Extracting clean water from streams in south-western Ethiopia

by W.J. Bradfield

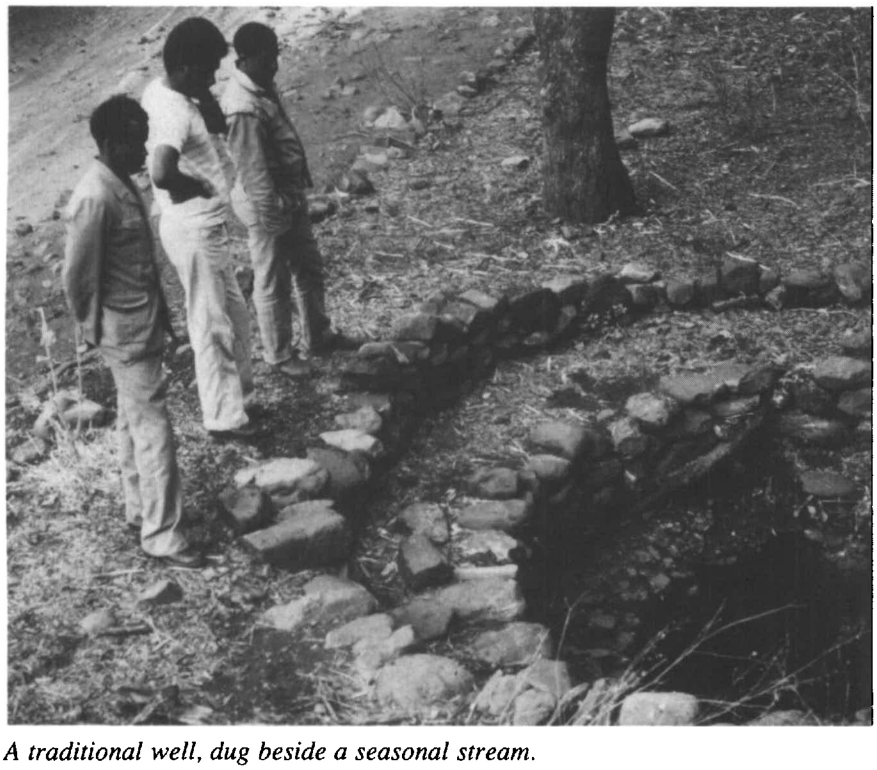
Surface water from streams can provide communities with a clean source of drinking-water during every season if a well is built to tap the underground source.

SOUTH-WESTERN Ethiopia is a large region with many very different terrains and climates. The Freedom from Hunger Campaign, a division of the Food and Agriculture Organisation of the United Nations has, together with other organizations, been implementing an integrated development project in a number of rural communities throughout the region. The goal was to help the communities recover after the recent droughts, and to help them to be better able to withstand the stress of inadequate rainfall in the future. The components of the project included providing oxen credit-schemes, teaching improved husbandry techniques, introducing short-season drought-resistant crop varieties and, obviously, improving the communities' access to clean water.

The existence of so many diverse conditions meant that each project had to be approached individually. A specific form of water development could not be selected and applied across the board. Appropriate developments ranged from spring protection, shallow wells, and boreholes, through to surface catchment techniques.

Quite often a community was extracting water for domestic use from a normally perennial stream, or burrowing into the sand of a seasonal stream. In one locality the digging of wells beside seasonal streams had taken place for generations, the appropriate site being identifited by the presence of a type of wild fig (known in the local Boranan dialect as 'Oda' or in Amharic as 'Warka') which grew on the site of relatively high water tables. The sites proved to be either an impermeable layer underlying the stream bed, or a point at which aquifer water seeped into the stream bed.

There are two forms of water development appropriate to these situations which, apart from the above example, were not previously being practiced in the region: infiltration wells beside the perennial streams, and sand wells in the dry river beds. Both techniques are low cost, and use the robust, cheap, and highly versatile Mono 'M' helical rotor suction pump.



A traditional well, dug beside a seasonal stream.

Infiltration wells

Infiltration wells are sited close to perennial streams, but also need a seam of permeable material through which water passes from the stream to the well. Many potential sites had to be discarded because this characteristic did not exist.

The wells should be sunk as far away from the bank as possible, because the farther the water has to flow through sand the better filtered it will be. The well must, however, be close enough to the stream that the rate of seepage is still adequately high to replenish the well — on average between two and four metres. The larger the diameter of the well casing the better, because a larger casing increases the storage capacity and intake. Because of the inaccessability of many of the locations, the smaller diameter (40cm) casings were often used for ease of transport. (Acquiring our own forms to make the casings ourselves would have solved this problem.) As the total depth of the wells was rarely more than six metres, a number of test holes were usually dug before the best location was selected.

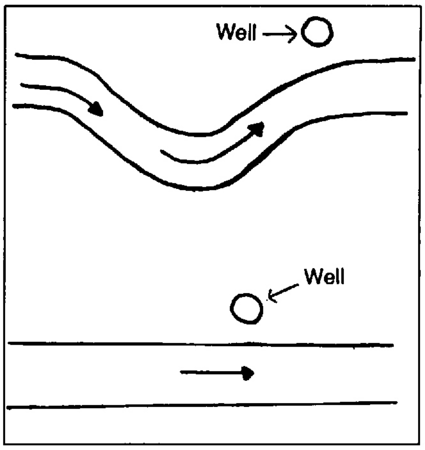


Figure 1. Ideal location for well on straight or meandering stream.

The site should be located, if possible, on a straight length of the stream, where the danger of the well being damaged by meandering is least. If it has to be located on a bend it should be along the back edge (Figure 1). The higher the ground the better, because it reduces the flooding risk. Ideally, digging should be done at the end of the dry season, when the stream is at its lowest, and should continue for at least two metres below the water table.

The method of sinking the concrete rings depends on the nature of the material being excavated, i.e. whether it is collapsing or not. The larger the diameter of the ring, the easier it is for a man to work inside it in order to sink it deeper through collapsing material. Some means of dewatering is necessary, but dewatering buckets severely hampers work. The same pump as is to be mounted on the well makes a good dewatering pump when fixed to a portable frame and fitted with one-inch flexible hose. The lowest culvert was usually the porous type, constructed with no sand in the mix in the central section.

The area outside the rings should be backfilled with gravel and stone, and the top layer sealed with packed clay and a concrete apron. A one-inch galvanized-iron riser with foot valve is sunk to 25cm from the bottom (Figure 2). A Mono 'M' helical rotor suction pump, bolted to a frame made of pieces of angle iron, is then mounted over the well.

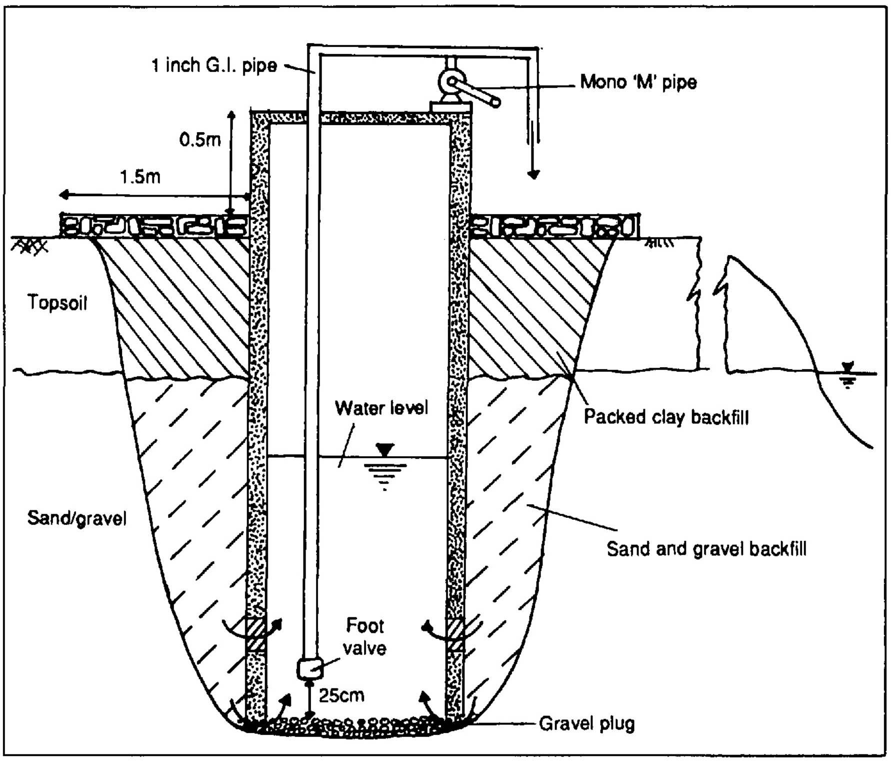


Figure 2. A typical infiltration well (not to scale). The culvert pipes can be 40, 60, or 80cm internal diameter.

Culverts with porous central sections. The cement:sand:aggregate ratio was 1:2:4 for the top and bottom sections of 15-20cm, and 1:0:4 for the central section.

Sand wells in seasonal streams

Sand wells are concrete pipes sunk in seasonal streams where water was already being extracted by digging into the sand, and where the height of the bank is no more than five metres. Figure 3 illustrates the principle using a suction pump to lift the water, the water thereby being filtered as it passes down through the sand to the well.

An appropriate site would have water present in the sand throughout the year, usually in an impermeable layer beneath the sandbed. The position should be no closer to the bank than one metre, and must be where seasonal flows are unhindered, and not where there might be eddies where fine material could settle and possibly pass down into the well. A straight section of river with an even bank is the ideal location.

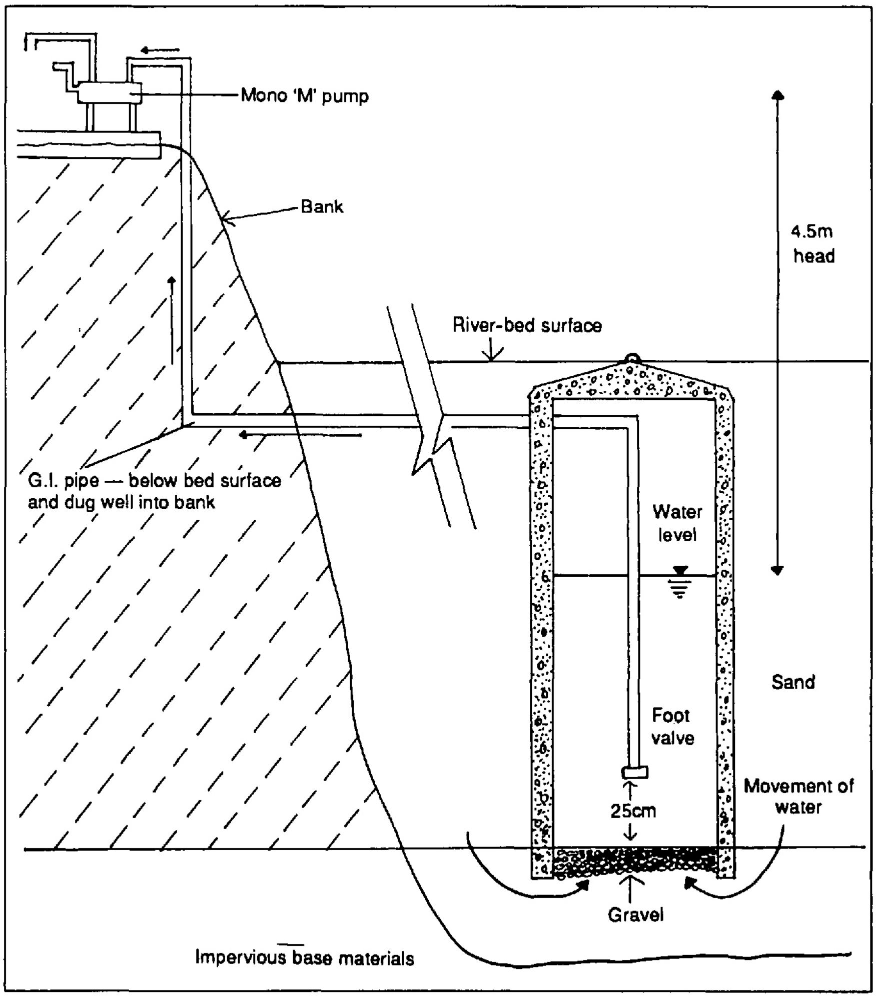


Figure 3. A typical sandwell (not to scale).

Concrete rings are sunk into the sand as deep as possible on top of one another. It is very important that the

A sandwell under construction. Note the sealed well at bottom right.

top ring is slightly below the bed level, or scouring will occur around it and mud will settle. There is also a good chance that it would be smashed during a flood. The bigger the ring diameter the better, though a 40cm internal diameter proved adequate in every case during our work. Dewatering will be necessary during the digging and sinking of the rings, again ideally using a Mono 'M' in a portable frame with flexible hose. Some coarse material, like gravel, should be laid in the bottom of the well to stop the influx of sand and silt. The galvanized iron down-pipe is then placed in the well with the footvalve approximately 25cm from the bottom.

The well is sealed with a permanent concrete lid. A one-inch galvanized iron pipe is fitted from the down-pipe, preferably below the surface of the bed to avoid damage from heavy debris during floods. It is very important that the lid is completely sealed, as it prevents the ingress of unfiltered water. The cross-pipe is dug as far into the bank as possible, so that the upright pipe is not too exposed to damage during floods. In some cases the upright pipe is strapped to a tree with wire. The pump is positioned where the suction head is not too high, but where it will be protected from floods. Five metres seems to be about the maximum height for the Mono 'M' pump after friction losses in the piping.

In only one location did the water in the sand dry up towards the end of the dry season, and a simple sand dam of anthill earth and stones is being planned. Apart from the normal training for the caretaker and the community in usage and routine maintenance, the community should be told about the importance of watering their livestock downstream of the well, and preventing livestock from trespassing close to it, otherwise any benefits could be lost.

The costs of the installations were kept down by using a pump which was substantially cheaper than the standard pumps in use in the area. With the present move to 'Village level Operation and Maintenance' (VLOM)-type pumps, the purists would most likely have gone for a direct action pump for the inflitration wells. The models available in the country were the Finnish-made Nira AF85 and the locally made 'Ibex', but they were substantially more expensive and less versatile. We would not, for instance, have been able to use the pump in the sand wells, as we did with the helical rotor suction pump. The principle of operation is simple, and in my opinion it nearly fulfilled the VLOM principle anyway, since only two tools were required. The caretakers were supplied with an adjustable spanner to tighten fittings and prime the pump when necessary, and with one allen key which opened up the inside. Rotors and stators came out easily, and spares of these were stocked by the service co-operative, the umbrella organization for each community, even though after a year there was no sign of any wear on them. The pumps were lifting on average three thousand litres per day, and in the first year the only breakdown was something that was easily repaired by a small workshop in the nearest town. The life of the gearbox was the only uncertain factor, as this would be difficult to replace.

Respectfully managed by the communities, both these systems provided a vastly improved water supply. In the case of the sand well, acceptance and co-operation during construction was more forthcoming. With infiltration wells, a certain amount of education was required as to the benefits of the new form of water supply. From the beginning the involvement of local health workers was sought, and their help, especially that of the nurse aids in the rural clinics, went a long way to getting the message across.

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Mono 'M' pump with flood protection wall behind it.

Table 1. Average costs of water supply options (£)

	Infiltration well	*Sand well*
Unskilled labour, provided by the community	100	80
Materials, including galvanized iron piping, fittings, concrete rings and cement	105	115
Mono 'M' pump	90	90
Total	295	285