WEDC

MOBILE NOTE 32

Cleaning and rehabilitating boreholes

TECHNICAL NOTES ON DRINKING-WATER, SANITATION & HYGIENE IN EMERGENCIES

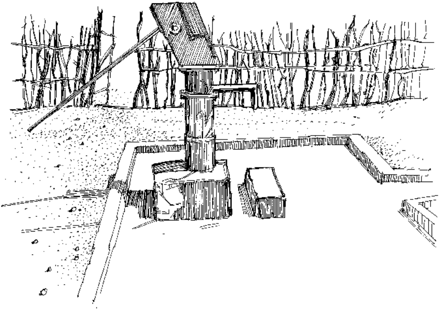
Originally designed for print, this is one of the series of highly illustrated notes prepared by WEDC for WHO to assist those working immediately or shortly after an emergency to plan appropriate responses to the urgent and medium-term water, sanitation and hygiene needs of affected populations.

TN 2

World Health Organization

Loughborough University

Contents



Boreholes are resistant to many forms of natural and man-made disasters. Although the components above ground may be damaged, the narrow opening at the top of the borehole often prevents contamination of the water source or damage to the pump components below ground.

The main exception to this is damage caused by earthquakes, which can be greater below ground than what can be seen on the surface. This technical note sets out the actions required to repair and rehabilitate a borehole after any disaster.

Driven and drilled boreholes

Boreholes fitted to handpumps fall into two categories pictured: *driven* and *drilled* (Figures 2 and 3). In general, it is easier and cheaper to replace damaged driven boreholes than rehabilitate them. It is usually worth rehabilitating drilled boreholes, however, as they are much more expensive to install and require specialist drilling equipment. This note focuses, therefore, on drilled boreholes.

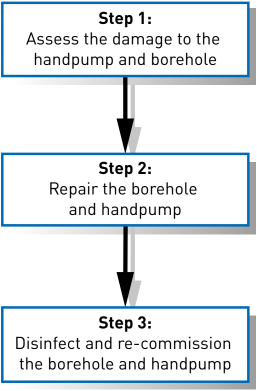


Figure 1. Steps for cleaning and disinfecting boreholes

Additional care is needed in the rehabilitation of boreholes close to the sea or coastal swamps because of the possibility of seawater intrusion of the groundwater. Figure 1 outlines a three-stage approach to rehabilitating damaged drilled boreholes. It is an emergency approach designed to produce water of a similar quality to that supplied before the disaster.

Box 1. Water quality

In general, groundwater contains no or low levels of harmful pathogens but it can be polluted with naturally occurring chemicals.

Unfortunately, the quality of water drawn from handpumps fitted to boreholes is variable. Contamination can be caused by poor sanitary protection at the top of the borehole. The installation of a sanitary seal and a well apron can dramatically reduce contamination from the ground surface (Figure 4). Sources of further information about improving and upgrading boreholes are given at the end of this note.

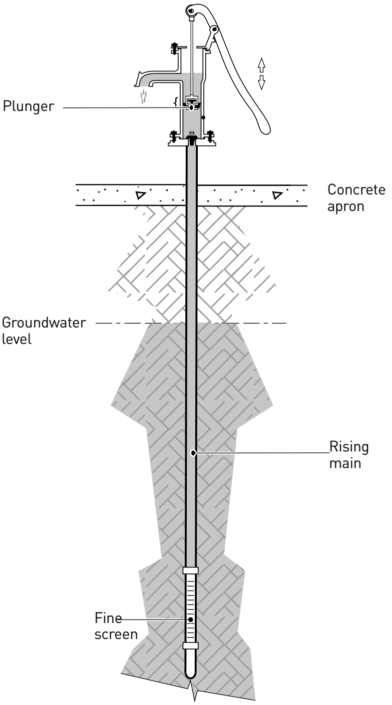


Figure 2. Direct action pump on a driven borehole

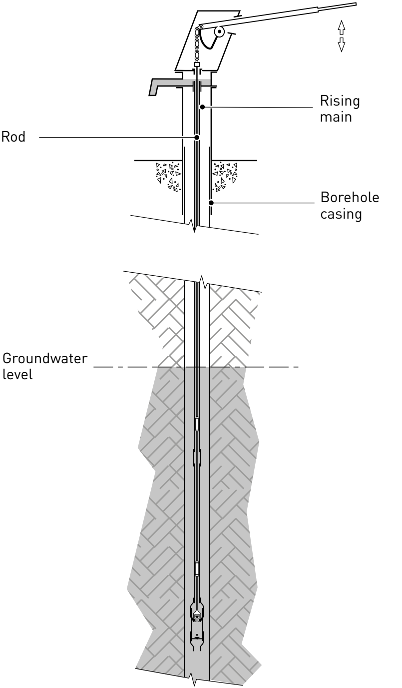


Figure 3. A deepwell pump on a drilled borehole

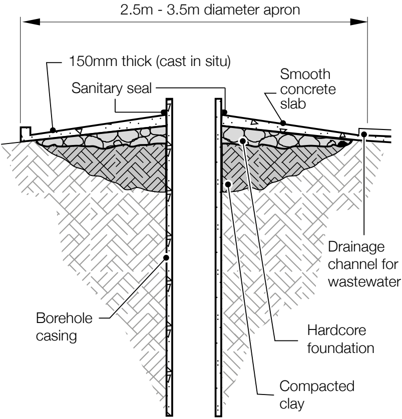


Figure 4. A sanitary seal and borehole apron (see Box 1)

Step 1: Assess the damage

- Meet with community leaders and ask them which handpumps serve each section of the community. Obtain any available records of the drilling of the borehole and the installation of the handpump, particularly concerning the materials used for lining the borehole, its overall depth and the depth to the screen.

- Select the handpumps that are most commonly used as a source of drinking-water, provided a plentiful supply before the emergency and are likely to be easiest to repair.
- In urban areas, check for possible contamination or pollution of the groundwater. Damaged septic tanks, leaks in industrial installations and fractured sewers may all be sources of contamination or pollution seeping into the ground. At the least suspicion of contamination or pollution, abandon the rehabilitation and seek specialist advice.
- Assess the type and extent of damage to the top of the well. This includes damage to the pump, its connection to the riser pipe and

borehole casing, the sanitary seal and the well apron.

- Remove the handpump and riser pipe from the borehole (Figure 5). Check for damage or blockage with silt.

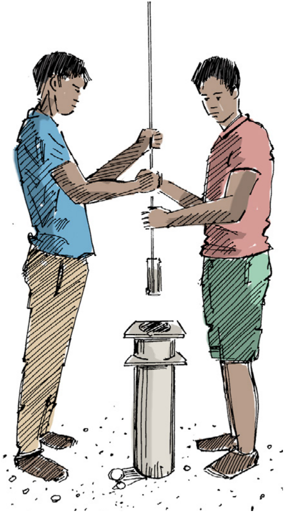


Figure 5. Removing the riser pipe

- Check the water level in the borehole. Ask the community what the water depth was before the disaster. Earthquakes, in particular, can cause a major change in groundwater levels. A significant lowering of the water level may require the riser pipe to be extended or, in the worst case, the abandonment of the borehole.
- Check for damage to the borehole casing and screen. Examine the pump riser pipe as it is extracted. If it is difficult to remove or has obvious signs of damage it is likely that the lining has been damaged. Borehole lining repair is difficult. For immediate improvement of the situation, stop the assessment and investigate alternative sources.
- Estimate the amount of silt and debris in the borehole. Examine the bottom of the pump riser pipe to see if it is covered in silt. A clean pipe

indicates that any silt that may have entered the borehole is lying below the bottom of the riser pipe.

- Dismantle the pump and riser pipe to check for damage and worn parts.
- Estimate resources needed for repairs (personnel, equipment, time and materials).

Step 2: Repair the borehole and handpump

1. Flush the sediment from the borehole. There are a number of ways of doing this but the simplest method is jetting. The silt at the bottom of the well can often be dislodged by a strong jet of water.

   Set up a system similar to that shown in Figure 6. The water jet will suspend the silt in the water flow and carry it to the surface as the water fills the hole. Continue pumping until the water flowing out of the top of the well is clear. From time to time you may have to lower the hose further into the borehole so that it remains close to the silt layer.

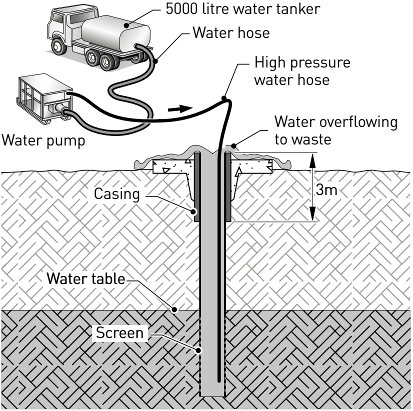


Figure 6. Flushing out a borehole by 'jetting'

Other methods are possible but require specialist skills and equipment.

2. Check the top of the borehole casing for damage. If it is bent or twisted it will not be possible to install the pump correctly. You may have to cut away the damaged portion of the casing and weld a new piece into place.
3. Repair any damage to the pump and riser pipe. Take the opportunity to replace worn parts.
4. Re-assemble the pump and reinstall the borehole components. Check that the pump is working, the water produced is clear of silt and the flow rate is acceptable. If the water still contains silt, remove the pump and flush out the borehole again. If, after two flushes, the borehole is still producing silty water, the borehole screen is probably damaged and no further attempt at repair should be made.
5. Repair the clay sanitary seal at the top of the borehole and the drainage

apron around the borehole to prevent surface contamination of the groundwater (Figure 4).

Step 3: Disinfect / recommission the borehole and handpump

Following rehabilitation, the borehole and all components must be disinfected to ensure a clean water supply. Operate the handpump for about an hour to remove any groundwater contamination caused by the disaster or the jetting process.

The most common method of disinfection is chlorination. The chlorine compound most commonly used is high-strength calcium hypochlorite (HSCH) in powder or granular form which contains 60 to 80% available chlorine. Sodium hypochlorite in liquid bleach form is also used but this only contains about 5% available chlorine.

The box below outlines a method for disinfecting a borehole using HSCH.

Pour the chlorine liquid into the borehole (you may have to remove part of the pump to do this). Replace the pump and operate it until chlorine can be smelled in the outflow.

Allow the water to stand in the borehole for 12 to 24 hours and then operate the pump until all the chlorinated liquid has been removed. If you have a chlorine test kit you can check the chlorine concentration in the water.

Alternatively, pump the water until it no longer smells of chlorine. Technical Note 11 gives more details on testing for chlorine.

Disinfection will not provide residual protection and therefore measures to ensure safe collection, handling and storage at home are highly recommended. This may include use of household water treatment.

Please see note 35 (TN 5) for details.

Calculating the chlorine dosage for disinfecting a well using high strength calcium hypochlorite (HSCH)

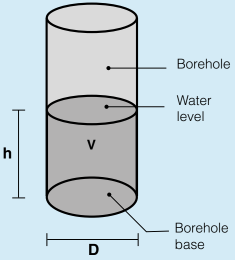
Equipment

- 20 litre bucket
- HSCH chlorine granules or powder

Method

- Calculate the volume of water in the well using the formula:

$$V = \frac{\pi D^2 h}{4}$$



Where:

V = volume of water in the well (m^3)
D = diameter of the well (m)
h = depth of water (m)
π = 3.142

- Multiply the answer by 1000 to convert the answer to litres
- Divide the volume of water (in litres) in the borehole by the volume of the bucket to establish how many buckets of disinfectant will be needed to replace the total volume of the water in the borehole.
- Fill the bucket with clear water
- Add 1g of HSCH powder and stir until dissolved (0.5g for every10 litres in the bucket)
- Pour the disinfectant into the borehole
- Make up sufficient buckets of disinfectant to replace the total volume of water in the borehole.

DANGER: HSCH and bleach give off chlorine gas which is a serious health hazard. Always add chlorine compounds to water rather than water to chlorine. Work in an area with a good flow of air to take away the chlorine fumes. Wear protective clothes, especially face and eye masks and gloves. Do not allow anyone to use the handpump during the cleaning process.

Further information

GODFREY, S. and BALL, P., 2003. 'Making Boreholes Work: Rehabilitation strategies from Angola', *29th WEDC Conference Proceedings,* WEDC, Loughborough, UK.

BALL, P., 1999. *Drilled Wells*, SKAT Publications, Switzerland.

EPA, 2006. *Private Drinking Water Wells: What to do after the flood* (viewed 03/02/2017) Available at: http://water.epa.gov/drink/info/well/whatdo.cfm

AGRICULTURE AND AGRI-FOOD CANADA, no date. *Water Well Disinfection Using the Simple Chlorine Method*, Water Stewardship Information Series. British Colombia. (viewed 03/02/2017) Available at: http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/wells/factsheets/PFRA_simple_chlorification.pdf

SKINNER, B. H., 2003. *Small-scale Water Supply: A Review of Technologies.* Practical Action Publishing, Rugby, UK

About this note

Prepared for WHO by WEDC.
Authors: Sam Godfrey and Bob Reed

Series Editor: Bob Reed

Illustrations by Rod Shaw courtesy of WEDC / IFRC.

Additional graphics by Ken Chatterton.

Designed and produced by WEDC

Water, Engineering
and Development Centre (WEDC)
School of Civil and Building Engineering
Loughborough University
Leicestershire LE11 3TU UK

Phone: + 44 (0) 1509 222885
Email: wedc@lboro.ac.uk
Website: wedc.lboro.ac.uk
Twitter: wedcuk
YouTube: wedclboro

World Health Organization
Water, Sanitation, Hygiene and Health Unit, Avenue Appia 20, 1211, Geneva 27, Switzerland

Phone: + 41 22 791 2111
Phone (direct): + 41 22 791 3555/3590
www.who.int/water_sanitation_health

BACK TO TOP