5-2-2. Water Demand and Population

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

Water consumption:	30 lcd/borehole
Served population:	250 persons/borehole

On the other hand, the basic figures in the Feasibility Study Report for the Phase 1 Project are as follows:

Water consumption:	15 lcd/borehole
Served population:	250 persons/borehole

The water supply quantity by borehole eqipped with the hand pump is usually not derived from yield capacity of the borehole but from the capacity of the facilities. The maximum pumping capacity of the hand pump is normally limitted within 900~1,000 l/hr under full continuous operation.

The urgently needed number of boreholes is 870 as shown in Tab.2-4-3, so the total number of 40 to be constructed under the Project is only a small part of the needed number. It can be said that this number of 40 is a kind of emergency measure.

The populations benefited by each borehole of the Project, as reported by Field Officer of Water of DDF, are given in Tab.5-2-1 and the total population was 27,000 persons. Therefore, the benefited population per borehole is 675 on an average. This population is much bigger than the 250 persons programmed in the Master Plan/Feasibility Study, and this figure shows that many more boreholes will be required.

Table 5-2-1 (1). List of Proposed Boreholes in Gokwe Area (1)

No.	Sub-area	Elevation (m)	Proposed B/H Dia (mm)	Proposed B/H Depth* (m)	Geology (m) Ka	Ba	SS	MS	Base	Population	Remarks
P-1	I	1,170	100	90	20	40	30	-	-	520	
P-2	I	1,220	100	90	50	40	-	-	-	900	
P-3	I	1,150	100	90	10	20	60	-	-	450	
P-4	III	700	100	80	-	-	80	-	-	400	
P-5	I	1,130	100	70	-	-	70	-	-	510	
P-6	III	750	150	250	-	-	50	200	-	700	
P-7	III	700	150	250	-	-	50	200	-	620	
P-8	II	1,065	100	50	-	-	-	-	50	690	
P-9	II	1,100	100	50	-	-	-	-	50	500	
P-10	I	1,100	100	70	-	-	70	-	-	460	
P-11	II	1,100	100	80	-	-	80	-	-	600	
P-12	II	955	100	80	-	-	80	-	-	620	
P-13	II	1,160	100	80	-	-	80	-	-	520	
P-14	II	800	100	50	-	-	-	50	-	650	
P-15	II	1,100	100	80	-	-	80	-	-	500	
P-16	II	950	100	80	-	-	80	-	-	490	
P-17	I	1,250	100	60	-	60	-	-	-	510	
P-18	III	920	100	80	-	-	80	-	-	600	
P-19	I	1,125	100	90	10	20	60	-	-	500	
P-20	I	1,200	100	60	-	60	-	-	-	450	

Note; Ka-Kalahari Sands, Ba-Basalt, SS-Sandstone, MS-Mudstone, Base-Basement Complex
* Projected depth

Table 5-2-1 (2). List of Proposed Boreholes in Gokwe Area (2)

No.	Sub-area	Elevation (m)	Proposed B/H Dia. (mm)	Proposed B/H Depth (m)	Geology (m) Ka	Ba	SS	MS	Base	Population	Remarks
P-21	I	1,000	100	70	-	-	70	-	-	580	
P-22	II	800	100	80	-	-	80	-	-	610	
P-23	III	850	100	80	-	-	80	-	-	700	
P-24	II	1,140	100	80	-	-	80	-	-	620	
P-25	II	1,150	100	80	-	-	80	-	-	650	
P-26	II	1,100	100	80	-	-	80	-	-	720	
P-27	III	855	150	250	-	-	50	200	-	510	
P-28	I	1,150	100	70	-	-	70	-	-	490	
P-29	II	730	100	80	-	-	80	-	-	600	
P-30	I	1,150	100	90	10	10	70	-	-	480	
P-31	III	800	150	250	-	-	50	200	-	350	
P-32	II	650	100	80	-	-	80	-	-	710	
P-33	II	700	100	50	-	-	-	50	-	690	
P-34	III	850	150	250	-	-	50	200	-	640	
P-35	II	950	100	80	-	-	80	-	-	610	
P-36	II	850	100	50	-	-	-	50	-	700	
P-37	III	850	100	80	-	-	80	-	-	700	
P-38	II	1,050	150	330	-	-	240	90	-	1,800	Engine Pump
P-39	II	750	150	250	-	-	120	130	-	1,800	Engine Pump
P-40	II	1,100	150	250	-	-	250	-	-	1,900	Engine Pump
Total				4,460	100	250	2,640	1,370	100	27,050	

5-2-3. Yield and Rest Level of Borehole

(1) Yield

There are no problems in equipping a borehole with a hand pump other than a depth limitation, if a borehole has a yield bigger than 0.9 - 1.0 m^3/hr, which is equivalent to pumping capacity. One of the criteria of successful boreholes in Zimbabwe is Q = 1 m^3/hr (≒ 0.25 l/sec), so this criterion will be fulfiled in principle in the Project. However, pumping is always suspended for the change of a bucket or other reasons, so considering a suspension of operations, it can be said that a yield of even 0.17 l/sec would be practically sufficient as the yield of a borehole equipped with a hand pump. In fact, it is precious water in an area where groundwater development is difficult, even if borehole yield is only 0.10 l/sec. It is not rare in Zimbabwe to install a hand pump on the boreholes of which yields are but small quantity as mentioned above.

Taking into account the above, the criteria on yield by hand for the Project is decided at 0.10 l/sec or more, and a borehole whose yield ranges between 0.1 to 0.2 l/sec will be equipped with a hand pump for its users.

(2) Rest Level

It is desirable that the maximum rest level depth be not deeper than 40 m for hand pump operation by women or children who have limited strength. But in Gokwe area it is the actual situation that boreholes of which rest level is not deeper than 60 m are used. So, for the Project the boreholes with rest levels not deeper than 60 m will be equipped with usual hand pumps, and the boreholes with rest levels deeper than 60 m will be equipped with improved special hand pumps. For the boreholes whose rest level is deep, some measures

such as use of a long handle and/or a weighter for balance shall be taken for easier operation.

5-2-4. Examination on Factors of Proposed Boreholes

(1) Borehole Sites

The proposed borehole sites total 40 in number as shown in Fig.3-3-1. These sites are urgently requested by the Zimbabwean side.

(2) Borehole Depth

Borehole depth at each site has been tentatively estimated as shown in Tab.5-2-1, taking into consideration such conditions as the land elevation, geological formation and geological structure shown on hydrogeological maps. These depths involve many unknown factors, and concrete ones shall be decided based upon the results of geophysical surveys which will be carried out in advance of actual drilling.

(3) Success Rates

The success rates for the Project are determined as follows, taking into consideration the facts that the records of dry holes are easily lost and that the sites for groundwater development are shifting from easy points to difficult points.

Subarea in Gokwe	Success Rate of Exist.B/H Below 100 m	100 m or Over	Success Rate of Project Below 100 m	100 m or over
Southwest	91	16	80	none
Central	69	50	50	50
(SS/MS* area)	(61)	(33)		
Northeast	77	57	70	50

* SS: Sandstone
MS: Mudstone

5-2-5. Site Selection

Site selection is one of the most important factors for the construction of successful boreholes. The methods of siting are mainly composed of geophysical prospecting such as GEP, E-M and/or seismic prospecting. However, it is also important to make a judgement on local conditions such as vegetation, lithofacies,and microtopography together with experience in the area.

MEWRD has geophysicists and hydrogeologists at its Head and Provincial Offices. The site selection will be executed by siting team(s) of MEWRD who are well versed in local conditions with assistance of Japanese engineer(s).

The siting methods are as follows;

(1) Analysis by Landsat Imagery
(2) Analysis by Airphotos
(3) E-M prospecting for deep boreholes
(4) GEP for shallow boreholes

5-3. Design of Facilities

5-3-1. Design of Boreholes

The borehole should be deeper than 30 m and have a six meters grout sealing zone at the minimum so as to secure safe and stable water and to protect water quality from contamination caused by the infiltration of surface water.

As described in Section 5-1, boreholes will be equipped with hand pumps, however, there are some sites where users are many and where hand pumps cannot lift water due to the deep rest level. For those sites with deep boreholes, the installation of engine pump in the future is being taken into consideration in planning to provide larger yield necessary to satisfy a big demand by many users.

Borehole diameter will be 100 mm for hand pumps as the same as in the Phase 1 Project, and for engine pumps it is decided at 150 mm. These diameters are most common in Zimbabwe.

The borehole types are designed as shown in Figs. 5-3-1 and 5-3-2, based on examination results of hydrogeology and results of the Phase 1 Project. Fig. 5-3-1 is prepared for shallow boreholes (under 100 m depth), and Fig. 5-3-2 shows a design of deep boreholes (100 m deep or more).

5-3-2. Design of Head Works

The types of head works for boreholes are standardized in Zimbabwe, and one of them has been applied to the Phase 1 Project. The same design will be adopted to the Project.

The designs of head works are given in Fig. 5-3-3.

Fig. 5-3-1 DESIGN OF SHALLOW BOREHOLE, UNDER 100m DEPTH

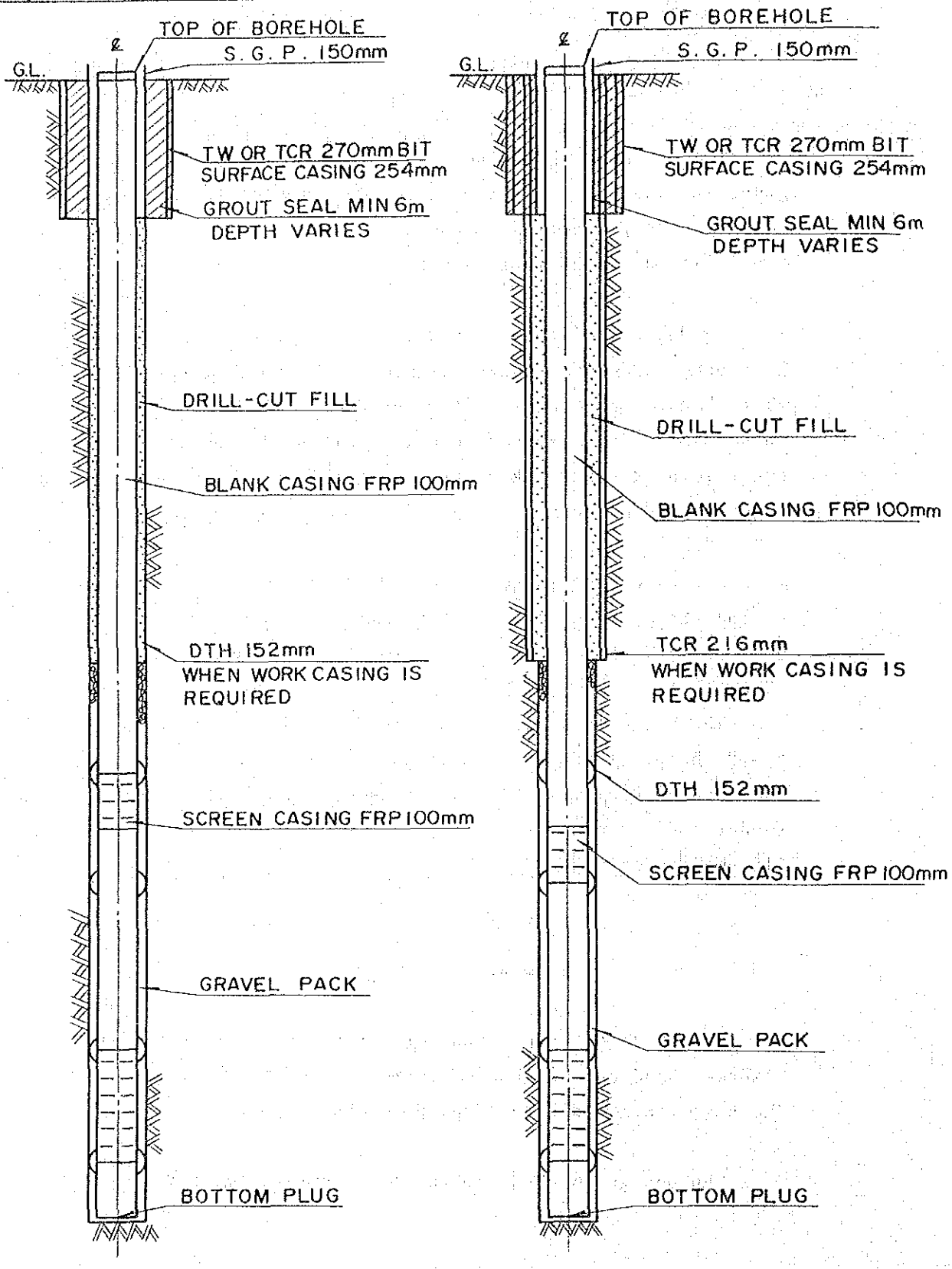
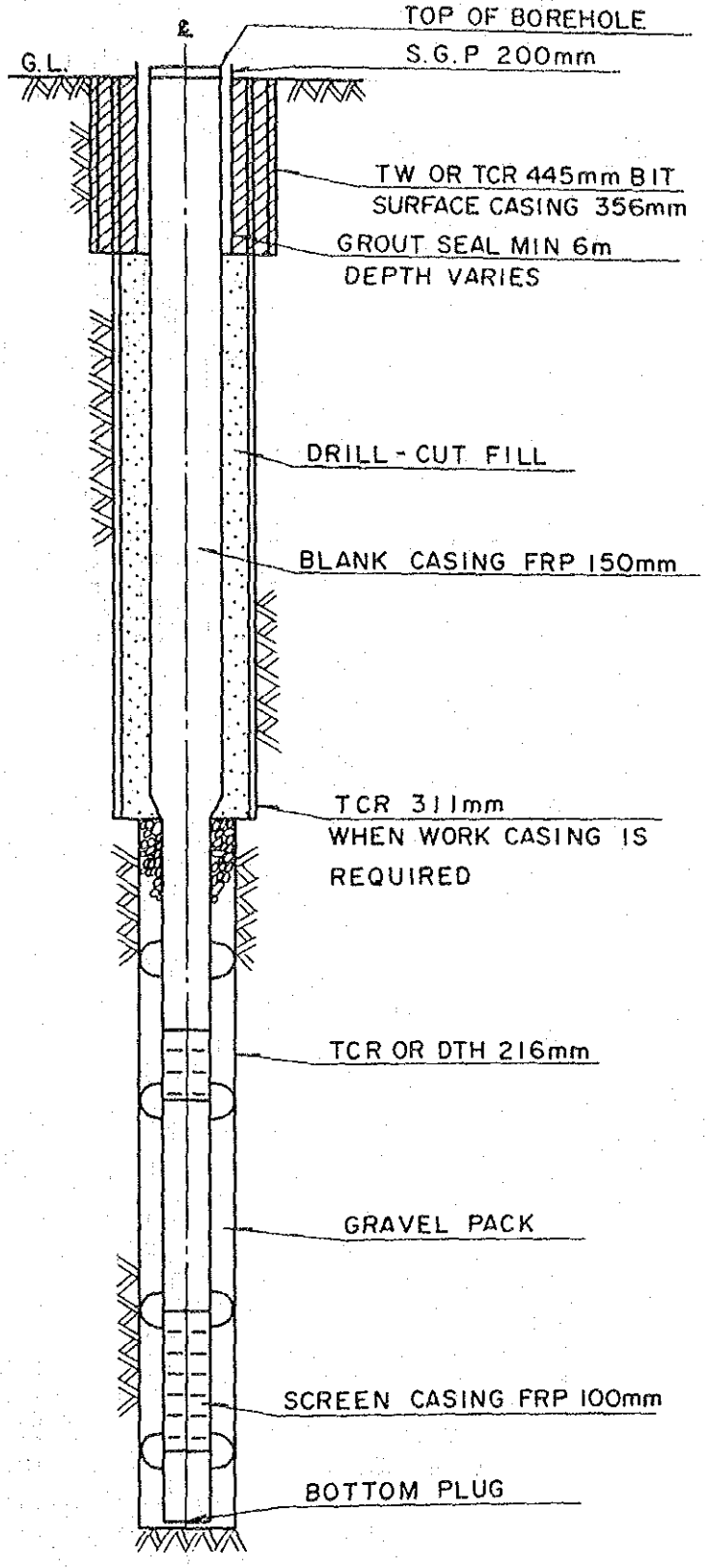


Fig.5-3-2 DESIGN OF DEEP BOREHOLE, OVER 100m DEPTH



TYPE B

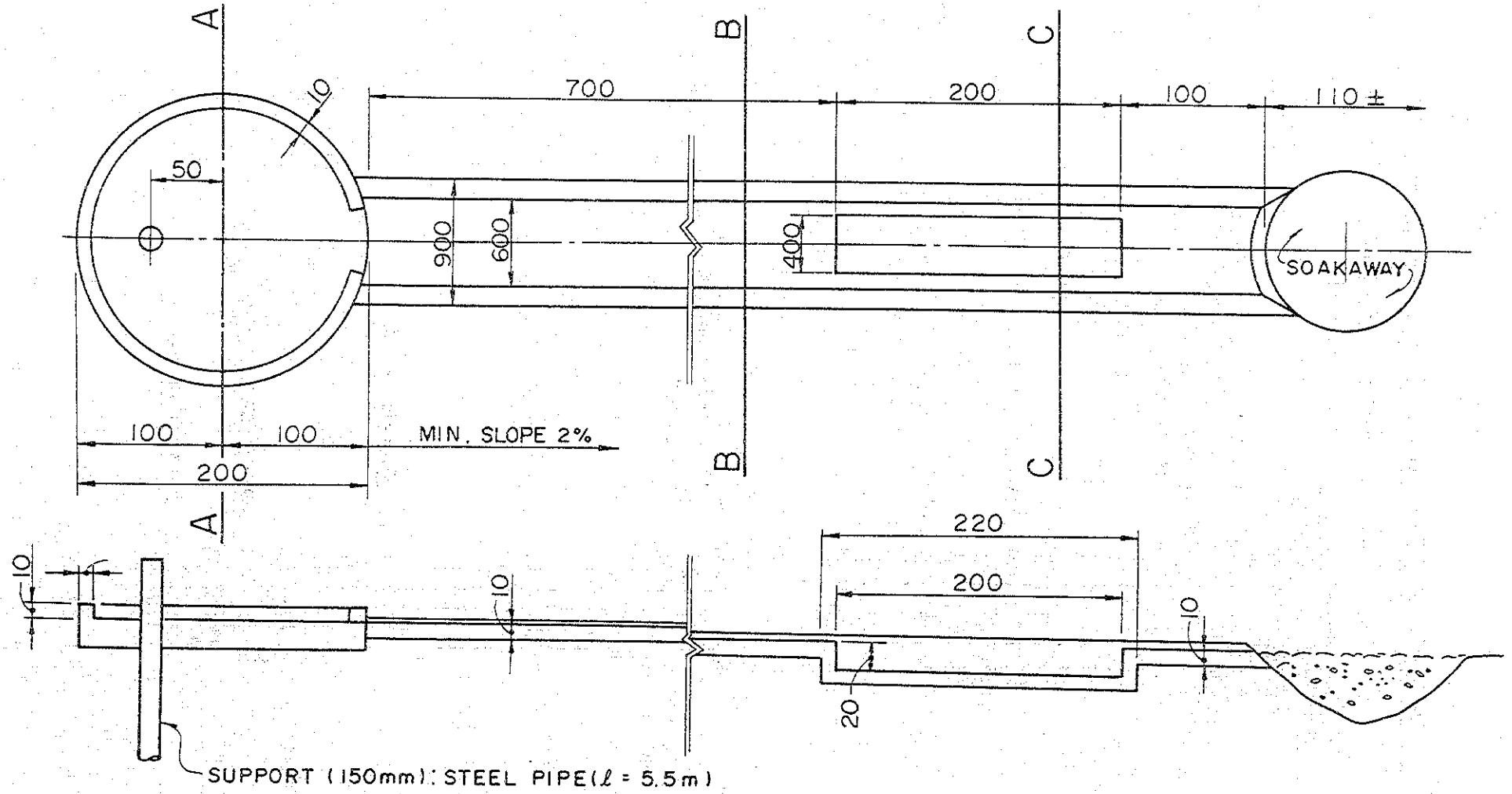
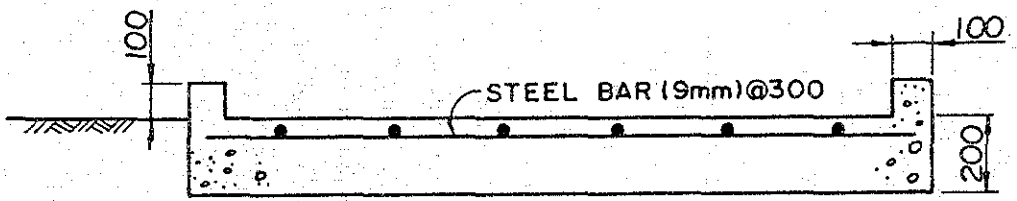
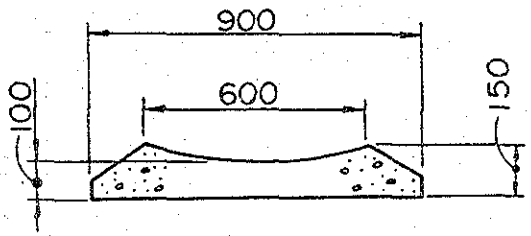


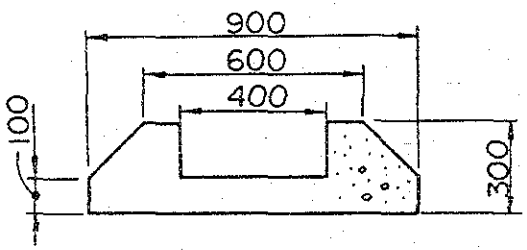
Fig. 5-3-3(1) PLAN AND PROFILE OF HEAD WORKS
S = 1:40 (Unit cm)



SECTION A-A S = 1:20



SECTION B-B S = 1:20



SECTION C-C S = 1:20

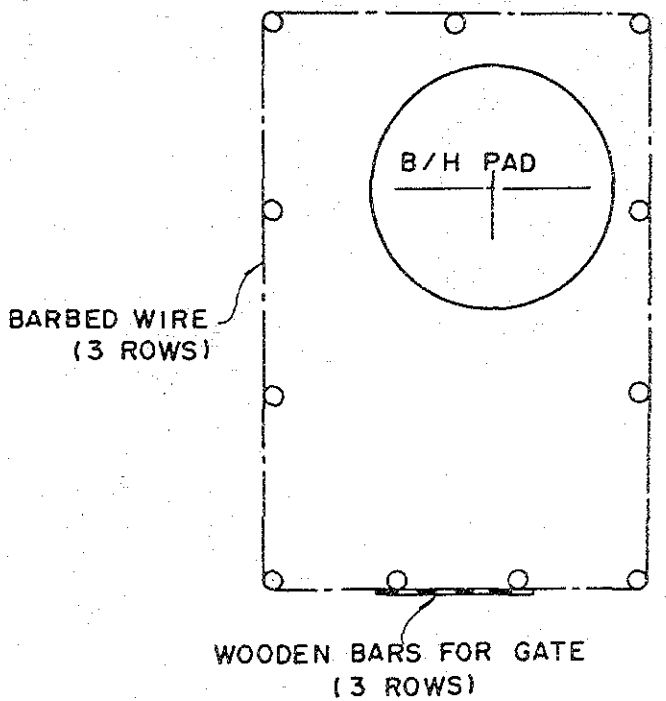


Fig.5-3-3(2) DETAIL OF SECTIONS AND PLAN OF FENCE

5-4. Basic Plan of Equipment and Materials

5-4-1. Selection of Major Equipment and Materials

The following major equipment and materials are necessary to implement the Project.

(1) Drilling rig
(2) High pressure aircompressor
(3) Supporting vehicles
(4) Geophysical prospecting equipment
(5) Borehole testing equipment
(6) Permanent casing pipes
(7) Water analysis kit
(8) Hand pump
(9) Radio system
(10) Engine welder
(11) Concrete mixer
(12) Mudwater agents
(13) Mobile workshop
(14) Spare parts

The said equipment and materials are selected as shown below;

(1) Drilling Rig

The Project Area mainly consists of granites, basalt, sandstone, mudstone and alluvial sand. A top-head-driven rotary drilling rig is most advantageous for high drilling performance at economical cost for hard/soft formations. Besides, the rig shall be capable of both mud-water circulation drilling and down-the-hole (DTH) drilling for high speed drilling of hard rocks. The type of rig shall also be capable of applying pressurized air as well as mud-water drilling fluid in order to cool the drill bit and to

exhaust drill-cut from the borehole, so as to meet the operating requirements where water is not easily available.

The rig is to be mounted on a carrier truck so as to be able to move speedily. The capacity of the rig is to be 300 m at the minimum depth with a 150 mm drill bit.

(2) High Pressure Aircompressor

The aircompressor is necessary to drive air-hammer and air-circulation drilling. The capacity of the compressor shall be at least 25 kg/cm^2 of air-pressure and 24 m^3/min of air delivery.

(3) Supporting Vehicles

The supporting vehicles for the Project implementation are described below. All vehicles are of right side steering and four-wheel drive type in principle. The total number of vehicles required by each working sector and working party is shown in Table 5-4-1.

(a) Cargo truck

i) Tool truck (6x6, 12 ton)

A tool truck with a twelve-ton payload is necessary to transport drilling tools such as drill pipes, casings and drill bits. This truck is equipped with a crane of three tons in capacity to handle heavy steel pipes for drilling work.

ii) Cargo truck (6x6, 12 ton)

Access roads in Gokwe C.L. are very poor, so a cargo

truck is necessary to transport the compressor from site to site. This truck is equipped with a six-ton capacity crane for loading and unloading the compressor. This is also utilized to transport fuel, gravel and container, etc.

iii) Truck for borehole testing and head works construction (4x4: 6 ton)

A cargo truck with a six-ton load capacity and a three-ton crane is necessary for borehole testing and head works parties to load and unload the equipment and materials such as generator, submergible pump, concrete mixer, and hand pumps, etc.

(b) Water Lorry (4x4: 6.0 m^3)

A water lorry of 6.0 m^3 capacity is necessary to supply water for drilling works.

(c) Light Vehicles

Light vehicles are required to transport personnel and materials for the drilling and other related surveys and borehole construction. A station wagon type is suitable for the transport of personnel and a pick-up type for equipment and materials. All the light vehicles shall be of a long-body type.

Table 5-4-1. Types and Numbers of Vehicles Required

Item	Party	Truck (ton) 6	Truck (ton) 12	Lorry	Light Vehicles Pick-up	Light Vehicles Wagon	Total
Supervising	1					1	1
Siting	1					1	1
Drilling	1		2	1	2	1	6
Borehole Testing	1	1					1
Head Works	1						
Total		1	2	1	2	3	9

(4) Geophysical Prospecting Equipment

Two kinds of geophysical prospecting equipment are necessary. Electromagnetic (E-M) equipment is suitable for deep boreholes and geoelectric equipment for shallow boreholes.

The E-M equipment shall have an output of 800W or more. The geoelectric equipment shall be capable of prospecting at more than 100 m in depth.

And together with the above geophysical equipment, it is necessary to study hydrogeological conditions by analizing Landsat Imagery.

(5) Borehole Testing Equipment

The following equipment for borehole testing, electric logging for screen design and pump testing to confirm yield will be procured.

(a) Auto-recording Electric Logger
(resistivity, S.P., density, with 300 m cable)

(b) Submergible Motor Pumps
(for 100 mm B/H, 1 set, for 150 mm B/H, 1 set)

(c) Diesel Generator

(d) Water Level Detector

(6) Permanent Casing Pipes

MEWRD is, in many cases, using 150 mm steel pipes for borehole casings due to difficulty in procurement of PVC pipe in the country. In view of cylinder size, PVC pipes of 100 mm in diameter, which were used in the Phase 1 Project, are sufficient to meet the requirements of the planned boreholes and are cheaper than steel pipes. Therefore, PVC pipes will be procured for the Project. However, PVC has a problem of its strength, if it is installed on a deep borehole with over 200 m in depth, so stronger FRP pipes will be installed on deep boreholes. Consequently, the following two kinds of casing are provided:

- For deep boreholes: FRP with d = 100, 150 mm
- For shallow boreholes: PVC with d = 100 mm

(7) Water Analysis Kit

A simplified water analysis kit is necessary, and it should be composed of 18 items as designated by WHO. The kit is to be of a portable type for field operation.

(8) Hand Pump

A type of Bush pump is widely diffused in the country, which is patented/designated by MEWRD. The Bush pumps were used for the Phase 1 Project, and will be used for the Phase 2 Project as well.

(9) Radio System

The road conditions in Gokwe are poor and no telephone service is available in the rural area. Hence, a radio system for communication between the basecamp and working sites is essential for a scheduled reporting and/or emergency calls for the Project implementation.

(10) Engine Welder

An engine welder is necessary for the welding and cutting of steel materials at borehole construction sites and for hand pump installation.

(11) Concrete Mixer

The head works concrete requirement is about 1.8 m^3 per site in quantity. So, a concrete mixer with engine is required for the construction of head works.

(12) Mudwater Agents

Mudwater agents will be necessary for circulation drilling. In Zimbabwe, bentonite is not allowed to be used for borehole drilling. Therefore, biodegradable agents are selected as the mudwater agent. In addition, a foam agent for DTH drilling is sometimes required to remove drill-cut easily from boreholes and to control scattering of slime around the ground surface.

(13) Mobile Workshop

A mobile workshop and containers for working space are required for repairing equipment and tools at the site of base camp due to a long distance from Gweru workshop of the Provincial Office of MEWRD which is located over 200 km from the sites.

A workshop warehouse will be necessary to move with the base camp and the trailer mounted type will be planned due to its heavy weight.

(14) Spare Parts

Spare parts sufficient for two years normal operation of a rig, vehicles and other equipment shall be secured in consideration of the difficulty of procurement in the country.

5-4-2. List of Major Equipment and Materials

The specifications and quantities of equipment and materials to be procured are described below, based on the examination mentioned before.

(1) Drilling Rig 1 unit

i) Borehole Specifications

Drilling diameter	:	152 mm - 445 mm
Drilling depth	:	over 300 m
Casing diameter	:	100 mm, 150 mm

ii) Drilling Type

Both mud water circulation rotary and DTH

iii) Truck-mounted Type

Truck : Water-cooled diesel engine, 6x6, right hand steering

Drilling capacity: 4-3/4" drill pipe x 350 m

Mud-pump : 1,200 lit/min, 28 kg/cm^2

iv) Standard Accessories and Consumables

(Drilling length 9,000 m) 1 set

Drill pipe	: 4-3/4"	420 m
Work casing	:	1 set
Drill collars, subs:		1 set
Bits, tools for mud-water circulation rotary drilling	:	1 set
Bits, tools for DTH drill:		1 set
Fishing tools	:	1 set
Water and fuel tanks:		1 set
Others		1 set

(2) High Pressure Air-compressor (Skid type) 1 unit

Capacity: 25 kg/cm^2, 24 m^3/min

(3) Cargo Truck with 3 Ton Crane 1 unit

Type : 6x6, right side steering, body length is over 6.1 m

Engine : Water-cooled diesel engine

Load : 12 tons

(4) Cargo Truck with 6 Ton Crane — 1 unit

Type : 6x6, right side steering, body length over 6.1 m
Engine : Water-cooled diesel engine
Load : 12 tons

(5) Cargo Truck with 3 Ton Crane — 1 unit

Type : 4x4, right side steering
Engine : Water-cooled diesel engine
Load : 6 tons
Accessory : Front-winch

(6) Water-Lorry — 1 unit

Type : 4x4, right side steering
Engine : Water-cooled diesel engine
Capacity : 6 m^3
Accessory : Front-winch

(7) Light Vehicles (Station wagon type) — 3 units

Type : 4x4, right side steering, long body
Engine : Water-cooled diesel engine
Accessory : Front-winch

(8) Light Vehicles (Pick-up Type) — 2 units

Type : 4x4, right side steering, long body
Engine : Water-cooled diesel engine
Accessory : Front-winch
Load : 1 ton

(9) Geophysical Prospecting Equipment

i) Geoelectric Prospecting Equipment — 1 unit
Prospecting depth over 100 m
Standard accessories

ii) Electromagnetic Prospecting Equipment — 1 unit
Output 800W or more
Standard accessories

iii) Landsat Imagery — 1 lot

(10) Borehole Logger — 1 unit

Measurement: Temperature, resistivity, S.P., density (Gamma), caliper
Recording : Auto-recording
Cable : 300 m
Standard Accessories (including generator)

(11) Pumping Test Equipment — 1 set

i) Submergible Pump for 100 mm (Q=100 lit/min, H=60 m)
Riser pipe length: 80 m

ii) Submergible Pump for 150 mm (Q=200 lit/min, H=100 m)
Riser pipe length: 200 m

iii) Diesel Engine Generator (50 Hz 390V, 30KVA)

iv) Water Level Detector (100 m cable, 300 m cable)

v) Standard Accessories

(12) Water Analysis Kit 1 set

i) Type : Portable type for field measurement

Items of analysis: turbidity, colour, odour, taste, consumption of $KMnO_4$, pH, nitrate, ammonium N, nitrite N, Cl, Cr, total Fe, Cu, Zn, total hardness, chloride, bacterias, coliform.

Number of sample : 100

ii) pH meter

iii) Conductivity meter

(13) Permanent Casing Pipes

i)	Top casing for supporter (SGP, L=5.5m, D=150mm)	45 Nos.
ii)	" (SGP, L=5.5m, D-200mm)	10 Nos.
iii)	FRP casing pipes (screw type, L=4.0m, D=100mm)	160 Nos.
	FRP screen pipes (screw type, L=4.0m, D=100mm)	70 Nos.
iv)	FRP casing pipes (screw type, L=4.0m, D=150mm)	240 Nos.
	FRP screen pipes (screw type, L=4.0m, D=150mm)	80 Nos.
v)	PVC casing pipes (socket type, L=4.0m, D=100mm)	1,230 Nos.
	PVC screen pipes (socket type, L=4.0m, D=100mm)	460 Nos.
vi)	Socket, Bottom Plug, Adhesive Agents	1 lot

(14) Hand Pumps

Bush Pumps with pipes 140 Nos.

(15) Radio System — 1 lot

i) Power : 100 W
ii) Stations: Fixed 1, Mobile 5

(16) Engine Welder — 1 unit

DC 250A, AC 10 KVA, Diesel Engine

(17) Concrete Mixer — 1 unit

Portable Type, with Diesel Engine
Capacity: 0.25 m^3

(18) Mudwater Agents — 1 lot

i) Air Foam
ii) CMC
iii) Biodegradable Agents

(19) Mobile Workshop — 1 lot

i) Trailer mounted storage house unit (1 No.)
ii) Container for working space (2 Nos)

(20) Workshop Tools and Equipment — 1 lot

5-4-3. Procurement of Equipment and Materials

The equipment and materials provided under the grant aid assistance of the Japanese Government shall be made in Japan or Zimbabwe in accordance with the institutional rules of the grant aid. Therefore, most of them, except for what can be procured in

Zimbabwe, shall be procured in Japan for import to Zimbabwe.

However, as for the aircompressor, MEWRD desires to procure an Atlas product as supplied under the Phase 1 Project because no product made in Japan was available at the time of the Phase 1 Project. In this case, an agreement shall be made on the procurement of a third country's product between both governments in accordance with the contents of the Exchange of Notes.

For this agreement, MEWRD is firstly requested to submit a letter to the Embassy of Japan in Harare explaining the necessity and reasons of the procurement of the third country's product.

5-5. Comparison of Major Equipment included in the Phase 1 and Phase 2 Project

The basic plan for the procurement of equipment and materials under the Phase 2 Project is described in the previous section "5-4". The comparison of the major equipment for the Phase 1 and the Phase 2 Projects is shown in Tab. 5-5-1.

The major different point in the comparison table is that deep borehole drilling in the 300 m depth class is necessary in the Phase 2 Project while the maximum drilling depth was 100 m in the Phase 1 Project. Therefore, a bigger rig and also bigger supporting cargo trucks to cope with heavy drilling tools are required for the Phase 2 Project.

Also the aircompressor is changed to a skid type from the trailer type for the Phase 1 Project, considering road conditions in the country. Thus, a big crane with a 6 ton capacity will be necessary for loading and unloading the compressor.

Table 5-5-1. Comparison of Major Equipment between Phase 1 and Phase 2

	Procured Major Equipment for Phase 1		Planned major Equipment for Phase 2	
Drilling Rig				
Model/Unit	Truck mounted high speed rig	: 2 unit	Truck mounted high speed rig	: 1 unit
Drilling Capacity	100 m with 4-3/4" drill pipe		350 m with 4-3/4" drill pipe	
Carrier Truck	GVW: 14 ton, (4 x 4)		GVW: 25 ton, (6 x 6)	
Air Compressor	P = 17 kg/cm^2, Q=20 m^3/min	: 2 units	P = 25 kg/cm^2, Q = 24 m^3/min	: 1 unit
B/H Testing Equipment				
Logger	Borehole Logger for 100 m	: 1 unit	Borehole Logger for 300 m	: 1 unit
Casing Pipe	PVC (ϕ100 mm)	: 1 lot	PVC (ϕ100 mm), FRP (ϕ100, 150 mm)	: 1 lot
Hand Pump		: 110		: 140
Supporting Vehicles				
Cargo Truck	GVW: 12 ton (4x2), 3 ton Crane	: 5 units	GVW: 22 ton (6x6), 3/6 ton cranes: 1 each GVW: 11 ton (4x4), 3 ton crane: 1 unit	
Light Vehicles	Pick-up (4 units), Wagon (3 units)	: 7 units	Pick-up (2 units), Wagon (3 units): 5 units	
Water Lorry	None		6 m^3 capacity (4x4)	: 1 unit
Camping Facility		1 lot	None	
Radio System	Stationary (1), Mobile (4)	: 5 No.	Stationary (1), Mobile (5)	: 6 No.

CHAPTER 6. PROJECT IMPLEMENTATION PROGRAMME

6-1. Main Body of Project Implementation

6-1-1. Main Body of Project Implementation

The main body of the Project implementation will be MEWRD of the Government of Zimbabwe. The Provincial Office of MEWRD shall be responsible for the following in the Project implementation, and the Head Office of MEWRD shall ensure the necessary budgetary arrangements and mobilization of personnel to the Provincial Office, and coordinate with the Project Manager assigned to the Provincial Office.

(1) Gokwe Area

- MEWRD shall select 40 borehole sites and construct the borehole facilities by using the equipment and materials provided under grant aid by the Government of Japan. For this purpose, MEWRD shall secure the necessary personnel, equipment and materials other than what are provided by the Government of Japan.

- MEWRD shall execute siting and construction with the cooperation of Japanese engineers to be dispatched to Zimbabwe. MEWRD shall continue the remaining works at its own resources after the return of Japanese engineers.

(2) Other Areas

- MEWRD shall construct 80 boreholes using the rigs in its possession. However, permanent casings and hand pumps for the above 80 boreholes will be provided under the grant aid.

The constructed boreholes will be handed over to each District Office of MLGRUD and maintained by the District Development Fund (hereinafter referred to as "DDF").

In addition, MEWRD shall take the necessary measures for the grant aid programme of Japan such as the Exchange of Notes (E/N), bank arrangements, tax exemption, etc., in cooperation with the government agencies concerned.

6-1-2. Consultant

The Consultant will enter into a contract with MEWRD for the following consultant services immediately after signing of the Exchange of Notes for the grant aid assistance to the Project.

a) Preparation of detail design and tender documents for the procurement of equipment and materials as well as a plan to dispatch the Japanese engineers to Zimbabwe.

b) Tendering evaluation of the offered tenders.

c) Witnessing and advising on the negotiations between MEWRD and the successful tenderer.

d) Other necessary technical services.

6-1-3. Contractor (Supplier)

The Contractor shall procure the equipment and materials specified in the contract, transport them to the site designated by MEWRD, dispatch the engineers to Zimbabwe for the contract period for on-the-job training and the transfer of technology to the Zimbabwean staff.

6-2. Responsibilities of the Governments of Zimbabwe and Japan

(1) Undertakings of the Government of Japan

a) Procurement, transport and handing-over of the equipment and materials described in the basic plan of equipment and materials (Section 5-4).

b) Dispatch of the construction engineers and transfer of technology to the Zimbabwean staff for the construction work of boreholes equipped with hand pumps.

(2) Undertakings of the Government of Zimbabwe

a) To complete the Project thoroughly.

b) To secure the necessary number of Zimbabwean personnel for the Project implementation and to bear all the expenses.

c) To procure the equipment and materials necessary for the Project implementation and bear all expenses other than those to be borne by the Japanese grant aid.

d) To acquire land space and right-of-way for the Project works.

e) To ensure tax exemption and customs clearance at a port in Zimbabwe to facilitate the import of equipment and materials for the Project implementation.

f) To ensure the exemption of taxes and duties on all personal goods, equipment and effects which are to be brought into Zimbabwe by Japanese personnel related to the Project.

g) To ensure the safety of Japanese personnel related to the Project.

h) To accord Japanese personnel related to the Project such facilities as may be necessary for their entry and/or re-entry into Zimbabwe and stay therein for the Project.

i) To bear the bank commissions based upon the banking arrangements.

j) To assist in the maintenance for the completed boreholes which will be done by DDF.

6-3. Construction Plan

6-3-1. Construction Plan Policy

The Project shall be completed by MEWRD. And the following construction plan has been formulated taking into consideration the efficiency, estimated construction quantity and the framework of the Japanese grant aid system.

The quantities of construction for the Project implementation are summarized below;

Table 6-3-1. Construction Quantities in Gokwe

B/H Type	B/H Nos.	Drill. Nos.	Dry Holes	Drill. Length (m)	Casing L. (m)
A-1	12	18	6	1,220	820
	(4)	(6)	(2)	(420)	(280)
A-2	20	36	16	2,780	1,560
	(7)	(12)	(5)	(960)	(560)
B	8	16	8	4,200	2,080
	(2)	(5)	(3)	(1,300)	(560)
Total	40	70	30	8,200	4,460
	(13)	(23)	(10)	(2,680)	(1,400)

Note: ( ) shows the quantities to be constructed during the Japanese engineers' stay in Zimbabwe.

The construction works are sub-divided into seven sectors as described below. The works of each sector shall be carried out by each working team for smooth and effective progress of the construction.

a) Project Management

- Coordination and communication with the government agencies concerned, both central and local,
- Supervision of the construction work,
- Management/coordination of the construction schedule,
- Management of standby equipment and spare parts,
- Recording, accounting, and others.

b) Construction Management

- Management/coordination of actual construction schedule and personnel,
- Supply and management of construction equipment and materials,
- Operation/management of base camp, etc.

c) Site Selection

- Selection of borehole sites/access road by geophysical prospecting and other field surveys.

d) Drilling Work

- Moving in/out of the rig and materials,
- Drilling, Logging, Developing of boreholes, etc.,

This drilling work is to be followed up by supporting members for the supply of drilling water and fuel.

e) Borehole Testing

- Borehole tests of successful boreholes to confirm borehole yield and water quality analysis.

f) Head Works

- Installation of hand pump,
- Construction of the concrete structure.

g) Maintenance

- Daily maintenance and management of rig, vehicles and so forth.

6-3-2. Construction Schedule Plan

Based on the construction quantities and plan, the plan of the construction schedule is formulated as follows;

(1) Working Day

Working days in a year for the construction work are estimated as follows, in accordance with customary work and climatic conditions of Zimbabwe.

- Work condition	8 hours per day (8:00AM-5:00PM) 5 days per week 14 days of national holiday per year
- Climatic condition	50% progress rate in rainy season (Dec. to Mar.)

Under the above mentioned conditions, the total holidays and time loss in the rainy season in a year are computed at 161 days as follows:

Weekly holiday:	52 weeks x 2 days	= 104 days
National holiday:		= 14 days
Time Loss in rainy season:	(4 months x 30 - 17 weeks x 2 days) x 50%	= 43 days
Total		161 days

Thus the annual working days are estimated at 204 days (365 - 161), and it is converted to 17.0 monthly working days.

(2) Site Selection

Site selection is to be carried out by pre-decipherment of Landsat Images, aerial photos and topo-maps, and on-the-spot surveys and E-M/GEP prospectings. The on-the-spot surveys will be done by a hydrogeologist for rough survey and selection of site to be surveyed in detail with a progress rate of 3 sites per day (0.3 day/site). The detailed survey requires one day per site. Accordingly, the total days required for selection of one site are 1.8 days, consisting of 0.5 day for office work, 0.3 day for the rough survey and 1.0 day for the detailed survey.

(3) Drilling Work

Drilling times for the three types of boreholes shown in "BASIC DESIGN" are calculated below, provided the drilling speed of;

- Rotary drilling with 445 mm bit, 4 m/hr
- Rotary drilling with 311 mm bit, 5 m/hr
- Rotary drilling with 270 mm bit, 6 m/hr
- Rotary drilling with 216 mm bit, 6 m/hr
- Rotary drilling with 216 mm bit, 8 m/hr
- Rotary drilling with 152 mm bit, 10 m/hr

And drilling speed is to be reduced 10% and 20% after reaching drilling depth of 100 m and 200 m, respectively. Each type of drilling time is as follows.

i) Type A-1 (Hard Formation), Average depth; 70 m

Rotary drilling with 270 mm bit,	6 m ÷ 6 m/hr	= 1.0 hrs
DTH drilling with 152 mm bit,	64 m ÷ 10 m/hr	= 6.4 hrs
Casing work for 254 mm,	6 m ÷ 12 m/hr	= 0.5 hr
Total		7.9 hrs

ii) Type A-2 (Soft Formation), Average depth; 80 m

Rotary drilling with 270 mm bit,	6 m ÷ 6 m/hr	= 1.0 hr
Rotary drilling with 216 mm bit,	34 m ÷ 6 m/hr	= 5.7 hrs
DTH drilling with 152 mm bit,	40 m ÷ 10 m/hr	= 4.0 hrs
Casing work for 254 mm,	6 m ÷ 12 m/hr	= 0.5 hr
Casing work for 172 mm,	24 m ÷ 15 m/hr	= 1.6 hrs
Total		12.8 hrs

iii) Type B (Soft Formation), Average depth; 260 m

Rotary drilling with 445 mm bit,	6 m ÷ 4 m/hr	= 1.5 hrs
Rotary drilling with 311 mm bit,	34 m ÷ 5 m/hr	= 6.8 hrs
DTH drilling with 216 mm bit,	30 m ÷ 8 m/hr,	
	50 m ÷ 7.2 m/hr and	
	30 m ÷ 6.4 m/hr	= 15.4hrs
Rotary drilling with 216 mm bit,	30 m ÷ 6 m/hr,	
	50 m ÷ 5.4 m/hr, and	
	30 m ÷ 4.8 m/hr	= 20.5hrs
Casing work for 356 mm,	6 m ÷ 12 m/hr	= 0.5 hr
Casing work for 254 mm,	34 m ÷ 15 m/hr	= 2.3 hrs
Total		47.0 hrs

Actual working hours of the drilling rig is to be 70% of the total hours of one day. Consequently, the work days required to complete one borehole are estimated as follows;

i) A-1 type (Ave. depth 70 m, 12 holes)

Moving in, preparation,	1.0 day
Drilling,	1.4
Casing installation, Development	1.0
Moving out, finishing up	1.0
Total	4.4 days

In case of a dry hole, it requires 3.4 days without casing installation and development.

ii) A-2 type (Ave. depth 80 m, 20 holes)

Moving in, preparation,	1.0 day
Drilling,	2.3
Casing installation, Development,	1.2
Moving out, finishing up,	1.0
Total	5.5 days

In case of a dry hole, it requires 4.3 days without casing installation and development.

iii) B type (Ave. depth 260 m, 8 holes)

Moving in, preparation,	1.0 day
Drilling	8.4
Casing installation, Development,	2.0
Moving out, finishing up	1.0
Total	12.4 days

In case of a dry hole, it requires 10.4 days.

(4) Borehole Testing (Pumping Test/Water Quality Test)

The schedule of borehole testing is given below.

Moving in/out, setting up,	1.0 day
Pumping test	1.0
Quality test	0.5
Total	2.5 days

(5) Pump Installation/Head Works Construction

The schedule of the above is given below.

Moving in/out equipment and materials,	1.0 day
Foundation construction,	1.0
Concrete work	1.0
Pump installation	0.5
Total	3.0 days

(6) Moving of Base Camp

The base camp will be set in two places in consideration of the extensive Project Area.

The distance between Gweru and Gokwe is 200 km, and the distance from one base camp site to the other is about 80 km. The days required for moving of base camps are estimated at 4 days.

(7) Total Construction Schedule

The total construction schedule is shown in Table 6-3-2 based on each construction work schedule. From the table, it is clear that the drilling work will be a critical path. The required total period for the Project implementation is 26.8 months which is composed of 0.5 month for preparation work, 0.5 month for moving of base camp and 25.8 months of drilling work.

Table 6-3-2. Construction Schedule by each Item

Item	Q'ty	Schedule (day/site)	Period (day and Month)	Team
Site Selection	70	1.8	126/7.5	1
Drilling				1
Success B/H	40	6.6	264/15.6	
Dry B/H	30	5.8	174/10.3	
Subtotal	70	-	438/25.8	
Borehole Testing	40	2.5	100/5.9	1
Pump/Head Works	40	3.0	120/7.1	1
Moving of Camp	2	4.0	8/0.5	

Note: Actual work days are 17.0 days per month as shown in section 6-3-2.

6-4. Personnel Plan

6-4-1. Zimbabwean Personnel Plan

(1) Working Teams and their Main Tasks

According to the plans of construction work and the schedule, the team formation of construction sectors is described below, and their main tasks are shown in sec. 6-3-1.

a) Project Management (One party)

b) Site Management (One party)

c) Site Selection (One party)

d) Drilling (One party)

e) Borehole testing (One party)

The borehole testing is to be carried out by the site selection party.

f) Pump and head works (One party)

g) Maintenance of equipment (One party)

The maintenance of equipment is to be executed by the drilling/pump and Head Works teams.

(2) Zimbabwean Personnel Plan

The allocation of personnel to each construction sector is shown in Table 6-4-1. The remuneration and wages for the Zimbabwean workers shall be borne by MEWRD.

6-4-2. Plan for Dispatch of Japanese Engineers

Japanese engineers will join the Zimbabwean staff so as to cooperate in the construction work for the first one year of the construction period under the Japanese grant aid system. Japanese engineers shall carry out technical transfer to the Zimbabwean staff through on-the-job training, as well as by advising and assisting them for smooth and effective implementation.

Table 6-4-1. Zimbabwean Personnel Required for Project Implementation

Task/Sector	Manage.	Siting	Drilling	B/H Test	Head Works	Total
Project Manager	1					1
Site Manager	1					1
Hydrogeologist		1		(1)		1
Mechanic			1			1
Civil Engineer					1	1
Driller (Senior)			1			1
Driller (Assistant)			1			1
Driver (H/Vehicle)			4		1	5
Driver (L/Vehicle)	1	1	3			5
Warehouse Manager	1					1
Accountant	1					1
Typist	1					1
Watchman	2		1			3
Labourer	3	4	5	(4)	5	17
Total	11	6	16	(5)	7	40

Note: B/H testing shall be carried out by the Siting Team.

The major tasks of the Japanese engineers are as follows;

1) Hydrogeologist (cum leader of the Japanese engineers)

- Selection of borehole sites and access roads,
- Geophysical prospecting, analysis and preparation of the report,
- Instruction of borehole sites and access roads to the construction team.
- Control and management of the tasks performed by the Japanese team.
- Borehole tests and water quality analyses.

2) Drilling Engineer

- Operation of drilling rig and other related equipment,
- Technical transfer on drilling work and logging.

3) Mechanical Engineer

- Operation and Maintenance of drilling rig, supporting equipment, vehicles and so forth,
- Management of stocked spare parts.

6-5. Implementation schedule

The Project will start after the Exchange of Notes (E/N) is signed by both the Governments of Zimbabwe and Japan.

It will take about five months from the signing of E/N to the supplier contract, about four months for the procurement of equipment and materials, and at least 2.5 months for ocean and inland transportation.

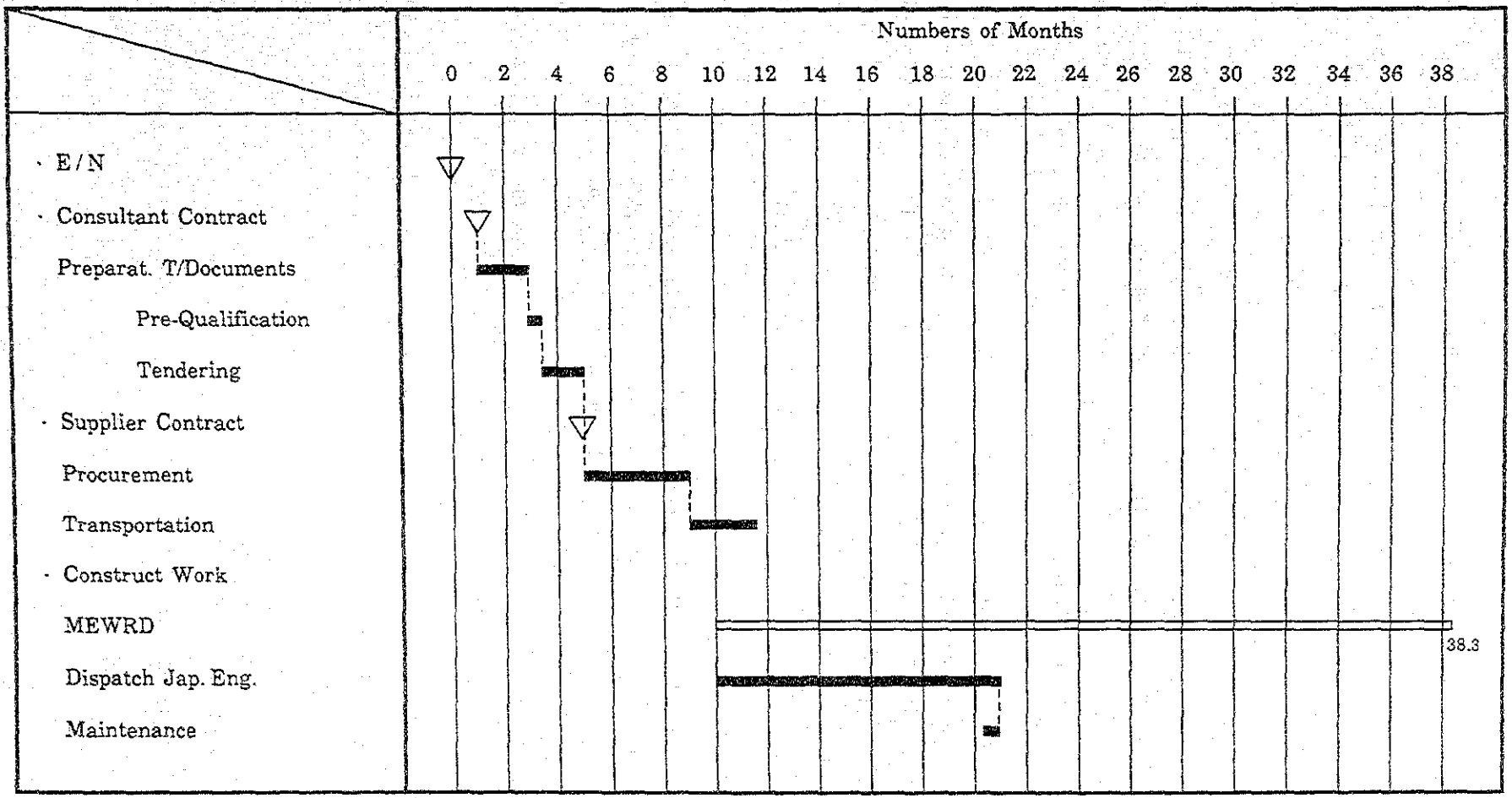
Consequently, a total of 11.5 months will be required after signing of the E/N for the arrival of equipment and materials in Zimbabwe. Equipment and materials, just after arrival in Zimbabwe, will be handed over to MEWRD. The registration/insurance of vehicles and other related formalities required in Zimbabwe are the responsibilities of MEWRD.

The construction of boreholes with head works in Gokwe will be carried out under the cooperation of the dispatched Japanese engineers for 11 months including site selection. It will take twenty-one months after signing of E/N until the expiry date of the cooperation including a half month of final maintenance of equipment which will be done just after completion of the actual construction work.

The subsequent construction work will be executed by MEWRD without Japanese cooperation. It is estimated that the total period required for the completion of 40 boreholes in Gokwe will be 38.3 months after signing of E/N.

The above implementation schedule is shown in Fig. 6-5-1.

Fig. 6-5-1. Implementation Schedule for the Project



6-6. Rough Estimation of Project Cost

The Project implementation costs for Zimbabwean side's work are roughly estimated as follows;

(1) Condition of Cost Estimation

i)	Estimated Date;	March 1988
ii)	Project Period;	38.8 months

(2) Estimated Costs

For Gokwe Area;

i)	Remuneration (Personnel cost)	Z$284,700
ii)	Materials	Z$201,600
iii)	Contingency	Z$91,000
	Subtotal,	Z$577,300

For Other Areas;

i)	Construction Cost	Z$473,500
ii)	Contingency	Z$88,000
	Subtotal,	Z$561,500

Grand Total	Z$1,138,800
Rounded figure	Z$1,140,000

The breakdown and unit prices taken in the estimation are attached in the Appendix.

CHAPTER 7. OPERATION AND MAINTENANCE PLAN

7-1. Operation and Maintenance System

Equipment and materials supplied to the Project will be handed over to MEWRD immediately after their arrival in Zimbabwe. Operation and maintenance for the above will be executed by MEWRD with cooperation of the dispatched Japanese engineers. After the return of the Japanese engineers, MEWRD will take full responsibility for operation and maintenance of the equipment and materials.

The completed boreholes will be handed over to DDF and maintained by DDF's maintenance team(s) through scheduled inspection and repair.

7-2. Maintenance Cost

Maintenance costs by DDF are mainly spent on road and workshop maintenance as shown in Table 7-2-1.

Table 7-2-1. Maintenance Costs by DDF, Midlands Province for 1987/1988

Borehole Maintenance	Z$249,200 (11.3%)
Road Maintenance	986,040 (44.8%)
Building Maintenance	55,000 (2.5%)
Workshop Maintenance	855,000 (38.9%)
Travel Expenses	55,000 (2.5%)
Total	2,200,240 (100.0%)

The maintenance costs of boreholes by each District are shown in Tab. 7-2-2 and the cost per borehole per year is Z$189. This cost is borne by DDF at present; however, the Government of Zimbabwe is expecting that the cost will be paid by users in the future. The number of users per borehole is estimated to be about 200-250, so completed by the benefit principle, the annual cost per user is less than one Z$.

Table 7-2-2. Borehole Maintenance Costs by District (1987/1988)

District	Numbers of Teams and Maintained B/H	Cost (Z$)
Gokwe	4 and 628	89,800
Mvuma	1 and 86	11,800
Shurugwi	1 and 55	11,000
Zvishavane	1 and 48	24,200
Mberengwa	2 and 143	44,400
Subtotal	9 and 960	181,200
Other Districts	Unknown	68,000
Total		249,200

CHAPTER 8. PROJECT EVALUATION

The Project is Phase 2 which is a continuation of the Phase I Project completed in March, 1985 for the "Rural Water Supply Project in Midlands Province". The Phase I project was composed of the procurement of two units of high-speed drilling rigs, supporting equipment, etc., and the construction of 89 boreholes equipped with hand pumps in the entire Project Area excluding Gokwe. The Phase 2 Project aims to accelerate the construction of 1,500 boreholes, together with the Phase 1 Project, which were programmed as the short term target in "The Master Plan for Rural Water Supply and Sanitation".

The direct effectiveness of the Project is composed of the following factors;

(1) To provide safe/clean drinking water to rural residents who have no adequate water supply facilities,

(2) To suppress diseases derived from unsafe drinking water, and

(3) To reduce the labour force required for fetching water.

The population benefited by the execution of the Project is estimated below;

(1) Gokwe area; about 27,000 (See Table 5-2-1)

(2) Other areas; 20,000 (250 people per borehole)

Furthermore, many more people will be benefited by further borehole construction after the Project, which will be done by MEWRD

using equipment supplied under this Project as in the Phase 1 Project.

The completed boreholes will be properly maintained by DDF's maintenance team under the management of the Field Officer for Water, with an annual budget of 189Z$ per borehole.

From the above facts, it is judged that grant aid assistance for the Project is justifiable from both the technical and financial points of view.

CHAPTER 9. CONCLUSION AND RECOMMENDATIONS

9-1. Conclusion

The conclusion reached as a result of the field survey in Zimbabwe, the basic design study in Japan and the discussions with MEWRD are as follows.

- The Project consists of two major components, (i) supply of equipment and materials and (ii) construction cooperation for Gokwe area. It will contribute to the Rural Water Supply Programme in Zimbabweas as one of the major bases.

- The drilling rig to be supplied under the Project has an essentially similar nature in operational technique to that supplied under the Phase 1 Project. And it is no doubt that the new rig will greatly contribute to further groundwater development for the rural water supply programme, after the completion of the Project.

- From the result of the Phase 1 Project, it is judged that the equipment and materials will be properly maintained by MEWRD and will be effectively operated by the Zimbabwean side.

- The grant aid assistance of the Government of Japan, which is extended for the procurement of equipment such as the drilling rig, vehicles and so forth, is one of the essential factors for the Project implementation, and it is concluded that the grant aid assistance is technically and financially justifiable.

9-2. Recommendations

The following would be recommended to the Government of Zimbabwe as a result of the basic design study for the Project.

(1) To install engin pumps as soon as possible on deep boreholes with 150 mm in diameter which have sufficient yields to supply water to a large population and for which hand pumps are not suitable due to deep rest levels.

(2) To strengthen borehole maintenance teams in respect to both fields personnel and equipment such as service trucks.

(3) To commence arrangements for the personnel mobilization and budget to execute the construction work apportioned to the Zimbabwean side.

ATTACHED DOCUMENTS

1. Member List of the Study Team

In Charge	Name	Office/Firm
Team Leader	Shin-ichi Teramura	Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs
Groundwater Development	Satoshi Nagata	Kyushu Regional Agricultural Office, Ministry of Agriculture, Forestry and Fisheries
Water Supply Facility	Yukitoshi Suzuki	Bureau of Water Supply, Yokohama City Council
Water Supply planning	Yoshio Matsumura	Sanyu Consultants Inc.
Hydrogeology	Komei Ozaki	Sanyu Consultants Inc.
Equipment planning	Makoto Uotani	Sanyu Consultants Inc.

2. Field Survey Itinerary

Date	Day	Activities
Jan. 31	Sun.	Left Tokyo
Feb. 1	Mon.	Left London
2	Tue.	Arrived in Harare. Courtesy call on Embassy of Japan.
3	Wed.	Courtesy call on Ministry of Finance, Economic Planning and Development (MFED). Meeting with Ministry of Energy and Water Resources and Development (MEWRD) and Submittal of Inception Report.
4	Thu.	Moved to Gweru. Meeting with Provincial Water Engineer. Inspection of Borehole sites constructed under the Phase 1 Project.
5	Fri.	Field survey for Gokwe District.
6	Sat.	Returned to Harare.
7	Sun.	Team Leader arrived in Harare and held a team meeting.
8	Mon.	Courtesy call on Minister of MEWRD. Discussion on Minutes.
9	Tue.	Exchanged the Minutes of Discussion. Inspected a working drilling rig supplied under Phase 1 Project.
10	Wed.	Study Members of the Ministries left Harare.
11	Thu.	Went to Gokwe for preparation of GEP (Geoelectric Prospecting) survey.
12	Fri.	Went to Gweru.
13	Sat.	Returned to Harare.
14	Sun.	Office work.
15	Mon.	Moved to Gweru.
16	Tue.	Office work and GEP preparation.
17	Wed.	Deployed to Harare/Gokwe,
18	Thu.	GEP in Gokwe and meeting with Head Office,

Date	Day	Activities
Feb. 19	Fri.	GEP in Gokwe and trip to Gweru,
20	Sat.	GEP in Gokwe and office work,
21	Sun.	Office work,
22	Mon.	GEP in Gokwe and meeting with Head Office
23	Tue.	GEP in Gokwe and Test-operation of Geologger
24	Wed.	GEP in Gokwe, Test operation of Geologger and moving to Gweru,
25	Thu.	GEP in Gokwe, meetings with Field Officers for Water and office work,
26	Fri.	GEP in Gokwe, meetings with Field Officer/Doctor and office work,
27	Sat.	GEP in Gokwe and office work,
28	Sun.	Office work,
29	Mon.	GEP in Gokwe and office work,
Mar. 1	Tue.	GEP in Gokwe and office work,
2	Wed.	Returned to Harare,
3	Thu.	Meeting with Head office and office work,
4	Fri.	Meeting with Head office and office work,
5	Sat.	Office work,
6	Sun.	Office work,
7	Mon.	Courtesy call on Embassy/MEWRD. Left Harare for Tokyo,
8	Tue.	Arrived in London/Amsterdam,
9	Wed.	Left Amsterdam,
10	Thu.	Arrived in Tokyo,

3. Member List of the Related Officials contacted by the Study Team

Embassy of Japan:

Mr. Ken Ikebe, Ambassador

Mr. Hiroyuki Eguchi, Counselor

Mr. Hatsumi Shimizu, Secretary

Ministry of Finance, Economic Planning and Development (MEFD):

Mr. C. Kanyuchi, Under Secretary.

Mr. W. Chirimuuta, Senior Administration Officer

Ministry of Energy and Water Resources and Development (MEWRD):

Mr. Hon. K. Kangai, Minister,

Mr. A. S. Mpala, Acting Permanent Secretary.

Mr. M. Tumbare, Management Engineer for Operation,

Mr. C. M. Zobgo, Chief Operations Engineer,

Mr. P. Sinnert-Jones, Hydrogeological Adviser,
Chief hydrogeologist,

Mr. George Nhunhama, Deputy Chief hydrogeologist,

Mr. A Mavurayi, Hydrogeologist for Masvingo and Midlands,

Mr. M. M. Sharpe, Drilling Adviser,
Drilling Superintendent,

Provincial Water Engineer's Office:

Mr. Adjad Chaudhry, Acting Provincial Water Engineer,

Mr. V. L. Masuku, Senior Executive Officer,

Mr. G. Marodza, Drilling Superintendent,

Mr. Daniel Ncube, Master Driller,

Ministry of Health:

Dr. Shiva, Provincial Medical Director's Office,

Midlands Provincial Administrator's Office:

Mr. Z. D. Mguni, Field officer for Water of DDF (District Development Fund)

Gokwe District Administrator's Office:

Mr. B. Ndanga, District Administrator,

Mr. Leopard Maguranye, Senior Cleak,

Mr. E.R. Magumise, Field Officer for Water of DDF,

Mr. N. Choeni, Field Officer for Water of DDF,

Zvishavane District Administrator's Office:

Mr. Naison Ndembera, Field Officer for Water of DDF,

Mberengwa District Administrator's Office:

Mr. A. Kugiwa, Assistant District Administrator,

Mr. C. T. Kundishora, Field Officer for Water of DDF,

MINUTES OF DISCUSSION
ON
RURAL WATER SUPPLY PROJECT(Phase-2)
IN
THE MIDLANDS PROVINCE IN ZIMBABWE

In response to the request of the Government of the Republic of Zimbabwe, the Government of Japan decided to conduct a basic design study for the Rural Water Supply Project (Phase-2) in some parts of the Midlands Province (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA") which is an official agency implementing the technical cooperation of the Government of Japan. JICA sent to the Republic of Zimbabwe the study Team headed by Mr. Shin-ichi Teramura for 40 days from 31st January to 10th March, 1988.

The Team carried out the Field Study, had a series of discussions and exchanged views with the authorities concerned of the Government of the Republic of Zimbabwe led by Mr. A. S. Mpala, Acting Permanent Secretary of the Ministry of Energy and Water Resources and Developmer (hereinafter referred to as "the Ministry").

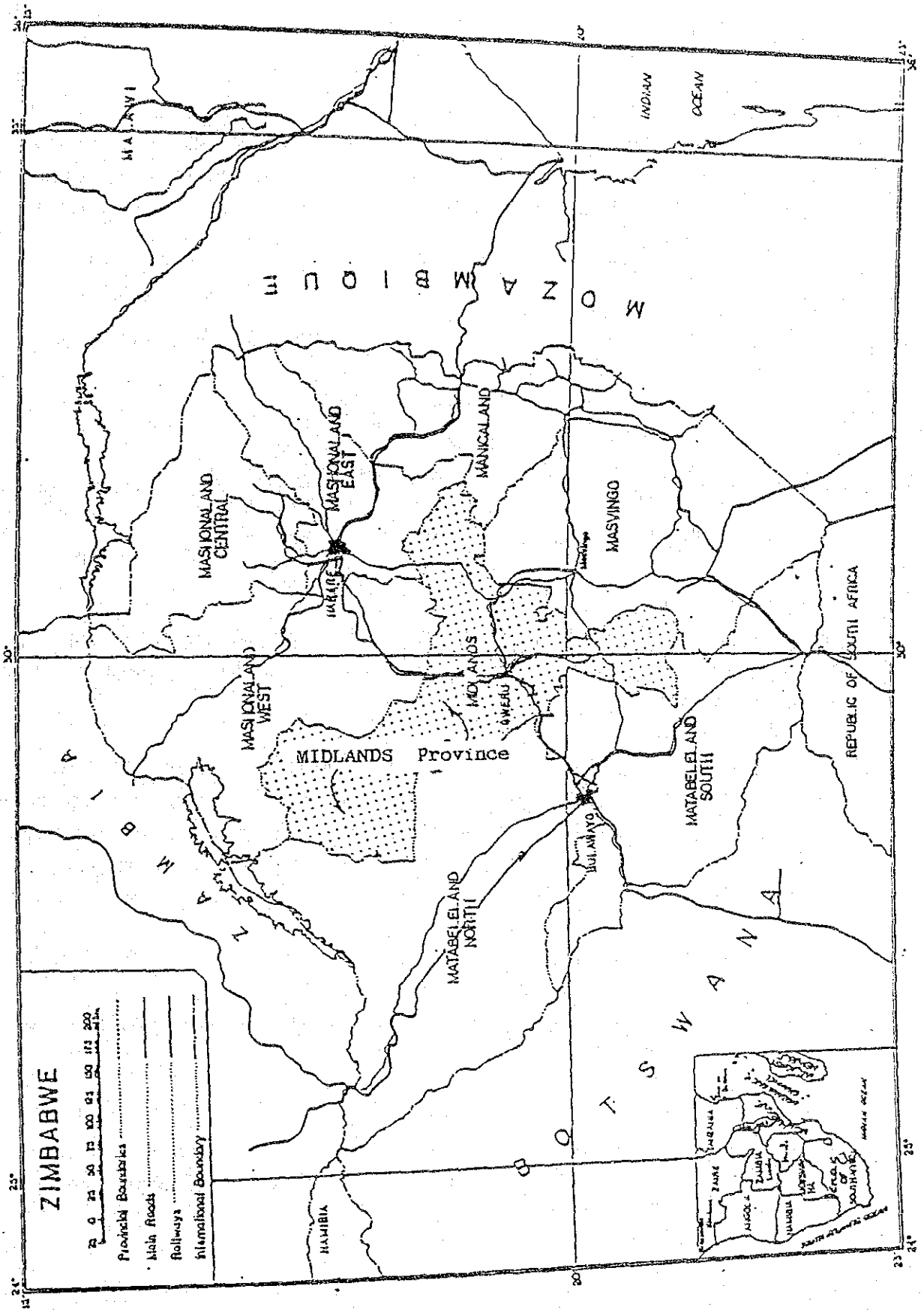
As the result of the discussions and the study, both sides agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

9th February, 1988
Harare, Zimbabwe

Mr. Shin-ichi Teramura,
The Leader of the
Study Team,
JICA

寺村伸一

Mr. A. S. Mpala,
Acting Permanent Secretar
The Ministry of Energy
and Water Resources and
Development



Location Map of Midlands Province

S. Teramura

ATTACHMENT

1. Objective

The objective of the Project is to provide the necessary equipment and materials and technical services for the Project in order to accelerate the rural water supply program in some parts of the Midlands province, in the Republic of Zimbabwe.

2. Project Area

The Project Area is composed of following Communal Lands(C.L.). in the Midlands Province.

1) Gokwe C.L. (Gokwe District)
2) Chilimanzi C.L. (Mvuma District)
3) Shurugwi C.L. (Shurugwi District)
4) Mazvihwa C.L. (Zvishavane District)
5) Mberengwa C.L. (Mberengwa District)

3. Executing Agency

The Ministry of Energy and Water Resources and Development is responsible for both technical and administrative aspects of the designated Project.

4. Undertakings of the Government of Japan

The Team will convey to the Government of Japan the intention of the Government of Zimbabwe that the former takes necessary measures to cooperate by providing the equipment, materials and services listed in ANNEX 1 within the scope of Japanese Grant Aid Program.

However, the Ministry strongly requested the items listed in ANNEX 2.

5. Understanding of Japan's Grant Aid System

The Zimbabwe side has understood Japan's Grant Aid System explained by the Team.

6. Undertaking of the Government of Zimbabwe

The Government of Zimbabwe will take the necessary measures listed in ANNEX 3, as suggested by the Team on condition that the grant Aid would be extended to the project.

S. Teramura

ANNEX 1

The following items for the Project have been reached to common understanding by the both parties as Grant Aid Assistance:

1. Gokwe District

(1) Truck mounted Top-drive drilling rig (Drilling Capacity; 100m-class) 1 set

(2) Air-compressor for the above 1 set

(3) Supporting vehicles for the above 1 set

(4) Construction Materials 1 set

(5) Dispatch of Japanese Expert(s) for Borehole Construction Works 1 set

(6) On-the-job Training of Zimbabwean Staff for Maintenance & Operation for Drilling Machine and Workshop 1 set

However, the items mentioned above are subject to change to a great extent if it has been found after the basic design study that enough pump discharge cannot be expected in Gokwe District within the depth of 100 meters.

And the new list of equipment to be provided in the Project will be proposed in the Draft Final Report of the Study.

2. Chilimanzi, Shurugwi, Mazvihwa and Mberengwa C.Ls.

(1) Construction Materials 1 set

S. Teramura

ANNEX 2

(1) Truck mounted Top-drive drilling rigs (one deep drilling rig (300-m class) and three shallow drilling rigs (100-m class))	4 lots
(2) Air-compressor for the above	4 lots
(3) Supporting vehicles	4 lots
(4) Construction Materials	1 lot
(5) Dispatch of Japanese Expert(s) for Borehole Construction Works	1 lot
(6) On-the-job Training of Zimbabwean Staff for Maintenance & Operation for Drilling Machine and Workshop	1 lot

S. Teramura

ANNEX 3

The following arrangements are requested to be taken by the Government of Zimbabwe:

1. To bear the following commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement.
   (1) Advising commission of Authorization to Pay
   (2) Payment of commission

2. To ensure prompt tax exemption and customs clearance for the products purchased under the grant at a point of disembarkation in Zimbabwe.

3. To exempt Japanese nationals from customs duties, income taxes and other fiscal levies which may be imposed in Zimbabwe with respect to the supply of the products and services under the verified contracts

4. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into Zimbabwe and stay therein for the implementation of their work.

5. To maintain and use properly and effectively the equipment purchase under the grant.

6. To bear all the expenses other than those to be borne by the grant.
   i.e. additional boreholes above those in Contract and payment of local staff.

S. Teramura

5. List of Reference Documents

(1) National Master Plan for Rural Water Supply and Sanitation:

Volume 1. Executive Summary (draft copy),
2.2. Hydrology,
2.2. Hydrogeology,
2.3. Water Quality,
3. Rural Water Supply Programme,
3.2. Soil and Water Conservation,
3.3. Inventory of Existing Water Supply System for Gokwe C.L.,
5. Operation and Maintenance,
8.1. Water Engineering Design,

(2) Topo-maps:

Sets of 1/50,000, 1/250,000 and 1/1,000,000 maps,

(3) Publications:

1) FIRST FIVE-YEAR NATIONAL DEVELOPMENT PLAN, 1988-1990, Vol.1,
2) THE CENSUS OF PRODUCTION, 1980/81, Mining, Manufacturing, Construction, Electricity and Water Supply,
3) ANNUAL ECONOMIC REVIEW OF ZIMBABWE, 1986,
4) STATISTICAL YEARBOOK, 1987,
5) NATIONAL INCOME AND EXPENDITURE REPORT, 1986,
6) Quarterly Economic and Statistical Review, June 1987,
7) QUARTERLY DIGEST OF STATISTICS, December 1987,
8) INTEGRATED PLAN FOR RURAL DEVELOPMENT, July 1978,
9) AN ASSESSMENT OF THE SURFACE WATER RESOURCES OF RHODESIA, 1972,

6. Patients with Water Borne Diseases and Medical Facilities in Midlands Province (Population in the Province; 867,000)
(Source; Provincial Medical Director's Office)

(1) Patients and Diseases

Diseases	1985 year		1988 year	
	Patients	Persons/1,000	Patients	Persons/1,000
Diarrhoea	49,442	57.0	42,563	49.1
Skin Diseases	38,651	44.6	53,925	62.2
Worms	3,618	4.2	2,795	3.2
Scabies	3,099	3.6	2,980	3.4
Malaria	61,125	70.5	67,217	77.5

(2) Numbers of Hospitals/Clinics and Beds by District

District	Nos. of Hospitals/beds			Nos. of Clinics	
	Big	Small	Beds	Urban	Rural
Gokwe	1	3	204	8	26
Mvuma	4	2	860	1	5
Shurugwi	1	3	237	5	17
Zvishavane	2	1	378	9	8
Mberengwa	3	2	569	2	19
Total	11	11	2,248	25	75

7. Population by Provinces and Administrative Units
(Source; Statistical Year book, 1987 by Central Statistical Office)

POPULATION DISTRIBUTION BY PROVINCES, 1969 AND 1982

Province	Population 1969	Population 1982	Percent Change	Area (km^2)
Total Zimbabwe	5,099,340	7,546,759	48.0	390,759
Manicaland	766,380	1,099,202	43.4	34,870
Mashonaland Central	375,580	563,407	50.0	27,284
Mashonaland East	879,720	1,495,984	70.1	24,934
Mashonaland West	617,300	858,962	39.1	60,467
Matabeleland North	578,820	885,339	52.9	73,537
Matabeleland South	406,370	519,636	27.9	66,390
Midlands	754,110	1,091,844	44.8	58,967
Masvingo	721,010	1,031,697	43.1	44,310

POPULATION DISTRIBUTION BY ADMINISTRATIVE UNITS

Unit	Population 1982	Percent	Area (km^2)
Zimbabwe	7,546,071	100.0	390,759
District Councils	4,276,900	56.7	169,556
Rural Councils	1,571,349	20.8	167,442
Municipalities	1,673,057	22.2	1,921
Other Areas	24,765	0.3	51,840

8. References for the Rough Cost Estimation

8-1. Unit Price/Cost

(1) Remuneration (Z$ per month)

Project Manager	1,715
Site Manager	1,332
Hydrogeologist	1,268
Mechanic Engineer	1,009
Civil Engineer	719
Senior Driller	449
Assistant Driller	293
Driver (Heavy Vehicle)	354
" (Light Vehicle)	232
Accountant	300
Typist	300
Watch man	215
Common Laborer	199

(2) Materials

Item	Specification	Unit	Price (Z$)
Cement	Portland, 50kg/bag	bag	6.00
Gravel	Aggregate	m^3	6.25
Sand	Aggregate	m^3	3.90
Steel bar	ϕ 9 mm	10 m	4.54
Nail	2 inch	kg	2.70
Boards	for frame	m^2	106.00
Sandgravel	river sand, 25kg/bag	bag	6.50
Casing	6" steel, 3 m length	piece	144.00
Gasoline		liter	1.50
Diesel Fuel		liter	0.75
Lub. Oil	#30	liter	2.02
Grease		kg	5.00
Oxygen	7.0 m^3/bottle	bottle	25.00
Acetylene	7.0 kg/bottle	bottle	70.00
Barbed wire	ϕ2 mm, 750 m/roll	roll	167.80
Wood	for fence, 1.8 m length	piece	5.00
Hand Pump	Bush Pump	set	525.00
Pipe	ϕ51 mm, 3 m length	piece	40.00
Rod	ϕ16 mm, 3 m length	piece	12.00

(3) Borehole Construction (Depth = 50 m)

Drilling	50 m x @60.00	=	Z$3,000
Casing	2 nos. x @144.00	=	Z$288
Siting		=	Z$750
	Total		Z$4,038
		Say,	4,040

8-2. Remuneration Cost for the Construction in Gokwe Area

The estimated costs for the above are Z$284,7000 and summarized in table A.

A; Remuneration Costs for Gokwe Area (Z$)

Personnel	Person	Month	Cost/Month	Amount
Project Manager	*			
Site Manager	1	26.8	1,332	35,698
Hydrogeologist	1	13.9	1,268	17,625
Mechanical Eng.	1	26.8	1,009	27,041
Civil Engineer	1	7.6	719	5,465
Driller	1	26.8	449	12,034
Driller (Assist.)	1	26.8	293	7,853
Driver (H. Vehicle)	5	26.8	354	47,436
Driver (L. Vehicle)	5	26.8	232	31,088
Warehous Manage.	1	26.8	215	5,762
Account	1	26.8	300	8,040
Typist	1	26.8	200	8,040
Watch Man	3	26.8	215	17,286
Labour (Siting)	4	13.9	199	11,046
" (Head Work)	5	7.6	199	7,562
" (Camp)	8	26.8	199	42,666
Total	39	-	-	284,660
			Say;	284,700

Note; The remuneration for Project Manager is excluded from the estimation since he is a permanent staff member of the Provincial Office.

8-3. Material Costs for Gokwe Area to be Borne by Zimbabwe

This is summarized in Table B together with quantity estimation basis. (shown in Table C and D)

B; Material Costs for Gokwe Area (Z$)

Item	Quantity		Unit Price	Amount
Diesel	181,970	l	0.75	136,478
Oil	9,099	l	2.02	18,380
Grease	1,456	kg	5.00	7,280
Oxygen/Acetylene	12	No.	95.00	1,140
Sand gravel	4,360	bag	6.50	28,340
Cement	808	bag	6.00	4,848
Sand	41	m^3	3.90	160
Gravel	43	m^3	6.25	269
Steel bar	80	No.	4.54	363
Wood for fence	600	No.	5.00	3,000
Barbed Wire	2,000/750	Vol.	525.00	1,400
Total				201,658
			Say	201,600

C; Consumption of Fuel and Others for Gokwe Area
(Borehole Nos. to be constructed by MEWRD: 70

i) Diesel

for Vehicles	1,330 l/hole x 70	= 93,100
for Machines	(1,393 l/hole x 40)	
	+ (1,105 l/hole x 30)	= 88,870
	Subtotal	181,970 l

ii) Oil 181,970 l x 0.05 = 9,099 l

iii) Grease 181,970 l x 0.01 x 0.8 = 1,456 kg

iv) Oxygen/Acetylene 40 hole x 0.3 No./hole = 12 NO.

D; Quantity of Construction Materials for Gokwe Area

i)	Sand gravel for Borehole	109 bag x 40holes = 4,360
ii)	Materials for Concrete	
	Cement	16.5 bag x 40 holes = 660bag
	Sand	0.79 m^3 x 40 holes = 32 m
	Gravel	1.07 m^3 x 40 holes = 43 m
	Steel bar	2 Nos. x 40 holes = 80 Nos.
iii)	Materials for Fence	
	Wood	15 Nos. x 40 holes = 600 No.
	Barbed wire	50 m x 40 holes = 2,000 m
iv)	Materials for Grouting Seal	
	Cement	3.7 bag x 40 holes = 148 bag
	Sand	0.22 m^3 x 40 holes = 9 m^3

8-4. Borehole Construction Costs (Z$) for the areas other than Gokwe.

Estimated drilling holes are 100 in number with success rate of 80% (80 ÷ 0.8 = 100).

i)	Moving, Site to Site	3,700 km x 5.0 =	18,500
ii)	"	250 hrs x 60.0 =	15,000
iii)	Drilling/Casing/Siting	100 sites x 4,040.0 =	404,000
iv)	Head Works	80 sites x 450.0 =	36,000
v)	Bush Pump ;	to be supplied by grand aid	
		Total	473,500

MINUTES OF DISCUSSION
ON
THE DRAFT REPORT OF THE BASIC DESIGN STUDY
ON
THE RURAL WATER SUPPLY PROJECT
IN
THE REPUBLIC OF ZIMBABWE

In response to the request of the Government of Zimbabwe, the Government of Japan decided to conduct a basic design study on the Rural Water Supply Project in Midlands Province and entrusted the study to the Japan International Cooperation Agency(JICA). JICA sent to Zimbabwe the study team from 31st January to 10th March, 1988.

As a result of the study, JICA prepared a Draft Basic Design Report on the study and dispatched a mission, headed by Mr. Satoshi Nagata, Kyushu Regional Agricultural Office, Ministry of Agricuiture, Forestry and Fisheries to explain and discuss it from 23rd April to 4th May, 1988.

Both Parties had a series of meeting on the report and have agreed to discuss with their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

29th April, 1988
Harare, Zimbabwe

永田 聡

SATOSHI NAGATA,
The Leader of the Mission,
Ministry of Agriculture,
Forestry and Fisheries.

J.J.CHITAURO,
Secretary,
Ministry of Energy and
Water Resoures and
Development.

ATTACHMENT

Major points of understnding are as follows:

1. The Zimbabwean side agreed in principle to discuss the basic design and financial proposal in the draft final report with the Zimbabwean Ministries concerned. Some appropriate alterations(ANNEX) to be in-corporated in the basic design report and those alterations are subject to JICA's approval.

2. Ten copies of final reports in English for basic design on the Project will be submitted to the Government of Zimbabwe in June, 1988.

3. The Zimbabwean side has understood the system of Japan's Grant Aid Programme and confirmed the arrangements to be taken by the Government of Zimbabwe for the Realization of the Project as agreed upon in the "Minutes of Discussion" dated 9th February, 1988.

4. The Government of Zimbabwe requested the Government of Japan to provide a detailed financial and economic evaluation under separate confidential cover to justify the Project outlined in the report.

5. The resolution of Banking charges/commissions are to be agreed between the Ministries of Finance in Zimbabwe and Japan.

ANNEX

1. Alterations of Equipment proposed/requested by the Zimbabwean side.

Alterations	Original in the draft report
1) Air-compressor 2 Nos., P=20 kg/sq.cm, Q=21 cu.m/min	1 No. P=25 Kg/sq.cm, Q=21 cu.m/min
2) Water Lorry (4x4: 6.0 cu.m)	(4x2: 5.0 cu.m)
3) Mud-pump for the Rig Q=1,200 l/min, P=28 Kg/sq.cm	Q=850 l/min, P=20 Kg/cm
4) Borehole Logger i) Mesurement To add Temperature & Gamma ii) Accessory Generator and others	

2. Besides the above alterations, the Zimbabwean side expressed his strong desire on apportionment of the Project cost of Zimbabwe as shown below:
It is very difficult to prepare the budget for the period from July 1988 to June 1989, so strongly requests the provision of local materials under the Japanese Grant Aid at least for the period of stay of dispatched Japanese engineers in Zimbabwe.