World Relief
MOZAMBIQUE

RURAL WATER SUPPLY AND SANITATION PROGRAMME

Chicualacuala, Chigubo, Guija, Mabalane and Massangena Districts
Gaza Province
January 1994 to September 1995

Final Report

Steve Ray Bsc, Msc
Programme Director

December 1995

World Relief Mozambique
Av Martires da Machava, 986
CP 680
Maputo, Mozambique.

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ACKNOWLEDGEMENTS

I would like to thank all the members of the World Relief water team for their commitment and hard work throughout the Programme Thanks are also due to all other World Relief staff who supported and assisted in the successful implementation of the Programme.

Assistance, advice and the continued cooperation of Leo Stolk at PRONAR, Justino Banhane and Ben Lamoree at DNA, Manuel Figueiredo at DPOPH-Gaza and EPAR-Gaza was much appreciated and without whom the Programme could not have been implemented as effectively.

LIST OF ACRONYMS

DNA	National Directorate of Water
DPOPH	Provincial Department of Public Works
EAR	Rural Water Supply Programme Workshop
EPAR	Provincial Workshop for Rural Water Supply Programme
EWSI	World Relief Emergency Water Supply Intervention (1992/93)
GEOMOC	Mozambican Parastatal Drilling Company
GOM	Government of Mozambique
INPF	National Institute for Physical Planning
LWF	Lutheren World Federation
MMMU	World Relief Mobile Pump Maintenance, Repair and Monitoring Unit
MSF (CIS)	Medecins Sans Frontieres Celula Inter Seccoes
NRC	Norwegian Refugee Council
OIM	International Organisation for Migration
OMM	Mozambican Women's Organisation
PEC	Community Participation and Education Programme
PMG	Pump Maintenance Group
PRONAR	National Rural Water Supply Programme
SCF	Save the Children Federation (US)
SDR	Swiss Disaster Relief
RWSSP	World Relief Rural Water Supply and Sanitation Programme
UNHCR	United Nations High Commissioner for Refugees
USAID	United States Aid for International Development
VLOM	Village Level Operation and Maintenance
WRC	World Relief Corporation

EXECUTIVE SUMMARY

World Relief's Rural Water Supply and Sanitation Programme (RWSSP) was a direct follow on from the 1992/93 Emergency Water Supply Intervention (EWSI) along the Limpopo Corridor in response to a continued severe shortage of water in the districts of northern Gaza. It sought ultimately to provide communities with access to clean secure water sources by drilling further boreholes and installing manual pumps that were sustainable in the long term and to expose the population to water, sanitation and health messages which made the link between maintaining a clean water source, good sanitation and hygiene practices and good health.

The programme covered an extensive area of about 50,000 km² in the north of Gaza Province and included the Districts of Massangena, Chigubo, Chicualacuala, Mabalane and Guija where it's activities touched on some 70 villages.

The implementation of the Rural Water Supply and Sanitation Programme began in January 1994 and came to an end in September 1995. During this time WRC:-

- Carried out a baseline survey in 4 districts, sampling 2022 households and 15,179 inhabitants.

- Drilled a total of 156 boreholes in two phases 127 were productive boreholes giving a success rate of over 80%. The overall average borehole depth was 46m. Average cost per productive borehole was about US$ 4,000 or US$ 85 per productive metre. A comparison of borehole costs with the 1992/93 EWSI reveals a significant (25%) reduction in drilling cost from the US$ 115 per productive metre it cost then.

- Drilled three shallow boreholes using manual drilling equipment (Vonder Rig) and rehabilitated a further three.

- Installed 133 handpumps - 109 Afridevs, 19 Volantas and 5 Bucket Pumps.

- Established community maintenance and sustainability capacity through training pump maintenance groups, encouraging communities to be financially responsible for their pumps by setting up maintenance funds and by making spare parts available for communities to purchase.

The Rural Sanitation Programme, based on the National Institute of Physical Planning (INPF) "Projecto de Latrinas Melhoradas", was implemented in selected areas for logistical, practical and geographical reasons. Community response to the programme was mixed but by the end of the programme 16 demonstration improved traditional pit latrines had been built by WRC in 13 villages and over 1,400 households had adopted the design and built latrines for themselves.

Community water, sanitation, hygiene and health education was carried out hand-in-hand with both handpump installation and latrine construction. It became clear that the link between clean water good sanitation and hygiene practices and good health was being made and understood by many of the communities.

Water source, time, distance and quantity analyses both before and after the implementation of the programme in Massangena District indicated that:-

- Use of protected pump water sources had changed from 7% of the population to over 97%
- Average usage per household had increased from 58 l/day to 77 l/day - an increase of 33%
- Average distance to source had been reduced from 2.6 km to 0.7 km
- Average time taken to collect water per day had been reduced from 84 minutes to 30 minutes
- The incidence of dysentery reported for the 3 month period before the respective surveys , had dropped from 32% of households sampled to less than 1%.

For the programme target area as a whole an estimated 130,000 people now have access to clean water. Protected water sources with pumps now provide about 1,450,000 litres per day or an average of 11 litres per person per day.

INTRODUCTION

In 1992 World Relief responded to the worsening drought situation in the northern districts of Gaza Province and specifically the Limpopo Corridor by implementing an Emergency Water Supply Intervention (EWSI) At the end of this intervention it was clear that there was still a severe water shortage in the region. With an anticipated influx of refugees/returnees from neighbouring South Africa and Zimbabwe following the realisation of the October 1992 peace accord and a timetable for elections the situation was set to get worse. A number of previously inaccessible areas were also opening up as returnees, with the assistance of UNHCR and OIM, made efforts to reach their original villages. To facilitate their return water was a priority

In response to this need and the recommendations for future work made in the EWSI Final Report of August 1993, World Relief (WRC) proposed a more extensive and integrated Rural Water Supply and Sanitation Programme to include two previously inaccessible districts - Massangena & Chigubo, to raise the quantity of potable water available in the other three districts - Chicualacuala, Mabalane and Guija, and to take into account the need to move away from emergency interventions and onto rehabilitation and development initiatives initiatives which focussed on community involvement, education and training.

The following report gives details of this Rural Water Supply and Sanitation Programme which began in January 1994. It is an attempt to record clearly and concisely the activities which made up the programme. It is hoped that it will provide objective information and recommendations which may be useful to others implementing or planning to implement similar programmes. A series of Appendice's contain most of the technical data and detailed information about the programme. Appendix E includes detailed schematic maps of the region.

Chapter 1 Background and History

In September 1993 WRC put together a proposal for an expanded Rural Water Supply and Sanitation Programme designed to build on the knowledge and experience gained during the implementation of the EWSI and to address the water needs in the 5 districts in northern Gaza - Massangena, Chigubo, Chicualacuala, Mabalane and Guija An integrated water, sanitation and basic hygiene and health education programme was proposed which encouraged community participation and education. It placed emphasis on developing the community's capacity to secure and maintain their water supply in the long term and in making the link between clean water, good sanitation and hygiene practices and good health.

1.1 Programme Objectives

The primary objective of the Rural Water Supply and Sanitation Programme was to achieve a secure supply of potable water to meet the recommended basic needs of the target population - a minimum of 10 litres per person per day for an estimated target population of 44,000, to ensure the communities acceptance of the responsibility for its water supply and invest in the communities capacity to maintain and manage its water supply in such a way that it independently meets its responsibilities in the long term.

This was to be achieved by:-

Carrying out a water resource survey and needs assessment in the districts of Massangena and Chigubo

Identifying in association with PRONAR, DPOPH-Gaza, local administrations, UNHCR and other NGOs areas of need which have the potential for groundwater development.

Drilling 110 producing boreholes. by tendering and contracting out to a drilling company and by training a team to drill shallow boreholes using manual equipment, following criteria of DNA and PRONAR.

Installing 110 handpumps (Afridev & Volanta) on the productive boreholes in line with the guide-lines of PRONAR and including PEC.

Strengthening and developing the community's responsibility for their water supply through:-

i) The training and support of community selected individuals in pump and well head maintenance and by encouraging communal participation
ii) Encouraging and motivating the community to take financial responsibility for their pump by setting up a maintenance contribution fund and by collecting money to buy spare pump parts
iii) Making spare pump parts available and accessible
iv) Providing technical and organisational support and advice and refresher training for a year after the implementation of the programme

Promoting improved public sanitation and health through the construction of improved traditional pit latrines following the guide-lines of INPF "Projecto de Latrinas Melhoradas" and through a community awareness and water, sanitation, hygiene and health education programme

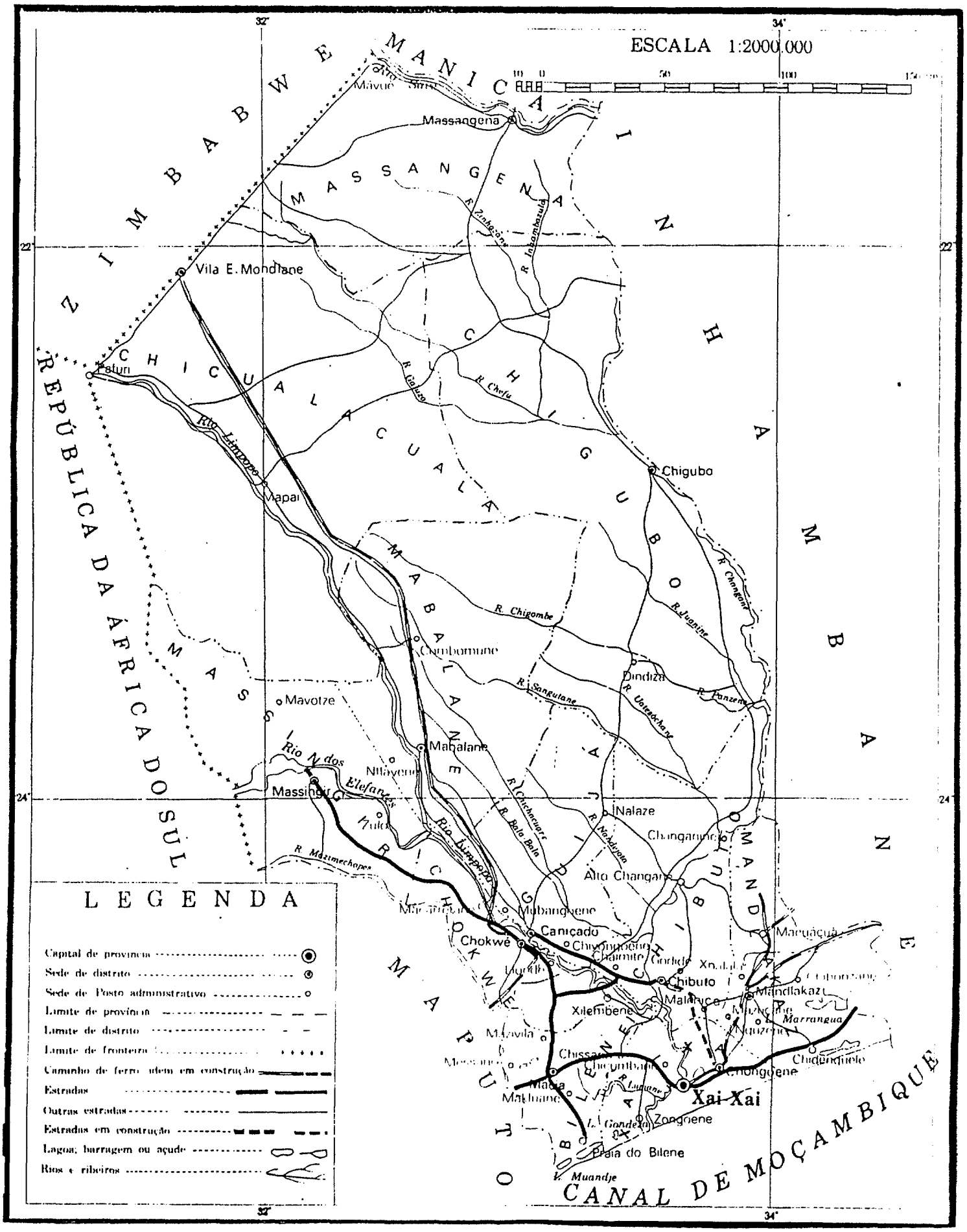
Carrying out a baseline survey and water source, time, distance and use analysis in selected target areas and to monitor the impact of the programme

Monitoring the performance of all boreholes and pumps, their use, water quality and changing community requirements.

Continuing to invest in human resource development and training of national staff in borehole design, water technologies and project planning, implementation, monitoring and reporting.

FIGURE 1

Província de Gaza



1.2 Funding

Funding for the Rural Water Supply and Sanitation Programme with a budget of nearly US$ 2,300,000 was provided through an amendment to the original grant for the EWSI from USAID and from UNHCR and WRC

1.3 Staffing

The staffing structure for the programme is shown in Figure 1.3. Other than the expatriate Programme Director and the South African Shangaan-speaking Community Education Advisor the staff were all Mozambican nationals. The overall male:female ratio was 8:10 (excluding the community masons).

The Borehole & Pump Test Technician (male) and Pump Installation Assistant (female) were contracted for 16 months from EPAR, Xai-Xai and 14 months from EAR, Chokwe respectively. Both had previously worked with WRC on the EWSI. The contractual agreement was such that WRC would pay salaries in line with their staff salary structure for Mozambique but would also pay EPAR/EAR for their services. The advantages of this agreement were three-fold. Firstly it meant the staff themselves received a reasonable salary for the work they were expected to do and were receiving similar salaries to staff contacted directly by WRC so there was no resentment within the team and they were motivated (a problem encountered during the EWSI when they continued to receive EPAR/EAR salaries). Secondly it meant that EPAR could theoretically take on and train 2 new members of staff paying them with the money they received from WRC thus building up their personnel resources for the future. Thirdly, WRC would not have to train all staff from scratch and could benefit from their experience with Agua Rural. In return they would go back to their respective posts having been exposed to programme planning, implementation and management training.

The Pump Installation Technician and Construction Supervisor also worked on the EWSI and were trained during that programme. These 4 key personnel formed the core of the 'water team'. All other staff members were recruited locally.

This structure represents the framework in which the programme was implemented. Considerable overlapping existed between the various activities. The ability and flexibility of all staff to do jobs outside their 'official' duties was of paramount importance due to the size and geographical extent of the programme. The need for this flexibility was reflected in the training staff received.

1.4 Staff Training

All staff members participated in short training courses and on-the-job training. Table 1.4 outlines the training undertaken both before and during the programme. In addition to these courses, larger training seminars/workshops were facilitated by WRC in association with other organisations. These will be detailed later on in the report under the relevant activity.

On-the-job training was carried out primarily during the first 6 weeks of the field programme in Massangena during April and May 1994. Massangena provided a good opportunity and environment for training for a number of reasons:-

i) All programme activities were to be carried out in the District so all staff members were present and interaction possible.
ii) At least 25 boreholes were to be drilled within a relatively short distance. One stable camp was possible and short travelling distances meant there was time for training
iii) The Programme Director could be present throughout the period to train and supervise training, stimulate discussions and develop lines of communication
iv) The District comprised both rural dispersed communities and communal villages so animators were exposed to the problems and differences associated with each early on.
v) The likelihood of success with the drilling programme and the potential impact appeared good and was thus a motivating factor for WRC staff.
vi) Massangena District is very isolated so there were few distractions!

Figure 1.3 Staffing Structure for Rural Water Supply and Sanitation Programme

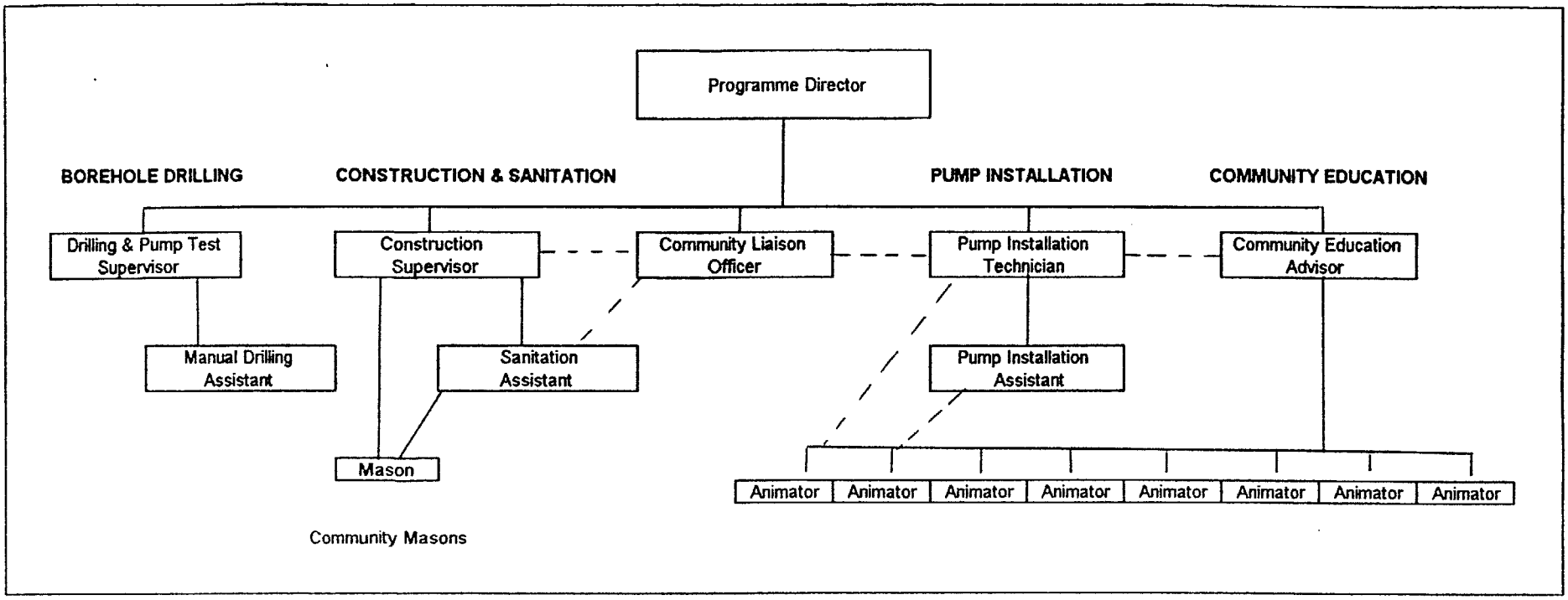


Table 1.4 World Relief Staff Training Courses

Training Course	Location	Participants	Objectives
Rural Sanitation 1 week	INPF, Xai-Xai	Construction Supervisor Sanitation Assistant Mason	Learn about Projecto de Latrinas Melhoradas Specifications for improved traditional pit latrines Learn how to make concrete latrine slabs and tops Recording of consumables used
*Animator Training (PEC) 2 weeks	World Relief, Chokwe	Animators Community Liaison Officer (Construction Supervisor) (Sanitation Assistant)	Identify scope of work, responsibilities and linkages between different activities of programme Learn methods, target groups and education messages for water, sanitation , hygiene and basic health matters
Baseline Surveys 3 days	World Relief, Chokwe Practical, Donga	Animators	Learn how to carry out Baseline Surveys, the need of, interviewing techniques and sampling method
Afridev Pump Installation 2 Days	7 de Abril, Guija	Animators	Be familiar with the Afridev pump, how it works, names of parts and costs, installation and maintenance
Manual Borehole Drilling 1 week	Barragem, Chokwe	Drilling Supervisor Manual Drilling Assistant	Learn how to use the manual drilling equipment - The Vonder Rig and the construction, casing and testing of shallow boreholes.

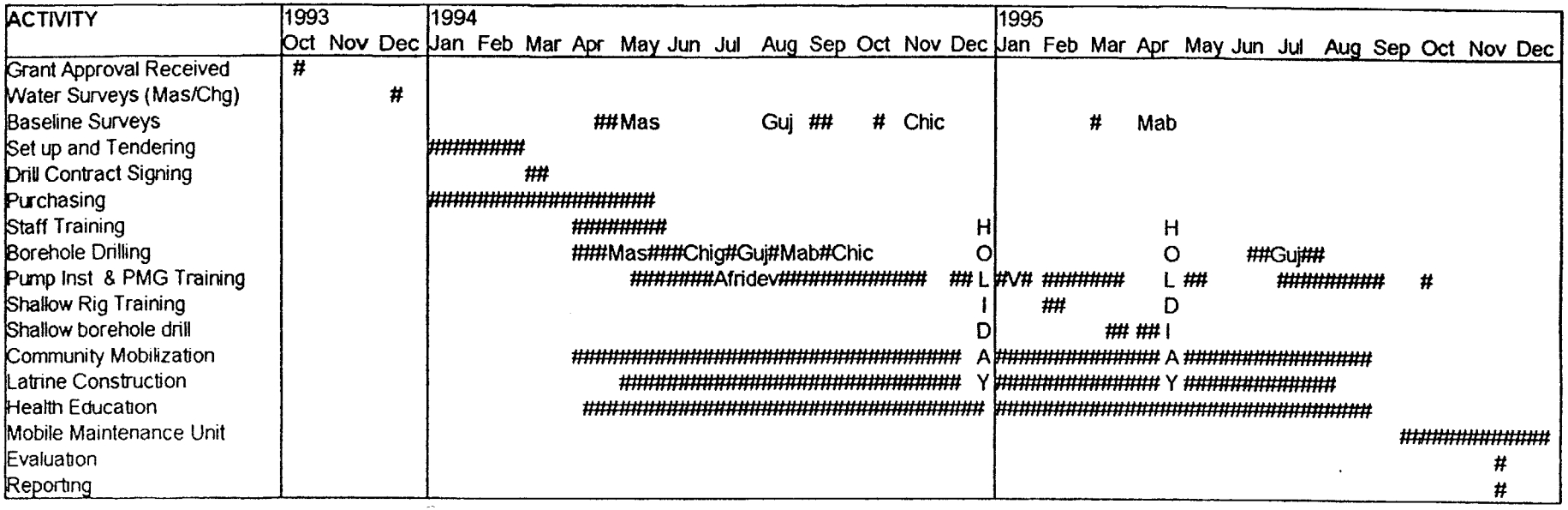
* Animator training broadly followed the guidelines of PEC

1.5 Programme Implementation

The schedule for the actual implementation of the RWSSP is illustrated in Figure 1.5

The geographical size of the programme area, some 50,000km² the lack of good roads and large travelling distances and times meant that a series of camps had to be set up at strategic locations and appropriate times during the course of the field programme which ran from April 1994 to September 1995 Where possible, and after the initial work in Massangena, two camps ran simultaneously with staff divided between them. The division depended on what activity was being carried out or emphasised in a particular area For practical, logistical and political reasons not all programme activities were carried out in every village that had a new borehole and pump. For example, in Chigubo District the population is dispersed, population densities are low and road access very poor. Implementation of the sanitation programme was therefore not appropriate.

Figure 1.5 Implementation Schedule for Rural Water Supply and Sanitation Programme



Mas = Massangena District
Guj = Guija District
Chic = Chicualacuala District
Chig = Chigubo District
Mab = Mabalane District

PMG = Pump Maintenance Group
V = Volanta Pump

1.6 Baseline Survey

In order to assess the impact of the programme a baseline survey was also carried out in the villages where a borehole(s) had been provisionally allocated (actual allocation depended on the outcome of the drilling operation) Chigubo District was the exception. No baseline survey was carried out here for a number of reasons.-

i) Politically the District was divided, access was bad and population data poor
ii) Population numbers were low and highly dispersed with no road access
iii) Many communities had been isolated because of the war and were wary of questions being asked
iv) Not enough information was available at the time on the locations of land mines and security in the area

The baseline survey was designed to gather information on:-

- Household size, gender balance and number of children under 5 years
- Residential status
- Water sources, availability (distance & time), collection and usage
- Sanitation practices
- Incidence and types of disease/ailments suffered by the population

1.6.1 Survey Questionnaire and Sampling Method

A 20 question survey questionnaire was prepared in Portuguese in consultation with MSF(CIS) and revised after testing out in the field. A copy of the final questionnaire is included in Appendix A1. All interviews were carried out in the local language Shangaan. Interviewers (Animators) received training in interviewing techniques and sampling method.

A thirty by fifteen cluster survey was initiated based on population data provided by the Administration Sampling of households was random.

1.6.2 Survey Problems

A number of problems were encountered in the field whilst carrying out the baseline survey. These can be divided into sampling problems and questionnaire completion problems.

Sampling Problems
- Population data provided by the administrations were old and inaccurate
- Movement of populations including repatriation programmes were taking place all the time
- Numerous houses were empty or abandoned. This in addition to the daily exodus of people to their fields meant finding people to interview was often difficult.

Questionnaire Completion Problems
- Although carried out in Shangaan the understanding of the mostly illiterate rural population, not only in what the question was asking but why it was being asked, could have led to inaccurate completion of the questionnaires.
- Time and distance to water sources and quantity used for different purposes were open to errors. Where possible these were measured by the animators.

1.6.3 Survey Analysis

A summary baseline survey analysis for the programme target area is shown in Table 1.6. Full data tables and analyses by district are presented in Appendices A2 to A5.

A total of 2022 questionnaires were completed representing over 15,000 inhabitants and more than 11% of the estimated total beneficiary population.

Table 1.6 Summary Baseline Survey Data and Water Source, Distance, Time, Quantity and Practices Analysis - Northern Gaza 1994/1995

District & Date	Number of Areas Sampled	Number of Households Questioned	Total Number of Inhabitants	Gender		Total No. Children <5 years	Residential Status			Household Principle Water Source					Aver Dist to So (km
				Male	Female		Resident	Displaced	Returnee	Pump	Well	Train	Lake	River	
Massangena April 1994															
Totals	13	575	3925	1731	2194	427	375	189	11	21	0	0	0	554	-
Average	-	-	6.8	-	-	0.7	-	-	-	-	-	-	-	-	3.(
Percentage	-	-	-	44%	56%	11%	64%	33%	2%	4%	-	-	-	96%	-
Chicualacuala October 1994															
Totals	23	510	4325	1964	2361	542	308	184	18	91	76	139	33	171	-
Average	-	-	8.5	-	-	1.1	-	-	-	-	-	-	-	-	2.(
Percentage	-	-	-	45%	55%	13%	60%	36%	4%	18%	15%	28%	6%	34%	-
Guija September 1994															
Totals	14	757	5463	2517	2946	652	628	75	54	111	480	0	94	72	-
Average	-	-	7.2	-	-	0.9	-	-	-	-	-	-	-	-	1.1
Percentage	-	-	-	46%	54%	12%	83%	10%	7%	15%	63%	0%	12%	10%	-
Mabalane March 1995															
Totals	7	180	1474	630	844	176	155	10	15	0	0	0	0	180	-
Average	-	-	8.2	-	-	1.0	-	-	-	-	-	-	-	-	2.3
Percentage	-	-	-	43%	57%	12%	86%	6%	8%	0%	0%	0%	0%	100%	-
Grand Totals	57	2022	15187	6842	8345	1797	1466	458	98	223	556	139	127	977	-
Overall Averages	-	-	7.5	-	-	0.9	-	-	-	-	-	-	-	-	2.2
Overall Percentages	-	-	-	45%	55%	12%	72%	23%	5%	11%	27%	7%	6%	48%	-

* = percentage of households that reported at least 1 case of the disease over the previous three months

BOREHOLE DRILLING AND HANDPUMP INSTALLATION PROGRAMME

Chapter 2 Borehole Drilling Programme

2.1 Preliminary Surveys and Investigations

Water resource surveys and needs assessments were carried out for Massangena and northern Chigubo in December 1993 and central and southern Chigubo and northern Guija in May 1994. These formed the basis on which borehole locations for the two districts not covered by the EWSI were decided. The knowledge, drilling experience and data collected during the EWSI provided a framework from which to provisionally allocate additional boreholes in the districts of Chicualacuala, Mabalane and Guija.

With population numbers and therefore water needs changing all the time due to the return of refugees and movements of internally displaced people, regular reassessments of the situation were required. There was also a degree of uncertainty about the quality of water likely to be found in parts of Chigubo and Mabalane in particular. As a result it was decided not to specifically allocate all proposed boreholes (148) but to adopt a more flexible approach and drill boreholes on an 'as required' basis taking into account amongst other criteria the PRONAR/UNICEF target of 1 borehole/pump per 500 people. Site selection however was only finalised after:-

i) community meetings to discuss the implications of the programme in terms of their commitment both during implementation and their responsibility afterwards for the maintenance of the borehole and pump,
ii) further consultations with the village leaders/bairro secretaries, and
iii) consideration of DNA/PRONAR criteria for the siting of boreholes/wells.

Although sites were generally chosen by the communities all were ultimately authorised by the Programme Director.

2.2 Borehole Drilling Tender and Contract

An integral part of the borehole drilling programme was the preparation and development of a borehole drilling tender document and subsequent contract. This process was considered of prime importance not only to the success of the RWSSP but also for the water sector in Mozambique. WRC wanted to stimulate competition in the drilling of boreholes in an attempt to improve the quality of borehole construction and to bring down the cost of drilling boreholes.

During January and February 1994 tender procedures and a tender document, including a prequalification questionnaire, were drawn up with help from the hydrogeological section at DNA for the drilling of 25 boreholes in the District of Massangena. An advertisement inviting bids was then placed in the national newspaper "Noticias".

Response to the tender, the first of its kind in the water sector, was very good with fourteen drilling operators buying the tender document. Ten drilling operators submitted bids which were opened in public on 7th March. Evaluation procedures as stated in the tender document were then followed with the top 5 financial bids being assessed on technical merit. The initial contract was subsequently awarded to Terrasearch Mozambique. The complete evaluation document with names and addresses of all the companies that tendered is included in Appendix B1.

Drilling began on 21st April 1994. The first 25 productive boreholes were completed by 11th June 1994, a period of 52 days. With only 1 unproductive borehole due to saline groundwater this represented a production rate of 1 complete borehole every 2 days. Average borehole depth was 54m.

With the performance of Terrasearch Mozambique as it was and with the machines and materials on site the decision was made to negotiate a further 100 borehole contract. This was achieved with an average cost reduction per productive metre of about US$ 5.

The tender procedure and contract developed by WRC was later revised and used by other NGOs working in the water sector and by early 1995 PRONAR/UNICEF were preparing a standard tender document to be used by all organisations involved in borehole drilling programmes with technical specifications and tender procedures clearly set out.

WRC used this prototype document for its 1995 borehole tender and contract in Guija District. The advertisement inviting bids was placed in the same way in early February and evaluated in March. The response to the tender and contract for 20 boreholes in Guija District starting on 1st May was disappointing. Only four companies submitted a bid. Evaluation of the bids led to the selection once again of Terrasearch Mozambique with a financial bid of US$ 92 per metre.

The PRONAR standard tender and contract document has since been revised further with the help of WRC and CARE International

2.3 Borehole Design and Construction

Borehole design, construction and inspection generally followed the criteria of DNA/PRONAR/DRH as stated in the document Nº 22/93 "Criterios Para a Construcao de Furos a Serem Equipados com Bombas Manuais em Mocambique".

All boreholes were drilled wherever possible using a rotary percussion method (down-hole-hammer) was used often with a foam flush. This was the cheapest and quickest option. However in caving formations rotary flush with a blade bit or direct circulation drilling with a tricone bit and polyflip was used.

Boreholes were drilled initially at 215mm (8.5") to allow the installation of temporary steel casing then at 165mm (6.5") to base of hole. 110mm (4") internal diameter threaded PVC casing and screen was installed on productive boreholes. Screen slot size was 0.5mm for 1994 contact and 0.3mm in 1995. All boreholes were pump tested for 1 hour and recovery measurements made. The electrical conductivity of the water was measured during drilling and during pump testing. A number of samples were also sent to the water analysis laboratories in Maputo (Agua de Maputo EE) for chemical analysis. Details of these analyses are presented in Appendix B4

A borehole was considered 'productive' if it had sufficient water (normally a minimum of $1m^3$), at a depth less than the maximum working depth of any handpump to be installed, (60m for Afridev and 85m for Volanta) and of an acceptable quality to the beneficiary population.

2.4 Borehole Inspection

The independent inspection of boreholes was arranged on a contract basis initially with DNA Maputo and later on in 1995 with DPOPH-Gaza.

In order to develop the capacity of DPOPH-Gaza and to provide further training for EPAR and WRC staff WRC sponsored a borehole inspection training course run by DNA during the 1995 drilling programme in Guija. As a result there are now 2 trained borehole inspectors (Fiscals) within DPOPH-Gaza and 1 in EPAR, Xai-Xai who can be contracted out in the future.

2.5 Drilling Programme Details

Details of all the boreholes drilled during the programme are presented by district in Appendices B2 and B3 for 1994 and 1995 respectively. Locations of all boreholes drilled since November 1992 are shown graphically on a schematic map of the region in Figure 2.5. Full drilling reports including lithological descriptions will not be included in this report. They have already been submitted to DNA for inclusion on the national borehole database.

Table 2.5 provides a summary analysis of the drilling programme. This has been divided into the two drilling contracts (1994 & 1995) so a comparison can be made between drilling time, metres drilled, success and cost.

A total of 156 boreholes were drilled of which 127 (81%) were productive and have subsequently been fitted with a handpump. Average borehole depth was 46m.

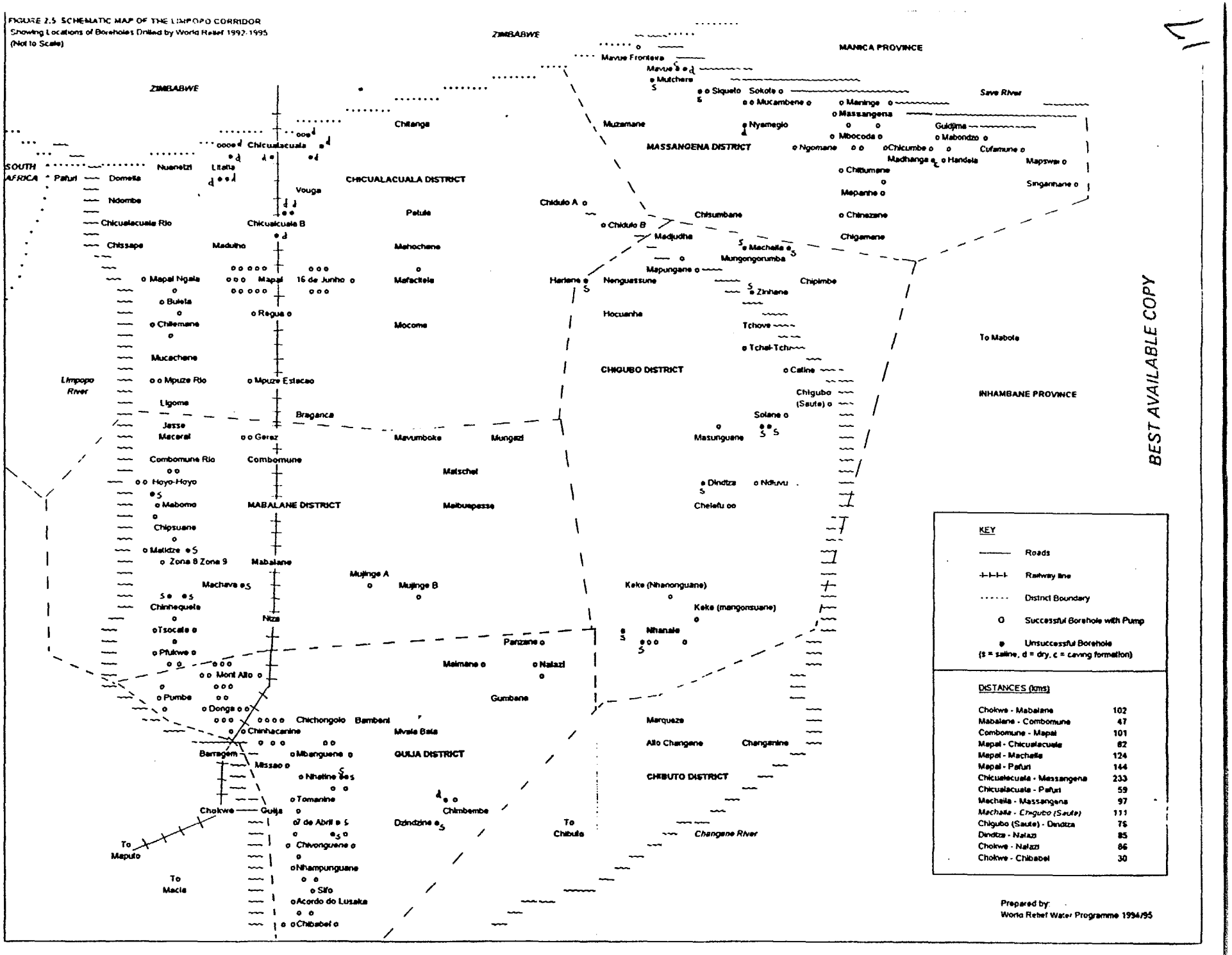


Table 2.5 Borehole Cost Analysis 1994/95

Name of District	Total Number of Boreholes	Total No. Producing Boreholes	Success Rate (%)	Total Metres Drilled	Total Drilling Cost (US$)	Average Cost per Metre (US$)	Total Productive Metres	Total Cost Productive Metres (US$)	Average Cost/Metre Productive (US$)	Average Borehole Depth (m)	Average Cost per Borehole (US$)
MASSANGENA	33	27	82%	1821	$142,910	$78.5	1468	$125,324	$85.4	54	$4,642
CHIGUBO	25	15	60%	640	$51,977	$81.2	399	$38,055	$95.4	27	$2,537
CHICUALACUALA	29	26	90%	2114	$152,035	$71.9	1804	$136,550	$75.7	69	$5,252
MABALANE	14	11	79%	720	$54,615	$75.9	570	$45,204	$79.3	52	$4,109
GUIJA (1994)	24	22	92%	882	$74,704	$84.7	802	$70,417	$87.8	36	$3,201
Totals 1994	125	101	81%	6177	$476,241	$77.1	5043	$415,550	$82.4	50	$4,114

Total number of days drilling = 184
Average number of work days per borehole = 1.5
Average number of metres drilled per day = 34
Total distance moved between sites (km) = 1400 (Massangena via Chigubo and Guija to Chicualacuala)

GUIJA (1995)	31	26	84%	928	$92,203	$99.4	809	$82,805	$102.4	31	$3,185

Total number of days drilling = 21
Average number of work days per borehole = 0.7
Average number of metres drilled per day = 44
Total distance moved between sites (km) = 180 (7 de Abril to Pumbe)

Programme Totals	156	127	81%	7105	$568,444	$80.0	5852	$498,355	$85.2	46	$3,924

Total number of days drilling = 205
Average number of work days per borehole = 1.3
Average number of metres drilled per day = 35
Total distance moved between sites (km) = 1580

2.5.1 Drilling Contractor Performance

The drilling contractor, Terrasearch Mozambique, provided first class drilling equipment for both the contracts in the form of Schramm T650W and T450W Rotadrill machines. During the first contract they achieved an average drilling rate of 34 metres per day and 1.5 days for each borehole. In 1995 this improved to 44 metres per day and 0.7 days per borehole or about 3 boreholes every 2 days.

Over the two contracts 7105 metres were drilled at a rate of 35m per day. This is only very marginally better than the performance of Modrill in 1992/93 who averaged 33m per day (EWSI Final Report).

Down time due to technical problems or breakdown of the drilling equipment was negligible. Delays were mainly the result of the failure of Terrasearch Mozambique to supply adequate quantities of casing and their naivety in the administration of their operations and knowledge of Mozambique. Although their drilling performance for the 1995 contract in Guija appears significantly better these figures hide the fact that they began the contract 50 days after the starting date stated in the contract. Including these days shows their performance to be very poor at only 13m per day.The quality of the boreholes was superior to the 1992/93 EWSI drilling programme though this was largely due to more detailed specifications for the construction of boreholes being stated in the tender and contract documents. On occasion despite this Terrasearch Mozambique failed to adhere to the contract by not providing the specified casing diameter or adequate pump test equipment in terms of pump capacity, electronic dip meter and electrical conductivity meter. The later led to much of the pump test data being of limited value. The quality of reporting throughout the 1994 contract was poor and like many of the invoices often inaccurate. In 1995 this improved significantly.

2.5.2 Costs

The average cost per productive borehole metre for the whole drilling programme was just over US$ 85. The analysis in Table 2.5 shows a breakdown of costs for 1994 and 1995. The increase in cost per metre for 1995 can be attributed to:-

i) Shallower boreholes (average of 31m as opposed to 50m) meant that the set up cost and pump test cost are proportionally higher

ii) Use of direct circulation drilling method in caving formations had an extra set up cost and higher per metre cost.

In comparison to 1992/93 the cost of drilling a borehole has been reduced by more than 25% from US$ 115 per productive metre to US$ 85. See Appendix B5 for cost comparison data. This is considered still too high.

Chapter 3 `Manual Shallow Borehole Drilling Programme

3.1 Aim of Programme

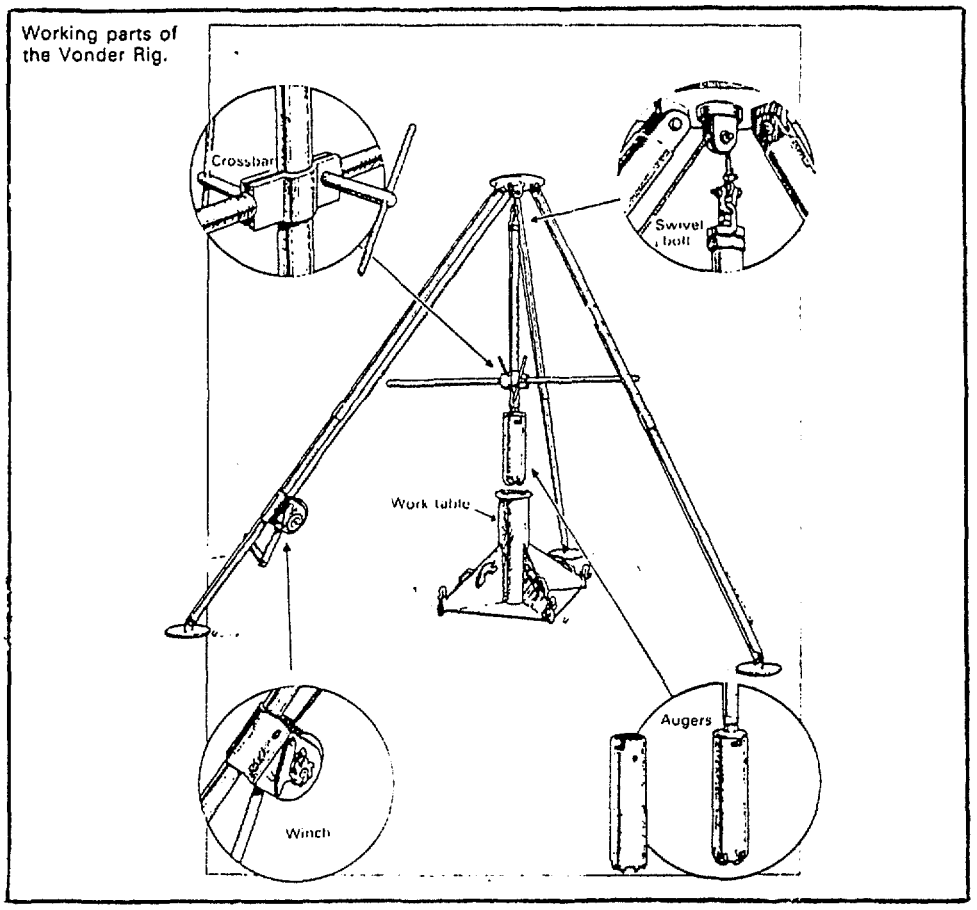
The aim of the manual shallow borehole drilling programme was to train a small World Relief team to drill and construct low cost boreholes through active community participation in areas of need where suitable groundwater and lithological conditions exist.

3.2 Drilling Equipment - The Vonder Rig

The drilling equipment - The Vonder Rig proposed for the programme was developed in Harare by V & W Engineering is illustrated in Figure 3.2. It basically consists of a tripod, worktable which aligns the drilling auger on a series of drill rods, a crossbar and a winch. The auger is a steel tube fitted with hard steel blades for cutting and lifting soil. This is attached through a bayonet adapter to the drilling rods. When in operation these rods are raised and lowered into position using the winch. The Vonder Rig is designed to drill 170mm (7") boreholes through soils and decomposing rock formations.

Additional equipment is also available to drill through sandy and muddy formations which are prone to collapse and caving. These 'sand attachments' consist of steel temporary work casing units, a specialised auger with non return valve and a steel bailer.

Figure 3.2 Working Parts of the Vonder Rig



3.3 Identification of Suitable Sites

It was initially proposed to drill shallow boreholes using the Vonder Rig in parts of the districts of Guija, Mabalane and Chicualacuala in the shallow alluvial aquifers along the Limpopo River.

The identification of suitable sites for the use of the Vonder Rig proved particularly difficult for a number of reasons:

a) In all 3 districts depth to groundwater generally exceeded 20m (Identified during contracted drilling programme)

b) Groundwater in Mabalane and parts of Guija at shallow levels was saline

c) It is only possible to drill about 3 metres into caving sand formations. Hydrostatic levels in alluvial aquifers are likely to fluctuate during the year. In order to give some guarntee of the borehole not drying up drilling in such formations should only take place at the driest time of the year.

d) Community commitment and interest despite efforts by the Community Liaison Officer was disappointing and restricted the implementation of the programme.

3.4 Programme Implementation

As a result of the problems in the selection of suitable sites outlined above the impact of the programme was clearly going to be small. Emphasis was therefore placed on the contracted borehole drilling programme. Additionally there was a long delay in the arrival of the sand drilling attachments from Zimbabwe. Training of technician and assistant in the operation of the machine was done by the Programme Director in February 1995. Four boreholes not exceeding 12 metres were subsequently drilled during March and April in Mabalane District. Three had sufficient water to be developed and were equipped with handpumps. Details can be found in Appendix B3.

Further drilling using the Vonder Rig was restricted by the lack of an adequate vehicle to carry all the equipment - the extra sand drilling attachments required meant transport in a 1 tonne pick-up was not possible, and the need to use staff for supervision and inspection of the second borehole drilling contract during June/July in Guija.

3.5 Appraisal of the Programme

The manual shallow drilling programme did not have the success and impact originally envisaged. This was predominantly due to the lack of suitable sites in the 3 districts proposed, the lateness in the arrival and limitations of, the drilling equipment and the need to deploy resources (personnel & vehicles) on the contracted borehole drilling and pump installation programmes in order to meet output targets. Progress was further limited by the reluctance of communities with whom the programme to provide adequate labour to do the work.

The drilling equipment was not suitable for the zones along the Limpopo as proposed due to hard gravel and conglomerate layers and depth to water table. It is felt however that the equipment could be used successfully in areas where the overburden is silts, sands and soft clays and where watertables are less than 10 metres. Motivating communities to do the work themselves without payments will remain a very real obstacle unless indigenous organisations like the Churches are directly involved.

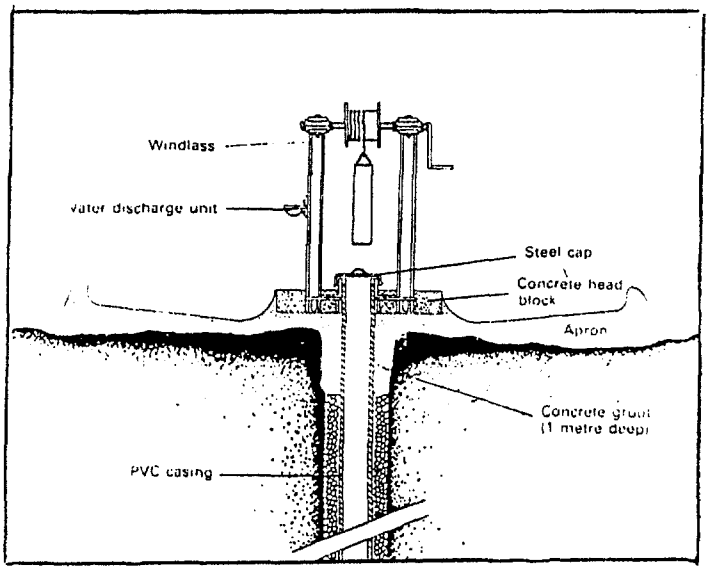
Chapter 4 Handpump Installation, Maintenance and Repair Programme

4.1 Introduction

In accordance with PRONAR policy on handpumps WRC installed the two types of recommended handpump; the Afridev for depths up to 60 metres (a revision of the original guide-line of 45m following the development of stronger forged steel hooks and eyes on the pump rods) and the Volanta for 60 - 90 metres. Both pumps operate by positive displacement and were originally considered village level operation and maintenance (VLOM).

A third type of pump was installed but only as a last option in places where there was a critical shortage of potable water and where the discharge of localised (suspended) aquifers was less than 0.5m³. The Bucket Pump, a simple bucket and windlass lifting device designed for boreholes was mounted in such cases eg. Keke in Chigubo District. See Figure 4.

Figure 4 The Bucket Pump



4.2 Components of the Programme

The implementation of the Programme can be divided into 4 main components; community awareness. construction of the concrete aprons and bases. pump maintenance group training and pump installation, and pump care, water transport and storage education.

4.2.1 Community Awareness

Prior to the start of any work on a new borehole the Community Liaison Officer (CLO) and 1or 2 animators would meet with the communities to remind them of all the responsibilities associated with having a borehole and pump. Namely:-

- Provision of labour for construction work
- Selection of 2 women and 2 men to form a pump maintenance group
- Install the pump under supervision
- Construction of a protective fence around the pump
- Set up and contribute to a pump maintenance fund from which to buy spares to maintain the pump
- Keep the pump environment clean and tidy and be open to receive water and sanitation education

Once this meeting(s) had taken place the Construction Supervisor in coordination with the CLO would devise a construction schedule. Each community would then be informed when they should be available and ready to work well in advance.

4.2.2 Construction of Pump Aprons and Bases

Although the pump aprons and bases for the Afridev and Volanta are different the organisation of the work was basically the same In order to facilitate the construction of the concrete aprons and bases (especially as water was scarce in most of the area) cement blocks were made at the WRC camps and transported to site along with other materials, gravel, sand, cement, water and tools. Construction usually took 1 to $1^{1}/_{2}$ days for Afridev bases and 2 days for Volanta bases.

4.2.3 Maintenance Group Training and Pump Installation

Afridev Handpump
Two men and two women were selected by the community to form a pump maintenance group (PMG) with responsibility for maintaining (and repairing) their pump and for keeping the pump environment in good order. One maintenance group for each pump - the smallest management unit - was found through experience to be the most effective. This group received 1 full day of pump training which where possible coincided with the construction work. This training done by the pump technician and/or pump trained animators involved the identification and naming of pump parts, learning how the pump worked, which parts were likely to wear and need regular replacing, how to diagnose problems and the concept of routine maintenance Immediately before the pump was installed this initial training was reviewed. The PMG then install the pump under the supervision of WRC staff. Where a number of pumps were to be installed in the same village or close by training may have been given to more than one PMG at a time. Each PMG would install their own pump and then assist in the installation of the others. In this way they were exposed to the installation procedure on several occasions - an advantage should a repair be required. It also meant that relationships were developed between PMGs and thus solutions to pump problems or lack of a spare part at a particular pump may be found more locally and easily.

Pump installation took a maximum of one day with the installation of the rising main followed by the foot valve, piston, rods and the fitting of above ground parts except the T - handle (to prevent use). The pump was then left overnight. The following day, assuming all conditions had been met eg. the protective fence was complete, the pump was handed over to the community . Handing over involved pumping water and cleaning the pump apron and drain, giving the PMG a fishing tool, M24 spanner. pump log book complete with borehole and pump installation data, a list of the costs of pump spare parts and a brush (to encourage cleaning) Once this small ceremony had taken place the community was both technically and financially responsible for the pump.

Volanta Handpump
The experience with the Volanta handpump from the EWSI had indicated it did not have VLOM characteristics at its present level of reliability primarily due to the high cost of spares. This meant that the community could never become financially responsible for the maintenance and repair of the pump - a conclusion confirmed in a report for CARE International on a cost recovery pilot project in Machase

As all but 3 of the Volanta pumps were located in Chicualacuala District and centered on Mapai a different approach was adopted Here a two man community 'repair team' was intensively trained in the installation, maintenance and repair of the pumps and supplied with tools and spare parts. They along with the WRC pump technician, assistant and the community then installed all the pumps. Basic training of 2 caretakers for each Volanta pump took place during the two day installation period. However they were mainly responsible for maintaining a clean pump environment and should a problem arise for informing the 'repair team' and then assisting in the repair.

The Volanta pumps were handed over in a similar way and the community encouraged to set up a maintenance fund with the view to making a contribution to the cost of repairing their pump eg. they were responsible for buying the glue, thinner and sandpaper required for any rising main repair.

4.2.4 Pump Care, Water Transport and Storage Education

Throughout the duration of the activities described above, and for a period after the installation of the pump, community meetings, home visits and informal pump site education sessions were carried out by pairs of animators. The target group was the women and girls, the primary collectors of water and users of the pumps. The aim was to make them aware of the need to keep the pump environment clean and hygienic and to educate them in how to transport and store water.

4.3 Pump Installation, Maintenance and Repair Details

4.3.1 Pump Numbers

A total of 133 handpumps were installed during the Programme - 109 Afridevs, 19 Volantas and 5 Bucket Pumps. This brings the total number of pumps installed on boreholes to 162 since the beginning of the original grant. Table 4.3 summarises pump numbers and types by district. A database of all pump installations (1992-1995) is included in Appendices C1 to C3. Standard PRONAR pump installation, maintenance and repair forms have also been completed and will be submitted to DPOPH

Table 4.3 Summary of Pump Installation Numbers and Type by District 1994-1995

District	Type of Pump			Comments
	Afridev	Volanta	Bucket	
Massangena	27	-	-	All new boreholes
Guija	51	1	-	3 rehabilitations
Chicualacuala	9	17	-	All new boreholes
Mabalane	11	1	1	3 Manual (Vonder Rig) boreholes
Chigubo	11	-	4	All new boreholes
Totals	**109**	**19**	**5**	

Total number of handpumps installed 1994/95 (RWSSP) = 133

Total number of handpumps installed 1992/93 (EWSI) = 29

4.3.2 Pump Performance and Pump Failures

Details of all reported failures, estimated repair costs and analyses for both the Afridev (in Massangena) and Volanta handpump are presented in Appendices C5 and C6.

The Afridev pump has proved in general to be reliable and has performed well in the short term. Of the 65 pumps that have been installed for more than one year 47 (72%) have never had a problem, 6 are reported to have failed just once and 12 more than once. Annual maintenance and repair cost at on average between US$20 and US$40 to the communities is considered acceptable and payable by most of the participating communities.

A number of problems however have been experienced with pumps installed to depths in excess of 55 metres and with large estimated user groups. Initial breakages of the hooks on the pump rods appears to have been resolved though a few breakages of the rods are still being experienced as are breakages/cracking of the PVC rising main. In the long term concern is expressed over the rate of corrosion of a number of metallic parts of the pump especially in areas where salinity levels are high.

The Volanta handpump remains unreliable and at present rates of failure unsustainable in the long term without external assistance. The vast majority of the failures are rising main related - separation of the rising main and breaking/cracking of the couplers used to join the PVC tubes. The pump manufacturers have recently produced new stronger couplers and PVC solvent cement. Both are being tested in Mapai. The introduction of centralisers should also be considered. The pumps installed during the current phase of the programme in December 1994/January 1995 are estimated on average to have been non functional due to pump failure for 20% of the time. The estimated average cost of maintaining each new pump in a working condition is US$ 1.00 per day. This is the cost of spare parts and materials alone and represents the level of contribution the community must collect in order to take financial responsibility for their pump.

4.4 Sustainability

Sustainability of the handpumps in the long term by the communities themselves remains a difficult issue and one that is not easily resolved especially in isolated rural areas where there is little or no infrastructure, poor communications and often barely a cash economy. In order for pumps to be sustainable the communities must be technically able to maintain and repair their pump, be financially responsible for their pump and have access to spare parts for their pump. WRC addressed these 3 constraints to sustainability for the Afridev handpump by:-

i) Training community pump maintenance groups before and during pump installation and by holding 1 day maintenance and repair workshops within 1 year of installation. The Mobile Pump Maintenance, Repair and Monitoring Unit (MMMU) will continue to provide refresher training at least until September 1996.

ii) Encouraging each family to contribute towards a pump maintenance fund and to buy spare parts when a significant fund has built up. Regular meetings were held by the CLO stressing the importance of such a fund and monitoring the contributions collected whenever possible. No specific figure for a per family contribution or how the money should be collected was impose by the Programme. The role of the CLO was more that of a facilitator so each community could discuss and decide what was appropriate for them.

iii) Making spare parts available, initially an attractive financial proposition for the communities and by providing outlets for the sale of spares and through the MMMU. No spares were given during installations all spares had to be purchased. Once a stock of spares had been acquired by WRC boxed sets of recommended spares were put together and sold/are being sold by WRC at a competitive price until the end of the year to encourage communities to buy spares.

The issue of sustainability was also addressed along with the issues of installation, routine maintenance , repair, reliability, quality control and the availability and commercialisation of spares during a week long seminar/workshop facilitated by WRC in association with CARE International at the 7 de Abril camp in Guija (July 1995).

The sustainability of the Volanta handpump is much more problematic for a number of reasons and at this stage is not sustainable without external assistance.

i) The pump working at depths over 60m has proved very unreliable as mentioned earlier. This has become a demotivating factor for the communities dependant on them.

ii) The availability of spares despite Stenaks taking on responsibility for their supply is poor as they still need to be imported from Holland

iii) The cost of spares is prohibitive for the communities to be able to afford.

WRC is committed to the communities served by the pump and has set up a two man community technical maintenance and repair capacity in Mapai. Small salaries and all spares are provided by WRC. In addition the MMMU will provide back-up support. Some communities eg. Gerez have been provided with a full set of tools and spares and have proved capable of repairing the pumps themselves. Further to this WRC is investigating the possibility of bringing in an independent consultant to assess the design limitations of the pump and propose a plan of action.

4.5 The Mobile Pump Maintenance, Repair and Monitoring Unit (MMMU)

Once the implementation phase of the RWSSP had been completed a team of 3, including the Pump Installation Technician and CLO, was set up to support the sustainability initiatives. The role of the MMMU includes:

- Assisting communities to repair pumps
- Encouraging the communities to carry out routine maintenance and help decide a maintenance schedule for each pump.
- Providing 'refresher training' for pump maintenance groups
- Reminding communities of the importance of keeping the pump clean and hygienic
- Monitoring and encouraging the community to collect contributions to the pump maintenance funds and to purchase spare parts regularly
- Providing an outlet for the sale of spare parts
- Supervising the work of the community Volanta repair team in Mapai and providing spares
- Monitoring the use and user group numbers for each pump
- Periodically measuring the hydrostatic water levels and the water quality in the boreholes to monitor any changes

Through this initiative it is hoped (expected) that most communities served by an Afridev handpump will independently meet its responsibilities and secure a clean safe water supply in the long term.

RURAL SANITATION AND HEALTH EDUCATION PROGRAMME

Introduction

The rural sanitation and health education components of the programme were designed to compliment the provision of clean safe water through the borehole drilling and pump installation programme so as to maximise beneficial impact, to promote improved public health and sanitation and encourage communal participation and care of water resources.

The Rural Sanitation Programme consisted of three main activities:-

- Construction of demonstration (model) pit latrines
- Making of concrete latrine slab and tops, and
- Education to encourage the adoption of improved hygiene and sanitation behaviour

Although the overall objective was to facilitate public awareness of sanitation-hygiene issues at all pump sites demonstrations of improved pit latrines were targeted on communities where population densities were higher eg Mbocoda in Massangena District, Mapai in Chicualacuala District and Donga in Guija District.

Chapter 5 Rural Sanitation Programme

5.1 INPF Improved Pit Latrine Project

In 1992 INPF (National Institute of Physical Planning) established technical standards and specifications for the construction and siting of improved pit latrines under the National Low Cost Sanitation Programme (Projecto de Latrinas Melhoradas). It was these specifications that were followed by WRC (Figure 5.1). In coordination with INPF, Xai-Xai the Construction Supervisor, Sanitation Technician and Mason attended a week long training course to familiarise themselves with these specifications, to learn how to make traditional pit latrine slabs for rural situations and to procure the appropriate latrine slab moulds for the programme.

Figure 5.1 The Improved Traditional Pit Latrine

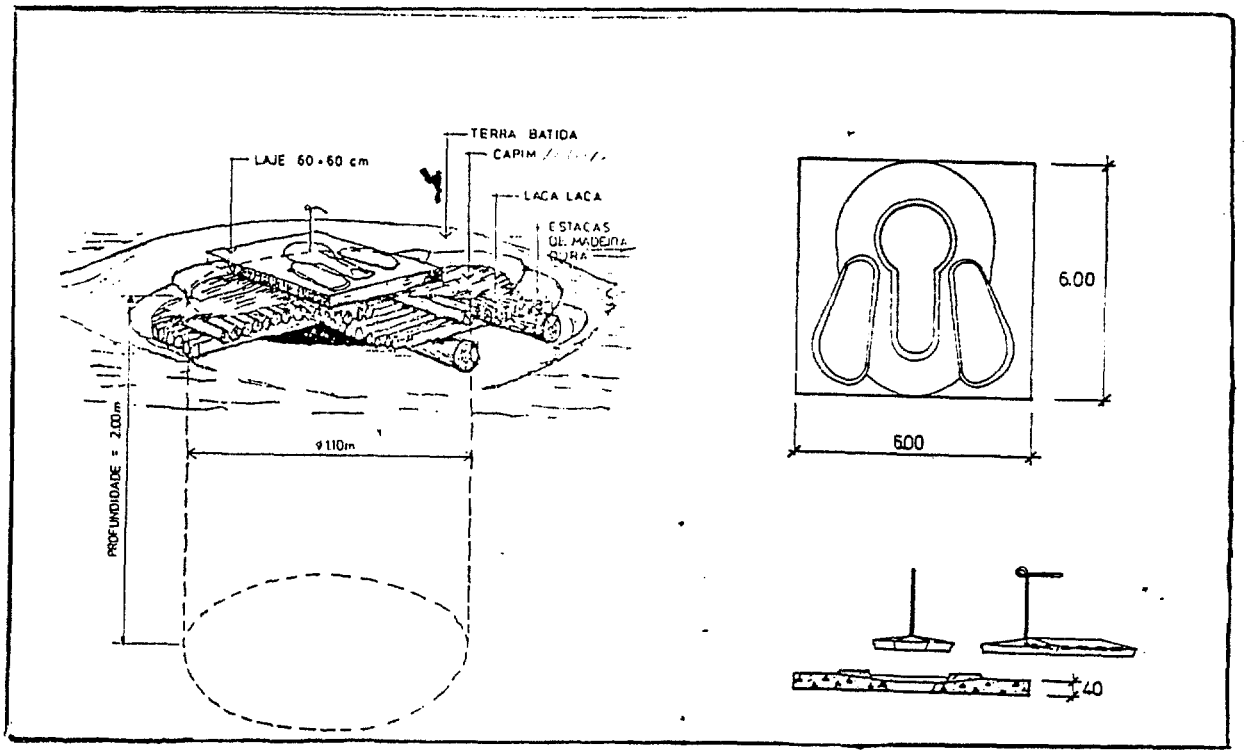
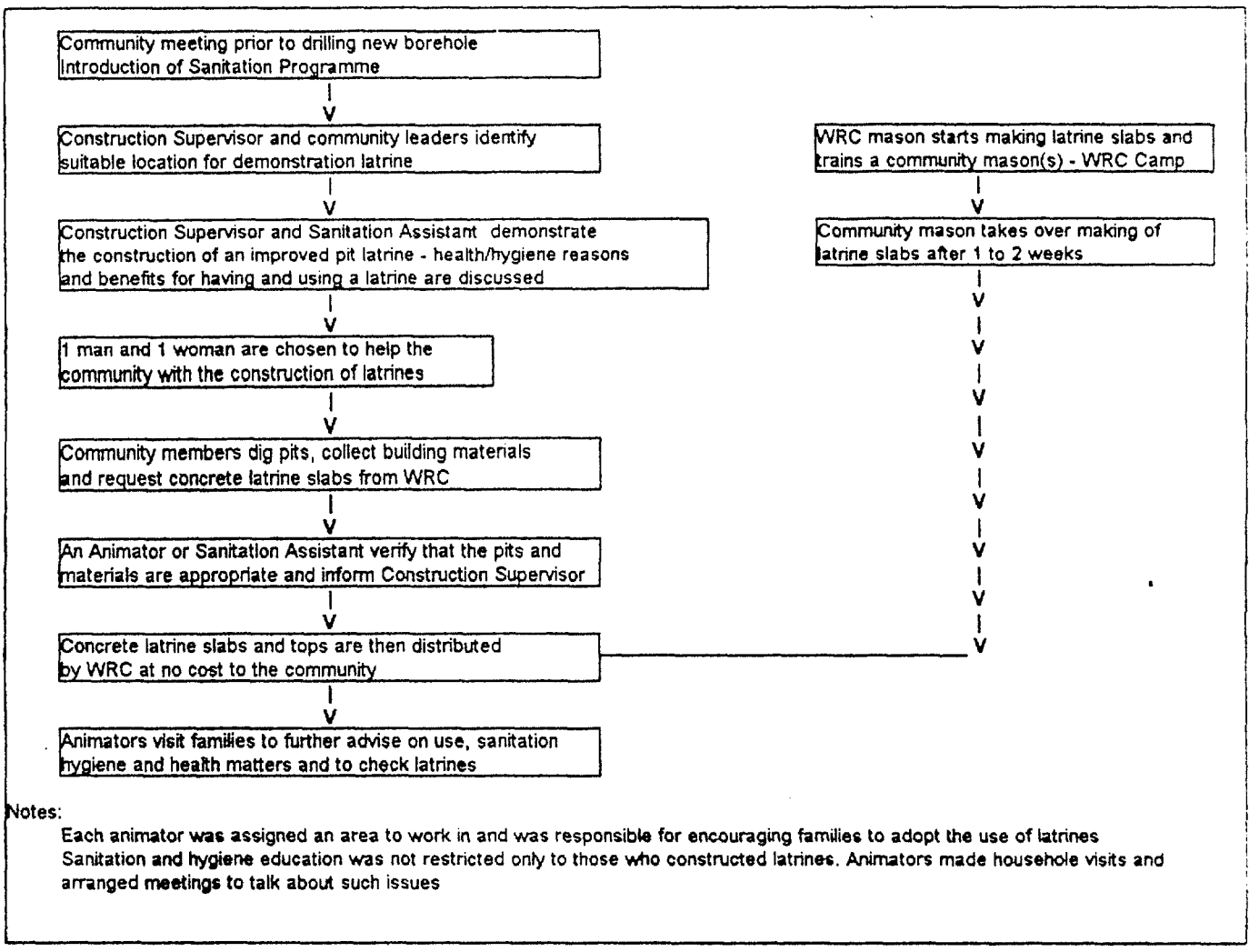


Figure 5.2 **Diagram Showing the Implementation Process for the Rural Sanitation Programme**



Notes:

Each animator was assigned an area to work in and was responsible for encouraging families to adopt the use of latrines
Sanitation and hygiene education was not restricted only to those who constructed latrines. Animators made household visits and arranged meetings to talk about such issues

Table 5.3 Summary of Distribution of Latrine Slabs

District	Number of Demonstration Latrines*	Number of Latrine Slabs Distributed
Massangena	5	255
Guija	8	651
Chicualacuala	3	512
Totals	16	1418

Notes:

* Does not include latrines built as demonstrations at the WRC Camps at Mapai, Donga, Mbocoda and 7 de Abril

5.2 Programme Approach

Figure 5.2 illustrates the steps in the implementation process.

5.3 Success

16 demonstration pit latrines were constructed and over 1400 families/households adopted the design and built latrines for themselves Table 5 3 above summarises the locations and numbers by district of demonstration latrines and the total number of latrine slabs distributed. Appendix D2 gives details of all villages where latrines were made.

5.4 Problems and Limitations

The introduction of up graded pit latrines was limited by:

- Perceived lack of need for improved sanitation practices despite education messages brought by WRC. This was particularly apparent in areas with low population densities, where there was plenty of bush and where populations made daily trips to their fields some distance from their homes.

- Reported lack of time to collect building materials and dig the pit at certain times of the year ie. harvesting and land preparation/planting

- Lack of tools to dig a pit and cut wooden poles

- Lack of natural building materials close by, the lack and cost of transport to collect raw materials. This is particularly acute in places with higher population densities where there is a greater and felt need for improved sanitation practices. Significant effort or expense is incurred if people wish to adopt even simple sanitation technologies. This in many cases in poor rural locations is a limiting factor.

- Type of underlying soil/rock formation. In some areas the ground was too hard to dig 2m deep pits without specialised tools in others the ground was prone to caving/collapsing after rainfall. Both were demotivating for communities.

- In parts of northern Gaza where many men are working in South Africa the lack of a male member of a household to dig the pit was reported as a limitation.

- The lack of time on the part of WRC animators to effectively get the sanitation messages across and limited time the population had to see the benefits of latrines from those who adopted the design early on before WRC latrine slabs were not available.

On the technical and practical side a number of problems were encountered:-

- The tops for the latrine slabs as specified were prone to breaking across the middle.

- Transport of the slabs was not easy and did lead to breakages and wastage

- Unless adequately supervised in using the latrine children were reported to have accidentally dropped the top into the pit!

- There was rarely enough raw materials to construct a roof for the latrine so after rain maintenance and refilling around the latrine slab was required.

- Often there was a lack of adequate containers to hold water in the household so no water was available for handwashing at the latrine after use.

Chapter 6 Community Water, Sanitation and Hygiene Education Programme

6.1 Aim of Programme

The primary aim of the programme was to make the link between a clean safe water supply, good sanitation and hygiene practices and good health. In doing so through an education and training programme it was hoped to encourage communal participation and care of water resources, improve public health and thus maximise the potential beneficial impact of the whole programme.

6.2 Scope of Work

After their initial training in Chokwe 5 female animators under the supervision of the Community Education Advisor were assigned specific areas/zones often bairros or villages for which they were responsible. After 4 months as the programme expanded geographically a further 4 animators were trained and assigned work locations.

Animators had the responsibility for community education (and training) associated with the 5 main activities of the programme:

- Pump care and hygiene (+/- maintenance)
- Water transportation, storage, utilization and water borne diseases
- Sanitation, use and maintenance of pit latrines
- Hygiene, personal, environmental and food
- Health, basic health messages to combat high incidences of diseases identified during the baseline survey eg. Bilharzia or diarrhoea.

The locations and methods used for community education were varied and depended primarily on the specific messages, type of community (dispersed rural, communal village, illiterate) and the time and resources available to the animators. Table 6.2 outlines the locations, methods used and target groups for education and training sessions.

During the initial water resource survey of Chigubo District it was evident that many communities had inadequate containers for collecting, carrying and storing water. Small broken, topless containers animal skins and rusty cans were being used. In response to this need WRC distributed nearly 2000 twenty litre water containers primarily in Chigubo and northern Guija but also latter on to needy families in Mabalane and Chicualacuala districts. Distribution figures are presented in Appendix E1.

6.3 Limitations to the Impact of the Programme

The size of the whole programme in terms of the number of beneficiaries and geographical size in relation to the resources (personnel and transport) available for education activities meant that an extensive rather than intensive approach had to be adopted. This in turn limited the potential impact of the programme. Behavioural and attitude change requires time.

The impact of the programme was further limited by the lack of time the mothers/women had to either attend small meetings/discussion groups or were at home to benefit from a home visit. Many women in the rural areas spend time in their fields during the day returning after 16:00 thus giving them little opportunity to receive education messages. Literacy in the programme area was estimated to be significantly less than 20% and although demonstrations and pictures were used wherever possible this too limited the promotion of improved hygiene and sanitation behaviour. Many communities were also in a state of flux due to population movements, repatriations and continuing internal displacements. Without a stable community it was impossible to set up health care groups or identify suitable village level promoters. Many families were not sure whether they would be staying or leaving

Table 6.2 Outline of the Components, Locations, Methods and Target Groups for Community Education

Component	Messages	Target Groups	Training Location	Training Method(s)
PUMP	Care of Cleanliness Maintenance	Pump Users - 98% women and girls	Community meetings Pump sites	Discussions Demonstrations and informal talks during time of collecting water
WATER	Transport Storage Usage	Water collectors Household keepers (women and girls)	Pump sites Small meetings Household visits	Demonstrations Discussions 1 to 1 conversations and instruction
SANITATION	Why use a latrine How to use latrine and handwashing Maintenance of latrine	Men and women Men, women and children over 5 years Men and Women	Community meetings Latrine constructions Small meetings Schools Household visits	Teaching sessions using pictures Discussions Practical demonstrations
HYGIENE	Personal (washing) Environmental (waste) Food	All All Women and girls	Schools and clinics Small meetings Traditional washing site eg. rivers/lakes Household visits	Teaching sessions using pictures Discussions Stroy telling ,songs and dramas 1 to 1 conversations
HEALTH	Area specific eg. Bilharzia, Scabies	Women and children	Clinics Small meetings Household visits	Teaching with pictures Discussions 1 to 1 conversations

Notes: Each animators work was evaluated during the course of the programme against a series of criteria eg. number of latrine slabs requested, standard of pump cleanliness, organisation of households in terms of cleanliness water storage, hygiene and waste disposal

Chapter 7 Programme Outputs and Initial Impact

Since the inception of the EWSI in November 1992 World Relief has drilled and equipped with manual pumps 162 boreholes. Table 7 1 shows that in the areas targeted by the RWSSP in the 5 districts these water points represent 94% of all protected water sources and provide an estimated 1 4 million litres each day to a beneficiary population of over 130,000. This represents an average of 11 litres per head per day Although this is still low it is a significant improvement especially as there is evidence that the population figures provided by the District Administrations and used here are inflated!

An initial impact assessment of the programme can be made by comparing the baseline survey data before the implementation of the programme and the resurvey data using the same questionnaire just over one year after the pumps were installed. Summary analysis data for Massangena only are presented in Table 7.2. A comparison shows that:_

- More than one third of all households sampled after programme implementation were returnees compared with only 2% before.

- 96% of the population draw water now from protected, clean and safe water points as opposed to 7% before the programme

- Collection of water per day per household has increased on average by 19 litres or 33%. This increase appears to be the result of more people collecting water rather than each person collecting more water.

- Distance to water source has been reduced to an average of 700 metres whereas before it was more than 2.6 km and time taken to collect the same volume of water has been reduced to 30 minutes from more than one hour and twenty minutes.

- The incidence of dysentery reported by households in the 3 months prior to the respective surveys has dropped from nearly one third of all households to less than one percent.

- A twenty five percent decrease in the incidence of bilharzia is also shown with the population spending less time at the river.

The indirect benefits from the programme should not be underestimated either. As a result of World Relief water points:

- Small vegetable gardens are being planted at up to 10 locations near the pumps

- Construction and improvement work has been possible within many villages as water (often drain flow) is used to make mud and bricks (for own use and for sale)

- Building work has made been possible on a larger scale by other NGOs working in the area. Schools. health posts (SCF, LWF, AMDA, MSF, NRC) an Agua Rural workshop (NOVIB), and Administration building rehabilitation have all been made possible as water in the region has become more accessible.

Table 7.1 Analysis by District of Number of People per Borehole and Estimate of Available Water from Handpumps per Head of Population

Name of District	Number of Villages	Number of World Relief Pumps			Number of Other Pumps	Total	Estimated Population now supplied	Date of Population Estimate	Ratio of People per Pump	**Estimate of Litres Pumped /Day	Available Water per Person/Day	Other Water Sources
		A	V	B								
MASSANGENA	18	27	0	0	1	28	25,716	23/08/95	918	268,800	10.5	Save River
CHIGUBO	11	11	0	4	0	15	6,600	16/05/95	440	117,120	17.7	Very limited A few hand-dug wells
CHICUALACUALA	12	9	30	0	0	39	18,922	26/09/95	485	230,400	12.2	Train - twice a week Limpopo River
MABALANE	11	14	2	1	0	17	9,376	20/10/95	552	146,880	15.7	Limpopo River
GUIJA	18	61	3	0	10	73	72,184	11/10/95	989	696,000	9.6	Some 34 hand-dug wells Limpopo River
Totals	70	122	35	5	11	172	132,798		772	1,459,200	11.0	

A = Afridev
V = Volanta
B = Bucket
Other pumps include Afridev, India MK II and National
** Based on field experience of 12 hours operating time per day at 80% utilization.
Afridev pump discharge 1000 l/hr, Volanta 500 l/hr and Bucket Pump 300 l/hr

Population estimates are based on latest available data from district Administrations and village leaders
All districts have seen and increase in population by at least 20% since the start of the programme.
eg. In Massangena District in December 1993 population estimate was 19,799

Table 7.2 Baseline Survey Data and Water Source, Distance, Time, Quantity and Practices Comparison - Massangena District, April 1994 and August 1995

Aldeia/Bairro	Number of Households Questioned	Total Number of Inhabitants	Gender		Total No. Children <5 years	Residential Status			Water Source		Distance to Source (kms)	Time Taken to Collect Water per Day (hrs)	Total Volume of Water Collected (litres)
			Male	Female		Resident	Displaced	Returnee	Pump	River			
April 1994													
Totals	285	1860	810	105	191	226	52	7	21	264	-	-	16,606
Average	-	6.5	-	-	0.7	-	-	-	-	-	2.6	1.4	*58
Percentage	-	-	44%	56%	10%	79%	18%	2%	7%	93%	-	-	-
August 1995													
Totals	225	1434	609	825	203	126	22	77	217	8	-	-	17,310
Average	-	6.4	-	-	0.9	-	-	-	-	-	0.7	0.8	*77
Percentage	-	-	42%	58%	14%	56%	10%	34%	96%	4%	-	-	-
Variation 1994 TO 1995 + or -		-0.1	-2%	+2%	+0.2 +4%	-23%	-8%	+32%	+89%	-89%	-1.9 km	-0.6 hrs (40 mins)	+19

Who Collects the Water?				Percent of Population Collecting	Average Volume of Water Carried per Person (litres)	Average Volume of Water Used per Person per Day (litres)	Latrines		Incidence of Disease			
Mothers	Daughters	Sons	Others				Yes	No	Malaria	Dysentry	Scables	Bilharzia
171	131	3	43	19%	-	-	50	235	247	92	37	127
-	-	-	-	-	48	8.9	-	-	-	-	-	-
49%	38%	1%	12%	-	-	-	18%	82%	*87%	32%	13%	45%
201	116	7	115	31%	-	-	54	171	78	1	45	38
-	-	-	-	-	39	12.1	-	-	-	-	-	-
46%	26%	2%	26%	-	-	-	24%	76%	*35%	0%	20%	17%
-3%	-12%	+1%	+14%	+12%	-9 litres	+3.2 litres	+6%	-6%	-52%	-32%	+7%	-28%

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APPENDIX A1

WORLD RELIEF MOÇAMBIQUE

PROGRAMA DE ABASTECIMENTO DE ÁGUA RURAL E SANEAMENTO

Distritos de Massengena e Chigubo

Província de Gaza

Abril 1994

****

Distrito: _____ Localidade: _____

Bairro: _____

Questionário

A entrevistada é (marca uma cruz)

_____ Mãe

_____ Outra (Quem?)_____

O Pai vive em casa? (se não onde vive o Pai)

_____

Além destas Mães, existem outras Mães na mesma casa? (quantas)

_____

1. Quantas pessoas moram na casa? (escreve o número)

_____ Pessoas (incluindo as crianças)

2. Quantas mulheres e quantos homens? (incluindo as crianças)

_____ Mulheres Homens _____

3. Quantas crianças com menos de 5 anos tem em casa? (escreve o número)

_____ Crianças com menos de 5 anos

4. Esta localidade é a sua zona de origem? (marcar uma cruz)

Sim Não

(Se não) Quanto tempo pretende cá ficar?

_____ Sempre _____ Pouco tempo

_____ Outra (Qual?)_____ _____ Não sabe

5. Qual é a sua situação residencial?

_____ Residente

_____ Deslocado

_____ Regressado

_____ Misto

6. Se é deslocado, de onde vieram?

Outro País_____ (País)

Outro distrito_____ (Distrito)_____ (Localidade)

Mesmo distrito_____ (Localidade)

Para onde vão?

Outro distrito _____ (Distrito)_____ (Localidade)

Mesmo distrito _____ (Localidade)

7. Onde é que a família recolhe água para casa? (marcar todas que identifica) Diga outras.

_____ Furo com bomba

_____ Poço aberto comunal

_____ Rio

_____ Água da chuva

_____ Lagoa

_____ Outro (Qual?) _____

8. Para quê que usam esta água?

_____ Beber

_____ Cozinhar

_____ Tomar banho

_____ Lavar loiça

_____ Lavar roupa

9. Onde é que a mãe lava a roupa? (marcar uma cruz)

_____ No mesmo furo com bomba

_____ No mesmo poço

_____ No rio ou lagoa

_____ Casa

_____ Outra (qual?)

10. Qual é a distancia á fonte principal de onde tira a água?

_____ Perto

_____ Longe

_____ Muito longe

Se possível diga o número de quilómetros? (medir com carro!)

_____ Km _____ Não sabe

11. Qual é a quantidade que consegue tirar por dia? (escreve o n de litros) Diga o número de latas.

Diga: É possível ver o tamanho das latas?
(de latas, calcule os litros. Ao mesmo tempo, podem ver como é que guardam a água em casa - coberta ou não)

_____ Litros

_____ Não sabe

12. Qual é a quantidade que a família utiliza cada dia para:

_____ Beber (escreve o número de litros ou latas)

_____ Tomar banho

_____ Cozinhar

_____ Lavar roupa

13. Quanto tempo leva para recolher toda a água para a família para um dia? (escrever o número) Diga: Inclui todas as viagens por todas as pessoas.

_____ Número de viagens

_____ Quanto tempo de viagem (incluir o tempo de ida e volta e espera à fonte) (escreve horas/minutos)

_____ Todo dia

_____ Não sabe

14. Quem recolhe a água?

_____ Mãe

_____ Filhas (Escreve o número e diga a idade)_____

_____ Filhos (Escreve o número e diga a idade) _____

_____ Outros (Quem?)_____

15. A família tem latrina? (marcar uma cruz)

_____ Sim _____ Não

(Se sim) Quem da família usa a latrina?

_____ Pai

_____ Mãe

_____ Crianças

_____ Crianças com menos de 5 anos com ajuda dos Pais

(Se sim) Outras famílias usam a latrina?

_____ Sim _____ Não

16. (Se não tem latrina) Onde é que a família defeca? (marca todas que identificar)

_____ No chão perto de casa (pergunta: onde?)

_____ No chão fora do quintal

_____ Outra latrina

_____ Machamba

_____ Outra (Onde?) _____

17. Onde vão quando estão doentes?

_____ Curandeiro

_____ Posto/Centro de saúde

_____ Outro (qual?)_____

_____ Nenhum lado

18. Se não vai ao Posto/Centro de saúde quando está doente diga porquê?

_____ Muito Longe

_____ Falta de transporte

_____ Falta de dinheiro

_____ Falta de pessoal qualificado

_____ Falta de medicamentos

_____ Outras (quais?)

19. Quais são as doenças mais comuns que as crianças sofreram nos 3 meses passados?

_____ Malaria/febres

_____ Sarampo

_____ Diarréia simples

_____ Diarréia com sangue

_____ Dor de estômago/vómitos

_____ Doenças de pele ou sarna

_____ Bilhaziose

_____ Outra (Qual?) _____

_____ Não sabe

20. Quantas das suas crianças fizeram fezes liquidas no mesmo dia durante os últimos três dias?

_____ Crianças

WORLD RELIEF RURAL WATER SUPPLY AND SANITATION PROGRAMME

Baseline Survey Data April 1994 - Massangena District

Aldeia/Bairro	Number of Households Questioned	Total Number of Inhabitants	Gender		Total No. Children <5 years	Residential Status			Water Source		Latrines		Incidence of Disease			
			Male	Female		Resident	Displaced	Returnee	Pumps	River	Yes	No	Malaria	Dysentry	Scabies	Bilharzia
Maninge	15	151	66	85	21	13	0	2	7	8	4	11	14	12	2	11
Massangena Sede	14	91	49	42	12	10	4	0	14	0	10	4	10	2	0	3
Chicumbo	59	420	173	247	53	32	25	2	-	59	9	50	55	25	9	23
Mbocoda	120	717	308	409	80	93	25	2	-	120	19	101	110	54	17	55
Ngomane	32	221	105	116	23	13	19	0	-	32	2	30	29	13	4	3
Mapanhe	33	293	138	155	30	3	30	0	-	33	2	31	32	16	6	15
Mabondzo	44	291	120	171	23	34	8	2	-	44	3	41	33	7	3	17
Cufamune	32	222	92	130	14	19	13	0	-	32	3	29	30	5	6	16
Mucambene	60	388	175	213	41	57	2	1	-	60	11	49	50	12	9	25
Siqetto	60	434	184	250	40	36	21	2	-	60	4	56	52	16	21	7
Muzamani	45	338	171	167	48	20	25	0	-	45	0	45	38	21	3	13
Mavue	46	300	122	178	37	32	14	0	-	46	14	32	45	26	26	1
Mavue Fronteira	15	59	28	31	5	12	3	0	-	15	0	15	9	1	0	5
Totals	575	3925	1731	2194	427	374	189	11	21	554	81	494	507	210	106	194
Average	-	6.8	-	-	0.7	-	-	-	-	-	-	-	-	-	-	-
Percentage	-	-	44%	56%	11%	65%	33%	2%	4%	96%	14%	86%	*88%	37%	18%	34%

* = percentage of households that reported at least one case of the disease in the previous 3 months

APPENDIX A2

WORLD RELIEF RURAL WATER SUPPLY AND SANITATION PROGRAMME

Water Source, Distance, Time, Quantity and Practices Analysis - Massangena District, April 1994

Aldeia/Bairro	Number of Households Questioned	Total Number of Inhabitants	Household Principle Water Source					Distance to Source (kms)	Time Taken to Collect Water per Day (hrs)	Total Volume of Water Collected (litres)	Who Collects the Water?				Average Volume of Water Carried per Person (litres)	Average Volume of Water Used per Person per Day (litres)
			Pump	Well	Train	Lake	River				Mothers	Daughters	Sons	Others		
Maninge	15	151	7	-	-	-	8	0.5	0.5	2285	10	8		6	95	15.1
Massangena Sede	14	86	14	-	-	-	0	0.5	0.5	1565	12	7		5	65	18.2
Chicumbo	59	420	-	-	-	-	59	5	1.5	3415	39	31		10	43	8.1
Mbocoda	120	717	-	-	-	-	120	2	1	6056	33	19		4	108	8.4
Ngomane	32	221	-	-	-	-	32	7	2	1410	35	9		8	27	6.4
Mapanhe	33	293	-	-	-	-	33	10	4	2170	37	8		7	42	7.4
Mabondzo	44	291	-	-	-	-	44	1	2	2295	45	41	1	8	24	7.9
Cufamune	32	222	-	-	-	-	32	1	2	1730	22	20		11	33	7.8
Mucambene	60	388	-	-	-	-	60	7	2	2675	49	36	2	9	28	6.9
Siqetto	60	434	-	-	-	-	60	7	2	2590	45	30		14	29	6.0
Muzamani	45	338	-	-	-	-	45	1.5	2	2545	46	31		13	28	7.5
Mavue	46	300	-	-	-	-	46	1	2	1035	39	22		2	16	3.5
Mavue Fronteira	15	59		-	-	-	15	3	1	555	12	8		4	23	9.4
Totals	575	3920	21	0	0	0	554	-	-	30326	424	270	3	101	-	-
Average	-	6.8	-	-	-	-	-	3.8	1.8	*53	-	-	-	-	38	7.7
Percentage	-	-	4%	0%	0%	0%	96%	-	-	-	53%	34%	0.4%	13%	-	-

APPENDIX A2

* = Average usage per household

WORLD RELIEF RURAL WATER SUPPLY AND SANITATION PROGRAMME

Baseline Survey Data September 1994 - Giuja District

Aldeia/Bairro	Number of Households Questioned	Total Number of Inhabitants	Gender		Total No. Children <5 years	Residential Status			Water Source				Latrines		Incidence of Disease			
			Male	Female		Resident	Displaced	Returnee	Pumps	River	Well	Lake	Yes	No	Malaria	Dysentry	Scabies	Bilharzia
Acordo do Lusaka	63	480	236	244	61	62	1	-	53	-	10	-	26	37	48	26	26	45
Chibabel	65	481	210	271	56	62	3	-	25	18	21	1	30	35	48	32	24	35
Chivonguene	71	505	228	277	45	69	2	-	-	-	71	-	9	62	56	41	19	38
Chichongoro	45	327	152	175	40	40	5	-	2	-	32	11	17	28	31	21	11	18
Chinhacanine	78	562	250	312	75	61	17	-	-	30	48	-	14	64	57	23	32	41
Chimbembe	59	541	263	278	73	48	11	-	-	15	-	44	18	41	38	19	19	30
Manguguane	32	273	119	154	44	25	7	-	2	2	28	-	22	10	25	2	9	10
Mbalavala	30	206	96	110	20	27	3	-	-	7	-	23	8	22	21	9	8	18
Mbanguene	45	322	132	190	39	36	9	-	-	-	45	-	3	42	35	14	12	20
Nhampunguane	62	325	151	174	31	61	1	-	-	-	62	-	1	61	31	17	31	28
Nhatine	15	125	63	62	22	0	3	12	-	-	15	-	2	13	13	7	9	8
Tomanine	89	557	253	304	56	44	6	39	29	-	60	-	4	85	64	27	26	13
Sifo	44	364	177	187	38	40	1	3	-	-	29	15	3	41	33	16	19	25
7 de Abril	59	395	187	208	52	53	6	-	-	-	59	-	7	52	41	12	18	26
Totals	757	5463	2517	2946	652	628	75	54	111	72	480	94	164	593	541	266	263	355
Averages	-	7.2	-	-	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-
Percentages	-	-	46%	54%	12%	83%	10%	7%	15%	10%	63%	12%	22%	78%	*71%	35%	35%	47%

*= percentage of households that reported at least one case of the disease in the previous three months

APPENDIX A3

WORLD RELIEF RURAL WATER SUPPLY AND SANITATION PROGRAMME

Baseline Survey Data October 1994 - Chicualacuala District

Aldeia/Bairro	Number of Households Questioned	Total Number of Inhabitants	Gender		Total No. Children <5 years	Residential Status			Water Source					Latrines		Incidence of Disease				
			Male	Female		Resident	Displaced	Returnee	Pump	Well	Train	Lake	River	Yes	No	Malaria	Dysentry	Diarrhea	Scabies	Bilharzia
Litatia	46	324	151	173	25	23	20	3		46				7	39	16	7	25	4	11
Chicualacuala Sede	15	131	60	71	17	15					15			14	1	11	3	10	6	1
Chic. B. B	15	129	59	70	24	3	12				15			14	1	11	2	6	6	2
Chic. B. Militar	15	101	47	54	11	5	10			1	14			15		9	2	3	5	1
Chic. B. Novo	15	153	72	81	19	10	2	3			15			14	1	13	8	13	4	3
Chic. B. Pafuri	15	103	41	62	16	3	12		15					10	5	6	2	3	2	
Chic. B.Communal	15	142	71	71	14	2	5	8			15			15		6	7	5	5	1
Chic. B. 25 Junho	15	139	64	75	15	5	10				15			9	6	9	10	5	5	2
Chicualacuala B	30	253	107	146	18	9	21					27	3	4	26	25	15	9	10	4
Mapai Estacao	15	106	43	63	10	10	4	1			9		6	13	2	9	7	3	5	4
Mapai B. Novais	15	105	42	63	16	10	5		2		1		12	12	3	6	5	3	4	5
Mapai B. Domingo	15	67	30	37	11	5	10				11	4		11	4	14	6	6	3	4
Mapai B. Militar	15	63	26	37	9	9	6				15			15		5	4	4	6	2
Mapai B. Feveriaro	15	111	48	63	17	5	8	2			13	2		5	10	12	4	6	6	4
Mukacane	30	362	161	201	60	24	6						30	7	23	21	17	4	9	17
16 de Junho	60	516	240	276	73	30	29	1	59		1			37	23	48	21	23	10	13
Regua	14	107	49	58	12	12	2		14					8	6	12	7	7	3	10
Mafasitela	13	131	61	70	12	13							13		13	10	0	2	3	4
Mpuze Est & Rio	46	390	191	199	47	39	7		1				45	15	31	40	20	28	9	20
Bulela	16	171	84	87	22	14	1						15	3	12	15	12	2	4	12
Chilemane	31	329	148	181	46	25	6						31		31	28	17	12	6	22
Mapai Ngala	15	122	54	68	12	7	8			1			14	1	14	11	0	9	5	1
Chidulo	30	270	115	155	36	30				28			2	6	24	23	6	15	6	6
Totals	510	4325	1964	2361	542	308	184	18	91	76	139	33	171	235	275	360	182	203	126	149
Average	-	8.5	-	-	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Percentage	-	-	45%	55%	13%	60%	36%	4%	18%	15%	27%	6%	34%	46%	54%	71%	36%	40%	25%	29%

APPENDIX A4

APPENDIX A3

WORLD RELIEF RURAL WATER SUPPLY AND SANITATION PROGRAMME

Water Source, Distance, Time, Quantity and Practices Analysis - Guila District, September 1994

Aldeia/Bairro	Number of Households Questioned	Total Number of Inhabitants	Household Principle Water Source					Distance to Source (kms)	Time Taken to Collect Water per Day (hrs)	Total Volume of Water Collected (litres)	Who Collects the Water?				Average Volume of Water Carried per Person (litres)	Average Volume of Water Used per Person per Day (litres)
			Pump	Well	Train	Lake	River				Mothers	Daughters	Sons	Others		
Acordo do Lusaka	63	480	53	10	-	-	-	1	2	5060	36	39		16	56	10.5
Chibabel	65	481	25	21	-	1	18	0.5	2	7720	66	64		27	49	16.0
Chivonguene	71	505	-	71	-	-	-	0.5	1	6995	61	45		24	54	13.9
Chichongoro	45	327	2	32	-	11	-	0.1	1	2220	30	6		3	57	6.8
Chinhacanine	78	562	-	48	-	-	30	0.5	1	3950	32	32		10	53	7.0
Chimbembe	59	541	-	-	-	44	15	0.5	2	8590	76	60		24	54	15.9
Manguguane	32	273	2	28	-	-	2	0.5	0.25	3340	27	43		3	46	12.2
Mbalavala	30	206	-	-	-	23	7	0.5	1	2490	23	7		9	64	12.1
Mbanguene	45	322	-	45	-	-	-	0.5	1	4090	30	43		15	46	12.7
Nhampunguane	62	325	-	62	-	-	-	3	2	4272	55	21	2	8	50	13.1
Nhatine	15	125	-	15	-	-	-	0.5	0.5	1176	11	6		2	62	9.4
Tomanine	89	557	29	60	-	-	-	0.3	1	6265	48	34		13	66	11.2
Sifo	44	364	-	29	-	15	-	1	2	4510	41	11		16	66	12.4
7 de Abril	59	395	-	59		-	-	4	2	4420	76	47		20	31	11.2
Totals	757	5463	111	480	0	94	72	-	-	65098	612	458	2	190	-	-
Average	-	7.2	-	-	-	-	-	1.1	1.4	*86	-	-	-	-	52	11.9
Percentage	-	-	15%	63%	0%	12%	10%	-	-	-	48%	36%	0%	15%	-	-

* Average usage per household

WORLD RELIEF RURAL WATER SUPPLY AND SANITATION PROGRAMME

Water Source, Distance, Time, Quantity and Practices Analysis - Chicualacuala District, October 1994

Aldeia/Bairro	Number of Households Questioned	Total Number of Inhabitants	Household Principle Water Source					Distance to Source (kms)	Time Taken to Collect Water per Day (hrs)	Total Volume of Water Collected (litres)	Who Collects the Water?				Average Volume of Water Carried per Person (litres)	Average Volume of Water Used per Person per Day (litres)
			Pump	Well	Train	Lake	River				Mothers	Daughters	Sons	Others		
Litatia	46	324		46				2	2.5	3375	35	27	0	17	43	10.4
Chicualacuala Sede	15	131			15			0.4	2	3410	11	9	1	1	155	26.0
Chic. B. B	15	129			15			0.6	1	2510	15	3	0	0	139	19.5
Chic. B. Militar	15	101		1	14			1.5	2	1620	12	2	0	6	81	16.0
Chic. B. Novo	15	153			15			2.5	3	1800	13	8	0	5	69	11.8
Chic. B. Pafuri	15	103	15					0.5	2	620	13	2	0	3	34	6.0
Chic. B.Communal	15	142			15			2.5	3	700	12	3	0	3	39	4.9
Chic. B. 25 Junho	15	139			15			2	1	770	15	4	0	0	41	5.5
Chicualacuala B	30	253				27	3	1	1	2045	27	20	0	3	41	8.1
Mapai Estacao	15	106			9		6	0.5	2	1565	11	9	1	3	65	14.8
Mapai B. Novais	15	105	2		1		12	2	1.5	1600	11	13	0	9	48	15.2
Mapai B. Domingo	15	67			11	4		0.8	2	955	13	2	1	0	60	14.3
Mapai B. Militar	15	63			15			0.2	3	1570	15	8	4	0	58	24.9
Mapai B. Feveriaro	15	111			13	2		0.5	1	900	11	6	7	0	38	8.1
Mucajane	30	362					30	1	1	4025	23	16	20	0	68	11.1
16 de Junho	60	516	59		1			1	1	5945	70	42	12	0	48	11.5
Regua	14	107	14					0.5	0.5	1350	14	5	8	0	50	12.6
Mafasitela	13	131					13	8	6	1375	14	3	4	0	65	10.5
Mpuze Est & Rio	46	390	1				45	7	5	3143	43	21	0	1	48	8.1
Bulela	15	171					15	5	3	1680	20	6	0	0	66	9.8
Chilemane	31	329					31	3	2	3210	29	25	0	4	55	9.8
Mapai Ngala	15	122		1			14	0.7	1	5150	11	6	0	6	224	42.2
Chidulo	30	270		28			2	2	1	3208	32	33	0	8	44	11.9
Totals	510	4325	91	75	139	33	171	-	-	52526	470	273	58	69	-	-
Average	-	8.5	-	-	-	-	-	2.0	2.1	103	-	-	-	-	60.4	12.1
Percentage	-	-	18%	15%	27%	6%	34%	-	-	-	54%	31%	7%	8%	-	-

APPENDIX A4

WORLD RELIEF RURAL WATER SUPPLY AND SANITATION PROGRAMME

Water Source, Distance, Time, Quantity and Practices Analysis - Mabalane District, March 1995

Aldeia/Bairro	Number of Households Questioned	Total Number of Inhabitants	Water Source: Lake	Water Source: River	Distance to Source (kms)	Time Taken to Collect Water per Day (hrs)	Total Volume of Water Collected (litres)	Who Collects the Water?: Mothers	Who Collects the Water?: Daughters	Who Collects the Water?: Sons	Who Collects the Water?: Others	Average Volume of Water Carried per Person (litres)	Average Volume of Water Used per Person per Day (litres)
Hoyo Hoyo	19	148		19	2	1	2570	21	16		12	52	17.4
Combomune Rio	30	234		30	5	3	2321	23	19		8	46	9.9
Zona-8	13	95		13	2	1.5	1275	10	7		6	55	13.4
Zona-9	17	140		17	1	1	1920	11	14		8	58	13.7
Matidze	31	249		31	1	0.75	3420	18	45		16	43	13.7
Mabomo	48	439		48	2	1	3250	30	21		13	51	7.4
Chipsuane	22	169		22	3	2	3200	25	14		11	64	18.9
Totals	180	1474	0	180	-	-	17956	138	136	0	74	-	-
Average	-	8.2	-	-	2.3	1.5	*100	-	-	-	-	52	12.2
Percentage	-	-	0%	100%	-	-	-	40%	39%	0%	21%	-	-

* = Average usage per household

APPENDIX A5

APPENDIX B1

WORLD RELIEF MOZAMBIQUE - Rural Water Supply and Sanitation Programme

Evaluation of Borehole Drilling Tender and Contract RWS 01/94

Background

On Tuesday 8th February 1994 World Relief published in the newspaper "Noticais" an invitation to tender for a contract to drill 25 boreholes in the Districts of Massangena and Chigubo. This same invitation to tender (attached) was also sent to a number of external (non-Mozambican) drilling companies who had learned of World Relief's rural water supply activities and had visited World Relief in Maputo over the last 6 months. As a result 14 companies collected the tender documents and by 4th March 1994 10 bids had been received. The names and addresses of these companies are also attached.

Opening Procedures

The original procedure for opening the documents, Point 8 in the tender document, was altered as a result of a discussion with World Relief's donors when it was decided more time should be made available for an evaluation of the technical bids. A fax notifying all bidders of this change was sent on 25th February 1994. Deadline for the submission of bids was 09:00 on 4th March. A public opening of the bids was held at the World Relief office in Maputo at 09:30 on that same day. All the financial proposals were opened and in turn the prices quoted for selected key items/works were read out to allow interested parties present an immediate assessment and comparison of the various bids. The selected key items/works were:

- Mobilisation cost
- Drilling cost for 0 - 50 metres
- Drilling cost for 50 - 100 metres
- Supply and installation of 4" PVC casing
- Supply and installation of 4" PVC screen (filter)
- Supply and installation of gravel pack

Financial Evaluation

Immediately following the public opening the World Relief Water Engineer undertook a cost comparison/evaluation exercise. This comparison was based on:

Initial mobilisation cost
300km of mobilisation beyond 20km

and the assumption of 25 Boreholes to 50m each with:-

110mm PVC casing to 50mm with 9m of screen
0.2m3 of gravel pack
3 hours development
pump and recovery test
sanitary seal
full set of reports

This enabled the financial bids to be ranked according to cost and to rationalise this cost a per borehole and per metre cost was calculated.

Two of the financial bids received did not meet the specifications or follow the tender guidelines and were therefore deemed non responsive. The other 8 bids were accepted and compare as overleaf.

Modrill - A Mozambican company with considerable experience in Mozambique but with a very varied reputation. Rate of progress is generally good but the quality of work especially if unsupervised has been report poor. The technical proposal is good but has two serious flaws; the experience of the foreman and the standard of the reporting forms and geological logs. Both points have been brought to their attention before. World Relief's concern is their ability to deal with hydrogeological problems should they arise, give good detailed reports and hydrogeological data and provide good logistical support and back-up.

Terrasearch - Although this South African company has no experience in Mozambique and is as yet unregistered it does have considerable experience in several other Southern African countries. The drilling rig and equipment provided for the contract allow the use of both rotary and down-the-hole hammer techniques. An understanding of waterwell problems and the hydrogeology of the area was indicated in both their technical and financial proposals. The experience, education and background of the foreman and standard of drilling log and reporting forms to be used are superior to Modrill. Concern over the logistical support and back-up provided for the programme could be justified. However both proposals indicate a professional approach to the task at hand.

Conclusion

The contract for the drilling of 25 boreholes in the Districts of Massangena and Chigubo was awarded to Terrasearch S.A on the condition that they immediately take steps to register as a company to operate in Mozambique and fulfil all legal requirements. Work will start no later than April 11th 1994.

The introduction of another drilling company to Mozambique was considered a positive move, in line with the recommendations made by World Relief after the Emergency Rural Water Supply Programme in September 1993, which it is hoped will further increase competitiveness, bring down drilling costs and improve standards.

Names and Addresses of Companies Who Submitted Bids to World Relief

Terrasearch S.A
Box 1433, Rivonia 2118, Johannesburg
Republic of South Africa

Modrill
285 Samora Machel Av. 5th Floor, Maputo
Mozambique

Profuro
Av. Kim Il Sung 961, Maputo
Mozambique

Southern Drilling Pipes
P.O.Box 39482, Moreleta Park 0044
Republic of South Africa

Geomoc E.E
Sede Av. Emilia Dausse 1144, Maputo
Mozambique

Agua Terra Construction Engineering Soc.
Samora Machel Avenue, Xai-Xai
Mozambique

Drilling Developments
P.O.Box 33925, Jeppestown 2043
Republic of South Africa

Technosol
Via Ciro Menotti No. 4, Roma
Italy

Geomechanik Bohrgesellschaft
Prakla Str. 1, 31311 Uetze
Federal Republic of Germany

Ground Water Practitioners
P.O Box 107, Sundra 2200
Republic of South Africa

Company Name	Total Cost	US$ Cost per Borehole	Cost per Metre
Agua Terra	97,460	3,898	78.0
Terrasearch	102,000	4,080	81.6
Modrill	108,238	4,330	86.6
Drilling Developments	117,369	4,695	93.9
Profuro	149,131	5,965	119.3
Tecnosol	220,010	8,800	176.0
Southern Drilling	227,500	9,100	182.0
Geomechanik	235,053	9,402	188.0

Geomoc 1992 prices add 30% for 1994. Bid not accepted. Specifications not met.

Ground Water Practitioners - Bid not accepted as specifications not met.

According to the revised evaluation procedure the best 5 financial proposals were then evaluated by the World Relief Water Engineer in consultation with the Engineering Officer and his Assistant Engineer from USAID.

Included in the tender document was a technical pre-qualification questionnaire. These questions were designed by World Relief who have experience of the technical and logistical problems that are likely to be encountered in the drilling project area and were used to assess the capabilities, professionalism and understanding of the bidding companies. Any bid which failed to address all these questions adequately were deemed non responsive.

Technical Evaluation

Following the disqualification of Agua Terra on their failure to submit any semblance of a technical proposal the 4 remaining technical bids were examined. Brief details of their strengths and weaknesses are given below.

Profuro - A new Mozambican company with very little operational experience in Mozambique and none in isolated rural areas. Capability unknown! The drilling rig and equipment proposed, background research of the area, experience of the foreman and the drilling log/reporting forms are good. However the overall cost some 30% higher than the successful bidder was the deciding factor with particular concern over the cost of the PVC screen and the mobilisation cost per site.

Drilling Developments - This South African company has no experience in Mozambique and little overall in waterwell drilling. Primarily a mining drilling company World Relief were concerned over their understanding and ability to deal with waterwell related problems. No geological/lithological log form is provided. In reading the technical proposal and the financial proposal, which contains a number of naive client conditions, the overall impression is that Drilling Developments are not prepared to set things up properly in country, the logistical backup is weak and they could potentially place too many administration and other demands on World Relief. Discrepancies within their conditions and costs were also a concern.

APPENDIX B1

WORLD RELIEF MOZAMBIQUE - Rural Water Supply and Sanitation Programme

Evaluation of Borehole Drilling Tender and Contract RWS 01/95

Background

During February 1995 World Relief published in the newspaper "Noticais" an invitation to tender for a contract to drill 20 boreholes in the Districts of Guija, Mabalane and Chokwe. As a result four companies collected the tender documents and by Friday 3rd March 1995 four bids had been received. The names and addresses of these companies are also attached.

The tender document used by World Relief was developed by PRONAR, DNA and UNICEF during the course of 1994.

Opening Procedure

A public opening of the bids was held at the World Relief office in Maputo at 09:00 on the 7th March 1995 to which PRONAR, DNA and USAID had been invited. In the event only the Country Director of World Relief, Ms Trudi Schwartz and the Director of the Rural Water and Sanitation Programme, Steve Ray were present.

Tender Comparison/Evaluation

Immediately following the public opening the World Relief Director of the Water and Sanitation Programme cost comparison/evaluation exercise. This comparison was based on:

Initial mobilisation cost
Set up cost per site
400 km of mobilisation between sites

and assuming 20 boreholes to 40m each with:-
100mm PVC casing to 40m including 6m of screen
0.1m3 of gravel pack
2 hours development
pump and recovery test
sanitary seal and cap

This enabled the financial bids to be ranked according to cost and to rationalise this cost a per borehole and per metre cost was calculated.

		US$	
Company Name	Total Cost	Cost per Borehole	Cost per Metre
Terrasearch	74,250	3,713	92.81
Mozaqua	74,340	3,717	92.93
ATC Engineering	89,540	4,477	111.90
Modrill	145,420	7,271	181.78

World Relief has firsthand knowledge of the all the drilling companies concerned, their equipment, technical ability, reliability and productivity. The contract for the drilling of 20 boreholes in the Districts of Guija, Mabalane and Chokwe was awarded to Terrasearch Mozambique. Work will start on Ist May 1995.

Names and Addresses of Companies Who Submitted Bids to World Relief

Agua Terra Construction Engineering Soc.
285 Samora Machel Av. 5th Floor
Samora Machel Avenue
Maputo

Modrill
P.O Box 161
Xai-Xai

Terrasearch Mocambique
P. O Box 472
Maputo

Mozagua
Av Emilia Dausse No. 857
Maputo

WORLD RELIEF MOZAMBIQUE - Rural Water Supply and Sanitation Programme

Borehole Drilling Tender and Contract - Cost Comparison /Evaluation of Bids (7th March 1995)

The cost comparison /evaluation of the bids opened on 7th March 1995 was based on:

Initial mobilisation cost
Set up cost per site
400 km of mobilisation (20 site moves)
20 Boreholes to 40m each with:-
- 100mm PVC casing to 40m including 6m of screen
- 0.1m3 of gravel pack
- 2 hours development
- pump and recovery test
- sanitary seal

Extra costs

****

Name and Address of Company: *Terrasearch Mocambique*
P.O Box 472, Maputo
Mozambique

Ref	Description	Unit	Unit Cost Bid US$	No. Units for Evaluation	Total Cost US$
1.1	Initial Mobilisation		2,000.00	1	2,000
1.2	Set up cost per site	per site	400.00	20	8,000
1.3	Moving cost	per km	10.00	400	4,000
2.1	Drilling 6"	m	38.50	800	30,800
2.2	Supply & Installation casing	m	22.00	680	14,960
2.3	Supply & Installation screen	m	27.00	120	3,240
2.4	Supply & Installation gravel pack	m3	250.00	2	500
2.5	Borehole development	hr	110.00	40	4,400
2.6	Pump & Recovery test	per hole	150.00	20	3,000
3	Installation sanitary seal	sum	55.00	20	1,100
				Sub total	**£72,000**

Extra costs

Drilling 203mm (8") @ US$ 44.5 per metre (assume 10m per hole)	1,200
Drilling Chemicals @ US$ 3.5 per metre (assume 15m per hole)	1,050

Note: If mud drilling is required extra costs will be incurred

TOTAL **£74,250**

Total Cost for comparison purposes is **£74,250**

Cost per Borehole = **£3,713**

Cost per Metre = **£92.81**

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WORLD RELIEF BOREHOLE DRILLING PROGRAMME - April to October 1994

Borehole Details

District: MASSANGENA

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Date of Drilling	Depth Drilled (m) 8.5"	Depth Drilled (m) 6.6"	Borehole Depth (m)	uPVC Casing and Screen "110mm (m)	Water Strike (m)	Static Water Level (m)	1 Hour Pump Test Q (m3/hr)	1 Hour Pump Test DWL (m)	Water Quality EC (uS/cm)	Lab Water Analysis	Action on Borehole
MUTETO (1)	21 34' 48" S 032 56' 11" E	01/WR/94	21/04/94	6	48	54	0 - 48m plain 48 - 54m screen	48	38 0	2 4	39 1	2340	Y	Afridev Handpump
MBOCODA (1)	21 34' 48" S 032 55' 57" E	02/WR/94	22/04/94	6	60	66	0 - 60 plain 60 - 66 screen	60	41 2	1 2	48.8	2390		Afridev Handpump
MBOCODA (2)	21 34' 46" S 032 56' 11" E	03/WR/94	22/04/94	6	68	74	0 - 68 plain 68 - 74 screen	65	37 8	1.6	44 0	2370		Afridev Handpump
NGOMANE	21 35' 37" S 032 53' 08" E	04/WR/94	23/04/94	18	49	67	0 - 61 plain 61 - 67 screen	60	50 5	1 3	52 3	1500		Afridev Handpump
MAPANHE (1)	21 45' 05" S 032 47' 53" E	05/WR/94	25/04/94	6	49	55	0 - 49 plain 49 - 55 screen	49	39 4	2 8	45 3	1500	Y	Afridev Handpump
MAPANHE (2)	21 45' 08" S 032 49' 29" E	06/WR/94	25/04/94	6	43	49	0 - 43 plain 43 - 49 screen	42	37 7	2 5	43 0	1530		Afridev Handpump
CHICUMBE (1)	21 36' 04" S 032 57' 31" E	07/WR/94	26/04/94	6	49	55	0 - 49 plain 49 - 55 screen	50	38 5	3 3	45 2	1120		Afridev Handpump
CHICUMBE (2)	21 35' 39" S 032 57' 31" E	08/WR/94	26/04/94	6	45	51	0 - 45 plain 45 - 51 screen	46	31.2	0 8	40 5	2340	Y	Afridev Handpump
MUCAMBENE (1)	21 33' 06" S 032 48' 33" E	09/WR/94	27/04/94	18	60	78	0 - 70 5 plain 70.5 - 78 screen	72	48 5	4 0	55 4	1800	Y	Afridev Handpump
MUCAMBENE (2)	21 33' 03" S 032 48' 56" E	10/WR/94	08/05/94	18	51	69	0 - 63 plain 63 - 69 screen	60	52 1	0 6	58 1	1820		Afridev Handpump
CUFAMUNE		11/WR/94	08/05/94	12	36	48	0 - 42 plain 42 - 48 screen	34	30 3	3.8	32.2	2260		Afridev Handpump
MABONDZO (1)	21 35' 28" S 033 01' 20" E	12/WR/94	09/05/94	12	24	36	0 - 30 plain 30 - 36 screen	26	21 5	4.8	25.0	2310	Y	Afridev Handpump
MABONDZO (2)	21 37' 17" S 033 01' 42" E	13/WR/94	11/05/94	12	36	48	0 - 42 plain 42 - 48 screen	42	25.2	3 8	25.7	2120		Afridev Handpump
CHITLUMANE	21 38' 28" S 032 55' 00" E	14/WR/94	05/05/94	6	48	54	0 - 48 plain 48 - 54 screen	49	42 7	1 2	42.7	2500	Y	Afridev Handpump
MASSANGENA SEDE (transit)	21 33' 13" S 032 57' 11" E	15/WR/94	25/05/94	18	24	42	0 - 24 plain 24 - 30 screen	37	8 4	2.4	18 2	2130	Y	Afridev Handpump
MASSANGENA SEDE (hospital)	21 32' 48" S 032 57' 23" E	16/WR/94	25/05/94	18	0	18	0 - 12 plain 12 - 18 screen	14	10.2	3 9	10.4	2900		Afridev Handpump
MANINGE	21 31' 54" S 032 56' 59" E	17/WR/94	26/05/94	0	35	35	0 - 29 plain 29 - 35 screen	32	15 9	3 2	16.4	1820		Afridev Handpump
MUTETO (2)	21 34' 33" S 032 58' 58" E	18/WR/94	27/05/94	6	42	48	0 - 42 plain 42 - 48 screen	27	25.4	3 2	38.4	2140		Afridev Handpump
SINGANHANE	21 42' 22" S 033 02' 22" E	19/WR/94	28/05/94	12	44	56	0 - 50 plain 50 - 56 screen	49	42 0	2 8	43 8	2000		Afridev Handpump
MAPSWAI	21 41' 21" S 033 02' 53" E	20/WR/94	11/06/94	6	48	54	0 - 48 plain 48 - 54 screen	42	42.1	1.3	42.2	1880	Y	Afridev Handpump
HANDELA	21 40' 41" S 032 54' 00" E	21/WR/94	31/05/94	12	54	66	0 - 60 plain 60 - 66 screen	58	49 0	2 4	55 3	1850		Afridev Handpump
MAVUE FRONTEIRA	21 20' 42" S 032 28' 07" E	22/WR/94	01/06/94	6	48	54	0 - 48 plain 48 - 54 screen	42	30.5	0.6	40.7	2000	Y	Afridev Handpump
SIQETTO (1)	21 30' 04" S 032 45' 00 E	23/WR/94	06/06/94	6	72	78	0 - 66 plain 66 - 72 screen	66	20.9	1 2	45.4	1910	Y	Afridev Handpump
SIQETTO (2)	21 28' 55" S 032 44' 39" E	24/WR/94	07/06/94	6	26	32	N/A	30	19.5	N/A	N/A	13000		Abandoned Saline water
MUCAMBENE (3)	21 32' 48" S 032 48' 21" E	25/WR/94	08/06/94	12	60	72	0 - 66 plain 66 - 72 screen	60	48 5	4 0	55 4	1700		Afridev Handpump
SOKOTE	21 31' 12" S 032 47' 52" E	26/WR/94	09/06/94	6	45	51	0 - 42 plain 42 - 51 screen	36	16.0	1.1	45 0	2000		Afridev Handpump

WORLD RELIEF BOREHOLE DRILLING PROGRAMME - April to October 1994

Borehole Details

District: MASSANGENA

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Date of Drilling	Depth Drilled (m) 8.5"	6.5"	Borehole Depth (m)	uPVC Casing and Screen "110mm (m)	Water Strike (m)	Static Water Level (m)	1 Hour Pump Test Q (m3/hr)	DWL (m)	Water Quality EC (uS/cm)	Water Analysis Y/N	Action on Borehole
NYAMAGIO	21 36' 18" S 032 47' 36" E	27/WR/94	10/06/94	6	72	78	N/A	54	N/A	N/A	N/A	1200		Abandoned Dry
CHICUMBE (3)	21 35' 06" S 032 58' 37" E	28/WR/94	10/06/94	12	42	54	0 - 48 plain 48 - 54 screen	48	39 1	5.5	48.1	2380		Afridev Handpump
MAVUE (1)	21 24' 18" S 032 31' 03" E	29/WR/94	27/06/94	6	67	73	N/A	N/A	N/A	N/A	N/A	N/A		Abandoned Dry
MAVUE (2)	21 23' 42" S 032 30' 37" E	30/WR/94	29/06/94	8	35	43	N/A	N/A	N/A	N/A	N/A	N/A		Abandoned Caving Formation
MUTCHERE	21 28' 14" S 032 39' 44" E	31/WR/94	29/06/94	11	37	48	N/A	42	27 8	N/A	N/A	11000		Abandoned Saline water
MADANGA	21 39' 22" S 032 55' 28" E	32/WR/94	30/06/94	11	68	79	N/A	72	N/A	N/A	N/A	N/A		Abandoned Caving Formation
CHINEZANE	21 52' 37" S 032 47' 48" E	33/WR/94	01/07/94	5	31	36	0 - 30 plain 30 - 36 screen	31	15 2	2 9	21 4	980	Y	Afridev Handpump

Notes:
* 110mm is internal diameter, 125mm outer diameter.
Screen slot size is 0.5mm
DWL = dynamic water level
Q = borehole discharge

WORLD RELIEF BOREHOLE DRILLING PROGRAMME - April to October 1994

Borehole Details

District GUIJA

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Date of Drilling	Depth Drilled (m) 6.5"	6.5"	Borehole Depth (m)	uPVC Casing and Screen "110mm (m)	Water Strike (m)	Static Water Level(m)	1 Hour Pump Test Q (m3/hr)	DWL (m)	Water Quality EC (uS/cm)	Lab Water Analysis	Action on Borehole
NALAZI (1)	24 03' 21" S 033 19' 33" E	77/WR/94	01/08/94	5 5	26	31 5	0 - 25 5 plain 25 5-31 5 screen	27	20 9	1 4	28 0	2700	Y	Afridev Handpump
NALAZI (2) (Panzane)	23 58' 58" S 033 18' 33" E	78/WR/94	01/08/94	5 5	27 5	34	0 - 28 plain 28 - 34 screen	30	18 9	1 8	20 2	1450	Y	Afridev Handpump
NALAZI (3)	24 02' 22" S 033 17' 08" E	79/WR/94	04/08/94	5 5	44 5	50	N/A	41	18.0	N/A	N/A	8400		Abandoned Saline water
NALAZI (4) (Maimane)	24 04' 02" S 033 10' 00" E	80/WR/94	05/08/94	5 5	39 5	45	0 - 39 plain 39 - 45 screen	36	23.1	1.0	44 5	3400		Afridev Handpump
7 de ABRIL (1)	24 28' 07" S 033 02' 48" E	81/WR/94	08/08/94	5 5	19 5	25	0 - 19 plain 19 - 25 screen	18	14.2	1 8	21 3	2450	Y	Afridev Handpump
7 de ABRIL (2)	24 28' 34" S 033 03' 38" E	82/WR/94	08/08/94	11 5	18 5	30	N/A	24	18 5	N/A	N/A	7500		Abandoned Saline water
CHIVONGUENE	24 31' 13" S 033 05' 52" E	83/WR/94	07/08/94	5 5	13 5	19	0 - 13 5 plain 13 5 - 19 screen	15	10 8	1 9	15 1	2800	Y	Afridev Handpump
CHINHACANINE (1)	24 23' 15" S 032 54' 32" E	84/WR/94	07/08/94	5 5	17 5	23	0 - 17 plain 17 - 23 screen	18	18.0	2 1	18 3	1900		Afridev Handpump
CHINHACANINE (2)	24 24' 18" S 032 53' 31" E	85/WR/94	08/08/94	11 5	42 5	54	0 - 42 plain 42 - 48 screen	34	40.5	1 6	41.0	1500		Afridev Handpump
CHINHACANINE (3)	24 24' 18" S 032 53' 51" E	86/WR/94	09/08/94	5 5	36 5	42	0 - 33 plain 33 - 39 screen	30	28 8	2 6	36 0	1800		Afridev Handpump
CHINHACANINE (4)	24 24' 40" S 032 53' 37" E	87/WR/94	08/08/94	11 5	36 5	48	0 - 42 plain 42 - 48 screen	36	38.3	2 5	37 5	2000		Afridev Handpump
CHINHACANINE (5)	24 24' 03" S 032 53' 07" E	88/WR/94	10/08/94	5 5	42 5	43	0 - 37 plain 37 - 43 screen	36	38 0	2 4	38 8	1300		Afridev Handpump
CHINHACANINE (6)	24 23' 15" S 032 53' 16" E	89/WR/94	10/08/94	5 5	30 5	36	0 - 20 plain 20 - 26 screen	20	19.8	2 4	20 1	800		Afridev Handpump
CHINHACANINE (7)	24 23' 26" S 032 53' 06" E	90/WR/94	11/08/94	24	11	35	0 - 27 plain 27 - 33 screen	24	23.3	2 3	28 1	1000		Afridev Handpump
CHINHACANINE (8)	24 23' 07" S 032 52' 58" E	91/WR/94	11/08/94	18	18	36	0 - 27 plain 27 - 33 screen	25	20 6	1 9	27 0	1500		Afridev Handpump
CHINHACANINE (9)	24 22' 58" S 032 53' 09" E	92/WR/94	12/08/94	12	14	26	0 - 20 plain 20 - 26 screen	18	15 9	2 3	23 4	500		Afridev Handpump
DONGA (3)	24 20' 18" S 032 52' 48" E	93/WR/94	12/08/94	41	0	41	0 - 30 plain 30 - 36 screen	30	28 3	1 5	30 0	2600		Afridev Handpump
DONGA (4)	24 20' 32" S 032 53' 05" E	94/WR/94	13/08/94	5 5	37 5	43	0 - 28 plain 28 - 37 screen	30	26 5	1 1	34 5	4200		Afridev Handpump
DONGA (5)	23 19' 58" S 032 52' 48" E	95/WR/94	13/08/94	5 5	36 5	42	0 - 30 plain 30 - 36 screen	30	30.2	2 2	30 8	1500		Afridev Handpump
DONGA (6)	24 20' 34" S 032 53' 13" E	96/WR/94	15/08/94	5 5	28 5	34	0 - 28 plain 28 - 34 screen	28	25 5	1 5	27 1	1000		Afridev Handpump
DONGA (7)	24 19' 52" S 032 52' 28" E	97/WR/94	15/08/94	5 5	30 5	36	0 - 30 plain 30 - 36 screen	30	28 4	2 1	29 4	2000		Afridev Handpump
DONGA (8)	24 19' 37" S 032 53' 17" E	98/WR/94	16/08/94	5 5	30 5	36	0 - 30 plain 30 - 36 screen	30	30 0	1 8	31 1	1560		Afridev Handpump
MONT ALTO (8)	24 14' 22" S 032 49' 48" E	99/WR/94	18/08/94	5 5	30 5	36	0 - 30 plain 30 - 36 screen	31	27 3	1 6	28 1	2000		Afridev Handpump
MONT ALTO (9)	24 14' 25" S 032 50' 34" E	100/WR/94	18/09/94	5 5	30 5	36	0 - 30 plain 30 - 36 screen	31	27.0	1.2	32 5	2000		Afridev Handpump
REHABILITATIONS														
MONT ALTO (2)				-	-	36	0 - 30 plain 30 - 36 screen	-	28 6	2 8	30 8	2110		Afridev Handpump
MONT ALTO (5)				-	-	34	0 - 28 plain 28 - 34 screen	-	28.1	0 9	29.1	2200		Afridev Handpump

Notes
* 110 mm is internal diameter, 125mm OD.
DWL = Dynamic water level, Q = Borehole discharge

WORLD RELIEF BOREHOLE DRILLING PROGRAMME - April to October 1994

Borehole Details

District CHICUALACUALA

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Date of Drilling	Depth Drilled (m) 8.5"	6.6"	Borehole Depth (m)	uPVC Casing and Screen *110mm (m)	Water Strike (m)	Static Water Level (m)	1 Hour Pump Test Q (m3/hr)	DWL (m)	Water Quality EC (uS/cm)	Action on Borehole
18 de JUNHO (5)	22 43' 32" S 032 05' 29" E	34/WR/94	04/07/94	10	68	78	0 - 72 plain 72 - 78 screen	72	57.1	1.6	62.8	1380	Volanta Handpump
18 de JUNHO (6)	22 43' 54" S 032 05' 42" E	35/WR/94	05/07/94	5	73	78	0 - 72 plain 72 - 78 screen	72	52.8	1.5	64.2	1290	Volanta Handpump
18 de JUNHO (7)	22 44' 00" S 032 05' 04" E	36/WR/94	06/07/94	8	66	74	0 - 66 plain 68 - 74 screen	66	59.4	1.2	60.8	700	Volanta Handpump
MAPAI (5)	22 44' 11" S 032 04' 03" E	37/WR/94	07/07/94	4	94	98	0 - 92 plain 92 - 98 screen	84	62.3	1.0	83.3	1080	Volanta Handpump
MAPAI (6)	22 43' 34" S 032 03' 39" E	38/WR/94	08/07/94	11	83	94	0 - 88 plain 88 - 94 screen	84	65.3	0.9	74.2	2400	Volanta Handpump
MAPAI (7)	22 44' 08" S 032 03' 38" E	39/WR/94	10/07/94	10	75	85	0 - 79 plain 79 - 85 screen	72	68.1	1.0	89.2	2320	Volanta Handpump
MAPAI (8)	22 44' 12" S 032 03' 15" E	40/WR/94	14/07/94	11	86	97	0 - 91.5 plain 91.5 - 97 screen	90	69.2	2.1	70.1	1010	Volanta Handpump
MAPAI (8)	22 41' 11" S 032 03' 58" E	41/WR/94	17/07/94	11	69	80	0 - 74 plain 74 - 80 screen	72	63.8	2.2	67.0	530	Volanta Handpump
MAFASTELA	22 32' 48" S 032 27' 52" E	42/WR/94	08/07/94	5	13	18	0 - 12 plain 12 - 18 screen	18	5.4	3.4	10.2	2270	Afridev Handpump
MAPAI NGALA (1)	22 51' 01" S 031 57' 48" E	43/WR/94	11/07/94	5	38	43	0 - 42.5 plain 42.5 - 48 screen	36	22.2	3.6	28.8	3170	Afridev Handpump
MAPAI NGALA (2)	22 52' 00" S 031 58' 21" E	44/WR/94	13/07/94	5	43	48	0 - 42.5 plain 42.5 - 48 screen	35	21.5	2.9	30.8	1850	Afridev Handpump
BUELA (1)	22 52' 25" S 031 59' 58" E	45/WR/94	11/07/94	5	27	32	0 - 28 plain 26 - 32 screen	27	14.7	3.4	24.7	1810	Afridev Handpump
BUELA (2)	22 52' 22" S 031 59' 40" E	46/WR/94	13/07/08	5	26	31	0 - 25 plain 25 - 31 screen	24	17.8	3.1	23.4	1610	Afridev Handpump
CHILEMANE (1)	22 58' 54" S 032 02' 02" E	47/WR/94	12/07/94	6	24	30	0 - 25 plain 25 - 30 screen	18	15.5	3.1	18.4	1500	Afridev Handpump
CHILEMANE (2)	22 58' 27" S 032 01' 55" E	48/WR/94	12/07/94	5	21	26	0 - 20 plain 20 - 26 screen	20	17.8	2.6	18.4	1500	Afridev Handpump
REGUA (2)	22 50' 59" S 032 07' 48" E	49/WR/94	15/07/94	10	68	78	0 - 72 plain 72 - 78 screen	73	63.0	1.9	64.6	2650	Volanta Handpump
MPUZE ESTACAO	23 02' 00" S 032 14' 53" E	115/WR/94	02/10/94	5.5	85.5	91	0 - 82 plain 82 - 91 screen	72	76.3	2.6	77.0	2800	Volanta Handpump
MPUZE RIO	23 04' 15" S 032 13' 00" E	116/WR/94	03/10/94	5.5	50.5	56	0 - 47 plain 47 - 56 screen	42	40.4	1.6	47.6	1800	Volanta Handpump
MAPAI (10)	22 43' 18" S 032 02' 45" E	117/WR/94	04/10/94	11.5	73.5	85	0 - 76 plain+ 76 - 85 screen	68	65.5	4.2	68.1	1400	Volanta Handpump
MAPAI (11) (Station)	22 44' 00" S 032 03' 18" E	118/WR/94	05/10/94	11.5	85.5	97	0 - 85 plain+ 85 - 97 screen	73	68.7	1.6	70.5	950	Volanta Handpump
MAPAI (12)	22 43' 46" S 032 03' 05" E	119/WR/94	06/10/94	11.5	85.5	97	0 - 85 plain+ 85 - 97 screen	90	67.3	2.4	71.4	1000	Volanta Handpump
MAPAI (13) (Hospital)	22 43' 58" S 032 03' 35" E	120/WR/94	07/10/94	11.5	86.5	98	0 - 86 plain+ 86 - 98 screen	72	67.4	3.0	70.1	1000	Volanta Handpump
CHICUALACUALA "B" (2)	22 29' 35" S 031 54' 32" E	121/WR/94	09/10/94	11.5	88.5	100	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned Dry
CHICUALACUALA "B" (3)	22 30' 32" S 031 54' 43" E	122/WR/94	15/10/94	5.5	96.5	102	N/A	N/A	N/A	N/A	N/A	N/A	Abandoned Dry
CHICUALACUALA (9)	22 04' 12" S 031 40' 59" E	123/WR/94	11/10/94	17.5	86.5	104	0 - 92 plain+ 92 - 104 screen	86	80.1	3.0	86.7	1600	Volanta Handpump
CHICUALACUALA (10)	22 05' 17" S 031 39' 52" E	124/WR/94	13/10/94	11.5	92.5	104	0 - 92 plain+ 92 - 104 screen	96	79.8	1.8	84.2	1600	Volanta Handpump
CHICUALACUALA (11)	22 04' 13" S 031 41' 11" E	125/WR/94	14/10/94	11.5	96.5	108	N/A	N/A		N/A	N/A	N/A	Abandoned Dry

Notes

* 110mm is internal diameter 125mm is external diameter. + denotes casing 125mm internal and 140mm external diameter

DWL = Dynamic water level. Q = Borehole discharge

WORLD RELIEF BOREHOLE DRILLING PROGRAMME - April to October 1994

Borehole Details

District: MABALANE

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Date of Drilling	Depth Drilled (m) 8.5"	Depth Drilled (m) 6.5"	Borehole Depth (m)	uPVC Casing and Screen *110mm (m)	Water Strike (m)	Static Water Level (m)	1 Hour Pump Test Q (m3/hr)	1 Hour Pump Test DWL (m)	Water Quality EC (uS/cm)	Action on Borehole
PFUKWE (4)	24 08' 44" S 032 43' 48" E	101/WR/ 94	19/09/94	5 5	45 5	51	0 - 45 plain 45 - 51 screen	48	38.1	3.0	40 0	2800	Afridev Handpump
PFUKWE (5)	24 08' 23" S 032 43' 24" E	102/WR/94	18/09/94	5.5	50.5	56	0 - 50 plain 50 - 56 screen	51	42.4	3 1	44 0	2300	Afridev Handpump
MACHAVA	23 52' 50" S 032 36' 53" E	103/WR/94	21/09/94	5 5	83 5	89	N/A	97	N/A	N/A	N/A	12400	Abandoned Saline water
MUJINGE (1)	23 50' 33" S 032 53' 12" E	104/WR/94	23/09/94	5.5	56 5	62	0 - 56 plain 56 - 62 screen	55	39.4	1.2	58.8	3130	Afridev Handpump
MUJINGE (2)	23 55' 30" S 032 56' 25" E	105/WR/94	24/09/94	5.5	42 5	48	0 - 35 plain 35 - 44 screen	40	34.6	3.4	35.7	4500	Afridev Handpump
MATIDSE	23 50' 03" S 032 33' 41" E	106/WR/94	26/09/94	5 5	21.5	27	N/A	25	N/A	N/A	N/A	24000	Abandoned Saline water
CHIPSUANE	23 45' 23" S 032 32' 00" E	107/WR/94	26/09/94	5.5	47 5	53	0 - 47 plain 47 - 53 screen	48	28.3	1.5	45 0	-	Afridev Handpump
MABOMO (1)	23 42' 03" S 032 31' 02" E	108/WR/94	28/09/94	5 5	50 5	56	0 - 50 plain 50 - 56 screen	50	37.8	2.0	41.7	3800	Afridev Handpump
MABOMO (2)	23 41' 56" S 032 30' 58" E	109/WR/94	28/09/94	5.5	48 5	54	0 - 48 plain 48 - 54 screen	49	35.8	2.7	38.8	5400	Afridev Handpump
HOYO HOYO (1)	23 53' 57" S 032 30' 08" E	110/WR/94	29/09/94	5.5	24.5	30	N/A	18	N/A	N/A	N/A	13500	Abandoned Saline water
HOYO HOYO (2)	23 35' 31" S 032 29' 25" E	111/WR/94	29/09/94	5.5	12.5	18	0 - 9 plain 9 - 14 screen	8	6.1	2.6	8.0	-	Afridev Handpump
COMBOMUNE RIO (1)	23 27' 55" S 032 28' 05" E	112/WR/94	29/09/94	5 5	36.5	42	0 - 33 plain 33 - 42 screen	24	25.5	2.1	40.4	1800	Afridev Handpump
COMBOMUNE RIO (2)	23 27' 45" S 032 27' 53" E	113/WR/94	30/09/94	5.5	40 5	46	0 - 40 plain 40 - 46 screen	30	28.3	3 0	33.9	1700	Afridev Handpump
GEREZ	23 13' 04" S 032 30' 24" E	114/WR/94	01/10/94	11.5	66 5	78	0 - 69 plain 69 - 78 screen	68	61.0	2.3	68.1	2000	Volanta Handpump

Notes:
*110 is internal diameter 125 is OD
DWL = dynamic water level. Q = Borehole discharge

WORLD RELIEF BOREHOLE DRILLING PROGRAMME - April to October 1994

Borehole Details

District: CHIGUBO

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Date of Drilling	Depth Drilled (m) 8.5"	6.5"	Borehole Depth (m)	uPVC Casing and Screen *110mm (m)	Water Strike (m)	Static Water Level (m)	1 Hour Pump Test Q (m3/hr)	DWL (m)	Water Quality EC (uS/cm)	Lab Water Analysis	Action on Borehole
MACHAILA (1)	22 15' 24" S 032 54' 42" E	50/WR/94	12/06/94	6	30	36	N/A	34	28.1	N/A	N/A	13900		Abandoned Saline water
MACHAILA (2) (Macapani)	22 13' 58" S 032 53' 57" E	51/WR/94	15/06/94	6	30	36	N/A	34	25.4	N/A	N/A	27100		Abandoned Saline water
MAPUNGANE (1)	22 21' 29" S 032 42' 18" E	52/WR/94	15/08/94	6	18	24	0 - 18 plain 18 - 24 screen	24	19.2	0.6	20.9	4240		Afridev Handpump
MAPUNGANE (2)	22 21' 09" S 032 42' 32" E	53/WR/94	06/08/94	5	25	30	0 - 24 5 plain 24.5 - 30 screen	24	17.3	3.4	22.1	3280	Y	Afridev Handpump
HARIANE	22 29' 40" S 032 36' 10" E	54/WR/94	16/06/94	6	12	18	N/A	18	N/A	N/A	N/A	13420		Abandoned Saline water
ZINHANE	22 21' 37" S 033 04' 18" E	55/WR/94	02/07/94	10	8	18	N/A	18	9.3	N/A	N/A	19860		Abandoned Saline water
CHIDULO (1)		56/WR/94	19/07/94	5	44	49	0 - 43 plain 43 - 49 screen	47	19.2	1.8	46.7	3020		Afridev Handpump
CHIDULO (2)	22 16' 10" S 032 31' 38" E	57/WR/94	13/08/94	5	28	33	0 - 27 5 plain 27.5 - 33 screen	30	13.5	2.1	30.0	3660		Afridev Handpump
TCHAI-TCHAI (Nhangatane)	22 41' 23" S 033 17' 49" E	58/WR/94	15/08/94	12	18	30	0 - 24 plain 24 - 30 screen	24	13.8	0.8	28.9	2900	Y	Afridev Handpump
CATINE	22 45' 23" S 033 24' 15" E	59/WR/94	16/08/94	5	26	31	0 - 25 plain 25 - 31 screen	24	17.8	3.6	18.6	3380	Y	Afridev Handpump
CHIGUBO SEDE (Sauta)	22 50' 01" S 033 31' 02" E	60/WR/94	17/08/94	11	58	69	0 - 63 plain 63 - 69 screen	65	34.4	2.1	38.0	6900	Y	Afridev Handpump
SOLANE (1)	22 58' 52" S 033 28' 10" E	61/WR/94	18/08/94	5.5	34.5	40	0 - 34 plain 34 - 40 screen	35	18.1	1.0	31.3	2700	Y	Afridev Handpump
SOLANE (2) (Masunguane)	23 03' 12" S 033 29' 42" E	62/WR/94	18/08/94	5.5	25.5	31	0 - 25 plain 25 - 31 screen	26	16.4	1.5	27.9	6400	Y	Afridev Handpump
SOLANE (3)	23 09' 31" S 033 30' 07" E	63/WR/94	19/08/94	5.5	11.5	17	N/A	13	13.0	N/A	N/A	18850		Abandoned Saline water
SOLANE (4)	23 10' 17" S 033 30' 23" E	64/WR/94	19/08/94	5.5	18.5	24	N/A	18	8.1	N/A	N/A	30000		Abandoned Saline water
DINDIZA (1) (L.Chelefu)	23 29' 43" S 033 27' 11" E	65/WR/94	20/08/94	5.5	11	16.5	0 - 10 5 plain 10 5-16 5 screen	11	11.2	2.8	12.1	1190	Y	Afridev Handpump
DINDIZA (2) (L.Chelefu)	23 29' 50" S 033 26' 58" E	66/WR/94	20/08/94	5.5	18.5	24	N/A	N/A	N/A	N/A	N/A	N/A		Abandoned Saline water
DINDIZA (3) (L.Chelefu)	23 29' 51" S 033 27' 20" E	67/WR/94	20/08/94	5.5	10	15.5	0 - 9 5 plain 9.5-15 5 screen	11	11.3	2.3	14.3	690	Y	Afridev Handpump
DINDIZA (4) (L.Dandasive)	23 28' 12" S 033 24' 37" E	68/WR/94	21/08/94	5.5	14.5	20	N/A	20	11.7	N/A	N/A	14000		Abandoned Saline water
DINDIZA (5) (L.Ndluvu)	23 31' 50" S 033 29' 25" E	69/WR/94	21/08/94	5.5	9.5	15	0 - 9 plain 9 - 15 screen	11	11.0	2.1	12.7	2300	Y	Afridev Handpump
KEKE (1) (L.Nhanonguane)	23 43' 06" S 033 26' 59" E	70/WR 94	22/08/94	5.5	12.5	18	0 - 12 plain 12 - 18 screen	15	11.1	0.3	15.2	4600	Y	Bucket Pump
KEKE (2) (L.Mangonsuane)	23 47' 22" S 033 29' 09" E	71/WR/94	28/08/94	5.5	14.5	20	0 - 14 plain 14 - 20 screen	18	11.1	0.2	19.0	6500	Y	Bucket Pump
NHANALE (1)	23 50' 48" S 033 30' 29" E	72/WR/94	23/08/94	5.5	14.5	20	0 - 14 plain 14 - 20 screen	18	9.2	0.3	19.5	4500	Y	Bucket Pump
NHANALE (2)	23 49' 35" S 033 31' 14" E	73/WR/94	27/08/94	5.5	12.5	18	0 - 12 plain 12 - 18 screen	17	11.1	0.5	14.2	7200	Y	Afridev Handpump
NHANALE (3)	23 50' 47" S 033 30' 26" E	74/WR/94	27/08/94	5.5	15.5	21	0 - 15 plain 15 - 21 screen	19	12.1	0.2	21.0	4860	Y	Bucket Pump
NHANALE (4)	23 51' 37" S 033 29' 22" E	75/WR/94	28/08/94	5.5	18.5	24	N/A	23	N/A	N/A	N/A	14000		Abandoned Saline water
NHANALE (5)	23 50' 50" S 033 30' 28" E	76/WR/94	28/08/94	24	0	24	N/A	23	N/A	N/A	N/A	13000		Abandoned Saline water

Notes

* 125 mm is internal diameter, 140mm OD. DWL = Dynamic water level. Q = Borehole discharge

WORLD RELIEF BOREHOLE DRILLING PROGRAMME - June/July 1995

Borehole Details

District: GUIJA

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Date of Drilling	Depth Drilled (m) 8.5"	Depth Drilled (m) 6.5"	Borehole Depth (m)	uPVC Casing and Screen *110mm (m)	Water Strike (m)	Static Water Level (m)	1 Hour Pump Test Q (m3/hr)	1 Hour Pump Test DWL (m)	Water Quality EC (uS/cm)	Lab Water Analysis	Action on Borehole
7 de ABRIL (3)	24 28' .57 S 033 03' .87 E	01/WR/95	21/06/95	5	20	25	0-17 & 23-25 plain 17 - 23 screen	18	13.4	6.0	18.6	2800	Y	Afridev Handpump
7 de ABRIL (4)	24 28' .17 S 033 04' .58 E	02/WR/95	22/06/95	5.5	26	32.5	0-24 & 30-32 plain 24-30 screen	18	12.4	6.0	21.0	2500	Y	Afridev Handpump
CHIVONGUENE (2)	24 29' .22 S 033 05' .05 E	03/WR/95	23/06/95	5.5	19.5	25	N/A	20	11.4	N/A	N/A	5120		Abandoned Saline water
CHIVONGUENE (3)	24 29' .88 S 033 05' .73 E	04/WR/95	23/06/95	5.5	14.5	20	0 - 14 plain 14 - 20 screen	15	10.9	3.3	14.7	1580	Y	Afridev Handpump
CHIVONGUENE (4)	24 29' .89 S 033 06' .46 E	05/WR/95	23/06/95	5.5	17.5	23	0 - 17 plain 17 - 23 screen	18	14.2	4.0	17.5	1890	Y	Afridev Handpump
CHIVONGUENE (5)	24 30' .98 S 033 07' .04 E	06/WR/95	24/06/95	5.5	19.5	25	0 - 19 plain 19 - 25 screen	19 & 24	11.4	7.2	18.9	4800	Y	Afridev Handpump
TOMANINE (1)	24 26' .92 S 033 01' .82 E	07/WR/95	24/06/95	5.5	32	37.5	0-29.5 & 35.5-37.5 29.5 - 35.5 screen	30	19.4	7.2	25.8	2520	Y	Afridev Handpump
TOMANINE (2)	24 26' .52 S 033 01' .38 E	08/WR/95	25/06/95	5.5	34.5	40	0-38 & 38-40 plain 32 - 38 screen	33	21.8	2.4	29.5	2000	Y	Afridev Handpump
TOMANINE (3)	24 25' .98 S 033 08' .34 E	09/WR/95	26/06/95	5.5	30	35.5	0 - 29.5 plain 29.5 - 35.5 screen	30	22.1	6.0	25.5	1300	Y	Afridev Handpump
NHATINE (1)	24 25' .30 S 032 58' .17 E	10/WR/95	26/06/95	5.5	19.5	25	N/A	20	15.2	N/A	N/A	5900		Abandoned Saline water
NHATINE (2)	24 25' .16 S 032 57' .72 E	11/WR/95	27/06/95	5.5	19.5	25	0 - 19 plain 19 - 25 screen	18	16.9	3	21.0	900	Y	Afridev Handpump
NHATINE (3)	24 25' .36 S 032 58' .04 E	12/WR/95	27/06/95	5.5	25	30.5	0 - 24.5 plain 24.5 - 30.5 screen	18	15.5	2.5	24.8	5090	Y	Bucket pump
MBANGUENE (1)	24 24' .97 S 032 56' .43 E	13/WR/95	28/06/95	5.5	27	32.5	0 - 26.5 plain 26.5 - 32.5 screen	24	24.1	4.4	27.5	1300	Y	Afridev Handpump
MBANGUENE (2)	24 24' .18 S 032 56' .31 E	14/WR/95	28/06/95	5.5	24.5	30	0 - 24 plain 24 - 30 screen	18	18.3	5.5	20.3	1950		Afridev Handpump
MBANGUENE (3)	24 25' .18 S 032 56' .05 E	15/WR/95	30/06/95	5.5	18	24.5	0-18.5 & 22.5-24.5 18.5 - 22.5 screen	18	18.3	1.6	23.8	1130		Afridev Handpump
MBANGUENE (4)	24 25' .08 S 032 56' .78 E	16/WR/95	30/06/95	5.5	24.5	30	0-22 & 28-30 plain 22 - 28 screen	21	21.6	4.8	22.3	1160	Y	Afridev Handpump
MISSAO	24 27' .56 S 033 00' .38 E	17/WR/95	01/07/95	5.5	24.5	30	0 - 24 plain 24 - 30 screen	17	14.5	0.9	21.0	1800		Afridev Handpump
DZINDZINE	24 24' .25 S 033 09' .48 E	18/WR/95	02/08/95	5.5	13.5	19	N/A	15	15.1	N/A	N/A	12500		Abandoned Saline water
CHIMBEMBE (1)	24 22' .89 S 033 18' .24 E	19/WR/95	02/07/95	5.5	20	25	0 - 19 plain 19 - 25 screen	18	14.9	1.0	24.5	1030	Y	Afridev Handpump
CHIMBEMBE (2)	24 22' .88 S 033 10' .18 E	20/WR/95	02/07/95	5.5	14.5	20	0 - 14 plain 14 - 20 screen	13	8.6	0.6	14.5	550	Y	Bucket pump
NHAMPUNGUANE (1)	24 31' .30 S 033 07' .76 E	21/WR/95	03/07/95	11.5	17	28.5	0 - 22.5 plain 22.5 - 28.5 screen	17 & 24	18.4	4.2	25.4	1950	Y	Afridev Handpump
NHAMPUNGUANE (2)	24 31' .55 S 033 08' .11 E	22/WR95	03/07/95	11.5	17	28.5	0 - 22.5 plain 22.5 - 28.5 screen	17 & 24	17.7	5.5	18.6	850	Y	Afridev Handpump
NHAMPUNGUANE (3)	24 31' .70 S 033 08' .52 E	23/WR/95	04/07/95	5.5	25	30.5	0 - 24.5 plain 24.5 - 30.5 screen	17 & 24	18.1	-	-	1015		Afridev Handpump
SIFO	24 32' .88 S 033 10' .18 E	24/WR/95	04/07/95	11.5	20	31.5	0 - 25.5 plain 25.5 - 31.5 screen	18 & 24	21.5	1.0	27.8	1890	Y	Afridev Handpump

Notes
* 110 mm is internal diameter, 125mm OD.
DWL = Dynamic water level. Q = Borehole discharge

WORLD RELIEF BOREHOLE DRILLING PROGRAMME - June/July 1995

Borehole Details

District: GUIJA

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Date of Drilling	Depth Drilled (m) 8.5"	Depth Drilled (m) 6.5"	Borehole Depth (m)	uPVC Casing and Screen *110mm (m)	Water Strike (m)	Static Water Level (m)	1 Hour Pump Test Q (m3/hr)	1 Hour Pump Test DWL (m)	Water Quality EC (uS/cm)	Lab Water Analysis	Action on Borehole
ACORDO LUSAKA (1)	24 33' .63 S 033 11' .41 E	25/WR/95	06/07/95	5 5	34 5	40	0-32 & 38-40 plain 32 - 38 screen	24 & 32	18.3	3 8	23 0	1295	Y	Afridev Handpump
ACORDO LUSAKA (2)	24 33' .90 S 033 11' .83 E	26/WR/95	07/07/95	6 5	31 5	37	0 - 31 plain 31 - 37 screen	24 & 31	20.2	4.5	30 4	2500	Y	Afridev Handpump
ACORDO LUSAKA (3)	24 34' .33 S 033 12' .24 E	27/WR/95	08/07/95	5.5	31 5	37	0 - 31 plain 31 - 36 screen	18 & 31	18.4	4 0	21.0	930	Y	Afridev Handpump
CHIBABEL (1)	24 36' .34 S 033 13' .30 E	28/WR/95	08/07/95	5.5	25	30 5	0 - 24 5 plain 24 5 - 30.5 screen	15 & 25	22 5	-	-	980		Afridev Handpump
CHIBABEL (2)	24 35' .63 S 033 14' .12 E	29/WR/95	09/07/95	5 5	31	36 5	0 - 30 5 plain 30.5 - 36.5 screen	18 & 32	19.1	4 2	22.4	1390	Y	Afridev handpump
CHIBABEL (3)	24 35' .83 S 033 14' .30 E	30/WR/95	11/07/95	5 5	31	36.5	0 - 30 5 plain 30.5 - 36.5 screen	18 & 31	18.4	0.8	33.3	1250	Y	Afridev Handpump
PUMBE (3)	24 11' .63 S 032 48' .98 E	31/WR/95	12/07/95	5.5	61 5	67	0 - 61 plain 61 - 67 screen	55	41.1	1.2	44.8	760	Y	Volanta Handpump

Notes
* 110 mm is internal diameter, 125mm OD.
DWL = Dynamic water level, Q = Borehole discharge

WORLD RELIEF MANUAL (Vonder Rig) DRILLING PROGRAMME MARCH/APRIL 1995

Borehole Details

District: MABALANE

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Date of Drilling	Depth Drilled (m) 8.5"	Depth Drilled (m) 6.5"	Depth Drilled (m) (170mm)	uPVC Casing and Screen *110mm (m)	Water Strike (m)	Static W.L (m)	Water Quality EC (uS/cm)
HOYO HOYO (3)	-	01/WRm/95	16/03/95	N/A	N/A	8.5	0 - 5.5 plain 5.5 - 8.5 screen	4.5	5.5	-
MATIDSE	23 50' 03" S 032 33' 26" E	02/WRm/95	22/03/95	N/A	N/A	7.5	0 - 4 5 plain 4.5 - 7.5 screen	5	5.0	-
ZONA 8 ZONA 8	-	03/WRm/95	01/04/95	N/A	N/A	10 5	0 - 6 5 plain 6.5 - 10.5 screen	8	6.0	-

Notes
* 110 mm is internal diameter, 125mm OD.

WORLD RELIEF RURAL WATER SUPPLY AND SANITATION PROGRAMME

WATER QUALITY ANALYSIS - Massangena District

Village	Ref No	EC us/cm		Anions					Total Anions	Cations					Total Cations	Total Ions	Organic Matter
		Field	Lab	Cl	SO	CO	HCO	NO	mg/l	NH	Ca	Mg	Fe	Na+K+Mn	mg/l	mg/l	mg/l
Muteto	01/WR/94	2340	2360	656	76	0	427	0.0	1159	0.1	48	298	0	2	348.1	1507	3
Mapanhe	05/WR/94	1500	1389	255	29	0	444	8.0	736	0.1	68	37	0	201	306.1	1042	1.3
Chicumbe	08/WR/94	2340	2200	482	165	0	500	28.0	1175	0.2	116	61	0	342	519.2	1694	2.3
Mucambene	09/WR/94	1800	1862	408	40	0	464	1.7	914	0.2	72	66	0	251	389.2	1303	0.8
Mabondzo	12/WR/95	2310	2380	539	9	0	442	9.7	1000	0.4	111	63	0.04	278	452.44	1452	2.4
Chitlumane	14/WR/95	2500	2330	567	16	0	384	7.4	974	0.4	92	59	0.04	306	457.44	1432	2.3
Massangena	15/WR/95	2900	2570	319	200	0	1159	9.2	1687	0.2	56	44	0	596	696.2	2383	1.7
Mapswai	20/WR/94	1680	1613	248	117	0	659	0.7	1025	0.3	84	71	0	235	390.3	1415	1.3
Mavue Fronteira	22/WR/94	2000	1062	121	14	0	516	7.4	658	0.1	78	23	0	149	250.1	909	0.8
Siquetto	23/WR/94	1910	1355	248	100	0	452	1.0	801	0.2	72	78	0	149	299.2	1100	1.2
Chinezane	33/WR/94	960	1006	270	6	0	147	1.6	425	0.1	19	24	0	166	209.1	634	1.2

Note: Analysis done by Agua do Maputo E.E

APPENDIX B4

WORLD RELIEF RURAL WATER SUPPLY AND SANITATION PROGRAMME

WATER QUALITY ANALYSIS - Chigubo District

Village	Ref No	EC us/cm		Anions					Total Anions	Cations					Total Cations	Total Ions	Organic Matter
		Field	Lab	Cl	SO	CO	HCO	NO	mg/l	NH	Ca	Mg	Fe	Na+K+Mn	mg/l	mg/l	mg/l
Mapungane	53/WR/94	3280	3400	979	155	0	415	2.3	1551	0.1	105	376	0	35	516	2067	2.7
Tchai-Tchai	58/WR/94	2900	3210	1064	56	0	134	0.0	1254	0.1	38	56	0.02	619	713	1967	5.6
Catine	59/WR/94	3360	602	92	15	7	210	0.0	324	0.1	10	9	0	122	141	465	1.0
Chigubo Sede	60/WR/94	6900	7340	2606	489	0	453	11.5	3560	0.1	249	244	0.04	1353	1846	5406	5.6
Solane	61/WR/94	2700	2700	582	188	0	760	3.9	1534	0.2	50	54	0	594	698	2232	3.2
Massungane	62/WR/94	6400	6960	2323	285	0	766	7.8	3382	0.1	120	212	0	1395	1727	5109	6.8
Dindiza (1)	65/WR/94	1190	848	99	6	0	421	0.0	526	0.1	83	33	0	69	185	711	1.7
Dindiza (3)	67/WR/94	690	659	39	24	0	388	0.5	452	0.1	43	31	0	75	149	601	2.7
Ndluvu	69/WR/94	2300	7610	2695	330	0	452	0.0	3477	0.0	369	249	0	1182	1800	5277	1.4
Keke (1)	70/WR/94	4600	8700	3161	350	0	639	1.0	4151	0.1	53	120	0	2172	2345	6496	6.2
Keke (2)	71/WR/94	6500	2800	744	100	0	459	2.3	1305	0.1	18	16	0	654	688	1993	4.3
Nhanale (1)	72/WR/94	4500	6800	2305	60	0	378	2.8	2746	0.1	156	163	0	1179	1498	4244	10.7
Nhanale (2)	73/WR/94	7200	10000	3687	894	0	439	0.0	5020	0.0	224	278	0	2202	2704	7724	1.4
Nhanale (3)	74/WR/94	4860	6270	2128	50	18	419	1.4	2616	0.0	96	146	0.05	1189	1431	4047	6.5

Note: Analysis done by Agua do Maputo E.E

APPENDIX B4

WORLD RELIEF RURAL WATER SUPPLY AND SANITATION PROGRAMME

WATER QUALITY ANALYSIS - Guija District

Village	Ref No	EC us/cm		Anions					Total	Cations					Total	Total	Organic
		Field	Lab	Cl	SO	CO	HCO	NO	Anions mg/l	NH	Ca	Mg	Fe	Na+K+Mn	Cations mg/l	Ions mg/l	Matter mg/l
7 de Abril	81/WR/94	2450	2300	479	70	0	647	0.0	1196	0.1	19	276	0	43	338	1534	2.8
7 de Abril	01/WR/95	2800	2980	773	112	0	564	0.0	1449	0.4	66	97	0	509	672	2121	2.6
7 de Abril	02/WR/95	2600	2850	667	165	0	645	0.0	1477	0.6	56	101	0	499	657	2134	3.7
Chivonguene	83/WR/94	2900	2720	631	98	0	830	17.0	1576	0.1	40	376	0	19	435	2011	4.3
Chivonguene	04/WR/95	1500	1652	291	95	0	537	0.0	923	0.1	6	12	0	407	425	1348	1.0
Chivonguene	05/WR/95	1800	1930	415	184	0	449	0.0	1048	0.2	38	42	0	403	483	1531	1.6
Chivonguene	06/WR/95	4800	5130	1369	735	0	854	2.5	2961	0.2	108	152	0	1151	1411	4372	4.8
Tomanine	07/WR/95	1400	2250	426	156	0	643	1.6	1227	0.4	43	48	0	453	544	1771	2.3
Tomanine	08/WR/95	1040	2380	457	165	0	644	0.0	1266	0.3	38	45	0	490	573	1839	2.2
Tomanine	09/WR/95	1300	1856	312	130	0	830	3.2	1275	0.1	34	29	0.05	483	546	1821	2.2
Nhatine	11/WR/95	900	913	113	40	0	421	1.6	576	0.3	25	30	0	167	222	798	48.0
Nhatine	12/WR.95	5500	6360	1546	735	108	1223	2.8	3615	0.0	9	52	0	1792	1853	5468	5.4
Mbanguene	16/WR/95	850	1062	103	28	0	489	0.0	620	0.2	21	19	0.3	204	245	865	6.4
Chinhacanine	85/WR/94	1500	1105	92	16	0	625	0.5	734	0.1	24	19	0	240	283	1017	0.9
Missao	17/WR/94	2250	1806	234	95	18	727	0.0	1074	0.0	3	5	0	471	479	1553	1.8
Chimbembe	19/WR/95	1400	1415	326	40	0	0.5	0.0	367	0.1	31	31	0	239	301	668	2.4
Chimbembe	20/WR/95	550	579	177	60	0	134	0.8	372	0.2	16	10	0.3	157	184	555	8.0
Nhampunguane	21/WR/95	1950	3130	621	128	0	813	11.5	1574	0.0	31	37	0	668	736	2310	2.5
Nhampunguane	22/WR/95	870	1052	88.7	70	0	403	39.0	601	0.4	8	7	0.2	234	250	850	2.0
Sifo	24/WR/95	1890	1182	177	58	0	369	0.0	602	0.1	22	20	0	218	260	862	5.1
Acordo Lusaka	25/WR/95	1295	1377	160	175	0	610	0.0	945	7.3	16	25	0	342	390	1335	29.6
Acordo Lusaka	26/WR/95	2500	1768	277	95	0	681	0.0	1053	0.6	34	30	0.05	384	449	1502	15.4
Acordo Lusaka	27/WR/95	1830	1876	305	165	0	818	0.0	1288	0.4	36	37	0.08	473	546	1834	12.8
Chibabel	29/WR/95	1390	1517	213	175	0	520	0.0	908	0.4	24	23	0	345	392	1300	16.0
Chibabel	30/WR/95	1250	1798	298	156	0	530	0.0	984	0.6	25	30	0.05	382	438	1422	29.6
Pumbe	31/WR/95	760	673	71	12	0	323	1.4	407	0.2	15	13	0	133	161	569	1.4
Nalazi	77/WR/94	2700	2860	621	218	0	476	80.0	1395	0.4	10	14	0	678	702	2097	6.0
Maimane	80/WR/94	3400	3850	993	360	0	488	1.8	1843	0.1	28	44	0	886	958	2801	4.3

Note: Analysis done by Agua do Maputo E.E

APPENDIX B4

WORLD RELIEF BOREHOLE DRILLING PROGRAMMES

Borehole Cost Comparison 1992/93 and 1994/95

Borehole Cost Analysis 1992/93

Name of District	Total Number of Boreholes	Total No: Producing Boreholes	Success Rate (%)	Total Metres Drilled	Total Drilling Cost (US$)	Average Cost per Metre (US$)	Total Productive Metres	Total Cost Productive Metres (US$)	Average Cost/Metre Productive (US$)	Average Borehole Depth (m)	Average Cost per Borehole (US$)
CHICUALACUALA	21	13	62%	1713	$185,475	$108.3	1048	$136,623	$130.4	81	$10,509
MABALANE	9	7	78%	512	$46,595	$91.0	411	$40,953	$99.6	59	$5,850
GUIJA	11	9	82%	505	$44,756	$88.6	420	$39,672	$94.5	47	$4,408
Programme Totals	**41**	**29**	**71%**	**2730**	**$276,826**	**$101.4**	**1879**	**$217,248**	**$115.6**	**65**	**$7,491**

Borehole Cost Analysis 1994/95

Name of District	Total Number of Boreholes	Total No: Producing Boreholes	Success Rate (%)	Total Metres Drilled	Total Drilling Cost (US$)	Average Cost per Metre (US$)	Total Productive Metres	Total Cost Productive Metres (US$)	Average Cost/Metre Productive (US$)	Average Borehole Depth (m)	Average Cost per Borehole (US$)
MASSANGENA	33	27	82%	1821	$142,910	$78.5	1468	$125,324	$85.4	54	$4,642
CHIGUBO	25	15	60%	640	$51,977	$81.2	399	$38,055	$95.4	27	$2,537
CHICUALACUALA	29	26	90%	2114	$152,035	$71.9	1804	$136,550	$75.7	69	$5,252
MABALANE	14	11	79%	720	$54,615	$75.9	570	$45,204	$79.3	52	$4,109
GUIJA (1994)	24	22	92%	882	$74,704	$84.7	802	$70,417	$87.8	36	$3,201
Totals 1994	125	101	81%	6177	$476,241	$77.1	5043	$415,550	$82.4	50	$4,114
GUIJA (1995)	31	26	84%	928	$92,203	$99.4	809	$82,805	$102.4	31	$3,185
Programme Totals	**156**	**127**	**81%**	**7105**	**$568,444**	**$80.0**	**5852**	**$498,355**	**$85.2**	**46**	**$3,924**

APPENDIX B5

APPENDIX C1

WORLD RELIEF RURAL WATER SUPPLY PROGRAMME

Volanta Pump Installation Details - January 1993 to September 1995

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Borehole Depth (m)	Static W.L (m)	1 or 5 Hour Pump Test DWL (m)	Q (m3/hr)	Type of Handpump	Date of Pump Installation	Number of Rods	Depth of Cylinder (m)	Pump Installation Technician	Water Quality EC (uS/cm)
CHICUALACUALA (1)	22 05' 18" S 031 39' 56" E	01/WR/92	72	49 9	69 4	2 1	Volanta	03/02/93	23	66 75	Sr Maibasse (EPAR)	2300
CHICUALACUALA (5)	22 05' 17" S 031 39' 53" E	05/WR/92	72	48 2	51.7	4 0	Volanta	30/01/93	23	66 75	Sr Maibasse (EPAR)	2140
CHICUALACUALA (8)	22 05' 17" S 031 39' 54" E	08/WR/92	72	50 7	69.0	2 9	Volanta	02/02/93	23	66 75	Sr Maibasse (EPAR)	2400
CHICUALACUALA (9)	22 04' 12" S 031 40' 58" E	123/WR/94	104	80 1	86 7	3 0	Volanta	21/01/95	30	86 70	Sr Juma Sr Zefanias	1600
CHICUALACUALA (10)	22 05' 17" S 031 39' 52" E	124/WR/94	104	79 8	84.2	1 8	Volanta	22/01/95	29	83 85	Sr Juma Sr Zefanias	1600
MAPAI (1)	22 43' 52" S 032 04' 22" E	01/WR/93	82	55.2	62.9	3.3	Volanta	15/02/93	23	66.75	Sr Juma (WR)	990
MAPAI (2)	22 43' 28" S 032 03' 10" E	02/WR/93	90	65 5	66.0	4.5	Volanta	23/02/93	24	69 60	Sr Juma (WR)	960
MAPAI (3)	22 43' 36" S 032 03' 14" E	03/WR/93	90	64 6	64.8	4 0	Volanta	25/02/93	25	72 45	Sr Zefanias (EPAR)	960
MAPAI (4)	22 43' 53" S 031 04' 18" E	04/WR/93	84	63 6	63.6	4 8	Volanta	24/02/93	24	69 60	Sr Zefanias (EPAR)	990
MAPAI (5)	22 44' 11" S 032 04' 03" E	37/WR/94	88	62.3	63.3	1.0	Volanta	07/01/95	23	66.75	Sr Juma Sr Zefanias	1080
MAPAI (6)	22 43' 34" S 032 03' 38" E	38/WR/94	94	65.3	74.2	0.9	Volanta	06/01/95	26	75 30	Sr Juma Sr Zefanias	2400
MAPAI (7)	22 44' 09" S 032 03' 38" E	39/WR/94	85	68 1	69.2	1.0	Volanta	10/01/95	24	69.60	Sr Juma Sr Zefanias	2320
MAPAI (8)	22 44' 12" S 032 03' 15" E	40/WR/94	87	69 2	70.1	2.1	Volanta	16/12/94	25	72.45	Sr Juma Sr Zefanias	1010
MAPAI (9)	22 41' 11" S 032 03' 58" E	41/WR/94	80	63.8	67 0	2.2	Volanta	19/12/94	24	69.60	Sr Juma Sr Zefanias	530
MAPAI (10)	22 43' 16" S 032 02' 45" E	117/WR/94	85	65 5	68.1	4.2	Volanta	29/11/94	25	72.45	Sr Juma Sr Zefanias	1400
MAPAI (11) (Station)	22 44' 00" S 032 03' 18" E	118/WR/94	97	68.7	70.5	1.6	Volanta	20/12/94	25	72.45	Sr Juma Sr Zefanias	950
MAPAI (12) (Admin Post)	22 43' 46" S 032 03' 05" E	119/WR/94	97	87.3	71.4	2.4	Volanta	17/12/94	25	72.45	Sr Juma Sr Zefanias	1000
MAPAI (13) (Hospital)	22 43' 59" S 032 03' 35" E	120/WR/94	88	67.4	70.1	3.0	Volanta	07/01/95	25	72 45	Sr Juma Sr Zefanias	1000
16 de JUNHO (1)	22 43' 30" S 032 05' 48" E	05/WR/93	78	80.8	64 0	3.3	Volanta	09/02/93	23	66.75	Sr Maibasse (EPAR)	1300
16 de JUNHO (2)	22 43' 47" S 032 05' 10" E	06/WR/93	84	54 4	82 0	2 9	Volanta	11/02/93	23	66.75	Sr Maibasse (EPAR)	1620
16 de JUNHO (3)	22 44' 08" S 032 05' 19" E	07/WR/93	78	58 6	74.0	2.8	Volanta	10/02/93	23	66.75	Sr Maibasse (EPAR)	880
16 de JUNHO (4)	22 43' 21" S 032 05' 46" E	08/WR/93	84	50.5	83.0	2 9	Volanta	05/02/93	23	66 75	Sr Maibasse (EPAR)	1200
16 de JUNHO (5)	22 43' 32" S 032 05' 28" E	34/WR/94	78	57 1	62 8	1 6	Volanta	11/01/95	22	63 90	Sr Juma Sr Zefanias	1360
16 de JUNHO (6)	22 43' 54" S 032 05' 42" E	35/WR/94	78	52 8	64.2	1 5	Volanta	12/01/95	23	66.75	Sr Juma Sr Zefanias	1290
16 de JUNHO (7)	22 44' 00" S 032 05' 04" E	36/WR/94	74	59 4	60.8	1.2	Volanta	13/01/95	24	69.60	Sr Juma Sr Zefanias	700

Notes:
Cylinder depth calculated using number of rods x 2.85m +1.2m (rod hanger)
DWL is dynamic water level
Q is discharge

WORLD RELIEF RURAL WATER SUPPLY PROGRAMME

Volanta Pump Installation Details - January 1993 to September 1995

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Borehole Depth (m)	Static W.L (m)	1 or 5 Hour Pump Test DWL (m)	1 or 5 Hour Pump Test Q (m3/hr)	Type of Handpump	Date of Pump Installation	Number of Rods	Depth of Cylinder (m)	Pump Installation Technician	Water Quality EC (uS/cm)
REGUA (1)	22 51' 01" S 032 07' 58" E	09/WR/93	84	67 1	66.2	3.8	Volanta	02/03/93	26	75.30	Sr Zefanias (EPAR)	3200
REGUA (2)	22 50' 59" S 032 07' 48" E	48/WR/94	78	63	64.6	1 8	Volanta	25/01/95	24	69 60	Sr Juma Sr Alfredo	2850
MPUSE RIO (1)	-	10/WR/93	78	57.6	58.0	4 8	Volanta	05/03/93	23	66.75	Sr Zefanias (EPAR)	1100
MPUZE RIO (2)	23 04' 15" S 032 13' 00" E	118/WR/94	58	40.4	47 8	1.6	Volanta	26/01/95	19	55.35	Sr Juma Sr Alfredo	1800
MPUZE ESTACAO	23 02' 00" S 032 14' 53" E	115/WR/94	91	76.3	77.0	2.6	Volanta	26/01/95	27	78.15	Sr Zefanias Sr Amos	2800
GEREZ (1)	23 13' 03" S 032 30' 24" E	11/WR/93	84	61 9	62.1	3.8	Volanta	07/03/93	25	72 45	Sr Zefanias (EPAR)	3500
GEREZ (2)	23 13' 04" S 032 30' 24" E	114/WR/95	78	61	69.1	2.3	Volanta	26/01/95	27	78.15	Sr Zefanias	3200
PUMBE (1)	-	27/WR/93	86	41 8	-	3.0	Volanta	14/07/93	21	61.05	Sr Juma (WR)	1500
PUMBE (2)	-	28/WR/93	72	41 0	-	3.5	Volanta	15/07/93	22	63.80	Sr Juma (WR)	700
PUMBE (3)	24 11' .83 S 032 49' .98 E	31/WR/95	67	41 1	4.8	44 4	Volanta	04/10/95	20	58.20	Sr Juma Sr Calanga	760

Notes:
Cylinder depth calculated using number of rods x 2.85m +1.2m (rod hanger)
DWL is dynamic water level
Q is discharge

APPENDIX C2

WORLD RELIEF RURAL WATER SUPPLY PROGRAMME

Afridev Pump Installation Details - May 1994 to August 1995

District: MASSANGENA

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Borehole Depth (m)	Static W.L (m)	1 Hour Pump Test DWL (m)	1 Hour Pump Test Q (m3/hr)	Type of Handpump	Pump Serial Number	Date of Pump Installation	Number of Rods	Depth of Cylinder (m)	Pump Installation Technician(s)	Water Quality EC (uS/cm)
MUTETO (1)	21 34' 48" S 032 56' 11" E	01/WR/94	54	38.0	39.1	2.4	Afridev		27/05/94	15	43.5	Sr Juma Sra Catarina	2340
MBOCODA (1)	21 34' 48" S 032 55' 57" E	02/WR/94	66	41.2	48.8	1.2	Afridev		30/05/94	18	52.2	Sr Juma Sra Catarina	2390
MBOCODA (2)	21 34' 48" S 032,56' 11" E	03/WR/94	74	37.8	44.0	1.8	Afridev		28/05/94	18	52.2	Sr Juma Sra Catarina	2370
NGOMANE	21 35' 37" S 032 53' 06" E	04/WR/94	67	50.5	52.3	1.3	Afridev		01/06/94	22	63.8	Sr Juma Sra Catarina	1500
MAPANHE (1)	21 45' 05" S 032 47' 53" E	05/WR/94	55	39.4	45.3	2.8	Afridev		04/06/94	18	52.2	Sr Juma Sra Catarina	1500
MAPANHE (2)	21 45' 06" S 032 49' 28" E	06/WR/94	48	37.7	43.0	2.5	Afridev		04/06/09	15	43.5	Sr Juma Sra Catarina	1530
CHICUMBE (1)	21 36' 04" S 032 57' 31" E	07/WR/94	55	38.5	45.2	3.3	Afridev		31/05/94	18	52.2	Sr Juma Sra Catarina	1120
CHICUMBE (2)	21 35' 39" S 032 57' 31" E	08/WR/94	51	31.2	40.5	0.9	Afridev		31/05/94	15	43.5	Sr Juma Sra Catarina	2340
MUCAMBENE (1)	21 33' 08" S 032 48' 33" E	09/WR/94	78	48.1	57.2	3.4	Afridev		09/06/94	20	58.0	Sr Juma Sra Catarina	1800
MUCAMBENE (2)	21 33' 03" S 032 48' 58" E	10/WR/94	69	52.1	59.1	0.5	Afridev		09/06/94	23	68.7	Sr Juma Sra Catarina	1820
MUCAMBENE (3)	21 32' 48" S 032 48' 21" E	25/WR/94	72	48.5	55.4	4.0	Afridev		15/06/94	20	58.0	Sr Juma Sra Catarina	1700
CUFAMUNE		11/WR/94	48	30.3	32.2	3.8	Afridev		13/06/94	16	46.4	Sr Juma Sra Catarina	2260
MABONDZO (1)	21 35' 29" S 033 01' 20" E	12/WR/94	36	21.5	25.0	4.8	Afridev		03/06/94	12	34.8	Sr Juma Sra Catarina	2310
MABONDZO (2)	21 37' 17" S 033 01' 42" E	13/WR/94	48	25.2	25.7	3.8	Afridev		03/06/94	15	43.5	Sr Juma Sra Catarina	2120
CHITLUMANE	21 38' 28" S 032 55' 00" E	14/WR/94	54	42.7	42.7	1.2	Afridev		30/05/94	18	52.2	Sr Juma Sra Catarina	2500
MASSANGENA SEDE (transit)	21 33' 13" S 032 57' 11" E	15/WR/94	42	8.4	18.2	2.4	Afridev		08/06/94	6	17.4	Sr Juma Sra Catarina	2130
MASSANGENA SEDE (hospital)	21 32' 48" S 032 57' 23" E	16/WR/94	18	10.2	10.4	3.9	Afridev		06/06/94	5	14.5	Sr Juma Sra Catarina	2800
MANINGE	21 31' 54" S 032 58' 59" E	17/WR/94	35	15.9	16.4	3.2	Afridev		06/06/94	10	29.0	Sr Juma Sra Catarina	1820
MUTETO (Escola)	21 34' 33" S 032 56' 58" E	18/WR/94	48	25.4	38.4	3.2	Afridev		07/06/94	15	43.5	Sr Juma Sra Catarina	2140
SINGANHANE	21 42' 22" S 033 02' 22" E	19/WR/94	56	42.0	43.8	2.8	Afridev		13/06/94	18	52.2	Sr Juma Sra Catarina	2000
MAPSWAI	21 41' 21" S 033 02' 53" E	20/WR/94	54	42.1	42.2	1.3	Afridev		22/06/94	16	46.4	Sr Juma Sra Catarina	1880
HANDELA	21 40' 41" S 032 54' 00" E	21/WR/94	66	49.0	55.3	2.4	Afridev		22/06/94	19	55.1	Sr Juma Sra Catarina	1850
MAVUE FRONTEIRA	21 20' 42" S 032 28' 07" E	22/WR/94	54	30.5	40.7	0.6	Afridev	1552	09/06/94	15	43.5	Sr Juma Sra Catarina	2000
SIQETTO (1)	21 30' 04" S 032 45' 00 E	23/WR/94	78	20.9	45.4	1.2	Afridev		06/06/94	16	46.4	Sr Juma Sra Catarina	1910
SOKOTE	21 31' 12" S 032 47' 52" E	26/WR/94	51	16.0	45.0	1.1	Afridev		06/06/94	15	43.5	Sr Juma Sra Catarina	2000
CHICUMBE (3)	21 35' 06" S 032 58' 37" E	28/WR/94	54	39.1	48.1	5.5	Afridev		27/06/94	17	49.3	Sr Juma Sra Catarina	2360
CHINEZANE	21 52' 37" S 032 47' 48" E	33/WR/94	36	15.2	21.4	2.8	Afridev		12/06/94	8	23.2	Sr Juma Sra Catarina	860

Notes:
None of the first pumps supplied by Stenaks had serial numbers
Depth of cylinder = No. of rods * 2.8m. DWL = Dynamic water level. Q = Borehole discharge

APPENDIX C2

WORLD RELIEF RURAL WATER SUPPLY PROGRAMME

Afridev Pump Installation Details - May 1994 to August 1995

District: GUIJA

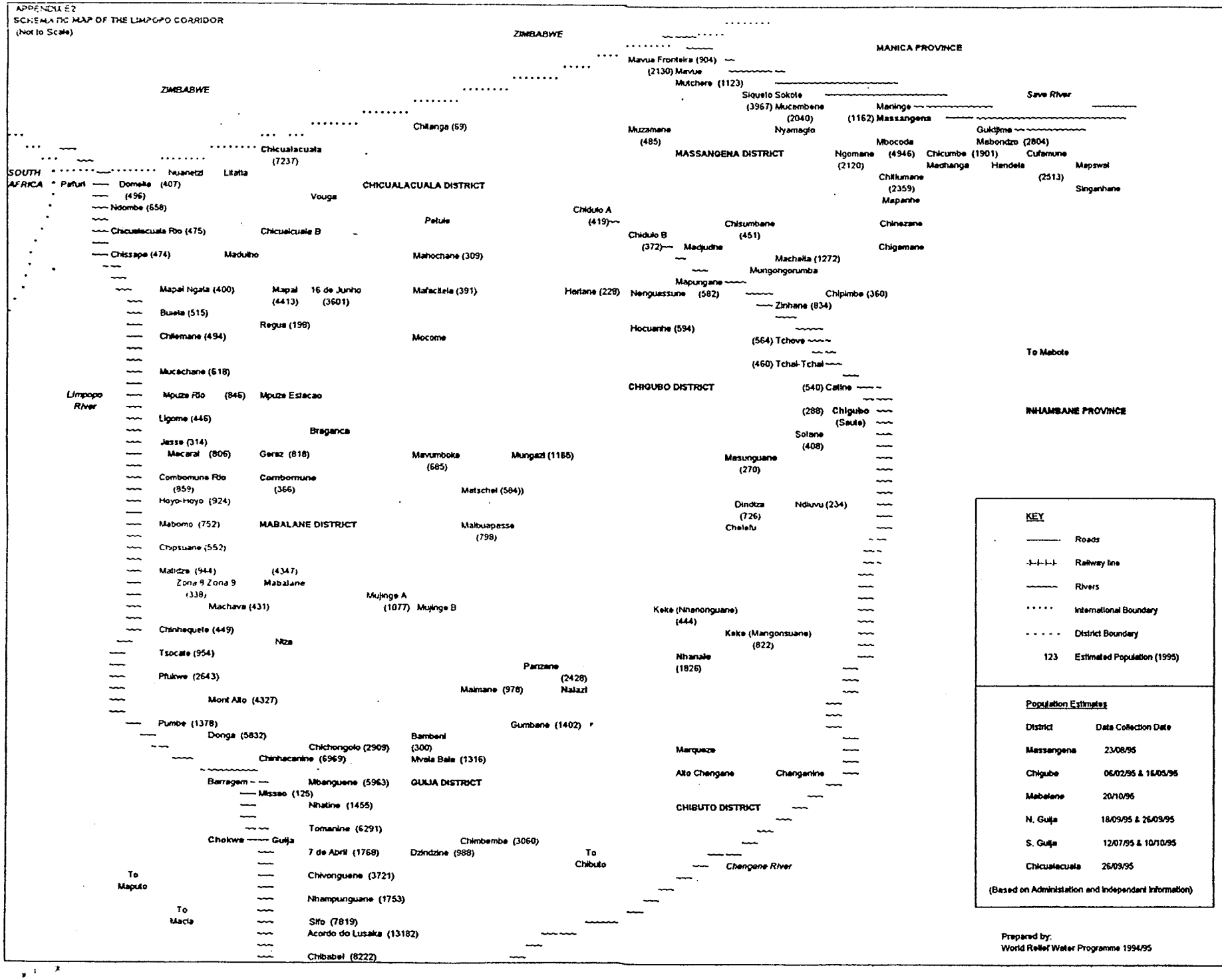
Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Borehole Depth (m)	Static W.L (m)	1 Hour Pump Test Q (m3/hr)	1 Hour Pump Test DWL (m)	Type of Handpump	Date of Pump Installation	Pump Serial Number	Number of Rods	Depth of Cylinder (m	Pump Installation Technician(s)	Water Quality EC (uS/cm)
7 de ABRIL (4)	24 28' .17 S 033 04' .58 E	02/WR/95	33	12.4	6.0	20.0	Afridev	10/07/95	2728	7	20.3	Sr Juma Sra Esperanca	2500
CHIVONGUENE (1)	24 31' 13" S 033 05' 52" E	83/WR/94	19/01/00	15.1	1.9	10.6	Afridev	15/08/95	2736	5	14.5	Sra Catanna Sra Esperanca	
CHIVONGUENE (3)	24 29' .69 S 033 05' .73 E	04/WR/95	20	10.9	5.2	11.4	Afridev	11/07/95	2737	6	17.4	Sr Juma Sra Esperanca	1580
CHIVONGUENE (4)	24 29' .69 S 033 06' .48 E	05/WR/95	23	14.2	4.0	17.5	Afridev	12/07/95	2738	6	17.4	Sr Juma Sra Esperanca	1880
CHIVONGUENE (5)	24 30' .96 S 033 07' .04 E	06/WR/95	25	11.4	-	-	Afridev	13/07/95	2780	6	17.4	Sr Juma Sra Esperanca	4800
TOMANINE (1)	24 26' .82 S 033 01' .82 E	07/WR/95	38	19.4	7.2	25.0	Afridev	01/08/95	2832	10	29.0	Sr Juma Sra Esperanca	2520
TOMANINE (2)	24 26' .52 S 033 01' .38 E	08/WR/95	40	21.8	2.4	28.5	Afridev	25/07/95	2744	10	29.0	Sr Juma Sra Esperanca	2000
TOMANINE (3)	24 25' .88 S 033 06' .34 E	09/WR/95	36	22.1	6.0	25.0	Afridev	02/08/95	2889	10	29.0	Sr Juma Sra Esperanca	1300
NHATINE (2)	24 25' .18 S 032 57' .72 E	11/WR/95	25	16.82	3.0	21.0	Afridev	18/07/95	2790	8	23.2	Sr Juma Sra Esperanca	900
MBANGUENE (1)	24 24' .97 S 032 58' .43 E	13/WR/95	33	24.1			Afridev	09/08/95	2868	10	29.0	Sra Esperanca Sr Calanga	1300
MBANGUENE (2)	24 24' .18 S 032 58' .31 E	14/WR/95	30	18.3		20.3	Afridev	10/08/95	2894	8.5	27.6	Sra Esperanca Sr Calanga	1950
MBANGUENE (3)	24 25' .16 S 032 58' .05 E	15/WR/95	25	18.3		23.8	Afridev	30/08/95	2880	7	20.3	Sra Esperanca Sr Calanga	1130
MBANGUENE (4)	24 25' .06 S 032 58' .76 E	16/WR/95	30	21.6	3.6	22.8	Afridev	25/07/95	2787	7	20.3	Sra Esperanca Sra Clemencia	1160
MISSAO	24 27' .55 S 033 00' .38 E	17/WR/95	30	14.5	1.2	27.2	Afridev	08/08/95	2884	9	26.1	Sra Esperanca Sr Calanga	1800
CHIMBEMBE (1)	24 22' .89 S 033 18' .24 E	19/WR/95	25	14.9	2.1	24.9	Afridev	19/07/95	2759	8	23.2	Sr Juma Sr Esperanca	1030
NHAMPUNGUANE (1)	24 31' .30 S 033 07' .78 E	21/WR/95	29	18.4	4.2	25.4	Afridev	03/08/95	2844	9	26.1	Sra Esperanca Sr Calanga	1950
NHAMPUNGUANE (2)	24 31' .55 S 033 08' .11 E	22/WR95	29	17.7	5.0	18.5	Afridev	04/08/95	2849	9	26.1	Sra Esperanca Sr Calanga	850
NHAMPUNGUANE (3)	24 31' .70 S 033 08' .52 E	23/WR/95	30.5	18.1			Afridev	05/08/95	2847	9	26.1	Sra Esperanca Sr Calanga	1015
SIFO	24 32' .86 S 033 10' .18 E	24/WR/95	32	21.5	1.0	28.5	Afridev	22/08/95	2645	10.5	30.5	Sr Calanga Sra Clemancia	1880
ACORDO LUSAKA (1)	24 33' .53 S 033 11' .41 E	25/WR/95	40	19.3	3.8	22.0	Afridev	22/08/95	2558	12	34.8	Sra Calanga Sr Clemencia	1295
ACORDO LUSAKA (2)	24 33' .90 S 033 11' .83 E	26/WR/95	37	20.2	4.5	29.0	Afridev	23/08/95	2670	12.5	36.3	Sr Calanga Sra Clemencia	2500
ACORDO LUSAKA (3)	24 34' .33 S 033 12' .24 E	27/WR/95	37	19.4	4.0	21.0	Afridev	23/08/95	2658	12	34.8	Sr Calanga Sra Clemencia	830
CHIBABEL (1)	24 35' .34 S 033 13' .30 E	28/WR/95	31	22.5			Afridev	24/08/95	2649	11	31.9	Sr Calanga Sra Clemencia	980
CHIBABEL (2)	24 36' .89 S 033 14' .12 E	29/WR/95	37	19.1	4.2	22.0	Afridev	24/08/95	2666	12	34.8	Sr Calanga Sra Clemencia	1200
CHIBABEL (3)	24 35' .93 S 033 14' .50 E	30/WR/95	37	18.4			Afridev	25/08/95	2664	12	34.8	Sr Calanga Sra Clemencia	1250
CHIBABEL (4)		Rehabilitation					Afridev	27/08/95	2670	11	31.9	Sr Juma	

Notes:
DWL = Dynamic water level. Q = Borehole discharge
Depth of cylinder = number of rods x 2.9m

APPENDIX E2

SCHEMATIC MAP OF THE LIMPOPO CORRIDOR

(Not to Scale)



KEY

- Roads
- Railway line
- Rivers
- International Boundary
- District Boundary
- 123 Estimated Population (1995)

Population Estimates

District	Data Collection Date
Massangena	23/08/95
Chigubo	06/02/95 & 15/05/95
Mabalane	20/10/95
N. Guija	18/09/95 & 26/09/95
S. Guija	12/07/95 & 10/10/95
Chicualacuala	26/09/95

(Based on Administation and Independant Information)

Prepared by:
World Relief Water Programme 1994/95

WORLD RELIEF RURAL WATER SUPPLY PROGRAMME

Afridev Pump Installation Details - May 1994 to August 1995

District: GUIJA

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Borehole Depth (m)	Static W.L (m)	1 Hour Pump Test Q (m3/hr)	1 Hour Pump Test DWL (m)	Type of Handpump	Date of Pump Installation	Pump Serial Number	Number of Rods	Depth of Cylinder (m	Pump Installation Technician(s)	Water Quality EC (uS/cm)
NALAZI (1)	24 03' 21" S 033 19' 33" E	77/WR/94	31.5	20.9	1.4	28.0	Afridev	12/11/94		10	29.0	Sr Juma	2700
NALAZI (2) (Panzane)	23 58' 59" S 033 16' 33" E	78/WR/94	34	19.9	1.8	20.2	Afridev	14/11/94	1428	9	26.1	Sr Juma	1450
NALAZI (4) (Maimane)	24 04' 02" S 033 10' 00" E	80/WR/94	45	23.1	1.0	44.5	Afridev	15/11/95	1424	14	40.6	Sr Zefanias	3400
CHINHACANINE (1)	24 23' 15" S 032 54' 32" E	84/WR/94	23	16.0	2.1	16.3	Afridev	02/02/95	1404	8	23.2	Sr Juma Sra Catanna	1800
CHINHACANINE (2)	24 24' 16" S 032 53' 31" E	85/WR/94	54	40.5	1.6	41.0	Afridev	24/11/94	1440	15	43.5	Sra Catanna Sra Esperanca	1500
CHINHACANINE (3)	24 24' 18" S 032 53' 51" E	86/WR/94	42	29.8	2.6	36.0	Afridev	02/05/95	1433	13	37.7	Sra Catanna Sra Esperanca	1800
CHINHACANINE (4)	24 24' 40" S 032 53' 37" E	87/WR/94	48	36.3	2.5	37.5	Afridev	01/02/95	1401	14	40.6	Sra Catanna Sra Esperanca	2000
CHINHACANINE (5)	24 24' 03" S 032 53' 07" E	88/WR/94	43	38.0	2.4	38.8	Afridev	31/01/95	2229	13	37.7	Sra Catanna Sra Esperanca	1300
CHINHACANINE (6)	24 23' 15" S 032 53' 16" E	89/WR/94	36	19.8	2.4	20.1	Afridev	30/01/95	1831	8	23.2	Sra Catanna Sra Esperanca	800
CHINHACANINE (7)	24 23' 26" S 032 53' 08" E	90/WR/94	35	23.3	2.3	28.1	Afridev	03/05/95	1410	10	29.0	Sra Catanna Sra Esperanca	1000
CHINHACANINE (8)	24 23' 07" S 032 52' 59" E	91/WR/94	36	20.6	1.9	27.0	Afridev	31/01/95	1421	10	29.0	Sra Catanna Sra Esperanca	1500
CHINHACANINE (9)	24 22' 59" S 032 53' 08" E	92/WR/94	26	15.9	2.3	23.4	Afridev	02/02/95	1449	8	23.2	Sra Catanna Sra Esperanca	500
DONGA (1)		29/WR/93	37	28.8			Afridev	09/07/93		11	31.9	Sr Juma	
DONGA (2)		30/WR/93	24	18.8			Afridev	10/07/93		7.5	21.8	Sr Juma	
DONGA (3)	24 20' 18" S 032 52' 49" E	93/WR/94	41	28.3	1.5	30.0	Afridev	23/11/94	1411	11	31.9	Sra Catanna Sra Esperanca	2600
DONGA (4)	24 20' 32" S 032 53' 05" E	94/WR/94	43	26.5	1.1	34.5	Afridev	21/11/94	1427	12	34.8	Sra Catanna Sra Esperanca	4200
DONGA (5)	23 19' 58" S 032 52' 46" E	95/WR/94	42	30.2	2.2	30.9	Afridev	16/11/94	1403	11	31.9	Sra Catanna Sra Esperanca	1500
DONGA (6)	24 20' 34" S 032 53' 13" E	96/WR/94	34	25.5	1.5	27.1	Afridev	17/11/94	1433	12	34.8	Sra Catanna Sra Esperanca	1000
DONGA (7)	24 19' 52" S 032 52' 26" E	97/WR/94	36	28.4	2.1	29.4	Afridev	14/11/94	2676	10	29.0	Sra Catanna Sra Esperanca	2000
DONGA (8)	24 19' 37" S 032 53' 17" E	98/WR/94	36	30.0	1.8	31.1	Afridev	22/11/94	2671	11	31.9	Sra Catanna Sra Esperanca	1560
MONT ALTO (1)		12/WR/93	37	26.6			Afridev	16/06/93		12	34.8	Sr Zefanias	2700
MONT ALTO (3)		14/WR/93	38	27.8			Afridev	19/06/93		10.5	30.5	Sr Zefanias	3000
MONT ALTO (4)		17/WR/93	38	28			Afridev	23/06/93		11	31.9	Sr Zefanias	2200
MONT ALTO (6)		17/WR/93	38	28			Afridev	22/06/93		11	31.9	Sr Zefanias	2400
MONT ALTO (7)		18/WR/93	42	28			Afridev	28/06/93		11.5	33.4	Sr Zefanias	2400
MONT ALTO (8)	24 14' 22" S 032 49' 46" E	99/WR/94	36	27.3	1.6	28.1	Afridev	14/02/95	1404	11	31.9	Sra Catanna Sra Esperanca	2000
MONT ALTO (9)	24 14' 25" S 032 50' 34" E	100/WR/94	36	27.0	1.2	32.5	Afridev	16/02/95	1406	11	31.9	Sra Catanna Sra Esperanca	2000
MONT ALTO (2)		Rehabilitation	36	28.6	2.8	30.8	Afridev	15/02/95		11	31.9	Sra Catanna Sra Esperanca	2110
MONT ALTO (5)		Rehabilitaion	34	28.1	0.9	29.1	Afridev	16/05/95		11	31.9	Sra Catanna	2200
7 de ABRIL (1)	24 28' 07" S 033 02' 49" E	81/WR/94	25	14.2	1.8	21.3	Afridev	12/08/94	2782	7	20.3	Sra Catanna Sra Esperanca	2450
7 de ABRIL (3)	24 28' .57 S 033 03' .87 E	01/WR/95	25	13.4	6.0	16.6	Afridev	08/07/95	2781	6	17.4	Sr Juma Sra Esperanca	2600

Notes: DWL = Dynamic water level. Q = Borehole discharge Depth of cylinder = number of rods x 2.9m

APPENDIX C2

WORLD RELIEF RURAL WATER SUPPLY PROGRAMME

Pump Installation Details - May 1994 to August 1995

District: CHIGUBO

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Borehole Depth (m)	Static W.L (m)	1 Hour Pump Test Q (m3/hr)	1 Hour Pump Test DWL (m)	Type of Handpump	Pump Serial Number	Date of Pump Installation	Number of Rods	Depth of Cylinder (m)	Pump Installation Technician(s)	Water Quality EC (uS/cm)
MAPUNGANE (1)	22 21' 28" S 032 42' 16" E	52/WR/94	24	19.2	0.8	20.9	Afridev	1408	07/10/94	8	23.2	Sra Catarina	4240
MAPUNGANE (2)	22 21' 08" S 032 42' 32" E	53/WR/94	30	17.3	3.4	22.1	Afridev	1419	08/10/94	9	26.1	Sra Catarina	3280
TCHAI-TCHAI (Nhangatane)	22 41' 23" S 033 17' 49" E	58/WR/94	30	13.8	0.8	28.9	Afridev	1402	20/10/94	10	29	Sr Juma	2800
CATINE	22 45' 23" S 033 24' 15" E	59/WR/94	31	17.8	3.6	18.8	Afridev	1418	20/10/94	7	20.3	Sr Juma	3360
CHIGUBO SEDE (Saute)	22 50' 01" S 033 31' 02" E	60/WR/94	69	34.4	2.1	38.0	Afridev	1405	21/10/94	14	40.6	Sr Juma	6900
SOLANE (1)	22 58' 52" S 033 28' 10" E	61/WR/94	40	18.1	1.0	31.3	Afridev	1407	05/10/94	12	34.8	Sr Calanga	2700
SOLANE (2) (Masunguane)	23 03' 12" S 033 29' 42" E	62/WR/94	31	16.4	1.5	27.8	Afridev	1408	08/11/94	10	29.0	Sr Zefanias	6400
DINDIZA (1) (L.Chelefu)	23 29' 43" S 033 27' 11" E	65/WR/94	16.5	11.2	2.9	12.1	Afridev	1413	11/11/94	5	14.5	Sr Juma	1190
DINDIZA (3) (L.Chelefu)	23 28' 51" 6 033 27' 20" E	67/WR/94	15.5	11.3	2.9	14.3	Afridev	1412	11/11/94	5	14.5	Sr Juma	690
DINDIZA (5) (L.Ndluvu)	23 31' 50" S 033 28' 26" E	69/WR/94	15	11.0	2.1	12.7	Afridev	1444	12/11/94	4.5	13.1	Sr Zefanias	2300
NHANALE (2)	23 48' 35" S 033 31' 14" E	73/WR/94	18	11.1	0.5	14.2	Afridev	1425	08/09/94	8	17.4	Sr Zefanias Sr Juma	7200

Notes
DWL = Dynamic water level. Q = Borehole discharge

APPENDIX C2

WORLD RELIEF RURAL WATER SUPPLY PROGRAMME

Pump Installation Details - May 1994 to August 1995

District: MABALANE

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Borehole Depth (m)	Static W.L (m)	1 Hour Pump Test Q (m3/hr)	1 Hour Pump Test DWL (m)	Type of Handpump	Pump Serial Number	Date of Pump Installation	Number of Rods	Depth of Cylinder (m)	Pump Installation Technician (s)	Water Quality EC (uS/cm)
PFUKWE (1)		18/WR/93	54	37.0	3.5	-	Afridev		28/11/94	15	43.5	Sra Catarina Sra Esperanca	2400
PFUKWE (2)		20/WR/93	60	40.0	3.0	-	Afridev		01/11/94	16	46.4	Sra Catarina Sra Esperanca	2700
PFUKWE (3)		21/WR/93	61	37.0	3.0	-	Afridev		06/12/94	15	43.5	Sra Catarina Sra Esperanca	2400
PFUKWE (4)	24 08' 44" S 032 43' 48" E	101/WR/ 94	51	38.1	3.0	40.0	Afridev		17/12/94	14	40.6	Sra Catarina Sra Esperanca	2800
PFUKWE (5)	24 08' 23" S 032 43' 24" E	102/WR/94	58	42.4	3.1	44.0	Afridev		18/12/94	15	43.5	Sra Catarina Sra Esperanca	2300
MUJINGE (1)	23 50' 33" S 032 53' 12" E	104/WR/94	82	39.4	1.2	58.6	Afridev		24/03/95	20	58	Sra Catarina	3130
MUJINGE (2)	23 55' 30" S 032 56' 25" E	105/WR/94	48	34.6	3.4	35.7	Afridev		24/03/95	13	37.7	Sra Catarina	4500
CHIPSUANE	23 45' 23" S 032 32' 00" E	107/WR/94	53	26.3	1.5	45.0	Afridev		28/03/95	16	46.4	Sra Catarina	-
MABOMO (1)	23 42' 03" S 032 31' 02" E	108/WR/94	58	37.8	2.0	41.7	Afridev	2231	23/03/95	14	40.6	Sra Catarina	-
MABOMO (2)	23 41' 58" S 032 30' 56" E	109/WR/94	54	35.6	2.7	38.8	Afridev		31/03/95	13	37.7	Sra Catarina	-
COMBOMUNE RIO (1)	23 27' 55" S 032 28' 05" E	112/WR/94	42	25.5	2.1	40.4	Afridev		Borehole filled with stones!			-	-
COMBOMUNE RIO (2)	23 27' 45" S 032 27' 53" E	113/WR/94	46	26.3	3.0	33.8	Afridev		27/03/95	13	37.7	Sra Catarina	-
HOYO HOYO (2)	23 35' 31" S 032 28' 25" E	111/WR/95	18	6.1	2.8	8.0	Afridev	1415	16/03/95	4	11.6	Sra Catarina	-

Notes
DWL = Dynamic water level. Q = Borehole discharge

Pump Installation Details - May 1994 to August 1995

District: CHICUALACUALA

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Borehole Depth (m)	Static W.L (m)	1 Hour Pump Test Q (m3/hr)	1 Hour Pump Test DWL (m)	Type of Handpump	Pump Serial Number	Date of Pump Installation	Number of Rods	Depth of Cylinder	Pump Installation Technician(s)	Water Quality EC (uS/cm)
MAFASTELA	22 32' 48" S 032 27' 52" E	42/WR/94	18	5.4	3.4	10.2	Afridev	1423	07/10/94	5	14.50	Sra Catarina Sra Esperanca	2270
CHIDULO (1)		56/WR/94	49	19.2	1.8	46.7	Afridev	1436	09/10/94	16	46.4	Sra Catarina	3020
CHIDULO (2)	22 16' 10" S 032 31' 36" E	57/WR/94	33	13.5	2.1	30.0	Afridev	1431	09/10/94	10	29	Sra Catarina	3660
MAPAI NGALA (1)	22 51' 01" S 031 57' 48" E	43/WR/94	43	22.2	3.6	28.8	Afridev	1434	28/09/94	10	29.00	Sra Catarina Sra Esperanca	3170
MAPAI NGALA (2)	22 52' 00" S 031 58' 21" E	44/WR/94	48	21.5	2.9	30.8	Afridev	1441	06/10/94	12	34.80	Sra Catarina Sra Esperanca	1850
BUELA (1)	22 52' 25" S 031 59' 59" E	45/WR/94	32	14.7	3.4	24.7	Afridev	1442	05/10/94	9	26.10	Sra Catarina Sra Esperanca	1810
BUELA (2)	22 52' 22" S 031 59' 40" E	46/WR/94	31	17.8	3.1	23.4	Afridev	1420	29/09/94	9	26.10	Sra Catarina Sra Esperanca	1610
CHILEMANE (1)	22 56' 54" S 032 02' 02" E	47/WR/94	30	15.5	3.1	18.4	Afridev	1422	03/10/94	7	20.30	Sra Catarina Sra Esperanca	1500
CHILEMANE (2)	22 56' 27" S 032 01' 55" E	48/WR/94	28	17.8	2.8	18.4	Afridev	1430	04/10/94	7	20.30	Sra Catarina Sra Esperanca	1500

Notes
DWL = Dynamic water level. Q = Borehole discharge

APPENDIX C3

WORLD RELIEF RURAL WATER SUPPLY PROGRAMME

Bucket Pump Installation Details - May 1994 to August 1995

Location (Aldeia/Bairro)	GPS Coordinates	Borehole Ref. No	Date of Drilling	Borehole Depth (m)	Static Water Level (m)	1 Hour Pump Test Q (m3/hr)	1 Hour Pump Test DWL (m)	Type of Handpump	Date of Pump Installation	Water Quality EC (uS/cm)
CHIGUBO										
KEKE (1) (L.Nhanonguane)	23 43' 08" S 033 28' 58" E	70/WR 94	22/08/94	18	11.1	0.3	15.2	Bucket Pump	15/03/95	4800
KEKE (2) (L.Mangonsuane)	23 47' 22" S 033 29' 09" E	71/WR/94	28/08/94	20	11.1	0.2	19.0	Bucket Pump	14/03/95	6500
NHANALE (1)	23 50' 46" S 033 30' 29" E	72/WR/94	23/08/94	20	9.2	0.3	18.5	Bucket Pump	09/09/94	4500
NHANALE (3)	23 50' 47" S 033 30' 26" E	74/WR/94	27/08/94	21	12.1	0.2	21.0	Bucket Pump	09/09/94	4880
MABALANE										
MATIDSE	23 50' 03" S 032 33' 41" E	02/WRmv/95	22/03/95	7.5	5.0	-	-	Bucket Pump	29/08/95	-
GUIJA										
CHIMBEMBE (2)	24 22' .88 S 033 10' .16 E	20/WR/95	02/07/95	20.0	8.6	0.8	14.5	Bucket Pump	26/08/95	550
NHATINE (3)	24 25' .38 S 032 58' .04 E	12/WR/95	27/06/95	30.5	15.5	2.5	24.6	Bucket Pump	12/08/95	5090
CHIVONGUENE (2)	24 28' .22 S 033 05' .05 E	03/WR/95	23/06/95	25.0	11.4	-	-	Bucket Pump	25/08/95	5100

APPENDIX C4

WORLD RELIEF RURAL WATER SUPPLY PROGRAMME

Afridev Pump Failure and Repair Details and Cost Analysis - June 1993 to November 1995

Location (Aldeia/Bairro)	Borehole Ref. No	Pump Serial Number	Date of Pump Installation	Depth of Cylinder (m)	Type of Pump Failure	Date of Failure	Date of Repair	Parts Replaced	Cost of Spare Part (US$)	Estimated User Group	Comments/Observations
MASSANGENA											
MASSANGENA SEDE (transit)	15/WR/94		06/06/94	17.4						291	No failures reported
MASSANGENA SEDE (hospital)	16/WR/94		06/06/94	14.5						291	No failures reported
MANINGE	17/WR/94		06/06/94	28.0						291	No failures reported
MUTETO (1)	01/WR/94		27/05/94	43.5	Broken pump rod hook	01/01/95	18/05/95	1 "new type" pump rod	54.26	989	Until May no new type hooks and eyes on pump rods were available
								U-seal	2.64		
								Plastic bearings	1.94		
					Broken pump rod hook	10/10/95	24/10/95	1 "new type" pump rod	54.26		Other spares were limited
								U-seal	2.64		
MBOCODA (1)	02/WR/94		30/05/94	52.2	Broken pump rod hook	-	18/08/94	1 pump rod	54.26	989	
					Broken pump rod hook	03/02/95	18/05/95	1 "new type" pump rod	54.26		
								U-seal	2.64		
								Plastic bearings	1.94		
								Foot valve & piston	12.30		
					Broken pump rod hook	05/11/95	12/11/95	1 "new type" pump rod	54.26		
								U-seal	2.64		
								Piston	6.15		
MBOCODA (2)	03/WR/94		28/05/94	52.2	Cracked/broken tube	27/04/95	20/05/95	2 PVC tubes	26.32	989	
								U-seal	2.64		
								Plastic bearings	3.88		
								Foot valve & piston	12.30		
						10/11/95	12/11/95	U-seal	2.64		
CHICUMBE (3)	28/WR/94		27/06/94	49.3	Broken pump rod hook	-	14/08/94	1 pump rod	54.26	989	
					Broken pump rod hook	02/05/94	19/05/94	1 pump rod	54.26		
								U-seal	2.64		
								Plastic bearings	1.94		
								Piston	6.15		
					Broken PVC rising main	?	?	PVC couplers			
MUTETO (Escola)	18/WR/94		07/06/94	43.5						989	
NGOMANE	04/WR/94		01/08/94	63.8	Broken pump rod hook	Before 12/9	-	1 pump rod	54.26	2120	
					Broken pump rod hook	07/04/95	19/05/95	1 "new type" pump rod	54.26		
								U-seal	2.64		
								Plastic bearings	1.94		
					Broken PVC rising main	11/11/95	13/11/95	2 PVC couplers	5.04		
								U-seal	2.64		
CHITLUMANE	14/WR/94		30/05/94	52.2	Broken pump rod hook	Before 12/9	02/12/94	1 "new type" pump rod	54.26	786	
								U-seal	2.64		
								Piston	6.15		
					Broken pump rod hook	24/03/95	20/05/95	1 "new type" pump rod	54.26		
					Separation of tubes			U-seal	2.64		
								Piston	6.15		
								Plastic bearings	1.94		
					Cracked PVC rising mai	08/09/95	?	2 PVC couplers	5.04		
MAPANHE (1)	05/WR/94		04/06/94	52.2						786	No failures reported
MAPANHE (2)	08/WR/94		04/06/09	43.5						786	No failures reported
CHICUMBE (1)	07/WR/94		31/05/94	52.2						951	No failures reported
CHICUMBE (2)	08/WR/94		31/05/94	43.5						951	No failures reported
MUCAMBENE (1)	09/WR/94		09/06/94	60.9	Broken pump rod hook	13/07/94	14/07/94	1 pump rod	54.26	1751	
					Broken pump rod hook	16/07/94	17/07/94	1 pump rod	54.26		
					Broken pump rod hook	02/08/94	08/08/94	1 pump rod	54.26		
					Broken pump rod hook	09/08/94	18/05/95	1 "new type" pump rod	54.26		Until May no new type hooks and eyes on pump rods were available. Other spares very limited
								U-seal	2.64		
								Piston	6.15		
								Plastic bearings	1.94		
					Broken pump rod hook	10/95	10/95	1 "new type" pump rod	54.26		
								2 PVC couplers	5.04		

Afridev Pump Failure and Repair Details and Cost Analysis - June 1993 to November 1995

Location (Aldeia/Bairro)	Borehole Ref. No	Pump Serial Number	Date of Pump Installation	Depth of Cylinder (m)	Type of Pump Failure	Date of Failure	Date of Repair	Parts Replaced	Cost of Spare Parts (US$)	Estimated User Group	Comments/Observations
MASSANGENA											
MUCAMBENE (2)	10/WR/94		08/08/94	60.9	Broken pump rod hook Borehole filled with stones!	12/08/94	13/08/94	1 pump rod	54.26	1751	Pump removed
MUCAMBENE (3)	25/WR/94		15/06/94	58.0	Separation of tubes Broken pump rod hook	08/08/94 Before 12/94	10/08/94 -	1 tube 1 pump rod Piston Compression cone	13.16 54.26 6.15 8.31	1751	
					Broken pump rod hook	20/02/95	19/05/95	1 "new type" pump rod U-seal Piston Plastic bearings 1 tube	54.26 2.64 6.15 3.88 13.16		
					Broken pump rod hook	10/95	10/95	1 "new type" pump rod 2 PVC couplers	54.26 5.04		
SOKOTE	26/WR/94		06/08/94	43.5						1751	No failures reported
SIQETTO (1)	23/WR/94		06/08/94	46.4						1751	No failures reported
MAVUE FRONTEIRA	22/WR/94	1552	09/08/94	43.5						904	No failures reported
MABONDZO (1)	12/WR/94		03/08/94	34.8						1402	No failures reported
MABONDZO (2)	13/WR/94		03/08/94	43.5						1402	No failures reported
CUFAMUNE	11/WR/94		13/08/94	46.4	Broken bolt in handle Worn out U-seal	Before 12/94 18/05/95	- 23/05/95	- U-seal Piston Plastic bearings	- 2.64 6.15 1.94	628	Repair made by community
SINGANHANE	19/WR/94		13/08/94	52.2	Broken pump rod hook	10/03/95	20/05/95	1 "new type" pump rod U-seal Piston Plastic bearings	54.26 2.64 6.15 1.94	628	
					Broken PVC rising main	10/11/95	12/11/95	1 tube 2 PVC couplers U-seal	13.16 5.04 2.64		
MAPSWAI	20/WR/94		22/08/94	46.4	Broken piston	14/08/95	18/08/95	U - seal Piston	2.64 6.15	628	Routine replcement of parts
					Broken PVC rising main	09/11/95	10/11/95	2 PVC couplers U-seal	5.04 2.64		
HANDELA	21/WR/94		22/08/94	55.1	Broken pump rod hook Cracked tube	18/05/95	17/08/95	1 tube U - seal Piston Plastic bearings	13.16 2.64 6.15 1.94	628	
					Cracked rising main	05/11/95	10/11/95	2 PVC couplers	5.04		
CHINEZANE	33/WR/94		12/08/94	23.2						<200	No failures reported

Total Cost $ 1,427.84

Notes:
Cost in US$ Stenaks 1995
Estimated User group based on village/bairro population estimates either from Administration or presidents/secretaries of villages/bairros
Where there is more than one pump in a village/bairro estimated user group is total population divided by number of pumps

ANALYSIS

Total number of pumps installed = 27

Total cost of repairs reported = US$ 1,430

Average number of months usage (June 1994 to November 1995) = 18

=> cost per pump per year = US$ 40

NB: Cost of replacing pump rods initially supplied = US$ 870 or 60% of total repair costs

APPENDIX C5

VOLANTA HANDPUMP – FAILURE and REPAIR DETAILS for PUMPS INSTALLED IN 1993

Pump N° and Borehole Ref.	Installation Depth (m)	Date of Installation	Date of Pump Failure	Date of Pump Repair	Type of reported Failure	Estimated Size of User Group	Condition of Pump at 20/11/95	Comments/Observations
Chicualacuala 1 01/WR/92	65	03/01/93	20/11/93 04/94 04/95	22/03/94 28/04/94 20/8/95	Separation rising main Separation rising main Broken coupler	>1000	Not Working	
Chicualacuala 5 05/WR/92	63	03/01/93	6 months 12/93 04/95	- 21/03/94 Unrepaired	Broken top bolt Separation rising main & Worn out conical seat Separation rising main	>1000	Removed	Volanta pump has been replaced by Zimbabwe Bush Pump by another organisation
Chicualacuala 8 06/WR/92	65	02/02/93	6 months 25/12/93 01/95	- 22/03/94 Unrepaired	Broken top bolt Separation rising main Separation rising main	>1000	Not Working	Rising main stuck in borehole Special tools/equipment required
Mapai 1 01/WR/93	68	15/02/93	6 months 10/93 ? 19/03/95 05/09/95 12/09/95	- 03/94 12/94 12/08/95 07/09/95 13/09/95	Broken top bolt Separation rising main & Worn out conical seat Separation rising main Broken coupler Broken coupler Broken coupler	1993/4 >1000 1995 370	Working	User group size dropped sharply after drilling programme in 1994
Mapai 2 02/WR/93	71	23/02/95	6 months 27/05/93 06/01/95 07/01/95 03/95 25/07/95	- 23/03/94 07/01/95 09/01/95 30/03/95 09/08/95	Broken top bolt Worn out conical seat Separation rising main Conical seat "fell out" Broken coupler Broken coupler	1993/4 >1000 1995 370	Working	 Factory fault Complete new rising main and new type couplers installed
Mapai 3 03/WR/93	74	25/02/93	6 months 10/93 01/94 10/94	- 01/94 03/94 Unrepaired	Broken top bolt Separation rising main & Worn out conical seat Separation rising main	1993/4 >1000 1995 370	Pump Removed	In attempting to repair/fish out rising main borehole was damaged and blocked
Mapai 4 04/WR/93	71	24/02/93	6 months 10/93 02/94 29/03/94 12/94 10/01/95 02/95 04/95 06/95	- 01/94 25/03/94 04/94 12/94 12/01/95 20/02/95 17/04/95 13/08/95	Separation rising main Worn out conical seat Separation rising main Separation rising main Separation rising main Broken coupler Broken top bolt Broken coupler Separation rising main	1993/4 >1000 1995 370	Working	
16 de Junho 1 05/WR/93	68	09/02/93	6 months 10/93 09/94 12/12/94 12/05/95	- 26/03/94 11/94 05/12/95 15/08/95	Separation rising main Worn out conical seat Separation rising main Worn out conical seat Broken coupler	1993/94 900 1995 510	Working	
16 de Junho 2 06/WR/93	68	11/02/93	6 months 10/93 10/94 ? 10/05/95 28/08/95	- 26/03/94 02/12/94 20/01/95 14/08/95 29/08/95	 Worn out conical seat Broken coupler Broken coupler Broken coupler Broken coupler	1993/94 900 1995 510	Working	
16 de Junho 3 07/WR/93	68	10/02/93	6 months 08/93 ? 10/94 06/95	- 26/03/94 04/94 12/94 08/95	- Worn out conical seat Separation rising main Worn out conical seat Broken coupler	1993/94 900 1995 510	Working	
16 de Junho 4 08/WR/93	68	05/02/93	6 months 10/93 08/94 17/04/95 06/95	- 25/03/94 16/02/95 21/04/95 08/95	Broken top bolt Worn out conical seat Broken coupler Broken coupler Broken coupler	1993/94 900 1995 510	Working	
Regua 1 09/WR/93	77	02/03/93	6 months 1 year - 05/09/94 08/95	- - 11/01/95 10/95	- 2 Broken top bolts Broken coupler Broken cylinder piston rod	200	Working	
Mpuze Rio 1 10/WR/93	68	07/03/93	6 months 11/03/93 10/94 25/02/95	- 27/03/94 11/02/95 24/08/95	- Separation rising main Separation rising main Broken coupler	600	Working	
Gerez 1 11/WR/93	74	08/03/93	6 months 1 year 11/01/94 08/94 07/95 10/95	- - 30/03/93 03/02/95 09/08/95 11/95	- Worn out conical seat & Sieved pump cylinder Separation rising main Broken coupler Broken coupler Broken coupler	820	Working	
Pfukwe 1 19/WR/93	53	24/06/93	6 months 1 year 07/94	- 28/11/94 N/A	- Separation rising main Separation rising main	1993/4 700	Replaced by AFRIDEV – 28/11/94	
Pfukwe 2 20/WR/93	56	29/06/93	6 months 1 year	- 01/11/94	- Separation rising main	1993/4 700	Replaced by AFRIDEV – 29/11/94	
Pfukwe 3 21/WR/93	58	30/06/93	6 months 06/12/94	- ?	- Separation rising main & Worn out conical seat	1993/4 700	Replaced by AFRIDEV – 30/11/94	
Pumbe 1 22/WR/93	61	14/07/93	6 months 1 year	- ?	- Separation rising main	1993/4 400	Working	
Pumbe 2 28/WR/95	64	15/07/93	6 months 1 year 07/95	- ? 11/95	- Separation rising main Separation rising main	1993/4 400	Working	

Total number of pumps = 19, Average depth = 66m

VOLANTA HANDPUMP – FAILURE and REPAIRS for PUMPS INSTALLED after TRAINING WORKSHOP in MAPAI (DEC 1994)

Pump N° and Borehole Ref.	Installation Depth (m)	Date of Installation	Date of Pump Failure	Date of Pump Repair	Type of reported Failure	Estimated Size of User Group	Condition of Pump at 20/11/95	Comments/Observations
Chimoio-sede 9 123/WR/94	83	21/01/95	05/95	Unreported	Separation rising main	>1000	Not Working	
Chimoio-sede 10 124/WR/94	86	22/01/95	05/95	N/A	Separation rising main	>1000	Replaced	Replaced by Zimbabwean Bush Pump by another organisation
Mapai 5 37/WR/94	66	07/01/95	02/95 03/95 24/06/95	04/02/95 04/04/95 14/08/95	Broken coupler Conical seat 'fell out' Broken coupler	370	Working	Factory fault
Mapai 6 38/WR/94	74	06/01/95	02/95	08/02/95	Broken coupler	370	Working	
Mapai 7 39/WR/94	68	10/01/95	02/95 22/06/95	10/02/95 13/08/95	Broken coupler Broken coupler	370	Working	
Mapai 8 48/WR/94	71	16/12/94	29/04/95	16/08/95	Separation rising main	370	Working	
Mapai 9 41/WR/94	68	19/12/94	29/03/95	12/08/95	Broken coupler	370	Working	
Mapai 10 117/WR/94	71	29/11/94	30/11/94 03/95 10/95	02/12/94 06/95 10/95	Separation rising main Broken coupler Separation rising main	370	Working	Used for building work by NOVIB
Mapai 11 118/WR/94	71	20/12/94	22/07/95	15/08/95	Broken coupler	370	Working	
Mapai 12 119/WR/94	71	17/12/95	24/06/95	10/08/95	Broken coupler	370	Working	
Mapai 13 120/WR/94	71	07/01/95	20/06/95	13/08/95	Broken coupler	370	Working	
16 de Junho 5 34/WR/94	63	11/01/95	20/07/95	13/08/95	Broken coupler	510	Working	
16 de Junho 6 35/WR/94	66	12/01/95	17/07/95 27/8/95	16/08/95 28/08/95	Broken coupler Broken coupler	510	Working	
16 de Junho 7 36/WR/94	68	13/01/95	21/05/95	21/08/95	Broken coupler	510	Working	
Ragua 2 44/WR/94	68	25/01/95	08/95	05/09/95	Separation rising main	200	Working	
Mpuze Estepe 115/WR/94	77	26/01/95	02/95	12/02/95	Leaking cylinder	200	Working	
Mpuze Rio 2 116/WR/94	54	26/01/95	02/95	11/02/95	Broken coupler	320	Working	
Gouxe 2 114/WR/94	74	28/01/95	07/95	08/95	Broken coupler	410	Working	
Pembe 3 91/WR/95	61		–	–	–	460	Working	

YOLANTA HANDPUMP – FAILURE ANALYSIS & COSTS – HANDPUMPS INSTALLED JAN – MAR 1993 (UP TO 01/08/95)

Pump N° and Borehole Ref.	Installation Depth (m)	Number of days since Installation	# Estimated N° Working days since Installation	% of Time Pump Worked	*Estimated Number of Pumping Hours	+Total N° Litres Pumped (1000's)	Type of reported Failure	Number of Failures	Frequency of Failure (per working hours)	~ Cost of Repair (US$)	Total Cost of Repairs Per Pump (US$)	Repair Cost Per 1000 lits Pumped (US$)	Cost per Working Day or 5000 lits (US$)	Condition of Pump at 01/08/95
Chicualacuala 1 01/WR/92	65	900	675	75	6750	3375	Separation rising main	3	1 per 2250	308 (each)	924	0.27	1.37	Not Working
Chicualacuala 5 05/WR/92	65	900	660	73	6600	3300	Broken top bolt Separation rising main Worn out conical seat	1 2 1	1 per 6600 1 per 3300 1 per 6600	8 308 34	658	0.20	1.0	Not Working
Chicualacuala 8 08/WR/92	65	900	630	70	6300	3150	Broken top bolt Separation rising main	1 2	1 per 6300 1 per 3150	8 308	624	0.20	1.0	Not working Rising main stuck in borehole
Mapai 1 01/WR/93	68	885	570	64	5700	2850	Broken top bolt Worn out conical seat Separation rising main	1 1 1	1 per 5700 1 per 5700 1 per 5700	8 358 324	690	0.24	1.20	Not Working
Mapai 2 02/WR/93	71	880	645	73	6450	3225	Broken top bolt Worn out conical seat Separation rising main Conical seat fell out Cracked coupler	1 1 1 1 1	1 per 6450 1 per 6450 1 per 6450 1 per 6450 1 per 6450	8 374 340 374 340	1436	0.45	2.25	Not Working
Mapai 3 03/WR/93	74	880	540	61	5400	2700	Broken top bolt Separation rising main Worn out conical seat	1 3 1	1 per 5400 1 per 1800 1 per 5400	8 356 (each) 390	1466	0.54	2.70	Not working Borehole destroyed – Rising main irretrievable
Mapai 4 04/WR/93	71	880	630	72	6300	3150	Separation rising main Worn out conical seat Broken coupler Broken top bolt	5 1 2 1	1 per 1260 1 per 6300 1 per 3150 1 per 6300	340 (each) 374 340 8	2762	0.88	4.40	Not Working
16 de Junho 1 05/WR/93	68	890	540	61	5400	2700	Separation rising main Worn out conical seat	2 2	1 per 2700 1 per 2700	324 358	1364	0.51	2.55	Not Working
16 de Junho 2 06/WR/93	68	890	570	64	5700	2850	Worn out conical seat Cracked coupler	1 2	1 per 5700 1 per2850	358 324	1006	0.35	1.75	Not Working
16 de Junho 3 07/WR/93	68	890	540	61	5400	2700	Worn out conical seat Separation rising main	2 1	1 per 2700 1 per 5400	358 324	1040	0.39	1.95	Not Working
16 de Junho 4 08/WR/93	68	895	525	59	5250	2625	Broken top bolt Worn out conical seat Broken coupler	1 1 2	1 per 5250 1 per 5250 1 per 2625	8 358 324	1014	0.39	1.95	Not Working
Regua 1 09/WR/93	77	870	840	97	4200	2100	Broken top bolt Broken coupler	2 1	1 per 2100 1 per 4200	8 372	388	0.18	0.90	Not Working
Mpuze Rio 1 10/WR/93	68	865	420	49	4200	2100	Separation rising main Broken coupler	2 1	1 per 2100 1 per 4200	324 324	972	0.46	2.30	Not Working
Gerez 1 11/WR/93	74	865	450	52	4500	2250	Worn out conical seat Cylinder seizure Separation rising main Broken coupler	1 1 1 1	1 per 4500 1 per 4500 1 per 4500 1 per 4500	340 530 356 356	1632	0.73	3.65	Not Working
TOTALS AVERAGES														
14	69	85	588	66	5582	2790	Broken top bolt Separation rising main Broken coupler Worn out conical seat Conical seat fell out Cylinder seizure	9 23 10 12 1 1	1 per 620hrs 1 per 243hrs 1 per 558hrs 1 per 465hrs 1 per 5582hrs 1 per 5582hrs	72 7564 3368 4068 374 530	1141	0.41	2.0	NO PUMPS WORKING
							TOTALS	56		15,976				

Notes:

* Based on average of 10 hrs pumping per day except for Regua with 5 hrs per day

Estimated number of working days is based on recorded failure and repair data. It is probably a higher estimate than reality due to non recorded failures and repairs by communities

+ Based on pumping rate of 500 litres per hour

~ Cost of repair is based on 1995 Maputo prices. The rising main repair cost is related to depth. Cost formula: (depth/2.85*2) = number of new couplers.

1 coupler costs US$ 16

2 PVC tubes cost US$ 96

1 tin PVC solvent cement costs US$ 10

1 tin thinner costs US$ 10

1 conical seat costs US$ 34

VOLANTA HANDPUMP – FAILURE ANALYSIS & COSTS – HANDPUMPS INSTALLED DEC 94 – JAN 95 (UP TO 01/08/95)

Pump N° and Borehole Ref.	Installation Depth (m)	Number of days since Installation	# Estimated N° Working days since Installation	% of Time Pump Worked	*Estimated Number of Pumping Hours	+Total N° Litres Pumped (1000's)	Type of reported Failure	Number of Failures	Frequency of Failure (per working hours)	Cost of Repair (US$)	Total Repair Cost Per Pump (US$)	Cost of Repair Per 1000 lits Pumped	Cost per Working Day or 5000 lits (US$)	Condition Pump at 01/08/95
Chicualacuala 9 123/WR/94	83	180	105	58	1050	525	Blocked cylinder	1	1 per 1050	–				Not Working
							Separation rising main	1	1 per 1050	404	404	0.77	3.8	
Chicualacuala 10 124/WR/94	86	180	100	55	1000	500	Separation rising main	1	1 per 1000	420	420	0.84	4.2	Not Working
Mapai 5 37/WR/94	66	200	105	53	1050	525	Broken coupler	1	1 per 1050	324				Not Working
							Conical set fell out	1	1 per 1050	358	682	1.30	6.5	
Mapai 6 38/WR/94	74	200	150	75	1500	750	Broken coupler	1	1 per 356	356	356	0.47	2.4	Not Working
Mapai 7 39/WR/94	68	200	135	68	1350	675	Broken coupler	1	1 per 1350	324	324	0.48	2.4	Not Working
Mapai 8 40/WR/94	71	225	150	66	1500	750	Broken coupler	1	1 per 1500	340	340	0.45	2.3	Not Working
Mapai 9 41/WR/94	68	225	165	73	1650	825	Broken coupler	1	1 per 1650	324	324	0.40	1.96	Not Working
Mapai 10 117/WR/94	71	240	220	91	2200	1100	Separation rising main	1	1 per 2200	340				Not working
							Broken coupler	1	1 per 2200	340	680	0.62	3.1	
Mapai 11 118/WR/94	71	225	215	96	2150	1075	–	–	–	–	–	–	–	Not working
Mapai 12 119/WR/94	71	225	210	93	2100	1050	–	–	–	–	–	–	–	Not working
Mapai 13 120/WR/94	71	200	180	90	1800	900	–	–	–	–	–	–	–	Not Working
16 de Junho 5 34/WR/94	63	200	150	75	1500	750	Broken coupler	1	1 per 7500	308	308	0.41	2.05	Not Working
16 de Junho 6 35/WR/94	66	200	175	88	1750	875	–	–	–	–	–	–	–	Not Working
16 de Junho 7 36/WR/94	68	200	160	80	1600	800	–	–	–	–	–	–	–	Not Working
Regua 2 44/WR/94	68	185	185	100	1850	925	–	–	–	–	–	–	–	Working
Mpuze Estaçao 115/WR/94	77	185	185	100	1850	925	–	–	–	–	–	–	–	Working
Mpuze Rio 2 116/WR/94	54	185	175	95	1750	875	Broken coupler	1	1 per 1750	276	276	0.31	1.60	Working
Gerez 2 114/WR/94	74	210	200	95	2000	1000	–	–	–	–	–	–	–	Working
TOTALS/AVERAGES							Separation rising main	3	1 per 549hrs	1164				
							Broken couplers	9	1 per 183hrs	2592				15 Not Working
18	71	204	165	80	1647	824	Conical seat fell	1	1 per 1647hrs	358	229	0.20	1.00	3 Working
							Blocked cylinder	1	1 per 1647hrs	–				
							TOTAL	14	US$	4,114				

Notes:

* Based on average of 10 hrs pumping per day unless stated otherwise.

\# Estimated number of working days is based on recorded failure & repair data. It is probably a higher estimate than reality due to non reported failures & repairs by the community.

\+ Based on pumping rate of 500 litres per hour.

~ Cost of repair is based on 1995 Maputo prices. The rising main repair cost is related to depth. Cost formula: (depth/2.85*2) = number of couplers

1 coupler costs US$ 16

2 PVC tubes cost US$ 96

1 tin PVC solvent cement cost

1 tin thinner costs US$ 10

1 conical seat costs US$ 34

WORLD RELIEF RURAL WATER SUPPLY AND SANITATION PROGRAMME

Baseline Survey Data April 1994 - Massangena District

Aldeia/Bairro	Number of Households Questioned	Total Number of Inhabitants	Gender		Total No Children <5 years	Residential Status			Water Source		Latrines		Incidence of Disease			
			Male	Female		Resident	Displaced	Returnee	Pumps	River	Yes	No	Malaria	Dysentry	Scabies	Bilharzia
Maninge	15	151	66	85	21	13	0	2	7	8	4	11	14	12	2	11
Massangena Sede	14	91	49	42	12	10	4	0	14	0	10	4	10	2	0	3
Mbocoda	120	717	308	409	80	93	25	2	-	120	19	101	110	54	17	55
Mabondzo	44	291	120	171	23	34	8	2	-	44	3	41	33	7	3	17
Cufamune	32	222	92	130	14	19	13	0	-	32	3	29	30	5	6	16
Mucambene	60	388	175	213	41	57	2	1	-	60	11	49	50	12	9	25
Totals	285	1860	810	1050	191	226	52	7	21	264	50	235	247	92	37	127
Average	-	6.5	-	-	0.7	-	-	-	-	-	-	-	-	-	-	-
Percentage	-	-	44%	56%	10%	79%	18%	2%	7%	93%	18%	82%	* 87%	32%	13%	45%

* = Percentage of households that reported at least 1 case of the disease in previous 3 months

Water Source, Distance, Time, Quantity and Practices Analysis - Massangena District, April 1994

Aldeia/Bairro	Number of Households Questioned	Total Number of Inhabitants	Household Principle Water Source					Distance to Source (kms)	Time Taken to Collect Water per Day (hrs)	Total Volume of Water Collected (litres)	Who Collects the Water?				Percent of Population Collecting	Average Volume of Water Carried per Person (litres)	Average Volume of Water Used per Person per Day (litres)
			Pump	Well	Train	Lake	River				Mothers	Daughters	Sons	Others			
Maninge	15	151	7	-	-	-	8	0.5	0.5	2285	10	8		6	16%	95	15.1
Massangena Sede	14	91	14	-	-	-	0	0.5	0.5	1565	12	7		5	26%	65	17.2
Mbocoda	120	717	-	-	-	-	120	2	1	6056	33	18		4	8%	108	8.4
Mabondzo	44	291	-	-	-	-	44	1	2	2295	45	41	1	8	33%	24	7.9
Cufamune	32	222	-	-	-	-	32	1	2	1730	22	20		11	24%	33	7.8
Mucambene	60	388	-	-	-	-	60	7	2	2675	49	36	2	9	25%	28	6.9
Totals	285	1860	21	0	0	0	284	12	8	18608	171	131	3	43	19%	-	-
Average	-	6.5	-	-	-	-	-	2.8	1.4	* 69	-	-	-	-	-	48	6.9
Percentage	-	-	7%	0%	0%	0%	93%	-	-	-	49%	38%	1%	12%	-	-	-

* Average usage per household

APPENDIX E1

WORLD RELIEF RURAL WATER SUPPLY AND SANITATION PROGRAMME

Baseline Resurvey Data August 1995 - Massangena District

Aldeia/Bairro	Number of Households Questioned	Total Number of Inhabitants	Gender		Total No Children <5 years	Residential Status			Water Source		Latrines		Incidence of Disease			
			Male	Female		Resident	Displaced	Returnee	Pumps	River	Yes	No	Malaria	Dysentry	Scabies	Bilharzia
Maninge	15	79	27	52	12	15	-	-	15	-	11	4	5	1	2	-
Massangena Sede	15	67	40	27	8	15	-	-	15	-	14	1	4	-	-	-
Mbocoda	80	340	141	199	45	29	18	13	58	2	21	39	13	-	9	10
Mabondzo	60	414	179	235	54	26	3	31	57	3	5	55	26	-	18	15
Cufamune	15	119	52	67	22	-	-	15	15	-	1	14	9	-	5	-
Mucambene	60	415	170	245	62	41	1	18	57	3	2	58	21	-	11	13
Totals	225	1434	609	825	203	126	22	77	217	8	54	171	78	1	45	38
Average	-	6.4	-	-	0.9	-	-	-	-	-	-	-	-	-	-	-
Percentage	-	-	42%	58%	14%	56%	10%	34%	96%	4%	24%	76%	* 35%	0%	20%	17%

* = Percentage of households that reported at least 1 case of the disease in last 3 months

Water Source, Distance, Time, Quantity and Practices Analysis - Massangena District, August 1995

Aldeia/Bairro	Number of Households Questioned	Total Number of Inhabitants	Household Principle Water Source					Distance to Source (kms)	Time Taken to Collect Water per Day (hrs)	Total Volume of Water Collected (litres)	Who Collects the Water?				Percent of Population Collecting	Average Volume of Water Carried per Person (litres)	Average Volume of Water Used per Person per Day (litres)
			Pump	Well	Train	Lake	River				Mothers	Daughters	Sons	Others			
Maninge	15	79	15	-	-	-	-	0.2	0.5	1700	15	14		4	42%	52	21.5
Massangena Sede	15	87	15	-	-	-	-	0.7	0.75	1460	10	5	3	5	34%	63	21.8
Mbocoda	60	340	58	-	-	-	2	0.5	0.75	4360	48	37		27	32%	40	12.8
Mabondzo	60	414	57	-	-	-	3	1	1	5025	61	29	4	34	31%	39	12.1
Cufamune	15	119	15	-	-	-	-	0.2	0.5	1220	15	4		16	29%	35	10.3
Mucambene	60	415	57	-	-	-	3	1	1	3545	54	27		29	27%	32	8.5
Totals	225	1434	217	0	0	0	8	3.8	4.5	17310	201	116	7	115	31%	-	-
Average	-	6.4	-	-	-	-	-	0.7	0.8	* 77	-	-	-	-	-	39	12.1
Percentage	-	-	96%	0%	0%	0%	4%	-	-	-	48%	28%	2%	28%	-	-	-

* Average usage per household

APPENDIX D1

Rural Sanitation Programme - Distribution of Latrine Slabs

Village Name	Demonstration Latrine	Number Slabs Distributed
MASSANGENA DISTRICT		
Ngomane		42
Mbocoda	2	56
Chicumbo		46
Chitlumane	1	13
Maninge	1	35
Massangena Sede		27
Mucambene	1	17
Mabondzo		3
Siquetto		16
CHICUALCUALA DISTRICT		
Mapai		
Bairro 1		96
Bairro 2	1	92
Bairro 3		56
Bairro 4		110
Bairro 5	1	66
16 de Junho		
Bairro 1	1	32
Bairro 2		54
Bueila		3
Mpuse Rio		3
GUIJA DISTRICT		
Mbanguene	1	47
Nhatine	1	25
Tomanine	2	40
Chivonguene	2	50
7 de Abril		98
Donga	1	346
Chinhacanine	1	45
TOTALS	16	1418

APPENDIX D2

World Relief Twenty Litre Water Container Distributions - 1995

Location	Date	Number Containers
CHIGUBO DISTRICT		
Catine	11/05/95	104
Tchai-Tchai	11/05/95	78
Saute (Chigubo Sede)	11/05/95	44
Solane	11/05/95	93
Dindiza	12/05/95	121
Lagoa Ndlufu	12/05/95	39
Keke	12/05/95	211
Nhanale	08/02/95	119
	09/02/95	103
	12/05/95	248
	Total	1160
GUIJA DISTRICT		
Nalazi	07/02/95	258
Pandzane	07/02/95	71
Maimane	07/02/95	149
	Total	478
MABALANE DISTRICT		
Chipsuane	09/08/95	117
Mabomo	09/08/95	110
Hoyo Hoyo	09/08/95	111
	Total	338
CHICUALACUALA DISTRICT		
Mapai	12/08/95	19
	Total	19
	Grand Total	1995

Notes:
5 containers were faulty/damaged on arrival or during transportation