EXECUTIVE SUMMARY

INTRODUCTION

Handpumps are already used extensively all over South Africa for community water supplies. In some areas these pumps, or additional ones, are also used for livestock watering and even micro industries such as brick-making. Yet, despite the fact that boreholes equipped with handpumps are among the simplest of community water supply technologies, much of the investment has been very ineffective in providing for the basic needs of these people because of high failure rates.

At any time, approximately 50% of the pumps installed for these dependent communities are not working. Often the users cannot even find out if the failure is due to the borehole drying up or to a mechanical pump failure. Of the pumps that are working, the majority are in extremely poor condition, causing long priming times in the morning and continued low delivery rates thereafter. The reason for the low delivery rates is not always clear. Pump handles have often been replaced by improvised ones, are loose at the point of attachment and have bearings that are worn right through. When pumps fail completely, it is often several months before they are repaired. The atrocious availability and performance are due to poor borehole development, inadequate pump design, poor pump selection and installation and, above all, completely inadequate monitoring and maintenance.

Water quality from many of the installations is poor. Sometimes the poor water quality is due solely to contamination caused by corrosion products leached from an incorrectly selected borehole pump and/or casing material.

International experience has demonstrated that high failure rates are not inevitable and that handpump installations can be transformed into effective reliable low-cost solutions through the systematic adoption of appropriate design technologies and implementation policies. A key factor in achieving this transformation, as motivated and reported by the World Bank, has been the adoption of the **VLOM** concept for the provision of these handpumps. This concept starts with the selection of handpumps specifically designed for **Village Level Operation and Maintenance** and extends to the whole question of the benefits of community participation, management and ownership, the training and employment of community operation and maintenance technicians, and the reduction (but not elimination) of the communities' dependence on external support systems.

The latest information available from the Department of Water Affairs and Forestry (DWAF) indicates that there are approximately 18 million people living in South Africa without access to a basic safe water supply, as defined by the RDP minimum level of service (DWAF, 2000), and that at current rates of investment it will take between 25 and 40 years to bring these people up to this minimum adequate level of service (DWAF, 1999). For health reasons alone, there is an urgent need to make **an improved water supply to the maximum number of people in the minimum period of time** a major national goal. On the basis of requiring the shortest lead time and lowest total monetary investment, the handpump option is probably the best current choice for an intermediate improved level of service for at least-one third of the 18 million people currently with an inadequate water supply.

It is therefore of vital importance that handpump manufacturers, suppliers, users, planners and project implementation agencies have access to up-to-date comprehensive information on the strengths and weaknesses of handpump installations and how the **VLOM** concept can and should be implemented.

AIMS

The aims of the research project were therefore to propose a strategy for overcoming these diverse problems in a cost-effective manner in order to improve the effectiveness of handpump installations in meeting community needs nationwide.

With these aims in mind the work was planned in two phases.

The aim of phase 1 was to review the situation in South Africa by:

- establishing the essential requirements for effective handpump installations,
- evaluating current practices to highlight problem areas,
- assessing the economics and effectiveness of centralised maintenance, and
- evaluating the handpumps currently available in South Africa and the back-up service provided by suppliers.

The aim of phase 2 was to formulate a cost-effective strategy for overcoming the key organisational and technical problems highlighted during phase 1. This was done by:

- assessing the potential of VLOM pumps for use in South Africa, such as the SKAT Afridev, the India Mark III and the Netherlands Volanta, and
- assessing the potential for training community-based operation and maintenance personnel and for introducing community management of maintenance.

The research succeeded in taking account of these objectives and has resulted in this report which comprises the following chapters:

- a literature survey supplemented with information obtained from handpump suppliers and personal communications,
- an overview of South African handpump installations and an analysis of records of groundwater levels and corrosiveness, and borehole recovery rates,
- the results of a survey of handpump stakeholders comprising a survey of South African handpump manufacturers, a worldwide survey of handpump purchasers and a survey of handpump users in rural villages from the Southern District of Northern Province, South Africa,
- a description of the planned test-rig evaluation of handpumps, and
- a discussion of the previous sections leading to conclusions and recommendations.

MAJOR FINDINGS

The literature survey was done to highlight the critical constraints impeding effective service delivery and to check how others had solved them. Technical problems reported were more extensive than anticipated. Whilst practical solutions were usually given, the occurrence of these problems does stress the need for careful project implementation and the systematic checking of site-specific criteria as implementation proceeds. The criteria to be checked are set out in five boxes in the final chapter of the report. Soft issues related to community participation and empowerment, skills training, cost recovery, transparency, the setting-up of a proper spares network and the building of capacity in decentralised institutions were also reported in the literature. The need for ongoing monitoring of village-level institutions was not stressed but appears to be essential for long-term effectiveness.

The in-depth analysis of borehole and handpump installation records was done to determine the extent to which the different critical constraints highlighted from the literature apply in South Africa. The analysis confirmed that they all apply. In addition, there is strong evidence that daily water level drawdown during pumping causes the average depth from which water is pumped in South Africa to be significantly greater than in the rest of the world.

The survey of different stakeholders was done to achieve better problem definition, to learn from the experience of others and to examine conflicting evidence before proposing a plan of action to implement effective community water supply systems using handpumps. The survey of South African manufacturers established that they make robust products in adequately equipped facilities to comprehensive quality control procedures. However, despite the urgent need as evidenced by all the other sections of this report, none make handpumps incorporating VLOM concepts or corrosion-resistant materials. This appears to be due to purchasers' buying on price alone and without an adequate specification. The survey of handpump purchasers revealed that most understand what is required to produce more effective installations. However, in contrast to purchasers from outside South Africa, local purchasers generally had a very negative attitude towards handpumps, which must lower their motivation to strive for improved installations.

Users made it clear that they appreciated the handpumps in their villages (when they worked). The alternatives, buying water from vendors, using unsafe water from rivers, relying on springs that dried up every winter and digging in river beds in search of clean water, all gave the users an appreciation of the benefits of village handpumps. As well as using them for domestic water supplies, the majority of communities use their handpumps for at least one other purpose: livestock watering 47%, community gardens 33% and building 13%. This indicates the importance of ensuring the effectiveness of handpump systems until they are upgraded to a higher level of service.

However, this appreciation should not be confused with satisfaction. Varying levels of dissatisfaction and unrealistic demands will still be the norm until users understand the costs associated with other options and see equitable tariffs more closely related to these costs being introduced systematically throughout their region for those who can afford them. In addition many communities fear that making handpump systems more effective will jeopardise their hopes of obtaining a higher level of service later. All communities want to know that they are being heard with consideration. A synthesis of their comments on what is required to provide an effective service using handpumps follows.

"Check the quality of the water before deciding if and how the borehole is to be fitted out. Improve the delivery rate of the pumps; this includes ensuring good preventative maintenance. Make the pumps more reliable. Above all shorten the time for repairs. Put in more pumps closer to our homes; this will cut down the walking and queueing times, and will also reduce the number of breakdowns because the pumps will not have to work so hard."

RECOMMENDATIONS

The consolidated findings from the literature survey, the analysis of borehole and handpump installation records, and the surveys of handpump stakeholders indicate that three broad areas of project implementation have to be carried out competently to achieve effective community handpump systems. The three broad areas are:

- the development of the borehole and the measurement of recovery rates,
- the selection and installation of the handpumps, and
- ensuring adequate village, local government and private enterprise institutional and skills capacity.

The three broad areas of handpump project implementation can be broken down into greater detail as follows:

The borehole

- Select drilling positions with the future customers.
- Check that the water quality is fit for purpose - health, taste and colour.
- Check if the borehole should be developed by over-pumping, intermittent pumping, backwashing or surging.
- Check the borehole pumping yield and recovery rates for different drawdown depths by doing a simple constant drawdown and recovery-from-drawdown test.
- If the recovery rates are all very low consider hydro-fracturing, and retest if hydro-fracturing is carried out.
- Check for indications that the water may be abrasive - if yes, select suitable filter packing to be used outside the well casing to minimise such abrasion.
- Check for indications that the water may be corrosive - if yes, use a uPVC casing material.

The handpump

- Check the preferences with future customers.
- Check the need to consider the corrosiveness of the water.
- Check the pump's likely future operational duty point by looking at the intersection of a good handpump's QH curve with the borehole's recovery rate curve.

- Check if the demographic area has already standardised on a VLOM pump which satisfies the three criteria described immediately above.
- If yes, buy the standardised pump. If no, write a specification for a suitable VLOM pump covering the three criteria described above. Buy against specification: never buy on price alone.
- Select a suitable pump platform to cater for all customer ergonometric and hygiene needs.
- Install the pump in a manner which allows the level of the water in the borehole to be measured without removing the pump. The level measuring area must normally be sealed off.

The institutional requirements

- Local water authorities and their agents need to have a positive attitude towards handpump installations.
- Before installing the handpumps, ensure that the location and number of handpumps installed is acceptable to the customers. The daily demand from each pump should be supplied in five hours.
- Having sufficient village level institutional capacity and technical skills for the day-to-day care of the installed handpumps is critical. Instruction books for monitoring the borehole and caring for the pumps must also be available.
- An equitable cost recovery system managed transparently by village level institutional structures is also critical.
- Sufficient local government capacity to monitor village-level institutions and manage major maintenance work is needed.
- Sufficient capacity needs to be built up locally to carry out major maintenance work.
- A proper spares network needs to be set up.

CONCLUSIONS

The project results clearly highlight what is required for the development of effective community water supply schemes using deep and shallow well handpumps. Despite the South African focus, the majority of the findings apply universally. The report also gives comprehensive details on how to implement the majority of the micro recommendations. For example, the report explains how to carry out a simple borehole recovery test, how to use the test results to draw a curve indicating the recovery rate at different drawdown depths and, finally, how to use the curve to help with the selection of a suitable handpump. Having demonstrated clearly that VLOM pumps do play an important role in the implementation of cost-effective sustainable projects, the report goes on to indicate that choosing the correct VLOM pump is still critical.

More countries around the world are paying attention to such technical details and critical socio-economic factors. The results can be seen in the improved percentage of pumps operable at any time.

However, in South Africa, in most areas of the Eastern Cape, KwaZulu-Natal and Northern Province this is not happening and the situation is critical. In neighbouring Botswana and Lesotho the standard of domestic water supplies is high but handpump installations seem to have been left out of the thrusts which achieved these impressive standards. Mozambique recently embarked on an ambitious programme of water delivery to rural areas using handpumps. However, there have been problems, many of which could be solved using the findings of this report.

The strength of the report lies in the manner in which it integrates information from diverse sources and comes to new insights through dealing with the borehole, the handpump and the community's circumstances as a single entity. Also innovative is the extent to which it encourages a structured analysis of situations before deciding on a definitive course of action. These comments are particularly true in cases where, up to now, community and local government empowerment have been weak and/or water is to be lifted from deep boreholes with low recovery rates. Other aspects covered comprehensively are abrasion and corrosion.

RECOMMENDATION FOR FURTHER RESEARCH

In the course of the study it was established that the majority of technical challenges in relation to requirements for the development of effective community water systems using deep and shallow well handpumps have been solved.

There are however still two outstanding queries with respect to the suitability of handpumps fitted with uPVC riser mains to handle pumping heads in excess of about 35 m . The test-rig built and partially commissioned as part of this study would be ideally suited to finding an accurate answer to one of these queries, namely: how effective riser main centralisers are in arresting elastic deformations in such riser pipes, which cause a major reduction in discharge rates at high heads. The second query is: how effective are such centralisers in overcoming the fatigue failures experienced with such riser pipes at high heads? It can reasonably be inferred that if such centralisers reduce the elastic deformations to the extent that they no longer affect the discharge rate they will also overcome the problem of fatigue failures. Thus using the test rig for such testing would provide answers to these questions.

The rig could also be gainfully used for speedily increasing our knowledge of the pumping rates that can be achieved by users of different types and makes of handpumps at different water levels, and for checking and perfecting the performance characteristics of new pumps.

Lastly uPVC riser pipes are difficult to manage during pump installation and, where necessary, abstraction because of the use of solvent cement site joints. Some research needs to be done to perfect a viable alternative. SKAT of Switzerland, together with Preussag of Germany, and/or Van Reekum Materials of the Netherlands, are ideally suited to carry out this work.

Other information gaps would be best met through the activities described below.

RECOMMENDATION FOR TRANSFER OF RESULTS

The report ends with recommendations on how to transfer the results of the study into best practice in the field. This requires two basic activities:

- the revision or writing of certain technical specifications, and
- the implementation of demonstration projects, with the support of a national coordinating organisation to ensure that these projects act as a catalyst for countrywide replication.

There are still information gaps. Most of these relate to the need to supplement qualitative findings contained in this study with more detailed quantitative information. The proper implementation of the proposed demonstration projects, together with the encouragement this will give for accurate borehole installation monitoring throughout South Africa, would fill these gaps and over time dramatically improve the effectiveness of community water supply systems using handpumps on deep and shallow wells.