JAPAN INTERNATIONAL COOPERATION AGENCY

THE REPUBLIC OF ZIMBABWE

THE MINISTRY OF LANDS, AGRICULTURE AND WATER DEVELOPMENT

BASIC DESIGN STUDY REPORT

ON

THE RURAL WATER SUPPLY PROJECT (PHASE-Ⅲ)

IN

THE REPUBLIC OF ZIMBABWE

January 1994

SANYU CONSULTANTS INC.

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PREFACE

In response to a request from the Government of the Republic of Zimbabwe, the Government of Japan decided to conduct a basic design study on the Rural Water Supply Project (Phase III) and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent a study team to Zimbabwe headed by Mr. Hiroshi NISHIDA, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs and constituted of members of Sanyu Consultants Inc., from August 24 to September 23, 1993.

The team held discussions with the officials concerned of the Government of Zimbabwe, and conducted a field study in the study area. After the team returned to Japan, further studies were made, and as a result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Zimbabwe for their close cooperation extended to the team.

January, 1994

Kensuke Yanagiya
President
Japan International Cooperation Agency

January, 1994

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

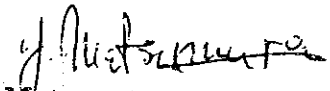
We are pleased to submit to you the basic design study report on the Rural Water Supply Project in the Republic of Zimbabwe.

This study was conducted by Sanyu Consultants Inc., under a contract to JICA, during the period August 13, 1993 to January 28, 1994. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Zimbabwe and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, and the Ministry of Health and Welfare. We would also like to express our gratitude to the officials concerned of the Department of Water Development, the Ministry of Lands, Agriculture and Water Development and the Embassy of Japan in Zimbabwe for their cooperation and assistance throughout our field survey.

Finally, we hope that this report will contribute to further promotion of the project.

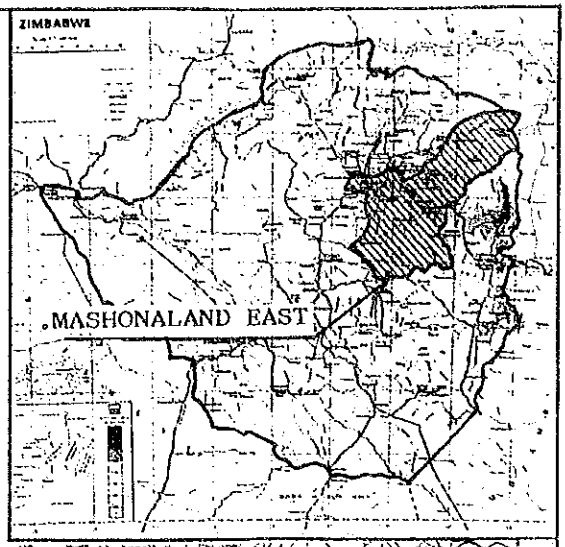
Very truly yours,

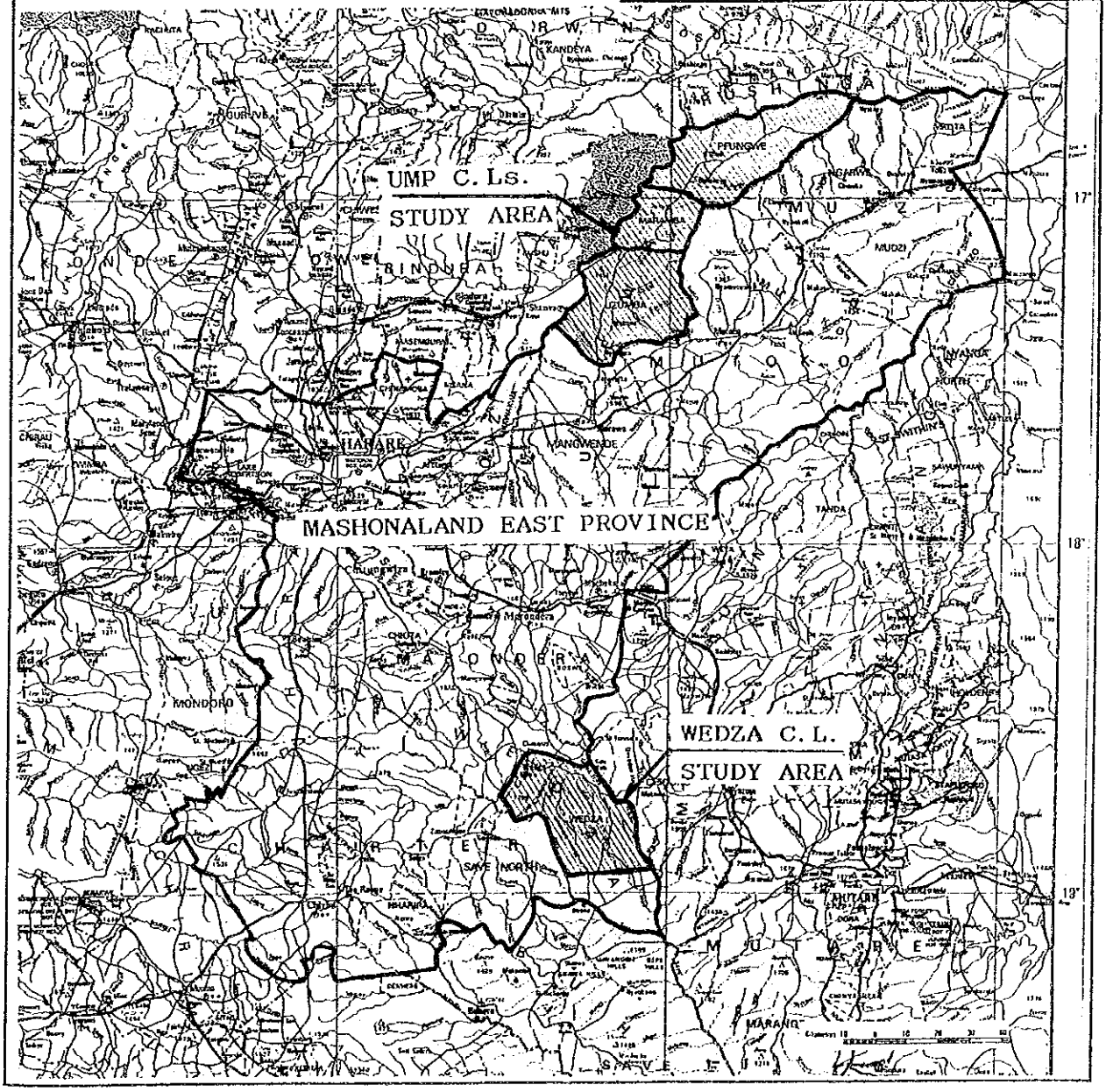


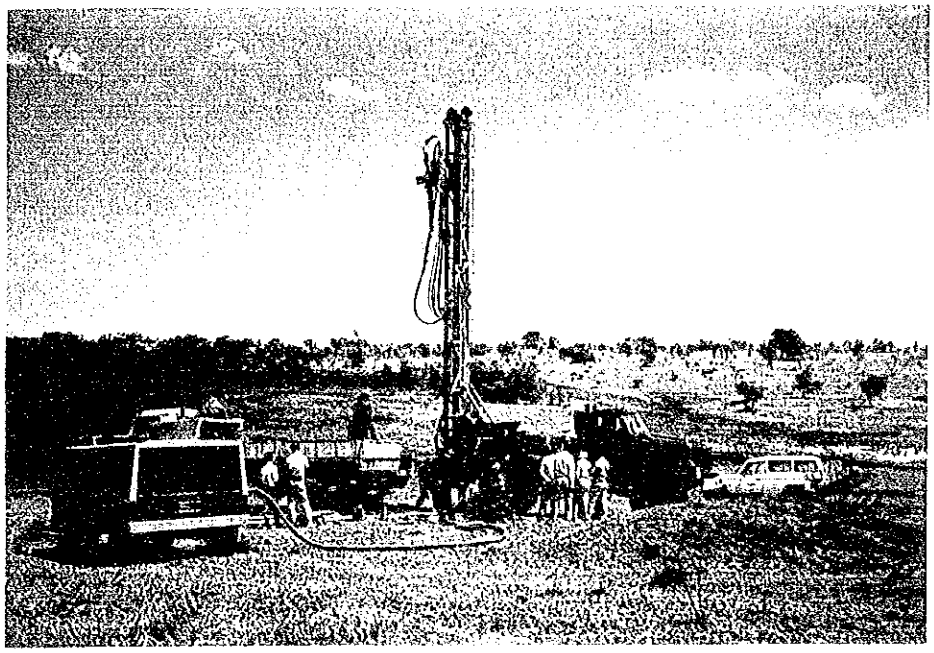
Yoshio Matsumura
Project manager,
Basic design study team on
the Rural Water Supply Project (Phase III)
Sanyu Consultants Inc.

LOCATION MAP OF THE STUDY AREA
FOR
RURAL WATER SUPPLY PROJECT (PHASE-3)

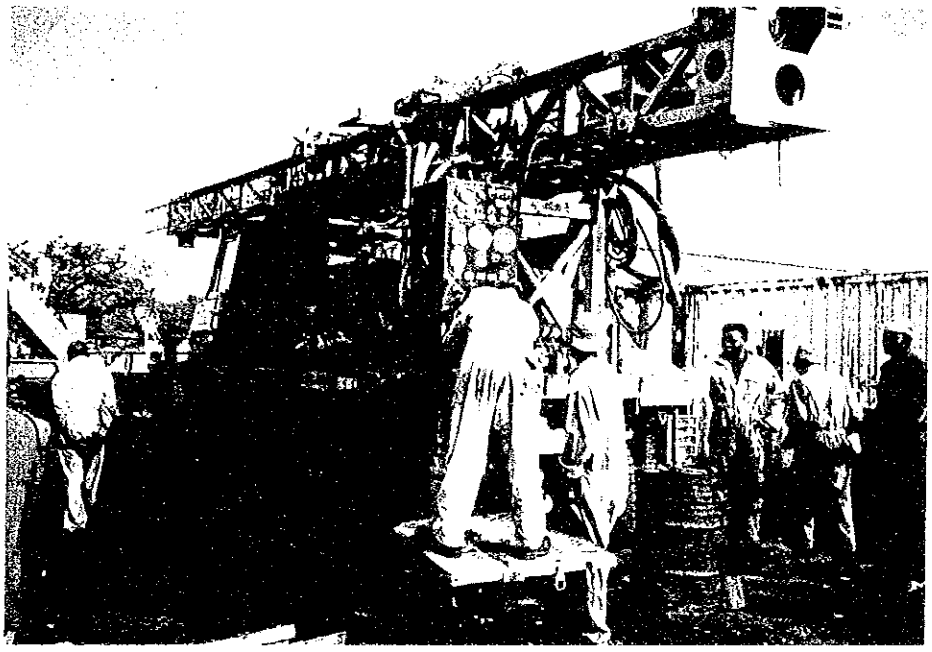
Scale 1:2,000,000



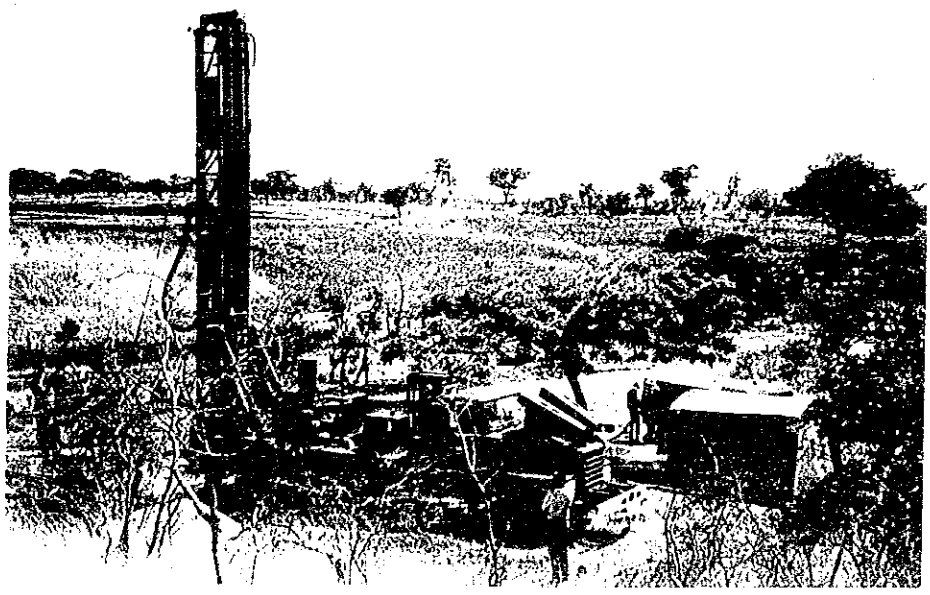




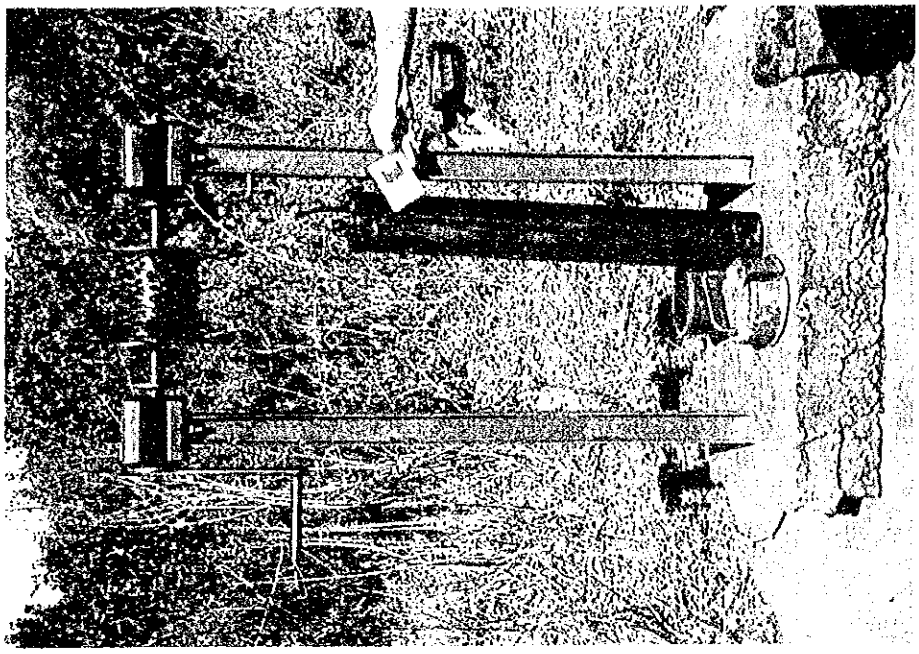
Drilling Rig,
supplied under
Phase-1 Project
(Drilling in Hwedza)



Drilling Rig,
supplied under
Phase-1 Project,
(Under repair at
Harare Workshop)

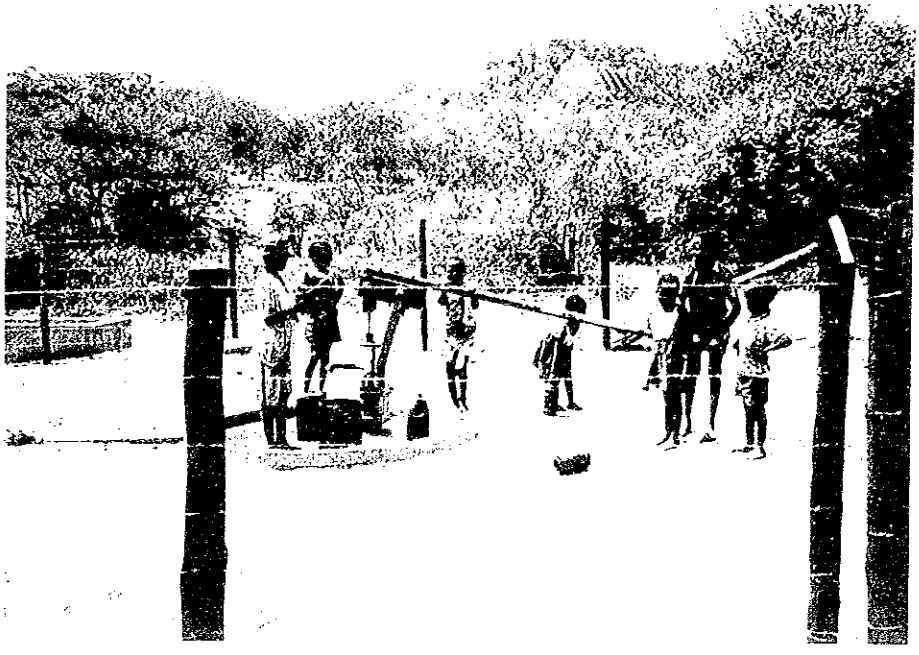


Drilling Rig,
supplied under
Phase-2 Project,
(Drilling in Gokwe)



Shallow Well,
(Equipped with bucket)

Deep Well,
(Equipped with
handpump)



Borehole,
(Equipped with
handpump)

SUMMARY

The Republic of Zimbabwe is situated in southern Africa. Being surrounded by neighbouring countries, this country is landlocked. It has an area of 391,000 km^2, and a population of 10,400,000 according to the Census in 1992. The country is located in the tropical zone; nonetheless, the temperature is moderate and comfortable due to its high elevation. The annual average temperature and precipitation at Harare, the capital, are 25.3°C and 800 mm, respectively. About 70 percent of the population depends upon agriculture for an income.

There are three types of agricultural management; large-scale commercial farming, peasant farming practised in the Communal Lands and small-scale commercial farming conducted in the resettlement areas. Most farmers are engaged in the second type of agriculture for home consumption. Many inhabitants of the Communal Lands have been suffered from water-borne diseases because of using unsafe water from rivers, ponds or shallow wells.

The Government of Zimbabwe completed a study on "The National Master Plan for Rural Water Supply and Sanitation" in 1986 to improve the situation mentioned above. Following the Master Plan, the Government of Zimbabwe formulated the "National Rural Water Supply and Sanitation Programme (NRWSSP)". The NRWSSP is being conducted as the "Integrated Rural Water Supply and Sanitation Project (IRWSSP)" district by district. However, it is difficult for the Government of Zimbabwe to execute the entire project of the IRWSSP by its own budget due to economic circumstances prevailing in Zimbabwe, and the Government of Zimbabwe requested a grant aid cooperation of IRWSSP for UMP, consisting of Uzumba, Maramba and Pfungwe Communal Lands, and Hwedza districts in Mashonaland East Province to the Government of Japan.

As mentioned below, Japanese grant aid cooperation in this field have been extended to the Government of Zimbabwe.

Phase-1 : E/N, 800 million Yen in 1983
Project area, 5 Districts in Midlands Province
Contents, Supply of 2 sets of rigs and supporting equipment, and 81 boreholes construction.

Phase-2 : E/N, 524 million Yen in 1988
Project area, 6 Districts in Midlands Province
Contents, Supply of 1 sets of large rig with supporting equipment, and on-the-job training

The actual situation of rural water supply in the Project area is shown in the following table. As shown in the table, 70 percent of the people, out of the total of 156,300, have no adequate water supply facilities. The main object of the IRWSSP is to provide adequate water supply facilities to those people.

District	Population (Source; 1992 Census)	Numbers		Benefited Population, (rate)	
		Borehole	Deep Well		
UMP	86,302	42	33	15,500	(18%)
Hwedza	69,981	128	0	32,000	(46%)
Total	156,283	170	33	47,500	(30%)

Note; Water Supply Situation as of 1991.

IRWSSP has a construction plan for 432 boreholes and 267 deep wells to improve the rural water supply situation in the Project area. The Japanese side shares responsibility in the term of the supply of equipment and materials for the construction of 400 boreholes and the construction of 40 boreholes which is to be conducted with the aim of the on-the-job training.

The Project area is mainly composed of pre-cambrian granites and gneisses which are extensive in Zimbabwe. The hydrogeological conditions in the area can be summarized as follows;

UMP District : From the hydrogeological point of view, over 80 percent of the area can be classified as having a groundwater yield lower than 50 m^3/day, and is composed of granites, gneisses and metavolcanics/metasediments. The aquifers of this area are mainly formed by the weathered zone. The other area is composed of greenstone and grey gneiss complex and yields 100 ~ 250 m^3/day.

According to the existing borehole data, the occurrence rate of boreholes with low yields of less than 0.5 m^3/hr is 17 percent. In addition to the above, the groundwater in this area has a water quality problem in terms of the salt content.

Hwedza District: The hydrogeological characteristics are almost the same as UMP District. Over 80 percent of the area is classified as having a groundwater yield lower than 50 m^3/day, and is composed of granites and gneisses. The aquifer of this area is also mainly formed by the weathered zone. The other area is composed of greenstone and grey gneiss complex and yields 100 ~ 250 m^3/day.

According to the existing borehole data, the occurrence rate of boreholes with low yields of less than 0.5 m^3/hr is 26 percent, and in the case of less than 1.0 m^3/hr it comes over 30 percent. However, the groundwater in this area has few water quality problems regarding the salt content.

The executing agency responsible for the project is the Department of Water Development (DWD), the Ministry of Lands, Agriculture and Water Development (MLAWD). DWD formerly belonged to the Ministry of Energy and Water Resources and Development (MEWRD), and was recently reorganized in the MLAWD. This reorganization has been effected involving the entire DWD, without changing the responsibilities and organization of the DWD from the previous ones.

DWD is executing the borehole construction at an annual rate of 1,000. DWD has a few problems concerning the absolute numbers of well-trained operators. However, the DWD is well organized and carries out satisfactorily their jobs for geophysical prospecting, drilling, maintenance of equipment and so forth. Consequently, the DWD has no problems regarding the execution of the Project.

DWD shall be responsible for the following Project implementation;

- To select the sites for 400 boreholes with alternatives through pre-siting works involving users.
- To secure the required numbers of Zimbabwean personnel to attend the on-the-job training and to bear all expenses for them.
- To execute the construction of boreholes, using the equipment and materials supplied under this Project, other than those to be executed by the Japanese side.
- To secure the necessary numbers of Zimbabwean personnel for the execution of the above construction and to procure the equipment and materials necessary for the Project execution and bear all expenses other than those to be borne by the Japanese grant aid.

The Japanese side is to be responsible for the following Project implementation;

- To procure the following equipment and materials necessary for the construction of 400 boreholes with depth of 30 to 70 m.

(1)	Truck-mounted drilling rig with necessary accessories and tools	2 units
(2)	Air-compressor for the above	2 units
(3)	Supporting vehicles	11 units
(4)	Geophysical equipment	2 lots
(5)	Borehole test equipment	2 lots
(6)	Radio-telephone systems	2 lots
(7)	Mobile workshop with equipment and tools	2 lots

(8) Submersible-motor pump with generator	3	units
(9) Casing materials	1	lot
(10) Drilling agents	1	lot
(11) Spare parts for the above	1	lot
(12) Others		

- To execute the borehole construction works, using the equipment and materials supplied under this Project, equivalent of 40 successful boreholes with 50 m depth on an average for the purpose of on-the-job training.

  However, the execution of borehole tests and headworks construction will be carried out by the DWD, except for the supply of materials and fuel required for the tests and construction.
- To conduct on-the-job training for techniques on geophysical prospecting, borehole drilling and maintenance of equipment.
- To hand-over the used equipment in good working condition and the remaining materials.

The Project implementation cost to be borne by the Zimbabwean side is estimated at approximately Z$13.8 million.

The Project implementation schedule is divided into two stages; the first is for the procurement of equipment and materials and the second is for the actual construction works.

The maintenance responsibility for the completed boreholes of the Project will be shifted to the users from the DDF under supervision of the Government. It is considered that this shift will be successfully made due to the capabilities of the Government and user's past performance in this regard.

It should be firstly pointed out that a direct benefit of the Project will be safe water supply to 100,000 people, in total. Furthermore, after completion of the Project, many more people will benefit from another IRWSSP to be executed by the Government of Zimbabwe using the equipment supplied under the Project.

The operation techniques of the equipment to be supplied under the Project are essentially similar to that of equipment which was supplied under the past Phase-1 and Phase-2 Projects. Further, the number of capable DWD operators will be increased through the on-the-job training executed under the Project, for the execution of the IRWSSP in future.

Regarding the objective and effectiveness of the Project, as well as the ability, capacity and technical levels of the DWD, it is concluded that the grant aid cooperation for the Project is justifiable and appropriate.

Basic Design Report (Phase III)
on the Rural Water Supply Project
in the Republic of Zimbabwe

CONTENTS

Appendices:

LIST OF ABBREVIATIONS

Agritex	Department of Agricultural Technical Extension (MLAWD)
DANIDA	Danish International Development Agency
DDF	District Development Fund (MLGRUD)
DWD	Department of Water Development (MLAWD)
EC	European Community
GTZ	German Technical Cooperation Agency
GOZ	Government of Zimbabwe
IRWSSP	Integrated Rural Water Supply and Sanitation Project
JICA	Japan International Cooperation Agency
KFW	German Development Bank
MOHCW	Ministry of Health and Child Welfare
MLAWD	Ministry of Lands, Agriculture and Water Development
MLGRUD	Ministry of Local Government, Rural and Urban Development
MOF	Ministry of Finance
NAC	National Action Committee for Rural Water Supply and Sanitation
NCU	National Coordination Unit for Rural Water Supply and Sanitation
NEPC	National Economic Planning Committee
NGO	Non-Governmental Organization
NORAD	Norwegian Agency for Development Cooperation
NRWSSP	National Rural Water Supply and Sanitation Programme
ODA	Overseas Development Agency (Great Britain)
SIDA	Swedish International Development Authority
Unicef	United Nations International Children's Emergency Fund

CHAPTER 1. INTRODUCTION

The water supply situation in the Republic of Zimbabwe is much poorer in the Communal Lands than in the cities. The former have a low percentage of pipe-supplied safe water, whereas the latter enjoy safe domestic water supply. Many inhabitants of the Communal Lands are using unsafe water from rainfall, rivers, lakes, or ponds.

To improve the above situation in the rural areas, the Government of Zimbabwe carried out the "National Master Plan for Rural Water Supply and Sanitation" (hereinafter referred to as "The Master Plan") in 1982 based upon "The International Drinking Water Supply and Sanitation Decade" launched by the United Nations in 1980, and completed in 1986. Following the Master Plan, the Government of Zimbabwe formulated and launched the "National Rural Water Supply and Sanitation Programme" (hereinafter referred to as "NRWSSP").

The Government of Zimbabwe requested a grant aid for rural water supply project in UMP and Hwedza Districts in Mashonaland East Province in 1992, as a part of NRWSSP.

The Government of Japan decided to conduct a basic design study for the Project (Phase III), after examination of the request. In response to this decision, the Japan International Cooperation Agency (hereinafter referred to as "JICA") sent a study team to Zimbabwe headed by Mr. Hiroshi NISHIDA, Grant Aid Division, Ministry of Foreign Affairs from August 24 to September 23, 1993.

The study team had a series of discussions with the officials concerned from the Department of Water Development (DWD), the Ministry of Lands, Agriculture and Water Development (MLAWD), the executing agency of the Government of Zimbabwe, and conducted a field survey in the Project Area. The results of the discussions between the DWD and the study team were summarized in the Minutes of Discussions signed on September 1, 1993 by the representatives of both parties.

The member list of the study team, its field survey itinerary, a list of Officials contacted by the team, a copy of the Minutes of Discussions, etc. are herein attached as Appendices.

Based upon this survey, the study team has carried out, since their return to Japan, an examination of the effectiveness of the Project, design of the water supply facilities, selection of the equipment and materials, a rough estimate of the Project costs and so forth. This report describes the most effective plan for the Project implementation.

CHAPTER 2. BACKGROUND OF THE PROJECT

2-1 GENERAL CONDITIONS IN ZIMBABWE

(1) General

The Republic of Zimbabwe is situated in southern Africa at 20 degrees south latitude and 30 degrees east longitude, and has a total land area of 390,757 km^2 and a total population of 10.4 million by the census carried out in 1992. Being surrounded by four neighboring countries, Zimbabwe is landlocked. Most of the land lies on a plateau higher than 500 m above sea level. The major cities like Harare, the capital, Bulawayo, and Mutare, etc., lie on the central high plateau. The country is located in the tropical zone, however, the temperature of the country is moderate due to the high elevation. The annual average temperature at Harare is 25.3 °C and the annual average precipitation is about 800 mm.

The country gained independence in 1980. It has a comparatively good economic infrastructure compared with other African countries, taking into consideration the progress of neighboring countries.

The population of the country was 7.61 million according to the 1982 census, so its population growth rate has been 3.13 percent during the last 10 years up to 1992.

(2) Economy and Industry

About 70 percent of the country's population is dependent on agricultural income. Three types of agricultural management have been developed; the large scale commercial farming, peasant forming practiced in the Communal Lands, and small scale commercial farming conducted in the resettlement areas. Most farmers are engaged in the second type of agriculture for home consumption.

The country's GDP, GNP per capita, and the domestic production at factor cost by industry are given in Appendix 6. (1). The major industries of the country

are manufacturing, agriculture/forestry, and mining/quarrying, sharing 26%, 13% and 8%, respectively. The per capita GDP at 1980 prices is 529 Z$ (850 US$).

(3) Assistance Tendency

The Government of Zimbabwe made a "Framework for Economic Reform (1991 - 95)" in 1991 aimed at sustaining higher growth and reducing poverty. This Framework shows that the country needs an external financing requirement amounting to US$690 million per annum as shown in Appendix 6. (2).

2-2 OUTLINE OF THE RURAL WATER SUPPLY PROJECT

Following the Decade inaugurated by the United Nations in 1980, the Government of Zimbabwe decided to prepare its Master Plan for the above decade in 1982. Under the assistance of the Norwegian Agency for International Development (NORAD), the contract for the Master Plan Study was made in July, 1983, with NORAD's Consultant.

The Master Plan's draft report was completed its in 1985 and the final report submitted to Zimbabwe in 1986.

The major policy shown in the Master Plan for the Rural Water Supply can be summarized as follows:

(1) Programme

By the target year of 2005, a total of 576 pipe-supplied water facilities and about 36,000 point-water sources are to be completed. The benefited population from the above water sources are estimated at about 36,000 from the pipe-supplied water facilities and 8.6 million from the point-water sources.

(2) Maintenance of Point-Water Sources

The maintenance of point-water sources is being carried out, at this time, by the DDF, Ministry of Local Government. The Master Plan recommends to shift the maintenance system from the DDF to the users as mentioned below: This recommendation is to be executed in the near future by the Government of Zimbabwe.

- To prepare a responsible person for the each pump and trained pump-minders in every village.
- To share the cost of pump-minders, Ward by Ward, and a pump minder is to be incharge of a maximum 50 pumps and training of a responsible person assigned to the each pump.

- To monitor the pump conditions, on a District by District basis, and to assist the pump-minders when required.

(3) Schedule to be Completed

The programme is divided into three phases;

- Short-term (1985 - 1990), Medium-term (1985 - 1995) and Long-term (1985 - 2005) Phases.

The target numbers of point-water sources are as follows;

- Short-term, 6,900 (900 for Mashonaland East Province)
- Medium-term, 15,500 (1,800 for the above)
- Long-term, 36,000 (4,000 for the above)

(4) Water Demand

The planned water demands are as follows;

- Individual Connections: 60 ℓ/cd (liters/capita/day)
- Communal Taps : 25 or 40 ℓ/cd (depend on walking distance)
- Boreholes : 30 ℓ/cd (250 persons/borehole)
- Deep Wells : 20 ℓ/cd (originally 30 ℓ/cd, 150 persons/well)

2-3 OUTLINE OF THE RELATED PROJECTS

(1) National Development Plan

The Government of Zimbabwe is executing its Second Five-Year National Development Plan (1991 - 1995) which has three main Development Strategy mentioned below:

- increasing the rate of savings and channeling them into productive investment
- achieving expansion in trade
- encouraging the operation of market forces

To achieve the above target, a public investment programme has been decided upon as shown in the following table. It is clear from the table that sectors for transport and communication, agriculture and energy & water have big shares compared with others.

FIVE-YEAR PUBLIC SECTOR INVESTMENT PROGRAMME

BY INDUSTRIAL SECTOR 1991/92 - 1995/96

(Z$ Million)

Sector	Budget 91/92	Five-Year Budget 91/92 - 95/96	Share (%)
1. Agriculture	427	2,702	22.1
2. Mining	10	100	0.8
3. Manufacturing	10	265	2.2
4. Energy & Water	405	2,355	19.2
5. Transport & Communic.	634	3,294	26.9
6. Housing & Urban Dev.	368	1,333	10.8
7. Education	100	790	6.4
8. Health	48	418	3.4
9. Public Administ.	90	265	2.2
10. Defense	178	378	3.1
11. Other Sectors	182	352	2.9
Total	2,452	12,252	100.0

(2) Development Plan in the Project Area

The development strategy for Mashonaland East Province, where the Project Area is located, is aiming to develop agriculture in the communal areas,

manufacturing industries in small and medium sized towns, and mining, considering the socio-economic level in the Province.

2-4 DETAILS OF THE REQUEST

(1) Background

About half of the population, out of a total 10.4 million in Zimbabwe, live in Communal Lands, many inhabitants are usually affected by water-related diseases such as hepatitis and some kind of diarrhea due to difficulty in obtaining safe water.

To deal with the above situation, the Government of Zimbabwe drew up the Master Plan and is executing the projects to improve the above situation.

This project aims to contribute to the above mentioned national effort. The Japanese Government extended grant aid in 1983 and 1988, amount of E/N: 800 million yen for Phase-1, 524 million yen for Phase-2 Project. Afterwards, a serious draught attacked southern Africa in 1991 and 1992. It is reported that 44 percent of deep wells and 20 percent of boreholes dried up or had reduced yield during the draught seasons. International assistance, including the World Bank, started an urgent draught recovery programme in 1992 and planned to construct many facilities in this water sector.

The Government of Zimbabwe requested grant aid from the Japanese Government, after formulation of the 400 boreholes Project in UMP and Hwedza Districts in Mashonaland East Province where the situation in most serious.

(2) Text of the Request

The text of the original request was the procurement of the equipment and materials mentioned below and dispatch of three experts on siting, drilling and mechanical maintenance for six months each. This original request has been amended after discussions with the study team. The final request by the

Government of Zimbabwe is shown in Table 4-3-2 and the Minutes of Discussions attached in Appendix.

ORIGINAL REQUEST ITEMS

(1)	truck-mounted top-head-drive rotary drilling rig;	2 units
(2)	standard accessories and tools for the above;	2 lots
(3)	high-pressure air-compressor;	2 units
(4)	cargo truck with 4-ton crane (4 × 4);	4 units
(5)	water lorry, 5,500 lit. capacity;	2 units
(6)	pick-up truck (4 × 4);	2 units
(7)	station wagon (4 × 4);	2 units
(8)	geophysical equipment;	2 lots
(9)	borehole test equipment;	2 lots
(10)	radio telephone system;	2 lots
(11)	trailor-mounted mobile workshop with necessary equipment and tools	1 lot
(12)	handpumps	250 units
(13)	submersible-motor pump with generator;	4 units
(14)	spare parts for the above equipment good enough for 3 years operation	2 lots
(15)	casing and screen for 400 boreholes	1 lot
(16)	drilling agent;	1 lot

2-5 WATER SUPPLY SITUATION IN THE PROJECT AREA AND INTERNATIONAL COOPERATION

In the Project Area, there are/was the following three projects on rural water supply:

- Draught Relief Programme by the Government of Zimbabwe
- Emergency Draught Recovery and Mitigation Project by a World Bank Loan
- Integrated Rural Water Supply and Sanitation Project (IRWSSP)

The outlines of the above projects are shown below;

(1) Draught Relief Programme by the Government of Zimbabwe

This project was carried out to fill in the time gap between the second and third projects with the Government's own budget. However, it has not been clarified by the team that Unicef and/or other organization(s) assisted the project or not. It is assumed that many sources of budget were gathered to execute this urgent programme, though the main source of budget was provided by the Government of Zimbabwe.

(2) Emergency Draught Recovery and Mitigation Project

This project for the water supply launched in September 1993. The numbers of boreholes allocated are 150 for each Province, amounting to a total of 1,200 in Zimbabwe as a whole.

The proposed number of borehole in the Project area is 15 in UMP and 20 in Hwedza. The allocated budget for the project is shown below, which is equivalent US$8,330.- per borehole.

- for siting and supervising : US$2,000,000.-
- for construction works : US$8,000,000.-

The total amount allocated to the water-related section is US$31,600,000.- and breakdown of the allocation is shown in the attached Appendix-6, (3). The item No.19 is the budget to procure the spare parts and tools for the equipments, mainly drilling rigs, supplied under Phase-1 of the Project.

(3) IRWSSP

This is the project programmed by the NRWSSP, and started in July 1987, assisted by NORAD. The IRWSSP's target is to provide one shallow well unit, (shallow well unit: one unit to one shallow well, three units to one deep well and five units to one borehole), for every fifty (50) persons. The IRWSSP were already completed in five districts out of the 57 districts in Zimbabwe, and 27 IRWSSPs are now under going with a completion target of 4 - 5 years. The financing for IRWSSP is drawn from a number of sources, both external and internal and can be summarized as follows: The Project Area is divided by financing source and no competitive area is recognized.

- NORAD : 9 Districts in 6 Provinces
- Dutch : 8 Districts in 7 Provinces
- DANIDA : 3 Districts in 3 Provinces
- JICA : 2 Districts in 1 Province
- KFW : 2 Districts in 1 Province
- GOZ : 1 District in1 Province
- NGOs and co-funded by GOZ : 2 Districts in 2 Provinces

(4) Progress in the Project Area

The progress and schedule of the IRWSSP in the Project Area is shown in Table 2-5-1. The total number of boreholes to be constructed is 309 in UMP and 123 in Hwedza, totally 432 in the whole area. The progress as of the end of August 1993 is also given in the same table, and the schedule of Hwedza is almost completed. The equipment used for Hwedza is planned to be moved to UMP, so it is expected that the schedule of UMP for 1993 will also be completed within 1993 fiscal year.

TABLE 2-5-1 RURAL WATER SUPPLY SITUATION AND SUMMARY OF IRWSSP

Existing Facilities and Programme

UMP District:

	Existing	Drought		Programme		
	No. 1991	P. (GOZ)	Total	World B.	IRWSSP	Total
Borehole	42	9	51	15	309	375
Deep Well	33	0	33	0	182	215
Shallow Well	99	0	99	0	0	99

Hwedza District:

	Existing	Drought		Programme		
	No. 1991	P. (GOZ)	Total	World B.	IRWSSP	Total
Borehole	128	11	139	20	123	282
Deep Well	0	0	0	0	85	85
Shallow Well	143	0	143	0	0	143

Summary of IRWSSP

UMP District: as of end of August 1993:

	92/93	93/94	94/95	95/96	96/97	Total	
						No.	(%)
Borehole;							
No. programmed	(40)	(60)	(69)	(70)	(70)	(309)	
No. completed	21	2 (60)	-	-	-	23	7.4
Deep Well;							
No. programmed	(25)	(35)	(41)	(41)	(40)	(182)	-
No. completed	11	-	-	-	-	11	6.0

Hwedza District: as of end of August 1993:

	92/93	93/94	94/95	95/96	Total	
					No.	(%)
Borehole;						
No. programmed	(30)	(31)	(31)	(31)	(123)	-
No. completed	30	30 (31)	-	-	60	48.8
Deep Well;						
No. programmed	(15)	(20)	(25)	(25)	(85)	-
No. completed	13	0	-	-	13	15.3

2-6 CONTENTS OF PAST COOPERATION AND PRESENT CONDITIONS OF EQUIPMENT

(1) Contents of Past Cooperation

The Japanese Government, as mentioned in Section 2 - 4: Details of the Request, extended the cooperation shown below for the sector of Rural Water Supply Project. These Projects were resulted in success and equipment supplied for the Projects have been satisfactorily operated by the DWD.

TABLE 2-6-1 PAST JAPANESE GRANT AND PROJECTS

Phase - 1 : E/N, amount of 800 million Japanese yen, 1983
Project Area, 5 Districts in Midlands Province
Supply of 2 sets of rigs and supporting equipment, and borehole construction of 81

Phase - 2 : E/N, amount of 524 million Japanese yen, 1988
Project Area, 6 Districts in Midlands Province
Supply of 1 set of large rig with supporting equipment, and on-the-job training

(2) Present Conditions of Equipment Supplied under Past Projects

The study team conducted a field inspection to confirm present conditions of Equipment supplied under past Projects. The team has confirmed that three of the rigs have been properly and satisfactorily maintained and operated by the DWD as shown below.

a) Equipment for Phase-1 Project:

According to DWD staff, this equipment, supplied almost ten years ago, are still in good working conditions. The team inspected one set of equipment in Hwedza and confirmed that it is satisfactorily working even though it has some defects due to its age. Other equipment is under repair and will be scheduled to be

transported to UMP. Based on the inspection, it is considered that those equipment are to be maintained in good condition by the DWD.

b) Equipment for Phase-2 Project:

This equipment is mainly composed of large machines. The team confirmed that it is satisfactorily working in Gokuwe District where the project area of Phase-2 is situated. The drilling rig shows 7,800 km in running distance and 6,600 hours in rig operation. According to the information from the DWD, the performance of the rig is about 30 boreholes per annum with average depths of 150 - 250 m.

CHAPTER 3. OUTLINE OF THE PROJECT AREA

The Project Area comprises both UMP and Hwedza Districts in Mashonaland Province. Both locations, however in the same Province, are far from each other, the former being located in the northern margin, and the latter in the southern margin of the Province. Due to the above locations, the socio-economic, geographical and geological conditions are rather different. Both locations are shown in the "Project Location Map" and Figure 3-3-1 and 3-3-2. The outlines of the Project Areas are shown below.

3 - 1 LOCATION, NATURE AND SOCIO-ECONOMIC CONDITIONS

3 - 1 - 1 Location and Socio-economic Conditions

(1) UMP District

UMP District is derived from the first letters of three Communal Lands, Uzumba C.L. in the southern part, Maramba C.L. in the middle part and Pfungwe C.L. in the northern part of the District and the three composed of UMP/ ZVATAIDA District.

This area is located about 130 km northeast from Harare, the capital, and between latitudes 16° - 40' and 17° - 25' south, and longitudes 31° - 40' and 32° - 35' east. Access to the area is rather good from Harare to Mutawatawa, the district capital, with about three hours driving on good paved road. However, after Mutawatawa the road is unpaved gravel and it takes another two hours from Mutawatawa to the northern extreme of the area.

According to the 1992 census the population of this district is 86,302 with 17,507 households and a population density of 32 persons/km^2.

The major industries in the area are agriculture and stockfarming. The landscape, however, is mostly hilly while usable land for cultivation covers only

about 35 percent of the area. The climate in the area is also unfavorable for agriculture, that is relatively hotter and much dryer than the high-veld around Harare. Furthermore, production is strongly affected by rainfall due to poor irrigation facilities. According to recent statistics, production during draught years is less than one-tenth of normal years.

Thus, the economic situation of the area is both poor and unstable due to the unfavorable climate and current agricultural conditions. And the general infrastructure in the area is also lagging compared to the other average areas, which is influenced by its remote location from the administrative center.

(2) Hwedza District

Hwedza town, the district capital, is about 140 km from Harare, situated in the northern part of the district. The district extends between latitudes 18° - 35' and 18° - 55' south, longitudes 31° - 30' and 32° - 00' east. Access condition from Harare is easier than to UMP, being about two hours driving by good paved road. Road conditions from Harare and crossing the district from south to north are good, so it is accessible within one more hour's driving from Hwedza to the southern end of the district.

Both north and south parts of the district are predominantly flat and utilized as cultivated or stockfarming areas. These areas are proposed resettlement areas and a resettlement programme is on going. The Project Area in the Communal Lands excludes the resettlement areas.

According to the census in 1992, the population in this district is 69,981 with 14,579 households and a population density of 64 persons/km^2.

The major activities in the area are agriculture and stockfarming. Usable land for cultivation covers about 40 percent of the area but only half of the area, about 200 km^2, is actually utilized. Besides this, the agriculture system is, the same as in UMP, strongly affected by rainfall. The maize production during the draught year of 1992 was reduced by about one-tenth of normal years.

The infrastructure in the Hwedza District is better than that of UMP District. There are facilities, though limited, of piped-water supply systems and irrigation systems in the major villages.

3-1-2 Hydrology

The distribution map of the annual rainfall in Zimbabwe is shown in Figure 3-1-1. The area between Harare and the border with Mozambique has annual rainfall of more than 800 mm. The rainfall in the Project Area ranges between 600 - 800 mm, with less than 600 mm in the northern part of Pfungwe C. L. The rainfall and surface run-off gauging stations in/around the Project Area are also shown in Figure 3-1-1. The observation results are shown in Figure 3-1-2, and summarized as follows:

a) UMP District

The rainfall data is taken at Murewa station neighboring Maramba C. L., and the run-off data is obtained at Singesi river station, on a tributary of the Nyadire river. The mean rainfall, as shown in Figure 3-1-2, is 890 mm and the mean run-off is 170 mm. Thus, 19 percent of the rainfall flows into the river.

The center of the Project Area is situated about 100 km north apart from the gauging station, so it ca be estimated that mean rainfall in the Project Area is around 700 mm. However, mean rainfall in the northern part of the District is less than 600 mm and the vegetation, as a result, changes to a semi-arid type.

b) Hwedza District

The mean rainfall is 790 mm and the mean run-off obtained at Save river station is 140 mm. From these data, the run-off rate in the District is calculated as 17 percent. Hwedza District has a slightly

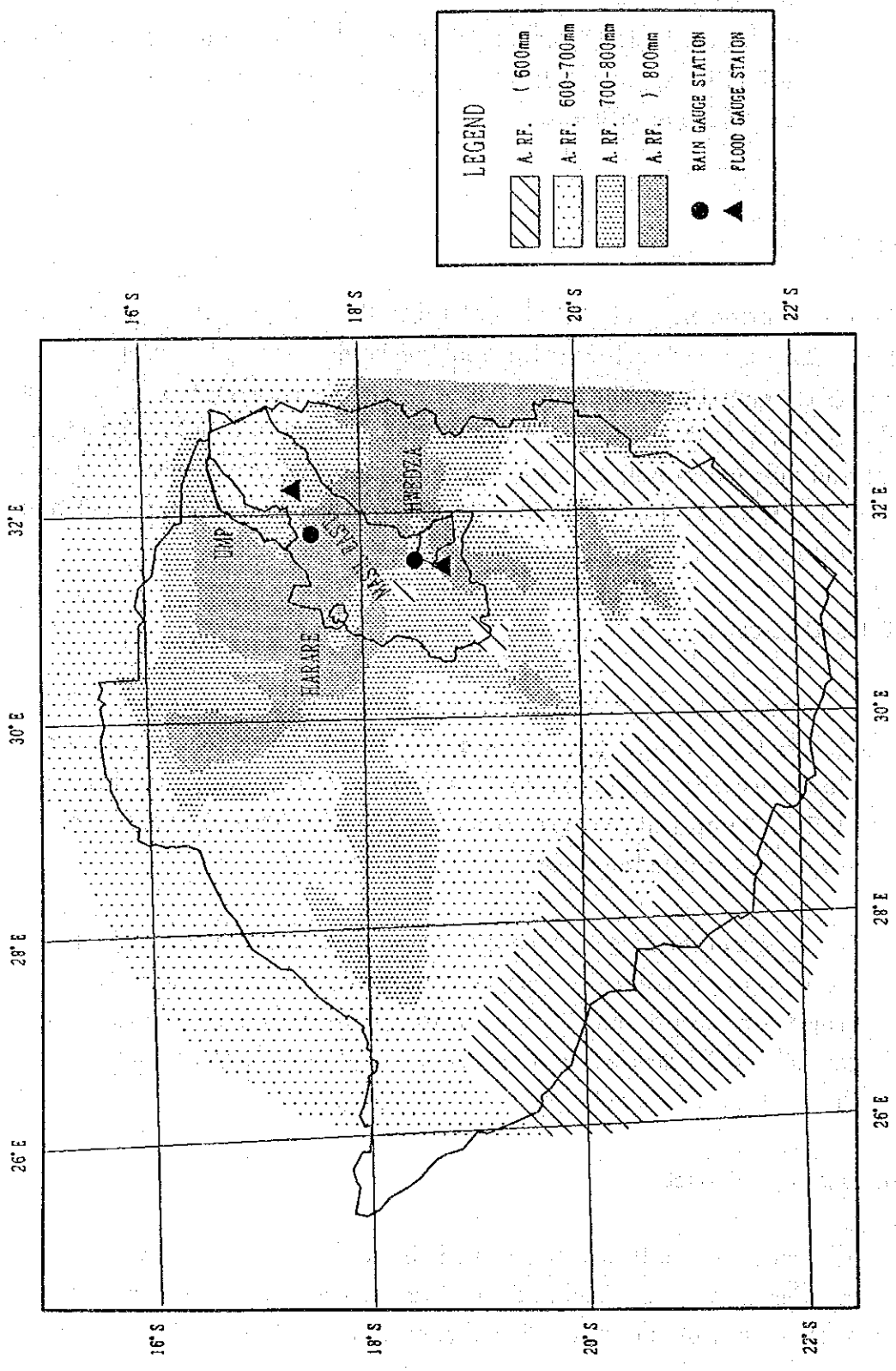


Figure 3-1-1 Distribution of Annual Rainfall in Zimbabwe

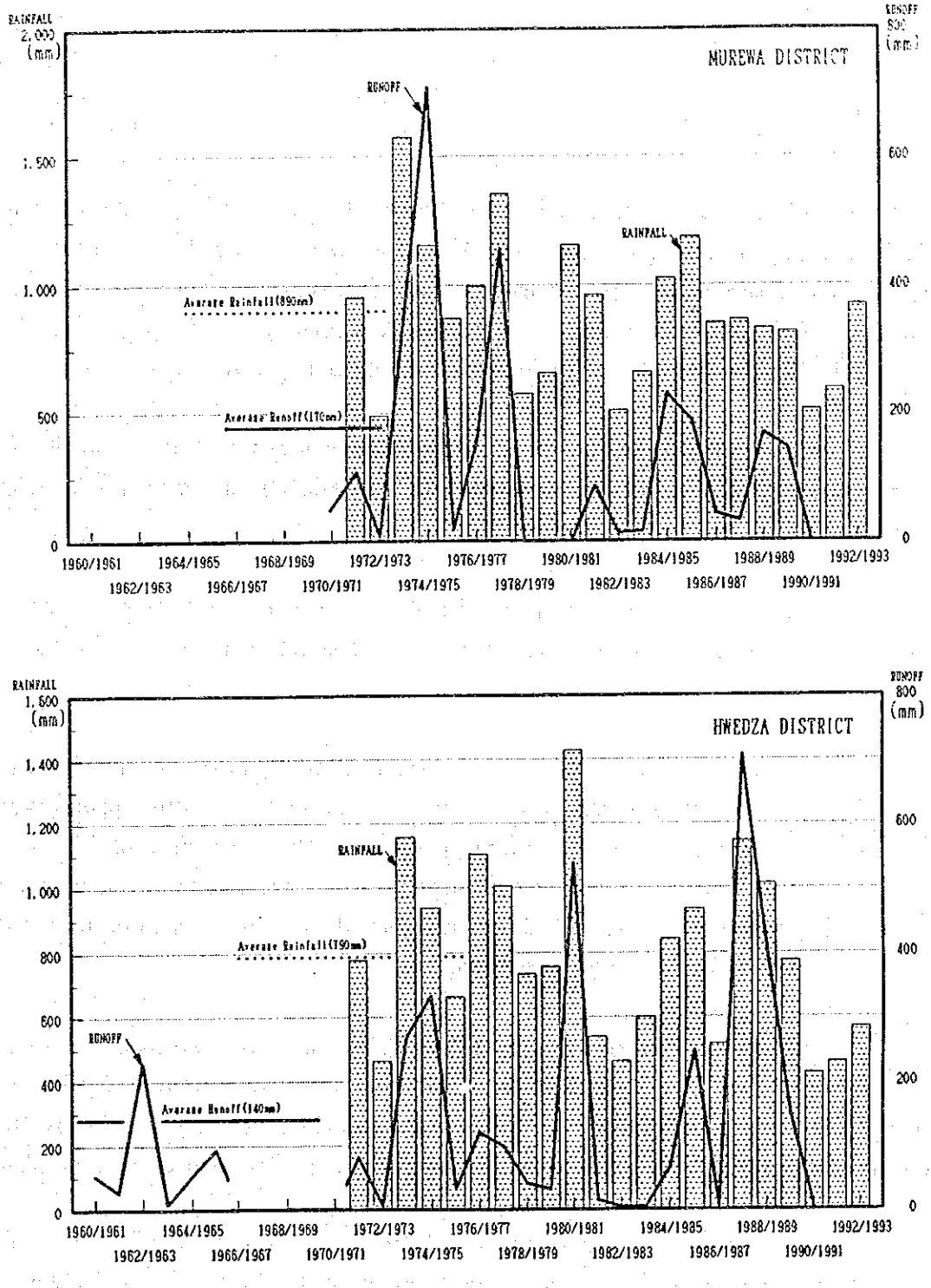


Figure 3-1-2 Rainfall and Run-off in the Project Area

heavier rainfall and therefore has thicker vegetation compared with UMP District.

3 - 1 - 3 Social Conditions

The UMP District is situated on the boundary between Mashonaland East and Mashonaland Central Province, and the district has been incorporated and reorganized from the above two provinces. Infrastructure in the district is inadequate, especially in the remote area of the northern part of Pfungwe C. L. It can be aid that the provision of infrastructure has yet to begin in this section.

A paved road from Harare and Murewa reaches Mutawatawa, however in the northern part of Mutawatawa no paved road is available and the road density is very low.

No telephone service is available in Mutawatawa, the district capital, so communication between the Provincial Office and District Office rely upon the use of radio.

Piped-water supply systems from groundwater sources are found in Mutawatawa and Manyika town, and a new Government supplied piped-water system for Mutawatawa is nearing to completion, with a capacity of 30 ton/hr. Point-water sources for the rural water supply are inadequate. There are 42 boreholes and 33 deep wells, as of 1991. The population served by adequate water sources is estimated to be about 20 percent only.

And also, the infrastructure in Hwedza District is inadequate, however, a major road penetrates the district from north to south and road density is better than UMP District. A telephone system is provided along the major road, so there are communications by telephone between the Provincial Office and District Office.

The piped-water supply systems fed by groundwater sources are located in/around Hwedza town and several major villages, so it is better than UMP at this Point. Concerning the point-water sources for rural water supply, there are 128

boreholes, as of 1991, and the population benefiting from the adequate water sources is estimated to be about 50 percent which is equivalent to more than double the rate in UMP District.

3 - 2 TOPOGRAPHY AND GEOLOGY

a) UMP District:

UMP District is an area with a long and narrow shape and the north and south sides are bordered by the Mazoe river and the Nyadire river. The district is 110 km long in a NE-SW direction and 30 km wide in a NW-SE direction, and the altitude decreases towards the North. The highest part of the District is situated in the Southeast, which is about 1,200 m in height. However, toward the Northeast, the altitude falls to as low as 500 m especially at the northeastern end. As the altitude becomes less, the climate, which influences the flora transition, becomes drier.

In the lowest part of Pfungwe, the thick forest disappears and the vegetation becomes sparse with trees in so called "open wood-land". It is commonly mixed with baobab trees and is classified as a significant type of dry area. In terms of vegetation, the groundwater resources are supposed to be poor in the area.

Topographic properties such as slopes and undulation, which, in some places are superimposed by the geological structures, is generally correlative with the geological units and their distribution. The land type, by this relation to geologic structure, is classified into three typographical units.

They are of (1) Southern Granitic Area, (2) Middle Schist Area, (3) Northern Gneissose Area and are Summarized in Table 3-2-1.

There are two major rivers, the Mazowe and the Nyadire. The Mazowe river runs along the southern edge of the District, while the Nyadire river flows down the northern boundary. The catchment area of the Nyadire river is rather small, so the stream often dries up, whereas the Mazowe river is perennial. However, the Mazowe river has also dried up, even a part of the mainstream as well as distributaries during

periods of prolonged drought. The geologic structural control, which is common in the topographical unit of (1), is also identifical on the topographic relief. The structural valleys, ordinary seen as the linear valley and aligning on the fault and dyke of dolerite, are also found out in this area.

TABLE 3-2-1 MAJOR GEOLOGIC FORMATION AND TOPOGRAPHIC PROPERTIES IN UMP DISTRICT

Topographic Classification	Area	Major Geology	Area
(1) Southern Granitic Area	UZUMBA C. L., South of MARAMBA C. L.	Granites	Granitic large dwals surrounded by flat sandy plain, relative elevation between hill and plain with about 200 m H.
(2) Middle Schistose Area	North of UZUMBA C. L., MARAMBA C. L.	Schists	Mountainous and hilly area, razor-back ridges of schistose rocks with steep sides, relative elevation between peak and plain is 200 - 400 m.
(3) Northern Gnissose Area	South of MARAMBA C. L., PFUNGWE C. L.	Gneiss	Relatively gentle to moderate rolling terrain with dissected shallow valley, small scaled undulation with 100 m relative height

b) Hwedza District

The Hwedza District is bordered on the West by the Save river and in the East by the Ruzawi river. The altitude of Hwedza town, district capital, is approximately 1,400 m. Some of the downstream area is below 900 m. However the conspicuous difference and floral change between high and low altitudes, are not as clear as in UMP. There are thus few baobab trees in the southern part of the plain. The topographic features, are similar to those of UMP District, and seem to be closely relate to the geological formations and their distribution. On the whole, the area covered by Schistose and Granitic rocks is correlative with the steeper landscape. The other area, outcrops of Gneissose rock, has relatively gentle terrain. On the basis of these topographic features, this area is classified into three topographic units of (1) North (upstream)

area, (2) Central (midstream) Area and (3) South (downstream) Area. The outline of these is summarized in Table 3-2-2.

TABLE 3-2-2 MAJOR GEOLOGIC FORMATION AND TOPOGRAPHIC CHARACTERISTICS IN HWEDZA DISTRICT

Topographic Classification	Area	Major Geology	Topographic Characteristics
(1) North (upstream) Area	Area above EL. 1,200 m	Schists and Granites	Hwedza Mountain (EL.1,789 m) is formed by Schsit belt, its ridge consists of narrow, steep sided hills with crests of elevation 450 - 600 m. Crest hills with elevation 1,300 m are common in the Granitic area and has a relative elevation of 200 - 300 m.
(2) Middle (mid-stream)	Area from EL. 950 m to 1,200 m	Granites and Geneisses	Gentle relief in the Gneissose area, relatively rugged and steeper hills in Granite area.
(3) South (down-stream) Area	Area below EL. 950 m	Gneisses	Gentle to moderate relief with deep dissection of area. A flat plain area is dominant.

There are three major rivers consisting of the Save in the West, the Ruzawi in the East and the Mare in Central. All rivers, consistent with the geological structure, flow down in a S-SE direction. As a significant characteristic of this topography, structural valleys, as long as 20 km, are sometimes formed by their fault systems on the Save river.

The catchment area of the Mare river is small where it extends into this District, therefore, the stream dries during the dry season. The other two rivers have bigger catchment areas, so they form perennial rivers although the degree of flows reduced greatly towards the end of the dry season.

3-3 INFLUENCE OF THE 1990/91 DROUGHT

(1) Rainfall and Surface Run-off

There are rainfall and surface run-off records of the past 30 years from the Murewa and Hwedza gauging stations. The former is located about 10 km south of the southern end of UMP and the latter is located in Hwedza District. They are shown in Figure 3-1-2. A comparison between the average rainfall and the drought year's is shown in Table 3-3-1. The table shows that rainfall in drought years is almost the half of the average rainfall. From this fact, it can be inferred that during drought years, serious water problem were caused.

TABLE 3-3-1 MEAN ANNUAL RAINFALL AND RAINFALL DURING DROUGHT YEARS

Station	Mean Annual Rainfall (mm)	1990/91 (mm)	1991/92 (mm)
Murewa	890 (100%)	492 (55%)	616 (69%)
Hwedza	790 (100%)	445 (56%)	460 (58%)

Note: values in parentheses show the ratio to average year

The run-off records are given in Table 3-3-2. The data show the surface run-off during the drought years were drastically deduced to the point where the rivers almost dried up.

TABLE 3-3-2 MEAN ANNUAL RUN-OFF AND RUN-OFF IN DROUGHT YEARS

Station	Mean Annual Rainfall (mm)	1990/91 (mm)	1991/92 (mm)
Murewa	170 (100%)	2.8 (55%)	- no record -
Hwedza	140 (100%)	0.1 (56%)	- no record -

Note: values in parentheses show the ratio to average year

(2) Groundwater Resources

The team investigated the results during the drought years based upon the records kept at the DDF Office in UMP, and with the assistance of the DDF staff who are in charge of the maintenance of boreholes and deep wells. The team also made a field survey with the technical interviews with users, to obtain actual experiences of the drought years and the groundwater resources.

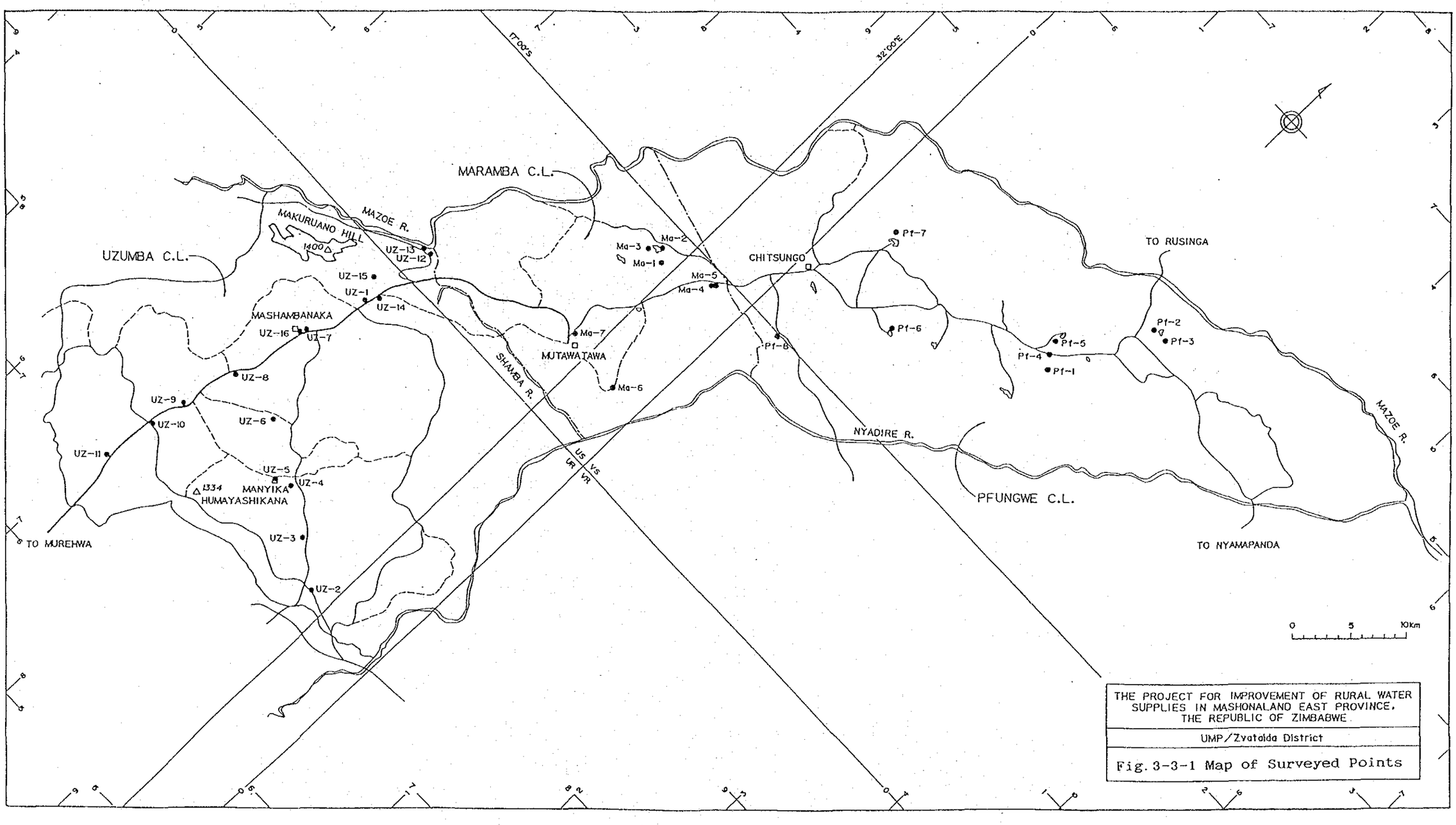
The results of the survey are summarized in Table 3-3-3 and surveyed points are given in Figures 3-3-1 and 3-3-2. There was no record on the inference by the drought at Hwedza DDF Office.

The report submitted to UMP's DDF Office shows that, even with boreholes, about 40 percent were affected and 4 percent dried up during the drought. The field survey results revealed that not a few boreholes received some problems by the drought. Based on the field survey, the boreholes which were affected by the drought are listed in Table 3-3-4. From this table, the following general observations can be made:

- The yield of these boreholes is lower than 1.0 m^3/hr.
- The water quality indicates low temperature and/or low conductivity which are common features in water derived from the unconfined, shallow aquifers.

From the above observations, it can be said that the problems of these boreholes may be caused by over-pumping, exceeding the yield capacity, due to increased the big demand of the borehole which come from the shortage of water provided by the surrounding deep/shallow wells, and original users give their complain to the drought instead of borehole having low yield.

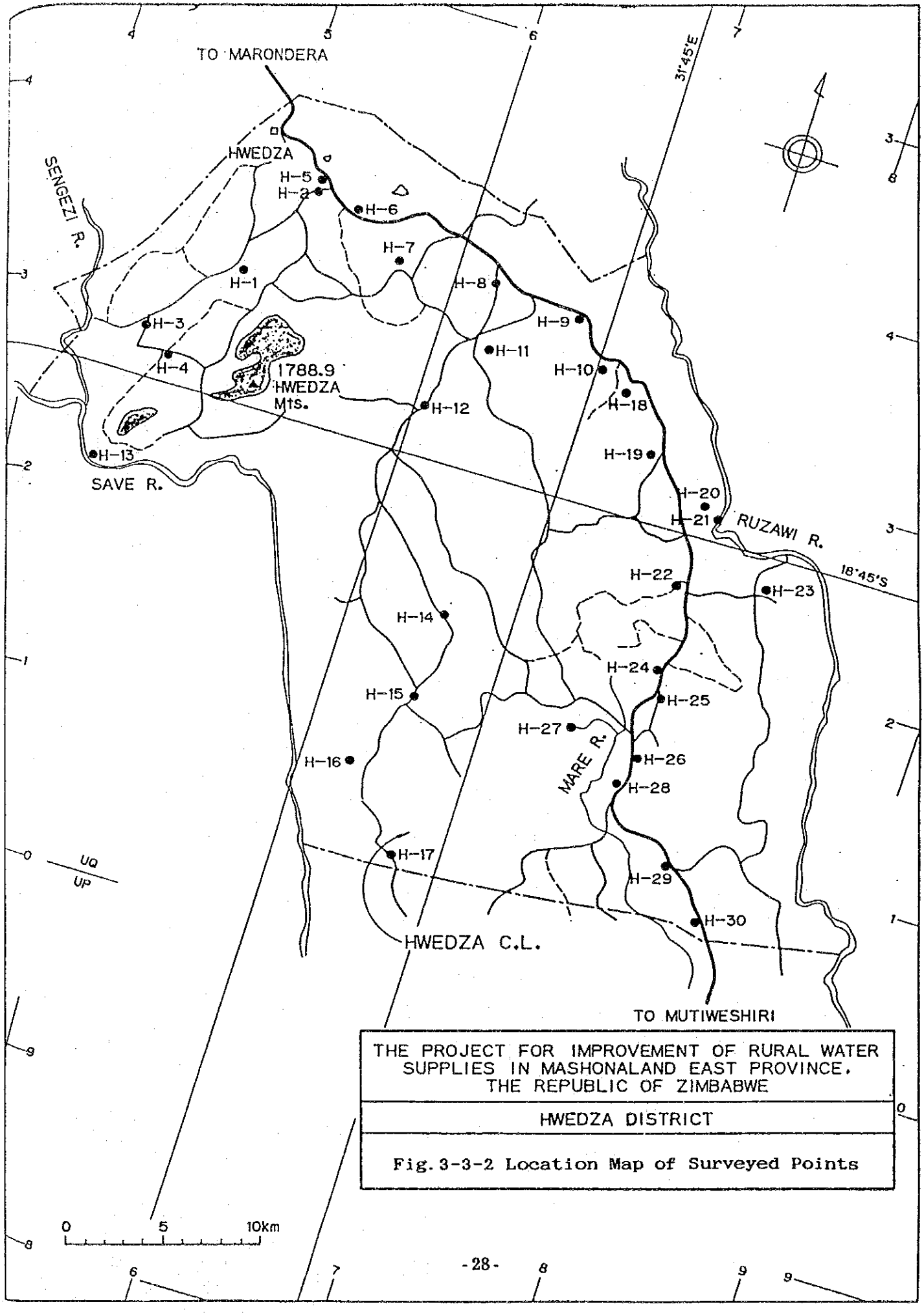
However, in a few cases in Hwedza, the low yield boreholes which are mainly recharged by shallow aquifer(s), are might become dried-up from the drought. In short, it could be considered that the boreholes with yields of more than 1.0 m^3/hr were seldom dry even during the drought seasons.



THE PROJECT FOR IMPROVEMENT OF RURAL WATER SUPPLIES IN MASHONALAND EAST PROVINCE, THE REPUBLIC OF ZIMBABWE

UMP/Zvataida District

Fig. 3-3-1 Map of Surveyed Points



THE PROJECT FOR IMPROVEMENT OF RURAL WATER SUPPLIES IN MASHONALAND EAST PROVINCE, THE REPUBLIC OF ZIMBABWE

HWEDZA DISTRICT

Fig. 3-3-2 Location Map of Surveyed Points

TABLE 3-3-3 INFLUENCE BY THE DROUGHT

DATA FROM UMP DDF OFFICE: February 20, 1992					
Type of Water Source		Influence			Remarks
		No (%)	Yes (%)	Dry (%)	
Borehole	(No. reported)	38 (56)	27 (40)	3 (4)	
Deep Well	(No. reported)	4 (11)	34 (89)		
Dam and Weir	(No. reported)	-	30 (79)	8 (21)	
RESULT BY THE FIELD SURVEY:					
Type of Water Source		Influence			Remarks
		No (%)	Yes (%)	Dry (%)	
Borehole in UMP	(No. surveyed)	20 (74)	6 (22)	1 (4)	
in Hwedza	(No. surveyed)	16 (69)	2 (9)	5 (22)	
Deep Well	(No. surveyed)	5 (50)	1 (10)	4(40)	

TABLE 3-3-4 BOREHOLES INFLUENCED BY DROUGHT

No.	Influence		Borehole Factors					Remarks
	Yes	Dry	Yield	S.W.L.	Depth	Tempe.	E-C	
			(m^3/H)	(m)	(m)	(°C)	(μ-m)	
P- 8	△		3.85	?	65.0	25.7	-	
8'	△		3.85	?	60.0	-	-	
M- 7	△		0.86	?	51.0	25.8	310	Down Pump Cylinder
U- 6	△		?	?	?	24.1	320	
U- 8	△		1.80	?	37.0	25.0	170	
U- 10	△		3.60	?	45.0	23.9	290	
H- 4	△	×	4.50	12.0	50.0	-	-	w/ Engine
H- 13	△	×	0.40	3.5	35.0	-	-	Pump Damaged
U- 3		×	0.80	?	55.0	23.9	600	
H- 1		×	1.19	18.0	38.0	24.4	590	
H- 5		×	?	?	?	23.8	110	
H- 6		×	0.29	50.0	60.0	24.4	90	
H- 17		×	0.50	13.0	45.0	23.5	280	
H- 19			0.86	13.0	42.0	24.5	74	

(3) Agricultural Production

Major crop production in the Project Area, between 1989/90 and 1992/93, including the drought years, is shown in Table 3-3-3. The production for 92/93 is considered normal production.

From the table, maize production, the staple food, in 1991/92 received considerable damage from the drought and the harvest was reduced to around 10 percent of the normal years.

CROP PRODUCTION IN THE AREA IN THE DROUGHT YEARS

(unit: ton)

Area	UMP				Hwedza			
Year	89/90	90/91	91/92	92/93	89/90	90/91	91/92	92/93
Maize	32,942	42,961	4,732	57,057	17,053	15,089	2,601	22,134
Groundnut	600	960	189	1,730	1,730	620	106	480

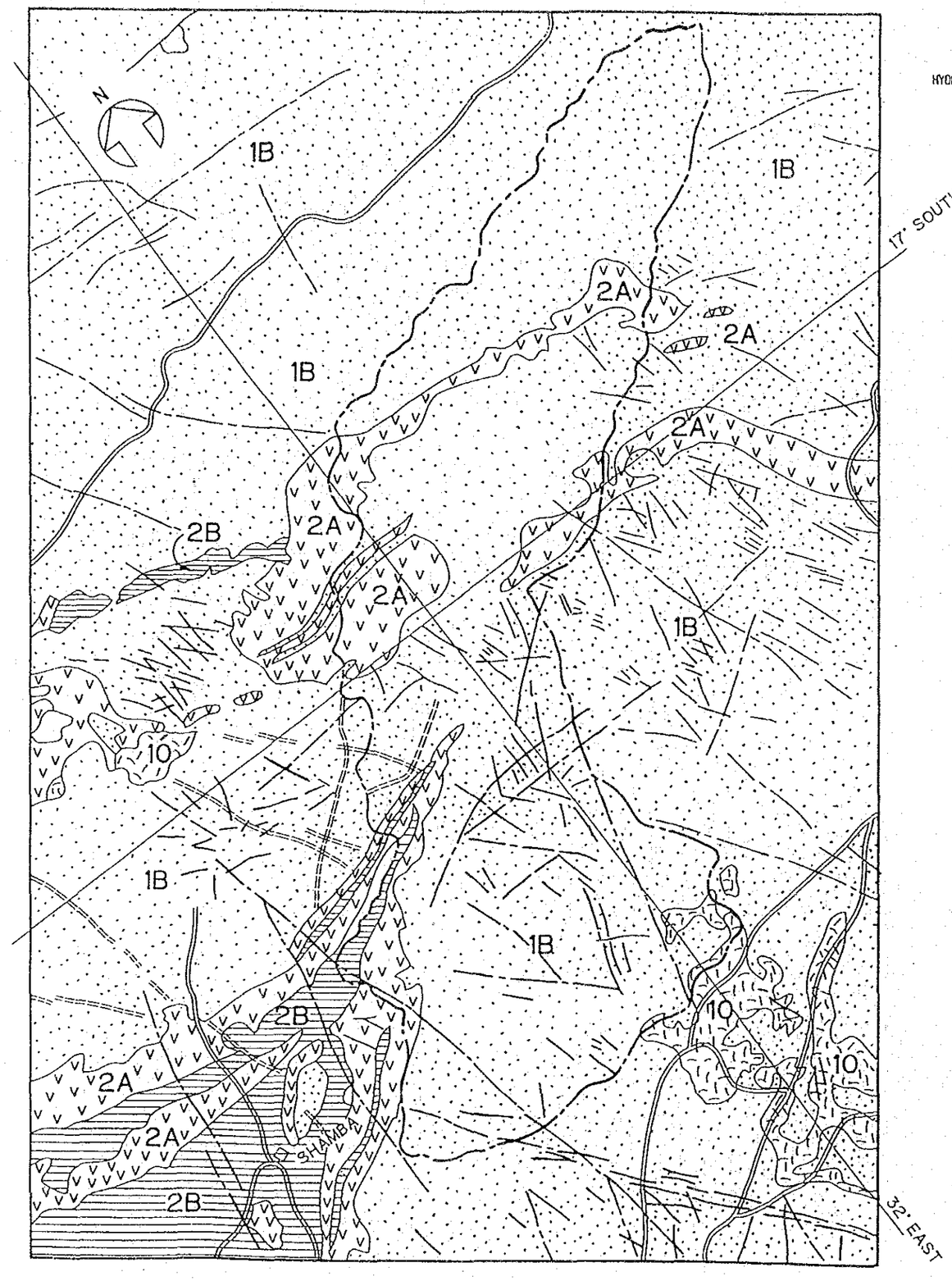
3-4 HYDROGEOLOGY

3-4-1 Outline

The Hydrogeological maps of UMP and Hwedza Districts are shown in Figures 3-4-1 and 3-4-2. The geological components of the areas, as shown in the Hydrogeological maps, eg., granite, schist, gneiss, dolerites, and so forth. The stratigraphic correlation of these layers both for Hwedza and UMP Districts is shown in Table 3-4-1.

TABLE 3-4-1 GEOLOGICAL COMPONENTS AND STRATIGRAPHY

Geological Subdivision	Age ($\times 10^6$ years)	Hydrogeological Unit	Lithology	Area of Occurrence	
				UMP	Hwedza
A : Mashonaland Dolerite, younger intrusive suite	(Proterozoic)	10	Basalt, Dolerite	Whole area	Whole area
B : Gneisses: Chimanda & Rushinga Gneiss, (Metamorphic Suite)	470 - 1830	1 B	Migmatitic Gneiss, Feldspathic Micaceous Gneiss,	Northeast of Pfungwe	Nil
			Metaquartzite	South of Pfungwe, Maramba, North of Uzumba	Hwedza Mt.
C: Green Stone, Grey Gneiss Complex	830 - 2600	2 B	Felsitic Suite, Mafic Suite, Ultramafic Suite, Metasedimentary Suite		
D: Granites	830 - 2600	1 B	Granites, Granodiorite	Maramba ~ North Uzumba	Central part
E: Migmatitic Gneiss	830 - 3200	1 B	Migmatite Complex, Tonalitic Augen Gneiss, Lucogneiss	North of Pfungwe	North & South Part



HYDROGEOLOGICAL LEGEND

HYDROGEOLOGICAL UNIT	GROUNDWATER DEVELOPMENT POTENTIAL CLASSIFICATION	LITHOLOGY	AVERAGE TRANSMITTING PROPERTIES	TYPE OF PERMEABILITY	AVERAGE DEPTH TO WATER TABLE (m)	AVERAGE SPECIFIC CAPACITY AND YIELD RANGE $m^3/d/m$	m^3/d
2A		BULAWAYAN. MAINLY MAFIC METAVOLCANICS WITH SUBORDINATE METASEDIMENTS	MODERATE TO LOW	SECONDARY	10-20	10-100	100-250
2B		SHAMVAIAN. MAINLY ACID METAVOLCANICS AND METASEDIMENTS.	LOW	SECONDARY	<10	1-5	10-25
1B		PRE-CAMBRIAN. OLDER GNEISS (G) AND YOUNGER INTRUSIVE GRANITES (Yg) OF THE CRATON, AND VARIOUS PARAGNEISSES OF THE ZAMBEZI (Z AND Mm) AND LIMPOPO (Mb AND Gn) MOBILE BELTS. OF THE POST AFRICAN AND PLIOCENE SURFACES.	LOW	SECONDARY	<10	2-20	10-50
1A		PRE-CAMBRIAN. OLDER GNEISS (G) AND YOUNGER INTRUSIVE GRANITES (Yg) OF THE AFRICAN SURFACE.	MODERATE TO LOW	SECONDARY	<10	30-50	50-100
10		MASHONALAND DOLERITE. DOLERITE SILLS AND DYKE.	MODERATE TO LOW	SECONDARY	<10	5-25	25-100
—		GREAT DYKE NORITE, GABBRO, SERPENTINE AND PYROXENITE ALKALI RING COMPLEXES	—	NO DATA AVAILABLE			—

TOPOGRAPHICAL SYMBOLS

- DISTRICT/ COMMUNAL L.BOUNDARY
- CITY/TOWN
- ROAD

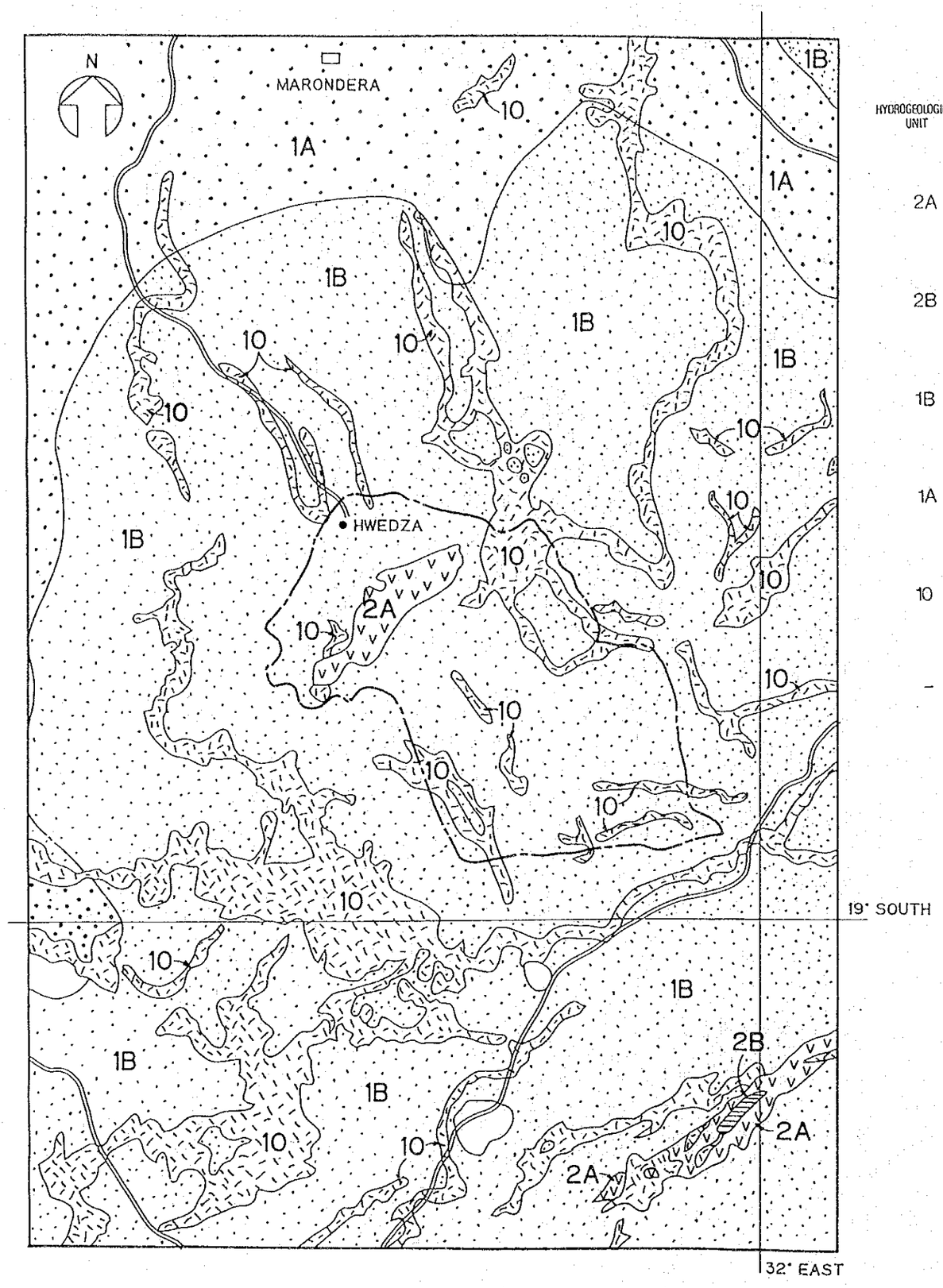
GEOLOGICAL SYMBOLS

- UNIT BOUNDARY
- PHOTOLINER (FAULT, FRACTURE, DYKE)
- DYKE

Figure 3-4-1 Hydrogeological Map of UMP Area

0 30km

SCALE 1:500.000



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2A		BULAWAYAN. MAINLY MAFIC METAVOLCANICS WITH SUBORDINATE METASEDIMENTS	MODERATE TO LOW	SECONDARY	10-20	10-100	100-250
2B		SHAMVAIAN. MAINLY ACID METAVOLCANICS AND METASEDIMENTS.	LOW	SECONDARY	<10	1-5	10-25
1B		PRE-CAMBRIAN. OLDER GNEISS (G) AND YOUNGER INTRUSIVE GRANITES (Yg) OF THE CRATON, AND VARIOUS PARAGNEISSES OF THE ZAMBEZI (Z AND Mm) AND LIMPOPO (Mb AND Gn) MOBILE BELTS, OF THE POST AFRICAN AND PLIOCENE SURFACES.	LOW	SECONDARY	<10	2-20	10-50
1A		PRE-CAMBRIAN. OLDER GNEISS (G) AND YOUNGER INTRUSIVE GRANITES (Yg) OF THE AFRICAN SURFACE.	MODERATE TO LOW	SECONDARY	<10	30-50	50-180
10		MASHONALAND DOLERITE. DOLERITE SILLS AND DYKE.	MODERATE TO LOW	SECONDARY	<10	5-25	25-100
–		GREAT DYKE NORITE, GABBRO, SERPENTINE AND PYROXENITE ALKALI RING COMPLEXES	–	NO DATA AVAILABLE			–

TOPOGRAPHICAL SYMBOLS

- DISTRICT/ COMMUNAL L.BOUNDARY
- CITY/TOWN
- ROAD

GEOLOGICAL SYMBOLS

- UNIT BOUNDARY
- PHOTOLINER (FAULT, FRACTURE, DYKE)
- DYKE

Figure 3-4-2 Hydrogeological Map of Hwedza Area

0 30km

SCALE 1:500.000

a) UMP District

From a geological point of view, this area is situated in the northeastern corner of the Zimbabwe Craton consisting of Archaean Sequences and the Zambezi-Mozambique Orogenic Belt and faces the older rocks of the Craton with contact faults at the northern part of Pfungwe C.L. The members of Zimbabwe Craton lay in the belt zone from Pfungwe C.L. to Uzumba C.L. On the whole, the Gneiss-migmatite rock is dominant in Pfungwe C.L., Green stone-Gneiss rocks are in Maramba C.L. and Granites are in Uzumba C.L. The Dolerite forms a dyke-like shape, the uppermost member, and is distributed throughout the whole area.

b) Hwedza District

Hwedza Mountain, located in the north of this area, is formed by various schistose rocks such as mafic greenstone, serpentinite and sedimentary metamorphic, while normally intrude and covered by the gneiss and/or granitic rocks. Within this area there is no evidence for the existence of older rocks than this schistose belt, accordingly the metamorphosed rocks forming the Hwedza Mountain are recognized as the basement rocks of this area. The upper gneissose rocks are classified into two types, loco-gneiss and mafic-gneiss. The distribution of luco-gneiss is restricted to the north of Hwedza Mountain, whereas the mafic-gneiss is restricted to the north of Hwedza Mountain, whereas the mafic-gneiss lays in the central to southern part of this area. The granitic rock is also distributed in the central part and commonly covers the gneissose rock as sheet occurrence. The dolerite appears as a dyke intruding into granites in a N-S direction.

3-4-2 Hydrogeology

The Hydrogelogic properties are given as a similar category of its geology, even though, there are various rocks are outcropping in this area. From the Hydrogeological point of view, the rocks in the areas can be classified into four Hydrogeological units, as shown in Figures 3-4-1 and 3-4-2. According to the Hydrogeological classification shown in the Master Plan Report, the Hydrogeological information of the Project Area is summarized in Table 3-4-2.

a) UMP District

Within UMP District, more than 80 percent of the area, is characterized by low groundwater potential with estimated yields below 50 m^3/day. The aquifer in this area is mainly a result of the weathered zone and is rarely expected to be in the deep fractured zone of the rock mass. The weathered zone is commonly restricted to the shallow horizon. Regarding water quality, there are some water sources contaminated by salty water. Considering the difficult hydrogeological conditions in the area, the further groundwater development in this area needs more detailed siting works.

b) Hwedza District

This area possesses similar geological constituents to UMP District. The low yield area, with of values ranging to less than 50 m^3/day, extends over 80 percent of the area. In the data of existing boreholes and/or deep wells, the groundwater is usually extracted from the weathered zone with a concentrated depth of 40 to 50 m. The boreholes and/or deep wells with low yields including these which are completely dry are sometimes found in drilling reports.

TABLE 3-4-2 HYDROGEOLOGICAL CLASSIFICATION IN THE PROJECT AREA

UMP District:

Geological Sub-division	H-geology Unit	Area (%) Occupied	Transmi-ssibility	Kind of Aquifer	S. W. L. (m)	Yield (m^3/d)
A: Mashonaland dolerite	10	5	low-middle	W-zone, F-zone,	< 10	25 ~ 100
B: Gneiss, (Gneisses, metamorphic suite)	1 B	35	low	W-zone, F-zone,	< 10	10 ~ 50
C: Green stone Grey gneiss complex (Bulawayan)	2 A	10	low-middle	W-zone, F-zone	10 ~ 20	100 ~ 250
C: Green stone Grey gneiss Complex (Shamvian)	2 B	5	low	W-zone, F-zone	< 10	10 ~ 25
D: Granite	1 B	25	low	W-zone, F-zone,	< 10	10 ~ 50
E: Migmatitic gneiss	1 B	20	low	W-zone, F-zone	< 10	10 ~ 50
Hwedza District						
A: Mashonaland dolerite	10	5	low-middle	W-zone, F-zone,	< 10	25 ~ 100
C: Green stone Grey Gneiss complex (Bulawayan)	2 A	10	low-middle	W-zone, F-zone,	10 ~ 20	100 ~ 250
D: Granite	1 B	25	low	W-zone, F-zone,	< 10	10 ~ 50
E: Migmatitic gneiss	1 B	60	low	W-zone, F-zone,	< 10	10 ~ 50

Note: * W-zone, Weathered zone, and F-zone, Fractured zone of rock mass

*Source: Master Plan Report, Vol. 2-2, Hydrogeology

3 - 5 DATA OF THE EXISTING BOREHOLES, WELLS AND AQUIFERS

On the basis of existing data, the properties of the aquifers in this area were examined by the team. As a consequence of this study, both the frequency of distribution of yield and the depth of the water sources, boreholes and deep wells, are shown in Figures 3-5-1 and 3-5-2. In addition, the relationship between yield and the depth is also given in Figure 3-5-3. These Figures are summarized as follows.

- The boreholes with low yields of less than 0.5 m^3/hr occupy 17 percent, (4 out of 24), in UMP District and 26 percent in Hwedza District, respectively. If boreholes with less than 1.0 m^3/hr are taken into account the total reaches one-third in both Districts.

- Based on this data, the successful rate of boreholes is calculated to be 69 percent in UMP and 82 percent in Hwedza District, respectively. Taking these rates into consideration, groundwater development is becoming more difficult as the time goes by. Greater difficulties could be encountered in future groundwater development.

- The depths of existing boreholes range between 35 m and 60 m with an average depth of 47 m in UMP and 46 m in Hwedza District, and with a maximum depth of 80 m.

- Some of the high yield boreholes have yields of over 5.0 m^3/hr in the Project Area. The depth of the high yield boreholes, however, are restricted within the range of 35 m to 50 m.

The Hydrogeologic properties described above may coincide with the description mentioned in the Master Plan Report. The Report says the aquifers of almost all of the boreholes are in the weathered zone as classified in the Hydrogeological Unit. The occurrence, however, of high yields of as much as 2.0 m^3/hr, i.e., 50 m^3/day, and even 10 m^3/hr, i.e., 240 m^3/hr, (most productive yield), is sometimes observed in the area. These high yields are usually found in not only the shallow aquifers of the weathered zone, but also from the deep aquifers occurring in

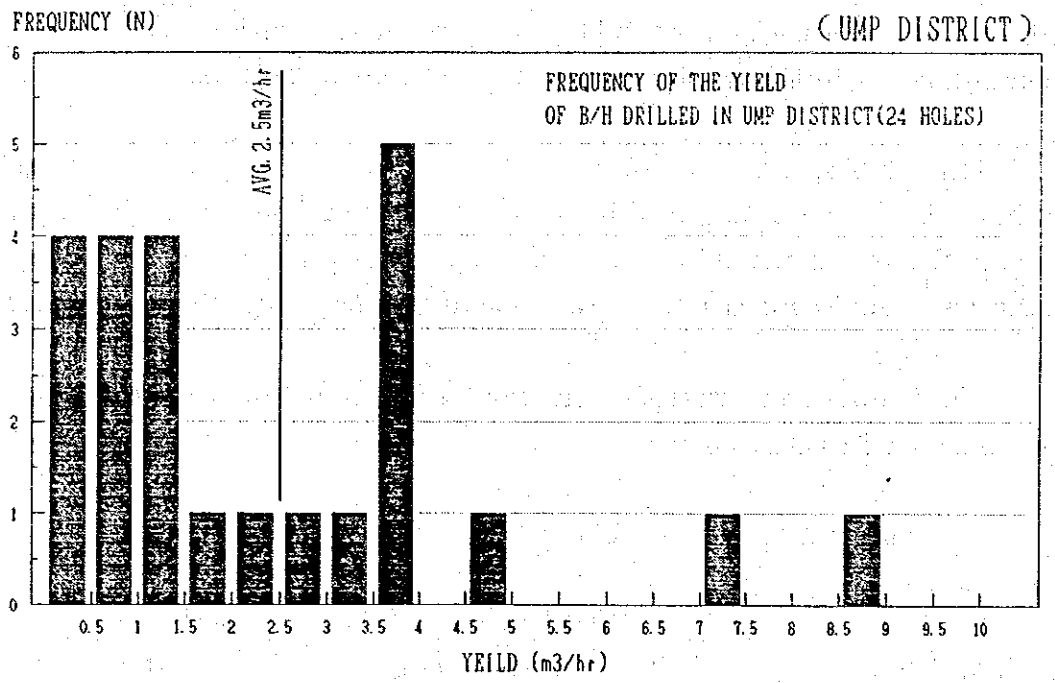
the fractured zone. In other words, there are two types of aquifers, comprising (1) Weathered zone, shallow aquifer and (2) Fractured zone, deep aquifer. The borehole yield might be controlled by the capacity of the combined aquifers.

The combination of aquifers is also identified in the groundwater quality from the boreholes data described below. In these types, one is similar to surface water signified by the susceptibility to air temperature and low EC, and the other is from the deep aquifer characterized by a constant water temperature and a high EC.

The aquifer characteristics, summarized by the data of the existing water sources is shown in Table 3-5-1.

TABLE 3-5-1 AQUIFER CHARACTERISTICS IN THE PROJECT AREA

Type of Aquifer		UMP District		Hwedza District	
		Upper W-zone	W-rock to F-zone	Upper W-zone	W-rock to F-zone
Type of Source	(m)	Deep Well	Borehole	Deep Well	Borehole
Depth of S. W. L.	(m)	-	-	-	1 - over 40
Average for Above	(m)	-	-	-	11
Depth of Aquifer	(m)	4 - 20	25 - 80	4 - 20	20 - 75
Avg. Depth of Source	(m)	11	47	11	46
Range of Yield	(m^3/hr)	-	01. - 9	0.1 - 3.6	0.1 - 18
Avg. of Yield	(m^3/hr)	-	2.5	0.5	3. 5



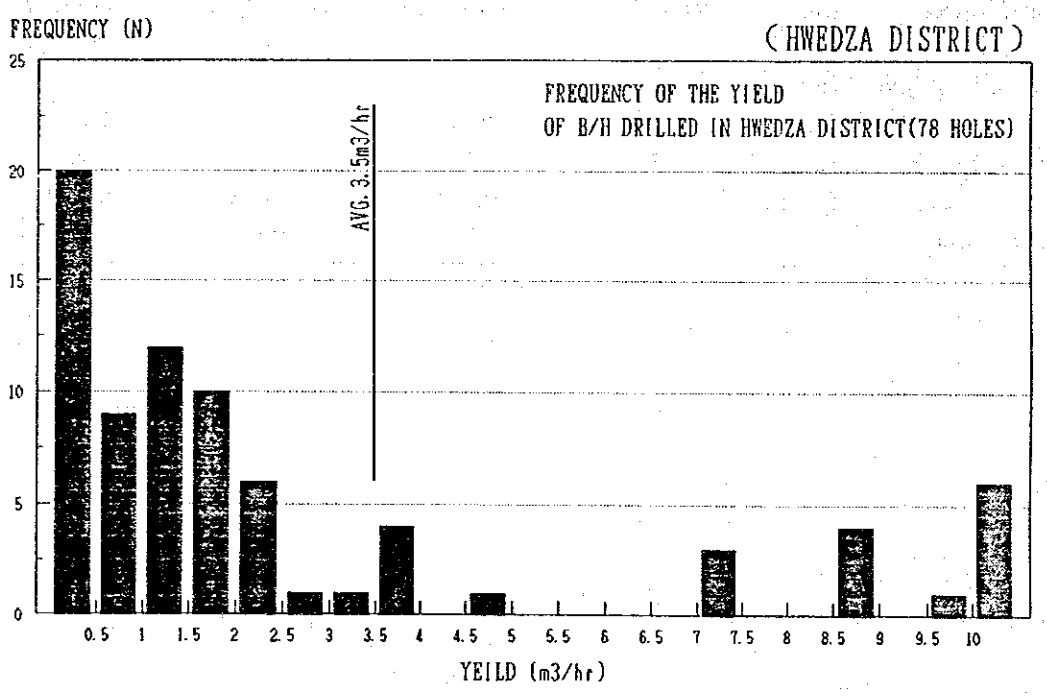
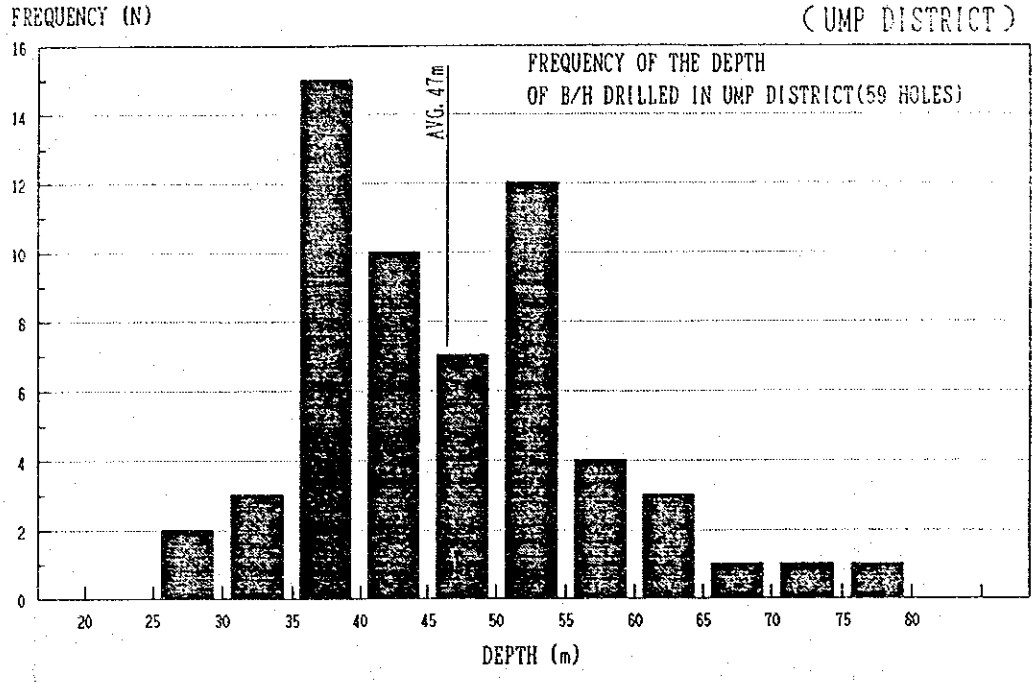


Figure 3-5-1 Histogram of Borehole Yield in the Project Area



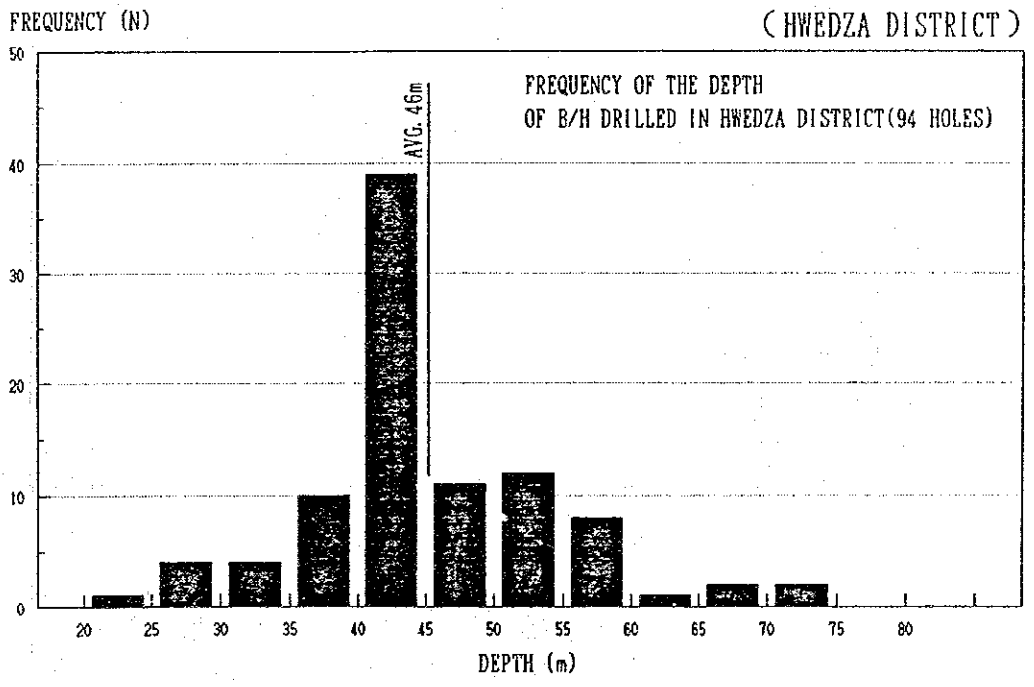


Figure 3-5-2 Histogram of Borehole Depth in the Project Area

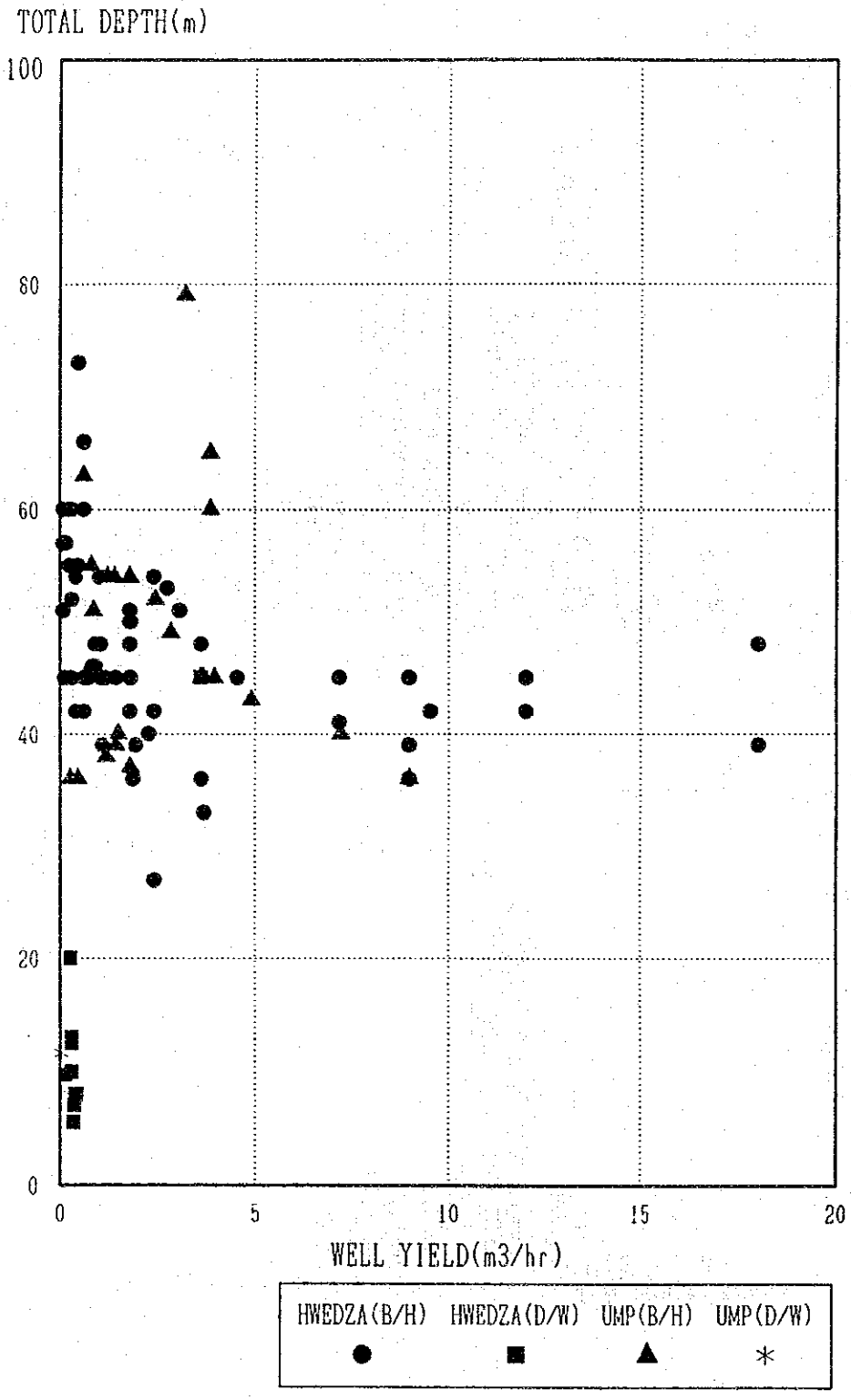


Figure 3-5-3 Relationship between Depth of Borehole and its Yield

3-6 WATER QUALITY TESTS FOR EXISTING BOREHOLES AND WELLS

In parallel with the field survey to assess Influence of the Drought, some simplified water quality tests for existing water sources were carried out by the team. The items and test methods are as follows.

Test Item	Test Method
i) Temperature, pH and EC (Electric Conductivity)	Portable EC and pH meter
ii) Total Coliforms and Microorganisms	Testing paper

The test results are given in Appendix-5, (2), and are summarized as follows.

- Shallow well : The well is equipped with a bucket. Contact between hands and bucket causes insanitary contamination. It is considered that contamination by hand is a bigger reason for pollution than other causes derived from the shallow aquifer itself which is easily contaminated.

- Deep well : The wells are equipped with hand pumps. In many cases, the well has been deepened into the base-rock, so water possesses similar quality to the deep aquifer's.

- Borehole : Of the 47 boreholes sampled, 25 percent are infected with coliforms. However, only 1 sample has over 10 coliforms. Considering the possibility of direct infection by hand during testing, it is justified the water quality of borehole is maintained as fairly sanitary condition.

CHAPTER 4. PROJECT OUTLINE

4-1 OBJECTIVES OF THE PROJECT

(1) Objectives of the Basic Design Study

As mentioned before, the Government of Zimbabwe has started its IRWSSP to realize "the National Master Plan" in 1987, which was formulated and completed in 1986.

The objectives of the basic design study are to study the basic design for the water supply facilities, to select the equipment and materials and to estimate the project's rough cost to be required for the project execution, etc., and to formulate the most effective plan to be responsible to Japanese side, based upon the justification result concerning Japan's Grant Aid System and Policy.

(2) Objectives of the Project

The objectives of the project are to supply safe drinking water to those people who have no adequate water supply facilities, to stabilize and improve their lives, and to contribute to the strengthening of infrastructure for national economic development.

Improvement of the people's water supply situation aims at such effects as the reduction of high occurrence rates of water borne diseases and the reduction of the labour force required for fetching water. This is one of the most urgent national policies and is on going in 27 Districts out of the 57 Districts in Zimbabwe.

The plan of the Project, the total outline of which is shown in Table 4-1-2, to be the responsibility of the Japanese side is composed of the procurement of the equipment and materials necessary for the construction of 400 boreholes which are considered to be difficult by the Zimbabwean side and to render on-the-job training to the Zimbabwean side through the construction work of 40 boreholes. The outline of the requested Project is as follows.

a) Project Area

The project area is composed of the following Communal Lands (C. Ls.) in Mashonaland East Province.

PROJECT AREA

(1)	UZUMBA C. L.	:	ZVATAIDA (UMP) District
(2)	MARAMBA C. L.	:	- do -
(3)	PFUNGWE C. L.	:	- do -
(4)	HWEDZA C. L.	:	HWEDZA District

b) Rural Water Supply and Sanitation Project (IRWSSP)

- Objective : The actual Rural Water Supply situation is shown in Table 4-1-1. The major objective of the Project is to provide safe water to all villagers. The planned water demands are 20 ℓ/cd per well and 30 ℓ/cd per borehole, and the water sources, which are mainly to be provided by boreholes, are to be installed at a ratio of one "Shallow Well Unit, S. W. U. as given below" to every fifty people.

S. W. U. for shallow well: 1 S. W. U. for fifty (50) people
S. W. U. for deep well : 3 S. W. U. for hundred fifty (150) people
S. W. U. for borehole : 5 S. W. U. for two hundred fifty (250) people

TABLE 4-1-1 WATER SUPPLY SITUATION IN THE PROJECT AREA

District	Population in 1992	Number		Benefited Population (rate)	
		Borehole	Deep Well		
UMP	86,302	42	33	15,500	(18%)
Hwedza	69,981	128	0	32,000	(46%)
Total	156,283	170	33	47,500	(30%)

The target number of water sources for the IRWSSP is shown in table 4-1-2.

TABLE 4-1-2 QUANTITIES FOR IRWSSP IN THE PROJECT AREA

District	Number of Construction		Number of Rehabilitation
	Borehole	Deep Well	
UMP	309	182	208
Hwedza	123	85	48
Total	432	267	256

4-2 STUDY OF CONTENTS OF THE REQUEST

4-2-1 Justification and Necessity of the Project

This Project aims at construction of 400 boreholes included in the above IRWSSP prepared by the Government of Zimbabwe.

The direct results of the Project will be, 1) To improve the conditions of rural water supply, 2) To reduce diseases resulting from unsafe drinking water and 3) to utilize the labour force which is required for fetching water to other activities. It has already been proven by projects executed in the past that these effects very much influence the improvement of the infrastructure and the activities of target population. The total people benefited is estimated at 100,000 which is equivalent to about 70 percent of the people in the Project Area. It is therefore evaluated that the Project will have a big impact on the population in the Project Area.

The potential for groundwater development in the area is not high, as described in section 3 - 4 on hydrogeology. Water sources are restricted to groundwater, from the point of view that houses are sparsely distributed over an extensive area. It could also be said that the type of groundwater mainly depends on the borehole water due to well water problems, such as those which dried up during the drought seasons, and unsafe water quality. It, therefore, seems justifiable for Zimbabwe to have a policy which will derive water from boreholes.

The executing agency and the operating body are shown in section 4-3-1. The executing agency (DWD), has adequate experience and performance of borehole construction work in both technical and administrative fields and the existing facilities are satisfactorily maintained, so there is justifiably no anxiety on the points mentioned above.

From the above factors, its can be judged that grant aid assistance for the Project is justifiable from both the objective and political points of view. IRWSSP has already been started by the Government of Zimbabwe, and it is very desirous that the project will be executed as soon as possible to accelerate the IRWSSP in the Project Area.

4 - 2 - 2 Programme of the Project

The main construction work of the Project will be carried out by the DWD which is constructing about one thousand boreholes per annum with no problems regarding technical and managerial abilities of the staff. The Government of Zimbabwe is executing IRWSSP on a nationwide scale; 27 Districts are making, satisfactory progress, so it can be said that there are basically no problems. It is recommendable, however, that on-the-job training would be desirable due to a shortage of well-trained technicians and mechanics for follow-up work of many ongoing projects.

The operating body of the Zimbabwean side is shown in section 4-3-1 and the budget for each District is given in Table 4-2-1 approved by NAC. The budgets for the borehole construction work in 1993 are Z$1,000 for each siting and Z$25,000 for construction work.

At one time, IRWSSP was suspended due to serious drought problems, but the IRWSSPs are now being completed in five Districts and considered it will be continuously executed in future as the one of the important national project.

TABLE 4 - 2 - 1 BUDGET ALLOCATION TO EACH DISTRICT, 1993

(Unit: Z$'000)

Activity	UMP	Hwedza
Borehole Construction	1,725	894
(No. of Boreholes)	(60)	(30)
Deep Well Construction	277	188
(No. of Deep Wells)	(35)	(20)
Rehabilitation Work	389	365
(No. of Facilities)	(208)	(48)
Others	461	490
Sub-total	2,852	1,937
10% Contingency	285	194
15% Price Increase	470	319
Grand-total	3,607	2,450

Source: Plan of Operation, July 1993 - June 1994, First Draft

4 - 2 - 3 Relationship between Other Related Projects and the Project

This has previously been described in section 2-5. The budgetary sources for each project is almost depending on the external assistances an the Project Area is arranged in the each part by the source of budget and no competition is found.

4 - 2 - 4 Project Components

This Project is composed of the following components.

- Presiting	:	Full consultation with the local community regarding siting of new water points
- Siting	:	The siting of water points is the responsibility of the DWD. The siting will be based on the pre-sites chosen by the community.
- Borehole Construction	:	The construction work will be carried out at point(s) approved by the DWD.
- Maintenance	:	Maintenance obligations will be shifted form the Government to the users in near future.

The important issue among the above points is siting. The Hydrogeological conditions in the area are not suitable for groundwater development. There are possibilities of abandoning the borehole site in cases where neither no recommendable site can be found within a reasonable distance from the village, and the proposed water source has to be changed from a borehole to a deep well, or the community do not accept the selected borehole point. In general, groundwater development begins at points where are easily developed. Further development thus becomes more difficult over time. It might be pointed out, therefore, that more detailed siting work and/or more flexible countermeasures for the selection of water sources will be required.

4-2-5 Requested Equipment and Facilities

The requested facilities are borehole facilities equipped with handpumps, with hole diameters and depths ranges from 100 to 150 mm and 30 to 80 meters respectively; these are facilities to be constructed in Zimbabwe. From the hydrogeological point of view, truck-mounted drilling rigs with dual functions for rotary and down-the-hole (DTH) are necessary, the same as those supplied in Phase-1 Project. And, to execute the borehole construction, some kind of supporting equipment such as high-pressure compressors, tool trucks, etc. are also required.

The requested equipment are drilling rigs, supporting trucks, and so forth. The dimensions and technical specifications of the requested equipment are basically the same as the equipment supplied under Phase-1 Project considering the hydrogeological conditions prevailing in the Project Area. The combination and quantity of equipment to be supplied under this Project will be determined based on the best plan resulting from the study of the construction programme, the investment effectiveness, and policy of the Japanese grant aid system under consideration at the request of the Government of Zimbabwe.

Spare parts for the equipment supplied under Phase-2 Project, an additional request during the field survey, is to be procured under this Project based upon the following survey results. It was confirmed by the team that the Phase-2 equipment have been properly and satisfactorily maintained and operated by the DWD, and construction performance during the annual 30 deep boreholes has been good and has justified the additional request.

4-2-6 Necessity of the Technical Cooperation

It might be thought that Japanese technical cooperation, was not essential as the DWD seems to already possess adequate construction and maintenance techniques regarding drilling work. However, as shown in section 4-3-1, Executing Agency, there are a total of fourteen drilling teams in the Mashonaland Provincial Office which will execute the construction works of the Project, and only about a half of them are accustomed to the new-type rigs, while the other half has

experience only of the old-type of cable percussion rigs. Therefore, in the case of supply of new-rigs, it is considered that some on-the-job training is necessary for staff who are not accustomed to new-rigs. In addition to drilling, it is also considered that some training on geophysical prospecting, including the operating methods of E-M prospecting is necessary.

From these points of view, the on-the-job trainings on drilling works, mechanical maintenance and prospecting are to be executed under the Project.

4-2-7 Implementation Policy

From the study results mentioned above, the effectiveness, the necessity, the ability of the executing agency, etc. to implement the Project have been confirmed, so the basic design of the Project will be conducted on the premise of Japanese grant aid, considering the following issues.

The contents of the requested equipment and materials are listed in Table 4-3-2, and differences between the request and the result of the basic design can be summarized as follows.

1) Truck with 4-ton crane: The capacity of the crane is amended to a 3-ton considering the loading capacity of the truck. A 3-ton crane is the same one with the Phase-1 Project and this amendment was agreed through discussion with the DWD and study team.
2) Handpump: The handpump is to be the responsibility to Zimbabwean side as it is able to procure by local Zimbabwean currency.
3) Casing Material: The casing materials are to be PVC for the boreholes constructed by the Japanese side and steel for the boreholes constructed by the Zimbabwean side.
4) Spare parts: The quantity of spare parts is to be equivalent to 10 to 15 percent of the cost of equipment itself according to the normal rate of Japanese grant aid projects.
5) Spare parts for Phase-2 equipment: Additional spare parts for Phase-2 equipment will be supplied under this Project as requested.

4-3 PROJECT OUTLINE

4-3-1 Executing Agency and Operating Body

(1) Executing Agency

The executing agency of the Project is the Department of Water Development (DWD), the Ministry of Lands, Agriculture and Water Development. DWD was originally organized in the Ministry of Energy, Water Resources and development (MEWRD) and newly reorganized in the above-mentioned Ministry. The organization chart of DWD and the Ministry is given in Figure 4-3-1 and DWD is possessing over 600 staff. The Groundwater Branch of the Head Quater through the Provincial Offices is responsible for the development of groundwater. DWD has five Provincial Offices in the country and Mashonaland East Province is governed by the Mashonaland Province Office together with mashonaland Central and Mashonaland West Provinces.

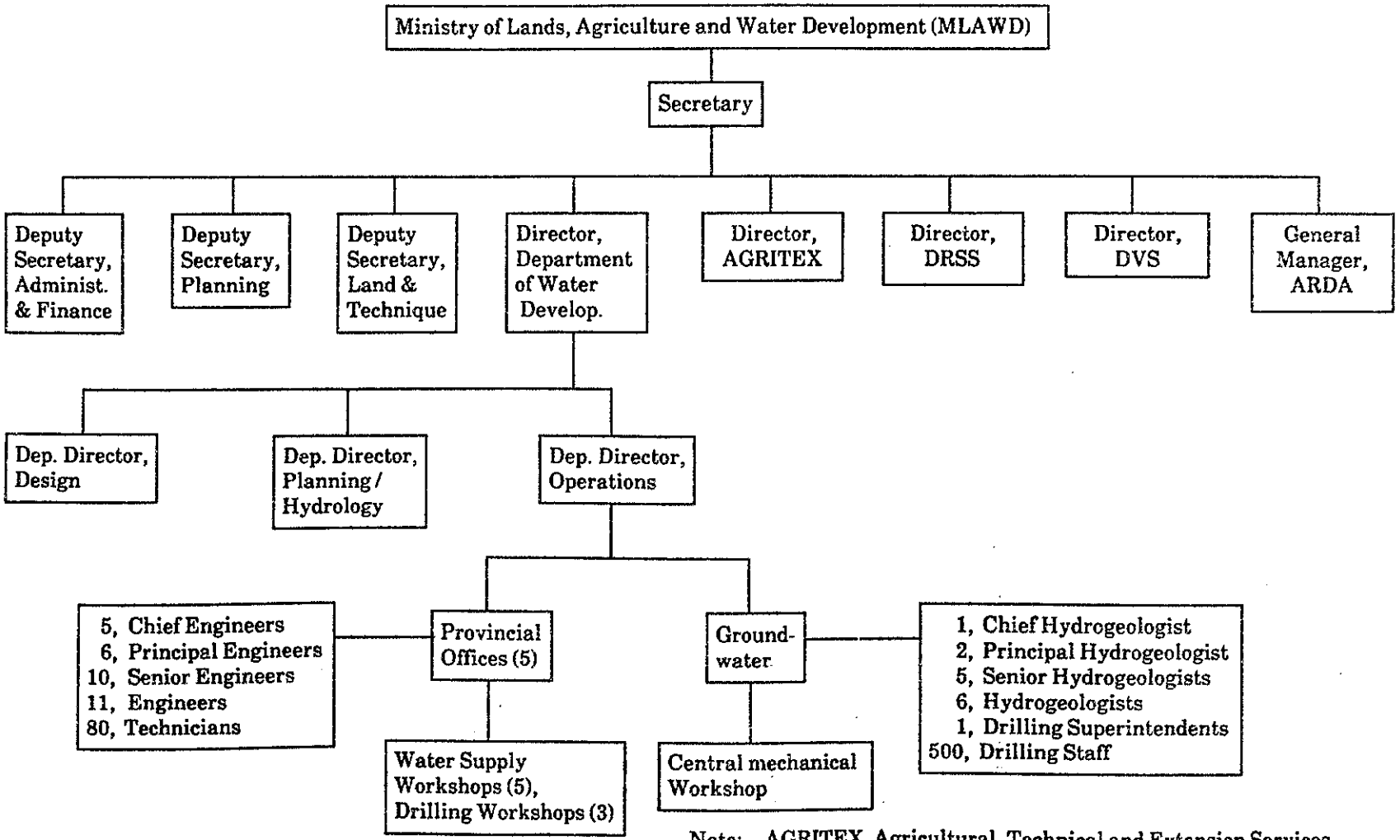
The Provincial Water Engineer assigned to each Provincial Office is responsible for surface/groundwater development and water supply planning, etc. to be executed in the Province.

(2) Operating Body

The Government of Zimbabwe established the National action Committee (NAC) to implement the Rural Water Supply Project mentioned in the Master Plan Report, and formulated the National Rural Water Supply and Sanitation Programme (NRWSSP) for all fifty-five districts and initiated it as the "Integrated Rural Water Supply and Sanitation Project (IRWSSP)" on July 1987.

IRWSSP is under execution by the NAC which is an interministerial organization headed by MLGRUD as shown in Table 4-3-1. The activities concerning the borehole construction works are as follows.

FIGURE 4-3-1 ORGANIZATION CHART FOR THE MINISTRY (MLAWD) AND DEPARTMENT OF WATER DEVELOPMENT (DWD)



Note: AGRITEX, Agricultural, Technical and Extension Services
DRSS, Department of Research and Special Services
DVS, Department of veterinary Services
ARDA, Agriculture and Rural Development Authority

FIGURE 4-3-2 ORGANIZATION CHART FOR MASHONALAND PROVINCIAL OFFICE

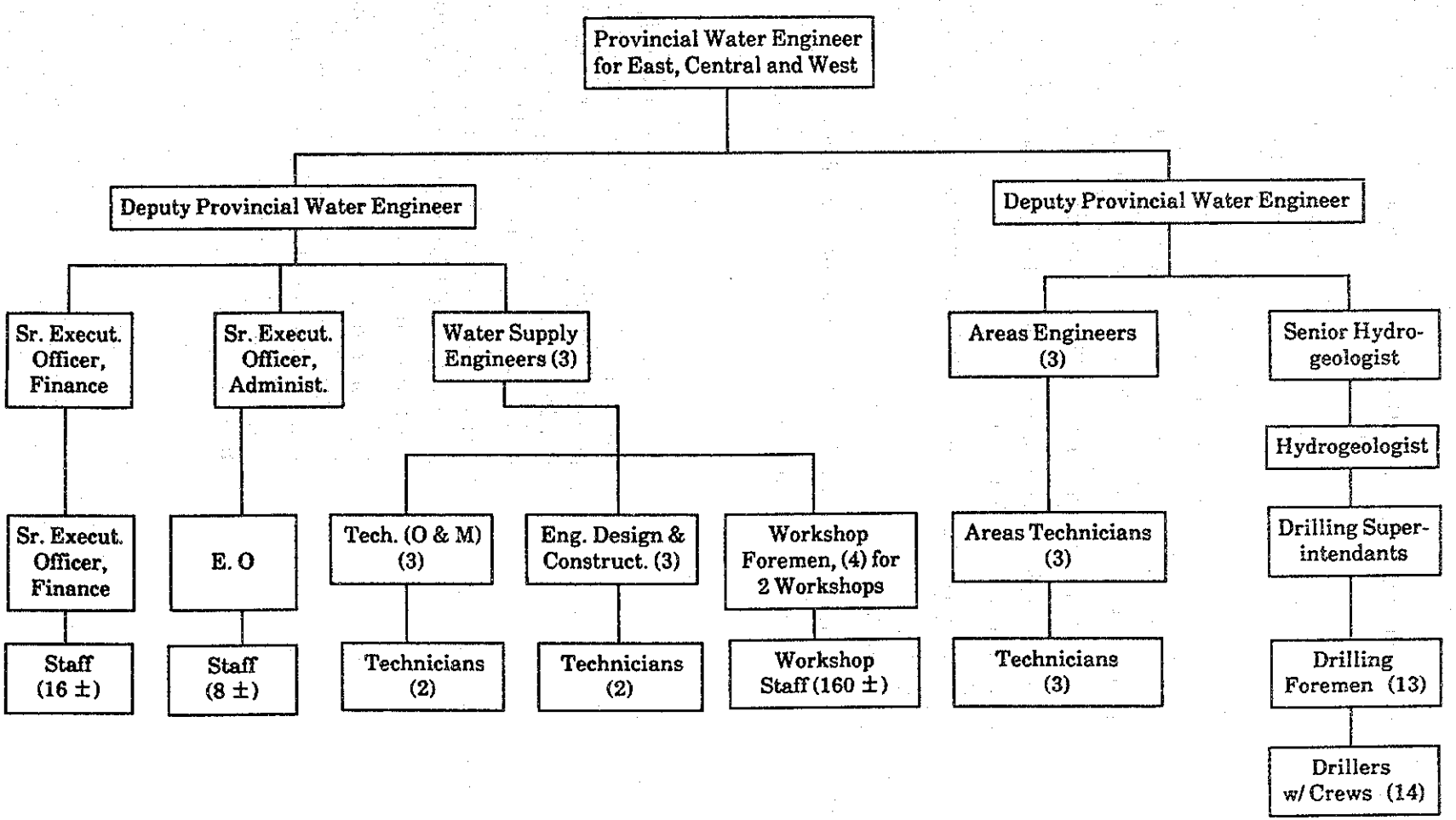


TABLE 4-3-1 DIVISION OF RESPONSIBILITIES AMONG GOVERNMENT AGENCIES

Source: Plan of Operation for IRWSSP,
First Draft, June 1993

MLGRUD	:	Planning, monitoring, coordination and reporting
DDF	:	Well sinking, borehole drilling, rehabilitation, construction of headworks, operation and maintenance, piped water supply, and training
MLAWD	:	Hydrogeological surveys, borehole drilling and piped schemes
MOHCW	:	Sanitation (Blair latrines), construction of shallow wells, spring protection, health and hygiene education, and training
MNAECC	:	Community mobilization and participation, monitoring of community inputs and training
AGRITEX	:	Land use planning
MOF	:	Donor coordination, control of funds and programme monitoring
NEPC	:	Project appraisal and evaluation

- Planning : Planning for new water sources is to be executed through the following steps, 1) proposal by the District Office, proposal by the Provincial Office, approval by the NAC and final approval by the NEPC.
- Borehole Construction: The construction works is, so far, responsible for DWD. And DDF is now under preparation of joining this field.
- Maintenance : The maintenance of the completed boreholes is, so far, the responsibility of the DDF. The Government aims to shift the maintenance system from the DDF to the local users in the near future.

4-3-2 Project Planning

(1) Components of the Project

The Zimbabwe's project is a part of the IRWSSP with a target of construction of 432 boreholes and 267 deep wells. This Project, however, covers the procurement of equipment and materials required for the construction of 400 boreholes and the construction of 40 boreholes which aims on-the-job training.

The boreholes, other than those constructed by Japanese side, will be constructed by the DWD. The DWD will continue the IRWSSP planned in other districts using the equipment supplied under this Project together with those supplied under past Japanese Projects.

(2) Project Planning

The Project is to be planned as follows.

i) This Project is to be linked with the IRWSSP and is to construct 400 boreholes in UMP and Hwedza Districts. The successful rate for the borehole construction work is estimated as 80 percent during the IRWSSP. The Project Area, however, is not endowed with easy-to-develop groundwater, so it will be difficult to sustain 70 percent successful rate for UMP District where is more difficult than Hwedza.

ii) The borehole will be equipped with a handpump and headworks. The borehole diameter is to be 100 mm for holes to be encased by PVC pipes and 150 mm for holes to be encased by steel casing considering the clean up work which might be required in future.

iii) The Project is to be conducted on the a premise of Japanese grant aid mentioned below;

- Procurement of the equipment and material necessary for borehole construction works

- On-the-job training experience through the 40 of borehole construction works

4 - 3 - 3 Outline of Equipment and Facility

The outline of the facilities to be constructed and equipment and materials to be procured for this Project are shown in Table 4-3-2 with comparisons drawn between requested and planned ones.

The requested handpumps are to be procured by the Government of Zimbabwe considering their availability with local currency in Zimbabwe. However, 40 boreholes will be equipped with handpumps which are to be constructed for on-the-job training assisted by Japanese staff.

An outline of the this is shown below.

(1) Borehole Facility

The borehole depth is planned to be 50 m on average with a range of 30 to 80 m. The borehole diameter is to be 100 mm for PVC casing and 150 mm for steel casing. Grout sealing for a minimum 6.0 m will be performed to prevent contamination by waste water.

(2) Headworks

The headworks, concrete made and 20 cm thick, will be placed arrounding the borehole to protect its head and to allow over flow.

(3) Equipment and Materials

The following equipment and materials are necessary for the borehole construction works.

TABLE 4-3-2 OUTLINE OF FACILITY AND EQUIPMENT AND MATERIALS

	Description	Quantity	
		Planned	Requested
I. Facilities :	- Borehole facility with a handpump	40	40
II. Equipment and Materials :	- truck-mounted top-head-drive rotary drilling rig;	2 units	2 units
	- standard accessories and tools for the above;	2 lots	2 lots
	- high-pressure air-compressor;	2 units	2 units
	- cargo truck with 4-ton crane (4×4);	-	
	- cargo truck with 3-ton crane (4×4);	4 units	-
	- pick-up track (4×4);	4 units	4 units
	- station wagon (4×4);	2 units	2 units
	- geophysical equipment;	2 lots	2 lots
	- borehole test equipment (borehole logger);	2 lots	2 lots
	- radio-telephone system;	2 lots	2 lots
	- drilling supporting equipment;	2 lots	2 lots
	- trailor-mounted mobile workshop with necessary equipment and tools;	2 lots	2 lots
	- handpumps;	(40) *1	400 units
	- submersible-motor pump with diesel generator;	3 units	3 units
	- spare parts for the above equipment;	1 lot	for 3-years
	- PVC casing pipes;	40 B/Hs	100 B/Hs
	- steel casing;	360 B/Hs	300 B/Hs
	- drilling agent;	1 lot	1 lot
	- spare parts for phase-2 equipment;	1 lot	1 lot

Note: *1 included in the category of construction.

1) Drilling Rig

Because of the hydrogeological conditions in the Project Area, a truck-mounted drilling rig with both the function of rotary for soft layer and DTH for hard formation is required. The model of the rig will be in the same class as the rig supplied under Phase-1 Project.

Two required rigs are necessary from the view point of the construction schedule mentioned below.

The progress of IRWSSP in the Project Area is shown in Table 2-5-1. The number of completed boreholes as of end of August 1993, was only 53 with 379 remaining. The remaining 370 are scheduled to be complete by 95/96 in Hwedza and 96/97 in UMP Districts. So, the required number of rigs is calculated as follows.

- Remaining Boreholes : 432 - 53 = 379
- Required annual progress: 70 ~ 75, drilling of 100 ~ 107 holes with success rate of 70%
- Years to the target : 2.5 in average
- Required rigs : 379 ÷ (70 ~ 75) ÷ 2.5 years = (5.4 ~ 5.1) ÷ 2.5 = 2.2 ~ 2.0 ≒ 2 rigs

2) Air-compressor

An air-compresor is to be prepared for each rig.

3) Supporting Vehicles

The construction work will be conducted by teams of borehole drilling, borehole testing, headworks construction and pump installation. The vehicles necessary for these teams are composed of tool tucks, cargo trucks, pick-ups and station wagons. In addition these vehicles, a break-down recovery truck is required for transportation of damaged

trucks from the site to Harare, Central Work Shop even though light damage can be repaired within the workshop located in the District.

The technical specifications and their major purposes are shown in section 5-4, Basic Plan of Equipment and Materials.

4) Geophysical Equipment

The following geophysical equipment is necessary for the siting.

- Electro-Magnetic (E-M) Instrument:

  E-M will be used for rough investigation prior to geoelectric prospecting.

- Geoelectric (GEP) Instrument:

  This instrument will be used for aquifer prospecting. The prospecting depth is to be more than 100 m.

5) Borehole Test Equipment

The borehole test equipment is composed of a borehole logger to inspect aquifer depth for encasement planning.

6) Radio-telephone System

Radio-telephone systems are required for communications between the drilling site and the Base camp/Provincial Office.

7) Mobile Workshop

A trailer-mounted workshop is necessary to make repairs at drilling site.

8) Handpumps

The Zimbabwe-made Bush pump will be equipped at the borehole. The pump is to be provided by the Zimbabwean side.

9) Submersible-motor Pump

A submersible-motor pump is necessary to execute borehole tests, pumping tests. A pump is also required at the site camp to ensure water supply at site. A total of three pumps are to be provided for the Project.

10) Casing Pipe

Two kind of the casing pipes, PVC and steel made, are requested. The borehole encased by PVC from top to bottom is permanently safe from collapse of borehole wall. PVC pipe, however, is susceptible to deforming during long-term storage in the open. On the other hand, the boreholes encased by steel pipes are widely used in Zimbabwe are familiar to the DWD staff.

From the points mentioned above, the casing to be used for the Project is to be as follows. The casing used by the Zimbabwean side is to be of steel while that used by the Japanese side is to be of PVC.

11) Drilling Agent

The following drilling agents are necessary for the borehole drilling.

- Air-foam for DTH drilling
- Fluid agents for rotary drilling

12) Spare Parts for Phase-2 Equipment

The spare parts requested on the occasion of the field survey are to be procured under this project based upon the results of the field survey.

4 - 3 - 4 Operation and Maintenance Plan

The objectives of the Operation and Maintenance (O & M) are the following:

- O & M for the completed boreholes
- O & M for the equipment supplied under the Project

(1) O & M for the Completed Boreholes

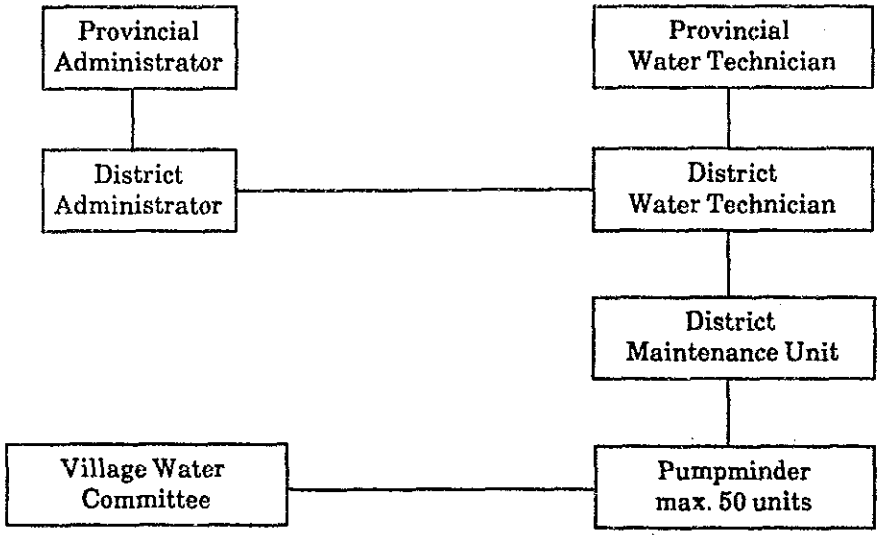
The maintenance of the completed boreholes is the responsibility of the DDF at the moment. It will, however, be shifted to the Users along with the maintenance costs under the establishment of the organization shown in Figure 4-3-3. This is the intended Government Policy and it can be considered that this intention will be successfully carried out due to the continuous efforts of the Government.

Total maintenance costs paid by the DDF in 1992 were Z$116,300 for a total of 325 holes. The converted unit cost per borehole of Z$358 is equivalent to Z$1.4 per person when the borehole area is maintained by 250 people. This amount can be owed by the users as the cash income of the inhabitants is extremely.

(2) O & M for the Equipment

The operation and maintenance of the equipment are responsible for the DWD. DWD has its own Central Workshop at the Head Quarter and three Drilling Workshops in the Provincial Offices, as shown in Figure 4-3-1 to ensure the maintenance. The maintenance ability of the DWD is assessed as good judging from the fact that ten-year-old equipment supplied under Phase-1 Project are still satisfactorily working even though some defects exist due to its age. The procurement of spare parts is not easy for the DWD due to a shortage of the foreign currency. DWD has purchased a large amount of spare parts and tools for the equipment of Phase-1 using funds from the World Bank as described in section 2-5. So, it can be said that the DWD will be able to obtain spare parts in future even though it will have to depend for budget on external assistance.

FIGURE 4 - 3 - 3 ORGANIZATION OF HANDPUMP MAINTENANCE



4 - 3 - 5 On-the-job Training and Construction Works

As shown in Section 2 - 4, the Japanese Government extended two times of cooperation for the sector of Rural Water Supply Project.

The on-the-job training to the Zimbabwean staff was included in the above Projects. Following this experience, the request for on-the-job training, 3 experts for 6 months, was included in the original request for this Project. This issue was strongly expressed by DWD through the discussions with the study team in Zimbabwe.

It has been confirmed by the team that three of the rigs have been properly and satisfactorily maintained and operated by the DWD staff who received on-the-job training from the past Projects. From this satisfactory result, on-the-job training is to be included in this Project. The requested period, however, is rather longer than usual cases, so this training is to be conducted through the actual construction and siting works for a period adequate for a necessary period for the training.

CHAPTER 5. BASIC DESIGN

5 - 1 Design Policy

The basic design of the Project will be conducted in line with following basic policies and concepts taking into consideration the particular conditions such as undeveloped infrastructure, difficulty of access to the site during rainy season, the hydrogeology of Precambrian formations to be drilled and the system of Japanese grant aid;

(1) Natural Conditions

The progress rate of drilling is deeply affected by rainfall which also make accessibility difficult. So, the progress rate of drilling work during the rainy season is to be reduced.

(2) Social Conditions

No social conditions exist in the Project Area which could inhibit the Project execution.

(3) Construction Circumstances

There is no difference in construction circumstances compared with other African countries. Two-days off per week is adopted in the country; however, saturday working, is not special in the case of construction works with some adequate compensation.

It can be generally said that permanent workers have working levels in accord with their positions and/or specialities; temporary workers, however, should have working levels for casual and routine workers only.

(4) Availability of Local Contractors and Materials

Reliable Consultants and Contractors are available in Zimbabwe and DWD employs them when required. A total of six Zimbabwean Contractors have been awarded the Contract by International Bidding for the Urgent Drought Relief and Mitigation Project through the World Bank Loan mentioned in section 2-5.

However, this Project mainly aims at procurement of Equipment and Materials which are to be used by DWD's construction works and at on-the-job training to DWD staff. From this point of view, the construction works allocated to the Japanese side is to be carried out by a Japanese Contractor without subcontractors, or local contractors.

The local materials available in Zimbabwe are to be used as far as possible. In Zimbabwe, there are few problems regarding procurement of the local materials.

(5) Maintenance Policy by the Executing Agency

The plan of operation and maintenance is shown in section 4-3-4 and can be summarized as follows.

The DWD, the executing agency, is responsible for the borehole construction and the DDF is responsible for the maintenance of the completed boreholes. The maintenance system is to be shifted to the users in the near future, however, after shifting of the system, DDF will be responsible for assistance and supervision of borehole maintenance.

The DWD is also responsible for the maintenance of the equipment, and it will be justified to expect the DWD to maintain and manage the equipment the same as in past performances.

(6) Policies for the Types of Facility and Equipment

The type of borehole facility is to be one which is familiar to users, so that design of the facility will follow the type widely used in Zimbabwe. The existing borehole facilities have never caused any problems and satisfied by the users.

The type and/or models of the equipment are to be the minimum to satisfy the required construction work of the Project. The drilling rig capacity, however, is necessary to recover from unforeseen accidents. The most serious accident is a collapsed wall, so the rig model will be selected taking into consideration the above circumstances.

A mobile workshop equipped with essential tools is required to do repairs at the drilling site, and other miscellaneous equipment required for the drilling are to be the Contractor's equipment.

(7) Policy for the Implementation Schedule

The implementation schedule must be completed within one year which is the restriction according to Japan's grant aid policy. It is estimated that a total of eight (8) months are necessary for completion of 40 successful boreholes and eight to nine (8 ~ 9) months for the procurement of equipment, including manufacturing. The implementation schedule for the Project is to be divided in two stages, the first stage is for the procurement of the equipment and materials and the second stage is for on-the-job training through the construction work. It is considered that the period for construction of 40 boreholes is enough to conduct on-the-job training.

5 - 2 Examination of design Criteria

5 - 2 - 1 Project Area

The project area is UMP and Hwedza Districts as shown in the Location Map attached in the Head of the Report. The borehole drilling is under execution by the Zimbabwean side as described in section 2-5, (4). The drilling work allocated to the Japanese side is to be conducted in UMP District which is scheduled for completion later than Hwedza.

The plans for the procurement of equipment and materials and the drilling schedule are shown below. The former is prepared for the whole Project Area and the latter for UMP District only.

The natural conditions, hydrogeological conditions and so forth have been described previously and the following factors will be noteworthy in preparing the plan of operation.

(1) Social infrastructure such as roads, communications, accommodation facilities are poorer than in Hwedza.

(2) Pfungwe C.L. in UMP is rather an arid zone and it is difficult to develop groundwater. It is located in the lower portion of the District and affected by Malaria. The planning will reflect these difficult conditions in Pfungwe C.L.

(3) From the hydrogeological point of view, UMP District can be divided into the following four sub-units even through most of the district is composed of granites and gneisses with low potentiality for groundwater development (see Figure 3-4-1).

- Granites and gneisses
- Bulawayan group
- Shamvian group
- Dolerite

5 - 2 - 2 Water Demand and Population

The basic figures shown in the Master Plan Report for rural water supply by borehole are as follows;

- Water demand : 30 ℓ/cd
- Served population : 250 persons/borehole

The above figures are to be considered as reasonable taking into consideration the rural water supply from boreholes equipped with handpumps. So, this report uses these figures for planning.

The Project's total served population is calculated on the basis of, 400 B/Hs × 250 persons = 100,000.- equivalent to 64 percent of the Project area's total population of 156,000 persons in 1992.

5 - 2 - 3 Factors of Proposed Borehole

(1) Borehole Diameter

The borehole diameters are to be 150 mm for those to be constructed by the Zimbabwean side and 100 mm for those to be constructed by the Japanese side.

(2) Borehole Depth

The borehole depth is planned at 50 m after rounding of the average depth, 47.0 m, of existing boreholes. The actual borehole site and depth will be decided based on the results of the geophysical prospecting.

(3) Success Rate

The success rates executed in UMP District were as follows;

- IRWSSP, 9 holes out of 13 holes : 70%