Annex 3

BILL OF QUANTITIES

Geophysical Survey, Drilling and Construction of 32 Solar-Powered Boreholes with Water Storage and Distribution Systems in Khartoum, White Nile and Northern States – All Lots (quantities for 32 boreholes)

Item No.	Item Description	Unit	Qty	Unit Cost (USD)	Total Cost (USD)
1. GEOPHYSICAL SURVEY, DRILLING & GEOPHYSICAL LOGGING					
1.1	Hydrogeological desk review and geophysical survey at each site: vertical electrical sounding (VES, Schlumberger array, AB/2 ≥ 500 m, minimum 3 soundings per site) and/or 2D resistivity profile, including interpretation by a qualified hydrogeologist and a siting report (field curves, interpreted layers, recommended drilling point with GPS coordinates, expected aquifer and target depth) submitted for AIDPOINT/WES approval before drilling.	Site	32		
1.2	Mobilization and demobilization of drilling rig, heavy machinery, test-pumping unit, compressor, technical crew and materials to each approved site across Northern, Khartoum and White Nile States, including rig set-up, mud pits, inter-site moves, demobilization and site restoration.	Site	32		
1.3	Drilling pilot borehole (minimum 8½" diameter) from ground level to design depth (target 215 m per borehole) by mud-rotary method with bentonite/polymer mud (or DTH air hammer where hard rock/basement is encountered), including formation sampling every 3 m and at each change of lithology, and a detailed drilling/lithological log.	Meter	6,880		
1.4	Downhole geophysical logging of the completed pilot hole (short/long normal resistivity, spontaneous potential and natural gamma) by a qualified operator, with interpreted logs and the proposed borehole design (casing and screen positions) submitted for approval before reaming.	Well	32		
1.5	Reaming the pilot hole to minimum 14¾" diameter from ground level to the approved design depth (to provide ≥ 75 mm annulus around the 8" casing for gravel pack), including supply and installation of a surface conductor casing of not less than 6 m.	Meter	6,880		

Item No.	Item Description	Unit	Qty	Unit Cost (USD)	Total Cost (USD)
1.6	Backfilling and sealing of an unsuccessful/dry borehole with clay and cement–bentonite grout, removal of any recoverable materials and restoration of the site – provisional item, payable only when instructed in writing by AIDPOINT (Section 1, clause 2.9).	Well	3		
2. CASING, SCREENING & WELL COMPLETION					
2.1	Supply and installation of 8" (DN200) uPVC deep-well blind casing, DIN 4925 heavy series or approved equivalent with adequate collapse resistance for the installation depth (steel casing where required by WES), threaded and coupled joints, centralisers at maximum 12 m intervals, extending 0.5 m above the finished concrete pad, including a 6 m sump pipe with bottom end cap. (Indicative 168 m per borehole; final lengths per the approved borehole design.)	Meter	5,376		
2.2	Supply and installation of 8" (DN200) uPVC slotted well screen, DIN 4925 heavy series or approved equivalent, slot size 0.75 mm (or as determined from sieve analysis of aquifer samples), placed against the productive aquifer zones identified from the lithological and geophysical logs. (Indicative 48 m per borehole.)	Meter	1,504		
2.3	Gravel pack: supply and placement by tremie pipe of washed, well-rounded silica gravel (≥ 90% silica, 2–4 mm or as designed from sieve analysis) in the annulus from the bottom of the borehole to at least 10 m above the top screen, with formation stabiliser above. (Indicative 8 m^3 per borehole.)	m^3	256		
2.4	Well lining and sanitary seal: bentonite pellet/chip seal (minimum 3 m) above the gravel pack, backfill with formation stabiliser, and cement–bentonite grout sanitary seal from ground level to a minimum depth of 10 m, in line with WES practice.	Well	32		
2.5	Borehole development by air-lifting with an adequately sized high-pressure compressor, surging/jetting and mud dispersant (where mud-rotary drilling is used) for a minimum of 12 hours and until the discharge is clear and sand-free (sand < 5 mg/L, turbidity < 5 NTU), including	Well	32		

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	verticality/alignment check and shock chlorination (minimum 50 mg/L free chlorine, 12–24 hours contact) followed by purging.				
2.6	Pumping test with test pump, generator, calibrated flow meter and electric dipper: step-drawdown test (minimum 4 steps × 100 minutes), constant-rate discharge test (minimum 24 hours; up to 72 hours where required by WES/AIDPOINT) and recovery test (to 95% recovery or 12 hours), including analysis report stating transmissivity, specific capacity, safe yield, recommended pump setting depth and duty point.	Well	32		
2.7	Physical and chemical water-quality analysis (pH, EC, TDS, turbidity, colour, temperature, hardness, chloride, sulphate, nitrate, nitrite, fluoride, iron, manganese, arsenic, sodium) by a WES/SSMO-recognised laboratory against WHO Guidelines and the Sudanese standard – samples at the end of the constant-rate test and at commissioning (2 per borehole).	Test	64		
2.8	Bacteriological water-quality analysis (E. coli/thermotolerant coliforms and total coliforms per 100 ml) by a WES/SSMO-recognised laboratory – samples at the end of the pumping test, after disinfection, at commissioning and before handover (One per borehole).	Test	32		
2.9	Borehole completion report per borehole (approved siting report, drilling/lithological log, geophysical log, as-built borehole design, casing/screen tally, static and dynamic water levels, pumping-test analysis, water-quality results, GPS coordinates and photographs), in English with Arabic summary, in hard and electronic copy.	Well	32		
3. HEADWORKS & SURFACE PROTECTION					
3.1	Construction of a reinforced concrete sanitary apron/pad around the wellhead (minimum 2.0 m × 2.0 m × 0.15 m, C25 concrete, sloped away from the casing with a raised edge and drainage outlet to a soak-away), with a lockable heavy-duty steel wellhead cap allowing sealed entry of the riser pipe and cables, and a 25 mm (¾") dip tube for water-level measurement.	Set / Well	32		

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4. SOLAR PV ARRAY & MOUNTING STRUCTURE					
4.1	550Wp Poly/Monocrystalline PV Modules: High-efficiency N-Type/PERC, Tier-1 (TUV/IEC certified), anodized aluminum frame, IP68 junction box, low temperature coefficient (≤ -0.35%/°C), rated for harsh desert environments. BOQ basis: 20 modules (11 kWp) per borehole; final array configuration per the approved sizing design (Section 1, clause 3.3).	Pcs	640		
4.2	Hot-Dip Galvanized Mounting Structure: Elevated ground-mount frame (heavy-duty, wind load capability > 130 km/h), clearance height 1.5m for ventilation and cooling, 15° fixed tilt, including legs, purlins, clamps, stainless steel (A2/A4) fasteners, and concrete footing pads (sized for 20 modules / 11 kWp per site), with anti-theft (tamper-proof) fasteners.	Set	32		
4.3	DC Cabling & Interconnections: 6 sq mm UV-resistant single-core solar DC cable (Red/Black), halogen-free, MC4 IP68 connectors, heavy-duty UV-stabilized conduit or trunking. Cables sized for ≤ 2% voltage drop.	Lot	32		
5. SUBMERSIBLE PUMP & MOTOR SET					
5.1	Heavy-duty 6" stainless-steel submersible pump set: 7.5 kW (10 HP), 3-phase 380–415 V motor with thermal protection, SS304/SS316 multi-stage centrifugal pump end with high sand tolerance for continuous duty; duty point to be confirmed from the approved pumping-test results (BOQ basis: 5–8 m^3/h at a total dynamic head of up to 150 m). Includes heavy-duty 4-core (3 + earth) 10 sq mm flat submersible drop cable matched to the approved pump setting depth (BOQ basis 120 m per borehole) and heat-shrink resin-filled waterproof cable joint kit. Sizing report from the manufacturer's software to be approved before procurement.	Unit	32		
5.2	Piping & wellhead assembly: 2" (DN50) galvanized steel riser pipes, heavy series (BS EN 10255 heavy) or approved equivalent rated for the pump shut-off head, length to suit the pump setting; wellhead flange/clamp assembly, pressure gauge, non-return valve, air-release valve, brass gate valve, sampling	Lot	32		

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	tap and DN50 bulk water meter.				
5.3	Submersible Safety Cable: 6mm stainless steel (SS316) wire rope with heavy-duty wire clamps for structural pump support. (BOQ basis 120 m per borehole; length to match the approved pump setting depth.)	Meters	3,840		
6. CONTROL, PROTECTION & SWITCHGEAR					
6.1	Solar Pump Inverter / VFD Controller rated not less than the pump motor rated power and full-load current (7.5 kW / 10 HP, 3-phase 380–415 V output; the next frame size, 11 kW, is acceptable for high-temperature derating), built-in MPPT (efficiency ≥ 99%), maximum DC input voltage compatible with the approved PV string design, IP54/IP65 enclosure (or IP20 mounted inside the control house), dual input (solar DC / generator AC), with dry-run, motor overload, phase-loss, over-temperature, over-voltage and under-voltage protection, soft start and display of operating data.	Unit	32		
6.2	DC/AC Combiner Box & Switchgear: Heavy-duty weather-proof IP65 box equipped with DC 1000V/1200V isolator switch, DC fuses (25A), DC Surge Protection Device (SPD Type II), AC circuit breaker, AC SPD, and status indicator lights.	Set	32		
6.3	Manual Changeover Switch: 4-Pole 40A/63A heavy-duty manual changeover switch (Solar VFD vs. External Standby Generator Input) in a lockable enclosure.	Unit	32		
6.4	Borehole & Tank Sensors: Water level sensors (dry-run probe for borehole, tank full probe for elevated storage tank) with low-voltage signal cable 3 x 1.5 sq mm.	Set	32		
7. EARTHING & LIGHTNING PROTECTION					
7.1	System Earthing Kit: Copper-bonded earth rods (5/8" x 2.4m), earth pit inspection chambers, ground enhancement compound (bentonite), 25 sq mm copper earth tape/cables connecting the structure, array frame, inverter, and pump house earth bar (earth resistance < 5 Ohms). Lightning Protection Kit: ESE or conventional air terminal spike mounted on array/mast, with down conductors (35 sq mm bare	Set	32		

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	copper) and dedicated earthing pit.				
8. GABION FENCING & SECURITY PROTECTION (12m x 12m Solar Array Enclosure)					
8.1	Gabion Mesh Boxes & Rock Fill: Double-twisted hexagonal galvanized or PVC-coated steel wire mesh gabion baskets (2m x 1m x 1m or 1m x 1m x 1m), filled with dense, weather-resistant hard stone rock fill for base wall (1m height x 1m width along 48m perimeter).	Fence	32		
8.2	Chain-Link Fence & Posts (Upper Extension): Heavy-duty galvanized steel pipes (2" diameter) anchored into gabion base, topped with 1.5m high PVC-coated chain-link mesh and 3 strands of galvanized barbed wire on Y-cranks (total fence height: 2.5m).	Fence	32		
8.3	Security Access Gate: Heavy-duty double-leaf steel swing gate (3m wide x 2.5m high) with padlocking mechanism.	Set	32		
9. PUMP CONTROL HOUSE (3m x 3m Outer Dimensions)					
9.1	Construction of a pump control/guard house, 3.0 m × 3.0 m outer dimensions, 2.8 m clear internal height: plain/reinforced concrete strip foundations 0.6 m deep; walls of 200 mm solid concrete blocks (or burnt bricks) in cement mortar 1:4, plastered and painted inside and out; 100 mm C20 concrete floor slab on 150 mm compacted hardcore; roof of galvanized corrugated iron sheets (gauge 28) on steel purlins with 0.3 m overhang, secured against wind uplift; lockable steel door (0.9 m × 2.1 m) and two steel-barred ventilation openings with fly screen; cable ducts/sleeves, wall-mounted equipment board for the inverter and switchgear, and one 6 kg dry-powder fire extinguisher.	Unit	32		
10. ELEVATED WATER TANK & TOWER STRUCTURE (15 Cu. Meters)					
10.1	Pressed Steel / Heavy-Duty 15 Cu. Meter Water Tank: hot-dip galvanized, non-toxic food-grade internal lining, UV-resistant, with lockable inspection manhole, external/internal ladder, level indicator, inlet, outlet, drain, and overflow connections. Includes 6-meter elevated galvanized steel tower structure (6m clear height under tank bottom), hot-dip galvanized columns, bracing, walkways with safety handrails, and reinforced concrete	Unit	32		

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	footings/pad foundations designed for seismic and heavy wind loads.				
11. WATER DISTRIBUTION POINT & DONKEY CART STATION					
11.1	Distribution & Supply Main Pipeline: HDPE (PN10/PN16, 2" to 2.5" diameter) buried distribution pipeline (indicative 100 m per site; paid on measured length) from elevated tank to tap stand and donkey cart point, including trenching (0.8m depth), backfilling, isolating gate valves, and fittings.	Meter	3,200		
11.2	10-Tap Community Tap Stand: Reinforced concrete splash pad, masonry stand structure with plaster/tiling, drainage channel to soakaway pit, fitted with 10 lockable 3/4" heavy-duty brass bib taps and internal manifold piping.	Unit	32		
11.3	Donkey Cart Water Filling Point: High-flow 2" galvanized steel/HDPE discharge pipe with heavy-duty quick-opening brass ball valve, flexible outlet hose, support structure, and reinforced concrete slab for cart parking and overflow runoff.	Unit	32		
11.4	Distribution Point Security Fence (8m x 6m): 2m high galvanized steel pipe posts anchored in concrete, 2m PVC-coated chain-link mesh along 28m perimeter, and 1.5m wide single-leaf steel access gate for crowd control.	Set	32		
11.5	Testing, commissioning and handover of the complete system: 30 m^3/day output test on a clear day (bulk water meter), pressure and leak test of pipework, check of all inverter protections, generator changeover test and earthing resistance test (< 5 Ohms); as-built drawings, O&M manuals (English/Arabic), warranty certificates, basic tool kit and one-day on-site training of caretakers/WASH committee.	Site	32		
12. TOTALS					
				SUBTOTAL (Items 1.0 to 11.0)	
GRAND TOTAL ESTIMATED COST (USD)					