

Annexure D: Drawings of Standard Details & Specifications for Drawings

Annexure E: Specifications for Valves and Fire Hydrants

1. General Guidelines for Valves and Chambers

All valves, fittings and chambers shall be constructed in accordance with SANS 1200L and all other relevant specifications referred to in SANS1200, should also be constructed to details as shown in the drawings and also meet the specifications set below:

General

- All valves to be rated either 16 bars or 25 bars working pressure as applicable to the design.
- Valves must be located directly opposite the closest splay corner pegs and intermediate valves opposite the common boundary peg between two erven.

Isolating valves

- Maximum distance between valves to be 600 m on internal reticulation systems and 1.5 km on trunk mains with sufficient scours to drain them.
- All isolating valves shall be painted light blue, except where these are used in hydrants, in which case the colour specified elsewhere in this document shall apply.
- Valves must be provided such that not more than four valves need to be closed in order to isolate a section of a water main.

Scour valves

- In reticulation networks, fire hydrants should preferably be used in place of scour valves and they must be placed such that they perform both functions
- Scour valves to be supplied at low points on network if above is not possible.
- Scour valves to be flanged.
- Sizing of scour valves should be such that a section of pipe can be drained within 2 hours.

Pressure reducing valves

- Pressure gauges to be supplied upstream and downstream of pressure reducing valves.
- Design to be done according to manufacturers specifications.
- Pressure differential upstream and downstream of the valve shall not exceed the ratio of 3 to 1.
- All pressure reducing valves to be installed with a by-pass arrangement with flanged gate valves on either side of the pressure reducing valve.
- Smaller pressure reducing valves to be supplied on the bypass lines to handle smaller flows.
- All valves to be flanged.
- Each pressure reducing valve must be protected by a gate valve on both sides of the valve.
- In-Line filters (strainers) to be supplied before each PRV.
- All pressure reducing valves shall be light blue in colour.
- Refer to drawing number JW100-DET10-W01 for a Typical PRV detail.

Strainers

- In-line strainers to be used in front of any control valve.
- Pressure gauges to be provided upstream and downstream of the filters.
- Filter material to be of stainless steel and capable of handling 2.5 bar over the sieve.
- Generally sieve openings of 5mm can be used.
- Filters must be installed to ensure easy maintenance.
- Sieve to point downwards.

Fire hydrants

- Hydrants to be tamperproof and installed above ground.
- Quick coupling head to be used.
- Hydrant stand pipes to be painted bright yellow on a sink chromate undercoat.
- Should isolating valves be required for hydrants, these shall also be painted in bright yellow.

Water meters

- All water meters to be installed above ground unless in exceptional circumstances or restricted areas where approval has to be sought from JW **Design Manager: CAPEX** or **Senior Manager: Development Control**.

Note: For any inconsistencies between the specifications under this Water Meters section, and the specifications in the Metering Guideline: Annexure B, the specifications above take precedence.

Refer to **Standard Detail Drawing No. JW 100-DET09-W01** for a typical above ground meter installation and Annexure B for Metering Guidelines in detail.

2. Definition on the Different Categories of Water Mains:

- i. **Bulk mains:** classified as main feeders with no take offs other than auxiliary mains. They are either dedicated feeds into reservoirs or main outlet pipes from reservoirs.
Sizes: generally 450 mm diameter and above but could be exceptions where bulk mains are less than 450 mm but by definition, it is a dedicated supply where no take offs will be permitted other than auxiliary mains.
- ii. **Auxiliary mains:** These are feeders teeing off bulk mains for the purpose of supplying reticulation mains. Generally no house/erf connections tee off auxiliary mains.
Sizes: generally 200 mm diameter – 400 mm diameter.
- iii. **Reticulation mains:** These mains are for supplying individual erven in townships and are fed via auxiliary mains.

Normal Sizes: 110 mm – 160 mm, however sizes greater than 160mm will be considered under exceptional situations.
- iv. **Erf connections:** are connections from reticulation mains to supply individual erven.

3. Requirements for bypass valves:

All isolating valves equal to or greater than 400 mm and where pressures exceed 900 Kpa should have bypass valves.

Sizing of bypass valves:

No built in bypass valves shall be permitted on the valve itself and only permitted on the pipe work. **Generally** for valves greater than 400 mm and up to and including 900 mm, 100 mm bypass can be used, for excessive lengths of mains a 150 mm bypass can be used provided the line has sufficient air valves on it. However, the appropriate size of the bypass must be designed to suit.

4. Sizing of air valves:

As a rule of thumb, the ratio of the water main to the air valve size is 5:1, however the recommended minimum air valve size is 100mm.

5. Types of Valves and Application

- i. **Wedge type gate valves:** Shall be used for and valves from sizes 200 mm and above and the valves must be as per SANS 664. (All valves greater than and equal to 300 mm should be geared).
- ii. **Resilient seal gate valves:** for valves sizes up to and including 150 mm;
- iii. **Air release valves:** single chamber, double orifice with integral anti-shock device.
- iv. **Hytrol valves:** can be piped as PRV's, pressure sustaining valves, level control valves, flow control valves etc. Other designs must be pre-approved;
- v. **Butterfly valves:** may be used in restricted areas upon approval by **Senior Manager: Development Control/Design Manager CAPEX**. Strictly not allowed in the reticulation.
- vi. **Reflux valves:** non-return valves must be approved by **Senior Manager Development Control/Design Manager CAPEX**.

Types used:

Weighted type: used essentially in pump stations and on reservoirs and in town installations;

Double-door dampered type: used on pumping mains;

- vii. Above ground hydrants: All new installations to be above ground. Underground hydrants only to be used if approved by **Senior Manager: Development Control/Design Manager: CAPEX**.

6. Chambers and Valve Boxes:

6.1 Definitions

Valve boxes: These are boxes which are built using pre-cast concrete forms placed on a screed which is at the level of just under the gland box, thus forming a valve box where maintenance can be carried out in situ on the valve glands.

Chambers: These are **designed by the Engineer to suit site conditions**, purpose and with provision for access and should be approved by the **Senior Manager: Development Control/Design Manager: CAPEX**.

Generally:

- a) All valves on reservoir sites must be in a chamber built from floor level at least 500 mm below the base of the valve.
- b) Any valve with a by-pass valve must be incorporated into a chamber built from floor level at least 500 mm below the base of the valve.

- c) The first auxiliary valve coming off a bulk main must be in a chamber built from floor level at least 500 mm below the base of the valve. Pressure points must be provided in the chamber both upstream and downstream (no pressure points on the bulk main).
- d) Generally all valves greater than 400 mm must be incorporated in a chamber (irrespective of whether there is a bypass or not).
- e) Valves smaller than 400 mm may be incorporated in a purpose-designed chamber in exceptional situations and approval should be granted by the **Senior Manager: Development Control/Design Manager: CAPEX**
- f) All valves associated with meters/strainers/air valves/PRV's etc must be incorporated in a purpose designed chamber. All stand-alone air valves must also be incorporated in purpose designed chambers.

Refer to standard drawing JW 100-DET03-W01 for a typical valve box.

TECHNICAL SPECIFICATIONS FOR VALVES AND HYDRANTS

- SCOPE** 1.1 This specification covers the requirements for the following waterworks valves that are intended for urban water supply applications at a working pressure up to 1600 kPa or 2500KPa where applicable.
- VALVE TYPES**
- 2.1 Spheroidal Graphite grade 42 wedge-type gate valves for vertical operation, of nominal sizes from 200mm to 900mm, non-rising spindle; double flanged (flat faced fully machined) manually operated with multi-stage open spur geared drives for sizes 300mm and upwards with the ratio of the gear drives being 4:1 for valves 300mm up to and including 400mm and 6:1 for valves 450mm up to and including 900mm.
- 2.2 Spheroidal Graphite grade 42 wedge-type gate valves for horizontal operation of nominal sizes from 400mm to 600mm, double flanged (flat faced fully machined), non-rising spindle, manually operated with a 90° angle drive bevel gear drives on all sizes, the ratio of the gear drives being 4:1 for valves 400mm and 6:1 for valves 450mm up to and including 600mm.
- 2.3 Spheroidal Graphite grade 42 resilient seal gate valves, of nominal sizes from 80mm to 150mm, double flanged, non-rising spindle, manually operated.
- 2.4 Single chamber (double orifice) with an integral anti-shock device, air release valves of nominal sizes from 025mm to 150mm.
- 2.5 Hytrol valve main body from cast steel to BS 1452 Grade 260.
- 2.6 Carbon steel to BS 5155 double flanged offset wafer type butterfly valves, manually operated of nominal sizes from 200mm to 900mm.
- 2.7 Spheroidal Graphite grade 42 Under-ground Fire Hydrants.
- 2.8 Spheroidal Graphite grade 42 Above-ground Tamperproof Hydrant.
- INSPECTION AND TESTING** 3.1 Any inspection or test at the manufacturer's works will not exempt the Supplier from any obligation under this specification.

- 3.2 Each valve must be inspected and tested in accordance with the relevant SANS specification test procedures by Johannesburg Water's Materials Officer at the manufacturer's works before coating. The manufacturer must provide all test facilities.
- 3.3 The Johannesburg Water's Materials Inspector must be advised at least 48 hours before the valves or components are ready for either inspection or testing.
- 3.4 Before assembly JW's inspector must suitably mark all approved castings and components.
- 3.5 A copy of the durability test as specified in SANS 664-1999, should be supplied with the sample valve (if available), which will be a strong recommendation for resilient seal gate valves only
- 3.6 All assembled Resilient Seal Gate Valves, Butterfly and Hytrol valve shall be so constructed that there is no leakage of water when subjected to an internal hydraulic test pressure of 3 200 kPa for a period of not less than five minutes for the Class16 valves and 3800kPa for the Class 25 valves for the body test. For seat and or gate sealing hydraulic testing where applicable, the following internal hydraulic test pressure shall apply, for the Class 16 valve 1600kPa and for the Class 25 valves 2500kPa
- 3.7 For Wedge Type Gate Valves when tested to an internal hydraulic test pressure of 1600kPa for the Class 16 and 2500kPa for the Class 25 valves the rate of seat leakage shall not exceed the value given in column 2 of Table E1 appropriate to the size of valve given in column 1. For the body test the same as in Clause 3.6 will apply.

Table E1 – Permission seat leakage

1	2	3
Size of valve (mm)	Maximum leakage rate (mL/min)	Test duration (in min) Body and Seat test
80	2.5	1
100	3.0	1
150	4.5	1
200	6.0	2
250	7.5	2
300	9.0	3
350	10.5	3
400	12.0	3
450	13.5	3
500	15.0	5
600	18.0	5
700	21.0	5
800	24.0	5
900	27.0	5

IDENTIFICATION AND MARKING

- 4.1 The following information must be legibly and indelibly cast or embossed on each valve body.
- (i) Manufacturer’s name or trade name or trade mark.
 - (ii) Valve size
 - (iii) Class of valve e.g. Class 16, PN 16.
 - (iv) The SANS mark approval.
- 4.2 A metal identification plate must be permanently fixed to each valve. The plate must bear the following information:
- a) Manufactures name, trade name or trade mark
 - b) Contract number
 - c) Nominal size in millimetres
 - d) Nominal pressure
 - e) Serial number
 - f) Date of manufacture
 - g) Type of trim
 - h) Mass of valve in kg
- 4.3 One flange shall be clearly marked with machined notches, 3mm wide and 3mm deep, with the length of the notches to suite the width of the flange. These notches shall be coated red. The following will apply:

- a) Two notches - 1600 kPa operating pressure.
- b) Three notches – 2500 kPa operating pressure.

- 4.4 Valve caps shall be coated black for the anti-clockwise closing valves and red for the clockwise closing valves. All direction indicator arrows with the "CLOSE" wording on the valve cap top must be highlighted in red for anti-clockwise closing valves and black for clockwise closing valves.
- 4.5 The wording "CLOSE" with direction indicator arrows should be legibly cast on the gland follower and must be highlighted in red.

FINISH

- 5.1 All parts must be smooth and free from fins and burrs.
- 5.2 All surfaces must, after they have been cleaned in a manner appropriate to the type of coating used, be coated internally and externally with an approved fusion bonded epoxy coating with a minimum coat film thickness of 250 microns and a maximum coat film thickness of 650microns.

END CONNECTIONS

- 6.1 Valves must be flanged to SANS 1123 Table 1600 in all areas except Midrand, where they should be flanged to Table D with the bolt holes drilled off centre for PN 16 valves and table 2500, SANS 1123 for PN25 valves. Flange stud bolts must be supplied and fitted if required by the valve design. Multi-drilled flanges will not be accepted.
- 6.2 Body ends must be sealed during delivery and storage to prevent entry of foreign matter.
- 6.3 The front faces of flanges shall be flat faced, fully machined, parallel to one another, with appropriate bolt holes being spot faced on the back for valve sizes 200mm and upwards. For resilient seal gate valves 80mm up to and including 150mm raised flanged faces shall be considered.

BOLTS

- 7.1 Bolts and nuts must comply with the requirements of SANS 135 or SANS 136.
- 7.2 Body gaskets in contact with water must be non-hydroscopic.

DRAWINGS

- 8. General arrangement drawings of all valve types indicating the main components such as body, bonnet, gate, spindle nut, sealing faces, channel guides, gate shoes and jacking screws with the method of securing channel guides, gate shoes and

sealing rings together with main dimensions with an itemized parts list and material specifications shall be submitted with the tender

**WEDGE-TYPE GATE
VALVES VERTICAL
OPERATION**

- 9.1 Valves must comply with SANS 664 Part 1 and Part 2 and bear their mark.
- 9.2 Valves must be Class 16 or Class 25, as per the design, non rising spindle, wedge type gate valves. Substantial ribs to minimize distortion under pressure shall be provided internally and externally.
- 9.3 Metallic components must be in accordance with Table 4 – General materials for valves of SANS 664 – Part 1. Non metallic materials shall be suitable for use within the temperature range of 0°- 50°C.
- 9.4 Valve spindles or drive shafts must be fitted with a spheroidal graphite iron to SANS 936 grade 42 valve caps, dimensioned to SANS 664 - 1, which shall have the wording "CLOSE" together with directional arrows legibly cast on the valve cap. The wording "CLOSE" as well as the direction arrows shall be highlighted in red against the black coated cap top for anti-clockwise closing valves. The valve cap top shall be secured to the spindle by means of an approved shearing pin of which will allow maximum operational torque of the valve in the open and close position. The shearing pin shall be easy replaceable in the field and hard driven taper pins and split pins shall not be allowed. Two spare shearing pins shall be attached to each valve.
- 9.5 In all areas, valves must be closed by turning the valve caps on the spindles or drive shafts in a direction that is anti-clockwise when seen from above the valve caps, except for the Midrand area, where valves must be supplied with a spindle or drive shaft that is closed by turning it in a clockwise direction when seen from above the valve caps.
- 9.6 Valves must be provided with gland seals that permit the maintenance of the glands while the valves are under pressure. The spindle seal for valves where no open spur gearbox are required shall consist of at least two O-rings and dirt intrusion into the seals and bearings must be prevented. For valves of sizes DN 300 to DN 900 where a

open spur gearbox is required a suitable gland packing of PTFE of similar approved packing may be utilized.

9.7 Each valve including and above 200 mm diameter must have two eyebolts of requisite strength for lifting purposes.

9.8 Valves, 300mm up to and including 400mm diameter, shall be multi stage open spur gear driven with a 4:1 minimum gear ratio and for sizes 450mm up to and including 900mm shall be multi stage open spur gear driven with a 6:1 gear ratio, having operating spindles on the input spindles and at a stage where the valve can be stroked without exceeding the maximum input torque if no differential pressure is applied to the valve. The gears shall be robust and machine cut and their mounting shall be of a substantial design. A permanently secured direction indicator dial shall be fitted to the gearbox to show the position of the gate. Stainless steel grease nipples shall be provided on the gearboxes for lubrication purposes. Enclosed gearboxes shall not be permitted. The supplier must furnish the following details on geared valves:

- a. Total number of turns of the valve cap to fully open the valve from a closed position.
- b. Maximum torque required to operate the valve.
- c. Gear ratios.

9.9 The operating mechanism shall be capable of withstanding an overload-input torque of 400 Nm for one minute at fully open and fully closed positions without damage to the valve or valve operating mechanism.

9.10 The spindle and thrust collar must be a homogeneous unit and located within the bonnet. For valve sizes larger than 450 mm \varnothing a thrust bearing must be provided.

9.11 The spindle nut shall be a one-piece, replaceable component which, for valve not exceeding 100mm, may be rigidly fixed in the gate.

9.12 All valves, including and above 400mm, must be fitted with jacking screws.

RESILIENT SEAL GATE VALVES

10.1 Valves must conform fully to SANS 664 - Part 1 and 3 and bear their mark.

- 10.2 Valves must be Class 16, (non-rising spindle), resilient seal gate valves.
- 10.3 Valves must be constructed of the following metallic materials:
 - (i) Body, bonnet, stuffing box, gates, gland --- spheroidal graphite iron to BS2789 grade 420/12, SANS 936 grade 42.
 - (ii) Spindle -- stainless steel to BS 970 grade 420 S29.
 - (iii) Spindle nut -- bronze to BS 1400 LG2.

Non metallic materials shall be suitable for use within the temperature range 0° - 50° C.

- 10.4 The valve spindle and thrust collar must be a homogeneous unit and located within the bonnet.
- 10.5 Valve spindles must be fitted with SG 42 valve caps dimensioned to SANS 664, secured to the spindle by means of a shearing pin that will allow maximum operational torque of the valve in the open and closed position.
- 10.6 Valves must be closed by turning the spindle in a direction that is anti-clockwise when seen from above the spindle, and for **Midrand area**, valves must be supplied with a spindle that is closed by turning it in a clockwise direction.
- 10.7 Valves must be provided with gland seals that consist of at least two O-rings and dirt intrusion into seals and bearings must be suitable prevented.
- 10.8 Sealing and gate-guide areas must be designed to eliminate deposits.
- 10.9 The operating mechanism must be capable of withstanding and overload input torque of 400 Nm for one minute at fully open and fully closed position without damage to the valve or valve operating mechanism.

For identification and marking of the Resilient Seal gate valve the conditions indicated in clause 4 will apply.

**DOUBLE FLANGED
OFFSET WAFER TYPE
BUTTERFLY VALVES**

- 11.1 Valves must be of the double offset wafer type, PN16, carbon steel design and conform to the requirements of BS5155.

Valves must be flanged to SABS 1123 table 1600 with the bolt

- 11.2 holes drilled off centre for PN16 valves and table 2500 for PN25 valves. Flange stud bolts must be supplied and fitted if required by the valve design and shall not exceed eight per valve.
- 11.3 Drive shafts shall be provided with SG 42 caps dimensioned to SANS 664 and be securely fitted to the spindle.
- 11.4 In all areas, valves must be closed by turning the drive shaft in an anti-clockwise direction when seen from above the cap tops, except for **Midrand area**, where valves must be supplied with a drive shaft that is closed by turning it in a clockwise direction. An indicator to show the position of the disc must be provided.
- 11.5 Valve components shall be constructed of the following materials specified in Table E2.

Table E2: Material composition

Component	Material type	Material Specification
Body	SG Iron	BS 2789 GR 420/ SANS 936 SG 42
Body seat ring	Stainless Steel	BS 970 Part 4, Grade 304 S15
Valve disc	SG Iron	BS 2789 GR 420/ SANS 936 SG 42
Disc/body seal	Elastomer/rubber	EPDM 75 ^o A / Nitrile
Seal retaining ring	Stainless Steel	BS 970 Part 4, Grade 304 S15
Valve shaft	Stainless Steel	BS 970 Part 4, Grade 304 S15
Shaft bearing/bushes	Phosphor Bronze	BS 1400 PB1C (Cu, Sn10, P)
Shaft seals	Radial lip type/cup seal	Nitrile / Viton
External fasteners	Steel (Hot dipped galvanized)	SANS 163 Grade 8.8
Internal fasteners	Stainless Steel	BS 970 Part 4, Grade 304 S15

- 11.6 Valves must have a replaceable stainless steel seat to the body or disc and a replaceable and adjustable resilient seal fitted to the edge of the disc or body and be a tight shut-off type.
- 11.7 The valve bodies shall have adjustable mechanical stops to prevent over travel of the valve disc in the open and closed position.

- 11.8 The preferred flow direction must be indicated.
- 11.9 Valve shafts must be stainless steel as indicated in Table E2. Two “Glacier DU” sleeve bearing with seals must be fitted to each shaft. A thrust bearing shall be provided to secure the valve disc in the centre of the valve.
- 11.10 The valves must be capable of operation by one man turning the cap top with a differential pressure of 1600 kPa across the disc. A thrust bearing to hold the valve disc securely in the centre of the valve seat must be provided.
- 11.11 The operating mechanism must be capable of withstanding an overload-input torque of 400 Nm for one minute at fully open and fully closed positions without damage to the valve or valve operating mechanism.
Sleeve bearings shall be provided to worm drive shaft with the casing being that of spheroidal graphite iron to SANS 936 grade 42 and weatherproof to IP65.

**DOUBLE ORIFICE
WITH ANTI-SHOCK
(ORIFICE) AIR
RELEASE VALVES**

- 12.1 Valves must be double acting air valves of compact single chamber design with both small and large air release orifices inside the chamber. The valve must also act as a vacuum breaker, with intake capacities of 60% of discharge rates given.
- 12.2 The valve shall be capable to provide all of the following functions:
 - 12.2.1 Pipeline filling:
Uninterrupted high volume air discharge through the large orifice
 - 12.2.2 Pipeline draining or column separation:
Uninterrupted high volume air intake through the large orifice.
 - 12.2.3 Pipeline full and operating:
Discharge of disentranced pressurized air through the small orifice.
 - 12.2.4 Rapid filling/column separation:
The valve must incorporate an integral surge alleviation mechanism which will automatically dampen surge pressures due to rapid air discharge or the subsequent rejoining of

separated water columns.

- 12.3 An independent test centre must substantiate the discharge and intake rates.
- 12.4 The valve body must be stainless steel T316 or SG 42 and the end connections must be the same nominal size as the valve designation.
- 12.5 The air valves must have the following minimum discharge capacities:
 - (i) 25 mm - 4,5m³/minute at 40 kPa differential pressure
 - (ii) 50 mm - 13m³/minute at 40 kPa differential pressure.
 - (iii) 80 mm - 27 m³/minute at 40 kPa differential pressure.
 - (iv) 100 mm - 34 m³/minute at 40 kPa differential pressure.
 - (v) 150 mm - 84 m³/minute at 40 kPa differential pressure.
- 12.5 End connections may be screwed to SANS 1109 or flanged to SANS 1123 Table 1600.
- 12.6 A stainless steel screen on the air outlet port must provide protection against dirt.

HYTROL MAIN VALVES

- 13.1 The valve shall consist of cast material to BS 1452 Grade 260 body and cover and a diaphragm assembly. No separate chambers shall be allowed between the main valve cover and body. The design of the valve shall be that of a globe, self acting, hydraulically operated, diaphragm actuated type with the diaphragm assembly being the only moving component separating the operating pressure from the line pressure. Semi-globe designs shall not be permitted.
- 13.2 All surfaces must, after they have been cleaned in a manner appropriate to the type of coating used, be coated internally and externally, with an approved fusion bonded powder epoxy coating with a minimum coat film thickness of 250 microns.
- 13.3 The valve shall contain a resilient, synthetic rubber disc with a rectangular cross section supported on all four sides by a disc retainer and disc guides. No o-ring type seals shall be permitted as the sealing surface.

- 13.4 The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly, preventing the possibility of being dislodged. No slotted or V-type disc guides shall be considered.
- 13.5 The disc retainer shall be of a sturdy one-piece design. It shall have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear. No hourglass shaped disc retainers shall be permitted.
- 13.6 The diaphragm assembly shall contain a non-magnetic stainless steel stem of sufficient diameter to withstand high differential pressure. The diaphragm assembly stainless steel stem shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat with the bearings being cast in a stainless steel material dissimilar to that of the stem material. Centre guides, V-notched systems acting as secondary bearings and piston actuated designs shall not be permitted. The stem shall be drilled and tapped in the cover end to receive any accessories deemed necessary. No gland seals shall be permitted.
- 13.7 The flexible and non-wicking diaphragm shall consist of a nylon fabric bonded with synthetic rubber that is compatible with urban potable water supply. The centre hole for the main stem shall be sealed by means of vulcanization. The diaphragm shall be fully supported in the valve body and cover by machined surfaces and shall not be used as the seating surface, either in the fully opened or fully closed positions.
- 13.8 The diaphragm shall withstand a Mullins Burst Test of a minimum of 41 bar per layer of nylon fabric and shall also be 100 000 times cycle tested. Proof of such to be submitted when requested.
- 13.9 The Hytrol valve shall be so constructed that the maintenance, repairs and modifications to the valve can be achieved without the removal of the valve from the reticulation system. The diaphragm assembly shall be a singular component removable by lifting it vertically from the valve seat without the need of removing any locating screws. The main valve seat and the stem bearings in the valve cover shall be replaceable.
- 13.10 The valve body and cover shall be machined with circulating locating edges to insure proper alignment of the valve stem. The pinned cover method shall not be permitted.

- 13.11 The valve shall be capable of withstanding a velocity of flow in the pipeline as high as 5 m/sec and shall be capable of a differential pressure ratio as high as 3:1 for fully ported valves or 4:1 for reduced ported valves. Under these conditions the valves shall not suffer from damage as a result of cavitations.

**UNDERGROUND FIRE
HYDRANT**

- 14.1 The Underground fire hydrant must comply fully to SANS 1128 – Part 1 with the SANS mark of approval permanently embossed on the body.
- 14.2 The outlet on the underground fire hydrant must be London “V” threaded and manufactured from Spheroidal Graphite Grade 42 iron and gunmetal coated.
- 14.3 The outlet must be attached to the hydrant by means of two 16mm High tensile Allen cap screws threaded into the outlet from beneath the hydrant body, ensuring that the removal of the outlet can only be done with specialized tools.
- 14.4 A blank cap from Spheroidal Graphite Iron must be secured to the hydrant body by means of a 3mm thick stainless steel chain.
- 14.5 The underground fire hydrant must be provided with gland seals that permit the maintenance of the gland while the hydrant is under pressure.
- 14.6 The spindle seal shall consist of at least two o-rings and dirt intrusion into the seals must be suitably prevented.
- 14.7 The underground fire hydrant must be, after it was cleaned in a manner as described in SANS 1217, be coated internally and externally with a non-toxic and non-tainting fusion bonded powdered epoxy coated with minimum and maximum coat film thickness of 250 and 500 microns respectively.
- 14.8 The following information must be legibly and indelibly cast or embossed on each underground fire hydrant body:
- a) Manufacturers name, trade name or trade mark.
 - b) The size of the hydrant.
 - c) The Class e.g. PN16.
 - d) The SANS mark of approval.

- 14.9 A metal information plate must be permanently fixed to each hydrant. The plate must bear the following information:
- a) Manufacturers name, trade name or trade mark
 - b) Contract number.
 - c) Test certificate number.
 - d) Date of manufacture.
 - e) Mass of hydrant in kg.
- 14.10 The underground fire hydrant must be constructed of the following Metallic material:
- a) Body; plug; stuffing box flange; outlet and Cap top:
Spheroidal graphite iron to SANS 936 Grade 42 or BS 2789 Grade 420/12.
 - b) Spindle:
Stainless steel BS 970 grade 420S29

ABOVE GROUND FIRE HYDRANT

- 15.1 The aboveground fire hydrant must comply fully to SANS 1128.
- 15.2 Metallic components of the valve body shall be Spheroidal Graphite grade 42.
- 15.3 The direction of opening for the aboveground hydrant valve shall be anti - clockwise.
- 15.4 The aboveground hydrant shall be of the right angle, tamperproof, single lug, instantaneous type.
- 15.5 The inlet of the valve shall be of a nominal size 80mm and shall be treaded. The treaded inlet shall comply with the relevant requirements of SANS 1109.
- 15.6 For the tamperproof aboveground hydrant the valve spindle shall be sheathed and be of the shielded type with dimensions complying with Fig 10 and Fig 11 as indicated in the SANS 1128 specifications.
- 15.7 The design of the spindle thread shall be of the acme or trapezoidal form, with the root diameter being at least 19mm.
- 15.8 The valve clack shall be of the swivel type and be fixed to the spindle in an acceptable manner.

- 15.9 The valve gland shall be so designed for use with an “O” ring type sealing.
- 15.10 When the aboveground hydrant valve is tested according with clause 9.4 of the SANS 1128 specification, it shall not burst or suffer such damage as would impair its normal operations.
- 15.11 The aboveground fire hydrant must be, after it was cleaned in a manner as described in SANS 1217, be coated internally and externally with a non-toxic and non-tainting fusion bonded powdered epoxy coated with minimum and maximum coat film thickness of 250 and 500 microns respectively.
- 15.12 Each component of the aboveground hydrant shall be legibly marked (by stamping or embossing) with the manufacturers name, trade name or trade mark.
- 15.13 The direction of opening of the aboveground hydrant shall be legibly marked or embossed on the hydrant.

Annexure F: Specifications for Corrosion Protection

Please Note: The Specifications for Corrosion Protection are not yet finalized.

For the time being, before any Consultant does any pipeline design which requires Corrosion and Cathodic Protection, they should approach Johannesburg Water's Edward Livesey for specifications, checking and approval of designs for each individual project.

His contact details are as follows:

Edward Livesey

Manager

Electrical Support Department

Operations

Johannesburg Water SOC Limited

Providing Water. Providing Life!

Direct : 011 688 1697

Fax : 011 688 1694

Mobile : 082 828 0229

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1. INTRODUCTION:

This document is aimed at assisting Consultants and Contractors for the design and upgrades of Reservoirs, Towers, Water Pump stations and Sewer Pump stations.

1.1 BACKGROUND:

Johannesburg Water (SOC) Ltd operates and maintains a fairly large number of reservoirs, towers and pump stations situated within the various regions of Johannesburg. Over the years, various products and specifications were applied to these sites without any consistencies. The need has become apparent to standardize plant and equipment and design philosophies for ease of repair and maintenance. In addition to this experience has taught us to avoid certain designs and products mainly due to high rate of failures as well as the limited skills level of operational staff.

1.2 COMPLIANCE AND APPROVALS

All designs/installations to comply with OHASA, SANS 10400, National Building regulations and all other applicable codes of practices and regulations (BS 8007, BS8110). All civil, electrical and mechanical drawings to be approved by the Divisional Manager: Development Control and Electro-Mechanical Manager prior to procuring any of these items/services.

1.3 FACTORY ACCEPTANCE TESTING (FAT):

All mechanical, electrical, HT, Generator and instrumentation equipment need to undergo a (FAT) prior to being installed on site.

2. RESERVOIR DESIGN

2.1 INTRODUCTION

Reservoirs come in all shapes and sizes. Some are square or rectangular, others are round. Some are dome shaped while others have a flat deck with gravel top. They may be built above ground or below ground level. The aesthetics of the site should generally blend in with the natural surroundings.

A reservoir above ground level is more favorable and this is mainly due to the fact that one can easily identify any leaks from the structure specifically around the walls and between the wall and floor joint. Another reason is that the underflow drains will be much shallower as compared to reservoirs below ground level and this makes identification of leaks and cleaning up of underflow sumps much easier. Reservoirs are concrete structures and must not be painted to facilitate ease of maintenance.

- Above ground reservoir more favorable.
- No painting of external structure.

2.2 LEVEL CONTROL

This will be considered upon approval from **JW's Design Manager CAPEX/Senior Manager Development Control**. The most popular reservoir level control is hydraulic. Hydraulic level controls are preferred over Actuators since they do not require any electricity and require minimal maintenance, with lower running costs.

Altitude Level Controls can be used where there is a dedicated feed to the reservoir (ie. no off takes on the reservoir supply). In cases where there is/will be off takes on the main reservoir supply, rather use a rate of flow level control with an orifice plate (sized for maximum flow) downstream of the level control. Float level controls will also be considered.

- Altitude level control (where there is a dedicated reservoir supply).
- Rate of flow level control (where there is no dedicated supply).
- Float Level control mechanism also considered.

2.3 PRESSURE REDUCING VALVES (PRV)

This will be considered upon approval from **JW's Design Manager CAPEX/Divisional Manager Development Control Engineer**. Typical reduction ratio of 1:3 is a standard. Hence, in systems that operates at a higher pressure it might be required to design a PRV installation in a series configuration. Note that a PRV up to 300mm diameter is not as heavy /cumbersome to strip as opposed to a 500mm diameter PRV. If 500mm PRV'S are used, suitable Lifting Equipment must be installed. Hence in order to ensure ease of maintenance/repairs a 300mm is desirable. Larger sizes can be assessed depending upon the system constraints. Newer design of PRV with an anti-cavitation device will also be

considered. This claims to have a large reduction ratio (1:5); however there is restriction of flow. This design will only be considered upon approval by the Engineer.

- With or without anti cavitation ring.
- 300mm Maximum diameter depending on system constraints.

2.4 VALVES

This will be considered upon approval from **JW's Design Manager CAPEX/Divisional Manager Development Control**, minimum pressure rating PN16. It must be a standard Water Works valve (anti-clockwise close) with the thrust collar located on the underside of the casing and not with thrust collar under the gearbox.

- Butterfly valves and RSV (resilient seal valves) are not permitted due to the fact that they do not seal properly with age.
- Air valves can be double or triple acting type.
- Non return valves can be the Arm-Weight type ,or "Klakker" type

2.5 BYPASS SYSTEM

Provision must be made for a bypass system for maintenance purposes. This system must be located within the reservoir boundary and be fitted with a PRV together with upstream and downstream isolation valves. The installation of a PRV on the bypass is dependent upon system pressures.

2.6 PIPEWORK

All pipe work to be steel and copon coated according to JW Standards.

- Butt welded joints are more favourable for long pipe sections, however flanged sections are also allowed. The typical class of pipe would be a Class 16. However, on high pressure systems Class 25 is suitable with a wall thickness of at least 12mm, depends on d/t ratio and design pressure.
- Flexible joints are not recommended. These include VJ Couplings and Victaulic clamps or flange adaptors etc.
- Any anchor blocks or thrust blocks must be so designed that no portion of the concrete will intersect any welded joint section of the pipe work.
 - Steel coupon coated pipe.
 - Class 16 or Class 25.
 - No VJ Couplings or Victaulic clamps or flange adaptors.

2.7 METERING AND TELEMETRY

Meters must be located on the inlet and outlet of the reservoir. The bypass may not be metered if the tie in for the bypass is located downstream of the inlet meter. Provision must be made for Telemetry for remote monitoring purposes

3. TOWER DESIGN

3.1 INTRODUCTION

Towers must be reinforced concrete in design and not steel. Steel poses a problem in medium to long term due to the corrosion factor. The shape of the tower must blend in with the natural surroundings in order to be aesthetically pleasing. Refrain from utilizing a one pipe system (common inlet and outlet). Towers must have a dedicated inlet and outlet/s.

3.2 LEVEL CONTROL

This will be considered upon approval from **JW's Design Manager CAPEX/Divisional Manager Development Control**. Hydraulic level controls are preferred over Actuators since they do not require any electricity and require minimal maintenance, with lower running costs. Altitude Level controls can be used where there is a dedicated feed to the tower (i.e. off takes on the reservoir supply). Where towers are filled by means of pumps, the level control mechanism in the tower will be an Ultrasonic level controller.

- Altitude level control
- Towers filled up by pumps will be ultrasonic level control mechanism

3.3 PRESSURE REDUCING VALVES (PRV)

This will be considered upon approval from **JW's Design Manager CAPEX/Divisional Manager Development Control**. Typical reduction ratio of 1:3 is a standard. Hence, in systems that operates at a higher pressure it might be required to design a PRV installation in a series configuration. Note that a PRV up to 300mm diameter is not as heavy /cumbersome to strip as opposed to a 500mm diameter PRV. Hence in order to ensure ease of maintenance/repairs a 300mm is desirable. Larger sizes can be assessed depending upon the system constraints.

Newer design of PRV with an anti-cavitation device will also be considered. This claims to have a large reduction ratio (1:5), however there is restriction of flow. This design will only be considered upon approval by the Engineer.

- CLA VALVE or similar approved, with or without anti cavitation ring
- 300mm Maximum diameter depending on system constraints

3.4 VALVES

Wedge type gate valves, minimum pressure rating of PN16. It must be a standard Water Works valve (anti-clockwise close) with the thrust collar located on the underside of the casing and not with thrust collar under the gearbox.

Butterfly valves and RSV (resilient seal valves) are not permitted due to the fact that they do not seal properly with age. Air valves can be double or triple acting type Non return valves can be the Arm-Weight type, or "Klakker" type or Ball type.

3.5 BYPASS SYSTEM

Provision must be made for a bypass system for maintenance purposes. This system must be located within the tower boundary and be fitted with a PRV together with upstream downstream isolation valves.

3.6 PIPEWORK

All pipe work to be steel and copon coated according to JW Standards.

- Butt welded joints are more favourable for long pipe sections. However, flanged sections are also allowed. The minimum class of pipe would be a Class 16. However on high pressure systems Class 25 is suitable with a wall thickness of at least 12mm, depends on d/t ratio and design pressure.
 - Flexible joints are not recommended. These include VJ Couplings and Victaulic clamps or flange adaptors etc.
 - Any anchor blocks or thrust blocks must be so designed that no portion of the concrete will intersect any welded joint section of the pipe work.
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- Steel copon coated pipe
 - Class 16 or Class 25
 - No VJ Couplings or Victaulic clamps or flange adaptors.

3.7 METERING AND TELEMETRY

Meters must be located on the inlet and outlet of the tower. The bypass may not be metered if the tie in for the bypass is located downstream of the inlet meter. Provision must be made for Telemetry for remote monitoring purposes.

3.8 RESERVOIR/ TOWER LEAK TESTING

All Reservoirs and Towers shall be subjected to the following tests:

1. The water-tightness of the reservoir roof should be tested before that of the reservoir itself by water being continuously sprinkled over the roof in an approved manner so that a film of water is maintained on the surface of the slab. The roof shall be considered watertight if no damp patches are visible on the underside after 48 hours of sprinkling.

2. The structure should be filled with water at a uniform rate not exceeding 2.0 m in 24 hours until the top water level has been reached. The water level should then be carefully noted and recorded by the Engineer in relation to a fixed bench-mark, and the structure should be allowed to remain filled for a period of two weeks to permit complete absorption of water by the concrete.

3. Any loss of water which may have occurred shall then be made up by again filling the structure to the top water level and by allowing the water to remain undisturbed for a period of not less than four days. The structure shall be considered to be watertight if the drop in level in 96 hours (less the drop caused by evaporation) does not represent more than 0.06% of the volume of the reservoir.

4. The evaporation shall be measured by the mean drop in level caused by the evaporation of the water in three flat containers floating in the water, being recorded.

In the event of an appreciable leakage being evident or visible at any stage of the filling or testing, or in the event of the final degree of water-tightness being unsatisfactory, the Contractor shall, when so ordered by the Engineer, discontinue such filling or testing and shall, at his own expense, take approved steps to rectify the leakage, until a test proves that a sufficient degree of water-tightness has been obtained.

Note, before the expiry of the defects liability period, JW shall have the right to retest the structure for water-tightness, results of such further tests will be made available for the information of the Contractor. In the event of these tests indicating an unsatisfactory degree of water-tightness, JW will, before issuing the final certificate, again require the Contractor to rectify the leakage, at his own expense, in such a manner as will cause the least interruption of the water supply to consumers and as will ensure the soundness of the work, to the satisfaction of the Engineer.

Should the failure of the reservoir to pass the first or any subsequent test for water-tightness necessitate the draining of the structure, JW reserves the right to utilise the water by discharging it into its water-reticulation network, in which case the Contractor:

- (i) shall not have to pay for the subsequent refilling of the reservoir;
- (ii) shall, if applicable, reimburse JW for any additional costs incurred to make the water fit for consumption; and
- (iii) shall not be entitled to claim for extra time whilst waiting for the water to be discharged into the network.

The costs of retesting the reservoir for water-tightness shall be borne by the Contractor.

JW will appreciate the Consultant submitting well documented results in a report form and where possible a JW Development Control and/or Operation Staff shall attend the taking of all measurements by the Contractor and should be notified in advance when measurement will be taken.

4. WATER PUMPSTATION DESIGN

4.1 INTRODUCTION:

Water pump stations are designed to pump water into a reservoir or water tower. In other applications, water pump stations pump directly into reticulation zones (Booster Pump stations) in order to maintain constant pressures within a zone. In the first scenario, the pumps will pump into a reservoir/tower and will be controlled by an Ultrasonic level controller. In the second scenario as above, the pumps will be controlled by a Variable Speed Drive and pump directly into a reticulation. The pump station must be so designed that the pumps operate a maximum of 2 duty cycles per hour.

4.2 PUMPS AND MOTORS:

This will be considered upon approval from **JW's Design Manager CAPEX/Senior Manager Development Control**. Preference for pumps are split case centrifugal type. Multi stage pumps are not desirable. The pumps must have a Fenno flex coupling or steel type coupling. Bronze or stainless steel impellers are preferable.

Motors must be 3 phase induction type motors with embedded sensors for thermal sensing and cut out. Preferred makes of motors: WEG

- Pumps = single stage, split case centrifugal pumps
- 3 phase induction motors.

4.3 LEVEL CONTROL

This will be considered upon approval from **JW's Design Manager CAPEX/Senior Manager Development Control**. For this application, the level control mechanism in the tower /reservoir will be an Ultrasonic level controller together with a back up float level control. Backup float level controls are optional.

- Towers/Reservoirs filled up by pumps will be ultrasonic level control mechanism with back-up float mechanism (optional).

4.4 VALVES

This will be considered upon approval from **JW's Design Manager CAPEX/Senior Manager Development Control**. From past experience, the most reliable isolation valve on Bulk Facilities is the Wedge type gate valves, minimum PN16. It must be a standard Water Works valve (anti-clockwise close) with the thrust collar located on the underside of the casing and not with thrust collar under the gearbox. Butterfly valves and RSV (resilient seal valves) are not permitted due to the fact that they do not seal properly with age. Provision to be made for suitable Air valves and Non return valves. Non return valves can be the Diaphragm type or Arm-Weight" type. Air valves to be double or triple acting.

- Wedge type gate valves
- Air valves- double/triple acting
- Non return valves: Diaphragm or Arm-weight type
- No butterfly valves or RSV valves permitted

4.5 PIPEWORK

All pipe work to be steel and copon coated according to JW Standards.

- Butt welded joints are more favourable for long pipe sections, however flanged sections are also allowed.
- The typical class of pipe would be a Class 16. However, on high pressure systems Class 25 is suitable with a wall thickness of at least 12mm.
- Flexible joints are not recommended. These include VJ Couplings and Victaulic clamps or flange adaptors etc.
- Any anchor blocks or thrust blocks must be so designed that no portion of the concrete will intersect any welded joint section of the pipework.
- Steel copon coated pipe
- Class 16 or Class 25
- No VJ Couplings, Victaulic clamps or flange adaptors

4.5 METERING AND TELEMTRY

Meters must be located on the inlet and outlet of the pump station. Provision must be made for Telemetry for remote monitoring purposes.

4.6 ELECTRICAL DESIGN

This will be considered upon approval from JW's Design Manager CAPEX/Senior Manager Development Control. Depending on the capacity of the pump station and specifically size of motors, the following electrical motor starters will be adhered to:

- (ii) Motors less than 37 Kw, Direct on line starters or Star Delta starters
- (iii) Motors above 37Kw, Soft starters with ramp up and ramp down functionality. Preferred make is Control techniques GPS Range of soft starters
- (iv) Variable speed drive applications. One pressure transducer (fixed calibration) to be used for pressure control. A pressure switch(mechanical type with range adjustment) to be used as a backup/failsafe, to be wired directly into the Emergency Stop of the Variable speed drives
- (v) PLC Controls: PLC'S are not advisable due to skills shortages as well as complexities.
 - Provision to be made for lighting and 1phase/3 phase power distribution on site.
 - Lighting must be energy saving floodlights (outdoors) and fluorescent or energy saving lighting (inside).
 - Where towers/reservoirs are being constructed, provision to be made for lightning protection as well.
 - Aviation lights in the vicinity of low flying aircraft will also be incorporated.

- Emergency stops to be located at the MCC Panels as well as the Pump/Motor
A 3 phase Electricity connection needs to be provided for every installation with the meter located inside the site boundary (if practically possible)

5. SEWER PUMPSTATION DESIGN

5.1 INTRODUCTION

Sewer pump stations take in sewer on gravity inlets and pump it into an outfall system via a rising main. Due to the nature of sewer as well as the environmental hazard caused by pump station failure, the design of a sewer pump station needs to be a lot more stringent as compared to water pump stations. The pump station must be so designed that the pumps operate a maximum of 2 duty cycles per hour during average flow conditions. All pump installations must be supplied with a standby pump of capacity equal to that of the largest duty pump. Standby pumps must be automatically activated when necessary. All pump stations must be fitted with a disintegrator to ensure the protection of the pumps.

5.2 PUMPS AND MOTORS:

This will be considered upon approval from **JW's Design Manager CAPEX/Senior Manager Development Control**.

- Preferences for pumps are: dry well, horizontal split case, centrifugal type/vertical pumps. Multi stage pumps are not desirable.
- The pumps must have a Fenno flex coupling.
- Bronze or stainless steel impellers are preferable although cast iron impellers are commonly used.
- Submersible type pumps must be avoided at all costs due to the frequent problems experienced on such units.
- The pump room must be at nominal ground level and not below ground level .Any depth greater than 1m below nominal ground level is not permitted.

Motors must be 3 phase induction type motors with embedded sensors for thermal sensing and cut out.

- Pumps = single stage, horizontal split case/vertical centrifugal pumps
- 3 phase induction motors
- Submersible pumps not recommended

5.3 ELECTRICAL DESIGN:

This will be considered upon approval from **JW's Design Manager/Senior Manager Development Control**. Depending on the capacity of the pump station and specifically size of motors, the following electrical motor starters will be adhered to:

- a) Motors less than 37 Kw, Direct on line starters or Star Delta starters
- b) Motors above 37Kw, Soft starters with ramp up and ramp down functionality.
- c) Variable speed drives applications. One pressure transducer (fixed calibration) to be used for pressure control. A pressure switch (mechanical type with range adjustment) to be used as a backup/failsafe
- d) PLC Controls: PLC'S are not advisable due to skills shortages as well as complexities.

- Provision to be made for lighting and 1phase/3 phase power distribution on site. Lighting must be energy saving floodlights (outdoors) and fluorescent or energy saving lighting (inside).
- Emergency stops to be located at the MCC Panels as well as the Pump/Motor
- A 3 phase Electricity connection needs to be provided for every installation with the meter located inside the site boundary(if practically possible)

5.4 LEVEL CONTROL:

This will be considered upon approval from the Engineer.

For this application, the level control mechanism will be an Ultrasonic level controller together with a back up float level control (optional)

- Level controller will be ultrasonic level control mechanism with back-up float mechanism(optional)

5.5 INLET WORKS

- Inlet works to the pump station must have a 316 stainless steel/galvanized filter Basket with/without Macerators.
- The inlet works must have a Sand Trap system together with a Bypass for maintenance purposes.
- The inlet works must be interconnected with the bypass via a sluice gate configuration.

5.6 SEWER SUMP

- The sewer sump must be divided into 2 halves for cleaning and maintenance purposes.
- They need to be interconnected by a series of valves/sluice gates. The sumps must have an overflow pipe which will discharge sewer in a pump station overflow condition.
- CAT Ladders, with safety cage to be installed inside the sump to facilitate access. These can either be 316 stainless steel or galvanized. Step irons are not permitted.
- Access manholes to be provided .These should be at least 900mmx900mm.

5.7 OVERFLOW TANK

- Any pump station located near a stream/river or whose capacity at full load delivers more than 150l/s must be constructed with an overflow dam with no less than 4hrs of storage time, but limited in capacity to 0.8MI during average flow conditions. This will enable maintenance personnel to repair any faults within a reasonable timeframe as well as prevent environmental pollution.
- CAT Ladders, with safety cage to be installed inside the overflow dam to facilitate access. These can either be 316 stainless steel or galvanized. Step irons is not permitted.
- Access manholes to be provided. These should be at least 900mmx900m

5.8 STANDBY GENERATOR:

This will be considered upon approval from **JW's Design Manager/Senior Manager Development Control**.

- All sewer pump stations to be fitted with a standby generator set capable of supplying the pump station with full load power for at least 6 hours.
- Generators to be fitted with a stainless steel diesel tank and have AMF(Automatic Mains failure detection)

5.9 VALVES

This will be considered upon approval from **JW's Design Manager/Senior Manager Development Control**. Wedge type gate valves are required. It must be a standard Water Works valve (anti-clockwise close) with the thrust collar located on the underside of the casing and not with thrust collar under the gearbox. Butterfly valves and RSV (resilient seal valves) are not permitted due to the fact that they do not seal properly with age. Non return valves should be Ball type or "Klakker" type. Air valves should be a double or triple acting type, for sewer applications.

- Wedge type gate valves
- NRVS: Ball or Klakker type or similar approved
- Air valves: Double/Triple acting for sewer applications
- No butterfly valves or RSV valves permitted

5.91 PIPEWORK:

All pipe work to be steel and copon coated according to JW Standards. Butt welded joints are more favorable for long pipe sections, however flanged sections are also allowed.

- The typical class of pipe would be a Class 16, however on high pressure systems Class 25 is suitable with a wall thickness of at least 12mm. Flexible joints are not recommended. These include VJ Couplings and Victaulic clamps etc.
- Any anchor blocks or thrust blocks must be so designed that no portion of the concrete will intersect any welded joint section of the pipework.

- Steel copon coated pipe
- Class 16 or Class 25
- No VJ Couplings ,Victaulic clamps or flexible couplings(unless otherwise stated)

5.92 METERING AND TELEMETRY:

Meters must be located on the outlet of the pump station. This must be an EMF Meter (full bore) to prevent clogging. Provision must be made for Telemetry for remote monitoring purposes

6. GENERAL

Chambers can be either casted (reinforced concrete) or brick type (use Engineer's brick). Chambers constructed of manhole rings, rectangular slats can be permitted for smaller valve chambers, but this needs to be agreed upon by **JW's Design Manager/Senior Manager Development Control**.

- Removable slabs each weighing not more than 1,5 ton with lifting hooks/eyes need to be used to make up the chamber roof/deck. Note that chambers need to have access manhole covers or mild steel covers at least 900mmx900mm wide opening in order to facilitate the removal/installation of the largest size of equipment mounted inside the chamber. For mild steel lids, these need to be bullet hinged type.
- CAT Ladders, with safety cage to be installed inside the chamber. These can either be 316 stainless steel or galvanized. Step irons (cast iron type) can be mounted instead of CAT Ladders for chambers not deeper than 2m.
- Chamber floor needs to slope to one corner and a sump minimum size (300mmx300mmx300mm)*** needs to be constructed in this corner. This will enable maintenance crews to pump out water that might leak into the chamber. Note that an access manhole needs to be provided directly above this floor sump.
- Meter chambers and chambers housing air valves , PRV's or level control valves need to be vented in the form of a galvanized breather pipe section with stainless steel vermin mesh.
- Clearance of any pipe work specifically flanges needs to be at least 500mm away from any of the chamber walls or floor. This enables easy access to maintenance crews should any repairs need to be performed

*** The Design Engineer should determine the actual size of the sump to suit the pump station based on the pump capacities.

6.2 DRIVEWAYS, FENCING AND GATES:

Perimeter fencing need to be installed around the entire pump station or reservoir/tower site. This will be preferably the bolt on type concrete palisade fencing. Minimum height will be 1.8m.

- Barbed wire/Razor wire can be installed on the top section of fencing.
- Gates need to steel in construction, sliding type gate, green in colour and at least 4m wide. The gate must also have a lockable Pedestrian gate access built into its frame. Galvanised gates can be installed provided that they do not get painted as per color coding.
- Reasonable access to the site needs to be provided from the main road to the site. This can be a concreted driveway or concrete tracks (farm tracks).Paving and interlocking bricks should be avoided.

6.3 APRONS:

Concrete aprons 0,5m wide need to be constructed around the entire length of the pump station building, tower structure and reservoir structure. This will enable proper dissipation of storm water as well as prevent water from entering the doorway of the

structure. The apron needs to be slightly sloped towards one edge, away from the structure.

6.4 COLOUR CODING

For water installations: Inlet pipe work must be light blue, bypasses must be brilliant green, outlets must be bright yellow and scours/overflow must be white in colour.

For sewer installations: Inlet pipe work to be green with brown stripes.

Doors, gates, floors: Doors to be dark blue in colour. Gates shall be green in color and floors to be painted green with yellow stripes for equipment demarcation. Only pump station floors to be painted green with yellow demarcation. Other structures such as tower floors and chamber floors need not be painted.

6.4 VENTILATION:

Pump stations and High voltage enclosures need to be equipped with sufficient ventilation. These can be whirly birds, extraction fans or static ventilation units. Meter chambers and chambers housing air valves, PRV's or level control valves need to be vented in the form of a galvanized breather pipe section with stainless steel vermin mesh.

6.5 FIRE EXTINGUISHERS AND LIFTING EQUIPMENT:

Pump stations to be equipped with suitable portable fire extinguishers (dry powder type). I Beams with a crawl and chain block needs to be provided inside pump stations. Large valve chambers/level control chambers need to have I-BEAM and crawl fitted to it. Test certificates need to be provided and a SWL Rating needs be to marked on the I-Beam.

6.6 POTABLE WATER CONNECTION:

A minimum ½" potable water connection needs to be provided at every sewer pump station for cleaning purposes.

6.7 STORMWATER DRAINAGE:

Surrounding area around pump station needs to be landscaped to such an extent that storm water and surface run off will be dissipated safely away from pump station and chambers. This is typically achieved by a retaining wall with weep holes and 1/2 round drains.

6.8 BUILDINGS:

Buildings to be facebrick and not plastered (interior and exterior). Steel roofing shall be in the form of IBR/Corrugated iron. Floors to be painted with suitable non slip paint. This should be green in colour with yellow stripe demarcation around plant/equipment. No glass windows permitted, however steel louvers with burglar bars are acceptable.

Buildings specifically used for Telemetry or Guard huts must be face brick, non plastered (exterior and interior) with a solid concrete slab roof, tapered from the middle in order to facilitate rain water runoff. Single phase electricity, with a sub distribution board (DB), with lighting needs to be provided.

- Guard huts need to have a concrete seat bench and table with a window.
- Telemetry Huts must not be fitted with windows. The only opening on these huts would be a solid steel single door with security gate.

Annexure H: Procedure for Percolation Test for Septic Tanks and French Drain Sites

Percolation Test

THE TEST PROCEDURE

The percolation test is designed to quantify the movement of liquids in the soils at a specific time of the year. Percolation rates usually change as the soil moisture content changes, and it is best to conduct the test in the rainy season. The percolation test should be regarded only as an indication of the suitability of the soil for a specific sanitation system. The following procedure should be followed.

Calculation of number of test holes

The number of test holes needed is affected by the size of the township and the variability of the soil conditions. Usually test holes should be spaced uniformly through the area, at the rate of five to ten holes per hectare, if soil conditions are fairly homogeneous.

Preparation of test holes

To prepare the percolation test holes, the topsoil layer should be removed to a depth of 500mm. Test holes should have a diameter of 150mm or should be 150mm square. A spade or a hand auger can be used. Test holes should be 300mm deep and the surface of each hole should be thoroughly scarified with a sharp pointed instrument to remove unnatural (such as smeared) soil surfaces. The holes should then be lined with a polyester filter fabric and the bottom of each covered with a 50mm layer of pea-sized gravel. This is to protect the surface from being scoured when water is added.

Pre-soaking

The test hole should be filled with clean water to a depth of 300mm above the gravel and this level should be maintained for at least eight hours prior to percolation measurements. Automatic siphons or float valves may be employed for this purpose. It may be difficult to maintain the water level in coarse, sandy soils and in such cases it is only necessary to fill the hole twice to a depth of 300mm above the gravel. The percolation test should immediately follow pre-soaking.

Percolation test

After the initial pre-soaking, the level of the water above the gravel should be allowed to drop to 180mm, and from this point onwards the percolation rate should be measured. The drop in the level should be measured at selected, constant intervals of between 5 and 60 minutes. A greater interval should be chosen as the percolation rate decreases. If the depth of the water above the gravel decreases to 130mm, water should be added in order to return this depth to 180mm while measurements continue. The test should continue until the drop in water level for two successive intervals does not vary by more than 10 per cent.

The percolation rate is calculated for each test hole by dividing the magnitude of the last drop in water level by the time taken, and this rate is expressed in millimetres per hour. The average percolation rate for the site (or parts of the site) should be calculated using the geometric mean method. (the n-th root of the product of n-measured rates).

THE SUITABILITY OF THE SITE

The values given below should serve only as a guide, to enable one to decide whether the soil conditions are suitable for a specific sanitation system.

A percolation rate of 1000mm/hour

Any on-site sanitation system may be considered, but special attention should be given to possible pollution of groundwater. It is recommended that the sand or gravel layer at the bottom of pits or soak-aways be replaced with a 600mm thick layer of loamy sand to enhance purification.

A percolation rate of 300 to 1000mm/hour

Any on-site sanitation system may be considered, but possible pollution of groundwater should not be overlooked.

A percolation rate of 100 to 300mm/hour

Any on-site sanitation system may be suitable; however, sites should be individually evaluated for septic tanks.

A percolation rate of 25 to 100mm/hour

Such sites may not be suitable for septic tank systems, especially if the sites are small.

A percolation rate of 15 to 25mm/hour

Suitable for all sanitation systems other than septic tank systems.

A percolation rate of 8 to 15mm/hour

Suitable for all dry sanitation systems, or possibly for semi-dry systems.

A percolation rate of 8mm/hour

Not all liquids may seep into the soil and therefore the site is unsuitable for systems requiring soak-aways. Pit latrines may function not as dry, but as wet, systems. More frequent emptying of such pits may be necessary in some cases.

Annexure I: Details of Manhole Floors

Slopes in manhole floors

- The minimum slope in any manhole from inlet pipe to outlet pipe in a straight line is the greater of:
 - 50mm
 - The slope of the inlet pipe, or
 - The slope of the outlet pipe.
 -
 - Where there is a change of direction in a manhole, the minimum height difference between inlet and outlet pipes should be increased to allow for the loss in energy around the bend.
- The minimum height difference in any case shall be 50mm.
- The following table gives an indication of the fall in manholes (mm), for various bends and pipe sizes.

Diameter	150Ø				250Ø				300Ø			
Angle	0°	22,5°	45°	90°	0°	22,5°	45°	90°	0°	22,5°	45°	90°
Gradient												
1:20	60	79	98	136	60	79	135	210	60	108	156	251
1:30	40	53	65	90	40	65	90	140	40	72	104	168
1:40	30	39	49	68	30	49	67	105	30	54	78	125
1:50	24	32	39	54	24	39	54	84	24	43	62	100
1:60	20	26	33	45	20	32	45	70	20	36	52	84
1:70	17	22	28	39	17	28	38	60	17	31	44	72
1:80	15	20	24	34	15	24	34	52	15	27	39	63

$$\text{Energy loss due to bend (in metres)} \quad h_b = k_b \frac{v_f^2}{2g}$$

k_b = Energy loss coefficient, which is a function of change in direction

v_f = Velocity in pipe at full flow conditions

Values of k_b

Angle	k_b
0 - 22,5°	0 - 0.1
22,5° - 45°	0.1 - 0.2
45° - 90°	0.2 - 0.4

Annexure J: JW Encroachment Conditions & Requirements

PUBLIC SERVICES OVER JW SERVITUDES

Listed hereunder are Johannesburg Water's conditions and requirements regarding encroachments over its sewer servitudes by public services.

1. Public services will only be permitted to cross servitudes on the express understanding that should access to the outside of a sewer be necessary for maintenance purposes, and such access will be hindered by the presence of public services, then such services will be removed by Johannesburg Water at the expense of the owner of the services, and no responsibility will rest on Johannesburg Water for the reinstatement of any such removed facility, nor for any consequences thereof. Should this requirement be unacceptable, then the pipe must be enclosed in a culvert of sufficient size to permit access to the outside of it from within the culvert. The design of such a culvert must be approved by Johannesburg Water before construction.
2. No additional loads over those that already exist are to be exerted over the pipes. In the case of large services such as roads and large diameter pipelines, a report by a registered professional civil engineer stating that the pipe can withstand the loads imposed by such services will be required. Failing this, suitable protection measures, such as slabs or culverts, must be designed under the supervision of the engineer, and these must be submitted for approval by Johannesburg Water.
3. There must be a clearance of at least 300mm between the underside of any service and the top of the pipe.
4. Where stormwater pipes or channels are to cross the servitude, they are to have sealed joints within the servitude area to prevent possible scour.
5. No heavy earthmoving machinery or equipment will be permitted to operate over JW pipelines. All excavations over the pipelines shall therefore be done by hand.
6. Should blasting be necessary in the vicinity of the pipeline, this JW must be consulted beforehand. The requirements of the Explosive Act and Regulations should be adhered to insofar as they are applicable. No blasting will be permitted within the servitude area nor immediately adjacent to a pipeline.
7. The positions of the services crossing JW servitudes should be clearly marked by means of suitably placed bollards. In addition, it is advisable to lay a strip of marker tape approximately 300mm below ground and above sensitive services such as electricity cables and water mains.
8. Whilst reasonable care will be taken when executing maintenance activities within the servitude areas, Johannesburg Water will not be liable for accidental damage, nor the consequences thereof, to other services within such areas, unless due to gross negligence on its part.

9. Johannesburg Water must be notified at least seven days before undertaking any work within the servitude area.

ENCROACHMENT OVER JW SERVITUDES BY PRIVATE DEVELOPMENTS

1. Under no circumstances whatsoever may any permanent structure be erected over a JW servitude. A permanent structure may be classified as one that requires the submission to and approval of plans by the local authority before construction may take place, but also includes swimming pools, tennis court, fish ponds, etc. This restriction applies to encroachments at ground level, below ground level, and aerial encroachments up to ten metres.

Should any contraventions of this clause be brought to the notice of Johannesburg Water the matter will be referred to the Council with a recommendation that the permanent structure be demolished or removed at the property owner's cost.

2. Where a JW service is laid in tunnel with a cover of more than 25 metres, clause (1) above will not apply. However, in such circumstances, no basement, deep rooted trees, boreholes, nor wells will be permitted within the servitude area.
3. The erection of garden and yard partitions, the laying of internal pipelines and services, and the construction of pathways and roadways over JW servitudes will be permitted subject to the under-mentioned restrictions.
4. No additional loads over those that already exist are to be exerted over a JW pipeline. In the case of large load bearing services, such as roads and large diameter pipelines, a Professional Engineer (Civil) shall be appointed by the owner to determine and report on whether the pipe will be able to support the maximum anticipated load, and if not, suitable protection measures shall be designed and submitted to Johannesburg Water for approval.
5. Notwithstanding the implementation of protective measures referred to in (4), any damage to a pipe, and any consequences thereof, as a result of loading within the servitude, will be the responsibility (in terms of liability) of the owner.
6. Should Johannesburg Water need to undertake maintenance operations within a servitude area, and should this work be hindered or obstructed by the presence of pipes, services, partitions, pathways, roadways, or structures of any kind, then such obstruction will be removed by Johannesburg Water at the expense of the owner, and no responsibility will rest on Johannesburg Water for the reinstatement of any such removed facility nor for the consequences of such removal.
7. The owner shall enter into an encroachment agreement with Johannesburg Water covering all works to be carried out by the owner within the servitude area and stating the above mentioned conditions.

8. The owner shall indemnify and hold harmless Johannesburg Water in respect of any loss or damage to property or persons that may occur as a result of allowing any encroachment over the servitude, and the owner shall be responsible for any such loss, costs, or damage.

Annexure K: Rand Water Conditions & Requirements

STANDARD CONDITIONS FOR CROSSING OF RAND WATER SERVICES

OCTOBER 2002

(Please contact Rand Water for any updated version of these conditions)

1. SERVICE CROSSINGS:

- 1.1 The number of crossings of Rand Water's pipeline/s and servitude/s or proposed servitude/s shall be kept to a minimum; such crossings shall be as close to 90 degrees (right angles) as possible and the cover over its pipeline/s shall not be materially altered.
- 1.2 No service shall be less than one metre from a joint in Rand Water's pipeline/s and a space of not less than 300 mm shall be maintained between any service and Rand Water's pipeline/s at the point of crossing, or as separately specified. Where Rand Water's pre-stressed concrete pipeline is crossed, this space shall be measured from the lightning protection wires installed above and below the pipeline. For service crossings under those of Rand Water, where further larger diameter pipelines are installed in the servitude in the future, Rand Water may require the service owner, at its own cost, to lower its service to comply with the foregoing.
- 1.3 No service running parallel to Rand Water's pipeline/s, no box, manhole, structure supporting any service, footing of any pylon, pole or stay wire and no stormwater culvert and / or appurtenances shall be within two metres of Rand Water's pipeline/s or on Rand Water's servitude/s or proposed servitude/s or discharge thereon unless the prior written permission of Rand Water has been obtained.
- 1.4 Half-round concrete pipes or other approved protection shall be placed over any cable that is within two metres of Rand Water's pipeline/s or on Rand Water's servitude/s or proposed servitude/s.
- 1.5 Where any service crosses Rand Water's servitude/s or proposed servitude/s, it shall be laid at minimum grade (sewers and stormwater) / at an even depth below ground level (all other services) over the entire servitude / proposed servitude width and its position where it intersects Rand Water's pipeline/s, servitude/s or proposed servitude/s shall be clearly indicated by suitable markers. Sewer crossings shall be designed to span over Rand Water's existing and proposed pipeline trenches.

2. ROADS AND RAILWAY LINE CROSSINGS:

- 2.1 Rand Water shall have unimpeded vehicular access to its pipeline/s at all times for inspection and maintenance purposes. Culverts shall be provided at all railway line crossings to provide such access. Under roadways culverts will be required unless it can be proved to Rand Water that traffic density and the cover over the pipeline/s will not adversely affect Rand Water in the exercise of its rights and that excavation through the road layers to gain access to the pipeline/s is acceptable to the service owner. In general, the cover over Rand Water's pipeline/s may vary between 800 mm and 1 500 mm however, an undisturbed layer of at least 300 mm shall be maintained between the pipeline/s and the roadworks during construction unless relaxed by Rand Water in writing. Reinforced concrete box culverts with compartments having minimum internal dimensions as indicated on Rand Water's standard drawings No. B1933 and B1934 shall be provided for both existing and future pipelines. Culverts shall preferably be drained by a gravity system.
- 2.2 Long diagonal crossings of Rand Water's pipeline/s and servitude/s or crossings of bends in Rand Water's pipeline/s shall be avoided. If this is not possible, Rand Water's pipeline/s shall be deviated so as to cross the proposed road/railway line at approximately right angles.

- 3. PIPELINE PROTECTION AND / OR DEVIATION AT DESIGN STAGE:**
- 3.1 Where any development affects the discharge of water from Rand Water's scour valves, arrangements shall be made in collaboration with Rand Water's Manager Bulk Water Services to accommodate, channel or divert such flow.
- 3.2 Detailed proposals, including longitudinal sections along Rand Water's pipeline/s depicting the level of the road/railway line or other service in relation to the pipeline/s, shall be submitted for Rand Water's approval before the commencement of proposed construction work.
- 3.3 It may be necessary for Rand Water itself to strengthen the lead-caulked joints of its pipeline/s located under roadways or in culverts, by means of double tapers, the fabrication of which requires at least two months notice. Such strengthening shall extend to a distance of at least two metres beyond the road prism/kerb line, measured at right angles to the road direction. (The estimated cost of which is R 7 000 per joint). The actual cost of joint strengthening shall be borne by the service owner who shall be responsible for all excavation and backfilling.
- 3.4 Since lengthy delays can occur between the planning and construction stages, the proposed dimensions of the culverts shall be confirmed by Rand Water at least 12 months before construction work commences.
- 3.5 All planning, survey work, preparation of designs, specifications and drawings shall be undertaken by the service owner or its consulting engineers and submitted to Rand Water for approval. A copy / Copies of the relevant specimen specification/s will be provided, on request, when more details of the work to be performed are known.
- 3.6 Contractors approved by Rand Water shall be engaged to undertake all construction work, including :
- (a) manufacture, supply and delivery of pipes;
 - (b) excavation and backfill of trenches etc;
 - (c) laying and jointing of pipes;
 - (d) recovery of redundant pipes; and
 - (e) construction of the necessary structures.
- 3.7 Rand Water shall be given reasonable notice prior to the commencement of the fabrication as well as the installation of pipes to enable it to undertake the necessary inspection work.
- 3.8 Except for the manufacture of pipes, which will be inspected by Rand Water or its agents, all work shall be supervised by the service owner or its consulting engineers who will also undertake all necessary negotiations with property owners and local authorities affected by any possible relocation of Rand Water's pipeline/s and obtain agreement from them in principle for the accommodation of Rand Water's pipeline/s in the proposed relocated position/s.
- 3.9 Where Rand Water is required to relocate its pipeline/s or servitude/s, the service owner shall bear the cost of the cancellation of Rand Water's servitude/s as well as the costs of acquiring, surveying and registering new servitudes that will provide Rand Water with rights equal to those provided by the servitudes to be cancelled.
- 3.10 Co-ordinates of the alignment of any proposed relocation/s shall be submitted to Rand Water to prepare the statutory notices for relocation/s of its pipeline/s. Relocation shall not take place until Rand Water has issued such statutory notices.
- 3.11 During the period April to August in any year, at a time suited to its water supply operations, Rand Water will, on receipt of 21 days notice, circumstances permitting, make the end connections from the deviations to the existing pipeline/s. Daywork rates shall be included in the pipelaying contract documents to allow for assistance to Rand Water.
- 3.12 Ownership of portions of the pipeline/s that become redundant as a result of relocations carried out at the service owner's cost will be transferred to it. If requested, Rand Water may

take into stock pipes and / or valves recovered in good condition and credit the service owner with the value determined by Rand Water. Materials thus taken into stock shall be delivered to Rand Water's pipe yard at its Zwartkopjes pumping station by and at the cost of the service owner.

- 3.13 The service owner hereby indemnifies Rand Water against any claim arising from the non-removal and disposal of any portion of Rand Water's pipeline/s made redundant by a relocation.
- 3.14 No pipeline in its relocated position shall be subject to the provisions of the Advertising on Roads and Ribbon Development Act No 21 of 1940 or the National Roads Act No 54 of 1971 as amended.

4. PIPELINE PROTECTION AND / OR DEVIATION AT CONSTRUCTION STAGE:

- 4.1 Rand Water's Manager Bulk Water Services (Telephone 011 724 9000) shall be notified and his permission obtained before any work is carried out within five metres of Rand Water's pipeline/s, servitude/s or proposed servitude/s and before backfilling any excavation exposing Rand Water's pipeline/s - Please quote inspection order No. as specified separately.
- 4.2 If detailed information of the positions or levels of the pipeline/s is required the pipeline/s may be exposed by the service owner or its consulting engineers, provided that the foregoing condition is complied with.
- 4.3 In terms of Regulation 10.17.1 of the Explosives Act No 26 of 1956, written confirmation of the measures proposed to protect Rand Water's pipeline/s shall be obtained from Rand Water for any blasting to be undertaken within 500 metres of its pipeline/s. The service owner shall be responsible for ensuring that the approved protection measures are complied with and that Rand Water's Manager Bulk Water Services is notified at least 24 hours in advance of each blast.
- 4.4 The pipeline/s shall be supported at not greater than five metre centres in culverts and where excavation takes place under the pipeline/s during construction.
- 4.5 No heavy earthmoving or compaction equipment shall be operated within two metres of the steel or five metres of the prestressed concrete pipeline/s unless specific proposals have been approved by Rand Water.
- 4.6 The prestressed concrete pipeline/s shall be haunched under the road or supported on pedestals where crossed by services located thereunder in accordance with the details depicted on Rand Water's drawing A3993, a print of which is available on request. Such haunching shall extend for a distance of two metres beyond the edge of the roadway on both sides, or to such greater length as may be required to complete the haunching of the nearest whole pipe length.

5. CATHODIC PROTECTION AT STEEL PIPELINE CROSSINGS:

- 5.1 Two 16 square millimetre leads or one 35 square millimetre lead appropriately marked must be provided at each crossing point and the crossing shall not be backfilled until Rand Water's staff have installed similar test leads on Rand Water's pipeline/s. The Electrolysis Section (011 682 0239 or 0240) must be contacted for the connections to Rand Water's pipeline/s.
- 5.2 The pipe to ground potential of Rand Water's pipeline/s at the crossing point will be monitored before installation of the service owner's steel service and that potential must be maintained irrespective of the cathodic protection applied to the service owner's steel service after installation.

6. INDEMNITY :

- 6.1 The service owner shall indemnify Rand Water against all claims for damage arising out of, and will be held liable for any damage that may be caused to Rand Water's pipeline/s and/or appurtenances as a result of any crossing during construction or the installation/construction and/or the presence of any service/road/railway line and/or appurtenances on Rand Water's servitude/s or within two metres of Rand Water's pipeline/s. Rand Water shall not be liable for any damage to any service/road/railway line and/or appurtenances that may be caused by it in the exercise of its rights, provided that Rand Water will remain liable for any damage that is proved to have resulted directly from the wrongful action of its employees.

7. **COSTS:**

- 7.1 The service owner shall bear the cost of any protective measure that may be necessary in order to prevent the exchange of stray direct currents between the cable/s or pipe/s and Rand Water's pipeline/s, the protection of existing installations and of making provision to accommodate future services, as outlined above as well as the cost of repairs to the lightning protection wires installed approximately 100 mm above and below Rand Water's prestressed concrete pipeline/s or to Rand Water's telemetering cable/s necessitated by the installation of the proposed service, and will be debited with all costs incurred by Rand Water on its behalf on the usual terms of actual cost plus 10% (ten per cent) for administration.

8. **ACCEPTANCE OF CONDITIONS:**

- 8.1 The above conditions together with Annexure B (Vaal Barrage Conditions) - if relevant, and any foregoing special requirements shall be accepted in writing by the service owner before any work may commence. If no reply is received within 60 days from date of Rand Water's written notification, the conditions will be deemed to have been accepted by the service owner.