BRITISH GEOLOGICAL SURVEY
Natural Environment Research Council

TECHNICAL REPORT WD/92/9R

Hydrogeology Series

Technical Report WD/92/9R

Report on a Visit to Zimbabwe, 3 to 14 March 1992

P J Chilton

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BRITISH GEOLOGICAL SURVEY

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The British Geological Survey is a component body of the Natural Environment Research Council.

Keyworth, Nottingham NG12 5GG
☎ Plumtree (06077) 6111 Telex 378173 BGSKEY G
Fax 06077–6602

Murchison House, West Mains Road, Edinburgh EH9 3LA
☎ 031–667 1000 Telex 727343 SEISED G
Fax 031–668 2683

London Information Office at the Geological Museum, Exhibition Road, South Kensington, London SW7 2DE
☎ 071–589 4090 Fax 071–584 8270
☎ 071–938 9056/57

19 Grange Terrace, Edinburgh EH9 2LF
☎ 031–667 1000 Telex 727343 SEISED G

St Just, 30 Pennsylvania Road, Exeter EX4 6BX
☎ Exeter (0392) 78312 Fax 0392–437505

Bryn Eithyn Hall, Llanfarian, Aberystwyth, Dyfed SY23 4BY
☎ Aberystwyth (0970) 611038 Fax 0970–624822

Windsor Court, Windsor Terrace, Newcastle upon Tyne NE2 4HB
☎ 091–281 7088 Fax 091–281 9016

Geological Survey of Northern Ireland, 20 College Gardens, Belfast BT9 6BS
☎ Belfast (0232) 666595 Fax 0232–662835

Maclean Building, Crowmarsh Gifford, Wallingford, Oxfordshire OX10 8BB
☎ Wallingford (0491) 38800 Telex 849365 HYDROL G
Fax 0491–25338

Parent Body
Natural Environment Research Council
Polaris House, North Star Avenue, Swindon, Wiltshire SN2 1EU
☎ Swindon (0793) 411500 Telex 444293 ENVRE G
Fax 0793–411501

EXECUTIVE SUMMARY

The first collector well at the Lowveld Research Station, Chiredzi continues to operate successfully, producing a few thousand litres per week for the irrigation experiments which are being carried out by staff of the Institute of Hydrology and the Lowveld Research Station. Although average abstraction has increased from about 1000 l/d in 1989 and 1990 to 1700 l/d in 1991, it remains a fraction of the safe yield of the well. By the time of the visit, only 80 mm of rain had fallen at the station in the 1991-92 rainy season and groundwater levels over the whole of the station have fallen consistently from April 1991 through into 1992 by 1-2 m.

Operation of the well at Tamwa/Sihande/Dhobani Kraals for irrigation commenced in July 1991. The water level fell steadily from July to November, when only half the garden was cultivated, drawing an estimated 5000-7000 l/d from the well. Since December, the whole garden has been cultivated. Abstraction has been metered since early January, and checked by direct counting of buckets. Water usage has increased to about 15,000 l/d, including about 3000 l/d for domestic use. As a consequence, water levels have fallen more rapidly in the period January to March. Extrapolating this accelerated decline, it is estimated that the water level would reach pump suction in June or July and the current abstraction rate cannot be maintained through the dry season to the end of 1992. Reducing abstraction to half the current rate could maintain supplies during this critical period. The implications of the monitoring results were discussed at a project progress meeting during the visit and presented to the garden members. It was agreed that steps would be taken to reduce abstraction, by reducing the number of beds cultivated by each family.

Using all the information from the two sets of exploratory boreholes at the Lowveld Research Station, the configuration of the local piezometric contours appears to confirm the presence of recharge sources in or to the south of the station, either from the irrigated sugarcane fields, the irrigated land on the station or the storage reservoirs. Chemical and stable isotope analyses from these boreholes appear to suggest that any such recharge is more likely to originate from within the station than from the sugarcane to the south.

Visits were made to Sangwe, Matibi 2 and Chivi Communal Lands to make a preliminary appraisal of the potential for further collector well sites.

The associated TC proposal to develop six collector wells and gardens has been approved by BDDSA and returned to the British High Commission for passing to the Zimbabwe Government. Both MEWRD and Agritex are very keen to proceed with this project as soon as possible.

Discussions were held with BDDSA on possible priorities for ODA assistance to Zimbabwe in the context of the current drought. ODA have decided to concentrate their efforts in this respect on the water sector, which in the immediate short term response to the current drought means groundwater. A number of possibilities were discussed.

1. INTRODUCTION

The Lowveld of Zimbabwe is the location for field activities in the project "Development of Limited Groundwater Resources for Small-Scale Irrigation". The project is a joint one between BGS and IH, and IH have a member of staff, Dr Chris Lovell, stationed at Lowveld Research Station (LRS), Chiredzi. Regular short visits are made by staff of both institutes, BGS concentrating on the hydrogeological aspects of the work and IH on the irrigation. Funding for the BGS component of the present project ends on 31st March 1992, and the visit was thus the last one of the project. The visit was undertaken with Charles Batchelor, head of IH Agrohydrology Section and Andrew Semple, the new IH economist. The visit took place towards the end of a rainy season with greatly reduced rainfall, only 80 mm had fallen at LRS, Chiredzi, and serious drought with water and food shortages is in prospect.

2. OBJECTIVES OF VISIT

The visit was a joint one with IH. The principal hydrogeological objectives were to:

(a) review the performance of the collector wells at Chiredzi and Tamwa/Sihande/Dhobani Kraals and collect and evaluate data on their operations,

(b) prepare a report on hydrogeological aspects of the project, covering work carried out between June 1990 and March 1992,

(c) discuss progress with the proposed TC collector well project, have some preliminary discussions of timing of inputs and make visits to consider possible sites.

Shortly before the visit took place, BGS were contacted by Colin Ellis the Senior Engineering Adviser at BDDSA, Lilongwe for their views on possible priorities for ODA assistance in the water sector in relation to the current drought. He was planning to be in Zimbabwe assessing ODA's response to the drought during the week of 7 to 13 March. Some preliminary ideas were sent to BDDSA and discussed by telephone, and it was agreed to meet in Harare towards the end of his visit. A brief note on the discussions is included as section 10 of this report.

3. ITINERARY

2/3 March	London Heathrow to Harare.
3 March	Meeting with Chief Hydrogeologist, MEWRD. Meeting with ODA TCO Social Development Consultant. Meeting with Director of Agritex. Collected BGS Landrover from MEWRD yard. Purchase of geological maps.
4 March	Short discussions with aid personnel, British High Commission. Harare to Chiredzi, visiting the collector well at Tamwa/Sihande/Dhobani Kraals, collected most recent monitoring data.
5 March	Discussions with staff of LRS. Data interpretation and report writing.
6 March	Visits to Sangwe Communal Lands (am) and Matibi 2 Communal Lands (pm) to look at potential for collector well sites.
7 March	Report preparation.

8 March	Report preparation.
9 March	Measuring water levels and collecting water samples from exploratory boreholes at LRS, Chiredzi. Data analysis and report preparation. Project progress meeting.
10 March	Visit to Tamwa/Sihande/Dhobani Kraals to collect water samples and hold meeting to discuss with the garden users reducing abstraction from the well. Visit to other gardens and possible collector well sites in Chivi Communal Lands.
11 March	Collect monitoring data at LRS Chiredzi, collect water samples at Chiredzi. Report preparation.
12 March	Round-up discussions at LRS Chiredzi, including selection criteria for collector well gardens. Chiredzi to Harare via Zaka/Ndanga Communal Lands.
13 March	Discussions at MEWRD, Meeting with British High Commission to discuss TC proposal for collector wells and small-scale irrigation. Meeting with BHC and BDDSA Engineering Adviser to discuss possible ODA activities in relation to drought relief. Report writing.
14 March	Report writing. Visiting friends.
14/15 March	Harare to London Heathrow.

4. PEOPLE MET

BRITISH HIGH COMMISSION (BHC)

David Ward, First Secretary, Aid
Michael Edwards, Second Secretary, Aid
Matthew Streeton, Aid Assistant

BRITISH DEVELOPMENT DIVISION IN SOUTHERN AFRICA (BDDSA)

Colin Ellis, Engineering Adviser

LOWVELD RESEARCH STATION (LRS)

Iasiah Mharapara, Head of Station
Dr Chris Lovell, IH Agrohydrology Section
Emlyn Jones, TC Agriculturalist
Michael Brown, TC Agricultural Economist
Monica Murata, Agronomist

MINISTRY OF ENERGY AND WATER RESOURCES DEVELOPMENT (MEWRD)

George Nhunhama, Chief Hydrogeologist
Michael Mtetwa, Hydrogeologist
Marcus Sharpe, TCO Drilling Adviser

AGRITEX

Joe Makhado, Acting Director

ODA CONSULTANT

Diana Conyers, Social Development Consultant

5. PROJECT REPORTING

As stated in the objectives, the principal activity during the visit has been the collection, collation and interpretation of data and preparation of a technical report on hydrogeological activities in the project since the time of the last technical report (Chilton et al, 1990). A summary of the siting, construction, testing and costs of the well at Tamwa/Sihande/Dhobani Kraals was given in the previous visit report (Chilton, 1991). This information, amplified and further interpreted is included in the second technical report. It also includes results of monitoring the operation of both collector wells and additional work which was proposed in Chilton et al (1990) to try to identify any possible local recharge influences on the well at Chiredzi. These are summarised in sections 6 and 7 of the present visit report. The outline of the proposed technical report is shown in Appendix 1. It is anticipated that the report will be completed in May 1992.

In addition, it is proposed to produce a short, joint technical summary report incorporating the results of both hydrogeological (BGS) and agrohydrological (IH) components of the project. It is intended that this should be a printed document of about a dozen pages with colour photographs and diagrams, to bring together the principal results obtained in the study between 1988 and March 1992, discuss their implications, and to permit wide dissemination of the results. This document is planned to be completed in the middle of 1992.

As this is the last visit of the present project, a full list of reports is included here as Appendix 2 for ease of reference.

6. PERFORMANCE OF COLLECTOR WELLS

6.1 Lowveld Research Station, Chiredzi

A programme of hydrogeological monitoring, operated by LRS, IH and BGS has been established and dates back to the completion of the first exploratory boreholes in October 1988. The results obtained in this programme to June 1990 were presented and discussed by Chilton et al (1990) and will be brought up-to-date in the second technical report. A few brief comments are included here.

Monitoring of groundwater levels at LRS now provides data over four rainy seasons (Figure 1), including the drought of 1991-92. In the early part of 1989, water levels in boreholes close to the collector well (No's 11 to 14) fluctuate in response to pumping for dewatering during construction of the well and the laterals and the test pumping. Levels appear to recover through the remainder of 1989, but show varying responses to the rainfall in 1989-90 and 1990-91, some showing a seasonal response to recharge, others less so. By the time of this visit, only 80 mm of rain had fallen in the 1991-92 season and groundwater levels over the whole area of the station have fallen consistently from April 1991 through into 1992.

Abstraction from the well has increased slightly during the period (Figure 2) averaging 900, 950 and 1700 l/d in 1989, 1990 and 1991 respectively. This remains, however, a fraction of the installed pump capacity of 22,000 l/d and estimated safe yield of 65,000 l/d. The monitoring regime is to be maintained.

6.2 Tamwa/Sihande/Dhobani Kraals

A similar programme of hydrogeological monitoring has been established for the Kraal well. Monitoring of the amount of water abstracted is complicated as water is used for domestic supply as well as irrigation. Since early January these have been separately metered, and estimated for the period July to December last year.

Chiredzi Observation Borehole Water Levels

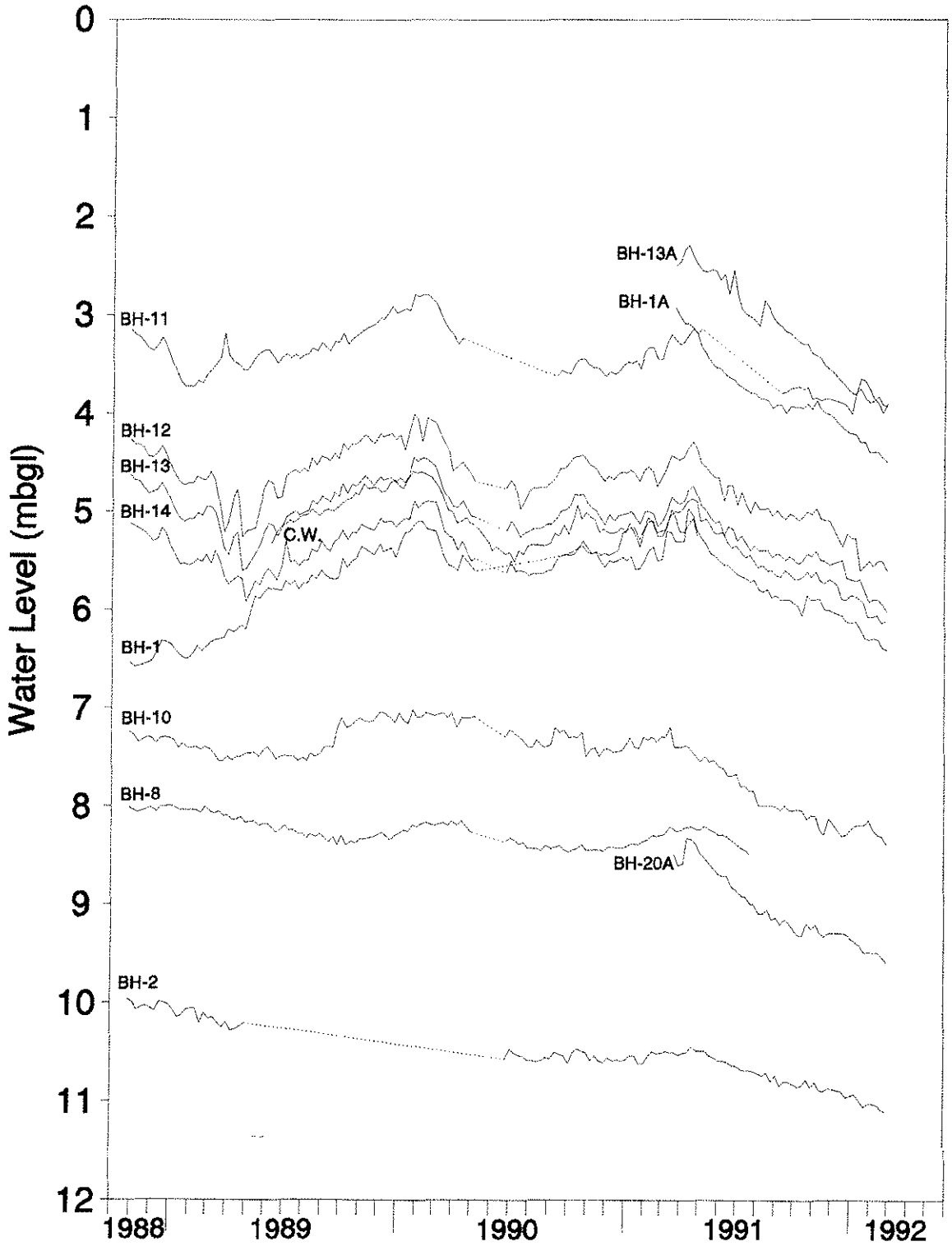

Figure 1. Water levels in exploratory boreholes at LRS, Chiredzi.

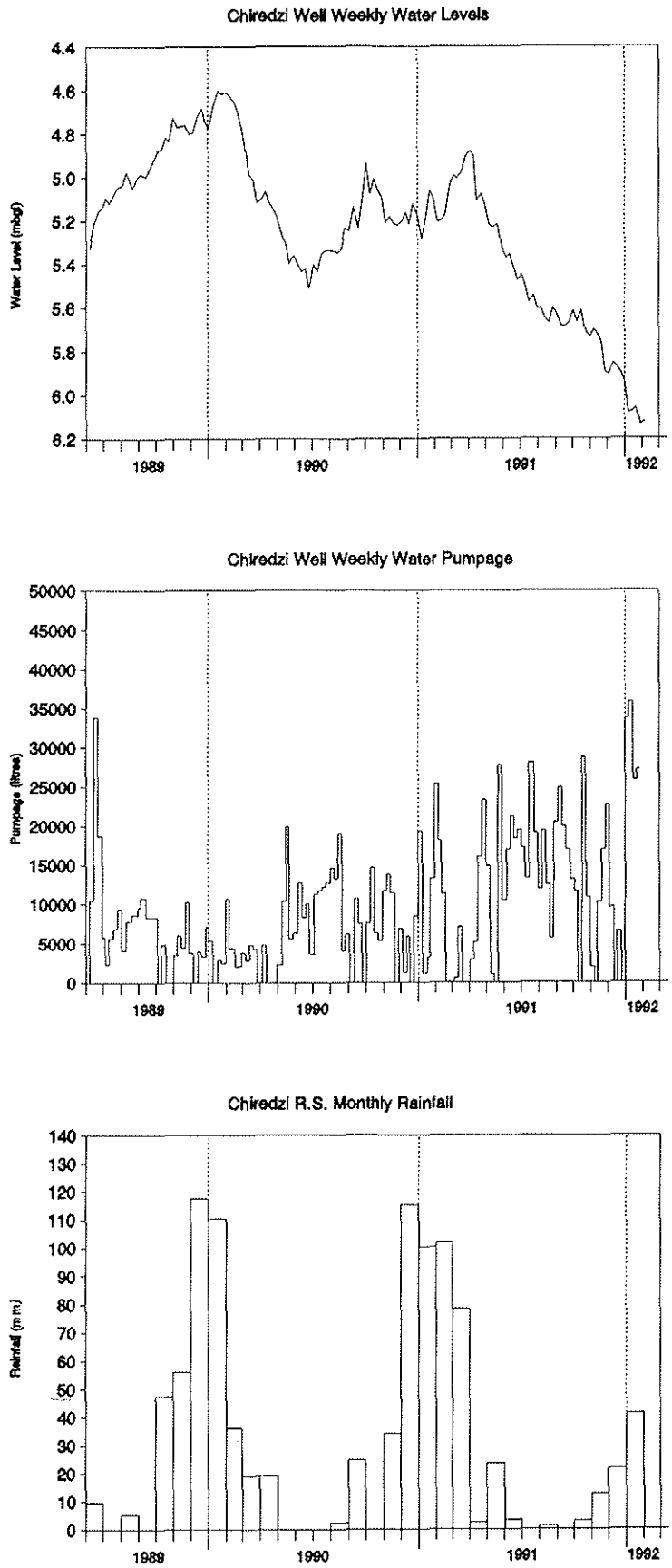

Figure 2. Water level, abstraction and rainfall, LRS collector well, Chiredzi.

Operation of the well for irrigation commenced in July 1991. Figure 3 shows the water level in the well and the volume of groundwater abstracted. The water level used is the highest observed during each weekly period, being the nearest to the recovered water level between periods of pumping. The water level in the well fell steadily from July to December and more rapidly since then. From July to November only half the garden was cultivated. Since the middle of December, the whole garden has been cultivated and the present operating regime is:

Monday, Tuesday	05.30 - 10.30	garden
Thursday, Friday	12.00 - 17.00	garden
	17.00 - 17.30	domestic use

Wednesday, Saturdays and Sundays, domestic use only

Though serious in many other ways, the 1991-92 drought provides an opportunity to test the projected long-term sustainable yield against actual abstraction and drawdown data. Figure 4 shows a semi-log plot of the same water level data. There appears to be a distinct breakaway point and change in slope which coincides with the increase in abstraction for the whole garden to be cultivated. Abstraction has been measured accurately since January and is estimated for the latter part of 1991. There has probably also been an increase in abstraction for domestic use with more people coming to the well as other sources dry up. Current estimates suggest that 1200 people depend on the well for drinking water. The increase may have been gradual rather than sudden, from around 6000 l/d initially to about 15,000 l/d currently (early March).

Extrapolating the steeper part of the decline, it is estimated that the water level would reach pump suction in June or July, assuming no recharge takes place during the remainder of the "rainy" season. Reducing abstraction back to something like half the current rate could extend the period of irrigation from the well to the end of the year. This analysis assumes that the accelerated fall in water level was caused by the increased abstraction for the second cropping season. If, however, the breakaway was caused by a geological boundary condition, then the situation may be more serious.

The implications of the monitoring results were discussed at the project progress meeting on 10 March, the minutes of which have already been circulated. It was agreed that the information in Figure 4 should be presented to the garden committee and members so that they could decide whether, and how, abstraction rates could be reduced. This was done the following day, when a meeting of garden members was called. It was agreed then that steps were required to reduce abstraction, so as to conserve water for domestic use for garden members and non-members alike. The members had already decided to cut their water demand by ceasing cultivation of some of the beds (currently growing tomatoes) and the consensus of the meeting was that members would work quickly over a short period (when harvesting current crops) to reduce the cultivated area from 7 beds to 4 beds per family.

The drought situation also provides an opportunity to encourage the use of improved irrigation techniques to achieve savings in water at the garden. Some scheme members were also using dry leaves as mulches and there was interest in the use of subsurface pipe irrigation. A mould was provided for making clay pipes. Every effort should be made to transfer improved irrigation techniques from LRS Chiredzi to the Kraal well garden. Monitoring of abstraction and water levels will continue to enable the performance of the well to be continuously assessed. The water level in the nearby traditional well will also be measured regularly. Further discussion will be included in the final technical report.

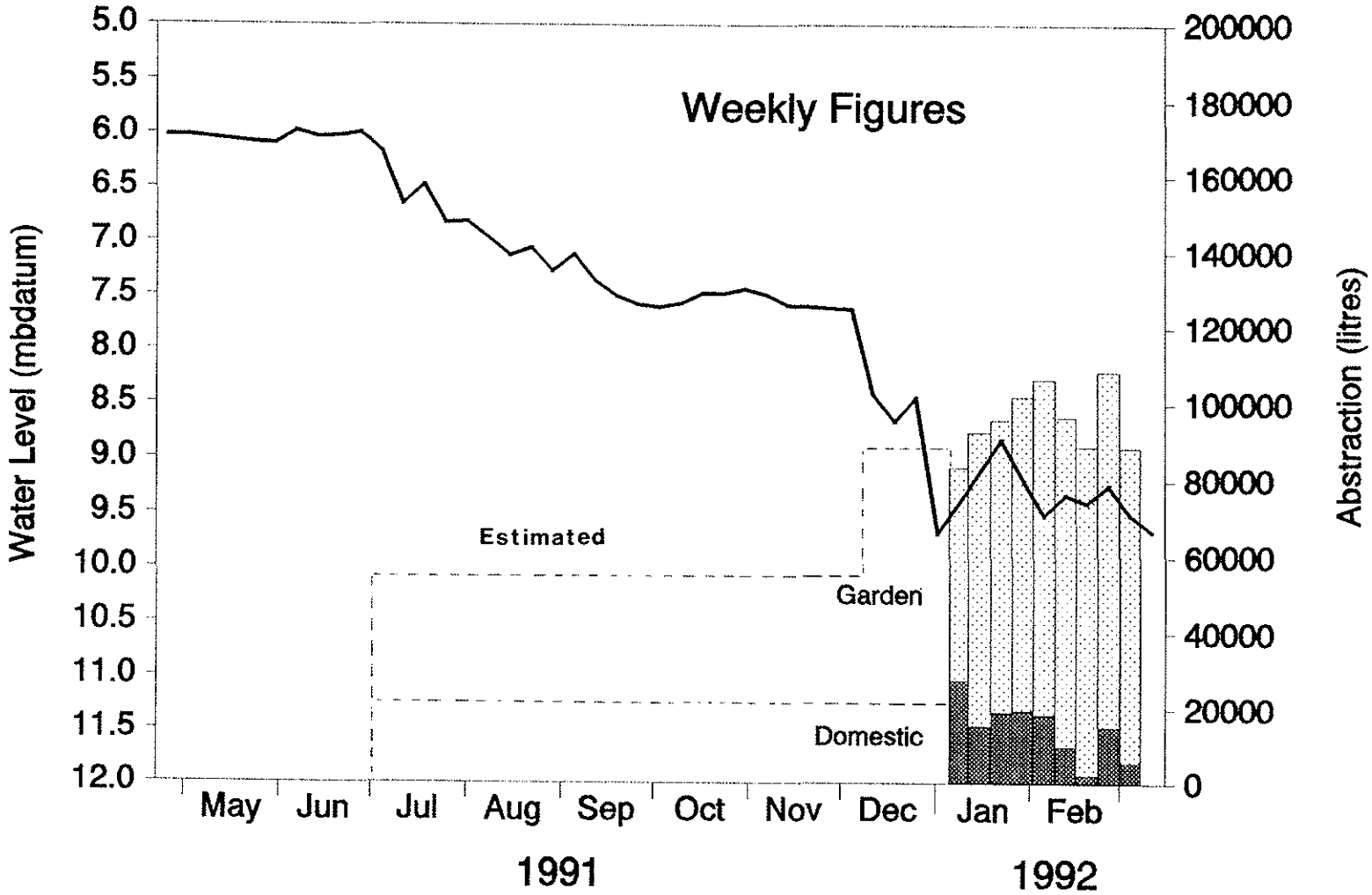

Figure 3. Water level and volume of groundwater abstracted, Tamwa/Sihande/Dhobani Kraals.

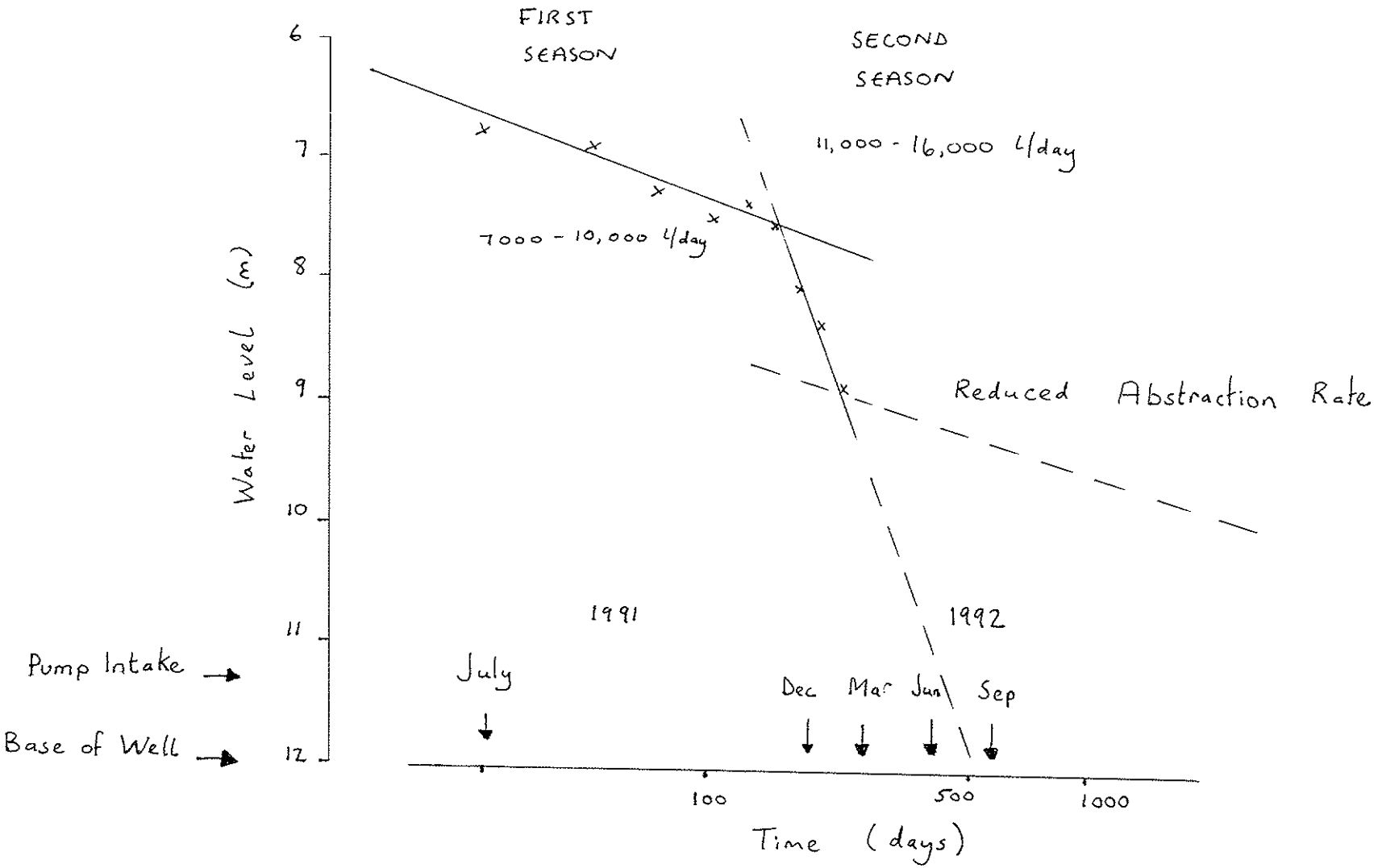

Figure 4. Semi-log plot of water level, Tamwa/Sihande/Dhobani Kraal.

During the visit, detailed data were collected by the IH and LRS economists. Economic analysis of the cropping of the scheme so far suggests an internal rate of return of 33% and a net present value of Z$55,600 at a discount rate of 12% on constant annual net cash flows of Z$9800 over a ten year period. Even with significant reductions in predicted cash flows, rates of return remain high, and it is clear that the scheme is economically viable.

6.3 Other Collector Wells

A considerable number of collector wells were constructed in Zimbabwe in the earlier project when the well construction techniques were being developed. In view of the present drought, it would be relevant to the present project to revisit them to ascertain whether any information exists to provide an indication of their current performance. Some of the wells were equipped with pumps soon after completion, others may have been more recently equipped. Shortage of time on the present visit prevented this from being done, but it is proposed that Peter Rastall, the BGS contract driller spend a few days to revisit the wells at the start of his next period in Zimbabwe. Information collected would be included in the final technical report. The possibility of promoting the use of some of these completed wells through the auspices of the National Action Committee was discussed with MEWRD.

7. ADDITIONAL WORK ON RECHARGE SOURCES AT CHIREDZI

With an average rainfall of about 450 mm, the Chiredzi area is considerably drier than any of the other successful collector well locations in Zimbabwe. Water levels at the Lowveld Research Station are much shallower than some other parts of the Lowveld, and it had been suggested this might result from enhanced local recharge from the irrigated sugar estates to the south. Further work to investigate this question was proposed, and in March 1991 another 20 shallow exploratory boreholes were drilled at selected points in the station to provide additional information on depth to groundwater.

Using a contour map of LRS, a plot of water level contours at the station indicates a hydraulic gradient from SW to NE in the southern part of the site. Groundwater flow appears to be generally towards the vlei. The local water table configuration appears to confirm the presence of recharge sources in or to the south of the station, either from the irrigated sugarcane fields, the irrigated land on the station or the storage reservoirs.

In April 1991 water samples were taken for chemical and stable isotope analysis from groundwater and from the possible sources of recharge. The stable isotope measurements (δ^2H and $\delta^{18}O$) show a very wide spread of results from all sources and, at first sight, do not appear to provide much help in identifying the influence of local recharge sources. Closer inspection shows that of the new exploratory boreholes, those at the extremities of the station group with isotopically lighter water, and are the most depleted in δ^2H and $\delta^{18}O$. If these are representative of local groundwater, less likely to be influenced by enhanced recharge from the irrigation, then it would appear that any such recharge is more likely to originate from within the station than from the sugarcane to the south. This is partly borne out by the chemical data. Additional water samples for chemical and isotope analysis were collected on the present visit to try to improve the interpretation. The full results and further discussion will be included in the technical report.

8. POTENTIAL SITES FOR COLLECTOR WELLS

A preliminary list of possible areas for collector well sites in communal lands and resettlement schemes was made during a visit in October 1988 and updated in 1989 (Table 1). Visits have been made to several of these in the course of the project, and detailed notes on six locations were included as

Table 1 Collector Well Sites in Communal Lands

	Name	Location	Underlying Geology
(a)	Matibi No. 1 (Neshuru)	100-120 km W of LRS	Precambrian basement gneisses
(b)	Maranda	130-140 km W of LRS	Precambrian basement gneisses
(c)	Ndanga (Zaka)	80 km N of LRS	Basement gneisses and granites
(d)	Sangwe	60-80 km E of LRS	Mostly Karoo, some paragneisses
(e)	Ndowoyo	70-80 km E of LRS	Karoo basalts
(f)	Mutema	150 km NE of LRS (near Birchenough Bridge)	Granite and dolerite
(g)	Matibi No. 2	30-50 km S of LRS	Karoo basalts
(h)	Sengwe	100-120 km S of LRS	Karoo basalts, ryholites and later granites
(i)	Chiswiriswi	30-40 km E of LRS	Paragneisses and Karoo
(j)	Nyahombe	80 km NW of LRS	Basement gneisses
(k)	Nyajena	80 km NNW of LRS	Basement gneisses
(l)	Chivi	110 km W of LRS	Basement gneisses

an appendix in Lovell et al (1990). Drilling to confirm the suitability of sites has been carried out in Sangwe, in Nyahombe Resettlement Scheme and at Tamwa/Sihande/Dhobani Kraals. Those at Nyahombe were briefly described in an earlier visit report (Chilton, 1990) and are described in more detail in the technical report which is in preparation. Further work may be carried out at Sangwe, so the information obtained so far will be retained for inclusion in a later report.

On the current trip, Sangwe, Matibi 2 and Chivi Communal Lands were visited. In Sangwe (Figure 5) some of the villages were visited in which exploratory drilling had taken place. Much of the Sangwe Communal Lands is underlain by Karoo Basalts. In the area around Machoka, Chegeru and Mupinga, large numbers of wells have been constructed, and well digging and deepening was observed during the visit. Groundwater levels are in the general range of 10 to 15 m below ground level. Many small fenced garden areas close to the wells were seen and, although some limited vegetable gardening was still going on, many people said they had stopped gardening to conserve water for drinking. There were no rainfed crops whatsoever and practically no pasture for livestock.

A very similar situation was observed in Matibi 2 (Figure 6). The underlying geology is again Karoo Basalts. Several wells were visited, but very little gardening was being done. Going southwards from the railway towards Chompani, water levels were initially greater than 15 m below ground, and over a distance of several kilometres, this gradually reduced to 10 m at the furthest point reached. At some of the wells excavated material appeared to be suitable for collector well construction, although sometimes hard and blocky. Returning northwards by the same route, and crossing the railway on the road to Makambi School and Boli (Figure 6) within 4-5 km of the railway at Manyuki several wells with water levels at about 10 m were seen. These were currently being used for domestic supply and livestock. This appeared to be an area worthy of closer examination for collector well potential. As the railway is approximately aligned with the watershed between the Runde and Nuanetsi river systems, it is possible that shallower water levels could be encountered further north and south, away from the railway.

After visiting the collector well at the kraal, visits were made to two nearby sites in Chivi where flourishing gardens had previously been observed. At Chamabhuku, a well on the banks of a dry gulley had been operated to provide water for a large garden. It had been suggested in 1991 that a rope-and-washer pump be fitted to the well, and one had been provided by Dr Lovell. Installation had not been completed, and the well was being operated by bucket and windlass. At the time of the visit, nothing was growing in the garden, and the little water in the well was being used domestically and for livestock. The water level in the well and in a second well across the gulley was at about 12 m below ground.

At Bedzanhomba a large garden had been operating in 1991, using a well in a sand river and a rope-and-washer pump. Staff from LRS Chiredzi had been to the well and garden last year at the invitation of Agritex for an open day. On the current visit, the garden was completely empty with no cultivation at all and the well was dry at about 3 m depth. The contrast between these two formerly successful gardens and the garden at Tamwa/Sihande/Dhobani Kraals emphasises the seriousness of the current drought situation.

A second loop (Figure 7) was made, further north in Chivi Communal Lands. In this area, population density appeared less in the south and greater in the north around Nemavuzhe. Numbers of shallow, dry wells were seen. At Mutoredzamawa Kraal a well 11 m deep had water at 10.2 m, and might be worthy of further investigation. On a general topographic and geomorphological basis, there appeared to be good potential for finding further collector well sites in Chivi Communal Lands.

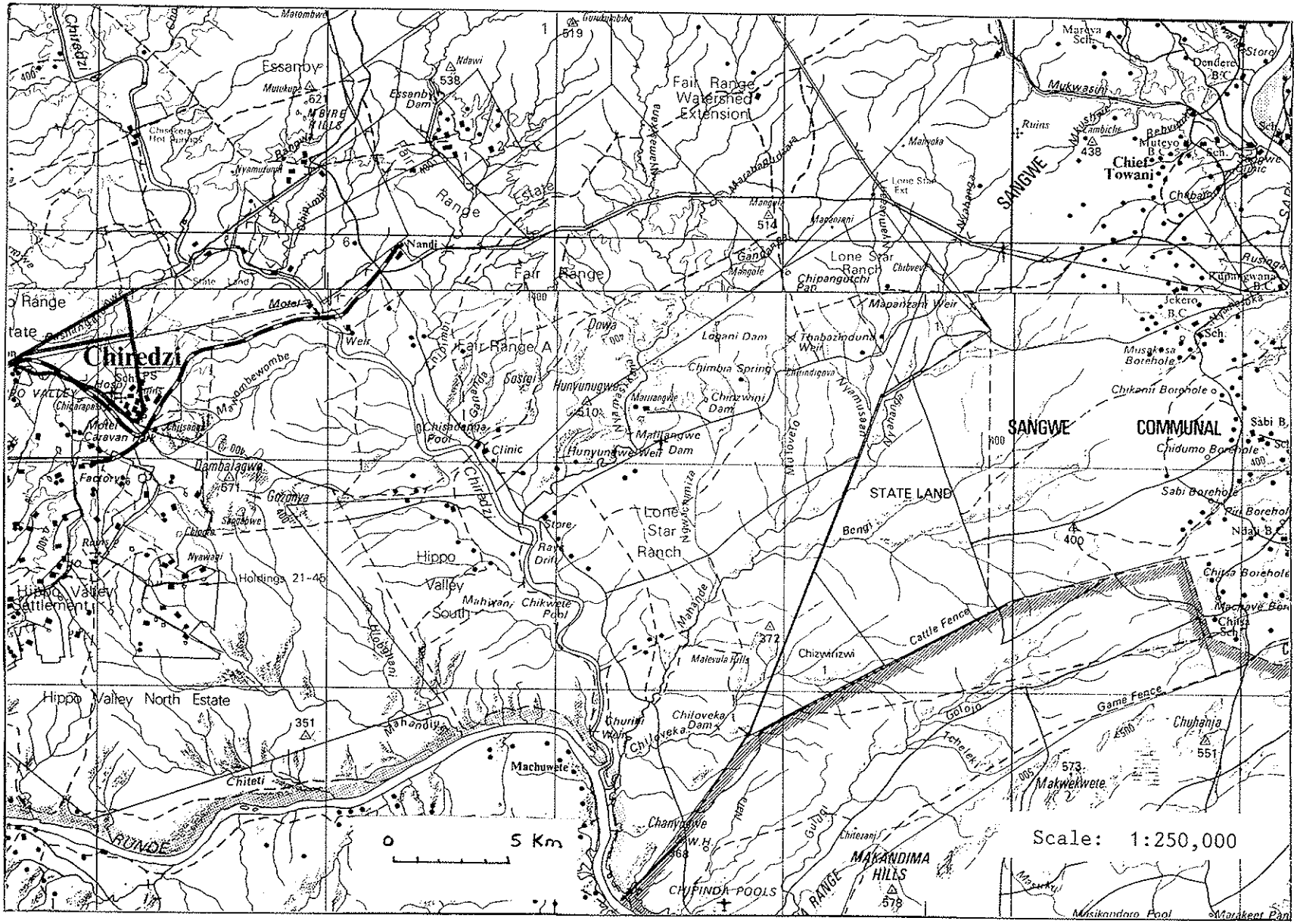

Figure 5. Location of area visited in Sangwe Communal Lands.

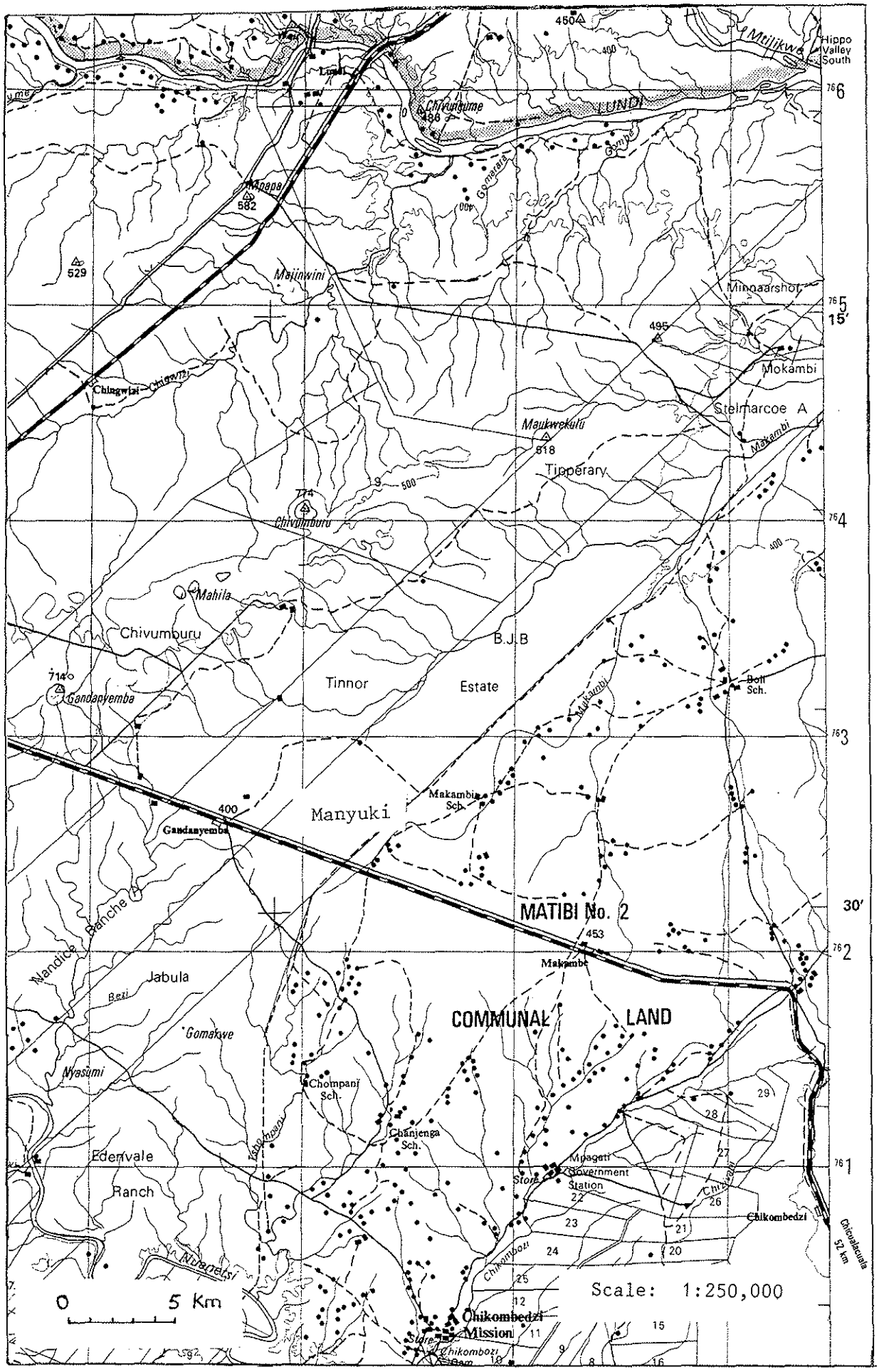

Figure 6. Location of area visited in Matibi 2 Communal Lands.

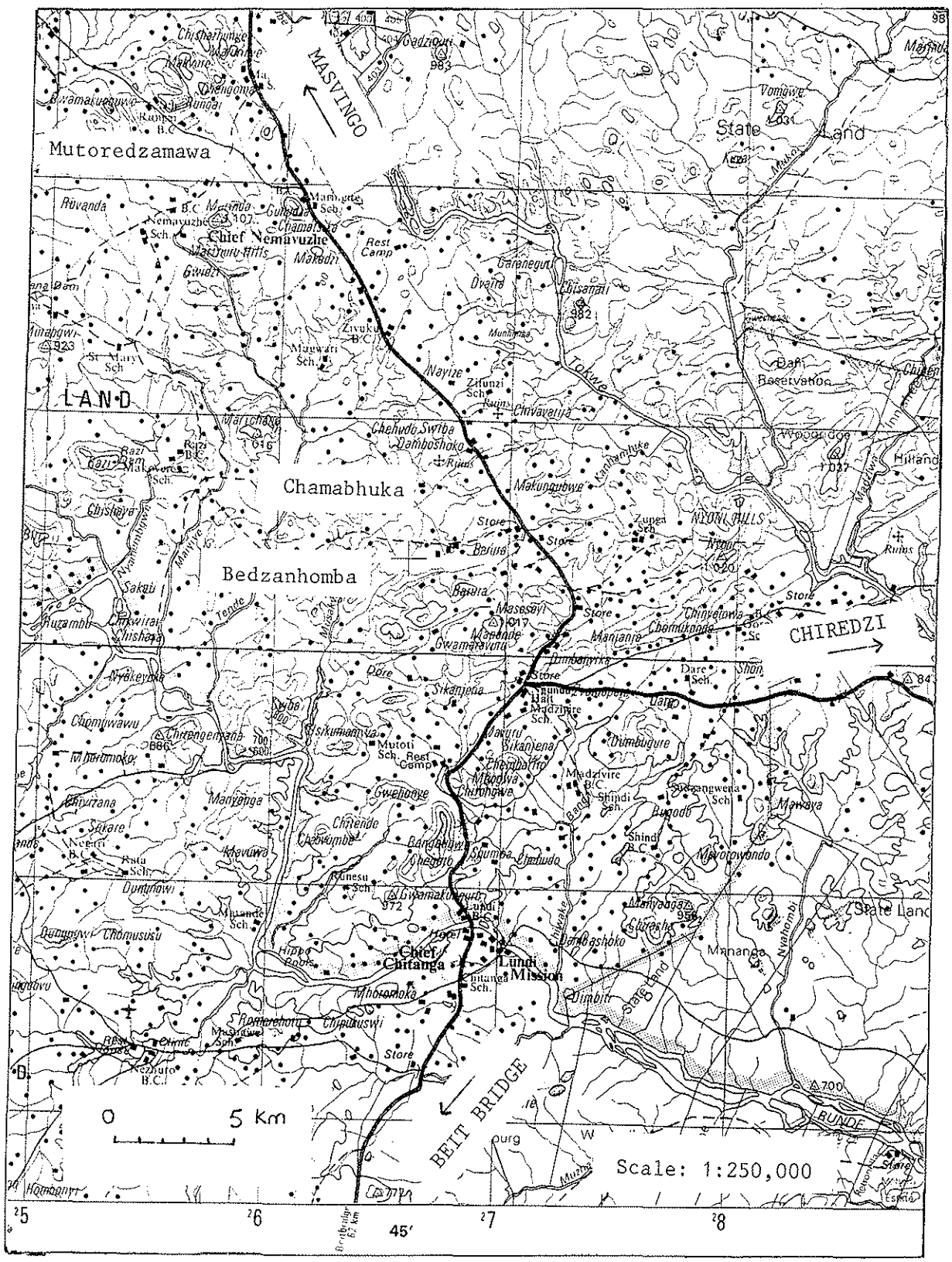

Figure 7. Location of areas visited in Chivi Communal Lands.

9. TECHNICAL COOPERATION PROPOSAL

At the British High Commission, the First Secretary, Aid was briefed on progress of the project. The minutes of the progress meeting held on 9 March were given to the High Commission, MEWRD and BDDSA, explaining the declining water levels at the kraal well and the discussions which had been held to encourage the garden members to reduce water abstraction. The TC proposal for development of collector wells and small-scale irrigation has now been approved by BDDSA and returned to BHC for passing to the Zimbabwe Government. In discussions at the beginning of the visit, both MEWRD and Agritex were very keen that the project should proceed as soon as possible and, in view of the current drought situation, it appears likely that the proposal will have a high priority at Government level. It was suggested that a start date of 1 July was a possibility.

The non-government organisation, Plan International had contacted Dr Lovell towards the end of 1991, with a view to taking up the collector well and small-scale irrigation idea. Their area of interest is primarily the Sangwe Communal Lands, underlain by Karoo Basalts. Detailed costs were provided by BGS and IH for a scheme comprising six wells and gardens. These were submitted in a proposal to Plan's regional office in Nairobi and, at the time of the present visit, it was learnt that approval has been given to make funds available for one scheme immediately, six in the next financial year and three in the following year.

10. THE 1991-92 DROUGHT IN ZIMBABWE

The following is a brief note on discussions with BDDSA and BHC on 13 March.

Present at the meeting were Ellis (BDDSA), Edwards (BHC), Chilton (BGS) and Batchelor and Semple (IH).

As a result of discussions between BDDSA, BHC and MEWRD, it had been proposed that existing funds allocated for the rehabilitation of old percussion rigs should be diverted to the provision of three or four new air-hammer rigs of the Hands-England 35W type, complete with accessories, together with 1000 m of plain and slotted casing for each rig. The casing might be either steel from Botswana or PVC from UK. It was anticipated that the prime objective in deploying these new rigs would be to enable MEWRD to make progress to catch up the backlog on its existing programme of improving rural water supplies throughout the country.

It was also recognised that, with long experience in various research and project management activities in Zimbabwe and other similar hydrogeological environments, BGS could provide specialist technical inputs to the drought relief programme. Two particular activities had been identified by BDDSA:

(a) Provision of hydrogeological advice and interpretation at a central, strategic planning level, closely associated with the National Action Committee and the National Coordination Unit. It was stated by BDDSA that MEWRD probably had sufficient junior staff for field supervision and that the principal requirement was for an experienced hydrogeologist to provide input to strategic planning, deployment of rigs, and make "informed decisions" on hydrogeological management of the programme. This person would not necessarily be tied to MEWRD, but in the planning process in government at the most appropriate place.

(b) Establishment or upgrading of a borehole database system and related information, including geology, hydrogeology, population density and distribution, land-use, soils; possibly developing a GIS approach. The size of this task was emphasised by both BGS and IH; it would be unlikely to assist significantly in planning priorities for the present

drought relief programme, but could be of great benefit in similar circumstances in the future.

The possible geographical priorities for assistance were discussed. It was pointed out by BGS that great care should be taken to learn from the previous drought relief programmes of borehole construction in 1983-84 in Matabeleland and Masvingo. The Gokwe and Bikita areas had been mentioned to BDDSA. Gokwe is underlain principally by Karoo rocks, and much of the experience of BGS on basement (in hydraulic fracturing and siting, for example) would not be applicable. Bikita is on the basement, between Masvingo and Birchenough Bridge. It appears that BDDSA may propose a rural water supply improvement project for that area, of a size and form as yet unspecified, but could include boreholes, wells, collector wells, gardens, and other components of relevant BGS research.

The question of water conservation and wastewater reuse had been raised with BDDSA, principally in respect of Bulawayo which faces a critical water shortage. The EC/ODA subvention work on wastewater reuse in Mexico was briefly described.

ODA have decided to focus their immediate response to the drought on water supply, rather than food or food transport. The situation is very serious, total surface water storage is at about 20% of capacity at the end of the "rainy" season. Some individual dams, e.g. Lake Kyle, are much lower (less than 1%), and will not last through the dry season unless extreme measures are taken. The town of Mutare, for example, is requisitioning all private boreholes (under powers in the Water Act) to supplement the municipal supply. In the short term, drought relief <u>is</u> groundwater, and there is clearly considerable scope for BGS involvement.

Appendix 1

OUTLINE OF FINAL TECHNICAL REPORT

COLLECTOR WELLS FOR SMALL-SCALE IRRIGATION:
Construction and Testing of a Well at Tamwa/Sihande/Dhobani Kraals and Further Work at Chiredzi

P J Chilton and J C Talbot

EXECUTIVE SUMMARY

1. INTRODUCTION
   Background, Objectives, Scope of report

2. COLLECTOR WELLS FOR COMMUNAL GARDENS
   Siting criteria, Location of sites (Nyahombe)

3. COLLECTOR WELL AT TAMWA/SIHANDE/DHOBANI KRAALS
   Site location and description, site maps, well siting investigations - exploratory drilling results, well construction, including lateral drilling, well testing, including modelling, well costs

4. PERFORMANCE OF COLLECTOR WELLS

   Chiredzi - all plots brought up to date from June 1990, discuss results. Kraal well - similar data, discuss implications, especially with reference to the drought. Other wells - obtain any information on the performance of previously-completed collector wells

5. ADDITIONAL WORK ON RECHARGE SOURCES AT CHIREDZI

   Additional exploratory drilling, chemical and isotope analyses, water level contours

6. CONCLUSIONS

ACKNOWLEDGEMENTS

REFERENCES

Appendix 2

LIST OF PROJECT REPORTS

(a) Technical Reports

Batchelor C H, Foster W M, Murata M, Gunston H and Bell J P (1990). Development of Small-Scale Irrigation Using Limited Groundwater Resources: First Interim Report. Institute of Hydrology Report ODG 3/90, pp 47.

Lovell C J, Batchelor C H and Murata M (1990). Development of Small-Scale Irrigation Using Limited Groundwater Resources: Second Interim Report. Institute of Hydrology Report ODA/11/90, pp 54.

Chilton P J, Talbot J C and Shedlock S L (1990). Collector Wells for Small-Scale Irrigation: Siting, Construction, Testing and Operation of a Collector Well at the Lowveld Research Station, Chiredzi. BGS Technical Report WD/90/20, pp 58.

Kitching R (1991). Collector Wells for Small-Scale Irrigation: Modelling Pumping Tests on a Collector Well at the Lowveld Research Station, Chiredzi, Zimbabwe. BGS Technical Report WD/91/24R, pp 8.

In Preparation

Chilton P J and Talbot J C (1992). Collector Wells for Small-Scale Irrigation: Construction and Testing of a Well at Tamwa/Sihande/Dhobani Kraals and Further Work at Chiredzi. BGS Technical Report, May 1992.

Kitching R (1992). Collector Wells for Small-Scale Irrigation: Modelling Pumping Tests on a Collector Well at Tamwa/Sihande/Dhobani Kraals. BGS Technical Report, April 1992.

Institute of Hydrology (1992). Development of Small-Scale Irrigation Using Limited Groundwater Resources: Third Interim Report, April 1992.

(b) BGS Visit Reports

Chilton P J. Report on a visit to Malawi and Zimbabwe, October 1988. BGS Report WD/88/19R.

Chilton P J. Report on a visit to Zimbabwe, May/June 1989. BGS Report WD/89/22R.

Chilton P J. Report on a visit to Zimbabwe, April 1990. BGS Report WD/90/13R.

Chilton P J. Report on a visit to Zimbabwe, April 1991. BGS Report WD/91/27R.

MONITORING REPORT: ACTION SUMMARY SHEET

NB This sheet should be kept prominently on file until all recommended action taken or otherwise dealt with. Then to be filed with Monitoring Report as Key Document

Project / Programme	Development of Limited Groundwater Resources for Small-Scale Irrigation.
Name(s) of Monitor(s)	P J Chilton
Date of Monitoring Visit	3 to 14 March 1992

SUMMARY OF RECOMMENDED ACTION IN ORDER OF IMPORTANCE

Recommended Action	Recommended Timing	Action to be Initiated by	Recommendation considered: approved action (if any) taken (initials and date)	See Item
Proposed TC Project to be circulated through Zimbabwe Government system.	Immediately	British High Commission		9