



TERMS OF REFERENCE (ToR)

“DRILLING OF BOREHOLES AND CONSTRUCTION OF WATER YARDS UNDER TRD – EU FUNDED PROJECT (REF CS.1038)”

1 Background

With funding from EU, IOM Sudan is implementing a ***Supporting Peace and Stability in Abyei PCA box: Decreasing tensions between the Misseriya and Dinka Ngok Communities*** Program in Mumo, El Fula locality, **West Kordofan** state. One (1) location have been identified in El Fula locality for drilling borehole and the installation of a water yard, namely: **Mumo**

IOM Sudan therefore seeks a drilling Contractor thereafter referred to as “the Contractor” to carry out the works of mobilizing machinery, performing hydrogeological surveying, drilling the boreholes, performing borehole development, testing up to the required standards, constructing a water yard tower fitted with a storage tank as per IOM design and a complete solar submersible system.

2 Scope of the works (SOW)

The project aims for the hydrogeological surveying and the drilling of a productive borehole capable of delivering 10m³/hr. Pump testing, water quality test, construction of a water tower, 4 cattle throughs, 2 water point and the installation of a submersible solar system and backup generator.

The work shall include the provision and installation of 8” casing and screens (STM), adequate gravel packing, materials for the construction of the manholes, disinfection of the well and system.

The detailed description of activities is specified in the Bill of Quantities and the drawings for borehole drilling, construction of the elevated water tank, the water points, which is part of this document and will constitute part of the contractual documents, therefore subject to validation for the actual completion.

3 Supervision

The IOM will appoint a **WASH Project Officer** to supervise the works, hereinafter referred to as the “IOM Site Supervisor”. Certain decisions must be validated by the IOM Drilling Technical lead as listed in the following sections of the ToR. Condition and specifications of the equipment and materials utilized will be subject to physical inspection and approval by IOM Drilling Technical Lead and should be disclosed by the Contractor prior to mobilizing the materials to the site.

The installation of the casing, gravel pack and complete pump testing must be done in the presence of the IOM Site supervisor.

4 Work force

The Contractor is expected to carry out all works as specified and in a professional manner. The Contractor shall carry out operations in accordance with the terms of the contract and to the satisfaction of the IOM. The Contractor shall supply efficient and experienced staff.

The Contractor must provide a list of the workforce it intends to use for execution of the project. The Contractor will provide an experienced hydrogeologist capable of performing and analyzing the hydrogeological survey and pump testing. The Contractor shall also provide an experienced driller to oversee and carry out the drilling, borehole construction and development.

The Contractor will maintain a complete drilling crew at the work site. If a member of the team quits for personal reasons or must leave because of illness or injury, the Contractor must replace the person as soon as possible, with a worker of similar experience. If the absence of one or more members of the drilling crew affects operations, the decision of whether to proceed will be at the discretion, and under the responsibility of the Contractor.

If the IOM Site supervisor is dissatisfied with the performance or attitude of members of the drilling crew, such members shall be informed of their shortcomings and warned by the Contractor. If no change results within a reasonable period, the Contractor will be notified and requested to take necessary measures to remove the unsatisfactory team member from the work site.

5 Equipment and Materials

The Contractor will provide full details of the proposed drilling methods and equipment to be used including rig type, model, manufacturing year, torque capacity and pullback capacity in their method statements. All equipment listed should be in perfect operational conditions and if changes are required during the execution of the contract, an equipment of similar characteristics needs to be put in place with formal written notification communicated to the IOM.

Materials that will form part of the complete works must be supplied new and never used. Materials must comply with the minimum specifications in the relevant codes. Materials not specified here must comply with the minimum specifications in the relevant codes of practice. Where a national standard does not exist for the material, the relevant British Standard shall apply. All materials that are to be temporarily or permanently installed in the boreholes during the works process are to be kept clean and away from contact with sources of contamination (hydrocarbons, effluent, animal matter etc.).

Condition and specifications of the equipment and materials, particularly the casings, screens and gravel pack utilized will be subject to physical inspection and approval by IOM Drilling Technical Lead. The Contractor shall bear the responsibility to ensure that the casing materials are properly transported to, and stored on site, protected from heat, UV light and any other risks of damage. The IOM Site supervisor must confirm that all materials delivered to site meet the relevant specifications, before work commences.

6 Borehole Sitting and Groundwater Investigation

Borehole locations shall be identified in agreement with the local communities and in consultation with the IOM Site supervisor. Sites selected should preferably be within the communities and not further away than 0.5km from 80% of people of the village. Boreholes should not be sited in or near to places that get flooded during rains. Flood plains should be avoided. Additional measures should be taken to ensure that sites are located outside the minimum distances prescribed from sanitation installations, sources of pollution, landfills, graveyards and animal pasture.

Prior to drilling and installation works commencing, the Contractor must perform a geophysical survey and analysis (hydrogeological survey) in the IOM pre-identified locations using geo-electrical techniques. The purpose of the surveys

will be to identify optimal drilling position at each location, as well as two back up drilling positions. The hydrogeologist shall recommend three suitable sites with the view that the proposed drilling will take place in the location where the demanded yield shall be attained as described in the TOR.

The results of these geophysical surveys will be compiled into a 'Geophysical Survey Report' to be submitted to the IOM Drilling Technical Lead prior to drilling operations commencing. This report will contain all results and locations of all geophysical profiles undertaken, and co-ordinates for the optimal and back up drilling positions.

The IOM Drilling Technical Lead will review this document and agree the proposed drilling positions are suitable prior to commencing.

7 Drilling stipulations

Any change in the set specifications for drilling such as: depth of hole, diameter of hole, depth of screen installation, materials for casing, gravel packing, etc., should be agreed by both parties (IOM and the drilling organization) and should be recorded in writing and signed by both parties in a variation order form.

7.1 Borehole depth and diameter

Drilling of number 1 borehole in all geologic possible environments with a minimum borehole diameter of 12,25", the average anticipated borehole depth will be of 1400ft. Shallower or deeper boreholes may be encountered but the final depth of the borehole shall be formally validated by the IOM Site supervisor. No additional payment shall be provided for meters drilled beyond the stated depth.

7.2 Verticality and alignment

It is a requirement to maintain verticality throughout the borehole depth as this will ensure the functionality and longevity of the pumping equipment.

Good drilling practices must be maintained at all times to ensure the boreholes achieve acceptable verticality. The wellbore, casing and screens shall be set round, plumb and true to line. If required by the IOM Site supervisor, the Contractor shall make a verticality test during and after drilling by approved methods and at his own expense to demonstrate that the departure from the vertical does not exceed 0.1% between ground level and the bottom of the well. If this departure is exceeded, the Contractor shall make the necessary corrections with approval from IOM Site supervisor, without additional payment. If the error cannot be corrected, then drilling shall cease, and a new borehole shall be drilled. The abandoned borehole shall be backfilled and /or capped. No payment shall be made for re-drilling, the sealing/backfilling of the abandoned borehole, or for moving to a new site. Any materials (i.e. casing, screens, gravel pack, cement, etc) lost in the abandoned borehole shall be at the Contractor's cost.

The Contractor shall include in their tender submission how they intend to maintain verticality of the boreholes and how they intend to check verticality of the borehole.

7.3 Drilling Method

The Contractor may use any motorized drilling technique that will achieve the depth and diameter required of the borehole, provided that the technique used is approved by the IOM site supervisor. The rig to be deployed must be capable of drilling to at least a depth of 25% beyond the anticipated final depth at the required diameter.

Sufficient drill collars and down-hole stabilizers will be required to ensure that good verticality is maintained throughout the drilling operation. All drill bits used throughout the works will be in good condition with minimal wear to the cutting teeth.

7.4 Drilling Fluid

The Contractor should make exclusive use of direct or reverse circulation rotary and down-the-hole hammer drilling techniques, using an appropriate (biodegradable) drilling fluid.

During rotary drilling using air as the circulating fluid, approved surfactants and artificial foam stiffening additives may be used if ground conditions warrant their use. Bentonite based fluid additives will not be accepted. Cellulose based reconstitution powder, or liquid polymeric additives may be required for viscosity enhancement. The Contractor will be required to state the type of polymer to be used, and describe the means by which the selected fluid additive will be mixed.

The Contractor shall make his own arrangements for obtaining, storing, transporting and pumping of the water required for drilling purposes. The IOM shall only supply logistical support, where this is clearly requested by the Contractor in their response to the call for tender, and subsequently agreed by the IOM Drilling Technical Lead.

7.5 Strata sampling and borehole geo data

Representative, continuous samples of 125 grams minimum of the strata penetrated shall be collected for every 2m interval and when required by the IOM Supervisor. The drilling organization shall take every possible precaution to guard against cutting contamination. Representative samples from the cuttings shall be preserved in polythene bags or suitable sealable containers and clearly marked in waterproof ink according to Location, borehole reference identification number (supplied by IOM), date taken and depth [from – to] by the Contractor. The samples shall be stored in a position where they will not be contaminated by site conditions or drilling operations. Lithological logging shall be the responsibility of the Contractor. All samples shall be handed over to the IOM Site supervisor upon completion of the works.

7.6 Total Depth of Borehole

The total depth of the borehole will be validated by the IOM Site supervisor. After the drilling process the Contractor is required to pull out all the equipment out of hole and then run in hole, reaming and flushing the borehole to total depth.

Once the borehole has been cleaned, the drilling assembly pulled out of hole and prior to casing installation, a tag-line supplied by the Contractor shall be used to check the true depth of the wellbore. This will ensure that no significant borehole balling or collapse has occurred. In the event of the borehole bridging or having extensive collapse, the Contractor shall have to perform another borehole flushing run down hole.

8 Well Construction

8.1 Casings and Screens

The Contractor shall produce a well design, which must be validated by the IOM Site supervisor before casing is installed. The Contractor may install temporary casings at their discretion as considered necessary to ensure the successful construction of the boreholes. Steel based temporary casings shall be extracted upon completion of the work to avoid groundwater contamination.

The Contractor shall install 8" STM drinking water standards casings, non-toxic plain casings with a 8" nominal diameter and 6.5 mm thickness for the total depth of wellbore except where screen casings are installed, regardless of the formation type.

Flushed or trapezoidal threaded connections are acceptable. Glued connections shall not be accepted. The intended casing joint type should be indicated in the tender submission.

The well design must include at least 3 metres of blank casing, fitted with a screwed on proprietary bottom cap, at the bottom of the casing column, to act as a back-sump for fine material which may enter the casing column during operation. The casing and screens must be centralized in the well so that an annular space. During installation, all casings and screens shall be accurately measured and their lengths recorded in casing tally. The casing tally shall be part of the borehole report handed upon completion of the works.

The Contractor will supply and install screens with vertical slot size between 0.5mm to 1mm with a minimum of 6% aperture. Hand-slotted casing will be rejected.

The casings and screens shall comply to ISO 9001:2018 and DIN4925 standards.

8.2 Gravel Pack

The Contractor will supply and install filter gravel pack which is washed, well-rounded of uniform grading from river beds consisting of particles with a diameter of 1-5mm. The gravel pack shall comprise of at least 95% siliceous material and must contain no clay, shale, silt, fines, excessive amounts of calcareous material or crushed rock. Prior to delivery a sample of gravel pack shall be subjected to inspection by the IOM Drilling Technical Lead for validation.

The volume of the filter pack required must be calculated taking into account the length of the screened area and an additional 50% to allow for settlement above screen casings, and the annular space between the borehole and the external diameter of the casing. The installation of the filter pack should be done with the aid of a tremmie pipe to ensure an even distribution of materials and to reduce the risk of materials bridging in the annulus. The use a funnel (sheet metal, plastic sheet or pipe) and flowing water shall also be accepted as a method of passing the gravel through the annular space between the casing and the sides of the borehole.

8.3 Sanitary seal and backfilling

The Contractor should ensure the installation of sanitary seal in the annular space between the screen casing and the borehole above the filter gravel pack to reach a minimum height of 3 meters. The sanitary seal shall consist of bentonite pellets of size between ¼" and ½". The bentonite pellets shall be installed in the annular space from the filter pack using tremie pipe system. Above the sanitary seal, the annular space shall be backfilled with cuttings extracted through drilling up to 3 meters deep below the ground level. The sanitary top seal in cement grout, corresponds to the first 3 meters below the surface. Including 2m of bentonite pellets and 1m of grout at the surface. If the Contractor cannot supply the bentonite pellets, a written request should be sent to IOM providing the justification and the specifications of an alternative sealing and plugging material for IOM to approve its installation.

9 Borehole development

Following the installation of the casing and annulus backfilling, the borehole will be developed through air lifting methods to remove drilling debris and sediment from the borehole.

The boreholes must be developed by airlifting for a minimum of 4 hours until a stabilized satisfactory yield is reached and the turbidity is less than 5 NTU. The nozzle of the air duct shall never be placed in front of the casing screens; it may be placed below or above.

10 Pumping Test

10.1 Step drawdown test

A step drawdown pumping test should be conducted by the Contractor for a minimum of 8 hours considering 4 step with different yield ($Q_{mx}/5$, $Q_{mx}/3$, $Q_{mx}/2$ and Q_{max}) and a recovery step. Each test should last a minimum of 1.5hr. Recovery test will be for one hour or such time when there is at least recovery of 90% of the static water level noted at the start of the pump test. The water level for every step shall be measured every 1 min for the first 10min, every 5 min until 60min has elapsed and every 10min until 90min has elapsed.

10.2 Constant rate test

The Contractor shall also conduct an 8 hours constant rate test allowing a minimum of 12 hours between the step drawdown test and the constant rate test. The pumping rate for the constant rate test shall be agreed and decided with the IOM Site supervisor. It is recommended to conduct the constant rate test at Q_{max} or $4m^3/hr$ – this should be discussed and agreed with the IOM Site supervisor. Recovery test will be for one hour or such time when there is at least recovery of 90% of the static water level noted at the start of the pump test. The water level for every step shall be measured every

1 min for the first 10min, every 5 min until 60min has elapsed, every 10min until 120min has elapsed, every 15min until 240min has elapsed 30min until 360min has elapsed 60min until 480min has elapsed.

Step draw down, constant pump test and recovery data should be reported on the IOM Pumping Test Log Sheet and should contain at least: Position of the WL measurement datum, Date of Test (Day, Month, Year), Total Depth of BH (m), Static Water Level (SWL) before test (m), Model of Pump used, Depth of Pump Intake (m), Discharge (Ltrs/Minute), Dynamic/Pumping water level (m).

The procedure should be discussed and agreed by both parties (IOM Site supervisor and Contractor) before starting the pumping test.

In the event of a breakdown during the tests, the groundwater level must be allowed to recover to the static level and the test must be re-started a minimum of 12hrs later. IOM shall not compensate for any failed pumping test needing repetition.

11 Water Quality

11.1 Laboratory Testing

Water samples for testing the physical, chemical and bacteriological properties shall be taken at the end of the test pumping. The Contractor will take two (2) times – one (1) liter samples in clean, properly sealable, sterilized plastic bottles for laboratory analysis. The Contractor shall be responsible for testing of the water quality in approved water testing laboratories and as specified, furnish the IOM with the test certificate. The samples should reach the laboratory within 6 hours from the time of collection.

The water quality shall comply with the minimum Sudanese quality standards. If one, or more, of the requirements are not met, the borehole will be considered unsuccessful, and treated as a dry borehole.

11.2 Borehole Disinfection

After collecting the water sample for testing, the borehole should be thoroughly disinfected with a chlorine-rich solution, preferably granular Calcium Hypochlorite (HTH) or Sodium Hypochlorite at a concentration of 500 grams per cubic meter of pack. This will initiate the process of sterilizing the borehole and the chlorine solution should stay in the borehole for at least 4 hours at the specified concentration, leaving a concentration of residual chlorine of 50 milligrams/litres (as per WHO standards). The disinfection procedure shall be discussed with IOM's Site supervisor in order to seek approval.

12 Borehole Acceptance

The IOM shall accept the borehole upon satisfactory completion of all drilling operations, installation of casings and screens, development works, pumping tests, presentation and approval of complete drilling reports and logs and provided the borehole yield is above minimum recommended values and water quality tests are suitable for potable water according to the GOSS standards.

If completion of the borehole is prevented by any failure of equipment, behavior of the ground, jamming of the tools, or casing or any other cause, the well shall be deemed to be abandoned and no payment shall be made for that borehole or for any materials not recovered.

In the event of an unsuccessful borehole, the Contractor shall drill a new borehole. The option of declaring any borehole unsuccessful shall rest with the Contractor, subject to the approval of the IOM Site supervisor.

Reasons for abandonment:

- Yield – the borehole shall meet the minimum requirement as stated in the terms of reference for the work and if not shall be classified as a dry borehole.

- Water quality and Salinity - If the borehole is seen to have a high salinity (EC over 1400 $\mu\text{S}/\text{cm}$) during drilling, airlift or pumping test, the borehole shall be abandoned and re-drilled at an alternative position.

For any borehole abandoned, the Contractor shall retrieve as feasible all materials from the borehole. The materials salvaged remain the property of the Contractor and may be re-used if not damaged.

The abandoned borehole shall be backfilled with soil from the bottom upward using materials clean and free of contamination (organic matter, oils/ fuels, general waste, animal matter etc.). The last 3 meters shall be sealed by concrete which shall be placed by a method approved by the IOM Site supervisor that will avoid segregation or dilution of material.

13 Loss of equipment

Any equipment lost down hole must be removed by the Contractor or the borehole shall be considered unsuccessful. A replacement borehole shall have to be constructed at the Contractor's expense. In the unfortunate event that the Contractor cannot extract the foreign body, the Contractor shall not be entitled to further payments.

14 Headworks and Pumping Equipment

Upon reception of satisfactory water quality test results, the Contractor is to cast a concrete well head as listed in the BoQ.

All construction materials shall be mobilized to the site immediately after the completion of the pump test and shall be of the following quality:

- Aggregates shall be hard, clean and free of all organic material. Coarse aggregates shall be comprised of clean, un-weathered, hard, well graded material of between 9.5mm and 20mm in size.
- Sand/gravel shall consist of grains with a maximum size of 9.5 mm. It shall be free of soil, clay, organic matter and other impurities and shall contain no more than 5% silt.
- Water used for mixing concrete and for curing shall be clean and free from injurious amounts of oil, acid, alkali, organic matters or any other deleterious substance. It shall be equal to potable water in physical and chemical properties.
- Cement shall be normal Portland cement. Bags shall be in perfect condition when delivered to the site. All broken bags or bags showing signs of dampness caking shall be immediately removed from the site. Reuse of spilled cement is not permitted.

Construction of the water tower, foundation, animal throughs and water point shall be in accordance with the engineering drawings.

15 Construction Materials

15.1 General

The contractor shall employ a fully competent and skilled supervisor for all concrete works, to ensure that required standards and ratios and good workmanship are maintained.

15.2 Cement

Cement shall comply with BS 12 for ordinary Portland cement and shall be free of lumps, the said quality cannot be found contractor shall mention available quality which shall be approved by client otherwise if found on site cement which fails to comply with the above quality and no mention was made prior to the inspection such cement will be removed from site.

15.3 Coarse Aggregates

Coarse aggregate shall be clean, hard, and durable crushed, comply with the requirements of BS 882. The aggregate shall be supplied in the normal sizes called for in the bid and shall be graded in accordance with BS 882 for each normal size.

15.4 Water for Concrete and Water for curing

Water used for concrete mix shall be from source that will be clean, fresh and free from organic matter in solution or suspension in such amount that may impair the strength or durability of the concrete.

15.5 Hand Mixing

Hand mixing maybe carried out subject to agreement with Field Teams, the mixing will then be done on hard surface. Mechanical concrete mixers are highly recommended for this process.

15.6 Placing / spreading of concrete.

The surface shall be clean, hard and sound and without any fore-standing water. The concrete shall be carefully worked round all obstructions and that all parts are completely full of compacted/vibrated concrete with no segregation. Concrete shall not be placed during rain which is sufficiently heavy or prolonged so that matter is worked from coarse concrete on the expose faces in the works.

16 Reporting

Upon completion of the borehole, the selected Contractor shall submit a report of the borehole construction work. The report shall include:

- Borehole location details including GPS data in decimal format;
- Daily journal record, capturing the activities performed each day from the day of mobilization, including downtime and failures and if applicable the drilling depth;
- Drilling pipe tally sheet with the start and end times of each drilling rod;
- Lithology log, capturing all the information pertaining to the appearance of water filtrations and aquifer, types of rock found and sampling details including geophysical testing analysis;
- Casing and screen manufacturer, size, positioning and installation depth;
- Filter pack details: size and depth of installation in the annulus;
- Step drawdown test with details of the pump used, installation depth, date of test, and SWL with analysis and determination of the specific drawdown;
- Constant rate test with details of the pump used, testing conditions and an analysis providing an estimation of transmissivity;
- Disinfection procedure followed and concentrations used;
- Submersible pump installation details: parts used, quantity and depth of installation;
- Water quality analysis
- Variation orders capturing deviation from ToR and BoQ signed by the Contractor and the IOM Supervisor

The Contractor shall report the above information in a report signed by the director of state water cooperation.

No payment will be made prior to reception of all the documents described above.

17 Health and Safety

The Contractor's team leader shall take all reasonable precautions to prevent any death or injury to persons during said undertaken activities. These precautions shall include but not be limited to providing his crew with safety helmets, hard-toed boots (safety boots) or gumboots, heavy duty gloves, protective glasses and ensuring that all tools and equipment are in a safe condition and ensuring that his employees adopt safe working methods.

No military-looking clothing will be accepted at any time.

Under this contract, the Contractor's team leader has the obligation and responsibility to safeguard the safety and security of its personnel, the drilling crew's equipment and other property, IOM-furnished equipment and supplies and personnel's personal effects and other property.

The Contractor's team leader shall develop a security plan in consultation with IOM, including detailed procedures to cover evacuation, personnel, equipment, safeguarding of IOM-furnished equipment and supplies, unlawful interference and prevention of sabotage.

Care must be taken in the handling and storage of all drilling fluids, oils, greases and fuel on site, to avoid any environmental degradation. The Contractor shall dispose of any toxic materials, drilling fluid and other additives, cuttings and discharged water in a manner approved by the **WASH Project Officer** so as not to create damage to public and private property.

The Contractor is to ensure that all materials, solid or liquid, are stored in a manner so as not to damage or contaminate any surface by spillage. All drilling equipment will be suitably leak free regarding oils or fuel. Care must be taken when re-fuelling on site.

18 Requirements of the Contractor for the tender

a) Experience

For a Contractor to be accepted to participate in the tender process, must provide evidence (satisfactory contract completion certificates) of at least 10 boreholes drilled in Sudan with other NGOs or government amounting to a total value of 100,000 USD during the last 5 years. In addition, the Contractor shall provide satisfactory contract completion for at least 5 water yard construction in Sudan over the past 3 years.

b) Time for completion

The organization should complete the activity no further than **3 months** after the signature of the contractual agreement. For the tender process, the Contractor should submit a work schedule (project Gantt chart) aligning activities to match the completion period. Any bid which schedule goes beyond the project estimated completion period of 1 month will not be accepted in the tender process. In the case of delays in the implementation process of the project, **penalties** will follow with immediate effect and the penalty criteria will be stipulated on the contract document.

c) Legal documents from the government of Sudan

The Contractor must present a copy of the valid drilling certificate; a copy of the company's registry in **the Sudan's Ministry of Legal Affairs and a copy of the trading license.**

d) Budget

The companies participating in this tender should present the BoQ in Annex fully completed with the unit prices for each activity. The full amount quoted should cover all expenses for the completion of the activities under the contract, as well any indirect cost and/or administrative costs that the Contractor must incur. The Contractor shall be responsible for the welfare (accommodation and food) of the crew.

19 Defect liability period

The construction works will be guaranteed for a period of 1 year after completion. In an event that there are defects found on the borehole within the 1-year period, the Contractor will be notified and authorized to correct all the said defects before the Contractor is paid the **retention** amount as stipulated on the contract document.

20 Annexes

Annex A – Engineering drawings

Annex B – BOQ for drilling boreholes

Annex C – Check list

Annex C CHECK LIST FOR COMPLETION OF BOREHOLE

Activities	Satisfactory Completion (Yes/No)	Changes /Progress Consulted with IOM (Yes /No)	Remarks / Evidence
Siting of the borehole			
Drilling of borehole to agreed depth			
Casing installation and material			
Screen installation			
Development			
Pump Testing			
Water Quality Testing			
Borehole Platform			
Drilling reports (Hydrogeological survey, water quality, GOSS, pumping test report including recovery data).			
SUMMARY:			

This form should be signed by both parties.

From IOM

Name:
Position:

Signature:

Date:

From the drilling organization (Replace for name of the organization)

Name:
Position:

Signature:

Date: