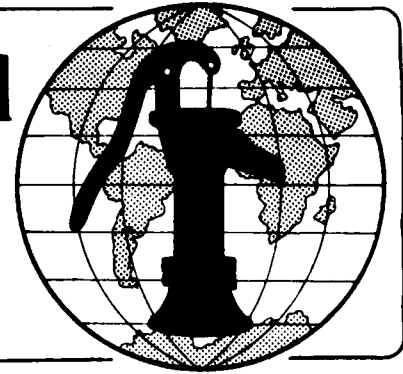


Water for the World



Constructing Cable Tool Wells Technical Note No. RWS. 2.C.5

Properly constructing a cable tool well, also called a percussion drilled well, is important to ensure a year-round supply of water and to protect the water from contamination. Constructing involves assembling all necessary personnel, materials, and equipment; preparing the site; drilling the well shaft; and installing the casing and screen. Finishing the well is discussed in "Finishing Wells," RWS.2.C.8.

This technical note describes how to construct a cable tool well. Read the entire technical note before beginning construction.

Useful Definitions

AQUIFER - A water-saturated geologic zone that will yield water to springs and wells.

CATHEAD - Metal hub bolted to a vehicle brake drum.

WATER TABLE - The top or upper limit, of an aquifer.

Materials Needed

The project designer must provide four papers before construction can begin:

1. A location map similar to Figure 1.
2. A design drawing of the method of drilling similar to Figure 2.
3. A design drawing of the well screen similar to Figure 3.
4. A materials list similar to Table 1.

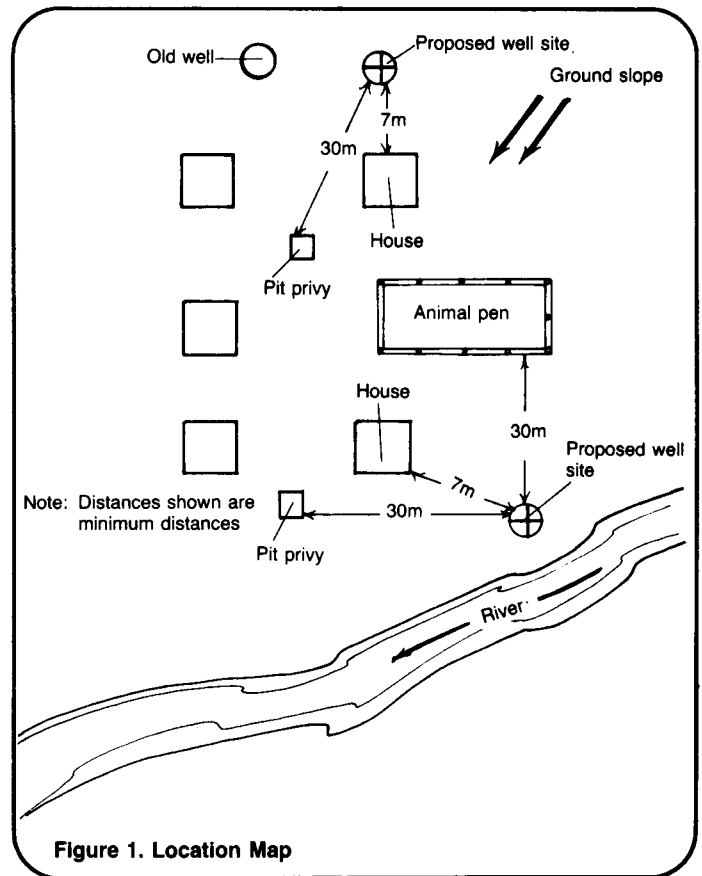


Figure 1. Location Map

Construction Schedule

Depending on local conditions, availability of materials, and skills of workers, some construction steps will require only a few hours, while others may take a day or more. Read the construction steps and make a rough estimate of the time required for each step based on local conditions. You will then have an idea of when specific workers, materials, and tools must be available during the construction process. Draw up a work plan similar to Table 2 showing construction steps.

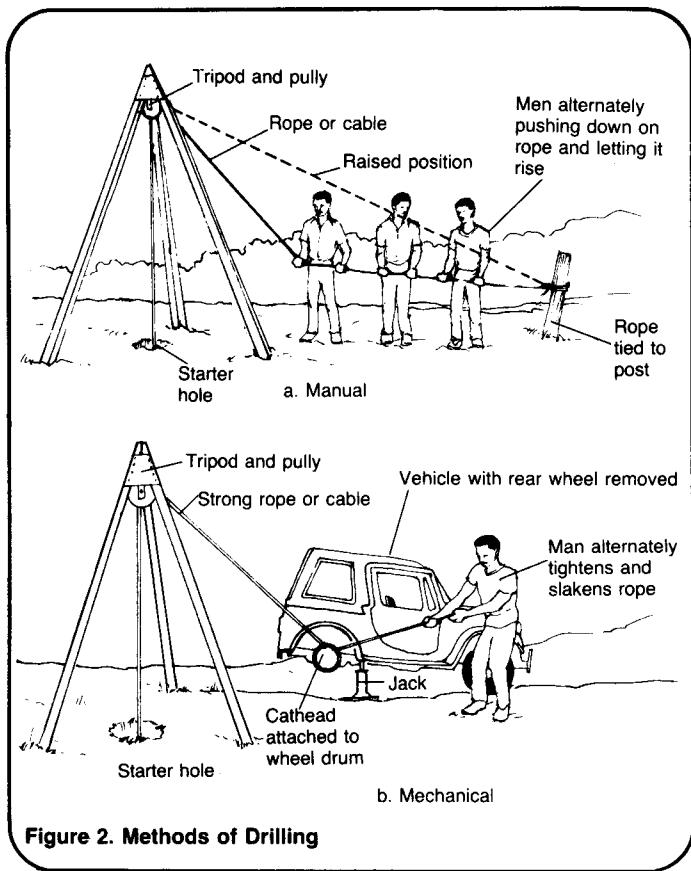


Figure 2. Methods of Drilling

Table 1. Sample Materials List for a Cable Tool Well

Item	Description	Quantity	Estimated Cost
Personnel	Foreman	1	---
	Blacksmith	1	---
	Workers	10	---
Supplies	Steel pipe section for casing; (75mm diameter, 2.0m long)	---	---
	Pipe couplings	---	---
	Well screen	---	---
	Plug to seal bottom of screen	---	---
	Cement mix	---m ³	---
Equipment	Tripod and pulley	---	---
	Heavy-duty ropes; each 50m long	---	---
	Percussion bit; 100mm x 1.5m long; 80kg	---	---
	Hollow rod bit; 100mm diameter; 1.0m long	---	---
	Bailer; 50mm diameter, 1.0m long	---	---
	Fishing tool	---	---
	Anvil	---	---
	Hammers (blacksmith)	---	---
	Hacksaw	---	---
	Metal files	---	---
	Wrenches	---	---
	Screwdrivers	---	---
	Shovels	---	---
	Measuring tape	---	---
	Plumb bob and line	---	---
	Other	---	---

Total Estimated Cost = ---

Caution!

1. The well must be drilled at the exact location specified by the project designer.

2. If the well is being drilled with a motorized cathead, an experienced worker is needed and care should be taken to avoid injuries.

Construction Steps

1. Using the location map and a measuring tape, locate the well site. Clear the area of any vegetation or debris that might interfere with work.

2. Assemble all laborers, materials, and equipment needed to begin construction.

3. Erect a sturdy tripod over the site and plant the legs firmly in the ground. Mark the exact point where the well will be drilled by lowering a plumb bob from the tripod's pulley. If the ground can be worked with a shovel, dig a starter hole 0.5m deep. See Figure 4.

4. Secure one end of the rope or cable to the percussion bit and run the rope over the pulley.

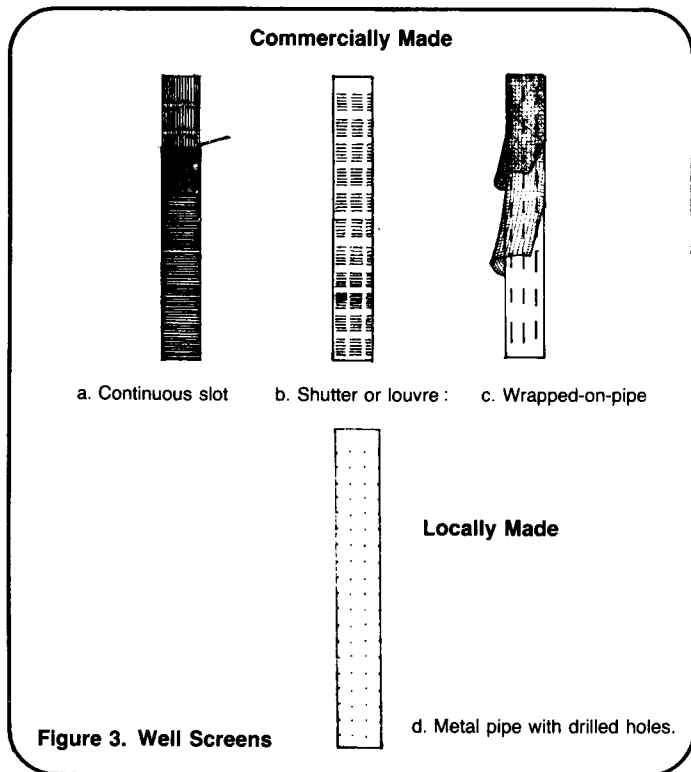


Figure 3. Well Screens

Table 2. Sample Work Plan for a Cable Tool Well

Time Estimate	Day	Task	Personnel	Materials/Equipment
1 day	1	Locate and prepare site; assemble materials	Foreman (present during entire construction); 3-5 workers	Measuring tape; drawings
1/2 day	2	Erect tripod; dig starter hole; attach percussion bit; fix rope to tree	3-5 workers	Tripod, pulley, rope, percussion bit, shovels
8 days	2-10	Begin excavating and bailing	10 workers	Bailer
1/2 day	10	Lower well screen and casing	10 workers	Well screen, casing sections, couplings
1 day	11	Excavate from within casing	10 workers	Bailer
1 day	12	Install plug; pour gravel and concrete mix around outside of casing	10 workers	Plug, concrete mix, containers, shovels

4a. In the manual method, drive a post securely in the ground 8-10m from the well site and find a convenient tree. Tie the rope to the post or tree at about shoulder height or slightly lower. Line up three to five workers along the rope line.

4b. In the mechanical method, park a jeep or truck 4-6m from the well site, jack up the rear end, and put rocks in front of the tires. Remove the rear wheel, bolt a cathead to the brake drum, and grease the cathead. Wrap the rope one turn around the cathead, and pull the loose end away from the well site. See Figure 4.

5. Begin sinking the shaft by raising and dropping the percussion bit. In the manual method, have the workers press down on the rope, then quickly raise up. In the mechanical method, start the engine and engage the cathead to set it spinning; pull taut the loose end of the rope to raise the bit, then let the rope go slack to drop the bit. In both methods, rapid and short strokes of about 0.5m seem to work best. See Figure 4.

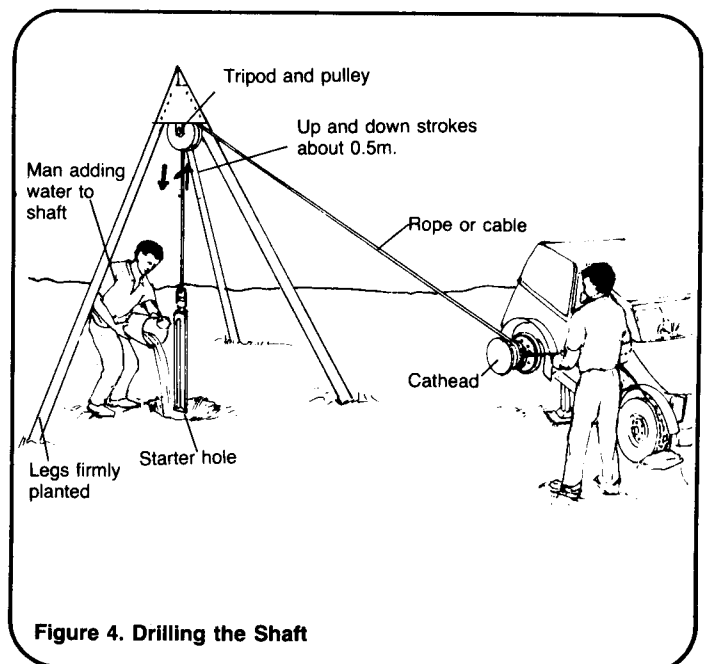


Figure 4. Drilling the Shaft

When the shaft is first being sunk, take extra care to be certain it is vertical. Check the shaft frequently with a plumb bob. As it deepens, the hole will guide the bit.

6. Add a little water to the shaft so that the cuttings will form a paste. This will make bailing operations more efficient.

7. Eventually the paste of cuttings and water will accumulate and prevent the percussion bit from coming in contact with the bottom of the shaft. Exactly when this begins to occur is a matter of experience and judgment. When it does happen, stop drilling and begin bailing. See Figure 5.

8. Remove the percussion bit from the shaft, lay it on the ground, and unfix the rope or cable. Attach the rope to the bailer, lower the bailer in the shaft, and begin raising and dropping it to pick up the debris in the hole. When the bailer is full or is no longer picking up material, remove it from the shaft and empty it. Continue bailing the shaft until little or no material is being picked up.

9. Remove the bailer from the shaft and detach it from the rope. Attach the percussion bit, lower it into the shaft, and continue drilling. Continue the process of alternately drilling or bailing until you reach the aquifer. If at any time the rope breaks, it can be retrieved from the shaft with a fishing tool as shown in Figure 6. Pull up the bit or bailer, repair or replace the rope, and continue drilling.

10. It may be that before you reach the water table, you encounter a loose, non-caving underground formation. If so, a hollow rod bit, as shown in Figure 6, can be used effectively in place of the percussion bit and bailer. Use longer strokes for the hollow rod bit, about 1 or 2m. When the bit fills or partially fills with soil, remove it from the shaft and empty it. Continue using this bit until you encounter harder formations. Then switch back to the percussion bit and bailer until you encounter the aquifer or another loose, caving formation.

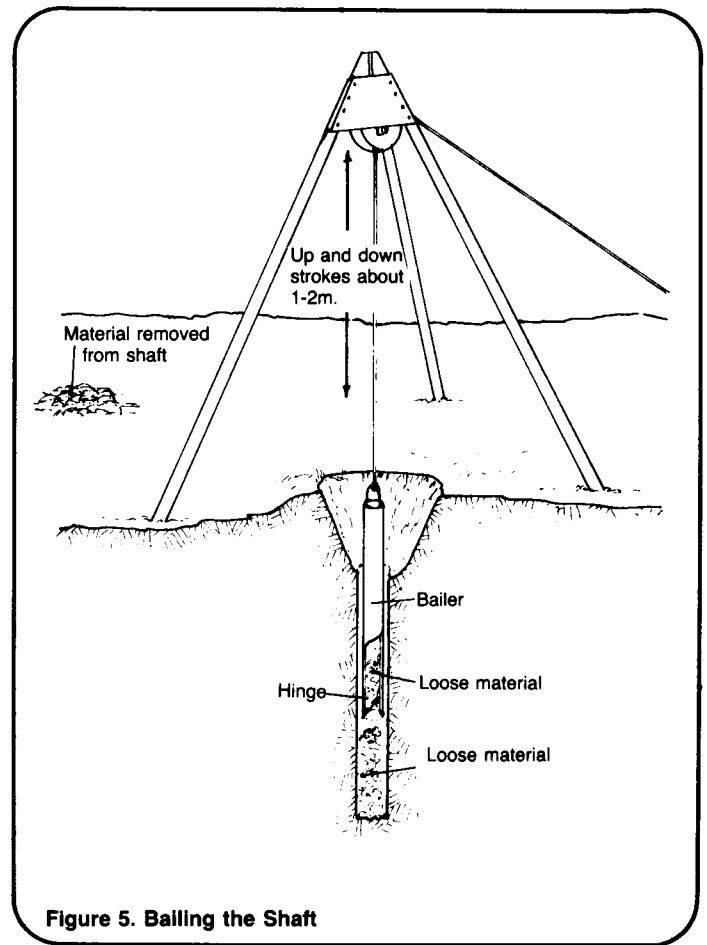


Figure 5. Bailing the Shaft

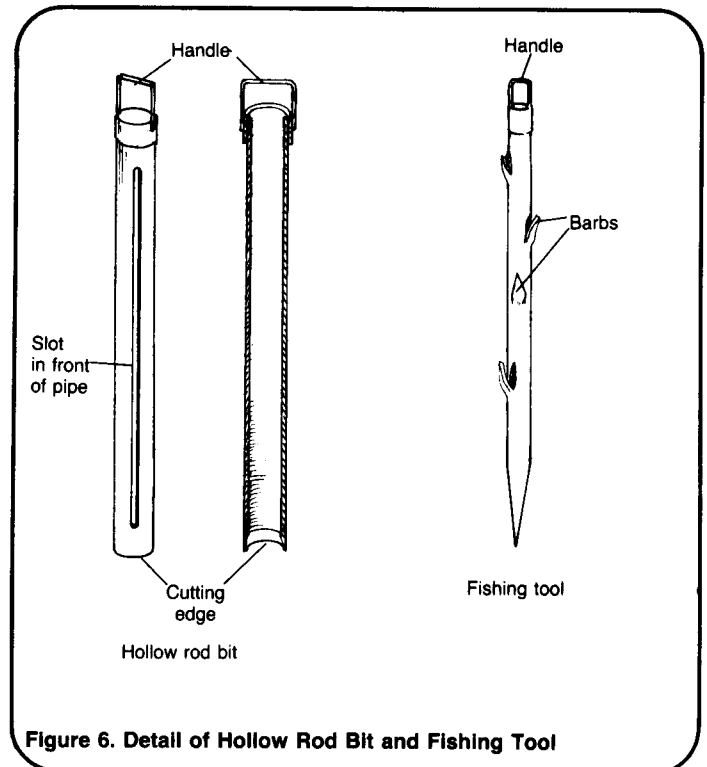


Figure 6. Detail of Hollow Rod Bit and Fishing Tool

11. When you encounter a caving formation, as will be the case with most aquifers, remove the bit or bailer from the shaft. Lower the well screen, with the bottom end open, and sections of casing into the shaft. Attach the bailer to the rope, lower it inside the casing, and continue excavating. The screen and casing material should sink as the loose, aquifer material is removed. Add more sections of casing as necessary. See Figure 7.

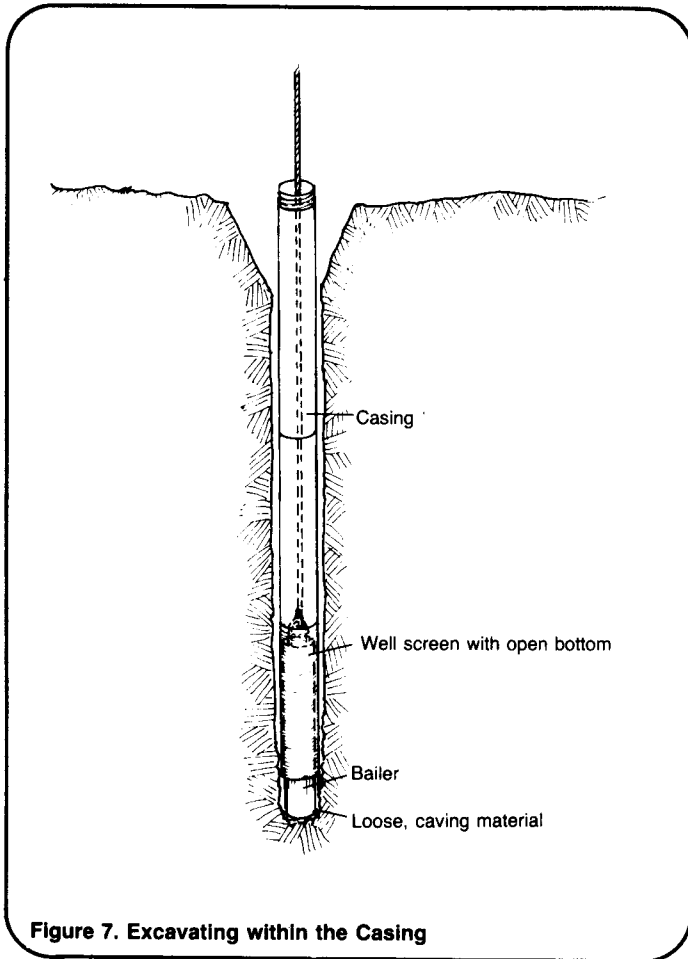


Figure 7. Excavating within the Casing

12. When the well screen and casing have been sunk into the aquifer to the desired depth, remove the bailer from the casing. The casing should protrude about 0.5m above ground level, so part of it may now have to be cut off with a pipe cutter. Drop a pre-seated plug into the casing to seal the bottom of the screen. The plug will prevent aquifer material from entering the screen. The plug should be made from concrete or other non-corrosive material. See Figure 8.

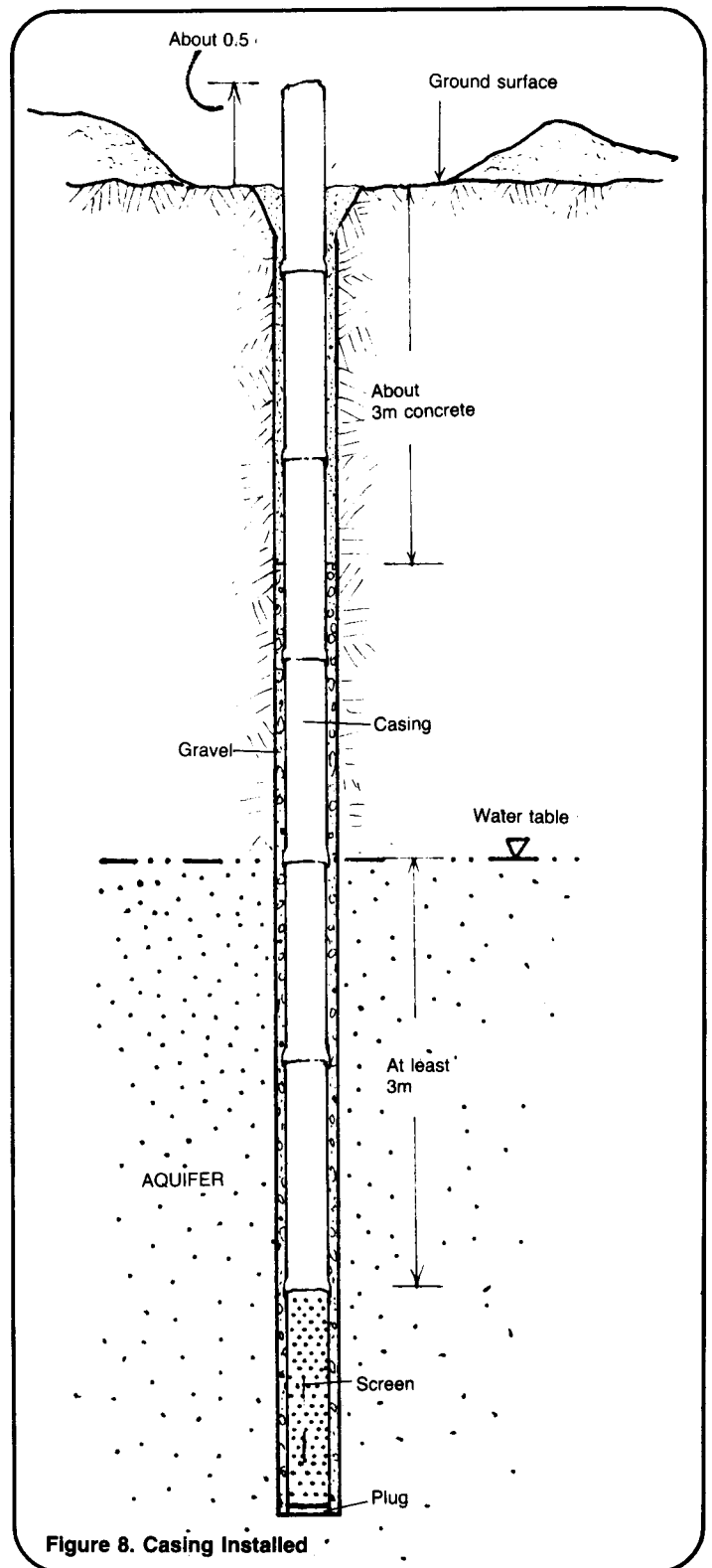


Figure 8. Casing Installed

13. Pour gravel or crushed rock around the outside of the casing and fill the last 3m with concrete mix, pouring it carefully around the outside of the casing.

14. To finish the well see "Finishing Wells," RWS.2.C.8.