No.

The Republic of Zambia
Ministry of Local Government and Housing

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR GROUNDWATER DEVELOPMENT IN LUAPULA PROVINCE IN THE REPUBLIC OF ZAMBIA

DECEMBER 2007

JAPAN INTERNATIONAL COOPERATION AGENCY

JAPAN TECHNO CO., LTD.

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PREFACE

In response to a request from the Government of the Republic of Zambia, the Government of Japan decided to conduct a basic design study on The Project for Groundwater Development in Luapula Province in the Republic of Zambia and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Zambia a study team from November 13 to December 21, 2006.

The team held discussions with the officials concerned of the Government of Zambia, 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 Zambia in order to discuss a draft basic design, and as this result, the present report was finalized.

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

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

December, 2007.

Masafumi Kuroki
Vice-President
Japan International Cooperation Agency

December, 2007

LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for Groundwater Development in Luapula Province in the Republic of Zambia.

This study was conducted by Japan Techno Co., Ltd., under a contract to JICA, during the period from November, 2006 to December, 2007. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Zambia 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,

Shoichi Yokogi
Project manager,
Basic design study team on
the Project for Groundwater
Development in Luapula Province
in the Republic of Zambia
Japan Techno Co., Ltd.

SUMMARY

SUMMARY

1. General Description

The Republic of Zambia (hereinafter referred to as “Zambia”) has a population of 11.9 million in 2006 covering an area of 752,610k ㎡. Zambia is located in the tropical zone between latitudes 8 ° S and 18 ° S, and altitudes are from 900m to 1,500m. Because of its geographical location, the country has a relative mild tropical savanna climate and has distinctive rainy and dry seasons, with the former one from November to March and the other from April to October. The precipitation increases from south to north.

Zambia consists of 9 provinces (Central, Copperbelt, Eastern, Luapula, Lusaka, Northern, Northwestern, Southern and Western). Luapula province, which is the targeted area of this project has an annual precipitation of 1,100mm to 1,500mm. There is more precipitation in the Northeastern part of the province than in the southwestern part. .

When January comes, because of heavy rain, construction machineries cannot reach construction sites. Even if the site is located near a paved road, drilling points are often inaccessible. That is the reason why construction works are not usually implemented from January to March in Zambia.

The geological features of Luapula province are roughly divided into 3 types by areas. In the southern part of the province, like Mansa, Milenge, Samfya and part of Mwense, granite and gneiss of Precambrian period are widely prevailing. In the central part, including Kawambwa and northern part of Mwense, distribution of sedimentary rocks such as sandstone of muva system from the Precambrian Era are found. In the northern part of the province, covering Nchelenge and Chiengi, siliceous rocks such as quartzite mainly exist. We can also find basalt and quartz porphyry penetrating into the previously cited siliceous rocks.

Besides these areas, in the western part of the province, sandstone and conglomerates that are believed to be of the Katanga group from Paleozoic period is prevailing from north to south along the Lualula river that also forms a border between Zambia and Congo.

As for the economy in Zambia, GNI is US$7.5 billion and US$630 per capita in 2006. Economic growth rate shows 6.0% and GDP growth rate is 5.8%. The primary industry comprises 18%; secondary, 25.7%; and tertiary, 56.3%. The main industry is production of copper that occupies 60% of exports of Zambia. According to this situation, Zambia’s economy has been easily affected by the amount of copper production and fluctuations of its international price.

In order to remedy this economic structure, the Muwanawasa Administration gives priority to industry restructuring that mainly consists of development of agriculture utilizing vast and fertile uncultivated land, and tourism taking advantage of its abundant touristic resources.

Recently, the economy of Zambia shows revealing good performance because of the rise in international price of copper. Besides, Zambia was relieved of debt repayments to donor

countries including Japan by becoming one of the Heavily Indebted Poor Countries(HIPCs) in April 2005. As a result, the amount of debt remarkably decreased. However, the government is still in financial difficulties and the recent rise in international oil prices can seriously affect its economy. Therefore, to precede reduction of poverty as one of the biggest problems in Zambia, continuous assistance from international society is still indispensable.

2. Background of the project

The Ministry of Local Government and Housing (hereinafter referred to as “MLGH”) formulated “the Rural Water Supply and Sanitation Program (2006-2015)”, in which MLGH set objectives to increase the coverage of water supply from 37%(the average coverage in 2006) to 75% and that of sanitation facilities from 13%(the average coverage in 2006) to 60%. By implementing this project, the amount of water for about 50,000 people will be secured and the present water supply coverage of 17% will be raised to 20%. Thus, the project is supporting the objectives of the policy for rural water supply and sanitation of the Zambian government that is also the project’s overall goal.

The coverage level of water supply and sanitation services in Zambia remains low, and the rate of access to safe water in Luapula Province, in the northern part of Zambia, also remains low at 17%. In villages where the number of water facilities is not enough and sanitary education is not adequately conducted, inhabitants are forced to take contaminated water from shallow wells and wadis that are located a few kilometers away from their residential areas. As a result of this, they are suffering from increase of waterborne diseases, burden of carrying water long distances and are seriously affected with respect to economic activities, education, health and so on.

To cope with this situation, the Government of Japan implemented the “Study on National Water Resources Master Plan (M/P)” from 1993 to 1995 and according to the results, the Zambian government formulated the “National Water Policy” (NWP). While the above-mentioned Rural Water Supply and Sanitation Program (2006-2015) aims to increase the coverage of water supply and sanitation facilities, in Luapula province, direct assistances to the water supply sector are not received except for water supply facilities for schools constructed by an UNICEF project.

To improve this situation in Luapula province, in 2004, the Government of Zambia presented its request to the Government of Japan for grant aid assistance for the Groundwater Development Project in Luapula Province (hereafter called the “Project”). Subsequently, the Government of Japan conducted a preliminary study from February to March 2006. As a result, the study team confirmed that the Government of Zambia gives its priority to borehole

construction rather than procurement of equipments and materials for drilling. Then, a preliminary screening of target sites was carried out and criteria for selection of the target sites for borehole construction were decided.

In the preliminary study, the possibility for implementing the Project under the scheme of "Community Empowerment Grant Aid" was considered, and reached a conclusion that there are many difficulties in implementing the Project under this scheme such as ensuring the quality of boreholes, effectiveness of cost reductions, and assurance in the number of successful boreholes. However, to examine the possibility of execution of the Project under the scheme of Community empowerment grant aid, the Government of Japan decided to conduct the Outline Design Study.

3. Outline of study results and description of the project

Based on results of the preliminary study and above-mentioned background, the Japanese side conducted field surveys for the Outline Design Study from November 13 to December 21, 2006, and carried out a survey on existing conditions of the requested communities. Also, apart from this Project, in "the Basic Research Study for Groundwater Development under the scheme of community empowerment Grant Aid in Rural Areas of Southern Africa in the Republic of Zambia" (hereafter called the "Basic Research Study"), the Japanese side conducted experimental construction of boreholes in 33 villages from the requested communities in Luapula Province for the Project from January to March 2007, and acquired information concerning quality of construction works in case of contracting directly with local construction companies and data related to groundwater development in Zambia.

As a result of the study, acknowledgment was made that issues such as effectiveness of cost reduction and assurance of sufficient successful boreholes still remain. Therefore, according to the examination in Japan, it was decided that the Project would be implemented under the scheme of General Grant Aid. Therefore, based on the result of the field survey done in November and December 2006, and result of the Basic Research Study, the data analysis work in Japan has changed from the Outline Design Study to Basic Design Study.

The Project plans to construct boreholes fitted with handpumps in 7 districts of Luapula Province and assure safe water supplies to a target population of 50,000 persons. Also, implementation of a Software Component Programme as support to insure sustainable operation and maintenance of these water supply facilities is planned.

In the Preliminary Study, concerning contents of the request, a) Borehole construction, b) Support for WASHE activities and c) Procurement of equipment for maintenance activities were confirmed to have more priority than procurement of borehole construction equipment and supporting vehicles. In the Basic Design Study, the contents of the request were reviewed and are shown below.

Item		Quantity
Equipment	Tools for maintenance of handpumps (Tools for APM)	81 sets
Construction	Boreholes with handpumps and appurtenant facilities	200 sites
Technology Transfer	Support activities for operation and maintenance of the facilities (Software Component)	1 set

The candidate sites for construction were verified based on criteria established in the Preliminary Study as shown below.

1) to have demand for water
2) to have accessibility for construction equipment into the site
3) to confirm condition of existing water supply facilities (sites with sufficient existing facilities are to be excluded)
4) to have no overlap with other donors' cooperation
5) to have organisational capacity to form a water management committee
6) to have willingness to pay the maintenance costs by the residents

According to results of the social condition survey based on criteria shown above, including the 33 sites targeted in the Basic Research Study, 289 sites out of the requested 355 sites are considered to be feasible to install water supply facilities in the Project. The project will be implemented in two stages. Firstly, the Detailed Design Stage and then the Main Component Stage.

In order to maintain appropriate management, the Project is to undertake construction by 2 teams at a maximum and the Project plans to construct 200 successful boreholes in about 2 years. Construction of appurtenant facilities and installation of handpumps should be done immediately after completion of boreholes. As for construction of iron removal plants, since their number is small and a certain period for monitoring of water quality is required, these should be undertaken from the Second Term.

District	Planned number	Term 1	Term 2	Term 3
1) Chiengi	28	28		
2) Nchelenge	24	20	4	
3) Kawambwa	36		36	
4) Mwense	31		31	
5) Mansa	26		26	
6) Samfya	26		26	
7) Milenge	29		21	8
Total	200	48	144	8

4. Project period and cost estimation

1) Project period

If the designed number of borehole drillings is 200, the implementation schedule becomes as shown below.

Detailed Design	Consultant Agreement, Detailed Design survey (siting, detailed design, drilling point siting, etc.), software-component program preparation, tender documents preparation and verification	4.0 months
Main Component	Consultant Agreement, general tendering procedures, Contracting with Contractor	4.0 months
	Borehole drilling, installation of handpump, construction of appurtenant facility and iron removal plant (to be suspended during the rainy season), software component activities execution	24.0 months （including pause during rainy season）
	Total	28.0 Months

2) Project cost estimation

If the project is to be implemented by a Grant aid scheme, the cost of project is estimated as 730million Japanese yen. (Japanese side: 719million yen, Zambian side: 11million yen)

5. Verification on feasibility of the project

By implementing the project, the following effects and improvements are expected.

1) After the construction of boreholes fitted with handpumps, sustainable safe water accessibility to 7 districts in Luapula province will increase from 162,300(17%)(in 2007) to 212,300 (20%)(in 2010).
2) The quality of water that is supplied from the constructed facilities will satisfy the design standard year-round.
3) Women and children will be relieved from the burden of fetching and carrying water and gain more spare time.
4) With the result that 81 APMs, who are repairing handpumps, are trained through the software component program, necessary technique for maintenance of water supply facilities can be acquired through resident's independent participation.
5) As a result of the software component activities, WASHE will be activated in Luapula province and a system for management and maintenance, which is based on resident's ownership and burden of responsibility, will be structured.

We consider that implementation of this project is feasible as a Grant Aid scheme of Japan because of the following points.

1) The beneficiaries of the project are residents in Luapula province and are estimated to be about 50,000 persons.
2) The objectives of the project are to improve the conditions of water supply and sanitation for the rural residents.
3) The water supply facilities constructed by this project are predicted to be sustainably operated and maintained by each level WASHEs.

4) The project corresponds to the policy of Rural Water Supply and Sanitation Program (2006-2015), in which MLGH set objectives to increase the coverage of water supply from 37%(the average coverage in 2006) to 75%, and is supporting the objectives of the policy.
5) The water supply facilities of the project are to be provided free to local villages where most of people are at the poverty level. After completion of the construction works, V-WASHE will manage and maintain the facilities by collecting fees from water users. Since making profit is not the objective, it is feasible to implement the project under the scheme of Grant Aid.

It is verified that the project should be implemented through Grant Aid because it can immediately support to the improvement of low coverage of water supply in Luapula province and also contribute to BHN of rural area residents who are mostly poor.

For effective and efficient implementation of the project, the following recommendations should be conformed to.

1) Standardization of handpumps for rural water supply

At present, more than 40 types of handpumps are in use within a widespread area. When we consider the maintenance of them and training of artisans, standardization of the type of handpump in Zambia is recommended.

2) System of operation and maintenance in targeted areas

A system that provides effective operation and maintenance of handpumps throughout Luapula province is necessary. Staff of rural health centers and school teachers should be involved and take main roles that precede the residents' maintenance activities and support to improve V-WASHE's capacity. If an Area Development Committee is organized in a village, the members should actively participate in the activities.

3) Necessity of continuous monitoring for operation and maintenance

Monitoring by the Zambian side should be conducted continuously in order to identify the effects of the project and appreciate changes in residents' consciousness and behavior patterns. By utilizing data accumulated through the monitoring, WASHEs in each district should confirm actual demands and necessity when they prepare annual activity plans, and then reflect them to other similar projects.

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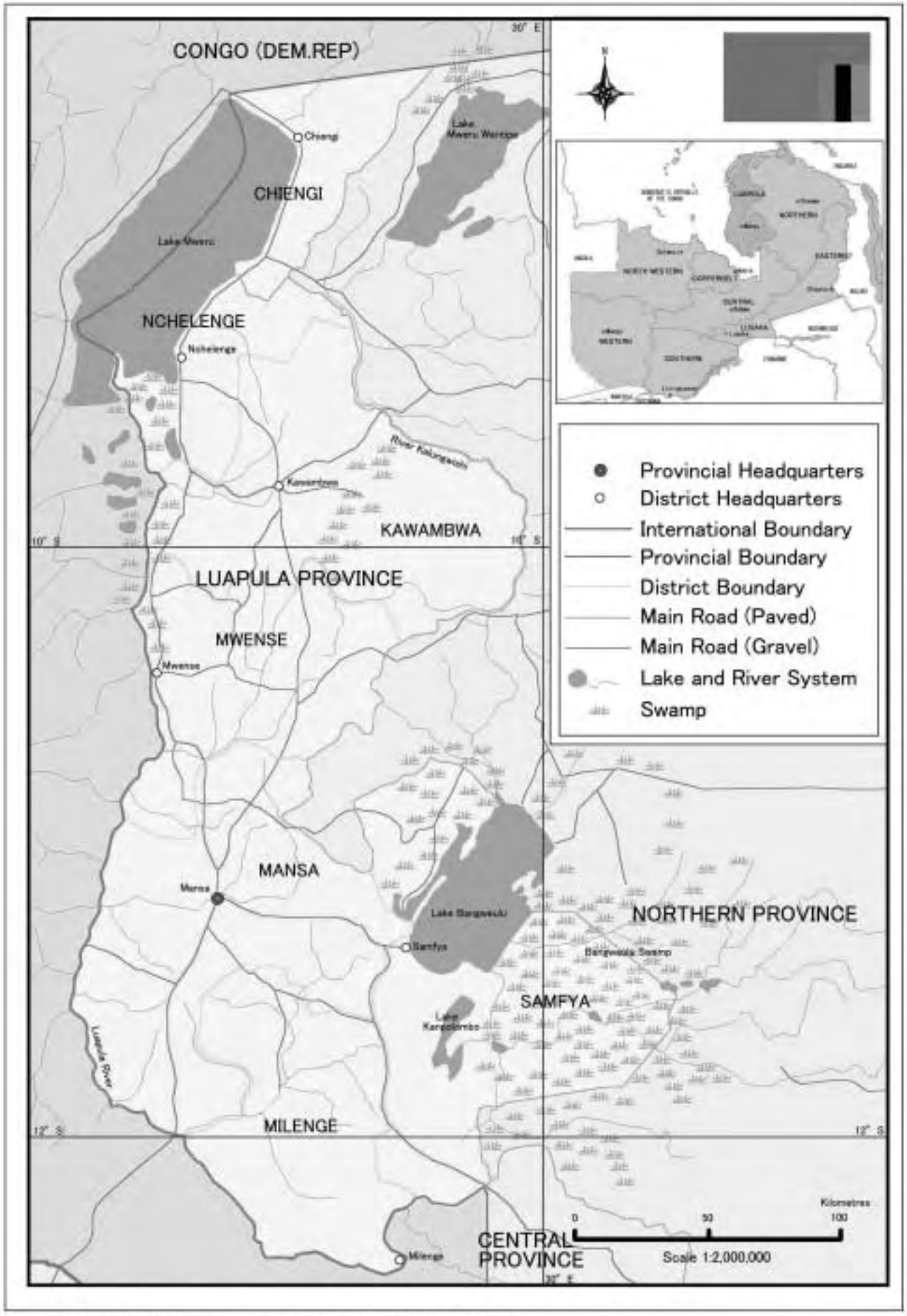

THE PROJECT FOR GROUNDWATER DEVELOPMENT
IN LUAPULA PROVINCE IN THE REPUBLIC OF ZAMBIA

LOCATION MAP OF PROJECT AREA

THE PROJECT FOR GROUNDWATER DEVELOPMENT IN LUAPULA PROVINCE IN THE REPUBLIC OF ZAMBIA

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LIST OF ABBREVIATIONS

ADC	: Area Development Committee
AfDB	: African Development Bank
A/P	: Authorization to Pay
APM	: Area Pump Mender
B/A	: Banking Arrangement
BHN	: Basic Human Needs
DANIDA	: Danish International Development Agency
DFID	: Department for International Development
DISS	: Department of Infrastructure and Support Services
DTH	: Down-the-Hole
DWA	: Department of Water Affairs
D-WASHE	: District Water, Sanitation and Health Education (Committee)
E/N	: Exchange of Notes
GDP	: Gross Domestic Product
GNI	: Gross National Income
GTZ	: Deutsche Gesellschaft fur Technische Zumsammenarbeit
HDI	: Human Development Index
HIPIC	: Heavily Indebted Poor Countries
HIV/AIDS	: Human Immunodeficiency Virus /Acquired Immuno-Deficiency Syndrome
IMF	: International Monetary Fund
JICA	: Japan International Cooperation Agency
KfW	: Kreditanstalt fur Wierderaufbau
MDGs	: Millennium Development Goals
MEWD	: Ministry of Energy and Water Development
MFNP	: Ministry of Finance and National Planning
MLGH	: Ministry of Local Government and Housing
NGO	: Non-governmental Organization
NORAD	: Norwegian Agency for Development Cooperation
NRWSSP	: National Rural Water Supply and Sanitation Programme
NWP	: National Water Policy
OJT	: On-the-job training
PDM	: Project Design Matrix
PRA	: Participatory Rapid(Rural) Appraisal
P-WASHE	: Provincial Water, Sanitation and Health Education (Committee)
RWSS	: Rural Water Supply and Sanitation
RWSSU	: Rural Water Supply and Sanitation Unit
SOMAP	: Sustainable Operation and Maintenance Project

Sub-WASHE	: Sub-District Water, Sanitation and Health Education (Committee)
UNDP	: United Nations Development Programme
UNICEF	: United Nations (International) Children's (Emergency) Fund
VIP	: Ventilated Improved Pit
V-WASHE	: Village Water, Sanitation and Health Education (Committee)
WASHE	: Water, Sanitation and Health Education
WHO	: World Health Organization
ZMK	: Zambian Kwacha

CHAPTER 1
BACKGOUND OF THE PROJECT

Chapter 1 Background of the Project

The coverage level of water supply and sanitation services in Zambia remains low, and the rate of access to safe water in Luapula Province, in the northern part of Zambia, also remains low at 17%. Presently, in Luapula Province, due to the lack of sanitary water sources, the residents are compelled to drink unsanitary water that can increase chances of water-borne diseases. Also, women and children are subjected to time consuming hard labour of fetching water.

To improve the situation, in 2004, the Government of Zambia presented its request to the Government of Japan for grant aid assistance for the Groundwater Development Project in Luapula Province (hereafter called the "Project"). Subsequently, the Government of Japan conducted a preliminary study from February to March 2006. As a result, the study team confirmed that the Government of Zambia gives its priority to borehole construction rather than procurement of equipments and materials for drilling. Then, preliminary screening of target sites was carried out and criteria for selection of the target sites for borehole construction were decided.

In the preliminary study, the possibility for implementing the Project under the scheme of "Community Empowerment Grant Aid" was considered, and reached a conclusion that there are many difficulties in implementing the Project under this scheme such as ensuring the quality of boreholes, effectiveness of cost reductions, and assurance in the number of successful boreholes. However, an Outline Design Study with the policy of Project implementation on an experimental basis under the scheme of Community empowerment grant aid was decided to be conducted.

Based on the above background, the Japanese side conducted field surveys for the Outline Design Study from November to December 2006, and carried out a survey on existing conditions of the requested communities. Also, apart from this Project, in "the Basic Research Study for Groundwater Development under the scheme of Community Empowerment Grant Aid in Rural Areas of Southern Africa in the Republic of Zambia" (hereafter called the "Basic Research Study"), the Japanese side conducted experimental construction of 41 boreholes in some of the requested communities in Luapula Province for the Project from January to March 2007, and resulted in achievement of 31 successful boreholes and acquired information concerning quality of construction works in case of contracting directly with local construction companies and data related to groundwater development in Zambia.

In the Basic Research Study, a confirmation was made that construction quality can be maintained even when a local private drilling company drills boreholes as long as a consultant supervises strongly the construction and monitor the process.

However, issues such as effectiveness of cost reduction and assurance of sufficient number of successful boreholes still remain to be resolved. Therefore, according to the results of examination in Japan, it was decided that the Project would be implemented under the scheme of General Grant Aid. Therefore, based on the result of the field survey done in November and December 2006, and result of the Basic Research Study, the data analysis work in Japan has changed from the Outline Design Study to Basic Design Study.

CHAPTER 2
CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Project Objective and Overall Goal

Project objective

The objective of the Project is to increase the population which can access safe water supplies and to improve the sanitation environment of the residents, through construction of water supply facilities consisting of boreholes fitted with handpumps at each village, school and rural health centre (hereafter called "RHC") in all of the 7 districts (Chiengi, Nchelenge, Kawambwa, Mwense, Mansa, Samfya, Milenge) in Luapula Province.

Means to achieve the objective

The Project plans to construct 200 boreholes fitted with handpumps in 7 districts in Luapula Province and assure safe water supplies to target population of 50,000. Also, implementation of a Software Component Programme and procurement of tools for maintenance of handpumps as support service to operation and maintenance of these water supply facilities are planned.

Overall goal

The "National Rural Water Supply and Sanitation Programme (2006-2015)" (hereafter called "NRWSSP") formulated by MLGH aims to improve the coverage of water supply from 37% (national average in 2006) to 75%, and coverage of sanitation facilities from 13% (national average in 2006) to 60%.

As mentioned above, the Project aims to improve the coverage of water supply in the target area from 17% at present to 20%, through the construction of 200 boreholes fitted with handpumps in 7 districts of Luapula Province and assurance of safe water supplies to 50,000 residents. Thus the Project follows the policy of the Government of Zambia for rural water supply and sanitation as the overall goal for this Project which can support achieving the goal of the national policy.

The total population of all target sites including the alternative sites becomes 330,314 residents. However, the design of the served population is calculated based on 250 persons per borehole fitted with handpump, and the number is considered for pumping capacity of the handpump and such its durability. Therefore, the Project adopts the number calculated from the Zambian standard (200 boreholes × 250 persons = 50,000 persons) as the served population of the Project.

In consideration of an optimum design concept for the grant aid from results of the field survey, the following PDM is proposed for this Project with the project purpose, overall goal, outputs, indicators to measure the achieved outputs and means of verification as indicated in the PDM. The PDM is formulated by reflecting the goals of the master plan of the Executing agency, the PDMs for existing similar projects in the target districts, and opinions on its feasibility from stakeholders.

Table 2-1 LOGICAL FRAMEWORK OF THE PROJECT（Project Design Matrix: PDM）

Project Title: the Project for Groundwater Development in Luapula Province in the Republic of Zambia
Target Area: 200 sites in 7 Districts in Luapula Province
(Chiengi, Nchelenge, Kawambwa, Mwense, Mansa, Samfya and Milenge)

Target Group：
【Direct】 Residents of the target villages
(50,000 persons)
【Indirect】 Residents in Luapula Province
(approx. 810,000 persons)

Period：Jan. 2008 – Feb.2010
Ver. 0.2
Developed on September 2007

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption
Overall Goal ☐ Health and Hygiene conditions of the residents in target area of the Project are improved.	☐ Rate of occurrence of water borne diseases in target area is decreased. ☐ The habits of the residents are improved on sanitation management of water sources, storage and use of drinking water, way of hand washing in household and use of sanitation facilities.	☐ FGD, PRA, monitoring reports, direct observation	
Project Purpose Safe water is supplied to the residents of the Project area consecutively.	☐ The residents can utilise the design supply rate of water from constructed water supply facilities throughout the year. ☐ The water quality of constructed facilities satisfies the design standard throughout the year. ☐ Time to repair the facilities fitted with handpumps including existing ones is shortened compared with present situation. ☐ Enough maintenance cost is reserved as frequently as residents agreed for maintaining the handpumps. ☐ Skills and knowledge which APM and Caretaker achieved are utilised for operation and maintenance activity.	☐ Interview survey, PRA, monitoring reports ☐ Monitoring reports ☐ Interview survey, monitoring reports, log book of APM & caretaker ☐ V-WASHE accounting record ☐ Interview survey, monitoring reports	☐ Condition of primary health care is improved in target area. ☐ Negative impact of HIV/AIDS is alleviated. ☐ Hygiene education and hygiene improvement promotion are sustained by the Government of Zambia.
Outputs(by the Project under the Japanese Cooperation) 1. 200 boreholes fitted with handpumps are installed to supply sustainable safe water, in the sites without access to protected safe water sources. Outputs by Software Component Programme 2. Skills for capacity development and hygiene education promotion necessary for voluntary participation of residents to maintain water supply facilities and for establishing maintenance system are settled in D-WASHEs. 3. D-WASHEs achieve improved capacity necessary for monitoring and evaluating the effects of water supply and sanitation improvement projects.	1-1 Number of villages using unprotected water sources for drinking is reduced compared with present situation in the target area. 1-2 Water quality of constructed water supply facilities satisfies the design standard. 1-3 Water amount of constructed water supply facilities satisfies the design standard. 2-1 D-WASHE trainers, WASHE facilitators and APM are allocated, who achieved necessary skills from the training for operation and maintenance of water supply facilities. 2-2 V-WASHE are established in all target sites, as a result of facilitation by D-WASHE. 2-3 V-WASHE in all target sites achieves skills for maintain water supply facilities by support from WASHE facilitators and APM. 3-1 D-WASHE will record and accumulate the monitoring results of water supply and sanitation improvement activities in villages and catchments areas. 3-2 The WASHE annual action plan is updated, reflecting the monitoring results done by D-WASHE.	1-1 Monitoring reports, interview survey 1-2 Results of water quality analysis 1-3 Completion report 2-1 Software component programme reports, maintenance manual, maintenance promotion guideline 2-2 Software component programme reports, member list of V-WASHE 2-3 Software component programme reports, WASHE action plan 3-1 Monitoring reports, software component programme reports 3-2 D-WASHE action plan	☐ Groundwater condition in the target area are not deteriorated more than expected. ☐ Water quality of its sources is not deteriorated. ☐ Social and economic conditions around the target group are not deteriorated suddenly. ☐ WASHE trainers, WASHE facilitators and V-WASHE trained in the Project will keep working as planned.
Activities **【Construction of Facility and Procurement of Equipment】** 1-1 Procurement of tools for maintenance of handpumps water supply facility. 1-2 Construction of 200 boreholes fitted with handpumps in the target sites. 1-3 Installation of iron removal plant for borehole water supply facilities with high iron contents. **【Capacity Development Assistance for establishing operation and maintenance system】** 2-1 Formulating agreement between D-WASHE on operation and maintenance system of boreholes fitted with handpumps and its action plan for promotion. 2-2 Training of D-WASHE trainers, WASHE facilitators and APM on necessary skills for maintenance and rehabilitation of boreholes fitted with handpumps up to each responsibility. 2-3 Training of WASHE facilitators on skills for community mobilisation, promotion of participatory planning and monitoring activity, improvement of capacity for operation and maintenance and implementation of participatory hygiene education. 2-4 Verification of the achieved skills of WASHE facilitators and APM through direct observation on site. 2-5 Formulation of maintenance manual for boreholes fitted with handpumps and guideline for promotion activity of operation and maintenance system. 2-6 Training of D-WASHE and ADC on confirmation and recording of progress of achievement, activity of monitoring and evaluation plan, achievement of outputs and effectiveness of the outputs.		**Inputs** **【Japanese Side】** Personnel; Basic design study team members, Detail design study team Consultant members for supervision Equipment; Tools for operation and maintenance Funds; Grant Aid **【Zambian Side】** Personnel; Counterpart engineer, Local consultant / NGO Equipment; Vehicles for Zambian side transportation, equipments for WASHE activity Funds; Local cost (Land for construction sites for boreholes with handpump, access road preparation, Banking commissions)	☐ Groundwater development in target sites becomes successful. **Precondition** ☐ Importation and custom clearance procedure will be carried out smoothly.

2-1-2 Outline of the Project

The list of items requested from the Government of Zambia is shown below.

Table 2-2 Summary of the Request

Requested Items		Quantity
(1) Construction of water supply facilities fitted with handpump		355 sites
(2) Procurement of Equipment and Materials		
1.	Equipment and materials for borehole construction	
1)	Drilling tools	1 set
2)	Materials for drilling work	1 set
3)	Casing, screen: diam. 4” x 60m	For 355 boreholes
4)	Handpump and spare parts	355 sets
5)	Cargo truck	2 nos.
2.	Geophysical survey equipment	1 set
3.	Supporting equipment for WASHE activities	
1)	Station wagon, 4WD	2 nos.
2)	Pick-up truck, 4WD, double cabin	8 nos.
3)	Motorbike	24 nos.
4)	Computer for database	2 sets
5)	Water quality analysis equipment	8 sets
(*1)	Tools for handpump maintenance （For APM use）	1～2 sets/Ward
(*1)	Computer	1 set/District
(*1)	Bicycle	1～2no./Ward(*2)

(*1) Item requested additionally during the Basic Design Study
(*2) The number would be decided depending on the size of ward, the number of facilities with hand pump and their location.

From results of the field survey conducted during the Basic Design Study, the following issues were verified.

(1) Procurement of the equipment

Based on the priority of each item in the request form from the Zambian side, which was already confirmed in the Preliminary Study, the Japanese side consulted with the Zambian side on the contents of the request. After the official request had been submitted, because of the

change in the Zambian side policy, the Executing agency was changed from DWA, as originally requested, to MLGH,. According to this situation, it was confirmed that the purpose of utilising "1. Equipment and materials for borehole construction" and "2. Geophysical survey equipment", out of the requested items shown above, lost its direct relationship with the Project. Also, confirmation was made that some items in "3. Supporting equipment for WASHE activities" are not be to procured.

(2) Screening of requested sites

According to the explanation by the Zambian side, the requested sites for borehole construction covers all of the 7 districts in Luapula Province, and the Government of Zambia gives priority to schools, RHCs and villages, in this order, though the villages still have extremely high priority. However, since implementation of all requested sites as Japan's cooperation is difficult, project implementation will be limited only to feasible sites. Thus the Japanese side will verify the priority of sites through confirmation of the present situation of water supply based on the field survey.

In terms of the number of sites, the candidate villages for construction are examined in detail using criteria shown below, which were established in the preliminary study.

1) to have demand for water
2) to have accessibility of construction equipment into the site
3) to confirm the extent of existing water supply facilities (sites with sufficient existing facilities are to be excluded)
4) to have no overlap with other donors' cooperation
5) to have organisational capacity to manage a water management committee
6) to have willingness to pay the maintenance costs by the residents

According to the results of the social condition survey based on criteria shown above, 289 sites out of the requested 355 sites are considered to be feasible for development of new water sources in the Project.

(3) Alternative sites and their priority

As mentioned above, there are 289 sites feasible for developing water sources, and of these, the highest prioritized 200 sites(boreholes) will be implemented in the Project. In terms of priority in each district, schools, RHCs and sites with large population and much demand for water are to be given maximum priority.

The 89 site excluded in this process are to be dealt as alternative sites for drilling in the Project. Namely, when 2 unsuccessful drillings per village are encountered, the Project is to select another site out of the 89 alternative sites in accordance with their priority to achieve 200 successful boreholes.

(4) The sites constructed in the Basic Research Study

In terms of successful boreholes achieved in the Basic Research Study mentioned above, handpump installation and appurtenant facility construction was also carried out in the same Study, and Software Component for maintenance of these facilities is to be conducted in the Project. In the “Basic Research Study” which was conducted in relation with this Basic Design Study, the 33 target sites for drilling were selected from the initial requested sites

(5) Water quality

In the field survey, the study team surveyed 77 existing boreholes in the target area, and conducted water quality analyses for these sources. As a result, 27 boreholes (35%) were found to contain iron concentrations exceeding the Zambian standard for water quality (1.0mg/l for iron). Also 51 boreholes (66%) were confirmed to have pH values lower than the guideline value (6.5), which are acidic. In groundwater development, the water quality often does not change even when boreholes are constructed at different points in the same village, and so there is concern that the Project is not able to achieve the targeted number of successful boreholes if guidelines for water quality are strictly followed.

Therefore, in consideration that, depending on their values, iron and pH are not harmful to humans and as a result of consultation with the Executing agency, the water quality standard to determine a successful borehole in the Project is to be adjusted to pH above 5.0 and iron content below 2.0mg/l, considering inhabitant’s demands for water, which is based on accessibility for safe water, complaint about the taste, etc. If the iron content exceeds this adjusted value, then installation of an iron removal plant as mentioned below maybe considered, otherwise the borehole will be abandoned.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

As stated before, the original plan was implementation under the "Community Empowerment Grant Aid" scheme, but as problems still remain such as attaining effective cost reduction and securing enough number of successful boreholes, it was decided to implement this Project under the scheme of General Grant Aid, as a result of analysis of the situation.

As a result of the Basic Design Study, the target project description including basic policies and considerations are shown below. Also, because this Project is to be implemented by local private contractors under the supervision of a Japanese contractor, considerations were made to maintain the quality to a certain level, on such aspects as construction capability, construction quality and schedule of works.

2-2-1-1 Basic Policy

The original request consisted of construction of boreholes equipped with handpumps in 355 sites, and procurement of drilling equipment, related equipment, construction materials and supporting vehicles. At the stage of the Preliminary Study, a) the priority for procurement of drilling equipment by the Executing agency and b) the necessity and feasibility for procurement cooperation were confirmed to be low. Moreover, as the Executing Agency was changed from MEWD/DWA to MLGH/DISS, during the Basic Design Study the priorities and necessities of the requested equipment were reviewed. As a result, procurement of drilling equipment, drilling related equipment and construction materials are excluded from the scope. The new scope of plan becomes construction of 200 boreholes equipped with hand-pumps and procurement of 81 sets of maintenance tools for handpumps.

In this project, boreholes drilling and construction works of facilities is to be implemented by local companies under the supervision of a Japanese company. More than 3 construction companies have capability for construction of boreholes where their abilities are considered to be sufficient.

Also, at first, technology of mud circulation drilling method (mud drilling) of the local private company was doubtful, but from the results of the Basic Research Study it was confirmed that a local company having the ability to apply the mud drilling method is available. Therefore, as groundwater development can be conducted even at the sites where drilling boreholes with mud drilling is necessary, these sites will be included in the target sites.

In the water supply sector of Zambia, an integrated approach consisting of establishment of an operation and maintenance system based on residents' ownership and responsibility, hygiene education and facilities construction is applied, which is called WASHE (Water, Sanitation and Health Education) activities. As far as water supply facilities are concerned, village level water and sanitation committee (hereinafter called "V-WASHE") is in charge of daily maintenance, collection and savings of maintenance fees, at district level the Local Authority is responsible and at catchment area level committee are in charge of distribution of spare parts and fostering the Area Pump Mender (hereinafter called "APM"). Likewise in this project, to encourage user based sustainable operation and management of the borehole fitted with handpump, assistance through a software component program is conducted. The details shall be mentioned in a latter section, but the outline of the activities conducted in the software component program is as follows:

1) Instruction concerning organization management and community management to the V-WASHE.
2) Dissemination of operation and maintenance technologies such as daily preventive maintenance and repair activities of the handpump water supply facility.
3) Promotion of operation and maintenance technologies for iron removal (only at sites requiring installation of iron removal plant).
4) Strengthening the capacities for guidance/facilitation and monitoring system of the awareness facilitators who facilitate the above activities at the village level as well as the APM.

(*) The software component program is to be conducted at the target 200 villages of this plan plus the 31 villages which gave successful boreholes in the test drillings of the Basic Research Study totalling 231 villages (It should be noted that the 31 villages of the Basic Research Study was selected from the requested sites).

2-2-1-2 Policy Concerning Natural Environment Factors

The situation of the hydrology and climate, and geology and topography of the target area is mentioned below:

1) Hydrology and climate

The rainfall in the target area is shown in the table below. Since the number of days which exceed 10 mm rainfall/day is under 10 days for every month, construction works can be conducted, but after January the accessibility to the sites which are not situated along the paved

roads worsen and even sites along the paved roads often have difficulties in accessing to the drilling points. This is because the drilling points are often decided at locations within fields or places where vehicles have to go through the fields, and so vehicles mounted with heavy materials such as drill pipes, casings or well drilling accessories bog down into the ground and thus create difficulties to drive further. Therefore in Zambia usually construction works are not conducted during January to March. This plan will also take this into consideration and determine this period to be a construction recess period.

Table 2-3 Number of days with more than 10mm/day Rainfall

Month / Observation Station	Unworkable number of days/month												
	1	2	3	4	5	6	7	8	9	10	11	12	Total
Kawambwa	9	6	9	3	0	0	0	0	0	2	6	6	41
Mansa	9	5	9	2	0	0	0	0	0	0	5	7	37

*Average of last 5 years

2) Topography and geology

By conducting site surveys and comparing existing material, it was confirmed that granite bedrock and sedimentary rocks of the Muva Super Group and Katanga Super Group covered almost whole area of the province excluding the swamp around Lake Bangweulu and Lake Mweru. Based on the topography, some lineaments is clear, including some faults. Therefore, in the beginning of the survey, it was expected fissured water in the consolidated formation too. However, according to the result of geophysical prospecting and test drilling during the Basic Research Study, in sedimentary rock of Muva Group it was confirmed considerable yield in the fractures, but in the granite and sedimentary rock of Katanga Group, considerable fracture zone were found but with very low yield or in dry condition. At the swamp around Lake Bangweulu and Lake Muweru, sand with clay accumulate several tens meter to more than hundred meters. It was found that permeable layers only exist in certain zones where sand contains less clay.

Based on the above confirmation, for determination of the drilling points, geological surveys and electrical prospecting should be conducted intensively at each site, including consideration on the villagers requested point. With the results of the survey, it is necessary to select the most appropriate sites that have high probability for groundwater development and estimate the formation and depth of aquifer to select the proper drilling method and its depth. Drilling points shall be selected properly by taking possible groundwater contamination sources into consideration such as inhabitant's activities and live stock waste.

3) Water quality

In this Project, the Zambian water quality guidelines are applied. However, as stated in "1-2 Project outline, (5) Water quality", if the developed groundwater quality shows iron content and pH to be exceeding the guideline value, handling of the sample shall be decided after discussions with concerned persons. As shown below, installation of iron removal plant and selection of the type of handpump should be implemented accordingly.

● Iron removal plant

As a result of the existing well survey and the drilling test in the Basic Research Study, many sites revealed high iron concentrations exceeding the guideline value, and if the judgment for a successful well is made based on the Zambian guideline value (1.0mg/l), then unsuccessful wells will increase and even if the water quality standard is modified at sites where the iron content is over 2.0mg/l, the water cannot be used considering the colour and taste.

Therefore, at boreholes where the iron content exceeds the above mentioned modified value of 2.0mg/l, the Executing agency, the consultant and the V-WASHE representative should consult with each other and consider installation of an iron removal plant accordingly.

●Type of hand-pump

An officially stated standard type of hand-pump for Zambia is not available, but at present the India Mark II is the most popular type. However, the riser pipe is made of galvanized steel which can easily be affected by the water quality, and if the groundwater is acidic, it shall cause corrosion or give the water a rusty taste.

On the other hand, the Afridev type hand-pump of which the riser pipe is made of PVC is gradually becoming used in Zambia. Therefore, the type of handpump will be selected from the above 2 types according to the quality of groundwater of the borehole. Also, for related pump accessories which will come in contact with water, anti-corrosive materials will be used whenever necessary. It is estimated that 50% of each type of handpump will be selected.

2-2-1-3 Policies for Socio-Economic Factors

Based on the analysis from the social survey, points to consider and policies are shown below.

1) Capability and willingness to pay the operation and maintenance fee by the Residents

From results of the survey on the responsible body for operation and maintenance of the water supply facility, most of the answers said that the responsible body is the village water

committee (63.9%), and as for the operation and maintenance cost, most of the answers said that it should be paid by the villagers or facility users (78.3%). However, the percentage of households who is paying even a small amount of money is only 6%, and for sites where the residents are paying water tariff, 60% of the households are paying under 1,000 ZMK/mon/hh as water tariff, and over 50% of the households paying water tariff feel that even the current water tariff is "very expensive" or "expensive".

35% of the target sites of the Basic design survey answered that the amount of money the residents are willing to pay for water tariff is in the range of 500-999 ZMK /month or 1,000 - 1,499 ZMK/month. If the actual water tariff is not set within this margin (according to the estimation from the basic design survey, the average for all sites is 480 ZMK/mon/hh), and especially for the sites that are much below the 5% line of household income (out of the 200 target sites 2 villages, and of the alternative 93 sites 8 villages fall under this category), the residents do not seem to realize the required cost for operation and maintenance of the hand-pump even if the residents have the ability to pay. Therefore, proper information must be given on the operation and maintenance cost through the software component program, and make them understand the importance of the maintenance cost through the payment of water tariffs.

2) Health and Hygiene Environment, Sanitation Behaviour and Awareness

193 sites out of all 355 surveyed sites has experienced health and hygiene activities, but the coverage of VIP latrines remains only at 1%, and 76% of the villages use traditional pit latrines. The condition of the health and sanitation environment is extremely bad that residents are infected by diarrhoea and malaria, which make up 70% (in dry season) to 90% (in rainy season) of all diseases, and catch many other water borne diseases. The Project adopts the policy to conduct educational activities to improve the health and hygiene environment and sanitation awareness of residents through support for WASHE activities.

3) Maintenance Situation of Existing Water Supply Facilities

As for 22 sites with handpumps broken out of the surveyed villages, half of them "tried to repair by themselves but failed", and another half "asked plumber for repair but waiting", as the action taken for broken handpumps. Survey results revealed that responsibilities for daily operation and maintenance rest on V-WASHE, schools, RHC and village head, but due to delays in fostering of APMs with necessary skills, appropriate actions are not taken. If fostering of APMs can be realized, such existing broken hand pumps can be repaired and utilized. Consequently, the Project proposes to support the development of APMs.

The rate of villages without handpumps who are using other water sources and never manage their existing water sources is 24%. Therefore, the Project adopts the policy to raise awareness on water resources management and sanitation at these sites.

4) Existing Organisations and Experience in Participation in Development Activities

It seems that most of villages have already formed various community organisations, and residents have capacity for mobilisation and experiences in development activities. However, although 60% of surveyed villages have already organised a V-WASHE, experience in health and sanitation activities at the surveyed villages remains only at 38% out of all the community activities, and support for construction of improved pit latrine at 5%. Also the contents of activities in the villages which answered to having experience in health and sanitation activities are basic, such as cleaning around the water sources, pulling out weeds, maintaining existing pit latrines, encouraging digging of pit latrines and boiling water. As diarrhoea is one of the main diseases in the target area, to prevent water borne diseases, awareness activities such as safe use of drinking water, food sanitation, promotion of hand washing, proper use of pit latrines, and conservation of environmental sanitation are necessary to enhance awareness, behaviour and practice of individuals, households and public health.

At present, as D-WASHE does not conduct training on methods for sanitation improvement promotion, the Software Component Programme needs to encourage the existing voluntary action by residents for improving health and sanitation, and furthermore, to implement training on promotion and accumulation of appropriate knowledge for "water and sanitation" in all the target sites.

5) Economic Situation of Households

In the Project target area, the rainy season, especially from December to February, overlaps both the planting period and fishery closed season. As the residents need cash income for seeding while they have no income from fishery, the burden on payment of water tariff during this season is heavier than other months. Less than half of the households in the target villages can earn cash income during this season, compared with the dry season. The villagers are not expected to earn other cash income during this season. Therefore, the Project adopts the policy to verify the method for collecting the maintenance cost (water tariff) in consideration of seasonal factors.

2-2-1-4 Policy on Construction / Procurement

As a design standard for borehole construction is not established in Zambia, at present each donor determines their own original standard. However, borehole drillings conducted by the

Government of Zambia widely adopts the borehole standard of Japan's Grant Aid, and problems in durability and quality of boreholes are not encountered. Therefore, the Project adopts the policy which applies such standard.

However, as for equipment and materials for borehole construction, the main materials such as cement, reinforcing bar, aggregates, PVC casings and screens, and handpumps can be procured in Zambia, with consideration for use of equipment under appropriate performance to meet the standard for borehole construction. As for other equipment and materials, the Project adopts the policy of procuring them in Zambia as much as possible.

2-2-1-5 Policy on Use of Local Contractors

Local contractors are introduced to undertake construction of water supply facilities consisting of boreholes fitted with handpumps supervised by Japanese contractors in the Project. The local contractors were confirmed to have enough capacity to complete the Project from results of the Basic Research Study. However, it is required a strict supervision based on a proper construction specification.

As the target sites are scattered widely in the area, in order to proceed with the construction smoothly, concentration of the construction area to a certain extent is necessary and by setting up a sub-base camp in the centre of the area, problems can be quickly resolved. Also efficient supervision can be achieved through this arrangement.

2-1-6 Policy on Capacity of Executing Agency for Operation and Maintenance

Policy on capacity of Executing agency for operation and maintenance is shown below.

- Full-time staffs in charge of rural water supply and sanitation are allocated in the district government, coordinate the project plan and implementation, facilitate the allocation of necessary resources and function as contact personnel of external affairs with province, central government other donors. Ministerial District offices and NGOs participating in D-WASHE provide necessary technical assistance to water supply and sanitation projects planned and implemented by the district government.
- The Area Development Committee (ADC), now being organised as media between local governments and residents in each district, functions as an organisation for coordination and promotion to formulate and implement all development plans in the target area. As for rural water supply and sanitation projects, ADC proposes appropriate project plans to district council by determining the needs of residents in cooperation with V-WASHE.

- The “Sustainable Operation & Maintenance Project for Rural Water Supply（SOMAP）” funded by Japan’s cooperation is now establishing a “(Draft) National Guidelines for Sustainable Operation and Maintenance of Rural Water Supply Facilities”. The guideline encourages adopting handpumps which are easy for handling, inspecting and rehabilitation, and feasible for daily use based on lifestyle practices of residents in the target area in consideration of its maintenance.

2-2-1-7 Policy on Grade of Facilities

The water supply facilities are to have durability as public goods and to be easy for operating, inspecting and repairing. The standards for facilities design and equipment and materials are to meet those of Zambia.

When standards of Zambia are not available, the Project adopts the policy to apply the same standards as those adopted in Grant Aid Projects previously implemented in Zambia.

2-2-1-8 Policy on Construction Schedule

In order to maintain appropriate management and quality control, the Project is to undertake construction by 2 teams at a maximum. Therefore, the Project plans to construct 200 successful boreholes in about 2 years. Construction of appurtenant facilities and installation of handpumps is conducted shortly after completion of borehole drilling. As for construction of iron removal plant, since their number is few and in order to raise operation efficiency, these should be undertaken during the Second Term.

As explained in “2-1-2 Policy Concerning Natural Environment Factors”, construction during the rainy season is to be avoided.

2-2-2 Basic Plan

2-2-2-1 Overall Plan

1) Contents of Request and Determination of Scope

In the Preliminary Study, concerning contents of the request, a) Borehole construction, b) Support for WASHE activities and c) Procurement of equipment for maintenance activities were confirmed to have more priority than procurement of borehole construction equipment and supporting vehicles. Therefore, in the Basic Design Study, the contents of the request were reviewed and the results are shown below.

Table 2-4 Contents of the Project

Item			Q'ty in preliminary study	Q'ty in Basic Design Study	Present Project
Equipment	1.	Equipment and materials for borehole construction			
	1)	Truck mounted drilling rig	2 sets	—	—
	2)	Standard tools and accessories	2 sets	—	—
	3)	Truck mounted compressor	2 nos.	—	—
	4)	Borehole logging equipment	2 nos.	—	—
	5)	Pumping test equipment	3 nos.	—	—
	6)	Geophysical equipment (including logging equipment)	1 set	1 set	—
	7)	Equipment for workshop	1 set	—	—
	2.	Supporting vehicles for borehole construction			
	1)	Cargo truck with crane (5.5t crane)	2 nos.	1 no.	—
	2)	Cargo truck with crane (3.5t crane)	2 nos.	1 no.	—
	3)	Water tank truck	2 nos.	—	—
	4)	Fuel tank truck	2 nos.	—	—
	5)	Pick-up truck, 4WD, double cabin	6 nos.	—	—
	3.	Spare parts			
	1)	Spare parts for above vehicles	1 set	—	—
	4.	Construction materials			
	1)	Consumable tools for drilling work	1 set	1 set	Included in the construction work
	2)	Consumable materials for drilling	1 set	1 set	
	3)	Casing/screen (4"x60m)	For 355 boreholes	For 355 boreholes	
	4)	Handpumps and spare parts kits	355 sets	355 sets	
	5.	Supporting equipment for WASHE activities			
	1)	Station wagon, 4WD	2 nos.	2 nos.	—
	2)	Pick-up truck, 4WD double cabin	8 nos.	8 nos.	—
	3)	Motor bike	24 nos.	24 nos.	—
	4)	Computer for data base	2 sets	7 sets	—
	5)	Water quality analysis equipment	8 sets	8 sets	—
	6)	Tools for maintenance of handpumps (Tools for APM)		2 sets/ Ward(*)	1set×81 Ward(**)
	7)	Bicycle		2nos/Ward	—
Construction	1)	Borehole with handpump and appurtenant facility	355 sites	355 sites	200 sites
Technology Transfer	1)	Support for operation and maintenance of the facilities	1 set	1 set	1 set

(*) The number was decided according to the size of the Ward and location of the sites

(**) This is included in the construction cost

2) Number of Sites

The candidate sites for construction were verified based on criteria established in the Preliminary Study as shown below.

① to have demands for water
② to have accessibility for construction equipment into the site
③ to confirm extent of existing water supply facilities (sites with sufficient existing facilities are to be excluded)
④ to have no overlap with other donors' cooperation
⑤ to have organisational capacity for water management committee
⑥ to have willingness to pay the maintenance costs by the residents

According to results of the social condition survey based on criteria shown above, excluding the 33 sites targeted in the Basic Research Study, 289 sites out of the requested 355 sites are considered to be feasible to develop new water sources in the Project. Feasible number of boreholes per district calculated on the basis of "2-1-2 Outline of the Project (2) Screening of requested sites" is shown below.

Although the number of boreholes constructed in the Project is 200, in consideration of proportional allocation to each district, the successful boreholes achieved in the Basic Research Study are added to the ratio. Therefore, the final designed number of boreholes is to be 200 + 31 (successful boreholes achieved in the Basic Research Study) = 231 boreholes.

Table 2-5 Number of Boreholes per District

District	Requested number (A)	Proportion per District (B)=A÷355	Number of Project sites including 31 from Basic Research Study (C)=231 x (B)	Number of successful boreholes under Basic Research Study (D)	Number of candidate sites under the Project (E)=C-D
1) Chiengi	43	12.1%	28	-	28
2) Nchelenge	50	14.1%	33	9	24
3) Kawambwa	70	19.7%	45	9	36
4) Mwense	58	16.3%	37	6	31
5) Mansa	50	14.1%	33	7	26
6) Samfya	40	11.3%	26	-	26
7) Milenge	44	12.4%	29	-	29
Total	355	100.0%	231	31	200

The selected Project site list and site location map are shown in the following pages.

Table 2-6 List of Project Sites

Site Code	Site Name	Pop.	Priority	Short list	Remarks
CHIENGI DISTRICT: 28 Project Sites					
CH-25	Puta Basic School	2,000	1	Project	
CH-6	Nyamfwa Basic School	1,650	2	Project	
CH-13	Muya Basic School	350	3	Project	
CH-32	Kasase Basic School	250	4	Project	
CH-17	Kalobwa Basic School	765	5	Project	
CH-11	Mutampuka School	650	6	Project	
CH-24	Puta Market	2,880	7	Project	
CH-41	Lambwe Chomba MCT	2,614	8	Project	
CH-26	Mutoba Village	2,527	9	Project	
CH-40	Munkanshya Village	1,920	10	Project	
CH-20	Mukabe Village	1,900	11	Project	
CH-15	Kafwanka Village	1,750	12	Project	
CH-14	Sichilaba Village	1,650	13	Project	
CH-5	Mukobeka Village	1,600	14	Project	
CH-33	Kasembe Village	1,200	15	Project	
CH-39	Chakaba Village	1,200	16	Project	
CH-38	Kapandila Village	1,100	17	Project	
CH-30	Chembe Village	1,078	18	Project	
CH-31	Shilumbwe Village	1,060	19	Project	
CH-3	Musonko Village	1,025	20	Project	
CH-27	Chilando Village	1,000	21	Project	
CH-29	Natende Village	900	22	Project	
CH-7	Mukonko Village	800	23	Project	
CH-43	Mikwela Village	718	24	Project	
CH-18	Sensele Village	700	25	Project	
CH-16	Kabungo Village	659	26	Project	
CH-8	Mukompa Village	600	27	Project	
CH-21	Kalima Village	600	28	Project	
CH-34	Kaputula Village	563	29	Alternative	
CH-42	Yakobo Village	500	30	Alternative	
CH-22	Kalembwe Village	465	31	Alternative	
CH-9	Musolo Village	400	32	Alternative	
CH-28	Kawila Village	365	33	Alternative	
CH-10	Mwilika Village	350	34	Alternative	
CH-12	Chishipula Village	320	35	Alternative	
CH-23	Katentu Village	300	36	Alternative	
CH-1	Mupela Village	224	37	Alternative	
CH-2	Mutembo Village	194	38	Alternative	
CH-19	Munkunta Village	3,500	39	Alternative	1 existing BH
CH-35	Chipungu Basic School	Existing water facility sufficient			
CH-4	Sula Village	Low motivation to form V-WASHE			
CH-36	Chibata Village	Low motivation to form V-WASHE			
CH-37	Eliya Shebele	Low motivation to form V-WASHE			
	Sub-total	36,662			

BH: Borehole

BRS: Basic Research Study

Site Code	Site Name	Population	Priority	Short list	Remarks
NCHELENGE DISTRICT: 24 Project Sites					
NC-36	Kalweo Comm. School	3,000	1	Project	
NC-28	Kawama Comm. School	1,650	2	Project	
NC-18	Kalimbwa Comm. School	300	3	Project	
NC-47	Mukeya Comm. School	250	4	Project	
NC-7	Kapambwe Clinic	3,171	5	Project	
NC-41	Chishima Village	4,786	6	Project	
NC-46	Chafuma	4,200	7	Project	
NC-13	Mulwe Village	3,500	8	Project	
NC-22	Chintakwa Village	2,280	9	Project	
NC-9	Chipayeni Village	2,172	10	Project	
NC-23	Kaseka Village	1,887	11	Project	
NC-16	Mumba Village	1,872	12	Project	
NC-27	Shikapande Village	1,869	13	Project	
NC-30	Kamwangila Village	1,500	14	Project	
NC-39	Seketi Village	1,500	15	Project	
NC-42	Kayope Village	1,500	16	Project	
NC-6	Kashita Village	1,400	17	Project	
NC-40	Chifwalo Village	1,317	18	Project	
NC-32	Yenga Village	1,290	19	Project	
NC-34	Mumpundu Village	1,200	20	Project	
NC-50	Kasasa Village	1,200	21	Project	
NC-19	Mutiwanama Village	1,080	22	Project	
NC-26	Mulumba Village	1,033	23	Project	
NC-14	Mukange Village	1,002	24	Project	
NC-43	Kapela Village	960	25	Alternative	
NC-44	Chula Village	886	26	Alternative	
NC-4	Nakafwaya Village	800	27	Alternative	
NC-31	Malulu Village	765	28	Alternative	
NC-17	Mukumbwa Village	736	29	Alternative	
NC-33	Mulambi Village	621	30	Alternative	
NC-48	Kaputo Village	596	31	Alternative	
NC-38	Mulonda Village	550	32	Alternative	
NC-1	Kasumpa Village	500	33	Alternative	
NC-8	Bupina Village	480	34	Alternative	
NC-49	Kamfunka Village	252	35	Alternative	
NC-21	Shikapambwa	250	36	Alternative	
NC-35	Kaseta Menda Village	4,020	37	Alternative	1 Existing BH
NC-10	Kampampi Village	3,722	38	Alternative	1 Existing BH
NC-37	Kafwala Village (*)	2,796	39	Alternative	Drilled in BRS
NC-24	Kafimbwa Village	1,887	40	Alternative	1 Existing BH
NC-20	Mutepuka Village	1,876	41	Alternative	1 Existing BH
NC-12	Chipakila Village (*)	1,500	42	Alternative	Drilled in BRS
NC-15	Kambwali Basic School (*)	1,386	43	Alternative	Drilled in BRS
NC-29	Chandwe Basic School (*)	1,179	44	Alternative	Drilled in BRS
NC-45	Lusha Comm. School (*)	886	45	Alternative	Drilled in BRS
NC-25	Chilongoshi Village (*)	815	46	Alternative	Drilled in BRS
NC-5	Mfundaula Village (*)	620	47	Alternative	Drilled in BRS
NC-11	Mantapala Basic School (*)	500	48	Alternative	Drilled in BRS
NC-2	Kasumpa Basic School (*)	300	49	Alternative	Drilled in BRS
NC-3	Mangamu Basic School	Existing water facility sufficient			1 Existing BH
	Sub-total	65,471			

(*) The boreholes drilled under the Basic Research Study (BRS), will be considered as a alternative site and if a second borehole is not drilled at the same site, only software component will be conducted.

Site Code	Site Name	Population	Priority	Short list	Remarks
KAWAMBWA DISTRICT: 36 Project Sites					
KA-53	Musungu School	385	1	Project	
KA-64	Chimfuntu School	362	2	Project	
KA-32	Kalyo School	208	3	Project	
KA-2	Chipunka	4,802	4	Project	
KA-55	Lumpa	3,000	5	Project	
KA-16	Stati	2,500	6	Project	
KA-54	Mutuna 1	2,000	7	Project	
KA-60	Mutuna 2	2,000	8	Project	
KA-1	Nshinka	800	9	Project	
KA-50	Musungu Yambala	773	10	Project	
KA-35	Mutuna	700	11	Project	
KA-15	Tomas	650	12	Project	
KA-42	Nachampana	608	13	Project	
KA-31	Chabanya	600	14	Project	
KA-57	Totolo	567	15	Project	
KA-44	Munasha/Malitti	540	16	Project	
KA-46	Chibatama	500	17	Project	
KA-62	Musuku	500	18	Project	
KA-68	Mapipo	486	19	Project	
KA-21	Chitembo	480	20	Project	
KA-37	Kusengulwila	453	21	Project	
KA-17	Domico	420	22	Project	
KA-69	Luena	420	23	Project	
KA-63	Chimfuntu	405	24	Project	
KA-22	Katungulu	400	25	Project	
KA-47	Wapamesa	400	26	Project	
KA-51	Mulilo	400	27	Project	
KA-65	Chapena	400	28	Project	
KA-58	Chipwalalw	376	29	Project	
KA-67	Lengwe	350	30	Project	
KA-70	Mbalashi	335	31	Project	
KA-38	Mbilima	330	32	Project	
KA-29	Mukuma 1	300	33	Project	
KA-10	Kasawo	284	34	Project	
KA-52	Chibende	280	35	Project	
KA-56	Chisheta	275	36	Project	
KA-24	Mwendakana	270	37	Alternative	
KA-23	Mulyoni	260	38	Alternative	
KA-9	Yamba	250	39	Alternative	
KA-25	Mwaba	250	40	Alternative	
KA-26	Sevent 1	250	41	Alternative	
KA-48	Folotiya	250	42	Alternative	
KA-27	Kabonde	249	43	Alternative	
KA-49	Kota	200	44	Alternative	
KA-36	Chinyama	160	45	Alternative	
KA-43	Shimwenya	155	46	Alternative	
KA-59	Chisembwe	3,600	47	Alternative	1 Existing BH
KA-14	Mukamba (*)	3,000	48	Alternative	Drilled in BRS
KA-41	Chitembwa	2,800	49	Alternative	1 Existing BH
KA-40	Kapambwe 2	2,000	50	Alternative	1 Existing BH
KA-12	Chipeta	1,500	51	Alternative	1 Existing BH
KA-13	Libansa	1,500	52	Alternative	1 Existing BH
KA-34	Yaya	1,500	53	Alternative	1 Existing BH
KA-3	Sesa Turn Off	1,330	54	Alternative	1 Existing BH
KA-11	Nakabamba	1,280	55	Alternative	1 Existing BH
KA-4	Salanga (*)	850	56	Alternative	Drilled in BRS
KA-5	Mumbolo	691	57	Alternative	1 Existing BH
KA-19	Sikalaba	681	58	Alternative	1 Existing BH
KA-45	Kabanda (*)	565	59	Alternative	Drilled in BRS
KA-8	Mwilu	500	60	Alternative	1 Existing BH
KA-39	Kapambwe 1 (*)	500	61	Alternative	Drilled in BRS
KA-7	Nsensema (*)	480	62	Alternative	Drilled in BRS
KA-6	Chilange Basic School (*)	422	63	Alternative	Drilled in BRS
KA-20	Nefas (*)	366	64	Alternative	Drilled in BRS
KA-61	Buyendele	300	65	Alternative	1 Existing BH
KA-30	Mukuma 2 (*)	300	66	Alternative	Drilled in BRS
KA-18	Paraffin School (*)	193	67	Only Soft-Comp	Drilled in BRS
KA-28	Chimpembe	Low motivation to form V-WASHE			
KA-33	Katontolo	Low motivation to form V-WASHE			
KA-66	John Mapipo	Low motivation to form V-WASHE			
	Sub-total	53,986			

Site Code	Site Name	Population	Priority	Short list	Remarks
MWENSE DISTRICT: 31 Project Sites					
MW-17	Muchinga School	2,600	1	Project	
MW-25	Mwense RHC	9,000	2	Project	
MW-22	Katuta RHC	2,000	3	Project	
MW-2	Kanyombo	4,000	4	Project	
MW-18	Musonda	3,595	5	Project	
MW-37	Musangu Filling Station	3,000	6	Project	
MW-46	Bunde Bunde	3,000	7	Project	
MW-27	Kapakala East	2,850	8	Project	
MW-58	Kaomamakasa-B	2,100	9	Project	
MW-26	Shingwe West	2,000	10	Project	
MW-56	Munganga	2,000	11	Project	
MW-30	Nakabeka	1,792	12	Project	
MW-34	Mulonga	1,668	13	Project	
MW-1	Shichama West	1,600	14	Project	
MW-12	Shibesa	1,500	15	Project	
MW-42	Kasonge	1,500	16	Project	
MW-57	Kaomamakasa-A	1,200	17	Project	
MW-8	Nkomba	1,117	18	Project	
MW-31	Kabosha	1,000	19	Project	
MW-38	Musangu Station	1,000	20	Project	
MW-49	Mutipula	1,000	21	Project	
MW-41	Chisopa	900	22	Project	
MW-51	Mwenda	803	23	Project	
MW-33	Loto	750	24	Project	
MW-36	Lifuka	750	25	Project	
MW-16	Chawe	720	26	Project	
MW-55	Lupososhi	670	27	Project	
MW-53	Mukanga	620	28	Project	
MW-50	Kamshimba	600	29	Project	
MW-5	Laula	580	30	Project	
MW-13	Mitamba B	510	31	Project	
MW-32	Chiposa	500	32	Alternative	
MW-45	Chifita	500	33	Alternative	
MW-14	Chuibumbi	486	34	Alternative	
MW-9	Soshiki	412	35	Alternative	
MW-54	Chipeleme	402	36	Alternative	
MW-11	Mukomansala	400	37	Alternative	
MW-6	Chintole	380	38	Alternative	
MW-19	Musalula	355	39	Alternative	
MW-3	Kabundafyela	330	40	Alternative	
MW-35	Saini	306	41	Alternative	
MW-47	Kankomba	300	42	Alternative	
MW-7	Mulangu	250	43	Alternative	
MW-28	Mwanda	240	44	Alternative	
MW-21	Kapesha	200	45	Alternative	
MW-23	Chipala	200	46	Alternative	
MW-10	Chafwa	157	47	Alternative	
MW-44	Kapala (*)	3,565	48	Alternative	Drilled in BRS
MW-39	Kapena	3,000	49	Alternative	1 Existing BH
MW-40	Mumporokoso	2,000	50	Alternative	1 Existing BH
MW-52	Mulunda (*)	1,200	51	Alternative	Drilled in BRS
MW-43	Chilolo	1,000	52	Alternative	1 Existing BH
MW-48	Chululuongo (*)	1,000	53	Alternative	Drilled in BRS
MW-4	Chimbini (*)	720	54	Alternative	Drilled in BRS
MW-24	Sunshine School (*)	270	55	Alternative	Drilled in BRS
MW-29	Kambule (*)	250	56	Only Soft-Comp	Drilled in BRS
MW-20	Chibondo RHC	Existing water facility sufficient			
MW-15	Chalata	Low groundwater potential. 2 attempt in BRS			
	Sub-total	74,848			

(*) The boreholes drilled under the Basic Research Study (BRS), will be considered as a alternative site and if a second borehole is not drilled at the same site, only software component will be conducted.

Site Code	Site Name	Population	Priority	Short list	Remarks
MANSA DISTRICT: 26 Project Sites					
MA-48	Kafuula Comm. School	340	1	Project	
MA-39	Mibenge RHC	500	2	Project	
MA-19	Elasto/Miyembe RHC	280	3	Project	
MA-32	Mano/Kabengele	5,931	4	Project	
MA-42	Kalyongo Village (A)	3,000	5	Project	
MA-43	Kalyongo Village (B)	3,000	6	Project	
MA-25	Kaseke Village	1,580	7	Project	
MA-16	Kale Village (A)	1,350	8	Project	
MA-17	Kale Village (B)	1,350	9	Project	
MA-8	Kaisala Village	1,230	10	Project	
MA-28	Chisamba Village	1,200	11	Project	
MA-46	Mabumba West	1,200	12	Project	
MA-23	Chisongo (A)	1,000	13	Project	
MA-26	Chisongo (B)	1,000	14	Project	
MA-2	Dominic Village	700	15	Project	
MA-50	Sepe Community	696	16	Project	
MA-49	Chalwe/Chiba	675	17	Project	
MA-6	Kasanga Village (B)	600	18	Project	
MA-45	Musaila Comm. Market	510	19	Project	
MA-22	Mutipula Village	432	20	Project	
MA-20	Twapya/Meleti	360	21	Project	
MA-5	Kasanga Village (A)	300	22	Project	
MA-7	Luo Village (Chipense)	300	23	Project	
MA-30	Kaseya/Kampalala 2	203	24	Project	
MA-12	Chiswishi/Jereman	105	25	Project	
MA-47	Kundamfumu RHC	10,000	26	Project	1 Existing BH
MA-31	Mano RHC (*)	5,931	27	Alternative	Drilled in BRS
MA-14	Chabala Village	5,000	28	Alternative	1 Existing BH
MA-41	Mabumba East (*)	2,000	29	Alternative	Drilled in BRS
MA-44	Kapyata Village (*)	1,200	30	Alternative	Drilled in BRS
MA-3	Temfwe Village	836	31	Alternative	1 Existing BH
MA-24	Mufuma Village (A) (*)	675	32	Alternative	Drilled in BRS
MA-36	Mano/Chibamba	492	33	Alternative	1 Existing BH
MA-4	Mulilo Village (*)	415	34	Alternative	Drilled in BRS
MA-33	Kaseye/Kampalala 1 (*)	203	Only software component		Drilled in BRS
MA-15	Yonda Village (*)	200	Only software component		Drilled in BRS
MA-10	Mibinde/Chipilipili	Existing water facility sufficient			1 Existing BH
MA-40	Chimbwa Village	Existing water facility sufficient			1 Existing BH
MA-9	Lusaya Village	Low groundwater potential. 2 attempts in BRS			
MA-1	Lumbu Village	Low motivation to form V-WASHE			
MA-11	Lwilu/Mwansa	Low motivation to form V-WASHE			
MA-13	Milombwe/Mpita	Low motivation to form V-WASHE			
MA-18	Katulwende Village	Low motivation to form V-WASHE			
MA-21	Mpemba Village	Low motivation to form V-WASHE			
MA-27	Mufuma Village (B)	Low motivation to form V-WASHE			
MA-29	Kalimba Village	Low motivation to form V-WASHE			
MA-34	Mbaso/Musabila	Low motivation to form V-WASHE			
MA-35	Mano Mulala/Chanda	Low motivation to form V-WASHE			
MA-37	Mashimi	Low motivation to form V-WASHE			
MA-38	Moloshi	Low motivation to form V-WASHE			
	Sub-total	53,674			

(*) The boreholes drilled under the Basic Research Study (BRS), will be considered as a alternative site and if a second borehole is not drilled at the same site, only software component will be conducted.

(1) Calculation of site number

- Requested site number (A): 355 sites
- Cancelled site (B): 33 sites
- Successful borehole on the BRS (C) : 31 sites
- Unsuccessful borehole on the BRS (D) : 2 sites
- Sites with possibility to develop groundwater (E)=A-B-C-D: 289 sites
- Number of sites under the Project (F): 200 sites
- Alternative sites (E - F) 89 sites

(2) Criteria for prioritization

- The Project sites was selected based on the agreed criteria in the Preliminary Study
- The highest priority is given to school, health center and village. Respectively where safe water is not yet secured, and secondly to the most populated sites.
- Priority is also given to the sites which have an existing borehole with handpump, but because of large number of population, more than one borehole is required. Depending on the priority rank in accordance with the number of population, it will be considered as a project site or an altenative site.

Population in case the drilling is done in the Project and Alternative Sites 330,314

Site Code	Site Name	Population	Priority	Short list	Remarks
SAMFYA DISTRICT: 26 Project Sites					
SA-36	Mpolo Comm. School	1,128	1	Project	
SA-15	Kalasa Middle Bas. School	960	2	Project	
SA-16	Kasaba Basic School	840	3	Project	
SA-17	Kanengo Comm. School	500	4	Project	
SA-6	Kaponda/Filipo Bas. Sch.1	420	5	Project	
SA-1	Chibuye Basic School	400	6	Project	
SA-26	Lwame Basic School	400	7	Project	
SA-7	Chikuwe Basic School	387	8	Project	
SA-2	Cholansega Basic School	380	9	Project	
SA-10	Sashi Basic School	300	10	Project	
SA-14	Kafwimbi Basic School	300	11	Project	
SA-29	Chisuku Basic School	300	12	Project	
SA-18	Chinweshiba Bas. School	274	13	Project	
SA-3	Chifuko Comm. School	257	14	Project	
SA-32	Njipa Rural Health Centre	5,742	15	Project	
SA-23	Kalasa M. RHC	412	16	Project	
SA-35	Kafubashi Agric. Camp	8,535	17	Project	
SA-31	Kasuba Village B	4,000	18	Project	
SA-30	Nambale Village	3,000	19	Project	
SA-39	Tula Village	1,600	20	Project	
SA-28	Kalimanshi Village	720	21	Project	
SA-22	Sakala Village	673	22	Project	
SA-21	Musokololo Village	570	23	Project	
SA-34	Mano/Malemba	450	24	Project	
SA-37	Malombola Village	355	25	Project	
SA-38	Musa Village	312	26	Project	
SA-33	Mungulube	250	27	Alternative	
SA-8	Masembe Village	232	28	Alternative	
SA-27	Mwita Village	212	29	Alternative	
SA-12	Kasaba/Chapa Village	165	30	Alternative	
SA-9	Kasamba/Kasanka	928	31	Alternative	1 Existing BH
SA-24	Kabongo RHC	760	32	Alternative	1 Existing BH
SA-25	Yamba Basic School	700	33	Alternative	1 Existing BH
SA-5	Kasuba Basic School (A)	Existing water facility sufficient			1 Existing BH
SA-11	Bombawamenshi Bas.Sch.	Existing water facility sufficient			1 Existing BH
SA-20	Lupili Market	Existing water facility sufficient			1 Existing BH
SA-4	Mwewa East	Low motivation to form V-WASH			1 Existing BH
SA-13	Mwansakombe Village	Low motivation to form V-WASHE			
SA-19	Mwamfuli Market	Low motivation to form V-WASH			1 Existing BH
SA-40	Maximo Village	Low motivation to form V-WASHE			
	Sub-total	23,462			

MILENGI DISTRICT: 29 Project Sites					
ML-36	Lwela Basic School	612	1	Project	
ML-26	Kapalala Basic School	406	2	Project	
ML-10	Katena Comm. School	330	3	Project	
ML-41	Milambo Basic School	252	4	Project	
ML-21	Mashika Basic School	200	5	Project	
ML-34	Mulumbi RHC	6,037	6	Project	
ML-35	Misenga Health Post	308	7	Project	
ML-29	Chishimuteshi RHC	226	8	Project	
ML-9	Mununshi Turn Off	2,400	9	Project	
ML-1	Lunga Village (A)	736	10	Project	
ML-32	Kachenje Village	715	11	Project	
ML-37	Kuyafya 1&2 Village	700	12	Project	
ML-11	Kubi Village	605	13	Project	
ML-3	Chisensa Village	600	14	Project	
ML-6	chalyafya-Kapande	586	15	Project	
ML-15	Musoolo Village	526	16	Project	
ML-17	Kalebaila Village	492	17	Project	
ML-25	Talayi Village (B)	467	18	Project	
ML-18	Malenga Turn Off	459	19	Project	
ML-27	Mapula Village	390	20	Project	
ML-19	Kulelwa Village	384	21	Project	
ML-8	Garden Village	380	22	Project	
ML-20	Issac Chifukula Village	372	23	Project	
ML-39	Springa Village	364	24	Project	
ML-40	Butute Village	360	25	Project	
ML-43	Kalaba Shitembeya	360	26	Project	
ML-14	Shitambuli Village	325	27	Project	
ML-38	Chintu Village	287	28	Project	
ML-13	Senama (Mwenda Chabe)	230	29	Project	
ML-4	Nyembe Village	220	30	Alternative	
ML-42	Buyantashi Village	218	31	Alternative	
ML-22	Changwe Neti Village	215	32	Alternative	
ML-12	Muntu (Kapala/Milenge TO)	207	33	Alternative	
ML-23	Lunga Village (B)	200	34	Alternative	
ML-24	Tola Village	186	35	Alternative	
ML-30	Chilimabwe	155	36	Alternative	
ML-28	Chungwe Village	122	37	Alternative	
ML-33	Totolo Village	116	38	Alternative	
ML-16	Muwaya Village	103	39	Alternative	
ML-5	Milenge High School	1,060	40	Alternative	1 Existing BH
ML-2	Talayi Village (A)	600	41	Alternative	1 Existing BH
ML-7	John Nkumba Village	500	42	Alternative	1 Existing BH
ML-31	Mulungushi School	Inaccessible			
ML-44	Kalebwe Village	Inaccessible			
	Sub-total	22,211			

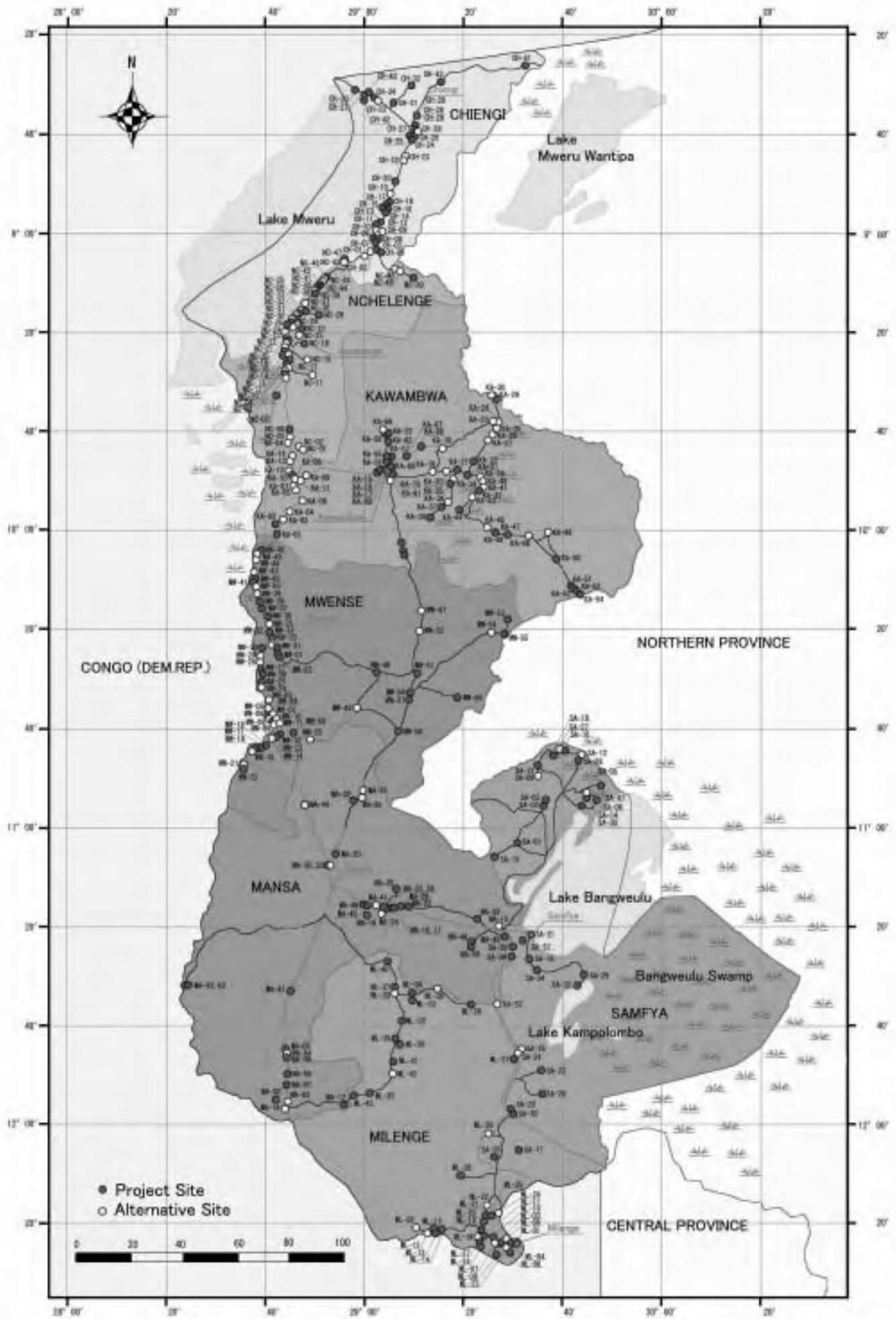


Figure 2-1 Location Map of Project Sites

2-2-2-2 Facilities Plan

1) Design standard for water supply facilities

The basic design plan for water supply facilities is as follows:

Type of facility	:	Borehole fitted with handpump
Unit supply rate	:	From the guideline for rural water supply in Zambia, the unit supply rate will be 30 liter/capita/day.
Design service population	:	250 inhabitants per handpump

For borehole construction, the following specifications shall be adopted.

Depth(*)	:	Not less than 30m
Drilling diameter(*)	:	- Mud circulation drilling: not less than 203mm - DTH drilling: not less than 152mm
Yield(*)	:	Not less than 0.2 liters per second
Pumping water level	:	Not more than 40m
Casing(*)	:	Inside Diameter: >ID100mm, thickness: >5mm, material: PVC
Screen(*)	:	Inside Diameter: >ID100mm, thickness: >5mm, material: PVC Slot size: 0.25mm to 1.5mm
Water quality	:	Zambian water quality guideline shall be followed. But for pH and Iron, as already described previously, in this particular case will consider pH5.0 and Iron 2.0mg/l. For parameters which are not described in the Zambian guideline, guideline of WHO shall be adopted.
Iron Removal Plant	:	In case Iron concentration is over the 2mg/l adopted in this Project, iron removal plant will be installed in sites determined to be effective after discussions with concerned parties.
Others(*)	:	- Other than the casing and screen, the borehole shall have a centralizer, bottom plug, sanitary sealing, gravel pack with appropriate material and minimum 2 m of cementation from the top. - The borehole should be constructed not less than 30 meters away from possible contamination sources.

(*)From the "National Guidelines for Sustainable Operation and Maintenance of Hand pumps in Rural Areas", MLGH/JICA, 2007.

2) Successful Ratio and Handling of Unsuccessful Boreholes

A success ratio of 75.6% is applied for the Project, as the results of hydrogeological survey, data analysis from the drilling result of "The Project for Groundwater Development in Northern Province", data from the geophysical survey and test drilling result done in the Basic Research Study.

During the drilling operation, if 2 points are determined as unsuccessful at the same site, then a third drilling will not be conducted as a policy of the Project. Therefore, that site is cancelled and the drilling crew will be moved to one of the alternative sites.

3) Priority and Handling of Alternative Sites

As mentioned above, there are 289 candidate sites and 200 feasible sites to be implemented in the Project. Therefore, 89 sites were screened out, but these will be kept as alternative sites for drilling. That is, after 2 unsuccessful drillings at one site, then selection from the alternative sites will be conducted in accordance with the priority of the list. The priority of the list of the target sites in each district is considered from hydrogeological conditions and population to be served (demand for water), and especially, high priority rests on schools and RHCs under the request of the Government of Zambia. For the villages, priority is given to most populated village without existing safe water source within the village.

4) Successful Sites in Basic Research Study

The Basic Research Study installed handpumps and constructed appurtenant facilities at sites with successful boreholes, and the Project will conduct the Software Component Programme with respect to maintenance of the facilities.

5) Iron removal plant

As mentioned above, when the residents are to use boreholes with high iron contents as their drinking water source, the Project will install iron removal plant. Based on the survey of existing boreholes, the estimated number of sites which will require the iron removal plant is approximately 60 (about 30% of the total). The iron removal plant will consist of simple structures easy for maintenance by residents. The Software Component Programme will conduct training on necessary maintenance.

6) Selection of Handpump

The Project is to utilise the handpump as the water pumping method for the water supply facilities with boreholes. As for the kind of handpump, the survey by the Community Management and Monitoring Unit (CMMU) under DWA in 1995 shows that there are more than 40 kinds of handpumps utilised in villages of Zambia. If many kinds of handpumps are installed, procurement of their spare parts will become difficult. Therefore, the ongoing SOMAP encourages standardising the handpumps, but does not come to a clear conclusion. However, SOMAP encourages narrowing down the kind of handpump to 2 types at a maximum from the viewpoint of maintenance. The India Mark II type handpump is most popular in Zambia, but there are growing cases to adopt Afridev from the viewpoint of durability of riser

pipes to low pH (acidity) and of easiness in maintenance.
The India Mark II type handpump is most popular in Luapula Province. However, there is a need to consider the groundwater quality (high iron contents and low pH value) in the target area, and therefore, the Project is to adopt Afridev as well as India Mark Ⅱ

Basically, if the result of dumping test and water quality analysis shows that the pH is lower than 6.5, Afridev type handpump maybe installed.
However, as the Afridev type handpump can have difficulties in lifting water below 40m, in such case, decision will be made after analyzing the situation from the point of view of pH and water level. In case that both, the pH and water level is lower than the above mentioned range, installation of India Mark-II handpump maybe considered after discussion between the Executing Agency, D-WASHE, villagers and consultant. Based on the results of water quality survey of the existing boreholes during the field survey, it is estimated that one hundred units of Indian Mark-II and one hundred units of Afridev type would be installed.

7) Construction of Appurtenant Facilities for Handpump

The appurtenant facilities for the handpump include the concrete apron, drainage and soakaway. The design of these facilities will be adopted from those being commonly used in Zambia.

Based on the policy to encourage burden sharing of part of the construction cost by residents in rural water supply and sanitation projects, the Government of Zambia tends to have residents responsible for materials for construction of appurtenant facilities of handpump such as sand and aggregate. However, as the quality of materials will affect the completed facilities, the Project decided that to implement such policy can be difficult and consequently, the Japanese side will be responsible for materials procurement and construction of appurtenant facilities.

As mentioned above, the Project is to install iron removal plant at target sites with high iron content. For effective iron removal, the handpump will be installed at a higher position than usual, and as convenience to users, concrete steps will be constructed.

8) Specifications of equipment and materials for construction

The major factors for decision on the specifications of equipment and materials to be used under the Project are shown in the following table.

Table 2-7 Factors to decide specifications of construction materials

	Item	Specifications and decision factor
1.	Handpump	Considering the "National Guideline for Sustainable Operation and Maintenance of Handpumps in Rural Areas" prepared under SOMAP, the groundwater level, water quality, quality of handpump, prices and availability of spare parts, the India Mark-II and Afridev type of handpump will be selected.
2.	Casing/Screen	Considering the water quality, availability in the local market, quality of the material and price, PVC type casing/screen will be selected. This material will be procured by the contractor as part of the construction work.
3.	Gravel pack	According to the policy of D-WASHE, in most cases, usually materials for gravel packing are collected from areas close to the project site, but considering the risk of quality, the Contractor will procure them according to the requirements of the specifications.
4.	Material for appurtenant facility	The relevant materials such as cement, sand, gravel and reinforcing bar will be procured by the Contractor locally and not by the villagers.
5.	Other materials for borehole construction	Foaming agent, bentonite and water for construction will be procured locally by the Contractor.
6.	Countermeasure for asbestos	All facilities under the Project will not use asbestos. Also, equipment and materials to be procured will be asbestos free. In this Project, demolition of facilities of any kind is not anticipated, but in case this is required, during such kind of activity, as a basic policy, asbestos dispersing prevention will be taken as countermeasure.

2-2-2-3 Equipment Plan

As mentioned above, since MEWD/DWA, in charge of drilling, was the organization to request assistance to Japan at first, the original request contained many equipment and materials relevant to borehole drilling. However, the Government policy has changed and the Executing agency was finally changed to MLGH/DISS. Therefore, the requested equipment became out of scope for procurement. The results of verification on each procurement item are shown below.

1) Equipment for DWA (borehole drilling equipment and cargo trucks)

Equipment and materials relevant to borehole drilling in the list above were expected to be procured if DWA is to conduct the borehole drilling. As mentioned above, due to situations of the Zambian side, MLGH/DISS is to become the executing. Therefore, the Project will not

procure these requested equipment and materials as their purpose of use do not meet the Project requirements directly.

2) Materials and Tools for Rehabilitation of Handpump

As for consumables and materials for borehole drilling, screen and casing, handpump and spare parts and tools for rehabilitation (including APMs'), the contractors are to procure them and they are to be included in construction cost.

3) Supporting Equipment for WASHE Activities

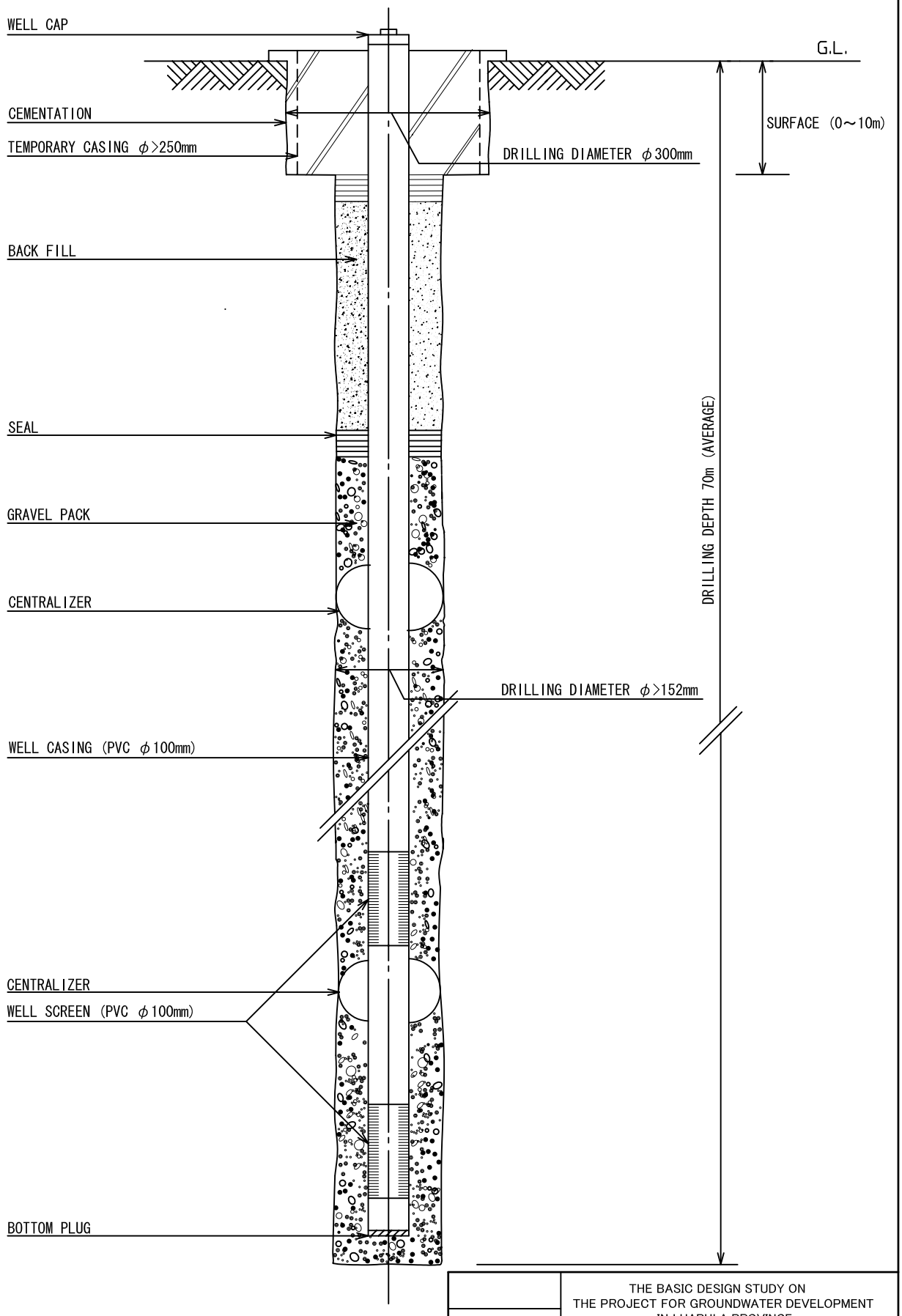
The results of survey and analysis on the WASHE related equipments are shown in the following table.

Table 2-8 The results of survey and analysis on the WASHE related equipment

Station wagon	Out of Project	Will be out of the Project based on the policy of the Government of Japan
Pick-up truck	Out of Project	Will be out of the Project based on the policy of the Government of Japan
Motorbike	Out of Project	Will be out of the Project based on the policy of the Government of Japan
Computer for data base	Out of Project	The survey on D-WASHEs found that, even with some differences in specifications and quantities, each D-WASHE has some kind of existing computer. It is clear that additional computers to the D-WASHE can improve the efficiency of the data base for WASHE activities, but as it is not urgently required, this will be considered out of the Project.
Equipment for water quality analysis	Out of Project	Other donors have procured them in each office of the Ministry of Health, and as these can be shared, it will be considered out of the Project.
Bicycle	Out of Project	Will be out of the Project based on the policy of the Government of Japan

2-2-3 Basic Design Drawing

The basic drawings of the borehole, appurtenant facility and iron removal plant are shown in the next page.

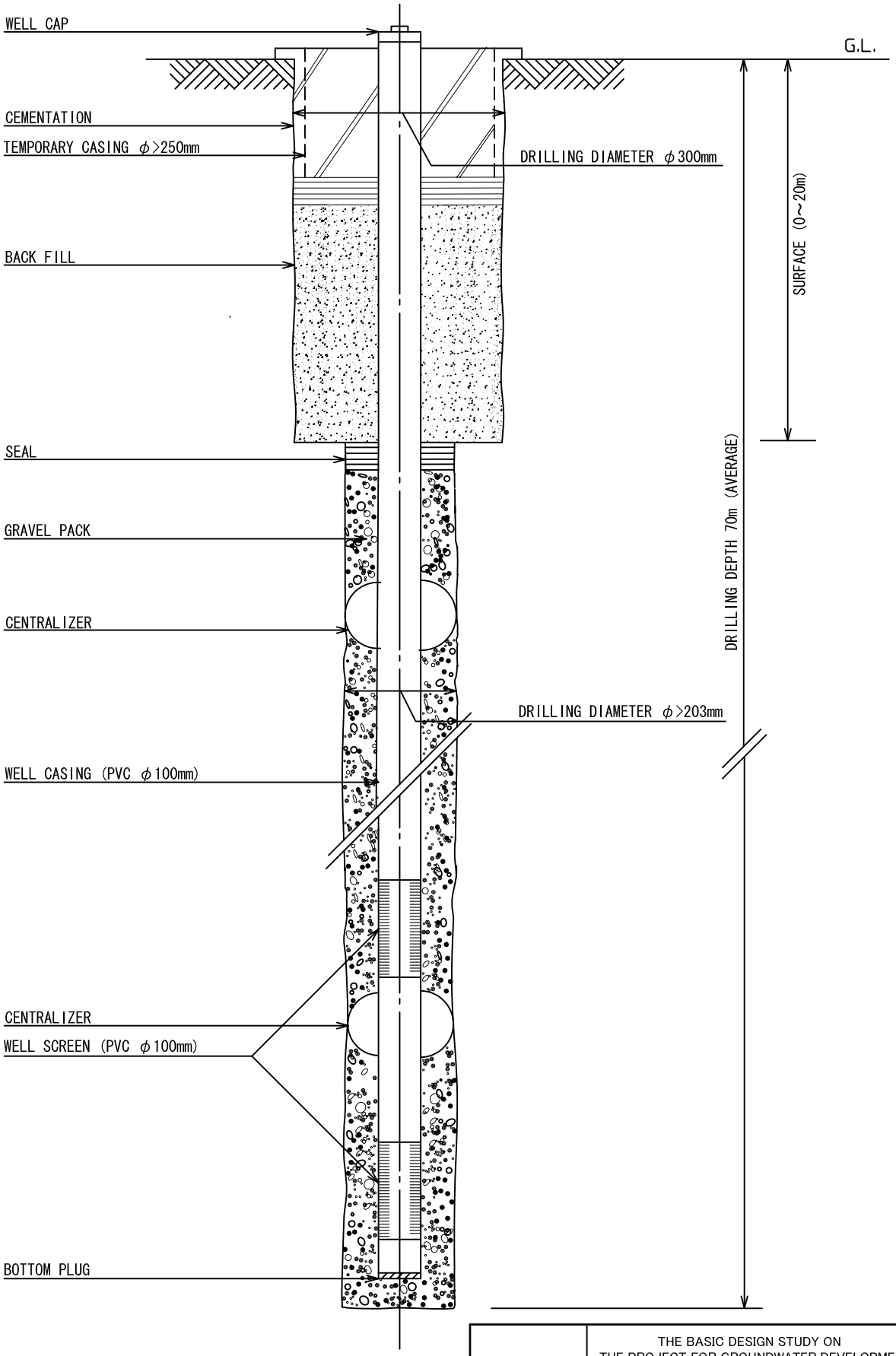


THE BASIC DESIGN STUDY ON
THE PROJECT FOR GROUNDWATER DEVELOPMENT
IN LUAPULA PROVINCE
IN THE REPUBLIC OF ZAMBIA

BOREHOLE STRUCTURE
(DTH DRILLING FOR
CONSOLIDATED FORMATION)

NOT TO SCALE | Fig 2-2

JAPAN TECHNO

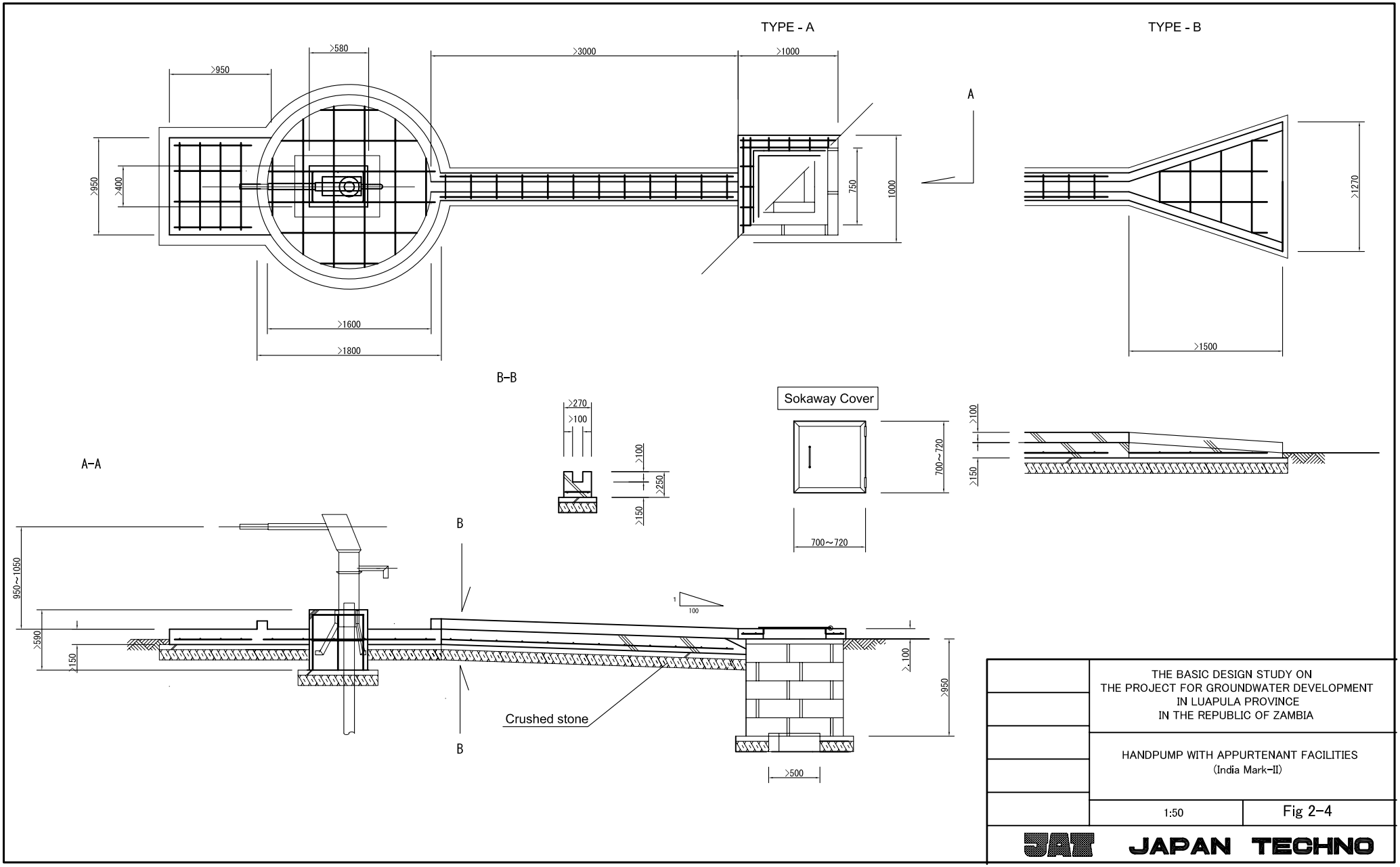


THE BASIC DESIGN STUDY ON
THE PROJECT FOR GROUNDWATER DEVELOPMENT
IN LUAPULA PROVINCE
IN THE REPUBLIC OF ZAMBIA

BOREHOLE STRUCTURE
(MUD DRILLING FOR
UNCONSOLIDATED FORMATION)

NOT TO SCALE | Fig 2-3

JAT JAPAN TECHNO

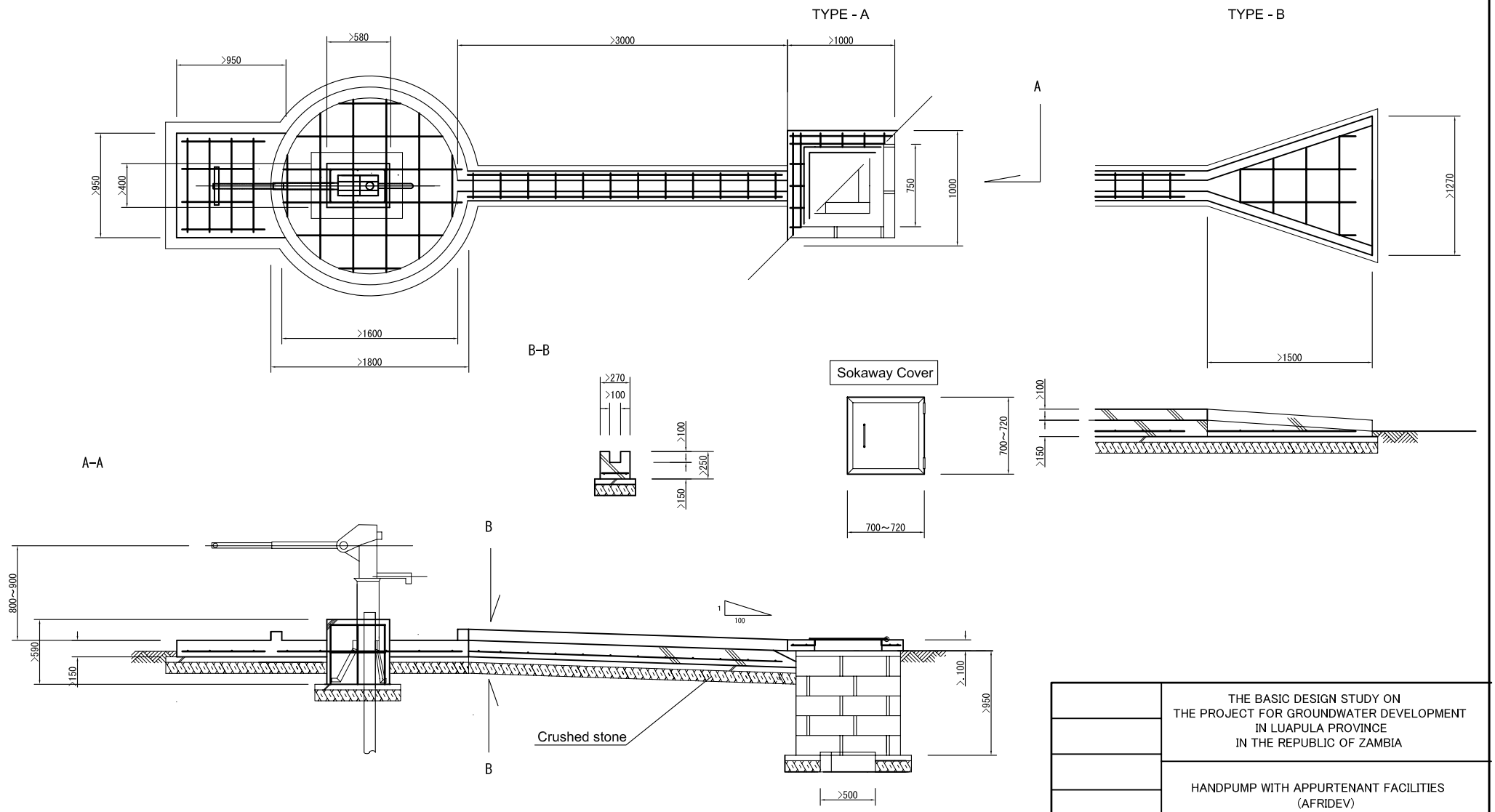


THE BASIC DESIGN STUDY ON
THE PROJECT FOR GROUNDWATER DEVELOPMENT
IN LUAPULA PROVINCE
IN THE REPUBLIC OF ZAMBIA

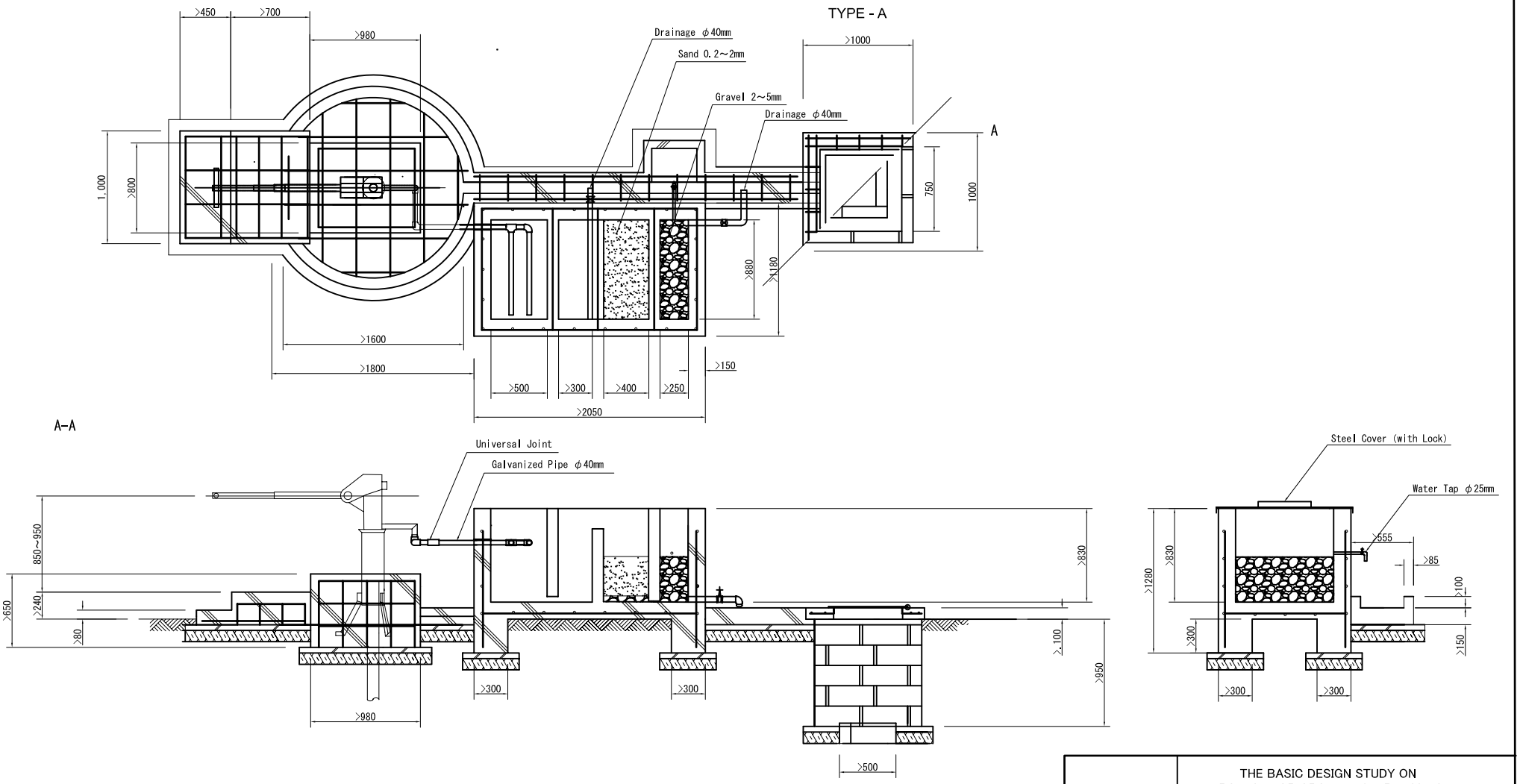
HANDPUMP WITH APPURTENANT FACILITIES
(India Mark-II)

1:50 | Fig 2-4

JAT JAPAN TECHNO



	THE BASIC DESIGN STUDY ON THE PROJECT FOR GROUNDWATER DEVELOPMENT IN LUAPULA PROVINCE IN THE REPUBLIC OF ZAMBIA
	HANDPUMP WITH APPURTENANT FACILITIES (AFRIDEV)
	1:50 / Fig 2-5
	JAT JAPAN TECHNO



	THE BASIC DESIGN STUDY ON THE PROJECT FOR GROUNDWATER DEVELOPMENT IN LUAPULA PROVINCE IN THE REPUBLIC OF ZAMBIA
	IRON REMOVAL PLANT
	1:50 / Fig 2-6
	JAT JAPAN TECHNO

2-2-4 Implementation Plan/Procurement Plan

2-2-4-1 Implementation Policy/ Procurement Policy

The prime contractor for execution of the works will be a Japanese firm under the Japanese Grant Aid scheme. The prime contractor will complete the procurement and construction of water supply facilities within the period stipulated in the contract.

For the Project implementation plan, it is necessary to set up appropriately the construction schedule and implementation structure, including sufficient consideration on the Grant Aid system. Fig. 2-10 shows the Project Implementation Structure.

The Project should be undertaken by MLGH/DISS and is responsible for the detail design study, construction and maintenance of the facilities. During the construction work, the persons in charge from DISS headquarters and Provincial offices will supervise the work, and V-WASHE will maintain the facility after completion. D-WASHE will be responsible for the sensitization activities and monitoring to V-WASHE, including supervision of the facilitators and APMs.

On the other hand, the Japanese consultant of the Project, after the Exchange of Notes between both countries, will sign an agreement with the Executing Agency to assist in preparation of the tender documents and in the execution of the tender. Also, the consultant will assist in supervision of procurement, construction and training in operating the equipment. Based on the results of the tender for construction, a contract will be signed.

In case that this Project is approved by the Government of Japan, and the Exchange of Notes is concluded, the consultant in charge of the Basic Design will be recommended by JICA to the Zambian side as the supervisory consultant. The consultant will carry out the detail design study, prepare the tender documents and supervise the construction works.

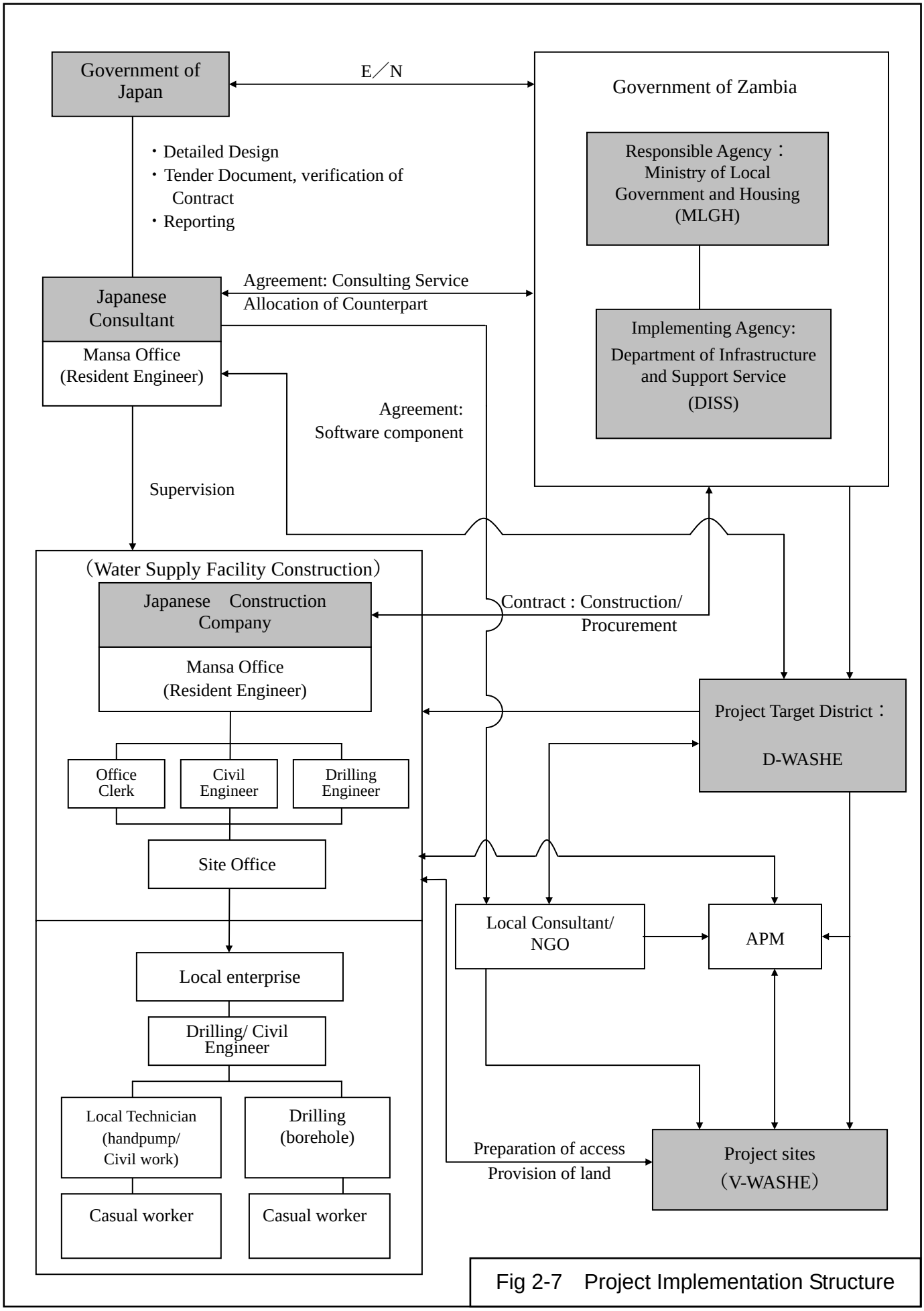


Fig 2-7　Project Implementation Structure

2-2-4-2 Implementation Conditions

The following are the conditions concerning implementation and procurement.

1) Since the project sites are scattered, to maintain the standard of the construction works, one Japanese consultant's resident engineer must work efficiently and one hydrogeologist will follow-up to handling the dry holes through spot supervision. On the other hand, by concentrating the working area as much as possible, the supervisor can respond quickly to any unexpected situations and supervise the works efficiently.
2) An appropriate transportation system will be planned upon confirming the conditions of access roads to the target sites.
3) Considering the access conditions to the drilling points during the rain season, as a principle, the construction works will be suspended from January to March.
4) The construction works will be proceeded upon sufficient discussions with the representatives of the target villagers (V-WASHE).
5) Based on the results of the Basic Research Study, awareness of the local contractors on safety management need to be raised as it is generally poor. Therefore, strong sensitization activities on safety management are needed before mobilization to the project area.
6) The quality and availability of local materials and equipment will be surveyed to ensure a stable supply.
7) As there is concern about the security conditions along the border between the Republic of Zambia and the Democratic Republic of Congo, updated information shall be gathered from the Government of Zambia. During the construction period, necessary arrangements shall be made, such as accompaniment of local police officers to Japanese nationals when works are carried out near the above mentioned borderline.

2-2-4-3 Scope of Works

The scope of works of the Zambian side and Japanese side consists of the following:

(1) Scope of works of the Zambian side

1) Related to the construction of boreholes fitted with handpump
   ① Securing, clearing and levelling of the land for construction works
   ② Preparation of access roads (clearing, repairing, expansion, etc.) to the drilling sites
   ③ Securing, clearing and levelling of space for storage of materials, base camp and

sub-base camp

④ Allocation of counterparts related to the implementation

⑤ Supervision and guidance on sustainable operation and maintenance of the constructed facilities

2) Related to procurement

Securing of proper storage area or warehouse for the materials and tools

3) Related to the software component

As part of the responsibilities of the Zambian side for the software component, provision of activities fees, assurance of personnel and allocation of their allowances. Refer to "2-2-5 Software Component Activity" for details.

Other responsibilities of the Zambian side are listed in "Chapter 2-3. Obligations of Recipient Country".

(2) Scope of works of Japanese side

1) Related to the construction of boreholes fitted with handpump

Construction of 200 boreholes fitted with handpumps in 7 Districts of Luapula Province

2) Related to procurement of equipment

Procurement of tools for maintenance of handpumps

3) Related to software component

Execution of the software component at 200 sites of the Project and additionally at 31 sites constructed in the Basic Research Study for a total of 231 sites.

2-2-4-4 Consultant Supervision

As the Project will be implemented under the Japanese Grant Aid scheme, a Japanese consultant firm will be in charge from the detailed design to the supervision of procurement and construction. The major service contents are described in the table below:

Table 2-9 Contents of Japanese Consultant's Services

1.	Before construction and procurement stage	Detailed design study Preparation of tender documents Assistance to execution of tender Evaluation of tender results

		Assistance in contracting process
2.	During construction and procurement	Supervision of construction works Preparation of reports, etc.

During the detail design study, with the cooperation of the Executing Agency and D-WASHEs, confirmation on the site situation such as land acquisition for the construction of water supply facilities will be done with the villagers to avoid problems during the construction.

Based on the results of the detail design study, tender documents will be prepared and after discussions with concerned parties, the schedule of tender will be decided. The consultant will support the Executing Agency in the tender procedure, including the evaluation and contracting with the construction company.

In the construction stage, a full time resident engineer will be allocated for the Project to supervise the construction works and carry out necessary coordination with the Executing Agency.

The assigned tasks of the Japanese consultant are summarized below:

Table 2-10 Assignment for Detailed Design and Supervision

Function	Assignment
Chief Consultant	Management of the entire Project. At commencement of the detailed design study, the chief consultant will hold discussions with the Zambian side on detailed design survey, preparation and verification of tender documents, etc.
Hydrogeologist	The hydrogeologist will make geological survey of the drilling points and hold discussions with the villagers to finally select the drilling points. Also, detailed design survey and preparation of tender documents will be part of the activity. During the drilling work, he will examine the results of the yield and water quality to give technical advice to the resident engineer of the Consultant to try to improve the success ratio of the drilling work. He will participate in supervision according to the progress of the construction works.
Geophysical Prospection	He will perform electrical prospecting at the target sites. Also, he will analyze the data and give the results/information on the prospection to the hydro geologist for use in the decision process of the drilling point in each target site. Because of the large number of sites and wide location, two prospection teams will perform the survey.
Operation and Maintenance Plan/ Sanitation	He will explain the Operation and Maintenance Plan to the Client and each District. Also, he will assist in the contracting process of local consultant/NGO and during commencement of software component, will give technical advice and conduct supervision.
Cost Estimation/ Tender	Design of the entire Project, cost estimation, execution plan and

Document/ Execution Plan	preparation of tender documents will be his responsibility.
Resident Engineer	He will transfer the Project sites to the Contractor prior to commencement of the works and make necessary coordination between the Client and local authorities for the smooth commencement of the works. The resident engineer will be based in Luapula Province to supervise the entire work and guide the local assistant resident engineer. Also, he will be in charge of selection of sites for installation of iron removal plant and supervision in general for quality control, safety and construction schedule.
Technical Supervision Engineer (Iron Removal Plant)	At sites where an iron removal plant is installed, he will check the performance of the maintenance and make necessary adjustments in the method of operation and maintenance of the facility. Also, monitoring for D-WASHE members on the maintenance technology of the iron removal plant will be performed.

2-2-4-5 Quality Control Plan

Following are the methods for quality control of the construction works and equipment and material to be used.

1) Equipment and materials

Almost all equipment and materials can be procured in Zambia, but handpumps, PVC casings and screens can also be procured from surrounding countries. Procurement will be under the responsibility of the prime contractor and before transportation to the sites or after arrival at the sites, the supervisor will check the delivered quality. Then, the supervisor from the consultant will inspect them before they can be used for the construction works.

On the other hand, equipment for borehole drillings possessed by the local private company is expected to be used, under the responsibility of the Japanese prime contractor. However, before mobilization of the equipment into the Project area, the consultant will verify the capacity of the equipment, its maintenance condition, and appropriateness of the tools and consumables to the geological condition of the Project area. Also, the consultant will confirm with the contractor on the measures to be taken in case problems arise in the equipment to avoid delays in the work.

2) Borehole drilling

- ✧ Samplings of the drilling cuttings are carried out at 2 m intervals (1m in case of sediments) and at points where stratums change in order to gauge the hydrogeological

conditions.

- ✧ After electric logging, determination of aquifer and the screen position will be selected by the contractor and approved by the consultant.
- ✧ Casing pipes, screens, centralizer and gravel pack will be installed. Also, cementation and sanitary sealing will be placed.
- ✧ Pumping tests and its data analysis will be conducted by the contractor and approved by the consultant.
- ✧ Water samples are taken whenever an aquifer is hit and before the end of the continuous pumping test to analyze the water quality.

3) Installation of handpump and appurtenant facility

- ✧ Foundation for the handpump will be constructed paying attention to maintaining the verticality of the riser pipe to avoid any bending inside the borehole.
- ✧ At sites where iron removal plants are to be constructed, attention will be paid to the installation of the handpump when it is required to be placed at a higher position.
- ✧ Attention will be paid in the slope of the drainage.

2-2-4-6 Procurement Plan

1) Equipment

Concerning procurement, as above-mentioned, tools for maintenance of handpump shall be procured. These tools can be procured locally and will be included in the construction cost.

2) Equipment and materials for construction

The India Mark II and Afridev handpumps can be procured from dealers in Lusaka city. However, Afridev handpumps will require more time in the procurement, and therefore, the contractor will need to make preparations with sufficient time. Cement, sand, gravel and steel bar, necessary for construction of appurtenant facilities are available in Luapula Province.

2-2-5 Software-Component Programme

1) Issues on Operation and Maintenance System in the Target Area

The following issues for consideration related to water use and operation and maintenance activities in target sites were confirmed through the Basic Design Study. Upon examination of

these issues, appropriate approaches and necessary support measures were considered to prepare the Software Component Programme.

(1) Capacity for Implementation of Operation and Maintenance Activities by the Community

Although most of the target sites have formed V-WASHEs, they do not have systematic knowledge, skills and experiences to conduct activities for improvements in water supply and sanitation and for operation and maintenance. Also, due to lack of information on the cost necessary for operation and maintenance, communities are not saving funds to cover expenditure required for operation and maintenance. Moreover, for existing handpumps, broken facilities are frequently left without repairs because communities lack knowledge and skills on measures to take in case of failures, and preventive maintenance and inspections are not carried out.

(2) Awareness on and Practice related to "Water and Sanitation" of Beneficiaries

Since most of the residents in the target sites use unsanitary water sources for domestic use, hygiene and sanitation conditions are very poor. Thus, a program for improvement of sanitary practices focused on promotion of use of safe water is needed, as villages with experience in activities for health and sanitation improvements are few.

(3) Lack of Human Resources with Skills and Experiences on Training for Operation and Maintenance of Water Supply Facilities with Boreholes Fitted with Handpumps

Even if the responsibility for operation and maintenance of water supply facilities is clarified, since training of Area Pump Menders (APMs) with necessary skills for repairs is delayed, appropriate management is not conducted. Also, because of the lack of human resources to train APMs at district level, the districts have difficulty in implementing the training by themselves.

2）Judgement on Necessity to Input the Software Component Programme

Until now, in Luapula Province, establishment of an operation and maintenance system in line with construction of water supply facilities is delayed, and promotion and adoption of village level operation and maintenance activities by V-WASHEs as well as strengthening of the support system of local administration are not sufficient. As each district acknowledges necessity to strengthen the aspect mentioned above, this is reflected in the WASHE annual action plan prepared by the district. However, because of financial limitations, the province has high needs for Japanese cooperation for initial training to necessary persons involved in

operation and maintenance activities, and anticipates implementation of the program with appropriate coordination with the construction schedule within the Japanese cooperation framework.

Considering this situation, to realise a sustainable supply of safe water through construction of water supply facilities with boreholes fitted with handpumps as mentioned in the project purpose, and to improve initial conditions to facilitate early realisation of the effects, implementation of the Software-Component Programme with aims of capacity development of district officers who support community-led maintenance activities and personnel in charge of support activities for communities at village level is considered to be feasible

The direct targets for development of technical skill and capacities by Japanese cooperation are the districts which takes administrative responsibilities for planning, implementation and operation and maintenance of rural water supply and sanitation projects within the districts; its technical advisory committees “D-WASHEs”; and WASHE facilitators in charge of instructing operation and maintenance activities directly to community members in coordination with the districts. Activities at the village level such as community mobilisation, awareness activities and training on operation and maintenance will be conducted as part of the programme for capacity building of government officers focused on the districts. By strengthening the administrative support system, continuation of the follow-up activities after completion of the project, and adoption of approaches and activities as well as utilization of human resources of this program into similar projects to be implemented by each district in the future can be anticipated.

The details of the Software-Component Programme are listed in the Appendix. The implementation period is also shown in “Annex 5-1 “Implementation Schedule of the Software-Component Programme”.

2-2-6 Implementation Schedule

The Project is implemented under the grant aid scheme two stages, and the implementation schedule is shown below.

1) Detail Design Stage
   a. Exchange of Notes（E/N）
   b. Consultant agreement
   c. Detail Design Study, Software Component Programme
   d. Preparation of tender documents

2) Main Construction Component Stage

a. Exchange of Notes（E/N）

b. Consultant agreement

c. Bidding, contractor contracts

d. Construction of water supply facilities

e. Completion and handing over

The implementation schedule needs about 28 months from E/N to completion of the main component consisting of borehole drilling, handpump installation, appurtenant facilities construction and installation of iron removal plant. Because of the long period required for construction, the main component is divided into 1st Term, 2nd Term and 3rd Term. The outline of implementation for each term is shown below.

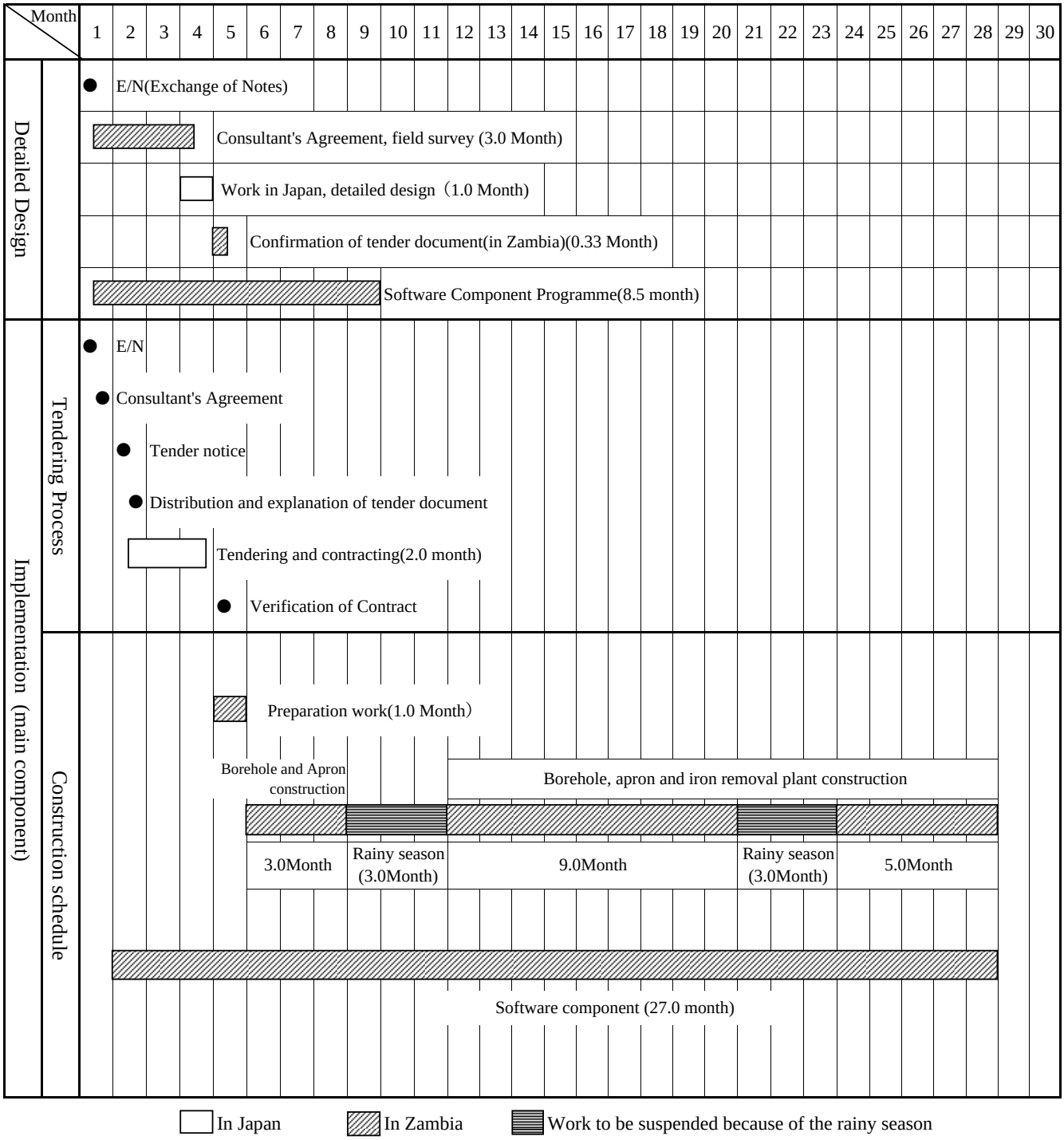
	Plan for Procurement of Equipment/ Construction of Facilities	Software-component
Detailed Design Survey	Detailed design survey, preparation of tender documents and verification	Establishment of V-WASHE, preparation of Manuals, Project orientation.
1st Term	Borehole drilling, construction of appurtenant facilities	Hygiene education, support to operation and maintenance
2nd Term	Borehole drilling, construction of appurtenant facilities and iron removal plant	Hygiene education, support to operation and maintenance of handpump and iron removal plant
3rd Term	Borehole drilling, construction of appurtenant facilities and iron removal plant	Hygiene education, support to operation and maintenance of handpump and iron removal plant

To maintain the quality of borehole drillings to be done as mentioned above, two drilling teams are the appropriate number and the designed number of borehole drillings is 200. The implementation schedule becomes as shown below.

Detailed Design	Consultant Agreement, Detailed Design Survey(siting, etc.), software-component, preparation and confirmation of tender documents	4.0 month
Main Component	Consultant Agreement, tendering process in general, Contracting process of Contractor	4.0 month
	Borehole drilling, installation of handpump, construction of appurtenant facility and iron removal plant (to be suspended during the rainy season), software component.	24.0month （including pause during rainy season）
	Total (main component)	28.0Months

The Implementation Plan formulated based on the above is shown in the next table.

Table 2-11 Implementation Schedule



2-3 Obligations of Recipient Country

When the Government of Japan decides to implement the Project under the scheme of grant aid, the Government of Zambia must confirm undertaking the following responsibilities in order for the project to proceed in a smooth manner.

- To allocate a Project Manager (PM) from the Executing agency in the target area in accordance with the Project and to bear the expenses for a PM.
- To secure land necessary to construct the water supply facilities, and to clear, level and reclaim the land prior to commencement of the construction.
- To secure land necessary for the base camp and stockyard in the target district during construction.
- To prepare access routes to the construction site and provide necessary incidental facilities in and around the project sites.
- To ensure quick procedures for customs clearance and internal transportation of distributed equipments and materials for the Grant Aid.
- To exempt Japanese nationals from customs duties and internal taxes which will be imposed in the recipient country with respect to the supply of the equipment and materials and services under the verified contracts and to accord Japanese nationals such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.
- To operate and maintain the facilities constructed and equipment procured under the Grant Aid properly and effectively, and to appoint necessary staff for this operation and maintenance.
- To bear the advising commission for Authorisation to Pay (A/P) and the payment commission to Bank.
- To bear all the expenses other than those covered by the Grant Aid.
- To bear the expenses for police officers attached to Japanese nationals in order to ensure their security when Japanese personnel work within 20km from the border with the Democratic Republic of Congo for all the field work after Exchange of Notes such as Detail Design Study, construction of the facilities, Software Component Programme, and so on.

2-4 Project Operation and Maintenance Plan

2-4-1 Framework for Operation and Maintenance

The operation and maintenance approach for this Project will be based on Zambia's rural water and sanitation sector development strategy using the WASHE concept, consisting of voluntary participation of residents and support service from the local government for promotion of the activities.

MLGH owes administrative responsibilities for operation and maintenance of rural water supply and sanitation improvement projects and DISS is in charge of policymaking at national level, policy and technical assistance to each province and district and coordination with relevant ministries and donors. While MLGH is the responsible organisation for operation and maintenance at national level in the Project, each district takes responsibilities for formulating and implementing the action plan of operation and maintenance for districts. Maintenance at level of each water supply facilities will be under the control of V-WASHEs, organised by residents in the target villages.

2-4-2 Basic policy on the Operation and Maintenance

The following issues are found with respect to operation and maintenance of water supply facilities with boreholes fitted with handpumps constructed in the Project, through research of existing systems in Luapula Province and social condition survey.

- In most of the villages with boreholes fitted with handpums and shallow wells, there are already organised V-WASHEs facilitated by D-WASHEs, but they have not taken the training necessary for implementation of V-WASHE activities such as the method of daily maintenance handpumps and the knowledge of accounting with respect to reserving maintenance cost, and maintenance of handpumps is up to voluntary activities by village after completion of construction. Thus, there are some cases where V-WASHEs become a mere facade and users are stuck to or misconduct rehabilitation of handpumps out of order, so there is a need to give support to achieving knowledge and skills for operation and maintenance of handpumps.
- There is a lack of personnel with enough skills for installing and rehabilitating the handpumps within each district, so that the rehabilitation work cannot be conducted promptly when the handpumps are broken. In each Ward, an administrative unit at lower

level of district, there is a need to develop and allocate enough APMs corresponding to the number of existing water supply facilities and the range of target area. At present, there are some districts where D-WASHE members who have taken training to be trainers for developing APMs, even in those districts the skill training for APMs is slow to be conducted because of the budgetary limit for the activities.

- There is a need to facilitate the active participation of ADC members in the area where ADC is organised as well as RHCs and school teachers as main actors for facilitating educational activities for residents and support of capacity development for V-WASHE.
- There is a need to develop the distribution system of spare parts for handpumps in each district. Within the province, one or two hardware stores sell spare parts of India Mark II in the town of Mansa, and D-WASHEs in Nchelenge, Kawambwa, Mwense and Mansa sell the spare parts of India Mark II distributed by UNICEF for community members at lower prices than their market prices. Under the revolving fund method, D-WASHE is to procure additional spare parts as necessary, based on the income from sales. However, as sales prices are decided at lower level under subsidy, there is a possibility in the future that D-WASHE cannot pay enough expenses for purchasing the spare parts directly from the distributors.

Based on the issues mentioned above, the basic policies for operation and maintenance in the Project are shown below.

(1) Ownership and responsibility of beneficiary residents

Operation and maintenance of constructed water supply facilities is focused on V-WASHE, and the residents make voluntary decisions under their responsibilities such as appropriate use of the facilities, cost sharing for operation and maintenance and necessary maintenance activities and manage the activities.

The members of V-WASHE consist basically of a chairperson, vice chairperson, clerical, accountant, caretaker and other members. Main roles of V-WASHE are stimulating the needs; formulating action plans and facilitating implementation with respect to improvement of water supply and sanitation environment; daily management and simple rehabilitation of the water supply facilities in the village; arrangement of work if large scale rehabilitation is necessary; collecting, managing and reporting of maintenance cost; enlightenment of users on appropriate use of the facilities; and improvement of sanitation and communication with the administration. The residents of the target community elect the members, though there is a need to consider the balance of gender. Thus, paying attention to gender balance among the members, the Project verifies the approach which enables women to participate in decision making actively.

(2) Promotion of skills for operation and maintenance of the water supply facilities with boreholes fitted with handpumps

Promotion of knowledge and skills delays with respect to daily preventive maintenance and rehabilitation of water supply facilities with boreholes fitted with handpumps in target area, so there are many cases where broken handpumps are left as they are without specifying the failure cause and rehabilitation. To improve these situations, the Project conducts training for caretakers allocated to each facility on preventive maintenance activities feasible for user to implement and allocates personnel with skills for rehabilitation of handpumps at closer level to the villages through training for APMs. As there is a policy in the Project that two kinds of handpumps are distributed depending on the hydro geographical conditions, the Project supports APMs to achieve appropriate skills for installing and rehabilitating both kinds of handpumps.

(3) Facilitation for improvement in awareness, action and practice for sanitation on the bases of water

Even if water supply facilities with capacity to provide safe water are installed in the target area, there is no possibility of sustainable and effective use of the facilities unless the community members understand importance of using improved water supply facilities, appropriate way of using water sources and handling drinking water. Also, improvement in health and sanitation environment through reduction of water borne diseases cannot be achieved from a long-term perspective. Therefore, it is essential to facilitate understanding of importance of improvement in sanitation environment including use of safe water as well as the linkage between the individual action and practice on sanitation and the water borne diseases before the commencement of construction of water supply facilities.

Also, the Project is to verify the installation of iron removal plants in the target site with high iron contents. It is also essential to facilitate the change of awareness for sanitation, in order for the residents to understand the importance of water supply facilities with iron removal plants and to utilise effectively. From such point of view, sanitation improvement activities at village level are implemented along with activities for developing the system of operation and maintenance.

(4) Strengthening of facilitation capacity for operation and maintenance activities by the district government

In the “National Rural Water Supply and Sanitation Programme (2006-2015)” formulated on March 2006, it aims to strengthen the implementation capacity for rural water supply and sanitation project by the district government over the next decade and verifies to establish the department of rural water supply and sanitation projects or to allocate full-time staffs. At present, it is the common case where either the department of planning or public works of the district government is in charge. However, the district often runs short of staffs and technical capacity for implementation, so it plan and implement the projects in cooperation with staffs from the field office of the ministries relevant to water and sanitation projects who are members of D-WASHE, such as MEWD, Ministry of Education, Ministry of Health, Ministry of

Community Development, Ministry of Agriculture and so on.

It is based on the premise that D-WASHE focused on district government participates in the facilitation of establishment of operation and maintenance plan at district level and support for capacity development for V-WASHE in the target village in the Project. Bearing in mind that the functional enhancement of district government will be realising by stages, it is considered for district government to achieve the abilities to implement rural water and sanitation projects through the Project such as leadership by the district government, coordination among the relevant actors, collecting and recording of information on operation and maintenance activities and establishment of action plan.

(5) Coordination with upper level plan and other donors

DISS is on the way of establishing the guideline for operation and maintenance of rural water supply facilities, including implementation policy with respect to developing the distribution system of spare parts of handpumps. As in the target area of the Project it is also desirable to establish the distribution system at district level, there is a need to coordinate with the approach at national level organised by DISS as Executing agency. The Project coordinates and cooperates with other donors which support the similar projects in the field of rural water supply and sanitation in the target area, and absorbs lessons learnt and good practice from operation and maintenance approach supported by other donors' projects.

2-5 Project Cost Estimation

2-5-1 Cost Borne by the Zambian Government

Total: ZMK378,202,588 (JPY11.1million)

Cost Item	Total	Calculation	Comment
Personnel Expense during siting work in the detail design study	ZMK11,700,000	3month×26days×3person× ZMK50,000/day/person	3 D-WASHE member. One to accompany the hydrogeological team, two for geophysical team.
	ZMK3,858,750	MLA: 63sites×ZMK61,250/site (4 persons)	63 sites located within 20km from the borderline with DR Congo, where it is required a police escort. (*)
Personnel expenses during Supervision work(**)	—	Supervision of construction and software component activity. Coordination with each District and V-WASHE of the target sites. (days×50,000/day/person)	Will be done by the staff of DISS, but the quantity will vary according to the necessity during the construction work.
	ZMK24,759,000	MLA: 63 sites×ZMK393,000/site (10 persons)	63 sites located within 20km from the borderline with DR Congo, where it is required a police escort. (*)
Personnel expenses during inspection for handover of facilities	ZMK41,600,000	16month×26days×2person× 50,000/person/day	2 Member of D-WASHE will attend the inspection for handover.
Personnel expenses for the software component under the responsibility of Zambian side	ZMK283,600,000		Details of expenses under Zambian side, see in Annex, "Zambian side responsibility for the software component activity".
Advising Commission for Authorisation to Pay (A/P)	ZMK339,600	A/P opening ZMK135,840×2 times A/P amendment ZMK67,920×1 time	
Payment Commission to Bank	ZMK12,345,238	Amount of contract×0.05%	
Total	ZMK378,202,588 (JPY11.1million)		

*During the work within the 20km from the borderline, the police officer will be deployed from each District headquarter.

**A Project Manager will be allocated to assist in the smooth implementation of the Project.

2-5-2 Conditions for Estimation

1) Estimation Base December 2006
2) Exchange Rate 1 US$ = 121.15 Yen
1 ZMK = 0.029447 Yen
3) Period of Construction and Procurement Total 28 month from the E/N.
For more detail, see table 2-11

4) Others　　This Project is to be implemented in accordance with the guidelines for Grant Aid Assistance of the Japanese government.

2-5-3　Operation and Maintenance Cost

The cost borne by Zambian side for operation and maintenance of the completed borehole facilities fitted with handpumps is estimated under the "(Draft) National Guidelines for Sustainable Operation and Maintenance of Rural Water Supply Facilities" (MLGH) and field practice survey for fuel fees. The results will be as follows.

（Unit：ZMK）

Target Organisation	Cost Item		Unit Cost	Q'ty	Amount
District Government	Operation and Maintenance and Monitoring Activities	*1	3,223,600 /District	7	22,565,200
Sub District Facilitators such as EHT and ADC	Operation and Maintenance and Monitoring Activities	*2	1,517,360 /Ward	65	98,628,400
V-WASHE	Operation and Maintenance Activities	*3	438,225 /Borehole	231	101,229,975
Total					222,423,575

*1 Cost for District Government O&M Monitoring Activities

Fuel Expense　:　6days/quarterly×10lit/day×Fuel Fee×4times
＝ZMK 1,623,600

Allowance　:　6days/quarterly×daily allowance×4times
＝ZMK 1,200,000

Preparation Fee for Quarterly Report　:　Unit cost of report×4times
＝ZMK 400,000

Sub-Total　:　ZMK 3,223,600

*2 Cost for Sub District Facilitators O&M Monitoring Activities

Fuel Expense　:　1day/month×10lit/day×Fuel Fee×12times
＝ZMK 717,360

Allowance　:　1day/month×daily allowance×12times
＝ZMK 600,000

Preparation Fee for Quarterly Report　:　Unit cost of report×4times
＝ZMK 200,000

Sub-Total	:	ZMK 1,517,360

*3 Cost for V-WASHE O&M Activities

Purchases Cost of Spare Parts	:	10% of Product Price(US$ 580) /year ＝ZMK 219,112.4
Reserve Fund for Replacement	:	Product Price (US$ 580)/10year ＝ZMK 219,112.4
Sub-Total	:	ZMK 438,224.8

As mentioned above, the necessary expenses for maintaining the water supply facilities in the target village is ZMK 438,224.8 per year. If compared with the responsible expense for each household (ZMK480/month/household) calculated from annual necessary expense / numbers of households in target site and the capacity to pay (5% of average household income; ZMK11,932/month/household), such necessary expense falls within the capacity to pay on all the target sites. Therefore, the cost required for this Project is determined to be feasibly payable by the residents.

CHAPTER 3
PROJECT EVALUATION AND RECOMMENDATION

Chapter 3 Project Evaluation and Recommendations

3-1 Project Effect

The effects and improvements expected to be achieved by this project are shown below.

Table 3-1 Effects and improvements due to this project

Current Status and Problems	Action Taken in the Project	Direct Effects and Level of Improvement	Indirect Effects and Level of Improvement
• Accessibility to safe water in Luapula Province remains low at 17% because water supply facilities are insufficient. • Residents in the target sites of the project are affected by water-borne diseases such as diarrhoea because of unsanitary drinking water and unstable water level throughout the year.	• 200 water supply facilities with boreholes fitted with handpumps are constructed in the target sites.	• The population with sustainable access to safe water in 7 districts in Luapula Province will increase from 162,300 (17%; 2007) up to 212,300 (20%; 2010) through construction of water supply facilities with boreholes fitted with handpumps. • The water quality of constructed water supply facilities will satisfy the design standard throughout the year. • Time consumed and heavy burden from fetching water by women and children are eased.	• The utilisation of safe and stable water will be expected to improve the sanitation status and to reduce water-borne diseases. • The residents in the target sites will be able to utilise the design amount of water (30 liter/ person/ day) from the constructed water supply facilities throughout the year.
• Each level WASHE has responsibility to maintain the constructed water supply facilities, but their capacity needs strengthening since the system is not fully established. Also, lack of tools for operation and maintenance is hindering the proper operation and maintenance of water supply facilities.	• Support service through the Software Component Programme will be executed to strengthen the operation and maintenance system of constructed facilities. • Tools for operation and maintenance of handpumps will be distributed.	• The skills necessary for maintenance of water supply facilities through voluntary participation of the residents will be fostered through training of 81 APMs conducted in the Software Component Programme. • WASHE activities in Luapula Province will be activated by the Software Component Programme and operation and maintenance systems based on ownership and responsibility of the residents will be established.	• The project will contribute to shorten the period of time necessary for repair of the facilities. • The project will contribute to enhance the skills in the districts and catchments areas for capacity development and hygiene education promotion necessary for maintenance of water supply facilities through voluntary participation of the residents and for establishing the operation and maintenance system. • The project will contribute to improve the system of monitoring and evaluation through improvements in water supply and sanitation improvement by D-WASHE and Sub-WASHE.

3-2 Recommendations

3-2-1 Recommendations for Zambian Side

(1) Standardisation of Handpump

The pumping system designed for the project is handpump. In terms of types of handpumps, the survey conducted in 1995 showed that over 40 kinds of handpumps were found to be used in the rural areas of Zambia. As use of many types of handpumps makes it difficult to distribute spare parts and other materials, the “SOMAP”, now in operation, suggests standardising handpumps but a concrete conclusion is not made at present. However, in terms of types of handpumps, SOMAP suggests adopting not more than 2 types of handpumps. At present, India Mark-II is popular in Zambia; however, adopting Afridev is now increasing because of the durability of its riser pipe against water with low values of pH (acidity) and simplicity of its maintenance system.

India Mark-II is most popular also in Luapula Province. However, as there is a need to consider the quality of groundwater (high concentrations of iron and low values of pH), Afridev will be adopted as one of the options in addition to India Mark-II in the target sites. And in consideration of the distribution of spare parts and training of APMs, it is desirable to narrow the type of handpump.

(2) System of Operation and Maintenance in the Target Sites

As a main actor of WASHE activities, D-WASHEs are organised at district level mainly by local governments (districts governments). However, the implementing capacity and activity status among districts depend on their social and economic situation and availability of cooperation from donors. A distribution system of spare parts for handpumps needs to be established in order to support the system of each district for WASHE activities including operation and maintenance of water supply facilities by the residents. Within the Luapula Province, there are one or two hardware stores selling spare parts in Mansa town, and in addition, D-WASHE in the districts such as Nchelenge, Kawambwa, Mwense and Mansa sell spare parts of India Mark II, which were distributed by UNICEF, to the residents below the market price. And where the Area Development Committee (ADC) is established, ADC members as well as Rural Health Centre staffs and school teachers are expected to participate actively as main actors to encourage community awareness activities and capacity development support activities for V-WASHE.

(3) Need for Sustainable Monitoring of Operation and Maintenance

The Software Component Programme to strengthen the operation and maintenance system is designed in the project. Sustainable monitoring is necessary to verify the effects of the project

and changes of the residents in awareness and practice after completion of construction. The results of monitoring of water supply and sanitation improvements activities in each village are expected to be recorded and compiled at sub-district and district levels. Also, in formulation of WASHE annual action plans in each district, these monitoring results are expected to be reflected in similar projects in the future in consideration of actual demands and needs.

3-2-2 Technical Assistance and Cooperation with Other Donors

As mentioned above, the project approach and implementing system are necessary to be harmonised with NRWSSP as all the projects regarding such sector are ranked as one of the activities to achieve the goals of NRWSSP. As a budgetary step for project implementation in each district, the fund for exclusive use for rural water supply and sanitation are established in MLGH, and costs borne by the Government of Zambia and financial cooperation by other donors will be totally managed and the budget of the project will be allocated through the fund based on the project plan established by each district. However, the donor agencies which do not participate in the common basket fund need to have project-type cooperation as before. Cooperation with other donors in implementation of the project seems to be unnecessary, but other donors including UNICEF are expected to support such sector in the future. There seems to be a need to exchange useful information for project implementation and promote understanding for the project because the donors in Zambia cooperate actively with each other in each sector including the water sector. Also, coordination of the project with support from the executing agency, district governments and D-WASHEs is expected in order not to duplicate the target sites for similar projects within each target site and not to distribute the resources unevenly.

3-3 Feasibility of the Project

In the Luapula Province, its accessibility to safe water remains low at 17% which is below the average of Zambia at 37%, and this is the worst in Zambia. Lack of enough water supply facilities is affecting seriously to increase the workload of fetching water by women and children, and to give negative effects to economic activities and education and health situation. Therefore, MLGH established the “National Rural Water Supply and Sanitation Programme” in order to improve the situation of water supply and sanitation. In this situation, the project is considered to be feasible for implementation as a Japan’s Grant Aid project based on the aspects shown below.

The feasibility in implementation of the project is shown below.

① The targeted beneficiaries of the project are the residents in the village in Luapula

Province, and the benefited population will be 50,000.

② The purpose of the project is improvements in water supply and sanitation for the residents.

③ Each level of WASHE is expected to sustainably operate and maintain the water supply facilities with boreholes fitted with handpumps constructed in the project.

④ The project is harmonised with the goal of NRWSSP (2006-2015) established by MLGH as a policy for rural water supply and sanitation, which is to raise accessibility to safe water from 37% to 75%, and support to achieve the goal.

⑤ The water supply facilities designed by the project are constructed in the rural villages where the poverty group lives and maintenance will be provided by V-WASHEs through collecting water tariffs after completion of construction. Thus the project is not profitable and feasible to be implemented by grant aid.

⑥ The rural water supply facilities to be constructed in the project are of small scale so that they will not have negative environmental impact.

⑦ The project does not have any special difficulties in being implemented through the system of Japan's grant aid.

3-4 Conclusion

Emergency support is to be provided to Luapula Province in order to raise the low accessibility to safe water through the project as mentioned before. Through the support, the residents in rural villages including many poverty groups will benefit from improvements in Basic Human Needs, and so Japan's grant aid is feasible to be adopted for implementation of the project. With appropriate coordination between each level of WASHE activities for the operation and maintenance system and development of the system, the project can be implemented in a smooth and effective manner. Consequently, the water supply facilities with boreholes fitted with handpumps completed in the project as well as the hygiene system enhanced through the project will become sustainable for the future.

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