No.

BASIC DESIGN STUDY REPORT
ON THE PROJECT
FOR
RURAL WATER SUPPLY, PHASE 2
IN
THE KINGDOM OF SWAZILAND

AUGUST 2002

JAPAN INTERNATIONAL COOPERATION AGENCY
PACIFIC CONSULTANTS INTERNATIONAL
MITSUI MINERAL DEVELOPMENT ENGINEERING CO., LTD.

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PREFACE

In response to a request from the Government of the Kingdom of Swaziland (GOS), the Government of Japan decided to conduct a basic design study on the Project for Rural Water Supply, Phase 2 and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Swaziland a study team from November 17 to December 26, 2001 and from January 10 to March 25, 2002.

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

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

I wish to express my sincere appreciation to the officials concerned of GOS for their close cooperation extended to the teams.

August 2002

Takao Kawakami
President
Japan International Cooperation Agency

August 2002

LETTER OF TRANSMITTAL

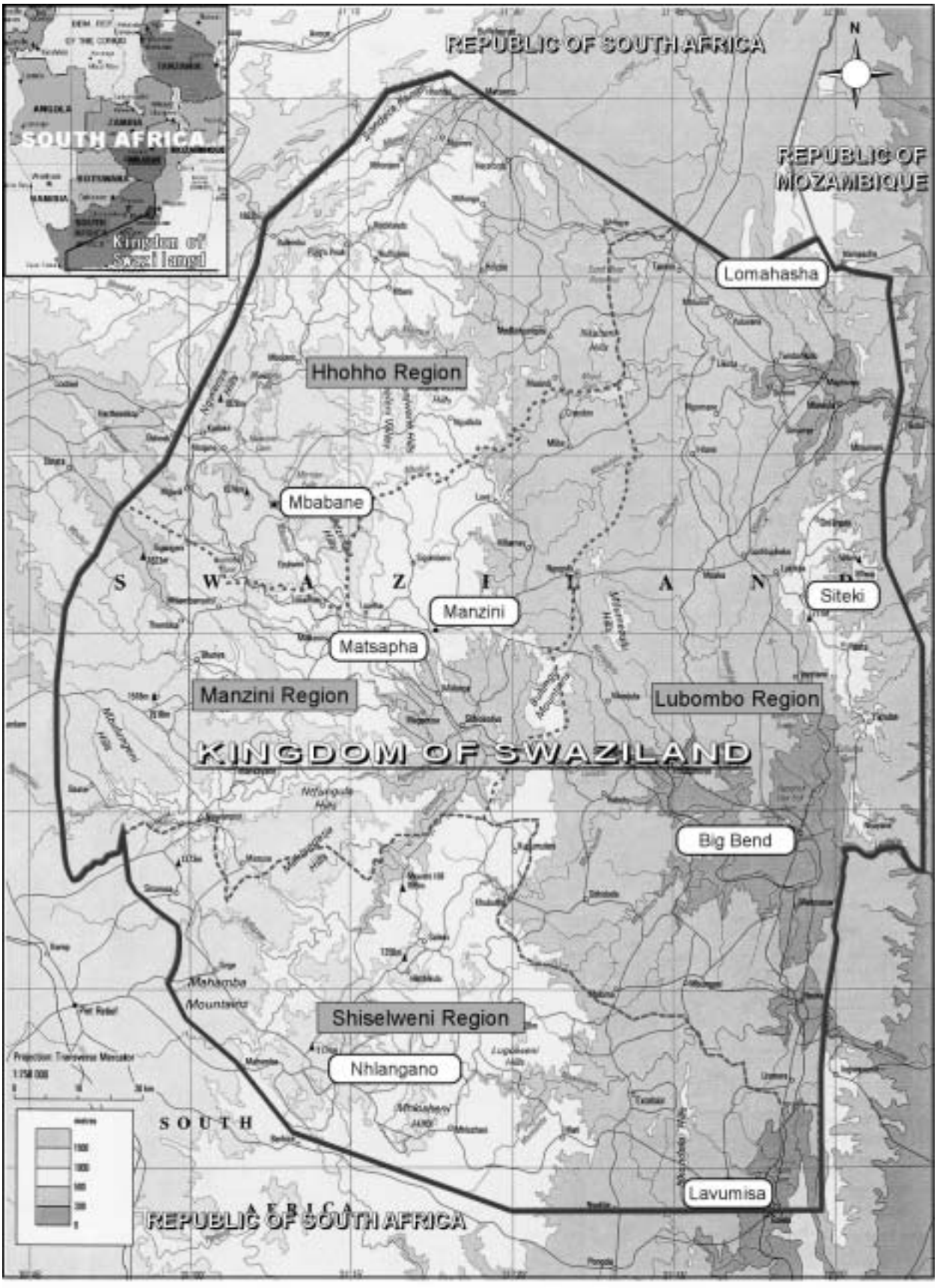
We are pleased to submit to you the basic design study report on the Project for Rural Water Supply, Phase 2 in the Kingdom of Swaziland.

This study was conducted by Pacific Consultants International, under a contract to JICA, during the period from November 12, 2001 to August 30, 2002. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Swaziland 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,

Soichiro Yumoto
Project Manager,
Basic Design Study Team on
the Project for Rural Water Supply, Phase 2
in the Kingdom of Swaziland
Pacific Consultants International



LOCATION OF STUDY AREA

SUMMARY

The population of rural areas in the Kingdom of Swaziland is 715,290, 77 % of the country's whole population of 929,718 according to the census of 1997. Only about 357,000, 49 % of the rural population is assured to access safe water, and this coverage is considered quite low compared with 90 % in urban areas of the country. The coverage of improved latrines in the rural areas is estimated at 71 %, which is considered lower than that of the urban areas (97 %). Health and welfare services in the rural areas are also considered behind those in the urban areas, which accelerates the increase of the disparity between rural and urban areas. Therefore, the improvement of the health and welfare services in the rural areas is considered to be an urgent issue in the country. In order to improve the water supply services in the rural areas, the country established the Rural Water Supply Branch (RWSB) in the Ministry of Natural Resources and Energy (MNRN), and has pushed up the construction of rural water supply facilities.

The Government of Swaziland puts the highest priority on the rural water supply sector in its national development plan to improve the situation of public health and welfare in the rural areas. In 1994, the request for the grant aid was submitted to the Government of Japan for construction of three (3) macro schemes and 24 micro schemes including the procurement of drilling equipment and materials. The project consisting of this construction and procurement was implemented from 1995 to 1997 (hereinafter referred to as the first phase project). Since then, rural water supply projects have been started by the government, but they have not progressed well because of the shortage of materials for construction of micro schemes and the difficulties in exploring groundwater resources for macro schemes. The government then submitted the request for grant aid with the following contents:

- Construction of 45 micro scheme water supply facilities
- Procurement of construction materials for 45 micro scheme water supply facilities which will be constructed by the government, and spare parts for the equipment procured under the first phase project.
- Construction of the macro schemes in the Lomahasha and Majunbeni areas.

In response to this request, a preparatory study team was dispatched in December 1999, and it was confirmed, as a result, that the project would consist of the construction of micro scheme facilities and the provision of the materials necessary for the construction and spare parts for the equipment to be procured under the first phase project. The construction of macro scheme facilities was not judged to be appropriate because of expensive construction and operation and maintenance costs.

The Government of Japan decided to conduct basic design on the project, and entrusted the study to the Japan International Cooperation Agency (JICA). JICA dispatched a basic design study team to Swaziland two times from November to December 2001 and from January to March 2002. The team held discussions with officials concerned 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 Swaziland in order to discuss a draft basic design. As a result, the present report was finalized and the summary is as follows:

This project has the following targets related to the improvement of rural water supply conditions as above mentioned.

1) Improvement of rate of water service and health and sanitation and living standard for rural population in Swaziland (improving rate of water rural service from 49% to 54%)
2) Establishment of sustainable well operation and maintenance system by community residents
3) Improvement of capacity of RWSB since it conducts well drilling work as the implementation agency

Basic policy in the study was to adopt a production plan based on total drilling depth for cost reduction to eliminate risk of contractor based on uncertainty of number of unsuccessful well. Scope of work of Japanese side is to drill boreholes by production method (total depth length 8,100 m (about 50 sites)) to meet the objectives to improve water supply conditions in Swaziland, to construct well facility superstructure work (8 sites: construction for test boring well drilled in basic design stage by the duty of Swaziland side) with installation of hand pump, to conduct OJT (about 20 sites remaining) of drilling work under the share of Swaziland side, to procure the required equipment and materials for borehole drilling, and to offer funds to conduct software assistance to contribute the smooth operation and maintenance of new constructed well facilities and drilling equipment procured by the first project. The basic design was drawn up based on the following design policy.

- The project should be implemented employing local contractors and suppliers effectively in order to reduce construction costs as much as possible, but the quality and durability of the constructed facilities should be assured at the level necessary for their sustainable operations.
- Construction of micro scheme facilities will be made both by the Swaziland and the Japanese sides, and the equipment and materials procured under the 1st phase of the project should be used exclusively for the construction works by the Swaziland side.
- Dry and wet seasons are clearly distinguished in Swaziland with much rainfall observed during the wet season from December to February. In planning the construction schedule, it is necessary to consider the bad road conditions during wet season.
- The materials to be incorporated in the construction works should conform to South African Bureau Standard (hereafter referred to as SABS) prevailing in Swaziland and/or those compatible to SABS. Although Japanese staff can be considered for supervising the construction works on a minimum basis, local engineers contractors who are considered to have technical knowledge and experiences capable to do the supervisory services satisfactorily should be used for supervision and construction works.
- The hand pumps to be installed for micro schemes should be of the Afridev type, for which the operation and maintenance are established on a community basis in Swaziland; the Bush type will also be considered as required.
- The population to be served by a micro scheme is set in the range from 250 to 500, and the water consumption per capita is set at 15 liters/capita/day.
- The success rate of the test drilling is set at 55.0 % based on those of the first phase project

as well as the test drilling conducted during the basic design stage.

The rationale and necessity of the micro scheme facilities were examined in each requesting community from the viewpoints of: i) access condition from main roads, ii) socio-economic condition and iii) hydrogeological condition. As a result, 78 sites (in 39 communities) were selected for the project targets. The regional breakdown of numbers of the selected sites and communities is presented in the following table.

The equipment and materials to be procured under the project are: i) the equipment and materials necessary for the construction of micro scheme facilities, and ii) spare parts for the equipment procured under the first phase project, as shown in the following table.

Regional Breakdown of Numbers of the Selected Communities and Sites

Region	Number of Sites	Number of Communities
Hhohho R.	14	3
Manzini R.	32	10
Lubombo R.	22	19
Shiselweni R.	10	7
Total	78	39

Confirmed Equipment and Materials Requested by the Swazi Side

№	Equipment and Materials		Qty	Unit	Remarks
<Requested Equipment and Materials>					
1	Hand Pump		1	Lot	
2	Casing and Screen Pipes		1	Lot	
3	Materials for Well Facilities (Sand, Cement, Aggregates)		1	Lot	
4	Fuel, Oil and Lubricants		1	Lot	
5	Bentonite and Forming Agent		1	Lot	
6	Back Hoe		1	Set	
7	Concrete Mixer		1	Set	
8	Fuel Tank Trailer		1	Set	2 m^3
<Spare Parts for Equipment and Vehicles Procured under Phase 1 Project>					
1	Truck-mounted Drilling Rig with Tools and Attachments		1	Set	
2	High Pressure Air Compressor with Tools, etc.		1	Set	
3	Diesel Generator with Tools		1	Set	
4	Electric Logging Equipment with tools, etc.		1	Set	
5	Geophysical Survey Equipment with Attachments, etc.		1	Set	
6	Pumping Test Equipment		1	Set	
7	Water Quality Analysis Equipment		1	Set	
8	Workshop Equipment		1	Set	
9	Vehicle Spare Parts	Rig Truck	1	Set	NISSAN TFA430KHN
		Compressor Truck	1	Set	NISSAN TFA430KHN
		Tank Lorry Truck	1	Set	NISSAN TFA430GLN
		Crane Cargo Truck	1	Set	NISSAN TFA430KHN
		Station Wagon (2 nos.)	1	Set	TOYOTA LAND CRUISER

The tubewells in the basic design study considered as successful for production (8 sites) should be finalized by constructing the related facilities such as hand pumps aprons, etc. by the Swazi side during the detailed design stage in order to facilitate the use of these facilities.

70 tubewells (which are the balance calculated after deducting the number of tubewells considered successful as a result of test drilling in the basic design period from the selected 78 sites), will be drilled as follows:

- 20 tubewells to be constructed by the Government of Swaziland with its own funds.
- 50 tubewell to be drilled during test drilling in the detailed design stage by the Japanese

consultant.

The following software assistance will be provided in order to facilitate smooth construction and to establish sustainable operation and management systems in each community after the implementation of the project.

- Software assistance on the operation and management of equipment and drilling equipment in order to improve the drilling capability of the existing drilling team for effective drilling works after the completion of the project.
- Software assistance on hydrogeological issues geophysical survey method, etc. necessary for proper and smooth determination of drilling sites by RWSB.
- Software assistance in the training and educational activities on sustainable operation and management of the micro scheme water supply facilities, which are to be conducted by the maintenance groups to be established in communities under the guidance of RWSB.

The following expenses will be borne by the Swazi side, of which total amount is estimated at 48.97 million US$ for smooth implementation of the project.

Estimated Expenses to be Borne by Swazi Side

(Unit: 10^6 yen)

Descriptions	Expenses	Remarks
(1) Preparation of the construction sites of micro scheme facilities	-	All the land is nationally-owned, but coordination and confirmation with villagers are required.
(2) Access roads to construction sites from major roads	-	To be constructed by the participatory activities of the beneficiaries.
(3) Yards and warehouse for storing the materials and consumables to be procured under the project including staffing	-	Preparation of the existing workshop in Matsapa.
(4) Procurement of construction materials for the tubewells to be constructed by Swazi side.	5.44	Among those necessary for the construction by Swazi side, some materials and consumables of fuel, lubricants, gravel are borne by Swazi side.
(5) Provision of equipment provided under the phase 1 project necessary for the construction by Swazi side including maintenance and repair of these equipment	30.38	Drilling rig, crane truck, air compressor, pick-up, etc.
(6) Drilling of boreholes for the tubewells to be constructed by the Swazi side including construction of related facilities and installation of hand pumps.	2.64	The materials for the works are stated separately in Item (4), and the construction works are to be made by the participatory activities.
(7) Construction of protection fences and soak pits	2.64	Gravels and foams for the works are provided by the Swazi side.
(8) Provision of staff and vehicles necessary for the training on drilling technology	1.07	Staff: 15 number x 14 months Drilling vehicles (14 months)
(9) Provision of staff and vehicles necessary for training on geophysical survey and site selection technology	1.14	Staff: 5 number x 3.5 months Vehicles: Pick-up (5 x 18.5 months: 1 pick-up for each CDO)
(10) Provision of staff and vehicles necessary for workshops and trainings on strengthening WSCs	5.66	Staff: 5 CDOs for 18.5 months each Vehicles: 5 vehicles x 18.5 months each
(11) Rooms in RWSB for lectures and workshops to be held in the course of software assistance on strengthening of WSCs	-	Rooms in RWSB will be used free of charge.
Total	48.97	-

By implementing the project, is the following results are expected: i) to increase the served

population of new rural water supply systems by 31,000 and to improve the service ratio from 49.0 % to 54.0 % in the rural areas, ii) to relieve women from the hard work of fetching and carrying water because the distance from the community to the tubewell will be shorter, iii) to establish the sustainable operation and management systems of the tubewells in the communities, and iv) to improve the capability to manage the drilling works and to maintain the drilling equipment and vehicles in a sustainable way. In addition, the following indirect effects are expected: i) to improve the living standard and environment in the communities, ii) to reduce the gap of the services for health and sanitation between the rural and the urban regions, and iii) to improve the sanitary environment and promote public health conditions including the reduction of mortality rate due to water borne diseases, and iv) to improve the entire level of well drilling technology in Swaziland as well as efficiency of construction works due to the technical transfer and its consequent ripple effect.

This project which is to be implemented based on the rural water supply action plan of Swaziland, is expected to improve the services for health and sanitation in the rural areas which is considered behind the urban areas. The increased population to be served by the 78 micro schemes to be constructed under the project is estimated at about 31,000. If tubewell construction works are implemented even after the project completion on the sustainable condition, more population of the rural areas will receive the benefit from such tubewell construction. It is further expected to establish an effective operation and management system in the communities as a result of software assistance which is intended to assist the population in the rural communities. In this context, this project is considered to be appropriate for the grant aid of Japan.

However, in order to operate and manage the water supply facilities in an adequate manner by the members of the communities where the new facilities are planned to be constructed and to implement groundwater exploitation and water supply schemes on a sustainable basis, it is indispensable to assure the employment of the RWSB staff even after project implementation, who will be trained in software assistance, in order to establish the regularly monitoring system of the water quality of the tubewells, and to establish a fair water charge collection and accounting systems.

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Preface
Letter of Transmittal
Project Location Map
Summary

Table of Contents

List of Figures

List of Tables

Appendices

Abbreviations

MEPD	Ministry of Economic Planning and Development
MNRE	Ministry of Natural Resources and Energy
RWSB	Rural Water Supply Branch
MPWT	Ministry of Public Works and Transport
CTA	Central Transport Administration
SPTC	Swaziland Post and Telecommunication Corporation
SEB	Swaziland Electricity Board
CIDA	Canadian International Development Agency
DFID	Department for International Development (Before 1997 ODA: Overseas Development Administration)
UNICEF	United Nations International Children's Emergency Fund
UNEP	United Nations Environment Program
USAID	The united States Agency for International Development
WHO	World Health Organization

WFP	World Food Program
UNDP	United Nations Development Program
EU	European Union
HDI	Human Development Index
PHAST	Participatory Hygiene and Sanitation Transformation
TOT	Training of Trainers
TOF	Training of Facilitators
WSC	Water and Sanitation Committee
RHM	Rural Health Motivator
CDO	Community Development Officer
VLOM	Village Level Operation and Maintenance
DTH	Down-the-Hole
OJT	On-the-Job Training
PVC	Polyvinyl Chloride
JIS	Japan Industrial Standard
SABS	South African Bureau Standard

CHAPTER 1 BACKGROUND OF THE PROJECT

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In the rural areas of Swaziland, only 49 % of the population is assured of the access to the safe water this is considered to be quite low comparing with about 90 % in the urban areas of the country. In addition, although 97 % of the urban population has improved latrines, only 71 % of the population in the rural areas has it. The health and sanitation services to the population in the rural areas are behind those in the urban areas, and since the gap of health and sanitation facilities and services between the rural and urban areas is becoming larger, to improve health and sanitation situation in the rural areas is considered to be one of the nation's urgent issues. In order to facilitate such improvement in the country, the Rural Water Supply Branch (hereafter referred to as RWSB) was established, and the RWSB has made various efforts in executing the water supply projects in the rural areas with the assistance of various donors.

In 1994, the Government of Swaziland (hereafter referred to as GOS) submitted to the Government of Japan (hereafter referred to as GOJ) the request for a grant aid project for the construction of three (3) macro schemes and 34 micro schemes as well as the procurement of equipment and materials necessary for the construction. The project was implemented from 1995 to 1997 (hereafter referred to as the first phase project). Since then GOS had make various efforts to proceed with the rural water supply schemes, but service ratios in the rural areas could not be improved as intended because of the shortage of materials for construction of micro schemes and the difficulties in exploitation of groundwater source for macro schemes. In 1998, GOS submitted to GOJ the request for grant aid project with the similar contents to the first phase project. According to the request submitted in 1998, the requested project consists of the following components.

- Construction of 45 micro schemes.
- Procurement of the equipment and materials which will be used for the construction of 45 micro schemes to be constructed by RWSB including spare parts for the equipment and vehicles procured under the phase 1 project.
- Construction of macro schemes in the Lomahasya and Majembeni areas.

In December 1999, the Preparatory Study Team was dispatched to Swaziland in response to the above request, and the contents of the request were confirmed. However, the macro schemes were not judged to be appropriate because of high construction costs, high operation and maintenance costs, etc.

CHAPTER 2 CONTENTS OF THE PROJECT

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2.1 Basic Concept of the Project

This project has the following project targets related to the improvement of rural water supply conditions as above mentioned.

1) Improvement of rate of water service and health and sanitation and living standard for rural population in Swaziland (improving rate of water rural service from 49% to 54%)

2) Establishment of sustainable well operation and maintenance system by community residents

3) Improvement of capacity of RWSB since it conducts well drilling works as the implementation agency

This project conducts the construction of 78 sites micro scheme, software assistance for training of promotion of technical transfer and capacity building for community leaders and government officers to achieve these targets. In these works, micro scheme construction, procurement of the necessary equipment and materials for construction, technical transfer of drilling works, and training and workshop for promotion of operation and maintenance by residents will be conducted by this Japanese grant aid project.

The general features of the project are summarized in Table 2.1 in the form of PDM (Project Design Matrix).

2.2 Basic Design of the Requested Japanese Assistance

2.2.1 Design Policy

Basic policy in the study was to adopt a production plan based on total drilling depth as contribution for cost reduction to eliminate risk of contractor based on uncertainty of number of unsuccessful well. Scope of work of Japanese side is to drill boreholes by production method (total depth length 8,100 m (about 50 sites)) to meet the objectives to improve water supply conditions in Swaziland, to construct well facility superstructure work (8 sites: construction for test boring well drilled in basic design stage by the duty of Swaziland side) with installation of hand pump, to conduct OJT (about 20 sites remaining) of drilling work under the share of Swaziland side, to procure the required equipment and materials for borehole drilling, and to offer funds to conduct software assistance to contribute the smooth operation and maintenance of new constructed well facilities and drilling equipment procured by the first project. The basic design was drawn up based on the following design policy.

(1) Overall Policy

- The project should be implemented employing local contractors and suppliers effectively in order to reduce construction costs as much as possible, but the quality and durability of the constructed facilities should be assured at the level necessary for their sustainable operations.
- It is considered quite difficult to explore groundwater in Swaziland since the target water is fissure water flowing in the cracks and faults of hard rocks. Considering this characteristics

of groundwater development in the country, the project implementation schedule and work should be established to make it easier for further groundwater development and higher success rate of drilling in order to implement the project smoothly.

- Construction of micro scheme facilities will be made both by the Swaziland and the Japanese sides, and the equipment and materials procured under the 1st. phase of the project should be used exclusively for the construction works by the Swaziland side.
- In case the first drilling attempt of a borehole is unsuccessful at a certain site, a second drilling attempt will be conducted. However, if the second borehole is also unsuccessful, then, it will be subject to discussion whether the third drilling should be conducted or not. If the third drilling is unsuccessful or both Japanese and Swazi sides agree the third drilling shall not be conducted, no alternative borehole site will be considered.
- The water supply facility to be constructed under the project should be the micro scheme which is considered to be a tubewell with a hand pump unit.
- The 8 tubewells confirmed as successful for production tubewells for test drilling in the basic design study should be deducted from number of sites constructed by Japanese side under the production method in the implementation stage, and their related facilities such as hand pumps aprons, etc. should be installed and constructed by the Swazi side in the implementation stage.

(2) Policy for Natural Conditions

- Dry and wet seasons are clearly distinguished in Swaziland with much rainfall observed during the wet season from December to February. In planning the construction schedule, it is necessary to consider the bad road conditions during wet season.
- The target aquifer expected for groundwater exploitation flows in cracks and faults in unweathered hard rock. This geological condition should be considered and it is necessary to plan the tubewell drilling schedule and the tubewell structures which enable the drilling of rock zone till 100 m deep.

(3) Policy Related to Socio-economic Conditions

- In Swaziland, the operation and maintenance of the tubewell facilities are considered as the responsibility of the community based on the participatory method. PHAST (Participatory Hygiene and Sanitation Transformation) workshops on the necessity of safe water for health and sanitation improvement and the training Seminars on the community-based management of Water and Sanitation Committee (hereafter referred to as WSC) shall be held. It is considered necessary to coordinate and facilitate these activities in implementing the project.
- The fence around micro schemes and the access road from main road to the site should be constructed by the community in order to facilitate understanding of identification of the tubewell facility to the community.

(4) Policy on Construction Condition

- The materials to be incorporated in the construction works should conform to South African Bureau Standard (hereafter referred to as SABS) prevailing in Swaziland and/or those compatible to SABS in order to make the construction easier and to assure the quality of the constructed facilities as well as the operation and maintenance of the facilities.

(5) Policy for Use of Local Contractors and Materials

- Although Japanese staff can be considered for supervising the construction works on a minimum basis, local engineers contractors who are considered to have technical knowledge and experiences capable to do the supervisory services satisfactorily should be used for supervision and construction works.
- The equipment and materials for the construction should be those of South African or Swazi makers who have factories or agents in Swaziland or South Africa.

(6) Policy on Capability of Executing Organization for Operation and Maintenance

- The RWSB drilling team is considered capable to drill boreholes by the DTH (Down-the-Hole) method, although they do not have experience in drilling by the rotary method or the combination of these methods. Since about five years has passed since the drilling equipment and vehicles were procured under the previous 1st phase project, mechanical trouble and damage takes place more frequently. However, the present operation and maintenance staff do not have operation and maintenance experience for drilling equipment. Further drilling works will not be able to be done without the equipment procured in 1st phase project. The working life of the equipment is considered as one of the important factors in the progress of construction works. Therefore, various training sessions should be held both in lecture rooms and fields as one of the activities of software assistances in order to transfer the technology of operation and maintenance of the drilling equipment as well as drilling skills for the establishment of sustainable formation of groundwater.
- Since there is shortage in the number of RWSB staff who are capable to determine drilling sites based on hydrogeological considerations, determination of geophysical survey method, etc., software assistance is considered necessary for RWSB to determine drilling sites properly by themselves.
- The operation and maintenance of the water supply facilities should be carried out by the maintenance group formed in the communities under the direction of RWSB. Software assistance consisting of trainings and educational activities should be made in order to facilitate their activities for smooth and effective implementation.

(7) Policy on Scope and Grade of Facilities and Materials

<Tubewell Construction>

- It is difficult to explore for groundwater in the study area because the groundwater targeted is typically fissure water. Therefore, the ratio of successful tubewells and standard yields should be set to match with the actual situation based on the results of drilling performed in the 1st phase construction as well as the test drilling carried out in the basic design stage.
- Hand pumps to be installed for micro schemes should be of the Afridev type, for which the operation and maintenance are established on a community basis in Swaziland. The Bush type will also be considered as required.
- The population to be served by a micro scheme is set in the range from 250 to 500, and the water consumption per capita is set at 15 liters/capita/day.
- The materials incorporated in the tubewell facility should be those used popularly in Swaziland, and the structures should ensure proper protection of the water points as well as

the groundwater.

<Procurement of Equipment and Materials>

- The spare parts of the equipment and vehicles procured under the 1st phase project should be procured basically in the countries of such procured equipment and vehicles, but the consumables and tools available in local or South African markets should also be included as much as possible.
- The electric generator procured under 1st phase project seems to be left unused because of inconvenience of transportation due to its size and weight. Hence it should be remodeled to trailer type to improve transportability.
- Spare parts should be supplied for drilling rig, air compressor, etc. procured in Japan. However, spare parts will not be supplied under the project for the vehicles procured in South Africa, since they are well maintained and kept in good conditions.
- The requested concrete mixer, back-hoe and fuel tank trailer should be procured in Swaziland or South Africa.

(8) Policy for Procurement Method and Implementation Period

- The project should be implemented in the manner that will enable completion of the project on a single budget year.
- In the implementation schedule, it is necessary to consider that the drilling of the sites where access is available only in the dry season should be made in the dry season.
- The time schedule for the construction (to be made by Swaziland side under the software assistance) should be prepared to maximize the training effects and to proceed smoothly considering the technical levels of the drillers.

2.2.2 Basic Plan

(1) Overall Plan

<Communities for Construction of Micro Schemes>

At the beginning of the basic design survey, 86 sites (46 communities) requested the construction of micro schemes, but during the confirmation process, the number increased to 100 sites (51 communities). Of these, 78 sites (39 communities) were selected for the micro scheme construction as shown in Table 2.2.

The appropriateness of these confirmed sites and communities for the micro scheme constructions were studied from the viewpoints of access conditions to the sites, socio-economic conditions, and hydro-geological conditions. Inadequate communities and sites were excluded from those for the construction. Consequently, 78 sites (39 communities) are selected for the micro scheme construction as shown in Table 2.2. Since eight sites had confirmed successful boreholes during test drilling, they were deducted from the total of 78 sites; thus, 70 sites (34 communities) are selected for construction of micro schemes in the implementation stage.

The hand pump installation and construction of related facilities for the eight sites of successful boreholes should be made in the detailed design stage by the Swazi side with the materials to be provided by the project in order to complete and receive the benefits of the tubewells. A civil

engineer will be assigned to facilitate these works as one of the activities of technical assistance.

The following table shows the regional breakdown of the number of communities and sites.

Number of Communities and Sites for Construction of Micro Schemes

Region	Original Request		Confirmed Request		Excluded Sites and Communities						Selected for Const.		Selected for Test Drilling	
					Access		Socio-economy		Hydrogeology					
	Site	Com'ty	Site	Com'ty	Site	Com'ty	Site	Com'ty	Site	Com'ty	Site	Com'ty	Site	Com'ty
Hhohho	19	4	19	4	-	-	5	1	(1)	-	14	3	13	3
Manzini	32	13	32	10	-	-	-	-	(3)	(1)	32	10	29	9
Lubombo	16	17	30	26	1	-	8	7	(3)	(3)	22	19	19	16
Shiselweni	19	12	19	11	1	1	8	3	(1)	(1)	10	7	9	6
Total	86	46	100	51	2	1	21	11	(8)	(5)	78	39	70	34

Note: Hydrogeological condition is based on the results of test drilling.

The location of each community is indicated in Fig. 2.1.

Access Condition

As shown in Table 2.2, the access conditions from main roads to most sites are considered to be good, although there are a few sites to which the access from main roads may become bad during the wet season. There are only two sites inaccessible throughout the year as shown in the following table.

Inaccessible Sites

NO.	Community No.	Region	Community	Sites
1.	L2-6	Lubombo	Mphanganyeti	One of two sites
2.	S2-1	Shiselweni	Mambuzikazi	One of one site
			Total	Two sites

The above two sites are excluded from those communities for tubewell construction under the project.

Socio-economic Conditions

The guidelines for applying the construction of rural water supply facilities and the necessity of the safe water in each community are considered as the socio-economical conditions. As a result, 21 sites (11 communities) are excluded from those for micro scheme construction as stated below.

According to the guidelines of Swaziland, the establishment of Water and Sanitation Committee and the deposit of initial funds are stipulated as essential conditions for micro scheme construction. These items are confirmed in the socio-economical study and 10 sites (7 communities) shown in the following table are excluded from those for the micro scheme construction because one or both of the above conditions are found lacking.

Communities Lacking Guideline Conditions

No.	Community No.	Region	Community	Site
<No Water & Sanitation Committee>				
1.	L2-20	Lubombo	Buloyini	1 site
2.	L2-24	Lubombo	Macambani	1 site

Communities Lacking Guideline Conditions

3.	S2-6	Shiselweni	Nenekazi	2 site
4.	S2-9	Shiselweni	Dinabanye	3 site
<No Initial Fund>				
5.	L2-4	Lubombo	Madadeni	1 site
6.	L2-15	Lubombo	Egushede	1 site
7.	L2-17	Lubombo	Etinqumatsini	1 site
			Total	10 site

The remaining communities are further evaluated from the viewpoint of the necessity of safe water considering the criteria indicated in the following table with the maximum mark set at 11.

Evaluation Criteria for Socio-economic Aspect

Item	Point	Description
Improved Latrine	1	Rate of Use: More than 50 %
	0	Rate of Use: Less than 49 %

Evaluation Criteria for Socio-economic Aspect

Item	Point	Description
Diseases	2	Diseases of 1 (very common) and 2 (common): More than 6
	1	Diseases of 1 (very common) and 2 (common): From 3 to 5
	0	Diseases of 1 (very common) and 2 (common): Less than 2
Distance to Water Source	2	Average Distance: More than 3,000 m
	1	Average Distance: From 1,000 to 2,999 m
	0	Average Distance: Less than 999 m
Yield in Dry Season (Satisfaction)	2	Average Yield: More than 3 (3=ok, 4=poor)
	1	Average Yield: From 2 to 2.9 (2=acceptable)
	0	Average Yield: Less than 1.9 (1=good)
Quality in Dry Season (Satisfaction)	2	Water Quality: More than 3 (3=ok, 4=poor)
	1	Water Quality: From 2 to 2.9 (2=acceptable)
	0	Water Quality: Less than 1.9 (1=good)
Water-related Problems	2	Number of Problems: More than 6
	1	Number of Problems: From 3 to 5
	0	Number of Problems: Less than 2

The results of evaluation are presented in Table 2.3, and the total points of each community varies from 2 to 11. The necessity of safe water is low in communities for which the total points is not more than four; Hence, the following 11 sites (4 communities) are excluded from those for micro scheme construction.

Communities for which Well Necessity is considered Low

No.	Community No.	Region	Community	Site
1.	H2-1	Hhohho	Meleti	5 sites
2.	L2-6	Lubombo	Mphanganyeti	2 sites
3.	L2-25	Lubombo	Mbokojweni V	1 site
4.	S2-10	Shiselweni	Osabeni/Mfulamudze	3 sites
			Total	11 Sites

Hydrogeological Condition

As a result of the test drilling conducted in the basic design study, the following 8 sites (8 communities) are confirmed as successful wells.

Successful Tubewells based on Test Drilling

No.	Community No.	Region	Community	Site
1.	H2-4	Hhohho	Mawombe	1 site
2.	L2-3	Lubombo	Mantjolini	1 site
3.	L2-5	Lubombo	Etipokweni	1 site
4.	L2-8	Lubombo	Maphungwane/Esibovini	1 site
5.	M2-1	Manzini	Moneni	1 site
6.	M2-7	Manzini	Ntabamhloshana	1 site
7.	M2-10	Manzini	Emseni Mfangibhekile	1 site
8.	S2-8	Shiselweni	Emaganyaneni	1 site
			Total	8 sites

As for these eight tubewells, their hand pump units will be installed and the related facilities will be constructed by the Swazi side as soon as the necessary materials for construction and installation are delivered to the site.

<Equipment and Materials to be Procured>

The following equipment and materials will be procured under the project.

Confirmed Equipment and Materials Requested by the Swazi Side

№	Equipment and Materials		Qty	Unit	Remarks
<Requested Equipment and Materials>					
1	Hand Pump		1	Lot	
2	Casing and Screen Pipes		1	Lot	
3	Materials for Well Facilities (Sand, Cement, Aggregates)		1	Lot	
4	Fuel, Oil and Lubricants		1	Lot	
5	Bentonite and Forming Agent		1	Lot	
6	Back Hoe		1	Set	
7	Concrete Mixer		1	Set	
8	Fuel Tank Trailer		1	Set	2 m^3
<Spare Parts for Equipment and Vehicles Procured under Phase 1 Project>					
1	Truck-mounted Drilling Rig with Tools and Attachments		1	Set	
2	High Pressure Air Compressor with Tools, etc.		1	Set	
3	Diesel Generator with Tools		1	Set	
4	Electric Logging Equipment with tools, etc.		1	Set	
5	Geophysical Survey Equipment with Attachments, etc.		1	Set	
6	Pumping Test Equipment		1	Set	
7	Water Quality Analysis Equipment		1	Set	
8	Workshop Equipment		1	Set	
9	Vehicle Spare Parts	Rig Truck	1	Set	NISSAN TFA430KHN
		Compressor Truck	1	Set	NISSAN TFA430KHN
		Tank Lorry Truck	1	Set	NISSAN TFA430GLN
		Crane Cargo Truck	1	Set	NISSAN TFA430KHN
		Station Wagon (two)	1	Set	TOYOTA LAND CRUISER

(2) Facility Plan

<Water Supply Plan>

According to the field survey, unit consumption per capita is considered to be 10 - 15 liters/day/capita, though it varies depending on type of available water source, distance to water source, etc. Tubewell water is usually only used for drinking and cooking, and the water of small streams and ponds for washing and bathing. The population served by one tubewell is set from 250 to 500 so that the distance to the water source points does not exceed one km

considering the shape of service area (community) and distribution of homesteads. The field survey confirmed that this condition is almost always fulfilled, although in some communities the served population was found to exceed this range. In this basic design, the population served by one tubewell and the water consumption per capita are set basically in the range from 250 to 500 and 15 liters/day/capita, respectively.

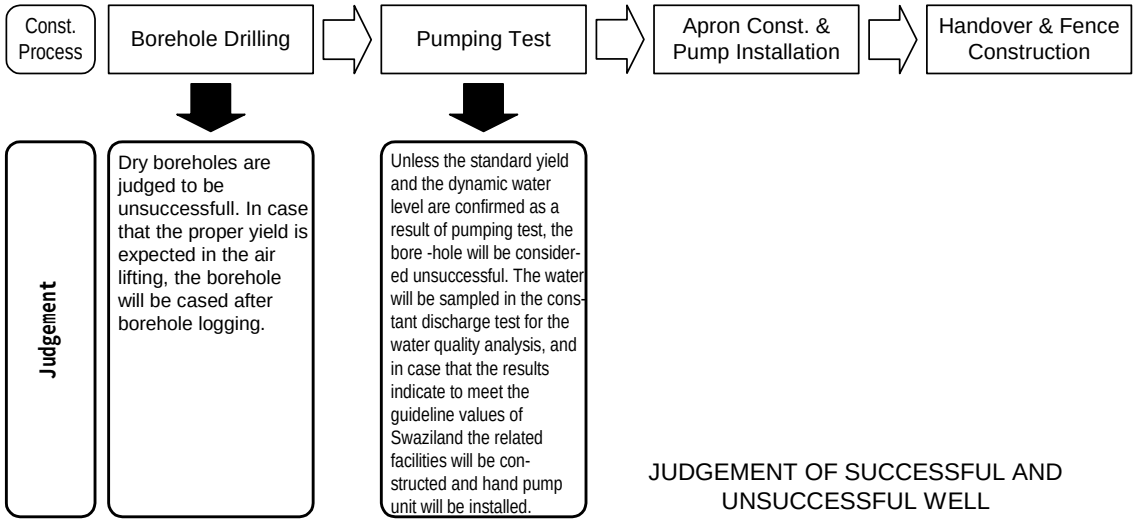
<Water Sources>

Water Quality

RWSB water quality records after the completion of Phase 1 project indicate that there are some parameters exceeding the values stated in the guidelines of Swaziland in some boreholes although the extent of such excess is small. Such parameters are iron, manganese, fluoride, chlorine and TDS. However, the distribution of boreholes for which the parameters exceed the guidelines does not seem to concentrate in any area except in the Manzini district; such boreholes are spread widely in the country. Therefore, water quality analyses will be conducted in all the boreholes to be drilled under the project, and in case any parameters are found to exceed the guideline values, the judgment as to whether such boreholes are to be used for water supply or not will be determined after discussion with RWSB and after considering the extent of excess, type of exceeding parameter, etc.

Judgment of Successful and Unsuccessful Well

The successful and unsuccessful wells will be judged by the procedures shown in the following figure.



JUDGEMENT OF SUCCESSFUL AND UNSUCCESSFUL WELL

In case no water is struck during drilling, the borehole is judged to be dry, and a second drilling will be conducted at a second site. If any water is found, and its yield is confirmed to be enough for a production well in the air lifting, then the borehole will be cased after electric logging. In the pumping test, its appropriate yield and draw down will be observed in order to confirm that the observed yield is not less than the standard yield and the dynamic water level is not less than the allowable depth. Standard yield is set at 0.2 liters/sec considering the pump-up capacity of the Afridev pump. The dynamic water level drawn down after pumping-up should not exceed 50

m because the maximum depth of groundwater level to which the male adult can pump up the water by Afridev pump is considered to be about 45 m. Therefore, the borehole for which the dynamic water level is observed to be more than 45 m deep will be considered unsuccessful. In case the yield is observed to be less or the dynamic water level of a tubewell is found to be below -45 m as a result of the pumping test, the judgment whether such boreholes are used for water supply or not will be determined after the discussion with RWSB and after considering the necessity of such water wells in the community.

Rate of Successful Boreholes

As shown in the following table, the rate of successful tubewells is 53.3 % in the test drilling conducted in the basic design study, and the rate of the phase 1 project is estimated to be 56.4 %. Therefore, 55.0 % is adopted for this project.

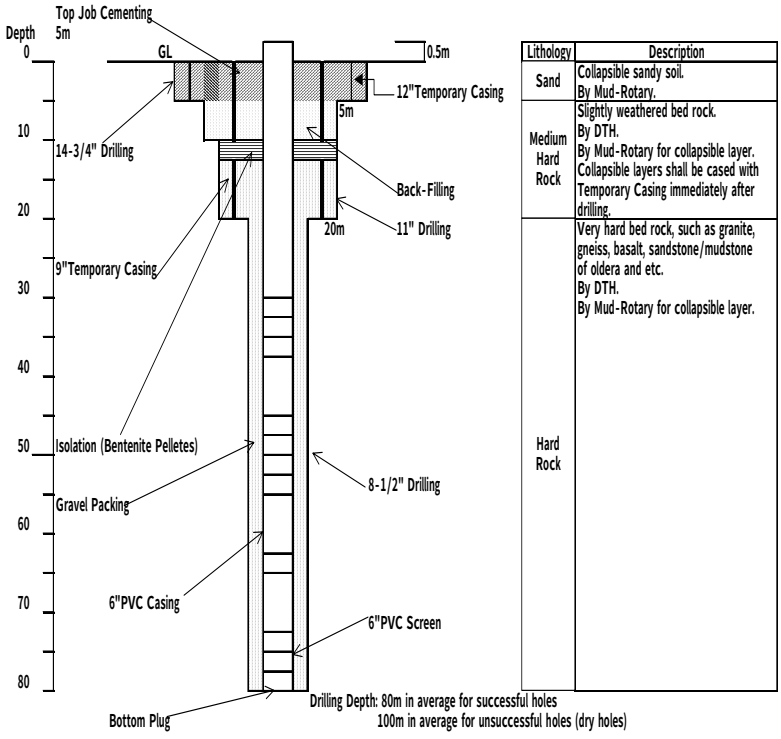
Rate of Successful Boreholes

Geology	Phase 1 Project		Test Drilling of Basic Design Study		Adopted Rates (%)
	No. of Boreholes	Rate (%)	No. of Boreholes	Rate (%)	
Granite	14	41.0	3	33.3	39.6
Gneiss	35	60.0	3	100.0	63.2
Sandstone	11	43.8	3	33.3	41.6
Basalt	5	65.4	2	100.0	75.3
Rhyolite	10	75.0	4	25.0	60.7
Total/Ave.	75	56.4	15	53.3	55.9

<Tubewell Facility>

Standard Tubewell

Geologically, rather unweathered rocks appear in the shallow depth in the Highveld area, while the surface portion is usually composed of weathered rocks which form the thick soil layers in the Middleveld and the Lowveld areas. Only four communities out of those proposed for micro scheme construction are located in the Hhohho region considered as the Highveld area, and the others are located in the Middleveld and the Lowveld areas. Therefore, it is necessary to provide casing pipes in the surface and weathered layers to protect the drilled borehole from collapsing during



STANDARD STRUCTURE OF TUBEWELL

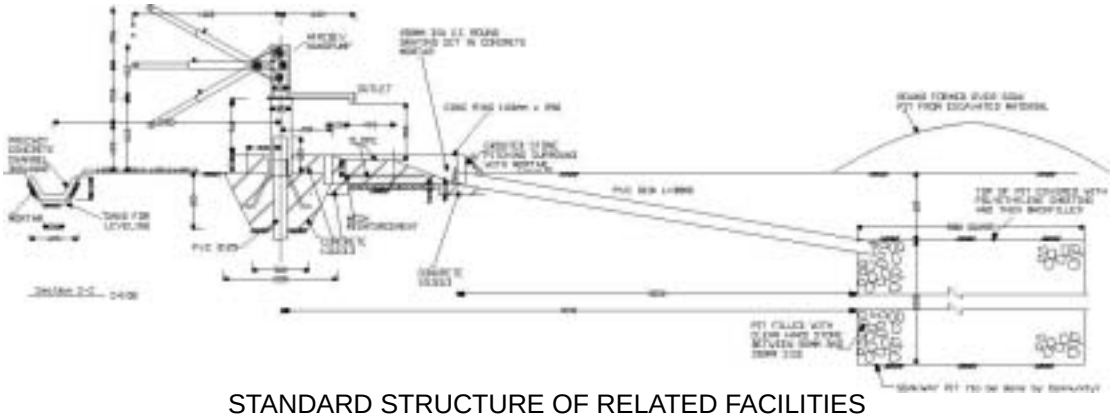
drilling. In Swaziland, the structure of the tubewell drilled for micro and macro schemes is standardized by RWSB, applying PVC casing and screen pipes of 6 in. dia. Based on this standardized tubewell structure, it is proposed to apply the telescopic type of tubewell in the project as shown in the following figure.

The records of 1st phase project indicate that the depths of drilled boreholes vary from 50 m to 120 m, and in the volcanic rock area it is rather shallower than the average and with the maximum depths of 66 m and 80 m, , while in the other areas, the maximum depth reaches to 120 m. The average depth weighted by the number of the proposed drilling sites is calculated to be 75.9 m, and the average and maximum depths of drilled tubewells are set at 80 m and 100 m, the as same as in 1st phase project.

Considering that the depths of successful and unsuccessful boreholes are 80 m and 100 m, respectively and the design success rate is set at 55.0 %, the total depth of drilling is calculated to be 8,100 m to construct the successful boreholes of 50 sites. Limited drilling of 8,100 m will be made during the construction stage of the project with the target to construct 50 successful tubewells. The Lomahasha area for which the construction of macro schemes were requested in the original request is situated geologically in the Rhyolite area. Since the success rate of this geological category is calculated to be as low as 25.0 % based on the result of test drilling conducted under the basic design study, it is considered to be quite difficult to explore the groundwater in the area. However, this area is considered to have the highest priority area in providing water supply system. The success rate of the Rhyolite area was as high as 75.0 % in the phase 1 project because the drilled sites were located at geologically rather advantageous sites. The average value was calculated to be 60.7 % based on the results of the test drilling conducted in the basic design study. Since 12 boreholes sites are planned to be constructed in the Lomahasha area under the project, the drilling should be limited with total drilling depth of 1,760 m based on the average success rate. This limit should give fair opportunity to the people in whole of the project area, because exploitation of the groundwater in the Lomahasha area is considered to be difficult.

Appurtenant Facilities

Appurtenant facilities of micro scheme consist of hand pump stand, apron, drainage pipe and protection fence. The hand pump stand and apron are concrete made structures, and the hand pump stand must be especially strong to guard against burglary. The soak pit is a cube measuring 2 x 2 x 2 m, and filled with cobble stones. The walls of soak pit are made of concrete blocks of 150 mm thickness. A PVC drainage pipe of 100 mm dia. is provided connecting the apron with the soak pit in order to convey the drainage water to soak pit. A drainage channel is provided around the facility, and gravel is placed in the area surrounding the apron to prevent the ground from becoming muddy. The area is surrounded by the protection fence to avoid intrusion of domestic animals. The fences and the soak pits will be constructed by community members as one of their participatory activities.



STANDARD STRUCTURE OF RELATED FACILITIES

Hand Pump

There are two types of hand pumps (Afridev and Bush Types) which are considered to be the standard type of VLOM pump in RWSB. The Afridev type hand pump was adopted in 1st phase project, and its maximum lifting head is as deep as 60 m. Because of its long durability under the proper maintenance, the Afridev pumps are used widely in Swaziland. The Bush pump, which has maximum lifting head of about 100 m, is considered to have good performance. However, the only agent in Swaziland has recently closed and it has become difficult to obtain its spare parts.

<Drilling Procedures>

The tubewells for micro schemes are drilled by the following procedure.

Standard Tubewell Drilling Procedure

Step	Work Descriptions
1	Drill the covering soil layer up to 5m with 14-3/4' tricone-bit. Insert a 9-inch conductor pipe to prevent collapsing of the drill wall. Rotary drilling with mud is employed.
2	Further drill down in the underlying fragile weathered rock with 11 inch DTH system until it reaches unweathered rock layer. The unweathered rock is expected be encountered at around 20m below GL. Insert a casing immediately after the termination of drilling to prevent collapsing of the drill wall that can be collapsed easily. In case the rock is found to be so highly fragile as to make the drilling with a DTH system impossible, the drilling with rotary bit and mud circulation is employed.
3	Install 9 inch casing to prevent collapsing of the drill wall.
4	Drill in the unweathered rock layer by the DTH system with 8- 1/2 inch hammer till the specified depth.
5	If more than a 0.2l/s of discharge by air-lifting is confirmed and the static water level is within 50m below GL at the same time, the drilling is considered to be successful. Insert 6 inch PVC screen-casings (inner dia.) in this case. If the well doesn't satisfy the above two conditions, it should be buried again as an unsuccessful well.
6	Develop the well using a compressor. The well should be cleaned until the water becomes clear.
7	Install a submersible pump and conduct pumping tests.
8	Collect water samples during the continuous pumping test.
9	If the water quality analysis results meet the standard of Swaziland, construct the well head structure and install a hand pump.

(3) Procurement Plan of Equipment and Materials

The equipment and materials to be procured under the project are listed below.

Basic Consideration of Procurement of Equipment and Materials

№	Item	Description
<Requested Equipment and Materials>		
1	Hand Pump	These will be procured for the micro scheme constructions executed by Swaziland side. Afridev and Bush pumps will be applied in terms of availability of those spare parts from South Africa and after service.
2	Casing and Screen Pipes	These will be provided for the micro scheme constructions executed by the Swaziland side. Considering the ease of procurement and durability against decay, PVC pipes manufactured based on South Africa Bureau Standard (SABS) or other equivalent standards will be applied.
3	Materials for Well Facilities (Sand, Cement, Aggregates)	These will be provided for the micro scheme constructions executed by the Swaziland side. These materials will be procured from suppliers in Swaziland.
4	Fuel, Oil and Lubricants	
5	Bentonite and Forming Agent	
6	Back Hoe	It should have the capability to prepare access roads and land leveling in the construction sites.
7	Concrete Mixer	It will be used for the construction of wells appurtenant facility , and it should be compact and mobile type.
8	Fuel Tank Trailer	Its capacity should be approximately 2 m^3.
<Spare Parts for Equipment and Vehicles Procured under Phase 1 Project>		
1	Truck-mounted Drilling Rig with Tools and Attachments	The equipment used for 5 years since it was procured under the Phase 1 Project, is entirely superannuated. Due to the vibration and impact in operation, some parts such as oil pressure hose, wire, line oilier, etc. have deteriorated, and replacement of these parts is required. At present, they are not in operation because some damage was found in the line oilier and in the shaft of gear box, oil pressure unit. For the future drilling plan, these parts are required to be replaced and repaired. Drilling tools will also be procured under the project together with the tools for assembling and disassembling the equipment.
2	High Pressure Air Compressor with Tools, etc.	The air compressor has been entirely exhausted, and cracks were found on oil pressure pipe. For the future drilling operation, it is necessary to replace these superannuated and deteriorated parts.
3	Diesel Generator with Tools	The equipment has been used for 5 years since it was procured under the Phase 1 Project, and partial consumable spare parts will be supplied. And trailer will be supplied for mobility.
4	Electric Logging Equipment with tools, etc.	The equipment has been used for 5 years since it was procured under the Phase 1 Project, and partial consumable spare parts will be supplied.
5	Geophysical Survey Equipment with Attachments, etc.	It is generally in good condition. However, supply of some parts such as battery charger is required.
6	Pumping Test Equipment	Two submersible pumps (one is high and the other one is low capacity pump) supplied in the phase 1 project are seriously damaged. Therefore, equivalent pumps should be supplied for the future development plan.
7	Water Quality Analysis Equipment	The reagents supplied in phase 1 project have been almost consumed. Equivalent quantity of those will be supplied.
8	Workshop Equipment	This consists of equipment and tools necessary for maintenance and management of drilling machines and existing wells; the welding machine and some other handling tools will be supplied.
9	Vehicle Spare Parts	Depending on each condition of these motor vehicles, general consumable spare parts and other necessary parts will be supplied.

2.2.3 Basic Design Drawing

The following basic design drawings are prepared for construction of micro schemes.

- Location Map of Communities Proposed for Micro Scheme Facility

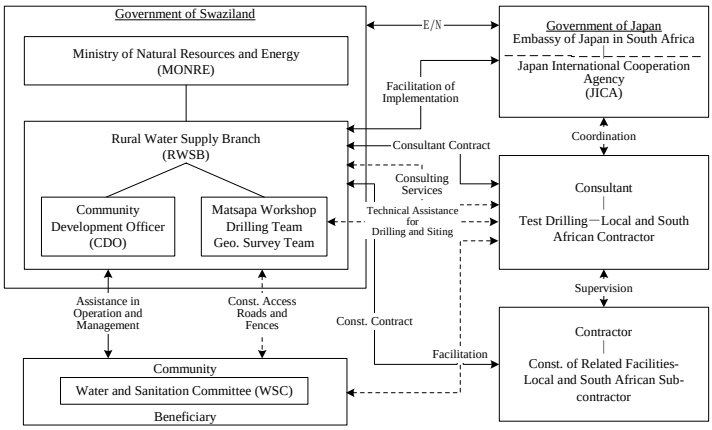
- Standard Tubewell Structure
- Hand Pump Installation and Standard Structure of Apron

2.2.4 Implementation Plan

(1) Implementation Policy

<Project Implementation Organization>

The project is implemented in accordance with the conditions stipulated in the Exchange of Notes agreed between Japan and Swaziland governments. The Rural Water Supply Branch (RWSB) of the Ministry of Natural Resources and Energy will be responsible for the implementation of the project. The operation and maintenance of the facilities and equipment will be conducted by RWSB after the project implementation. RWSB will hire the consulting firm for engineering services such as detailed design, preparation of tender documents, construction supervision, procurement management, software assistance, etc. The local contractors who have the ability to conduct the drilling works of the project will be utilized as much as possible in the drilling of boreholes. The organizations related to the project and their relationships are presented in the figure.



IMPLEMENTATION ORGANIZATION

<Methods of Construction>

The total number of the proposed drilling sites is 78 sites (39 communities), 8 sites (5 communities) was confirmed as successful tubewells and the completion of works such as installation of hand pump etc. will be made by Swazi side. The remaining 70 sites (34 communities) will be constructed under the micro scheme. In this grant aid, the Japanese contractor will construct the production work as total drilling depth of 8,100 m (about 50 sites) and the Swazi side will construct the remaining sites (about 20 sites) under the OJT of the drilling company.

The drilling team of the RWSB Matsapha workshop is responsible for operation and maintenance of the equipment procured under the 1st phase project, and this drilling team will be assigned for the construction of tubewells. The members of the drilling team were trained by a Japanese drilling contractor during the 1st phase implementation, and they have some skill to perform the drilling works by DTH method in the rock zone. However, they are not familiar with the drilling works by the rotary or the combination of rotary and DTH methods, and it is considered that they need some technical assistance in this aspect. The number of tubewells to be drilled by the government drilling team will be determined considering their experience and the available period for drilling.

<Use of Local Engineer>
During project implementation, about 3 or 4 drilling rigs and at least one pump-up test team will always work in the sites under the Japanese consulting firm during the test drilling. Many engineers and supervisory staff will be required for management and control of the construction works. The local human resources such as engineers and supervisors will be utilized as much as possible to reduce project costs.

<Necessity of Technical Transfer>
RWSB has so far constructed about 30 tubewells since the hand-over of equipment procured under the 1st phase project; however, their work efficiency is not considered to be good. This might have occurred because of shortage of funds, but it is mostly due to lack of drilling skills, shortage of daily equipment maintenance activity, lack of knowledge in scheduling the supply of drilling consumables (such as fuel and lubricant), and lack of technical knowledge in selecting the drilling site properly. Therefore, in the construction on its own account basis, the technical assistance of overall management of the drilling works (including progress control, procurement management of construction materials, operation and maintenance of the equipment) as well as the technical transfer in drilling technology will be provided. In addition, it is necessary to provide technical transfer by a hydrogeologist to guide the technical staff who are able to study and analyze the results of geophysical survey considering the geological data and records for selecting the proper drilling sites. It is possible to establish the work in RWSB to conduct a series of activities such as selection of proper drilling sites, electric logging, pump-up tests effectively on sustainable basis.

(2) Implementation Conditions

<Access Condition>
The wet and the dry seasons are clearly distinguished in Swaziland. Due to the bad conditions of access roads in the wet season, it is impossible to access the drilling sites. It is necessary to consider the travel among the drilling sites especially during the wet season in order to smoothly conduct the drilling works.

<Construction Schedule and Technical Transfer>
The project tubewell construction will consist of those for the account of Swaziland and those carried out by the Japanese contractor. The drilling works Swaziland's own account will be conducted with technical assistance by a Japanese drilling engineer. The drilling team members of Swaziland have been trained with on-the-job training (OJT) by the Japanese contractor during the 1st phase implementation, and they are judged able to manage the drilling works by DTH method. However, they are not familiar with the drilling by the rotary and the combination of both methods. Their skills for daily and regular maintenance of the equipment is not considered satisfactory since it is lacking measures for urgent treatment in case of accident, etc. In addition, they do not have the proper technology and know-how for managing the drilling works. The construction schedule for the works to be carried out by Swaziland has to be prepared to allow enough time to provide the technical assistance.

<Obligation of Swaziland Side>
As mentioned later, the equipment and materials for the construction works for the account of

Swaziland will be procured under the project, but the salary and allowances of the drilling staff, and the consumables such as fuel and lubricants for the equipment will be shouldered by the Swaziland side. It is important to coordinate between Japanese and Swaziland sides on timing and quantities to be supplied in order to proceed smoothly with the construction works as well as to avoid the unnecessary idle time.

(3) Scope of Works

The scope of works of the Japanese and the Swaziland sides are stated in the following table.

Scope of Swaziland and Japanese Government

Description		Japanese Side	Swazi side
(1)	Land Acquisition for Facilities and Const. Works		○
(2)	Land Acquisition for Warehouse of Equipment		○
(3)	Preparation of Access roads to the Sites		○
(4)	Procurement of Spare Parts for Equipment Provided under Phase 1 Project	○	
(5)	Procurement of Materials and consumables for Facilities to be Constructed by Swazi Side	○	○
(6)	Drilling of Tubewells and Construction of Related Facilities*	○	○
(7)	Installation of Hand Pumps*	○	○
(8)	Const. of Soak Pits and Protection Fences**		○

Note *: The construction of related facilities and the installation of hand pumps for the tubewells (to be constructed by the Swazi side) will be conducted by the Swazi side.
**: The construction of soak pits and protection fences will be conducted by the beneficiary after handing over.

Among materials indicated above in Item (5), the following materials and consumables will be procured by the Japanese side.

Materials and Consumables to be Procured by Japanese Side for Construction by Swazi Side

・ Bentonite	・ Casing Pipes	・ Gravel for Packing	・ Concrete Ring
・ High Early Strengthen Agent	・ Screen Pipes	・ Cement	・ Concrete Channel
・ Forming Agent	・ Centralizers	・ Wire Mesh (3mm dia.)	・ Grating
・ Mud-water Admixture	・ Bottom Plugs	・ PVC Pipes (110mm dia.)	・ Hand Pumps

The other materials and consumables locally available such as fuel, lubricants, water, sand, gravel for aggregates, concrete forms, cobble stones, etc. will be procured by the Swazi side.

The construction works will be conducted by both the Japanese and the Swaziland sides. The construction works are the direct works by the Swaziland side utilizing the equipment procured under the 1st phase project and the works by Japanese contractor. Japanese contractor will construct by commissioning works to local subcontractors. The protection fence and the soak pit will be constructed by community members as part of their participatory activities.

(4) Supervision Plan

The project will be implemented under the Japanese Grant Aid System. A consultant will execute the detailed design study and construction supervision, including the software assistance and selection of well sites, etc., necessary for the implementation of the project.

Detailed Design

In this phase, the detailed design, drawings, tender documents and other documents necessary for the execution of the Project will be prepared. When the production method will be adopted, selection of well site based on geophysical survey which has been conducted by the contractor strongly affects well success rate, which has been conducted by the contractor. Therefore, the contractor does not do site selection; it is handled by the responsibility of the consulting firm.

Tendering

Consultant will assist RWSB in tendering procedure of the Project. The contract between RWSB and the successful tenderer will go into effect after the verification by the Japanese Government.

Construction Supervision

Consultant will assist RWSB to complete the Project by the scheduled completion date mentioned in the Exchange of Note (E/N), including meeting with contractor prior to the commencement of the construction works, witnessing the shipment of the materials and equipment for the projects sites, and providing the contractors with instructions related to the construction works, equipment installation, test operations, and post installation inspection.

(5) Procurement Plan

In principle, most of the materials/equipment required for the Project are to be procured in Swaziland or in South Africa. Since some equipment procured in the Phase 1 Project were Japanese products, spare parts for this equipment has to be procured from Japan. Drilling tools, bits, etc., are able to be supplied from South Africa. Also backhoe and concrete mixer used for micro scheme constructions will be procured in Swaziland or South Africa. The countries for scheduled procurement by item are listed below.

Scheduled Procurement Country for Main Equipment/Materials

№	Items	Countries		
		Japan	Swaziland	South Africa
Requested equipment and materials for constriction of micro schemes				
1	Hand Pump		○	
2	Casing/Screen Pipe		○	
3	Finishing materials for well construction (aggregates, cement, etc.)		○	
4	Fuel, Oil, Lubricant		○	○
5	Drilling mud and additives, and form agents			○
6	Backhoe		○	
7	Concrete Mixer		○	
8	Fuel Tank Trailer		○	
Spare Parts for Equipment Procured in the Phase 1 Project				
1	Truck Mounted Drilling Rig and Tools	○		
2	Truck Mounted Air Compressor	○		
3	Generators	○		
4	Well Logging Equipment	○		
5	Geophysical Survey Equipment	○		
6	Pumping Test Equipment	○	○	
7	Water Quality Analysis Equipment			○
8	Spare Parts for Equipment & Materials for	○	○	○

Scheduled Procurement Country for Main Equipment/Materials

№	Items	Countries		
		Japan	Swaziland	South Africa
	Workshop			
9	Spare Parts for Motor Vehicles	○		

In the case of procurement in Japan, the equipment and materials will be transported by sea from Japan to Durban, South Africa, and then transported by land from Durban to the RWSB workshop in Matsapha, Manzini Region, through the border in Lavumisa, Swaziland. In the case of procurement in Swaziland, no issue is considered for transportation because most suppliers are located in Mbabane, capital of Swaziland, or Matsapha. In the case of procurement in South Africa, the equipment and materials will be transported by land from Johannesburg to Matsapha through the border of Ngwenya, Swaziland. The final destination for delivery is also the RWSB workshop of in Matsapha.

(6) Implementation Schedule

<Construction Period>

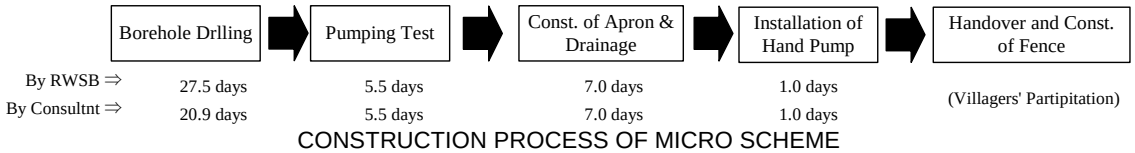
Workable Days

In Swaziland, the usual annual workable days are set as 248 days considering five working days a week, and 13 national holidays. However, the revised annual workable days are set as 258 days considering Saturday as a working day and 42 days as non-working days mainly during the rainy season.

Period for Well Constructions and its Site Number

Most equipment and materials can be procured in Swaziland or in South Africa. It is expected that the procurement period for these equipment and materials is a couple of months for transportation including customs clearance from South Africa.

Borehole drillings will be executed by both RWSB and Japanese contractor who will be selected under the Guideline of Japanese Grant Aid System. RWSB will conduct the drillings using a drilling rig and other equipment that were procured in the Phase 1 Project. On the other hand, Japanese contractor will conduct the drilling as test borings using local sub-contractor(s). The test drilling will be conducted with two or three drilling rigs owned by the local sub-contractor(s).



CONSTRUCTION PROCESS OF MICRO SCHEME

In successful boreholes drilled by RWSB, those appurtenant facilities (apron, drainage, and hand pump) will also be constructed by RWSB. On the other hand, in successful boreholes drilled by Japanese contractor as test boreholes, the construction of the appurtenant facilities will be executed by Japanese contractor selected according to the guideline of Japanese Grant Aid System; the Japanese contractor will implement the construction with the local

sub-contractor. The construction of fence for all the successful wells is to be done by the benefiting villagers after hand-over. In the eight boreholes judged as successful wells in this Basic Design Study phase, RWSB is responsible for the construction of the appurtenant facilities, and should execute the construction after the delivery of the materials supplied under the project.

Each work will be conducted by a separate team such as drilling team, pump test team, installation team, etc. The necessary days for each work are shown in the above figure. In direct construction by RWSB, the period required for the borehole drillings includes time for guidance by Japanese engineer(s) as OJT of the contractor as mentioned before. The period necessary for completion of one well is estimated as 41.0 days for the direct construction by RWSB, plus 34.4 days for the construction by Japanese side including test drilling by the contractor.

Well construction will be executed at 78 sites. After subtracting the eight sites drilled and succeeded in the Basic Design Study phase, 70 sites are the object areas under this Project. It is estimated that RWSB may be able to construct 20 successful wells. Therefore 20 sites will be executed by RWSB, and 50 sites will be conducted as test drillings by Contractor of Japanese side. RWSB is also responsible for the construction of appurtenant facilities for the eight boreholes made in the Basic Design Study phase.

The number of wells to be drilled is calculated as 127 considering the success rate of 55 % (70/0.55 = 127). Out of this, 36 are to be drilled by RWSB, and 91 are to be drilled by Contractor of Japanese side. Since the standard (average) depth of the successful wells is designed as 80 m and 100 m in unsuccessful wells, the total drilling depth is calculated as 8,100 m in the drilling to be conducted by Contractor, and 3,200 m in the direct construction by the RWSB drilling team.

The drilling to be conducted by Contractor of Japanese side is to drill the boreholes of 8,100 m in total with the target to construct successful tubewells at 50 sites. In case the successful tubewells at 50 sites are constructed before the total depth of drilling reaches 8,100 m, the use of remaining depth will be determined after the discussion with the Swaziland government. If as a result of the discussion, additional drilling is continued, it will not be done at sites of direct works by Swazi side. Further, in case the successful tubewells are not constructed even though the drilling of 8,100 m has been conducted, the drilling works will be considered to be completed and the construction of related facilities and the installation of hand pumps will be made for the tubewells considered as successful. If the related facilities could not be constructed at sites of Japanese side, it will be done at wells of the direct works by Swazi side on the discussion.

<Procurement of Equipment and Materials>

For drilling conducted by Contractor of Japanese side, the necessary materials for well construction will be prepared and supplied by the local sub-contractor(s) according to its progress, while the materials for construction to be done by RWSB will be principally procured by this Project.

In principal, these construction materials of micro scheme are to be procured in Swaziland or in South Africa. For procurement, transportation, and delivery inspection, it is assumed that the period required is three to four months when the spare parts are procured in Japan, and one to two months when the materials are procured in South Africa. Actually, eight months will be necessary to prepare the drilling rig for use (since the operation has been stopped), considering the time required for: contractor selection (tendering), delivery of the parts and tools, replacement and repairing, etc.

Japanese Contractor will execute the construction of appurtenant facilities for the boreholes made by Contractor of Japanese side. Approximately, four months will be necessary for the constriction, and the materials necessary for the construction will be provided by the local sub-contractor hired by the Japanese contractor.

<Implementation Term>
As previously mentioned, the Project will be executed within a single budget year. The terms for detailed design study, test boring, and software assistance is shown in Fig. 2.2.

2.3 Obligations of Recipient Country

<Scope of Works of Swazi Side>
The scope of works to be undertaken by the Government of Swaziland is as follows:

(1) To provide data and information necessary for the implementation of the Project
(2) To secure the safety of construction sites
(3) To bear the following commissions of the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement
    - Advising commission of Authorization to Pay (A/P), and
    - Payment commission
(4) To ensure prompt unloading and custom clearance of the materials and equipment procured by the Project
(5) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Swaziland with respect to the supply of the products and services under the verified contracts
(6) To ensure the proper manner of use and the operation and maintenance of the facilities to be constructed and the equipment to be provided under the project.
(7) Exclusive utilization of the equipment and vehicles provided under the phase 1 project
(8) To bear expenses, other than those to be borne by the Grant Aid, necessary for the execution of the project, such as assignment of the RWSB technical staff necessary for the project execution free of charge.

Estimated Expenses to be Borne by Swaziland Side

(Unit: 10^6 yen)

Descriptions	Expenses	Remarks
(1) Preparation of the construction sites of micro scheme facilities	-	All the land is nationally-owned, but the coordination and confirmation with villagers are required.

Estimated Expenses to be Borne by Swaziland Side

(Unit: 10^6 yen)

Descriptions	Expenses	Remarks
(2) Access roads to construction sites from major roads	-	To be constructed by the participatory activities of the benefiting community.
(3) Yards and warehouse for storing the materials and consumables to be procured under the project including staffing	-	Preparation of the existing workshop in Matsapa.
(4) Procurement of construction materials for the tubewells to be constructed by Swazi side.	5.44	Among those necessary for the construction by Swazi side, some materials and consumables of fuel, lubricants, gravel are to be borne by Swazi side.
(5) Provision of equipment provided under the phase 1 project necessary for the construction by Swazi side including maintenance and repair of the equipment	30.38	Drilling rig, crane truck, air compressor, pick-up, etc.
(6) Drilling of boreholes for the tubewells to be constructed by the Swazi side including construction of related facilities and installation of hand pumps.	2.64	The materials for the works are stated separately in Item (4), and the construction works are to be made by the participatory activities.
(7) Construction of protection fences and soak pits	2.64	Gravel and foam for the works are to be provided by the Swazi side.
(8) Provision of staff and vehicles necessary for the drilling operation control	1.07	Staff: 15 x 14 months Drilling vehicles (14 months)
(9) Provision of staff and vehicles necessary for training on hydrogeology and site selection plan	1.14	Staff: 5 x 3.5 months Vehicles: Pick-up (5 x 18.5 months: 1 pick-up for each CDO)
(10) Provision of staff and vehicles necessary for workshops and trainings on strengthening WSCs	5.66	Staff: 5 CDOs for 18.5 months each Vehicles: 5 vehicles x 18.5 months each
(11) Rooms in RWSB for lectures and workshops to be held in the course of software assistance on strengthening of WSCs	-	Rooms in RWSB will be used free of charge.
Total	48.97	-

According to the taxation system of Swaziland, the Value Added Tax (VAT) and the Import Taxes to be imposed on the equipment and materials procured under the grant aid project will be exempted.

2.4 Project Operation Plan

2.4.1 Micro Scheme Facilities

<Guidelines on Operation of Rural Water Supply Facilities in Swaziland>

In Swaziland, requests, construction and O&M of water schemes are done in accordance with "Procedures for the Approval of Rural Water Schemes in Swaziland"; a guideline prepared by Rural Water and Sanitation Sector Liaison Committee in 1998. The basic principle of this guideline is participatory management of water facilities by their users, and the guideline clarifies the roles and responsibilities of WSC.

Application Procedure for Construction of Water Supply Facilities in the Guideline

Step		Items Needed to Get Approval (only those items on participatory management)
1	Proposal	・ Request letter from villagers to an organization that plans to construct water facility or a letter from WSC, proving that villagers understand the construction plan

Application Procedure for Construction of Water Supply Facilities in the Guideline

Step		Items Needed to Get Approval (only those items on participatory management)
2	Planning	・ Proof that villagers understand/accept their roles and responsibilities in O&M of water facility ・ Proof that WSC is established and functioning, and that the initial funds have been collected
3	System Design	・ Detailed plan of participatory management of water facility ・ Contents and plan of training for villagers to follow the above mentioned plan of O&M

According to the Guideline, WSC is made up of a chairperson, a vice-chairperson, secretary, and a treasurer, and all the members of a community choose these executive members through democratic election. Water facility maintenance and repair are carried out by Water Minders who are also elected by community members.

Roles of WSC (The Guideline)

- To establish contact with sector committee and external organizations
- To hold committee meetings regularly to deal with problems
- To notify community regularly of things related to water scheme
- To collect cost (in cash or kind) for facility construction, operation and maintenance from people in community
- To keep record of income and expenditure of construction and O&M cost, and account to the community
- To confirm that water facility O&M is done properly, and supervise Water Minders

Community Development Officer (CDO) at RWSB branch office in each region is in charge of extension, training and education for sustainable management of water facilities. Work of CDO also includes supporting of WSC and monitoring of water facilities. Despite the importance of these roles in water facility management, all the posts of CDO are vacant, and there are four assistant CDOs, one in each region, who are actually doing the work of CDOs. Since each assistant CDO is in charge of more than 100 WSCs, it is practically impossible for them to give enough support to all the water facilities and WSCs in the country, including those of this project.

Accountants are responsible for collecting and keeping maintenance fund of water facilities, but in most cases they open an account at a neighborhood bank to keep the funds. By assigning well repairers outside WSC, they engage in practical management of water facilities, but they are detached from monetary affairs.

In regard to maintenance fund, the following is stated in the Guidelines:

- Community contributes no less than 25% of the cost for facility construction in the form of cash and/or labor
- Maintenance funds shall be made up of initial fund and monthly water fee, both of which are collected from community
- For repair of major parts of water facility, the government bears 50% of the cost of spare parts, and the rest is borne by community

The above guideline states the methods from how a community can request facility construction to how the community can establish and operate WSC, but this actually does not happen according to the guideline. The main reason is that WSC is not adequately supported due to the shortage of labor and budget. The community in this project requested construction of Micro Scheme Facilities, but WSC was not established or initial funds were not collected.

<Operation and Management of Micro Scheme Facilities>
For support of WSC, RWSB is supposed to hold training sessions on committee management for WSC executive members. This training, however, has rarely been held due to the lack of budget and personnel. Training/Workshop on health and hygiene, on the other hand, has been held by Department of Environmental Health in the Ministry of Health. Due to insufficient support of WSC by RWSB and CDO owing to financial and personnel constraints, the training does not include the method of repairing, the means of WSC management, etc., and therefore, operation and Management of the existing facilities are not carried out smoothly.

This project plans to provide support to CDOs by dispatching local consultants as a way to strengthening WSC activities in project villages based on the Guideline.

Plan of Activities to Strengthen WSC

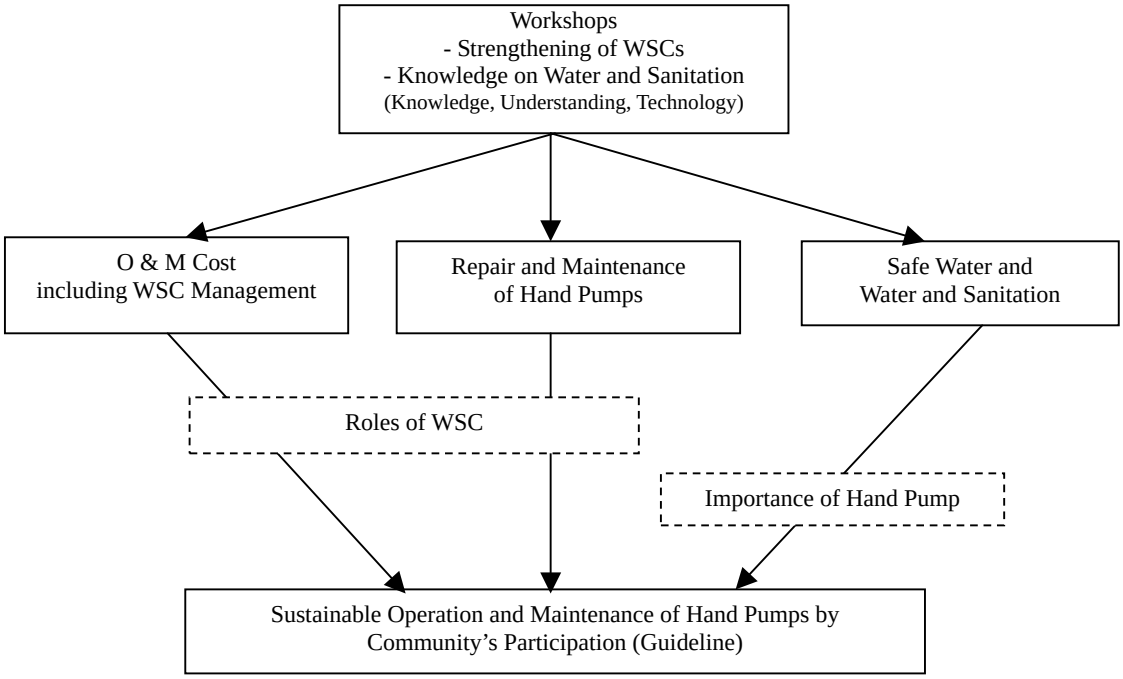
Before Construction	WSC Workshops and Village Workshops Having villagers understand the project and realize the importance of safe water Promotion of participation and sense of well/hand pump ownership ♦ Explanation of Project ♦ Explanation on the selection of particular water points ♦ Explanation and mutual agreement on labor contribution by villagers ♦ Teaching/Confirmation of relationship among well, safe water, health and sanitation ♦ Training of WSC executives on committee management ♦ Training of Water Minders on hand pump maintenance and repair
During Construction	(Villagers should never be ignored in the construction process. Construction activities should be undertaken with constant confirmation of people's participation and understanding. For this purpose, CDO and WSC should act as coordinator between villagers and the construction team.) Demonstration Workshop At the time of hand pump installation, proper usage of hand pump is explained to villagers
After Construction	Follow-up Workshop and Follow-up Study Follow-up and monitoring of the situation of hand pump and WSC through community visits Support to villagers through teaching and guidance when needed ♦ Checking of hand pump condition: usage, maintenance and repair, etc. ♦ Checking of WSC management and activities; especially handling and management of maintenance fee ♦ Clarifying and solving issues through discussion with villagers on sustainable O&M of water facility

The above activities are carried out to assist RWSB to provide more support to WSC, which will further lead to hand pump sustainability.

WSC is recognized and supported by community leaders through such activities, and relationship between WSC and villagers is strengthened. Moreover, when well repairers and WSC directors acquire the technique of repairing and checking of hand pump, the method of collecting maintenance funds and the method of holding meetings (such as taking its record, new activities) and the accompanying consciousness are established, WSC will become

sustainable.

Villagers who use hand pumps feel familiar with the project by their participating in the project. Also, they recognize roles of WSC and their own through workshops. In addition, villagers understand the importance of safe water and environmental sanitation more by hearing the explanation about sanitation in the workshop. Their understanding will obviously promote the decrease of water disease and the increase of house toilet construction. Moreover sanitary behavior such as washing hands more often and not drinking unpurified water will spread. The method of keeping water at their houses will also be improved. The understanding about safe water leads to recognition of the importance of hand pumps.



OPERATION AND MAINTENANCE OF MICRO SCHEMES BY COMMUNITY

By teaching villagers concrete knowledge needed in hand pump management (maintenance funds, role of WSC), techniques (repair and check of hand pump), and attitudes (importance of safe water) at workshops, participatory operation and management of water facilities, which the guideline advocates, will spread and become sustainable in the community of the project.

<Operation and Maintenance Costs for Micro Scheme Facilities>

Afridev Pump, a standard pump of the village level operation & maintenance (VLOM) type, has become popular in Swaziland. This pump has brought many good results and has a high reputations in Swaziland because it has high durability under appropriate maintenance even though it is necessary to exchange some consumable parts periodically. Including some exchanges, the maintenance is basically carried out by the community members who are the beneficiaries. The community has to reserve funds for buying consumable parts etc. under supervision of the WSCs; otherwise it is impossible for them to carry out even easy repairs,

purchase of necessary parts or ordinary exchanges. Although repairs for heavy damage and rehabilitation of the well or hand pump are carried out by RWSB, the costs are basically borne by the communities.

According to the socio-economic survey carried out in the project villages, the amount of initial funds collected per homestead ranged widely from 2 to 500 E. The bigger the amount, the lower the collection rate because payment of big amounts is too much of a burden for poor households. The amount of monthly water fee per homestead ranged from 0.25 to 30 E. Although the cost of spare parts for the main parts of the hand pump is to be shared equally between RWSB and the community, it remains only as a principle because the Guideline does not state which parts are main or minor ones.

Cost Sharing of Hand Pump Wells

Item	RWSB	Community	Remarks
Daily maintenance and cleaning		○	
Regular replacement of consumable parts		○	
Unexpected breakdown of hand pump	○	○	Purchasing and changing of parts
Maintenance and repair of supplementary facility		○	Setting up fence, Repairing of aprons
Renewal of old hand pumps	○	△	

○in charge of work and cost payment △partial payment

Water Minders are in charge of daily maintenance, replacement of consumable parts, and minor repair of hand pump. As the necessary tools for hand pump maintenance and repair will be given to WSC at the time of hand pump turnover, Water Minders need not purchase tools at first. Training of Water Minders starts before the beginning of construction, and will continue even after construction as a follow up by local consultants and CDOs.

The estimated cumulative cost for 15 years for replacement of spare parts of one Afridev hand pump that will be installed in the Project is estimated as follows:

Estimated Cost for Replacement of Spare Parts - Afridev Hand Pump (15 years)

Item	Replacement Interval (years)	Unit Cost（US$）	Unit	Total（US$）
U-Seal	0.5	0.27	30	8.10
O-Ring	1	0.15	15	2.25
Valve, Bobbin (×2)	1	0.47	15	7.05
Bearing (×2)	1	2.43	15	36.45
Rod Centralizers	1	6.00	15	90.00
Pump Rods	6	198.00	2	396.00
Pipes	6	90.00	2	180.00
Cylinders	5	85.5	3	256.50
Hanger Pin	2	5.84	7	40.88
Fulcrum Pin	2	8.64	7	60.48
Foot Valve	8	3.90	1	3.90
Rope	4	7.50	3	22.50
Stand, Head, and Handle	15	139.50	1	139.50
Total				1,243.61

Based on the above calculation, the annual replacement cost is about US$83 (1,243.61÷15). Since the average number of homesteads using each hand pump in the Project is 67, the annual cost per homestead is E.13 (83÷67×10), and the monthly cost per homestead is E.1.1 Even if only 40 homesteads (much less than the estimated number) are to use one hand pump, the annual cost per homestead is E. 21, and the monthly cost is E. 1.75.

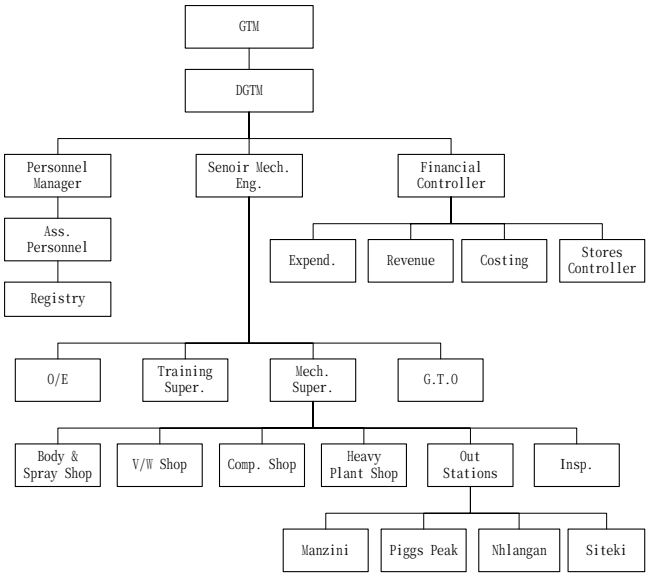
In socio-economic and household survey, it was found that the average monthly water fee that WSCs plan to collect was E. 5.6 per household, and that every household paid at least E. 4 (total) every month for the purchase of candles, oil for lamps, and meat which are necessities for community life. Considering these amounts, all the homesteads in the project communities are capable of paying the necessary cost for hand pump maintenance and repair.

Even if some poor homesteads cannot afford to pay the water fee, it does not mean that such poor homesteads will not get to use a hand pump because the community as a whole is responsible for the hand pump maintenance cost. Some communities may take special measures for poor homesteads so that they are allowed to use the hand pump. Strength of unity as a community, a sense that a hand pump is a shared property of the community, and a strong will to share the goodness of hand pump by all the members of the community are important keys to sustainable O&M. The actual amount of water fee, its collection method and disbursement are decided by villagers. This includes whether water fee is collected every month or only after harvesting season, whether poor homesteads, rich homesteads, large homesteads with many members, small homesteads with a small number of members, etc. pay the same amount, and whether remuneration for Water Minders is included in the water fee.

2.4.2 Equipment and Vehicles

<Operation and Management by CTA>

In Swaziland, Central Transport Administration (CTA) is managing approximately 2,400 motor vehicles belonging to the governmental organizations including motorbikes and construction machines. CTA is in charge of the arrangement of these vehicles; in addition, it is carrying out maintenance, inspection, repairing, and overhaul of body, chassis, engine, driving system, and the electrical system. As shown in the following figure, CTA belongs to the Ministry of Public Works and Transport. CTA It has repaired and maintained the motor vehicles supplied in the phase 1 project (i.e., one truck mounted drilling rig,



ORGANISATION OF CTA

one truck mounted compressor, one crane mounted truck, one water tank lorry, two station wagons, one pickup as double cabin, and two pickups with single cabin) limited to the main body, and has supplied fuel, oil, and other parts.

All governmental motor vehicles including construction machines are managed by CTA, and each governmental organization use these vehicles by paying a rental charge to CTA. CTA has its own fuel stations throughout Swaziland, and supplies fuel (gasoline or diesel) to government vehicles at the government price decided by CTA. The purchase of fuel from commercial stations is not permitted in principle. The rental charge decided by CTA consists of two costs: renewal expense of the vehicle and operation expense of CTA. The vehicle renewal expense is transferred to the Ministry of Finance and saved as a reserve fund for each vehicle. The government fuel price includes operation and maintenance (O/M) and repair cost of the vehicle added to the base fuel cost. The renewal terms of the vehicles depend on the type: for example, sedan/pickup and cargo truck should be renewed every 5 and 7 years respectively.

Thus, managing all the governmental vehicles in CTA enables each government organization to contentiously utilize these vehicles and to receive certain levels of maintenance for the vehicles. However, the current organization and system of CTA are not sufficient to manage thousands of vehicles. Moreover, CTA cannot obtain sufficient parts and tools for the repairing because of shortage of budget. For these reasons, there is a delay for several months for the repair according to the content and the degree of the breakdown, and this creates the need to arrange for an alternative vehicle. The current situation has not improved, although CTA takes measures to consign repair to the workshop of a domestic private company when the degree of the repair is heavy.

<Operation and Management by RWSB>

At present, the O/M and management of the equipment and materials procured in the phase 1 project are being executed by the team with the following composition.

Teams for Equipment Procured in Phase 1 Project

Works	Team Organization	Number of Staff	Remarks
Geophysical survey (site selection)	Geophysical survey engineer Assistants	1 3	also pumping test also pumping test
Borehole Drilling	Driller Assistants Mechanical Engineer Drivers (vehicle and machine)	1 7 1 4	
Pumping test	Engineer Assistants	1 3	
Installation of pump	Engineer Assistants	1 4	

<Operation and Management Plan>

The geophysical survey equipment consists of the following: a proton magnetometer, an electromagnetic system, well logging equipment, and a GPS (breaking down now). This equipment is operated and managed by the RWSB geophysical survey team. It is judged that this equipment has been well used considering their records and results.

Regarding the drilling team, there are, in general, some weak points in their drilling technology knowledge including repair, checking, and maintenance of the drilling rig, and other related equipment procured in the Phase 1 Project, although they have drilled some boreholes for the tubewells themselves with the drilling equipment during the three years from handover. It is judged that technology transfer with practice for the staff in charge of drilling in RWSB is necessary.

In regard to vehicles, most repairs and the maintenance have been executed by CTA, and no problem is observed in ordinary maintenance. However, long periods to repair are often required, since acquisition of spare parts for the vehicles, which are Japanese products, is sometimes difficult.

The procurement of the spare parts for these equipment, machines, and vehicles will be executed in this project. Even after this project is completed, operation and the maintenance should be continued with these procured spare parts by the teams (the above-mentioned team staff should be secured). In regard to the well construction, it is judged that drilling of 10-15 wells a year is possible by the drilling team considering the current results and records.

In this case, the cost necessary for future well construction is roughly calculated as follows:

Rough Estimate of Expense after Completing the Project

(Unit: 1,000 E)

	Cost for one Well	Annual Cost (for 15 wells)	Remarks
1. Drilling Work			
・Personnel expenses (driller and other staff)	47	705	
・Construction material cost	81	1,215	
・O/M cost for equipment	8	120	
・Others	23	345	
Sub-total	159	2,385	
2. Pumping Test			
・Personnel expenses (engineer and other staff)	7	105	
・O/M cost for equipment	2	30	
・Others	0.5	8	
Sub-total	9.5	143	
3. Construction of Appurtenant Facilities			
・Construction for apron, drainage, etc.	19	285	
・Installation of hand pump	8	120	Afridav:14 sites, Bush:1 site
Sub-total	27	405	
Total	195.5	2,933	

<Operation and Maintenance Costs for Equipment and Vehicles>

The annual cost for the maintenance and management of equipment is shown in the following table.

Cost for Operation and Maintenance Equipment and Vehicles

(Unit: 1,000 E)

No.	Name of Equipment	Qty.	Expenses		
			Fuel	Lease from CTA	Personnel & Others
1. Equipment related to Drilling					
1.1	Truck Mounted Drilling Rig and Tools	1	96.4	75.0	-
1.2	Truck Mounted Air Compressor	1	152.1	29.0	-
1.3	Pumping Test Equipment	2	0.80	35.0	-
1.4	・Crane Mounted Truck	1	16.9	35.0	-
	・Water Tank Lorry	1	11.0	19.0	-
	・Pickup Truck	1	3.1	24.8	-
	・Fuel Tank to be pulled	1	-	6.0	-
	・Land Cruiser	2	8.9	72.0	-
Sub-total		-	289.2	295.8	464.0 (1,049.0)
2. Equipment related to test and analysis					
2.1	Well Logging Equipment	1	-	-	-
2.2	Water Quality Analysis Equipment	1	-	-	-
2.3	Geophysical Survey Equipment	1	-	-	-
2.4	Pickup Truck	1	3.1	24.8	-
Sub-total		-	3.1	24.8	55.9 (83.8)
Total		-	292.3	320.6	519.9 (1,132.8)

2.5 Software Assistance Plan

The following three software measures have been proposed for the implementation of this project.

(1) Maintenance and Management of Equipment and Operation and Management of the Drilling Works

<Background and Issues>

In Swaziland, RWSB has been developing rural water supply system within its macro-scheme and micro-scheme projects. The RWSB drilling team has already realized 28 wells for the micro-scheme project after the handover of the drilling equipment in phase 1 of this project. Therefore they are considered to have the minimum level of skill and experience concerning DTH system. However, in view of future groundwater development activities which may include drilling in alien terrains, they should acquire sufficient experience in rotary drilling as well as DTH drilling. In addition, efficient operation of drilling requires not only skilled drilling work itself but also sufficient experience in the management of the whole operation including procurement and transportation of materials and equipment, furnishing of spare parts and refueling. This operation needs constant checking of the work progress and repair of equipment that can be realized only on the basis of the accumulation of experience and know-how. At the moment, however, RWSB drilling team doesn't have sufficient experience and know-how of this kind. Considering the fact that most of the equipment procured during phase 1 have been used for 5 years and is prone to trouble, one of the principal issues is how the drilling crew can accumulate the necessary experience and know-how to deal with anticipated troubles in order to achieve efficient drilling work and sustainable use of the equipment.

The general problems and issues to be addressed in Swaziland are as follows:

The General Problems and Issues to be Addressed in Swaziland

Issues	Details
Unfavorable Hydro-geological Conditions	Geology of Swaziland is roughly divided into the basement rocks of granite and gneiss, the sedimentary rocks in the plain area, the rhyolites that form the eastern plateau and the basaltic rocks that penetrate all the rocks mentioned above. The occurrence of groundwater reflects the geological characteristics of the area. In the basement rocks, water is found in its weathered and fissure zones (fractures associated with faults, joints and cracks). In the case of the sedimentary rocks, some of them may form aquifers andmay also have fissures, but there is a risk of coal seams affecting the quality of water. The rhyolites form a plateau where there is no clear hydrogeological basins. The rocks are hard and have similar characteristics to the basement rocks. Considering the characteristics of each geological unit, it is not easy to hit groundwater in the Lochiel Granite which is widely distributed in the northwest area in Swaziland, the Mliba Granite occupies the central area, and the Ecca Group of the Karoo Super Group crops out in the southern and eastern area. The Lochiel Granite and the Mliba Granite are generally massive and fissures are poorly developed in the rocks. Such fissures are not expected to be groundwater bearing ones. The Ecca Group is composed of hard sandstone and shale intercalated with coal seams. The majority of the 90 sites for the micro-scheme project in the four study areas (Hhohho, Manzini, Shiselweni and Lubombo Regions) are underlain by either of those geological units. Therefore, it can be said that the hydrogeological condition of the study area is unfavorable for groundwater development by deep wells.
Existence of water unfit for drinking	Some groundwater samples from the study area show high contents of F, Fe and salinity that are above the drinking water standard of Swaziland. The occurrence of such water often can be associated with the geology of the water bearing layer. In Swaziland, high contents of F and Fe derived from granitic rocks is observed in the mountains and hilly areas. Some of the sedimentary rocks in Laufelt have coal bearing layer and the water sometimes shows high salinity. Considering these characteristics of groundwater, much attention shall be paid to its quality as well as to its quantity.
Lack of human resources for efficient well construction	The number of wells the RWSB crew has drilled with the use of the drilling rigs procured in 1998 for phase 1 of the project is as small as 28. The authorities point out that it is not only because of the lack of ability of the crew but also of improper management and supply of materials. It is also said to come from essential institutional weakness. Although the crew members for drilling and material procurement are posted in Matsapha workshop and in the head office of RWSB, they are sometimes obliged to wait for some time before they can get on to their work, which is probably due to inappropriate coordination of the organizations concerned. In order to improve the situation, it is necessary to strengthen the institutional capacity of RWSB aiming at enabling sustainable operation of the organization and self-powered rural water supply projects. In concrete, elevating the level of all the staff concerned especially the drilling crew and revitalizing mutual coordination should be the priorities.
O/M issues to be addressed	- In well drilling work, try to coordinate the timing of supply and requirement of the fuel and other consumables in order to minimize the time that would, otherwise, be wasted on waiting for the goods. - Proper allocation of funds to consumables and to other items based on well tailored drilling schedule will assure assignment of personnel and procurement of materials and consequently facilitate project execution. - Securing personnel who have sufficient knowledge and experience in O/M organization and having them draw up work and procurement schedules and supervise the work will help efficient execution of projects.
Technical issues to be addressed	- The drilling equipment procured in the phase 1 project includes DTH tools designed for hard rocks and rotary drilling tools with use of mud circulation designed for unconsolidated or the sediment that can be easily crumbled. WRSB has drilled about 30 wells so far with the DTH system. But the work was done under the supervision of a Japanese expert and the crew has not yet reached the point where they can operate the drilling properly alone under various geological conditions. In phase 2 of the project, they will have to operate under harder conditions in terms of hydrogeology. Therefore, strengthening of their ability to cope with sedimentary rocks, which the DTH system is not suitable for (weathered rocks and those that can easily crumble). - More than 5 years have passed since the drilling rig that RWSB possess was first put into use and its condition is more prone to various trouble (requiring replacing the parts that are broken or worn out). The operators of the rig have learned only about regular inspection, repair and

The General Problems and Issues to be Addressed in Swaziland

Issues	Details
	overhaul of the rig through the manual and on-the-job training during phase 1 of the project. They should be well trained to deal with various troubles which they have never experienced.

<Necessity of Introduction of Software Assistance>

For RWSB, technical on-the-job training has been provided so far by the contractor as part of well drilling and construction work of this project. This type of training is normally done on site and thus is practical. However, it inevitably poses a time limitation and the training is limited to leaning the basic operation of the equipment, regular maintenance and attending the troubles that accidentally happen. In consideration of this situation, the sustainable operation of RWSB will be only realized through a comprehensive system of operation and maintenance including human resources development and institutional strengthening as well as enhancing the capacity of the drilling crew. In other words, in addition to the technical training provided at the site, software assistance should be given. The combination will enable RWSB to realize proper labor management, sufficient safety measures, comprehensive maintenance capability, appropriate techniques on pumping test and well management, inventory management for spare parts and construction materials, and management of project contracts. All these aspects working effectively together will enable the streamlined execution of rural water supply projects.

In the plan of this project, we propose cooperation on the aspect of comprehensive management. It is thought to be important to address issues such as reducing O/M cost, raising the rate of operation, promoting safety on the job, proper management of the inventory of materials. Therefore the proposed measures will include all these aspects. The specific items are mentioned below.

- Maintenance of drilling equipment - regular checkups and periodical inspection and repair
- Construction control of well drilling, procedure of drilling works, operation and quality control, safety management and labor management
- Procurement and inventory management of materials - efficient and appropriate management

<Objectives>

1. For the efficient and economic implementation of this project, RWSB is to establish the system of operation where RWSB construction control can be independently executed at an early stage.
2. Improve the success ratio of well drilling by efficient drilling works and dissemination of use of accumulated data and know-how on preparing construction plans and on quality improvement.
3. Establishing the system of support for drilling projects by realizing proper operation and management and proper procurement and inventory management.

<Outcomes>

1. With the handover of the drilling equipment, RWSB will be able to independently construct wells and consequently the implementation of this project will be facilitated.
2. By realizing efficient execution of well construction, RWSB can reduce the cost of

operation for water supply projects on their own.

3. Technical training will be done at the RWSB office , its workshop and at site. The training aims to promote both managerial and technical aspects to build their skills. This will consequently help to increase the capacity for comprehensive and systematic water supply project implementation.

The PDM (Project Design Matrix) of software assistance is presented in Table 2.4.

<Details of Activities>

Software assistance will be carried out in the following manner. Prior to the arrival of the drilling equipment, the study team will conduct training on the management of drilling work, maintenance of rigs, procurement of materials and management of inventory. The support of operation control method will be done during the period of actual drilling works by RWSB. As shown in the table below, one operation control expert (Japanese) and one local engineer as supervisor for construction of peripheral facilities will be assigned.

Implementation Schedule of Software Assistance
for Operation Control of the Drilling Works

Project	Work Schedule/ Staffing	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Overall Project	Contract of Consultants		▼																			
	Procurement of Equipment			▒	▒	▒	▒	▒	▒	▒												
	Drilling work (by RWSB)										▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	
Software Assistance	O/M						□	■	■	■												
	Equipment Maintenance									■												

The contents of the work is summarized in the following table.

Contents of Software Assistance for Operation Control of the Drilling Works

Issues	Work Items
O/M	Prior to the actual start of the project, the expert will give training to build capacity of workshop and management sections. In specific, technical training on the following items will be conducted with the aim of making the staff understand the flow of the drilling project from project planning to execution for smooth project execution. Drawing up of well construction plans and order the materials needed (order forms, in-out forms for inventory, other forms) Deployment of equipment used for well construction and its operation record. Deployment of personnel concerned with well construction and subcontracts management-template of management record. Preparation of construction (drilling) plans and construction using format for the construction management record, quality control sheet. Safety control – safety work record, manuals for accidents and response handling record
Equip -ment Mainte -nance	Technical training on the repair, adjustments and maintenance of procured spare parts and existing drilling equipment will be conducted through replacement of the parts procured in this project and through overhauling of the existing machines. This will pave the way for efficient maintenance of the relevant equipment and procurement of the materials concerned. - Daily inspection method - Preparation of operation and maintenance manual

Contents of Software Assistance for Operation Control of the Drilling Works

Issues	Work Items
Technical Training on Peripheral Facilities Construction	- Teaching techniques on operation control of the works through facilities constructions at 8 successful wells during the Basic Design stage.

The target of the technical training will be 15 employees from the managerial, O/M and drilling sections of the RWSB. RWSB drilling team has the following staffing:

Staffing of RWSB Drilling Team

No.	Job	Work Assignment	Number
1	Operation control	Construction plan, safety management, general O/M issues	1
2	Equipment and materials management	Management of materials, management of warehouse inventory, subcontract management	1
3	Maintenance management	Inspection of equipment, repair, renewal plan,	1
4	Drilling expert	Drilling direction, quality control, safety measures	1
5	Drilling assistant	Drilling direction, prevention of accidents	7
6	Drilling rig operator	Operation of drilling equipment, daily checkups, operation management of machines	4
Total			15

(2) Hydrogeology and Site Selection Plan

<Background and Issues>

In Swaziland, rural water supply projects have been carried out by RWSB within its macro-scheme and micro-scheme projects. Micro-scheme projects involve drilling of deep wells. In order to realize economical implementation of the projects, the success ratio of the drilling has to be improved. It is very important to properly determine where to drill a well to achieve higher success rates since the unfavorable hydrogeological conditions of the country require proper methods of geophysical investigation, analysis and site selection technique and since its interpretations will greatly affect the success ratio. In consideration of this situation, RWSB faces an urgent need to bring up hydrogeological expert.

<Necessity of Introduction of Software Assistance>

As explained in section 2.5 above, the groundwater development effort has encountered great difficulties in the country (i.e., unfavorable hydrogeological conditions, existence of water unfit for drinking and lack of human resources for efficient well construction). As a matter of fact, the success ratio of the well drilling carried out in phase 1 of this project as averaged 55%. Since proper determination of drilling points before the construction works the hydrogeological analysis greatly affects the ratio of unsuccessful wells (which is eventually reflected on the project cost), these skills and experience of hydrogeology are considered to be highly important in groundwater development of Swaziland.

RWSB also recognizes the need of hydrogeological investigations for raising the success ratio and reducing project cost in a terrain where granites and gneiss are widely exposed. It is now trying to organize a groundwater investigation team that conducts geophysical investigations

making use of the existing equipment (such as proton magnetometer) prior to the drilling work.

However, it is still an urgent requirement to establish a system to improve the situation and to foster expertise in the system. Personnel should be able to systematically carry out the following items: grasp the hydrogeological and geographical characteristics of the target area, clarify the groundwater potential and its flow characteristics, utilize the existing database, pin-point drilling points through the interpretation of geophysical data, and judge the suitability of the water for drinking. Currently RWSB entrusts all the task concerning determination of drilling points to the two hydrogeologists of the department of geological survey and mines. It is, therefore, inevitable to establish the same function group of necessary hydrogeological analysis in RWSB in order to execute drilling projects without delays. This is where the software assistance of grant aid project comes in. The proposed software assistance includes lecturing on the basic knowledge of groundwater investigation and technical training on field survey (i.e., use of geophysical prospect, geophysical data analysis, and interpretation of the data).

<Objectives>

1. Establish system of site selection plan for a hydrogeological investigation team within RWSB at an early stage for smooth and economical implementation of this basic design study.
2. Provide technical training on efficient groundwater investigation as well as on the methods of data analysis and interpretation. In addition, teach the use of accumulated data and know-how for improvement of success ratio to all the staff of RWSB.
3. Deploy geophysical prospecting equipment. Efficiently use personal computers for data analysis since they will be in place along with their maintenance system.

<Outcome>

1. RWSB will be able to conduct hydrogeological analysis on its own, which will lead to smooth implementation of the phase 2 of the basic design study.
2. Raising the success ratio of the wells will eventually reduce project (operation) cost.
3. The training will be conducted at Matsapha workshop to facilitate participation of the employees. This will help to increase the skill level of the whole workforce of RWSB.

The PDM (Project Design Matrix) for the software assistance is presented in Table 2.5.

<Details of Activities>

The software-assistance is scheduled to be implemented in four months based on the execution schedule of the drilling work. One hydrogeological investigation expert will be assigned as shown in the following chart.

Implementation Schedule of Software Assistance for Hydrogeology and Site Selection Plan

Project	Schedule / Staffing	1	2	3	4	5	6	7	8	9	10	11	12
Overall Project	Contract of consultants			▼									
	Drilling work (by contractor)			■	■	■							
					▨	▨	▨	▨	▨	▨	▨	▨	▨
	Drilling work (by RWSB)								■	■	■	▨	▨

Implementation Schedule of Software Assistance for Hydrogeology and Site Selection Plan

Project	Schedule / Staffing	1	2	3	4	5	6	7	8	9	10	11	12
Hydro-geological Expert	Preparation in Japan (Materials)				□								
	Field training				■	■	■	■					

The work of the expert will consist of training materials preparation in Japan and lectures, field demonstration, training on data analysis and interpretation on the site. During the preparation in Japan, visual materials (OHP sheets) will be prepared for effective execution of general guidance, lectures, technical training. The details of the on-site training are as follows:

Details of On-site Training

Work Item	Details
Initial discussion with RWSB	Hold discussions with RWSB over details of the software-assistance, its schedule, venue and site for training. Also participants from RWSB, RWSB's contribution to the project, and construction schedule of facilities.
Preparation of technical training schedule	Following the results of discussion described above, the expert will make necessary revision of the training materials and finalize the training schedule.
Preparations for Guidance	The expert will visit Matsapha workshop that is to be used as the main venue for the training to check the condition of the room, preparedness on RWSB side, over head projector and other things.
Lectures on the theory of groundwater investigation and hydrogeological analysis	The lectures on the theory of groundwater investigation will be given following the introductory guidance for the RWSB staff. The lectures will especially focus on the aspect of geophysical prospecting in hard rock areas and on the use EM equipment and hydrogeological analysis software.
Selection of sites for field training	Determine the model sites for the training for geophysical investigation and hydrogelogical analysis in Mbabane area which have similar geologically components to the other areas of the country. In selecting the model sites, areas of various geological components will be covered; sedimentary rocks, granitic rocks, rhyolites, gneiss.
Field training for groundwater prospecting	Field training will be conducted at each model site by having the RWSB staff use the proton magnetometer and vertical/horizontal electromagnetic device (EM). The aim is to teach them how to understand the geographical and geological characteristics of the area and about appropriate methods of investigation depending on the conditions of the area in order to acquire efficient investigation techniques.
Hydrogeological analysis	Training will be given method of hydrogeological analysis based on the data of groundwater investigation. A manual on the evaluation of analysis result will be prepared, if it is found necessary.
Lectures on water quality test	Considering the fact that some waters in the country contain above-standard Fluorine, Iron and salinity, it is important to check the quality of water from wells for the supply of safe water. Therefore, lectures on the knowledge of water quality and training on the water quality test using rapid field analysis equipment will be given. Water quality investigation manual will be prepared.
Preparation of a manual for hydrogeological analysis and site selection plan	A technical manual on hydrogeological analysis and site selection plan will be prepared by working together with the RWSB staff. The manual will utilize all the data employed in the training and reflect hydrogeological characteristics of the country.
Reporting for RWSB and JICA	A final report will be compiled, which will sum up the schedule, contents and outcome of the training in addition to suggestions based on the present problems.

The target staff consists of the following 5 members of RWSB.

Outline of Groundwater Investigation Group of RWSB

No.	Job	Work Assignment	Number
1	Hydrogeological expert	Schedule management, planning of site selection	1

2	Prospecting expert	Operation of prospecting equipment, data analysis	1
3	Assistant	Assistance for the expert	3
Total			5

(3) Strengthening of Water and Sanitation Committee

<Background and Issues>

Rural water supply guideline is to be established, and water supply projects are planned for proper execution and CDO work in RWSB in Swaziland. However, the appropriate operation management is not being sufficiently executed because of the shortage of staff members who are strong. It is necessary to establish the strengthening of organization of WSC and well maintenance system as the nucleus of RWSB for execution of re-education of well management method and maintenance method for sustainable well management and the proper utilization of the provided wells. Therefore, software assistance will be executed for the objects of capacity building of the facilitators in RWSB and proper maintenance management in the villages in this project. The repetition education method will be adopted for reaching software assistance outcome and facilitation done by consultant (with RWSB staff) in 20 villages within 39 villages (78 wells) and by OJT training of RWSB (under the guidance of Consultant) in the remaining 19 villages.

The problem points and issues of WSC in Swaziland are shown in the following table.

Issues on Micro Scheme Water Wells in Swaziland

Issues	Contents/Remarks
RWSB	RWSB cannot fully function to play their role to give guidance and assistance to WSCs because the positions for Community Development Officer at RWSB (1 position) and CDOs at Provincial Rural Water Supply Office (4 positions) have been vacant. Presently 4 Assistant CDOs (one in each region) are doing such work, but in reality, one CDO's assisting more than 100 WSCs is virtually impossible. For this reason, conditions of all the water schemes and information on all the WSCs do not reach RWSB, and RWSB do not have enough personnel to give participatory training on O&M to all the WSCs.
Training of WSC	In addition to the lack of personnel, insufficient budget makes RWSB rarely give training of O&M for WSCs. Due to the lack of communication and exchange of information between WSCs and RWSB through training, WSCs are not very active and WSC executives are not fully aware of what the committee entails including their roles and responsibilities, and practical ways to run the committee. Although some training on WSC management was held, it was a once-for-all training in which each WSC was trained only once. Such training without any follow-up may have positive effects, but they tend to be temporary and new knowledge and behavior will not sustain them in the long run. Furthermore, WPC executives who took the training will be replaced by new members, and without any follow-up training, the new executives will have no chance to have WSC training. There will be an increase of WPC executives without training experience.
Water Users	The lack of sufficient communication between RWSB and WPCs directly effects water users. There are some cases in which broken water facilities are left untouched because the users do not know how to repair. Some water users do not know much about WSC, which is a new community organization for them. They tend not to know clearly about their rights and responsibilities as water facility users, and the roles of WSC. Another issue DWRS is facing is the prevalence of water-born diseases such as diarrhea. Prevalence of water-borne diseases is a direct reflection of difficulty in getting safe water. In places where safe water is available, prevalence of water-borne diseases is a sign of improper handling and treatment of water, unhygienic behavior and little awareness of safe water. Water-borne diseases are, thus, in close relationship with water, and the prevalence of such diseases needs to be solved.
Others	Although most water activities such as fetching, washing, cooking, and cleaning are done by women, WSC executives are mostly men. Even when the majority of executives of WSC are women, the chief executive is likely to be a man. In such a case, not noticing the contradiction, both male and female executives take it for granted that it is the way it is supposed to be. To have voices of female water users heard directly by WSCs and communities without having men in the middle will likely increase

Issues on Micro Scheme Water Wells in Swaziland

Issues	Contents/Remarks
	female participation in WSC and understanding of WSC, which will lead to productivity in the communities. Such female participation is a key to successful management of WSC, and thus needs to be promoted. WSC is to represent all the well users, but there are some cases in which only a certain group of well users support WSC, and the other groups are indifferent and uncooperative. Presence of such one-sided support from well users makes it impossible for WSC to represent all the users.

As mentioned above, Procedures for the Approval of Rural Water Schemes in Swaziland are established to implement the rural water supply schemes properly, and CDOs are assigned in RWSB for this purpose. However, there are some water supply facilities which are not operated and managed in proper condition because of lack of facilitation by CDOs. The posts of CDOs are at present vacant, and only the assistant CDOs are engaging in various activities, resulting in the shortage of communication with the communities. Such shortage of communication causes the stagnation of the communities' activities as well as hazard to the proper operation and management of the facilities. As a result, sustainable operation and management are not able to be achieved. Therefore, it is necessary to provide assistance in facilitating, supporting and supplementing the CDOs' activities in the communities by assigning community development specialists for the communities targeted in the project in order to reinforce the capacity of WSCs for realizing the sustainable operation and management of the facilities with OJT for the facilitator such as CDO of Swaziland.

The issues and solutions in operation and management of the facilities are summarized in the following table.

Issues and Solution on Operation and Management of Facilities

	Issues	Solutions
On RWSB	Training of WSC executives and community leaders on participatory O&M is not sufficiently given by RWSB due to lack of personnel.	Local consultants assist CDOs on activities in project villages.
	RWSB cannot fully grasp situations of WSC and water facilities due to the lack of personnel.	Local consultants visit communities whenever possible to monitor hand pump conditions, WSCs and their activities with CDOs.
On WSC	Even if WSC is already established, executives do not know much about ways of committee management such as handling and recording of water charge, recording of meetings, etc. Some are unclear about their roles and responsibilities.	（In WSC Workshop for WSC executives, community leaders, and government officers） Explanation of WSC：Roles and responsibilities of executives, WSC/community meeting procedures, relationship with villagers, monitoring Accounting / keeping account records Meeting procedures, recording of meeting
	Management training of WSC is usually held once, and the positive training effects tend to wear off over time.	WSC Workshop for follow-up / monitoring is held.
On Community/ Villagers	Villagers are aware of importance of wells and safe water, but do not exactly know the maintenance and repair practices of hand pumps.	Explanation of WSC in Village workshop Training of water minders on hand pump maintenance and repair
	Villagers are not clear about roles of WSC as well as roles and responsibilities of themselves as hand pump users.	(In Village Workshop) Explanation of WSC Explanation of roles and responsibilities of villagers
	Prevalence of water-borne disease, especially diarrhea	（In WSC Workshop on PHAST） Explanation of safe water, health, and hygienic behavior （In Village Workshop on PHAST） Explanation of safe water, health, and hygienic behavior

Issues and Solution on Operation and Management of Facilities

	Issues	Solutions
Others	Despite a strong relationship between water and women, the number of female WSC executives is small.	WSC Workshop and Village Workshop will include gender awareness / sensitization, focusing on water.
	WSC sometimes do not represent the whole community or all of the villagers. （WSC cannot mobilize the community fully; WSC stays outside of traditional socio-political structure of Swaziland）	WSC Workshop participants are not only WSC executives but also community leaders such as the elders, RHM, teachers, executives of women's group, etc. (WSC maintains relationship with traditional socio-political structure)
	Some water scheme development projects are externally driven, which do not promote initiative and participation among villagers/hand pump users (awareness of importance of hand pump and hand pump owners)	Villagers understand more and are clearer about close relationship between water, health and hygiene among villagers. WSC Workshop serves as TOF/TOT Workshop. WSC executives and community leaders facilitate Village Workshop.

<Objectives and Purposes>

Understanding the above issues concerning rural water in Swaziland, this project is going to have a software assistance program on WSC as a way to achieve the project goal of "Improvement of water supply and hygiene conditions in the project villages." The program purposes of this software assistance are as follows:

i) People in the project villages will do sustainable O&M of hand pumps.
ii) Relationship (Communication) between WSCs and RWSB will be stronger.

PDM (Project Design Matrix) of the software assistance is shown in Table 2.6.

<Outputs>

Outputs of the software assistance program on WSC are as follows:

i) Strengthening of WSCs in project villages
ii) Stronger sense of responsibility of hand pumps among the users
iii) Stronger sense of health and hygiene among the users
iv) Easing of the lack of personnel in Community Development Section of RWSB

<Activities>

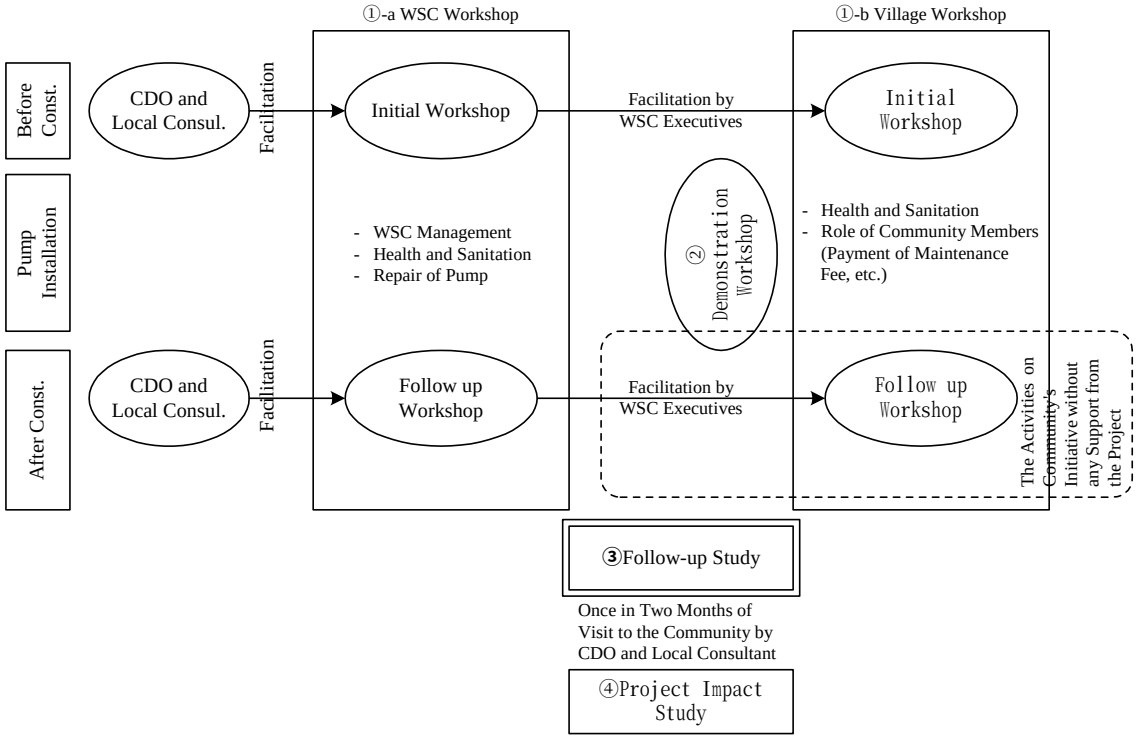
The above outputs result from the following activities:

i) WSC Workshops for WSC executives, water minders, community leaders and government officers
ii) Village Workshop for well users
iii) Demonstration Workshop
iv) Follow-up Study
v) Project Impact Study

The direct outputs of the above activities are as follows:

i) WSC executives/community leaders facilitate workshops for villagers

ii) Water minders inspect and repair hand pumps
iii) WSC executives manage their committees properly
iv) Villagers actively engage in WSC activities
v) Villagers pay a water fee every month
vi) Villages have better hygiene practice
vii) Number of water borne disease in project villages decreases



Activities for Strengthening WSCs

This software assistance is for the strengthening of organization system of WSC in the proposed villages and the facilitation system of RWSB. The facilitation activities are for villagers and to be executed with repetition method as shown in the following contents. of concrete activities shown in table 2.6. Some local consultants are employed for the actual activities to be executed by the system and the Japanese expert will supervise their activities.

a. Facilitation before construction
i) Understanding of project contents and residents responsibility
ii) Understanding of contents of concrete residents responsibility (water charge collecting method, repairing inspection and health and hygiene etc.)
iii) Explanation for residents (from project contents to maintenance)
b. Facilitation activities after construction
iv) Method of use and maintenance method at installation of hand pump
v) Follow up (review and improvement regarding above mentioned items i) to iv))
vi) Investigation and measurement of effects

WSC and Village Workshops are at the core of the software assistance program on WSC. These workshops are rather bottom-up participatory workshops that make much of initiatives of participants through facilitation rather than top-down training. All the workshops are held in each community, using the local language. Since some villagers are illiterate, handouts using texts should be avoided as much as possible, and instead, many visual aids will be used. Contents of the two kinds of workshops are as follows:

Brief Descriptions of Workshops

	WSC Workshop	Village Workshop
Facilitator	CDOs and local consultant will be facilitators.	WSC executives and community leaders who participated in the workshop for WSC will be the facilitators. CDOs and local consultants will attend the workshop as observers and secretaries.
Participants	Participants are WSC executives, water minders, community leaders including the elders, teachers, traditional healers, medical staff, community police, clergymen, and government officers including RHM, HI, and RWSB officers.	Participants are hand pump users
Form	Participants will acquire not only knowledge and technique of WSC management, but also know-how of Village Workshop facilitation. For this reason, this workshop serves also as TOF/TOT (Training of Facilitators/ Training of Trainers).	Village follow-up workshop is to be held only by villagers without any assistance from the project.
Method	Both workshops will be held in each community. If a community is to have several WSCs, one WSC Workshop will serve for all the WSCs.	

At the time of hand pump installation, Demonstration Workshop is held to explain hand pump usage to villagers and have water minders to review what they learned on hand pump maintenance and repair. This workshop is to be facilitated by CDOs and the local consultants.

Together with WSC Follow-up Workshop in which monitoring of hand pump use and WSC activities is done, Follow-up Study is done by CDOs and the local consultants. In this study, monitoring is done by those who are outside of the communities through field visits. Follow-up Study is to be done in every community, using questionnaires and through interviews whenever CDOs and the local consultants have time to do it. If some issues and problems on WSC management and hand pump repair are identified through Follow-up Study, CDOs and the local consultants are to deal with such problems.

Project Impact Study is done just before the end of the project to examine the values of indicators in the Project Design Matrix. Since these values are based on the results of the baseline survey, questionnaire survey is to be conducted using the same questions as in the baseline survey. Aside from indicators on PDM, the Impact Survey questionnaire is to examine matters relating to the effects of the project.

Work schedule and assignment schedule of software assistance for the strengthening of WSC is shown in the following schedule.

Implementation Schedule of Software Assistance
for Strengthening of Water and Sanitation Committee

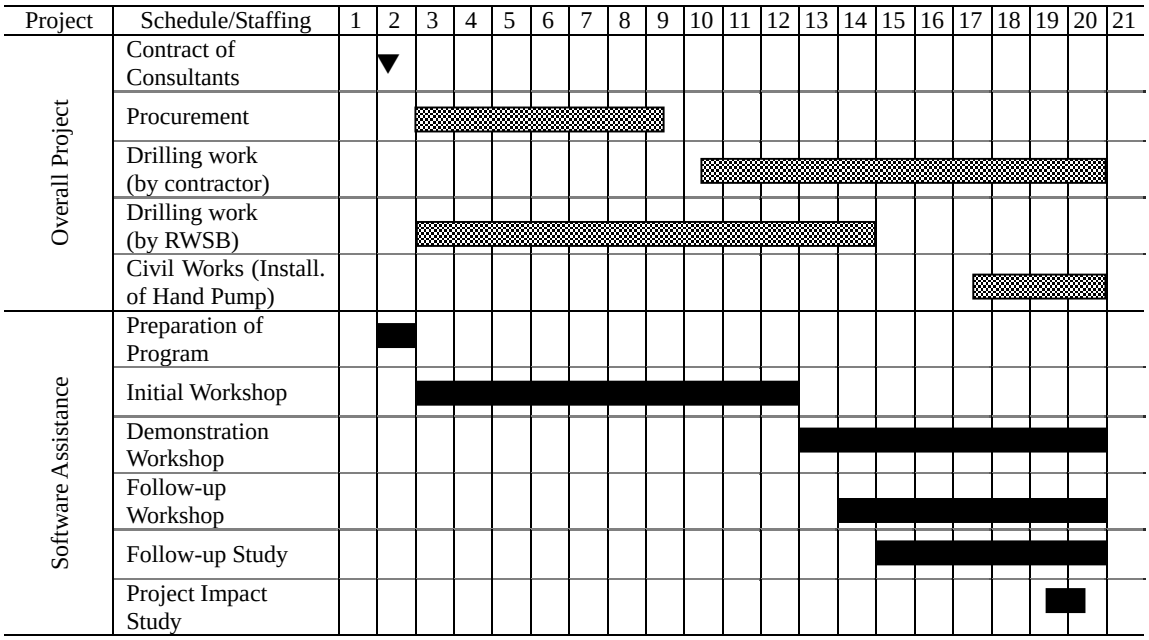


Table 2.1 General Descriptions of the Project (Project Design Matrix)

Narrative Summary	Indicators/ Aims	Means of Verification	Important Assumptions
Overall Goal (I) Improvement of water supply and hygiene conditions in the nation	The national average rate of access to safe water will improve from 49% to 55%	RWSB data	Rural Water Supply Policy of RWSB in Swaziland remains the same
	Time to the water source on foot will be reduced	Swaziland Population and Housing Census	
	Number of rural households with latrines will be more than 23,862 in the nation	Swaziland Population and Housing Census	
	Diarrhea will be the reason for less than 11.2% of hospital visits in the nation	Health Statistical Report by the Ministry of Health	
Overall Goal (II) Improvement of water supply and hygiene conditions in the project villages	More than 41% of households in the project area will have a latrines.	RWSB data (Records kept by CDOs)	Cooperation between RWSB and Ministry of Health for rural water supply remains the same.
	Average distance from a household to a well will be less than 2,056 m in the project area.	Impact Survey: Questionnaire survey after the well construction with the same contents of the Baseline survey	
	Average time per day per household for fetching water from a well will be less than 112 minutes.	Follow-up Survey, Impact Survey: Questionnaire survey after the well construction with the same contents of the Baseline survey	
	Women in the project area will feel that fetching water is easier after well construction.	Follow-up Survey	
	Rate of water-borne disease in the project area will be reduced	Impact Survey: Questionnaire survey after the well construction with the same contents of the Baseline survey	
	After the well construction, people in the project area will feel that they are healthier.	Follow-up Survey	
Project Purpose Provide steady supply of safe water to people in the project villages	More than 50% of wells in the project area will have good water quality even in the dry season.	Impact Survey: Questionnaire survey after the well construction with the same contents of the Baseline survey	Conditions of existing water sources and hygiene in the project area will not be worse than before the project began.
	More than 42% of wells in the project area will have good amount of water even in the dry season.	Impact Survey: Questionnaire survey after the well construction with the same contents of the Baseline survey	
	People in the project area will feel that they have access to safer water after the well construction.	Follow-up Survey	
	Average daily consumption of water for a family of ten will be more than 155 liters.	Follow-up Survey	
	Hand pumps will be in operation continuously	Activity record by CDOs, Interview with RHM、WSC activity records, Well maintenance/repair records	
Outputs 1. Hand pump wells	78 hand pumps will be installed in 39 communities.	RWSB/Project well construction records	Policy on WSC and participatory O&M of water supply facilities remains the same.
2. Capacity building of RWSB well construction staff	RWSB staff will be able to construct wells using equipment donated by Japan.	Training attendance records, training records, RWSB/Project well construction records	
3. O&M by WSC	Water Minder will conduct regular maintenance and repair.	Well maintenance records, Well repair records	
	Rate of collection of water fees will increase.	Water fee account book, WSC records	
	Water fees will be managed correctly.	Water fee account book	
4. Understanding of the importance of water and sanitation (Active participation in the project, Understanding of the importance of wells and well management)	People in the project area will have better hygiene practices.	Follow-up survey, Interview with RHM	
	More people in the project area will attend WSC meetings.	WSC meeting records	
	Many people in the project area will participate in well construction.	RWSB/Project well construction records	
	People in the project area will pay the water fee every month.	Water fee collection records	
Activities 1. Well construction (Japanese side) 2. Training of RWSB staff on well drilling and site selection 3. WSC Workshop 4. Workshop for hand pump users in the project area	Inputs Japan (personnel) Management personnel for planning and construction Drilling engineer, Hydrogeologist Expert on equipment maintenance and management (equipment) Equipment and materials for well construction (cost) Consignment charge for local well drilling company	Swaziland (personnel) Well drilling staff Geophysical survey staff Community development staff (equipment) Drilling rigs, etc. (already provided in Phase I) Well construction materials (local cost) Cost for O&M of equipment Salary, allowance, etc. of government staff	Government staff who attended the training continue working for RWSB. WSC members who attended the workshops maintain their positions in WSC. Pre-Conditions People in the project area are not against well construction. WSC already in existence represents all the people in the communities.

Table 2.2 Communities for Construction of Micro Schemes

Region	No.	Community	Surveyed		Excluded Community			Target Community		
			Home -stead	Micro Scheme	Access Condition*	Socioeconomic Condition**	Hydrogeological Condition***	Home -stead	Micro Scheme	Drilled Well
Hhohho	H2-1	Meleti	160	5	A (3 sites), B (2 sites)	P (2)	-	-	-	-
	H2-2	Ndzingeni	150	5	A	(6)	-	150	5	5
	H2-3	Luhlangotsini	130	2	A (1 site), B (1 site)	(5)	-	130	2	2
	H2-4	Mawombe	150	7	A	(6)	○	150	7	6
	Sub-total		590	19	-	-	-	430	14	13
Lubombo	L2-1	Entandweni	60	2	A	(5)	-	60	2	2
	L2-2	Lawini	60	1	B	(9)	-	60	1	1
	L2-3	Mantjolini	30	1	A	(8)	○	30	1	-
	L2-4	Madadeni	70	1	A	F	-	-	-	-
	L2-5	Etipokweni	40	1	A	(5)	○	40	1	-
	L2-6	Mphanganyeti	70	2	B (1 site), C (1 site)	P (4)	-	-	-	-
	L2-7	Thuthuka	105	2	A	(9)	-	105	2	2
	L2-8	Maphungwane/Esibovini	30	1	B	(6)	○	30	1	-
	L2-9	Ntandane	20	1	A	(8)	-	20	1	1
	L2-10	Mbololweni	50	1	A	(9)	-	50	1	1
	L2-11	Mncumaneni	30	2	B	(5)	-	30	2	2
	L2-12	Mdumezule/Manjolo	40	1	B	(8)	-	40	1	1
	L2-13	Buchochatfombi	83	1	A	(7)	-	83	1	1
	L2-14	Ekutheleni	60	1	A	(5)	-	60	1	1
	L2-15	Egushede	40	1	A	F	-	-	-	-
	L2-16	Mlangane	61	1	B	(6)	-	61	1	1
	L2-17	Etinqumatsini	42	1	B	F	-	-	-	-
	L2-18	Emsengeni	35	1	A	(7)	-	35	1	1
	L2-19	Mbokojweni (IV)	31	1	A	(6)	-	31	1	1
	L2-20	Buloyini	60	1	A	W	-	-	-	-
	L2-21	Junjwini	45	1	B	(6)	-	45	1	1
	L2-22	Nhlambelo	40	1	B	(6)	-	40	1	1
	L2-23	Mhlabubovu	44	1	B	(6)	-	44	1	1
	L2-24	Macambani	32	1	B	W	-	-	-	-
	L2-25	Mbokojweni V	41	1	B	P (4)	-	-	-	-
	L2-26	Mbokojweni (I, II, III)	40	1	A	(5)	-	40	1	1
	Sub-total		1,259	30	-	-	-	904	22	19
Manzini	M2-1	Moneni	65	1	B	(7)	○	65	1	-
	M2-2	Masekweni	86	1	B	(5)	-	86	1	1
	M2-3	Nkhangala	83	1	B	(6)	-	83	1	1
	M2-4	Bhadzeni II	100	3	B	(5)	-	100	3	3
	M2-5	Mancubeni	100	1	B	(10)	-	100	1	1
	M2-6	Kantunja	83	2	B	(6)	-	83	2	2
	M2-7	Ntabamhloshana	250	5	B	(10)	○	250	5	4
	M2-8	Mponono	220	5	B	(8)	-	220	5	5
	M2-9	Kulesibovu	150	5	B	(7)	-	150	5	5
	M2-10	Emseni Mfangibhekile	357	8	B	(9)	○	357	8	7
	Sub-total		1,494	32	-	-	-	1,494	32	29
Shiselweni	S2-1	Mambuzikazi	10	1	C	(11)	-	-	-	-
	S2-2	Kajele	20	1	B	(5)	-	20	1	1
	S2-3	Nkezwane	21	1	B	(9)	-	21	1	1
	S2-4	Dlayinyoni	16	1	B	(8)	-	16	1	1
	S2-5	Mdunusa	35	2	A	(8)	-	35	2	2
	S2-6	Nenekazi	41	2	A	W	-	-	-	-
	S2-7	Hlabangamehlo	14	1	B	(6)	-	14	1	1
	S2-8	Emaganyaneni	22	1	A	(8)	○	22	1	-
	S2-9	Dinabanye	42	3	B	W	-	-	-	-
	S2-10	Osabeni/Mfulamudze	60	3	B	P (4)	-	-	-	-
	S2-11	Sibovini	136	3	B	(9)	-	136	3	3
	Sub-total		417	19	-	-	-	264	10	9
Total			3,760	100	-	-	-	3,092	78	70

Note: *: A: All season, B: Seasonal, C: Not passable
**: W: No WSC, F: No fund prepared, P: Total point not more than 5, ( ): Total point of each community.
***: Results of the test drilling conducted during the study.

Table 2.3 Selection of Communities Based on Socio-economic Aspect

Region	No.	Community	Surveyed		Items for Necessity of Safe Water						Total Point*
			Home -stead	Home -stead	Latrine	Disease	Dist. to Water Source	Yield in Dry Season	Quality in Dry Season	Water -Related Issues	
Hhohho	H2-1	Meleti	160	5	0	1	0	0	0	1	P (2)
	H2-2	Ndzingeni	150	5	1	1	0	0	2	2	6
	H2-3	Luhlangotsini	130	2	1	1	1	0	1	1	5
	H2-4	Mawombe	150	7	1	1	0	0	2	2	6
Lubombo	L2-1	Entandweni	60	2	0	1	1	1	2	0	5
	L2-2	Lawini	60	1	1	2	1	2	2	1	9
	L2-3	Mantjolini	30	1	0	1	1	2	2	2	8
	L2-4	Madadeni	70	1	-	-	-	-	-	-	F
	L2-5	Etipokweni	40	1	0	1	0	2	2	0	5
	L2-6	Mphanganyeti	70	2	0	0	1	1	2	0	P (4)
	L2-7	Thuthuka	105	2	1	2	1	2	2	1	9
	L2-8	Maphungwane/Esibovini	30	1	0	1	0	2	2	1	6
	L2-9	Ntandane	20	1	0	2	2	2	1	1	8
	L2-10	Mbololweni	50	1	1	2	0	2	2	2	9
	L2-11	Mncumaneni	30	2	0	1	0	2	1	1	5
	L2-12	Mdumezule/Manjolo	40	1	1	2	0	2	1	2	8
	L2-13	Buchochatfombi	83	1	0	0	2	2	2	1	7
	L2-14	Ekutheleni	60	1	0	1	0	1	2	1	5
	L2-15	Egushede	40	1	-	-	-	-	-	-	F
	L2-16	Mlangane	61	1	0	1	1	0	2	2	6
	L2-17	Etinqumatsini	42	1	-	-	-	-	-	-	F
	L2-18	Emsengeni	35	1	0	1	2	2	2	0	7
	L2-19	Mbokojweni (IV)	31	1	0	1	0	2	2	1	6
	L2-20	Buloyini	60	1	-	-	-	-	-	-	W
	L2-21	Junjwini	45	1	0	1	0	2	2	1	6
	L2-22	Nhlambelo	40	1	0	0	1	2	2	1	6
	L2-23	Mhlabubovu	44	1	0	0	1	2	2	1	6
	L2-24	Macambani	32	1	-	-	-	-	-	-	W
	L2-25	Mbokojweni V	41	1	0	0	0	1	2	1	P (4)
	L2-26	Mbokojweni (I, II, III)	40	1	0	0	0	2	2	1	5
Manzini	M2-1	Moneni	65	1	0	1	0	2	2	2	7
	M2-2	Masekweni	86	1	1	0	1	0	2	1	5
	M2-3	Nkhangala	83	1	1	0	0	2	2	1	6
	M2-4	Bhadzeni II	100	3	1	0	0	1	2	1	5
	M2-5	Mancubeni	100	1	1	1	2	2	2	2	10
	M2-6	Kantunja	83	2	1	1	0	1	1	2	6
	M2-7	Ntabamhloshana	250	5	1	1	2	2	2	2	10
	M2-8	Mponono	220	5	1	2	2	0	2	1	8
	M2-9	Kulesibovu	150	5	0	2	2	0	2	1	7
	M2-10	Emseni Mfangibhekile	357	8	1	1	1	2	2	2	9
Shiselweni	S2-1	Mambuzikazi	10	1	1	2	2	2	2	2	11
	S2-2	Kajele	20	1	0	1	0	0	2	2	5
	S2-3	Nkezwane	21	1	1	2	0	2	2	2	9
	S2-4	Dlayinyoni	16	1	0	2	0	2	2	2	8
	S2-5	Mdunusa	35	2	0	1	1	2	2	2	8
	S2-6	Nenekazi	41	2	-	-	-	-	-	-	W
	S2-7	Hlabangamehlo	14	1	0	2	0	0	2	2	6
	S2-8	Emaganyaneni	22	1	0	2	0	2	2	2	8
	S2-9	Dinabanye	42	3	-	-	-	-	-	-	W
	S2-10	Osabeni/Mfulamudze	60	3	0	1	2	0	0	1	P (4)
	S2-11	Sibovini	136	3	1	2	0	2	2	2	9

Note: *: W: No WSC, F: No fund prepared, P: Total point not more than 5.

Table 2.4　Project Design Matrix for Software Assistance for Drilling Operation Control

Project Title：　The Project for Rural Water Supply, Phase 2 in the Kingdom of Swaziland　　Period：　August 2002～June 2003
Target Country: Swaziland　　Target Group：　Employees of RWSB
Date：February, 2002

Project	Objectively Verifiable Indicator	Means of Verification	Important Assumptions
Overall Goal 1. Reduce the constraints of rural water supply project by raising success ratio of well drilling 2. Supply safe drinking water to reduce incident of water-born disease and infant mortality rate	1. Success ratio is more than 70%. 2. Reduce the incident of water-born disease and infant mortality rate by 10% compared with the figures before project.	・ RWSB annual activity report ・ Annual statistics ・ UNNDP, HDI report	・ There will be no change in the national policy on rural water supply.
Project purpose 1. Increase the ability of RWSB staff for drilling work supervision and equipment maintenance. 2. Supply safe water	1. Water quality 2. Number of wells contracted 3. Number of beneficiaries	・ Water quality test ・ RWSB reports ・ Monitoring	・ Political situation of the country stays stable. ・ The rural water supply projects will be continued.
Outputs 1. The drilling equipment will be properly operated and the work will be smoothly executed. 2. Management (of stock, adjustment, operation, accounting) will be properly done.	1. Properly scheduled work record 2. Proper operation of drilling equipment and reduction of maintenance cost 3. Management record, filling of forms and maintenance	・ Construction supervision record ・ Operation record of equipment ・ Maintenance record of equipment ・ In-out record of materials ・ Accounting record ・ Safety management record	・ RWSB will continue its rural water supply projects. ・ The local people will understand the project and cooperate with RWSB.
Activities 1. Construction of water supply facilities (Construction of wells：78 sites) 2. Check and arrange the inventory of materials and equipment 3. Prepare an operation and maintenance manual 4. Keep record of operation, check and repair 5. Improvement of format for construction and quality control record 6. Establish a systematic construction system 7. Establish a system of labor management including subcontract management 8. Establish a safety management system	Input <Japanese side> 1. Supply of drilling equipment 2. Supply of peripheral equipment for well construction 3. Dispatch of an expert of drilling operation control - 1 person x 4 months	Input <Swaziland side> 1. Provision of venue for training 2. Provision of staff and consumables 3. Participation of RWSB staff of groundwater section 4. Obtaining permission of use of the site, removal of bushes and so on 5. Securing safety of all the personnel concerned	・ The trained RWSB staff will stay in the workplace. ・ Securing materials, spare parts and budget Preconditions ・ RWSB groundwater staff and would be staff will join the training. ・ RWSB is ready to cooperate with the staff for software assistance.

Table 2.5　Project Design Matrix for Software Assistance for Hydrogeology and Sitting Plan

Project Title： The Project for Rural Water Supply, Phase 2 in the Kingdom of Swaziland　　Period：　August 2002～June 2003
Target Country: Swaziland　　Target Group：　Employees of RWSB
Date：February, 2002

Project	Objectively Verifiable Indicator	Means of Verification	Important Assumptions
Overall Goal 1. Reduce the constraints of rural water supply project by raising success ratio of well drilling 2. Supply safe drinking water to reduce incident of water-born disease and infant mortality rate	1. Success ratio is more than 70%. 2. Reduce the incident of water-born disease and infant mortality rate by 10% compared with the figures before project.	・ RWSB annual activity report ・ Annual statistics ・ UNNDP, HDI report	・ There will be no change in the national policy on rural water supply.
Project Purpose 1. Increase the ability of RWSB staff to investigate groundwater and interpret the data.	1. RWSB will be able to determine appropriate drilling sites through its own operation of investigation and data interpretation	・ RWSB groundwater investigation report ・ Success ratio of well drilling	・ Political situation of the country remains stable. ・ The rural water supply projects will be continued.
Output 2. Raise RWSB groundwater prospecting engineer's ability 3. Prepare an English geophysical prospecting manual for RWSB staff. 4. RWSB staff will utilize the manual. 5. Maintenance of the equipment will be properly done.	1. 5 members of RWSB will complete the training program during 2002. 2. English operation manuals for major equipment will be in place. 3. Prospecting manual will be distributed. 4. The data of hydrogeological survey and geophysical prospecting will be properly analyzed and interpreted.	・ Number of participants to the training ・ Number of manuals prepared for equipment and prospecting method ・ The analysis and interpretation record of the relevant survey data	・ Sufficient budget will be allocated for the groundwater investigation projects in Swaziland. ・ The local people will understand the project and cooperate with the staff.
Activities 1. Give field training on groundwater prospecting for RWSB staff 2. Conduct training on the method of interpretation of hydrogeological survey 3. Conduct training on the operation and data analysis of prospecting equipment and its maintenance. 4. Make technical manuals on groundwater investigation method and analysis techniques.	Input <Japanese side> 1. Supply of drilling equipment 2. Supply of peripheral equipment for well construction 3. Dispatch a hydrogeology and site selection plan expert - 1 person x 3 months 4. Distribute training materials in English	Input <Swaziland side> 1. Provision of research facilities 2. Provision of staff and consumables 3. Participation of RWSB staff of groundwater section 4. Obtaining permission of use of the site, removal of bushes and so on 5. Provision and transportation of equipment for geophysical prospecting and water quality analysis 6. Securing safety of all the personnel concerned	・ The trained RWSB staff will stay in the workplace. ・ Existing prospecting equipment will be available. Preconditions ・ RWSB groundwater staff and would-be staff will join the training. ・ RWSB is ready to cooperate with the staff for software assistance project.

Table 2.6 Project Design Matrix for Software Assistance for Capacity Building of WSC

Project: Swaziland Rural Water Supply Project Phase II
Duration: Sept. 2002 to March 2004
Location： Kingdom of Swaziland
Target Group: Local Community

Made on Feb. 1, 2002

Narrative Summary	Indicators	Means of Verification	Important Assumptions
Overall Goal Improvement of water supply and hygiene conditions in the nation	Rate of access to safe water Latrine coverage rate / Number of latrines in rural area	RWSB Ministry of Health	Rural Water Supply Policy of RWSB in Swaziland remains the same
Program Purposes People in the project villages will do sustainable O&M of hand pumps	Rate of operation of project hand pumps	Project Report / Report by CDO Workshop Report	Major repairs of hand pumps are done by RWSB
Relationship (Communication) between WSCs and RWSB will be stronger	Kinds and number of reports submitted to RWSB by WSC Number of visits to project villages by CDO or RWSB officers	Follow-up Study Report Monitoring Form	
Outputs 1 WSCs in project villages will be strengthened 1-1 WSC executives / community leaders facilitate workshops for villagers.	Number of TOF/TOT workshop participants who facilitated the workshops for villagers Conditions of workshops for villagers	Observation of workshops Workshop Report	Support by relevant government organizations and personnel such as CDO, HI and RHM remains the same
1-2 Water minders inspect and repair hand pumps.	Number of water minders who attended workshops Rate of repair of broken hand pumps Conditions of hand pump repair Conditions of hand pump maintenance	Workshop Report Hand pump maintenance/ repair Record Report by CDO Follow-up Study Report	
1-3 WSC executives manage their committees properly.	WSC meetings are held regularly (or whenever needed) Rate of payment of Water Fee Management of Water Fee	WSC Meeting Record Water Fee Payment / Management Records Follow-up Study Report	
2 Villagers will have a stronger sense of ownership of hand pumps. 2-1 Villagers actively engage in WSC activities 2-2 Villagers pay water fee every month	Rate of Participation / Number of Participants of WSC Meeting Rate of Participation / Number of WSC Activity Participants / Number of villagers who offer their labor Water Fee Collection Rate Conditions of WSC activities Meaning / Significance of hand pump and WSC to villagers	WSC Meeting Record Well Construction Record Water Fee Collection Record Follow-up Study Report Interview with villagers	
3 Villagers will have a stronger sense of health and hygiene. 3-1 Villagers have better hygiene practices 3-2 Number of water borne disease in project villages decreases	Number of new latrines constructed in project villages Conditions of water borne diseases such as diarrhea Conditions of cleanliness around hand pump Water storage condition at home Meaning / Significance of water to villagers	Follow-up Study Report Report by Health Inspector Interview with HI/RHM Interview with villagers / Site visit	
4 Lack of personnel in Community Development Section of RWSB will ease.	Support of CDO by local consultants	Work report by local consultants	

Activities

1 WSC Workshop for WSC executives, water minders, community leaders, and government officers: This should be held regularly to serve as follow-up and monitoring of project activities
- Brief description of project
- (TOF/TOT) PHAST
- Gender awareness
- Hand pump repair and maintenance
- WSC and its activities (water fee management, management and records of meetings, committee rules, roles and responsibility of WSC executives, etc.)
- How to run Workshop for villagers, how to facilitate
- Problems on water and hygiene in community
- WSC activities, problems and suggestions for improvement
- Health and hygiene conditions in community, problems and improvements
- Conditions of hand pumps, problems and improvements

2 Village Workshop for well users facilitated by participants of the WSC Workshop: This should be held regularly to serve as follow-up and monitoring of project activities
- Brief description of project
- WSC and its activities
- Roles and responsibilities of villagers
- Water Fee
- Gender awareness
- Health and hygiene: Safe water and health

3 Demonstration Workshop at the time of hand pump installations

4 Follow-up Study done through site visits by the local consultant leader
- Hand pump conditions
- WSC conditions
- Hygiene conditions in community, Health conditions of villagers
- Villagers' comments and requests to project

5 Project Impact Study: Questionnaire and field visits

WSC executives, water minders and government officers who attended the workshop continue to keep their work positions

Villagers who attended workshop continue to live in their communities

Preconditions

Villagers are not against well construction

WSCs have been established already

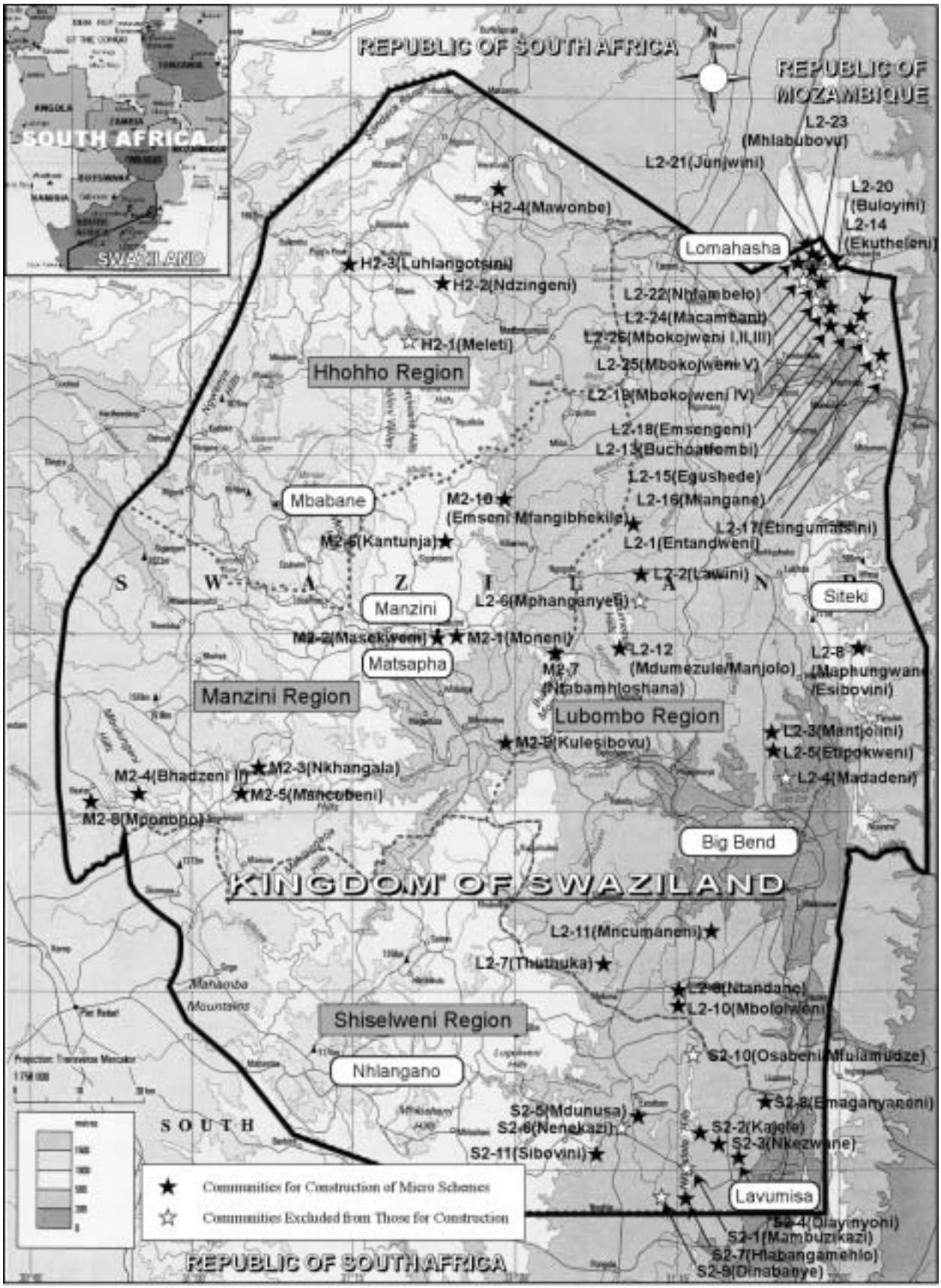
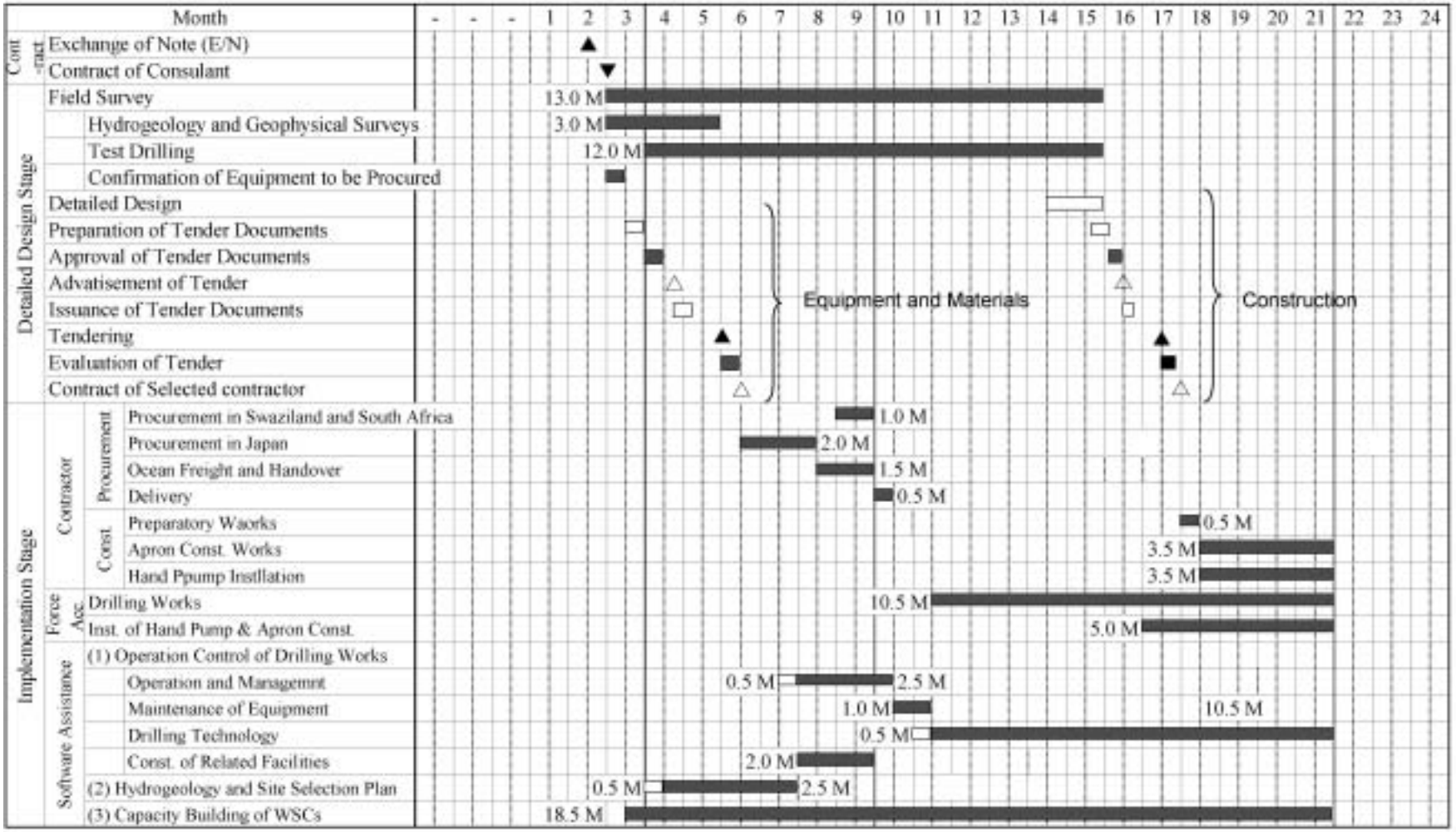


Fig. 2.1 LOCATION OF COMMUNITIES FOR CONSTRUCTION OF MICRO SCHEMES

Fig. 2.1 PROJECT IMPLEMENTATION SCHEDULE



CHAPTER 3 PROJECT EVALUATION AND RECOMMENDATIONS

CHAPTER 3 PROJECT EVALUATION AND RECOMMENDATIONS

3.1 Project Effect

The following direct and indirect effects are expected by implementing the Project.

(1) Direct Effects

i) Improvement of Service Ratio of Water Supply

Through the implementation of 78 tubewell construction works, a population of 31,000 in the rural areas of Swaziland will be benefited. As a result, the present service ratio of 49.0 % will be improved to 54.0 % in 2004 upon completion of this project.

ii) Relief from Hard Work for Fetching and Carrying Water

Women in the rural area have to fetch and carry water from distant water sources, sometimes even from a distance of several kilometers away from their residences. Since they spend much time and energy for this hard work, they have to sacrifice their educational and job opportunities. The project will relieve both their time and energy.

iii) Establishment of Sustainable Operation and Management System by Community Members

The activities of the software assistance for the building of WSCs capacity will be conducted in order to supplement and reinforce the various CDO's activities which are considered to be insufficient because of shortage of the number of CDOs. Sustainable operation and management systems are expected to be established in each community by this software assistance.

iv) Strengthening of operation control for Tubewell Drilling Works

In the course of the software assistance, technical training and OJT will be carried out for the geophysical survey and drilling staff of the Matsapha Workshop of RWSB covering technical knowledge on well site selection plan and operation control system for drilling works and operation and maintenance of equipment and vehicles and drilling technique by rotary method as well as DTH method. This should result in improvement of operation control system for drilling works and sustainable management capability of RWSB.

(2) Indirect Effects

i) Improvement of Living Standard

It is expected that availability of necessary and safe water throughout the year will diffuse its utilization, and thereby improve the life environment and living standard of the population.

ii) Reduction of Regional Gap

The service ratio of water supply in the rural areas of Swaziland is less than 50 %, while it reaches 90 % in the urban areas, and the coverage rate of improved latrine is 71 % (lower than the 97 % of urban areas). This results in remarkably low coverage of health and sanitation service in rural areas. This project is expected to contribute to reducing the regional gap of health and sanitation service between the rural and urban areas, because of the improvement of water supply ratio and the various activities on health and sanitation conducted under the technical assistance.

iii) Improvement of Sanitary Environment

Supply of safe water without contamination will contribute to improve sanitary environment and promote public health conditions with hygiene and sanitation transformation to the communities by Rural Health Motivators. This will lead to reduction of infant mortality rate due to water borne diseases and/or diarrhea.

iv) Improvement of Drilling Technology

Through the project implementation, technical transfer will be carried out to the drilling and geophysical survey teams of RWSB. This technical transfer and its consequent ripple effect will improve the entire level of well drilling technology in Swaziland as well as efficiency of construction works.

3.2 Recommendations

In order to properly maintain the drilling equipment and facilities, and for the sustainable management of groundwater development and rural water supply project, it is indispensable to consider the following aspects.

(1) Project Budget and Staff for Project Implementation

In order to operate the procured drilling rigs and the other equipment efficiently and to carry out consecutive construction works to attain the project target, it is necessary to provide sufficient budget including personnel expenses to employ RWSB staff who are trained by software assistance as a part of the project. Especially it is necessary to increase the number of CDOs who are considered indispensable in establishing the sustainable operation and management systems in the communities in order to mitigate the load of extension services and to enable them to conduct thorough activities.

(2) Water Quality Control of Raw Water

It may be possible to face problems caused by deterioration of water quality, intrusion of contamination from the soil and/ or ground to the source aquifer after utilization for a long period. Therefore, it is necessary to maintain environment around the well facilities and conduct periodic sampling and analyses of water quality. If some unusual results are observed, appropriate countermeasures including restriction of usage should be considered.

(3) Collection of Water Fee and Establishment of Transparent Accounting System

Once the management system of well facilities is established and sustainable operation and maintenance are started, any unforeseen breakdown or obsolescence of the hand pump, flushing bore, or elimination of deposit can occur during the lifetime of the facilities, which will require extra expenditure. To cope with such situations, it is important to collect water fees properly and completely, and to pay enough attention to fund reserves and bookkeeping. It is especially important that the accounting system be independent and transparent to prevent embezzlement and/or misappropriations.

Various projects are being carried out by DFID, EU, UNICEF, etc. in Swaziland at present. Out of these on-going projects, the Rural Water Supply, Sanitation & Hygiene Project being implemented under the assistance of DFID is required to be considered to the most relevant one to the country. Since this project includes the consideration on the procedures to be taken for

implementing rural water supply project, it is necessary to reflect any modifications and changes in such procedures (if any) properly to the activities of CDOs.