensate tray and test drainage for proper operation
S-12	Check filter/dryer
S-13	Check superheat and functioning of expansion valve
S-14	Check operation of HP and LP switch
S-15	Check operation of controllers
S-16	De-rust, neutralize and touch up paint work
S-17	Check cooling and heating cycle
S-18	Clean evaporator and condenser coil chemically
S-19	Clean all filter frames and seals
S-20	Check fan motor and compressor current
S-21	Check and test overload settings
S-22	Lubricate all bearings

Note: The above biannual actions include the activities of the monthly maintenance actions.

**TECHNICAL SPECIFICATION**

**HB STANDBY POWER SYSTEMS**

**CONTENTS**

HB 01	SCOPE
HB 02	STANDARD SPECIFICATIONS, REGULATIONS, CODES AND ADDITIONAL SPECIFICATIONS
HB 03	OPERATING AND MAINTENANCE MANUALS
HB 04	TEST AND INSPECTION FOLLOWING COMPLETION OF REPAIR WORK
HB 05	LOGGING AND RECORDING PROCEDURES
HB 06	MAINTENANCE TOOLS AND SPARES
HB 07	QUALITY ASSURANCE SYSTEM
HB 08	RE-COMMISSIONING OF INSTALLATION
HB 09	REPAIR WORK TO INSTALLATIONS
HB 10	DIESEL GENERATORS : TECHNICAL DETAILS
HB 11	MAINTENANCE OF STANDBY POWER INSTALLATIONS

**HB 01 SCOPE**

**HB 01.01** This specification comprises all aspects regarding the maintenance and servicing of standby power systems. The standby power sources consist of:

- a) Kosi bay land of entry
- i) One 60 kVA diesel generator Kosi Bay Port of Entry
- ii) One 15 kVA UPS unit at Kosi Bay Port of Entry

**HB 01.02** This specification shall form an integral part of the maintenance and servicing contract document and shall be read in conjunction with Portion 3, the Additional Specifications included with this document.

**HB 02 STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

**HB 02.01** The latest edition, including all amendments up to date of tender of the following specifications, publication and codes of practice shall be read in conjunction with this specification and shall deemed to form part thereof.

**HB 02.02 SANS Specifications**

02.02.01 SANS 10400 : NATIONAL BUILDING REGULATIONS  
 02.02.02 SANS 10142 : WIRING CODE

**HB 02.03 Department of Public Works Specification PW 774**

**HB 02.04 Occupational Health and Safety Act of 1993**

All regulations and statutory requirements as laid down in the latest edition of the Occupational Health and Safety Act of 1993: Construction Regulations, 2003 as promulgated in Government Gazette No 25207 and Regulation Gazette No 7721 of 18 July 2003 shall be adhered to.

**HB 02.05**      **Manufacturer's specifications and maintenance instructions**

**HB 02.06**      **Additional requirements**

Equipment and material supplied and installed shall be new and unused.  
The Contractor shall ensure that all safety regulations and measures are applied and enforced during repair and maintenance work on cabling, wiring, fuel tanks, batteries and diesel engines.

**HB 03**      **OPERATING AND MAINTENANCE MANUALS**

**HB 03.01**      The Contractor shall be responsible for the compilation of a complete set of Operating-and-Maintenance manuals.

This shall be done in accordance with the Additional Specification SB – Operating and Maintenance manuals.

All information shall be recorded and reproduced in electronic format as well as supplying the Engineer with seven sets of hard copies.

**HB 03.02**      Over and above what is specified in the Additional Specification – SB Operating and Maintenance manuals, the Operating and Maintenance Manual to be compiled shall be structured and shall at least include the following:

**03.02.01**      **Description of installation**

- a) Complete system description of each standby power source. This shall be done for each installation individually. The system description shall contain detailed information regarding the supply configuration (cabling, distribution boards), the switching arrangement (change-over and override facilities) and the refuelling procedure as well as the earthing, fire and lightning protection arrangement.
- b) Service records

**03.02.02**      **Commissioning Data**

- a) Complete commissioning, test and inspection data of standby power system.

This shall be done for each installation individually. The commissioning data will comprise voltage and output current measurements, running hour meter readings, battery voltage during starting and engine compression tests.

**03.02.03**      **Operating Data**

- a) Safety precautions to be implemented.
- b) Operation of systems; automatic, manual and bypass switching.
- c) Emergency starting and forced change-over procedure.

**03.02.04**      **Maintenance Documentation**

- a) Recommended service intervals with service descriptions.
- b) Projected service life of:
  - diesel engine to next overhaul
  - diesel engine starter batteries
  - electronics on UPS units
  - battery pack
- c) Trouble shooting diagrams.
- d) Schedule of consumable spares.
- e) Schedule of batteries comprising the battery bank.

**HB 04 TEST AND INSPECTIONS PRIOR TO PRACTICAL COMPLETION OF REPAIR WORK**

**HB 04.01** It is the responsibility of the Contractor to provide all labour, accessories and properly calibrated and certified measuring instruments necessary to record the following parameters:

- 04.01.01 output phase voltages
- 04.01.02 output current per phase
- 04.01.03 insulation testing at 500V
- 04.01.04 system earthing resistance testing by means of wheatstone bridge instrument
- 04.01.05 load testing, utilising dummy loads

The Contractor is responsible for the arrangement of such tests. He shall give at least 72 hours notice to the Engineer prior to the test date.

**HB 05 LOGGING AND RECORDING PROCEDURES**

**HB 05.01** The Contractor shall as part of this Contract institute a Recording system as part of his Maintenance Control Plan as defined in the Additional Specification SA – General Maintenance. This shall consist of a Record book which shall be utilised to log and record all faults, system checks, services, overhauls, breakdowns, maintenance visits, inspections, etc.

**HB 05.02** The logbook shall be stored in a safe place inside each generator room and shall only be utilised by the Contractor and Engineer. A copy of the monthly entries and recordings into this logbook shall be submitted by the Contractor together with his monthly report to the Engineer.

This logbook shall be structured to at least include the following:

- 05.02.01 Monthly inspection and maintenance actions.
- 05.02.02 Scheduled services.
- 05.02.03 Breakdown / call out reports.
- 05.02.04 Major overhaul or battery replacements.

**HB 06 MAINTENANCE TOOLS AND SPARES**

**HB 06.01** On commencement of the Repair and Maintenance Contract, the Contractor shall supply and deliver certain tools and spares to the user client. These tools and spares will be the property of the Department of Public Works. Any deficiencies or short fall or damaged Tools and Spares during the contract shall be replaced with new equipment / material.

**HB 06.02** The Tools and Spares shall be kept safe in a lockable store room on site. The Contractor shall provide his own lock for the designated store room. The inventory of the Tools and Spares shall be verified on a monthly basis. Any short fall shall be replaced by the Contractor as part of his responsibility under this contract.

**HB 06.03** The Tools and Spares shall at least include the following:  
 Distribution Board key (3 off)  
 Distribution Board face plate square key (3 off)  
 20L HD diesel oil as per engine manufacturer's specification  
 220V diesel jockey pump  
 5m 20mm Ø diesel hose  
 10mm<sup>2</sup> battery jumper cables : 1 pair  
 First Aid Kit  
 Industrial type wall mounted (aluminium) paper towel dispenser with paper cartridge per generator room similar or equal to "Kimberley Clark MP Wall Stand"

**HB 07 QUALITY ASSURANCE SYSTEM**

- HB 07.01** Following formal approval of his Quality Assurance system by the Engineer to the Contractor shall implement the approved Quality Assurance system.
- HB 07.02** Records of this Quality Assurance system shall be kept throughout the duration of the contract and shall be submitted to the Engineer as required by the Department.

**HB 08 RE-COMMISSIONING OF INSTALLATION**

On practical completion of the repair work, battery replacement and services, the installations shall be put into operation.

**HB 09 REPAIR WORK TO STANDBY POWER INSTALLATIONS**

- HB 09.01** The various systems shall be repaired during the first phase of the repair and maintenance contract.
- HB 09.02** The scope of the repair work shall include, but shall not be limited to the activities listed below.
- HB 09.03** The Contractor shall record the repair actions in tabular format before the Contractor's responsibility for maintenance commences.
- HB 09.04** Repair work shall be executed within the approved period for repairs.
- HB 09.05** New equipment and material (eg. batteries, fuel pumps, starter motor, etc shall be supplied with a written guarantee confirming a defects liability period of 12 months from date of practical completion. These guarantees shall be furnished in favour of the Department of Public Works.

**HB 10 STANDBY GENERATORS : TECHNICAL DETAILS**

**HB 10.01 Installation description**

ITEM No.	Locality	Engine Description	Alternator Description	Output kVA	Auto/ Manual/ Switching	Operational Yes/No	Approx year of installation	Critical load	Last service
1	Kosi Bay Port of Entry Mini Sub 1	John Deere CD4036B030661	Marathon electric	57	Auto	Yes	2007	Offices and Security lights	2010

**HB 10.02 Scope of repair work : Generators**

**HB 10.02.01 Service diesel engine and steam clean engine, alternator as well as day tank.**

Inspect all rubber hoses and wiring; replace if required.

Service existing battery.

Do cold starting volt drop test on prime mover starter battery; replace starter battery if required.

Clean sliprings and inspect brushgear. Open alternator terminal box, clean and tighten terminations. Check and record earthing value as measured with resistance measuring instrument.

Service alarm and control panel and clean internally and externally. Simulate and verify all alarm and shut down conditions. Replace all inoperative lamps, sirens and meters. Check and complete all labelling and notices.



## HB.5

Repair lagging on exhaust system.

Reinstate fuel shut off system with fusible link.

Fit new padlocks on enclosure.

Supply and install a fuel/water separator with automatic water dump feature in the fuel line from the tank to the generator. The separator shall be manufactured from robust corrosion resistant material and shall be similar or equal to Duvalco MK3 series.

Supply and install a fuel modular filtration with automatic water dump feature at the bulk fuel tank. The fuel modular filtration shall be manufactured from robust corrosion resistant material and shall be similar or equal to Duvalco FMS series.

**HB 10.02.02** Do witnessed dummy load test.

**HB 10.02.03** Service change-over switchgear. Disassemble contactors and clean. Test operation following service.

**HB 10.02.04** Add an 12/24 V DC fluorescent emergency light, with switch above the control panel door of each generator installation. The light shall be energised via a push button switch with adjustable run down timer (0 – 120 minutes)

**HB 10.03** **Generator repair work : measurement and payment**

**HB 10.03.01** **Repair plant room**

The unit of measurement shall be the number of plant room cleaned and painted.

The tendered rate shall include full compensation for the repair of Floors that shall be washed (Steam cleaned) and painted with grey 2-part industrial self levelling epoxy paint.

Cable trenches shall be cleaned and finally vacuumed. All cable sleeves shall be sealed with builders foam and chicken wire.

**HB 10.03.02** **Service genset**

The unit of measurement shall be the number of services performed on alternators in the 20kW up to 250kW range

The tendered rate shall include full compensation for the complete mechanical/electrical service of the generator installation according to the manufacturer's instructions, replacement of wiring, opening and cleaning of alternator and alarm panel as well as the steam cleaning of the assembly as described in Clause HB 10.02.

**HB 10.03.03** **Diesel engine service**

The unit of measurement shall be the number of mechanical services performed on diesel engines in the 20kW up to 250kW range.

The tendered rate shall include full compensation for the execution of a full engine service as per the manufacturer's recommendations including air, fuel and oil filters, oil, replacement of wiring, V-belts and hoses as needed and other consumable items as described in Clause HB 10.02 and the steam cleaning of the assembly.

The tendered rate shall further include for the supply and installation of a fuel shut off system with fusible link including all consumables such as pipes, cables, fittings and taps.

**HB 10.03.04 Replace starter battery**

The unit of measurement shall be the number of diesel starter batteries replaced.

The tendered rate shall include full compensation for the removal of the existing battery, the installation and reconnection of a new "Deltec Heavy-Duty Freedom"-type battery and final test of start up volt drop.

**HB 10.03.05 Dummy load test**

The unit of measurement shall be the number of on-site dummy load tests performed.

The tendered rate shall include full compensation for the opening of the alternator terminal box, connection of dummy load, 30 minute full load test, recording of test results and disconnection of load and reconnection of site load.

**HB 10.03.06 Change-over switchgear service**

The unit of measurement shall be the number of assemblies serviced.

The tendered rate shall include full compensation for the disassembly of the change-over contractor pair, cleaning and reinstallation as well as the testing following completion of the test.

Service alarm and control panel and clean internally and externally. Simulate and verify all alarm and shut down conditions. Replace all inoperative lamps, sirens and meters. Check and complete all labelling and notices.

**HB 10.03.07 Supply and install padlocks**

The unit of measurement shall be the number of 75mm padlocks installed.

The tendered rate shall include full compensation for the ordering, supply, engraving and installation of the plant room padlocks.

**HB 10.03.08 Supply of diesel fuel**

The unit of measurement shall be the quantity of diesel fuel supplied and transferred into day tanks upon instruction from the Engineer.

The tendered rate shall include full compensation for the supply, transport and transfer of diesel fuel.

**HB 10.03.09 Supply of Tools and Spares**

The unit of measurement shall be a lump sum. The tendered rate shall include full compensation for the supply and delivery of the Tools and Spares specified.

**HB 10.03.10 Repair alarm sounder**

The unit of measurement shall be the number of alarm / flasher units installed. The tender rate shall include full compensation for the repair of the panel mounted alarm and circuit and the supply and installation of the specified external alarm/flasher unit, in full working order including all cabling to and from the Control panel.

**HB 10.03.11 Add 12/24V DC emergency light.**

The unit of measurement shall be the number of lights installed. The tender rate shall include full compensation for the supply and installation of all materials, brackets and fixings for the specified emergency light in full working order above the Control panel.

**HB 10.03.12 Supply and install fuel water separator**

The unit of measurement shall be the number of fuel/water separator units with automatic water dump installed.

The tendered rate shall include full compensation for the ordering, supply, installation and commissioning of the fuel/water separator unit similar or equal to Duvalco MK 3 series or Duvalco Modular Filtration System.

**HB 10.03.13 Supply and install a fuel drip tray**

The unit of measurement shall be the number of fuel drip trays supplied and installed.

The tendered rate shall include full compensation for the manufacturing, supply and installation of a fuel drip tray as described in Clause HB 10.03

**HB 10.03.14 Supply and install water jacket heater**

The unit of measurement shall be the number of water jacket heaters supplied and installed.

The tendered rate shall include full compensation for the installation of a water heater complete with a thermostat, element connection of all water hoses including all couplings and taps, cabling to and from the control panel and testing and commissioning of the unit

**HB 10.03.15 Repair Exhaust**

The unit of measurement shall be a sum for the removal of the existing exhaust and the supply and installation of the new exhaust similar to the existing.

The tendered rate shall include full compensation for the supply and installation of the new exhaust including, lagging, flexible connections and sealing of the room exit port.

**HB 10.03.16 Re-condition Diesel Engine**

The unit of measurement shall be the number of diesel engines re-conditioned according to the manufacturer's specifications.

The tendered rate shall include full compensation for the disconnection, removal and complete overhaul of the diesel engine at an approved mechanical engineering works.

The tender rate shall further include for the replacement of all the internal components, seals, pipes, fittings etc of the diesel engine.

**HB 11 MAINTENANCE OF THE INSTALLATION**

**HB 11.01** Monthly maintenance responsibilities for each installation including all units and components as specified, shall commence with access to the site. A difference shall be made in payment for the maintenance prior to and after practical completion of repair work.

Maintenance responsibilities of the completed installation shall commence upon the issue of a certificate of practical completion for repair work, and shall continue for the remainder of the 36-month contract period.

**HB 11.02** The following maintenance actions will be required under the contract:

- 11.02.01** Routine Preventative Maintenance
- 11.02.02** Corrective Maintenance
- 11.02.03** Breakdown Maintenance

These actions are defined in the Additional Specification SA – General Maintenance.

**HB 11.03** The maintenance schedules and frequency of services and maintenance activities shall be developed under the maintenance control plan which will be instituted by the Contractor. The Contractor's responsibility in this regard is specified in the Additional Specification SA – General Maintenance.

**HB 11.04** Generator maintenance : scope of work.

**HB 11.04.01** Monthly inspection

(a) The following activities shall be executed during the monthly generator inspections:

- check oil level and top up as required.
- check oil viscosity for dilution by water or fuel.
- check starter battery terminals and apply contact grease.
- check battery cables for damage and secure terminations.
- check battery electrolyte.
- check battery voltage and record.
- check battery voltage drop during engine cranking and record.
- check battery charger operation after cranking test.
- check starter motor for abnormal noise.
- check diesel engine while running for noise, vibration or loose components.
- check all flexible hoses for leaks, corrosion and ageing.
- check all engine V-belts.
- monitor engine / alternator coupling for noise.

(b) Verify that alarm functions are operational by simulation:

- low oil pressure.
- high engine temperature.
- low engine coolant level.
- abnormal speed.
- synchronising failure (if applicable)
- cooling water pump failure.
- cooling tower fan failure (if applicable).
- low battery voltage.
- low fuel day tank.
- fuel pump failure.
- low fuel bulk tank (if applicable).

(c) Test that following alarms trigger correctly by creating the alarm condition:

- |   |                          |   |   |
|---|--------------------------|---|---|
| - | Unit not in auto         | : | turn selector switch to manual or test  |
| - | Battery charger failure  | : | switch off AC supply to battery charger |
| - | Auxiliary supply failure | : | switch off auxiliary power supply       |

(d) Alternator shall be checked for accumulation of dust on the regulator and for any loose components.

(e) Test run shall be undertaken, if possible on load, and volt, ampere and frequency readings recorded.

(f) Alternator shall be cleaned and switched back into 'auto' mode.

(g) Complete Standby Generator monthly log sheets

(h) Record running hours, diesel consumption etc.

**HB 11.04.02** Annual or 150 hour service inspection

The following activities shall be executed in addition to the monthly maintenance work after every twelve months.

## HB.9

- (a) Drain an oil sample and submit for analysis to establish need for an oil change. Fix test report in Record book.
- (b) Record output parameters while on load.
- (c) Record running hours.
- (d) Replace oil and fuel filters.

### **HB 11.04.03 Every two years : inspection and service**

In addition to the annual service, the cooling system shall be drained, flushed and refilled with water and prescribed water conditioner.

### **HB 11.05 Generator maintenance : measurement and payment**

Refer to Clause SA 06 of the ADDITIONAL SPECIFICATION : SA GENERAL MAINTENANCE.

**TECHNICAL SPECIFICATION**

**HC LOW VOLTAGE RETICULATION**

**CONTENTS**

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HC 11	LOW VOLTAGE DISTRIBUTION BOARDS : TECHNICAL DETAILS
HC 12	LOW VOLTAGE DISTRIBUTION KIOSKS : TECHNICAL DETAILS
HC 13	LOW VOLTAGE OVERHEAD DISTRIBUTION SYSTEM : TECHNICAL DETAILS

**HC 01 SCOPE**

- HC 01.01** This specification comprises all aspects regarding the maintenance of low voltage systems. Low voltage comprises :
- ◆ low voltage distribution boards
  - ◆ low voltage kiosks
- HC 01.02** This specification shall form an integral part of the maintenance contract document and shall be read in conjunction with Part C, the Additional Specification included with this document.

**HC 02 STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

**HC 02.01** The latest edition, including all amendments up to date of tender of the following specifications, publication and codes of practice shall be read in conjunction with the specification and shall be deemed to form part thereof.

**HC 02.02** **SANS Specifications**

- ◆ SANS 10142-1
- ◆ SANS 10142-2
- ◆ SANS 141
- ◆ SANS 1091
- ◆ SANS 763
- ◆ SANS 1195
- ◆ SANS 784

**HC 02.03** **Department of Public Works Specifications**

- ◆ PW 774

**HC 02.04**                    **Occupational Health and Safety Act of 1993 (OHS-Act)**

**HC 02.05**                    **Manufacturer's specifications and maintenance instructions**

**HC 02.06**                    **Additional requirements**

Equipment and material installed shall be new and unused.  
All equipment shall bear the SANS stamp. The Contractor shall ensure that all safety regulations and measures are applied and enforced during repair and maintenance work on low voltage distribution boards and kiosks.

**HC 03**                        **AS-BUILT INFORMATION AND OPERATING AND MAINTENANCE MANUALS**

**HC 03.01**                    **No current as built information on the installation is available.**

The Contractor shall, be responsible for the compilation of a complete set of as-built drawings, inventory list and Operating- and -Maintenance manuals. The Contractor shall be responsible for the verification of the correctness of all such information.

This shall be done in accordance with the Additional Specification SB-Operating and Maintenance manuals.

The Contractor shall allow for the required tools and equipment to establish the correct as-built information.

All information shall be recorded and reproduced in electronic format as well as supplying the Engineer with three sets of hard copies.

**HC 03.02**                    Over and above what is specified in the Additional Specification - SB Operating and Maintenance manuals, the Operating and Maintenance Manual to be compiled shall be strured and shall at least include the following :

◆    **System Description**

- Complete system description of the low voltage system. This shall be done for each low voltage installation individually. The system description shall contain detailed information regarding the system configuration (system input, cabling system output), the installed components (circuit breaker ratings, meter configuration) as well as the earthing and lightning protection.
- Complete details of L.V distribution boards, panels and kiosks and overhead reticulation system.

◆    **Commissioning Data**

- Complete commissioning, test and inspection data of the low voltage system.

This shall be done for each low voltage system individually. The commissioning data will comprise of usual inspection sheets startup and running current measurements. Full data on equipment fitted with installation dates.

◆    **Operating data**

- Safety precautions to be implemented.

- ◆ Maintenance instructions
  - Procedure to verify operation of circuit breakers.
  - Procedure to replace low voltage kiosk.
  - Trouble shooting diagram.
  - Equipment details, including manufacturer brochures / pamphlets, order number, list of components and equipment specifications.
  - Schedule of serviceable components per low voltage system.
  - Procedure to replace wooden poles for overhead reticulation
  - Procedure to replace broken isolators for overhead reticulation
  - Procedure to tension overhead conductors by adjustment of anchors.
  - Hoisting equipment specification, if applicable.

**HC 04 TEST AND INSPECTION FOLLOWING COMPLETION OF REPAIR WORK**

**HC 04.01** It is the responsibility of the Contractor to provide all labour, accessories and properly calibrated and certified measuring instruments necessary to record the following parameters :

- Phase voltages and current
- Earthing resistance testing

The Contractor is responsible for the arrangement of such tests. He shall give at least 72 hours notice to the Engineer prior to the test date.

**HC 05 LOGGING AND RECORDING PROCEDURES**

**HC 05.01** The Contractor shall as part of this Contract institute a Recording system as part of his Maintenance Control Plan as defined in the Additional Specification SA - General Maintenance. This shall consist of a Record book which shall be utilized to log and record all faults, system checks, services, overhauls, breakdowns, maintenance visits, inspections, etc.

**HC 05.02** The logbook shall be stored in a safe place inside the main substation and shall only be utilized by the Contractor and the Engineer. A copy of the monthly entries and recordings into this logbook shall be submitted by the Contractor together with his monthly report to the Engineer.

This logbook shall be structured to at least include the following :

- Monthly low voltage equipment inspection and maintenance actions.
- Bi-annual inspection and testing of low voltage systems.
- Annual earthing and insulation test report.
- Breakdown / call out reports.

**HC 06 MAINTENANCE TOOLS AND SPARES**

**HC 06.01** On commencement of the Repair and Maintenance Contract, the Contractor shall compile an inventory of the existing Tools and Spares in the presence of the User Client. Any deficiencies or short fall or damaged Tools and Spares shall be replaced with new equipment / material, as part of the contract.

**HC 06.02** The Tools and Spares shall be kept in a lockable store room on site. The Contractor shall provide his own lock for the designated store room. The inventory of the Tools and Spares shall be verified on a monthly basis. Any short fall shall be replaced by the Contractor as part of his responsibility under this contract.



**HC 06.03            The Tools and Spares shall at least include the following :**

DB Key  
DB face plate square key.

**HC 07                    QUALITY ASSURANCE SYSTEM**

**HC 07.01**            Following formal approval of his Quality Assurance system by the Engineer, the Contractor shall implement the approved QA system.

**HC 07.02**            Records of this QA system shall be kept throughout the duration of the contract and shall be submitted to the Engineer as required.

**HC 08                    RE-COMMISSIONING OF INSTALLATION**

On completion of the repair work, the low voltage reticulation shall be put into operation.

**HC 09                    REPAIR WORK TO LOW VOLTAGE RETICULATION**

**HC 09.01**            The distribution boards, kiosks and overhead reticulation system shall be repaired as measured in the bills of quantities, during the first period of the repair and maintenance contract.

**HC 09.02**            The scope of the repair work shall include, but shall not be limited to the activities listed below.

**HC 09.03**            The Contractor shall record the repair actions in tabular format before the maintenance phase commences.

**HC 09.04**            Repair work shall be executed within the approved period for repairs. This period shall be agreed at the start of the contract period.

**HC 09.05**            New equipment and material shall be supplied with a written guarantee confirming a defects liability period of 12 months from date of hand-over. These guarantees shall be furnished in favour of the User Client.

**HC 09.06**            The maintenance phase of this contract shall commence once the repair work on the installation have been commissioned and handed over to the satisfaction of the Engineer.

**HC 10                    LOW VOLTAGE RETICULATION MAINTENANCE**

**HC 10.01**            The various low voltage systems shall be maintained following the initial repair work. The maintenance contract shall run for the balance of the 36 month contract period.

**HC 11                    LOW VOLTAGE DISTRIBUTION BOARDS : TECHNICAL DETAILS**

**HC 11.01            Installation description**

This section describes the electrical distribution network that will be repaired and maintained in terms of the contract.

Substations

The low voltage supply is distributed from the low voltage compartment in the miniature substation.

**HC 11.02** Scope of repair work

**HC 11.02.01** General repair work

- Service low voltage distribution boards : clean, secure circuit breakers, secure terminations, label circuit breakers and cables.

**HC 11.03** Repair work: measurement and payment

<u>Item</u>	<u>Unit</u>
(a) Service low voltage distribution boards	No

The unit of measure shall be the number of low voltage boards serviced.

The tendered rate shall include full compensation for the opening and cleaning of low voltage board, vermin protection, secure MCBs and terminations, fitting of engraved labels and blank covers.

**HC 11.04** Scope of Maintenance work

**HC 11.04.01** Monthly inspection

- a) Verify operation of volt and ammeters.
- b) Check that access covers are secure.
- c) Visually check distribution board.
- d) Check all connections.
- e) Check operation of switching timers.

**HC 11.04.02** Annual inspection

- a) Service all low voltage boards.
- b) Measure phase voltages and line currents in low voltage distribution board.
- c) Record values in record book.

**HC 11.05** Maintenance work : measurement and payment

Refer to clause SA 06 of the ADDITIONAL SPECIFICATION : SA GENERAL MAINTENANCE.

**HC 12                      DISTRIBUTION AND METERING KIOSKS : TECHNICAL DETAILS**

**HC 12.01                      Installation description**

This section describes the electrical distribution and metering kiosks that will be repaired and maintained in terms of this contract.

This part of the distribution network consists of freestanding low voltage outdoor kiosks. The kiosks contain circuit breakers, switching and instrumentation equipment.

**HC 12.02                      Scope of repair work**

- 1) Open distribution kiosk, check locks, door hinges, clean inside, provide rodent protection, secure circuit breaker and terminations : label all kiosks, label circuit breakers, label cables and provide warning notices.
- 2) Measure earth resistance.
- 3) Touch up kiosks : Remove all rust with an anti corrosion agent and repaint kiosks.
- 4) Replace handles and padlocks on distribution kiosks.
- 5) Replace door hinges and latches
- 6) Replace panel catches

**HC 12.03                      Repair work : measurement and payments.**

<u>Item</u>	<u>Unit</u>
(a) Service distribution kiosk	No

The unit of measurement shall be the number of distribution kiosks serviced.

The tendered rate shall include full compensation for the servicing of the distribution kiosk, vermin protection, cleaning of circuit breakers, general cleaning of the kiosk, earth testing, securing of MCB and terminations. The contractor shall submit a report on the general condition of the kiosk (damage, rust etc.)

<u>Item</u>	<u>Unit</u>
(b) Remove rust and paint kiosks	No

The unit of measurement shall be the total number of kiosks painted.

The tendered rate shall include full compensation for the removal of rust with a anti corrosion agent and the repainting of the whole kiosk.

<u>Item</u>	<u>Unit</u>
(c) Label kiosks	No.

The unit of measure shall be the total number of kiosks labelled.

The tendered rate shall include full compensation for the labelling of kiosks circuit breakers, cable and the warning notification to be installed.

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<u>Item</u>	<u>Unit</u>
(d) Supply and install padlocks	No.

The unit of measurement shall be the number of padlocks installed.

The tendered rate shall include full compensation for the ordering, supply, engraving and installation of the padlocks, locking devices and seals.

Lock shall be "keyed alike".

<u>Item</u>	<u>Unit</u>
(e) Replace distribution meter and stubby kiosks.	No.

The unit of measurement shall be the number of distribution kiosks replaced.

The tendered rates shall include full compensation for the removal, the ordering, supply and installation of the new meter boxes and stubbies.

<u>Item</u>	<u>Unit</u>
(f) Replace door hinges on meter and distribution kiosks.	No.

The tendered rate shall include full compensation for the removal of damaged hinges, the supply, delivery and installation of new hinges.

<u>Item</u>	<u>Unit</u>
(g) Supply and install handles.	No.

(Perano type lockable turn catch door handle (heavy duty))

The unit of measure shall be the total number of handles installed.

The tendered rate shall include full compensation for the removal of the old handle and ordering, supply and installation of a lockable turn catch handle.

<u>Item</u>	<u>Unit</u>
(h) Supply and install low voltage PVC/SWA/PVC Cu cable and bare copper earth wire.	No.

The unit of measurement shall be the total length of cable supplied and installed.

The tendered rate shall include the ordering and delivery to site of the cable. (Excavations measured somewhere else.)

<u>Item</u>	<u>Unit</u>
(i) Termination of low voltage PVC/SWA/PVC Cu cables.	No.

The unit of measurement shall be the total number of terminations removed and new terminations made. The tendered rate shall include full compensation for the supply and installation of cable glands and lugs.

<u>Item</u>	<u>Unit</u>
(j) Jointing of low voltage PVC/SWA/PVC Cu cable.	No.

The unit of measurement shall be the total number of joints made.

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The tendered rate shall include full compensation for the supply and installation of all material needed to complete the joints.

<u>Item</u>	<u>Unit</u>
(k) Excavations for cable trenches and meter boxes.	m <sup>3</sup>

The unit of measurement shall be the total volume excavated and backfilled in dimensions as specified by the engineer.

<u>Item</u>	<u>Unit</u>
(l) Supply and installation bare copper earth conductor.	meter

The unit of measure shall be the total length of cable supplied and installed. The tendered rate shall include the ordering and delivery to site of the cable (Excavations measured somewhere else).

<u>Item</u>	<u>Unit</u>
(m) Termination of bare copper earth conductor.	No.

The unit of measure shall be the total number of terminations removed and new terminations made.

The tendered rate shall include full compensation for the supply and installation of cable glands and lugs.

<u>Item</u>	<u>Unit</u>
(n) Re-wiring of kiosk.	No

The unit of measure shall be number of kiosks re-wired.

The tendered rate shall include full compensation for removal of the existing wiring, re-wiring, labelling and commissioning of the kiosk.

<u>Item</u>	<u>Unit</u>
(o) Reposition contactors on kiosk.	No

The unit of measure shall be number of contactors repositioned.

The tendered rate shall include full compensation for removal of the existing wiring, removal of contactors, mounting in new positions re-wiring, labelling and commissioning of the kiosk.

<u>Item</u>	<u>Unit</u>
(p) Supply and install front covers.	No

The unit of measure shall be number of covers supplied and installed.

The tendered rate shall include full compensation for measuring, manufacturing painting and installation of front covers.

<u>Item</u>	<u>Unit</u>
(q) Replace distribution meter kiosks.	No.

The unit of measurement shall be the number of distribution kiosks replaced.

## HC.9

The tendered rates shall include full compensation for the removal, the ordering, supply and installation of the new 6/4 way meter boxes complete with watt hour meters, circuit breakers, gland plate, labelling and concrete foot strip as specified. The distribution kiosks shall be similar or equal to Eprotech or Aluex.