Community involvement in borehole siting and construction

At a glance

Before construction begins

Where will the borehole be located? (hydrological, geological, social and legal considerations)

- Who is involved?
- What legal rules and requirements need to be obeyed?
- Is the water quality good enough?

During construction

- Is the borehole being constructed at the right time of year?
- Is the borehole being drilled correctly? (depth of well, supervision of drilling team, materials used)
- Will the well be properly developed and tested? (pumping test and quality test)

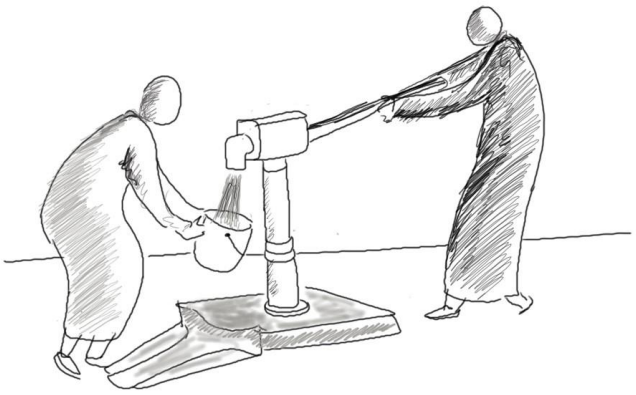
Once the well is constructed

- How much water can be drawn from the well without damaging the environment?
- How will the groundwater source be protected?
- How will the borehole be maintained? (user fees, repairs, spare parts availability, servicing the pump, monitoring)

Why use this tool?

Boreholes (also called drilled wells or tubewells) are an important source of drinking water in many countries. They can be used by individual households, institutions, businesses or whole communities, in both rural and urban areas. They are less likely to become contaminated than hand-dug wells.

Most local communities do not have the knowledge, resources and machinery to drill and construct boreholes themselves. This is usually done by external contractors with the necessary skills, experience and equipment. However, it is very important that communities are involved throughout the design, siting and construction process.



A brief description

This tool is not a guide on how to drill and construct a borehole. Instead, it provides guidance on what information communities and contractors need before starting work on a borehole. It also suggests key questions that communities could be asking before and during the construction process.

Explaining the words we use

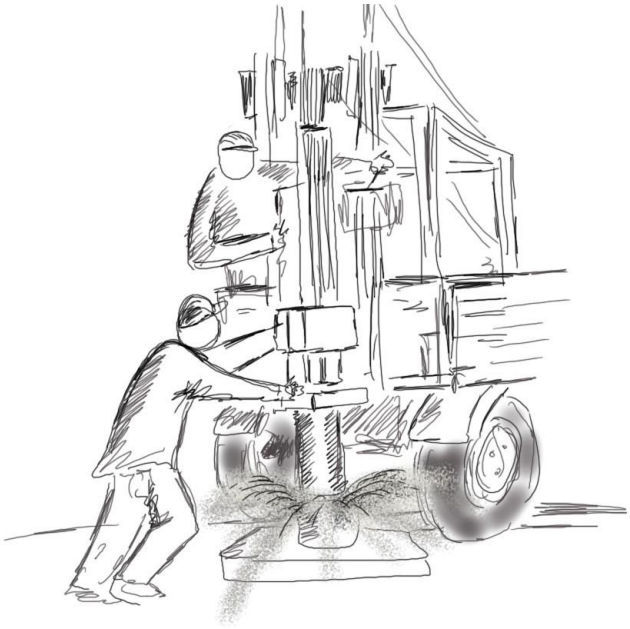
Apron – concrete plinth (base) surrounding a water well at the ground surface. It provides a clean environment and controls the drainage of water away from the well.
Aquifer – underground water source. A layer of rock, or materials such as gravel, sand or silt, that holds water.
Borehole – a water well or hole, drilled in the ground and into the aquifer. It is partially or fully lined, and groundwater is extracted through it by a hand pump or motorised pump. Good construction and protection of the well is very important.
Contaminate –water becoming dirty or 'infected' through exposing it to faeces or other harmful substances.
Groundwater – water that is located beneath the earth's surface within an aquifer. The groundwater level (or 'water table') may be located close to the ground surface, or up to a hundred metres or more below the surface.
Water table (or ground water level) – the level below the earth's surface at which water can be found – the 'top' of the aquifer. The water table varies seasonally; it is deeper in the dry season, and closer to the surface in the wet season.

Time taken

A borehole can take several weeks to complete. The rate of drilling depends on the rock types in the ground, and on the method of drilling.

You will need

This tool focuses on the **information** communities need to ensure that good decisions are made in siting and constructing a borehole, rather than on the equipment and resources needed to drill a well.



What are the main advantages and disadvantages of boreholes, compared to other water sources?

Advantages:

- Quicker to sink than hand-dug wells
- Less vulnerable to contamination
- Safer to construct and use (compared to hand-dug wells)

Disadvantages:

- Skilled staff and experts are required for drilling
- More technical equipment is needed for construction (compared to hand-dug wells)
- They are much more expensive if the borehole is deep (more than 50 metres)

Keys to success

- Choosing the location of a borehole is extremely important. There needs to be evidence that water will be found where the drilling takes place. It is also vital to consider the needs and choices of those who will use the borehole (mostly women and children). It needs to be acceptable to them and accessible all year round.
- Boreholes must be drilled and constructed by experienced, registered contractors. Poor construction can lead to failure of the well or contamination of the water supply.
- The groundwater source should be protected from contamination. No latrines, rubbish/garbage sites or burial sites should be built within 50 metres of the well, and fertilizer/pesticides should not be used on land within 50 metres of the well. Wells should not be located downhill from, or close to, a chemical industry or a mine.
- Many boreholes stop working because they are not properly operated and maintained. Regular monitoring of the ground water level is good practice.
- For hand pumps and powered surface-mounted pumps, spare parts for the pump must be available on local markets, and people need to be trained in servicing and mending the pump. Electric submersible pumps require less maintenance, but when they fail, professional attention is required, and the pump must be removed from the borehole (which is a job requiring skilled workers).

What to do

Before starting – what do you need to know?

Where will the borehole be located?

The location is very important; there are many factors to consider.

Are the right rock structures beneath the ground, and is there evidence of groundwater?

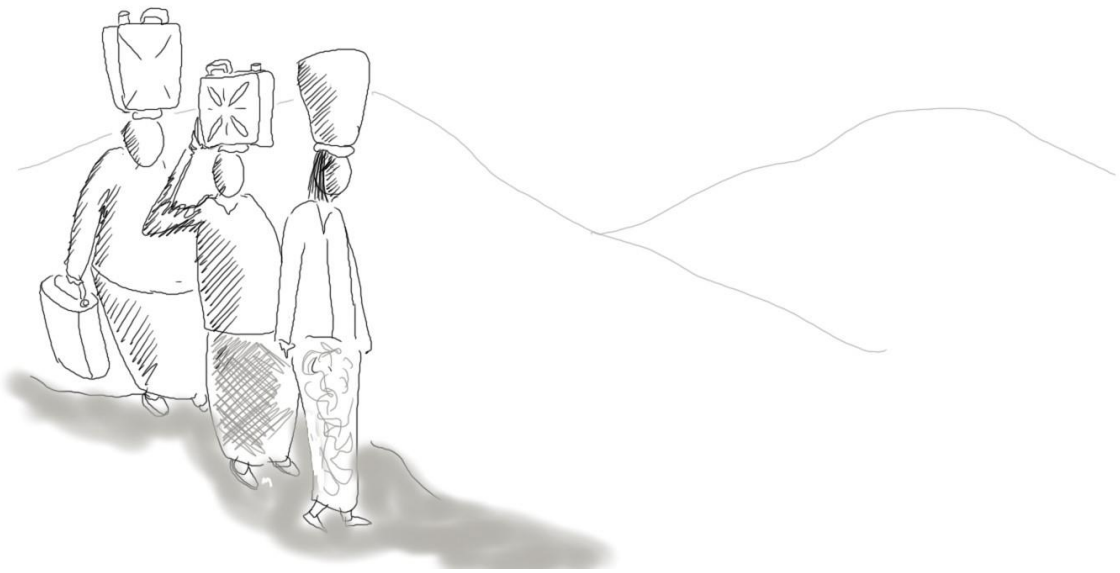
It is important that those responsible for drilling the well understand the hydrology (where water is located) and geology (rocks) of the area. They need to have studied maps and other documents. They may also need to undertake tests using technical equipment that will show whether ground water is likely to be present and accessible by drilling, and whether the ground is appropriate for a drilled well. Before starting, an expert needs to provide the following information:

- evidence of ground water
- an assessment that there is *enough* water to serve the community (the 'yield')
- evidence that the aquifer will recharge fast enough to be a sustainable source of water, and
- evidence that quality of water is good enough (ie safe for human consumption)

Is the location acceptable to and accessible by everyone in the community throughout the year?

It is extremely important to consider the needs and choices of those who will be using the well - especially women. It should not be more than 500 metres from the homes of people who will be using the water.

It is also important to ensure the location does not mean that some people will be unable to use the well, such as people with disabilities, or people of a certain class or caste.



Is it legal to construct a well in this location? Who owns the land that the planned well will be on, and the access routes to the well? Do you have permission to use the land? (see section below).
Does the location mean that the well can easily be maintained and cared for?
Is the location above the (seasonal) flood level of nearby rivers or lakes?
Is it far enough away from existing wells or natural springs?

Who is involved?

Is the local district government water department aware and supportive of your project?
It is important to consult them in the design, planning and construction of the well. They may also have money for this type of work.

Who will be drilling the borehole?
This decision may have already been made, but if appropriate, the community could think about how local contractors could be given the contract (providing local employment and helping the local economy), rather than large external companies. See **Tool C1: Advocacy – communicating with people in power** for guidance. However, it is extremely important that contracts are awarded to experienced and qualified consultants and drilling contractors. Any organisations undertaking the work must ensure the work meets national standards and they should be regulated by the public sector.

What legal rules and requirements need to be obeyed?

Is the construction company aware of, and complying with, all relevant rules and regulations?
In most countries, you cannot just drill a well! You need permission from relevant authorities such as the Ministry of Water or Environment - this is often called an 'abstraction licence'. There are strict requirements that have to be met about the quality of water, location of the well, quantities of water allowed to be pumped, and how close the well can be to other wells.

Is the water quality good enough?
Ground water is normally safe to drink, because the water is naturally filtered as it moves through the rock layers. However, chemical contamination is possible, which is why the well should never be located downhill from, or close to, a chemical industry or a mine. Contamination from pit latrines and garbage/rubbish sites also needs to be prevented.

Is the borehole far enough away from any agricultural activities where pesticides or fertilisers are applied?
Is the location close to or downhill from a chemical industry or mine? (if so, this location should be avoided).
Is the borehole at least 50 metres from any source of pollution such as pit latrines or rubbish/garbage sites?
It is not only the distance from the well itself that must be considered, it is distance from the edge of the aquifer. Sometimes aquifers travel for miles underground. It is important that all efforts are made to check to ensure that the aquifer itself is not contaminated by any source (pesticides, fertilisers, mines, chemicals, pit latrines, garbage sites).

Is the borehole being constructed at the right time of year?

Drilling boreholes (like digging wells) should ideally be carried out in the dry season, when water tables are at their lowest. However, this is more important for hand-dug well construction.

During construction

Is the borehole being drilled correctly?

Boreholes are usually drilled by machine, although in softer ground (such as river gravels) they may be drilled by hand. Manually drilled wells are usually a maximum of 35 metres deep. If the hole is any deeper, machinery is usually needed. Some powerful machines can drill up to 200 metres below the earth's surface. It is particularly important that the borehole is vertical (ie straight down) otherwise a "down the-hole" (submersible) pump may be hard to operate and may become damaged.

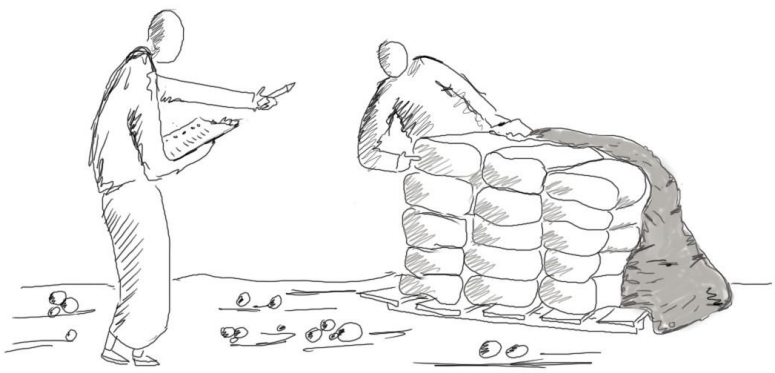
Many different drilling methods exist, depending on what machinery is available and the types of rocks in the ground (the geology). For more information on the different methods, please see the documents listed in 'Finding out more', below.

Is the contractor drilling to the correct depth? Sometimes, a contractor may want to drill deeper than is necessary – as they get paid per metre depth of completed hole! Drilling too deeply can cause damage to the borehole as water in an aquifer may be drained away. Also, water quality may be affected by hitting an aquifer where the water is saline (salty). (However, it is also the case that drilling may need to take place through a poor quality water aquifer to reach good quality water).

Is the supervisor present at the site for the right amount of time?

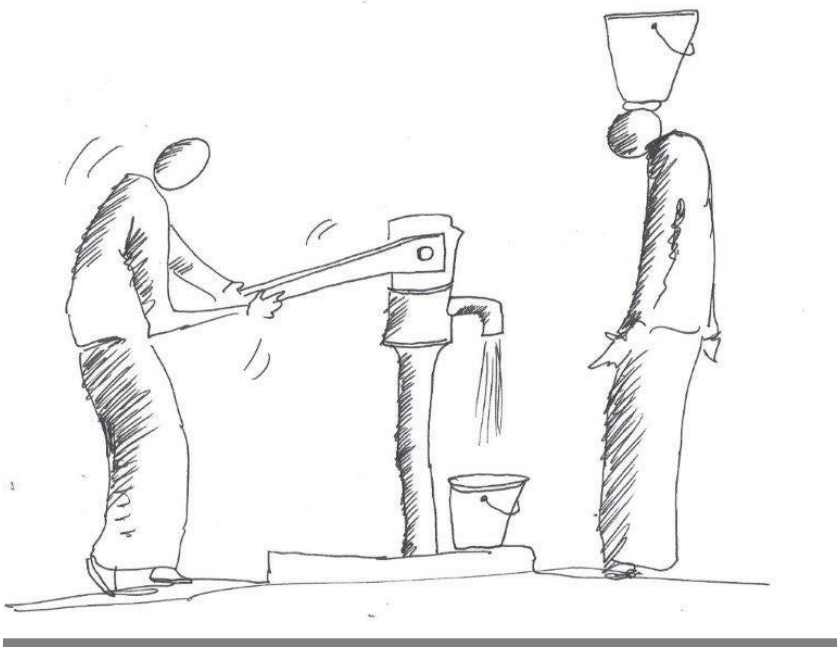
Are the contractors using the right type and amount of materials?

In some places, communities monitor the construction and supervision of boreholes. For example, communities could monitor the number of casing pipes installed, the number of bags of cement used by the contractor and the presence of the supervisor. See **Tool C1: Monitoring government spending** for more information on monitoring projects such as borehole construction.



What type of pump will the borehole have?

There are different types of pumps available. Hand pumps are often used, and the particular type depends on what is available locally. However, for a high-yielding borehole, it is worth considering a solar-powered submersible pump. This could feed to an elevated water storage tank, which could then feed, by gravity, to various tapstands. This is a much more expensive option in terms of the actual cost of the pump and equipment, but it means water can travel much further and so becomes cost-effective in quite a short time. For more information on solar-powered water pumps, see Practical Action's website: http://practicalaction.org/pumping-water-by-solar-power



Before the well is used

Will the well be properly developed and tested?

Before the well is used, it is good practice for it to be **'developed'**. This involves deliberately over-pumping water so that further fine particles are drawn into the sand and/or gravel packing. Flushing continues until the water from the hole is clean and free of fine materials.

Once the well has been constructed, it is also important for it to be tested **(a 'Pumping test')**. Testing gives useful information about whether the water supplied will be sufficient for its intended purpose. It will also give information on the maximum amount of water that can be drawn without risking overexploitation of the well. The water quality should also be tested before the well starts being used by the community.

Questions to ask include:

Will the well be developed before it starts being used?

Who will test the well? When will it be tested? How will the results of the testing be shared with the community?

Will the water quality be tested? How will the results be shared with the community?

It is very important that these criteria are written in the drilling contract so that the community are not left with an un-useable well.

Once the borehole is constructed

How much water can be drawn from the well?

It is important not to pump too much water from a borehole. Over-abstraction may cause the water table to drop lower that the depth of the well. If this happens:

- wetland could dry up
- the ground could collapse and craters could form meaning the land can no longer be used for agriculture
- saltwater intrusion could occur in coastal areas (increased salt concentration in the soil or groundwater)

How will the community ensure that over-abstraction does not happen?

How will the groundwater source be protected?

It is important to ensure that the groundwater does not become contaminated.

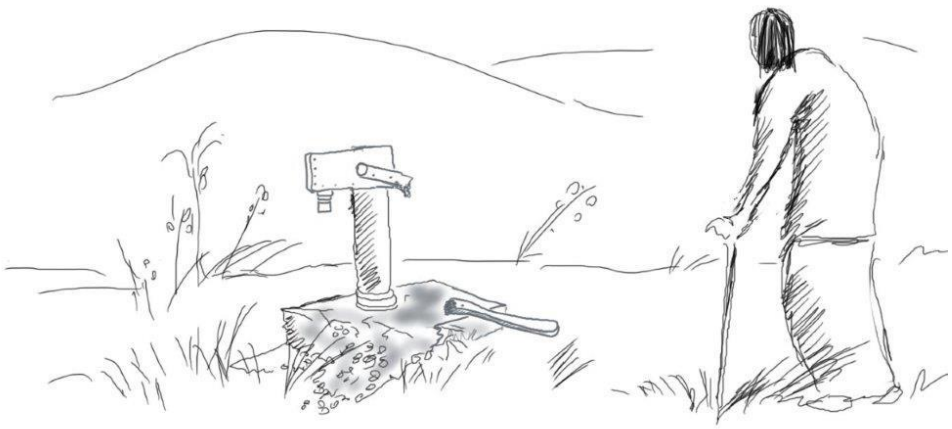
- no latrines, rubbish/garbage sites or burial sites should be within 50 metres of the well
- no chemical works or industries or mines should be built in a location that risks contaminating the aquifer which serves the borehole
- fertiliser/pesticides should not be used on land within 50 metres of the well, and a borehole should never be located on ground that is lower than the pesticide/fertiliser source

The water quality should be checked at key times of the year for bacteriological and chemical contamination. Groundwater levels should also be monitored.

Are measures in place to ensure that water quality and groundwater levels are checked at key times throughout the year? How will the results be shared with the community?

How will the borehole be maintained?

Many boreholes stop working after a few years because they are not looked after by the communities using them.



Communities need to decide on how to ensure the borehole will be operated and maintained. Some communities choose to set up a Management Committee (See **Tearfund's Footsteps 41** for more information about this – see **Finding out more**, below).

It is important for community members to understand that some payment is necessary for the water they use. These fees can pay someone to manage the borehole, and somebody to be responsible for the mechanical maintenance of the pump and motor including regular servicing.

- There are different ways of collecting fees. Here are two examples:
  a small fee each time water is taken. This relies on honesty and integrity of the caretaker and users).
- a monthly fee (people visiting are not included and there is no incentive to reduce wastage). This is a preferable method as it provides a monthly 'income' which can be used to pay a pump attendant, or replenish spare parts.

Ideally, the fee should be small enough to allow even the poorest people to use the borehole. However, the community may choose to allow the poorest families to access the well without payment, perhaps for a period of time.

However the community decides to collect fees, the accounts need to be kept by somebody trustworthy and respected, and be available to be checked by anyone in the community. All costs need to be thought about when deciding the level of fees. For example, the costs of maintaining and possibly replacing the parts of a hand pump, or the operation of a diesel-driven pump including the provision of fuel.

How will the borehole be looked after and maintained?
How will user fees be collected?
What is the procedure for making changes to the amount of fees or fundraising for major repairs?
If the pump or any parts of the well break, are replacement parts available in local markets/stores?
Will the community be able to purchase replacement parts?
Who will regularly service the pump and repair it when needed? If the pump is motorised (and particularly if it is a submersible pump), it will need somebody to remove the pump for repair. In case this happens, it is useful for the community to have a stand-by pump, or to be able to borrow one. Solar-powered submersible pumps are becoming popular. Ideally, with this technology, a repair contract needs to be agreed before buying it.
Will those responsible for construction return to the community to monitor the borehole and pump? Monitoring is needed 6 months after the borehole is constructed, and then once a year for the first ten years after construction.

Finding out more

- WaterAid (2008) Technology Notes, Section 7: Tubewells and boreholes
- Tearfund (1999) Footsteps 41 – *Looking after our land,* Article on Managing a borehole
- http://tilz.tearfund.org/en/resources/publications/footsteps/footsteps_41-50/footsteps_41/managing_a_borehole/
- Danert et al (2010) *Code of practice for cost effective boreholes*, Rural Water Supply Network
- Carter et al (2010) *Siting of drilled water wells: A guide for project managers*, Rural Water Supply Network
- http://www.sswm.info/content/drilled-wells Sustainable sanitation and water management

Related tools:

- B – Water for blessing (Bible study) *[B: Water, sanitation & hygiene-3]*
- B – Water for life (Bible study) *[B: Water, sanitation & hygiene-4]*
- C2 – Rainwater harvesting *[C2: Water, sanitation & hygiene-1]*
- C2 – Protecting a spring *[C2: Water, sanitation & hygiene-2]*
- C2 – Constructing a hand dug well *[C2: Water, sanitation & hygiene-3]*