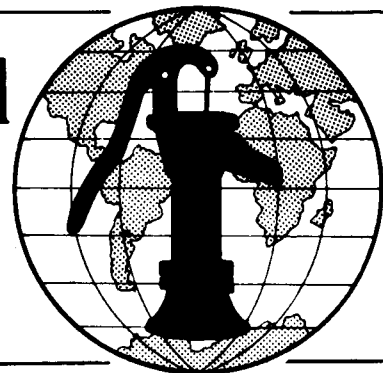


Water for the World



Finishing Wells Technical Note No. RWS. 2.C.8

Finishing a well is important to protect the water from contamination, to prevent people and animals from falling into a hand dug well, and to ensure that water can be drawn from the well with maximum efficiency. How a well is finished depends on whether it is hand dug or drilled. The term "drilled" includes driven, bored, jetted, and cable tool wells. Finishing a hand dug well involves constructing a headwall, an apron, and perhaps a cover; and installing a water-lifting device other than a pump. Finishing a drilled well involves constructing an apron and developing the well.

For drilled wells and for hand dug wells that will have a pump, the pump must be at the well site before the well can be finished. Refer to the following technical notes: "Installing Mechanical Pumps," RWS.4.C.2 and "Installing Hand Pumps," RWS.4.C.3.

This technical note describes how to finish a well. Read the entire technical note before beginning the process.

Useful Definition

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

Materials Needed

For a hand dug well, you will need many of the same tools and materials that were used to construct the well, including cement, sand, gravel, mixing containers, reinforcing steel, wood or metal for forms, and assorted hand tools. See "Constructing Dug Wells," RWS.2.C.1. You will also need a water-lifting device or pump.

For a drilled well, driven, bored, jetted, or cable tool, you will need cement, sand, gravel, mixing containers, reinforcing materials, shovels, and trowels for building the apron. To develop the well you will need a pump and probably a surge plunger and shaft.

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 1 showing construction steps.

Caution!

Workers must take care when working around a hand dug well not to fall in or drop tools or materials into the well.

Finishing a Hand Dug Well

1. Break away the weak mortar layer around the top of the well, being careful not to knock debris into the well. Bend the re-rods protruding from the well lining into a vertical position.

2. Scrape smooth a circular area extending 2.0m out from the well. This will form the bottom of the apron. The area should be 25-50mm below the top of the well lining. It should be well-tamped and slope slightly downward away from the well.

Table 1. Sample Work Plan for Finishing a Well

Time Estimate	Day	Task	Personnel	Materials/Equipment
1/2 day	1	Prepare area for apron	Foreman (present during entire construction); 2 workers	Measuring tape, shovels
1/2 day	1	Place reinforcing material	Foreman (present during entire construction); 2 workers	Re-rods, wire, wire cutter
1 day	2	Mix and pour concrete; form curb and cut notch; cover with wet burlap	Foreman (present during entire construction); 2 workers	Cement, sand, gravel, containers, shovels, trowels, burlap
7 days	3-9	Keep moist for 7 days	Foreman (present during entire construction); 2 workers	-----
1 day	3-4	Dig trench and soak-away; line trench with mortar; fill soakaway with rocks	Foreman (present during entire construction); 2 workers	Shovels, concrete mix, rocks
1 day	10	Remove cover material; develop well	Foreman (present during entire construction); 2 workers	Surge plunger, shaft, bailer

3. Bend 2.9m-long sections of re-rod into right angles and tie them with wire to the protruding re-rods, so that 0.9m is in the vertical position and 2.0m is in the horizontal position radiating out from the well. Place small wooden spacer blocks under the horizontal portion of the re-rods, as shown in Figure 1.

4. Fashion four circles of re-rod. The diameter depends on the diameter of the circle formed by the vertical sections of re-rod. Fix the circles of re-rod in a horizontal position around the vertical re-rods, and space them about 250mm apart.

5. Make eight circles of re-rod for the apron. Fashion the smallest circle so that there is about 200mm between it and the outside edge of the well lining. Fashion each consecutive circle so that its radius is about 250mm larger than the one before it.

The largest circle should fit just inside the ends of the horizontal re-rods. Tie the circles to the horizontal re-rods. Build up a small mound of soil around the ends of the re-rods to contain the concrete when it is poured.

6. Fix a set of steel shutters (1.0m high) around the inside of the well lining. Use metal shims or other means to tightly wedge the shutters in place. They should rise to nearly their full height (1.0m) above the top of the lining.

7. Mix concrete in the proportions of one part cement, two-and-a-half parts sand, five parts gravel, and enough water to make a workable mix. Pour concrete into the apron and make it 75-100mm thick. Trowel smooth the surface of the apron so that it slopes gently downward away from the well. Form a curb of concrete around the outside edge of the apron; make it about 25-50mm high to contain spilled water.

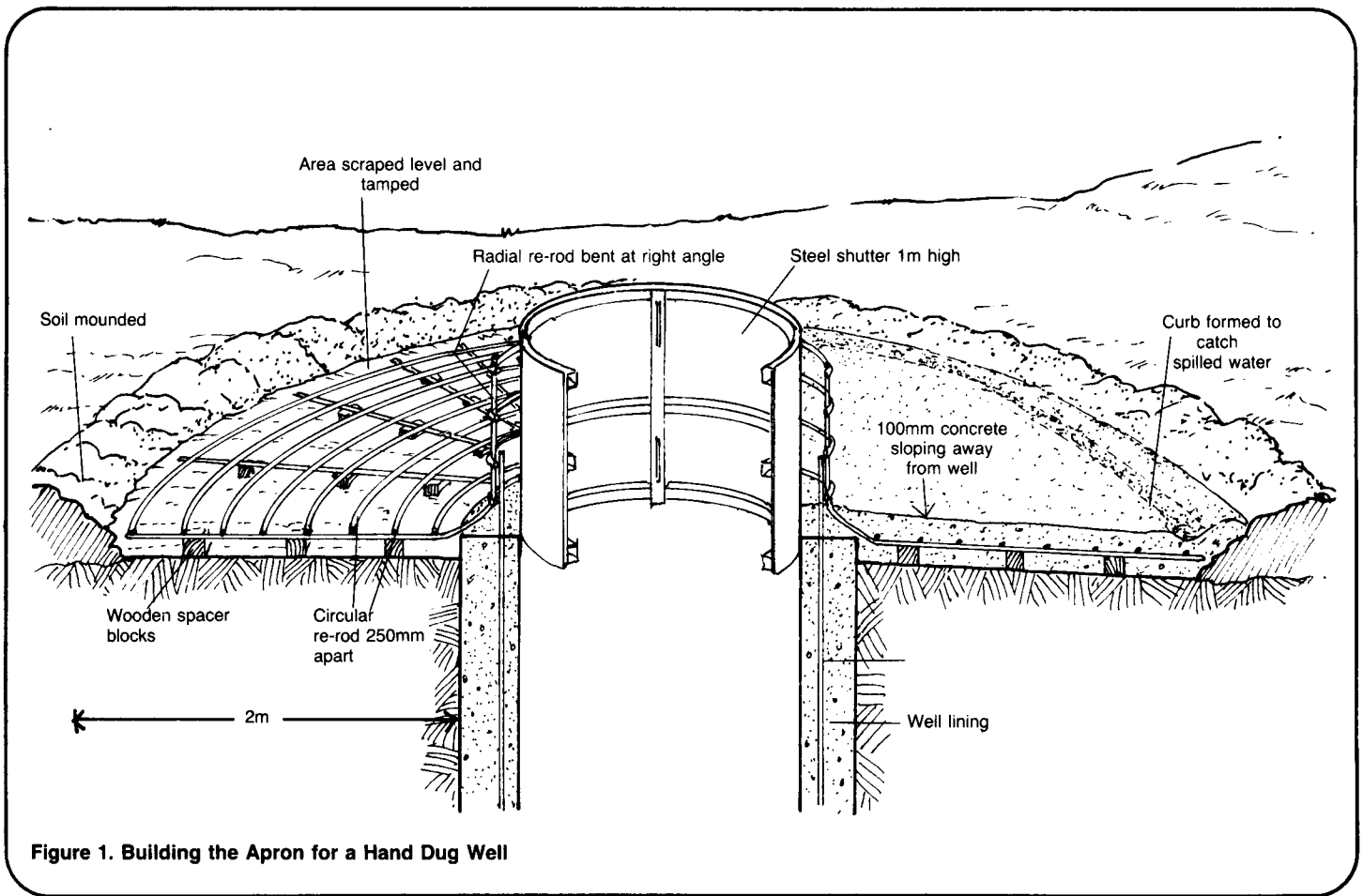


Figure 1. Building the Apron for a Hand Dug Well

8. Cover the concrete with straw or wet burlap and keep it moist for seven days. Before the concrete has fully set, pour water on the apron to determine the low point at the edge. Cut a notch out of the curb at this point to allow water to drain away, as shown in Figure 2.

9. Dig a shallow ditch from the notch in the curb to a soakaway pit, a small pit filled with rocks, or other drainage area a few meters or more away from the well. Line the ditch with mortar.

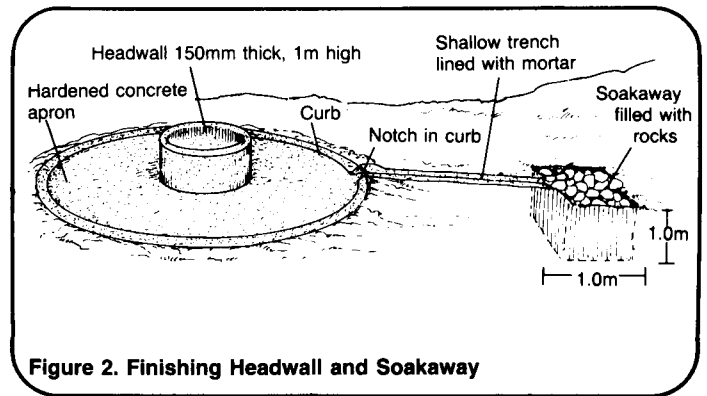


Figure 2. Finishing Headwall and Soakaway

10. When the concrete apron has firmly set, remove the cover material. Position forms for the outside of the headwall. The radius of the forms should be 150mm greater than the radius of the steel shutters already in place. This will make the headwall 150mm thick. Pour concrete into the headwall forms and trowel smooth the top. See Figure 2. If a water-lifting device other than a pump is to be fixed to the

headwall, set the base of the device, or the bolts to hold it, into the fresh concrete. Cover the concrete with straw or wet burlap and keep moist for seven days.

11. If the well is to have a pump, build a concrete cover for the well. This can be done while the headwall is curing.

11a. Build a circular form 100mm high and with the same diameter as the outside of the headwall. Place the form on a flat, oiled sheet of tin as shown in Figure 3.

11b. Make a circle of tin about 600mm in diameter and 200mm high. Set it inside the form for the cover at least 200mm from the outside edge. This will form the access hole. Fashion another circle of tin to form a hole large enough for removal of the riser pipe and pumping unit.

11c. Fill the form about one-third full with concrete. Set re-rods in place as shown in Figure 3. Fill the form with concrete and trowel the top smooth. Before the concrete has set up, form a lip around the access hole to prevent spilled water from entering. Set bolts in the fresh concrete for the pump and the access hatch. Cover the concrete with straw or wet burlap and keep moist for seven days.

12. When the concrete headwall has firmly set up, remove the outside form and the steel shutters.

13. If the well is to have a water-lifting device, set the device in place and bolt it to the headwall. See Figures 4a, 4b, 4c, and 4d.

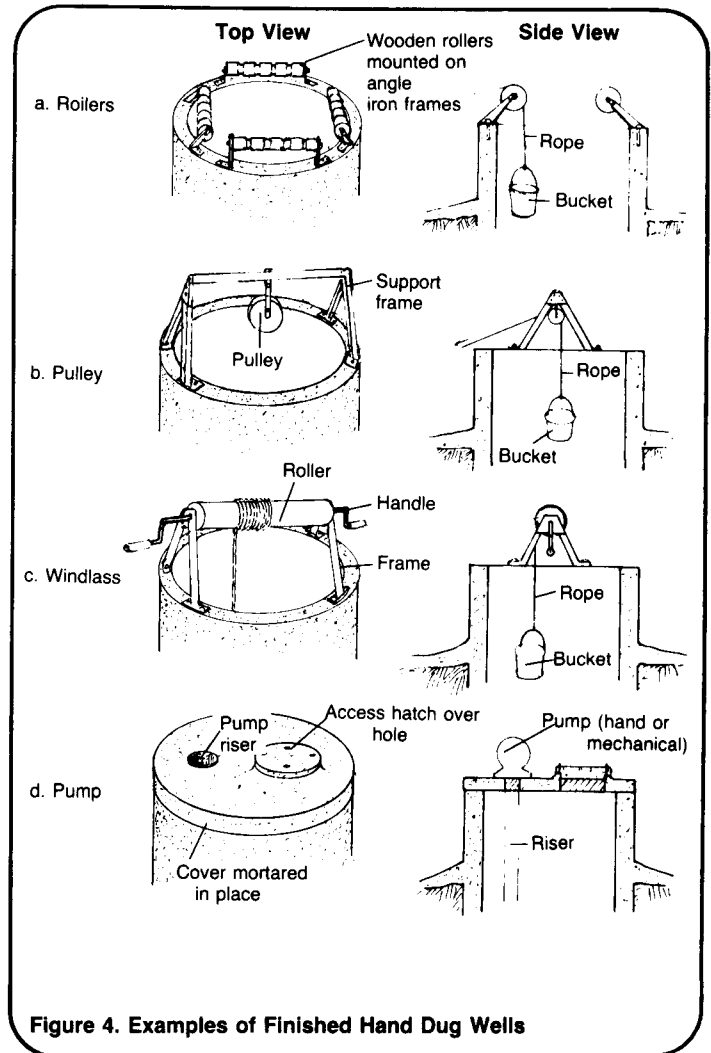
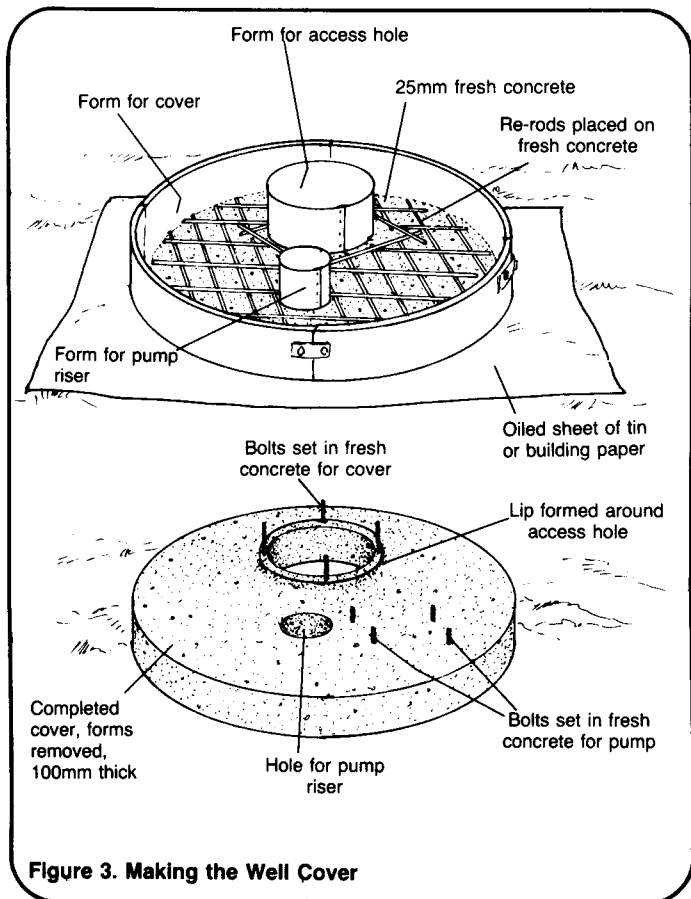


Figure 4. Examples of Finished Hand Dug Wells

14. If the well is to have a pump, remove the forms from the well cover after the concrete has set up and set the cover on the headwall, as shown in Figure 4d. Seal around the edges with concrete mortar. Bolt the access hatch in place. To install the pump, refer to "Installing Mechanical Pumps," RWS.4.C.2, or "Installing Hand Pumps," RWS.4.C.3.

Finishing a Drilled Well

Finishing a drilled well, driven, bored, jetted, or cable tool, involves building an apron or platform and, usually after the pump is installed, developing the well.

To build the apron:

1. Scrape smooth a square area of about 2.0m on each side with the well casing in the center. The area should be well-tamped and slope slightly downward away from the well. Build a small mound of soil around the outside edge.

2. Lay 1.9m-long re-rods in a grid pattern in the area. Space the re-rods about 250mm apart, tie them together with wire, and raise them up on 25mm high wood spacer blocks. See Figure 5.

3. Mix concrete in the proportions of one part cement, two-and-a-half parts sand, five parts gravel, and enough water to make a workable mix. Pour concrete into the apron area. Make it about 100mm thick at the well casing and sloping slightly downward away from the well. Trowel it smooth. If the pump or the base of the pump is to be bolted to the apron, set bolts into the fresh concrete in exactly the required position. Form a curb of concrete around the outside edge of the apron; make it about 25-50mm high to contain spilled water. See Figure 6.

4. Cover the concrete with straw or wet burlap and keep it moist for seven days. Before the concrete has fully set, pour water on the apron to determine the low point at the edge. Cut a notch out of that point to allow water to drain away.

5. Dig a shallow ditch from the notch in the curb to a soakaway pit, a small pit filled with rocks, or other drainage area a few meters or more away from the well. Line the ditch with mortar. See Figure 6.

6. When the concrete apron has firmly set, remove the cover material.

To develop the well:

Developing a well removes the fine particles in the aquifer from around the well screen. This improves the yield of the well, and it may lengthen the operating life of the well and the pump. The three basic methods of developing a well are overpumping, backwashing, and surging.

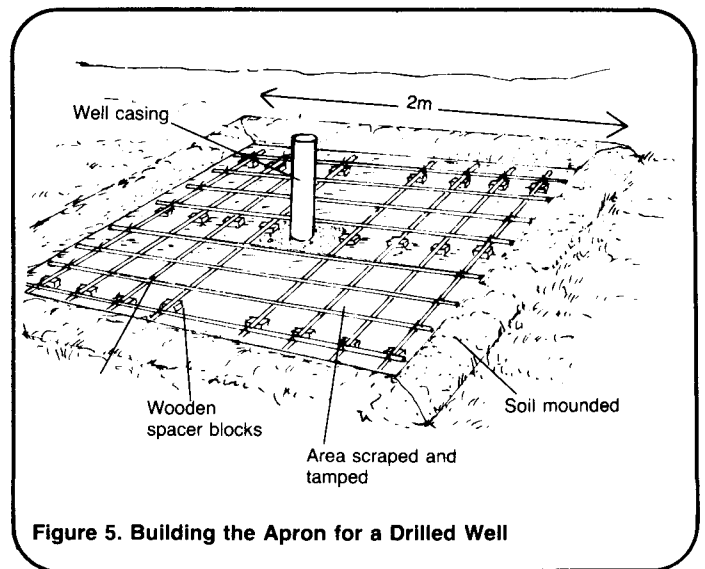


Figure 5. Building the Apron for a Drilled Well

Overpumping. Pump the well at a faster rate than normal, until no more fine aquifer particles are removed with the water. Use a separate pump for this process, because the fine particles will cause excessive wear on the pump and result in early pump failure. Although this is the simplest method, it does not fully develop the well.

Backwashing. Pump water to the surface and let it flow back into the well, and repeat the process many times. Although this method may be more effective than overpumping, in most cases it is difficult to accomplish. The reason is that most pump risers have a foot valve that prevents water from flowing back down; therefore, the pump may have to be completely removed to allow the water to flow down.

Surging. This is the most common and effective method of well development. It involves forcing water back and forth through the well screen. This not only removes small aquifer particles from around the screen, but it also forms a graded filter around the screen. The filter prevents the entry of small particles that would eventually clog the well or damage the pump.

1. Attach a surge plunger, solid or valve type, to a shaft and lower it down the well casing. See Figure 7. The shaft should be longer than the depth of the well so that if it is dropped, part of it will stick up out of the casing and be easy to remove.

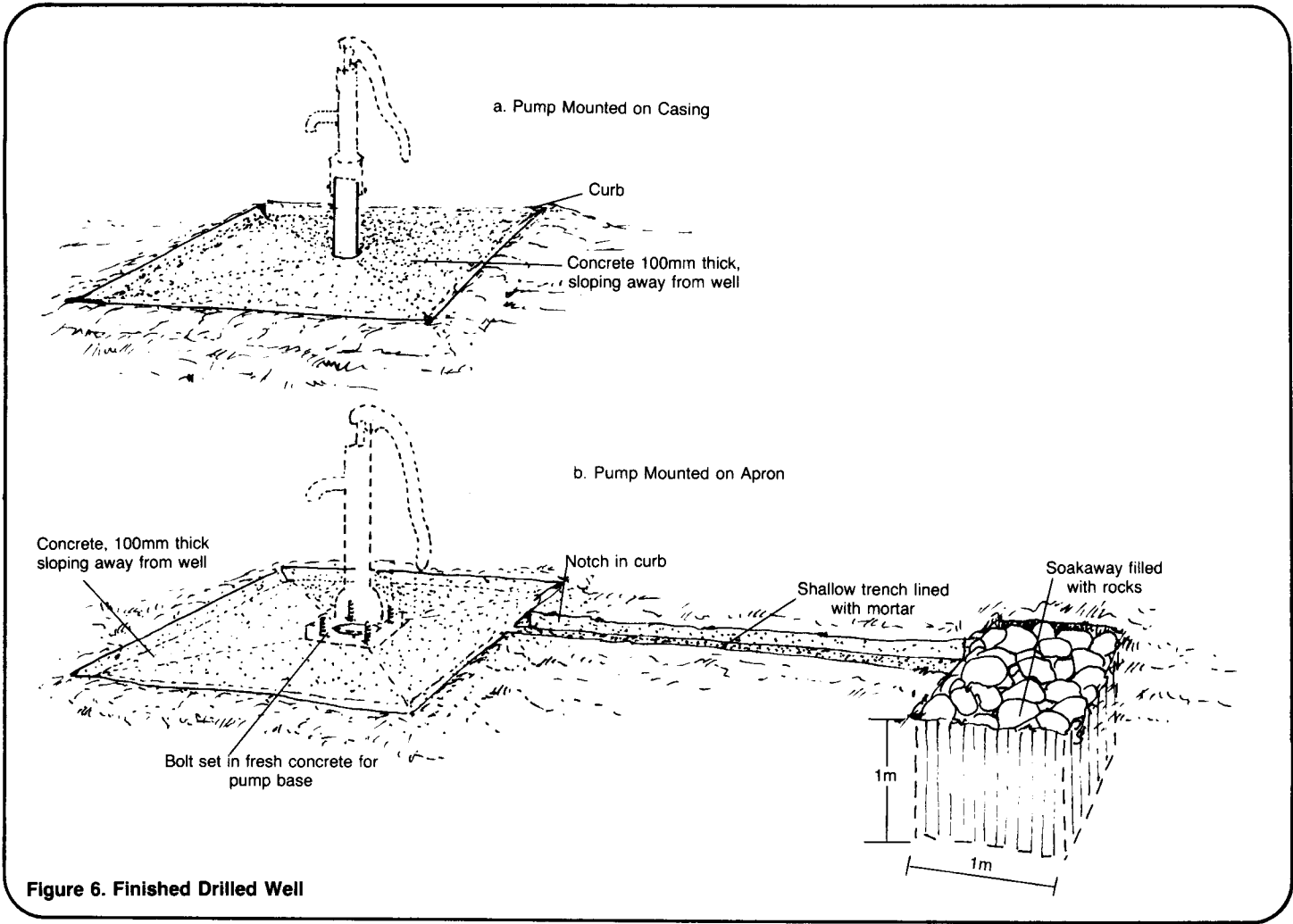


Figure 6. Finished Drilled Well

2. Lower the plunger until it is below the water level. Begin surging by rapidly raising and lowering the plunger for several minutes. Make the strokes about 0.6-1.0m long. See Figure 8.

3. Remove the plunger and shaft from the casing. Disconnect the plunger from the shaft, attach a sand bailer, and lower the bailer into the casing. Use the bailer to pick up fine particles and remove them from the shaft.

4. Disconnect the bailer and attach the plunger to the shaft. Continue surging and bailing until no more fine particles are removed with the water.

5. Remove the shaft and plunger or bailer from the casing and install the pump. See "Installing Mechanical Pumps," RWS.4.C.2, or "Installing Hand Pumps," RWS.4.C.3.

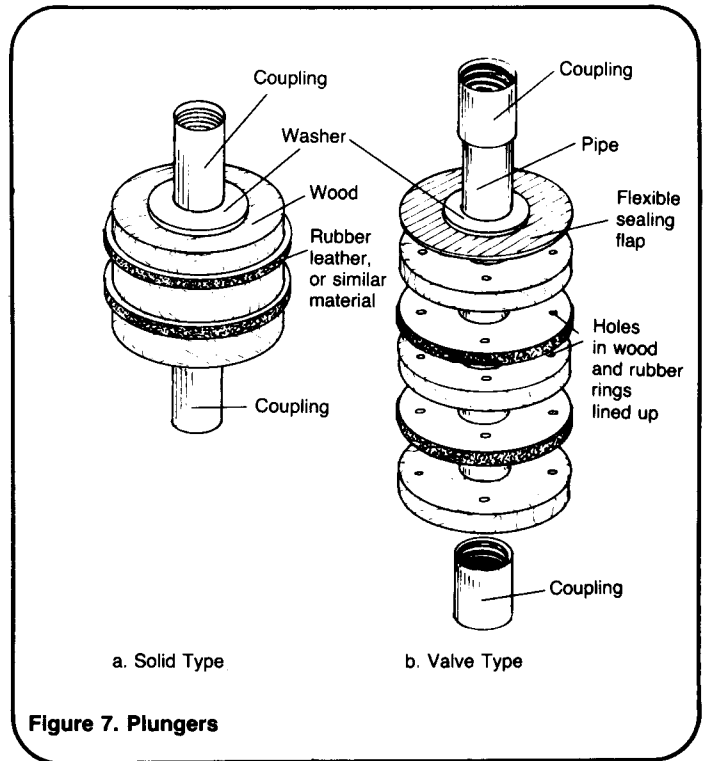


Figure 7. Plungers

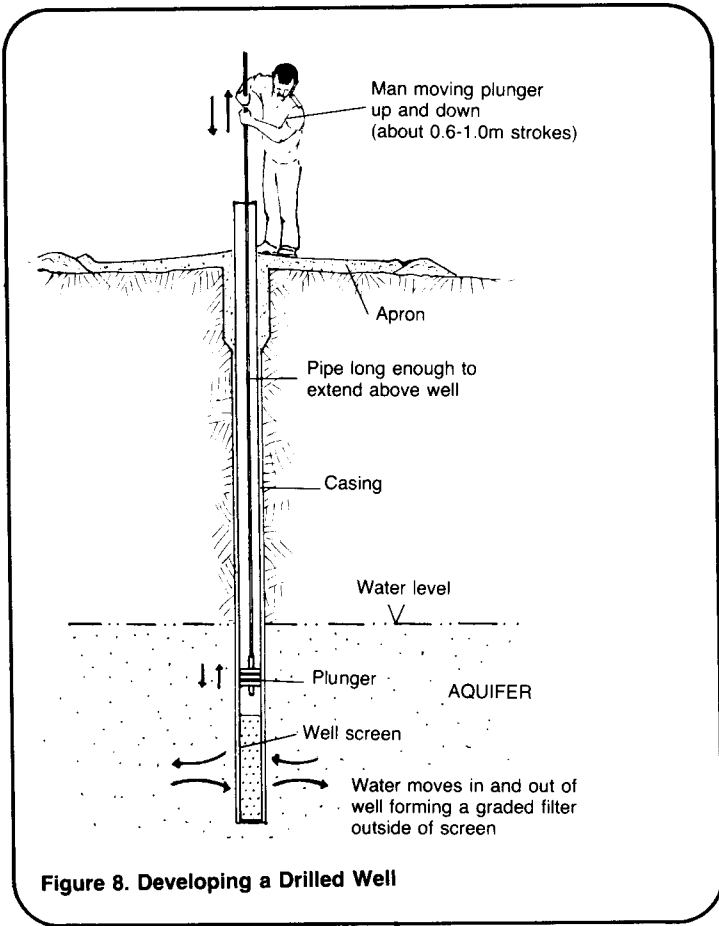


Figure 8. Developing a Drilled Well