C3.4: PARTICULAR SPECIFICATIONS

In addition to the Standardised and Project Specifications, the following Particular Specifications / Policies shall apply to this contract:

PSX BRICKLAYING

PSX 1 SCOPE

This section of the Specification covers all aspects of brickwork, including building in of various items, reinforcing of brickwork, etc, as well as the supply of all materials and labour.

PSX 2 MATERIALS

PSX 2.1 STANDARDS

All materials used shall comply with the following standard specifications, the latest of which shall be held to apply:

SABS 28	Metal ties for cavity walls
SABS 227	Burnt clay masonry units
SABS 471	Portland cement
SABS 626	Portland blast-furnace cement
SABS 831	Portland cement 15 and rapid-hardening Portland cement 15
BS 1200	Sand for plaster and mortar, Concrete Masonry Assoc: The Masonry Manual

PSX 2.2 MASONRY UNITS

PSX 2.2.1 GENERAL

Bricks shall be free from cracks, chips or other defects, and at least one end of 20% of the bricks shall have the same general colour and texture as the faces.

Special care shall be exercised in loading, stacking and handling face bricks, as no damaged bricks shall be used, and bats may only be used where required to obtain bond.

General-purpose stock bricks or common bricks shall have a minimum average compressive strength of 7 MPa unless otherwise specified. Where stock bricks are required for load-bearing walls or foundations, then the compressive strength shall be 28 MPa.

Facing bricks shall be of the type, origin and colour specified in the Schedule of Quantities or on the drawings and shall be selected for uniformity of dimension and colour.

Satisfactory proof of the load-bearing capacity of bricks offered shall be submitted before

deliveries are made to the site.

For samples, 6 units of each type of brick shall be submitted to the Engineer for approval. All subsequent deliveries shall be to the standard of the approved samples.

All bricks which, in the opinion of the Engineer, do not comply with the abovementioned requirements, shall be removed from the site forthwith at the Contractor's cost.

PSX 2.2.2 BURNT CLAY BRICKS

Burnt clay bricks shall comply with SABS 227 and:

Engineering bricks shall be of high compressive strength and durability, with 49 a minimum average compressive strength and selected for their uniformity of dimension and shape. Bricks shall be clay and pressed or wire-cut. Water absorption after a 24-hour test shall not exceed 12% by mass.

Facing bricks shall have a minimum average compressive strength of 28 MPa. Bricks shall be clay and pressed to wire cut. Water absorption after a 24-hour test shall not exceed 12% by mass. Bricks shall have sharp, clean and well-defined edges.

General purpose stock bricks or common bricks suitable for general building work shall be clay, pressed or wire cut, even in size, smooth in texture and with sharp well defined arises. Water absorption after a 24-hour test shall not exceed 14% by mass.

PSX 2.3 CEMENT

Cement used in masonry shall comply with the requirements of SABS 471, SABS 626 and SABS 831.

PSX 2.4 FINE AGGREGATE (SAND)

Fine aggregates used in mortar shall be naturally occurring sand or consist of crushed rock or gravel, or a combination thereof, with naturally occurring sand being hard, clean and free from dust, shale, clay, loam, roots and other impurities.

Fine mortar aggregates shall comply in all respects with SABS 1090.

PSX 2.5 WATER

Water shall be clean and free from injurious amounts of acids, alkalis, sugar and other organic substances. Water suitable for drinking purposes shall be acceptable. If so required by the Engineer, the suitability of water shall be proved by tests carried out by an approved laboratory.

PSX 2.6 MORTAR

Mortar shall unless otherwise specified, be Class II mortar and shall consist of 1 part

Portland cement, one part hydrated lime and 5 parts of sand by volume for normal brickwork. Mortar for foundations, lintels and for all load bearing walls higher than 3000 mm shall be Class I mortar and shall consist of 1 part Portland cement, ¼ part hydrated lime and 4 parts sand. The ingredients shall be measured in proper gauge boxes on a timber or steel-mixing platform with water added and thoroughly mixed in to obtain a uniform consistency throughout. Alternatively, mixing may be by means of an approved mechanical batch mixer.

In the case of a cement-milled slag mortar, the sand and slag shall be mixed first and then the cement added.

Cement mortar shall be used within two hours of the first contact of the cement with water. No mortar which is older than two hours or has begun to set shall be used.

PSX 2.7 WALL TILES

Metal wall ties in brickwork and blockwork shall be galvanised crimped steel, single wire type, 4 mm diameter minimum, complying in all respects with SABS 28.

Ties cavity walls shall be PWD butterfly type formed of 4mm diameter steel wire, galvanised class A for coastal conditions, and to such lengths that no less than 75mm can be built in at each end.

PSX 2.8 REINFORCEMENT

Wall reinforcement shall consist of two 3.15 mm diameter longitudinal wires at appropriate centres for the thickness of the wall, with 2.80 mm diameter cross wires welded to the longitudinal wires at 300 mm centres. All wire used shall be of high tensile steel.

PSX 2.10 CONCRETE TO BRICKWORK TIES

Ends of junctions of brick walling to concrete are to be tied to the concrete by means of 1.6 x 32 x 500 mm galvanised hoop iron ties.

Brick linings to concrete are to be tied with 4 mm diameter crimped galvanised wire ties to SABS 28.

PSX 2.14 STORAGE OF MATERIALS

Cement and aggregates shall be stored in such a manner as to prevent deterioration or contamination by foreign matter, damp, and chemicals spilt on the ground or which may settle out of the atmosphere.

Perishable materials likely to be damaged by exposure shall be stored under cover.

PSX 3 EQUIPMENT

The Contractor shall provide and maintain in good working order, adequate equipment for

carrying out the required work in accordance with this specification in a sage efficient manner.

PSX 4 CONSTRUCTION

PSX 4.1 BRICKWORK GENERALLY

All brickwork shall be laid in stretcher bond, plumb and true to line. Mortar beds shall be 10 mm thick, unless otherwise described, and are not to exceed 12 mm in thickness, and no four successive joints shall rise more than 40 mm (for 10 mm joints). Clay bricks are to be well wetted (saturated in hot weather) with water before being laid, and the course of bricks laid last shall be well wetted before fresh bricks are bedded upon it. Bricks shall be well buttered and laid on a full bed of mortar, and joints shall be flushed up.

Bricks in the foundation walling are to be extra hard. Beam filling is to be built to a depth of 106 mm, and the space between the beam filling and the roof covering shall be filled with a stiff mixture of 1 to 3-cement mortar tightly pressed in. The brickwork shall be carried up in a uniform manner, no one section being raised more than 1,200 mm above another section at one time, and no brickwork is to be carried more than 4 courses above immediately adjoining or intersecting brickwork. Block bonding or toothed and keyed construction will only be allowed in alterations to existing work.

One-brick walls (230 mm) built stretcher bond in two skins shall be tied together with galvanised wall ties staggered not more than 1 m apart horizontally and every fourth course vertically with extra ties at reveals and openings, etc., as may be necessary. Brick linings to concrete walls shall similarly be tied together, while galvanised hoop iron ties cast into concrete columns shall be built into the joints of butting brick walls as specified. Where specifically required, the outer face of the inner skin of all external one-brick walls above the damp course level shall be waterproofed before the outer skin is built up. The face to be treated shall be bagged over until all crevices are filled. When thoroughly dry, the face shall be twice coated with an approved liquid bituminous compound and worked around wire ties to produce an unbroken waterproof coating.

Where called for on the drawings, wall and concrete ceiling surfaces shall be bagwashed with a wet sack dipped in liquid cement grout whilst the mortar in the brickwork joints is still soft until all joints and crevices are eventually filled. Projections of concrete shall be rubbed off, and any defects shall be made good in cement mortar.

PSX 4.2 REINFORCED BRICKWORK

Brickwork over door and window openings shall be reinforced with welded wall reinforcement placed in each course of brickwork over openings for a minimum of 4 courses or as shown on the drawings. Reinforced brickwork shall continue at least one and a half bricks on either side of the opening. Where two of more openings are less than 675 mm apart, the reinforced brick lintels shall be continuous over all such openings and their dividing piers, plus 1½ brick bearing at both extreme ends.

Brick lintels in cavity walls, which are exposed to the weather, shall have a continuous

damp-proof bourse built into the outer skin of the wall immediately above the lintel to cover the top of the lintel, raked up one course and carried through the inner skin.

Where called for on the drawings, brickwork shall be reinforced with wall reinforcement laid in every fourth course of all brick walling or as directed by the Engineer. The reinforcement shall be built truly central to the wall, and all longitudinal laps shall not be less than 450 mm. Reinforcement in half-brick walls shall be built 106 mm into the main cross walls.

PSX 4.3 FACE BRICKWORK

All facings shall be kept clean during the progress of the work, and face-brick surfaces with mortar spattering will not be accepted. Unless otherwise specified, the horizontal and vertical joints shall be pointed and finished with a round key joint and both rubbed smooth as the building work proceeds.

The various colours of the face bricks shall be selected and mixed at random to prevent portions of the face work showing a preponderance of one colour. Where sufficient storage is available on site, the full quantity of face bricks required for the works (or such quantity as to keep supply well advanced of construction) shall be delivered to the site.

PSX 4.4 FAIRFACE BRICKWORK

Where called for on the drawings and in the Schedule of Quantities, internal walls shall be of smooth stock-bricks, built fair and kept clean during construction and jointed as in Clause PSX 4.3.

PSX 4.5 PRECAST PRESTRESSED CONCRETE LINTELS

Approved precast prestressed concrete lintels of suitable size the thickness of the wall and the width of the opening shall be used over openings in plastered and bagged walls.

Wherever possible, the minimum bearing for precast prestressed lintels, at their ends and over intermediate supports, shall be:

a) for openings not exceeding 600 mm - ½ brick (115 mm)
b) for openings exceeding 600 mm - 1 brick (230 mm)

Where this requirement necessitates a total lintel length exceeding 6.6 m, a joint may be introduced centrally over an intermediate pier in a position to be approved by the Engineer. Such joints shall be stiffened by the introduction of welded wall reinforcement as specified in PSX 4.2 and extending a minimum of 300 mm on either side of the joint, i.e. 600 mm minimum total length.

PSX 4.6 CONCRETE/BRICK TIES

At the end of the junction of brick walls with concrete columns or walls, brickwork is to have galvanised hoop iron ties built into the joints of each ½ brick skin at maximum 8 course

height intervals alternately to each skin or at 4 course height intervals if single skin only. Ties are to be cast into concrete at course heights by tacking L-shaped ties to the inside face of shutters and bending down ends for building in after shutters are stripped, or shot fixed to concrete with approved nails and strength of shot to provide adequate fixing.

Galvanised crimped wire ties for fixing of brick linings to concrete are to be cast a minimum 75 mm deep into concrete at brick course eights (four per square metre staggered), bent down after shutters are stripped and built into brickwork.

PSX 4.7 DOORS

Timber for doors shall be selected, well-seasoned, kiln-dried Red Meranti and shall be treated with an approved oil-soluble preservative. The following preservative is recommended: 5% Pentachlorophenol in a vessel consisting of 50% white spirits and 50% power paraffin or 100% white spirits. The Contractor shall obtain and submit to the Engineer a certificate from the merchant supplying the timber or doors to the effect that the timber has been treated as required.

After erection, doors shall be well sanded and prepared, and then coated with two coats of an approved penetrating sealer compatible with the treatment applied to the timber.

PSX 4.8 LOUVRES

Louvres and frames shall be manufactured from prepainted galvanised steel sheet coated on both sides. The coating shall comply with the manufacturer's specifications for 'Chromadek' with PVC Plastisol coating or 'Colomet' and 'Versacor' base and SMP weathering coat, or similar coating approved by the Engineer.

PSX 4.9 BRICK CLADDING TO EXPOSED FACE

The brick cladding to the outlet chamber and to the exposed faces of the reservoir wall shall consist of a single skin of face bricks as obtained from Independent Brick Supplies (or similar approved) and laid in bands as directed by the Engineer. This skin is to be fastened to the concrete as specified elsewhere.

The brickwork shall be in stretcher bond 4 1 cement mortar. The brickwork shall be supported on suitably staggered concrete ledges with cross-sectional dimensions of 150 mm by 150 mm. R10 reinforcing starter bars will be used to tie the ledges into the reservoir wall, and two Y10 bars shall be used in the longitudinal direction. The slope of the bank against the wall is to be indicated on the drawings.

Payment for the formwork for reinforced concrete ledges shall be per metre and shall include the following: -

a) the positioning and staggering of the brickwork support ledges to keep a minimum depth to the top of the ledges of 150 mm below finished ground level.

b) supply erection and stripping of the necessary shuttering and temporary

supports.

Payment for the brickwork shall be by the square metre and shall include the supply and laying of all materials, including the galvanised steel ties as specified, and their installation.

PSX 4.10 SUNDRIES

a) Rough and fair cutting shall be performed as required, and the brickwork fitted around structural steelwork. Face brickwork shall be carefully cut and fitted when next to the finishings.

b) Chases shall be left or formed in brickwork for edges of concrete floors, roofs, staircases, etc. Vertical chases shall be provided in brickwork and blockwork wherever required for pipes, conduits, switch boxes, distribution boards, etc.

c) Oversailing courses, corbels, etc., should be built where required.

d) Ends of cills, thresholds, step joints, etc, shall be built in, cut, or pinned in cement mortar where required.

e) Steel windows to be built into walls shall be set plumb and true with the cill bar resting on wedges to ensure that it is perfectly level. All lugs shall be bolted up tight and built in solid as walling proceeds, the channel frame of the window being caulked tight with Class B (1-¼-4) cement mortar, pointed up neatly all round and made watertight.

f) Passed steel doorframes shall be securely strutted when placed in position to prevent distortion of any kind during building. The frame shall be built solidly into the walls and grouted solidly at the back with 12:3 cement mortar as the work proceeds and properly pointed all around.

g) Timber doorframes and windows to be built into walls shall be primed before building in and set plumb and true. The underside of each vertical to the doorframes shall be provided with a 12 mm diameter steel peg projecting 75 mm from the bottom of the frame and these pegs shall be securely grouted into the floor threshold. 2 mm thick hoop iron cramps 40 mm wide, screwed to frames shall be built 450 mm into walls with ends turned up, four cramps to each jamb. At flush junctions of walls and frames a V-joint shall be ruled between frame and wall rendering. The junctions between timber frames or windows and face brickwork or unrendered concrete on external faces shall be sealed by pointing around the timber frames with an approved polysulphide-based waterproofing compound finished off in a neat and workmanlike manner.

h) All necessary openings for ends of timber, gratings, cramps, holdfasts, dowels, consecutive bedding wood plugs and slips for fixing jointer's work, hoop iron ties, etc., shall be formed, built in with 1:3 cement mortar, and made good with properly performed rough and fair cuttings.

i) Damp proof courses shall be formed in the walls as described by building three joints and all vertical joints between solid walls in 2:1 cement mortar with an approved waterproofing compound added in accordance with the manufacturer's instructions.

PSX 5 TOLERANCES

PSX 5.1 TOLERANCES

Tolerances for clay brick dimensions, strength, warpage and efflorescence shall be as SABS 227.

PSX 5.2 DEGREE OF ACCURACY

Permissible deviations in the final finished surfaces to the degree of accuracy required will be applied to linear dimensions, position, verticality, level, squareness and bow.

The degree of accuracy may be one of the following:

Degree of accuracy III for use where a high degree of accuracy is unnecessary, e.g. mass storage warehouse walls and floors.

Degree of accuracy II for what is commonly called “good work”.

Degree of accuracy I where the use of special, as opposed to normal, methods and/or materials is required.

PSX 5.3 TABLE OF PERMISSIBLE DEVIATIONS

		Permissible Deviation Degree of Accuracy			**Corobrick Brick**
	Classification Item Finish	III mm	II mm	I mm	Guide
PSX 5.3.1	Stock brickwork				
	- against earth	20	15	10	NFX
	- to receive plaster	17	10	7	NFP
	- to be bagged	13	8	5	NFP
	- fairface	8	5	3	FBS
PSX 5.3.2	Faced brickwork with bricks				
	- generally uniform in shape and size	8	5	3	FBS
	- high degree of				
	- uniformity in shape & size	5	3	2	FBX
	- non-uniform in shape	13	8	5	FBA
PSX 5.3.3	Out of alignment with				
	Adjoining finishes on	4	3.0	15	FBS
	projecting items	3.5	2.5	1	FBX
	(windows & door frames)	5	3.5	2	FBA
PSX 5.3.4	Out of verticality of perps				
	(dependent on bond)	40	15	5	
PSX 5.3.5	Out of alignment	2.5	2.0	1.5	FBS
	horizontally top edge to	2.0	1.5	1	FBX

		Permissible Deviation Degree of Accuracy			Corobrick Brick
	top edge adjoining bricks	3.0	2.5	2	FBA
PSX 5.3.6	Out of trueness vertically	2.5	2	1.5	FBS
	(top edge to lower edge	2.0	1.5	1	FBX
	Of next course)	3.0	2.5	2	FBA
PSX 5.3.7	Squareness of rooms - measured on the diagonals*	20	10	5	
PSX 5.3.8	Out of square or true of a corner or angle measured 300 mm from the angle*	7	4	2	

A similar degree of accuracy will be required to irregular shaped rooms. The governing factor shall be the general appearance, and it may be necessary or acceptable to depart from the above guidelines if required.

PSX 6 TESTING

PSX 6.1 COMPRESSIVE STRENGTH

Determination of the minimum average compressive strength of clay bricks shall be in accordance with SABS 227 at frequencies required by the Engineer.

PSX 6.2 COSTS OF TESTS

Costs of Tests described above shall be borne by the Contractor who shall be deemed to have included these costs in the scheduled rates for brickwork.

PSX 7 MEASUREMENT AND PAYMENT

PSX 7.1 BRICKWORK

The unit of measurement shall be square metre (m^2).

The unit of measurement for all brickwork shall be the square metre of the specified type and thickness laid. The measurement of the work will be taken net, with door and window openings deducted, but will include for lintels, airbricks, etc.

The rates tendered for ordinary brickwork shall be inclusive of supply of bricks, brickforce, lintels, airbricks, wall ties, damp proof course, mortar and everything necessary to erect the brick work shown on the drawings, and for testing, all plumbing of corners and faces, linings, levelling, ruling of joints, forming reveals and openings, cutting where necessary but not specially scheduled, supply and building in wall plugs, wall ties, etc, hoisting to

various levels, soaking all bricks in water before laying, any selecting of face-bricks on site to maintain an even texture when laid and for cleaning down with spirits of salts all facework on completion.

PSOH HEALTH AND SAFETY SPECIFICATIONS & BASELINE RISK ASSESSMENT

The health and safety specifications and baseline risk assessment outlines and issues/requirements specific to this project that need to be managed and can be found in Annexure C3.6.3

PEM ENVIRONMENTAL MANAGEMENT SPECIFICATION

PEM 1 PURPOSE

The purpose of the EMP is to encourage good management practices through planning and commitment with respect to environmental issues, and to provide rational and practical environmental guidelines to minimise disturbance of the natural environment.

PEM 2 RESPONSIBILITIES FOR ENVIRONMENTAL MANAGEMENT

The contractor will be responsible for environmental control on-site during construction and the maintenance period. The construction activities will be monitored by an independent environmental specialist and audited against the EMP.

PEM 3 TRAINING AND INDUCTION OF EMPLOYEES

The contractor has a responsibility to ensure that all those people involved in the project are aware of and familiar with the environmental requirements for the project (this includes sub-contractors, casual labour, etc.).

PEM 4 COMPLAINTS REGISTER AND ENVIRONMENTAL INCIDENT BOOK

Any complaints received by the project team from the community will be recorded. The complaint will be brought to the attention of the site manager.

All complaints received will be investigated and a response given to the complainant within 28 days.

All environmental incidents occurring on the site will also be recorded.

PEM 5 ENVIRONMENTAL SAFETY

The management of impacts associated with various categories of concern is discussed as separate topics, indicated below.

PEM 5.1 SOIL

(a) Topsoil should be temporarily stockpiled, separately from (clay) subsoil and rocky material, when areas are cleared. If mixed with clay sub-soil, the usefulness of the topsoil for rehabilitation of the site will be lost.

(b) Stockpiled topsoil should not be compacted and should be replaced as the final soil layer. No vehicles are allowed access onto the stockpiles after they have been placed.

(c) Stockpiled soil should be protected by erosion-control berms if exposed for a period of greater than 14 days during the wet season. The need for such measures will be indicated in the site-specific report.

(d) Topsoil stripped from different sites must be stockpiled separately and clearly identified as such. Topsoil obtained from sites with different soil types must not be mixed.

(e) Topsoil stockpiles must not be contaminated with oil, diesel, petrol, waste or any other foreign matter, which may inhibit the later growth of vegetation and micro-organisms in the soil.

(f) Soil must not be stockpiled on drainage lines or near watercourses without prior consent from the Project Manager.

(g) Soil should be exposed for the minimum time possible once cleared of invasive vegetation; that is, the timing of clearing and grubbing should be coordinated as much as possible to avoid prolonged exposure of soils to wind and water erosion. Stockpiled topsoil must be either vegetated with indigenous grasses or covered with a suitable fabric to prevent erosion and invasion by weeds.

(h) Limited vehicular access is allowed across rocky outcrops and ridges.

(i) All cut and fill surfaces need to be stabilised with appropriate material or measures when major civil works are complete.

(j) Erosion and donga crossings must be dealt with as river crossings. Appropriate soil erosion and control procedures must be applied to all embankments that are disturbed and destabilised.

(k) All equipment must be inspected regularly for oil or fuel leaks before it is operated. Leakages must be repaired on mobile equipment or containment trays placed underneath immobile equipment until such leakage has been repaired.

(l) Soil contaminated with oil must be appropriately treated and disposed of at a permitted landfill site, or the soil can be regenerated using bio-remediation methods.

(m) Runoff must be reduced by channeling water into the existing surface drainage system.

PEM 5.2 WATER

(a) Adequate sedimentation control measures must be instituted at any river crossings when excavations or disturbance of the riverbanks or riverbeds takes place.

(b) Adequate sedimentation control measures must be implemented where excavations or disturbance of drainage lines of a wetland may take place.

(c) All fuel, chemical, oil, etc., spills must be confined to areas where the drainage of water can be controlled. Use appropriate structures and methods to confine

spillages, such as the construction of berms and pans, or through the application of surface treatments that neutralise the toxic effects prior to the entry into a water course.

(d) Oil absorbent fibres must be used to contain oil spilt in water.

(e) During construction through a wetland, the majority of the flow of the wetland should be allowed to pass downstream.

(f) Vehicular traffic across wetland areas must be avoided.

(g) No dumping of foreign material in streams, rivers and/or wetland areas is allowed.

(h) The wetland area and/or river must not be drained, filled or altered in any way, including alteration of the bed and/or banks, without prior consent from the DWAF. The necessary licenses must be obtained in terms of Sections 21 and 22 of the National Water Act, 36 of 1998, from DWAF.

(i) No fires or open flames are allowed in the vicinity of the wetland, especially during the dry season.

(j) No swimming, washing (including vehicles and equipment), fishing or related activity is permitted in a wetland or river without written permission from the Project Manager.

(k) Disturbances to nesting, breeding and roaming sites of animals in or adjacent to wetland areas must be minimised.

PEM 5.3 AIR

(a) Speed limits must be implemented in all areas, including public roads and private property to limit the levels of dust pollution.

(b) Dust must be suppressed on access roads and construction sites during dry periods by the regular application of water or a biodegradable soil stabilisation agent. Water used for this purpose must be used in quantities that do not result in the generation of run-off.

(c) The site-specific investigation will quantify the impact of dust on nearby wetlands, rivers and dams in terms of sedimentation. Mitigation measures identified during the site-specific study must be implemented.

(d) The Contractor must notify the Principal of all schools within 50m of the site of proposed activities. The Principal must, in turn, ensure that children with allergies and respiratory ailments take the necessary precautionary measures during the construction period. The Contractor must ensure that construction activities do not disturb school activities, e.g. dust clouds may reduce visibility, affecting sports activities.

(e) Waste must be disposed of as soon as possible at a municipal transfer station, skip

or on a permitted landfill site. Waste must not be allowed to stand on site to decay, resulting in malodours.

(f) Noise control measures must be implemented. All noise levels must be controlled at the source. All employees must be given the necessary ear protection gear. IAPs must be informed of the excessive noise factors.

(g) The Contractor must inform all adjacent landowners of any after-hour construction activities and any other activity that could cause a nuisance, e.g. the application of chemicals to the work surface. Normal working hours must be clearly indicated to adjacent landowners.

(h) No loud music is allowed on site and in construction camps.

(i) No fires are allowed if smoke from such fires will cause a nuisance to IAPs.

PEM 5.4 SOCIAL AND CULTURAL

(a) Access by non-construction people onto any construction sites must be restricted. The Contractor's activities and movement of staff must be restricted to designated construction areas only.

(b) The Contractor's crew must be easily identifiable due to clothing, identification cards or other methods.

(c) Rapid migration of job seekers could lead to squatting and social conflict with resident communities and increase in social pathologies if not properly addressed. The Contractor must ensure that signs indicating the availability of jobs are installed.

(d) Criteria for selection and appointment (by the Contractor) of construction labour must be established to allow for preferential employment of local communities. The Local Authority must be actively involved in the process of appointing temporary labourers.

(e) Sub-Contractors and their employees must comply with all the requirements of this document and supporting documents, e.g. the Contract document that applies to the Contractor. Absence of specific reference to the sub-contractor in any specification does not imply that the sub-contractor is not bound by this document.

(f) No member of the construction workforce is allowed to wander around private property, except within the immediate surroundings of the site.

(g) The Contractor must provide suitable sanitation facilities for site staff. Sanitation provided during the construction phase should be managed so that it does not cause environmental health problems. The use of the surrounding veld for toilet purposes is not permitted under any circumstances.

(h) The Contractor must arrange for all his employees and those of his sub-contractors to be informed of the findings of the environmental report before the commencement

of construction to ensure:

- A basic understanding of the key environmental features of the work site and environments, and

- Familiarity with the requirements of this document and the site-specific report.

(i) Supervisory staff of the Contractor or his sub-contractors must not direct any person to undertake any activities which would place such person in contravention of the specifications of this document, endanger his/her life or cause him/her to damage the environment.

(j) The demand for construction materials and supplies will have an effect on the local economy. This impact can be optimised by sourcing and purchasing materials locally and regionally wherever possible, insofar as the material complies with the design specification.

(k) The Contractor must maintain a detailed complaints register. This must be forwarded, together with solutions, to the authorities when requested.

PEM 5.5 AESTHETICS

(a) Scenic Quality

Damage to the natural environment must be minimised.

Trees and tall woody shrubs must be protected from damage to provide a natural visual shield. Excavated material must not be placed on such plants, and movement across them must not be allowed, as far as practical.

The clearing of all sites must be kept to a minimum, and surrounding vegetation must, as far as possible, be left intact as a natural shield.

No painting or marking of natural features must be allowed.

(b) All above-ground structures could be treated or painted to blend in with the natural environment.

(c) Cut and fill areas, river and stream crossings and other soil stabilisation works must be constructed to blend in with the natural environment.

(d) Natural outcrops, rocky ridges and other natural linear features must not be bisected. Vegetation on such features must, as far as possible, not be cut unless absolutely necessary for construction.

(e) Excavated material must be flattened (not compacted) or removed from site. No

heaps of spoil material must be left on site once the Contractor has moved to a new construction site.

(f) Any complaints from interest groups regarding the appearance of the construction site must be recorded and addressed promptly by the Contractor.

PEM 5.6 ARCHAEOLOGY AND CULTURAL SITES

(a) All finds of human remains must be reported to the nearest police station.

(b) Human remains from the graves of victims of conflict, or any burial ground or part thereof which contains such graves and any other graves that are deemed to be of cultural significance, may not be destroyed, damaged, altered, exhumed or removed from their original positions without a permit from the South African Heritage and Resource Agency (SAHRA).

(c) Work in areas where artefacts are found must cease immediately.

(d) Under no circumstances must the Contractor, his/her employees, his/her sub-contractors or his/her sub-contractors' employees remove, destroy or interfere with archaeological artefacts. Any person who causes intentional damage to archaeological or historical sites and/or artefacts could be penalised or legally prosecuted in terms of the National Heritage Resources Act, 25 of 1999.

(e) A fence at least 2 m outside the extremities of the site must be erected to protect archaeological sites.

(f) All known and identified archaeological and historical sites must be left untouched.

(g) Work in the area can only be resumed once the site has been completely investigated. The Project Manager will inform the Contractor when work can resume.

PEM 5.7 FLORA

(a) All suitable and rare flora and seeds must be rescued and removed from the site. They must be suitably stored for future use in rehabilitation.

(b) The felling and/or cutting of trees and clearing of bush must be minimised.

(c) Bush must only be cleared to provide essential access for construction purposes.

(d) The spread of alien vegetation must be minimised.

(e) Any incident of unauthorised removal of plant material, as well as accidental damage to priority plants, must be documented by the Contractor.

(f) Woody vegetative matter stripped during construction must either be spread

randomly throughout the surrounding veld so as to provide biomass for other micro-organisms and habitats for small mammals and birds, or it may be stockpiled for later redistribution over the reinstated top-soiled surface. No vegetative matter must be burnt or removed for firewood other than that removed during the grubbing and clearing phase. Such vegetation can be made available to the local inhabitants to be used as firewood.

(g) No tree outside the footprint of the Works area must be damaged.

PEM 5.8 FAUNA

(a) No species of animal may be poached, snared, hunted, captured or willfully damaged or destroyed.

(b) Snakes and other reptiles that may be encountered on the construction site must not be killed unless the animal endangers the life of an employee.

(c) Anthills and/or termite nests that occur must not be disturbed unless it is unavoidable for construction purposes.

(d) Disturbances to nesting sites of birds must be minimised.

(e) The Contractor must ensure that the work site is kept clean and free from rubbish, which could attract pests.

PEM 5.9 INFRASTRUCTURE

(a) The relevant authorities must be notified of any interruptions of services, especially the Local Municipality, National Road Agency, Spoornet, TELKOM and ESKOM. In addition, care must be taken to avoid damaging major and minor pipelines and other services.

(b) The integrity of property fences must be maintained.

(c) No telephone lines must be dropped during the construction operations, except where prior agreement by relevant parties is obtained. All crossings must be protected, raised or relocated as necessary.

(d) All complaints and/or problems related to impacts on man-made facilities and activities must be promptly addressed by the Contractor and documented.

(e) Storage Facilities

- Proper storage facilities should be provided for the storage of oils, grease, fuels, chemicals and hazardous materials.

- The Contractor must ensure that accidental spillage does not pollute soil and water

resources.

- Fuel stock reconciliation must be done on all underground tanks to ensure no loss of oil, which could pollute groundwater resources.

- Cement must be stored and mixed on an impermeable substratum.

(f) Traffic Control

All reasonable precautions must be taken during construction to avoid severely interrupting the traffic flow on existing roads, especially during peak periods.

Before any work can start the Local Traffic Department must be consulted about measures to be taken regarding pedestrian and vehicular traffic control.

(g) Access Roads

The Contractor and the affected landowner must collaborate on the planning and construction of new access routes and the repair or upgrading of existing routes.

Access to the site must be controlled such that only vehicles and persons directly associated with the work gains access to the site.

Temporary access roads must not be opened until required and must be restored to its former state as soon as the road is no longer needed.

(h) Batching Plants

Concrete must be mixed only in an area demarcated for this purpose. All concrete spilled outside this area, must be promptly removed by the Contractor and taken to a permitted waste disposal site. After all concrete mixing is complete, all waste concrete must be removed from the batching area and disposed of at an approved dumpsite. Stormwater must not be allowed to flow through the batching area. Water laden with cement must be collected in a retention area for evaporation and not allowed to escape the batching area. Operators must wear suitable safety clothing.

(i) Chemical toilet facilities should be managed and serviced by a qualified company. No disposal or leakage of sewerage should occur on or near the site.

(j) Blasting

Blasting must not endanger public or private property.

Noise mufflers and/or soft explosives must be used to minimize the impact on animals.

All the provisions of the Explosives Act, 26 of 1956 and the Minerals Act, 50 of 1991 must be complied with.
The Contractor must take measures to limit flyrock.

PEM 5.10 SAFETY

(a) Measures must be taken to prevent any interference that could result in flashover of power lines due to breaching of clearances or the collapse of power lines due to collisions by vehicles and equipment.

(b) Measures must be taken during thunderstorms to protect workers and equipment from lightning strikes.

(c) All tall structures must be properly earthed and protected against lightning strikes.

(d) The process of excavation and backfilling must be carried out as a sequential process, following one another as quickly as possible. Excavations must only remain open for a minimum period of time, and during this time, they must be clearly demarcated. If excavations place the public at risk, these sites must be fenced.

(e) The residents directly affected by open trenches must be notified of the dangers. This will be done during the site-specific phase.

PEM 5.11 WASTE

Solid Waste

(a) Littering on the site and the surrounding areas is prohibited.

(b) Clearly marked litter bins must be provided on site. The Contractor must monitor the presence of litter on the work sites as well as the construction campsite.

(c) All bins must be cleaned of litter regularly.

(d) All waste removed from the site must be disposed of at a municipal/permitted waste disposal site.

(e) Excess concrete, building rubble or other material must be disposed of in areas designated specifically for this purpose and not indiscriminately over
(f) the construction site.

(g) The entire works area and all construction sites must be swept of all pieces of wire, metal, wood or other material foreign to the natural environment.
(h) Contaminated soil must be treated and disposed of at a permitted waste disposal site or be removed and the area rehabilitated immediately.

(i) Waste must be recycled wherever possible.

Liquid Waste

(a) The Contractor must maintain mobile toilets on site.

(b) The Contractor must provide adequate and approved facilities for the storage and recycling of used oil and contaminated hydrocarbons. Such facilities must be designed and sited with the intention of preventing pollution of the surrounding area and environment.

(c) All vehicles must be regularly serviced in designated areas within the Contractors camp such that they do not drip oil.

(d) All chemical spills must be contained and cleaned up by the supplier or professional pollution control personnel. Run-off from wash bays must be intercepted.

Hazardous Waste

(a) No hazardous materials must be disposed of in the veld or anyplace other than a registered landfill for hazardous material. Hazardous waste must be stored in containers with tight lids that must be sealed and must be disposed of at an appropriately permitted hazardous waste disposal site. Such containers must not be used for purposes other than those originally designed for.

(b) The Contractor must maintain a hazardous material register.

PEM 5.12 REHABILITATION AND SITE CLEARANCE

(a) When all major construction activities are completed, the site must be inspected to determine site-specific rehabilitation measures. This may be considered unplanned work, e.g. soil rehabilitation due to oil spills.

(b) All temporary buildings and foundations, equipment, lumber, refuse, surplus materials, waste, construction rubble, fencing and other materials foreign to the area must be removed.

(c) If waste products cannot be recycled, they must be disposed of at a permitted landfill site.

(d) All drainage deficiencies, including abandoned pit latrines and waste pits, must be corrected.

(e) Cut and fill areas must be restored and re-shaped.

(f) The area must be restored to its natural vegetation condition using indigenous trees, shrubs and grasses as directed by a grassland and/or rehabilitation expert.

(g) Borrow pits must be re-shaped into even slopes and surfaces to blend with the natural terrain, and topsoil must be replaced.

(h) The grass mix, shrubs and trees used for rehabilitation must be compatible with the species identified in the site-specific investigation.

(i) Areas compacted by vehicles during construction must be scarified to allow penetration of plant roots and the regrowth of natural vegetation.

PEM 6 MEASUREMENT AND PAYMENT

An item has been included in the Bill of Quantities to comply with the above actions.

PAA PARTICULAR SPECIFICATION: DAYWORK SCHEDULE

PAA 1 GENERAL

a) In cases where the Engineer orders any variation in the form, quality or quantity of the work or any extra work to such an extent that the tendered rates for specific items are no longer applicable, or where a combination of tendered rates cannot be applied to compensate for such work, the Engineer may, in terms of the General Conditions of Contract, order that the amended or extra work be carried out as daywork at the cost of labour, plant and materials. For that purpose, provision is made for the Contractor to tender his rates for labour and plant in the Daywork Schedule, which forms part of this contract.

b) No work will be measured as daywork unless:

   a. The Engineer agrees that the varied work is not in accordance with the specification or scope of a measured item in the contract;

   b. The Engineer has issued an order in writing for the execution of such varied work; and

   c. Statements of plant and labour are submitted daily to the Engineer for his consideration and approval.

c) All work valued at the tendered rates in the Daywork Schedule will be subject to contract price adjustment as applicable to the Contract.

PAA 2 SALARIES AND WAGES OF WORKMEN

a) The amount to be paid for labour will be based on the rates tendered in the Daywork Schedule for the workers executing the work. The tendered rates shall be all-inclusive and shall be held to cover all charges for the Contractor's profits, timekeeping, clerical work, insurance, establishment, superintendence, the use of hand tools, etc., and no additional surcharge over and above the tendered rates will be applicable.

PAA 3 CONSTRUCTIONAL PLANT

a) The rates for construction plant as tendered in the Daywork Schedule shall cover all costs, overheads and profit for the contractor, and no further surcharge will be payable on the tendered rates. The cost of operators shall be included in the tendered rates except where otherwise specified in Clause PAA-5 (Measurement and Payment) hereafter.

b) Where plant or equipment for which no rates exist in the Daywork schedule are employed, the cost thereof shall be determined as agreed with the Engineer in terms of the General Conditions of Contract. In such a case, the contract price adjustment will only be applicable if the agreed cost is based on rental rates at the time of the base month before closing of tenders, or if the ruling rates current at

the time of the execution of the work are de-escalated to the base month.

c) The Contractor will be paid for the transport to and from the site of the construction plant, not on site, and specially ordered by the Engineer to be brought on site. No payment will be made for transport of equipment listed in the Contractor's Schedule of Constructional Plant in the tender document, or for equipment which has been removed from the site on request of the Contractor, or for equipment already on site, regardless of whether it appears on the Schedule of Constructional Plant or not.

PAA 4 MATERIALS

Materials required for daywork items which cannot be compensated under existing rates and have to be purchased will be paid for at cost, excluding VAT, plus a surcharge of 15%. The cost of materials provided for daywork at current rates at the time when the work is executed will not be subject to contract price adjustment unless the prices of the materials are de-escalated to the base month for escalation.

PAA 5 MEASUREMENT AND PAYMENT

Item		Unit

PAA 5.1 LABOUR

(a)	Unskilled workers	hour (h)
(b)	Skilled workers (Artisans).....	hour (h)
(c)	Operators and drivers (where measured separately)	hour (h)
(d)	Foremen	hour (h)
(e)	Others (specify)	hour (h)

I. The unit of measurement is the hour or part thereof during which workers were engaged in daywork.

II. The tendered rate shall include full compensation for all salaries, wages, bonuses, pension, insurance, medical aid and other benefits as well as overheads arising from administrative personnel, site agents, supervisors, tools and profit. No surcharge will be paid on the tendered rates

III. The cost of operators included in the rates for constructional plant, will not be measured again under Labour.

Item		Unit

PAA 5.2 CONSTRUCTIONAL PLANT

(a) Lowbed transport of plant to and from the site…….ton-kilometre (t.km)

(b) Bulldozer and ripper

(i) ..... (Specify power and mass) ..... hour (h)
(ii) ..... etc. (for other bulldozers)..... hour (h)

(c) Grader

(i) ..... (Specify power and mass) ..... hour (h)
(ii) ..... etc. (for other graders)..... hour (h)

(d) Front-end loaders

(i) ..... (Specify type, power and mass) ..... hour (h)
(ii) ..... etc. (for other front-end loaders)..... hour (h)

(e) Back-acting excavators

(i) ..... (Specify type, power and mass) ..... hour (h)
(ii) ..... etc. (for other back-acting excavators) ..... hour (h)

(f) Tractors and drawn rollers and trailers

(i) Tractor ..... (Specify type, power and mass)..... hour (h)
(ii) Roller ..... (Specify types, masses) ..... hour (h)
(iii) Tractor with trailer, complete (Specify tractor, and type and capacity of trailer) ……. hour (h)

(g) Compactors

(i) ..... (Specify type and mass) ..... hour (h)
(ii) ..... etc. (for other types and masses) ..... hour (h)

(h) Compressors

(i) ..... (Specify capacity and number of tools)..... hour (h)
(ii) ..... etc. (for other compressors and tools)..... hour (h)

(i) Trucks

(i) ..... (Specify type, and capacity)..... hour (h)
(ii) ..... etc. (for other trucks)..... hour (h)

(j) Light delivery vehicles

(i) ..... (Specify load capacity)..... kilometre (km)
(ii) ..... etc. (for other) ..... kilometre (km)

	Item	Unit
PAA 5.3	Cost of materials delivered to ..... site (specify)	P-Sum or as scheduled

a) The unit of measurement for subitem 5.2(a) is the ton of constructional equipment multiplied by the kilometre distance over which the plant has been transported with a lowbed transporter as ordered by the Engineer.

b) The unit of measurement for subitems 5.2(b) to (i) is the hour or part thereof during which the item of plant had been in active use for the daywork operation, including stopping time of less than five minutes.

c) Where applicable, travel time to and from the normal parking position on site, or the position of the most recent non-daywork activity, as well as stopping time exceeding five minutes, shall be multiplied by a factor of 0,6. Time shall be measured by means of a vibrating clock card.

d) The unit of measurement for subitem 5.2(j) is the kilometre travelled to collect or transport small quantities of materials. Kilometres travelled in light delivery vehicles by supervisors in the execution of normal supervisory duties shall not be measured for payment.

e) The tendered rates shall include full compensation for the supply, maintenance, service, repairs, depreciation as well as fuel, lubricants, licensing, insurance, overheads and profit. It shall also include the cost of drivers and operators except in the case of subitem PAA-5.2(h), where the operators of tools are paid for under labour.

PCL COMMUNITY LIAISON OFFICER

PCL 1 COMMUNITY LIAISON OFFICER & LOCAL LABOUR

a) A Provisional Sum has been provided in the document for the employment of a Community Liaison Officer (CLO) for the duration of the contract. The primary role of the CLO shall be liaison and facilitation of communication, which shall include inter alia: -

i. assist in all aspects related to the recruitment of local labour, and advise them of their rights
ii. Act as a source of information for the community and Councillors on issues related to the contract
iii. Keeping the contractor advised on community issues
iv. Keeping the contractor advised on any issues pertaining to local security
v. assisting in setting up any meetings/ negotiations with affected parties
vi. Keeping a site diary and recording details of any labour/community issues that may arise
vii. monitoring and reporting on general Health & Safety issues on site
viii. assisting in HIV/AIDS awareness programmes
ix. It must be noted that the CLO has no authority to issue any instructions to the Contractor

b) The CLO needs to be seen as neutral by all parties, and therefore should endeavour not to take sides should conflict arise

c) The minimum skills for a CLO shall include: -
i. An ability to work with others
ii. An ability to communicate in Zulu and English
iii. An ability to communicate in writing
iv. Sound interpersonal skills

d) The Ward Councillor shall be responsible for the selection of the CLO, however the selected CLO shall be accountable to the Contractor. Where a project traverses several different wards, the respective Ward Councillors shall collectively identify a single CLO. The Ward Councillor should consult with the local community and other affected Councillors when identifying the CLO.

e) The CLO shall be employed on a full day basis, for the duration of the contract, and shall be paid at a rate based on 200% of the Civil Engineering Industry minimum wage. In addition to this, all statutory conditions of employment in respect of UIF, Workmen's Compensation etc should be met.

f) Responsibility for the identification of a pool of suitable labour shall rest with the CLO, although the contractor shall have the right to choose from that pool. The contractor and sub-contractors shall have the right to determine the total number of labourers required at any time, and this will vary through the duration of the contract.

g) The contractor shall have the right to replace labour that is not performing adequately. The contractor should ensure that the replacement of any labour due to inadequate performance is done so in conjunction with the CLO.

h) Local labour shall be paid in accordance with the Civil Engineering Industry minimum wage, and all statutory conditions of employment shall be met.

PSEL 1 ELECTRICAL, INSTRUMENTATION AND CONTROL SPECIFICATIONS

PSEL 1.1 GENERAL INFORMATION

PSEL 1.1.1 STANDARDS AND REGULATIONS

PSEL 1.1.1.1 GENERAL

The Standard Specifications forming part of this tender document shall apply unless otherwise indicated in this section. The Project Specification shall take preference if any discrepancies exist or if there are any uncertainties. The drawings issued herewith are to be read in conjunction with the Specifications and Schedules contained herein, together with all ancillary equipment necessary for a correct and complete installation and for compliance with the codes and standards referred to in the Specification.

The Tenderer shall, at the time of tendering, draw the Employer's Representative's attention to any omission or discrepancy between the specifications and the drawings and request clarification of undefined responsibilities.

PSEL 1.1.1.2 REGULATIONS

All plant and equipment, installed and tested under this contract, shall comply with the requirements of the regulations as described under the relevant clauses of this specification or the Standard Specification document included elsewhere in this enquiry as follows:

a) Electrical and ancillary installations:

- SANS 10142 - 1 & 2: "Codes of practice for the wiring of premises" as amended
- SANS 10400: "The application of the National Building Regulations" as amended
- SANS 60439 - Parts 1 & 2 LV Switchgear and Control Assembly
- SANS 1765 and SANS 60947 – Low Voltage Switchgear and Control Gear Assemblies, Contactors and Motor Starters
- SANS 1973-1,3 - Low Voltage Distribution Boards and Control Gear Assemblies
- SANS 10199 - The Design and Installation of an Earth electrode as amended
- SANS 10313 - The Protection of Structures against Lightning
- IEC62305 – Lightning Protection
- The Occupational Health and Safety Act (85 of 1993) as amended and contingent regulations
- The regulations and standards of the eThekwini Water and Sanitation and the Local Municipality
- where applicable
- Applicable NRS and SANS codes for electrical equipment
- BS or IEC codes where South African codes are non-existent
- Local or Municipal Electrical Department standards and regulations
- Government and local authorities' ordinances or other supply authority governing its use

- Any other applicable by-laws or local authority by-law and amendments
- Eskom standards and regulations, where applicable
- The regulations and standards as described under the relevant sections in the Standard Specifications

Any other applicable by-laws or local authority by-laws and amendments

PSEL 1.1.1.3 QUALITY CONTROL PROCEDURES

QCPs and associated documentation for all equipment specified in accordance with Municipality Standards or industry standards shall be submitted to the Employer's Representative or Engineer for comment and approval. No equipment shall be procured without the necessary QCP approvals.

PSEL 2 SCOPE OF WORK

PSEL 2.1 ELECTRICAL, INSTRUMENTATION & ANCILLARY WORK

The electrical, instrumentation and ancillary work installation comprises and includes the design, manufacture, supply, delivery, installation, testing, commissioning, guarantee and maintenance of the following:

Mobeni Reservoir Rehabilitation and Telemetry Room:

a) Disconnect and remove existing DB from the old telemetry room, cabling and other associated electrical and instrumentation equipment
b) Design, manufacture and install the new DB 01 for Mobeni Reservoir with associated switchgear, control equipment, etc
c) Submission of the DB drawings prior to any panel construction work commencing
d) New power cabling from the Municipal meter to the telemetry room DB 01.
e) Cabling, including sleeves, and cable support systems from the meter to the DB and to the telemetry panel and site lighting
f) Instrumentation, including level transmitters and integration to flow meters and flow control valve solenoid valves supplied by the civil contractor
g) New telemetry systems, including an intruder and fire alarm system
h) New lighting for the telemetry room and site lighting
i) New small power and socket outlets for the telemetry room
j) Lightning protection and earthing installation for the telemetry room and reservoirs 1 & 2
k) Earthing of the complete electrical installation of the new telemetry room and reservoirs 1 & 2
l) Liaison with the municipal supply authority or EWS Mobeni depot for the electricity supply and facilitate the connection of the new MCC to the electricity meter or DB
m) Submit a preliminary schedule showing all tasks leading up to final commissioning within the stipulated timelines
n) Issuing of the Electrical Certificate of Compliance (COC)
o) Issue of the lighting protection test and commissioning certificates
p) Issue of the Earth test certificate
q) Supply 5 hard copies and 5 soft copies of the O & M manuals, consisting of

datasheets of all equipment, drawings, and programming (electronic and printed copies).

PSEL 2.2 SITE AND GENERAL

a) The supply and installation of new site lighting around all the new structures, reservoirs and telemetry room
b) The supply and installation of main power cabling to the new DB and site-wide cable systems
c) All external power cables and instrumentation cables, sleeves, and support systems
d) Where required, cable manholes and associated work (manholes by civil contractor)

PSEL 2.3 INSTRUMENTATION

a) Ultrasonic level probes and transducers in each of the reservoirs for monitoring and control of the inlet control valves into each reservoir
b) Integration of inlet control valve and solenoids from signals from the level transmitters to control the inlet into each reservoir (flow control valves/solenoids to be provided under the civil contractor's scope of work)
c) Integration of inlet and outlet flow meters for reservoirs 1 & 2 to the telemetry system for signal transmission and integration to the SCADA system (flow meters to be provided under the civil contractor's scope of work)
d) Intruder and fire alarm system for the telemetry room and integration to the telemetry system
e) New telemetry systems
f) Integration of all flow, level and flow control valves/solenoids, etc, to the respective telemetry systems for onward transmission to the SCADA system
g) Integration to the existing SCADA system at the existing EWS Control Room in Pinetown
h) All instrumentation cabling

PSEL 2.4 STAND-BY DIESEL GENERATORS

Stand-by generators will not be provided for the telemetry room under this contract.

PSEL 2.5 OVERVIEW OF PUMPING OR FLOW SYSTEMS

Mobeni Reservoirs 1 & 2

The project does not include any pumping systems. The flow into both existing reservoirs 1 & 2 is via gravity from the existing Woodlands reservoir systems.

PSEL 2.6 EXCLUSIONS (ITEMS BY MAIN CIVIL CONTRACTOR OR BY OTHERS)

Parts of the installation to be undertaken by local authorities, civil contractor specialists or other sub-contractors or installation work that is not allowed for is defined below and covers the following general sections:

a) The telephone/data/IT/PA/CCTV/alarm/intercom/security and fire detection wiring, equipment and connections.
b) Geysers and hot water appliances or apparatus
c) Standby generator power
d) Solar power systems
e) The intercom/security, fire detection wiring, equipment and connections.
f) The Municipality's incoming main supply is covered by the supply authorities' responsibilities to a defined consumer responsibility point.
g) Any item of a building or structural component, including louvres, grilles, etc
h) Builders' work details, openings in brickwork, floors, slabs, etc.
i) Manholes
j) Mechanical equipment, pumps, dosing equipment and motors, etc (by mechanical contractor)

PSEL 3 DRAWINGS

The following civil and pump station drawings may be issued and shall form part of the tender documents and should be read with the specifications at all times.

- E-0001 - Site Plan Instrument and Cabling Layout
- E-0002 - Reservoir Plan Lightning Protection & Earthing Layout
- E-0003 - Telemetry Room Electrical, instrument & Earthing Layout
- E-0004 - P & ID Diagram

PSEL 4 POWER SUPPLY & ELECTRICAL SYSTEM

PSEL 4.1 MAIN INCOMING POWER SUPPLY

The power provider of power to the existing Mobeni depot site is the eThekwini Electricity Department.

The contractor shall be responsible for liaising with eThekwini Municipality and the depot for the upgraded or new supply and making all applications for the electrical connections. He shall be in attendance for all applications, negotiations and switch-on of the supply to the site/s.

The costs of any electricity upgrades or new supply shall be paid for by the contractor and are included as provisional sums covered in the bill of quantities.

There is no standby generator power that will be provided to the site.

PSEL 4.2 RETICULATION ON SITE

The low voltage supply distribution and reticulation on site is to be a 230/400volts system. All new systems shall match this rating.

PSEL 5 CONTROL PANELS, MCC'S & DISTRIBUTION BOARDS

PSEL 5.1 GENERAL

The MCC or DB design shall be undertaken by personnel who are qualified and able to demonstrate experience in the field of water treatment and pumping plant, including PLC control and telemetry systems.

The construction of the main and local control panels and distribution boards shall be in accordance with the following Codes and Standards:

- The latest issue of SANS 556: “Low-voltage switchgear Part 1: Circuit-breakers
- The latest issue of SANS 1765: “Low-voltage switchgear and control gear assemblies (distribution boards) with a rated short-circuit withstand strength up to and including 10 kA”
- The latest issue of SANS 60439 1-5: “Low-voltage switchgear and control gear” assemblies
- The latest issue of SANS 60947: 1-8: “Low-voltage switchgear and control gear”,
- The latest issue of SANS 1973: “Low-voltage switchgear and control gear Assemblies Part 1-8”

PSEL 5.2 DRAWINGS AND DATA TO BE PROVIDED BY CONTRACTOR

The contactor shall provide to the Client and the Employer’s Representative or Engineer comprehensive and detailed specifications, wiring and layout diagrams, etc, of the following for comments and approval:

- Wiring and layout diagrams of all motor control panels, local control panels, main panels, distribution boards, etc
- Component and parts list of all motor control panels and distribution boards
- FDS (Functional Design Specifications)
- P & I D diagrams for the entire project
- Process flow diagrams
- PLC and Telemetry wiring diagrams
- PLC and Telemetry I/O lists
- PLC and Telemetry program
- Process control network diagrams
- Instrument loop block diagrams
- Instrument tag numbers
- Cable schedule and numbering (power and instrumentation)
- Cable block diagrams

The above requirements will only apply to what is specified for this project.

The Client and the Employer’s Representative or Engineer will comment and confer approval once they are satisfied with the specifications and requirements. These drawings shall be revised when changes are required and updated to as-built for inclusion in the operations and maintenance manuals.

PSEL 5.3 MOBENI RESERVOIR TELEMETRY ROOM DB01

The DB shall be a surface wall-mounted IP65 panel constructed of 3CR12 material, epoxy powder-coated and is to be installed in the new telemetry room. The DB panel shall have a lockable door and shall have front access only.

The DB will be equipped with switchgear and other breakers to feed outgoing circuits.

The DB main switch shall be rated at 60 Amps three-phase at a fault level of 5 kA. The DB shall be a bottom cable entry only.

The DB shall be fed from the municipal electricity meter

The DB shall be designed, installed and tested in accordance with industry standard specifications and the EWS standard specifications. The type of electrical equipment components shall be as per the Client's approval and standards or as per the equipment schedule attached.

This DB shall be labelled " Mobeni Reservoir DB " with the source of supply and cable size.

Mobeni Reservoir DB – Domestic Distribution:

The panel shall be equipped as follows:

- 1 No. 60Amp Main Switch Isolator
- 1 x 60Amp/30mA earth leakage relay for plug circuit
- 2 x 20Amp SP CB (plugs)
- 3 x 15Amp SP CB (lights)
- 4 x 15Amp SP CB (external single-phase pole-mounted light circuits)
- 1 x 5Amp SP CB (telemetry panel)
- 1 x 5Amp SP CB (photocell)
- 1 x 5Amp SP CB (by-pass)
- 2 x 10 Amp SP CB (spares)

The DB layout and wiring diagrams must be submitted to the Engineer for approval prior to manufacture.

PSEL 6 CABLE RETICULATION SYSTEM

PSEL 6. GENERAL

The electrical contractor shall supply, deliver to the site, lay in sleeves, ducts, and manholes, lay in cable trenches excavated by himself, backfill the cable trench, connect up, test and commission the power and control cables.
A general description of the cables to be installed is tabulated in the Cable Schedule elsewhere in this specification or as quantified.
Cable lengths shown on the schedule are approximate only. Actual lengths shall be physically measured on site before ordering cables. Joints in cabling will not be permitted. Cables physically installed shall be claimed for payment. This applies to all other equipment.
Cable glands shall be CCG corrosion-proof (Corrogland/Corruguard) or similar approved.

Plastic cable marker tape shall be placed 150 mm above cables during backfilling. Standard concrete cable markers shall be installed as indicated on the drawings all to SABS Specifications.

All power cabling shall be PVC/SWA/ECC/PVC, with copper conductors to SANS 1507. In instances, cables shall embody an extra earth core as specified. Cables shall be buried at a depth of min 500mm. Power cable glands and shrouds shall comply with SANS 1213 type CCG or similar approved. Cables shall be full-length point-to-point; no joints will be permitted.

All instrumentation cabling shall be multi-strand copper braided cable or multi-strand twisted
Pair cable installed in a sleeve or fixed to a cable tray.

Instrumentation cable glands and shrouds shall be type CCG, Pratley or similar approved brass
compression or as approved by the Client or Engineer. Each cable end shall be labelled with a Bowthorpe Hellerman or similar type PK tag showing the cable details as indicated in the standard specification.

Cable tray and ladders shall be of the StrutAhead or similar and equal approved pre-galvanised epoxy painted, medium-duty tray supported on the wall by galvanised P2000 at intervals not exceeding one meter on the vertical or 750 mm on the horizontal, or P2000 cantilever arm if secured to the floor.
All trenches for low-voltage and control cables are to be 600mm deep and 400mm wide.

Cable marking tape 150mm wide is to be installed at a depth of 300mm below the ground line. All trenches must be inspected before they are backfilled. The trench must be backfilled and compacted with a plate compactor in layers not exceeding 150 mm. Ducts must be installed complete with 1.6mm galvanised draw wire. Two ducts may be laid in the same trench at a minimum distance of 150mm apart. All bends must be the long radius type. No more than 500 metres of excavation may be left open at a time. Excavations may not be left open, especially over the December / January builders' shut-down period.

Cable markers shall be LG Green or similar and are to be installed at distances not exceeding 10 meters and at every change of direction. Markers are to consist of a concrete block 100mm c 100mm x 300mm and installed in the vertical position. An aluminium plate 75 x 75mm is to be embedded in the concrete or secured to the top of the block by means of two ram set screws 25mm long. The plate is to be punched with numbers and arrows on a smaller than 10mm.

Installed cabling shall be made vandal-proof, which includes encasing the cables in concrete by the civil contractor where specified.

PSEL 6.2 CABLING TO MCCs, DBs AND EQUIPMENT

All pumps, etc, and other equipment shall be fed from the DB01 and Telemetry Panel located in the Telemetry Room situated on top of the reservoir.

Cables will be located on cable ladders or trays for the pumps and instrumentation. Local isolators and stop buttons will be provided for local and emergency power isolation. All powered instruments and powered equipment, such as the level sensors, flow meters, actuators, solenoid valves, vibrators, load cells, etc., will be supplied from the local distribution board located as part of the DB or MCC panel.

Wires to lights, plugs, fans, aircon units, etc., shall be wired in conduit. All electrical cables shall be PVC SWA PVC with integral ECC in accordance with SANS 1507 & SANS 10142. No separate earth conductor will be provided. Main power feeder cables shall be buried in the ground or in uPVC sleeves.

Surface cables and instrument cables shall be routed within buildings or structures.
Cable trays shall be hot-dipped galvanised and adequately sized to suit the number of cables they carry. Cables shall be suitably rated and sized for their anticipated loads and voltage drop.

Refer to the cable schedule and the drawings (where provided) for the new site electrical distribution system and cable reticulation. For other power cable requirements, refer to the cable schedule in clause PS 9.6.1.3 below. The Engineer will direct the cable positions and routes where no drawing is available.

PSEL 6.3 INSTRUMENT CABLES

Instrumentation cables shall be 1.5 mm², 1,0mm² and 0,5mm² flexible stranded twisted copper wire for normal instrument signals or as scheduled in the cable schedules. All Ethernet cables shall be CAT 6E industrial-grade.

All terminations of cables will be terminated using appropriate termination glands with particular attention to any chemical dosing rooms, where all equipment, cable terminations and connections are suitable for this EXE hazardous location.

PSEL 6.4 CABLE SCHEDULE

A cable schedule is tabulated below showing proposed cabling requirements between the MCC, PLC and related equipment. The following is a summary of cables required, but this shall not take away the responsibility from the contractor to provide and ensure all cables and wiring for a complete working and operational system.
Note that all cables are re-measurable, and cable lengths shall be physically measured on site before ordering. The bill must not be used for ordering, as actual cable lengths installed shall be claimed for payment.

The contractor shall be responsible for providing the correct size and rated cabling for each application to be measured on site. Cables shall be full length, and jointed cables will not be permitted unless they are over a drum length. All lengths are re-measurable, and payment will be made for actual lengths installed.

Note that each operating/safety device is to be supplied with a separate cable to an IP65 CCG box or weatherproof isolator at the device. Multi-core cables running to two or more devices will not be acceptable.

a) All cables are to be numbered according to the standard specification.
b) Wiring colour codes must be adhered to in accordance with the EWS standard specifications.
c) All light and plug circuits are to be labelled in accordance with the standard specification.

The following minimum cables are required and as itemised in the schedule of quantities. The final cables selected shall suit the final motor sizes and capacities chosen for their appropriate loads or pumps.

CABLE SCHEDULE

Cable Ref	Cable Destination		Cable Type Size and No.	Installation Method	Length (m)
	From	To			
PS 9.1.1.1 UMKOMAAS SEWER AND SAPPI EFFLUENT PUMP STATIONS					
E01	Ex DB in Kitchen of Mobeni Depot Complex	DB-01	25 mm^2 x 4 Core ECC	Sleeves & ground	50 (approx.)
E02	DB01	Telemetry Panel	2,5 mm^2 x 2 Core ECC	Sleeves & ground	5
E03	DB01	External pole mounted LED streetlights	16 mm^2 x 2 Core ECC	Sleeves & ground	Varies
E04	DB01	Instruments (if required)	1,5 mm^2 x 2/3 Core ECC	Sleeves & ground	Varies
PS 9.1.1.2 INSTRUMENTATION CABLING					
C01	Telemetry Panel	All Instruments (Flow meters, level transmitters, flow control valve solenoid switches etc)	1,5mm^2 4 Pair SWA individually screened overall screened CAT6 armoured instrument cable	Sleeves & ground and cable tray	Varies
C02	Flow meter sensor	Flow meter transmitter	1,5mm^2 16 Pair SWA individually screened overall screened CAT6 armoured	Sleeves & ground and cable tray	Varies

Cable Ref	Cable Destination		Cable Type Size and No.	Installation Method	Length (m)
	From	To			
			instrument cable		

NB. The cable numbering above is indicative and for tender purposes only. The contractor shall determine and provide the final cable schedule and numbering to suit. Although not all the cables required may be in the above schedule, there are sufficient cables measured in the bill of quantities to cover all the cable requirements.

Refer to the stand-by generator specifications and BOQ for the cable requirements for the gen-set.

The contractor shall determine the cable lengths and complete the above schedule with the correct lengths.

PSEL 7 STAND-BY GENERATORS

Currently, stand-by generators are not required for this project; however, one could be installed at a later stage if it is required.

PSEL 8 LIGHTNING AND SMALL POWER SYSTEMS

Buildings:

All lighting and small power circuits shall be wired in PVC or galvanised conduit for all the new pump stations, buildings or structures. Conduits for offices, control rooms, etc, shall be flush installed and cast in concrete floors, chased into internal faces of brickwork and installed inside ceiling spaces. Conduits for pump station, telemetry rooms, and other industrial-type buildings shall be surface-mounted unless instructed otherwise by the Engineer. Isolators adjacent to any plant equipment for motors shall be surface-mounted and cabled from the MCC. All plugs, switches, sockets, isolators, etc. shall be Crabtree or similar and equal approved and to match existing. All electrical and associated equipment shall be SABS approved.

Exposed conduits shall be galvanised.

The installation shall be carried out as shown on the drawings or as directed by the Engineer on site, where no drawing is available.

Light fittings shall be supplied and installed in positions as shown on the drawings and as quantified in the bill of quantities. Lights shall be similar to what exists on site, where applicable.

Lights and socket outlets shall be wired as follows:

- Lights: 2.5mm² including neutral & earth wires
- Sockets: 4 mm² including neutral & earth wires

- Welding Plugs: 16mm² x 4C cable

a) All light and plug circuits are to be labelled in accordance with the standard specification or as directed by the Engineer.

The following luminaires or similar and equal approved and as quantified in the schedule of quantities shall be installed in the various areas as follows: -

Telemetry Rooms, Pump Stations, Filter Building, Stores, Workshop, Sludge Building, Chemical Dosing Buildings, etc	Type A	TLF- CRA - 2 x double LED 1.5m corrosion-resistant light fittings with polycarbonate diffusers and LED energy-efficient lamps
External Areas	Type B	TLF- LRBH-16W LED external bulkhead lights with LED lamps
External Areas	Type C	TLF - LFL-100W LED floodlight with 100-watt LED lamps or similar approved
Reservoir/Roads and General Areas	Type D	TLF- Beka Ledlume 103W LED streetlights with surge arresters, photocell and with spigots/mounting arms

Lighting supplied shall be type TLF or similar and equal to the approved.

All work shall be carried out by qualified artisans and all work shall comply with the latest versions of SANS 10142 and the Occupational Health and Safety Act and Regulation (OHS Act). The certified person who is qualified shall issue the electrical compliance certificate (COC).

Site Lighting:

New poles and streetlight fittings where required are to be installed as shown on the drawings.

The poles to be installed on the reservoir concrete roof are to be 10m high, mid-hinge type with base plates, and the ones planted in the ground are to be ground-planted type. The poles are to be hot-dipped galvanised as supplied by TLF- Global Steel High Mast Fabricators or similar and equal approved. The poles shall be supplied complete with lightning rods at the top. The light fittings required are industrial-grade aluminium supplied by TLF-Beka Ledlume 103W LED streetlights or similar and equal approved with high efficiency and improved reflector using the latest lighting technology. The fittings shall incorporate suitable surge protection. Poles shall be mid hinge type 10m hot dipped galvanised, complete with 5amp circuit breaker, photocell, lightning rod, etc. Cable supplies shall be as shown on the cable schedule.

All lighting shall be of local manufacture and carry the SABS mark of approval, with spares and replacements readily available.

PSEL 9 LIGHTNING PROTECTION AND EARTHING SYSTEMS

The earthing system for the DB and electrical installation and equipment shall be carried out in accordance with SANS 10142 “Wiring of Premises” as amended. All exposed metal parts and equipment shall be bonded to the earthing system to ensure that any fault currents are diverted to earth without causing any harm or damage to personnel or equipment.

The telemetry room and reservoirs are situated on the site with the structures therein susceptible to damage from lightning strikes; therefore is proposed to install lightning protection systems for all new or existing structures that have a metal or concrete roof over them.

The following structures and buildings require a lightning protection and earthing system to be installed:

PSEL 10 INSTRUMENTATION, SCADA & PLC SYSTEM

PSEL 10.1 GENERAL INSTRUMENTATION SPECIFICATIONS

All instrumentation and other equipment shall comply with the Industry Standard specifications, such as IEC, BS, American or SANS standards. The requirements of the EWS Standard Specifications for Instrumentation, Telemetry and PLC installations shall take precedence.

Where the specifications contradict each other or where there are technical uncertainties, this project specification shall take precedence.

Full details and specifications with literature of all instrumentation equipment offered by the tenderers shall be submitted with the tender. The equipment offered shall comply with the requirements of the standard and detailed specifications.

PSEL 10.2 SCADA/ MONITORING OF WORKS

All the new instrumentation shall be integrated into the existing SCADA at the EWS Control Room in Pinetown via the new telemetry system.

The SCADA and telemetry integration shall comply with the EWS standards and recommended specifications.

PSEL 10.3 TELEMETRY/PLC/HMI SPECIFICATION AND REQUIREMENTS

A PLC is not required; however, all instruments and systems shall be interfaced and integrated to the new telemetry panel in the new telemetry room to EWS standards, requirements and details.

A new telemetry panel and RTU are required for the following sites :

- Telemetry Room for Mobeni Reservoirs 1 & 2

PSEL 10.4 PROGRAM / SCHEDULE/ MANAGEMENT

The electrical contractor must provide the programs or project schedules clearly indicating the start dates from award of contract and the estimated completion dates. The program must address the following as a minimum:

- Logical flow of activities, milestones and deliverables
- The schedule must be realistic in relation to provided key resources and sub contractors. (WBS)
- Include verifiable milestones, e.g. Telemetry/RTU development complete, equipment ordering complete, Factory Acceptance testing etc.
- Clearly indicate the critical path on the program (if applicable).
- The schedule must be resource loaded to show which resources (OEM, Tenderer, sub-contractor, EWS and others) will be completing each activity. (RACI Matrix)
- Make provisions for lead times (hardware ordering times, Client approval times, etc.) Include schedule assumptions to help the evaluation team understand how certain durations were estimated or arrived at and others.

The contractor must provide a Project Communications Plan, Implement a Change Management Request Process as well as a Lessons learnt Register on Handover.

PSEL 10.5 INTELLECTUAL PROPERTY

All Intellectual Property developed in the course of a contractual relationship with the Municipality during this project shall remain in full control of the Municipality in terms of ownership and control rights. Intellectual Property rights assigned to the Municipality shall include but not be limited to the following:

PSEL 10.6 WORKS RELATED DESIGN AND DOCUMENTATION

The Contractor grants the Municipality the right in accordance with the provisions of Section 22 of the Copyright Act 1978:

- The PLC or Telemetry codes shall not be protected or locked in any way
- To copy any plan, diagram, drawing, document, specification, bill of quantities, design, calculations, works specific software developments and configurations, e.g. standard templates, mimics, reports, etc. or any other similar document made by the Contractor in connection with the works;
- To make free and unrestricted use thereof for its own purposes, modify same or have it modified by a third party for any reasons, without obtaining permission from the Contractor;
- To provide copies thereof to others (third party Contractors or Consultants of the Municipality) to be used by them for purposes of tendering, consultancy or service delivery.

The project will not be signed off for payment before all snags identified in the preliminary inspection are complete and a compliance certificate and test report is issued.

PSEL 10.7 PROJECT OVERVIEW

This project involves the supply and installation of new telemetry systems at the following sites, forming part of the Mobeni Water Supply Project with the affected sites being:

Site 1 - Mobeni Reservoir 1 & 2 (Telemetry Room)
Site 2 - Existing SCADA at EWS Control Room in Pinetown

The new infrastructure will be constructed and installed in each of these sites. With the new infrastructure being installed, there is a need for the installation of the new telemetry or the improvement of the existing telemetry systems and instrumentation to ensure the adequate monitoring and control.

The project also involves, inter alia, the supply, installation, configuration, testing and commissioning of the new telemetry and instrumentation equipment. It also involves the integration to the existing SCADA configuration at the Control Room in Pinetown. The scope of work for each site is detailed below.

a) Mobeni Reservoir 1 & 2 :

Scope of work

- Integration to the telemetry system of the three (3) new mag flow meter for the inlets to the existing reservoirs 1 & 2. The new mag flow meters will be installed on the common inlet into both reservoirs and on separate outlets from each of the reservoirs.
- Integration to the level transmitters of the two (2) level probes and transducers in the existing reservoirs 1 & 2. The new level submersible level probes and transducers will be installed in both reservoirs and used for monitoring, integration and control of the flow control valves/solenoids for inlets into both the reservoirs
- Integration and monitoring of the two (2) inlet control valves for the inlets into reservoirs 1 & 2 for automatic opening and closing of the valves based on levels in the reservoirs 1 & 2
- Supply, install and commission a new telemetry panel as per specification. Power supply to the telemetry panel will be provided by the electrical contractor
- The panel must include Schneider RTU 474 and Elpro 415U-E digital modem radio amongst other equipment
- Supply and install 45A/hr batteries and battery charger complete in cabinet. To include battery box/cabiner intruder alarm
- Supply, install and incorporate dual point Hydroranger 200 (type Siemens 1P 7ML50344BB01) level controller for reservoirs 1 & 2
- Supply and install the XPS-10 two-level ultrasonic transducers (7ML11153CA30) with stainless steel brackets and housings as per agreed positions
- Supply and installation of new omni directional Webb Yagi 3 Element Radio Antenna 7db (380-470 MHz
- Supply and install RG213 (30m) coaxial cables with N type male/female connectors including antennae mounting brackets and accessories.
- Supply and wire optical isolation between serial devices (Moxa TCC120I) (4 sets)
- Supply and wire serial surge protection and DC surge protection devices for all telemetry equipment
- Supply and Install new level instrument cables and any additional installation accessories
- Enabling monitoring of the intruder alarm, fire alarm and battery box alarm for the new Telemetry Room.
- Existing SCADA configuration and integration
- Provide project management

Deliverables

- A fully functional and integrated telemetry system, enabling monitoring of all alarms and events of the reservoir levels, flow meters, inlet control valves & solenoids etc

on the existing SCADA. This is to include reservoir level monitoring.

- Enabling monitoring of the new mag flow meters on the inlets to reservoirs 1 & 2. The meters will be installed in chambers or bunkers within the pump station or reservoir sites.
- Enabling monitoring of the intruder alarm, fire alarm and battery box alarm for the new Telemetry Rooms.
- Re-established communication between sites and front end
- Detailed Project Documentation and Safety File (Hard Disk)
- Documentation pack with all drawings, wiring diagrams, loop diagrams , P & ID diagrams, I/O lists , FDS (functional design specifications) , as-builts , O & M manuals etc complete
- Integrated Telemetry and instruments , enabling the monitoring of all alarms and events, on the existing GeoSCADA at the EWS Control Room in Pinetown.
- Booked training on SCADA, Instrumentation and Telemetry Systems provided by specialist equipment supplier

b) Overview of the control and instrumentation system

1. Mobeni Reservoirs 1 & 2:

The control philosophy for the Reservoir 1 & 2 is described below.

- The reservoirs consist of 1 x mag flow meter on the inlets to reservoirs 1 & 2 and separate flow meters on the outlets of both reservoirs
- The reservoir consists of 2 level monitoring instruments for monitoring of the levels and for control of the inlets into both reservoirs
- The reservoirs consist of inlet flow control valves with solenoid switches. There will be one (1) control valves for the one inlet into reservoir 1 and one (1) control valve for the inlet into reservoir 2.
- The control valves will be programmed to automatically open and close based on the levels of both reservoirs
- A new telemetry panel/RTU is to be installed in the new telemetry room to be constructed on top of reservoir 2
- The inlets into both reservoirs will be fully automated, operating on the levels from the level sensors and monitored by the telemetry and SCADA system.
- The telemetry system will be programmed to carry out this function.

New mag flow meters will be installed on the inlets to reservoirs 1 & 2. These flow rates and totalizer signals shall be transmitted via telemetry to the existing SCADA at EWS Control Room.

In order to monitor and control the new infrastructure, there is a need to install new Telemetry and Instrumentation systems for these sites. The telemetry and existing SCADA system at the EWS Control Room needs to be integrated to include for the new sites comprising reservoir levels, new flow meters, inlet flow control valves, telemetry room intruder, battery box intruder and fire alarms etc.

PSEL 10.8 DEPENDENCIES

Access	-	The Client or their appointed civil contractor to provide site access when required
Transducer Coring	-	Civil contractor to ensure that the transducer cores and associated galvanized enclosures are provided in advance of installation.

Civil Structures - Civil contractor to ensure that the civil structures such as Telemetry Room and Pump Rooms are ready for installation of equipment. Civil Contractor to ensure that trenching for transducer cabling is carried out and that cables are concreted in as per requirements.

Routing - Agreement on the positions for equipment mounting and the routing of cabling.

Power - Power should be installed and made available in the Telemetry room before Telemetry work can proceed.

Commissioning - An authorized person from the telemetry contractor must be available to sign off all testing, delivery, site installation and handover/commissioning and documentation for the project.

Communication process for the project to follow EWS guidelines as per the table below:-

Communication	Medium	Delivery Date	Frequency	Description/Notes	Audience	Owner
Project Team Communication	Meeting	Ongoing	Weekly	Weekly status meeting to discuss schedule, communications, actions, risks & issues	Project Team	PM
EWS Communication	Email	Ongoing	Weekly	Weekly status report for overview of the project progress	EWS	PM
	Meeting	Ongoing	Monthly	Monthly executive overview of the project progress	EWS	PM
	Email/Phone	Ongoing	As required	Queries	EWS	PM
	Meeting	Ongoing	As required	Safety File	EWS	Safety Officer
Main Contractor Communication	Email	Ongoing	Bi-monthly	Bi-monthly status report for overview of the project progress	Main Contractor	PM
	Email/Phone	Ongoing	As required	Queries	Main Contractor	PM
	Meeting	Ongoing	Monthly	Monthly overview of the project progress	Main Contractor	PM

A 1mm² 2 pair PVC overall screened cable such as a DEKORON cable is to be installed within a telemetry encasement and cable tray from the main panel to the telemetry panel.

Refer to eThekwini Telemetry and Instrument Install Specification Revision 01 & 02 included with the tender.

PSEL 10.9 SECURITY, FIRE & INTRUDER ALARM

Fire Detection:

A detector type photoelectrical smoke detector of type Regal Altro Type (photoelectric smoke detector model No. JIC-636AR) must be installed on the ceiling or roof slab near the telemetry panel in accordance with the supplier's specification and in a position where the smoke will accumulate if there is a fire in the telemetry room. The detector must be wired back to the main panel in 4 core 0.25mm² telephone cable and must be wired directly to the isolation relay and telemetry RTU. The unit may not be installed near ventilation fans, florescent lights or in the A frame roof space.

Intruder Alarm:

An intruder alarm system shall be provided inside the Telemetry Room consisting of a single passive infra red and microwave detector (IR AND MW) in each room, directly wired to the isolation relay and telemetry RTU for remote monitoring through the telemetry system. Cabling shall be a 0.25mm² 4 core telephone type cable. The detector

shall be wall mounted at a height of 2.6 meter from floor level opposite the door and shall be a Regal Altro Type (Rokonet digital Zodiac PIR/QUAD RK-410QD0000A).
A siren with strobe lights shall be installed outside the Telemetry Room and be activated when the PIR sensor is activated. All control panels and keypads etc where required shall be included.

The fire detection system in to include all control panels, alarm siren with flashing beacon light, all wiring and notices and warning signage.

All wiring shall be installed in PVC conduit and neatly installed.

The fire and intruder alarm signals and alerts shall be sent via radio telemetry to the existing Client's SCADA system.

The above installations are to be undertaken by the telemetry contractor.

PSEL 10.10 PARTICULAR SPECIFICATION FOR ULTRASONIC LEVEL TRANSMITTERS & INSTRUMENTS

The contractor is to ensure that the correct level sensors has been selected before the tender closes and priced accordingly. The specifications for the level transmitters is to be confirmed by the level sensor supplier to ensure that it is correct for the application. The requirements of the EWS standard specifications for level transmitters shall take precedence at all times.

The following level transmitters and their positions are required on this project:

Instrument Ref No	Item	Sensor Location	Description/ Principle	Qty	Function	Transmitter Location	PLC/ SCADA	Drawing No.
LIT-01	Level sensor 1	Reservoir 1 Roof	Level Measurement %/m	1	Level monitoring, Control	Telemetry Panel	Yes	N/A
LIT-02	Level sensor 2	Reservoir 2 Roof	Level measurement %/m	1	Level monitoring, control	Telemetry Panel	Yes	N/A

The sensors shall have a range of 0-10m.

The transmitters shall be installed inside the relevant MCCs (motor control centres) or in the telemetry panel.

PSEL 10.11 MAG FLOW METERS

The contractor is to ensure that the correct mag flow meter has been selected before the tender closes and priced accordingly. The below specifications is to be confirmed by the flow meter supplier to ensure that it is correct for the application.

Outdoor type IP67 rated mag flow meters suitable for potable water are required as follows :

Instrument Ref No	Item	Instrument Location	Description/ Principle	Qty	Pipe diameter (mm)	Function	PLC/ SCADA
FIT-01	Flow meter – 1 DN 250	Inlet into Reservoirs 1 & 2	Electronic/flow	1	DN 315	Remote flow monitoring + local	Yes
FIT-02	Flow meter – 2 DN 300	Outlet from Reservoir 1	Electronic/flow	1	DN 400	Remote flow monitoring + local	Yes
FIT-03	Flow meter – 2 DN 300	Outlet from Reservoir 1	Electronic/flow	1	DN400	Remote flow monitoring + local	Yes

The flow meters are to be supplied and installed under the civil contractor's scope or work and is specified elsewhere in the tender documents under the civil works.

The mag flow meters shall be set, connections checked, tested and commissioned on site by the supplier of the meter. All test and connections diagrams to be verified and confirmed. The test reports and diagrams shall be submitted on commissioning of the meters and included in the O & M manuals.

The flow meters will be installed in meter chambers to be constructed by the civil contractor.

Full technical details of the flow meters shall be provided and submitted with the tender for evaluation purposes. Full QCP documentation is to be provided for approval prior to ordering of the units.

The flow meters selected shall conform to the EWS standards for flow meters. This standard shall take precedence over all other specifications or standards.

PSEL 11 DIGITAL INSTRUMENT PANEL

Not required.

PSEL 12 OTHER INSTRUMENTATION

a) Pressure Transducer

Pressure transducer where specified and required are to be mounted on the delivery

main in the pump station or on the inlets to the reservoirs and shall be the type WIKA S-10, 0-25 bar 4-20mA loop powered (2 wire) unit supplied complete with a PTFE pressure washer. The max pressure setting will be given to the contractor prior to ordering of the unit/s. The contractor is to obtain prior approval if he intends using a transducer from another supplier.

b) Pump Casing Temperature Transducer (Supplied with Pump)

Not required.

c) No Flow Switch

Not required.

d) Low Level Cut-Out Switch

Not required.

PSEL 13 VENTILATION SYSTEM

Mechanical ventilation systems for the Telemetry Room or the reservoir sites are not required.

Whirlybird type roof ventilations will be installed in the Telemetry Room under the civil contractor's scope of work.

PSEL 14 FIRE PROTECTION

The fire protection installation shall comprise of the following:

- Portable handheld fire extinguishers of 9kg dry chemical power and 5kg CO2 extinguishers installed in plant rooms or telemetry rooms.
- All associated statutory signage for the above extinguishers. These shall apply to fire hose reels where they are required. Signage shall be rivetted or screwed to walls or doors.

Where required, all fire water pipes where required shall be hot dipped galvanized screwed pipes. The pipes shall be painted fire water red with primer coats. Painting shall be carried out in accordance with the manufacturer's instructions.

The installation shall be carried out as shown on the drawings or as directed by the Engineer where no drawing exists.
The fire protection installation shall be carried out in accordance with SANS10400 Part T & Part W.

PSEL 15 SIGNAGE

Signage inside and on the outside of the door to the pump stations or other buildings shall be provided in compliance with OHS Act (85 of 1995) and SANS 10142-1. In addition, a sign with the designation of the relevant pump station shall be fixed above the pump station door. A sign installed on the outside of the door shall read "UNAUTHORISED ENTRY NOT PERMITTED or NO UN-AUTHORISED ENTRY, "

Standard off the shelf "WARNING ELECTRICTY DANGER" signs & "MACHINE STARTS

AUTOMATICALLY DANGER" signs shall be installed at all pump stations and other buildings as indicated by the Engineer.

Where pumps are installed, a label no smaller than 80mm high shall be mounted adjacent to each pump to identify it as a "PUMP 1 or "PUMP 2" etc. Number plate type signage is required adjacent each pump.

PSEL 16 STANDARD ETHEKWINI SPECIFICATIONS APPLICABLE TO THIS PROJECT

The following eThekwini standard specifications enclosed with this document shall apply and be read with this specification at all times;

- eThekwini Municipality PLC_Specification_Rev06
- eThekwini Municipality Telemetry and Instrument Install Specification_Rev01
- eThekwini Municipality Quality Control Specification_Rev03
- EWS Standard Electrical Specifications, 19.05.2020 : GS1 - Standard Specifications for DB's and Motor Control Centres
- Commissioning _ Fat Forms 19112020 Test Reports FAT Combined
- EWS List of Preferred Instrumentation Equipment 7

PSEL 17 TESTING

PSEL 17.1 GENERAL

- The contractor shall provide all equipment for testing purposes and arrange for the Employer's Representative or Engineer to witness such tests.
- No test will be recognised unless it is documented in an agreed format. The test procedure shall ensure that every combination of switches and events is tested for correct functioning and each such combination will be on the test sheet and checked off.
- The contractor shall supply all test equipment and consumables.
- The contractor shall conduct tests at the following stages. The Employer's Representative or Engineer shall be advised of the tests two weeks in advance of the test dates.
  - At manufacturers works before equipment is released to site
  - During installation where testing is necessary before final connections are made.
  - After installation is complete. This is to be witnessed by the Employer's Representative.

- At each stage tests shall be carried out by the contractor and a typed report submitted to the Employer's Representative or Engineer. After submission of the test report, the Employer's Representative or Engineer may call for all or some of the tests to be repeated in his presence.
- Should any test be unsatisfactory at this time, the Employer's Representative or Engineer reserves the right to have his reasonable abortive costs deducted from the contract sum.
- The civil contractor shall be in attendance when the reservoirs pumps and pipework or other equipment is tested and commissioned. Where pumps are involved , the pump contractor shall be in attendance.

PSEL 17.2 WORKSHOP TESTS

- The Employer's Representative or Engineer shall be granted the opportunity of

inspecting progress at the manufacturer's works.

- The motor control centre or DBs shall be erected in the workshop complete and where required shall comprise PLC, telemetry level, controls, instrumentation etc. and operation shall be proved by simulation of operating conditions.
- Motor Control Centres and DBs
- Inspections are required when the motor control centre or DB metal work is complete but unpainted, after 80% of the components have been installed and wired and on final completion.
- On final completion the following factory acceptance tests (FAT) shall be carried out in addition to any tests that the contractor or Engineer may wish to carry out.
- Insulation resistance of busbars and wiring shall be measured at 500 volts DC using a hand-cranked megger.
- Busbars shall be pressure tested at 2 000 volts AC for 10 minutes.
- Small wiring shall be pressure tested at 2 000 volts AC after disconnection of voltage sensitive devices.
- Functional and simulation tests of control and interlocking circuits shall be carried out.
- Operation of current transformer driven equipment shall be proved by primary current injection. The current transformer ratio and polarity shall be checked.
- Indicating instruments shall be checked at the normal operating point and calibrated against an instrument of certified accuracy. Adjusting screws shall be sealed by means of paint.
- Test instrumentation used, the calibrating authority and calibration date shall be recorded.
- The test results shall be recorded in the agreed format and submitted to the Employer's Representative for approval.
- The equipment may not be released to site before the test report has been approved by the Employer's Representative or Engineer.

PSEL 17.3 SITE TESTS

The following site acceptance tests (SAT) shall be carried out in addition to any tests that the contractor may wish to carry out or other tests required by the Engineer.

Motor Control Centres and DBs.

All tests carried out at the manufacturer's works shall be repeated on site and the test report endorsed accordingly.

Cables

- The insulation resistance of power and control cables shall be measured at 500 volts DC using a hand cranked megger and the result recorded.
- The insulation resistance shall be measured between each core and all other cores plus armouring and between armouring and earth.
- The earth loop impedance of each cable shall be measured after glanding off and bolting into place but before connection. A null-balance megger shall be used, and the result recorded.

Instrumentation

- Each instrument loop shall be calibrated by simulation of the measured quantity at 20%, 50%, 80% and 100% of the range.

- Calibration shall be carried out in accordance with manufacturer's instructions or in a manner to be agreed with the Employer's Representative in the absence of such instructions.
- An ohmmeter shall be used to measure resistance of instrument cable loops and resistance from each core to all other cores plus earth and/or screen. The results shall be recorded.

PSEL 17.4 TELEMETRY, PLC PROCESS AND TESTS

Refer to the standard electrical specifications for the Telemetry or PLC specification testing procedures.

PSEL 17.4.1 PROJECT FLOW (PF)

a) Propose and develop control philosophy (consult with Client and Engineer)
b) Review above philosophy
c) Raise queries with Client or Engineer
d) Receive final control philosophy from Client and Engineer
e) PLC & Telemetry Quality Control and FDS, Processes and Procedures (where required)
f) Program PLC & Telemetry (where required)
g) Create HMI Screens (where required)
h) Send HMI screens for approval (where required)
i) Review and finalise screens with Client and Engineer
j) Factory acceptance test
k) Site acceptance test

PSEL 17.4.1 FACTORY ACCEPTANCE TEST (FAT)

a) Visual inspection to confirm that the drawing matches the physical panel.
b) Input & output testing (Confirm correct wiring to and from PLC, RTU or other control systems)
c) Verify HMI signals correspond to items above
d) Verify telemetry signals
e) Operating and control philosophy
f) All external signals to be simulated

PSEL 17.4.3 SITE ACCEPTANCE TEST (SAT)

a) Input & output testing of field wiring and marshalling
b) Test all signals as per FAT

PSEL 17.4.4 SITE RETICULATION

All tests specified in SANS 10142-1 shall be carried out on all circuits connected to the MCC, DB and sub distribution board.

PSEL 18 CERTIFICATE OF COMPLIANCE OF ELECTRICAL INSTALLATION AND MOTOR CONTROL CENTRES

a) A separate certificate of compliance is required for each complete electrical installation, building or structure in addition to each DB or MCC.
b) A certificate of compliance, type testing and compliance with SANS 1014-2 for each motor control centre or DB is required from the contractor.

PSEL 19 COMMISSIONING

Commissioning shall proceed in accordance with a previously agreed procedure which shall be documented, and which shall form the basis of the commissioning report.

During commissioning the operating parameters of each piece of equipment and each device shall be established and recorded at no-load, average and full load conditions.

The final set-points of all adjustable devices shall be recorded.

Full details of the commissioning procedures for the entire plant as a whole is specified elsewhere in this contract document. Where no commissioning plan is available, the contractor shall submit same to the Engineer for comments and approval

PSEL 20 SLEEVES & MANHOLES

The electrical contractor shall be responsible to supply and install cable sleeves in positions shown on the drawings under in ground trenches, roadways or through buildings and chamber walls. The sleeve requirements are shown on drawing number and on the individual building or pump station drawings. Where no drawing exists, the Engineer will

The manholes and covers as shown on the above drawings shall be supplied and built by the main civil or building contractor. The electrical contractor shall assist to co-ordinate the manhole construction in conjunction with the placing of the sleeves.

PSEL 21 EARTHING THE COMPLETE INSTALLATION

Supply, install and connect up and effectively earth the complete installation in accordance with the relevant clauses of the Standard Technical Specification contained herein together with the South African Bureau of Standards SANS10142-1 “Code of Practice for the Wiring of Premises” and the earthing regulations of the relevant supply authority.

- Earthing of the buildings must meet the requirements of SANS 10313 as amended and SABS/IEC 61024 as amended. The main earth from the Supply Authority must not be relied upon as an effective
- ground earth.
- The testing of the earthing and lightning protection systems must be witnessed by the Clients representatives and the Engineer.

PSEL 22 CONTRACTOR TO DESIGN AND ENGINEER

- It is the contractor’s responsibility to design and engineer the motor control centre and DB power and control circuitry installation in accordance with the specification and good engineering practice.
- The design shall be undertaken by personnel who are able to demonstrate qualifications and experience in the field of water treatment and pumping plant including control systems and telemetry. The Contractor shall approve and sign design drawings and as-built drawings.
- The Client’s Employer’s Representative or Engineer will review all drawings for conformance with the design concept but will not confer formal approval for construction.

PSEL 23 PREFERRED EQUIPMENT

PSEL 23.1 General

The tenderer shall base his main tender price on the equipment listed and as specified elsewhere in this specification.

The tenderer may however offer alternative equipment, but in this event:

It shall be offered in a covering letter as an add or an omit to the main tender price.

a) He shall submit sufficient documentation at the time of tender to allow the Client or Employer's Representative to evaluate the equipment.
b) He shall make himself available during the tender adjudication period for one or more discussions on the detail of the equipment and its operation in a system.
c) The decision as to final choice of equipment shall rest with the Client or Employer's Representative but this shall not relieve the contractor of his contractual obligations in terms of the specification.
d) All alternatives shall be approved by the Employer's Representative or Engineer prior to the tenders closing.

PSEL 24 ELECTRICAL PANEL AND CIRCUIT DIAGRAMS

Complete control panel layouts, distribution boards layouts, circuit diagrams and wiring diagrams indicating clearly the proposed method of wiring shall be furnished. Panel layouts shall show dimensions and complete schedule of equipment together with full description, type, manufacturer, code, reference number, rating etc. of all electrical equipment and components. No variation from such diagrams as submitted or as subsequently modified to meet the requirements of the Employer's Representative or Engineer, will be permitted without the prior approval in writing of the Employer's Representative or Engineer. Layouts and wiring diagram/components shall be approved by the Employer's Representative or Engineer prior to manufacture of the panels, all in accordance with the Standard Technical Specification. PLC and Telemetry I/O diagrams and I/O lists shall be included in the drawings and wiring diagrams.

On completion of the internal wiring to be carried out under this Section of the Contract, complete circuit diagrams indicating the wiring "as executed" shall be supplied to the Employer's Representative or Engineer prior to the issue of the Certificate of Completion. The drawings shall be included in the operating and maintenance manuals to be supplied under the electrical and mechanical section. Three copies of the full plant operating and maintenance instructions for the mechanical process and electrical equipment shall be supplied.

PSEL 25 SPARE PARTS: ELECTRICAL & INSTRUMENTATION

Tenderers shall allow for the supply and delivery of spares for the electrical and instrumentation equipment which they consider should be held in stores, but in any case they shall include for the supply of one complete set of contacts for each type of starter and similarly for completed sets of operating coils. The electrical spares allowed for shall be described in the Annexures or on a separate schedule and submitted with the tender.

PSEL 26 PAINTING OF PANELS

Where sheet metal is used, the whole of the metal work is to be treated against corrosion with an approved rust removal inhibitor, then a primer and finally finished with two coats of

an approved paint of selected colour all in accordance with the EWS Standard Specifications.

PSEL 27 THE COMPLETE INSTALLATION

The meaning and intent of this electrical specification is that at the completion of the Contract, the Client shall be provided with a finished installation, complete in all respects, tested and passed as ready for use.

PSEL 28 HAND OVER, O&M MANUALS AND DATA PACKS

The contractor shall supply and deliver to the Clients Representative or Engineer and Client 5 hard copies and 4 soft copies of the O & M manuals and data packs on successful testing and commissioning of the complete electrical, mechanical, process and instrumentation installations for the project made up as follows as a minimum:

- Electrical COC's (one for each MCC, DB and for each building or structure)
- Earth test certificates
- As built DB and MCC layouts and wiring diagrams
- As built motor control panel layouts and wiring diagrams including component lists
- MCC quality control and test reports
- Factory routine test certificates (SANS1473-1)
- Partial type test certificates for MCC over 10Ka
- MCC or DB paint thickness certificate
- FAT & SAT inspection and test reports
- Instrumentation equipment and details (flow meters, actuators, solenoid valves etc complete)
- Programmable and manual parameters of all electronic and instrumentation equipment
- Instrumentation and electrical devise settings and set-points
- As built FDS (control functional design specification and operational specification)
- Cable specifications and cable schedule
- PLC, HMI and telemetry specifications
- PLC and HMI program
- Process control network diagrams
- PLC, HMI and telemetry wiring diagrams
- Telemetry equipment and layout drawings and diagrams
- All equipment specifications and literature with brochures including cables, lights etc
- Cable block diagrams
- Instrument loop and block diagrams
- Specifications and details of all electrical equipment used on the project including literature and brochures. To include transformers, LV & MV equipment etc.
- Details of all pumping plant, valves, pumps, motors and other mechanical equipment used on the project
- Details of all chemical or other dosing pumps and other equipment
- Details of all instruments used on the project (flow meters, level sensors, level floats, flow switches, pressure switches etc)
- Details of all dosing or other pumps and other equipment used on the project
- All maintenance and servicing schedules of all electrical, instrumentation and mechanical equipment
- The operating and maintenance instructions for all electrical, instrumentation and mechanical equipment, valves, pumps, motors etc

- OEM manuals of all mechanical, electrical and instrumentation equipment
- Fault finding procedures and instructions
- Supplier details of all major equipment
- QCPs of all equipment
- Calibration certificates of instruments and other equipment
- Guarantee certificates
- Pipework and plant drawings
- As built drawings and site and building cable schematics and layouts

Only items above that pertain to this project will apply.

Training:

- Full training shall be provided to the Client's operations and maintenance staff on all the electrical, instrumentation and mechanical equipment pertaining to this project.
- The details of the contract and details of the contractor and sub-contractors must be included in the manuals. The files must comprise an index with fly sheets.
- The contractor shall submit draft copies of the manuals to the Engineer for comment and approval prior to compiling and submitting the final manuals. The manuals and documents must be available before the final commissioning and hand-over of the project to the Client.
- The requirements and details for other equipment are found elsewhere in the tender documents and
- should be read in conjunction with this specification. The above are minimum requirements and the contractor shall submit all other documents deemed necessary for the operation and maintenance of the plant.

PSEL 29 GUARANTEE, FINAL INSPECTION, MAINTENANCE & HAND-OVER

- A final inspection will be conducted jointly by the Employer's Representative or Engineer, the Contractor or the Main Contractor on satisfactory completion of all official tests. This inspection may be phased where a Contract is to be taken over in sections by arrangement with all parties concerned.
- A list of defects, remedial or incomplete works requiring attention will be drawn up following this inspection and issued to the Contractor for his immediate attention.
- Once the items listed have been attended to the satisfaction of the Employer's Representative or Engineer, the Contractor shall issue a certificate of compliance, thereafter a completion certificate will be issued by the Employer's Representative or Engineer.
- The contractor shall arrange for the handover of the completed electrical and mechanical installations to the Employer's Representative or Engineer and Client on successful commissioning of the works.
- The complete electrical and instrumentation system shall be guaranteed for a period of twelve months from the date of the practical completion system when the Client takes beneficial use of the equipment.
- During the guarantee period the contractor shall maintain the electrical and pumping system where applicable for a period of twelve months. The maintenance shall include greasing of all bearings and moving parts, topping up of any fluids, checking for loose connections and tightening of terminals and bolts, measuring insulation resistance, checking for vibration and noise and general conditioning monitoring on all pumps, motors, valves etc. The contractor shall also check that all indicator lights are working, test earth leakage units, test and check stop locks and all control

circuitry and instrumentation or any other checks and tests that are required.

- The project will not be signed off for payment and hand-over before all snags identified in the preliminary inspection are complete and a compliance certificate and test report is issued.

PSEL 30 SCHEDULE OF PREFERRED AND ACCEPTABLE EQUIPMENT

Schedule of recommended equipment. The tenderer may, however, offer alternatives but these shall be approved by the Engineer and Client prior to the tenders closing. All equipment shall comply to the latest EWS Standard Specifications and this shall take precedence.

Soft starters	Schneider, ABB or similar approved
Variable speed drives	Schneider, ABB or similar approved
Circuit Breakers , ACB's	Schneider, Merlin Gerin, ABB, CBI
Contactors, isolators, indication lamps	ABB, Telemecanique,
Relays, fuses, motor protection relay	Omron, ABB,Finder
Control switches, selector switches	Krause and Naimer, ABB, Telemecanique, Moeller
Electronic Motor Controller	ABB UMC22-FBP, Omron SEK
Ammeter, voltmeter, current transformer, operations counter, hour meter.	Hartmann and Braun
Cables, Wire	Aberdare
Cable trays , ladders , wire baskets, trunking	Strutahead
HRC fuses and holders	G.E.C.or similar
DC Power Supplies	Meanwell Ad-155B
Electrically operated solenoids	Festo, Asco, Burkert
Level Control	Siemens Milltronics Multiranger MR200 DP 6R, Siemens stainless steel echo max transducer brackets FMS310.
Surge Arrestors	Dehnguard 275 and 1 No. DehnGap
Power supplies	Siemens / SITOP series
Relays , timers	Omron, ABB
Terminal relays	Weidmuller, Klippon, Phoenix Contact
Electrical motors	WEG, ABB , Siemens
Emergency stop stations, push buttons	Cutler Hammer, ABB or similar

Circuit breakers	ABB, CBI, Schneider, M&G
Fuse switches	ABB Stromberg or similar
Terminals	Klippon, Phoenix Contact
Cable glands	CCG Corrogland
Junction boxes	York enclosures or similar
Power monitor	Schneider, ABB, Rockwell
Open channel measurement flow meter	Siemens Milltronics Multiranger MR-200 DP 6R or similar
Radar level meter	Krohne, VEGA, Siemens
Magnetic flow meter	Safmag, Siemens, Krohne, Endress & Hauser
Other flow meters	Siemens, Fuji, Krohne, Endress & Hauser
Flow switches	IFM , EGE (electronic). IFM preferred
Pressure transmitter	Wika, Siemens
Differential pressure transmitter	Wika, Siemens
Analogue pressure gauges	Wika, Siemens
Chlorine gas leak detectors	Siemens, Grundfos
Residual chlorine meter	Siemens, Grundfos
Dissolved oxygen meter	Hach LDO type
Turbidity meter	Hach, Endress & Hauser
Temperature measurement	Wika, Siemens
Pressure gauges	Wika ,Siemens
Air flow meters - Thermal resistance type	Endress & Hauser
Proximity switch	Efector (Shorrock Automation)
Solenoid operated valves	Bürket
Surge protection	Surgetek : BCT BE24 (signals) DEHNguard 275 (line) DEHNgap B (neutral) Phoenix Type TT-2-PE- 24VDC
Other surge protection	DehnVentil 255 - Mains
Loop splitters	Omniflex type LPI/LPS
UPS	APC

SCADA	Adroit , Schneider or similar approved
PLC	Schneider, Delta, Allen Bradley Compact Logix L1 to latest EWS Standard Specifications
HMI	Schneider Touch Screen
Industrial Ethernet network switch	Unmanaged - Hirschmann Managed - Hirschmann
Pneumatic actuators	Festo, Biman
Electrical Valve actuators	Aumanat or Rotork
Telemetry Unit	Scheider Scada Pack, GeoSCADA to latest EWS Standard Specifications
Pipework Coating	Plascoat PPA 571 Aqua
Non-Shrink Grout	Pro-Struct 531-MCI
Switches, sockets outlets, isolators etc	Crabtree
Light luminaires/fittings	TLF - The Lighting Factor or similar and equal approved

Note : QCPs and technical specifications for all equipment is to be submitted to the Engineer for approval prior to ordering of any equipment.