TECHNICAL NOTE No.4

Manual Drilling Techniques

UNICEF, Practica and Enterprise Works/VITA have developed a toolkit for African countries wishing to embark on the professionalisation of manual drilling. This toolkit includes Technical Notes, Technical Manuals, Advocacy Materials, Mapping of suitable areas for manual drilling, Case Studies, and Implementation and Training Manuals. This initiative builds the capacity of the local private sector in order to respond to the ever increasing demand for safe water in rural areas. This Technical Note is the **fourth** in a series of five.

Overview

When a borehole is drilled, different types of sediment and rock layers can be encountered. To drill through all these different layers a range of manual drilling techniques have been developed and are used around the globe. In each case the drilling technique must (a) break or cut the layers, (b) remove the cut material from the hole, and (c) if necessary provide support to the walls of the hole, to prevent collapse during drilling. Each drilling technique has been developed for either one or a range of specific sediment and rock types. In some situations, complementary drilling techniques can be used together for a single borehole. All existing drilling techniques can be classified in four main drilling principles: Hand Auger, Percussion, Sludging and Jetting.

Hand Auger

The hand auger consists of extendable steel rods, rotated by a handle. A number of different steel drill bits can be attached at the bottom end of the drill rods. The augers are rotated into the ground until they are filled, and then lifted out of the borehole to be emptied.

A different drill bit can be used for each sediment type. Above the water table, the borehole generally stays open without the need for support. Below the water table a temporary PVC casing may be used to prevent the hole from collapsing, and can be emptied either with an auger or a bailer. The permanent well casing is then installed, while the temporary casing has to be removed. Augers can be used up to a depth of about 15-25 meters, de-pending on the geology.

Hand Auger

Sludging

Sludging uses water circulation to bring the cuttings to the surface. The drill pipes are moved up and down. On the down stroke, the impact of the drill bit loosens the soil and on the up stroke, the top of the pipe is closed by hand, drawing up the water through the pipe and transporting the cuttings to the surface. On the next down stroke, the hand opens the top of the pipe and the water squirts into a pit, in front of the well. In this pit, the cuttings separate from the water and settle out, while the water flows back into the well. The borehole stays open by water pressure. To prevent the hole

Sludging

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from collapsing and reduce the loss of drilling fluid, additives can be useful. In this case the hole must be well developed to improve water quality. Sludging can be used up to depths of about 35 meters.

Percussion

With percussion drilling a heavy cutting or hammering bit attached to a rope or cable is repeatedly dropped into the open hole or inside a temporary casing. Usually a tripod is used to support the

Manual Percussion

tools. By moving the rope or cable up and down about a meter, the cutting or hammering bit loosens the soil or consolidated rock in the borehole, which is then extracted later by using a bailer. Just as with hand augering, a temporary casing of steel or plastic may be used to prevent the hole from collapsing. When the permanent well screen and casing are installed, this temporary casing has to be removed. Manual percussion drilling is generally used up to depths beyond 25 meters.

Jetting

Jetting is also based on water circulation and water pressure. As opposed to sludging, water is pumped down the drill pipe and the water and cuttings are transported up the hole between the drill pipe and the borehole wall. A motor pump is used to achieve an adequate water flow. The drill pipe may simply have an open end, or a drill bit can be added.

Jetting

Partial or full rotation of the drill pipe can be used. To prevent the hole from collapsing and reduce the loss of drilling fluid, additives can be useful. Manual jetting is generally used up to 40 meters.

Additional Information

Manual: Understanding groundwater and wells in manual drilling

Desk study: Inventory of manual drilling techniques.

Map of suitability for manual drilling

The RWSN hand drilling cluster group, see the website www.rwsn.ch

These Technical Notes and other materials are available in UNICEF web, www.unicef.org/wash/index_watersecurity.html

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