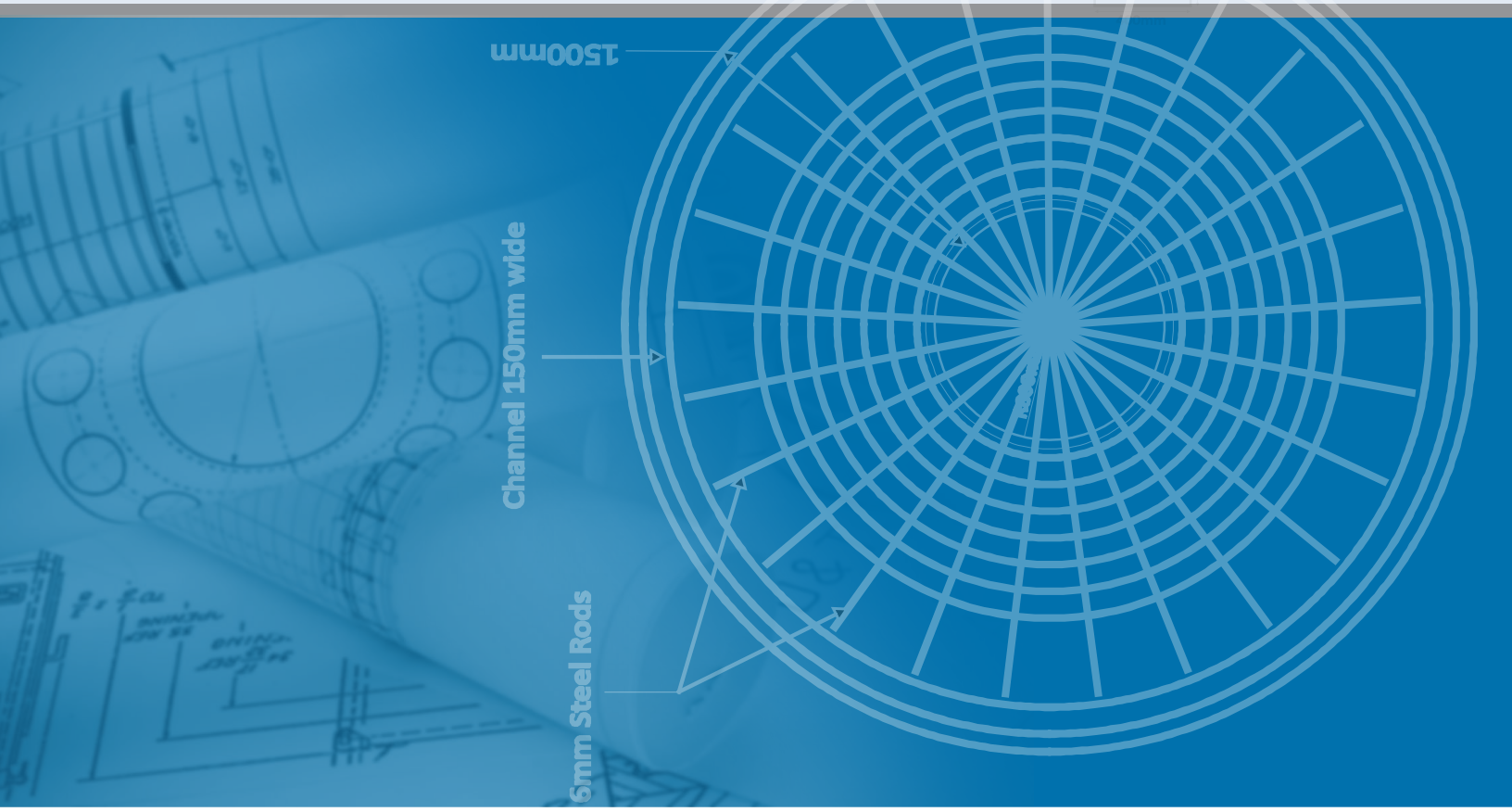
Republic of Sierra Leone | Ministry of Water Resources

Technical Guidelines for the Construction and Maintenance of Hand Dug Wells

April 2014



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sanitation program

GOVERNMENT OF
SIERRA LEONE

This document represents the official guidelines of the Government of Sierra Leone on the issue of the construction and maintenance of hand dug wells. It was compiled through a collaborative effort led by the Ministry of Water Resources of Sierra Leone, with financial support from the World Bank's Water and Sanitation Program, and with key inputs from sector stakeholders including, but not limited to, UNICEF, Adam Smith International, Concern, GOAL, Oxfam, and Freetown WASH.

Photograph credits: UNICEF

The drawings have been adapted to specifications of Sierra Leone by *Adedotun Adekile*.

Republic of Sierra Leone | **Ministry of Water Resources**

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Acknowledgments

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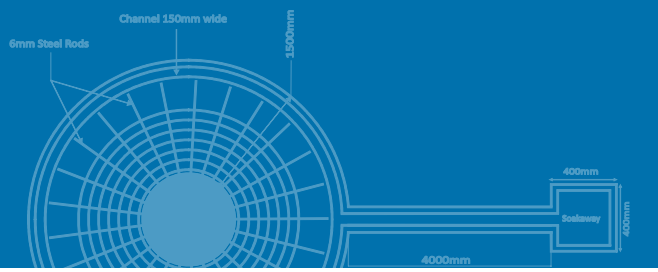

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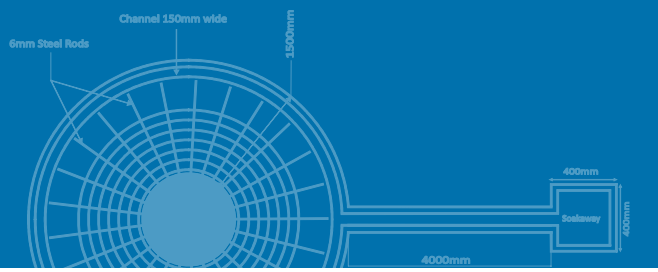


Foreword

Many organizations, such as local councils, international and national development agencies, private contractors, and communities are involved in the construction, rehabilitation, and upgrading of hand dug wells. But serious failings in the quality of implementation and construction may impede these efforts, from which recovery is difficult without significant additional investment.

There are many examples in Sierra Leone of hand dug wells and hand dug wells fitted with handpumps providing water all the year round to satisfy the needs of local populations. However, there are also numerous examples of hand dug wells falling into a state of disrepair, or providing water on a seasonal basis only. Poor construction quality or digging wells at the wrong time of the year can undermine all efforts to keep water points working.

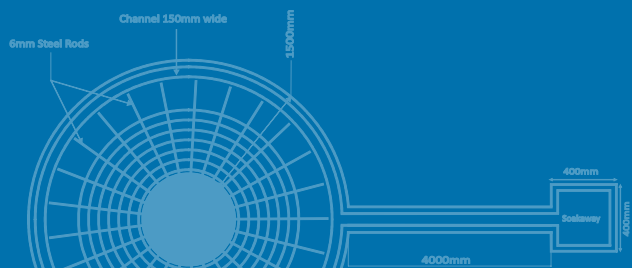
The premise of this guideline document is that certain basic mandatory standards should be adhered to when implementing and constructing hand dug wells. This will help to professionalize the water supply, sanitation, and hygiene (WASH) sector.

This publication is intended for water sector practitioners and managers who coordinate and oversee water supply service delivery. It is the outcome of a partnership between the Ministry of Water Resources, Water and Sanitation Program (WSP), and a number of implementing agencies working in the WASH sector in Sierra Leone. If this publication can contribute to permanent and lasting water points in Sierra Leone, and better standards of construction, then it will have achieved its purpose.

Lamin K.S. Souma
Director, Water Directorate,
Ministry of Water Resources, Sierra Leone

Acronyms and Abbreviations

Cm	Centimeter
L	Liter
M	Meter
Mg	Milligram
Mm	Millimeter
MoEWR	Ministry of Energy and Water Resources
MoU	Memorandum of Understanding
MoWR	Ministry of Water Resources
NGO	Nongovernmental organization
NWSP	National Water and Sanitation Policy
RWSSTS	Rural Water Supply and Small Towns Strategy
WASH	Water supply, sanitation and hygiene
WSP	Water and Sanitation Program



Introduction

A survey of over 28,000 water points in Sierra Leone in 2012 revealed that only 48 percent of the rural population have access to improved water supply sources, and up to 40 percent of the water points that do exist are seasonal, providing insufficient water in the dry season (MWR 2013). These figures illustrate the importance of additional infrastructure construction as well as of ensuring that new points and rehabilitations are implemented according to clear quality standards to avoid the currently high rates of seasonality and breakdown.

Over 25 major implementing organizations are actively involved in building and funding water points in Sierra Leone. These are in addition to smaller nongovernmental organizations (NGOs), government agencies, local communities, religious groups, and private persons who are also doing the same (MoEWR 2012). Different agencies use different designs and modes of construction without any clear guidelines or standards. It is against this background that the Ministry of Water Resources (MoWR) decided to publish *Technical Guidelines for the Construction and Maintenance of Hand Dug Wells in Sierra Leone.* The use of these guidelines should harmonize hand dug well construction practices among all stakeholders operating in the country in line with international best practices.

The guidelines are based on the National Water and Sanitation Policy and the Rural Water Supply and Small Towns Strategy (RWSSTS). They build on existing guidelines in use by various organizations in Sierra Leone. All stakeholders operating in the country are expected to adhere to the provisions of the guidelines. Ensuring compliance with the guidelines is the responsibility of the District Councils.

The use of these guidelines should harmonize hand dug well construction practices among all stakeholders operating in the country in line with international best practices.

These are the first in a series of WASH guidelines to be developed in Sierra Leone. Their application is meant to safeguard both public and private investment in water supply. The guidelines set out the minimum standards that are expected in the construction of hand dug wells for village water supply, self-supply, and semi collective water supply as defined in the RWSSTS Document.

Some of the provisions of the *Technical Guidelines* document are mandatory. However, due to the variety of local conditions and socioeconomic circumstances across the country, as well

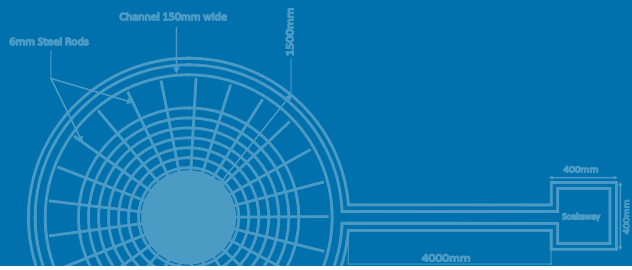
as the need for communities and households to select options that work best for them, some provisions are recommendations, and their adoption is left to discretionary judgement.

For the purpose of this document, hand dug well construction has been arranged into four stages, with each stage requiring a set of actions. The stages and actions are illustrated in Table 1. The guidelines are structured according to the different stages and are elaborated upon in the rest of the document. Some of the stages are mentioned only briefly in this document to avoid repetition as they will be covered in detail in specific guidelines devoted to the particular stage.

TABLE 1: STAGES IN HAND DUG WELL CONSTRUCTION

Stage	Actions
Stage 1: Community sensitization and mobilization	- Stimulating demand
	- Community contribution
	- Setting up postconstruction monitoring
Stage 2: Site selection	- Community consultation
	- Site selection to ensure health and hygiene as well as a productive well
Stage 3: Well construction	- Mobilization; appointment of contractor and supervisor
	- Excavation, lining, completion
	- Well maintenance
Stage 4: Handpump installation	- Installation
	- Operation and maintenance

Source: *Government of Sierra Leone.*



Community Sensitization and Mobilization

Detailed guidance on community sensitization and mobilization and other software activities is the subject of other guidelines. Planners and implementation agencies should also familiarize themselves with these. This section stipulates four provisions relating to community sensitization and mobilization that are crucial for the sustainability of water wells.

Provision 1.1: Stimulating demand

Government and other implementation agencies involved in hand dug well construction should stimulate demand through health and hygiene education or by raising awareness of the human right to access to safe and adequate drinking water. The large numbers of nonfunctional water points in Sierra Leone is partly because local communities are not sufficiently involved in the design, implementation, and management of water supply improvements. The first step in planning a new water source is for the community to want an improvement in the first place. At the same time, training should be provided regarding the safe collection, storage, and use of water, as well as cleanliness around the water point. The implementer's task will be easier when communities themselves demand action.

Once demand from communities has been expressed, government and other implementation agencies must explain to communities how water supply improvements can be achieved and the approaches possible. Activities to support the construction of water source improvements, or providing guidance for self supply, should be fitted into the joint government's/NGO's program of work in the area concerned.

The large numbers of nonfunctional water points in Sierra Leone is partly because local communities are not sufficiently involved in the design, implementation, and management of water supply improvements.

Provision 1.2: NGO involvement

It is mandatory that NGOs are registered with the District Councils and that all well construction is implemented with the involvement and approval of the District Council. NGOs must not implement projects in communities without consulting or informing the District Council authorities. The District Councils are to ensure that the NGOs comply with these *Technical Guidelines.*

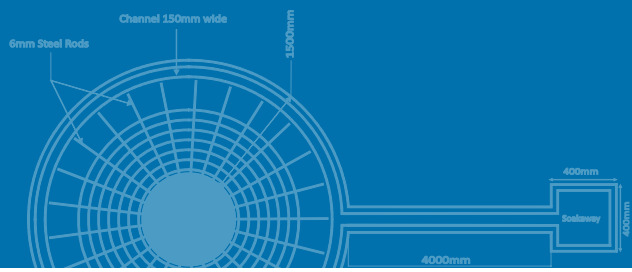
Provision 1.3: Community contribution

Community members should make financial contributions to the capital cost of the desired improved facility in their community in line with the Rural Water Supply Strategy, except in emergency situations. There should be evidence that the money has been collected—deposited either in a bank account or with the implementing agency before the implementation. The expected community contribution to the capital cost of the desired improved facility should be spelt out and adhered to. The financial implications of the postconstruction operation and maintenance should also be analysed and the community should accept the responsibility for them. This should be stated in a Memorandum of Understanding (MoU) between the community and the implementation agency. It is not enough to regard community participation as a source of unpaid labor, where community members gather stones and sand and provide labor for construction. Financial contribution is an indication of demand and commitment to the project which would foster ownership and sustainability.

Implementers should assist the communities in developing water pricing guidelines and tariff structures based on recurrent costs and the ability and willingness of the people to pay. Tariffs should cover operations cost and repairs. Community members, local artisans, and contractors who will assist and participate in the implementation should be identified and trained on their expected tasks whilst the implementing agency should also indicate the sources of support and spare parts.

Provision1.4: Postconstruction monitoring of functionality

Communities and District Councils are responsible for postconstruction monitoring and collection of WASH data at community level so that support for repairs and maintenance, where required, can be provided by the District Council and reported centrally. The data collected by the communities should be sent to the District WASH desk from where they should be sent to the Water Directorate.



Site Selection and Assessment

Selecting the location of a new hand dug well site within the community or homestead needs to take both technical and sociocultural aspects into consideration.

Provision 2.1: Equity

To strive towards ensuring equitable access to safe and reliable drinking water supplies, all stakeholders should first focus on the communities that are least served. If existing and functional improved village water supplies serve less than 250 people in a community and the sources are less than 500m from the homes, implementers should consider alternative communities. The District Council should be consulted to arrange alternative communities that have been mobilized and are ready to benefit from a new or rehabilitated hand dug well.

Provision 2.2: Community involvement

It is mandatory that the community is involved in the selection of the site. This should be set out in the MoU that is signed between the community leaders, the implementation agency, and the contractor (see Appendix 2). Community members should be guided in the site selection by the technical personnel of the District Council and the implementing agency. The community's (particularly women's) preferences should be considered first. If the preferred sites are not suitable for technical reasons, this must be explained to the community. Alternative locations should be proposed for consideration by the community. Note that (a) a well is a place women can discuss confidential business without fear of men hearing; (b) a well in the compound of an influential person may be considered to be personal property; (c) a well outside a mosque may only be used by men for ablutions before prayers; (d) a well inside a chief's compound may not be widely used because men may fear being persuaded to do unpaid work, or unmarried women may fear becoming another wife.

The community's (particularly women's) preferences should be considered first. If the preferred sites are not suitable for technical reasons, this must be explained to the community.

Provision 2.3: Reconnaissance

If there is no previous experience of well digging and no information on the groundwater potential, the advice of an experienced geologist, possibly equipped with geophysical equipment, should be sought in siting the well. If previous wells have failed or do not provide water throughout the year or there is evidence of hard rock at shallow depths, alternative technology options such as a borehole should be considered. If a large number of wells in a particular area are planned, it may be cost effective to employ a geologist and geophysical techniques in the siting of the wells. The increased success rate may offset the extra cost of hiring a geologist.To a nongeologist, the following might be indicators of groundwater occurrence:

1. The existence of other productive wells and springs in the area.
2. The existence of surface water bodies, streams, swamps or lakes,
3. Low-lying areaswhich offer greater chances of success,

Provision 2.4: Land ownership

For a public/community well, it is **mandatory** to determine the ownership of the land selected. The consent of the owners to use the land for the well and allow access indefinitely must be set down in writing. If compensations are agreed on, they must be settled before commencement of any construction work.

Provision 2.5: Accessibility

It is **mandatory** that the site is accessible all year round to all people in the community. There should be easy access for construction and maintenance equipment for the well. If possible, the well should be centrally located within the community. If this is not possible, the well should not be more than 500m from the community. For schools and health centers, the wells must be located within the premises. Household wells should be located within the homestead.

Provision 2.6: Preventing contamination

To ensure that the well is hygienic, it is mandatory to site it beyond the minimum distance from existing water points and contaminants as set out in Table 2. The well should be located upstream of any possible pollutants. A well must not be sited where it could be flooded or in depressions with poor drainage. The site must not be liable to erosion and it must not be in an area where pesticides or fertilizers are being used.

TABLE 2: MINIMUM DISTANCE (M) FROM WELL

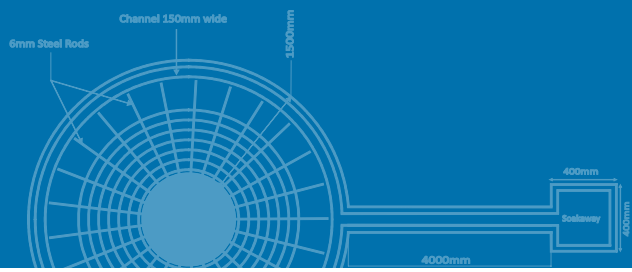
Existing Structures	Minimum Distance from Well (m)
Existing public water points (well/borehole)	20
Other existing water wells	10
Latrines/septic tanks/soak ways	30
Streams, canals, irrigation ditches	20
Buildings	3
Approved or informal solid waste dumps, burial grounds, lubricant depots	500
Coastline	100

Source: *Government of Sierra Leone.*

Provision 2.7: Rehabilitation

In the case of rehabilitation of an existing well, an assessment must be carried out to diagnose the problem and establish whether it is worth rehabilitating or not. It is essential to assess the following points:

1. Whether the source has failed due to a problem with the pump or with the well itself.
2. Whether rock was encountered during excavation—this may indicate that the well cannot be deepened further.
3. Whether the well dries up in particular months of the year but has soft material at the bottom—this well may have the potential to be rehabilitated to provide an all-year water supply.
4. The distance of the well to any potential contaminants should be checked. If the distance is less than that provided in Table 2, it should not be rehabilitated.
5. Whether the well lining has collapsed—if this is the case, the cost of rehabilitation may be prohibitive and it may be preferable to construct a new well.
6. Whether the well is unlined—it could be lined with concrete rings and fitted with a new well head and apron according to the specifications.



Well Construction

The provisions in this section apply to hand dug wells that are financed by government, NGOs, and development partners. Provisions 3.5 to 3.7 should also be considered by households that are upgrading their existing water supplies (that is, self supply).

Provision 3.1: Indigenous and reputable contractor

If a contractor is going to be appointed for the construction or rehabilitation, it must be a reputable firm. Ideally, it should be a local firm operating within the district. Contact details for the contractor including the location of the firm's premises should be stated in the MoU. This is so that the contractor can easily be reached by the community if there are complaints.

Provision 3.2: Contract documentation

In the case of works that are contracted out, the following **mandatory** conditions apply:

1. In cases where the District Council is the implementing agency, the written contract for the hand dug well, or wells, including the specific site(s) and all specifications must be signed in duplicate by the contractor and District Council before the commencement of works.

2. In cases where an NGO is the implementing agency, a written contract for the hand dug well, or wells, including the specific site(s) and all specifications must be signed in duplicate by the contractor and implementing agency before the commencement of works. In addition, an MoU must be signed between the NGO and the District Council setting out roles and responsibilities (including site supervision), specifying the sites(s) and project schedule.

On completion of the works a certificate of partial completion shall be issued to the contractor duly signed by the implementing agency, the community representative, the District Council, and the Water Directorate. After the defects liability period and satisfactory completion of all

If a contractor is going to be appointed for the construction or rehabilitation, it must be a reputable firm. Ideally, it should be a local firm operating within the district. Contact details for the contractor including the location of the firm's premises should be stated in the MoU.

remedial works, a certificate of final completion shall be issued to the contractor signed by the same designated persons.

Provision 3.3: Defects liability

A defects liability period of at least six months should be included in every contract to ensure that contractors can be called back to effect liable repairs during this period without further costs.

Provision 3.4: Appointment of a foreman

It is mandatory to include a clause in the contract that the contractor appoints a foreman or headman who shall be responsible for all decisions on site and reports to the supervisor. Site instructions issued to the contractor by the supervisor while on site should be in writing and in duplicate, and signed by both the contractor and supervisor, with each party keeping a copy.

Provision 3.5: Supervision

There should be a trained and experienced **supervisor** on the site throughout the well construction or rehabilitation period. The responsibilities of the supervisor are to:

1. Make sure that the roles and responsibilities of all stakeholders are clear to the community and that the community MoU has been signed.
2. Introduce the contractor to the community, making sure that the contractor can be contacted by the community, and discuss the work schedule with all parties, making arrangements as necessary.
3. Ensure that the site selected for the well adheres to the provisions of the *Technical Guidelines.*
4. Ensure that safety measures in provision 3.8 of the *Technical Guidelines* are adhered to.
5. Ensure that the design specifications are adhered to.
6. Decide when to stop the excavation in case hard formation is struck and the well cannot be dug deep enough to ensure sufficient water throughout the year, or in case of other reasons.
7. Ensure that all the required data are collected in the approved format.
8. Ensure that records are submitted to the appropriate authorities.

If the supervisor cannot be on site full time, he should arrange for members of the community (teachers, health workers, and so on) to deputize for him. He must, however, be on site at the

commencement of the excavation, at the stopping of excavation, and on completion of the well lining. The supervisor could be a consultant or implementation agency staff member.

Provision 3.6: Timing of construction

Well construction and rehabilitation should be avoided in the rainy season.[1] Ideally, construction should take place towards the end of the dry season when water levels are at their lowest and digging can penetrate as much of the aquifer as possible. If this is not possible, arrangements should be made to deepen the well by caissoning when the water table drops. At no time are donors allowed to place restrictions or conditionalities on funding that undermine this provision, that is, the timing of construction.

Provision 3.7: Dewatering pumps

Contractors must utilize dewatering pumps during construction and rehabilitation, provided that they are fully trained in their proper use and safety measures.

Provision 3.8: Safety measures

The safety measures in Table 3 are **mandatory** to eliminate or reduce the possibility of an accident in the course of the construction.

TABLE 3: MANDATORY SAFETY MEASURES

No.	Measure
1	There must be a minimum of four persons at a well at any time to ensure that there are enough people to raise an alarm and assist in a rescue operation in case of an accident; no solo digging should ever be undertaken.
2	Proper signalling arrangements, using either a flashlight or whistle, must be in place between the diggers and the crew at the surface in case of any danger to the digger.
3	A tape or barrier should be used to demarcate the construction area and indicate a no-go area for onlookers, and the above-ground crew should ensure that the onlookers are kept behind this barrier. The security perimeter must remain in place till the end of the construction work.
4	The excavated pit must be covered with a strong timber platform at the end of every day.
5	The construction crew must wear hard hats, gloves, and boots.
6	All equipment including ropes, lifting gear, pick axes, tripods, and hammer heads must be in good working condition.
7	Petrol or diesel-driven pumps should never be lowered into the excavated well during excavation as it can lead to asphyxiation.

[1] The months of the rainy season vary from north to south of the country. Implementers are advised to define the months for the project area and ensure that construction or rehabilitation is avoided in the rainy season.

8	When excavating in difficult formations, it is advisable to change diggers every 15-30 minutes for safety and efficiency.

Source: *Government of Sierra Leone.*

Provision 3.9: Backfilling

Any abandoned excavated pit must be backfilled either before or during the excavation of a new pit, so that it is not a source of danger to the community or a source of pollution to other groundwater abstraction points.

Provision 3.10: Technical specifications for well construction

The construction of the wells should proceed according to the following steps:

STEP 1—SITE CLEARING AND SETTING UP

The site should be cleared for a 5m radius of the well center point. The ground should be levelled and barriers set up to demarcate the construction area. The layout of the construction site should allow for easy access to the well for moving the materials, for easy and appropriate disposal of the soil excavated from the well, and for the rapid and safe disposal of the water when dewatering.

STEP 2—MARKING OUT THE DIAMETER OF THE SHAFT

The center point of the well should be located where water can easily drain away and the well radius (0.90m) drawn on the ground around the center point, giving a shaft excavation diameter of 1.8m.

STEP 3—EXCAVATION AND LINING

The soil should be excavated down to 0.90m and a shutter inserted to hold the topsoil from collapsing. The well shaft should then be excavated to a depth of 5m or to the top of the water table, whichever occurs first. A plumb bob should be used by the supervisor to ensure the verticality of the wall. Unless the soil is particularly stable, it is not advisable to excavate further without lining. Shutters of 1.6m diameter should then be placed in the shaft and reinforcement bars, both vertical and horizontal, are placed behind the shutters and concrete poured in at 1m lifts. The reinforcement steel bars should be 6 mm (numbering 26) for the vertical rods and 6 mm (numbering 5 at 20mm grid) for the horizontal rods and the concrete mixed in the ratio 1:2:4.

STEP 4—CAISSONING INTO THE AQUIFER AND CONSTRUCTION OF THE INTAKE

A caisson should be set below the water table. A caisson lining is of concrete, constructed at the bottom of the well inside the main lining. Its outside diameter should be 1.4m to allow it to be sunk into the 1.6m internal diameter of the main lining. The wall thickness should be 100mm. The caissons should have seepage holes, made by inserting wooden pegs in the

wet concrete and then removing them before the concrete is set. The caissons should be reinforced with 6mm vertical (numbering 20) and 6mm (numbering 5 at 20mm grid) horizontal steel rods. If possible, excavation should proceed at least 3.5m below the water table, the water being pumped out of the shaft with a dewatering pump.

A bed of gravel 300mm thick of 10mm diameter rounded river gravel should be placed at the bottom of the intake chamber of the well to prevent fine particles from entering the well while admitting water. See Figure 1A on page 21 of these *Technical Guidelines.*

STEP 5— CONSTRUCTION OF HEAD WALL, APRON, DRAINAGE CHANNEL, AND COVER SLAB

The **head wall** is an extension of the well lining and should extend 300mm above ground level.

The **apron** is meant to provide a clean and well drained area around the well. To ensure good drainage the surface of the apron slab should be 100mm above ground level. It should have a gradient of 1:20 towards the drainage channel. It should have a radius of 1.5m around the well. It should be cast with concrete mixed in the ratio of 1:2:4 reinforced with 6 mm horizontal and radial steel rods. It should be allowed to cure for 21 days. The ground immediately around the apron slab should be covered with a layer of stones to prevent the soil becoming muddy, and the soil around the slab eroding away and undermining the edge of the slab. When the apron is being cast the following data about the well should be inscribed into the wet concrete in an area that will not be easily eroded:

1. Date of completion.
2. Depth of the well.
3. Static water level.

The ground immediately around the apron slab should be covered with a layer of stones to prevent the soil becoming muddy, and the soil around the slab eroding away and undermining the edge of the slab.

The **drainage channel** should be 4m long, 200mmwide and 50mm deep. It should terminate in a soak away pit of 400 x 400 x 400mm.See Figure 1B on page 22 of these Technical Guidelines.

The **cover slab** for wells fitted with a handpump should be the exact diameter of the protruding well head, that is, 1.8m (the internal diameter is 1.6m plus 10cm concrete wall on each side). The construction of the cover slab has to be coordinated with the pump installation as the pump stand has to be imbedded in the cover slab. It should be 100mm thick, reinforced with 8mm steel rods at 150mm grid, concrete mixed in the ratio of 1:2:4 and allowed to cure for 21 days.

It should incorporate a manhole of 400mmx 400mm, fitted with a lockable steel lid set in a frame and hinge style so that it can be opened if the pump breaks down and a bucket and rope can be used to fetch water. It also permits groundwater monitoring and well inspection. See Figure 1C on page 23 of these guidelines.

The **cover slab** for wells using a rope and bucket is the same as described above, except that it should have a 400mm x 400mm lockable metal lid set in a frame and hinge style in the center of the slab.

STEP 6—ESTIMATING THE YIELD, DISINFECTION, AND WATER QUALITY ANALYSIS

A well fitted with a handpump is expected to give a yield of at least 1000l/hour. This should be established by conducting a three-hour pumping test. The yield can be measured with a flow meter on the discharge pipe or by timing how long it takes to fill a container of known volume. At the same time the drawdown in the well should be monitored using a dip meter. Another method is to pump out the water and monitor how long it takes to recover. If the recovery is very slow it may not meet the demand.

It is **mandatory** that all wells should be disinfected on completion. Disinfection is by chlorine solution yielding at least 50 mg/l of active chlorine in all parts of the well. The chlorine solution should be prepared from calcium hypochlorite or sodium hypochlorite. The disinfectant should stay in the well for at least 24 hours after which the water should be pumped out.

After disinfection a sample of the water should be tested for bacteriological and chemical parameters by the District Council. The parameters to be tested and the permissible limits (adapted from WHO Guidelines) are presented in Appendix 5.

STEP 7—COMPLETION AND SITE RESTORATION

On completion of the works, the area round the well should be levelled and all material and equipment removed. It is mandatory that the well area must be fenced off with a lockable gate. However, the materials to be used and design should be left for the community to decide.

Provision 3.11: Certification

It is mandatory that the final certification is carried out by trained and experienced personnel from the District Council (see Appendix 4 for a sample certificate). If the District Council lacks the required technical staff, it should be supported by the Water Directorate to fulfil this role. The final certificate of completion must be signed by the implementation agency, community representative, the District Council, and the Water Directorate Engineer within three months of the completion of the well.

The supervisors must ensure that all records and reports are completed and submitted to the appropriate agency before final certification. The records to be submitted shall include:

1. Water quality analysis report (based on Appendix 5).
2. Checklist for hand dug well construction completion (see Appendix 1).

3. Hand Dug Well Construction/ Rehabilitation Completion Form (see Appendix 3).

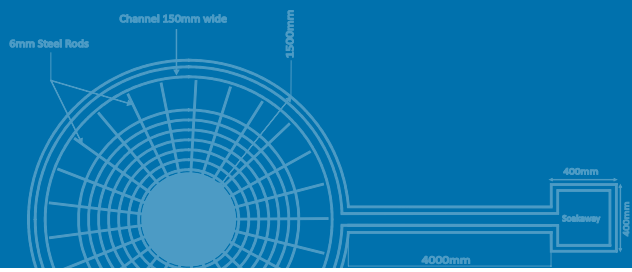
Provision 3.12: Well maintenance

Once the well has been completed, it needs to be properly maintained to prevent contamination of the source and to avoid reduction in its service life span. This is the responsibility of the well caretaker, supervised by the water users' committee. A recommended schedule of maintenance is presented in Table 4.

TABLE 4: RECOMMENDED WELL MAINTENANCE SCHEDULE

Timing	Activity
Daily	Clean and sweep the immediate surroundings.
Weekly	Make temporary repairs to any damaged/cracked items.
	Inspect pump; repair if necessary.
Monthly	Check for potential pollutants and remove or correct.
	Check that any barriers to keep animals away are in good condition.
Annually (at lowest water table)	Clean out well base and walls.
	Repair and clean all damaged and cracked items.
	Clean out drain and soak away.
	Check that apron is not being undermined by erosion.
	Disinfect well whenever contamination is suspected.

Source: *Government of Sierra Leone.*



Handpump Installation

The 2012 water point mapping exercise recorded eight different handpumps being used in the country. Too high a variety of pump types is inefficient, because spare parts are often not compatible, reducing synergies in spare-part supply and maintenance expertise. Thus, when choosing a pump, technical criteria should be complemented by a review of common pump types in the area to make use of spare-part supplies and repair expertise. Across the country, the three most commonly used pump types are the India Mark II, Kardia, and Inkar pumps.

Every make of handpump comes with its own installation guidelines and manuals from the manufacturers which must be followed and for which each installation crew must be properly trained. It is beyond the scope of these *Guidelines* to set standards for the installation of all the pumps in use. The installation manuals for some of the pumps available on the Internet and the sources are listed in the bibliography. Technicians and supervisors involved in handpump installation should consult them and use them as the standard to follow.

Handpump sustainability and the spare parts supply chain remains a weak link in rural water supply provision. Work is currently going on to improve the sustainability of the handpumps and water points in general, which is likely to be consolidated into a separate set of guidelines. This section sets provisions for aspects of installation common to the pumps currently being used, as well as the roles and responsibilities of different stakeholders in the operation and maintenance of handpumps.

Every make of handpump comes with its own installation guidelines and manuals from the manufacturers which must be followed and for which each installation crew must be properly trained.

Provision 4.1: Installation

Pump installation must be coordinated with the pad construction as the pump stand has to be embedded in the pad. It is essential that the pump stand, which is placed over the protruding casing, is at the correct height and is absolutely vertical. The pump stand needs to be secured well with stones or wooden struts, so that it does not change its position during the grouting process.

A common problem with handpumps on hand dug wells is the water level falling below the pump cylinder in the dry season and therefore not delivering water. On the other hand, if the pump cylinder is set too close to the bottom of the well, silts can cause damage to the cylinder. Therefore, the cylinder should be set 1mabove the well bottom to strike a balance between the falling water level and incursion of loose sand from the bottom of the well.

The right tools and procedures for assembling each pump must be used—using the wrong tools and shortcuts can damage the pump and compromise the safety of the people installing the pump. Nuts and bolts must not be overtightened nor undertightened. Spring washers, locking adhesives and locknuts must be used to stop nuts working loose. Well maintained heavy lifting equipment and clamps should be used when needed.

Provision 4.2: Operation and maintenance

Management of handpumps is delegated to water users' associations. These associations are expected to monitor and manage water supply systems and defend the interests of end users. Often there is insufficient financial mobilization to cover maintenance and replacement costs. To bring about improvements, the roles and responsibilities of the water users' associations and of the District Councils need to be clearly defined from the planning stage and understood by all the stakeholders.

District Councils should have the facility to provide support for major repairs and to give advice when required by the community.

The roles of the water users' executive committee in ensuring water point functionality are:

1. Mobilize community members to participate in water point protection, for example, regularly cleaning the surrounding area.
2. Keep a regularly updated list of the water users.
3. Collect and safely keep the financial contributions for construction, operation and maintenance.
4. Pay regular visits to monitor the conditions and performance of the handpump.
5. Verify the purchase of materials needed for the repair or maintenance of the handpump.
6. Pay for repairs carried out on the well and handpump.
7. Provide security for the protection of handpump against theft.
8. Supervise and provide support for the caretakers of the water source.

The roles of the caretakers are:

1. Demonstrate the proper use of the well and handpump.

2. Carry out regular maintenance of the water point, for instance, sweeping and clearing the bush.
3. Keep the records of all the maintenance work carried out on the source either directly by the caretaker or the handpump mechanic, plumber or mason.
4. Mobilize community members to participate in maintenance activities, for example, regular cleaning of the surrounding of the water source, advice the community on regular cleaning of the containers, and on storage and collection.
5. Lock and open the security device on the handpump when not in use and for use.

The village pump mechanics, responsible for routine and regular maintenance of the handpumps, should be provided with the standard and special tools required for maintenance.

Provision 4.3: Handpump maintenance

Once installed, the handpump requires regular and routine maintenance. Recommendations on a schedule of general handpump maintenance are provided in Table 5.

TABLE 5: RECOMMENDED HANDPUMP MAINTENANCE SCHEDULE

Timing	Activity
Monthly	• Tighten the handle axle nut and lock nut.
	• Look for loose or missing flange bolts and nuts.
	• Open the front of the head cover and clean inside the pump.
	• Check the chain anchor bolt for proper fitment. Tighten if necessary.
	• Clean the chain assembly. Apply graphite grease.
	• Look for rusty patches and clean them.
	• Check whether the handpump base is loose in the foundation. In case it is loose, it should be reconstructed.
Annually	Examine the pump carefully and check the following:
	• The discharge is satisfactory.
	• The handle is not shaky.
	• The guide bush is not excessively worn.
	• That all bolts, nuts, and washers are in position.
	• The chain has not worn out.
	• The roller chain guide is not excessively worn.
	Overhaul the pump as follows:
	• If chain/bearing spacers are damaged, replace them.
	• If roller chain is badly worn out, replace the handle assembly.

	• If there are any damaged pipes, have them replaced.
	• Open out the cylinder assembly and replace cup washers, sealing rings, and other components found to be faulty.
	• Check the condition of the water tank riser holder. If the threads are worn out, replace water chamber.
	• Check for any other seam line failures or cracks.
	• Reinstall the pump.

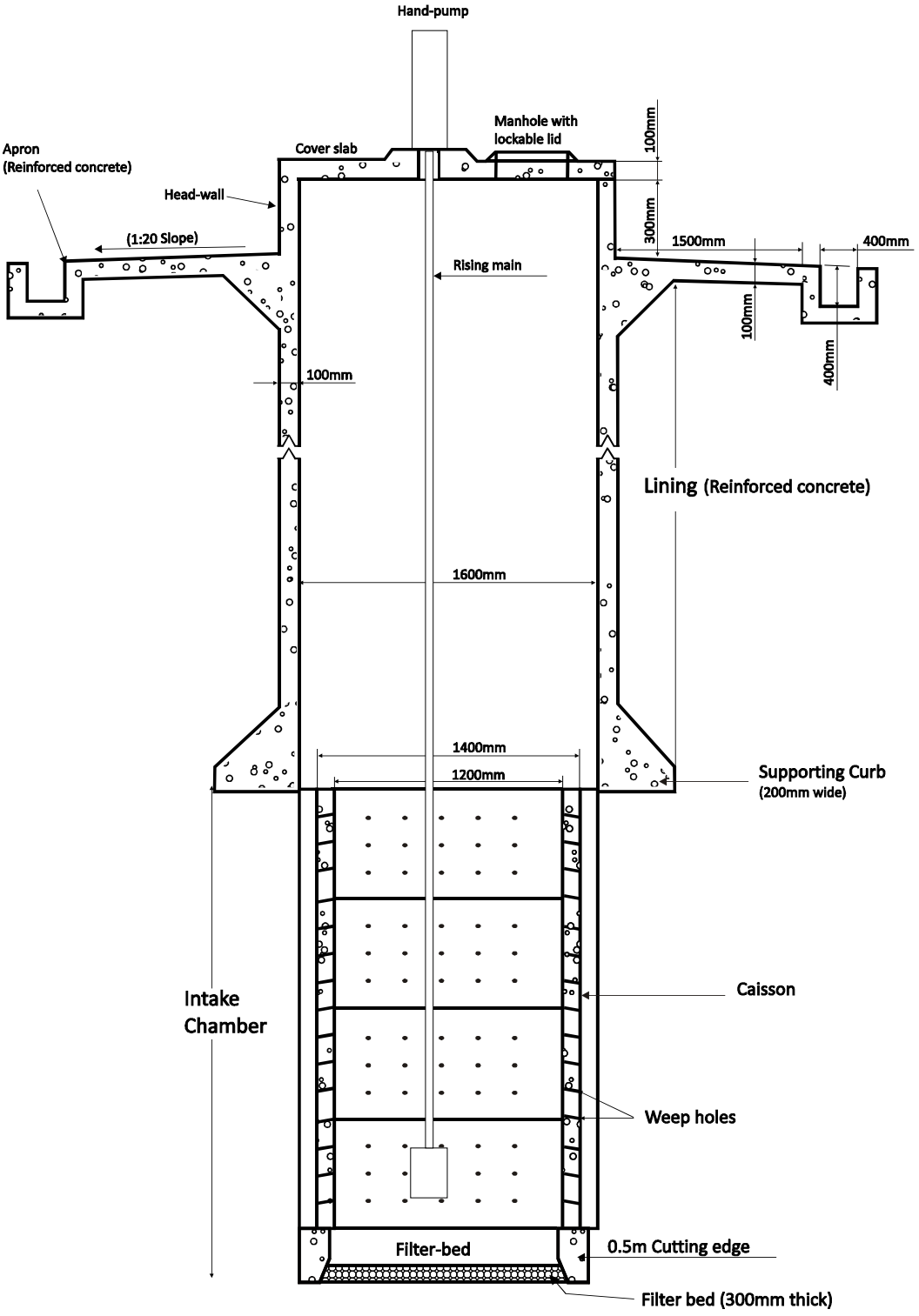
Source: *Government of Sierra Leone.*

Provision 4.4: Handpump security

Handpump theft is a frequent occurrence in the country. It is the responsibility of the water users' association executives to ensure the security of the handpumps. UNICEF has developed an anti-theft device for handpumps. It is expected that this will become the standard protection for handpumps in the country. Every handpump will be expected to be installed with one such device, and it will need to be fabricated by each owner. The details of the design and steps in construction are shown in Appendix 6.

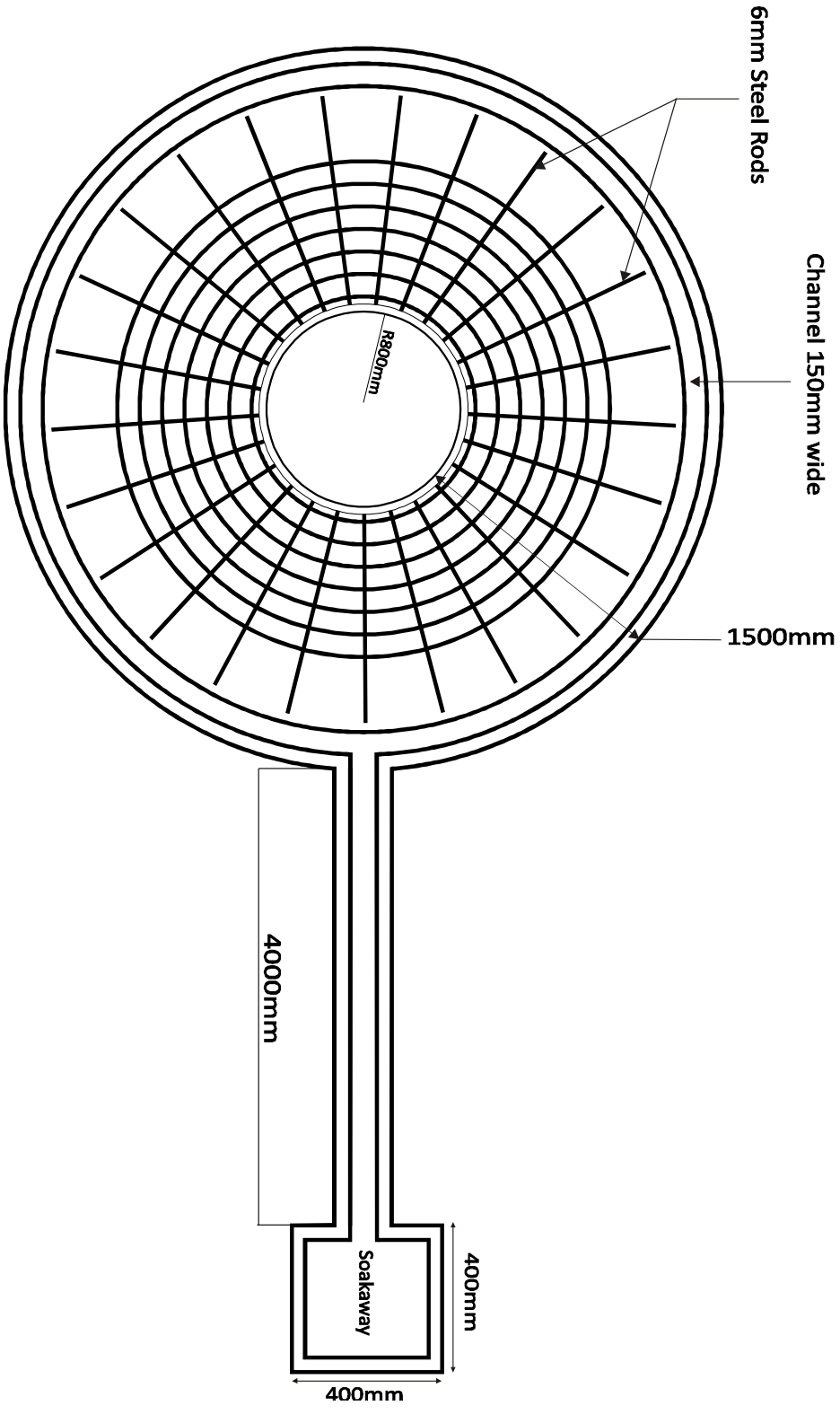
A UNICEF-designed anti-theft device for handpumps.

FIGURE 1A: WELL SECTION



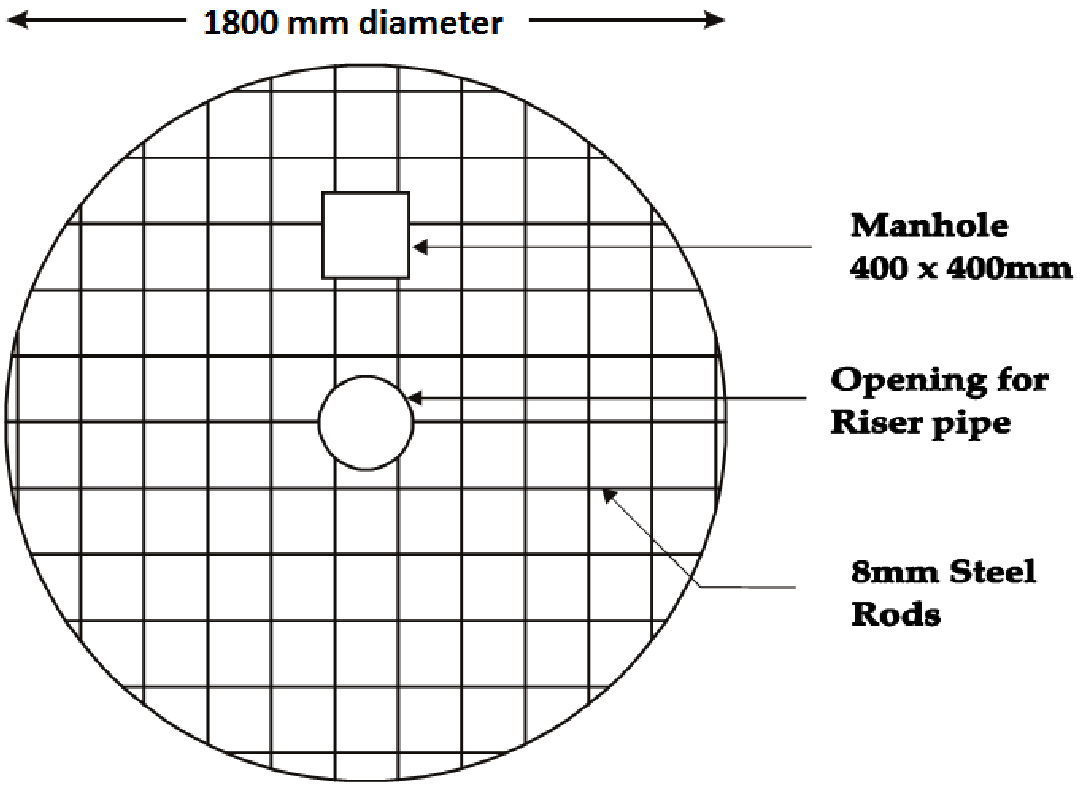
Source: *Government of Sierra Leone.*

FIGURE 1B: APRON SLAB, DRAINAGE, AND SOAK AWAY PIT

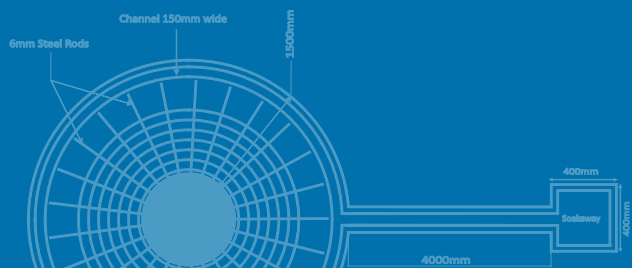


Source: *Government of Sierra Leone.*

FIGURE 1C: CONCRETE SLAB



Source: *Government of Sierra Leone.*



> BIBLIOGRAPHY

ACF (Action against Hunger) Uganda Mission. 2010. *Indian Mark II Installation and maintenance manual for Handpump Technicians and Borehole caretakers.* ACF WASH.

Collins, Seamus. 2000. *Hand dug shallow wells.* Skat Series of manuals on Drinking Water Supply, Volume 5.

Crawley, Peter. Undated. *Concern Sierra Leone Hand Dug Well Guidelines.*

GOAL. Undated. *Hand dug well construction manual.*

Inter Aide Sierra Leone. Undated. *Maintenance Guideline for Kardia Handpump.*

Ministry of Energy and Water Resources. 2012. *Sierra Leone Water Point Report Review Version 6th June 2012.*

Ministry of Water Resources. 2013. *A Rural Water Supply and Small Towns Strategy Document.* Government of Sierra Leone.

Morel, S.W. 1976. *Geology and Mineral Resources of Sierra Leone.* Fourah Bay College Press.

Pickford, John. 1991. *The Worth of Water. Technical briefs on health, water and sanitation.* London, U.K.: Intermediate Technology Publications.

Public Water Corporation. 2009. *Technical Guidelines for the Construction and Management of Boreholes with hand pump, A Manual for Field staff and Practitioners.* Government of National Unity Sudan and Ministry of Water Resources and Irrigation, South Sudan.

Public Water Corporation. 2009. *Technical Guidelines for the Construction and Management of Hand Dug Well Water Yard, A manual for Field Staff and Practitioners.* Government of National Unity Sudan and Ministry of Water Resources and Irrigation, South Sudan.

Republic of Liberia. 2010. *The Guidelines for Water and Sanitation Services in Liberia.* Ministry of Public Works in collaboration with the Liberia WASH consortium and UNICEF.

RWSN (Rural Water Supply Network). 2007. *Installation and Maintenance Manual for the Afridev Handpump.* Available at http://www.rural-water-supply.net/en/resources/details/286.

RWSN. 2007. *Maintenance Guideline for Kardia Handpump.* Available at http://www.rural-water-supply.net/en/resources/details/477

RWSN. 2008. *Installation & Maintenance Manual for the India Mark II Handpump.* Available at http://www.rural-water-supply.net/en/resources/details/328.

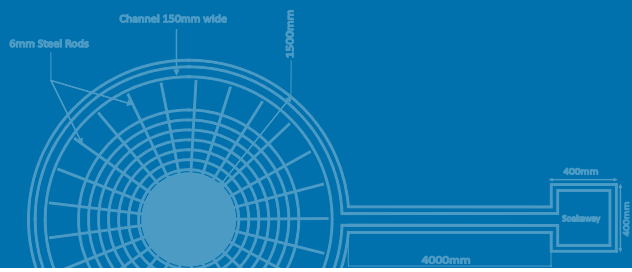
RWSN. 2008. *Installation & Maintenance Manual for the India Mark III Handpump.* Available at http://www.rural-water-supply.net/en/resources/details/329.

RWSN. 2009. *Afridev Handpump Maintenance Card.* Available at http://www.rural-water-supply.net/en/resources/details/237.

Skat Resource Centre and Consultancy for Development. 2008. *Installation and maintenance manual for India Mark III Handpump.* Available at http://www.rural-water-supply.net/_ressources/documents/default/INDIA-MARK-III_Installation-Manual_Ed-2008.pdf. Skat-RWSN.

UNICEF Sierra Leone. 2012. *Draft WASH Technical Guidelines.*

Watt, S.B., and W.E. Wood. 1979. *Hand dug wells and their construction.* ITDG Publishing.



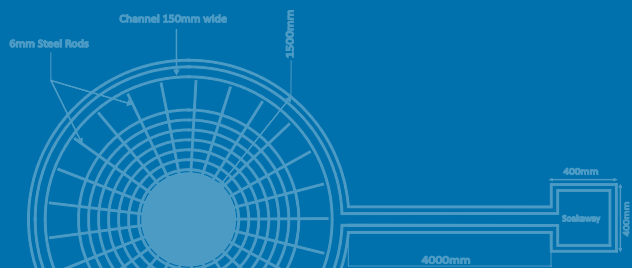
> APPENDIX 1:

Checklist for Hand Dug Well Construction Completion

Well No.	District	Community	GPS Coordinates
Activity	**Activity Checklist**		**Comment**
Community mobilization	☐ Community has been mobilized		
	☐ Community has made contribution		
	☐ Hand pump mechanics have been trained		
	☐ Monitoring mechanisms have been put in place		
Site selection	☐ Community participated in the site selection		
	☐ Land ownership has been resolved		
	☐ Well is at least 30m from contaminants		
	☐ Well is located within 500m of community		
Excavation	☐ All safety measures were taken		
	☐ Shaft is straight and plumb		
	☐ Excavation done in the dry season		
	☐ Excavated 3.5m below the water table		
Lining	☐ Lining done with concrete mix 1:2:4		
	☐ Lining straight and all joints filled		
	☐ 6mm rods used as verticals		
	☐ 6mm rods used as rings		
	☐ Caissons cast with a concrete mix of 1:2:4		
	☐ Concrete reinforced with 6mm verticals steel rods and 6mm rods as rings		
	☐ Caisson wall thickness is 10cm		

Well No.	District	Community	GPS Coordinates
Activity	**Activity Checklist**		**Comment**
Head wall and slab	☐ Head wall is 0.3m high		
	☐ Head wall is ofreinforced concrete mix of 1:2:4		
	☐ Head wall is neatly dressed and finished		
	☐ Cover slab ofconcrete mix of 1:2:4		
	☐ Concrete reinforced with 8mm steel rods at 150mm spacing		
	☐ Allowed to cure for 21 days		
	☐ Slab diameter is 1.80m		
Manhole	☐ Manhole400 x 400mm with lockable metal lid		
Apron	☐ Apron has radius of 1.5m around well		
	☐ Slopes away from the well		
	☐ Reinforced concrete mix of 1:2:4		
Drainage	☐ Drainage 4m long		
	☐ Width is 2m		
	☐ Slopes away from the well to soak pit		
	☐ Concrete mix in 1:2:4		
Soak pit	☐ 4 Soak pit 400x 400 x 40mm indimension		
	☐ Filled with boulders		
Disinfection	☐ Well disinfected according to specification		
Water quality analysis	☐ Water quality analysis carried out		
Fencing	☐ Fencing with lockable gate installed		
Data and reports	☐ All data collected and submitted		

Supervisor:..... **Date**.....



> APPENDIX 2:

Sample Format of Memorandum of Understanding for Hand Dug Well Construction or Rehabilitation between the Implementing Agency and the Community and the Contractor

Memorandum of Understanding

Between	*(Insert the name of the implementing agency/sponsor, for example, District Council/NGO)*
And	*(Insert the name of the community)*
And	*(Insert the name of the contractor)*
Purpose	

The *(Insert sponsors name and address)* and *(Insert the community name and address)* collectively hereinafter referred to as "the parties" enter into this Memorandum of Understanding on this.....day of ..... with respect to the *(Insert construction or rehabilitation of hand dug well and/or installation of handpump)* for the supply of safe drinking water to the community of *(Insert the name of the community)*

Location of facility:

(Insert District Council, chiefdom, community)

Purpose:

The purpose of this memorandum is to clearly define the roles and responsibilities of each party in the *(Insert construction/rehabilitation and installation of the hand dug well and installation of the handpump)*.

Responsibilities:

Each party will appoint a person to serve as official contact person who will coordinate and ensure that the activities as earmarked in the MoU are accomplished. The contact persons shall be as stated in the table below.

Sr. No.	Name	Title and Organization	Phone Number
1	*Insert Implementing agency representative*		
2	*Insert Community representative*		
3	*Insert Contractor's representative*		
4	*Insert Supervisor's name*		

1. *(Insert the name of the sponsor or implementing agency and list the responsibilities below).*
2. *(Insert the name of the community and list the responsibilities below).*
3. *(Insert the name of the contractor and list the responsibilities below).*
4. *(Insert the name of the Supervisor and list his responsibilities below).*

Terms of understanding

- All disputes about the MOU will always be resolved through negotiations by all the parties involved. Should this MOU require modification by either of the parties, either party must agree to the proposed changes in writing
- This MOU will always be sued to serve as reference to the facilities installed as a result of this project

Authorization

The content including the terms and conditions of the MoU have been discussed and understood by the representatives of all the parties and signed below to signify acceptance.

On behalf of the organization I represent, I wish to sign this MoU and contribute to its further development.

Signed on behalf of……..... Witness.....

(Insert the name of implementing agency)

Name……..
Name……...

Signature……
Name……..

Date……
Date……

Signed on behalf of …… Witness

(Insert the name of the community)

Name……..
Name……..

Signature…… Signature……

Date……
Date……

Signed on behalf of …… Witness

(Insert the name of the contractor)

Name……..
Name……..

Signature……
Signature……

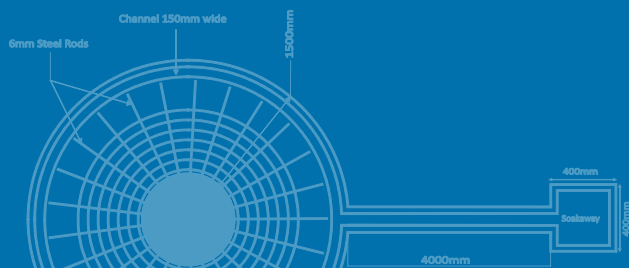
Date……
Date……

Supervisor:

Name……..

Signature……

Date……

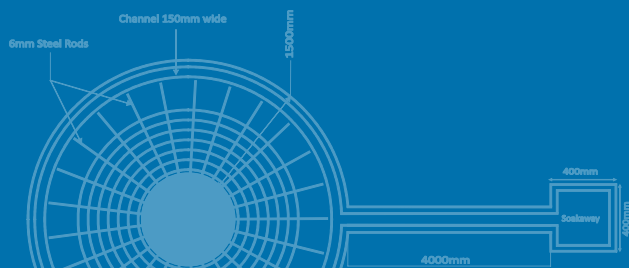


> APPENDIX 3:

Hand Dug Well Construction/Rehabilitation Completion Form

Water Well Reference No.			Use: ☐ Community ☐ Household ☐ Health facility ☐ School
District:	Chiefdom:	Community:	GPS coordinates:
Financing program/project/private:			
Contractor's name:			
Date work commenced:			Date work completed:
Work done: ☐ Construction ☐ Rehabilitation ☐ Assessment			
Description of work carried out:			
Well diameter: m	Depth of well: m		Static water level: m
Lining condition: ☐ Intact ☐ Broken ☐ None ☐ Newly installed			
Excavation stopped because of hard rock was encountered? ☐ Yes ☐ No			
Strata log:			
Was the well telescoped?: ☐ Yes ☐ No			If yes, diameter : m
Telescoped from: m to: m			Depth of water in intake: m
Type of pump installed:			
Pump status: ☐ Newly installed ☐ Works ☐ Does not work ☐ Works but defective ☐ Looted			
Disinfection carried out: ☐ Yes ☐ No			Fencing done ☐ Yes ☐ No
Final well yield: l/s			Static Water level: m

Depth of water in well up to 3 m ☐ Yes ☐ No			
Report prepared by supervisor:			Date:
	Name	**Signature**	**Date:**
Community representative			
District Council representative			



> APPENDIX 4:

Sample Certificate of Hand Dug Well Completion

Contract no.	
Implementing agency	
Contract title	
Project commencement date	
Project duration	
Project substantial completion date	
Date of final completion	
Project handover date	

The work included under this contract has been inspected by authorized representatives of the District Council, Water Directorate, *(Insert name of implementing agency)*, and the project is hereby declared finally completed.

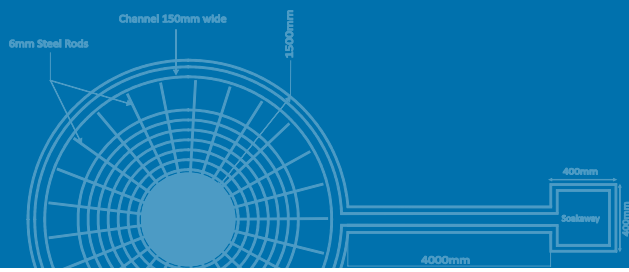
(Insert the name of the District Council) hereby certifies that the Implementing Agency, the Contractor, and the Community have complied with all the requirements of substantial completion as stated in the Contract agreement and Memorandum of Understanding for this project. The District Council and Water Directorate accept the project as finally completed and will assume full possession are handing over to the (Insert the name of the community)who will be responsible for the operation and maintenance of the facility.

Implemented by
Implementing agency:
Name of representative:
Designation:
Signature :

Handed over to	
Water Users' Committee	District Office
Name of chairperson:	Name of representative:
	Designation:
Signature:	Signature:
Water Directorate	
Name of representative:	
Designation:	
Signature:	

ATTACHMENTS:

1. Water quality analysis report.
2. Checklist for hand dug well construction completion.
3. Hand dug well construction/rehabilitation completion form.

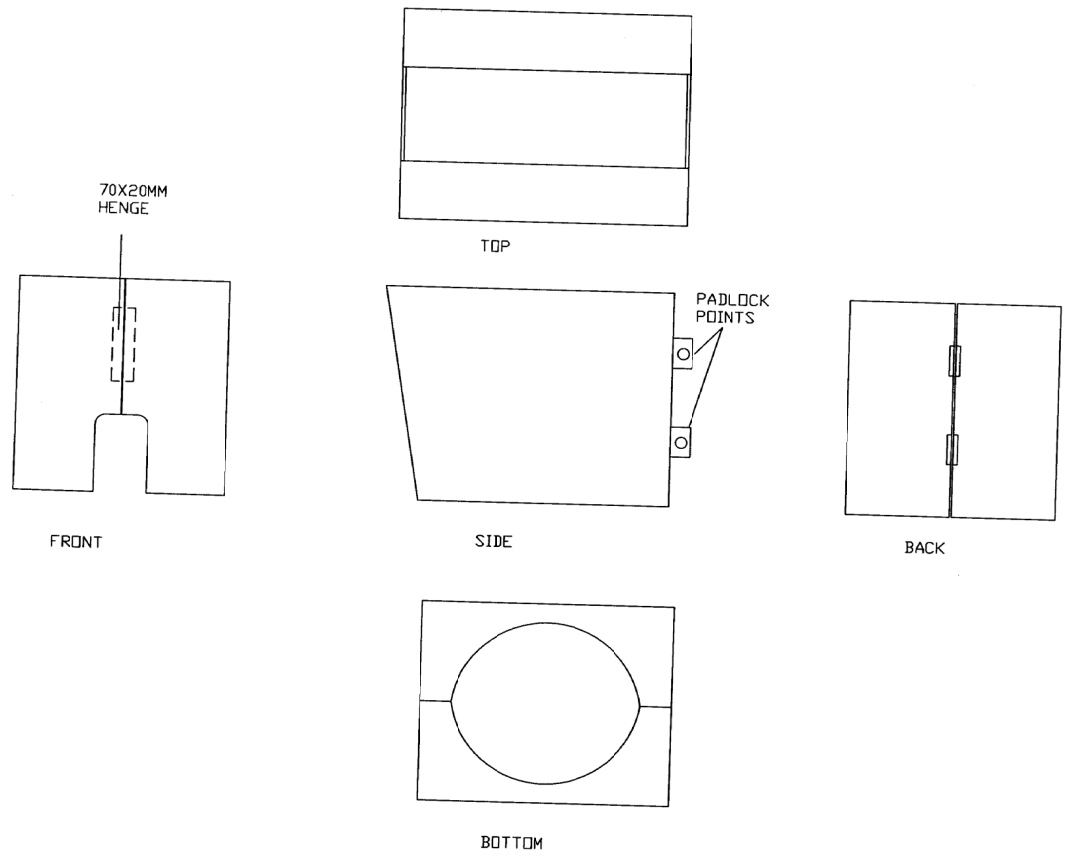


> APPENDIX 5:

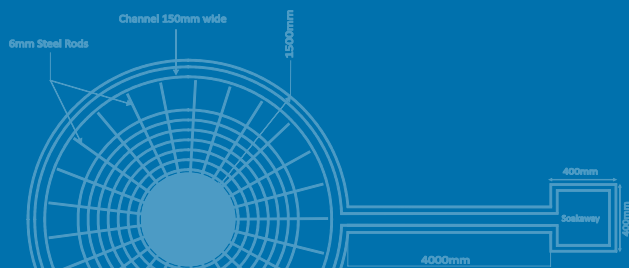
Guidelines for Drinking Water Quality (Regular Parameters)

Parameter	Unit	Maximum Limit
Physical		
Color	TCU	15
Odor	-	Unobjectionable
Taste	-	Unobjectionable
Temperature	Degree Celsius	Ambient
Turbidity	NTU	5
Conductivity	US/l	1000
Chemical		
Chloride	mg/l	240
Fluoride	mg/l	1.5
Hardness as $CaCo_3$	mg/l	150
Hydrogen Sulphide (H_2S)	mg/l	0.05
Iron (Fe^{+2})	mg/l	0.03
Magnesium	mg/l	0.2
Manganese	mg/l	0.2
Nitrate (No_3)	mg/l	50
Nitrite (NO_2)	mg/l	0.2
pH	-	6.5-8.5
Sodium	mg/l	200
Sulphate	mg/l	100
Total dissolved solids	mg/l	500
Microbiological		
Thermo-tolerant Coliform (E.Coli)	Cfu/100 ml	0
Fecal Coliform	Cfu/100 ml	0
Streptococcus	L	0
Total Coliform count	Cfu/100ml	10

Design Details of the UNICEF Handpump Anti-Theft Device



	Item Description	Quantity
1	a. 2mm galvanized steel plate (For all cut-out shapes) b. All cut-out shapes welded for either side c. 20mm x 70mm hinge welded at the back and padlock rings at the front	1
2	d. One coat red oxide (on all surfaces) e. Two coat silver oil paint (on all surfaces)	1
3	f. Large size padlock	2



> APPENDIX 7:

List of Participants in the Discussion of the Draft Technical Guidelines

Attendance: Finalization Meeting of July 5, 2013

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wsp
water and
sanitation program

GOVERNMENT OF
SIERRA LEONE