

TECHNICAL SPECIFICATIONS

BOREHOLE DRILLING IN GUNDA AREA, PHALOMBE DISTRICT AND TIZORA AREA, NSANJE DISTRICT.

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SECTION 1: GENERAL CONTRACT SPECIFICATION

1.1 General

Luckson Ngalu, UNDP Engineer



Any clauses in this specification, which relates to work or materials not required by the Bills of Quantities or subsequently by a variation or extra works order shall be deemed not to apply.

The SI system shall be the official system of units.

It should be noted, however, that in the event of any dispute arising over a Metric Equivalent, it must be recalculated exactly in accordance with BS 350 Conversion Factors or equivalent/ equal.

1.2 Scope and Applications

These Specifications shall apply to well siting using geophysical investigation methods, drilling, supply and installation of casing, well development, pump testing, capping, construction of civil works such as aprons, drainage, soak away and washing slabs, hand pump supply and installation, water quality analysis etc. The Works are to be investigated and constructed in accordance with but not limited to the details and descriptions in the Specification, Bills of Quantities, Contract Drawings and other Contract Documents or any variations or additions thereto which may be issued under the Terms of Contract.

1.3 Approval of Suppliers, Services, Materials and Goods

All materials to be provided shall be new, unused, of the most recent manufacture and incorporate all recent improvements in the design and material unless provided otherwise in the Contract.

Before entering into any sub-contract for the supply of any material or goods the contractor shall obtain the Project Engineer's approval, in writing, of the sub-contractor or supplier from whom he proposes to obtain such materials or goods. Should the Project Engineer at any time be dissatisfied with such materials or goods or with the method or performance of such sub-contractor's work or place of business, the Project Engineer shall be empowered to cancel his previously given approval of such sub-contractor. The Contractor shall then obtain the said services, materials or goods from such other sub-contractor or supplier as may be approved by the Project Engineer and shall bear any additional cost therefore.

If during the Contract, through any reason n, a supplier should increase the cost of materials above that of other equally reputable suppliers, the Director of Child Affairs may only authorize payment for materials at the rates of other suppliers.

1.4 Contract's Orders for Materials

Without prejudice to any other clause in the Specification, the Contractor shall, before ordering any borehole construction, refurbishment and/or testing materials, or other articles for use and installation in the Works, seek the approval of the Project Engineer on the names of the persons or firms from whom he desires to obtain any such articles.

1.5 Sample

In addition to any special provisions herein from sampling and testing of materials, the Contractor shall submit to the Project Engineer as he may require samples of all materials and goods he proposes to use or employ in or for the Works. Such samples, if approved, will be retained by the Project Engineer, and no materials or goods of which samples have been submitted shall be used on the permanent works unless and until such samples have been approved in writing by the Project Engineer. Notwithstanding the Project Engineer's approval as provided for herein, the Contractor shall be solely responsible for the quantity of all materials and goods supplied unless specified otherwise.

The cost of supplying all such samples and of conveying the same to such place of inspection or testing as the Project Engineer may designate within the country of origin and/or the Employer's country and of complying with the requirements of this Clause shall be deemed to be included in the Bid rates and prices.

1.6 Test Certificates

Luckson Ngalu, UNDP Engineer



Should the Project Engineer not inspect any materials or goods at the place of manufacture, the Contractor shall obtain certificates of tests performed on such materials or goods by an agency approved by the Project Engineer and shall certify that the materials or goods concerned have been tested in accordance with the requirements of the Specification and shall give the results of all the tests carried out. The Contractor shall provide adequate means of identifying the materials and goods delivered to the site with the corresponding certificates.

1.7 Contractor's Work Programme

A programme for the performance of the works as a whole and showing the proposed construction of particular undertakings shall be submitted by the Bidders with his Bid

Pursuant to Clause 7 of the Conditions of Contract, the Contractor shall, within 7 days of the Commencement Date submit the work programme, showing in detail the order in which the various parts of the Works are to be implemented, with dates of commencement and completion and where necessary, intermediate stages of works and the dates thereof.

The programme shall, where required by the Project Engineer, be accompanied by sketches showing in details the different stages of the programme. The said programme shall take into account the seasonal rainfall and flow of surface water.

After approval by the Project Engineer, the Work programme shall be binding on the Contractor. Changes in the programme may be done by the Contractor only after prior approval to them has been obtained from the Project Engineer, which shall not be unreasonably withheld.

The programme shall fully take into account and allow, in a methodical manner, for the need to coordinate procedures with other contracts being carried out in the area and the community in each drilling site.

The Project Engineer shall be entitled at any time to demand changes in the work programme as he deems necessary for the proper and expedient performance of the works.

1.8 Drawings

1.8.1 General

Luckson Ngalu



The whole of the Works shall agree in all particulars with the details shown in the Drawings and Project Engineer's instruction.

The Contractor shall carefully check the drawings supplied to him and shall bring any errors or discrepancies discovered therein to the attention of the Project Engineer, who will issue the necessary instructions for corrections.

1.8.2 Additional Construction Drawings

The Project Engineer may at any time during the Contract period issue such **additional construction drawings** as may deem necessary for proper performance of the Works.

1.8.3 Records and As-Built Drawings

After the work has been completed, and prior to obtaining the Certificate of Completion, the Contractor shall furnish "As Built" drawings prepared during construction, showing the Works as constructed, together with all other information that may either be required or be useful in the future.

1.9 Rates and Prices

The rates and prices inserted by the Contractor are to be the full and inclusive value of the work described. They are to cover all costs, expenses and general risks which may be involved together with all liabilities and obligations set forth or implied in the specification

and other documents on which the tender is based. They must include all general works of preparation, all plant, tools, materials sheds, offices, overhead charges and profit, transportation of materials and men, labour etc. necessary for carrying out the work. They must also take into account conditions referred to in General Conditions, proper and sufficient protection to works, necessary lighting, watching, fencing, safety of persons and property, the provision of temporary works, setting out, testing and all other matters requisite for the satisfactory completion and commission of works, the provision of all design work, specification, etc. to the approval of the Project Engineer as required by these documents.

1.10 Discharge of Water from Works

Luckson Ngalu, UNDP Engineer



The Contractor shall make such provisions for the discharge of any water, whether fouled or discoloured or otherwise, from the Works as shall be satisfactory to the Project Engineer and to any authority and/or person having rights over the lands or watercourses over or down which such water is discharged. The Contractor shall hold the Employer indemnified against any claim that may be made through non-compliance with this Clause.

In the event of there being any interference with existing land or road drainage due to the construction of the Works within or without the limits of the works, the Contractor shall take immediate steps to restore the drainage to the satisfaction of the Project Engineer and owners, occupiers, or the authority concerned.

1.11 Access to Site

The Contractor shall make his own arrangements for access to the various parts of the Sites but all such accesses shall be subject to the approval of the Project Engineer and shall be maintained by the Contractor throughout the construction period at no extra cost.

1.12 Contractor's Office and Temporary Buildings

The Contractor shall make his own arrangements, at his own, expenses for all local accommodation he may require for offices, yards, stores, labour camps etc. and all buildings and all services in connection therewith as required for the efficient execution of the Works. The Contractor shall pay proper regard to the prevention of obstruction and the avoidance of nuisance to the public and to residents; offices etc. shall be located to the satisfaction of the Project Engineer.

1.13 Relations with Local Authorities and Residents

The Contractor shall liaise with the Phalombe District Council on matters concerning the impact of his operations on the local communities. The Project Engineer assisted by the District Water Development Officer shall perform a central role in supervision and ensuring

quality of works. They will also certify completion of works and submit signed reports to the Employer. The Contractor is expected to work in close collaboration with the community. Any problems which cannot be resolved by the Contractor should be referred to the Employer through the Project Engineer.

Public Relations

The Contractor shall not publish or provide any information relating to progress or financial status of the Works to any person or organization without the prior consent of the Employer.

1.14 Property outside the Site

Luckson Ngalu, UNDP Engineer



The Contractor shall not enter private or Government land outside the site without written approval from the Project Engineer and the owner and /or occupier of the land

The Contractor shall take all practicable measures in coordination with appropriate authorities or private owners of the land in the immediate vicinity of the Contractor's working sites or site establishment areas to ensure that no member of his work force erects or situates any temporary accommodation, shelter, trading stall, or other type of settlement or establishment on this land unless such person or persons have obtained written permission from appropriate authorities or private owners of the land for the erection or situation of such settlement or establishment.

1.15 Compensation

There will be **no** compensation payable to anyone under this project.

Construction of the Works in particular area shall not commence until the beneficiary community provides consent for the use of the land.

1.16 Graves and Tombs

Access will not be permitted to any areas within the site which contain graves and /or tombs unless written authorization to enter such areas has been obtained from the responsible District Commissioner. A copy of each letter of authorization shall be submitted to the Project Engineer before the area is entered

Separate payment will not be made for complying with the requirements of this Clause and all costs shall be deemed to be included in the rates in the Bill of Quantities.

1.17 Storage of Goods and Materials

The Contractor shall store all materials on site in a neat and orderly fashion and in such a manner which, in the opinion of the Site Manager, will minimize the risk of damage or theft.

The Contractor shall select and arrange at his own expense, for any temporary occupation of land outside the site which he requires for the efficient execution of the works. The Contractor must comply fully with all Bye-laws and Regulations currently in force in the area.

1.18 Contractor's Plant and Method of Working

Luckson Ngalu, UNDP Engineer.



All plant and equipment used by the Contractor in the execution of the works, shall be of such types and sizes, and shall be used in such manners as approved by the Project Engineer or as in submitted bidding documents.

The Contractor shall only adopt methods of working approved by the Project Engineer, but any approval that may be given will not relieve the Contractor of his responsibility for the proper execution and safety of the Works.

If circumstances arise which, in the opinion of the Project Engineer, necessitate a change in the method of working, or the suspension of the use of any part of the plant or equipment, either temporarily or permanently, and notwithstanding the previous approval of the Project Engineer of the method of working, or of the type, size and manner of using such plant or equipment, either on the portion of the works effected, or on any other portion of the Works, the Contractor shall immediately adopt another approved method of working, or other approved plant, and shall have no claim against the Employer for costs incurred by him in changing the method of working, the suspension of use of any part of the Plant, or in the provision and use of such other Plant.

1.19 Temporary Works

The Contractor shall make such provision in the nature of temporary works as may be required for the purpose of ensuring the safety of the Works and adjoining property, and for the protection of persons and animals. The Contractor shall also make provision, where applicable, for the erection of all constructional plant, all works for temporary diversion of drainage channels and other services, pumping, extra excavation, timbering and shoring, storing materials.

Details of temporary works shall be submitted in advance to the Project Engineer for his approval and the approval shall not relieve the contractor of complete responsibility for their safety and satisfactory operation.

1.20 Adjoining Properties and Buildings, Traffic Flow and Diversions

The Contractor shall so carry out all his operations as not to encroach on or interfere with, trespass on or injure adjoining land, properties, roads, structures, places and things in the vicinity of the Works.

The Contractor shall maintain a clean, safe and adequate passageway for pedestrians along highways, footways and tracks and to each adjoining property and is reminded that he has a special duty to persons with disabilities. Unless he has obtained the written consent of the appropriate authority to close the road, he shall also maintain a satisfactory passageway for vehicular traffic. He shall at his own expense provide and operate such methods of traffic control as are required Phalombe District Council or the competent authority.

The Contractor is responsible for ensuring that traffic is not held up during the execution of the Works and should he consider that a road closure or diversion is necessary he shall be responsible for obtaining permission from the appropriate authority and for making all necessary arrangements and meeting all costs arising from such road closure or diversion.

1.21 Temporary Traffic Signs, Direction Signs and Boards

The Contractor shall erect and maintain on the works and at prescribed points on the approaches to the works, all traffic signs necessary for warning, direction for visitors and control of traffic and the size of all such signs and the lettering and wording thereon shall be approved by the Phalombe District Council before erection. The sign should be reflectory or adequately illuminated at night by approved means.

1.22 Contractors Staff

The Contractor engaged upon the execution of the Works shall be deemed to employ, or to procure the employment of, staff skilled and experienced in works of a similar nature to the Works.

1.23 Quality of Materials and Workmanship

Luckson Ngalu, UNDP Engineer



Unless specified otherwise or approved by the Project Engineer, all materials and workmanship shall comply with the latest issue of the appropriate Malawi Bureau of Standards (MBS), SABS or equivalent/ equal or Code of Practice including all current amendments. Materials not covered by above Standard Specification shall be the best of their respective kinds, unless materials of inferior quality are particularly specified by the Project Engineer and shall always be subject to the Project Engineer's approval.

The Contractor shall supply at his own expense provide any evidence that the Project Engineer may require of the compliance of this Clause and when satisfactory evidence is not forthcoming, the Contractor will be required to supply samples and arrange for testing

of such samples in a manner to be determined by the Phalombe District Council. The cost of all samples and testing shall be borne by the Contractor.

Any materials which in the opinion of the Project Engineer or his office representative are deemed unsatisfactory, **shall not** be used on the Site and alternative materials shall be supplied at the Contractor's expense.

1.24 Protection and Repair of Construction

All works shall be protected and should the Contractor fail to adequately protect any parts of the works and they become heaved, cracked or otherwise damaged, all such damaged portions of the work shall be completely repaired and made good by the Contractor at his own expense.

1.25 First Aid Facilities

Luckson Ngalu, UNDP Engineer.



The Contractor shall provide and maintain in easily accessible positions at the site of the works adequate equipment and first aid facilities for the duration of the contract, all in accordance with the Laws of Malawi.

The Contractor shall allow in his rates and prices and shall be responsible for the cost of all welfare, first aid and health requirements. The Contractor shall ensure that first aid kits are readily available at all points where work is being carried out.

1.26 Site Diary and Report

During the course of the Contract the Contractor shall furnish two copies of each of the following contract records to the Project Engineer for his review and approval:

- Fortnight progress reports of work in an agreed format, and the report shall be issued before the 12th day of each fortnight and shall give details of progress with the Contract during the preceding fortnight, including order, stocks of materials, delivery, etc;
- Groundwater investigation report for borehole siting at each village including the VES curves and their interpretations for each drilling site;
- Day to day diary sheet recording plant, materials delivered to site, employed manpower and work executed, weather condition, visitors; and other items as specified or required by the Project Engineer.

1.27 *Progress Meetings*

The Contractor shall be required to attend regular Site Progress Meetings with the Project Engineer or his representative based at the District Councils where the progress of construction will be reviewed. Such meetings shall normally be held monthly or as may be required and may be attended by representatives of the Employer. The Contractor shall present a report on progress to the Project Engineer or his representative from the District Council before the meeting at a time to be agreed for circulation to participants by all parties.

The progress meeting agenda will include approval of previous minutes, a report on progress of construction in relation to the construction programme and matters arising from any difficulties encountered in the construction of the Works.

When the minutes of the meeting prepared by the Project Engineer or his representative have been accepted by the other participants, the minutes will be deemed to be a true record of the declaration, instructions and decisions taken during the meetings.

When requested by the Project Engineer, the Contractor will be required to attend other meeting from time to time on special subjects.

1.28 *Construction Methods*

Luckson Ngalu, UNDP Engineer.



1.28.1 General

Unless otherwise confirmed in writing, acceptance of the Tender will not signify acceptance of the Contractor's proposed methods of construction or materials, nor will it in any way relieve the Contractor of any of his responsibilities for the Works. Further, it will not be accepted as a basis for claiming additional compensation where the proposed methods of construction, its end results, or the proposed materials do not comply with the Specification not approved.

1.28.2 Submissions to the Project Engineer

Wherever the Specification requires that the Contractor shall make a submission to the Project Engineer, he will consider such submission and reply to the Contractor in accordance with the relevant provision of the Conditions of Contract. Unless a defined period of time is stated in the Specification, each submission shall be made by dates to be agreed with the Project Engineer. The Project Engineer will either approve or comment on submission from the Contractor expeditiously but no later than 7 days after receipt except where otherwise stated in the Contract. Where, in the opinion of the Project Engineer, substantial checking or calculation work would be required before he would be able to approve or comment on the Contractor's submission, the Contractor shall not unreasonably withhold his agreement to a longer period of time as requested by the Project Engineer.

Documents submitted other than drawings and manufacture's literature, shall be A4 in size. All documents shall be in English and any abbreviations shall be explained. All calculations and technical information shall be in units conforming to the System Internationale d'Unites (SIU).

All drawings shall be A3 paper size. Notes shall be in English. All drawings shall have the appropriate scales drawn on them. All dimensions shall be in metres or millimetres and all weights in metric tonne or kilograms.

All drawings shall include the title of the Contract at the bottom of the drawing followed by the title of the drawings concerned.

1.28.3 Correspondence with the Project Engineer

All correspondences shall be numbered and distributed in accordance with an agreed procedure.

1.29 Units of Measurement

- (1) Unless specifically stated to the contrary, the units of measurement to be used throughout the Contract shall be based on the S.I. system.
- (2) Abbreviations, whether singular or plural, shall be as follows:

Kilometre	km
Metre	m
Millimetre	mm
Hectare	ha
Square metre	m ²
Cubic metre	m ³
Litre	l
Millilitre	ml
Tonne	t
Kilogramme	kg
Gramme	g

Luckson Ngalu, UNDP Engineer.



SECTION 2: CONCRETE WORK

3.1 *Cement*

Unless otherwise specified the cement used in the Works shall be Ordinary Portland Cement (OPC) complying with BS 12 or equivalent/ equal at the time of use.

3.2 *Aggregates General*

Aggregates shall consist of natural sands and gravels, crushed rock, or other inert substances having clean, uncoated grains of hard, strong, durable materials in accordance to the relevant international Standard or equivalent/ equal.

3.3 *Fine Aggregate for Concrete Works*

Luckson Ngalu, UNDP Engineer.



Fine aggregate shall be natural sand or crushed gravel or stone; clean, sharp, coarse grit; pit or river sand; free from silt, dust, clay, salt or any other matter. All sand shall be washed and sieved as often as is required to make it conform to this Specification.

3.4 *Coarse Aggregate*

Coarse Aggregate shall be natural gravel, stone or other approved materials, hard strong and durable, nonporous, free from adherent coating or other harmful matter. The cost for the coarse aggregates will be paid for under the items for civil works in the BoQ.

3.5 *Water*

Water used in the Works shall be free from oil, acid, alkali and any matter which is harmful to any material with which it is used. If available, a drinking water supply shall be used.

3.6 *Surface Finishes*

Concrete surfaces of paved areas shall have a finish similar to that left by a vibrated hardwood board, 50 mm thick, when used for screeding concrete to its proper level and profile immediately after disposition. Other exposed upper surfaces shall be floated with a wood float to a smooth finish. The floating shall be executed so as not to bring excess laitance or fine material to the surface.

3.7 *Measurements of Ingredients*

Aggregate shall be measured by volume except as otherwise specified or approved by the Project Engineer or his representative. Cement in standard sacks need not be weighed, but the use of fractional sacks will not be permitted.

3.8 *Transporting of Concrete*

The concrete shall be handled so that at the point of deposition it is of the specified quality and consistency, nothing having been added to it or lost from it since leaving the mixer, and segregation of the concrete ingredients is avoided.

3.9 *Placing of Concrete*

Luckson Ngalu, UNDP Engineer.



The Project Engineer or his representative may prohibit placing of concrete at any time when atmospheric conditions are not suitable.

All placing shall be done as rapidly and continuously as practicable until the unit of operation is complete or until satisfactory construction can be made as called for on the Drawings, or as permitted by the Project Engineer or his representative.

3.10 *Compaction of Concrete*

Concrete during and immediately after depositing shall be thoroughly compacted by means of tamping and hand spading.

3.11 *Curing of Concrete*

Until it has thoroughly hardened, concrete shall be protected from the harmful effects of wind, sun, temperature and variations of temperature, premature loading or deflection or impact, and aggressive groundwater. Concrete surfacing to building and structures shall be cured by covering completely with a waterproof membrane for period not less than 7 days.

3.12 *Formwork*

Formwork shall include all temporary or permanent moulds for forming the concrete, together with all temporary construction required for their support. The formwork must maintain the concrete in its correct position during placing, compaction, setting and hardening, without loss of any material, and provide against its own deformation under load. All formwork must be removed without damage to the concrete.

3.13 *Reinforcement*

The Contractor shall procure reinforcing steel only from reputable manufacturers/suppliers. Reinforcing steel shall be of mild steel grade 250 or high yield steel grade 450/425 as indicated in the Drawings and must comply with BS 4449, BS 4461 or another approved standard or equivalent/ equal. Steel fabrics shall comply with BS 4483 or equivalent/ equal.

The Contractor must inform the Project Engineer or his representative of the completion of any reinforcement in time, in order to facilitate its inspection and check of conformity with the Working Drawings well before the concreting. Relevant formalities shall be agreed upon between the Contractor and the Project Engineer or his representative at the appropriate time. Reinforcing steel bars and fabrics shall be supplied in the standard lengths/sizes, straight.

SECTION 3: SITING, WELL DRILLING, PUMPING TEST and DEVELOPMENT

4.1 General

The work covered by this section consist of borehole geophysical surveys and siting, drilling, well development, hand pump supply and installation, disinfection and construction of civil works (pump head base or plinth, and pump testing, drains, and soak away pit, etc.). These shall be constructed according to the Drawings, Specifications and Bill of Quantities and inclusive of all pertaining accessories necessary to complete the work.

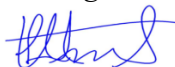
The Contractor shall use an experienced Hydro-geologist with complete set of equipment to conduct geophysical surveys (Vertical Electrical resistivity Survey using Terameter or similar equipment) and determine the point for borehole drilling which shall be in accordance with the wishes of the community. Vertical Electrical Sounding results shall be interpreted and recommendations drawn by the Contractor to the approval of the Project Engineer or his representative.

4.2 Well Siting (*Hydrogeological Assessment and Geophysical survey*)

The Contractor must allow the community and Phalombe District Council to be involved 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 site selected by the community 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 Engineer 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 Engineer prior to the start of the drilling work.

4.3 Drilling

Luckson Ngalu, UNDP Engineer.



4.3.1 Drilling Rig

A suitable rig capable of drilling boreholes of minimum diameters up to **113 mm** and to a maximum depth of **63 meters** shall be employed. The rig should have all the necessary accessories for rimming, fishing etc. It is also worth mentioning that a reasonable thickness of the subsurface formation is expected to be soft. Therefore, the drilling equipment and the method have to be capable of drilling through both **soft and hard formations**. The Contractor has to use temporary steel casing to drill in the upper soft formation.

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.

4.3.2 Drilling Fluids

In all formation that will be encountered during drilling only air or approved type of foam may be used as drilling fluid if down-the-hole hammer bit is used. If boreholes are drilled with rotary equipment the following drilling fluids may be used:

- a) Air
- b) Air with foam
- c) Clear water
- d) Drilling mud composed of water and a thickening agent containing no solid particles. Examples are the starch based mud, Revert, and Polymer based mud such as Quick Thick. Use of **bentonite** is specifically **prohibited**. Mud cake formed during this activity has to be removed to the satisfaction of the Project Engineer or his representative.

4.3.3 Drilling Diameter

Luckson Ngalu, UNDP Engineer.



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.

4.3.4 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. However, drilling may be ordered to be stopped at shallower depth of **45 metres as minimum**, or to be continued to a **maximum of 63 m**. The Contractor's Hydro-geologist 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 Engineer 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 0.25 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 0.25 l/s attaining depth.

In all cases interim yield tests shall be performed as stated under **Section 4.3.6.**

4.3.5 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 Engineer or his representative. The completion of an effective and efficient borehole design is the responsibility of the contractor.

Dry Boreholes

The contractor shall seek instruction from the Project 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 Project Engineer or his representative and is approved as such by the Project Engineer or his representative.

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

4.3.6 Interim Yield Tests

Luckson Ngalu, UNDP Engineer.



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. The method employed for establishing interim yields will be at the discretion of the contractor. Details should, however, be included in the Methods Statement. In general air lifting will be regarded as the ideal method for interim yield tests with measurement of the discharge being made by channelling the flow into either (i) a container of known volume and measuring the time taken to fill that container using a reliable stop watch; or (ii) a V notch weir of suitable dimension for the yield to be accurately established.

Interim tests should be carried out for at least 20 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 60 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.

4.3.7 Well Casings and Riser Pipes

Luckson Ngalu, UNDP Engineer.



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

The casings, plain and slotted, shall be of class 10 and have an outer diameter of not less than 113 mm and each 3 m long. Similarly, riser pipes shall be UPVC class 16 with an outer diameter of 63 mm and in 3-metre lengths. All casings and riser pipes shall have socket and spigot joints. All casings shall come with casing centralisers already fixed by manufacturers. Damaged and deformed pipes due to mishandling will not be accepted for installation. The casings shall be securely stored and protected from direct sunlight.

To ensure that the casing is central and vertical in the borehole and to provide a uniform annular space for the filter pack, centralisers of suitable size shall be fitted to both casings and screens at minimum 3 m intervals as per the manufacturer's recommendation.

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

Immediately after completion of the drilling operation, the Contractor has to provide the well installation design, and actual casing and screen, for the approval by the Project Engineer or his representative. The Contractor shall only adopt design approved by the Project Engineer or his representative, but any approval that may be given will not relieve the Contractor of his responsibility for the proper execution of the Works.

Casing shall be installed in the sizes and depths as per the result of the well logging and final well design.

At least a 1m length of plain casing of the same diameter shall be installed below the slotted casing. The bottom of this plain casing shall be sealed with a suitable end cap/bail plug. Plain casing shall be installed from the depth at which water was struck to a height of 1m above the ground and capped.

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

The inner diameter and wall thickness of the screen shall be the same as for the plain casing. The open area of the screens shall be at least 10% of the surface area of the pipe.

Slots, which are prepared by using hacksaw, are not allowed, and all slots have to be factory or machine made.

4.3.8 Gravel Pack

The Contractor shall be responsible for obtaining screened filter pack from the Ministry of Irrigation and Water Development approved gravel pack source (Nkhuzi Bay in Mangochi, Senga Bay in Salima and Chilumba in Karonga). 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 Engineer or his representative.

To avoid bridging of the gravel, it is not allowed to fill-in the gravel by mechanized equipment. The gravel must be filled-in by hand slowly and carefully or by shovels during well development up to the level determined by the Project Engineer or his representative depending on the static water level.

Filling will proceed slowly and carefully during well development. The correct placing of gravel will have to be controlled by continuous recording of the volume of gravel consumed and by repeated measurement of the level of packing.

Where temporary drill casing has been installed, initial packing will continue inside the drill casing, prior to casing pull back, to a height of at least 1.5m above the base of the temporary casing.

Once initial placement of filter pack material has reached a height of 0.6m above the base of casing placement above screen, gentle well development shall commence.

Placement of gravel, temporary casing pull back and gentle well development will proceed until gravel is settled without bridging the level to a height of 0.5m above the top of the screen. Gravel will be topped up as necessary during well development to maintain this level.

4.3.9 Well Development

Luckson Ngalu, UNDP Engineer



Well development has to be carried out after completion of the construction of a well and prior to test pumping. The objective of development is to improve well performance, to increase well capacity and to reduce an unacceptable level of the amount of sediment contained in the water yielded by the well.

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 Engineer or his representative or any assigned Government extension worker.

Development shall continue until 5 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/l.)

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.

4.3.10 Cement grouting

Luckson Ngalu, UNDP Engineer



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. Before grouting takes place a bridging medium of sand and puddle clay should be placed on the gravel pack in order to avoid any cement infiltration into the gravel. A minimum amount of water shall be used to obtain desired workability. **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. The Contractor shall advise the Project Engineer or his representative at the start of the drilling operation the method he intends to employ for grouting. Regardless of the method used, the grout shall be introduced at the bottom of the space to be grouted. In no circumstance will this be less than 5 m below the well head. The method proposed by the Contractor will be changed or modified if and as required to suit the site conditions.

4.3.11 Concrete Pad

The Contractor shall construct a concrete pad having concrete mix ratio of cement, sand and gravel (1:2:4) for all productive boreholes to dimensions shown in the Drawings. The Contractor shall ensure that the sides of the pad are straight by properly anchoring the forms. The top of the pad shall be trowelled to provide good standing and easy drainage. The

identification code number of the well provided by the Project Engineer or his representative has to be inscribed on the concrete pad.

The Contractor shall excavate and concrete the drainage channel for a distance of 10m down slope away from the centre of the borehole as shown in the plan view.

The materials used for the construction work shall have to satisfy the requirements of Section 2 of the Specification.

4.3.12 Well Disinfection

Luckson Ngalu, UNDP Engineer.



After drilling and clearing, wells should be disinfected to make sure that no bacteria, viruses and other pollutants are remaining in the well, which may have entered the well during drilling, construction and installation works.

4.3.13 Plumbness and Alignment

The borehole shall be tested for verticality and straightness using deviation measuring instruments like Inclinator, Drift Indicator, etc, at any time when the Project Engineer or his representative may request that the alignment be checked.

The Contractor may also conduct these and any other tests he may deem necessary to satisfy himself that the borehole is being drilled plumb and straight. These tests shall be made entirely at the Contractor's own expense.

If the hole is out of alignment as determined by the dummy or more than 1% out of vertical, then the hole shall be abandoned and re-drilled.

4.4 Pumping Test

The Contractor shall supply at least 2 power generators of appropriate capacity to run the pumps. The Contractor shall have sufficient stand-by pumping sets and parts on the sites to guarantee uninterrupted pumping.

The equipment and crew shall be capable of performing a continuous test for up to 10 hours if required and shall include all necessary tools and equipment to carry out a pump test with accurate measurement of water flow and water level in the well.

Discharge measurements could be done either by standard v-notch, calibrated water meter or by simple container of known volume.

Pumping test result will not be accepted if interrupted due to negligence or technical defects of the pump, generator, or water level indicator and any other causes. The Contractor will repeat the test at his own expense.

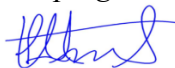
Pumping test data shall be recorded on prepared sheets in the English language. The data sheets prepared in triplicate shall include the following information:

- a) the location of the well being tested.
- b) the physical characteristic of the well including depth, diameter, size and length of casing and screen.
- c) characteristics of the test pump.
- d) depth of setting of the test pump in meters.
- e) date and time of start and finish of pumping test.
- f) static water level at commencement of test, dynamic water levels and discharge rates at prescribed time intervals.
- g) draw-down recovery immediately after pumping is completed.
- h) date and time of start of removal of test pump from the borehole.

The pumped water during pumping test should not be allowed to form pools so as to avoid re-infiltration in the vicinity of the wells. The water should be disposed off by means of discharge pipes towards a nearby natural drain over a distance of at least 100 m downstream from the well being pumped.

4.5 *Pumping Test Procedures*

Luckson Ngalu, UNDP Engineer.



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

- a) Interim yield test as stated under Section 4.3.6- in order to determine constant pumping test rate.
- b) If the well yields below 0.25 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 6 hours, or until such an earlier time when no further drawdown is achieved.

- d) The recovery test shall be carried out until 90% percent recovery of the drawdown is attained.
- e) Electric water level indicator has to be used for the measurements of the water level. The electric water level shall be provided with sound and light signals.
- f) Discharge measurements could be done as stated in section 4.9.12 elsewhere in the Specification.
- g) No bulk spilling of water is allowed to re-infiltrate in the vicinity of the well. The discharged water has to be carried away by means of discharge pipe towards a natural drain.
- h) Water samples shall be collected for analysis as stated under Section 4.6.

For boreholes to be equipped with hand pumps, the test pumping will take the form of a continuous discharge test (Constant Yield Test) at the discharge rate to be determined during development of the borehole. The discharge rate shall not be less than the minimum acceptable yield of 0.25 litres per second. The minimum period of the test shall be 180 minutes. The test will however stop after the pumping water level stabilizes or until the maximum period for test of 360 minutes has been reached.

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 cases where a yield higher than the minimum 0.25 l/sec is not sustainable for the period of the constant yield test pumping at the sustainable yield shall be 360 minutes.

In all cases draw down reading shall be taken at the following time intervals using an electric or alternative water level dipper graduated at 0.01 metre 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.

Luckson Ngalu, UNDP Engineer.



- (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.

4.6 *Water Sampling and Quality Test*

Luckson Ngalu, UNDP Engineer.



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 Ecoli-Coliform. The laboratory water tests may be carried by any other approved competent laboratory as the Contractor may wish or the Central Water Laboratories of the Ministry of Agriculture, Irrigation and Water Development but the results will have to be checked by the Project Engineer or District Water Officer.

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.

Samples will be stored in a cool place and delivered within 24 hour to the Central Water Laboratory in Lilongwe or any other laboratory acceptable to the Employer as the Contractor may wish to choose.

If water samples collected during drilling show that the water is not of suitable quality for domestic use, the well will be abandoned. The Contractor will be paid for the completed work as per the rates in the Bill of Quantities considering the well as successful one.

Communication

The Contractor shall communicate at least weekly by telephone with the Project Engineer or his Representative, detailing the progress achieved.

4.7 *Supervision Work*

Luckson Ngalu, UNDP Engineer.



The communities through their water point committee members, with the assistance of the representative of the District Water Development Office and District Project Team will be actively engaged in the supervision of all aspects of the contract to their capacity in addition to the supervision provided by the Project Engineer or his representative. The Contractor shall facilitate involvement of the water committee members in the supervision work and during the installation of hand pumps.

4.8 *Work Sheets and Records*

The Contractor shall maintain a work-sheet in which all the information concerning the works would be recorded, sample of daily recording format is attached. This would enable the Project Engineer or his representative to be precisely informed on the drilling activities upon arrival at site. The work-sheets will contain the following information:

- a) General Information
 - i. Traditional Authority Area
 - ii. Village Name
 - iii. Grid reference
 - iv. Borehole number

- v. Distance from previous destination
- vi. Contractors Name
- vii. Date arrival on site
- viii. Date of starting drilling
- ix. Consultants Name and signature

b) Drilling Rig

- i. Registration number of Equipment
- ii. Make model, type and size of drilling rig
- iii. Type of work performed and number of hours on each type of work
- iv. Names of all crew members
- v. Size of hole and number of meters drilled per shift
- vi. Penetrated sample description
- vii. Length and size of casing installed.
- viii. Length and size of screen installed.
- ix. Length and size of observation pipe installed.
- x. Problems encountered during drilling.
- xi. Total standby time, and.
- xii. Other site specific items as appropriate

c) Test Pump Unit

Luckson Ngalu, UNDP Engineer.



- i. Location.
- ii. Make, model and capacity of test pump.
- iii. Type of work performed and number of hours on each type of work.
- iv. Names of all crew members.
- v. The static water level.
- vi. Pump position during testing.
- vii. Total duration of the pumping test operation
- viii. Total standby time,

- ix. Other site specific items as appropriate

4.9 *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 Water Supervisor 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.

4.10 *Measurement and Payment*

4.10.1 Mobilization and Demobilization

Luckson Ngalu, UNDP Engineer.



Payment for mobilization and demobilization shall be made on Lump sum bases as specified in the Bills of Quantities.

The price shall include the complete mobilization of the necessary drilling equipment, materials and crew from and to the Contractor's yard and to and from the working areas including the construction of temporary roads required for access to the working areas, inter site mobilization, and the complete installation of the equipment. It also includes cleanup of the sites, restoration and cleanup of anything disturbed by the construction and use of the temporary access roads.

4.10.2 Borehole Siting

Payment for borehole siting will be made on lump sum basis for all activities performed and equipment used and any other incidentals there including the report only for each successful well after the drilling is completed and the well is accepted as successful by the project Manager.

4.10.3 Drilling

Luckson Ngalu, UNDP Engineer



Drilling works shall be measured and paid per linear metre as specified in the Drawings and Bills of Quantities.

Measurement will be made vertically to the nearest 0.1m from the original ground level to the base of the completed hole. This price will include all materials, equipment, cutting, welding, labour and all work incidentals thereto except for those items for which payment is specified additionally to that of the drilling.

No payment will be made for boreholes abandoned or incomplete as a result of lost or stuck tools, stuck casing, failure to meet plumpness or alignment tests, or any other reason that is the fault of the Contractor.

In all other cases, dry holes shall be at the expense of the Contractor. No payment will be made for abandoned or dry boreholes.

4.10.4 Well Casing

Well casing shall be measured and paid per linear metre as specified in the Drawings and Bills of Quantities.

Measurement will be made to the nearest 0.1 meter vertically from the top flange of the well head to the bottom of the casing in the borehole less any section of screen, which is paid for separately. This price shall include supply and secure storage of casing, cleaning fluid,

solvent cement and couplings, welding, installation, testing and all work incidentals thereto. No payment will be made for temporary casing, which is installed to facilitate drilling and is subsequently to be removed. No payment will be made for well casing installed in abandoned boreholes.

4.10.5 Casing Bottom Cap or Bail Plug

Casing bottom cap shall be measured and paid per number as specified in the Drawings and BoQs. This price shall include supply, installation, testing and all work incidentals thereto.

4.10.6 Gravel Pack

Gravel pack shall be measured and paid per cubic metre as per the Bills of Quantities. This price shall include supply, installation, testing and all work incidentals thereto.

4.10.7 Well Heads or Concrete Pad

Payment for well heads will be made on Lump Sum basis per well head as specified in the Bill of Quantities. This price shall include materials, excavation, prefabrication, installation, soak away, drainage, backfilling, site grading and all work incidentals thereto. It also includes supply and placement of sand and paddle clay seal.

4.10.8 Grouting

Payment for grouting will be made at the unit price per meter shown in the Bill of Quantities.

Measurement will be made vertically to the nearest 0.1 m. from the top to the bottom of the completed grouting. This price shall include materials, installations and all work incidentals thereto.

4.10.9 Well Development

Luckson Ngalu, UNDP Engineer.



Payment for well development will be made at the price per hour shown in the Bill of quantity. The price will include materials, equipment and all work incidentals thereto.

4.10.10 Plumbness and Alignment Test

Payment for plumbness and Alignment Tests if requested by the Project Engineer or his representative will be made at the price per well site shown in the Bill of Quantities. The price will include material, equipment and all work incidentals thereto. No payment will be made for tests carried out by the Contractor for his own information.

4.10.11 Pumping Test

Payment for pumping test will be made at the unit price per hour shown in the Bill of Quantities.

No payment will be made for tests terminated prior to the time specified by Project Engineer or his representative or rendered unsatisfactory by reason of breakdown, lack of fuel or for any other reason that is the responsibility of the Contractor. The price shall include materials, equipment and work incidental thereto.

4.10.12 Monitoring Recovery

Payment for monitoring recovery will be made at the unit price per hour shown in the Bill of Quantity.

No payment will be made for monitoring terminated prior to the time specified by the Project Engineer or his representative or rendered unsatisfactory by reason of breakdown, lack of fuel or any other reason that is the responsibility of the Contractor. The price shall include materials, equipment and all work incidentals thereto.

4.10.13 Well Disinfection

Payment for well disinfection will be made on Lump sum basis per well as shown in the Bill of Quantities. The price will include supply of chlorine, equipment and all work incidentals thereto.

4.10.14 Final Report Production

Payment for Final Reports will be made at unit price per productive well Reported.

Luckson Ngalu, UNDP Engineer.



BENEFICIARY SUPERVISION FORM

BOREHOLE SITE..... TA DISTRICT

A. SITE SURVEY AND BOREHOLE SITING

Date of survey..... Number of crew in survey team..... Survey Machine **YES / NO..**

No. of sites surveyed..... Date started..... Date finished..... No. of Hrs

Team leader.....(sign.....)

B. DRILLING

Date started..... Date finished..... Number of drilling rods

No. of pvc pipes installed..... (slotted.....plain.....) Pipes capped at bottom...**YES / NO.....**

Type of rig: **Percussion / Air-rotary** Water seen after how many rods.....

Gravel Pack Installed: **YES / NO;** **Clean / Dusty / Dirty**

Team Leader..... (sign.....)

C. DEVELOPMENT

Date..... Start Time..... End Time..... Method **AIR / WATER**

After Development is water: **Clean / Muddy / Milky / Silty / Cloudy**

Team Leader..... (Sign.....)

D. PUMPING TEST

Date..... Time Started Time ended Water: **Clean / Muddy / Milky / Silty / Cloudy**

Team Leader..... (sign.....)

Luckson Ngalu, UNDP Engineer



E. CIVIL WORKS

Date started..... Date finished.....

Apron: **YES/NO**; Bucket Stand: **YES/NO**; Washing Slab: **YES/NO**; Soakaway Pit: **YES/NO**

Community contribution - Labour: **YES / NO**; Sand: **YES / NO**; Quarry Stone: **YES / NO**;
Bricks: **YES / NO**

Reinforcement : **Steel bars / Wire Mesh**

Mixture: (1:2:4) Cement Sand..... Quarry.....

Curing Period: Date Started..... Date Completed.....

Date Started Using:

F PUMP INSTALLATION

Date.....

Luckson Ngalu, UNDP Engineer



No. of 63 mm pvc pipes installed:

No. of Pump Rods Installed:

No. of Rod Centralisers Installed:

Sets of Bush Bearings Installed:

Repair Kit handed over to the Community

Spanner:	YES / NO
Flat Spanner No. 17:	YES / NO
Fishing Tool:	YES / NO
Rod Centraliser	YES / NO - Number _____
Bush Bearing Set	YES / NO
Bobbin	YES / NO - Number _____
U-Seal	YES / NO - Number _____
O-Ring	YES / NO - Number _____

SUPERVISION FORM FOR SITE AGENT

(A) CONTRACT DETAILS

Luckson Ngalu, UNDP Engineer



Name of Contract: _____

Name of Contractor: _____

Address: _____

Report Compiled by: _____

Date: _____

(B) GEOGRAPHICAL SURVEYS AND BOREHOLES SITING

Borehole Site Name: _____ TA: _____ District

Grid Reference: _____

Elevation: _____

Date(s) _____

Method(s) used: _____

Contractor's Hydro geologist: _____

Remarks: - Sanitation: _____

Distance from the road: _____

(C) DRILLING

Rig Type: _____ Date Rig arrived on site: _____

Date Drilling started: _____ Date Drilling Completed: _____

Drilling Method(s): _____

Drilling Depth: _____ Final Drilling Diameter: _____

Water Struck at: _____ (M)... Main Water Supply between _____ (M)

Date Drilling Completed: _____

Size, Type and Class of Borehole Casing:

Number of slotted casings _____ Placed between M below gl

Number of Plain casings _____ Placed between M below gl

Borehole logging: _____

Depth of gravel pack from ground surface: _____

(D) DEVELOPMENT

Luckson Ngalu, UNDP Engineer



Date: _____

Static water level at the beginning of development: _____

Development Method: _____

Time Started _____ Time Completed: _____ Period (Hrs) _____

Sand free water observed _____

Drawdown level at the end of development: _____

(E) PUDDLE CLAY SEAL and CEMENT GROUT

Puddle Clay Seal placed: **YES / NO**

Grouting method: _____

Total depth of grout: _____

(F) PUMPING TEST

Date _____ Time Started _____ Time Completed _____ Period (hrs) _____

Type of pump: _____

Pump Set Depth: _____

Type: (a) Step test done: _____

(b) Constant test : _____

(c) Recovery: _____

Estimated yield: _____

Any observations: _____

(G) CIVIL WORKS

Date started _____ Date Completed _____

General Quality _____

Ancillaries: Apron _____
Drain _____
Bucket Stand _____
Washing Slab _____
Soak Away Pit _____

Community contribution - Labour: **YES / NO**; Sand: **YES / NO**; Quarry Stone: **YES / NO**;
Bricks: **YES / NO**

Concrete Mixture:

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Quality of materials

Reinforcement: Wire Mesh size Reinforcement Bars diameter:

Bricks Sizes: Quarry Stone size:

(H) PUMP INSPECTION

Date Installed _____

Pump type _____ Name of manufacture _____

Riser Pipes size and class: _____

Type of Pump Rods: **Stainless Steel / Galvanised**

Type of foot valve body: **Brass / Nylon**

Type of plunger body: **Brass / Nylon**

Type of Seal: **U – Seal / Cup Seal**

(I) FORM FOR DETAILS OF DAILY DRILLING RECORDS

SECTION E: FORM FOR DETAILS OF DAILY DRILLING RECORDS							
Daily Drilling Records							
				Other			
	Hours	From	To	Work	W.L. at	Geological Formation	Remarks
Date	Drilled	(M)	(M)	(hrs)	Start (m)	Encountered	
(1) Water first strike at metres below ground level and rose to metres after hours							
(2) Main water supply from metres to metres below ground level							
(3) Temporary casings of metres long inserted from m to m below ground level							
(4) 4 hours specific capacity (yield – draw – down at 4 hours) litres per minute per metre							
Specify additional comments here							

Luckson Ngalu, UNDP Engineer



(J) **FORM FOR DETAILS OF PUMPING TEST** **Luckson Ngalu, UNDP Engineer**



PUMPING				RECOVERY				
Local time	Minutes since pumping started	Water Level (m)	Draw Down (m)	Minutes since pumping stopped	Water Level (m)	Draw down (m)	Time Ratio	Percentage Recovery
	0			0				
	0.5			0.5				
	1			1				
	1.5			1.5				
	2			2				
	2.5			2.5				
	3			3				
	3.5			3.5				
	4			4				
	4.5			4.5				
	5			5				
	6			6				
	7			7				
	8			8				
	9			9				
	10			10				
	12			12				
	14			14				
	16			16				
	18			18				
	20			20				
	25			25				
	30			30				
	35			35				
	40			40				
	45			45				
	50			50				
	60			60				
	70			70				
	80			80				
	90			90				
	100			100				
	120			120				
	140			140				
	160			160				
	180			180				

	210			210				
	150			150				
	270			270				
	300			300				
	330			330				
	360			360				
	420			420				

(K) WATER SAMPLING AND ANALYSIS

Sampling date _____, hour _____

Sample label(s) _____

(L) FINAL REPORT

Luckson Ngalu, UNDP Engineer



After completion of each well (drilling, development, pumping test, etc.) the Contractor should prepare and submit to the Project Engineer incorporating all-important results of specific activities. A representative of the Project Engineer and target Community / CBCC committee should counter sign the final report/s

BOREHOLE WORKS CERTIFICATE OF COMPLETION

This is to certify that
has satisfactorily completed the drilling, construction and installation works of a borehole
at..... bearing the following details:

Borehole Name:

Borehole No.

Traditional Authority:

District:

Borehole Depth: M Static Water Level: M (bgl); Yield: l/s

Handpump set at M deep. Date of Completion:

Certified By: Community/School Representative.....Signature.....

Position Date

Certified By: Project Engineer's Rep Signature

Position Date