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INTEGRATED DEVELOPMENT FOR WATER SUPPLY AND SANITATION

Low technology drilling methodology (LTDM)

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SIMPLE DRILLING METHODS for rural handpumpequipped water supplies are becoming more widespread in their use. However, work to-date in this area has tended to concentrate on technological aspects. The sociological dimension cannot be ignored otherwise the application of sound engineering principles could fail. This paper presents a Low Technology Drilling Methodology (LTDM) which attempts to integrate social, economic and engineering criteria, and (if adhered to) should ensure success and sustainability of borehole-based rural groundwater supplies.

Drilling techniques

Drilling into the ground is not a new technology. Boreholes have been constructed in China for the last 4000 years (Driscoll 1986), and over 800 years ago some 4900 holes were recorded in Sichuan, China (Vogel, 1993). The techniques and equipment used were simple (cable percussion), and completion took considerable time periods, but the achievements cannot be ignored.

In the last 100 years drilling technology has evolved rapidly such that boreholes kilometres deep are common place and all types of rock can be penetrated. There is a whole range of engineering and technology now available. Augers are effective at shallow depths in unconsolidated deposits, and cable percussion is a simple but effective, although sometimes slow, way of making a borehole in weak to moderate strength rocks. Rotary drilling is the dominant drilling technique for hydrocarbon, mineral and water exploration. For the hardest rocks, such as granite or gneiss, down the hole hammers are effective (Driscoll 1986, BDA 1992, Elson 1994).

All of these techniques have been used in the last three decades to drill boreholes to tap groundwater, which can help solve the lack of drinking water in many parts of the world. However, despite the successes, with many boreholes completed, the operation of large drilling rigs is usually the domain of international donor agencies or governments. For communities that are developing and wanting self sufficiency and sustainability this presents several problems.

Problems for drilling in developing countries

Modern drill rigs are usually designed for speed and efficiency of operation with manual work minimised. They tend towards technological complexity and, as a result, are high cost and require specialist skills. Large engines are needed for the high energy inputs needed, and the resulting vehicles are often restricted in places they can access. Remote rural communities can be beyond their reach.

The economics of purchase, operation and maintenance of drill rigs puts them beyond the reach of all but very large organisations, thus there is a continuing dependence on donor or governmental agencies by smaller communities.

Importing technology and specialist skills for short periods does little to aid the process of development. Transfer of skills and knowledge takes time. It has been suggested that 90 per cent of technology transfer takes place within the private sector (Heeks 1995), but most drilling programmes do not fall in that category.

For many communities the water source is a focal point, and for longevity there needs to be community involvement and ownership. Visits by outsiders and their equipment do little to engender a sense of ownership or to enhance the overall development process.

Simple drilling techniques

In response to the potential problems, whether economic, institutional or technological, there has been a steady development of drilling techniques suitable for use by rural communities. This was a progression from the well established work in China and was documented by McJunkin (1967) who described options for simple percussion drilling and jetting.

An alternative is the Vonder Rig, an auger which was developed in Zimbabwe by Von Elling. Since 1990 internal combustion engine powered rotary rigs have also been available including the Eureka Port-a-rig, PAT and Lonestar machines. A summary of all of the techniques was presented at an earlier conference (Elson 1994, Elson & Shaw 1995).

Collectively, these drilling methods are suitable for weak rocks such as alluvium, colluvium or deep weathered zones where low energy inputs can excavate boreholes sometimes as deep as 80 metres. However, there are geological circumstances where they are not appropriate and the only alternative is larger sophisticated equipment.

Additionally simple drilling also tries to address some of the problems identified earlier. They are, relatively, lower in cost and because of their mechanical simplicity can be easily operated or possibly owned by rural communities. Being labour inefficient is a bonus because avenues for community involvement are provided, The small size is an advantage as portability will allow use in very remote locations.

Development framework

One of the key themes of development is that communities should be aiming towards self-reliance and long term sustainability. However, to achieve this a holistic approach is needed. To date consideration of drilling has tended to concentrate on technology, but for systems to be totally effective other aspects, discussed below, should be considered and integrated.

Technology

The drilling method should be suitable and appropriate for the given geology. The level of technology should, where possible, be indigenous and be matched to potential users in terms of ability and economics. It should be robust, easy to use and maintain, and spare parts must be available and standardised. Where possible manufacture should be local.

Social and institutional

Many members of the community should be involved and development not be stifled. Only a few days should be needed to train competent operators, and the drilling process should be a mechanism for the development and transfer of skills. Local manufacture would assist with investment in human resources. The mode of operation should not be divisive for any members of the community. It should be gender neutral and be operable by both women and men.

Economics

The cost of drilling should be low and ideally a least cost solution. Capital investment should be minimised, or the capital recovery period be low.

Environmental

Any environmental impacts must be low, and negative effects on infrastructure minimal.

These are target criteria and some may even be mutually exclusive, but this should not prevent progress.

Low technology drilling methodology

In order to summarise and encapsulate this holistic approach to simple drilling techniques it is suggested that it is called Low Technology Drilling Methodology (LTDM). A similar encapsulation of ideas related to the operation and management of handpumps was proposed by Arlosoroff et al in 1987. This is the well known VLOM design principle.

LTDM

For a drilling method to contribute towards sustainable development it should attempt to comply with the following criteria.

Socially aware

- The community where drilling is taking place must be actively involved.
- It must be a mechanism for the development or transfer of skills.

• The activities should be gender neutral.

Design simplicity

- Equipment should be portable so that localities without roads can be reached.
- It should be easy to use, requiring minimal formal training.
- Maintenance should be straight-forward with no complex operations.

Robust

- Resistant to abuse.
- Equipment to be durable and with a long life.

Standardisation

- Drilling methods to be appropriate to the geological environment.
- Avoidance of unnecessary variations.
- Systems to be adopted and supported by many governments and NGO's.

Locally made

- Made or assembled in-country from freely available plans.
- Spares available locally.

Cost

• Least cost solution.

Technology alone cannot solve developmental water supply problems but it is suggested that using LTDM will encourage people-centred problems to be addressed. There are many anecdotal examples of borehole water sources failing because of lack of perceived ownership. Sometimes technology is used that has required years of training for proficiency, so that it appears utterly alien to rural communities. Drilling works are usually of relatively short duration, thus exposure to new skills in a particular location is limited.

All of these are "software" problems for which solutions are less well defined. However, unless the problems are acknowledged they can never be solved. LTDM provides the framework for an integrated approach which in the long-term could provide simple drilling equipment for selfreliant and sustainable community use.

LTDM (Low Technology Drilling Methodology)	
	Socially Aware
	Design Simplicity
	Robust
	Standardisation
	Locally Made
	Least Cost Solution

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