RfQ FOR THE DRILLING OF 44 BOREHOLES UNDER AF PROJECT

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1.0 BILL OF QUANTITIES

BILL OF QUANTITIES FOR 44 BOREHOLES

BILL OF QUANTITIES FOR BOREHOLE DRILLING					
ITEM	DESCRIPTION	UNIT OF MEASURE (UOM)	QTY	UNIT RATE (GHS)	AMOUNT (GHS)
1	**Mobilization and Demobilization (Includes, moving, setting up, maintaining and dismantling the drilling unit from the field and cleaning site)**				
1.1	Mobilization per borehole	Sum	1		
1.2	Demobilization per borehole	Sum	1		
1.3	Mounting and Dismounting	BH	1		
2	**Movement**				
2.1	Movement between work sites	km	30		
3	**Borehole Drilling to a finished diameter of 125 mm**				
	Including the application of appropriate methodology of drilling (e.g. air drilling, mud drilling, reverse circulation drilling, water drilling etc.). Also includes drilling larger diameter pilot holes for the installation of recovered and unrecovered working and protection casings as well as installation of Bell Mouth				
3.1	Drilling through overburden and highly weathered rock	m	9		
3.2	Drilling through partially weathered to fresh crystalline, consolidated, unconsolidated, any type of rock	m	51		
4	**BOREHOLE CONSTRUCTION**				

	Including the supply and installation of centralizers, PVC pipes and PVC screens, gravels and grout seals				
4.1	Supply and Install PVC plain pipes with centralizers to a finished diameter of 125mm	m	46		
4.2	Supply and Install PVC slotted pipes (screen) with centralizers to a finished diameter of 125mm	m	15		
4.3	Supply and place 2-4mm gravels, packed, as in design type A	m	52		
4.4	Supply cement, mix and place grout seal above gravel as in design type A	m	1		
4.5	Backfill annulus space above grout seal as in design type A	m	3		
4.6	Supply cement, mix and place grout seal above backfill as sanitary grout seal as in design type A	m	4		
5	**BOREHOLE DEVELOPMENT**				
	Including any appropriate borehole development methodology and or combination of borehole development methods to develop water to clarity (e.g. air lifting, mechanical surging, high velocity jetting, backwashing, over-pumping	hours	3		
6	**PUMPING TEST**				
	Including supply, installation and removal of pumping test equipment, constant rate discharge test and recovery test				
6a	Supply, install and remove equipment for carrying out pumping test on hand pump boreholes	l/s	1		
6b	Conduct minimum 6-hour constant rate discharge test on hand pump	hours	6		
6c	Conduct up to 90% recovery test on hand pump boreholes	hours	3		

7	**WATER QUALITY TEST**				
	Including sampling, physico-chemical and bacteriological analysis				
7a	Take, label and store sample of water from borehole for analyses	l/s	1		
7b	Carry out physico-chemical analyses as specified	l/s	1		
7c	Carry out bacteriological analyses as specified	l/s	1		
8	**MARGINAL AND UNSUCCESSFUL BOREHOLES**				
	Including boreholes with yields less than 10 litres per min. and completely dry wells				
8a	Supply and install 1m reducer (200/140 mm) well seated in formations in preparation for hydrofracture in marginal yield boreholes including temporary cap on protection casing	m	0		
8b	Backfill unsuccessful boreholes	l/s	0		
9	**BOREHOLE CAPPING/BAIL PLUG**				
9a	Supply and fix suitable cap on borehole	l/s	1		
9b	Supply and fix bail plug on bottom as in design type A	l/s	1		
10	**BOREHOLE CONCRETE PAD**				
10a	Supply all materials and construct concrete pad on positive borehole for hand pump installation as specified by drawings	l/s	1		
11	<u>SUPPLY OF HANDPUMPS</u>	Each			
	Supply Afridev pumps (30 meters depth)		1		
	Supply Nira AF - 85 pumps (10 meters depth)		1		
11a			1		
	Supply Vergnet HPV – 60 pumps (30 meters depth)				
11b		Each	1		
	Supply Ghana Modified MarkII pumps (w/ 30 meters pipe)				
11c		Each	1		

11d	Additional Ghana Modified Mark II rising main Installation of Handpumps	Each	1		
11e	Installation of Afridev pump Installation of Nira AF-85 pump	Each	1		
11f	Installation Vergnet HPV - 60 pump Installation Ghana Modified Mark II pump	Each	1		
11g	**Training of Pump Caretakers** Training of Afridev pump Caretakers	Each	1		
11h	Training of Nira AF-85 pump Caretakers Training of Vergnet HPV – 60 pump Caretakers Training of Ghana Modified Mark II pump Caretakers		1		
12	**SUB TOTAL FOR 44 NO BOREHOLES**				
13	Each borehole should be embossed with an aluminum plate describing the name of the project, borehole number or any technical inscription, name of community and names/logos of Project partners(Adaptation fund, UNDP, MESTI/EPA)		44		
1	**Grand Total**				

2.0 DESCRIPTION OF ACTIVITIES

Correct design and long-term maintenance of boreholes is critical to ensuring sustainable water supplies from groundwater. In the case of Adaptation Fund Project, the drilling of borehole is focused on improving water supply systems for multiple uses and users. In this regard, the boreholes are expected to be of high yielding for the purpose of mechanization for supply of water to agricultural productivity and other domestic community livelihoods. Thus, the project has already selected the project communities, which have been described as vulnerable to climate change impacts, especially scarcity of water. The firm is therefore expected to drill 50 successful boreholes. The hydrological investigations, sittings and the supervision of the drilling of the 50boreholes would be undertaken by an independent contractor.

3.0 Key deliverables and PAYMENT SCHEDULE

- 20% upon submission of inception report within 20 days after signing the contract
- 20% upon successful drilling of half of the total boreholes offered by 10 December 2019
- 20% upon successful drilling of second half of the total boreholes offered by 5 January, 2020
- 40% upon successful completion and installation of all the total boreholes offered by 30 March 2020

4.0 DETAILED SPECIFICATIONS OF WORK

4.1 Borehole Identification

The Project Manager shall confirm to the Contractor the location at which each borehole is to be drilled and shall allocate a temporary number to each borehole. The Contractor shall mark the identification number on the borehole casing. A location map will also be drawn by the Contractor.

4.1.2 Borehole Drilling

A suitable rotary rig capable of drilling boreholes of finished diameters up to 200mm to a maximum depth of 100 meters shall be employed. The rig shall have air and water/mud flush facilities for drilling through the over burden and down-the-hole hammer facilities for drilling in hard rock. Rock types to be encountered during drilling would include igneous rocks such as granites, granodiorites and basalt, sedimentary rocks such as sandstones, shale, mudstones and siltstones and metamorphic rocks such as phyllites, schists, quartzites and gneisses. The rig should have the necessary accessories including sufficient working casings to drill through the various rock types. Drilling would be carried out through the over-burden and highly weathered rock up to average depths of 10 - 30 meters and then through the moderately weathered rock and the fresh rock up to an average depth of 30 - 40 meters. The maximum depth is estimated to be around 60 metres. If direct circulation rotary is used, the flushing medium should be air, water or stable foam. If, at any stage the use of mud is considered necessary either as a primary fluid or as an additive to create "stiff foam", only degradable high-quality polymer will be acceptable. Bentonite is specifically prohibited.

4.1.3 Sampling

During drilling samples of unwashed drill cuttings would be collected at 1m interval or at every change of rock type or colour of weathered material. The samples would be logged by the driller and the record kept on a daily log sheet. The record should indicate:

a) Lithology

b) Degree of consolidation or hardness

c) If unconsolidated, nature of grounder material, i.e subjective description of grain size, degree of rounding, clay content, colour.

A representative sample of every distinct horizon or change of rock type to be directed by the Project would be prepared in polythene bags and accurately labelled with the name of the village, borehole number, date and depth of sampling.

4.1.4 Rate of Drilling

Accurate records of penetration rate per metre shall be maintained and included on the daily log sheet.

4.1.5 Interim Yield Tests

Interim yield tests would be carried out at the first struck of water and at each stage during drilling when the flow of water increases. The depths of measurement and the yield of water shall be recorded on the daily log sheet. Interim yield tests should be carried out for at least 30 minutes to establish the optimum yield at the final depth of drilling.

4.1.6 Final Drilling Depth

The Project Manager or his representative has the responsibility for determining the final drilling depth. A maximum of two (2) holes shall be allowed for each successful borehole. Any deviation from this would require the Project manager's prior approval.

4.2 Borehole Construction

4.2.1 Design

For all boreholes, design type A will be used. Other designs according to site conditions shall be allowed. All boreholes will be designed by the District Engineer

4.2.2 Borehole Lining

All boreholes shall be lined completely with high impact-resistant Poly Vinyl Chloride (UPVC) plastic casings and screens specifically manufactured for bore holes.

4.2.3 Plain Casings

The casings shall have an inner diameter of 126mm (5ins.) and a wall thickness of 7mm, that is 126/140.

4.2.4 Screens

The inner diameter and wall thickness shall be the same as for the plain casing. For all types, the screen shall have a slot size of 0.75mm to 2mm depending on the aquifer material. The open area of the screens shall be at least 10% of the surface area of the pipe.

4.2.5 Joints

All casings and screens shall have screwed flush joints. The threads must be sturdy. either curved or angular with no eccentricity, to allow for easy handling.

4.2.6 Centralizers

Centralizers of suitable size (certified by the District Engineer) shall be fitted to both casings and screens at 6m intervals.

4.2.7 Bail Plugs

Bail plugs as in design shall be fitted at the bottom of each string of pipes.

4.3 Gravel Pack

All boreholes shall be gravel-packed as in designs with clean, well rounded quartz gravel of 1-3mm grading for sedimentary formation and 2-4 grading for basement aquifer.

The gravel shall be placed within the annulus using approved methods and the level measured accurately before grouting. Other material to be used as gravel pack should be approved by the District Engineer

4.4 Grouting

Grout seals shall be placed as follows; *(For Hand pump Boreholes)*

(i) 1m thick grout seal above the gravel pack. A layer of sand about 300mm shall be placed on top of the gravel pack before grouting.

(ii) 4m thick grout seal above the back-filled material.

4 Back Filling

(i) The annulus between two grout seals of successful boreholes shall be filled with drill cuttings or other suitable material approved by the Project Manager.

(ii) All unsuccessful boreholes shall be filled with drill cuttings or other suitable material to 1m below ground surface and a grout seal placed on top to properly cover the hole.

4.6 Borehole Capping

All permanent borehole linings will be completed 0.8m above ground surface and be temporary capped if necessary, with a suitable capping device approved by the Project Manager.

4.7 Borehole Development

Development of completed boreholes will be carried out initially by **surging** with compressed air and **air-lifting**. If the development is not complete, that is free from sand and clay, after 3 hours, further development will be carried out by **horizontal jetting** with suitable jetting tools and **air-lift pumping** for at most 5 hours. The borehole shall be declared poorly designed by the District engineer if the water is not clear (that is free from sand and clay) at the end of the 8 hours development.

5.8 Pumping Tests (*For Hand pump Boreholes)*

A 6-hour constant discharge test shall be carried out with a suitable submersible pump approved by the District engineer at a discharge rate of between ½ and ¾ of the estimated air-lift yield of the borehole to be determined by the District engineer. This would be followed by a 3-hour recovery test.

4.9 Water Quality Test

A sample of water from the borehole shall be taken at the end of the constant rate test for both chemical and bacteriological analyses. The chemical analysis would determine the following: PH, temperature, colour Total **Iron,** Chloride, **Nitrate**, **Nitrite**, **Fluoride**, **Manganese**, **Lead**, **Total Hardness**, **Zinc**, **Copper** and **Sulphate**.

The bacteriological analysis would determine **Total Coliform** and **E. Coliform**. All water quality tests shall meet GWCL standards for acceptance.

4.10 Verticality and Alignment

All boreholes shall be constructed and all linings installed plumb and true to line such that all pumping plant can be easily installed.

4.11 Work-on Site Journal

The Contractor shall maintain a work-on site journal in which all the information concerning the works would be recorded. This would enable the District engineer or his representative to be precisely informed on the drilling on arrival at site. The information to be recorded would include:

- site name (name of village)
- borehole number
- time and date of arrival and departure of the rig
- number of kilometres indicated on the rig truck when the leaving
- compressor time counter at the beginning and end of drilling, and

  similarly, for development and pump testing.
- time at which the rig was set up and at the start of drilling

- drilling time for each rod
- diameter and technique used with each rod.
- depth reached with each rod.
- description of drilled formation indicating as well whether it is soft, hard etc.
- shut down period due to breakdown.
- length of casings, screens, gravel pack etc.
- duration of development, yield and state of water.
- any other information considered technically necessary.

4.12 Successful Borehole (*Hand pump Boreholes)*

The minimum acceptable yield of a completed borehole shall be 13.51/min. after pump test.

4.13 Borehole Disinfection

All successful boreholes shall be disinfected using calcium hypochlorite in powdered or tablet form before the water quality analysis.

4.14 Concrete Pad

The Contractor shall install a concrete pad around each positive borehole for hand pump installation. An anchor bolt shall be cast into the pad using a stainless-steel template at the appropriate spacing for the pump. A brass plate (30mm by 60mm) shall be punched with the Borehole Identification Number provided the by Consultant and cast into the base pad so as to be visible when the pump has been installed. Well pad can only be installed after result of the water quality analysis are available and the contractor has been instructed by the consultant to construct.

The Contractor shall excavate and concrete the drainage channel for a distance of 7m down slope away from the centre of the borehole as shown in the plan view. The Contractor shall also fabricate and install a standard foundation bolt iron grid of dimensions 171mm by 171mm. The stick out of the 16mm bolt shall be 4cm. A brass plate 30mm x 60mm shall also be cast into the concrete pad so as to be visible when the pump has been installed, onto which shall be punched the borehole number.

4.15 Concrete Mix

The concrete used for the pad shall be prepared using normal Portland cement with a mixture of coarse and fine aggregate. The concrete shall meet the following specifications:

- Fine aggregate: 0.15mm to 9.5mm
- Coarse aggregate: 2.4mm to 40.0mm
- Minimum cement content: 320kg/cubic meter
- Compressive strength at 28 days: 25Mpa
- The concrete shall have a ratio of 1:2:4

Water used for mixing concrete and for curing shall be clean, and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substance. It shall be equal to potable water in physical and chemical properties.

5.0 SPECIFICATION FOR GOODS (Hand pumps)

The critical issue in selecting a hand pump for installation at the community level is its potential for sustainability. Village Level Operations and Maintenance (VLOM) hand pumps are generally understood to possess attributes of robustness, high discharge at relatively shallow depths, ease of maintenance and cost effectiveness. They are designed to have most of the maintenance work to be done at the community level and require few tools and inter-changeable wearing parts. One of the major risks to the sustainability of hand pumps is the availability of spare parts for the community to purchase locally. The chance of spare part availability is increased when there is standardization on a small number of hand pumps throughout the country. This standardization makes it easier for the private sector to procure hand pumps and spare parts, as well as to set up retail networks. Hand pump standardization also facilitates the training requirements for community level caretakers and area mechanics.

Based on the national sector policy initiated in 1992, Ghana standardized on the use of the following VLOM hand pumps at the national level:

- the Afridev (suitable for 10 m to 45 m)
- the Nira (suitable up to 15 m)
- the Ghana Modified India Mark II (depths above 10 m)
- the Vergnet (depths from 10 m to 45 m)

The Afridev pump should be the SKAT/HTN Afridev Hand pump Specification Revision 3-1998, with the following options:

- Cylinder assembly (with brass plunger)
- Pump rod arrangements AISI 304 (hook and eye pump rods)

- Stand assembly 2, suitable for mounting directly onto the pump apron with cast-in anchor bolts (as used in Ghana).

The Nira pump should be the Nira AF-85 Direct-Action hand pump.

- Direct-Action meaning that the plunger is directly connected to the handle and no lever arm is needed. Pump body is galvanised , base plate and standing plate are galvanised. Handle is stainless steel.
- The rising main and the piston rod are made of High Density Polyethylene. All underground pipes are modulised, an advantage when installing..
- 63mm cylinder for maximum depths of 15meters. These cylinders are replaceable and both fit with the standard rising main and piston rod.

The Vergnet pump should be the HPV – 60 Vergnet pump.

The IM2 pump should be the Ghana Modified India Mark II (depths above 10 m)

The final selection of pump may be modified by the community after the completion of the borehole, when the dynamic water level is known. However, this is only expected to happen in isolated circumstances.

An average setting of 30 meters should be used for estimating the unit cost of all pumps except the Nira which will be 15 meters.

Each pump must include the standard tool set and an O&M manual.

The pump and accessories shall be guaranteed for 12 months from the date of installation, or 18 months from the date of supply, whichever is earlier, against faulty workmanship and/or materials.

The District Assembly reserves the right to sample 10% of the pumps upon delivery to check components for dimensional conformity to the drawings and carry out a stroke test on the cylinder.

The nameplate shall be permanently attached to the pump body. If pop-riveting is used the height of the nameplate shall be such that the lowest rivet is above drainage holes. The nameplate shall have the following stamped on it:

- Manufacturer's name and address:
- Serial number;
- Year and month of manufacture.

The name of the Community shall also be engraved on the pumphead before pump is installed.

The pumphead flanges and stand flanges shall be marked permanently with the manufacturer's name/identification mark and year of production.

The Cylinder body, shall have the manufacturer's name/identification mark and year of production marked in permanent ink.

6.0 COMMUNITY PARTICIPATION

In addition to the supervision provided by the District CWSA rep, communities will be actively engaged in participating in the supervision of all aspects of the contract and will be given forms to help track borehole drilling. At least two hand pump caretakers should be actively engaged at the time of hand pump installation to receive hands-on training

7; LIST OF COMMUNITIES:

REGION	DISTRICT	SELECTED COMMUNITY FOR BOREHOLE DRILLING
Northern	Savelugu (5 boreholes)	1. Zaazi 2. Kukobila 3. Tampion 4. Sugtampia 5. Libga
Northern	Zabzugu	1. Sabare #1 2. Sabare #2 3. Mognegu#1 4. Mognegu#2 5. Kolikolini
Upper East	Bawku West	1. Farik 2. Tilli Azupunpuga 3. Timonde 4. Dagunga 5. Lamboya
Savannah Region	Bole	1. Chache 2. Sonyor 3. Kiape 4. Cheribawale

		5. Ntreso 6. Serikpe 7. Kakiase
Upper East	Bongo	1. Kunkua 2. Yidongo 3. Dua 4. Aliba 5. Adaboya
Upper East	Builsa South	1. Kasiesa 2. Kanjarga Nyandem 3. Gbedema Kunkua
Upper west	Sisala East	1. Tumu 2. Walembelle 3. Bugubelle 4. Kong 5. Tarso 6. Kulfou
Upper West	NANDOM	1. Ko -Bukom 2. Nabugaugn 3. Dabagteng-Naapaal 4. Sonne 5. Guri
Upper West	Nadowli	1. Zupiiri 2. Goli 3. Takpo