PREFACE

In response to a request from the Government of the United Republic of Tanzania, the Government of Japan decided to conduct a basic design study on the Rural Water Supply Project in Hanang, Singida Rural, Manyoni and Igunga Districts and entrusted the study to the Japan International Cooperation Agency (JICA).

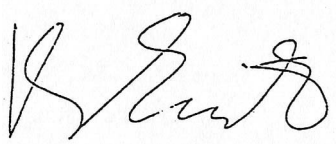
JICA sent to Tanzania a study team from 9 April 2000 to 5 July 2000 for the 1st field survey and 29 September 2000 to 26 November 2000 for the 2nd field survey.

The team held discussions with the officials concerned of the Government of the United Republic of Tanzania, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Tanzania in order to discuss a draft basic design, from 11 April 2001 to 18 April 2001, and as this 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 United Republic of Tanzania for their close cooperation extended to the teams.

June, 2001



Kunihiko Saito
President
Japan International Cooperation Agency

June, 2001

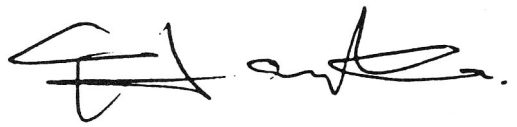
Letter of Transmittal

We are pleased to submit to you the basic design study report on the Rural Water Supply Project in Hanang, Singida Rural, Manyoni and Igunga Districts in the United Republic of Tanzania.

This study was conducted by Japan Techno Co., Ltd, under a contract to JICA, during the period from March 2000 to July 2001. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Tanzania and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

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

Very truly yours,



Yoshitaka Hamanaka

Project Manager,
Basic design study team on the Rural Water Supply Project in Hanag, Singida Rural, Manyoni and Igunga Districts in the United Republic of Tanzania

Japan Techno Co., Ltd.

The Rural Water Supply Project in Hanang, Singida Rural, Manyoni and Igunga Districts in the United Republic of Tanzania

LOCATION MAP OF PROJECT AREA

Project Area

Hanang Dist. (Arusha Region)
Singida Rural Dist., Manyoni Dist. (Singida Region)
Igunga Dist. (Tabora Region)

N

0 100 200 km

UGANDA
RWANDA
BURUNDI
KENYA
DEMOCRATIC REPUBLIC OF CONGO
ZAMBIA
MALAWI
MOZAMBIQUE
Indian Ocean

Lake Victoria
Lake Natron
Lake Eyasi
Lake Manyara
Lake Tanganyika
Lake Rukwa
Lake Nyasa

Bukoba
Musoma
Mwanza
Shinyanga
Kigoma-Ujiji
Tabora
Arusha
Moshi
Shingida
Dodoma
Iringa
Sumbawanga
Mbeya
Songea
Tanga
Wete
Chakechake
Zanzibar
Kibaha
DAR ES SALAAM
Morogoro
Lindi
Mtwara

Igunga Dist.(Tabora Reg.)
Hanang Dist.(Arusha Reg.)
Singida Rural Dist.(Singida Reg.)
Manyoni Dist.(Singida Reg.)

Wembere
Pangani
Miigsi
Uwimbi
Rungwa
Kilombero
Rufiji
Mbemkuru
Ruvuma

- District Headquarter
- Regional Headquarter
- Capital City
- District Boundary
- Regional Boundary
- International Boundary

The Rural Water Supply Project in Hanang, Singida Rural, Manyoni and Igunga Districts in the United Republic of Tanzania

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ABBREVIATIONS

BHN	Basic Human Needs
DDCA	Drilling and Dam Construction Agency
E/N	Exchange of Notes
PRA	Participatory Rural Appraisal
PVC	Polyvinyl Chloride
Tsh	Tanzania shilling
WHO	World Health Organization

Summary

The United Republic of Tanzania is located in the eastern part of the African continent, between 1 ° south and 11 ° 45 ′ south, and between 29 ° 21 ′ east and 40 ° 25 ′ east, with an area of 945,000km^2, and population of 32,100,000 in 1998. The United Republic of Tanzania was formed by the union of Tanganyika and Zanzibar in 1964.

Tanzania is bordered on the south by Mozambique, Malawi, and Zambia; on the west by Zaire, Burundi, and Rwanda; on the north by Uganda and Kenya; and on the east by the Indian Ocean. The country comprises several topographic zones: fertile coastal belt and mountain ranges to the north, and a high plateau in the central and southern regions. The present administrative divisions are composed of 25 regions (20 regions on the mainland).

The GNP per capita is US$210 (1998) and the Human Development Index was as low as 156th out of 174 countries surveyed according to a Human Development Report in 1999 (published by UNDP). 51% of the entire population is estimated to live below the poverty line, 80% of whom live in the provinces. Economically, some 90 % of the total working population is engaged in agriculture, which accounts for 50% of the GDP. Approximately 80% of them are small-scale traditional farmers who are easily affected by the climate and price fluctuations of the international market. Particularly, the rural inhabitants are experiencing a high population increase in addition to these unstable economic factors. This leads to a severe life condition and a lower level of diffusion of accessible social services such as safe water supply and medical and public health services in comparison to the urban areas. Therefore, consolidation of social services infrastructure in rural areas is considered as one of the important issues in Tanzania.

The government of Tanzania has been implementing various development plans concerning the Basic Human Needs (BHN) in order to improve the national health. In the “Twenty-years water supply programme of 1971”, the target for 1991 is that ‘all of the rural residents can have access to safe water within 400m from each house’. However, due to the economic depression in the country, the programme has shown little progress. The statistics data of 1993 show that the coverage rates by supply systems are as low as 67% in urban areas and 46% in rural areas.

Especially, the coverage rates in areas of the Central Regions show much lower rates than the average: that of Hanang District is 32%; and those of Singida Rural District, Manyoni District and Igunga District are 37%, 49% and 30%, respectively.

A sustainable operation and maintenance of water supply facilities in the provinces of Tanzania is hard to realize. The operational rates of the existing facilities are only 20 to 30 %. The cause is

traced to free public services, which have been provided by the socialist's policies since the country's independence. The government of Tanzania places the introduction of the concepts such as community participation, operation and maintenance by the beneficiaries, cost sharing and water sanitation as the important development strategies. Presently, fees for water supply are compulsory. However, it is thought that a wide diffusion of these concepts among the rural population in the entire country will still take time due to delays in the following measures:

- Policy planning and implementation on community participation at the central government level;
- Policy planning and implementation with regard to operation and maintenance;
- Implementation of a hygiene education programme to enhance improvement of water supply and sanitary conditions;
- Establishment of a system to coordinate stakeholders (including the government, donors, NGOs).

Under this situation, the government of Tanzania requested the Groundwater Development Study for 4 Districts to the Government of Japan in September 1996. As a result, the government of Japan started a development study in November 1996, and the Final Report was completed in August 1998 after the 8 months of field surveys and the analytical works in Japan. In this development study, the potential of groundwater in these 4 Districts were surveyed, and the implementation plans were considered for short, middle and long terms. Based on the results of the study, a short-term goal was set to expand the water supply facilities. The government of Tanzania requested the government of Japan to make a water supply facilities expansion plan and to finance the implementation of the Project.

The details of the request are as follows.

i. Construction and rehabilitation of water supply facilities (380 sites for construction and rehabilitation of water facility in 284 villages)
ii. Procurement of equipment to conduct the project (pickup trucks, workshop tools, etc.)
iii. Training and monitoring for O&M by the villagers

In response to the request, the government of Japan decided to execute a basic design study, and Japan International Cooperation Agency (JICA) dispatched the 1st field survey team from 9th April to 5th July 2000 and the 2nd field survey team from 29 September to 26 November 2000. The study team was sent to Tanzania for explanation of the draft basic design between the 11th and the 18th of April 2001, and an agreement on the contents of the plan was concluded.

In the basic design study, the following survey was conducted in response to the request. During the study period (in November 2000), the Ministry of Water was reformed to the Ministry of Water and Livestock Development.

Regarding the relevant standards for water quality, the Government of Tanzania enacted the Temporary Standards of Quality of Domestic Water in Tanzania in 1974. However, as to some items such as fluoride and nitrite that are found in high concentrations in the concerned target villages, the values are far from conformity to the standards of Japan or WHO guideline for drinking water quality. Prior to the dispatch of the 1st study team, the Government of Japan clarified that the Tanzania's temporary standards cannot be adopted, as the health effects are unproven and the results of medical investigations are uncertain, particularly for the fluoride content standard at present. The standard of Japan is 0.8mg/l and the WHO guidelines suggest 1.5mg/l for the fluoride content of drinking water. For the Project it was recommended that the health significant indicators of WHO guidelines for drinking water quality be observed and the Government of Tanzania agreed to it. From the results of the 1st study (April to July 2000) in Tanzania, the hydrogeological conditions of the project area revealed fluoride concentrations above 1.5mg/l (a maximum value of 33mg/l was measured in the project area). Furthermore, it was calculated that 17,890 residents, merely 2.14% of the total population of 834,774 of the target 4 districts, are provided with safe drinking water from boreholes of good water quality as water sources. In other words, it was learnt that if the development of groundwater of good quality through boreholes and expansion of water supply facilities equipped with hand pumps are to be implemented as the core plan, then the restriction will be on water quality of sources. Therefore, in order to investigate the availability of shallow aquifer groundwater, although it is easily contaminated and its yield fluctuates between the dry and rainy seasons, the 2nd field survey was conducted during the dry season (September to November 2000). Concluded from the field survey, both shallow water intake facilities structured to prevent surface contamination and boreholes which yield groundwater of good quality can properly be utilised as water sources at different sites.

Under these circumstances, in order to supply safe water as many people as possible, the system that can supply water to the residents in areas remote from the water sources needs to be adopted. The Project adopts the level-2 system taking into account its convenience and hygienic considerations during the transport.

On the other hand, the operational rate of existing facilities in the project area is merely less than 20 % and operation and maintenance of these facilities are difficult. Therefore, the Project establishes a system that enables sustainable operation and maintenance. For this reason, Japan's aid will be limited to one system per district or four in total, which can become a prototype for

future projects as appropriate water supply facilities.

As the quality of water in the Project area is poor, securing drinking water becomes an important task. As a consequence, the volume of water to be supplied has to be limited. Generally, the volume of water for supply is determined by multiplying the unit supply rate of 25 l/day/person to the design population as stipulated in the "National Water Policy". However, this Project will determine the average water supply rate based on the following concepts.

The basic design study surveyed 284 villages in the 4 target Districts. The table below shows water consumed by households. For individuals, it is 4.58 litres per day per household including 2.41 litres of drinking water. In concordance with the concept to supply the limited amount of water to as many people as possible, the Project sets an average water supply rate at 5 litres/day/capita.

Water Consumed by Households

District	No. of surveyed villages	Average household size	Quantity of water for drinking per household	Quantity of water for drinking per person	Quantity of water for drinking and cooking per household	Quantity of water for drinking and cooking per person
Hanang	33	6.69	14.67 litre	2.19 litre	30.23 litre	4.54 litre
Singida Rural	130	6.87	16.86 litre	2.45 litre	36.37 litre	5.29 litre
Manyoni	72	6.40	11.34 litre	1.79 litre	24.93 litre	3.90 litre
Igunga	50	8.07	26.00 litre	3.22 litre	-	-
Ave.		7.01	17.22 litre	2.41 litre	30.51 litre	4.58 litre

（Source: the field survey from April to May 2000）

The following Table shows the selected four systems. The supply rate is computed from the potential target population based on the number of wells, the pumping rate, operation hours, the daily pumping volume at the respective water sources. In addition, the operation hours of pumps are set at 6 hours considering the possible working hours of the system.

List of Facilities

System No.	District	Target Village	Design Served Population (coverage %)	Facility	Quantity
H-4	Hanang	Lambo, Masakta, Masqaroda	7,540 (100%)	Intake Facility for Shallow Groundwater	2
				Machinery House	2
				Ground Tank	50m³× 1 20m³×2
				Submersible Motor Pump	4 units
				Pipeline	18.6 km
				Solar Pumping System	4 sets
				O&M Office	1
S-1	Singida Rural	Ikungi	3,239 (84%)	Borehole Depth:100m	1
				Machinery House	1
				Elevated Tank	20m³× 1
				Submersible Motor Pump	1 unit
				Pipeline	6.7 km
				Power Receiving Facility	1
				O&M Office	1
M-8	Manyoni	Mbwasa, Mwiboo, Chikuyu	6,819 (88%)	Borehole Depth:100m	2
				Machinery House	1
				Ground Tank	40m³× 1
				Submersible Motor Pump	2 units
				Pipeline	15.8 km
				Solar Pumping System	1 set
				O&M Office	1
I-1	Igunga	Chibiso	2,704 (71%)	Intake Facility for Shallow Groundwater	1
				Machinery House	2
				Ground Tank	20m³× 1
				Submersible Motor Pump	1 unit
				Pipeline	6.0 km
				Solar Pumping System	1 set
				O&M Office	1
District Water Engineer Office in Katesh (for defluoridation activities)				Work Floor Stock yard	1 1

The procurement plan for operation and maintenance is as follows.

① In District levels

As has been stated, O&M in the project area is difficult. It is indispensable to improve the capacity of the District Water Engineer's Office for the success of this project. Therefore, the capacity of the District Engineer's Office will be strengthened for better O&M. In the original request, pick-up trucks were included in the procurement plan, but in this project pick-up trucks would not be procured, but instead motorbikes are included.

② Equipment for O&M of water supply facilities

Since the water supply facilities have been changed to Level-2, the required equipment are now as follows: motorcycles for patrolling, maintenance tools, and bicycles for the operators of water distribution facilities, radio sets, and others.

③ Equipment for activities for Defluoridation

The project will provide support activities to develop practical methods of defluoridation. Fluoride was the main reason for changes in the plan from the original request. The Ngrudoto Defluoridation Research Station in Arusha is currently proceeding feebly with experiments in defluoridation. Although some methods have been proven to be effective, practical methods employable in rural areas are not yet developed. In the Project, trial defluoridation tests will be carried out in Katesh of Hanang District based on the results of experiments at the Ngrudoto Defluoridation Research Station in Arusha. This activity will terminate at the end of the project and necessary equipments will be procured. A social development component will support the intervention activities.

The following table shows the equipment to be procured.

Equipment to be Procured

a. Equipment for O&M in District levels (District Engineer's Office)

		Specifications	Qty	Remarks
a.	Motorcycle	For regular inspection of the facilities	4	One for each District
b.	Tools for O&M (for plumbing and relating works)	Electric welder, maintenance tools, electric appliances (bolt threading machine, etc.), shovel, safety tools	4	One for each District
c.	Water quality testers	Water quality tester (for Fe, Cl, NO3, residual chlorine, etc.), EC meter, pH meter, water level meter	4	One for each District
d.	Radio set	For communications from water supply systems	4	One for each District
e.	Warehouse	Container house	4	One for each District
f.	Others	Megaphone	4	One for each District

b. Equipment for O&M of water supply facilities

		Specifications	Qty	Remarks
a.	Motorcycle	For regular inspection of the facilities	4	One for each system
b.	Bicycle	For collection of water fees and community awareness activities	26	One for each system
c.	Tools for O&M (for plumbing and relating works)	Maintenance tools (valve, tap, etc.), shovel, safety tools, etc.	4	One for each system
d.	Equipment for community participation and hygiene education	Laminator, Office tools	4	One for each system
e.	Radio set	For communication between water supply systems	4	One for each District
f.	Water level meter	To measure the water level	4	One for each water source

c. Equipment for removal of fluoride

		Specifications	Qty	Remarks
a.	Motorcycle	For patrolling	1	
b.	Water quality testers	Simple water test kits, ion meter, stirrer, flask, beaker, chemicals, etc.	1	
c.	Equipment for hygiene education (activities for research and promotion)	Computer, printer, megaphone, etc.	1	
d.	Equipment to produce bone charcoal	Furnace for charcoal, crusher, sieve, etc.	1	
e.	Warehouse	Container house	1	

The following outputs are expected through implementation of the Project.

① The project enables to supply safe water to approximately 20,000 people.
② The hygienic conditions will be improved around the water supply facilities by the establishment of water supply facilities that can supply safe water
③ The sense of ownership and awareness on hygiene will increase in the target villages. This leads to realization of adequate operation and maintenance of the facilities.
④ The results of defluoridation equipment tests conducted in Katesh within the project areas will serve as useful data for similar projects with defluoridation processes in the future.

The Project expects the effects described above and at the same time, will contribute to improvement of BHN of the villagers in the project areas. Thus it is confirmed that for part of the Project, the Japanese Grant Aid System is appropriate.

The following important assumptions need to be fulfilled in order for the effects of the project to be sustainable.

- The villagers of the project area persistently keep the will to accept the facilities.
- Trained District Water Engineers as well as operation staff are continuously in charge of the services (substitutes must have equivalent skills).
- The quality of target water sources does not deteriorate worse than the results of water quality tests obtained by the basic design study (Due to changes in natural conditions the water quality can fail to meet the WHO guidelines).
- The villagers of the project area are satisfied with the water supply coverage rate.

Changes in these assumptions need to be checked, monitored and followed-up upon completion as well as five years after completion of the project.

CONTENTS

CHAPTER 1 BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

The government of Tanzania has been implementing various development plans concerning Basic Human Needs (BHN) in order to improve the national health. In the "Twenty-years water supply programme of 1971", the target that 'all of the rural residents can have access to safe water within 400m from each house until 1991' was stated. However, due to the economic depression in the country, the programme has shown little progress. The statistics data for 1993 show that the coverage rates by the water supply systems are as low as 67% in urban areas and 46% in rural areas. Especially, the rates in the areas of the Central Regions show much lower rates than the average: that of Hanang District is 32%; and those of Singida Rural District, Manyoni District and Igunga District are 37%, 49% and 30% respectively.

Under this situation, the government of Tanzania requested the Groundwater Development Study for these 4 Districts to the Government of Japan in September 1996. As a result, the government of Japan started a development study in November 1996, and the Final Report was completed in August 1998 after the 8 months of field surveys and the analytical works in Japan. In this development study, the potential of groundwater in these 4 Districts were surveyed, and the implementation plans were considered for short, middle and long terms.

(1) The request from the government of Tanzania

The details of the request are as follows. Due to the problem in water quality, the concept of the project was changed. The details will be described in Chapter 2.

i. Construction and rehabilitation of water supply facilities (details are shown in Table 1-1)
ii. Procurement of equipment to conduct the project (details are shown in table 1-2)
iii. Training and monitoring for O&M by the villagers

Requested sites are shown in Table 1-3.

Table 1-1 Water Supply Facilities in the Request

		District			
		Hanang	Singida Rural	Manyoni	Igunga
Number of villages	**284**	**33**	**129**	**72**	**50**
1. Construction of boreholes with handpumps	264	45	106	59	54
2. Construction of water supply facilities of "Level-2"	9	1	4	2	2
3. Construction of water supply facilities with solar pumps	7	0	4	3	0
4. Rehabilitation of boreholes with handpumps	17	1	10	6	0
5. Rehabilitation of shallow wells with handpumps	16	13	3	0	0
6. Rehabilitation of boreholes with wind pumps	2	0	0	2	0
7. Rehabilitation of water supply facilities of "Level-2"	1	0	0	1	0
8. Construction of charco dams	64	12	24	17	11
Total	**380**	**72**	**151**	**90**	**67**

Table 1-2 Equipment in the Request

	Hanang	Singida Rural	Manyoni	Igunga	Total
1. Pick-up trucks	1	3	2	1	7
2. Equipment for workshop	1	2	1	1	5
3. Kits for water quality analysis	1	2	1	1	5
4. Equipment for office	1	1	1	1	4
5. Maintenance tools					10

These requests will be described in Chapter 2. The following background explains the progress of the basic design study.

Table1-3 List of Requested Sites

HANANG DISTRICT

No.	Village Name	Pop. 1997	
1	Mulbadaw	3,696	
2	Dang'aida	580	
3	Dajamet	774	
4	Laghanga	1,818	
5	Gawidu	1,801	
6	Garawja	4,438	
7	Bassodesh	1,992	
8	Hirbadaw	3,007	
9	Mwanga	3,229	
10	Wandela	420	
11	Gatanuwas	1,471	
12	Gidika	1,348	
13	Dumbeta	1,370	
14	Dirma	2,190	
15	Gisambalang	1,626	
16	Waranga	1,021	
17	Murero	1,388	
18	Diloda	1,385	
19	Mingenyi	2,424	
20	Ishponga	1,494	
21	Mara	1,976	
22	Gidahababeig	2,290	
23	Endasaboghechan	2,290	
24	Hidet	2,000	
25	Bassotughang	1,480	
26	Sirop	1,870	
27	Matangarinu	2,280	
28	Simbay	621	
29	Gidagharabuk	618	
30	Masakta	3,584	
31	Lambo	2,390	
32	Masqaroda	2,504	
33	Getasum	1,126	
	TOTAL	62,501	

SINGIDA RURAL DISTRICT

No.	Village Name	Pop. 1997		No.	Village Name	Pop. 1997		No.	Village Name	Pop. 1997	
1	Ikungi	2,646		44	Igombwe	2,049		88	Mvae	4,033	
2	Ighuka	3,256		45	Msosa	1,421		89	Makhandi	3,125	
3	Ulyampiti	2,103		46	Mgungira	2,183		90	Kinyagigi	2,514	
4	Matongo	2,897		47	Ufana	1,390		91	Mwanyonye	3,060	
5	Muungano	1,444		48	Iyumbu	2,724		92	Ikanoda	2,409	
6	Matare	3,198		49	Irisya	2,608		93	Mjughuda	3,934	
7	Mahambe	1,360		50	Mwasutianga	1,357		94	Msimimihi	3,549	
8	Issuna	3,303		51	Mtinko	3,910		95	Mdilu	2,819	
9	Choda	1,325		52	Malolo	3,048		96	Mwasauya	3,463	
10	Mkiwa	1,827		53	Mughanga	2,318		97	Mgamu	4,093	
11	Nkuhi	2,199		54	Mpambaa	2,756		98	Mipilo	4,221	
12	Samaka	3,502		55	Kijota	1,716		99	Mangida	3,351	
13	Ujaire	1,631		56	Nduu	1,992		100	Sefunga	2,705	
14	Kipumbuiko	2,208		57	Minyenye	4,034		101	Ghata	3,638	
15	Mkinya	1,662		58	Ikiwu	3,803		102	Msange	4,180	
16	Mang'onyi	2,102		59	Makuro	2,568		103	Mgori	1,640	
17	Tupendane	1,570		60	Ghalunyangu	2,454		104	Mkhola	2,379	
18	Mwau	4,039		61	Mpipiti	4,043		105	Sughana	2,693	
19	Sambaru	1,273		62	Mpoku	3,216		106	Unyampanda	1,270	
20	Ihanja	3,814		63	Matumbo	3,090		107	Mughunga	1,195	
21	Isseku	1,797		64	Mkenge	2,389		108	Nduamughanga	1,356	
22	Nkoiree	3,006		65	Migugu	2,437		109	Ngimu	3,995	
23	Unyangwe	2,234		66	Ughandi 'B'	2,501		110	Mwighanji	2,938	
24	Chungu	2,996		67	Nkwae	1,899		111	Itaja	5,249	
25	Minyughe	2,225		68	Laghanida	2,849		112	Pohama	3,175	
26	Misake	2,810		69	Misinko	3,658		113	Mungaa	2,532	
27	Muhintiri	2,929		70	Ntondo	1,473		114	Minyinga	2,163	
28	Mnyange	1,838		71	Msisi	3,513		115	Kinku	2,517	
29	Mpetu	1,320		72	Senene Mfuru	1,071		116	Kimbwi	2,318	
30	Matyuku	1,691		73	Madamigha	3,679		117	Unyamighumbi	2,809	
31	Utaho	2,832		74	Mrama	4,382		118	Misughaa	1,427	
32	Isalanda	838		75	Mwahango	1,851		119	Msule	1,218	
33	Kituntu	2,453		77	Mwakiti	2,307		120	Sakaa	1,410	
34	Msambu	1,827		78	Itanka	2,263		121	Mnane	1,860	
35	Nkuninkana	2,094		79	Sekoutuure	2,280		122	Nkundi	2,092	
36	Wibia	2,238		80	Kinyeto	3,991		123	Siuyu	2,530	
37	Msimi	5,580		81	Ntunduu	2,367		124	Unyankanya	2,466	
38	Msungwa	3,379		82	Mkimbii	1,883		125	Nkunguakihendo	2,298	
39	Kintandaa	3,794		83	Minyaa	2,158		126	Ntuntu	2,245	
40	Mnang'ana	2,972		84	Igauri	1,795		127	Ntewa	3,437	
41	Mtunduru	4,481		85	Ntonge	2,380		128	Mampando	2,824	
42	Mwaru	2,368		86	Mghamo	4,392		129	Lighwa	2,258	
43	Mlandala	2,516		87	Merya	4,590		130	Mwisi	2,038	
									TOTAL	339,791	

Table1-3 List of Requested Sites

MANYONI DISTRICT

No.	Village Name	Pop. 1997		No.	Village Name	Pop. 1997	
1	Manyoni	5,209		37	Mbwasa	1,866	
2	Kipondoda	5,210		38	Mwiboo	2,934	
3	Mwanzi	1,333		39	Makutupora	1,365	
4	Muhala	2,256		40	Makanda	1,422	
5	Mdunundu	1,703		41	Mangasai	1,421	
6	Mitoo	893		42	Kitalalo	1,425	
7	Mkwese	2,630		43	Kintinku	1,430	
8	Kinangali	2,912		44	Lusilile	3,130	
9	Aghondi	1,027		45	Udimaa	1,710	
10	Mabondeni	599		46	Nkonko	2,655	
11	Njirii	751		47	Mpola	1,489	
12	Kamenyanga	1,449		48	Ntumbi	2,224	
13	Idodyandole	2,250		49	Chikola	2,152	
14	Mbugani	2,172		50	Chidamsulu	1,081	
15	Kashangu	862		51	Winamila	889	
16	Itigi Mjini	8,258		52	Heka	3,425	
17	Doroto	1,410		53	Sasilo	3,734	
18	Kitaraka	1,574		54	Chikombo	3,751	
19	Sanjaranda	2,183		55	Isseke	971	
20	Gurungu	1,471		56	Simbanguru	1,164	
21	Kitopeni	2,032		57	Igwamadete	2,048	
22	Ipande	2,488		58	Mpapa	1,837	
23	Muhanga	1,660		59	Sanza	2,634	
24	Damwelu	1,350		60	Ntope	2,545	
25	Mgandu	4,988		61	Chicheho	1,327	
26	Kalangali	696		62	Ikasi	1,118	
27	Itagata	1,479		63	Msememboo	2,658	
28	Kayui	2,899		64	Saranda	2,768	
29	Makale	2,074		65	Londoni	1,205	
30	Rungwa	1,857		66	Hika	467	
31	Mwamagembe	1,793		67	Kilimatinde	1,247	
32	Kitanula	410		68	Solya	1,709	
33	Maweni	1,741		69	Sukamahela	3,169	
34	Mvumi	1,298		70	Majiri	2,314	
35	Ngaiti	2,347		71	Sasajila	1,017	
36	Chikuyu	2,762		72	Makasuku	1,031	
					TOTAL	147,358	

IGUNGA DISTRICT

No.	Village Name	Pop. 1997		No.	Village Name	Pop. 1997	
1	Matinje	4,536		26	Kinungu	2,555	
2	Buchenjegele	3,842		27	Mwandihimiji	2,827	
3	Mondo	2,517		28	Mwamapuli	2,331	
4	Mwashiku	2,279		29	Mwajilunga	1,375	
5	Ngulu	2,023		30	Migongwa	2,092	
6	Imalilo	2,354		31	Ntobo	2,720	
7	Mwansugho	1,543		32	Mwamloli	2,031	
8	Chomachankola	6,460		33	Mwabubele	1,885	
9	Chibiso	2,499		34	Itunduru	3,557	
10	Bulangamilwa	4,061		35	Kagongwa	1,307	
11	Ziba	4,923		36	Mwabaraturu	4,768	
12	Ibologero	4,643		37	Mwayunge	3,112	
13	Bulumbela	2,274		38	Nyandekuwa	3,166	
14	Ndembezi	5,293		39	Ussongo	2,463	
15	Ntigu	1,496		40	Itale	2,170	
16	Kitangili	3,176		41	Nanga	2,424	
17	Moyofuke	1,817		42	Kaumbu	3,181	
18	Nkinga	6,321		43	Bulyangombe	3,327	
19	Ulaya	2,453		44	Igogo	1,951	
20	Ugaka	2,495		45	Bukoko	2,445	
21	Mwakabuta	1,855		46	Ipumbulya	2,932	
22	Ikunguipina	1,392		47	Itumba	1,239	
23	Igurubi	4,425		48	Lugubu	1,231	
24	Mwagala	1,933		49	Sungwizi	2,692	
25	Kalangale	1,618		50	Nguriti	4,689	
						142,698	

Regarding the relevant standards for water quality, the Government of Tanzania enacted the Temporary Standards of Quality of Domestic Water in Tanzania in 1974 (refer to Table 1-4). However, as to some items such as fluoride and nitrite that are found in high concentrations in the concerned target villages, the values are far from conformity to the standards of Japan or WHO guideline for drinking water quality. Prior to the dispatch of the 1st study team, the Government of Japan clarified that the Tanzania's temporary standards cannot be adopted, as the health effects are unproven and the results of medical investigations are uncertain, particularly for the fluoride content standard at present. The standard of Japan is 0.8mg/l and the WHO guidelines suggest 1.5mg/l for the fluoride content of drinking water. For the Project it was recommended that the health significant indicators of WHO guidelines for drinking water quality be observed and the Government of Tanzania agreed to it. From the results of the 1st study (April to July 2000) in Tanzania, the hydrogeological conditions of the project area revealed fluoride concentrations above 1.5mg/l (a maximum value of 33mg/l was measured in the project area). Furthermore, it was calculated that 17,890 residents, merely 2.14% of the total population of 834,774 of the target 4 districts, are provided with safe drinking water from boreholes of good water quality as water sources. In other words, it was learnt that if the development of groundwater of good quality through boreholes and expansion of water supply facilities equipped with hand pumps are to be implemented as the core plan, then the restriction will be on water quality of sources. Therefore, in order to investigate the availability of shallow aquifer groundwater, although it is easily contaminated and its yield fluctuates between the dry and rainy seasons, the 2nd field survey was conducted during the dry season (September to November 2000). Concluded from the field survey, both shallow water intake facilities structured to prevent surface contamination and boreholes which yield groundwater of good quality can properly be utilised as water sources at different sites.

Under these circumstances, in order to supply safe water as many people as possible, the system that can supply water to the residents in areas remote from the water sources needs to be adopted. The Project adopts the level-2 system taking into account its convenience and hygienic considerations during the transport.

Table 1-4 Standards for Drinking Water Quality of WHO, Tanzania and Japan

	Item		Chemical Symbol	WHO (mg/l)	Tanzania (mg/l)	Japan (mg/l)
Substances and parameters of health significance for drinking-water	Bacteriological Quality of Drinking-Water	Standard Plate Count	-	n.m.	n.m.	must be less than 100 groups in any 1 ml sample
		Coliform groups	-	must not be detectable in any 100ml of sample	n.m.	must not be detectable in any sample
	Inorganic Constituents	Cadomium	Cd	0.003	0.05	0.01
		Mercury	Hg	0.001	n.m.	0.0005
		Selenium	Se	0.01	0.05	0.01
		Lead	Pb	0.01	0.01	0.05
		Arsenic	As	0.01	0.05	0.01
		Cromium	Cr	0.05	0.05	0.05
		Cyanide	CN	0.07	0.2	0.01
		Silver	Ag	n.m.	n.m.	n.m.
		Barium	Ba	0.7	1	n.m.
		Nitrate	NO3	50	100(NO3+NO2)	10 (NO3+NO2)
		Nitrite	NO2	3	100(NO3+NO2)	10 (NO3+NO2)
		Fluoride	F	1.5	8	0.8
Substances and parameters in drinking-water that may give rise to complaints from consumers	Inorganic Constituents	Zinc	Zn	3	15	1
		Iron	Fe	0.3	1	0.3
		Copper	Cu	2	3	1
		Sodium	Na	200	n.m.	200
		Manganese	Mn	0.5	1.5	0.05
		Chloride	Cl	250	800	200
		Calcium	Ca	n.m.	n.m.	300 as Ca,Mg
		Magnesium	Mg	n.m.	n.m.	300 as Ca,Mg
		Total Dissolved Solid	TDS	1000	2000	500
	Organic Constituents	Surfactants ABS (Alkyl Benzyl Sulphonates)	ABS	n.m.	2	0.2
		1,1,1-trichloroethane	1,1,1-CH3CCl3	2	n.m.	0.3
		Phenol	-	0.0001 to 0.3 depending on each phenol type	0.002	0.005
	Inorganic/Organic Constituents	COD (consumption of KMnO4)	-	n.m.	20	10
	Physical Parameters	pH	-	n.m.	6.5-9.2	5.8-8.6
		Taste	-	n.m.	acceptable	acceptable
		Odour	-	n.m.	acceptable	acceptable
		Colour	-	15 TCU	50	5 TCU
		Turbidity	-	5 NTU	30	2 NTU
		Total Hardness	-	n.m.	600	300
		Sulphate	SO4	250	600	n.m.
		Ammonium	NH3	1.5	n.m.	n.m.
		Total Nitrogen exclusive Nitrate	-	0.1	1	n.m.
		EC (electric conductivity)	-	n.m.	n.m.	n.m.

n.m.: not mentioned

References:

WHO, 1983, "Guidelines for drinking-water quality, second edition, Volume 1 Recommendation"
Ministry of Lands, Water, Housing and Urban Development in Tanzania, Dec 1996, "Water supply design manual Chapter 3 water quality"
Ministry of Water in Tanzania, July 1997, "Design Manual for Water Supply and Waste Water Disposal: Second Draft: Volume I"
Ministry of Health and Welfare in Japan, 1992, "Registry No. 69: standards for drinking water quality"

CHAPTER 2 CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

As stated in chapter 1, the Project adopts the health significant indicators of WHO Guidelines for drinking water quality instead of the Temporary Standards of Quality of Domestic Water in Tanzania. In order to grasp the seasonal fluctuations of the water quality and consumption, the 1st field survey (the rainy season: April to July) was carried out followed by the 2nd field survey (the dry season: September to November). Based on these data, it was estimated that safe drinking water from boreholes in the 4 districts of good water quality as sources is supplied to the population of 17,890, which counts merely 2.14% of the 4 districts' total population of 834,774. The request centred on the development of boreholes of good water quality fitted with hand-pumps for a wide area. However, it became clear that such a plan would encounter great restrictions in terms of the water quality of sources. Therefore, the contents of the basic design have largely been altered from the original request. The details of the 1st and 2nd field surveys and discussions are elaborated in "(1) Consideration of the request". The Basic Concept of the Project is described in "(2) Overall goal and project purpose" and "(3) Basic Concept of the Project". Table 2-6 compares the overall goals, the project purposes, outputs and activities, the request between the original request and the basic design.

(1) Consideration of the request

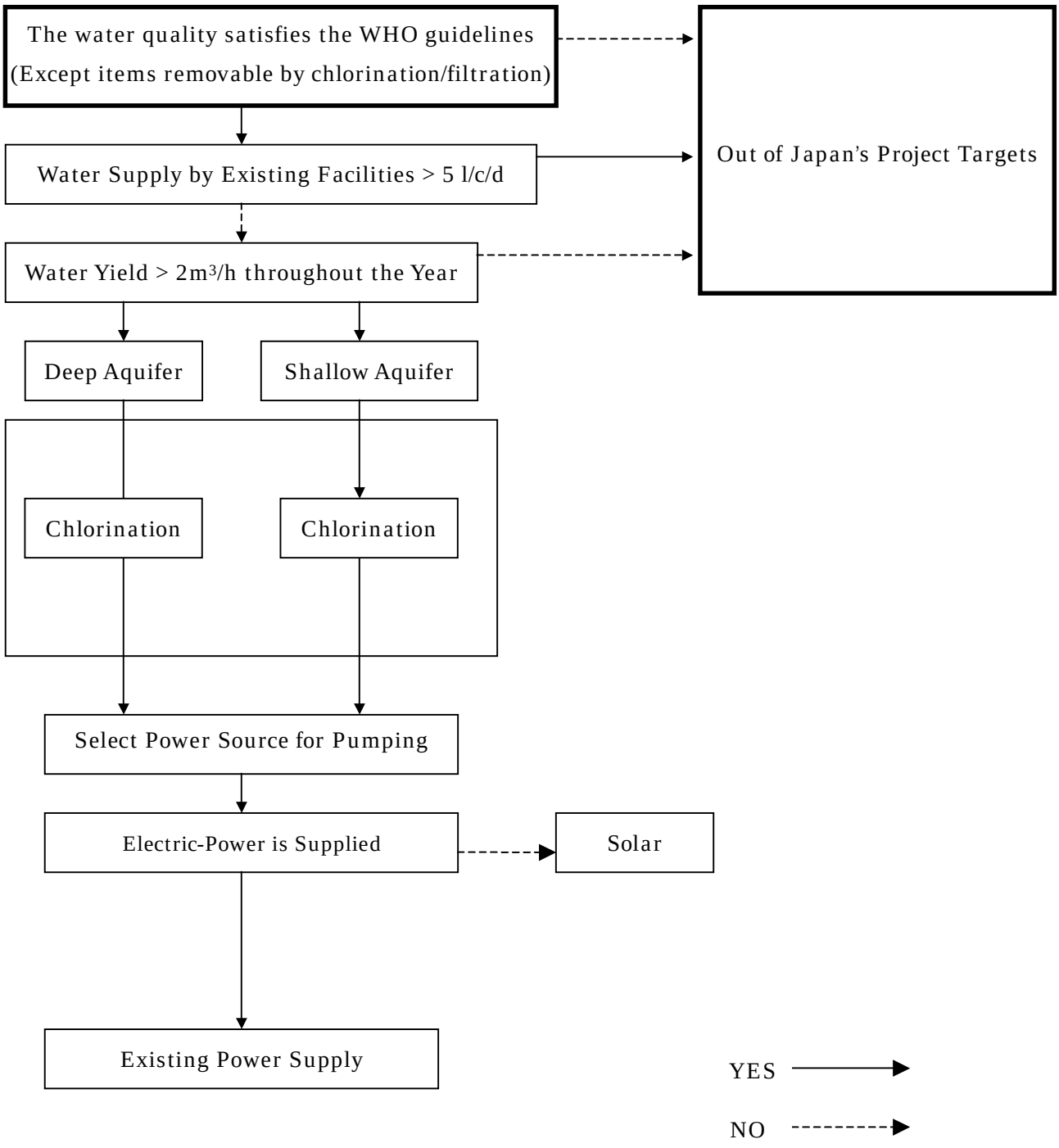
1) Target villages

The Project mapped out the "Flow chart for Identification of Target Sites (Fig.2-1)" to select water sources that can supply safe drinking water.

The 1st field survey selected sites that fulfil the following 3 indicators:

1. Fluoride concentrations are below 1.5mg/l of the WHO guidelines,
2. It is possible to secure more than 2m3/h throughout the year,
3. The existing facilities have not achieved a safe drinking water supply rate of 5l/day/person.

The analysis results of the fluoride concentration at the 1st field survey are shown in Appendix-6 (1). This clearly shows that the potential of boreholes that can supply safe drinking water is narrowly limited. Further, the fluoride concentrations of shallow groundwater from shallow wells and water holes were below 1.5mg/l, possibly because they were measured just after the rainy season. However, many of these do not have sufficient potential to secure more than 2m3/h year round. In addition, villages that can secure safe drinking water from boreholes whose flow rates are enough to cover the village population are excluded from the target.



Function of Water Source：Capable to supply 5 lit/capita/day of water which satisfies the quality for drinking use as recommended by the WHO guidelines

Fig.2-1 Flow Chart for Identification of Target Water Source

The 1st field survey concluded that the poor water quality is caused by geological conditions and influenced largely by the rainfall. As the 1st field survey was just after the rainy season (April to July), the 2nd field survey was carried out during the dry season (September to November). The target sites for the 2nd field survey selected from results the 1st field survey and their results are shown in Table 2-1. The 2nd field survey considered the water supply from one source to more than one village, based on the concept to supply water from limited sources to as many people as possible.

2) Facilities for water supply

① Standards for water quality

Regarding the relevant standards for water quality, the Government of Tanzania enacted the Temporary Standards of Quality of Domestic Water in Tanzania in 1974 (see Table1-4). However, as to some items such as fluoride and nitrite that are found with high concentrations in the concerned target villages, the values are far from conformity to the standards of Japan or WHO guidelines for drinking water quality. Prior to the dispatch of the 1st study team, the Government of Japan clarified that Tanzania's temporary standards cannot be adopted, as the effects to health are unproven and the results of medical investigations are uncertain, particularly for the fluoride content standard at present. The standard of Japan is 0.8mg/l and the WHO guidelines suggest 1.5mg/l for the fluoride content of drinking water. For the Project it was recommended that the health significant indicators of WHO guidelines for drinking water quality be observed and the Government of Tanzania has agreed.

② Water sources

In order to investigate availability of shallow groundwater, although it is easily contaminated and its yield fluctuates between the dry and rainy seasons, the 2nd field survey was conducted during the dry season (September to November 2000). Concluded from the field survey, both the shallow water intake facilities structured to prevent surface contamination and boreholes which yield groundwater of good quality will properly be utilised as water sources at various sites.

Table 2-1 Sites Studied in the 2nd Field Survey

District	System No.	Serial No. in the Request	Site	Feasibility		Type of Water Source	Water Quality and Quantity	Remarks
				as a water source	to install a water tap			
Hanang	H-1	6	GARAWJA	N	N	Borehole	High in Fe, Mn, Cl	
		2	DANG'AIDA		N			
		10	WANDELA		N			
	H-2	8	HIRBADAW	P	P	Borehole	High in Fe (0.3<Fe<1.0)	
		11	GETANUWAS		P			
	H-3	26	SIROP	N	N	Borehole	High in Cl	
	H-4	31	LAMBO	P	P	Shallow well	High in Fe (0.3<Fe<1.0) Disinfection is needed	
		30	MASAKTA		P			
		32	MASQARODA		P			
Singida Rural	S-1	1	IKUNGI	P	P	Borehole		
	S-2	21	ISSEKE	N	N	Borehole	High in Cl	
		20	IHANJA		N		High in Cl	
	S-3	37	MSIMI	N	N	Borehole		
	S-4	117	UNYUAGHUMPI	N	P	Borehole	High in NO_3	(Water can be supplied from Kinbwi and Minyinga)
	S-5	113	MUNGAA		P			
		115	KINKU		P			
		116	KIMBWI	P	P	Shallow well	Disinfection is needed	
		114	MINYINGA	P	P	Shallow well	Disinfection is needed	
	S-6	38	MSUNGWA	N	N	Shallow well	High in F	
	S-7	104	MUNKHOLA	N	N	Shallow well	High in Cl	
Igunga	I-1	9	CHIBISO	P	P	Shallow well	High in Fe (0.3<Fe<1.0) Disinfection is needed	
	I-2	26	KINUNGU	N	N	Shallow well	High in Fe (0.3<Fe<1.0) Water quantity is not enough	
	I-3	45	BUKOKO	N	N	Shallow well	Water quantity is not enough	
	I-4	46	IPUMBULYA	N	N	Shallow well	High in F	
	I-5	48	LUGUBU	N	N	Shallow well	Water quantity is not enough	
Manyoni	M-1	3	MWANZI	N	P	Borehole	High in Cl	(Water can be supplied from Muhalala)
		2	KIPONDODA		P			
		4	MUHALALA	P	P	Borehole		
	M-3	6	MITOO	N	N	Borehole	High in NO_3	
		7	MKWESE		N		High in Fe, Mn, Cl	
	M-4	24	DAMWELU	N	N	Borehole	High in Cl	
	M-5	25	MITUNDU	P	P	Borehole		
		29	MAKALE		P		High in Cl	
	M-6	27	ITAGATA	N	N	Borehole	Water quantity is not enough	
	M-7	28	KAYUI	P	P	Borehole		
	M-8	37	MBWASA	P	P	Borehole		
		38	MWIBOO		P			
		36	CHIKUYU		P			
TOTAL				10 water sources	21 sub villages			

N: negative, P: positive

③ Facilities for water supply

The field survey originally targeted the boreholes in 284 villages but as the water from many of the boreholes contains high concentration of fluoride, the potential of shallow wells and surface water were also considered in the 1st field survey. Only water sources which have enough quantity of safe water were listed up to be used, and thus, not many water sources were qualified. As a result, according to the concept of 'safe water for more people', main designs for water facilities were also changed from 'Level-1' to 'Level-2' and the government of Tanzania expressed its agreement for this change.

3) Procurement of equipment

In the initial request from the government of Tanzania, mainly the District Water Engineer's Office requested equipment and materials for boreholes with handpumps. However, the change in project concept required that the mainly boreholes with handpump facilities be changed to Level 2 piped systems. Likewise, the organisation for operation and maintenance had to also be change from that for handpumps to piped schemes which require District level support. Yet, due to the changes in the facility plans, the following equipment and materials are now needed.

① Equipment and materials for O&M in the District levels
② Equipment and materials for O&M of the water supply facilities
③ Equipment and materials for defluoridation activities.

4) Education, training and monitoring

Originally, the request was made for education and training of communities on operation and maintenance of handpumps (Level 1). However, the water quality problem attributed to the change in facilities scale to piped systems (Level2) which necessitated the introduction of an O&M system appropriate to the facility design of Level-2. Moreover, hygiene education will be carried out so that the local people would recognize the importance of safe water more. As this is the first time for these areas to be introduced to this approach, the plan should be made with thorough consideration on the social aspects of the target sites.

In this project, a number of water sources with high fluoride contents makes the planning difficult. Thus, the support for defluoridation is also added to the Project. That includes the procurement of equipment and materials needed for defluoridation and the support for social development interventions ("Soft component programme").

Table 2-2 summarizes the changes between the original request and the basic design. The selection of the water supply system can be referred to (3) Basic concept of the Project.

Table2-2 Comparison between the Initial Request and the Basic Design

	Request (July 1997)	Basic Design (March 2001)
Sites	284 villages in Hanang, Singida Rural, Manyoni and Igunga Districts	8 villages in Hanang, Singida Rural, Manyoni and Igunga Districts
Facilities	Water supply facilities with handpumps in 284 villages (* refer to Table 1-1)	One water supply system (Level-2) in each district to supply 34 sub-villages of 8 villages in total
Water sources	Boreholes	Shallow wells and boreholes
Standard for drinking water quality	-	WHO guideline (indicators relating to health), Iron < 1 mg/L
Supply system	-	Level-2 supply systems run by the District Water Engineers Office Also, supported by Government of Japan
Others	-	Support for removal of fluoride

(2) Overall goal and project purpose

The goal of the Project is to secure safe water sources and establish an appropriate system which enables sustainable operation and maintenance in the 4 districts. Under severe water supply conditions, the facilities will be constructed in order to 'supply safe water to as many people as possible' through development of limited sources as well as to consolidate an infrastructure for sustainable operation and maintenance.

The contents of the Project have been altered from the original request after completion of the 1st and 2nd field surveys. The reasons are water quality problems and the communal environment (O&M). While the water quality can be improved by utilization of equipment or facilities, the sustainable operation and maintenance appears to be hard for water supply at a village level such as in this project, where operational rates of existing facilities (including handpumps) low and the villagers are not even aware of forming water committees and collecting fees. In particular, a long term measure such as hygiene education is necessary to promote the dangers of fluoride that has no odour nor taste to the villagers who have no knowledge of water quality.

A water supply plan needs be made including measures for water quality improvement. At this

stage, however, water supply from safe sources and consolidation of an infrastructure for sustainable operation and maintenance are regarded as stepping stones for future plans. Therefore, the purpose of the Project is to establish an emergency measure as well as to imply a direction for Japan's aid scheme.

(3) Basic concept of the Project

Based on the data obtained in the 1st field survey (April to July, 2000, after the rainy season), by estimating the supply rate of safe drinking water, from the pumping rate and served population, if boreholes in the 4 districts of good quality are used as water sources, the amount can be supplied to a population of 17,890, which counts merely 2.14% of the 4 districts' total population of 834,774 (in 2000). Under these circumstances, water needs to be transmitted for some distance in order to supply water to as many people as possible. The Project introduces the pipeline supply facilities (Level-2) taking hygiene and convenience aspects into account.

On the other hand, the operational rate of existing facilities in the project area is merely less than 20 % and operation and maintenance are difficult. Therefore, the Project will constructs systems that enable sustainable operation and maintenance. For this reason, Japan's aid is limited to one system per district, which can become a prototype for an appropriate facilities and water supply project in the future. In addition, goods will be procured and social development interventions will be included to support defluoridation measures.

1) Target districts for facilities of water supply construction

According to the field survey results, 10 sources in Hanang, Singida Rural, Manyoni, Igunga Districts are possible to be developed further as displayed in the following table. Only these 10 sources are considered to be safe. From these sources, the water supply facilities and villages per district that are appropriate for Japan's Grant Aid scheme were selected.

Villages which 'currently possess no safe water sources' were prioritised in the selection of (water supply system) target villages. In addition, the importance of management, operation and maintenance, hygiene education as well as District Water Engineers were emphasized in the selection. District Water Engineers play the role as key persons in the Project. It is improbable for future development of the water supply sector to be sustainable, unless their sufficient experience and results through the Project are accumulated. From this aspect, the principle of one district one supply system was considering an adequate size for capacity building without an excess burden on the District Water Engineer Office.

The project cost and the beneficiary population were compared based on tentatively selected villages and a pipeline plan for facilities to which water can be supplied from sources in Table 2-3 (For the selected 4 systems see "2-2-3 Basic Design Drawing", and from the remaining 6 systems, see "APPENDIX-6(4) Layout Plan of Water Supply System in 6 Areas").

Table 2-3 Prospective Water Sources

District	System No.	Water source	Quantity to be pumped (m^3/h)	Proposed No. of wells	Daily Supply Rate(m^3/d)	Served Population	Types of water sources
Hanang	H-2	HIRBADAW	3.0	2	36.0	7200	borehole
	H-4	LAMBO	3.3	2	39.6	7920	shallow well
Singida Rural	S-1	IKUNGI	3.0	1	18.0	3600	borehole
	S-4	KIMBWI	2.0	3	36.0	7200	shallow well
	S-5	MINYINGA	2.0	3	36.0	7200	shallow well
Igunga	I-1	CHIBISO	3.0	1	18.0	3600	shallow well
Manyoni	M-1	MUHALALA	3.0	2	36.0	7200	borehole
	M-5	MITUNDU	3.2	2	38.4	7680	borehole
	M-7	KAYUI	2.2	1	13.2	2640	borehole
	M-8	MBWASA	3.0	2	36.0	7200	borehole

These 4 water supply systems were selected, because firstly, the Project adopts the concept of one system per district and secondly, presently there are no safe water sources (or extremely limited). Table2-4 shows the conditions of existing facilities of the 10 water supply systems in the target villages and the 4 selected water supply systems. Table 2-5 lists the Project Sites, and Fig.2-2 shows their locations.

Table 2-4 Water Supply System Selection

District	System No.	No. of Beneficia-ries	No. of Served Villages	No. of Sub-Villages	Existing Water Facility			Comment
					*No. of Existing Boreholes	Type of Pumping in Existing Borehole	Served Population per Borehole	
Hanang	H-2	6,833	2	8	1	HP	6,833	Distance between the 2 villages is 8km
	H-4	7,540	2	14	-	-	-	
Igunga	I-1	2,704	1	4	-	-	-	
Singida Rural	S-1	3,239	1	6	1	WM	3,239	
	S-4	7,109	3	9	-	-	-	Many safe water sources are available if chlorinated.
	S-5	6,136	3	11	-	-	-	Many safe water sources are available if chlorinated.
Manyoni	M-1	6,921	3	6	4	E/WM/HP	1,730	The height difference between the village with water source and villages to be supplied is 120m
	M-5	7,586	1	2	11	WM/HP	690	
	M-7	2,618	1	2	2	HP	1,309	
	M-8	6,819	3	10	1	WM (Quantity deficit)	6,819	
Total		57,505						

＊The number of existing boreholes represents the total boreholes which satisfy WHO guidelines other than Fe.
WM: windmill pump, HP:handpump, E:engine-driven pump
The system is selected by Districts as one system per district. The sites without safe water sources are given priority.

Further in the Project, the Japanese side will support the Tanzanian side for social development interventions with regard to operation and maintenance which can raise awareness of the villagers. The villagers' sense of participation is key for operation and maintenance of facilities. Therefore, depending upon the progress of the operation and maintenance system, some sub-villages may be excluded from the detailed design stage in phase 2.

Table2-5 List of the Project Sites

System No.	Population (2005)	Planned Population to be Served (2005)	* Capacity of Water Source for the System in Population	Coverage (%)	Target Village	Sub-Village No	Sub-Village	Population (2000)	Planned Population to be Served* (2005)
H-4	8,923	7,540	7,920	84	LAMBO	1	MALLA	552	651
						2	HAYEDA	453	534
						3	BAKCHAN	539	636
						4	MARSANDA	522	616
							Total	2,066	2,437
					MASAKTA	1	GATINDAGAW	342	403
						2	BOHOO	375	442
						3	TIPIRI	367	433
						4	BUBU	492	580
						5	MOHETU	521	615
						6	HOMARI	245	289
						7	YAROSIRONG	258	0
							Total	2,600	2,762
					MASQARODA	1	BUBU	407	480
						2	GUDEDESH	668	788
						3	DERMO	303	357
						4	GARODESH	607	716
						5	NG'ALDA	911	0
							Total	2,896	2,341
							Sub Total	7,562	7,540
S-1	3,689	3,239	3,600	88	IKUNGI	1	MBWANJIKI	217	0
						2	MIRI	354	410
						3	IKULUME	172	0
						4	GAHILU	89	103
						5	MISIRI	150	174
						6	MTAKUJA	575	666
						7	IKUNGI	717	830
						8	TAMBUKARELI	912	1,056
							Sub Total	3,186	3,239
I-1	2,704	2,704	3,600	100	CHIBISO	1	CHIBISO	528	547
						2	BULOLANGULU	588	609
						3	ILOMBAMISO	726	752
						4	MWANKONO	768	796
							Sub Total	2,610	2,704
M-8	9,595	6,819	7,200	71	MBWASA	1	MBWASA KATI	307	353
						2	MUULAGWA	262	302
						3	NKAMBALA	360	414
						4	MLOWA NG'AMBO	387	0
						5	MPYONKO	330	380
							Total	1,646	1,449
					MWIBOO	1	MANG'ONYI	480	552
						2	USANGUNI	380	437
						3	MWIBOO	500	575
						4	NDEBESI	600	691
						5	MUWALANKONDO	180	0
							Total	2,140	2,255
					CHIKUYU	1	CHIKUYU KATI	1,302	1,498
						2	KORRO	1,435	0
						3	CHILEJEHO	325	0
						4	CHIKUYU MJINI	1,405	1,617
						5	MTIWE	83	0
							Total	4,550	3,115
							Sub Total	8,336	6,819
Grand Total								21,694	20,302
Total of the Sub-Villages for the Water Supply									34

* : Planned Population to be Served is 0 (zero) in Sub-Villages which are out of the target

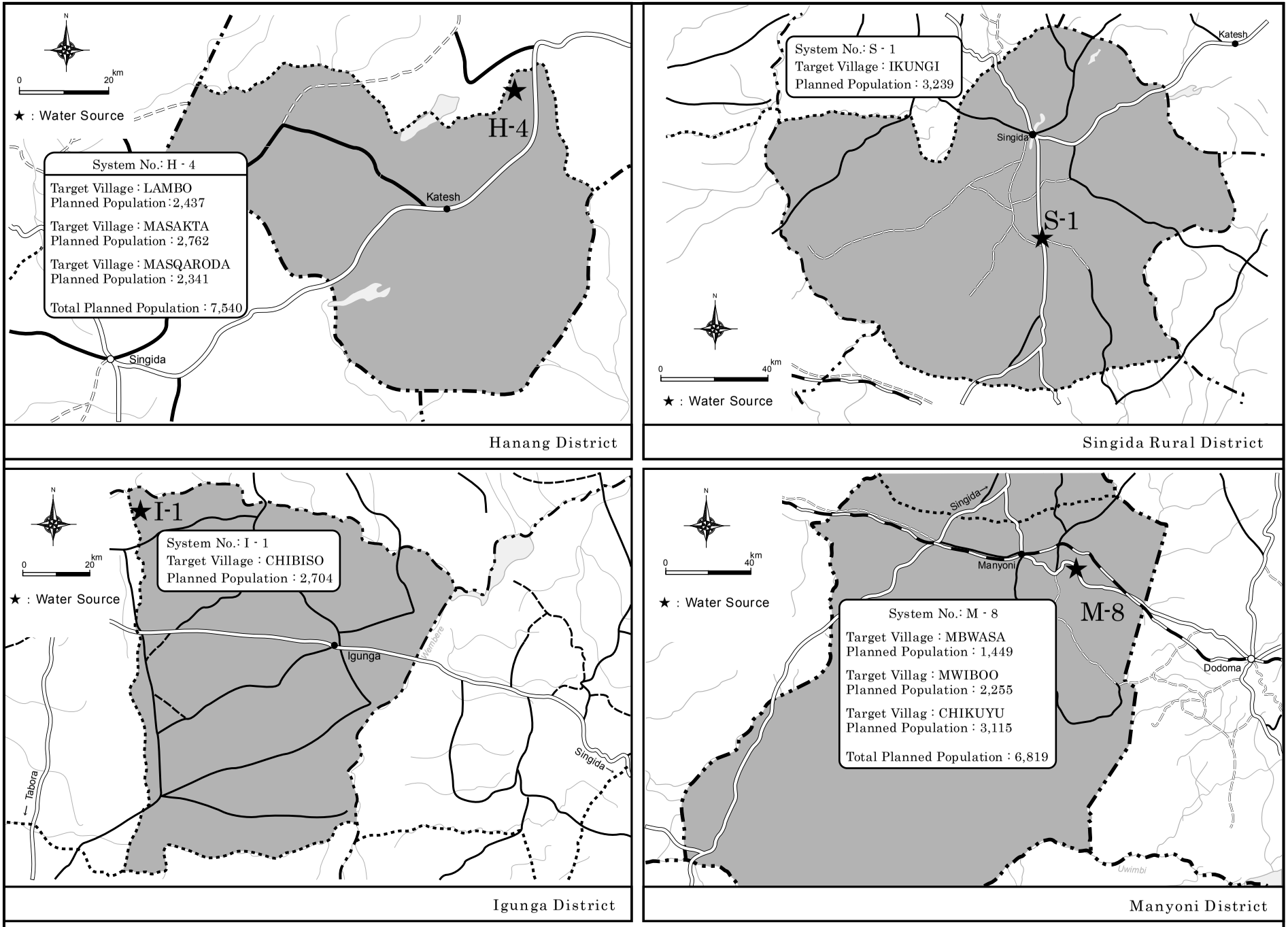


Fig.2-2 Location Map of Project Sites(4 Water Supply Systems)

2) Support for establishment of operation and maintenance system through "social development interventions"

The Project will support a process for operation and maintenance system establishment through social development interventions with regard to the following expected outputs (direct impacts).

① Willingness to participate and sense of ownership is enhanced

If participatory involvement and hygiene education are implemented for some period prior to the construction, then community participation and sense of ownership can be enhanced. In this way, communities can realize the benefits and conveniences of having water supply facilities and necessity to establish community-based operation and maintenance systems for sustainable utilization of the facilities.

② Health and hygiene awareness is improved

The communities are expected to realize the risks on one's health through consumption of contaminated water from existing water sources. In particular, the communities in the Project area where fluorine-contained water is prevailingly consumed are expected to fully realize that drinking water with a high fluoride content affects one's health, while the communities are also expected to realize other health risks of water-borne diseases by consuming contaminated water. It is important to enhance expectation for the facilities to be constructed and willingness to participate in operation and maintenance of the facilities through improvement of hygiene understanding and awareness.

3) Support for defluoridation measures through social development interventions

The Project supports to seek an appropriate defluoridation method. A technically feasible method for defluoridation has not yet found. So far, defluoridation trial tests were conducted only at the Ngrudoto Defluoridation Research Station in Arusha. One purpose of the Project support is to help District Engineers to conduct such tests at Katesh in the Project area and obtain data for future use. The contents of the tests are: a) to accumulate experience in defluoridation using easily procurable removal agents such as bone charcoal or brick, and b) to realize defluoridation equipment with appropriate removal agents for practical use. Additionally, the 4 District Water Engineer Offices in conjunction with other District Water Engineer Offices will conduct a basic field survey on fluorine contamination by water examination and consumption rates survey.

4) Comparison between the original request and the basic design

The differences between the original request and the basic design are summarized in Table 2-6.

Table 2-6 Comparison between the Original Request and the Basic Design

The original request	Basic Design
Overall goal	
To improve hygiene and life conditions in Tanzania.	To contribute to water supply plan and implementation including water quality improvement in future.
Project purpose	
The water supply coverage increases in the central districts.	The target population use limited but safe water in a sustainable and developmental manner.
Output	
1. Water supply facilities are constructed in the project area. 2. Necessary equipment for O&M by the executing agency will be procured. 3. The villagers build capacity for O&M.	1. Water supply facility is constructed in the project area and limited but safe water is supplied. 2. Necessary equipment for O&M by the counter part will be procured and utilized continuously and efficiently. Expected output by social development interventions for O&M 3. Sense of participation and ownership of the communities will increase. 4. Understanding and awareness on hygiene of the communities will increase. 5. Support system is constructed for O&M by the communities and the executing agency. 6. The communities and the executing agency will build capacity for O&M of the water supply system.
Activities	
1-1) Construct boreholes with hand-pumps at 264 sites. 1-2) Construct boreholes with solar pumps at 7 sites 1-3) Rehabilitate 17 existing boreholes with hand-pumps 1-4) Rehabilitate 16 existing shallow wells with hand-pumps 1-5) Rehabilitate 2 wind-generated boreholes with hand-pumps. 1-6) Rehabilitate 1 water supply facility for Level -2 1-7) Construct 64 reservoirs for livestock 1-8) Procure materials necessary for O&M 1-9) Execute training for the local repair personal 1-10) Facilitate a PRA at target villages 1-11) Facilitate awareness activities at target villages 1-12) Execute monitoring activities	1-1) Conduct basic and detailed design field survey and plan water supply 1-2) Develop 4 water sources in the project area and construct 4 water supply system (Level-2) 1-3) Procure necessary materials for O&M of the facilities Social development activities for O&M 3-1) Train the local staff (Development facilitators, Sanitary and hygiene facilitators) 3-2) Facilitate participatory activities at each community 3-3) Promote establishment of a Water Fund in the project area 4-1) Promote hygiene education to the community 5-1) Create and reorganize water committees 5-2) Establish a water supply system management centre 6-1) Transfer technology to the water committees 6-2) Transfer technology to the water supply system management centre regarding O&M 6.3) Execute monitoring regularly regarding participation enhancement, hygiene education and O&M

* In the basic design, the support for the activities of defluoridation is also added to the Project. That includes the procurement of equipment and materials needed for the activities of defluoridation and the support for social development interventions.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Policy

The purpose of the Project is to secure safe water and establish an appropriate system with sustainable operation and maintenance in the 4 districts. These systems develop limited water sources, construct facilities for water supply in the project areas under the severe water supply conditions in order to supply limited but safe water to as many people as possible and establish a sustainable operation and maintenance infrastructure. According to the results of the 1st and 2nd field surveys, water sources that can supply safe drinking water were found at 10 sites. As described in the previous chapter, these 10 sites were scrutinized whether construction of water supply systems is appropriate for the Project, and eventually 4 sites were selected (See Table 2-4). Next sections elaborate the policy towards conditions.

(2) Concept on natural environment

As stated in “2-1 Basic concept of the Project”, the geological conditions in the target sites are rather disadvantageous. Especially, high concentration values of fluoride have exceeded the WHO guideline values at many sites. Therefore, only water sources which can satisfy the WHO guideline were selected. In the Project, fractured zones will be utilized as the aquifers of new boreholes. These fractured zones are situated in granite and volcanic rocks such that these aquifers do not extend out on a vast surface. Referring to the existing data, the success rates of boreholes are between 70 and 80%. On the other hand, for the new intake facilities for shallow groundwater, the water charged in the valleys is targeted, but routes of water in the surrounding areas might be changed in the long-run, and thus, the locations for intake facilities should be carefully chosen.

(3) Concept on social conditions

As already mentioned, the local people are highly dependent on the external supports for the social services, and thinking that water can be acquired for free of charge. Thus, unless this mentality is changed, the effects of the Project would be very limited. To avoid such a case the Japanese side will support the social development interventions, in which the participation of the local people will be encouraged. Yet, the educational programmes such as this will be the first time for the responsible organizations as well as the local people in this area. Therefore, full consideration and time allowance are necessary.

The existing water supply facilities (engines, pipes, etc.) are being stolen and vandalised. Awareness activities to water committees and users, and facilities planning which consider these circumstances are required (fence around the facilities, locks on well pits and valve boxes, etc.)

(4) Concept on gender

- Decision on the location of public taps within a village

  At the discussion table to decide the locations of public faucets, women are expected to participate (PRA method will be introduced if needed) and gender aspects are carefully considered.

- Tap attendant

  Tap attendants will receive hygiene education so as to transfer knowledge about the importance of safe water to women and children who come to fetch water on a daily basis. It is preferable for this purpose that women who are concerned for the health of their children become tap attendants to raise their awareness towards children's health. On the other hand however, it is probable that troubles at the public faucet (such as non observance of the rules) can occur, and women may not be suitable to resolve the problem. Therefore, a balance should be reflected at each tap stand and water station with the water committee personnel (principally men and women should be equal in number), and the male-female ratio of tap attendants and water committee members should be gradually improved. Monitoring will be required after the completion of construction.

(5) Conditions for construction works

In these 4 Districts, the development of the infrastructure is far behind the other areas of the country. A general construction firm with foreign investment in Tanzania proceeds construction works on the project basis. No works are undertaken nor construction firm operates in these 4 Districts. Therefore, either the base of a subcontractor or a Japanese contractor will be located in Dar es Salaam, and the construction base will be at Singida, a central location of all 4 Districts. All of the materials will be transported from the capital, Dar es Salaam, and it normally takes 4 to 5 days by vehicle.

In Tanzania, cement is locally available and steel bars are also readily acquired. Most of the materials for the water supply facilities are imported and available at agencies in Dar es Salaam. The materials for construction of boreholes donated by different donor organizations are not consistent with the specifications but they are also available at

agencies in Dar es Salaam. The construction materials for the Project can be purchased either in Japan or in Tanzania.

This is the same case for pumps and generators.

Moreover, drilling rigs and construction machineries are mostly available in the capital, Dar es Salaam. Therefore, it is not necessary to transport construction machineries from Japan but rather to lease them in Tanzania.

(6) Concept on the local contractors

Neither construction nor drilling firms capable of handling the required works are found in the project area. Therefore, construction and drilling firms as sub-contractors will be selected from the capital, Dar es Salaam. As to construction firms, there are a few foreign invested major construction firms in Dar es Salaam with enough capacity to undertake urban water supply projects. Regarding drilling firms, some firms including the Drilling and Dam Construction Agency (DDCA) are available and well experienced (foreign investment included). Although DDCA possesses the highest amount of equipment, there are not much differences in the capacities of the firms. There were rumours before that the technical capabilities of drilling firms are not satisfactory but are quite feasible to carry out adequate construction under the supervision of Japanese engineers. Three boreholes will be constructed by the project, and so a supervision organization of Japanese engineers will be structured for this purpose. There are local consultants who can meet the requirements of the Project with experiences in projects by Japan and other international organizations.

(7) Concept on capacity of the executing agency for operation and maintenance

Although this is the first time for the Ministry of Water and Livestock Development to receive Japan's grant aid as an executing agency, they have experienced many schemes of Japan's technical cooperation. It is considered that the levels of finance, human resources and technology are enough to execute the Project as a counterpart. Furthermore, there is no difficulty with human resources and technology at the District Water Engineers Offices, which will mainly undertake activities at the sites. The purpose of the Project is to operate and maintain individual water supply systems on its own finance, so that no expenses are expected from the District level, but District Water Engineers Offices need to patrol to check the operation. In the Project, the plan will be to have the District Water Engineer Offices exchange agreements with individual water supply systems in order for them to pay fixed fees. Additionally, training on O&M to District Water Engineers Offices is provided in order

to strengthen the capacity. The training will be supported by social development activities

(8) Concept on grade set up for facilities and equipment

Considering the purpose of the project, the water supply facilities will be constructed in such way that target villagers can easily use them, and as to equipments, its spare parts should be inexpensively and easily acquired. On the other hand, a certain quality needs to be maintained to endure the severe natural environment. Therefore, parts which need to be replaced frequently such as faucets, gate valves, and PVC pipes will be those procurable in Tanzania, and specialized parts such as pressure reducing valves will be imported from Japan. Solar panel systems to be employed will be those made in EU countries that are generally on the market in Dar es Salaam.

(9) Duration for construction

The project will be divided into 2 phases for the following reasons. In the project area, the condition of the roads generally becomes bad during rainy seasons from November to December and from the middle of February to April. During these seasons, the accessibilities from Arusha or Dodoma to the target sites become seriously difficult. Considering this condition, the actual duration of construction works is only 7 months in a year.

Furthermore, since each of the water supply systems are scattered at 40, 145, 169 and 205 km from the base office in Singida, difficulties in management of construction works would arise if all facilities were constructed in parallel. On the other hand, capacity building and awareness raising activities on operation and maintenance are to be conducted at all sites prior to the construction works, because the residents need to be motivated in advance.

Therefore, the Project requires two phases for effective implementation. Due to phasing of the project, the facilities constructed in Phase I can be monitored in Phase II to confirm the situation of operation and maintenance. Also, the impacts of the awareness raising programme can be confirmed during the construction in Phase II. Thus, from the viewpoint of technical aspects with construction as well as community involvement, implementation in 2 phases is considered to be advantageous.

2-2-2 Basic Plan

2-2-2-1 Water Supply Facility Plan

(1) Water sources development

As mentioned in “2-1 Basic Concept of the Project” shallow wells and boreholes will be used in this project.

① Development of shallow groundwater

Shallow wells generally rely on rainwater. In this project, the locations of the shallow wells were identified in the 2nd survey from September to November 2000. The design of the shallow wells will be of the widely used concrete lining type. Full attention needs to be paid to avoid contamination of water in the event of gravel packing and cementing of the lining.

② Development of deep aquifer

As mentioned, fissures will be used as water sources for boreholes in the Project, and thus, the points should be carefully selected. Since the relation between the drilling depth and water quality can vary depending on the drilling point, in-situ water quality tests at the time of drillings will be essential.

(2) Water supply plan

1) Per capita supply rate

In this project, water will be supplied to the total population of 20,302 in 8 villages consisting of 34 sub-villages in 4 districts.

① Quantity of water to be supplied

The quantity of water per person per day is described as 25 litres in the National Water Policy of Tanzania. However, in this project, since the quantity of safe water is very limited, the water supply rate will be 5 litres/day/person. According to the field survey for the 284 villages, the quantity consumed by each household will be 10 to 25 litres per day. For individuals, it is 4.58 litres per day including 2.41 litres for drinking (Table 2-7). Based on this estimation, the average water supply rate for drinking water is set at 5 litres/day/person.

Table 2-7 Water Consumed by Households

District	No. of surveyed villages	Average household size	Quantity of water for drinking per household	Quantity of water for drinking per person	Quantity of water for drinking and cooking per household	Quantity of water for drinking and cooking per person
Hanang	33	6.69	14.67 litre	2.19 litre	30.23 litre	4.54 litre
Singida Rural	130	6.87	16.86 litre	2.45 litre	36.37 litre	5.29 litre
Manyoni	72	6.40	11.34 litre	1.79 litre	24.93 litre	3.90 litre
Igunga	50	8.07	26.00 litre	3.22 litre	No data	No data
Ave.		7.01	17.22 litre	2.41 litre	30.51 litre	4.58 litre

(Source: the field survey from April to May 2000)

② Potential beneficiaries

Table 2-8 shows the daily supply for each site. The population is calculated based on 5 litres of daily supply per person. The daily pumping duration is set as 6 hours on assumption of using a solar panel unit. A solar pumping system is not maintenance free, but it is advantageous that the system can function during the presence of sunlight.

Table 2-8 Potential Daily Supply Rates by Site

System No.	Water source	No. of wells	Potential pumping rate (m^3/h)	Pumping hours	Potential daily pumping rate (m3/d)	No. of potential beneficiaries from pumping rate
H-4	LAMBO	2	3.3	6	39.6	7,920
S-1	IKUNGI	1	3	6	18	3,600
I-1	CHIBISO	1	3	6	18	3,600
M-8	MBWASA	2	3	6	36	7,200

③ Target year

The target sites in this project have been suffering from high concentration levels of fluoride and nitrate in the water, and that should be dealt with urgently. The objective of this project is to supply water to the people who have no access to safe water. Therefore, as an emergency remedy, the facilities for this project are designed to meet the demand until 2005.

④ Design served population

The projected population was calculated by multiplying the population in November 2000 by the growth rate based on the Health Statistics Abstract of 1996. The growth rates are as follows.

Hanang District :3.36%
Singida Rural District :2.97%
Manyoni District :2.85%
Igunga District :0.71%

However, it is difficult to cover the whole projected population with the newly constructed facilities. In this project, the systems are designed to cover at least 70% of the projected population in each sub-village. The population and the supply rates for each sub-village are shown in Table 2-5.

2) Facility design

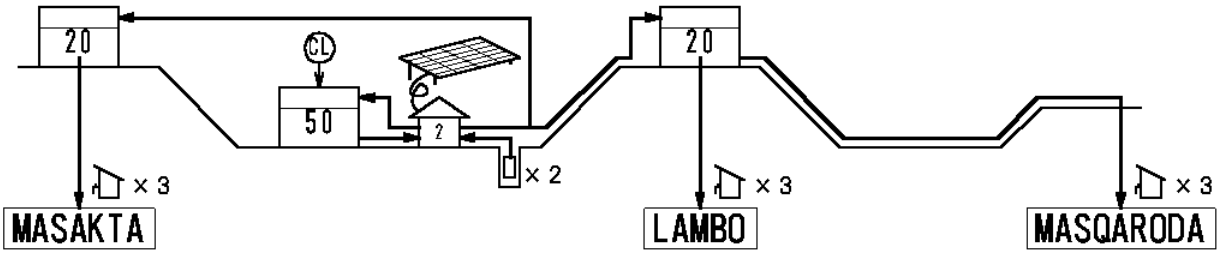
Table 2-9 shows the List of Facilities and Fig. 2-3 shows the schematic flow of the water supply facilities.

Table 2-9 List of Facilities

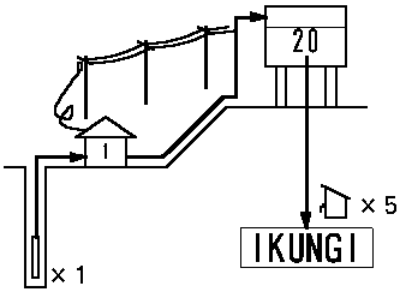
System No.	District	Target Village	Design Served Population (coverage %)	Facility	Quantity
H-4	Hanang	Lambo, Masakta, Masqaroda	7,540 (100%)	Intake Facility for Shallow Groundwater	2
				Machinery House	2
				Ground Tank	50m³× 1 20m³×2
				Submersible Motor Pump	4 units
				Pipeline	18.6 km
				Solar Pumping System	4 sets
				O&M Office	1
S-1	Singida Rural	Ikungi	3,239 (84%)	Borehole Depth:100m	1
				Machinery House	1
				Elevated Tank	20m³× 1
				Submersible Motor Pump	1 unit
				Pipeline	6.7 km
				Power Receiving Facility	1
				O&M Office	1
M-8	Manyoni	Mbwasa, Mwiboo, Chikuyu	6,819 (88%)	Borehole Depth:100m	2
				Machinery House	1
				Ground Tank	40m³× 1
				Submersible Motor Pump	2 units
				Pipeline	15.8 km
				Solar Pumping System	1 set
				O&M Office	1
I-1	Igunga	Chibiso	2,704 (71%)	Intake Facility for Shallow Groundwater	1
				Machinery House	2
				Ground Tank	20m³× 1
				Submersible Motor Pump	1 unit
				Pipeline	6.0 km
				Solar Pumping System	1 set
				O&M Office	1
District Water Engineer Office in Katesh (for defluoridation activities)				Work Floor Stock yard	1 1

FIG. 2-3 CONCEPTUAL DESIGN OF 4 WATER SUPPLY SYSTEMS

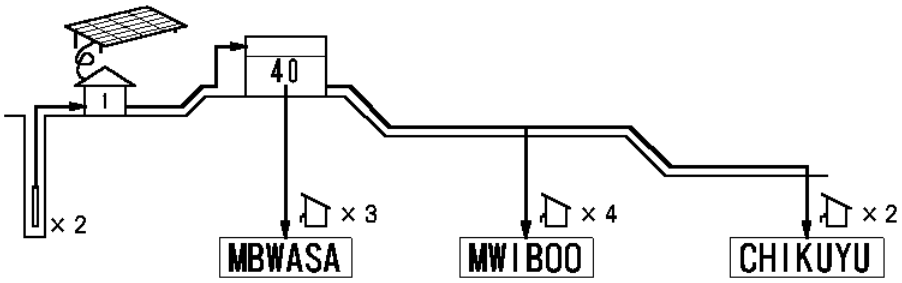
H－4



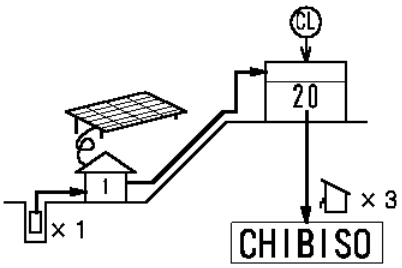
S－1



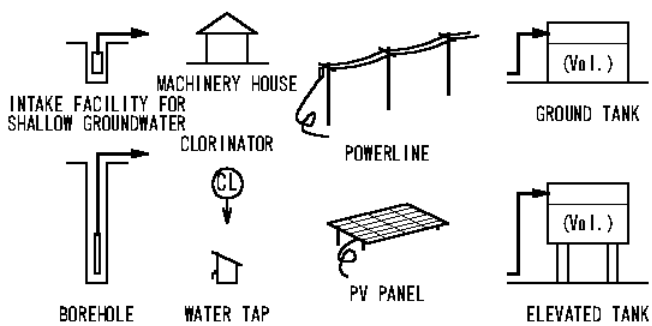
M－8



I－1



SYSTEM NO.	SOURCE	WATER TANK TYPE
H－4	INTAKE FACILITY FOR SHALLOW GROUNDWATER x2	GROUND TANK x3
S－1	BOREHOLE x1	ELEVATED TANK x1
M－8	BOREHOLE x2	GROUND TANK x1
I－1	INTAKE FACILITY FOR SHALLOW GROUNDWATER x1	GROUND TANK x1



① Water sources

As mentioned in Section 2-2-1, Design Policy "(2) Concept on Natural Environment", this project aims to supply safe water from both boreholes and shallow wells.

Considering the hydrogeological conditions, the specifications of the water sources were identified based on the concepts of this project.

Specifications of boreholes

Diameter of borehole	10"～12"
Diameter of screen	6"
Depth of borehole	100m
Discharge	3.0m³／hr

Specifications of shallow wells

Diameter	1.5m
Depth	15～20m
Discharge	3.0～3.3m³／hr

② Intake facilities

A submersible motor pump is used for intake facilities. The submersible motor pump selected for 3 target sites out of the total of 4 sites will have sufficient total head capable of delivering water from the source to the storage tank. The pump for the remaining one site will be capable of delivering water from the well to a water tank installed near the source. The quantity of pumped water is determined by the specific capacity. The maximum operation period is 6 hours for one well, and more than one well will be used when the capacity of the well cannot satisfy the needs of the area.

③ Transmission Facility

Due to the topography of the project area, for the 3 sites mentioned above, the delivery pump will directly pump water to the water storage tank. For the other site (H-4) which requires transmission to several tanks, after delivering the water to the tank located near the source, water from this tank will be transmitted by booster pumps to storage tanks located in 2 other villages through separate pipes. Like the intake facilities, the transmission facility adopts a submersible motor pump. The capacity of transmission is determined by the population of sub-villages and the volume of the water tank.

④ Water tank

The size of a water tank is determined by the yield and consumption of water at a well per day. Individual size of water tanks for each water supply system is shown in Fig.2-3 and Table 2-9. Except for H-4, one water tank is provided to each system. Due to

topographical conditions and the location of supply areas, H-4 needs 3 water tanks. The tank volumes are large enough to supply the entire supplied population.

System No.	Water volume for the entire supplied population per day	Size of water tank
H-4	37.30m^3	50m^3 (at the source)
S-1	16.20m^3	20m^3
I-1	13.50m^3	20m^3
M-8	34.10m^3	40m^3

For the design conditions of water tanks, the test results of geological conditions of the tank construction sites conducted during the 2nd survey, or any available data of existing facilities will be used. The design conditions are listed below.

Ground tank	Brown Sandy clayey silt N=10	Unit weight: γ =1.60tf/m^2 Cohesion: C=0 .0tf/m^2 Internal friction: ϕ=30°	Reinforced concrete dead load : γ c=2.5tf/m^3 Person load : Wp=0.10tf/m^2 Wind load : Ww=0.30tf/m^2 Seism inertia force : Kh=0.10
Elevated tank	Yellowish-Brown Sandy silty clay N=15	Unit weight: γ =1.70tf/m^3 Cohesion: C=1.2 tf/m^2 Internal friction: ϕ=0°	

⑤ Piping

Polyvinyl chloride (PVC) will be used as the material of pipes to be laid under the ground, while carbon steel pipes will be used for pipes which are to be laid on the ground. These are the same for all pipes to be used for conveyance, transmission and distribution. These pipes should also withstand the respective pressures of 16, 10 and 6 kg/cm^2. The diameters of pipes are calculated by using the Hazen-Williams' equation, and the minimum velocity of water going through pipes will also be identified. An air release valve will be installed in convex topography, whereas a drain valve will be installed in concave topography depending on the length of the pipe. Gate valves will be set in some parts of pipes so that the water can be stopped in the event of maintenance works. If necessary, water meters will be set in water conveyance pipes, transmission pipes and distribution pipes. Water meters can give necessary data such as the yield of water, transmitted amount, distributed amount, and consumed amount, as well as amount of leakages to control effective use of water.

⑥ Disinfection facilities

Disinfection facilities using chlorine will be installed for water supply facilities which take water from shallow wells. Considering the size of the systems and the availability of chlorine in the rural areas, the disinfection facilities will have a mixing tank in which the amount of bleaching powder (calcium hypochlorite) could be controlled, and this should be easy to operate.

⑦ Power source

Submersible motor pumps in this project will be mobilized by solar panel units or existing commercial power supply sources.

⑧ Solar pumping system

To design the solar pumping systems, the existing data on the climate of Arusha, Tabora and Singida were analysed for system design.

According to the statistics of the last 15 years, solar radiation is 4.25 to 6.50 kWh/m^2/day and insolation ranges between 5.7 and 9.8 hours. In Hanang District surrounded by Hanang mountains, the daylight hours may be less than 6 hours during the rainy seasons. The analysis of the target population and the possible yield suggested that 95% of the possible yield (5.7hrs/6.0hrs =0.95) can sufficiently supply water to the target population. Under the conditions of 4.0kWh/m^2/day and 6 hours of average insolation, it was confirmed that a system of the normal size (pump rating of 2.2kW) is enough even to supply water of 39.6m^3/day.

2-2-2-2 Procurement plan

① Equipment for O&M for district levels

As has been stated previously, O&M in the project area is difficult. It is indispensable to improve the capacity of the District Water Engineer's Office for the success of this project. Therefore, the capacity of the District Engineer's Office will be strengthened for better O&M. In the original request, pick-up trucks were included in the procurement plan, but in this project pick-up trucks would not be procured, and motorbikes are included instead.

② Equipment for O&M of water supply facilities

Since the water supply facilities have been changed to Level-2, the required equipment are now as follows: motorcycles for patrolling, maintenance tools, and bicycles for the operators of water distribution facilities, radio sets, and others.

③ Equipment for activities for Defluoridation

The project will provide support activities to develop practical methods of defluoridation. Fluoride was the main reason for changes in the plan from the original request. The Ngrudoto Defluoridation Research Station in Arusha is currently proceeding feebly with experiments in defluoridation. Although some methods have been proven to be effective, practical methods employable in rural areas are not yet developed. In the Project, trial defluoridation tests will be carried out in Katesh of Hanang District based on the results of experiments at the Ngrudoto Defluoridation Research Station in Arusha. This activity will terminate at the end of the project and necessary equipment will be procured. A social development component will support the intervention activities.

Table 2-10 shows the equipment to be procured.

Table 2-10 Equipment to be procured

a. Equipment for O&M in District levels (District Engineer's Office)

		Specifications	Qty	Remarks
a.	Motorcycle	For regular inspection of the facilities	4	One for each District
b.	Tools for O&M (for plumbing and relating works)	Electric welder, maintenance tools, electric appliances (bolt threading machine, etc.), shovel, safety tools	4	One for each District
c.	Water quality testers	Water quality tester (for Fe, Cl, NO3, residual chlorine, etc.), EC meter, pH meter, water level meter	4	One for each District
d.	Radio set	For communications from water supply systems	4	One for each District
e.	Warehouse	Container house	4	One for each District
f.	Others	megaphone	4	One for each District

b. Equipment for O&M of water supply facilities

		Specifications	Qty	Remarks
a.	Motorcycle	For regular inspection of the facilities	4	One for each system
b.	Bicycle	For collection of water fees and community awareness activities	26	One for each system
c.	Tools for O&M (for plumbing and relating works)	Maintenance tools (valve, tap, etc.), shovel, safety tools, etc.	4	One for each system
d.	Equipment for community participation and hygiene education	Laminator, Office tools	4	One for each system
e.	Radio set	For communications between water supply systems	4	One for each District
f.	Water level meter	To measure the water level	4	One for each water source

c. Equipment for removal of fluoride

		Specifications	Qty	Remarks
a.	Motorcycle	For patrolling	1	
b.	Water quality testers	Simple water test kits, ion meter, stirrer, flask, beaker, chemicals, etc.	1	
c.	Equipment for hygiene education (activities for research and advertisement)	Computer, printer, megaphone, etc.	1	
d.	Equipment to produce bone charcoal	Furnace for charcoal, crusher, sieve, etc.	1	
e.	Warehouse	Container house	1	

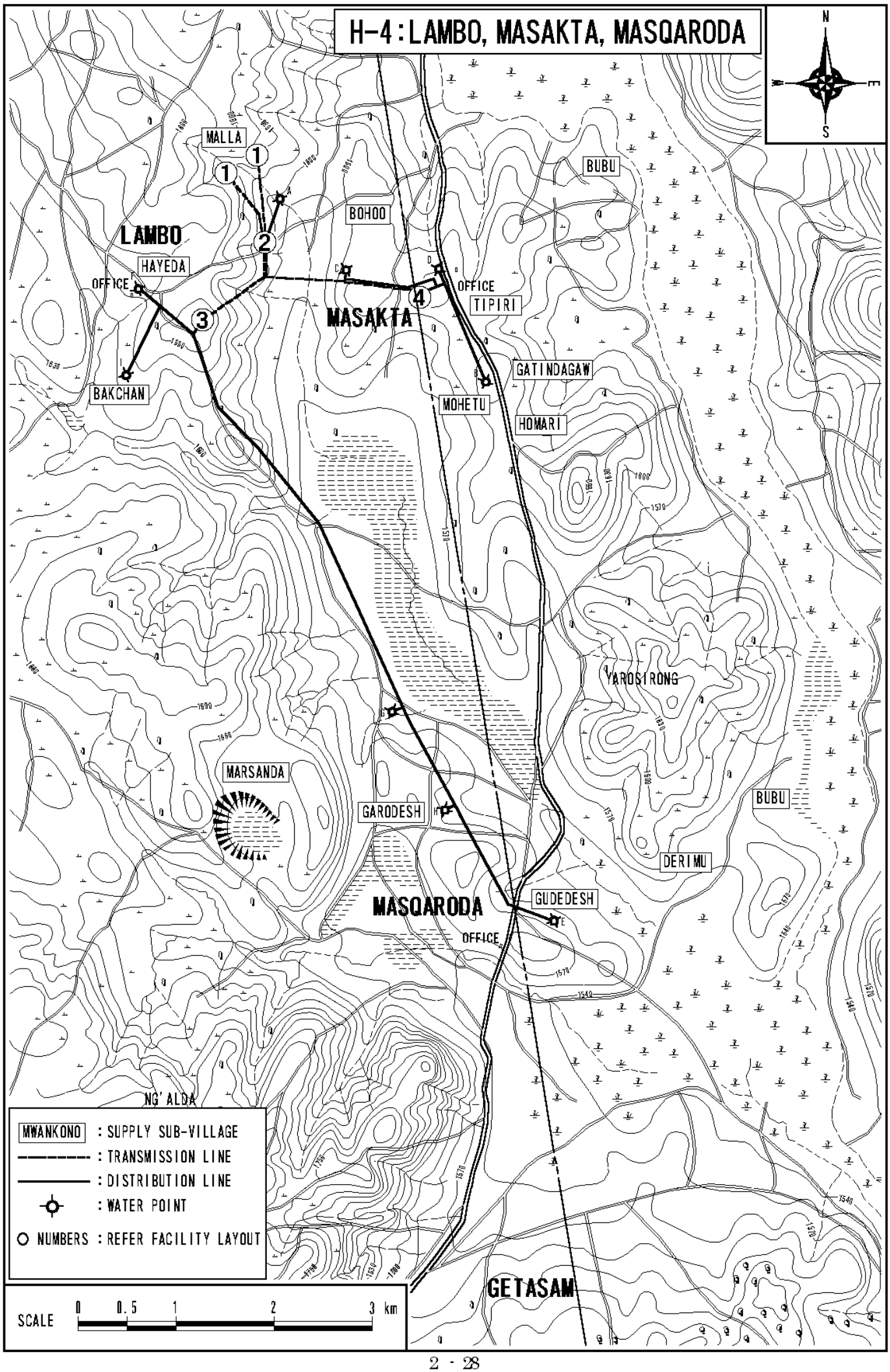
2-2-3 Basic Design Drawing

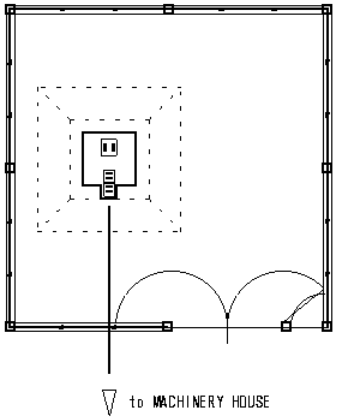
(1) **Plans of water supply systems**

1. Hanang District「H-4」 : Site Plan
2. Hanang District「H-4」 : Facility Layout
3. Singida Rural District「S-1」 : Site Plan
4. Singida Rural District「S-1」 : Facility Layout
5. Manyoni District「M-8」 : Site Plan
6. Manyoni District「M-8」 : Facility Layout
7. Igunga District「I-1」 : Site Plan
8. Igunga District「I-1」 : Facility Layout

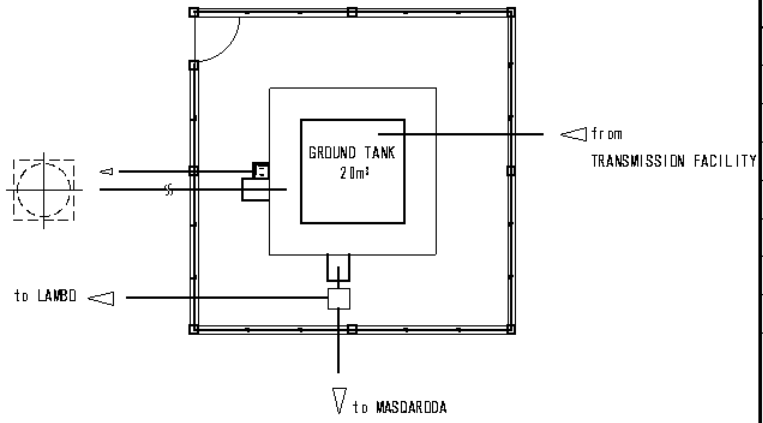
(2) **Drawing of main facilities**

9. Borehole Structure
10. Intake Facility for Shallow Groundwater Structure
11. Machinery House
12. Elevated Tank
13. Ground Tank
14. PV Panel, Waterstand Structural Drawing

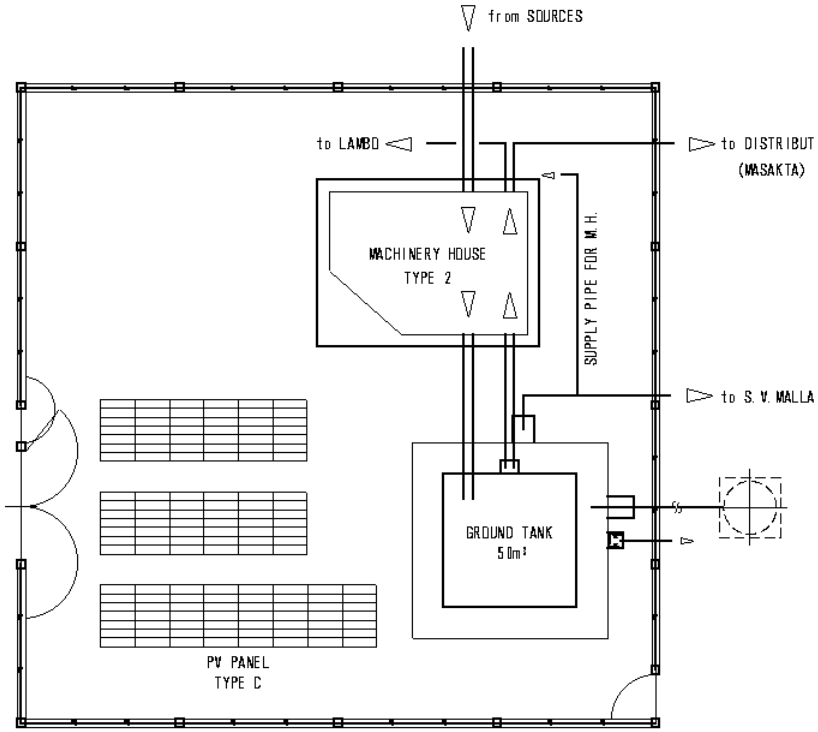

H-4 : LAMBO, MASAKTA, MASQARODA
N
S
E
W
MALLA
BUBU
BOHOO
LAMBO
HAYEDA
OFFICE
OFFICE
TIPIRI
MASAKTA
GATINDAGAW
BAKCHAN
MOHETU
HOMARI
YAROSIRONG
MARSANDA
GARODESH
BUBU
DERIMU
GUDEDESH
MASQARODA
OFFICE
NG'ALDA
GETASAM
MWANKONO : SUPPLY SUB-VILLAGE
: TRANSMISSION LINE
: DISTRIBUTION LINE
: WATER POINT
NUMBERS : REFER FACILITY LAYOUT
SCALE
0 0.5 1 2 3 km



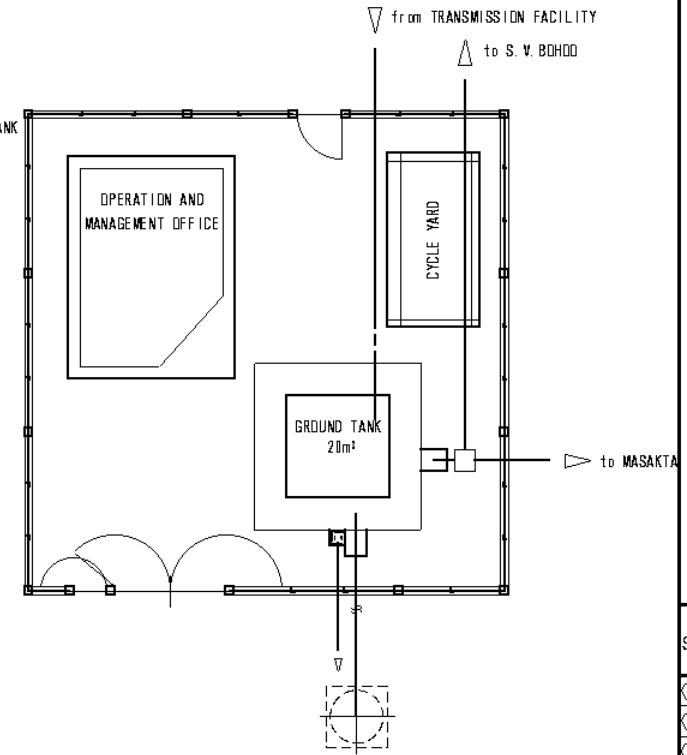
①SHALLOW GROUNDWATER INTAKE FACILITIES(×2)



③DISTRIBUTION TANK(LAMBO)



②TRANSMISSION FACILITY



④OPERATION AND MANAGEMENT OFFICE DISTRIBUTION TANK(MASAKTA)

L E J E N D

	DISTRIBUTION PIPE	
	DRAIN PIPE	
	POWER SUPPLY LINE	
	FENCE	
	GATE	
	GATE	
	SOAKAWAY	
	VALVE BOX	

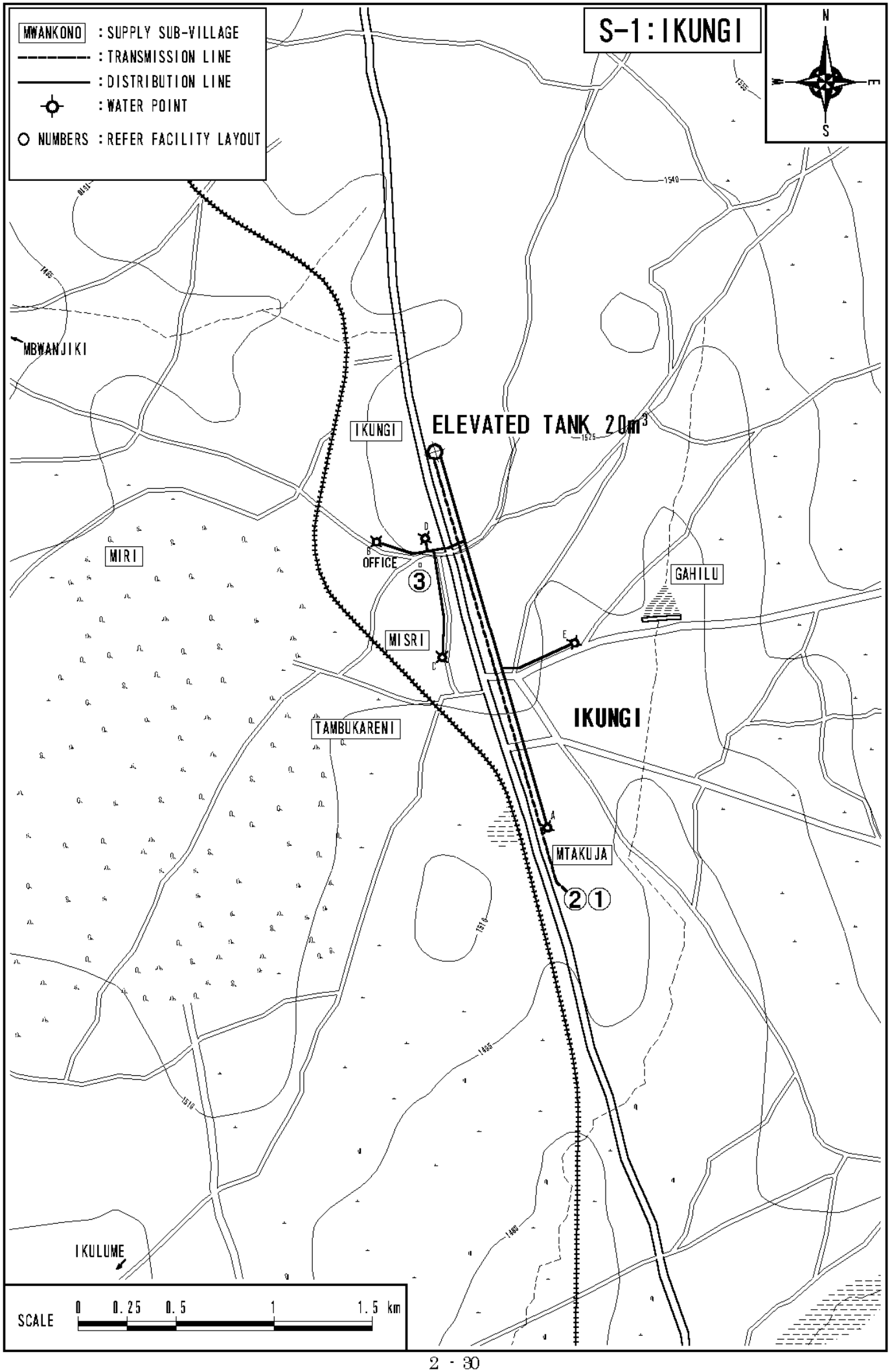
SCALE 0 2 5 10 15 m

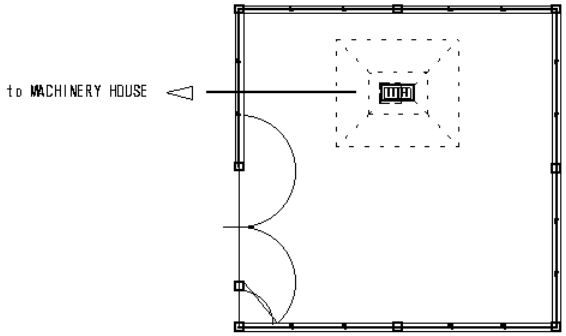
H-4 LAMBO, MASAKUTA, MASDARODA

FACILITY LAYOUT

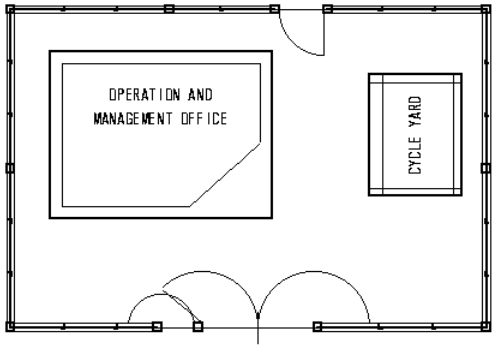
2

JAPAN TECHNO


S-1 : IKUNGI
MWANKONO : SUPPLY SUB-VILLAGE
: TRANSMISSION LINE
: DISTRIBUTION LINE
: WATER POINT
NUMBERS : REFER FACILITY LAYOUT
N
S
E
W
MBWANJIKI
IKUNGI
ELEVATED TANK 20m3
MIRI
OFFICE
GAHILU
MISRI
IKUNGI
TAMBUKARENI
MTAKUJA
IKULUME
SCALE
0
0.25
0.5
1
1.5 km

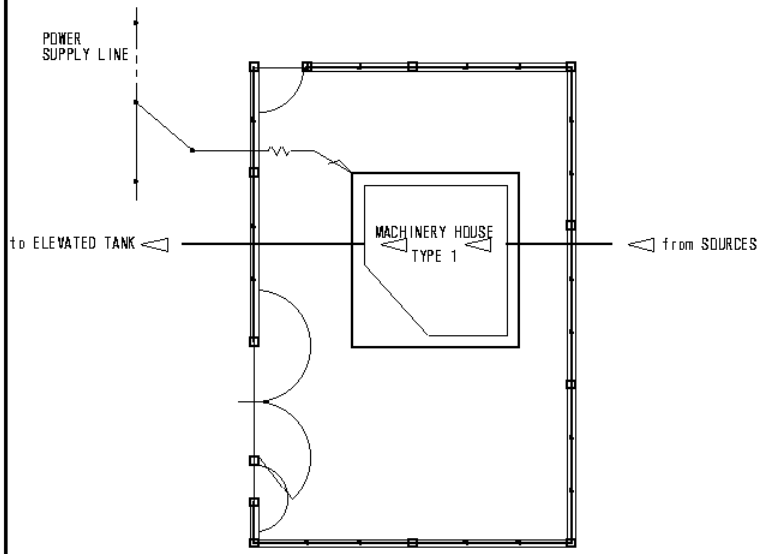


①BOREHOLE



③OPERATION AND MANAGEMENT OFFICE

POWER SUPPLY LINE



②MACHINERY HOUSE

L E J E N D

	DISTRIBUTION PIPE	
	DRAIN PIPE	
	POWER SUPPLY LINE	
	FENCE	
	GATE	
	GATE	
	SOAKAWAY	
	VALVE BOX	

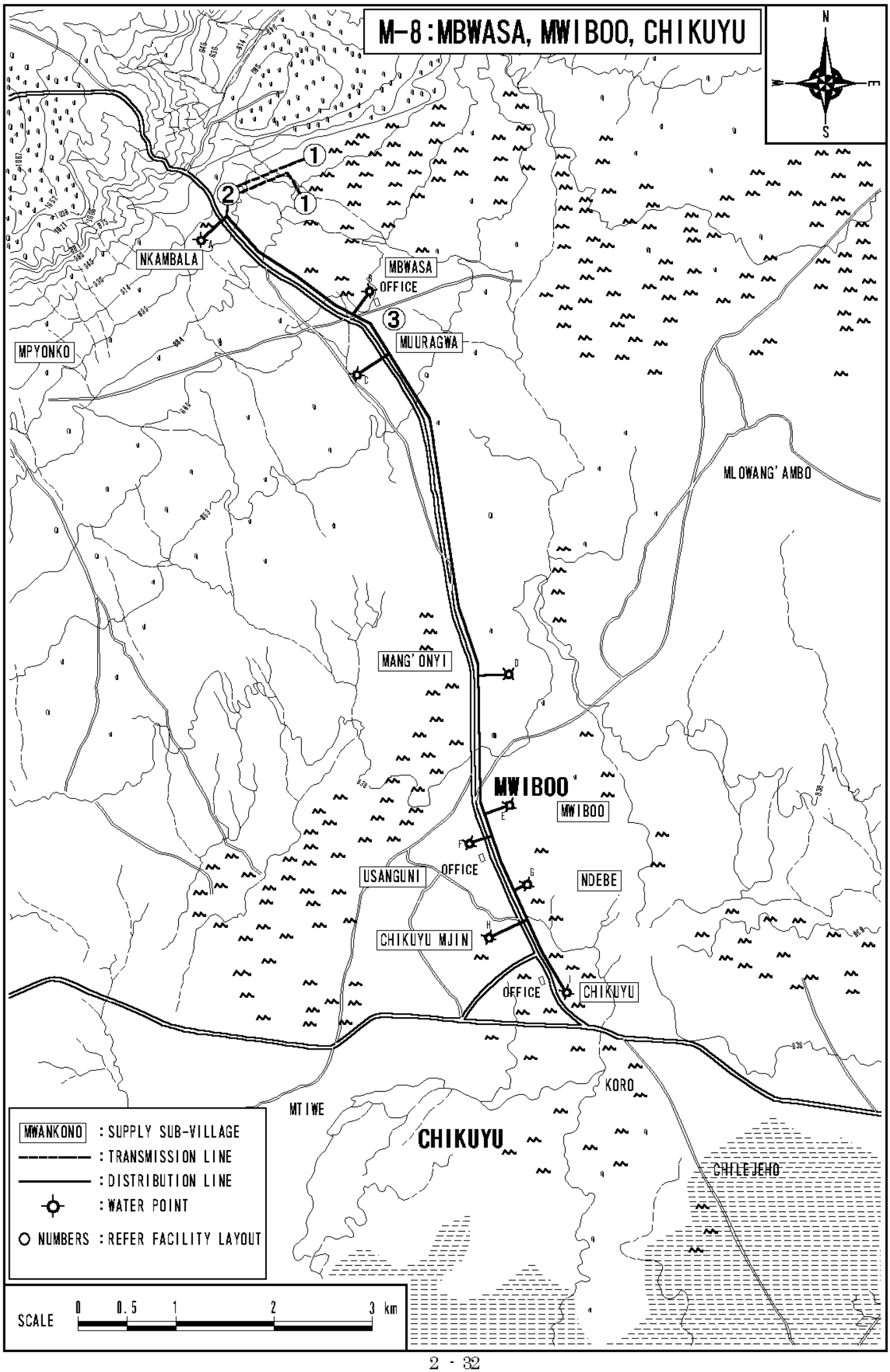
SCALE 0 2 5 10 15 m

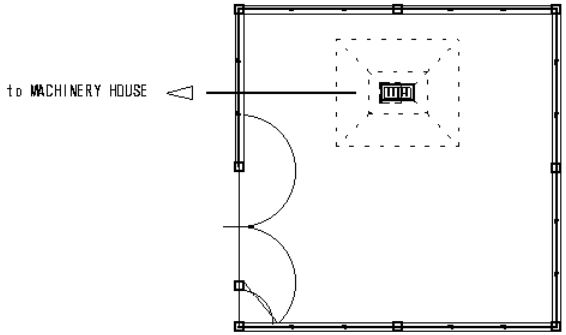
S-1 IKUNGI

FACILITY LAYOUT

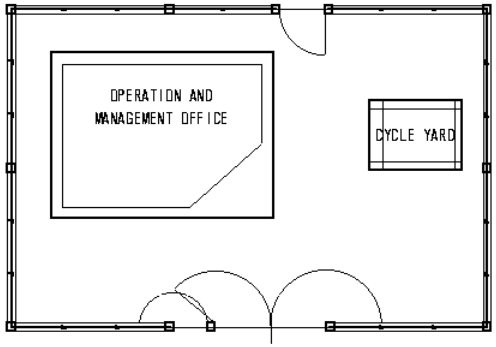
4

JAPAN TECHNO

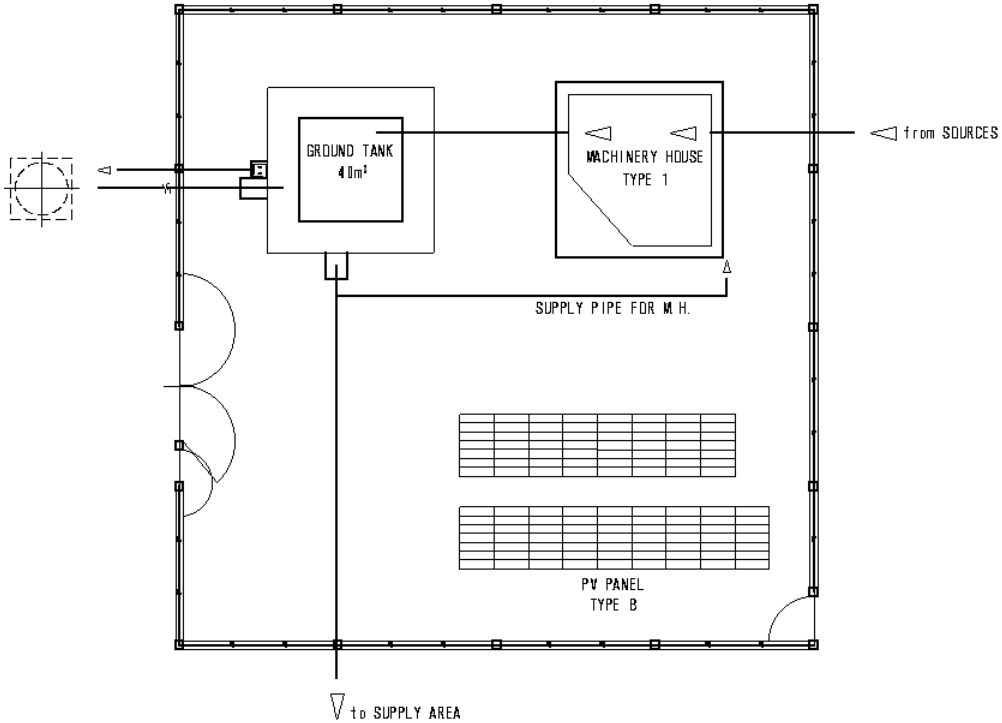

M-8 : MBWASA, MWIBOO, CHIKUYU
N
S
E
W
NKAMBALA
MBWASA
OFFICE
MUURAGWA
MPYONKO
MLOWANG' AMBO
MANG' ONYI
MWIBOO
MWIBOO
USANGUNI
OFFICE
NDEBE
CHIKUYU MJIN
OFFICE
CHIKUYU
KORO
MTIWE
CHIKUYU
CHILEJEHO
MWANKONO : SUPPLY SUB-VILLAGE
: TRANSMISSION LINE
: DISTRIBUTION LINE
: WATER POINT
NUMBERS : REFER FACILITY LAYOUT
SCALE
0
0.5
1
2
3 km



①BOREHOLE×2



①OPERATION AND MANAGEMENT OFFICE



②MACHINERY HOUSE
DISTRIBUTION TANK

L E J E N D

	DISTRIBUTION PIPE	
	DRAIN PIPE	
	POWER SUPPLY LINE	
	FENCE	
	GATE	
	GATE	
	SOAKAWAY	
	VALVE BOX	

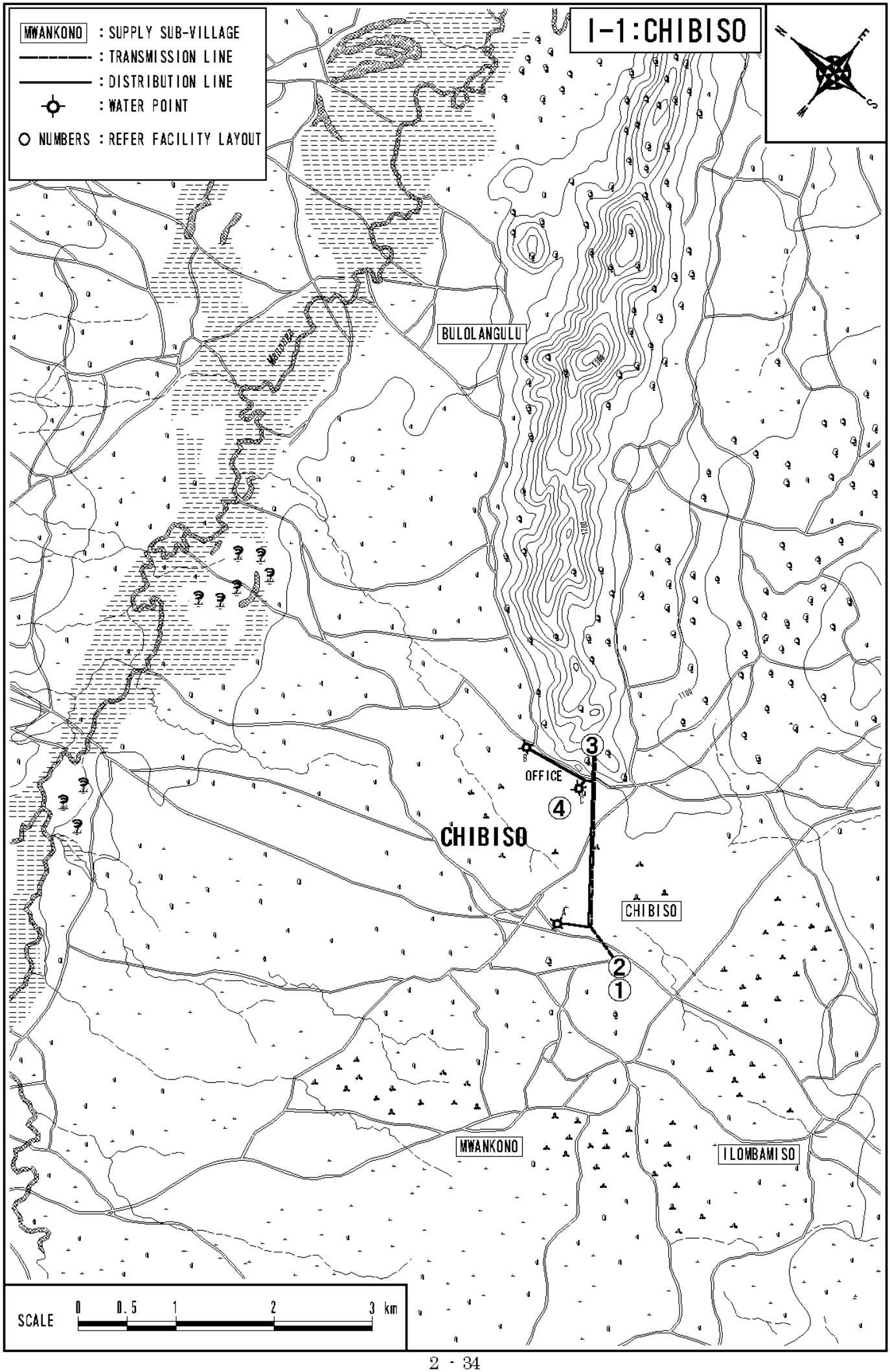
SCALE 0 2 5 10 15 m

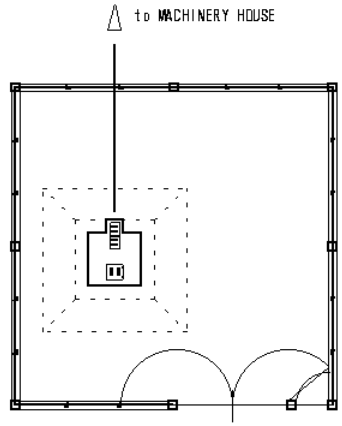
M-8 MBWASA, MWIBOO, CHIKUYU

FACILITY LAYOUT

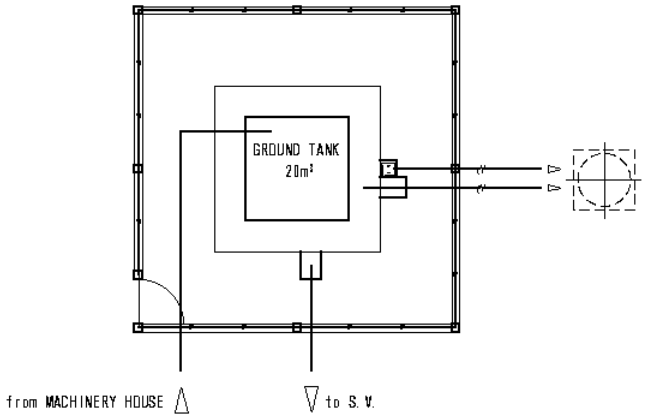
8

JAPAN TECHNO

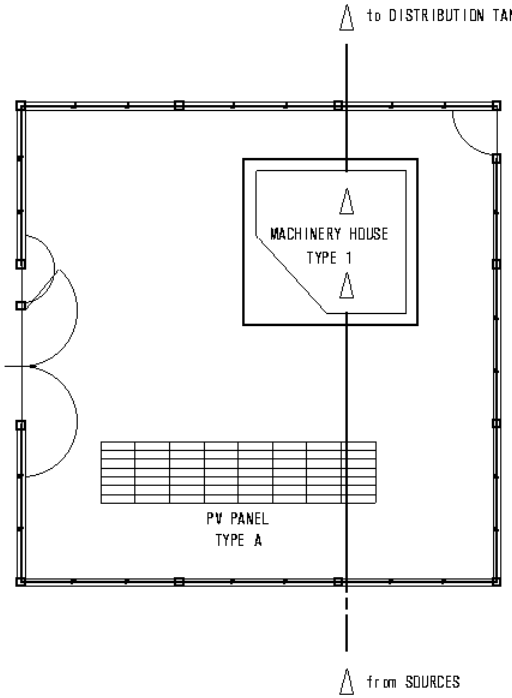

I-1:CHIBISO
MWANKONO : SUPPLY SUB-VILLAGE
: TRANSMISSION LINE
: DISTRIBUTION LINE
: WATER POINT
NUMBERS : REFER FACILITY LAYOUT
N
E
S
BULOLANGULU
OFFICE
CHIBISO
CHIBISO
MWANKONO
ILOMBAMISO
1
2
3
4
SCALE
0
0.5
1
2
3 km



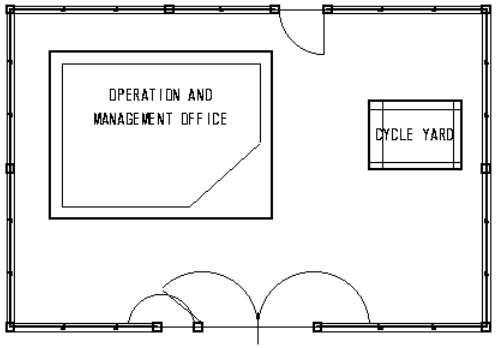
①SHALLOW GROUNDWATER INTAKE FACILITIES



③DISTRIBUTION TANK



②MACHINERY HOUSE



④OPERATION AND MANAGEMENT OFFICE

L E J E N D

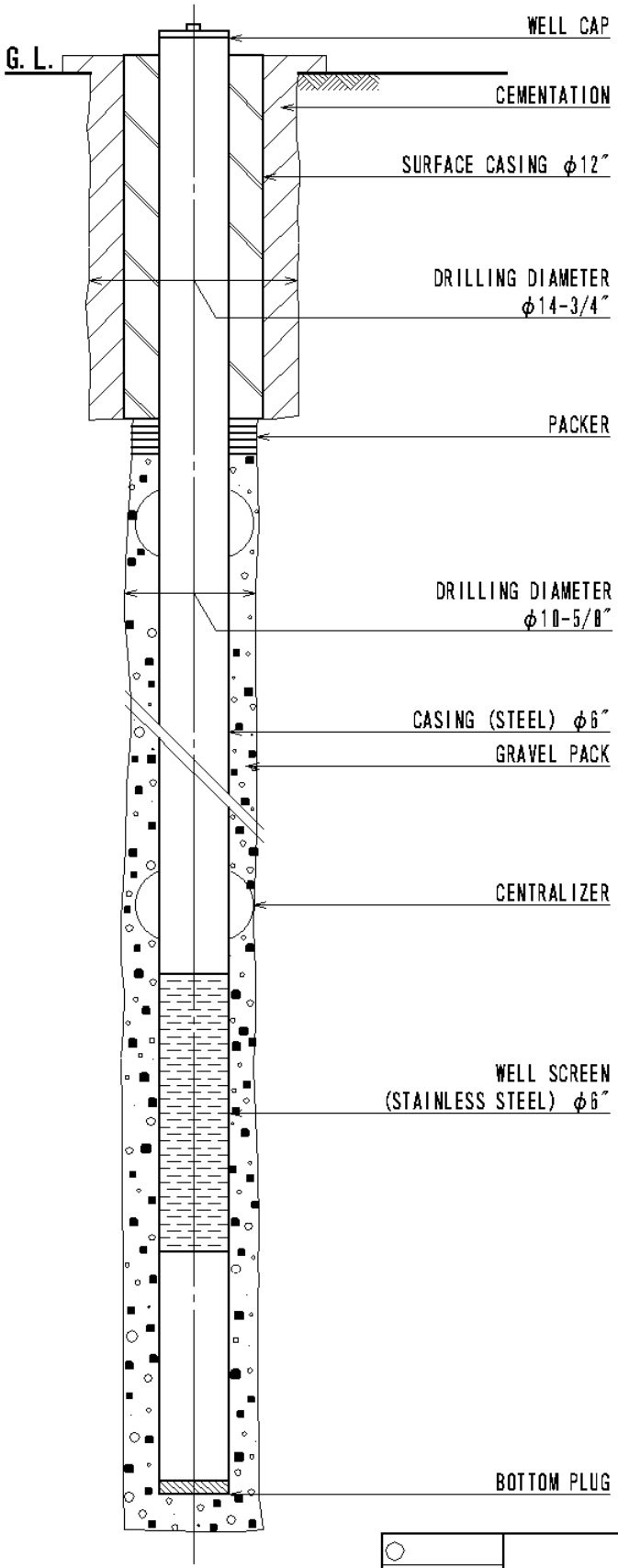
	DISTRIBUTION PIPE	
	DRAIN PIPE	
	POWER SUPPLY LINE	
	FENCE	
	GATE	
	GATE	
	SOAKAWAY	
	VALVE BOX	

SCALE 0 2 5 10 15 m

I-1 CHIBISO

FACILITY LAYOUT

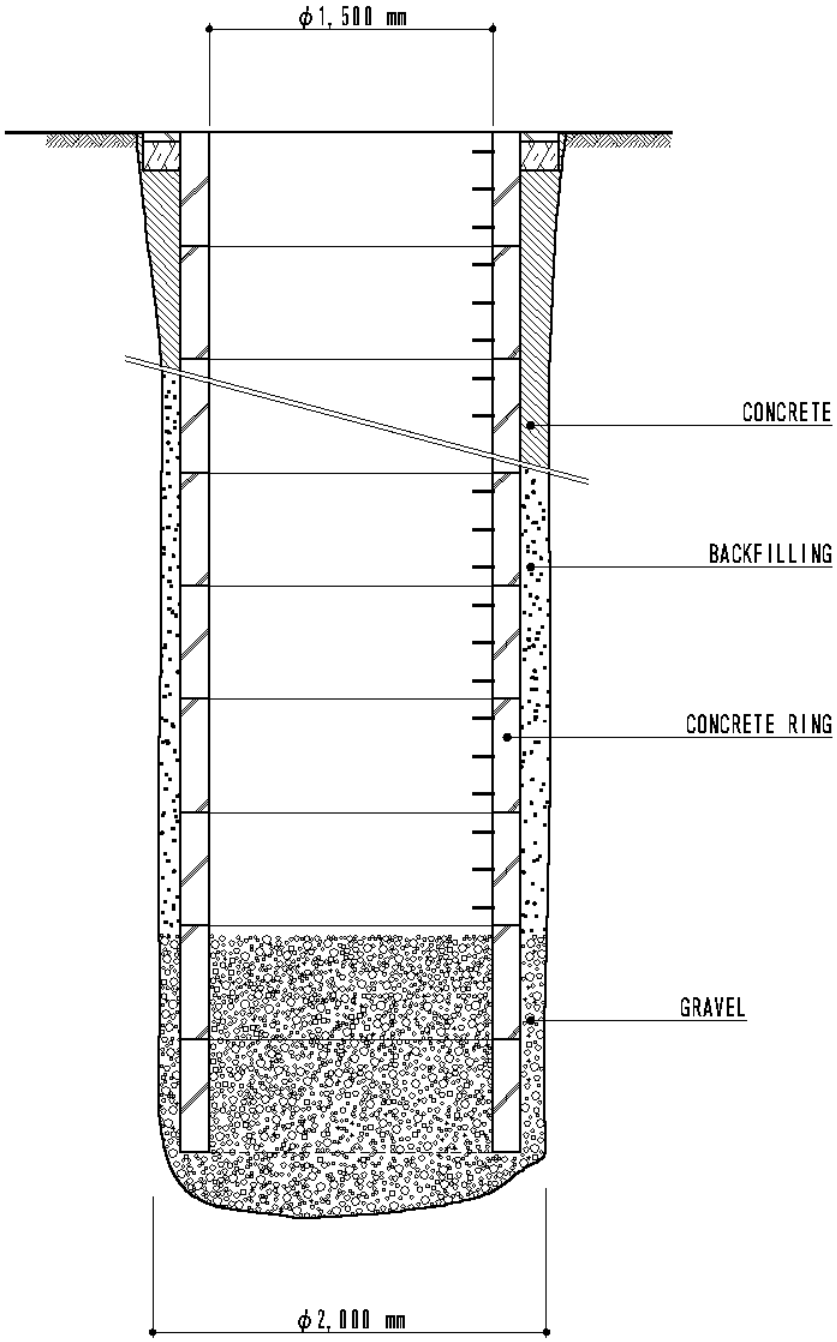
JAPAN TECHNO



Borehole Structure

9

JAPAN TECHNO

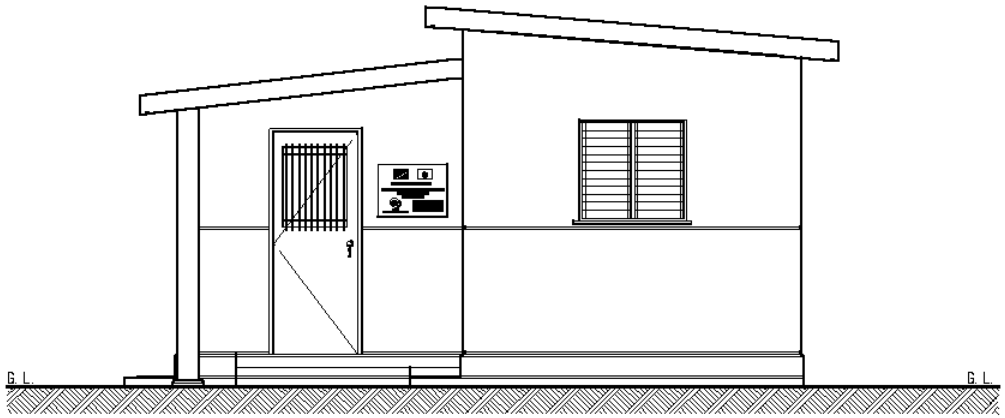


Intake Facility for Shallow Groundwater

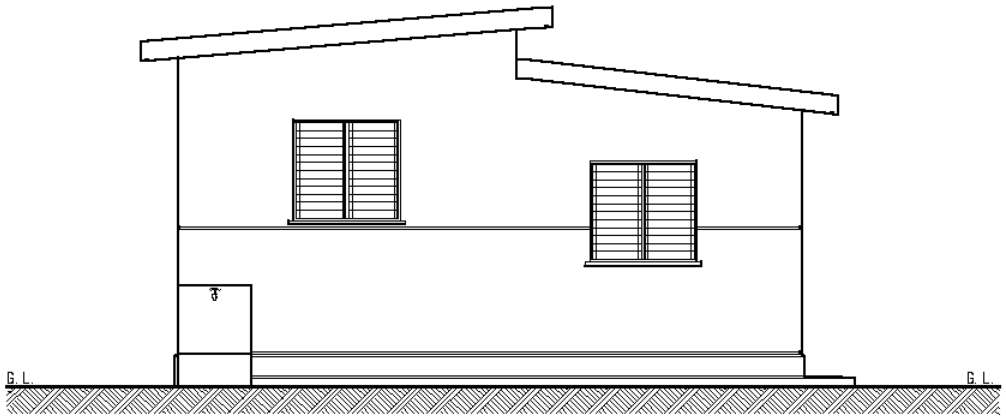
Structure

10

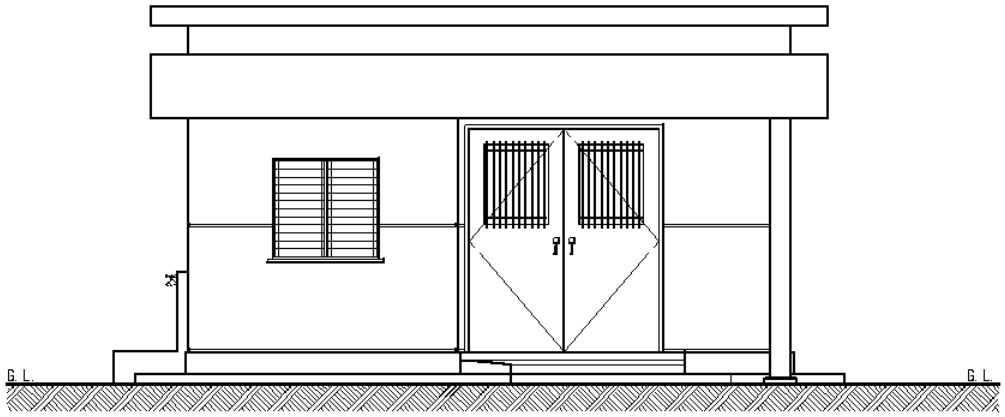
JAPAN TECHNO



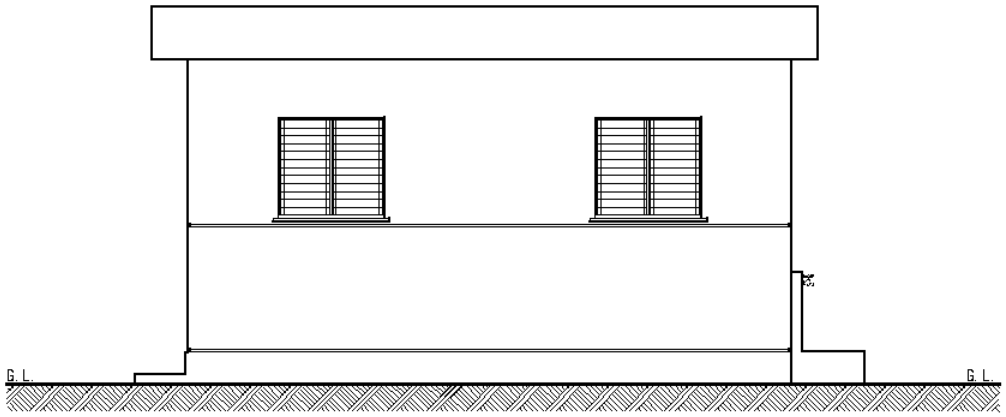
ELEVATION A



ELEVATION C



ELEVATION B



ELEVATION D

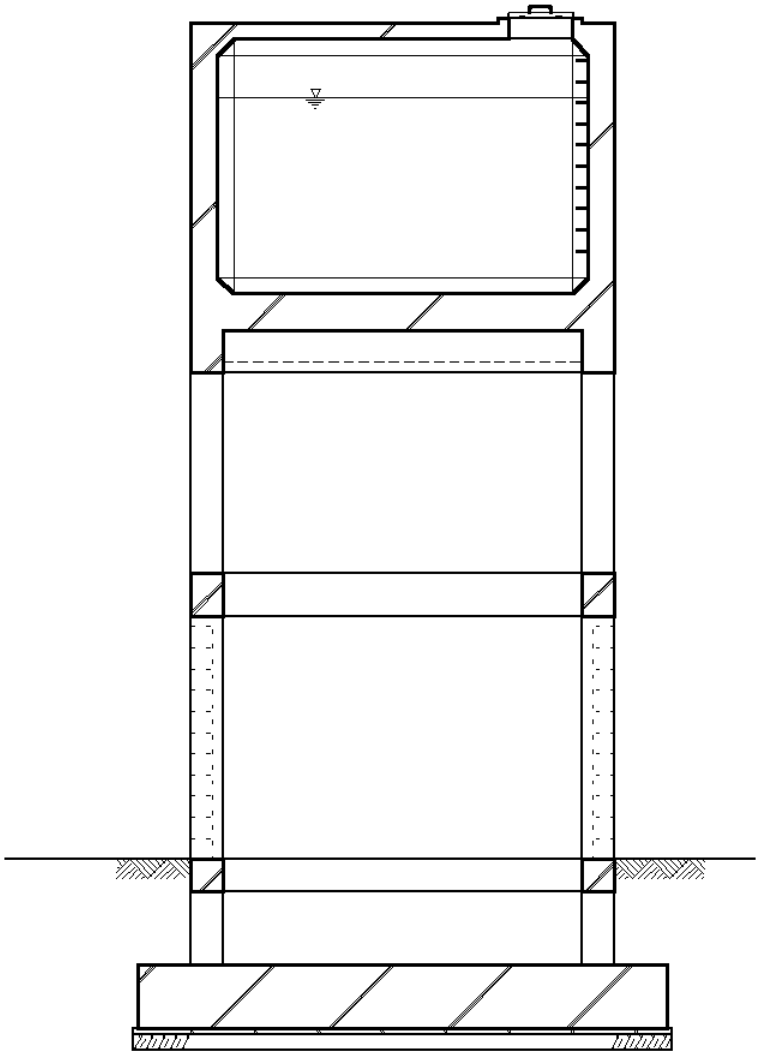
SCALE 0 0.5 1 2 3 m

MACHINERY HOUSE

ELEVATION

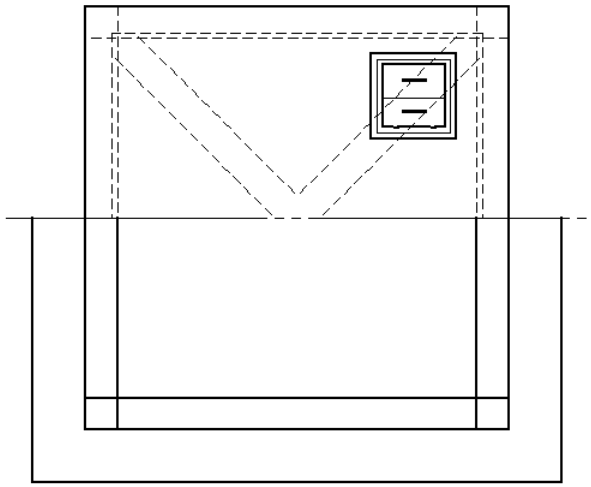
11

JAPAN TECHNO

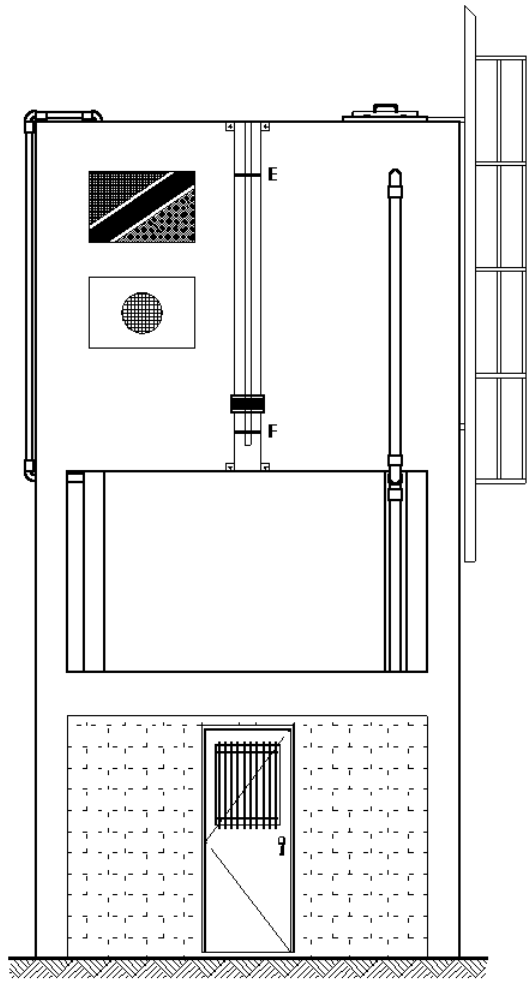


A-A SECTION

B-B SECTION



C-C SECTION



ELEVATION

SCALE 0 0.5 1 2 4 m

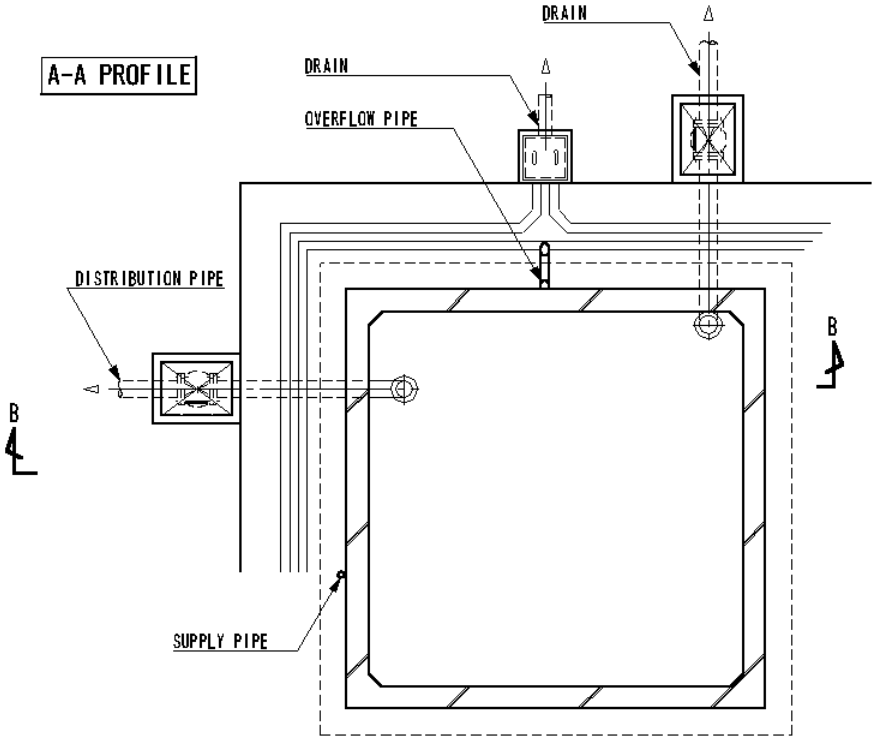
ELEVATED TANK (H=5.0m) : 20m³

SECTION, ELEVATION

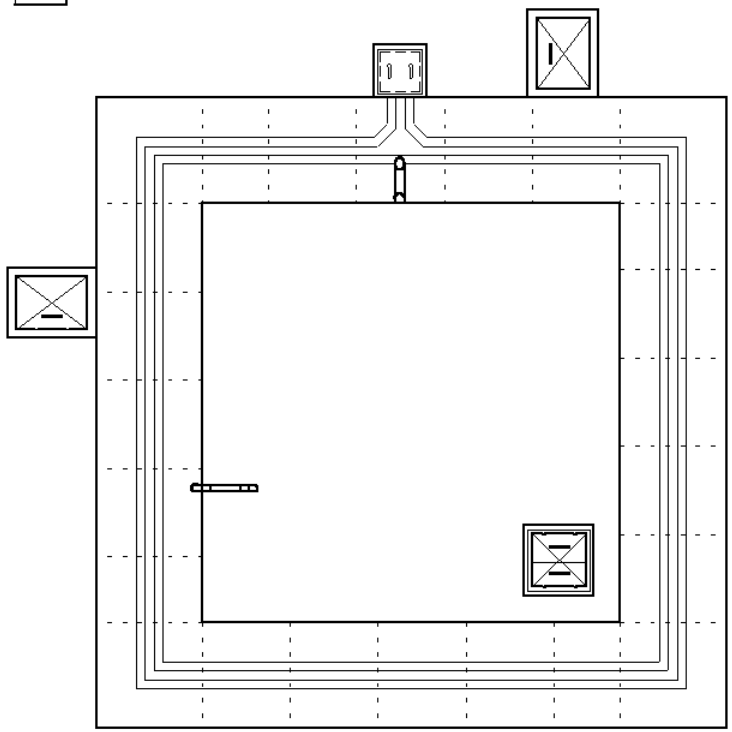
1/2

JAPAN TECHNO

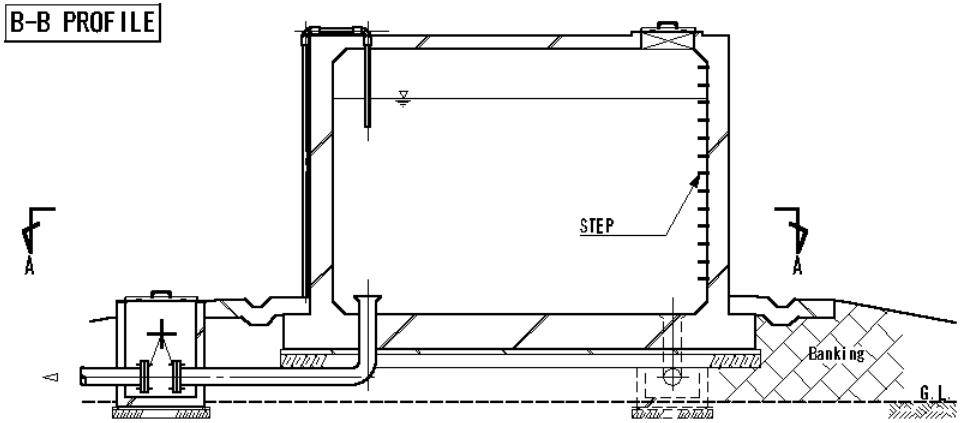
A-A PROFILE



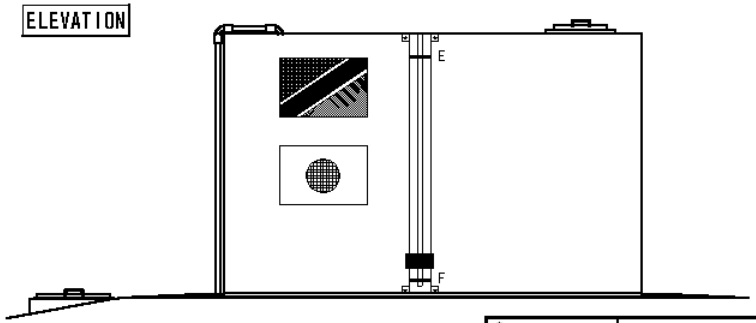
PLAN



B-B PROFILE



ELEVATION



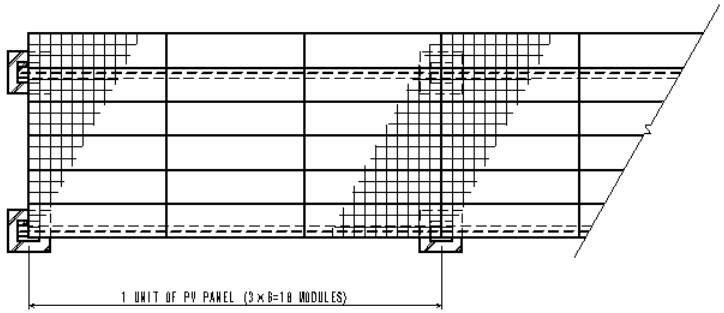
SCALE 0 0.5 1 2 4 m

GROUND TANK

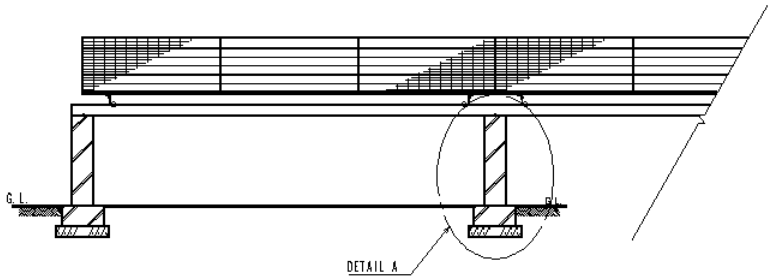
SECTION, ELEVATION

13

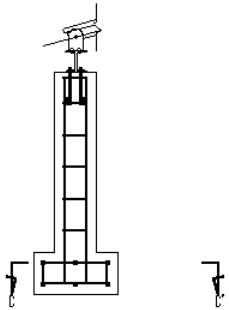
JAPAN TECHNO



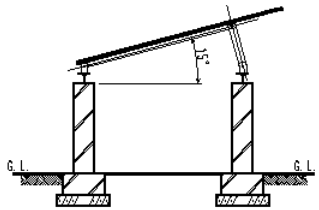
PLAN



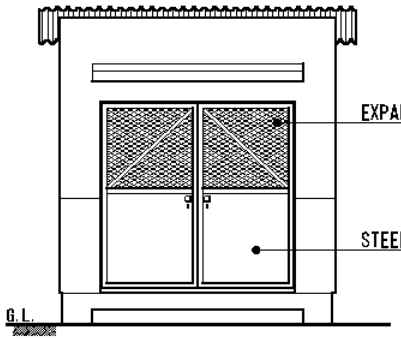
ELEVATION



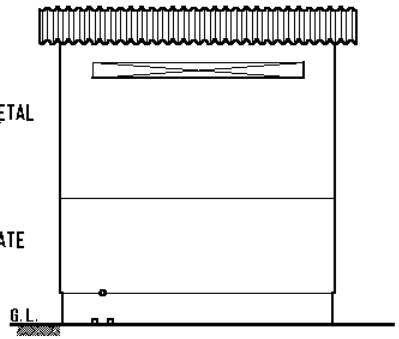
DETAIL A



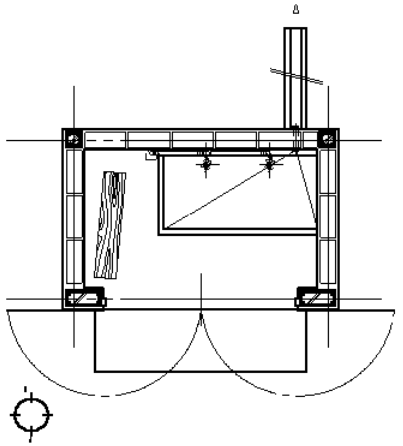
SECTION



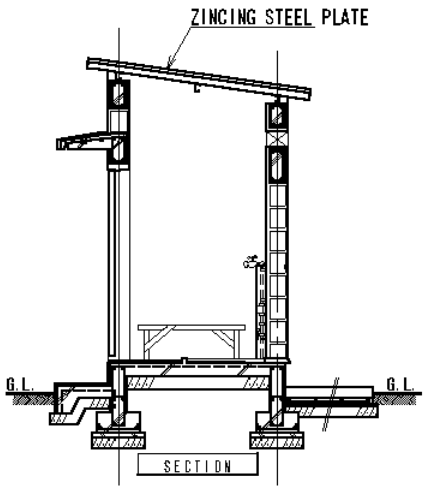
ELEVATION A



ELEVATION B



PLAN



SECTION

PV PANEL, WATERSTAND
STRUCTURAL DRAWING

14

JAPAN TECHNO

2-2-4 Implementation plan

Principally, local contractors and equipment and materials on the local market will be employed as much as the circumstances allow with the capacity of firms and the qualities of equipment and materials well considered. Nevertheless, Japanese engineers will be dispatched for the tasks with high technical requirements as well as to support the local capacity. Furthermore, the equipment and materials that are either not available in Tanzania or of insufficient quality will be imported from Japan or a third country. Products from third countries are only those procurable in Tanzania and to be regarded as Tanzanian products.

2-2-4-1 Implementation Policy

The main contractor is a Japanese firm under the Japanese Grant Aid scheme. The Project will include construction of water storage tanks, machinery houses and other concrete structures, and laying of pipelines. These construction works are practically undertaken by local sub-contractors under the supervision of the main contractor.

The Project is to be executed in close collaboration with the District Water Engineers Offices in respective Districts in the project area. In addition, the Ministry of Water and Livestock in Dar es Salaam, District Water Engineer Offices in Arusha (Hanang District), Singida (Singida Rural, Manyoni District), Tabora (Igunga District) also liaise with each other for the Project to be undertaken properly. Taking operation and maintenance into consideration, selection of equipment will consider spare parts available Tanzania as far as possible.

2-2-4-2 Implementation Conditions

The following are conditions concerning implementation and procurement.

① Duration for construction

The actual duration of construction works can only be 7 months in a year and the Project will be divided into two phases. Shipment delay of equipment and materials will put negative impact on the proceeding. Therefore, procurement of the materials need careful attention from the preparation of documents to shipment and storage.

② Conditions for construction works

The project area is some 1,000km remote from the capital, Dar es Salaam. Road infrastructure is not well developed, and thus it normally takes 3 to 4 days by vehicle. This implies that delay at construction sites causes delay of the entire plan, and therefore, an adequate construction

plan and management organization need to be carried out. Furthermore, the one consultant assigned for supervision must be efficient, as construction sites are apart from one another both during the first and second phases.

2-2-4-3 Scope of Works

The scope of works of the Tanzanian side is divided as follows:

① Preparation of the access roads
② Leveling of the land for the construction works
③ Connection of power (only for those sites that will use existing power lines)
④ Securing place for storage of materials

2-2-4-4 Detailed Design and Supervision

A full-time supervisor for the construction stationed at the sites will mainly supervise the entire process. For the drilling, a hydrogeologist supervises the process and the pipeline installation is supervised by a water supply engineer. The project manager will be in charge of planning and discussing with the counterparts and contractors. The scope of works undertaken by the Japanese consultant is summarized in Table 2-11.

Table 2-11 Assignment for Detailed Design and Supervision

	Description
Chief Consultant / Management, Operation and Maintenance Planner	Management of the entire Project Detailed design, Preparation of tender documents and drawings
Water Supply Planner	Detailed design, Preparation of tender documents and drawings for water supply plan
Hydrogeologist	Detailed design, Preparation of tender documents and drawings for drillings and borehole construction
Water Source Development Planner	Detailed design, Preparation of tender documents and drawings for intake facilities for shallow groundwater
Cost Estimation/ Procurement Planner	Detailed design, Preparation of tender documents and drawings
Full-time supervisor for construction	Supervision of the construction at project sites

2-2-4-5 Quality Control Plan

The procurement plan for equipment and materials are described below.

(1) Equipment and materials

As stated before, construction materials will be procured mainly in the capital, Dar es Salaam. Thus, a procurement officer of the main contractor firstly checks the quality and orders them. After the materials arrive at the sites, civil engineers and architects will check the quality again. Consultants will check them before construction.

(2) Drilling boreholes

- Sampling of the soil is carried out at 3 m intervals and at the points of change of stratums in order to gauge the hydrogeological conditions.
- During drilling, the water quality needs to be checked with a portable analyser as much as possible.
- After electric logging, the screen position will be selected by the drilling engineer (a Japanese national).
- The drilling engineer supervises pumping tests and the consultant analyses the records of tests.
- Water sample is taken before the end of the pumping test to analyse the water quality.

(3) Concrete works

Table 2-12 shows the requirements for compressive strength tests for concrete works of individual facilities.

Table 2-12 Frequency of Compressive Strength Test

Facility	Testing parts	Frequency
Ground tank	Foundation, Floor, Wall, Roof	3 times (3 samples each)
Elevated tank	Foundation, Pillar, Floor, Wall, Roof	5 times (3 samples each)
Machinery house	Foundation, Pillar	2 times (3 samples each)

Concrete needs to go through a slump test, an entrapped air ratio test, and a chloride quantity ration test. Further, aggregate must go through sieve analysis tests and density tests by lots.

(4) Pipe installation

Piping materials including fittings and valves will be checked through the entire line by methods such as visual testings and temporary connections. Before the piping trenches are covered, they need to be tested under water pressure to check for leakages.

(5) Others

- Concrete blocks need to go through compressive strength tests for each lot.
- After installation, power distribution service wires need to go through insulation tests.
- Fittings are checked by visual tests.

2-2-4-6 Procurement Plan

In the 4 Project Districts, the development of infrastructures is far behind the other areas of the country. All of the materials will be transported from the capital, Dar es Salaam. Gravel and sand for concrete are acquired either in Singida or near the construction sites, after the quality is checked. Although nearly all of the equipment and materials are not produced in Tanzania, products imported from the EU countries, India, China, and South Africa are on the market and their agencies are available. Therefore, the origin of these products is outside Tanzania, but will be treated as Tanzanian products. Construction equipment are to be leased. Main procurement locations are listed in Table 2-13.

Table 2-13 Procurement Locations

Locations	Materials
Tanzania (Dar es Salaam)	Cement, reinforcing steel bars, pipes, solar panels, metal sheets, etc.
Tanzania (Singida or neighbourhood)	Gravel, sand, concrete blocks
Japan	Lined steel pipes, high pressure pipes, special valves

2-2-4-7 Implementation Schedule

The Project will be divided into two phases: Phase I and II. Each phase will commence upon finalizing the Exchange of Notes (E/N) for Japan's Grant Aid scheme between the Tanzanian and Japanese governments and need to be completed within the same Japanese fiscal year.

Upon conclusion of an E/N, the executing agency, the Ministry of Water and Livestock Development will sign a contract with a Japanese consulting firm. After the government of Japan

verifies the contract, the consultants will design the systems (detailed design), prepare the tender drawings, and acquire the approval from the governments of both Japan and Tanzania. In addition, the consultant shall support the Ministry of Water and Livestock Development concerning the tender for the construction works or actually conduct it on behalf of the Ministry of Water and Development, and also assist in the negotiation with the lowest tenderer. After that, the consultant will supervise all of the works including construction works, procurement of the equipment and materials, and test runs until the facilities are handed over to the government of Tanzania.

As mentioned, the contractor is responsible to procure the equipment and materials, and construct the facilities. Most of the equipment and materials will be procured in Tanzania or imported from Japan. Customs clearance and internal transportation generally requires about 4 months. Phase I and II should last about 7.0 months each. Table 2-14 shows the implementation schedule.

2-3 Obligations of the Government of Tanzania

If the government of Japan decides to implement this project under Japan's Grant Aid scheme, the government of Tanzania shall take the necessary procedures described below for the smooth implementation of the project.
The government of Tanzania shall:

① provide information and data necessary for the project (information necessary for detailed design, implementation, procurement as well as construction);

② secure the necessary lands and repair/expand the necessary roads and power connections (the Project plans that 1 out of the 4 supply systems will use the existing power. Therefore, connection arrangement is needed for this site);

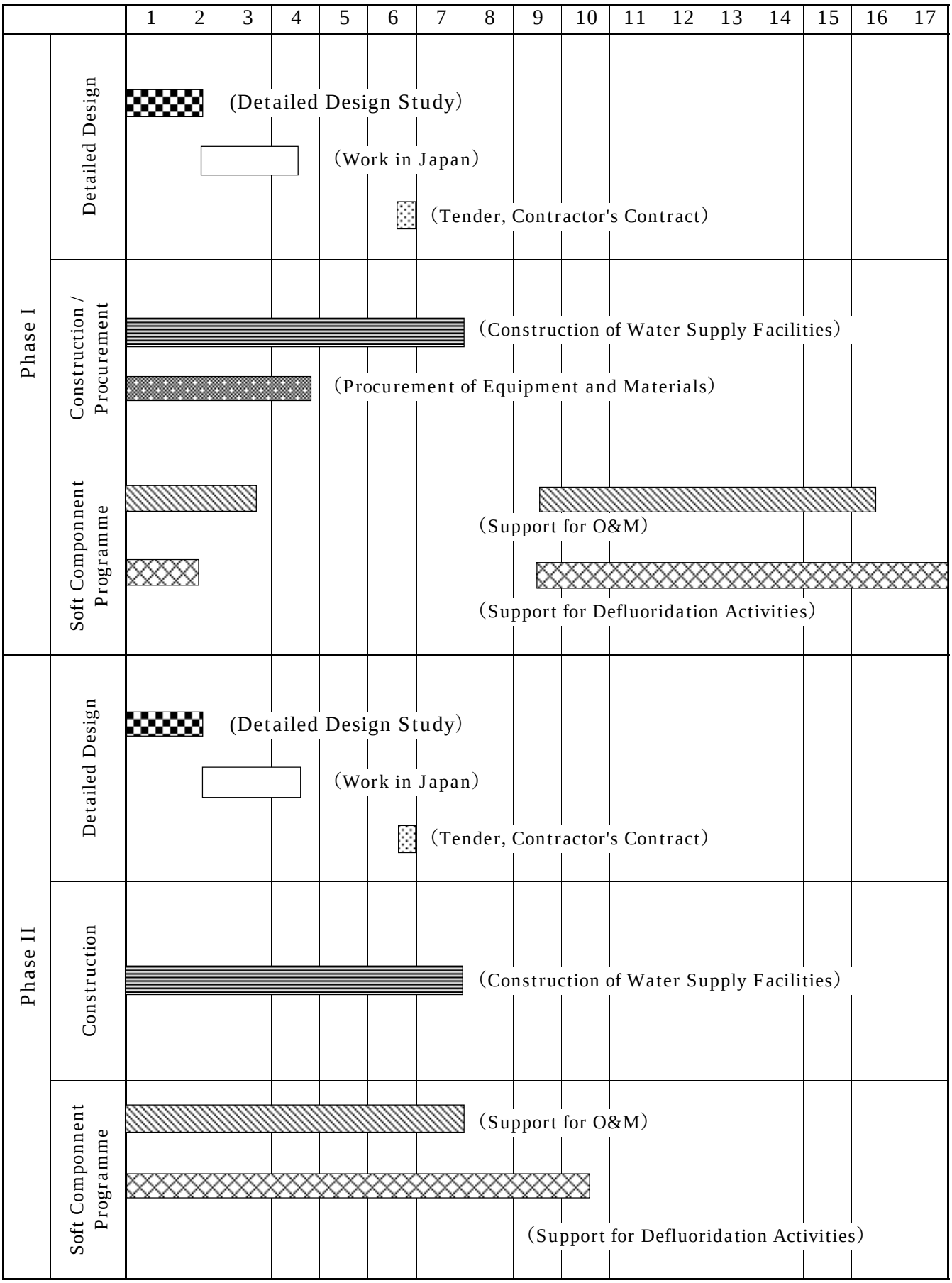
③ provide the storage space for the equipment and materials during the Project, the lands for workshops, temporary offices, warehouses, and storage areas;

④ pay the bank commissions of Japanese foreign exchange banks based on the Banking Arrangement for this project;

⑤ arrange for the smooth procurement and transportation of the equipment and materials, such as tax exemption, customs formalities, and so on;

⑥ arrange for the smooth entry to and departure from Tanzania of Japanese nationals who are involved in the procurement of the equipment and materials, based on the contract verified by the government of Japan;

Table 2 - 14 Implementation Schedule



⑦ exempt all of the taxes including the customs duties and VATs of Tanzania from the Japanese nationals involved in the project in accordance with the contract verified by the government of Japan;

⑧ operate, maintain and manage the constructed water supply facilities and the procured equipment and materials in effective manners;

⑨ reorganize the management and O&M systems including budgeting and recruiting in order to utilize the water supply facilities and equipment and materials in effective manners; and secure the necessary budget and staff in order to implement the project effectively.

2-4 Project Operation Plan

(1) Present situation of Operation and Maintenance of water supply facilities

At present, as far as the existing water supply facilities are concerned, the percentage of functioning facilities is very low. This is mainly resulting from the low motivation of the local people to pay water tariffs and participate in O&M and their ignorance of the importance of hygiene. To avoid the same situation and operate and maintain the systems in sustainable manners, this project also aims to let the local people know more about the importance of safe water, encourage their ownerships, and make the local people participate in O&M of the water supply facilities. In addition, the quantity of water for each person per day is set at 5 litres in this project, and it is also important to encourage the consumers to conserve water by separating uses for drinking and for other uses.

(2) Operation and maintenance of facilities to be constructed

Fig.2-4 shows the operation and maintenance system of the water supply facilities to be constructed as described in “2-5 Other Relevant Issues (Social Development Plan)”.

1) District Water Engineer’s Offices

District Water Engineer’s Offices are the leading body of this project. Its roles are mainly to make the Agreements with the Water Stations on the roles and functions for O&M, and to supervise and instruct the Water Committees and the Water Stations regarding the O&M of the water supply systems. Moreover, if trouble arises which the Water Stations cannot deal with, the District Water Engineer’s Offices would give technical supports to them.

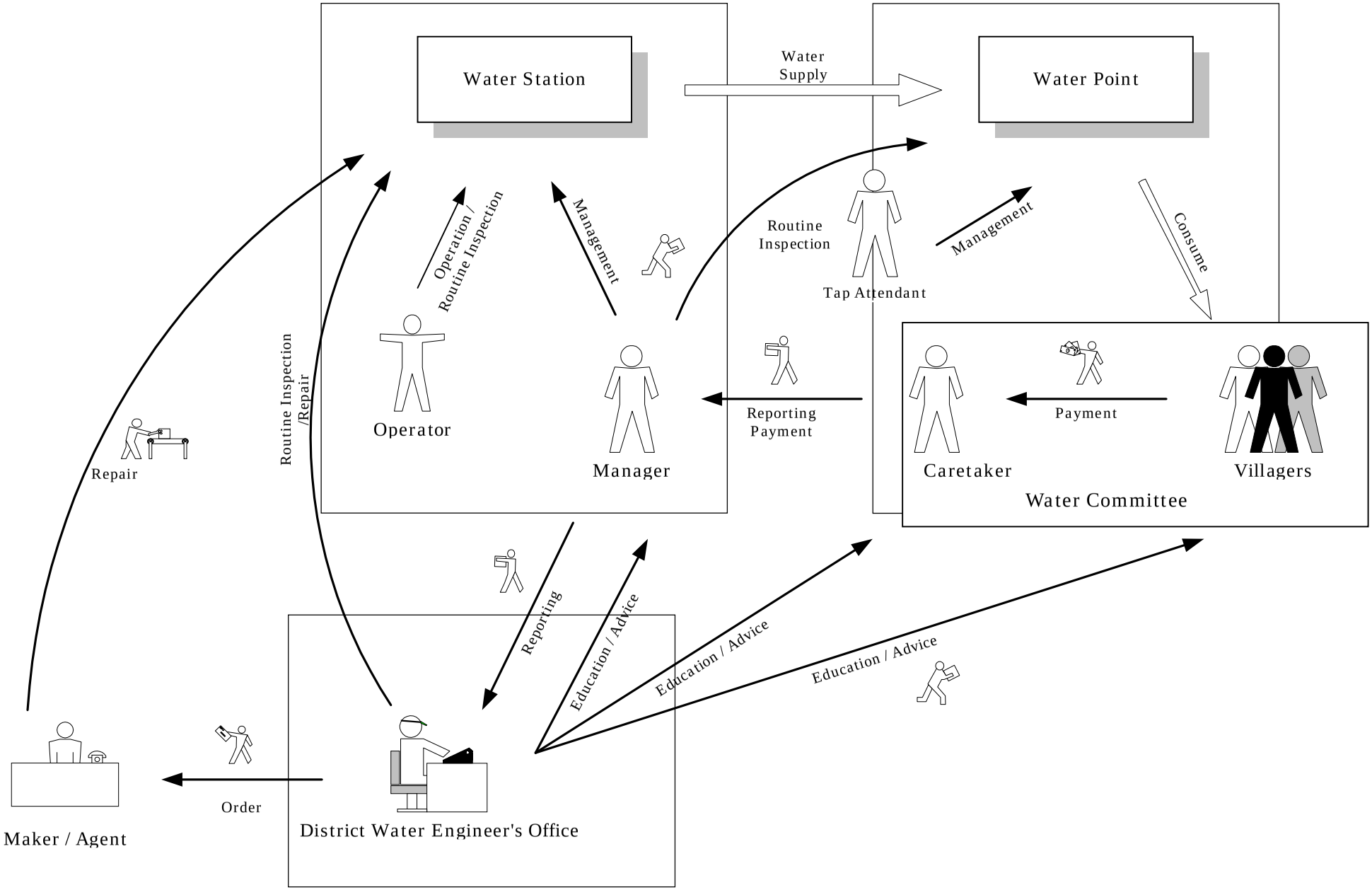


Fig.2-4 Conceptual Design of O&M System

2) Water Stations

A Water Station will be established for each water supply system, and function as an operation centre so as to operate and maintain the whole system technically. The costs for O&M of this centre will come from the collected water tariffs. The Water Station will make an agreement with Water Committees for the activities on O&M.

① Manager: assign one person for each water supply system as a responsible of a Water Station to manage the operation. Daily tasks include: check-up of the facilities and water supply; correspondent with the District Water Engineers' Office; record operation based on the information reported by operators and tap attendants; report the situation of fee collection to the District Water Engineers' Office.

② Operator: assign the same number as the machinery houses. Daily tasks include: daily operation; inspect machinery; record the water level at the source; dilute bleaching liquid for disinfection; check meters; report to the manager whether machinery is operating smoothly without impediment.

③ Tap attendant: assign the same number as the water points (public faucets). Daily tasks include: visit the water point by bicycle to open the lock; start water supply; check end of supply; check meter; and collect fees or promote fee collection (See the section for Water Committee). It is presumed that the functions of Water Committees and tap attendants may overlap depending on Water Stations and water points. In that case, each Water Station and Committee will choose an efficient way with which villagers can agree. In all cases, tap attendants and water committees are expected to choose a way that enables to keep a good relationship with each other. Additionally, as elaborated in "2-2-1 Design Policy", the gender aspects need to be considered.

3) Water Committee

A Water Committee will be organized by the local people (the consumers) for each of the water points. Although there have been similar organizations made in accordance with the National Water Policy, many of them are virtually not functioning at present. Basically, more than one water tap will be installed in one sub-village in this project. However, in case more than one sub-village share the water point in the future, these organizations should be reorganized for better co-operation.

The roles and functions of the organizations are mainly the O&M of each water point and

the smooth communication within the area. The details are, for instance, to encourage the local people's communication, to decide the location of public faucets, to decide the water tariff and how to collect them, to operate and maintain the public faucets including the clean up of the water taps and the surrounding areas, to check the functioning of the water taps, to conduct hygiene education and so on. In addition to the water tariff collection, they are also responsible to pay to the Water Stations (It is also possible that tap attendants will collect water fees).

4) Costs for Operation and Maintenance

As costs of the O&M after this implementation, running costs for the water supply facilities and costs for O&M of the Water Stations will be needed. The table below shows the cost estimation for the O&M of the 4 systems and the management of District Water Engineer's Offices in this project.

Table 2-15 Costs and income for O&M of the 4 systems

	Item	Unit	Systems				Remarks
			H-4	S-1	I-1	M-8	
①	Served Population		7,540	3,239	2,704	8,317	
②	No. of taps		9	5	3	9	
③	Consumption per month	m³/month	1,131.0	485.9	405.6	1,247.6	Daily consumption per person is 5 litres.
④	Costs for workforce	Tsh/month	230,000	150,000	110,000	250,000	The workforce includes the managers, the operators and the fee collectors. The number of these staffs is different in each system.
⑤	Costs for operation	Tsh/month	30,532	41,586	13,878	27,756	These include the costs for chlorination
⑥	Costs for routine check of the systems	Tsh/month	55,000	55,000	55,000	55,000	These include the cost for fuel for transportation.
⑦	Costs for miscellaneous things	Tsh/month	63,106	48,392	35,776	69,000	20% of the sum of ④ and ⑤
⑧	Total costs per month	Tsh/month	378,638	290,352	214,654	414,000	Sum of ④, ⑤ and ⑥
⑨	Income per month	Tsh/month	1,131,000	485,850	405,600	1,022,850	Selling price is 20 Tsh/20litre-water. The rate of fee collection is assumed to be 100%.
⑩	Balance per month	Tsh/month	752,362	195,498	190,946	608,850	
⑪	Balance per year	Tsh/year	9,028,345	2,345,976	2,291,357	7,306,200	

As this balance sheet shows, the system can be sustainably operated and maintained, if 20 Tsh is paid for 20 litres of water. The incomes of the system can exceed the outgoes as far as the rate of the tariff collection is above 60%.

2-5 Soft component programme (Social Development Plan)

(1) Operation and maintenance

① Needs and problems

As the project areas are particularly under severe water quality conditions, the project purpose was set to develop safe water sources and to supply safe water to as many people as possible even if the amount is limited. To realize this purpose, it is indispensable that the local villagers understand the importance of drinking safe water for their own health and hygiene. However, the existing water supply facilities in the project area are being broken and abandoned, even facilities with hand pumps (Level-1), which employ relatively rudimental technology and are inexpensive to maintain. To break such a status, and supply safe drinking water, the local villagers need to nurture the sense of ownership and participation and consequently operate and maintain the facilities by themselves. It is further expected that the local villagers understand the importance of changes in behaviour as a result of such changes in ideas. The government is expected to continuously support activities to create favourable environment.

As such, the government of Tanzania requested the government of Japan give support to both the supplier and the recipient of water services.

② Expected output

The following are three outputs (direct effects) expected through implementation of the social development programme.

- The sense of ownership and participation of the local villagers will increase.
- Sanitation and health consciousness and awareness for safe water drinking will increase.
- A operation and maintenance system will be established under cooperation of the supplier and the recipient.

③ Activities

The operation and maintenance system of the facilities constructed under the Project are described in “2-4 Project Operation Plan”. As Fig. 2-5 indicates, the activities are undertaken by three stakeholders: District Water Engineer Offices; Water stations; and Water committees. Social development activities will target these three stakeholders and water consumers.

- Promote hygiene education and facilitate participation at the target villages

  In order to contribute to a continuous O&M system at the village level, the programme

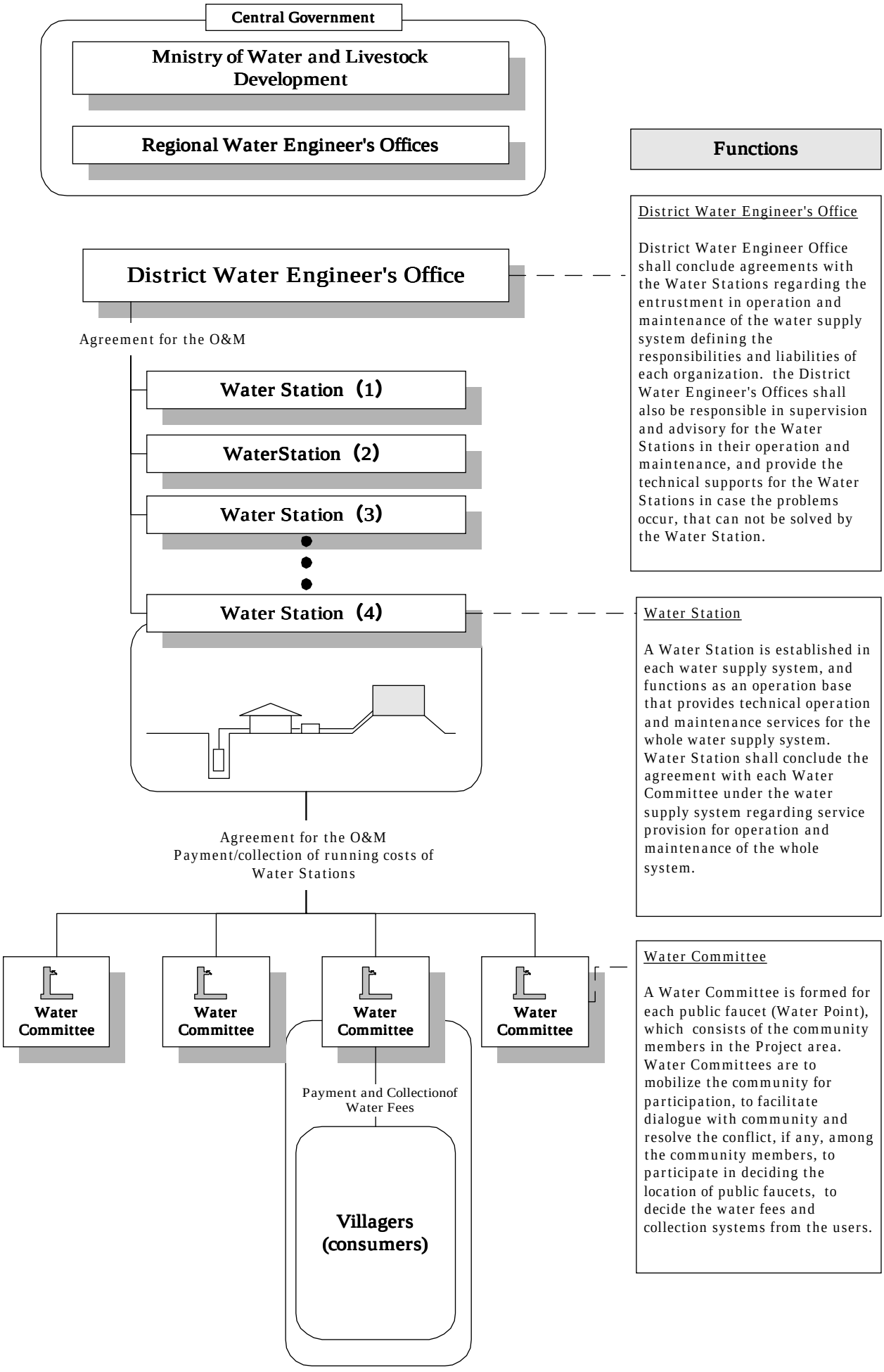


Figure 2-5 O&M System for Water Supply Facilities

will promote hygiene education and facilitate participation at the target villages. In order for the local villagers to accept a water supply of 5 l/person/day and efficiently use it, the emphasis is put on the importance of drinking “safe water”.

- Formation of water committees

  Water committees will be formed and/or reformed at the village level through community meetings. This aims to increase the sense of ownership.

- Conditions on support activities

  These activities target villages that fulfil the following conditions considering the efficiency of the programme and the present state of the project area.

  The villages are evaluated and selected during the detailed design study in terms of establishment of water committees and its activities, and money reserve for a Water Fund. The activities will be undertaken prior to the construction of the facilities.

(2) Defluoridation support activities

① Needs and problems

The reason for the great revision of the contents from the original request was the high fluorine content in most of the target areas. The government of Tanzania started its survey about fluoride in 1969 and has been seeking measures, but so far no effective remedy is found. Presently, the Tanzanian standard for water quality (temporary) is 8.0mg/l (WHO guidelines value:1.5mg/l). This implies slow progress for a solution and the difficulty of removal of fluoride. Health hazards caused by fluoride such as dental fluorosis, skeletal fluorosis are widely spread and measures need to be expeditiously taken. The government of Tanzania requested the government of Japan to support activities to use the results of experiments obtained at the Ngrudoto Defluoridation Research Station in Arusha. The Ngrudoto Defluoridation Research Station in Arusha, under the Ministry of Water and Livestock Development, is the only organisation in Tanzania to carry out research on defluoridation with proven results. Groundwater containing high concentrations of fluorine (over 1.5 mg/l) is found widely in Tanzania, but since these are found mostly in rural areas, development of household level (domestic level) defluoridation methods are being promoted. Nevertheless, these have not yet reached the practical stage. The household methods must 1) use locally procurable defluoridizing materials, 2) be a method which can handle raw water, and 3) be easily operable by the villagers. A concrete activity is to conduct pilot tests for practical methods of defluoridation in Katesh in Hanang District which can meet the above 3 conditions. As a result of this, data necessary to develop a practical method suitable for the project area can be accumulated.

② Expected output

As stated, Tanzania is seeking methods for defluoridation. Only the Ngrudoto Defluoridation Research Station in Arusha has undertaken experiments for defluoridation. The outputs (direct effects) obtained by social development interventions can be useful data for future plans under the supervision of District Water Engineers within the project area in Katesh. The data will be more practical for use in defluoridation technology development at provinces of Tanzania.

③ Activities

- Study the accumulated knowledge of the Ngrudoto Defluoridation Research Station in Arusha

  Magnesite, red soil and bone charcoal are already experimented. The results and methodologies will be reviewed.
- Other removal materials

  Referring to the study results including experiments on a domestic level in Northern Tanzania, examine the capacity of various defluoridation removal materials. The Project will confirm the capacity of those materials for defluoridation.
- Capacity of defluoridation

  Draw water treatment flow charts for each removal material and determine the best conditions for a domestic system and its operation.
- Practical potential of bone charcoal

  Possible methods of using bone charcoal as a removal material will be sought at the Ngrudoto Defluoridation Research Station in Arusha, and development of new methods with bone charcoal will be further sought including the best conditions for operation. In addition, an adequate production method of bone charcoal and the availability of raw materials on the market will be examined, considering the economical, regional and operational aspects.
- Conditions for support activities

  These activities target villages that fulfil the following conditions considering the efficiency of the programme and the present state of the project area.

  a) Only those materials that are already reported as defluoridation capable and available in Tanzania will be examined. When a removal material is considered to be difficult for construction of a practical system, it will be excluded.
  b) As defluoridation for drinking purposes will be target, the priority will be given to a simple method which can be treated on household level. In case the treatment at the well appears to be more effective in the future, it will be also be taken into account.

CHAPTER 3 PROJECT EVALUATION AND RECOMMENDATIONS

Chapter 3 Project Evaluation and Recommendations

3-1 Project Effect

Table 3-1 summarizes the effects and degree of improvement of project implementation.

Table 3-1 Effects and Degree of Improvement through Project Implementation

Present Situation and Problem	Solution in this Project	Effect and Improvement
(1) Tanzania aims at improving water supply coverage rates in the 4 target districts from 40 to 60% by 2001, based on "The Study on the groundwater development for Hanang, Singida Rural, Manyoni and Igunga Districts in the United Republic of Tanzania" executed in 1998. As the Temporary Standards in Tanzania are in use, the safe drinking water supply rate that matches WHO guidelines is notably low. Currently the 34 target sub-villages are under severe water supply conditions.	Construction of water supply facilities at 34 sub-villages in 4 districts.	The Project will supply safe drinking water to 20,000 people. By 2005 safe drinking water will have been provided to 70% of target villagers.
(2) Villagers in the project areas use unhygienic shallow wells, which are possibly contaminated by sewage from outside toilets, for drinking water and daily use.	The Project will supply water throughout the year from the sources that meet the WHO guidelines.	Installation of safe drinking water supply facilities enables to improve hygiene conditions.
(3) Villagers' willingness to participate is low and water supply facilities are inadequately managed. Less than 20% of existing facilities are in operation.	Social development interventions will be carried out to enhance villagers' participation and provide hygiene education as well as build capacity on operation and maintenance.	Increased participation and sense of ownership enables to sustain operation and maintenance of water supply facilities.
(4) Many water sources contain high concentrations of fluoride, and measures against this situation are being sought.	Social development interventions will test trial fluoride removal equipments at Katesh in the project areas reflecting the results of the Defluoridation research station in Arusha.	The results of fluoride removal trial tests at Katesh can contribute to fluoride removal. In the future, the accumulated data can be useful for projects in other areas.

3-2 Recommendations

The following important assumptions need to be fulfilled in order for the effects of the project to be sustainable.

(1) The villagers of the project area persistently keep the will to accept the facilities.

The project will undertake activities to raise awareness on community participation. During the basic design study, village leaders, village water supply committee leaders and the District Water Engineers agreed upon acceptance, and operation and maintenance of the water supply facilities. This does not confirm however, that all sub-villagers will sustain their willingness to accept facilities after completion of the Japanese support project. Therefore, monitoring and follow-up surveys are necessary upon completion as well as five years after completion of the project.

(2) Trained District Water Engineers as well as operation staff will continuously be in charge of the services (substitutes must have equivalent skills).

District Water Engineers and operation staff are basically permanently kept, although in the future, trained officers and staff may not be able to continue their duties due to retirement or transfer to the Water Authorities of townships at District headquarters. Therefore likewise in (1), monitoring and follow-up surveys are necessary upon completion as well as five years after completion of the project.

(3) The quality of target water sources will not deteriorate worse than the results of water quality tests obtained by the basic design study (Due to changes in natural conditions the water quality fails to meet the WHO guidelines).

The basic design study selected water sources that may hydrogeologically fulfil WHO guideline values even in the future. Nevertheless, it cannot be denied that phenomena such as changes in groundwater recharge mechanism due to abnormal climate and groundwater flow changes by geological movements do not possibly cause water quality changes. The Project recommends that the District Water Engineer Office regularly tests basic indicators for drinking water quality through which the changes in quality can be checked and the change fluctuations can be traced. Countermeasures for these changes would depend on the Ministry of Water and Livestock Development and other donor agencies. Therefore again, monitoring and follow-up surveys are necessary upon completion as well as five years after completion of the project.

(4) The villagers of the project area are satisfied with the design water supply rate.

The Project will undertake activities to improve villagers' concepts on hygiene through which the villagers are able to understand why the Project can supply water only for drinking use. However, having understood all the reasons, the villagers may still demand better convenience and more water volume. Therefore, monitoring and follow-up surveys are necessary upon completion as well as five years after completion of the project.

As explained previously, the contents of the Project have been largely altered from the original request. Therefore, the following surveys will be required to rearrange the Project concepts.

① Medical investigation into health hazards by fluorides in the project areas
② Water quality analyses, in particular, to determine the distribution of fluoride concentrations (surface water, shallow groundwater, deep aquifers) and water usage (drinking water) survey at all water sources in the project areas
  ・Seasonal fluctuations in fluoride concentrations (monthly measurements)
  ・Seasonal fluctuations in drinking water consumption (monthly measurements)
③ Investigation on the necessity of water treatment and its methods for all water sources in the project areas
④ Study on impacts (both environmental such as deep aquifers and social conditions) in cases that water supply facilities are constructed in the project areas
⑤ Study on standardization of appropriate water supply facilities including treatment installations in the project areas

The most difficult task in this basic design study was the countermeasure for the water quality problem. Had the water sources development been proceeded without consideration of fluoride, similar to the arsenic problem which caused troubles in many developing countries in recent years, the problem could have spread wider to such already known health hazards as dental fluorosis and skeletal fluorosis. Although light health hazards like dental fluorosis are vastly observed, at this stage where the results of medical investigations and evidence of hazardous influence towards human health are not yet clear, it is adequate to adopt the WHO guidelines for drinking water quality.

Moreover, as fluoride concentrations are greatly influenced by the geological composition, groundwater utilization through boreholes is highly at risk. The boreholes in the project areas were constructed some 30 years ago and are fairly new to their life style. The Project includes shallow wells and boreholes as water sources, but there is indigenous know-how on water quality improvement

knowledge and how to get water supplements from such sources as fruits and milk of cows and goats. In order to secure adequate drinking water, and to achieve the goal that 'all of the rural population can have access to safe water within 400m from each house until 1991' as underlined in the "National Water Policy", a plan for drinking water supply needs to be made taking into consideration the life style, geological conditions and other multidimensional aspects.