HAND-DUG WELLS IN SENEGAL

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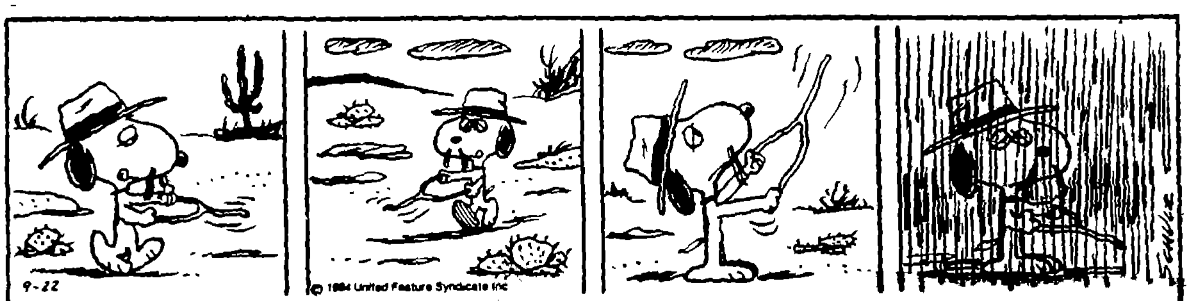
Peace Corps/ Senegal



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INTRODUCTION

One of the major goals of a Peace Corps Volunteer supervising a wells project is to teach the well digger improvements on the traditional method of digging without adding substantially to the cost of a locally funded well. Using too much outside equipment in a project makes little sense during a Volunteer's two-year service if, when he or she leaves, the villagers do not have the means to make contact with the proper services or to pay the extra costs necessary for the transport and operation of the equipment. Working with traditional methods minimizes the amount of teaching that the Volunteer must do, and shows recognition of the well digger's skills and experience; most likely he he has already constructed several wells in the area.

This manual is designed to explain some of the principles of traditional well construction and new techniques that Peace Corps Volunteers have recently been teaching to well diggers. It is meant to be an introduction to wells in Senegal. More details can be found in the books and manuals in the Peace Corps Resource Library, all of which were used as sources for this manual.

Most of my experience with wells construction has been in the Louga Region, where I served as a Volunteer for three years. However, I have had some experience in other regions while acting as wells resource person. Although traditional methods may differ from region to region, new techniques mentioned in this manual can be introduced in most regions and may help diggers construct wells resulting in an increased water output and cleaner water.

- John Wilkinson
September 1984

II. SURFACE WATER TABLE (NAPPE PHREATIQUE)

The water table (nappe d'eau) is the level at and below which water can be found in the ground. The saturated soil layer below this is called the aquifer. By digging into this aquifer as far as possible, and lowering circular cement casings (buses) to prevent the sand from filtering back into the water, a new water source is given to the villagers.

This first "nappe" stops at a layer of impermeable rock below which water can no longer penetrate. Although there are other nappes below this impermeable rock, it is this first surface water table or "nappe phreatique" which Peace Corps Volunteers implementing hand-dug wells are usually interested in exploiting. If there is no large body of water nearby, the water from this surface water table usually comes from rain water filtering through the soil until it collects above the impermeable layer.

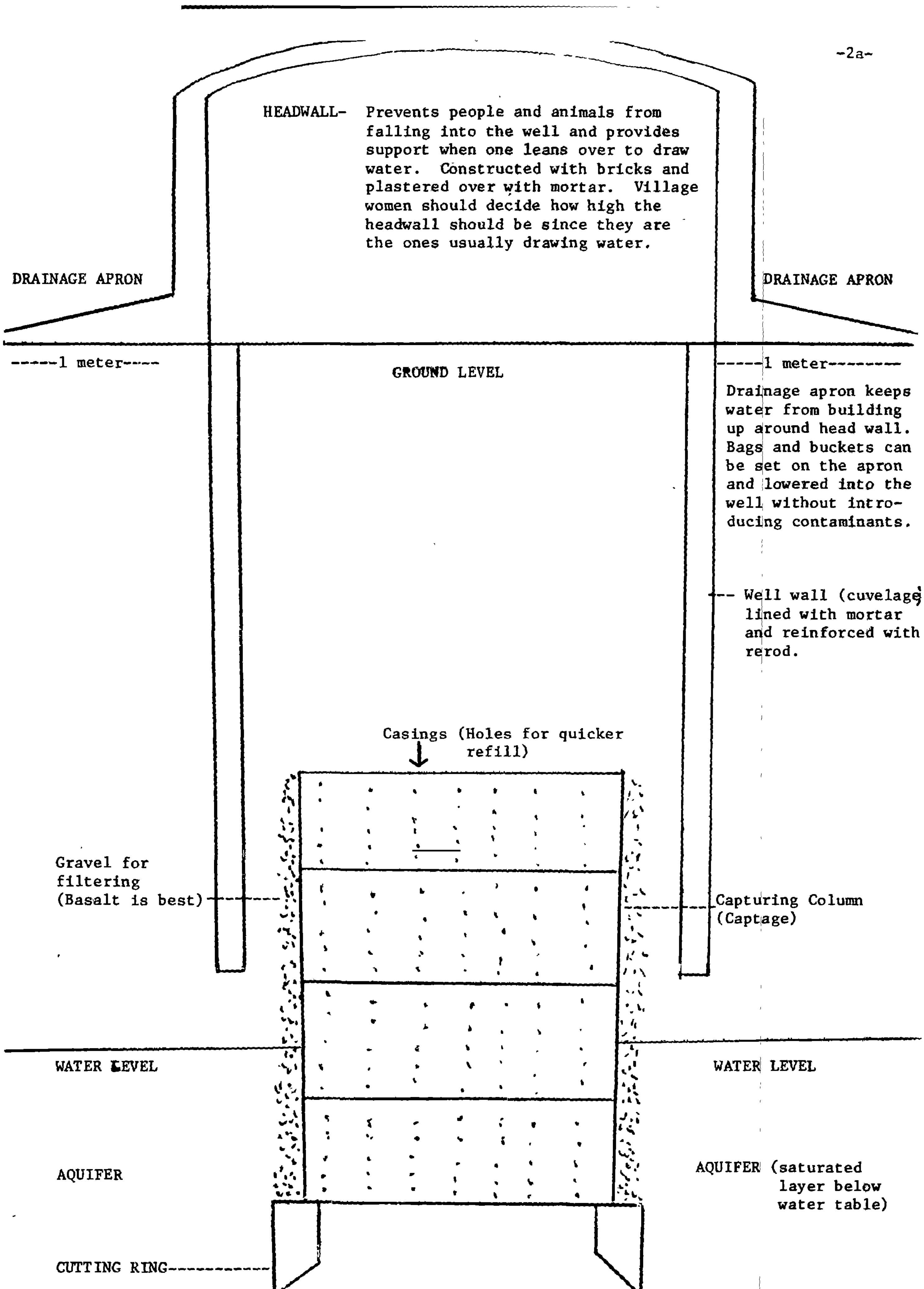
Depending on which region you are working in, the depth of the water table may change considerably from village to village. In the flat area of the Kebemer Department where I worked, the water table was almost always found at between 37 to 40 meters. However, as one moved further north towards the Linguere area, the water table became deeper. I have heard of one Volunteer in the Thies Region who had two wells in his village - in one well the water table was found at about 20 meters and in the other at 65 meters.

In some regions, particularly in Louga and Diourbel, the well digger may hit a "false water table." This is a pocket of water which did not descend all the way to the surface water table. The Volunteer should rely on the well digger's judgment to determine if the surface water table has been reached.

III. CHOOSING A WELL SITE

Although I left the decision for location of the well up to the villagers, I tried to make sure that it was a majority decision. Often the village chief will want the well right behind his compound even though that adds a great distance to what another compound sharing the well must walk. In one case in Louga, a marabout insisted that the well be located behind his compound and the villagers were in apparent agreement. However, once work on the well began, it was extremely difficult to get enough workers to come to the well each day to provide labor.

Often villagers like to build wells right next to existing wells, since the first well had good water. If the existing well is still being used, this is not a wise choice, as drawing from both wells at the same time (and the same aquifer) will cause both wells to run dry more quickly. Two wells in the same village


HEADWALL- Prevents people and animals from falling into the well and provides support when one leans over to draw water. Constructed with bricks and plastered over with mortar. Village women should decide how high the headwall should be since they are the ones usually drawing water.
DRAINAGE APRON
DRAINAGE APRON
-----1 meter-----
GROUND LEVEL
-----1 meter--------
Drainage apron keeps water from building up around head wall. Bags and buckets can be set on the apron and lowered into the well without introducing contaminants.
Well wall (cuvelage) lined with mortar and reinforced with rerod.
Casings (Holes for quicker refill)
Gravel for filtering (Basalt is best)
Capturing Column (Captage)
WATER LEVEL
WATER LEVEL
AQUIFER
AQUIFER (saturated layer below water table)
CUTTING RING

should be at least 100 meters from each other. All wells should be at least 50 meters from a latrine. In areas where there is a shallow water table, contamination from the latrine may filter down into and contaminate the well water if it is any closer.

One should check with the local or national Service Hydraulique to see if there are maps available of your area showing where to find the best water source. Unfortunately, these maps are of little help in finding the depth of the nappe phreatique, which changes from season to season and continues to descend in many regions because of the drought. The maps may help in finding a salt-free area to dig into, but they cover general areas rather than specific villages. If the Volunteer provides transport costs and a small fee, local Service Hydraulique agents can visit the village and help locate a good site for the well.

Village elders are excellent sources to help choose a site as they can often remember where original unlined wells that have since caved in had been dug in the past. Also, well diggers who have dug many wells in the area are good judges of where the best spot would be.

IV. SENSITIZING AND ORGANIZING VILLAGERS

After the first few months in the village, you may decide that a well is needed in the area but not in your own village. You should begin a tour of area villages to see which particular village has the greatest need for a new well. Ideally, you should be accompanied by the President of the Communauté Rurale (or other notable) and a well digger so that you can be introduced and your work can be explained clearly (you may not yet be fluent in your local language).

Once you have decided on one or two villages and receive funding for the wells, you should go back to the village accompanied by the same people and once again go over your responsibilities and those of the villagers. Normally, the funding that you received will pay for the cement and rerod, ropes, tools (the well digger will probably have some of his own), the salary of the well diggers/masons, and the transport of the materials to your village. In my case, the villagers transported the cement and rerod from the Arrondissement to their villages nine to fifteen kilometers away by horsecart, since the truck drivers refused to drive on the soft sand. As a Volunteer, you should also act as technical advisor.

The villagers are responsible for providing laborers for the well diggers (to man the ropes, lift sand from the well, dry the well once water is reached, etc.), providing food and lodging for the well diggers, making a small contribution for extra expenses (i.e., 300 - 500 CFA per household), storing the materials, and, if possible, keeping records on usage of the materials. One of the villagers, usually the chief, is responsible for seeing that the workers are at the well site each day and that things are running smoothly - this should not be your job alone! At your initial village meeting, make sure that these responsibilities are understood and agreed upon.

If the well is in another village, you should make it a point to be at the site at least once a week to see how the work is progressing. Check the records of daily usage and see if it corresponds with the amount of cement remaining. Talk to the well diggers and the villagers about any problems encountered and comment on their work. Once water is reached, you should try to be there every day until the well is finished. This is the most interesting part of the well construction and in everyones mind the most important.

When planning a wells project, make sure that you have taken into consideration all of the following necessary inputs[1]:

Cement, wire, rerod, tools, sand, rope, water, gravel, well digger/mason and his salary, basin for water, barrels, well digger's team, supervisor, food and lodging for mason, storage room, village organizer, transport of materials, village laborers, loading and unloading, secretary/bookkeeper, casing mold (if used), pulley, crossbar, two Y-supports and a brakepost, and hardhats (at least two).

[1]Fleuve Wells Manual, Rick Byess, 1977

V. CEMENT AND REROD

Cement should be mixed with sand at a 1 to 3 ratio to produce the mortar mixture used for the well wall (cuvelage). Although a mortar mixture that is too wet will not be as strong as a dry mixture, it has to be wet enough to throw onto a wall by hand and smoothed over.

When cement is also mixed with gravel, the mixture (called concrete) is stronger than mortar. This mixture should be used to make casings (if a casing mold is available - see Section IX), and the well apron if there is enough gravel on hand.

Cement on its own has good compressive strength but little tensile strength (strength to reduce twisting pressures). For this reason, 6 or 8 mm rerod bars (which have tensile strength but little compressive strength) are used as reinforcement to prevent cracking. Technical manuals recommend a 15 to 20 centimeter rerod grid of vertical and horizontal bars to ensure the most reinforcement, but well diggers accustomed to working on locally funded projects often use much less. The first well diggers I worked with had never used horizontal bars for the well wall, but agreed to do so after much discussion.

All rerod should be completely covered with cement in order to prevent oxidation. Oee possible problem with Peace Corps Senegal's method is that rerod staples inserted between vertical and horizontal rerod intersections in the well wall (see Section IX) extend through the cement into the soil, where they are left exposed. In theory, there is a danger that the rerod will gradually rust away, eventually causing the well wall to collapse. I can only say that the oldest well I've seen constructed in this manner is 79 years old with its walls still intact. In almost all of the existing wells I've checked out, the problems have been with faulty casings and a descending water table rather than serious problems in the well wall.

Perhaps anchoring curbs (described in manuals available at the resource library) could be used as an alternative to staples, but the purpose of this manual, once again, is to discuss existing traditional techniques.

VI. WELL DIAMETER

In Senegal, some Regional Service Hydraulique officials have asserted that all wells should have a finished inside diameter of either 1 meter 80 cm. or 2 meters. (This means a starting outside diameter - before lining - of 2 meters or 2m20 or slightly less.) The reason for this is that well repair equipment owned by Service Hydraulique is designed to be used for wells with these diameters. However, in my communauté rurale, for example, the communauté rurale president's preference is to do a 1m60 well and use the extra cement and rerod to repair other wells. The president told me that S.H. would never come out to the area (9 km on soft sand off of the paved road) and that even if they did their equipment is not made for hand-dug wells. The thin walls would not be able to take the weight of the heavy equipment. When I applied to a funding agent for the financing of a casing mold (see Section X) with diameters for a 1m60 well, the agent said that if Senegal doesn't standardize well diameters throughout the country and has different sized casing molds for different regions, the country cannot have an effective program. I argued that when communauté rurale funds are used (with money coming from taxes), local officials try to get as many projects completed as possible with the materials available. If I had not received the funding, the communauté rurale would still be constructing 1m60 wells, but they would be using traditional casing construction methods.

In "Hand-dug Wells and Their Construction" (Watt and Wood, 1977), the authors say that the smallest practical diameter for two well diggers to dig in is 1.3 meters with one meter being the minimum for one man. The well diggers I worked with in Louga told me that 1.5 m is the smallest diameter they would consider working in, but I have seen smaller diameter wells in the Department of Kedougou, At the national office of Service Hydraulique, an official told me that the decision on well diameter should be made by local officials and the villagers. While Service Hydraulique makes recommendations, they are not mandatory, he said.

The amount of water and output in a well depends not only on well diameter but on permeability of the aquifer. Large-diameter wells are more expensive than small-diameter wells, are not dug as deeply into the aquifer, and are likely to run dry more quickly. The latter two reasons are not problems if one has access to pumps capable of draining the water. But in most cases villagers do all draining by hand using collapsible rubber bags or buckets.

Be sure to check with your communauté rurale president and Sous-Préfet to see if there are any regulations concerning well diameter. If there are none, I recommend a 1m60 diameter. A well digger used to digging a 1m80 well will be pleased at a reduced diameter.

VII. WELL SAFETY

Whenever a Peace Corps Volunteer writes a wells proposal, he should include at least two hardhats, as there will often be two well diggers in the well at the same time. Sometimes rocks or tools left around the well opening are inadvertently kicked into the well. A hardhat can save the well digger's life, or at least prevent possible injury. Confined to a hole less than 2 meters wide, the digger has little room to avoid falling objects and even less if there are two diggers inside the well at the same time. I was once supervising the repair of one well where the digger was 37 meters below without a hardhat. A trowel had been left on the headwall and a child coming to look inside the well accidentally knocked it loose. The trowel landing in the water sounded like an explosion. Fortunately, the well digger had dodged the trowel, but I had work halted until I could get to Dakar to buy a hardhat. The idea that the purchase of a hardhat should be up to the well digger is not valid, since if it is left to him he will probably choose to risk working without one.

Young children who are not helping at the well in any way should be forbidden to approach the well. Children become curious and sometimes play games around the open well during breaks in work, not worrying about the risks. I always stress to parents the importance of keeping their children at a safe distance from the well.

For each new well, three new ropes should be purchased, each one at least 10 meters longer than the estimated depth of the completed well. One rope can be used for all the lowering and raising, and one used exclusively for the lowering of the heavy casings. The third rope should be used as a guard rope. This rope, tied to the crossbar, gives the well digger extra security in case the rope gets away from the villagers while he is being lowered, and gives him more control over where he will land.

Well diggers sometimes don't worry about ropes in poor condition and tend to take their chances. (In many cases, for locally-funded wells, well diggers must purchase ropes out of their own salary; thus, they want the rope to last as long as possible.)

While the well is being worked on, the hole is usually left open, increasing the likelihood of a serious accident. One solution to this problem is to build a one-brick high wall surrounding the well opening. While this does not eliminate things being kicked into the well, it greatly reduces the possibility. Evenings and during breaks, when no one is working on the well, some type of cover (such as logs) should be placed on the well to prevent children or animals from falling into it.

The brake posts and crossbar will take a lot of abuse during the construction of a well, so trust the well digger's judgment if he tells you that they are not large or solid enough. Villagers (who don't go down the well in most cases) are often too easily satisfied. This goes for tools and locally made sacks and bags also. If a well digger has doubts about safety, so should you. Let your well digger and the villagers know this before starting the well. There are horror stories in every region about accidents which could have been avoided.

When the well digger is in the well, he sometimes requests that a tool of object be sent down the well. This is usually put in a bucket and lowered down. Whenever this is done, if there is any possibility at all that the bucket might tip over before reaching the bottom, the material should be secured to the handle with wire (always available at the site). Also, nothing should ever be passed from one person to another over the well opening.

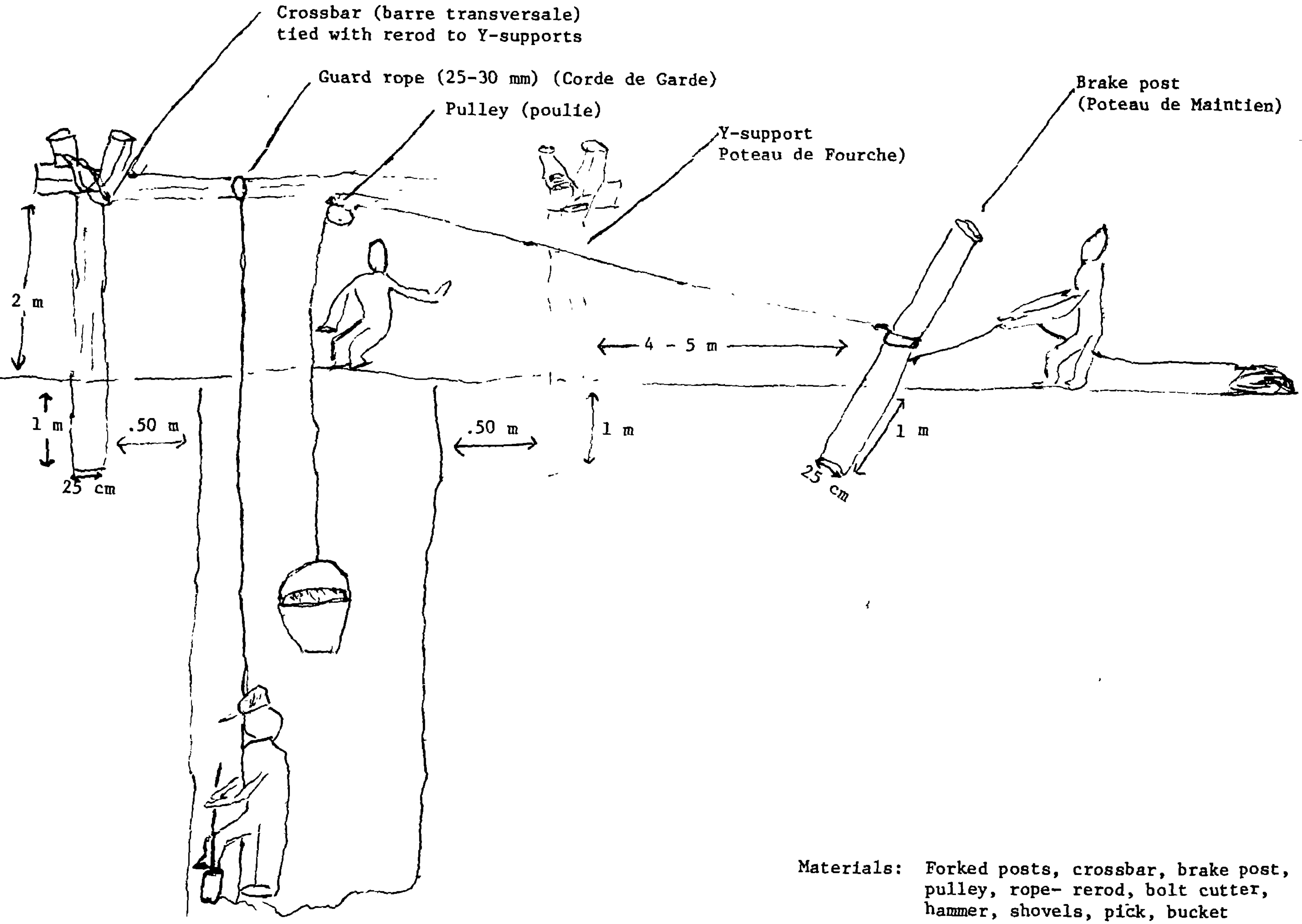
VIII. CHOOSING A WELL DIGGER

If there is a well digger in your area who has worked for another Peace Corps Volunteer and has been recommended by that Volunteer, you would probably be wise to work with him. Although some of the techniques written in this manual might not be familiar to the digger, he has already had a good working relationship with a Volunteer struggling through the local language.

Another way to choose a good well digger is to accompany an area digger to his past projects and talk to the villagers about his performance. If the well looks good and has a lot of water, he would be a good choice.

Often sous-préfets and communauté rurale presidents have their own choices of who should be digging wells in the area, and these choices are not always the best qualified. However, by going against their wishes, you may find yourself working on the project without their much-needed assistance (especially the president's). If you do choose one that they do not agree with, it may be necessary to discuss it with them beforehand and defend your decision. Always keep in mind that when you leave the village, everyone else will remain, and future wells may be constructed by the well digger that you did not choose.

LOWERING AND RAISING WORKERS AND EQUIPMENT
La Main d'Oeuvre, son Equipement, ses Actions



Materials: Forked posts, crossbar, brake post, pulley, rope- rerod, bolt cutter, hammer, shovels, pick, bucket

Once you have chosen a well digger, you should have a long talk with him about the techniques you want to use. It may take a long time for him to understand, but it's worth the effort. If you save something until the last minute you may find yourself arguing in front of the entire village around the well site. Using visual aids such as photographs, the books used as sources for this manual, and your own designs, may make it clearer. Have the well digger explain the methods back to you to be sure he understands.

Having a good working relationship with the well digger is important. The Volunteer must recognize the well digger's abilities and accomplishments, but the well digger must also understand that this is not a locally-funded well and that you as supervisor have the right to introduce new techniques. You should also explain to the villagers before starting that you will be trying new techniques that have proven themselves successful in producing more water in wells. They have probably seen wells constructed in the area which are now dry, and so will tend to trust you and be willing to try something new.

Different Techniques as Opposed to Traditional Techniques

No one can become a well expert after a few weeks of Peace Corps training and some outside reading. The most important first step is to learn as much as you can about traditional well construction methods in your area. Well diggers are proud of their past work and a toubab who has never dug a well does not have the credibility to tell a well digger to change all of his ways. However, the Volunteer can make improvements on the well digger's techniques that can be taught to the digger. Although the digger may be somewhat skeptical at first, he will usually be convinced by the successful results. It can be shown to communauté rurale council members that the new method is not much more expensive than the old one, and that they will save in the end because of fewer wells needing deepening after one or two years.

The method that Peace Corps Volunteers have been using in the Louga and St. Louis regions is to dig one to two meters at a time and then plaster and line by hand.

The advantages of the Peace Corps method over methods used by other technical services are: 1) the cost per meter dug is lower; 2) a minimum of technical expertise is needed; 3) constant surveillance is unnecessary, so a Volunteer can be in charge of a number of wells at the same time; and 4) a minimum of equipment is needed, so that small, remote villages can be easily served.[2]

The following text is from the Peace Corps Handbook:

[2]Fleuve Wells Manual, Rick Byess, 1977

Example of a Well Digger's Contract

Région du
Département de
Arrondissement de

CONTRAT

Projet: Foncage du Puits
Localisation: Village
Financier:

Il est convenu entre M.____________. puisatier a______et______________, Volontaire du Corps de la Paix Americain, ce qui suit:

Le puisatier s'engage a foncer et cuveler un puits au village d'ayant les caracteristiques suivantes: diametre 1.80 metre jusqu'a l'eau; pose de 12 buses; construction de margelle et dalle anti-bourbiere. Le puits aura une hauteur d'eau minimime de 6 metres avec l'aide d'une pompe pour evacuer l'eau ou deux metres sans pompe, et aura une profondeur moyenne de 17 metres environ.

Le puisatier consent à respecter les conditions suivantes:

- Le pusatier ne s'absentira pas du travail 2 jours consecutifs sans la permission du Président du Comité Puits,___________, ou son adjoint.

- En cas d'accident ou de blessure, ni le village d'__________ ni le Volontaire,______________, sera responsable des frais médicaux. Il est recommandé que toutes mesures de securité soient prises par le puisatier.

- S'il arrive que le pusatier ne puisse pas completer le travail qu'il se charge dans ce contrat, il devra se remplacer par un autre puisatier qualifié qui completera le travail selon les conditions ici agrées.

- Le travail sera completé au plus 60 jours après le demarrage.

- Avant chacue paiement, le travail sera inspecté par le Comité et le Volontaire.

- Tous les materiaux fournis au puisatier pour la construction du puits appartiennent au village d'____________et ne seront utilisée que pour les projets collectifs approvés par le Comité, le Volontaire, et le financier.

- S'il arrive que le village d'_________ne fournisse pas au puisatier et son equipe, chaque jour, 5 assistants et 3 repas, selon les conditions requises constatées dans leur accord avec le Fond "Peace Corps Small Projects Assistance," le puisatier aura le droit d'arreter le travail jusqu'a la main d'oeuvre villageoise et l'alimentation suffisante sont fournises.

Fait à___________le 7 avril 1984

Le Volontaire du Corps de la Paix Americain	Le Puisatier	Le Chef de Service Départmental du Développement Social

IX. STEP-BY-STEP CONSTRUCTION OF HAND-DUG WELL (with photos)

SENEGAL: Hand-dug Plastered Well

1) Clear away all loose topsoil and level the area of the proposed well site. Drive a straight piece of rerod into the ground. Attach a piece of string, the length of the desired radius of the well, to the base of the rerod. Tie another piece of rerod to the other end and use this "compass" to draw a circle on the ground.

2) Bend a bar of 6 mm rerod into a circle which conforms to the desired circumference of the well. The circle on the ground will act as your guide. Once the bar conforms to the circle on the ground, bend it around again, so that it is actually doubled, wrap the passes together with tie-wire, and cut off any excess. (One alternative, with the help of a blacksmith, is to bend a 10 mm rerod bar into a circle, and have the ends welded together. This reduces the possibility of the drop-bar warping as it is lowered.

3) Dig along the inside of the drop-bar with a trowel and lightly tap the drop-bar until it is slightly below ground level.

4) Dig one meter and be careful not to displace the drop-bar or excessively dig outward at the wall. After you have dug one meter, you are ready to use the drop-bar. For right-handers, place your left hand lightly on the bar. Hold the trowel sideways under your left forearm. Using the upper back corner of the trowel, work towards your body and scrape away the dirt below the bar. Continue along the circumference, scraping away just enough dirt to allow the bar to drop. Continue until the bar is at the bottom of the hole. If you constantly eyeball the bar and keep it level, the bore of the well will be straight and consistent. Dig a bit with the trowel until the bar is below the floor of the first dig and cover it with sand. Do not smooth the wall.

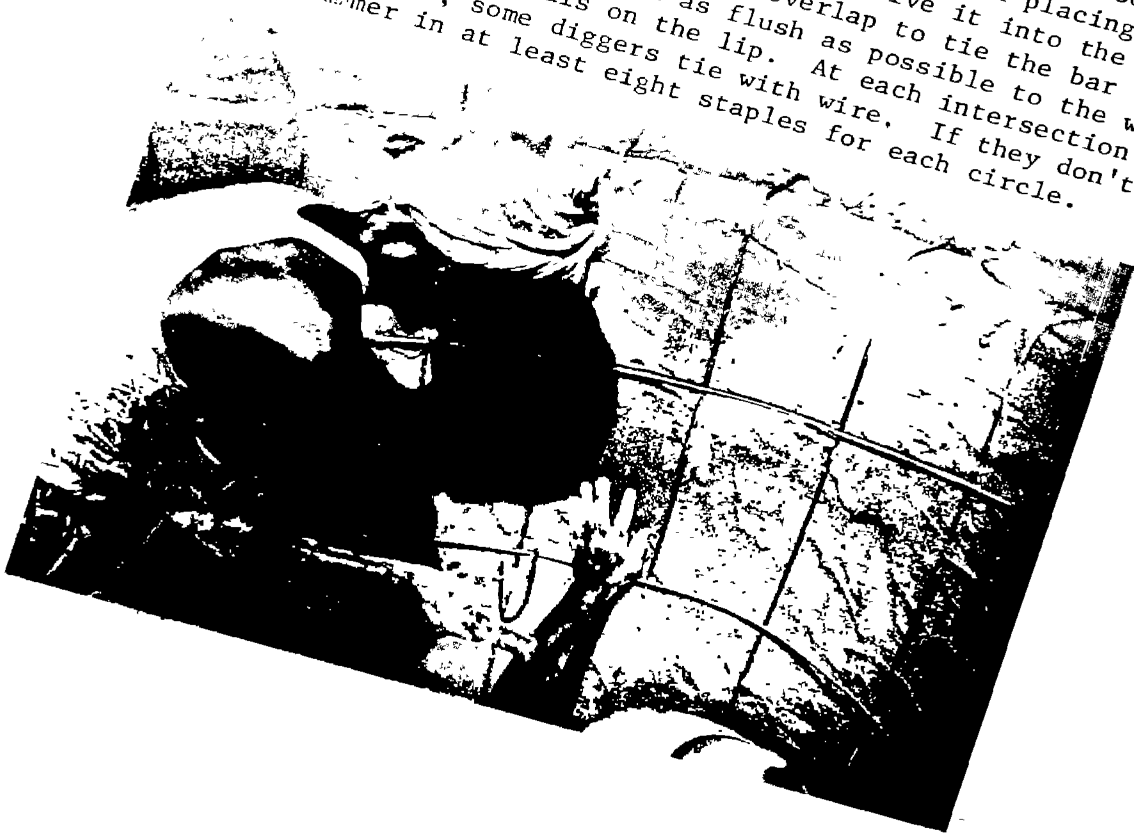
5) Prepare a 4 to 1 water/cement mixture. Mix it well and splash it onto the well wall and the lip of the hole. This mixture helps seal the wall, prevents crumbling into loose sand, and gives the plaster an adhesive receiving surface.

6) Mix a 3 to 1 sand/cement mixture and begin plastering along the bottom of the wall. After the circuit is completed, begin working upward (always work in an upward direction, not side to side), forcing the cement into the gaps left by scraping. Plaster the well lip with a thick application. If a poured-lip concrete is desired, leave this aside until after the first dig is dry, dig along outside the wall, and pour your concrete. The rerod will already be in place if you follow the next step.

7) Cut and bend rerod for the verticals. Allow for the desired width of the well lip (usually 30 cm), the depth of the dig (1 meter or more), and a hook at the lower end (5 - 10 cm).

8) Place the verticals after horizontals (or vice versa) at 20 cm intervals along the wall. A 90 degree bend should be made at 1m so that part of the bar rests on the lip and the rest hangs down the wall. The hooks will make the bar longer than the depth of the dig, so dig a bit and bury the hooks, but make sure they are on the same side of the drop-bar as you are.

9) Cut and bend rerod for the horizontals (circumference plus 30 - 35 cm). Place the horizontals at 70 cm and 90 cm depth. When placing the horizontals bend 15 cm of the excess length outward and drive it into the wall to anchor the bar. The other 15 cm of excess is overlap to tie the bar to itself. At all times, place the iron-work as flush as possible to the wall. Also, place elbows of the verticals on the lip. At each intersection of the verticals and horizontals, some diggers tie with wire. If they don't do this, they should hammer in at least eight staples for each circle.



10) Apply the second coat of plaster but start 15 cm from the bottom of the dig. Smooth and plumb the wall with a trowel or straight edge. Fill in all gaps.

11) Dust the wall with pure dry cement and smooth it into surface with the trowel. This helps harden, smooth, and protect the masonry. Leftover cement should be used to make bricks. These bricks will eventually be used to build the headwall.

12) Knock off for the day.

13) Repeat Step 4. The drop-bar and eyelets should be free if they were buried properly. Tap the bar lightly if it is stuck and lower it in the prescribed manner. Repeat Steps 5 - 12, except for Step 7. Instead of making the elbow as described, cut the bars at 1m long plus enough excess (10 - 15 cm) to make a hook at each end. Attach the hooks to those of the verticals in the course above. Continue with the rest of the iron work as described in Step 7.

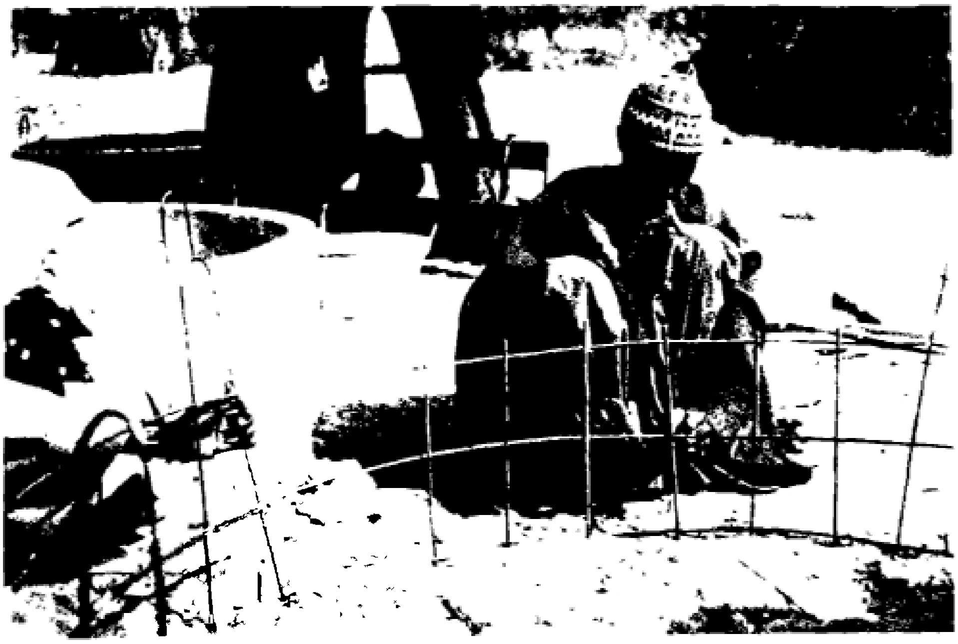
14) Continue in this manner until you find water.

15) Casings (Buses): If you have casing molds, use them. The outside circumference should be two pieces that can be bolted together. The inside should be four pieces which have hinge-eyelets and 10 mm rerod bar which can be slid in and out of the eyelets to connect and disassemble the interior. The angle iron is bent to the circumference of each piece. The exterior portion's angle iron faces outward, the interior's, inward. Holes (6 mm) should be drilled through both sections so that they line up and one can place rerod spacers during pouring to leave filtration holes after the casing is dry. For a 1m80 diameter well, your casing molds should have an outside diameter of 1m60 and an inside diameter of 1m46. They should be 50 centimeters high.

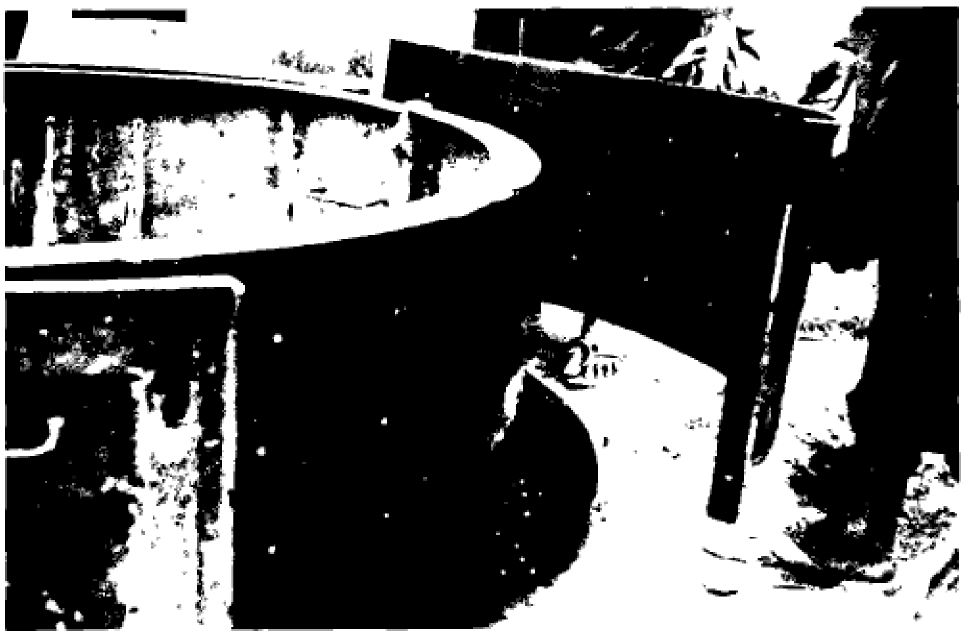
a) Measure 3 horizontal bars at 1m53 to fit between the inside and outside sections of the buse mold. Do this by hammering several 40 centimeter pieces of rerod into a circle in the ground and bending the rerod around it.

b) Cut 45 centimeter pieces of rerod to be used as verticals and tie inside horizontals at 20 centimeter intervals.

c) Horizontals should be spaced at an even distance from each other. Make sure the assembled cage will fit entirely into the buse mold. Bend 4 longer pieces of rerod with hooks at the bottom and tie them onto the outside of the horizontals, evenly spaced. These loops will extend over the top of the buse mold and will later be used to tie the rope around for lowering them into the well.



d) Grease the buse mold with motor oil and assemble.



e) After pouring wet concrete into bottom 5 centimeters of the mold, lower the assembled rerod cage inside.

f) Pour concrete into mold until full. Tamp down the cement with long sticks as it is filling to eliminate air bubbles. Smooth top of buse. Make sure loops are centered.

If you don't have casing molds, use the method currently employed in Senegal as follows:

a. Repeat Steps 1 - 3. Make sure the exterior diameter of the casing is adjusted to clear the interior diameter of the well wall by 10 cm on either side. (Since the wall is usually about 7 cm thick allow 14 cm for both sides, plus 10 cm for clearance, therefore 34 cm.) Thus, your casing drop-bar is 34 cm smaller than the one you used on the well.

b. Dig 50 cm, lower the drop-bar, and remove the bar. Use the same drop-bar for all the casings in each well.

c. Apply the cement/water mixture.

d. Plaster.

e. Cut verticals of 50 cm and place them at 15 cm intervals. Cut 3 horizontals (circumference plus 15 cm overlap) and place them at 10 cm, 25 cm, and 40 cm in depth. The 15 cm is overlap to tie the bar to itself.

f. Apply the second coat of plaster. Make sure the walls are straight all the way to the top with no fall-away. Dust with cement.

g. Poke holes (about 20), sloping downwards from inside at a 45-degree angle, along the wall with a piece of rerod, Ø6.

h. Place 8 rerod staples, in pairs one above the other, at the intersections of the top and bottom horizontals with the verticals at 3, 6, 9 and 12 o'clock. These staples are used to attach the lowering ropes. After the casing has cured and has been dug up, bend the excess part of the staple outside the wall upward.

i. Make five or six casings. (As a rule, you may need more.)

16) The cutting ring can be made without using a mold:

a) Drive a straight piece of rerod into the ground. Attach a piece of string, the length of the desired radius of the outside diameter of the cutting ring (5 centimeters less than the well diameter), to the base of the piece of rerod. Tie another piece of rerod to the other end of the string and use this "compass" to draw a circle on the ground. Do the same with a different piece of string to mark out the inside diameter of the cutting ring. The total thickness of the cutting ring should be 5 centimeters greater than that of the buses.

b) Using a wooden model as your guide, trace out the correct shape in the hole after you have dug it out roughly to size.

c) Cut and bend rerod verticals (about 24) in the same shape as the wooden model but slightly smaller. This can be done by hammering four pieces of rerod into the ground in the required shape and then bending the rerod around it. Another way is to mark the location of each bend on the rerod and bend it using a hollow metal bar (ex.: a bed leg) as shown in the photo.

d) Assemble rerod cage. There should be about a 20 centimeter difference between each vertical. Three horizontals should be placed inside the latter and tied in with rerod, like this: 

e) Line the mold with a weak cement/water mixture (1 to 5).

... the hole with your concrete mixture and then ... rerod cage. Pour in the concrete mixture and tamp
consolidate and remove the air bubbles.

2) Finish and let cure for one week before digging out,

17) Lower the cutting ring and buses into the well. Try to line up all the loops on the casings, tie them with rerod, bend them flush to the casing wall, and plaster over them. Also, plaster between casings. (See 26a)

18) Dig until the top of the uppermost casing is 30 cm above the lowest extent of the well wall.

19) Fill in the area behind the casing with gravel.

20) Lay bricks for the guard wall.

21) Plaster over the headwall with a mortar mixture.

22) Smile, you're finished.

<u>Material Estimates</u>:

	Bars 6 mm rerod (1 bar of 12 m)	Sacks of cement (50 kg per sack)	Depth
Inside diameter - 1m80	6 total	2.5 - 3	1 m
	25-30 vertical rods ea. 1.20 4-5 horizontal rods/linear m ea. 6.20 m 20 staples per meter ea. .20 m		
Casing - 1m60	3.9 total 33 vertical rods ea. 50 cm length 3 horizontal casings ea. 5.20 cm 8 staples ea. .60 cm	2	50 cm

Sand — 1/4 cubic meter per meter depth

Gravel — 4 cubic meters (preferably basalt) is enough for the entire well, as it is only needed in the capturing column (see Diagram 30A).

Prices change from region to region and are usually higher outside of Dakar. The following figures (taken in September 1984) are from Dakar Materiaux on Lamine Gueye which transports to all regions.

For 10 meters of digging:

30 sacks of cement	44.275 CFA
60 bars of rerod 6	42.000
2.5 cubic meters of sand (if not available in village)	2.500
4 cubic meters of gravel (enough for entire well)	34.000
	122.775 CFA
Transport	

When estimating cost, don't forget to add in all the other inputs (see Sensitizing/Organization, Section IV). Also add on the materials needed for casings.

The Ziguinchor, Kolda, and Tambacounda regions tend to have soil consisting of hard clay and laterite. In these regions, I have seen unlined wells with no casings inside. Instead of cement headwalls, there are often logs placed around the well opening. Women drawing water from the well sometimes stand on top of these logs to draw water. Contaminants are introduced into the well through the bottoms of the women's feet, and from bags laid to rest on the muddy surface surrounding the apronless well and then lowered into the well to draw water.

One solution used by Peace Corps Volunteers is to build a 30 cm high headwall (normally it is 75 - 90 cm high) and then put logs on top. Since pulleys are not used, the top of a cement headwall causes ropes to be worn away quickly when they are lowered and raised. Having logs on top of the wall avoids this problem. Both the headwall and ropes will last much longer. In addition, women will stand around the headwall since it is no longer possible to stand on top, thus reducing the number of contaminants introduced into the well. I have also seen tires used as headwalls, a technique which would be just as effective in improving the well.

In these regions in particular, I have seen very few well aprons, and it would be a good idea for a Peace Corps Volunteer to look for funding for one or two of these to show the villagers the advantage in having a relatively dry cement drainage apron as opposed to a muddy, slippery surrounding. It only costs a few sacks of cement and the mason's salary.

Inside the wells in these regions, even though the soil texture is hard, the well will eventually fill in at the bottom unless there are casings inside. Each casing only costs a couple sacks of cement and a few bars of rerod and it can save the villagers the trouble of going inside the well every year to dig it out. Even without casing molds, traditional casings can be used.

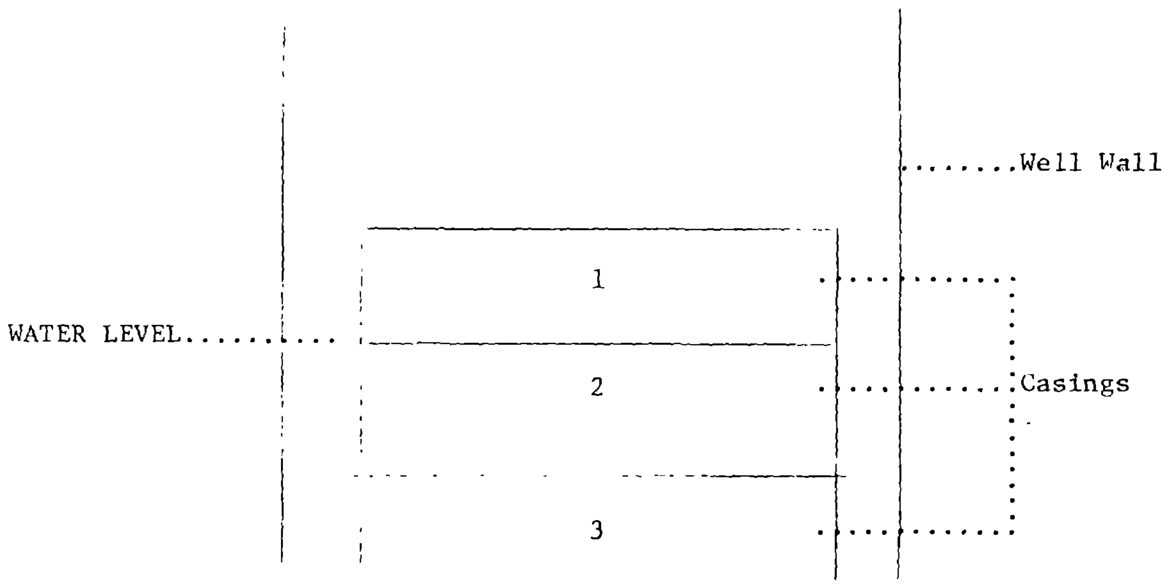
It should be noted that if a cement headwall is used in these three regions, at least the top meter of the well should be lined to prevent erosion around the well opening and the possible collapse of the headwall. At the bottom of that first meter, an indentation 5 cm deep should be dug all around the wall, and then filled in with mortar, creating what is called an anchoring curb that will prevent the top section from falling in. As noted earlier, staples can be used to provide additional support.

In solid rock, casings are not needed. A well should be lined only until the rock layer is reached.

X. MORE ON CASINGS (BUSES) AND CUTTING RINGS

As explained in the step-by-step description, traditional casings are constructed by digging a one-half meter hole, lining the hole, setting the rerod in place, and plastering on the second coating. A mortar mixture (cement, sand and water) is used rather than a concrete one (cement, gravel, sand and water) since the latter cannot be plastered against a wall easily by hand. In some instances, the well digger is accustomed to using only one continuing spiral piece of rerod without putting in vertical bars, making the casings even weaker.

This traditional method of well digging in Senegal calls for lowering three to four casings with walls 3 to 7 centimeters thick into the well one at a time once water is reached. The well digger then digs into the aquifer (water-bearing layer) while lowering the casings as far as he can. Usually one meter of water can be attained before there is too much water or hard clay to continue digging. The well is then considered finished. Thus, the inside of the well looks like this:



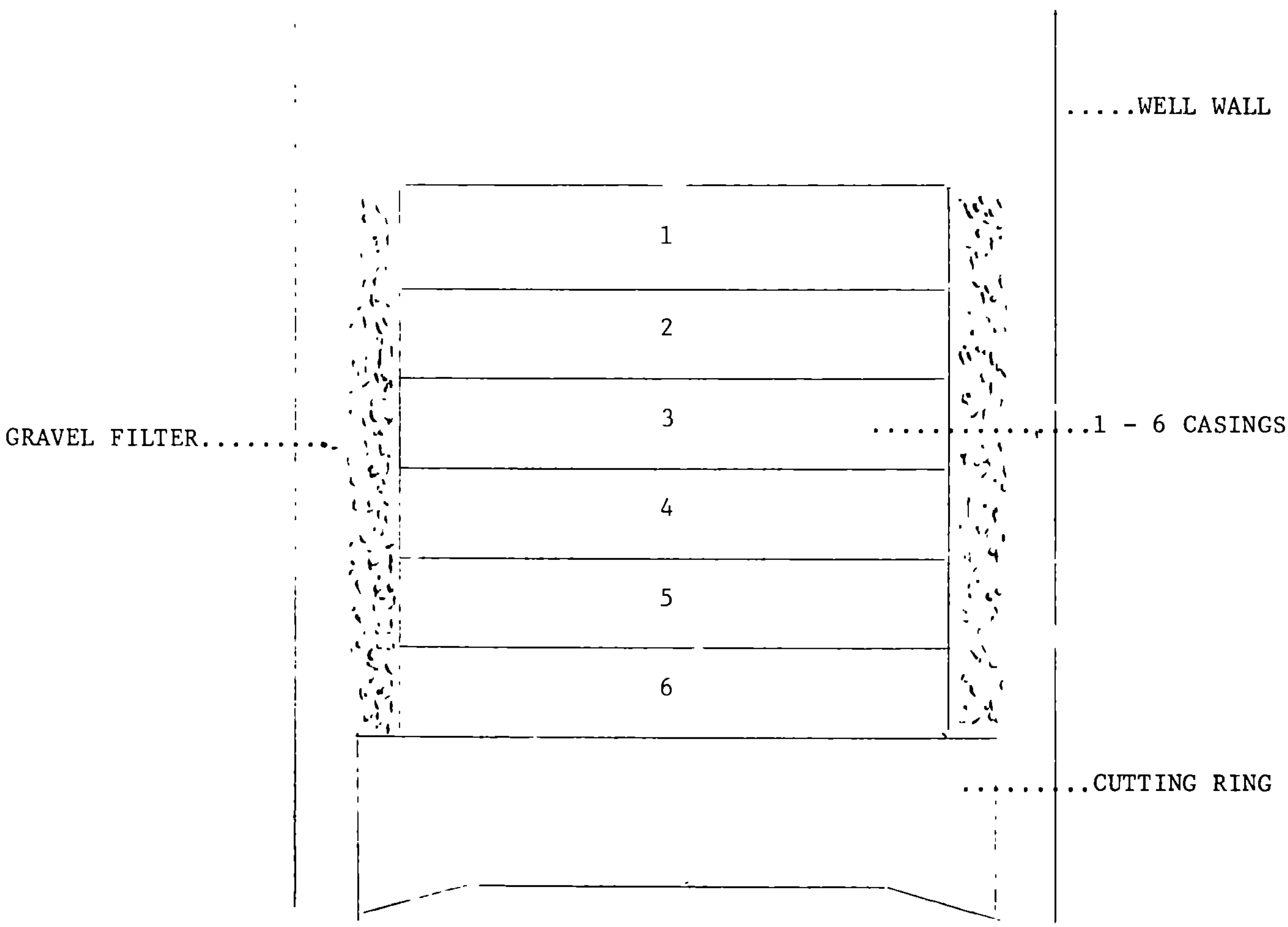
Although there are holes in the sides of these casings, there is no gravel between the casing and the well wall; thus, sand rushes into the water. Even if gravel is used, it will not sink into the sand as the heavy casings will, but will be halted by the sand.

Using a metal casing mold, symmetrical concrete casings with walls 10 centimeters thick can be made which are much stronger and heavier than traditional casings. Each casing will be the exact same size and will sit perfectly on top of another casing.

Five or more of these casings are to be lowered into the well. With each casing having a height of 50 centimeters, two meters of water should be reached with one casing above the water for insurance in case the water level rises.

Before lowering the casings, a cutting ring must be constructed which will go into the well first. The bottom of the cutting ring has a sharp edge, allowing it to penetrate the well bottom more easily. By lowering the five casings on top of the cutting ring, the tremendous weight of the entire group causes the casings to sink as the well digger digs. With the villagers constantly drawing water, the well digger can reach two meters of water or more before stopping.

In addition, the cutting ring has an extra feature that allows the gravel (between the well wall and the casing) to sink as the casings sink. The cutting ring is 10 centimeters wider than the casing all the way around. This creates a shelf for the gravel to rest upon, so that when the casings sink the gravel will remain on the shelf and not get trapped in the sand. The result is cleaner water.



LOWERING CUTTING RING AND CASINGS (BUSES)

To lower the cutting ring and casings into the well:

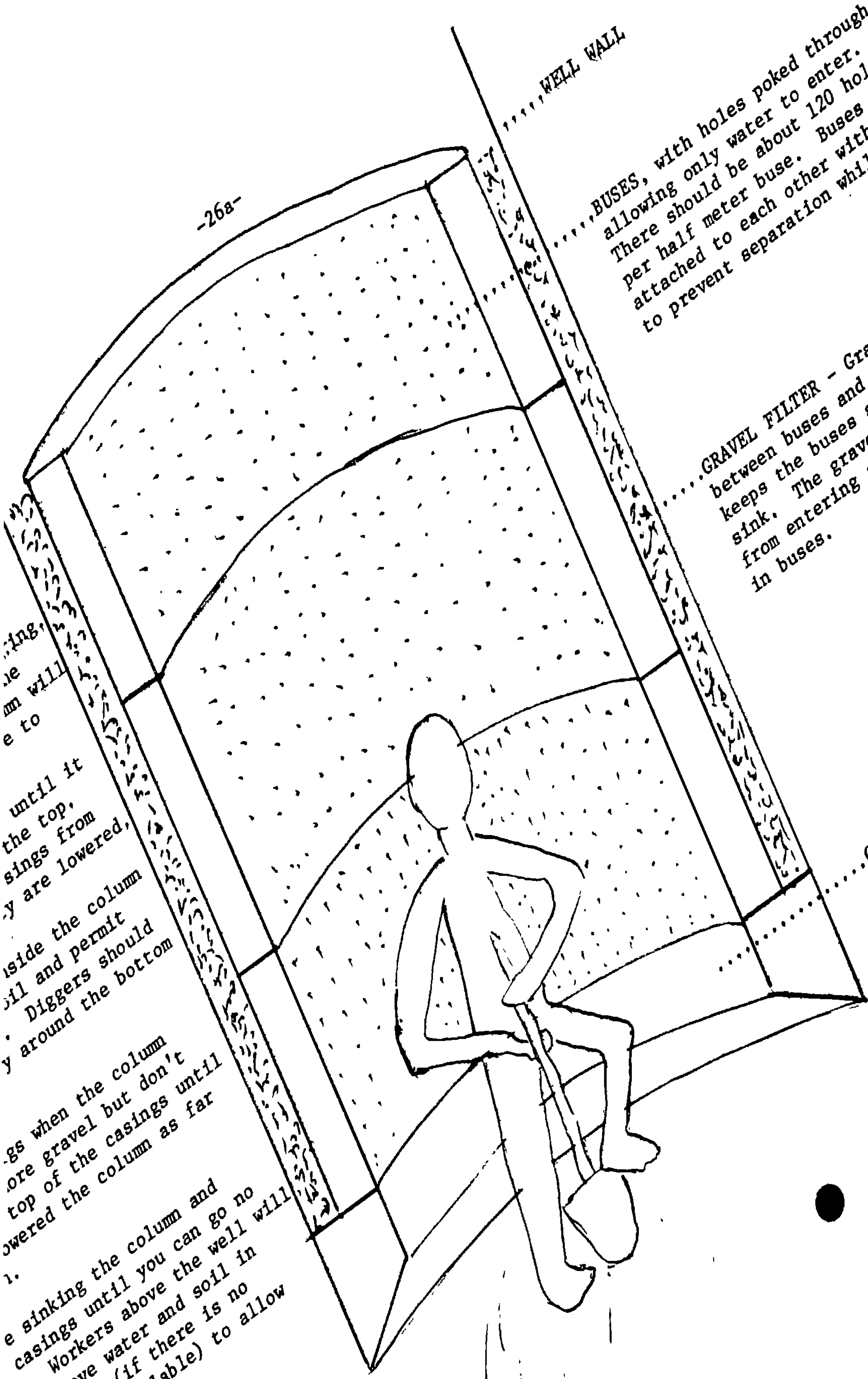
Sections of rope should be put underneath one casing at a time (beginning with the cutting ring). The casing is lifted over the well by several villagers. Before doing this, two horizontal pieces of rerod should each be inserted through two loops of rerod extending out of the casing.

The rope used to lower the casing should be securely tied around the intersection of these two pieces of rerod.

Once the villagers have lifted the cutting ring over the well, the digger should be in position behind the brakepost, having twice looped his end of the rop around the brakepost with the rest of the rope behind him untangled (see illustration 10A). He then gives the order for the villagers to pull the ropes out of the well one at a time until he has complete control. Everyone should then stand behind the well digger, who lowers the ring slowly. Once the cutting ring hits bottom, the well digger must go into the well and center the ring by asking the villagers to lift it slowly. This step is repeated until the cutting ring and all casings (preferably at least five) are in the well.

The four loops above each casing should be hammered down towards the inside of the casing before the next casing is lowered. These loops should all be lined up so that, at the end, one long piece of rerod can be put through each row of loops (four total), and bent down as flush as possible to the wall of the casing.

In the end, mortar is thrown over all exposed rerod to prevent rust. Mortar is also used to plaster between each casing. This should be left for at least one da and then the sinking of the capturing column (attached buses and cutting ring)shou begin by digging out the sand at the base of the cutting ring. (See illustration 30A.)



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-y are lowered,

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-gs when the column
-ore gravel but don't
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-owered the column as far
-.

e sinking the column and
casings until you can go no
-er. Workers above the well will
to remove water and soil in
-gs and sacks (if there is no
-rainage pump available) to allow
the digger to continue.

XI. TROUBLE SHOOTING - REPAIRING EXISTING WELLS

When a village requests a well, your first question should be whether there are any other wells in the village. Often the answer is "Yes, but there's not much water in them." In many cases, deepening an existing well can be just as valuable as digging a whole new well, and only a fraction of the cost. You should accompany the well digger to the existing well and descend into the well with him to determine the problem. (Entering the well is not mandatory for you, as you can wait for the well digger to come out and explain. The explanation will make a lot more sense to you, however, if you can see what he's talking about.)

Once inside the well, you may notice that the well wall (cuvelage) is still in good shape but that the casings below are cracked or broken, allowing sand to seep in and reduce the amount of water available to the village. This problem can be resolved by having diggers construct new casings (petite buses) to put into the well, inside of the existing casings (the new ones being constructed at a slightly smaller diameter). The casings are then sunk as deeply as possible into the aquifer as the digger digs out sand and clay. The villagers above are responsible for pulling water out of the well to allow for digging.

If a smaller diameter casing mold is available, it should be used. As explained in Section X, using the cutting ring, molded casings, and a gravel filter should result in a cleaner, more plentiful water supply.

If the casings in the well are in good condition, and the lack of water is due to the descending water table, new casings of the same diameter can be constructed and placed on top of the existing ones. The digger once again digs out as much sand and clay as possible as the casings are lowered.

As mentioned earlier, a rock well does not require casings. If a rock well runs dry, the well digger can deepen it using traditional techniques - usually a hammer and chisel. If the Volunteer can borrow a jackhammer, this may help, but it cannot be used underwater.

If the well digger and you have decided that repairing the well is either impossible or too dangerous, a new well would be justified. An example of a well that is dangerous to repair is one that was dug into a sandy aquifer and later dried up. Some of the sand which had originally been behind the casings may have since filtered into the well, leaving a cavity behind the casings. If these casings are sunk, the cavity may become larger until the entire well wall collapses

Another example is a well that has hit quicksand. Although a repair may be possible, I have worked with well diggers trying to repair one but eventually had to give up after achieving only 30 centimeters of water.

One way of "repairing" a well and improving sanitation, (often neglected in regions such as Ziguichor, Kolda and Tambacounda) is the addition of a head-wall above the well and a drainage apron around this wall. Without the apron, contaminants are often introduced into the well by bags and ropes which are allowed to lie in the mud and then are lowered into the well. The drainage apron provides a platform for water run-off, leaving a clean surface upon which to set bags. Ideally, this apron should be swept off from time to time. The headwall also prevents people and animals from falling into the well.

In the Thies region, I have seen wells over ten meters deep where the women draw water without the use of a pulley. The Volunteer might try to purchase a pulley and show the women how much it eases the workload. This would mean, of course, that a crossbar and two Y-supports would have to be set up. (See Diagram 1A.)

XII. <u>OTHER WATER SOURCES IN RURAL SENEGAL</u>

In addition to hand-dug wells there are other sources of water found in villages. A "forage" (small-bore well) is a well drilled with special equipment descending into the Maestrichtien table (usually 300 or more meters below the phreatic table which hand-dug wells reach). A manual pump or windmill is often placed above the forage, usually with poor results due to breakdowns and lack of spare parts. Many forages are drilled and left unequipped - villagers never receive an instrument with which to pump out the water.

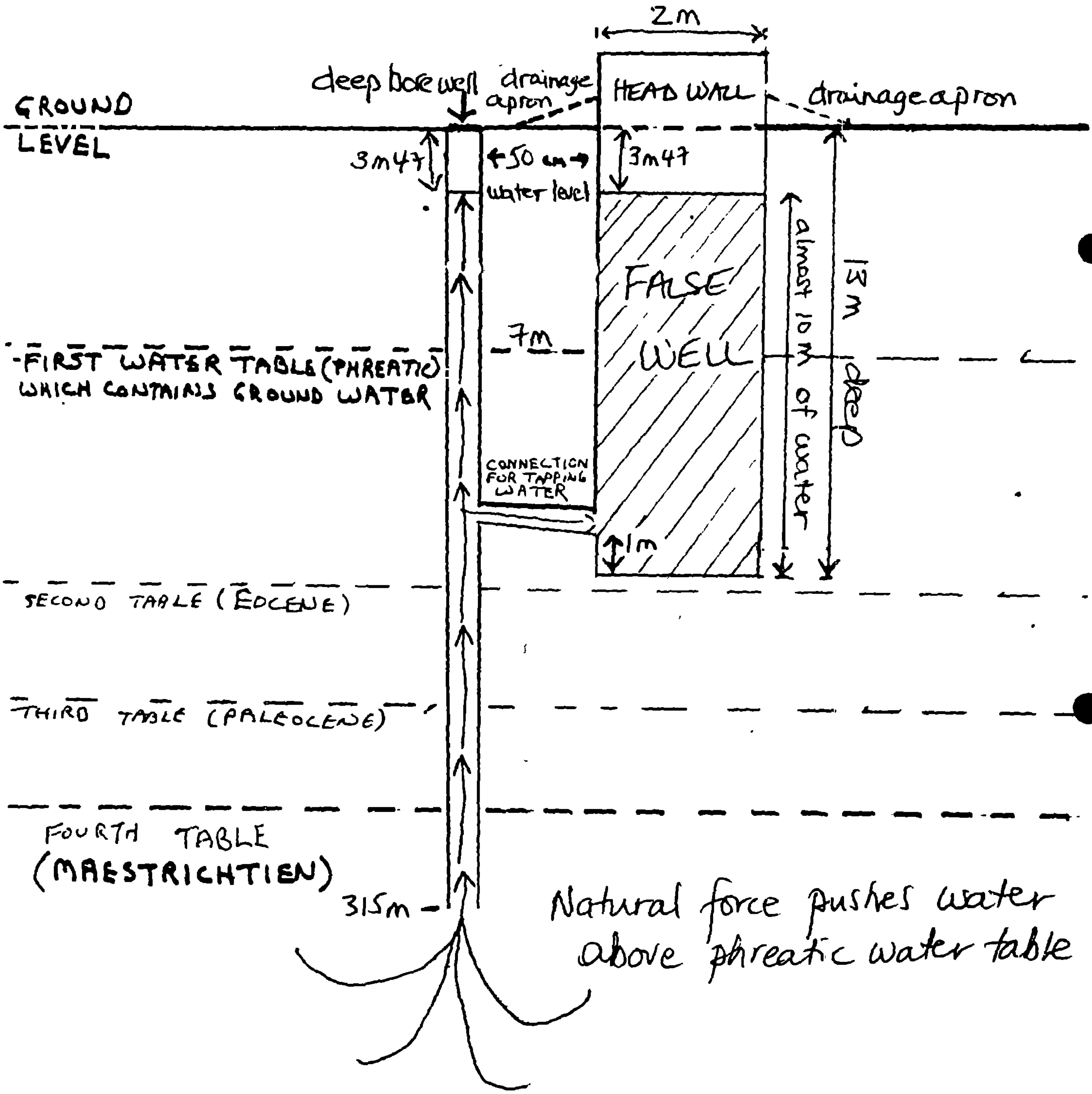
One way of exploiting water in this forage without adding a pump is to construct a "faux puits" (false well). This well is constructed less than a meter from the forage and connected to it by a pipe. If the phreatic table is found at 7 meters, for example, the artesian effect resulting from penetration of the fourth table pushes water above the phreatic table to 3m47. By digging the "faux puits" six meters below the phreatic table and then sealing the well, the well is assured a constant supply of over nine meters of water (see diagram).

The "faux puits" that I saw constructed was done by Bati-Sahel in Dakar, but other organizations such as Intrafor-Cofor and SONAFOR are also involved in this type of construction. If your village has a sealed forage, this might be an excellent project for you.

Senegal has received windmills from both Italy and Argentina and is testing ones made using local materials, but these are still at an experimental stage.

Villagers along the Senegal River or the Lac de Guiers often choose to drink water directly from these sources rather than construct a well. This is a more serious problem in the case of the lake, whose water is stagnant. Those villages surrounding the lake should all have at least one well to provide drinking water.

FALSE WELL (FAUX PUITS)



In some villages, stagnant pools form during the rainy season and if there is no alternative, villagers will drink water from these pools. In one village in the Tambacounda region I observed women walking into a pool like this, filling their pans, and walking out. A hand-dug well is now being constructed in this village, and should create a much more sanitary water supply. These pools run dry after the rainy season and a constant source of water is obviously needed. (In the only existing well in the village, two horses had fallen into the well and contaminated the water. The low headwall was the cause of this accident.)

XIII. SERVICES IN SENEGAL

The following is a summary of water services in Senegal that I have visited, and the services they may provide.

DAKAR

Direction de l'Hydraulique Urbaine et Rurale, Hann
Rte de Père Mariste
B.P. 2041

Telephone: 21-42-79/22-57-76

I spoke to Monsieur Diamé Dieng, Coordination de Brigade de Puits. He said that a Volunteer wishing to borrow equipment from the service must first address a request to Service National, which will make the request to his or her regional Brigade de Puits. Although this brigade has its own program, it is under-utilized, according to Dieng, and the brigade is there to provide services to all who ask.

Other services that Direction de l'Hydraulique can provide are:

1) Advice on well construction.
2) Cost estimates (devis estimatif) for materials and a current salary scale for diggers.
3) Intervention on behalf of the Volunteer with local Brigade de Puits.

Approximately 40,000 CFA per meter will pay for bringing materials, running equipment, diesel fuel, and freight. The well digger must first dig until he hits water. Machines will then lower casings, drain the water, and dig. This will assure six meters of water in the well, according to Dieng. I have included a pricing scale in this manual.

There is a national program for the construction of wells and forages in rural Senegal and only the Service National can provide complete details on it. Service de l'Hydraulique Regional may have a list of proposed wells and forage construction, but it may not be up to date, according to Dieng. A Volunteer wanting to know if his village is on the list would therefore be safer checking with the Direction in Dakar.

Before Service de l'Hydraulique decides on a program in a region, it checks the results of a feasibility study done by the Bureau d'Etudes. The bureau takes into consideration social factors (marabouts' influence, politics) and water output. Each village inhabitant should have 40 liters of water per day for all his needs. The bureau puts villages into four categories based on population: a) less than 500; b) between 500 and 1000; c) between 1000 and 2000; and d) between 2000 and 5000.

Direction de l'Hydraulique has documentation for each region showing the depth of the Maestrichtien table. Maps showing the "Nappe Phreatique," which Volunteers are more interested in, are not valid, as they are not precise and the water table is liable to drop or rise during different seasons.

The Bureau d'Inventaire des Resources, Division Hydrologie, can give more complete information on water tables if desired, according to Dieng.

<u>THIES</u>

Service de l'Hydraulique Regional

I spoke to Chef de Brigade, Malick Sy. He said that the service can lend its jackhammer and compressor to Volunteers, but that requests should be made seven to ten days early. Often the equipment is being used for their own program and thus it cannot be made available immediately to Volunteers. If the Volunteer does borrow the equipment, he (or the villagers) must pay costs for transporting equipment, diesel fuel to run the equipment, and the salary for the skilled laborers. The cost of the latter depends on rock type. Although the official payscale may be expensive, the Volunteer can bargain with them for a lower rate. There are four men in the team - one chief and three workers. (If villagers provide labor only one paid worker is needed.) Villagers must also provide food and lodging for the group.

When I spoke to Monsieur Sy, he said that Hydraulique's pump for draining water was broken but that, when working, it can pump out 40 cubic meters of water per hour (40,000 litres).

With special authorization from Dakar Direction, dynamite can be used for digging through rock.

The maps showing water tables are 20 years old and no longer valid, according to Monsieur Sy. "Map makers use averages anyway. If one well is 40 meters, one 30 and the other 50, the average, 40, is written down," he said.

Monsieur Sy said that although the Conseil Rural can choose well diameters for their local projects, he recommends a two-meter diameter for the following reasons: a) more workers can fit inside the well at the same time;

b) wider wells are cooler; and c) Hydraulique's equipment is made for wider wells.

A village requesting an inspection of the work on their well must pay indemnities to the Chef de Brigade.

Thirty windmills from Argentina were mounted in the region. The villages were chosen because they had wells containing a lot of water. Senegalese teams were sent around the regions to set them up. Dakar should have all the spare parts, according to Sy. If the well in your village has a lot of water, you can write a letter requesting a windmill to "Monsieur le Chef de la Subdivision de l'Hydraulique Rurale" in Thies with copies going to the Sous-Préfet, Préfet, and the Gouverneur. The letter should be passed on to the Sous-Préfet, who will forward it for you.

THIES

Maison Familiale

I spoke to Famara Diedhou, Director, and Cheikh Drahmé Tidiane, Chef de Service Technique. They told me that although they have a pump and compressor they are willing to loan to Volunteers, both have been broken for a long time. Financial problems prevent a quick repair. If repaired, the terms for the loan are the same as those of Service de l'Hydraulique - the Volunteer must pay for transport and diesel fuel, and must agree to repair the equipment if he or she breaks it.

The Maison Familiale has a one-meter high casing mold they can lend out but a winch is also needed to lower it. This would require a large truck to transport the equipment to the village.

In 1982, the Maison Familiale placed three small windmills made out of local materials on wells in the region. Only one is still working, since there is a lot of water in the well. The project was originally financed by a French organization, DELLO, but is now run by the Maison Familiale. With more funds, they hope to continue experimenting.

CARITAS THIES

I spoke to Etiènne Dione, Permanent Diocesain de Caritas. As of September, 1984, Caritas had a compressor and pump with a Bernard motor in their possession. They have a program to do eleven repairs and seven new wells, after which they will return the materials to the Direction in Dakar. Volunteers needing these materials can request them at Caritas Thies, which can help get the materials from Dakar, according to Dione.

Caritas Thies owns a jackhammer which can also be loaned to Volunteers.

Caritas has worked with an Italian organization in installing windmills on wells. The organization told Caritas that if they knew of wells with over three meters of water, the villages would be put on the list. Volunteers in Thies having wells with this much water should advise Caritas Thies.

THIES
L'Ecole National du Genie Sanitaire, Khombeul

I didn't visit this school, but was told in Thies that it trains technicians to disinfect water. There is a laboratory in Khombeul that can check water samples. The technicians are involved in a program including 186 villages only in the Arrondissement of Thienaba (26 kilometers from Thies). The school is open between October and August. Technicians have vehicles to go to villages, but villagers must pay for 10 liters of gas. This school might be worth looking into for someone in this arrondissement.

~~LOUGA~~
SOM H - Sub-Division d'Outillage Mécanique de l'Hydraulique

I spoke to Moussa Faty, Chef de Sub-Division. He said that SOM H is concerned with all forages in rural Senegal, not just in the Louga Region. Subsections of SOM H are located in Louga, Linguere, Ndioum, Matam, Tambacounda, and Kaolack. The sub-section in Louga takes care of Louga, Thies and Diourbel.

The service installs pumps and provides maintenance. They also construct basins and provide advice on forages and equipment.

Anyone requesting a forage for his or her village should go to the Direction de l'Hydraulique Rurale et Urbaine,

LOUGA
Service de l'Hydraulique Regional

I spoke to Mamadou Seck, Chef de la Brigade de Puits, and Babacar Sarr, Chef de Bureau Regional Hydraulique Urbaine et Assainissement. They said that at the moment the wells program in Louga is such that they cannot lend out their jackhammer to Volunteers. In the future such a loan is possible, as in the past the service has lent the machine to local communautés rurales. They have no drainage pump.

Maps of water tables are from 1982, showing Louga, St. Louis, and a little of Diourbel. The service also has maps showing the water's salt content. In all cases, the maps are not precise, as they do not show individual villages.

The two men told me that a Volunteer who has found financing for a well should always advise Service de l'Hydraulique.

Windmills donated from Argentina will all be repaired, but Monsieur Seck told me that he thought they were too weak for the windy region of Louga.

The service can recommend well diggers.

The two men said that if a Volunteer wants more precise maps, he or she should go to SONED (Société Nationale des Etudes de Développement) in Dakar.

They said that the Institute Universitaire de Technologie, in Dakar, is working on building windmills out of locally available parts.

They said that Centre Experimental de Recherches et d'Etudes pour l'Equipement (CEREEQ) does tests on water and soil. It is located on Rte du Sce Geographique, B.P. 189.

I did not visit any of the above places.

ST. LOUIS

Service de l'Hydraulique Regional

I spoke to Adama Faye, Chef de Sub-Division Hydraulique Urbaine et Rurale. He told me he was most concerned with urban areas but that there was a Brigade de Puits located in Ndioum (which handles Dagana and Podor) and one in Matam.

He said that the Brigades de Puits have a specific program but that a Volunteer could contact them for assistance. The Brigades have all the equipment needed, according to Faye. If the Volunteer's village is located near a village in the program, and if the villagers agree to pay transport costs and diesel fuel, the Brigade may be able to help. Before the Volunteer goes to the Brigade, he should tell Service de l'Hydraulique, which may be able to facilitate things.

Service de l'Hydraulique in St. Louis has no equipment to dig forages, as this is all handled by SONAFOR.

The maps showing water tables are from 1965.

The Brigade de Puits can recommend well diggers.

CARITAS ST. LOUIS

This organization has no well equipment but can do windmill mechanics training

Example of Regional Wells Program

0 0 64

République du Sénégal

Ministère de l'Hydraulique

Service Régional de l'Hydraulique
de l'Equipement Rural et de
l'Assainissement

L O U G A

REF : Marché N° C/31/FM
Projet KFW N°79-65-379

PROCES - VERBAL

Implantation de 7 forages-puits et de 8 puits.

L'An Mil Neuf Cent Quatre Vingt Deux et le mardi et Mercredi 11 et 12 Mai, une commission composée de :

MM. Habib NDIAYE	Chef de Service Régional de l'Hydraulique de l'Equipement Rural et de l'Assainissement
- Babacar SARR	Chef de la Subdivision de l'Assainissement
- MARCHAL	Bureau d'Etude DIWI

s'est rendue dans les localités consignées dans le tableau suivant en vue de l'implantation des ouvrages prévus dans le cadre du projet sus-référencié.

L O U G A

1	Kébé N'Deuth	1 puits
2	N'Dame Khalil	1 puits
3	N'Gagnakh Dieng	1 puits
4	N'Logal Dieng	1 puits
5	N'Diakhaté NDiaye	1 forage puits
6	Kanène	1 forage puits 4 puits en transformation
7	Diougène	1 puits

8	Déhalé Dégouma	1 puits
9	Thilmakha	1 forage puits
10	Kabdou	1 forage puits
11	Médina Ka Tidiane	1 forage puits
12	Thioune Khouma	1 forage puits
13	N'Gol	1 puits
14	Loro	1 forage puits en variante
15	Sine Guèye	1 puits

Les autorités locales, Gouverneur, Préfets, Sous-Préfets et Présidents de Communautés Rurales ont été informées associées à cette opération.

La Commission n'a rencontré aucune difficulté majeur dans l'exécution de cette opération.

Fait à Louga, les jour, mois et an que dessus

M. NDIAYE   B. SARR   MARCHAL

NB : Sur Avis de la Commission d'Implantation, le village de Kébé NDeuth qui dispose déjà d'un Forage avec adduction d'eau, a été remplacé par celui de NBaron qui ne dispose d'aucun point d'eau viable.

REPUBLIQUE DU SENEGAL

MINISTERE DE L'HYDRAULIQUE

DIRECTION DE L'HYDRAULIQUE
URBAINE ET RURALE

BAREME DE FONCAGE DES PUITS

Fonçage + ferraillage + cuvelage

Pour compter de juillet 1982 (en francs CFA)

COUT DES TRAVAUX AU METRE LINEAIRE

A. HORS D'EAU

Profondeur en mètres	1ère Catégorie terrains tendres		2e Catégorie terrains durs	
	Groupe I sans M. Mécanique	Groupe II avec moyen mécanique	Groupe I sans moyen mécanique	Groupe II avec moyen mécanique
0 à 10	7 000	6 000	10 000	9 000
10 à 20	8 000	7 000	12 000	11 000
20 à 30	11 000	10 000	15 000	14 000
30 à 40	13 000	12 000	17 000	16 000
40 à 50	15 000	14 000	20 000	19 000
50 à 60	18 000	17 000	22 000	21 000
60 à 70	23 000	22 000	25 000	24 000
70 à 80	25 000	24 000	27 000	26 000

B. DANS L'EAU

Profondeur en mètres	1ére Catégorie Terrains tendres Groupe I sans moyens mécanique	Groupe II avec moyen mécanique	2e Catégorie Terrains durs Groupe I sans moyen mécanique	Groupe II avec moyen mécan.
0 à 40	15 000	Forfait = 40 000	19 000	15 000
au delà de 40 m	25 000		29 000	20 000
		Pour équipe mise en eau pour : -assurer mise en place des buses. - assurer verticalité colonne de captage. - mise en place massif filtrant.		

REPUBLIQUE DU SENEGAL

MINISTERE DE L'HYDRAULIQUE

DIRECTION DE L'HYDRAULIQUE URBAINE ET RURALE

BAREME DE CONSTRUCTION D'EQUIPEMENTS DE PUITS

N° Référence	Désignation des travaux	Unité	P. Unitaire en (F.CFA)	Observations
1	- Installation et approvisionnement du chantier	Forfait (F)	15.000	
2	- Construction de dalle d'ancrage	Unité (U)	7.500	
3	- Construction de rouets d'ancrage	U	10.000	
4	- Construction de buses filtrantes	U	4.200	
5	- Mise en place des buses filtrantes, gravier, filtre	U	1.500	
6	- Construction et pose d'une trousse coupante	U	1.000	
7	- Construction et pose de la dalle de fond avec mise en place du massif filtrant	F	2.500	
8	- Construction de dalle anti-bourlier	U	7.500	
9	- Construction de la margelle	U	15.000	
10	- Pose du dispositif d'exhaure (l'unité)	U	3.000	
11	- Développement et essai de débit (l'unité)	U	18.000	
12	- Prime pour 7e mètre d'eau captée stabilisée	U	25.000	

Composition et classification des équipes

Equipe maçon

- 1 Maçon : code 0819 - 5e C.
- 1 Aide Maçon : Code 0815 3e C.
- 2 Manoeuvres spécialisés : Code 0813 2e C.

Equipe puisatier

- 1 Puisatier : Code 1026 - 6e C.
- 1 Aide puisatier : 1025 - 5e C.
- 2 Manoeuvres : Code 1014 - 4e C.

L'Inspecteur Régional du Travail.

Le Directeur de l'Hydraulique Urbaine et Rurale.

Bocar CISSE

C -**Classification** :

Terrains : **1ère Catégorie** = terre argileuse mélangées de pierrailles, sables boulants, roches moyennement tendres (calcaires, grés et marnes compactes)

2ème Catégorie : roches, calcaires durs, calcaires gréseux, basalte, granite, schiste.

Travaux : **Groupe I** = terrains se travaillant avec outils de terrassiers

Groupe II = terrains se travaillant avec moyens mécaniques (marteau brise à béton, perforateur, éclateur, benne automatique).

Visa du Directeur de l'Hydraulique

Directeur de l'Hydraulique
Urbaine et Rurale

XIV.

GLOSSARY[1]
(French/Wolof)

This is a list of some of the more commonly used words associated with wells. When a local language term is not given, it is because the French term is the commonly used one. As with any other discipline here, even masons who speak no French at all generally know the vocabulary used with wells. Móst masons speak no French, but know that a margelle is a pind.

ENGLISH	FRENCH	WOLOF
apron, curb	dalle antibourbière, trottoir	
aquifer		
assistant	apprenti	manevar
anchoring curb	dalle d'ancrage	
bucket	seau	siwo
buy	acheter	jend
casing	buse	biis, mool
casing mold	moule ã buse	mool-u-kaay
cement (v)	maçonner	raax
cement (s)	ciment	siman
cover w/cement (e.g., fer)	couvrir	sangg, muur
collar, headwall	margelle	pind
chisel	ciseau	
contractual rate	taux forfaitaire	
clay	argile	ban
deep	profond	xoot
deepen	approfondir	xootal waqi
descend (v it)	descendre	wacc
dry	sec	wow
drinking-water well	puits d'alimentation	tennu ndox
drinking trough	abreuvoir	mbalq
dig	creuser, foncer, forer	gass
emplacement	emplacement	fu ñu gass
empty (v)	vider, verser	sotti
empty (adj. e.g, well)	vide	wow

[1]English, French, and Wolof taken from "Fleuve Wells Manual" by Rick Byess.

ENGLISH	FRENCH	WOLOF
financing	financement	xalis
gravel	gravier, gravillon	doj'(pl), xer (pl)
hand-dug	creusé à main	loxo moo ko gass
help (v)	aider	dimbëli
help (s)	aide	ndimbël
hydraulic engineer	ingénieur hydraulique	boroom xamxamu tenn
hit water	toucher l'eau	bëtt ndox
hardhat	casque	casket
inspect	inspecter, vérifier	seet
iron	fer	weñ
jackhammer	marteau-piqueur, concasseur	masinu gassukaay, masinu tojukaay
level	niveau	fu ndox me tollu
lower buses	faire descendre les buses	wacc buse yi
ladder	échelle	sell
meeting	réunion	ndaje
measure (v)	mesurer	natt
mason, well-digger	mason, puisatier	gasskat
mix (v)	mélanger	jaxas
mix (s)	dosage	
order (v)	commander	ndigal
pump	pompe	masinu pompukaay
project	projet	ligeey
pay (v)	payer	fey
payment	avance, tranche	xaj, wall
pay scale	baréme	baremu xalis
pull	tirer	xëcc
quicksand	sable mouvant	ngiro
repair	réparer	defaraat
run dry (v it)	être épuisé	amatul ndox, wow
run dry (v t)	vider	jexal, dindi bëy mu wow, nëcc
replace (i.e., bring materials)	ravitailler	indi
rock	pierre	xer
raise water	puiser	duy
rope	corde	bum
stock (v)	stocker, emmagasiner	dencc
stock (s)	stock, restant	ndessit
sanitary	sanitaire	weer
sanitation		weeraay

ENGLISH	FRENCH	WOLOF
straight	droit	jub
straighten	défausser	jubal
soft	mou	nooy
surface water table	nappe phréatique	nappundox
shallow	peu profond	bu xootul
shovel	pelle	
sand	sable	suuf su weex
small-bore well	forage	
technique	façon de travail, technique	faso ligeey
trace out	tracer	wonn place bë, nett, rëdd
tie-wire	fil de fer	weñ bu sew
underwater work	travail sous l'eau	ligeey ci biir ndox
water table (a false water table is a céane)	nappe	
width	épaisseur	yatuwaay
winch	treuil	masinu xëccukaay

Words for which I know of no equivalent in French or English are ngasstu, a heavy iron bar four to six feet long, pointed at the end like a chisel which is used for digging in heavy clay, and the fabulous daaba, which is a cross between a hatchet, a spade and a pick. There is a verb manseli, which is very imprecise, and is used to mean anything from "finishing this meter" to "scraping the clay." The general meaning is "bringing this bit of work to completion." I would be grateful for a translation.

GLOSSARY[1]

(French/Bambara)

ENGLISH	FRENCH	BAMBARA
apron, curb	dalle antibourbière trottoir	dali ga
assistant	apprenti	parenti
bucket	seau	palan
buse mold	moule à buse	mulu, mulu dilalan
buy	acheter	ka___san
cement(v)	maconner	ka___jo
cover w/cement (e.g. fer)	couvrir	ka___bili, ka bari
collar, headwall	margelle	kōkōn da
contractual rate	taux forfaitaire	bēn kēra da min kan
cement (n)	ciment	siman
chisel	ciseau	kēmēsu (siso)
clay	argile	bōgō pasan - bwa
caisson, filtration ring	buse	mulu
deep	profond	dun
deepen	approfondir	da___dunya
descend	descendre	ka___jigin
dry	sec	jalan
drinking-water well	puits d'alimentation	kōlōn or jiminta kolon
drinking trough	abreuvoir	waaro (minyoro)
dig	creuser, foncer, forer	ka___sen
emplacement	emplacement	yōrō or senyoro
empty (adj., e.g., well)	vide	lankolon
financing	financement	wari
gravel	gravier, gravillon	belēkisē or bere
hand-dug	creuse à main	bololasenni
help (v)	aider	ka___dēmēn or dema
help (n)	aide	dēmēn
hydraulic engineer	ingenieur hydraulique	jidōnbaa

[1] Bambara done with the assistance of Peace Corps Mali's Language Training Staff.

ENGLISH	FRENCH	BAMBARA
hit water	toucher l'eau	ka se ji ma, ta ji soro
hardhat	casque	kasikē (fugula)
inspect	inspecter, verifier	ka sēgēsēgē or laje
iron	fer	nēgē
jackhammer	marteau-piqueur, concasseur	gosilan, kaba shilan
level	niveau	niwo
lower buses	faire descendre les buses	ka___lajigin ka mulu la jigin
ladder	echelle	yēlēnyēlēnnan
meeting	reunion	tonsigi
measure (v)	mesurer	ka__suma
mason, well digger	mason, puisatier	kōlōnsenna
mix (v)	melanger	ka nyagami or nooni
mix (n)	dosage	nyagamini
order (v)	commander	ka___nyini
pump	pompe	pompu or pompi
project	projet	"projet" (jatē)
pay (v)	payer	ka___sara
payment	avance, tranche	nyēbila
pay scale	barême	baremu (wari)
pull	tirer	ka___sama
quicksand	sable mouvant	fugan
repair	reparer	ka___dila
rock	pierre	kaba kabakuru
raise water	puiser	ka ji bo or ji labo
fill	remplir	ka___fa or lafa
rope	corde	juru (jurukisē) julu
stock (v), store (v)	stocker, emmagasiner	ka___lamara
stock (n)	stock, restant	tō
sanitary	sanitaire	nyēgēn
sanitation	hygiène	jèya or seneya
straight	droit	tilennen
straighten	defausser	tilen
soft	mou	magan
surface water table	nappe phrêatique	ji napu
shallow	peú profond	surun
shovel	pelle	pelu
sand	sable	cēncēn or kēnkēn
small-bore well	forage	kōlōnsen

ENGLISH	FRENCH	BAMBARA
technique	façon de travail	baara cogo
trace out	tracer	ka___ci
tie-wire	fil de fer	nēgējuru
width	epaisseur	bonya

XV. WELLS CONSTRUCTION REFERENCES/SOURCES FOR THIS MANUAL

Hand Dug Wells and Their Construction by S. B. Watt and W. E. Wood. Published by Intermediate Technology. 1977.

"This manual is intended as a guide to the hand digging of wells, especially village wells in tropical or sub-tropical areas, where cost has to be kept to a minimum and the villagers themselves are able and willing to contribute the labour required.

The manual describes hand-dug shaft wells and their construction by relatively unskilled villagers. Modern concepts, methods and designs are incorporated, but in such a way that those who will carry out the actual work do not require a high degree of education, training or supervision."

Wells Construction (Hand Dug and Drilled) by Richard E. Brush. Peace Corps Information Collection and Exchange.

"Wells Construction brings together in one volume the principles of wells construction and the practical techniques currently being used and tested around the world."

Fleuve Wells.....everything you need to know by Rick Byess, Dakar 1977.

"This book was written especially to be used as a training aid for the 1977 Animation "stage" in Senegal. It is admittedly limited in content; its major purpose is to draw together a number of different topics into a single volume, and thus to serve as a general introduction to well-digging in Senegal."

Wells Manual by Action/Peace Corps. Program and Training Journal Publication. 1975.

"This manual is to provide information on a wide range of well construction techniques. Sections include miscellaneous pieces on well pump studies and specific well projects. There is also a short piece on the use of dynamite. In addition, a bibliography section dealing with sources of information has been included."