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Ministry of Water and Sanitation,
Private Bag 390,
Lilongwe 3,
Malawi

REQUEST FOR QUOTATIONS

Procurement Number: MoW/DWS/HPB/2024-25/01

To:

Date: 13th Dec, 2024

The Procuring Entity named above invites you to submit your quotation for carrying out the works as described herein. Any resulting order shall be subject to the Government of Malawi General Conditions of Contract for Local Purchase Orders (available on request) except where modified by this Request for Quotations.

SECTION A: QUOTATION REQUIREMENTS

1) Description of Works and Location

CONSTRUCTION OF Two (2) SOLAR-POWERED HIGH YIELDING WATER SUPPLY RETICULATED SYSTEMS UNDER DEPARTMENT OF WATER RESOURCES.

- 2) Works are to commence by **1 week** from the date of order.
- 3) Works to be completed by: **8 weeks** from the date of order.
- 4) Quotations must be valid for **30 days** from the date for receipt given below.
- 5) Quotations and supporting documents as specified in Section B must be clearly marked with the Procurement Number given above and must indicate acceptance of the stated terms and conditions.
- 6) Quotations must be received, in sealed envelopes no later than: 14:00Hrs on 23rd Dec., 2024.
- 7) Quotations must be returned to: The Chief Procurement Officer, NEW MANOBEC Building, City Centre, Ministry of Water and Sanitation, Private Bag 390, Lilongwe 3.
- 8) The attached **Activity Schedule (for lump sum contracts) at Section C** details the works to be performed. You are requested to quote by completing Sections B and C. Quotations shall cover all costs of labour, materials, equipment, overheads, profits and all associated costs for performing the works including all taxes and duties. The whole cost of performing the works shall be included in the items stated and the cost of any incidental works shall be deemed to be included in the prices quoted.
- 9) Quotations that are responsive, qualified and technically compliant will be ranked according to price. Award of contract will be made to the lowest priced quotation by the issue of a Local Purchase Order.

Signed: Name: **Thomson Wasambo**

Title/Position: **Chief Procurement Officer**

For and on behalf of the Procuring Entity

Your quotation is to be returned on this Form by completing and returning Sections B and C including any other information and certification as stated within this RFQ.

SECTION B: QUOTATION SUBMISSION SHEET

- 1) Currency of Quotation: Malawi Kwacha
- 2) Works will commence withindays/weeks/months from date of Purchase Order.
- 3) Works will be completed bydays/weeks/months from date of Purchase Order
- 4) Validity period of this quotation isdays from the date for receipt of Quotations.
- 5) We attach the following documents:
 - i. Section C of the Request for Quotations completed and signed;
 - ii. A copy of our Trading Licence
 - iii. A copy of our Annual Tax Clearance Certificate (for last financial year)
 - iv. Copy of Valid Annual Tax Clearance Certificate as evidence of Compliance to Tax Laws
 - v. NCIC Registration Certificates for Borehole Drilling
 - vi. NWRA Registration Certificate
 - vii. Copies of Work Completion Certificates on similar completed works in the past five years

Qualification Criteria

To qualify for award of the Contract, in accordance with ITB Sub-Clause 12.1 bidders shall meet the minimum qualifying criteria:

A. EXPERIENCE IN SIMILAR WORKS AND COMPLEXITY

- (a) Experience as prime contractor in the geophysical investigation and drilled at least 5 No. high yielding boreholes of not less than 2 liters per second in the last 5 years.
- (b) Experience in hydraulic structures (concrete weir structures) with one (1) or more contracts involving repairs to concrete structures especially water retaining structures, operations and reinforced concrete works of approximate volumes up to 100m³ in the last 5 years.
- (c) Have successfully installed at least 3 No. solar powered borehole water system of flow of at least 5 litres per second with minimum power output of 10kW.
- (d) A minimum number of similar contracts specified above that have been satisfactorily and substantially completed as a prime contractor or joint venture member between 1st January 2018 and 23rd December, 2024:
3 (three) contracts, each of minimum value MK 150,000,000.00

B. FINANCIAL CAPABILITIES

- a) The Bidder shall demonstrate that it has access to, or has available, liquid assets, unencumbered real assets, lines of credit, and other financial means (independent of any contractual advance payment) sufficient to meet the construction cash flow requirements estimated as MK 200 Million for the subject contract(s) net of the Bidder's other commitments
- b) The Bidders shall also demonstrate, to the satisfaction of the Employer, that it has adequate sources of finance to meet the cash flow requirements on works \geq MNB V currently in progress and for future contract commitments.
- c) The audited balance sheets or, if not required by the laws of the Bidder's country, other financial statements acceptable to the Employer, for the last 3 years shall be submitted and must demonstrate the current soundness of the Bidder's financial position and indicate its prospective long-term profitability.
- d) **Average Annual Construction Turnover**, Minimum average annual construction turnover of MK 200 Million calculated as total certified payments received for contracts in progress and/or completed within the last 3 years.

C . KEY PERSONNEL

The Bidder must demonstrate that it will have suitably qualified (and in adequate numbers) Key Personnel, as described in the Specification.

The Bidder shall provide details of the Key Personnel and such other Key Personnel that the Bidder considers appropriate to perform the Contract, together with their academic qualifications and work experience as indicated below **PER LOT**. The Bidder shall complete the relevant Forms in Section IV, Bidding Forms.

Contractor's Representative and Key Personnel

Item No.	Position/ specialization	Relevant academic qualifications	Minimum years of relevant work experience
<i>Key Personnel</i>			
1.	Site Manager – 1 No	Shall have a BSc. in Civil Engineering, Hydrogeology, project management or equivalent with at least 3 years' experience in management of water supply systems	3
2.	Hydro – geologist	Shall have at least BSc in Earth Sciences or Geography or Civil/Mechanical Engineering and professional experience in groundwater development and management. The Hydro – geologist shall have at least five (5) years relevant verifiable experience.	5
3.	Electrical Mechanical Engineer	Shall have at least BSc in Electrical Engineering or Renewable Energy with at least 3 years' verifiable experience in solar system installations in similar environment or conditions.	3
4.	Environmental, Health, Safety and Social Specialist	Shall have BSc Degree in Environmental Science or related field with 5 years' experience, having completed at least two (2) related assignments. Should be able to speak and write English fluently.	5
5	Driller	Shall have Diploma in Earth Science or Hydrogeology related qualification with at least 10 years' experience in drilling of similar boreholes in similar environment or conditions.	10

C. EQUIPMENT

Proposals for the timely acquisition (own, lease, hire, etc.) of the following essential equipment. The Bidder must demonstrate that it will have access to the key Contractor's equipment listed hereafter:

No.	Equipment Type and Characteristics to be brought to the site for the required work	Minimum Number required PER LOT
1	Drilling Rig	1
2	Compressor	1
3	Mud Pump	1
4	Concrete Mixers	1
5	7 Tonne lorry	1
6	Poker Vibrators	2
7	Pump Testing Equipment	1set

The Bidder shall provide further detailed evidence of proposed items of equipment.

- (e) liquid assets and/or credit facilities, net of other contractual commitments and exclusive of any advance payments which may be made under the Contract, of no less than **MK150 million**;
- (f). A consistent history of Non-Performing Contracts or litigation or arbitration awards against the Bidder may result in disqualification.
- (g). Subcontractors' experience and resources will be taken into account in determining the Bidder's compliance with the qualifying criteria.

Note to Bidders: This Bid Submission Form should be on the letterhead of the Bidder and should be signed by a person with the proper authority to sign documents that are binding on the Bidder. If the Bidder objects to the Adjudicator proposed by the Procuring Entity, he should so state in his Bid, and present an alternative candidate, together with the candidate's daily fees and biographical data, in accordance with Clause 35 of the Instructions to Bidders.

Bid Submission Form

Date: **[insert date]**

Procurement Reference No.: **[insert procurement reference number]**

Page **[insert page number]** of **[insert total number of pages]** pages

To: **[insert complete name of Procuring Entity]**

We, the undersigned, declare that:

- (a) We have examined and have no reservations to the Bidding Documents, including Addenda No.: **[insert the number and issuing date of each Addenda]**;
- (b) We offer to execute the **[insert the name and procurement reference number of the Contract]** in conformity with the Bidding Documents for the Contract Price of **[insert amount in numbers and words]** Malawi Kwacha;
- (c) The advance payment required is: **[insert amount in numbers and words]** Malawi Kwacha;
- (d) Our bid shall be valid for a period of **[specify the number of days that the bid is valid for]** calendar days from the date fixed for the bid submission deadline in accordance with ITB Sub-Clause 20.1, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;
- (e) We have no conflict of interest in accordance with ITB Sub-Clause 3.2;
- (f) Our firm, its affiliates or subsidiaries—including any subcontractors or suppliers for any part of the contract—has not been debarred from participation in public procurement by the Government of the Republic of Malawi, in accordance with ITB Sub-Clause 3.4;
- (g) Our firm, its affiliates or subsidiaries, including subcontractors or suppliers for any part of the contract are not under investigation by the Anti Corruption Bureau or any other law enforcement body in Malawi relating to participation in any public procurement tender exercise or execution of any public procurement contract relating to the purchase of goods, works and services by any Procuring Entity.
- (h) The names and physical addresses of the Directors of our firm are provided in the table below or we enclose a copy of our latest Audited Accounts (issued within the last twenty-four (24) months):

Name	Address

- (i) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed.
- (j) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.
- (k) We accept the appointment of **[insert name of adjudicator proposed in the BDS]** as the Adjudicator. **[or]** We do not accept the appointment of **[insert name of adjudicator proposed in the BDS]** as the Adjudicator, and propose instead that **[insert name]** be appointed as Adjudicator, whose daily fees and biographical data are attached.

Signed: **[insert signature of person whose name and capacity are shown]** In the capacity of **[insert legal capacity of person signing the Bid]**

Name: **[insert complete name of person signing the Bid]**

Duly authorised to sign the bid for and on behalf of: **[insert complete name of Bidder]**

Dated on _____ day of _____, _____ **[insert date of signing]**

Note to Bidders: Bidders shall submit a fully priced Bills of Quantities for Admeasurement Contracts or Activity Schedule for Lump Sum Contracts as provided in Section 6 of the Bidding Documents.

Each page of the Bills of Quantities or the Activity Schedule should be signed by a person with the proper authority to sign documents for the Bidder.

Priced Schedules
(Bills of Quantities or Activity Schedule)

Note to Bidders: This Bid Security should be on the letterhead of the issuing Financial Institution and should be signed by a person with the proper authority to sign the Bid Security. It should be included by the Bidder in its bid.

Form of Bid-Securing Declaration

Date: *[insert date (as day, month and year)]*

RFB No.: *[insert number of Bidding process]*

Alternative No.: *[insert identification No if this is a Bid for an alternative]*

To: *[insert complete name of Employer]*

We, the undersigned, declare that:

We understand that, according to your conditions, bids must be supported by a Bid-Securing Declaration.

We accept that we will automatically be suspended from being eligible for bidding or submitting proposals in any contract with the Employer for the period of time specified in Section II – Bid Data Sheet if we are in breach of our obligation(s) under the bid conditions, because we:

- (a) have withdrawn our Bid prior to the expiry date of the Bid validity specified in the Letter of Bid or any extended date provided by us; or
- (b) having been notified of the acceptance of our Bid by the Employer prior to the expiry date of the Bid validity in the Letter of Bid or any extended date provided by us, (i) fail or refuse to execute the Contract, if required, or (ii) fail or refuse to furnish the Performance Security and, if required, the Environmental and Social (ES) Performance Security.

We understand this Bid-Securing Declaration shall expire if we are not the successful Bidder, upon the earlier of (i) our receipt of your notification to us of the name of the successful Bidder; or (ii) twenty-eight days after the expiry date of the Bid validity.

Name of the Bidder* _____ *[insert complete name of person signing the Bid]*

Name of the person duly authorized to sign the Bid on behalf of the Bidder** *[insert complete name of person duly authorized to sign the Bid]*

Title of the person signing the Bid *[insert complete title of the person signing the Bid]*

Signature of the person named above _____ *[insert signature of person whose name and capacity are shown above]*

Date signed *_[insert date of signing] day of [insert month], [insert year]*

*: In the case of the Bid submitted by joint venture specify the name of the Joint Venture as Bidder

** : Person signing the Bid shall have the power of attorney given by the Bidder to be attached with the Bid *[Note: In case of a Joint Venture, the Bid-Securing Declaration must be in the name of all members to the Joint Venture that submits the Bid.]*

Declaration

I, the undersigned Key Personnel, certify that to the best of my knowledge and belief, the information contained in this Form PER-2 correctly describes myself, my qualifications and my experience.

I confirm that I am available as certified in the following table and throughout the expected time schedule for this position as provided in the Bid:

Commitment	Details
Commitment to duration of contract:	<i>[insert period (start and end dates) for which this Key Personnel is available to work on this contract]</i>
Time commitment:	<i>[insert the number of days/week/months/ that this Key Personnel will be engaged]</i>

I understand that any misrepresentation or omission in this Form may:

- (a) be taken into consideration during Bid evaluation;
- (b) my disqualification from participating in the Bid;
- (c) my dismissal from the contract.

Name of Key Personnel: *[insert name]*

Signature: _____

Date: (day month year): _____

Countersignature of authorized representative of the Bidder:

Signature: _____

Date: (day month year): _____

Note to Bidders: The information to be filled in by bidders in the following pages will only be used for purposes of post-qualification or for verification of pre-qualification as provided for in Clause 4 of the Instructions to Bidder, and will not form part of the Contract. Attach additional pages as necessary. If used for pre-qualification verification, the Bidder should fill in updated information only.

Qualification Information Form

1. Individual Bidders or Individual Members of Joint Ventures

1.1 Constitution or legal status of Bidder: **[attach copy]**

Place of registration: **[insert]**

Principal place of business: **[insert]**

Power of attorney of signatory of Bid: **[attach]**

1.2 Average annual volume of construction work performed in the previous number of years specified in Section 3, Evaluation and Qualification Criteria: **[insert details below and state average]**

Year:					
Volume:					

1.3 Work performed as prime Contractor on works of a similar nature and volume over the last five (5) years. Also list details of work under way or committed, including expected completion date.

Project name and country	Name of client and contact person	Type of work performed and year of completion	Value of contract
(a)			
(b)			

1.4 Major items of Equipment proposed for carrying out the Works. List all information requested below.

Item of equipment	Description, make, and age (years)	Condition (new, good, poor) and number available	Owned, leased (from whom?), or to be purchased (from whom?)
(a)			
(b)			

1.5 Qualifications and experience of key personnel for administration and execution of the Contract. Attach biographical data.

Position	Name	Qualifications	Years of experience (general)	Years of experience in proposed position
(a)				
(b)				

1.6 Proposed subcontracts and firms involved.

Sections of the Works	Value of subcontract	Subcontractor (name and address)	Experience in similar work
(a)			
(b)			

1.7 Financial reports for the last five (5) years: balance sheets, profit and loss statements, auditors' reports, etc. List below and attach copies.

- 1.8 Evidence of access to financial resources to meet the qualification requirements: cash in hand, lines of credit, etc. List below and attach copies of supporting documents.
- 1.9 Name, address, and telephone, telex, and facsimile numbers of banks that may provide references if contacted by the Procuring Entity.
- 1.10 Information on any current litigation in which the Bidder is involved.

Other party(ies)	Cause of dispute	Amount involved
(a)		
(b)		

1.11 Proposed Program (work method and schedule). Descriptions, drawings, and charts, as necessary, to comply with the requirements of the bidding documents.

2. Joint Ventures

- 2.1 The information listed in 1.1 - 1.10 above shall be provided for each partner of the joint venture.
- 2.2 The information in 1.11 above shall be provided for the joint venture.
- 2.3 Attach the power of attorney of the signatory(ies) of the Bid authorising signature of the Bid on behalf of the joint venture.
- 2.4 Attach the Agreement among all partners of the joint venture (and which is legally binding on all partners), which shows that
 - (a) all partners shall be jointly and severally liable for the execution of the Contract in accordance with the Contract terms;
 - (b) one of the partners will be nominated as being in charge, authorised to incur liabilities, and receive instructions for and on behalf of any and all partners of the joint venture; and
 - (c) the execution of the entire Contract, including payment, shall be done exclusively with the partner in charge.

3. Additional Requirements

3.1 Bidders should provide any additional information required in Sections 2 or 3 of the Bidding Document or to fulfil the requirements of Sub-Clause 4.1 and Clause 30 of the Instructions to Bidders, if applicable.

SECTION C: ACTIVITY SCHEDULE (TO BE PRICED BY BIDDER)

TECHNICAL SPECIFICATIONS FOR DRILLING OF SOLAR POWERED BOREHOLES AND ASSOCIATED RETICULATION SYSTEM

A. Scope of Works

The works shall include geophysical survey, drilling of borehole, installation of pipe casings, well development, pump testing, pump-head construction, supply and installation of solar powered pump, construction of a tank stand and installation of tanks, construction of a water reticulation system and installation of taps.

B. TECHNICAL SPECIFICATIONS

SECTION 1: SITING, WELL DRILLING, PUMPING TEST AND DEVELOPMENT

1.1. Well Siting (Hydrogeological Assessment and Geophysical survey)

The Contractor shall consult and involve all stakeholders in siting of the boreholes. The contractor has to conduct hydrogeological assessment supported by geophysical survey work for all sites to verify the potential for ground water.

Vertical Electrical Resistivity Survey method can be used and the penetration depth should not be less than the recommended maximum drilling depth. However, if the Contractor is not convinced that the proposed site has the required potential for ground water extraction, he has the responsibility, in consultation with the community, to locate a better site to the satisfaction of the community and Project Manager or his representative. The Contractor is advised to make use of all available study documents and reports regarding assessment of ground water potential in the proposed drilling area. The Contractor shall submit the assessment report including VES curves and their interpretation to the Project Manager prior to the start of the drilling work.

At each site location, three possible boreholes sites are to be indicated in order of preference according to the survey results. GPS coordinates of each of these sites will be recorded.

2. Drilling

2.1. Drilling Rig

A suitable rig capable of drilling boreholes of minimum diameters up to 200 mm and to a maximum depth of 150 meters shall be employed. The rig should have all the necessary accessories for rimming, fishing etc

2.2. Drilling Diameter

Drilling diameter of the production wells will vary depending on geological and hydrogeological set-up of the areas. However, the final inside diameter of any completed borehole section should not be less than 171 mm. All drilling should be carried out with the completion diameter of not less than 171 mm.

2.3. Well Depth

Well depths are envisaged to vary from one area to another depending on the geological conditions of the area, and the hydrogeological assessment and the survey results will determine the borehole depth. The Contractor's Hydrogeologist has the primary responsibility for determining drilling depths from the survey results. The Contractor is, therefore, required to provide drilling instructions including, the recommended drilling depths, with clear professional justification, in the borehole siting report to be submitted to the Project Manager or his representative for approval prior to commencement of the drilling program.

The total depth to be drilled for each borehole will be determined from the results of the interim yield tests. The acceptable minimum yield for boreholes is **1 l/sec** but drilling will continue beyond that depth assuming a continuing incremental increase in yield is indicated by the drilling results obtained beyond the initial 1 l/s attaining depth.

2.4. Well Logging

The Contractor shall collect unwashed drilling samples at 3 m intervals and at every change of formation, and store the samples in heavy gauge polythene bags clearly labelled and kept on site until the completion of drilling and testing. The samples are to be logged by the driller and record of strata at 3 m intervals will be kept on a daily log sheet. The record of strata will show:

- (a) Lithology
- (b) Degree of consolidation or hardness
- (c) If unconsolidated - nature of granular material (i.e. subjective description of grain size, degree of rounding, clay content, colour).
- (d) In basement areas it is most important that the weathered rock/fresh bedrock transition point is noted.

Following attainment of the final depth details of the proposed borehole design should be submitted to the Project Manager or his representative. The

completion of an effective and efficient borehole design is the responsibility of the contractor.

2.5. Dry Boreholes

The contractor shall seek instruction from the Engineer or his Representative if water is not struck within the specified depth where it is expected to strike water. No movement from site shall be permitted until the dry hole is notified by the Contractor or his representative to the Engineer or his representative and is approved as such by the Engineer or his representative.

The Contractor will be paid for wet boreholes only. All dry boreholes shall be at the expense of the contractor.

2.6. Interim Yield Tests

On striking water, interim yield tests must be initiated. These tests should be repeated at the contractor's discretion though flushing of the hole should take place after the drilling of every rod length. Interim tests should be carried out for at least 10 minutes to establish yields of less than 1.0 l/sec. Once a yield which is regarded as the optimum for the borehole is indicated, the test should be continued for at least 20 minutes to confirm the result.

The results of interim yield tests against a total depth at time of test must be recorded on drilling records.

2.7. Well Casings

Boreholes have to be lined with high impact-resistant Poly Vinyl Chloride (uPVC) plastic plain and slotted casings specifically manufactured for bore holes.

The casings, plain and slotted, shall be of class 10 and have an outer diameter of not less than 165 mm and each 3 m long.

To avoid the flow of surface water into the well 1.0-meter length of the casing shall be kept above the ground surface.

The protruding casing must be sealed with a suitable cap to prevent any unauthorized opening until the hand pump is installed.

2.8. Gravel Pack

The Contractor shall be responsible for obtaining screened filter pack from the Ministry of Water and Sanitation, approved gravel pack source. The pack should have a d50 size not exceeding 1.0 millimetre and a uniformity coefficient not greater than 2.0 (the contractor being responsible for grading). Ironstone or

calcareous fragments in gravel packs are unacceptable. The gravel pack shall consist of well rounded and washed round quartz grain and shall be placed in the annular space between the borehole wall and the outer portions of casings and screens, to the satisfaction of the Project Manager or his representative.

2.9. Well Development

Well development shall be carried out using appropriate techniques (over pumping, surging, back washing, jetting etc) after casing installation and gravel packing and prior to pumping test. The work shall be carried out for a minimum of 4 hrs and to the satisfaction of the Project Manager or his representative.

Development shall continue until five (5.0 No.) visually sand free water samples of at least 1 litre collected over five separate 1 minute periods at least 10 minutes apart should be obtained from the total discharge. (Actual sand tolerance will be 5 mg/1.)

Should such a sample not be obtained development shall continue up to a maximum of 8 hours. If 5 sand free samples cannot be obtained at this point the borehole will be considered to have an unsatisfactory design and construction. Periods of development in excess of the 8 hours on a borehole set out in the schedule of prices shall therefore be at the Contractor's expense.

During the development the gravel will be topped up as necessary to maintain the level in annulus at 3.0 meters below ground level.

2.10. Cement grouting

The annular space between borehole and wall of the casing shall be grouted with mixture of cement and water slurry by a pour-in method from the top. Cement grout should not be placed before the end of the pumping test to allow the gravel to settle and to be filled-up as necessary. After the test pumping is completed the annulus between the surface casing and the wall of the well shall be sealed with cement grout containing no aggregate from a depth of 5m to the ground surface.

Cement grouting shall be carried out in one continuous operation before initial setting of the cement occurs.

2.11. Concrete Pad

The Contractor shall construct a concrete pad having concrete of **class 20MPa** for all productive boreholes. The Contractor shall ensure that the sides of the pad are straight by properly anchoring the forms. The identification code number of the well provided by the Project Manager or his representative has to be inscribed on the concrete pad.

3. *Pumping Test*

After development the water will be allowed to recover and stabilize prior to the pumping test process.

- a) Interim yield test shall be used as a benchmark in order to determine constant pumping test rate.
- b) If the well yields below 1 l/s after the interim yield test the well is deemed to be dry well and has to be abandoned.
- c) The constant discharge test as the name implies, must be run uninterruptedly for a maximum of 24 hours.
- d) The recovery test shall be carried out until 90% percent recovery of the drawdown is attained.
- e) Water samples shall be collected for analysis

For boreholes to be motorized, the test pumping shall take the form of a Step Test of 400 minutes' duration using 100 minutes each step. This will be followed by an aquifer test at a constant discharge rate for a period not less than 720 minutes. The test will continue until the pumping water level stabilizes or the maximum acceptable period of 1440 minutes is reached.

At the end of either form of test, recovery shall be taken until either the well recovers in full or a period of 120 minutes elapses, whichever is the earlier.

For Step Tests, the discharge rates shall be based on the results of the Interim Yield tests. The rates should be close to 50%, 70%, 100% and 150% of the expected long-term yield. Where the Contractor fails to achieve requirements of the Step Test, the results will be treated as an aquifer test and the Contractor will be paid accordingly.

In all cases draw down reading shall be taken at the following time intervals using an electric or alternative water level dipper graduated at 0.01metre intervals. The datum point for measurements shall be recorded plus the height of the datum above ground level.

The time intervals for the Step Test and Constant Yield Test shall be as follows:

(a) Step Test:

One minute intervals from 0 - 10min;

Two minute intervals from 10 - 30min;

Five minute intervals from 30 - 100min.

(b) Constant Yield Test:

One minute intervals from 0 - 10min;

Two minute intervals from 10 - 30min;

Five minute intervals from 30 - 100min;

Ten minute intervals from 100 - 200min;

Twenty minute intervals from 200 - 400min;

Fifty minute intervals from 400 - 600min;

Hundred minute intervals from 600 - 1500min.

In all cases recovery shall be recorded, at the same time interval as above, until either full recovery has been attained or a period of time equivalent to the pumping period has passed.

3.1. Water Sampling and Quality Test

To ensure that water being delivered from the newly drilled boreholes is potable, the contractor shall be required to carry out quality tests on the water samples. "Water quality" is a term used here to express the suitability of water to sustain uses or processes.

A sample of water from the borehole shall be taken at the end of the constant rate test for Physical, Chemical and Bacteriological analyses. The physical and chemical analysis would determine the following: pH, temperature, colour, turbidity, total dissolved solids (TDS), Calcium, Magnesium, Sodium, Potassium, Total Iron, Manganese, Bicarbonate, Sulphate, Chloride, Nitrate, Nitrite, Fluoride, and Total Hardness.

The bacteriological analysis would determine Total Coliform and E. Coliform. The laboratory water tests may be carried by any other laboratory as the Contractor may wish but the results will have to be checked by the District Coordinating Teams.

Each sample consists of 2 containers, one in a calibrated, hermetically closed glass or suitable plastic container of 1 litre capacity. Water samples should be clearly marked showing name and number of well, date of sampling, hour of sampling, temperature of water during sampling and signature of person taking the sample.

4. *Final Reports*

After completion of each well (drilling, development, pumping test, etc.) the Contractor has to submit a final technical report prepared in English incorporating all important results of specific activities in three copies. The report should be counter signed by DCTs and respective target Community / School representatives.

The report should include the details of the following points:

- Siting of water wells including GPS readings
- Description of VES data, including resistivity graphs and interpretations
- Recommendations on the possible aquifer depth and depth of drilling
- Equipment and instruments used for the drilling operation,
- Description of borehole logging results,
- Final well design for the installation of casings and screens,
- Equipment and instruments used for the pumping test operation,
- Data collection sheets of the pumping test and relevant remarks about the data acquisition,
- Static and dynamic water levels,
- The plotted pumping test graphs,
- Description about the analytical methods and the relevant calculations and the interpretation of pumping test results,
- Recommended pump position and yield,
- Water quality analysis and test result, and well disinfection,
- Description of the well construction should have to include quantity of materials used for the well, well head and pump complete,
- The final report has to contain remarks on special observations, difficulties encountered and findings that would be followed by interpretation of results and proposed recommendations.

SECTION 2 - PIPELINES

5. *GENERAL*

All pipes, valves, fittings and other accessories shall be of the best quality available and shall be of the type and class required by the Specifications, Drawings or the direction of the Supervisor. Pipes, valves and fittings shall be stored in accordance with the manufacturer's recommendation or as directed by the Supervisor. The end of the pipes shall be protected and when pipes are

placed alongside the trench, they shall be supported so that they are clear off the ground.

6. PIPE MATERIALS

6.1. HDPE Pipes

Metric sized high density polyethylene pipes complying with the relevant I.S.O. standards for metric sized HDPE pressure pipes for the conveyance of potable water shall be used.

HDPE water pipes shall be jointed according to the manufacturer's recommendations or as specified by the supervisor. All HDPE pipes shall, notwithstanding any further requirements of the relevant standards, be marked indelibly on the outside of the pipe barrel at intervals not greater than 3m with the manufacturer's identification, the number of the standard to which the pipes are manufactured, the nominal size and class or pressure rating and year of manufacture.

Any pipe or fitting on which this marketing is not clear or, in the opinion of the Supervisor, is likely to be unclear at a later date, will be rejected. It is recommended that the markings be embossed as painted markings are likely to result in rejection of the pipes.

7. PIPE FITTINGS

7.1. General

All fittings shall be of Cast Steel, Cast Iron, Malleable iron or galvanised iron where applicable depending on operating pressures. Fittings shall be supplied from reputable manufacturers. The types of and materials used for fittings are indicative only. Alternative types and materials of equivalent quality may be supplied, subject to the approval of the Supervisor.

All pipeline fittings, valves, air valves, etc. shall be rated for normal maximum operating pressures of 16 bar. Additionally, where shown on the Drawings, fittings, etc. shall be for high pressure.

Fittings on the gravity main line shall be rated for normal maximum static pressures unless specified otherwise. Flanges on fittings shall, as stated on drawings, be to the required pressure, except for 'high pressure' fittings described above. Flanges to comply generally to BS 4504. Threaded joints to ANSI B2.1 NPT.

The nominal pressure rating or class, Mark No. and other information as specified of all fittings, etc. shall be clearly and indelibly marked on the fitting,

preferably by embossing or casting on at the time of manufacture. Adhesive or tied-on labels will not be accepted. Fittings not adequately marked will be rejected.

Fittings shall be purpose made in the factory. Only in exceptional circumstances, and at the discretion of the Supervisor, shall site fabrication be allowed.

In certain cases, the Contractor shall also be responsible to take-off the type, size and quantities of fittings required. The rates in the bills of quantities shall include for such quantification including supply, transport to site, install and test as required by these documents.

7.2. HDPE Fittings

HDPE water main fittings shall be purpose made in the factory. They shall not be fashioned out of straight pipe by warming and bending except as part of a carefully controlled factory process; neither shall fittings be fabricated by the solvent welding together of pieces of straight pipe.

HDPE pipes and fittings with integral flanges shall, wherever possible be avoided. Steel or other metal fittings/flanges may be screwed or otherwise fixed directly onto HDPE pipes at low-pressure location upon prior written approval of the Supervisor.

HDPE fittings for the water mains shall be highest pressure rated for use with the pipes regardless of their position in the Works or the class of adjacent pipe.

8. SURVEYING AND SETTING OUT

The Supervisor will approximately indicate the line of the pipeline to the Contractor, and the Contractor shall survey and setting out the most suitable and economical alignment for the pipeline. The Contractor shall take into consideration the following during the surveying and setting out of the pipeline alignment:

- a) Ensure that the gradients are always falling in the direction of the flow of water in the pipes so as to avoid air valves and washouts; If necessary he shall allow for deep excavations along short lengths to avoid too many high/low points;
- b) Ensure that the water points are located as required by the local Community;
- c) Ensure that the storage and break pressure tank are located in suitable sites to the satisfaction of the Community;
- d) Try to locate water points at high points to avoid air valves;
- e) Minimise on stream crossings to avoid aerial crossings;
- f) Establish temporary markers along the pipeline alignments especially at bends, tees, etc.;
- g) Ensure that co-ordinates (using a GPS or equivalent) of all-important locations (e.g. water sources, bends, tees, tank sites, water points, etc.) has been taken.

The Contractor shall prepare the profiles of the pipelines at suitable scale for the approval of the Supervisor before starting excavation. The Contractor shall

also accurately make the alignment on a map of suitable scale (say 1:10,000 enlarged from the 1:50,000 maps).

9. PIPELAYING

9.1. Trenching

The trenches shall be dug so as to maintain mainly falling gradients (sometimes raising) over as long sections of pipeline as possible. The minimum depth of the trench will be 60 cm and the maximum depth will be 100 cm, the width of the trench will be at least 40 cm. The Supervisor shall direct if and where a change from a rising gradient to a falling gradient, or vice-versa, is to be made. Generally, gradients shall be maintained across rough or gently undulating ground, in which case 'normal cover' shall be the minimum cover, and the Contractor shall excavate to greater depths as necessary or as directed to avoid a change from a rising to a falling gradient or vice-versa. If directed by the Supervisor, the Contractor shall erect profiles over the trench and provide boning rods, to ensure that the trench is dug and that the pipe is laid to an even gradient.

9.2. Backfilling

The pipe shall initially be covered to a depth of 600mm for at least two thirds of its length, leaving the joints exposed until after testing. Where special backfill material is required for pipes, this shall be laid first along the whole length of the pipe, except at the joints.

For all the pipes, backfill for 100mm around, and 150mm above the pipe shall be good quality sand or granular material or selected excavated material, not containing stones larger than 10mm in diameter. Backfill for the top part of the trench for all the pipes, may be selected excavated material, subject to the exclusion of stones larger than 80mm maximum dimension, mud, organic matter, rubbish, or other unsuitable materials, all to the Supervisor's approval. Backfill material shall be as shown on drawings and carefully worked under and around pipes. It shall be replaced in layers and tamped into place so as to provide a firm support and anchor for the pipe.

10. PRESSURE TESTING OF PIPELINES

10.1. *Preparation for Testing*

All pipes shall be hydrostatically tested in the presence of the Supervisor's representative after laying. The Contractor shall give the Supervisor not less than one week notice of his intention to carrying out a pressure test.

Before any pressure is applied to any pipeline each pipe shall be securely anchored and when in trench shall be compacted for at least two-thirds of its length with not less than 500mm of backfill materials leaving the joints exposed.

No joint shall be backfilled or moulded or covered in any way until after the satisfactory completion of the pressure test.

Pressure testing shall be carried out as the work proceeds in such lengths, generally not exceeding 1 km, as are convenient and meet the approval of the Supervisor. When splitting up the pipeline for testing, due regard shall be taken of sections laid with pipe of different pressure ratings.

If possible, lengths containing only one class of pipe shall be tested in one section, and the point of application and monitoring of the test pressure shall be at the lowest point of the section under test.

The ends of the length of pipeline under test shall be closed by means of caps or blank flanges. Pipeline valves shall not be used for this purpose. All washout valves shall be fitted with blank flanges and valves opened before the commencement of any pressure test.

The pipe shall be slowly filled with clean water and allowed to stand for reasonable time. Care shall be taken to expel all air as far as is practicable.

The water pressure shall then be raised by means of a metering test pump, to a pressure equal to 1.5 times the static pressure of the pipe, at the point where pressure is being monitored.

Any fall in pressure after the pipeline has been isolated from the test pump for 1 hour shall be made good by further pumping.

The pipeline shall be brought up to the required test pressure every hour and amount of water noted for a total time of 4 hours. During the progress of the test, the pipeline shall be visually inspected and any signs of leakage or faults shall be remedied, whether the total leakage from the pipeline under test is less than the allowable leakage or not. Should any length of pipeline fail to pass the pressure test, the Contractor shall, at his own expense, carry out all work necessary to locate and remedy the faults and to retest the pipeline until it satisfactorily passes the test.

If leakage is within the allowable limit and no "sweating" joints can be found, the second test time may be reduced to 2 hrs. Leakage tests shall run from an air valve at the top end to a test plug or section valve at lower end. To avoid leaving long sections of trench open for a long time and for making "temporary connections" to the main, a special test plug shall be prepared by the Contractor

and the line shall be tested every 2-3 days. The joints should not be wrapped until tested and approved.

The Contractor shall provide all pumps, gauges, water, labour, drains, stoppers, caps, bends, thrust blocks and other needful appliances for carrying out tests and no pipelines or other work shall be covered up until they have been seen and passed by the Supervisor.

The Contractor shall allow for the cost of testing in his rates for main laying.

SECTION 3: STORAGE TANK AND TANK STANDS

11. 6.1 High Density polyethylene (HDPE) Tanks

HDPE tanks should be nontoxic and non-absorbent, and they should not impart any taste or odour. Recommended HDPE tanks for this project should be cylindrical vertical tanks. The tank stand will be 4-meters-high and its tank stand should withstand the capacity of water in the tank.

12. 6.2. Chlorination Units

Each reticulated water system shall be provided with a simplified effective water treatment unit for chlorinating water before storage in the reservoir tanks.

SECTION 4: ELECTROMECHANICAL WORKS

13. 7.1 Solar pump

The contractor will supply and install Grundfos SQFlex pumps or Grundfos SP pumps.

14. 7.1.1 General specifications

Both Grundfos SQFlex pumps and Grundfos SP pumps should meet the following criteria

Performance: The selected pump must meet the specified water demand and head, during the design month, which can be the month with the least irradiation

Pumps should have a built-in non-return valve, dry-running protection and a MPPT software and motor protection

Reliability and durability: The pump should be used for at least 7 years without failure

Conformity: The pump should meet the International Electrotechnical Commission EN 809 & EN 60034-1

Robustness: Constructed of non-corrodible material such as stainless steel (AISI 304 or higher) and closely matched to groundwater temperature and water quality

Serviceability: Modular design, i.e. detachable pump and motor

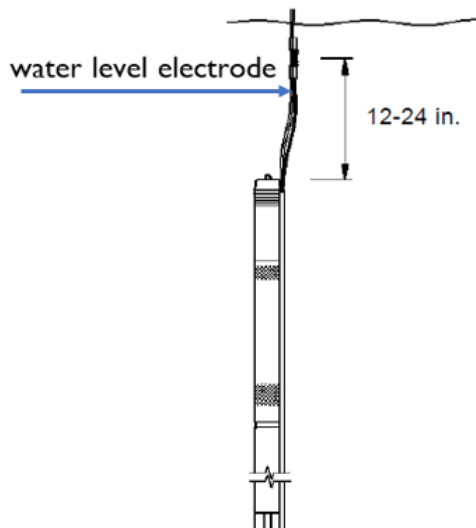
Maintenance free: Brushless motor

Suitable for horizontal as well as vertical installation

The pump will be protected with concrete manhole with a lockable metal cover. Inside the manhole, the well head cover will be welded so that the pump cannot be removed without having to grind them off.

15. 7.1.2 Dry-running protection

Pumps should be equipped with a water level electrode placed on the motor cable 12-24 inches above the pump depending on the type of pump as shown below



The water level electrode measures the contact resistance to the motor sleeve through the water and when the water level falls below the water level electrode the will pump will cut out. The pump should automatically cut in again 5 minutes after the water level is above the water level electrode.

16. 7.2 Solar Panels

The solar modules should meet the following criteria

- Monocrystalline
- Using highly efficient PASSIVATED EMITTER REAR CONTACT TECHNOLOGY (PERC) cells

- Peak Wattage > 300 Wp
- Module Efficiency: Minimum 16 %
- In conformity with the International Electrotechnical Commission IEC/EN 61215 & 61730
- IEC61701 - Salt Mist Corrosion Testing
- IEC62716 - Ammonia Corrosion Testing
- **IEC TS 62804 - PID Testing**
- ISO9001:2015 - Quality Management Systems Requirements
- ISO14001:2015 - Environmental Management system
- Product warranty – 10 years
- Power warranty – linear 25 years – 80%

Mandatory PV System Features are :

- **Fixed, safe and secure access to the solar array is provided for purposes of inspection, cleaning and maintenance.**
- **Remote monitoring system and online analysis package to show the live performance of the solar system**
- **Use of energy meter to keep track of the production**
- **The PV array is free from shading during all seasons of the year for at least 4 hours prior to and 4 hours after solar noon.**
- **Provision is made for security lighting.**

16.1. *7.3 Cabling and accessories*

All cables (electric wire) should be in a conduit and be UV rated. Unless otherwise specified, all materials including equipment fittings, cables etc, shall be in new condition. Defective equipment or that damaged in course of installation or test shall be replaced. Should any replacement be necessary, the Contractor shall bear the cost of the substitution of all associated builder's work and making good finishes.

16.2. *7.4. Specifications of batteries and charge controllers:*

There shall be a need to store the excess energy from the solar panels when the pump is not pumping water. This excess energy will be stored in the batteries through the use of MPPT controller and then be distributed to the nearby school or health facility with the help of an inverter.

The battery that suits the requirement is Trojan's Trillium TR12.8-110 Li-Ion. Similar configuration battery will also be considered

Following requirements and standards are recommended for Inverters:

- IEC 60068-2 – Environmental Systems
- IEC 61683 – Efficiency Measurements
- IEC 61000 – EMC (Electromagnetic Compatibility)

- IEC 62109-1 – General Safety Requirements, -2 – Inverter Specific Safety
- IEC 61727 – characteristics of the utility interface
- IEC 62103 – Electronic equipment for use in power installations
- VDE AR N 4105:2011-08 – Harmonics/Flicker/Frequency
- Warranty at least 5 years

Following requirements and standards are recommended for batteries:

- IEC 61427-1, -2
- IEC 62133 or UL 2054 2nd edition
- UL 1642 and UL 1973
- UN/DOT 38.3
- Battery Life cycle > 3500 cycles at 95% DOD
- LiFePO₄ technology or similar
- Warranty at least 5 years
- Expected life of battery > 12 years