No.

Federal Ministry of Agriculture and Water Resources

The Federal Republic of Nigeria

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR WATER SUPPLY
IN
BAUCHI AND KATSINA STATES
IN
THE FEDERAL REPUBLIC OF NIGERIA

DECEMBER 2009

JAPAN INTERNATIONAL COOPERATION AGENCY

YACHIYO ENGINEERING CO., LTD

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PREFACE

In response to a request from the Government of the Federal Republic of Nigeria, the Government of Japan decided to conduct a basic design study on the Project for Water Supply in Bauchi and Katsina States and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Nigeria a study team from March 1 to April 12, 2009.

The team held discussions with the officials concerned of the Government of Nigeria, 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 Nigeria 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 the Government of the Federal Republic of Nigeria for their close cooperation extended to the teams.

December 2009

Izumi Takashima
Vice-President
Japan International Cooperation Agency

December 2009

LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for Water Supply in Bauchi and Katsina States in the Federal Republic of Nigeria.

This study was conducted by Yachiyo Engineering Co., Ltd., under a contract to JICA, during the period from February to December, 2009. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Nigeria 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,

Kenji Yoshida
Project manager,
Basic design study team on
the Project for Water Supply in Bauchi and
Katsina States
Yachiyo Engineering Co., Ltd.

SUMMARY

SUMMARY

① Overview of the Country

The Federal Republic of Nigeria (hereinafter called Nigeria) borders the Gulf of Guinea in central West Africa and is a federal republic having a population of 140 million (2007, according to the National Census Data) and an area of 923,700 km2 (approximately 2.5 times the size of Japan). The GNI of Nigeria is US$ 38,700 million and the per capita GNI is US$ 640 (2006, according to the World Bank). The country is divided into two characteristic regions by the Niger and Benue Rivers - a semi-arid zone to the north and a wet (damp) zone to the south. Accordingly, lifestyles, etc. have a major impact on the cultural fabric of the nation, which can be roughly classified into north and south.

② Background of the Project

Having gained independence in 1960, Nigeria was one of the most productive agricultural countries in Africa exporting a wide variety of farm products, however, following the discovery of petroleum in the south of the country in the latter part of the 1960s, it adopted an economic structure dependent on oil revenues. Moreover, due to repeated civil strife and coups surrounding the petroleum reserves, the domestic political situation has remained unstable and little progress has been made on mitigating poverty and developing infrastructure.

Against such a background the Government of Nigeria stressed the importance of the following nine areas in Nigeria Economic Policy (1999-2003): 1) Increase of food production and promotion of agriculture, 2) Promotion of education, 3) Eradication of poverty, 4) Improvement of the health and medical care sector, 5) Economic infrastructure, 6) Water supply, 7) Economic liberalization and deregulation, 8) Employment creation, and 9) Development of natural resources, etc. Moreover, in the National Economic Empowerment and Development Strategy (NEEDS) that was announced in May 2004 (NEEDS II is currently being compiled), the following were raised as priority sectors: 1) Agriculture and rural development, 2) Roads, 3) Education, 4) Public health, 5) Water supply, and 6) Electric power. Thus, water supply including water supply in rural areas was raised as a priority sector.

Regarding the water supply and sanitary situation in Nigeria, the water supply rate is low in rural farming areas, where people have no choice but to utilize unsanitary water resources such as hand dug wells and spring water and a lot of damage is caused by water-borne diseases. Under such circumstances, the Government of Nigeria formulated National Rural Water Supply and Sanitation Policy in 1999 and National Rural Water Supply and Sanitation Programme (A Strategic Framework) in 2004. Following this, the national water supply rate was improved to 80% by 2007 and it is eventually intended to supply safe water to all citizens by 2011. Within this goal, it is intended to secure 30 liters of water supply per person per day, to keep water carrying distances to no more than 250 m and to provide water supply points for every 250~500 people in all rural communities with population of no more than 5,000.

In spite of various government efforts to improve the water supply rate, the ratio of people with access to safe water declined from 49% in 1990 to 48% in 2004 due to population increase, etc., and the ratio is especially low in rural areas at 31% compared to 68% in the cities. In provincial rural areas especially, there is an urgent need to secure safe water supply because many people drink untreated water from rivers, marshes and puddles and water-borne diseases such as cholera and infant diarrhoea, etc. are prevalent.

In these circumstances, the Government of Nigeria in 2007 requested the Government of Japan to provide grant aid for the procurement of well drilling and prospecting equipment and well building materials, etc. in the five states of Katsina, Plateau, Borno, Kogi and Bauchi, where the poverty rate is especially high and access to safe water is extremely poor. At the time of project examination in 2007, it was decided to conduct further review due to the inadequate organization, personnel setup, budget, equipment and water supply facility plans, etc. within the Rural Water

Supply and Sanitation Agency (RUWASSA), which was the implementing agency in the five target states at that time. In August 2008, as a result of the project formation study implemented by the JICA Nigeria Office, information was collected on water supply facilities development in the five states and the equipment ownership of RUWASSA, and additional information was gathered through diplomatic routes after that study was finished. As a result, the targets were narrowed down to the two states of Katsina and Bauchi, and these two states submitted a new request entailing revised equipment quantities and borehole drilling plan (including list of target villages).

③ Outline of the Study Findings and Project Contents

In response to this request, the Government of Japan decided to carry out a Basic Design Study and the Japan International Cooperation Agency (JICA) dispatched a Basic Design Study Team to Nigeria from March 1 to April 12, 2009 in order to confirm the components being requested and to carry out a site survey, etc. After returning to Japan, a draft final report was compiled based on the necessity and the social and economic effects, and the relevance of the Project was examined based on materials collected during the field survey and an analysis conducted in Japan. The Basic Design Study Team was again dispatched to the said country from August 24 to September 2, 2009 in order to explain the draft final report. The Basic Design Study Report was then prepared based on the draft final report.

The requested Japanese assistance formulated from the results of the study includes the procurement of equipment and materials for construction of handpump borehole water supply facilities and technical support via the soft component. As for the construction of water supply facilities including the selection of sites, both governments have agreed that the Nigerian side will take responsibility.

After the Basic Design Study Team returned to Japan, the basic design compiled its finding from a field survey and discussions with the Nigerian side as outlined in the following table.

Outline of the Basic Plan

	Contents of Equipment and Materials	Quantity	
1.	Drilling Equipment		
(1)	Drilling rig	Bauchi □1 Katsina □1	Unit
(2)	High pressure air compressor	Bauchi □1 Katsina □1	Unit
(3)	Cargo truck with crane	Bauchi □1 Katsina □1	Unit
2.	Survey Equipment		
(1)	Geophysical survey equipment	Bauchi □1 Katsina □1	Unit
(2)	Water analysis equipment	Bauchi □1 Katsina □1	Unit
(3)	Pumping test equipment	Bauchi □1 Katsina □1	Unit
3.	Borehole Construction Materials		
(1)	Hand pump	Bauchi □76 Katsina □92	Set
(2)	Village level mechanic tools	Bauchi □76 Katsina □92	Set
(3)	LGA level mechanic tools	Bauchi □8 Katsina □5	Set
(4)	PVC casing pipe & screen pipe	Bauchi □76 Katsina □92	Set

The “Soft Component” of the project consists of the following two components:

- Technical Training for Borehole Construction and Data Management
- Technical Training for O&M System for Supply Facility Facilities

④ Project Period and Estimated Project Cost

The responsible agency in the recipient country is the Federal Ministry of Agriculture and Water Resources and the implementing agency is the WATSAN Project in Bauchi State and RUWASSA in Katsina State. The project, when implemented as a grant aid, will require about 36 months in total, with 24 months as facility construction period by the Nigerian side, 12 months as procurement period of equipment and materials and 3 months for "Soft Component". As for the construction of water supply facilities including the selection of sites by the geophysical survey, the Nigerian side will take responsibility. In order to effectively utilize and operate the procured drilling equipment by the Nigerian side so as to improve the water supply rate and ensure safe water supply to residents in rural areas, it is necessary for Bauchi and Katsina States to secure the water supply utility budget and to sustain the organization and technical capability of RUWASSA/WATSAN Project, which is in charge of the regional water supply service.

In implementing the Project under the grant aid scheme of the Government of Japan, the total cost of the Project to be implemented in accordance with the Japan's Grant Aid scheme will be determined before concluding the Exchange of Notes (E/N) for the Project.

⑤ Verification of the Relevance of the Project

Upon the completion of this project, 168 boreholes will be constructed and 50,400 people will receive safe water. Furthermore, RUWASSA/WATSAN Project will have a new up-to-date drilling rig with good work efficiency and this rig will be continuously utilized for borehole constructions after this project. It is expected that the facilities constructed for over four years benefit a population of approximately 96,000. The ability of RUWASSA/WATSAN Project personal on borehole construction management and operation and maintenance of water supply facilities will increase by the technical training for borehole construction and data management and operation and maintenance system of water supply facilities through the "Soft Component" of the project. In addition, the system for water supply and sanitation services will be strengthened and technical knowledge and skills for these services will be improved.

As an indirect effect, the number of patients with water borne diseases in the project sites will decrease. Furthermore, owning to reduced distance of carrying water, workload of woman and children for obtaining water will be reduced.

The effects mentioned above can be expected under the Project and therefore implementation of Japan's Grant Aid is judged to be appropriate.

In order to execute the maintenance of equipment procured under the Project and manage the sustainable rural water supply project, it is indispensable to consider the following aspects.

- Securing budget for rural water supply and enforcement of organization structure of RUWASSA/WATSAN Project
- Improvement of operation & maintenance and monitoring systems of water supply facilities
- Establishment of collection system of water charge by community
- Collaboration with technical assistance (NWRI training)
- In addition to the above, in order to execute the project smoothly and effectively, the following matters must be improved and enhanced.
- Community participation to rural water supply and sanitation project
- Public education to communities by RUWASSA/WATSAN Project and officials concerned

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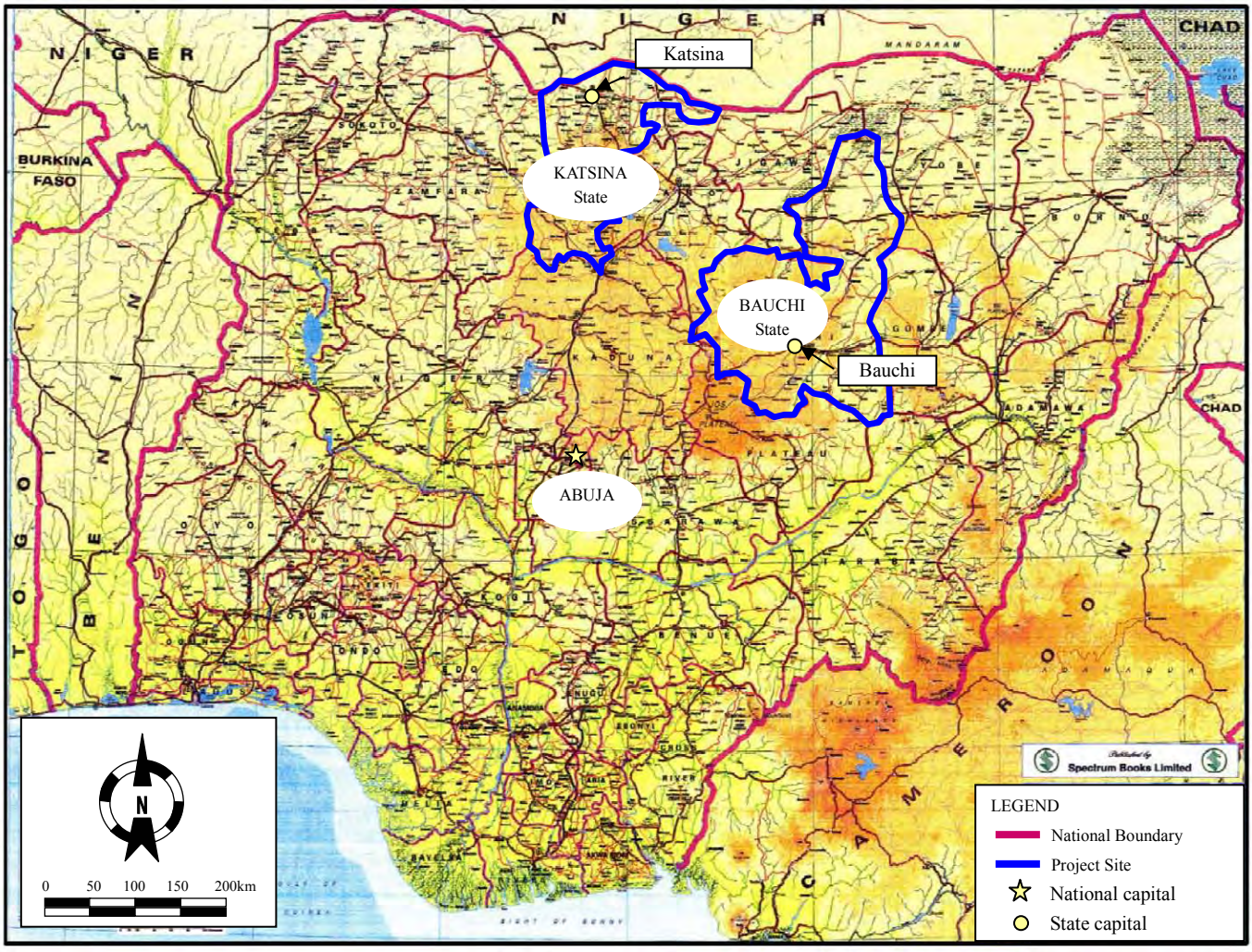

Location Map of Study Area

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ABBREVIATIONS

A/P	Authorization to Pay
ASTM	American Society for Testing and Materials
B/A	Banking Arrangement
BS	British Standard
DTH	Down The Hole hammer
DIN	Deutsche Industrie -Norm
EC	Electric Conductivity
E/N	Exchange of Note
FMAWR	Federal Ministry of Agriculture and Water Resources
G.L.	Ground Level
GNP	Gross Domestic Product
JIS	Japanese Industrial Standards
JICA	Japan International Cooperation Agency
LGA	Local Government Areas
M/D	Minutes of Discussion
MDG	Millennium Development Goal
MWR	Ministry of Water Resources
NEEDS	National Economic Empowerment and Development Strategy
NGN	Nigerian Naira
NPC	National Planning Commission
NWRI	National Water Resources Institute
OJT	On-the-Job Training
O&M	Operation and Maintenance
PDM	Project Design Matrix
PHCN	Power Holding Community of Nigeria
PVC	Polyvinyl Chloride
RUWASSA	Rural Water Supply and Sanitation Agency
UNICEF	United Nations International Children's Fund
uPVC	Unplastised polyvinyl Chloride
VLOM	Village Level Operation and Maintenance
WASHCOM	Water, Sanitation and Hygiene Committee
WATSAN Project	Water and Sanitation Project
WHO	World Health Organization

CHAPTER 1

BACKGROUND OF THE PROJECT

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Against such a background the Government of Nigeria stressed the importance of the following nine areas in Nigeria Economic Policy (1999-2003): 1) Increase of food production and promotion of agriculture, 2) Promotion of education, 3) Eradication of poverty, 4) Improvement of the health and medical care sector, 5)Economic infrastructure, 6) Water supply, 7) Economic liberalization and deregulation, 8) Employment creation, and 9) Development of natural resources, etc. Moreover, in the National Economic Empowerment and Development Strategy (NEEDS) that was announced in May 2004 (NEEDS II is currently being compiled), the following were raised as priority sectors: 1) Agriculture and rural development, 2) Roads, 3) Education, 4) Public health, 5) Water supply, and 6) Electric power. Thus, water supply including water supply in rural areas was raised as a priority sector.

Regarding the water supply and sanitary situation in Nigeria, the water supply rate is low in rural farming areas, where people have no choice but to utilize unsanitary water resources such as hand dug wells and spring water and a lot of damage is caused by water-borne diseases.

Under such circumstances, the Government of Nigeria formulated National Rural Water Supply and Sanitation Policy in 1999 and National Rural Water Supply and Sanitation Programme (A Strategic Framework) in 2004. Following this, the national water supply rate was improved to 80% by 2007 and it is eventually intended to supply safe water to all citizens by 2011. Within this goal, it is intended to secure 30 liters of water supply per person per day, to keep water carrying distances to no more than 250 m and to provide water supply points for every 250~500 people in all rural communities with population of no more than 5,000.

In spite of various government efforts to improve the water supply rate, the ratio of people with access to safe water declined from 49% in 1990 to 48% in 2004 due to population increase, etc., and the ratio is especially low in rural areas at 31% compared to 68% in the cities. In provincial rural areas especially, there is an urgent need to secure safe water supply because many people drink untreated water from rivers, marshes and puddles and water-borne diseases such as cholera and infant diarrhoea, etc. are prevalent.

In these circumstances, the Government of Nigeria in 2007 requested the Government of Japan to provide grant aid for the procurement of well drilling and prospecting equipment and well building materials, etc. in the five states of Katsina, Plateau, Borno, Kogi and Bauchi, where the poverty rate is especially high and access to safe water is extremely poor. At the time of project examination in 2007, it was decided to conduct further review due to the inadequate organization, personnel setup, budget, equipment and water supply facility plans, etc. within the Rural Water Supply and Sanitation Agency (RUWASSA), which was the implementing agency in the five target states at that time. In August 2008, as a result of the project formation study implemented by the JICA Nigeria Office, information was collected on water supply facilities development in the five states and the equipment ownership of RUWASSA, and additional information was gathered

through diplomatic routes after that study was finished. As a result, the targets were narrowed down to the two states of Katsina and Bauchi, and these two states submitted a new request entailing revised equipment quantities and well drilling plan on the local side (list of target villages).

In consideration of the above points, it was confirmed as appropriate to implement the Project as an equipment supply undertaking.

The Study in hand intends to: 1) gauge the background, objectives and contents of the Project, 2) implement basic design of the most appropriate contents, scale and expenses, etc. required to secure the outputs of the cooperation upon verifying the status and effect of Japan's grant aid in Project implementation as well as the technical and economic validity of the Project, 3) conduct a rough cost estimation of the project, and 4) recommend the scope of works of the local side, the implementation plan and consideration points necessary in order to realize the outputs and targets of the Project.

CHAPTER 2

CONTENTS OF THE PROJECT

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CONTENTS OF THE PROJECT

2-1 Basic Concept of the Project

2-1-1 Overall Goal and Project Objectives

(1) Superior Targets

The superior national development plans to the project are Vision 2010 and the National Economic Empowerment and Development Strategy (NEEDS) that revised this in 2004. NEEDS, which aims to "create a new Nigeria," raises eradication of poverty, creation of employment and construction of wealth, etc. as priority goals (NEES II is under preparation).

As for national policy regarding water supply and sanitation in rural communities, the National Water Supply and Sanitation Policy was compiled in 1999 and the National Rural Water Supply and Sanitation Programme (A Strategic Framework) was established in 2004. These policies aim to raise the water supply rate to 60% by 2003, 80% by 2007 and to supply safe water to all citizens by 2011.

(2) Project Targets

WATSAN Project in Bauchi State aims to raise the rural water supply rate, which was 30% in 2008, to 62% by 2016. In order to realize this goal, it is planning to install 520 motorised boreholes and 1,676 hand pump boreholes over six years from 2011 to 2016.

On the other hand, RUWASSA in Katsina State has a plan to raise the rural water supply rate, which was 50% in 2008, to 87% by 2016. In order to achieve this, RUWASSA is planning to construct 474 motorised boreholes and 868 hand pump boreholes over the six years from 2011 to 2016.
The Project aims to provide equipment supply and equipment operation and maintenance support over an appropriate scope as a grant aid undertaking of the Government of Japan in order to contribute to the realization of the above rural village water supply facilities construction plans.

In order to realize the above plans, the Project aims to drill 76 hand pump boreholes in Bauchi State and 92 hand pump boreholes in Katsina over two years using the supplied equipment, and these facilities will benefit a population of approximately 50,400 and raise rural water supply rate by 0.67% in Bauchi State and 0.59% in Katsina State.

The procured drilling rigs will continue to be used for construction of water supply facilities in RUWASSA and WATSAN Project for four years. It is expected that the facilities constructed this time will benefit a population of approximately 36,000 in Bauchi and 60,000 in Katsina and raise the rural water supply rate by 0.93% and 1.10% respectively.

2-1-2 Outline of the Project

The Project is composed of equipment and materials procurement and the soft component.

The equipment and materials procurement part will entail the procurement of equipment and materials for the drilling and construction of boreholes, and the said equipment and materials will be used to support the construction of 76 boreholes in Bauchi and 92 boreholes in Katsina by the Nigeria side. The outline of the basic design is shown in Table 2-1-1.

Table 2-1-1 Procured Equipment and Materials

	Contents of Equipment and Materials	Quantity	
1.	Drilling Equipment		
(1)	Drilling rig	Bauchi : 1 Katsina : 1	Unit
(2)	High pressure air compressor	Bauchi : 1 Katsina : 1	Unit
(3)	Cargo truck with crane	Bauchi : 1 Katsina : 1	Unit
2.	Survey Equipment		
(1)	Geophysical survey equipment	Bauchi : 1 Katsina : 1	Unit
(2)	Water analysis equipment	Bauchi : 1 Katsina : 1	Unit
(3)	Pumping test equipment	Bauchi : 1 Katsina : 1	Unit
3.	Borehole Construction Materials		
(1)	Hand pump	Bauchi : 76 Katsina : 92	Set
(2)	Village level mechanic tools	Bauchi : 76 Katsina : 92	Set
(3)	LGA level mechanic tools	Bauchi : 8 Katsina : 5	Set
(4)	PVC casing pipe & screen pipe	Bauchi : 76 Katsina : 92	Set

The Japanese consultant will take the initiative in implementing the soft component, which will comprise the implementation of technical training for construction management and support for strengthening of the operation and maintenance system for the water supply facilities.

The following outputs are anticipated as a result of the above Project activities.

a) The equipment required in order to build borehole water supply facilities will be made available in Bauchi and Katsina States.
b) The water supply and sanitation utility implementation and organizational setup of RUWASSA in Katsina State and WATSAN Project in Bauchi State will be reinforced.

Table 2-1-2 shows the Project Design Matrix (PDM) for the Project.

Table 2-1-2 Project Design Matrix（PDM）

Project：Water Supply in Bauchi & Katsina States in Federal Republic of Nigeria
Project Duration：2 years
Target Area：76 Sites in Bauchi State and 92 Sites in Katsina State　　Target Group：Communities in the Study Area

Design Summary	Project Monitoring Indicators	Source of Indicators	External Conditions
［Ultimate Goal］ • Improvement of water supply and sanitation condition in rural areas in Bauchi and Katsina States	• Ratio of increase of water supply in rural areas of Bauchi and Katsina States • Decrease in patients with water-borne diseases in the rural areas of Bauchi and Katsina States	• Statistical data of water supply • Statistical data of water-borne diseases • Statistical data published by Ministry of Health	• There is no change in the national policy about rural water supply. • The health environment irrelevant to water supply and health facilities does not deteriorate remarkably.
［Purpose］ • To keep functioning installed boreholes with appropriated maintenance in the target area • To establish Water Sanitation and Hygiene Committee (WASHCOM) in the communities of the target area and to encourage the WASHCOM keep managing and maintaining the relevant water supply facilities in the target area	• Hand pump boreholes will be constructed and water supply conditions of communities will be improved. • WASHCOM will be established in the communities. • Assuming that each borehole provides 25 liters of water to 300 people per day, safe water will be supplied to approximately 50,400 people. • Water drawing work load of women and children will be reduced.	• Progress report of borehole construction of RUWASSA and WATSAN Project • Inventories of borehole management by RUWASSA and WATSAN Project • Monitoring report by LGA	• There is no radical economic change in the country. • O/M system of water facilities will be maintained.
［Outputs］ • Necessary equipment and materials for the drilling and construction of boreholes will be provided to RUWASSA/WATSAN Project. • Technical level of RUWASSA and WATSAN Project for the construction of boreholes and O&M will be improved in Bauchi and Katsina States. • The water supply and sanitation services system and management system of RUWASSA and WATSAN Project will be strengthened. • WASHCOM in the communities system will be strengthened.	• The extent of procurement equipment and materials as planned. • The number of borehole construction by the Nigerian side. • The number of established WASHCOM in the target villages	• The shipping document of equipments • The delivery of goods/receipts of equipments • Construction record, etc. • Project progress report • Monitoring record by the LGA water health administration unit submitted to RUWASSA and WATSAN Project	• The rural water supply project will continue to be implemented after this study.

Design Summary	Project Monitoring Indicators	Source of Indicators	External Conditions
[Activities] <Japanese Side> • Equipments and materials supply for well drilling • OJT on operation and maintenance of the above-mentioned equipment and materials. • Supply of equipment and materials for construction of 76 water supply facilities in Bauchi and 92 in Katsina • Well drilling planning and data management support (soft component) • Strengthening of O/M system of water supply facilities (soft component) <Nigerian Side> • Construction of 76 hand pump boreholes in Bauchi State and 92 boreholes in Katsina • O/M of water supply facilities by communities	**[Inputs]** (Japanese Side) • Equipment and materials for borehole construction • Technical assistance by soft component • Human resources and project cost (Nigerian Side) • Securing of sites, personnel and budget and construction of 76 hand pump boreholes in Bauchi and 92 hand pump boreholes in Katsina over two years • Ongoing groundwater development following completion of the Project • Ongoing education of citizens and support for organized maintenance of water supply facilities • Human resources and project cost		• Intensive inflation and exchange rate fluctuation do not occur during planned implementation. • Remarkable natural disaster does not occur and the security situation does not change during planned implementation.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Concept

The basic concept of the Project is described below.

1) Scope of the cooperation

- Considering the effective realization of the grant aid, the scope of the aid shall cover the following: a) procurement of drilling machines and other borehole construction equipment and materials, b) transfer of technology by the supplier regarding the operation and handling of the procured equipment and materials, c) soft component by the consultant to support the operation and maintenance activities.
- RUWASSA and WATSAN Project will construct the borehole facilities using construction equipment and materials (hand pumps, casing and screen pipes) supplied by the Japanese side for two years. After that, RUWASSA and WATSAN Project will continue to construct the borehole facilities using the procured equipment.
- The Nigerian side will bear the cost of bentonite, mud control additive, cement, gravel, reinforcing bars, fuel, water, other borehole construction materials, equipment and labor.

2) Site selection

- The borehole construction period for 76 boreholes in Bauchi and 92 boreholes in Katsina shall be set at two years in consideration of the possible storage time for borehole construction materials such as casing pipes, etc. procured by the Japanese side.
- For the first two years, boreholes shall be constructed in 76 sites in Bauchi and 96 sites in Katsina selected according to the implementation capacity of the counterpart agency based on the results of survey of social conditions and natural conditions with prioritized villages.
- RUWASSA and WATSAN Project will determine the borehole drilling locations upon implementing detailed electrical sounding surveys.

(2) Concept regarding Natural Conditions

The climate of Bauchi and Katsina States is roughly the same, consisting of two seasons, i.e. rainy and dry. The rainy season lasts from May to October, with the greatest precipitation, at about 300mm, occurring in July and August. The main roads in each state are well paved, and there is little disruption in road traffic due to heavy rains. However, many if not most of the branch roads leading away from the main highways toward target villages are not paved and are in bad condition during the rainy season, so this would have an effect on vehicular traffic in such areas. Because sites would be difficult to access, it is almost impossible to construct wells during this season, so this must be considered when drafting the construction plan.

The groundwater in the target areas is believed to be divided into the following two types: 1) In sedimentary layers, there are aquifers in mainly sandy soils. 2) In weathered layers of basement rock formations, there are aquifers and fissures. We are formulating well drilling plans and well structure plans in view of both these conditions.

Regarding water volume, existing well data show the average capacity in Bauchi State to be about 150ℓ/minute, and about 40ℓ/minute in Katsina State. While there are generally fewer wells in Katsina than in Bauchi State, this probably does not pose a problem.

Regarding water quality, some groundwater has been confirmed to contain nitric acid, fluorine, salt and/or iron. We recommend that water quality surveys be sufficiently carried out in surrounding areas after a well is drilled. However, there are few cases where water quality surveys conducted in the two states produce values that are well in excess of WHO standards. If water quality does not meet WHO standards, then consideration should be taken to exclude the site as a target for groundwater development.

(3) Concept regarding Social Conditions

RUWASSA and WATSAN Project already have a model called Water, Sanitation and Hygiene Committee (WASHCOM) for operation and maintenance of water supply facilities and have experience of establishing such committees. This WASHCOM will be established for new hand pump boreholes constructed by the Project, and communities will be in charge of operation and maintenance of the new boreholes. WASHCOM plays a role not only in operation and maintenance but also in sanitation promotion. Women often do not participate in community activities due to religious reasons in northern Nigeria. But, WASHCOM encourages women to become members and gives training on sanitation, etc. to women. Women as end users of water can improve sanitary conditions in homes and prevent water-borne diseases if they have correct knowledge, and women understand the importance of payment for operation and maintenance as well. The past practices of WASHCOM tell us that women have become members of WASHCOM and frequently assume the job of treasurer. Thus, women will be encouraged to become members, and then the boreholes will be used for a long time.

(4) Concept regarding the Construction Situation and Utilization of Local Contractor, Equipment and Materials

WATSAN Project in Bauchi State alone had constructed 217 boreholes by the end of 2008 after it was established in 1995, using one drilling rig offered by UNICEF. Boreholes are drilled by teams of seven, and WATSAN Project currently has the capacity to organize two drilling teams. Accordingly, it has enough personnel to operate the new rig to be procured in the Project in addition to the existing one. Furthermore, judging from the past drilling experiences and achievements of WATSAN Project staff, they have fundamental skills required to drill boreholes and can implement the Project if they are given basic technical assistance.

RUWASSA in Katsina State, which was established in 2004, has so far independently constructed 254 boreholes using two existing rigs. RUWASSA currently has the capacity to organize three such drilling teams. Accordingly, it has personnel enough to operate the new rig to be procured in the Project in addition to the existing ones. Furthermore, judging from the past drilling experiences and achievements of RUWASSA staff, they have fundamental skills required to drill boreholes and can implement the Project

When implementing the Project, RUWASSA and WATSAN Project, which have sufficient execution capability, shall be entrusted to construct the facilities, and local contractors shall not be utilized. In order to secure quality, equipment and materials required for the construction shall be selected from products that comply with international standards as much as possible.

In consideration of service and maintenance, major items of equipment such as drilling machines and vehicles shall be purchased from makers that can readily supply parts.

(5) Concept regarding the Operation and Maintenance Capacity of the Implementation Agencies

Support will be provided to RUWASSA and WATSAN Project regarding the compilation of well construction procedures, process control and quality control of facilities construction and other aspects of execution planning. Since WATSAN Project does not have a manual for WASHCOM establishment in communities or a manual on hand pump repairs and is not as well organized as RUWASSA in Katsina, support will be provided for strengthening water supply facilities maintenance. Concerning the handling and maintenance of newly procured equipment and materials, in addition to enhancing initial operation guidance, technology will be transferred by means of guidance conducted via the NWRI(National Water Research Institute). Technology will also be transferred via the said agency concerning well construction procedures and process control, quality control of facilities construction and other aspects of execution planning.

(6) Concept regarding the Grading of Equipment

- The capable depth of the drilling rig shall be set in consideration of the depth of stratum and the static water level.
- Truck-mounted rig and compressor shall be selected to ensure easy accessibility and

mobility.
- 4-wheel-drive vehicles shall be selected for crane cargo trucks in consideration of bad road conditions.
- Indian Mark III (VLOM type), the standard promoted by the Federal Government, shall be selected for hand pumps.
- Structure of boreholes, drilling methods and plans for equipment which meet the local geological conditions shall be proposed.
- Peripheral structures such as platforms, drainage ditches and soakage pits shall be designed in consideration of preventing infiltration of domestic waste water, in order to avoid adverse impact on water quality.

(7) Concept regarding Works and Procurement Methods and Works Period

- As the stratum of hard bedrock is distributed widely in Bauchi and Katsina States, the drilling method shall be chosen in consideration of the geological characteristics such as shallow landslide during drilling. Both mud circulation rotary and DTH methods shall be applied as the drilling method depending on geological conditions.
- Drilling schedule shall be prepared taking into account the past record of RUWASSA and WATSAN Project and lower efficiency of drilling boreholes in the rainy season due to deterioration of accessibility to the drilling sites and so forth.
- The total Project period shall be conservatively scheduled taking into account the time necessary for procurement, the capacity of RUWASSA and WATSAN Project and the period for conducting the soft component.

2-2-2 Basic Plan

WATSAN Project in Bauchi State currently owns one fairly deteriorated drilling rig (donated by UNICEF in 1995), and keeps it in working order in spite of difficulties obtaining spare parts and preventing breakdowns. It has used the drilling rig to drill 217 boreholes so far. Moreover, WATSAN Project has the staff to organize two drilling teams (one team consists of seven persons).

On the other hand, RUWASSA in Katsina State owns two drilling rigs (one made in UK in 2004 and one donated by UNDP in 1996). RUWASSA currently has the capacity to organize three drilling teams. These are the only borehole drilling teams in both states and since they are also dispatched to drill boreholes under the jurisdiction of the Federal Ministry of Water Resources, they possess ample basic technology for drilling. Moreover, RUWASSA and WATSAN Project implement OJT and conduct workshops aimed at improving theoretical ability in order to improve drilling capacity (quality).

In view of the above points, it is deemed that RUWASSA and WATSAN Project will have sufficient project implementation capacity providing that the necessary technical guidance is conducted. The Project will be limited to the supply of equipment and materials, whereas the Nigerian side will execute the construction of facilities using the equipment and materials provided under the Project and those currently owned by RUWASSA and WATSAN Project.

2-2-2-1 Overall Plan

(1) Target Villages

In the villages targeted for drilling in the initial two years, the social conditions survey was implemented to confirm the need for new wells and the future feasibility of establishing WASHCOM and levying water charges. Some of the target villages only have boreholes, and even in the villages that have more than one deep well, the residents have to use boreholes due to insufficient water flow, lack of water and long distances to water sources. As a result, although there have been no cases of Guinea worm in any of the target LGA due to the eradication campaign over the past few years, water-borne diseases were observed in all the villages where survey was implemented. According to information collected by RUWASSA and WATSAN Project and from the LGA, it was confirmed that all the 116 requested villages in Bauchi and 171 villages in Katsina

have similar conditions and are in need of new wells.

Furthermore, according to the groundwater potential survey, it is deemed that installation of boreholes with hand pumps should be sufficient in the targeted villages in the two states. The deepest groundwater level in the target villages was found to be 30 m in Bauchi State and 38 m in Katsina State, and the average groundwater level is 16 m. Therefore, since the projected groundwater level in all target villages is less than 40 m, installation of hand pumps is deemed to be sufficient and no villages have been excluded from the Project.

After that, the number of boreholes that can be excavated using the procured equipment over two years in Bauchi and Katsina States was investigated and determined upon taking the drilling capacity of the implementing agency into account. In carrying out selection, water supply rate was compared in each LGA and priority was given to areas with the lowest rates. As a result, construction of 76 boreholes in 64 villages in eight LGA have been planned in Bauchi State, while 92 boreholes in 78 villages in five LGA have been planned in Katsina State. Tables 1-3 and 1-4 show the lists of selected villages while Figure 1-1 shows the location map of selected villages.

a) Standards for evaluating groundwater potential

The main hand pumps in use are Afridev, India Mark II, and India Mark III. In the two states, 85% of the hand pumps are India Mark III, with the remaining 15% divided between Afridev and India Mark II. The maximum water pumping capacity of the India Mark III is estimated to be at a groundwater level of about 40m. Pumping water from wells is mainly the work of women and children. Pumping water from deeper than 40 meters is very labor-intensive, requiring several people to work the pump. Furthermore, the longevity of the pump decreases as the groundwater level increases, and pumping deep water is often a cause of breakdowns, so it is concluded that hand pumps are not suitable for pumping water more than 40 meters deep. However, it should be noted that in RUWASSA and WATSAN Project, wells that were too deep for hand pumps were equipped with solar-powered pumps.

b) Social Conditions Evaluation

Based on the results of the social conditions survey, all the requested villages will be rated from A to D by considering the need of a new borehole and possibility of establishing a functional operation and maintenance system. Willingness of participation and potential ability in operation and maintenance of each village is important, but contents of training and assistance provided by RUWASSA and WATSAN Project and Local Governments (LGs) will have an influence on establishment of an operation and maintenance system at village level and stability of the system. Therefore, the possibility of establishing a functional operation and maintenance system is evaluated from experiences and ability of LGs. The following four criteria are used.

i) Current Water Sources

Dug well only	3 point
Hand pump borehole	2 point
Motorized borehole	1 point

ii) Water-Borne Diseases

Many	3 point
Average	2 point
Little	1 point

If there is no data at community level due to some reasons such as no health facility, the data at LGA or ward level is used.

iii) Capacity of LGs on providing training and assistance to community regarding operation and maintenance

Enough experience	3 point
Some experience	2 point
Have knowledge but no experience	1 point

iv) Management Capacity of LGs

Very good	3 point
Good	2 point
Just satisfactory	1 point

This is evaluated from their ability of submitting necessary data which was requested by the JICA Study Team.

According to the total points from the above four criteria, each village is ranked from A to D.

Table 2-2-1 Evaluation from the results of the Social Conditions Survey

Total Points	10-12	7-9	4-6	1-3
Ranking	A	B	C	D

c) Implementation Capacity and Water Coverage of LGA

Judging from the well construction capacity in WATSAN Project, it is possible to dig around four wells per month if using a new rig. This means that 40 wells can be excavated per year after taking out suspension of work for two months during the rainy season. Accordingly, it will be possible to dig the 76 wells planned in the Project using only one new rig. Judging from the past RUWASSA drilling record and work capacity, it should be possible to dig 50 wells per year using one rig. Therefore, it will be possible to excavate the 92 wells planned in the Project over two years.

In addition to the above well drilling capacity of the implementing agencies, upon verifying the budget control and expenditure control capacity, the equipment utilization plan is deemed to be appropriate in both Bauchi State and Katsina State.

Incidentally, when narrowing down the target villages, priority was given to villages where the LGA water supply rate is low. Table 2-2-2 shows the water supply rates of selected LGA and number of wells in Bauchi and Katsina.

Table 2-2-2 Selected LGA and No of Boreholes

Bauchi

LGA	Rural water supply coverage (%)	No of boreholes
Alkaleri	19	7
Bauchi	15	13
Gamawa	20	9
Ganjuwa	22	9
Shira	19	8
Tafawa Balewa	22	8
Toro	17	14
Ningi	22	8
Total		**76**

Katsina

LGA	Rural water supply coverage (%)	No of boreholes
Datsun-Ma	35	15
Safana	19	21
Mashi	45	20
Faskari	28	16
Kankara	22	20
Total		**92**

Table 2-2-3 Target Villages (Bauchi) (1/2)

NO.	ID	LGA	Village	Population (2006)	Existent Borehole			No of Requested Borehole	Geology	Estimated Drilling Depth(m)	Estimated Water Level(m)	Social Condtion Evaluation
					Open Dug Well	Hand Pump Borehole	Motprize Borehole					
1	A-1	Alkaleri	Yola Doka	1,853	8	1		1	Kerri-Kerri	40	20	B
2	A-2	〃	Dan	892	4	2		1	Kerri-Kerri	40	20	B
3	A-3	〃	Yashi	1,461	5	2		2	Kerri-Kerri	45	10	B
4	A-4	〃	Guruntun	868	3	2		2	Kerri-Kerri	40	10	B
5	A-5	〃	Kufa	1,318	4			1	Kerri-Kerri	50	20	B
6	B-1	Bauchi	Badakoshi	1,042	2			1	Basement	45	12	B
7	B-2	〃	Bishi	3,506	3	1	1	2	Basement	40	10	B
8	B-3	〃	Gokaru	2,894	6	1		2	Basement	50	15	B
9	B-4	〃	Luda	1,144	3	2	1	1	Basement	45	12	B
10	B-5	〃	Kundum	478	1	1		1	Basement	40	10	B
11	B-6	〃	Gwaskwaram	582	2	2		1	Basement	40	10	B
12	B-7	〃	Gokiram	830	3			1	Basement	40	10	B
13	B-8	〃	Lugge	787	2	1		1	Basement	50	15	B
14	B-9	〃	Sabon Garin Garkuw	693	3			1	Basement	45	12	B
15	B-10	〃	Rehu	1,339	2			1	Basement	45	15	B
16	B-11	〃	Garin Kadiri	1,008		1		1	Basement	45	15	B
17	G-1	Gamawa	Bullanna	1,157	2	1		1	Chad	60	20	B
18	G-2	〃	Raba-Raba	389	1			1	Chad	60	20	A
19	G-3	〃	Bawari	341	3			1	Chad	60	20	B
20	G-4	〃	Buskuwa	1,095	1			1	Chad	60	20	B
21	G-5	〃	Garuwa	1,155	2	1		1	Chad	70	30	B
22	G-6	〃	Katsinawa	945	3	1	1	1	Chad	60	20	B
23	G-7	〃	Gayawa	1,103	2	2		1	Chad	60	20	B
24	G-8	〃	Supa	1,137	1	1		1	Chad	60	20	B
25	G-9	〃	Garin Kure	1,079	2			1	Chad	60	20	B
26	U-1	Ganjuwa	Zure	1,163	2			1	Basement	40	12	A
27	U-2	〃	Wuro Bogga	1,116	1	1	1	1	Basement	35	12	B
28	U-3	〃	Manga	963	5	1		1	Basement	40	12	A
29	U-4	〃	Gurum	1,034	1	1		1	Basement	39	12	A
30	U-5	〃	Lamba	942	3	2		1	Basement	40	15	A
31	U-6	〃	Dutsen Kura	1,152	2			1	Basement	35	10	A
32	U-7	〃	Daman guza	890	2	1		1	Basement	38	10	A
33	U-8	〃	Deno	998	1			1	Basement	40	12	A
34	U-9	〃	Wuro Nai	701	4			1	Basement	35	9	A
35	I-1	Itas-Gadau	Abdallawa	902	5	1	1	1	Chad	60	20	B
36	I-2	〃	Dumari	3,380	6	1		1	Chad	60	20	B
37	I-3	〃	Bambai	923	1	1		1	Chad	60	20	B
38	I-4	〃	Buzuwa	514	5	1		1	Chad	60	20	B
39	I-5	〃	Gamsha	903	6	1		1	Chad	60	25	B
40	I-6	〃	Gwarai	1,798	4	1		1	Chad	60	20	B
41	I-7	〃	Magarya	3,669	7	1	1	1	Chad	60	20	B
42	I-8	〃	Nomari	2,183	8	1		1	Chad	60	20	B
43	J-1	Jama'are	Pango	855	3	1		1	Chad	50	15	B
44	J-2	〃	Jurara	1,593	4	1		2	Chad	60	20	B
45	J-3	〃	Kadawan	826	1			1	Chad	60	20	B
46	J-4	〃	Jibbiri	1,039	1			1	Chad	60	20	B
47	J-5	〃	Hanafari	4,375	7	2	3	2	Chad	60	20	B
48	J-6	〃	Buzuzu	1,003	1			1	Chad	60	20	A
49	J-7	〃	Daramshe	966	2			1	Chad	60	20	B
50	J-8	〃	Dogon Daji	2,171	10	4	3	2	Chad	60	20	B
51	J-9	〃	Digelji	994	2			1	Chad	60	20	B
52	J-10	〃	Jagawa	1,032	1			1	Chad	60	20	A

Table 2-2-3 Target Villages (Bauchi) (2/2)

NO.	ID	LGA	Village	Population (2006)	Existent Borehole			No of Requested Borehole	Geology	Estimated Drilling Depth(m)	Estimated Water Level(m)	Social Condtion Evaluation
					Open Dug Well	Hand Pump Borehole	Motprize Borehole					
53	K-1	Katagum	Chara-chara	2,625	25	2		2	Kerri-Kerri	50	15	B
54	K-2	〃	Kare	680	2			1	Kerri-Kerri	50	15	A
55	K-3	〃	Malori	1,587	5	1	1	1	Kerri-Kerri	50	20	B
56	K-4	〃	Jimbari	1,680	3	2	2	1	Kerri-Kerri	60	20	B
57	K-5	〃	Barkeji	1,166	6	1	1	1	Kerri-Kerri	60	20	B
58	K-6	〃	Bula Jalaje	685	3			1	Kerri-Kerri	60	20	B
59	K-7	〃	Duhuwar Kura	1,226	2		1	1	Kerri-Kerri	50	15	B
60	K-8	〃	Rigar Pafi	966	3	1		1	Kerri-Kerri	50	15	B
61	K-9	〃	Yayu	4,538	6	1	1	2	Kerri-Kerri	50	12	B
62	K-10	〃	Zinmai	1,585	2			1	Kerri-Kerri	50	20	B
63	K-11	〃	Bailako	1,091	3	1		1	Kerri-Kerri	60	20	B
64	K-12	〃	Gorokawo	1,023	1	1		1	Kerri-Kerri	60	20	B
65	K-13	〃	Ragwam	653	4	1		1	Kerri-Kerri	50	15	B
66	K-14	〃	Zindi A	738	10	2		1	Kerri-Kerri	50	20	B
67	R-1	Bogoro	Boi	1,979	3	4		2	Basement	45	12	B
68	R-2	〃	Bon Baki	1,407	1			1	Basement	40	10	A
69	R-3	〃	Gwaranga	1,785	2	1		1	Basement	50	12	A
70	R-4	〃	Kurum Sarauta	1,023		1		1	Basement	45	12	A
71	R-5	〃	Dinkin fate	679	1			1	Basement	35	12	A
72	S-1	Shira	Lafiyari	1,234	2			1	Basement	45	15	B
73	S-2	〃	Gudda	956	3			1	Basement	45	15	B
74	S-3	〃	Kargo	948	4			1	Chad	50	15	B
75	S-4	〃	Dogon dutse	1,595	5			1	Basement	45	12	B
76	S-5	〃	Andubun	3,338	8	1		2	Chad	50	15	B
77	S-6	〃	Yelwa	903	2	1		1	Chad	60	20	B
78	S-7	〃	Yakasai	1,052	4			1	Chad	60	20	B
79	M-1	Misau	Natsira	947	3			1	Basement	50	20	B
80	M-2	〃	Zadawa	4,018	5	1		2	Kerri-Kerri	60	25	B
81	M-3	〃	Beti	918	10	1		2	Kerri-Kerri	60	25	B
82	M-4	〃	Galdimawo	514	1			1	Kerri-Kerri	60	20	B
83	M-5	〃	Goliyo	1,063	3			1	Kerri-Kerri	60	20	B
84	M-6	〃	Madakiri	1,396	5			1	Kerri-Kerri	60	20	B
85	M-7	〃	Jarmari	1,391	7			2	Kerri-Kerri	60	20	B
86	M-8	〃	Adari	1,021	2			1	Kerri-Kerri	60	20	A
87	M-9	〃	Ajili	595	9	1		2	Kerri-Kerri	60	20	B
88	F-1	TafawaBalewa	Banshi	688	1			1	Basement	45	12	A
89	F-2	〃	Zwall	1,671	8	3	1	2	Basement	45	12	B
90	F-3	〃	Gambar Lere	625	3	1		1	Basement	45	15	B
91	F-4	〃	Sara	1,604	2	1		1	Basement	45	15	B
92	F-5	〃	Shall	1,265	8	1	1	2	Basement	45	15	B
93	F-6	〃	Waptang	1,459	4	2	1	1	Basement	35	12	B
94	T-1	Toro	Ribina	2,978	10	1		2	Basement	40	10	B
95	T-2	〃	Pingi	1,585	5			1	Basement	35	12	B
96	T-3	〃	Badikko	1,352	2			1	Basement	40	15	B
97	T-4	〃	Lame	1,192	2	3	1	2	Basement	45	12	B
98	T-5	〃	Zull	1,105	2	2		1	Basement	39	15	B
99	T-6	〃	Rauta	1,346	3			1	Basement	40	12	B
100	T-7	〃	Zaranda	4,803	1	1		2	Basement	45	15	B
101	T-8	〃	Diriko	1,173	4			1	Basement	45	12	B
102	T-9	〃	Gurungu	1,128	2			1	Basement	35	12	B
103	T-10	〃	Panshanu	945	5	1		1	Basement	35	12	B
104	T-11	〃	Geji	745	2	2		1	Basement	45	15	B
105	N-1	Ningi	Lumbu	2,141	10			1	Basement	45	15	B
106	N-2	〃	Tambu	1,373	2			1	Basement	45	15	B
107	N-3	〃	Ari	1,698	5	2	1	2	Basement	45	15	B
108	N-4	〃	Guda	1,162	5	1		2	Basement	45	15	B
109	N-5	〃	Tiffi	3,026	5	3	1	1	Basement	45	15	B
110	N-6	〃	Samma	1,131	4	1		1	Basement	45	15	B
111	W-1	Warji	Aru	1,911	5	3		1	Basement	45	15	B
112	W-2	〃	Baima	4,697	20	1		1	Basement	45	15	B
113	W-3	〃	Dagu	1,199	6	3		1	Basement	45	15	B
114	W-4	〃	Gabanga	1,192	10	3		1	Basement	45	15	B
115	W-5	〃	Tiyim	969	6	2		2	Basement	45	15	B
116	W-6	〃	Bunga	1,735	2	4		1	Basement	45	15	B
Total				164,084				139				

Table 2-2-4 Target Villages (Katsina) (1/3)

NO.	ID	LGA	Village	Population (2006)	Existent Borehole			No of Requested Borehole	Geology		Estimated Drilling Depth(m)	Estimated Water Level(m)	Social Condtion Evaluation
					Open Dug Well	Hand Pump Borehole	Motprize Borehole						
1	B-1	Batsari	Bakon Zabo	1,800			1	1	Basement		50	17	C
2	B-2	〃	Dankar	3,000	1	1		1	Basement		55	16	C
3	B-3	〃	Tulluwa	1,450	2	1		1	Basement		50	16	C
4	B-4	〃	Kauyen Dan Baru	860		1		1	Basement		50	17	C
5	B-5	〃	Garwa	2,780		1	1	1	Basement		50	16	C
6	B-6	〃	Ruma	3,480	2	1		1	Basement		50	16	C
7	B-7	〃	Mai Katanga	1,455	2	1		1	Basement		50	17	C
8	B-8	〃	Kurna	860		1		1	Basement		50	18	C
9	B-9	〃	Randa	1,350	2	1		1	Basement		50	19	B
10	B-10	〃	Tashar Kwantagi	1,100	1			1	Basement		50	17	B
11	B-11	〃	Kandawa	3,000	1	1	1	1	Basement		50	7	C
12	B-12	〃	Tashar Kwantagi	1,450	2	1		1	Basement		50	18	C
13	B-13	〃	Kadaji	450		1		1	Basement		45	19	C
14	B-14	〃	Jambali	1,350	2	1		1	Basement		50	16	C
15	D-1	Dutsinma	Bagaggadi Ward	4,500		1	1	1	Basement		45	11	B
16	D-2	〃	Dabawa Ward	2,100	1	1		1	Basement		50	22	B
17	D-3	〃	Dutsin-MA 'A'	4,750	2	1	1	2	Basement		45	13	B
18	D-4	〃	Ruwan Dorowa	1,700		1		1	Basement		40	16	B
19	D-5	〃	Karofi 'A'	4,700	1	1	1	2	Basement		40	16	B
20	D-6	〃	Karofi 'B'	4,800	1	1		2	Basement		40	18	B
21	D-7	〃	Kuki 'A'	1,800	1			1	Basement		50	22	A
22	D-8	〃	Turare	550	2			1	Basement		50	22	A
23	D-9	〃	Kutawa	3,000		1		2	Basement		40	12	B
24	D-10	〃	Shema	1,800	1	2		2	Basement		40	9	B
25	R-1	Rimi	Lamba	1,800	1	1		1	Basement		45	14	B
26	R-2	〃	Kadaji	900	3	1		1	Basement		35	7	B
27	R-3	〃	Sabin-Magama	1,450	2	1		1	Basement		45	16	B
28	R-4	〃	Hausawa	860		1		1	Basement		45	14	B
29	R-5	〃	Abukur	1,200	2	1	1	1	Basement		40	14	B
30	R-6	〃	Tudun Kadir	2,480	2			1	Basement		45	16	B
31	R-7	〃	Remawa	1,100	2	1	1	1	Basement		50	25	B
32	R-8	〃	Agira	860		1		1	Basement		45	19	B
33	R-9	〃	Gunau	1,350	2	1		1	Basement		45	19	B
34	R-10	〃	Mallamawa	1,860	2	1		1	Basement		45	17	B
35	R-11	〃	Faruwa	1,250	1	1		1	Basement		45	16	B
36	R-12	〃	Kurabau	2,100	1			1	Basement		45	16	B
37	R-13	〃	Karni	4,750	2	1	1	1	Basement		45	14	B
38	R-14	〃	Dogara	1,300		1		1	Basement		45	17	B
39	R-15	〃	Tokawa	4,700	1	1		1	Basement		45	18	B
40	S-1	Safana	Yar' Jigawa	4,800	1	1	1	1	Basement		40	9	B
41	S-2	〃	Kanomawa	1,800	1			1	Basement		40	6	B
42	S-3	〃	Dole	450		1		1	Basement		45	18	B
43	S-4	〃	Tsamiya	942		1		1	Basement		45	12	B
44	S-5	〃	Baure	2,800	1	2	1	1	Basement		45	9	B
45	S-6	〃	Sararraki	450		1		1	Basement		45	15	B
46	S-7	〃	Babban Duhu	4,100		2		1	Basement		45	16	B
47	S-8	〃	Kinfau	2,100		1		1	Basement		40	6	B
48	S-9	〃	Madaddala	2,200	1	1		1	Basement		45	14	B
49	S-10	〃	Salihawar Humo	250	1			1	Basement		45	14	A
50	S-11	〃	Karafa	2,780		1	1	1	Basement		45	14	B
51	S-12	〃	Sabon Dawa	855		1		1	Basement		45	14	B
52	S-13	〃	Ummadau	2,200	1	1		1	Basement		45	18	B
53	S-14	〃	Garin Waziri	860		1		1	Basement		45	17	B
54	S-15	〃	Garin Tambari	2,780		1	1	1	Basement		45	16	B
55	S-16	〃	Unguwar Rima	3,480	2	1		1	Basement		45	16	B
56	S-17	〃	Garin Masau	1,455	2	1		1	Basement		45	16	B
57	S-18	〃	Ung. Korau	850	1			1	Basement		45	16	A
58	S-19	〃	Dagarawa	1,100	2	1		1	Basement		45	16	B
59	S-20	〃	Turkunawa	960	1	1		1	Basement		40	16	B
60	S-21	〃	Bukurawa	865	1	1		1	Basement		40	19	B
61	M-1	Mashi	Mashi Pri. Sch.	600				1	B	S	45	22	B
62	M-2	〃	Sabuwar Rijiya(Majigi wa	1,800	2	1		2	B	Gundumi	45	20	B
63	M-3	〃	Jigawa	1,100	1			2	B	Gundumi	40	15	B
64	M-4	〃	Karau	705		1		2	Gundumi	B	45	19	B
65	M-5	〃	Gallu	4,600	2	3		2	Basement		45	20	B
66	M-6	〃	Tamillo 1	1,100	3			2	Sedimentary		50	18	B
67	M-7	〃	Tamillo 2	1,100	1		1	2	Gundumi		50	18	B
68	M-8	〃	Doguru	4,860	2		1	2	Gundumi		50	30	B
69	M-9	〃	Sonkaya	4,350	2	1	1	2	Gundumi		55	30	B
70	M-10	〃	Saye	1,500		2		1	Gundumi		45	22	B
71	M-11	〃	Bamle	4,300	2	1		2	Gundumi		50	34	B

Table 2-2-4 Target Villages (Katsina) (2/3)

NO.	ID	LGA	Village	Population (2006)	Existent Borehole			No of Requested Borehole	Geology	Estimated Drilling Depth(m)	Estimated Water Level(m)	Social Condtion Evaluation
					Open Dug Well	Hand Pump Borehole	Motprize Borehole					
72	V-1	Sandamu	Kwasarawa	2,100	4		1	1	Gundumi	50	20	C
73	V-2	〃	Katsayal	4,100	4		2	1	Gundumi	50	18	C
74	V-3	〃	Daba	710		1		1	Gundumi	50	18	B
75	V-4	〃	Dadin Kowa	640	1	1		1	Gundumi	50	20	B
76	V-5	〃	Jar Kuka	1,800	2	1		1	Gundumi	50	20	C
77	V-6	〃	Jan Bara	1,350	2	1		1	Gundumi	48	20	B
78	V-7	〃	Maye	1,860	2	1		1	Gundumi	50	20	B
79	V-8	〃	Janbagi	2,000	1	1	1	1	Gundumi	50	20	B
80	V-9	〃	Jiba	3,600		1	1	1	Gundumi	50	20	C
81	V-10	〃	Fagore Fulani	910	2	1		1	Gundumi	45	18	C
82	Z-1	Zango	Yakubawa	650	1	1		1	Gundumi	50	27	B
83	Z-2	〃	Garni	1,800		1		1	Gundumi	50	30	B
84	Z-3	〃	Tarke	1,750	3			1	Gundumi	40	14	B
85	Z-4	〃	Masassaka	1,800	1	1		1	Gundumi	45	18	B
86	Z-5	〃	Aduwawa	1,400		1		1	Gundumi	50	20	B
87	Z-6	〃	Koki	1,100	4			1	Gundumi	50	22	B
88	Z-7	〃	Hangota	1,800	1	1		1	Gundumi	45	20	B
89	Z-8	〃	Kirgi	1,400	1	1		1	Gundumi	45	20	B
90	Z-9	〃	Kyakykyawa	850		1		1	Gundumi	50	25	B
91	Z-10	〃	Dushe	1,100	3			1	Chad	65	38	B
92	Z-11	〃	Rindi	1,350	2	1		1	Gundumi	55	30	B
93	Z-12	〃	Dawan Madaka Gari	1,860	2	1		1	Gundumi	50	33	B
94	Z-13	〃	Gurdo	1,205	1			1	Gundumi	50	30	B
95	Z-14	〃	Sharawa	1,350	2	1		1	Gundumi	45	28	B
96	Z-15	〃	Yandaka Fulani	1,860	2	1		1	Gundumi	50	30	B
97	F-1	Faskari	Tashar Ice	600				1	Basement	45	11	B
98	F-2	〃	Unguwar Kurmi	1,800	2	1		1	Basement	45	11	B
99	F-3	〃	Birnin Ruwa	1,100	1			1	Basement	45	12	B
100	F-4	〃	Sullubawa	705		1		1	Basement	45	12	B
101	F-5	〃	Zamfarawa	4,600	2	3		1	Basement	45	14	B
102	F-6	〃	Tsuru	1,809	1	1		1	Basement	45	15	B
103	F-7	〃	Doma	1,100	1			1	Basement	45	14	B
104	F-8	〃	Yarmalamai	2,000	1	1		1	Basement	45	14	B
105	F-9	〃	Unguwar Baso	2,800	1	1		1	Basement	45	14	B
106	F-10	〃	Ruwan Godiya	3,850	10	1	1	1	Basement	45	12	C
107	F-11	〃	Bele	600				1	Basement	45	15	B
108	F-12	〃	Danguda	1,800	2	1		1	Basement	45	14	B
109	F-13	〃	Kagana	1,100	1			1	Basement	45	14	B
110	F-14	〃	Unguwar Miko	705		1		1	Basement	45	14	B
111	F-15	〃	Mafara	4,600	2	3		1	Basement	45	14	B
112	F-16	〃	Maigora	4,700	6	1	2	1	Basement	45	13	C
113	K-1	Kafur	D/Kura Pri. Sch.	400				1	Basement	40	9	B
114	K-2	〃	Comm. Sec. sch. GOZAKI	500		1		1	Basement	45	9	B
115	K-3	〃	S//Kasa pri Sch.	450				1	Basement	45	12	B
116	K-4	〃	Yarkawari	2,700	1	1		1	Basement	45	13	B
117	K-5	〃	Tsaunin Tinya	1,350	2	1		1	Basement	45	12	B
118	K-6	〃	Unguwar Nashe	1,860	2	1		1	Basement	40	9	B
119	K-7	〃	Takawa	850		1		1	Basement	40	9	B
120	K-8	〃	Rigoji	3,400	1	1	1	1	Basement	40	9	B
121	K-9	〃	Daren Fada	1,800	2	1		1	Basement	40	9	B
122	K-10	〃	Ung. S/Hausawa	1,230	1			1	Basement	40	11	A
123	K-11	〃	Kufan Sallau	706		1		1	Basement	40	11	B
124	K-12	〃	Ung. Lawal Mahangi	2,600	2	1		1	Basement	40	9	B
125	K-13	〃	UNG. Bedi	1,809	1	1		1	Basement	40	12	B
126	K-14	〃	UNG. Shukau	1,100	3			1	Basement	40	12	A
127	K-15	〃	Gidan Kesau	2,000	1	1		1	Basement	40	13	B
128	K-16	〃	UNG Maitaba	2,800	1	1		1	Basement	40	12	B
129	K-17	〃	Santar Arab	1,800		1		1	Basement	40	12	B
130	K-18	〃	Kagadama	1,350	2	1		1	Basement	45	11	B
131	K-19	〃	Bagari	1,860	2	1		1	Basement	45	11	B
132	E-1	Kankara	Marabar Gurbi	850		1		1	Basement	45	13	B
133	E-2	〃	Gidan Baki	2,860	2	1		1	Basement	45	9	B
134	E-3	〃	Mai Sabulu	3,350	2	1	1	1	Basement	45	12	B
135	E-4	〃	Mashigi	1,500		2		1	Basement	45	12	B
136	E-5	〃	Abduwa	4,300	2	1		1	Basement	45	11	B
137	E-6	〃	Gundawa	3,800	2		1	1	Basement	45	12	B
138	E-7	〃	Danmarabu	1,350	2	1		1	Basement	40	13	B
139	E-8	〃	Mabai	1,800	2	1		1	Basement	40	14	B
140	E-9	〃	Bela	850		1		1	Basement	45	18	B
141	E-10	〃	Barebari	220	1	1		1	Basement	45	17	B
142	E-11	〃	Danmarke	1,800	2	1	1	1	Basement	45	13	B
143	E-12	〃	Baraka	1,100	1			1	Basement	45	8	A
144	E-13	〃	Salahawa	705		1		1	Basement	45	18	B
145	E-14	〃	Abduwa	3,600	2	3		1	Basement	45	17	B
146	E-15	〃	Tudu	3,700	10	2	1	1	Basement	45	14	B
147	E-16	〃	Kabuke	1,800	2	1		1	Basement	45	14	B
148	E-17	〃	Salihawa	1,105	1			1	Basement	45	17	A
149	E-18	〃	UNG Nagamda	712		1		1	Basement	45	16	B
150	E-19	〃	UNG Turare	4,602	2	3		1	Basement	45	14	B
151	E-20	〃	Garagi	3,800	5	2	1	1	Basement	45	16	B

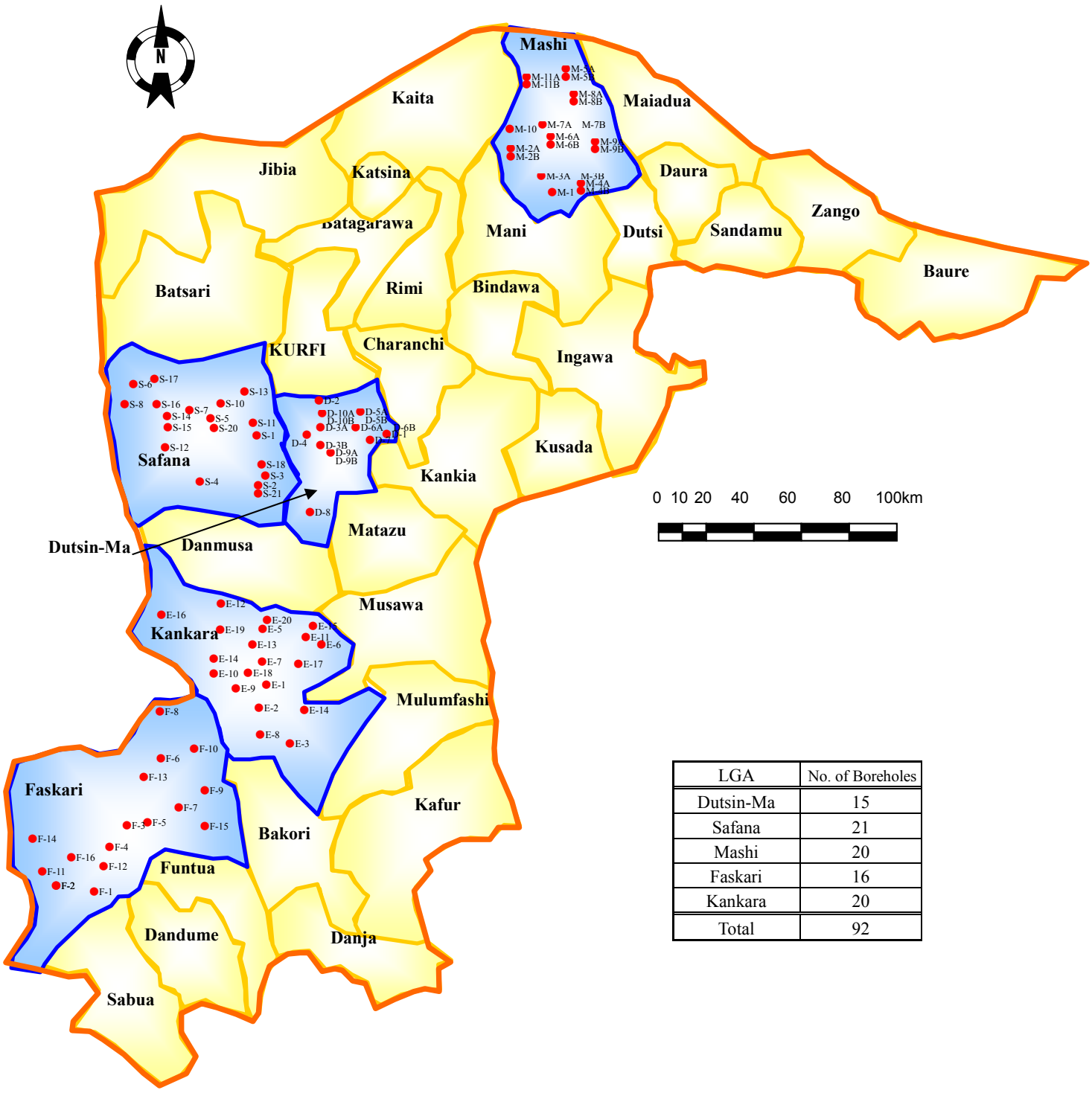
Table 2-2-4 Target Villages (Katsina) (3/3)

NO.	ID	LGA	Village	Population (2006)	Existent Borehole			No of Requested Borehole	Geology	Estimated Drilling Depth(m)	Estimated Water Level(m)	Social Condtion Evaluation
					Open Dug Well	Hand Pump Borehole	Motprize Borehole					
152	I-1	Malumfashi	Borindawa	728	2	1		1	Basement	40	16	B
153	I-2	〃	Jallawa	1,350	2	1		1	Basement	45	14	B
154	I-3	〃	Gero	1,860	2	1		1	Basement	45	11	B
155	I-4	〃	Unguwar Maidoki	1,350	2	1		1	Basement	45	12	B
156	I-5	〃	Unguwar Barmo	1,860	2	1		1	Basement	45	11	B
157	I-6	〃	Zango	850		1		1	Basement	45	9	B
158	I-7	〃	Kauyen Gabas	2,000	1	1		1	Basement	45	11	B
159	I-8	〃	Yandoka	850		1		1	Basement	45	14	B
160	I-9	〃	Gundurawa	2,500		1		1	Basement	50	15	B
161	I-10	〃	Dogon Marke	850	2	1		1	Basement	50	14	B
162	I-11	〃	Yandoka 2	2,550	2	1		1	Basement	50	12	B
163	I-12	〃	Grave Yard M/Fashi	600	2			1	Basement	45	8	B
164	I-13	〃	UNG Sale	850		1		1	Basement	45	11	B
165	I-14	〃	Jigawa	850		1		1	Basement	40	26	B
166	I-15	〃	Nasarawa	1,300	2			1	Basement	45	11	B
167	I-16	〃	Unguwar Ahi	1,350	2	1		1	Basement	45	11	B
168	I-17	〃	Unguwar Dada	1,860	2	1		1	Basement	40	11	B
169	I-18	〃	Hayin Gada	3,480	2	1		1	Basement	40	12	B
170	I-19	〃	Kwandawa	1,350	2	1		1	Basement	45	13	B
171	I-20	〃	Katanga	1,860	2	1		1	Basement	45	19	B
Total				324,968				185				

Marked villages by blue color indicate targeted villages in the Project

LGA	No. of Boreholes
Alkaleri	7
Bauchi	13
Gamawa	9
Ganjuwa	9
Shira	8
Tafawa Balewa	8
Toro	14
Ningi	8
Total	76

Figure 2-2-1 Location of Target Villages in Bauchi State



LGA	No. of Boreholes
Dutsin-Ma	15
Safana	21
Mashi	20
Faskari	16
Kankara	20
Total	92

Figure 2-2-2 Location of Target Villages in Katsina State

(2) Water Supply Units

In 1999, the "National Water Supply and Sanitation Policy" was implemented with the following targets for supplying water to villages of less than 5,000 population: 30 liters per person per day should be provided, with a maximum water carrying distance of 250 meters, and about 250-500 beneficiaries per water supply facility. However, the actual daily water use for the target villages in the two states is estimated to be no more than 12ℓ/person/day. The following shows the calculation base. It should be noted that the calculations were made using the number of existing wells (with hand pumps and motorized pumps), excluding artesian wells.

(Bauchi State)

The targets of this project in Bauchi State include 109 hand pumps and 24 motorized pumps. The total beneficiary population of the target villages, if we consider 500 to be the maximum number of beneficiaries per water supply facility, is about 66,500 (133 pumps X 500 people), or about 40% of the total population of 164,084 (66,500 ÷ 164,084= 40%). By multiplying the target of 30ℓ/person/day in the "National Water Supply and Sanitation Policy" by this percentage, we get the per capita water supply per well. In other words, 30ℓ/person/day x 0.4 = 12ℓ/person/day

(Katsina State)

There are 109 existing hand pumps and 24 motorized pumps. The total beneficiary population of the target villages, if we consider 500 to be the maximum number of beneficiaries per water supply facility, is about 94,000 (188 pumps X 500). This is about 28.57% of total population of 324,968 (94,000÷324,968＝28.57%). By multiplying the target of 30ℓ/person/day in the "National Water Supply and Sanitation Policy" by this percentage, we get the per capita water supply per well, i.e. 30ℓ/person/day X 28.57%=8.6ℓ/person/day.

After all of the water supply facilities to be built in this project are completed, it is expected that water use will increase slightly, but it's hard to imagine that it will reach the target level of 30ℓ/person/day. In addition, if the actual water use is significantly less than the planned water use, then it will be difficult to meet the operating and maintenance expenses with just the money collected from water fees, and there is even a possibility that some unfortunate conditions, such as shut-down of facility operations, might occur. By setting the water supply unit a little lower, it will be possible to keep operating and maintenance expenses down, which in turn will enable local residents to use the water supply facilities for a long time.

In RUWASSA and WATSAN Project, the water supply unit was set at 25ℓ/person/day, with actual use of about 12ℓ/person/day. The water supply unit of 25ℓ/person/day is a little lower than the target of 30ℓ/person/day in the "National Water Supply and Sanitation Policy".

(3) Planned operating time and beneficiary population of hand pumps

The operating time of hand pumps varies considerably from village to village. In regions where there is high groundwater potential, much water is pumped, and it is possible to pump water even in the dry season. However, in regions where the groundwater potential is low, there are some villages where pumping volume is poor, and pumping time is limited to allow the groudwater to recharge. In Japan, there are the Basic Design and Survey Guidelines related to the Proposals for Groundwater Development Using Interest-free Funding. Regarding the Level I and Level II pumps designed under these guidelines, the hand pumps were designed to operate an average of 8-10 hours/day and pump 675ℓ/hour. The motorized pumps were also designed to operate an average of 8-10 hours/day, but their pumping capacity was set at over 1,500ℓ/hour. If we assume 10 hours/day running time for each pump in this plan, then the hand pumps will pump approximately 675ℓ/hour or ≒11 ℓ/minute, while the motorized pumps will pump 1,500ℓ/hour or 25ℓ/minute. The number of beneficiaries per well was calculated as follows:

For hand pumps: 11 ℓ/minute × 10 hours = 6,600 ℓ/day 6,600 ℓ/day÷25 ℓ/person/day= 264 people

For motorized pumps: 25 ℓ/minute × 10 hours = 15,000 ℓ/day 15,000 ℓ/day÷25 ℓ/person/day= 600 people

The number of beneficiaries calculated above is roughly equal to the figure of 250-500 calculated as the number of beneficiaries per water supply facility in the national policy of Nigeria. The number of beneficiaries per facility in this project was set at 300.

(4) Investigating water sources

The water sources selected in the target regions must have safe and stable sanitary conditions and be suppliable on a sustainable basis. Potential sources of water in the target regions include rivers, dams, reservoirs, dug wells and hand pump wells, among others, but deep groundwater is the best source for water of a consistently high quality. First are estimates of the amount of water in each state two years after the procurement of equipment/machinery.

(Bauchi State)

Pumping capacity (Q) of the 53 existing hand pumps

＝6,600 ℓ/day/well×53wells×365days＝127,677,000ℓ≒0.13×10^6m^3/year

Pumping capacity (Q) of the 10 existing motorized pumps

＝15,000 ℓ/day/well×10 wells×365 days＝54,750,000ℓ≒0.05×10^6m^3/year

Pumping capacity (Q) required of the 76 hand pumps

＝6,600ℓ/day/well×76wells×365 days＝183,084,000ℓ≒0.18×10^6m^3/year

Therefore, the required pumping capacity (Q) is about 0.36×10^6m^3/year

(Katsina State)

Pumping capacity (Q) of the 77 existing hand pumps

＝6,600 ℓ/day/well×77 wells×365 days＝185,493,000ℓ≒0.19×10^6m^3/year

Pumping capacity (Q) of the 18 existing motorized pumps

＝15,000 ℓ/day/well×18 wells×365 days＝98,550,000ℓ≒0.10×10^6m^3/year

Pumping capacity (Q) required of the 92 hand pumps

＝6,600ℓ/day/well×92 wells× 365 days＝221,628,000ℓ≒0.22×10^6m^3/year

Therefore, the required pumping capacity (Q) is about 0.51×10^6m^3/year

Groundwater is recharged by rainwater, and the recharge rate is considered to be some percent of the amount of precipitation. The average annual rainfall in the target areas is about 900 mm～1,100mm, of which about 1% is believed to be recharged as groundwater. In the case of a well supplying the standard unit of 25ℓ/person/day for a beneficiary population of 300 people, the amount of water pumped from wells constructed in two years after procuring equipment and the recharge rate in each state were calculated as follows:

(Bauchi State)

Groundwater recharge rate (R)= [1,100mm (annual rainfall)] X [1% (groundwater recharge amount)] X $49,359\times10^6$m$^2\times0.6$ (Proportion of the targeted 8LGA areas to the entire state) = 325.77×10^6m^3/year

In other words, Q＝0.36× million m^3/year＜R＝325.77×million m^3/year, for a required recharge rate of 0.11%. This is determined to be a satisfactory recharge for the planned water volume.

(Katsina State)

Groundwater recharge rate (R)= [900mm (annual rainfall)] X [1% (groundwater recharge amount)] X $24,192\times10^6$m$^2\times0.2$ (Proportion of the targeted 5LGA areas to the entire state) = 43.54×10^6m^3/year

In other words, Q＝0.51× million m^3/year＜R＝43.54×million m^3/year, for a required recharge rate

of 1.17%. This is determined to be a satisfactory recharge rate for the planned water volume.

(5) Raw Water Quality

During WATSAN Project in Bauchi State, water quality tests were conducted independently in the project office. In Katsina State, water samples were sent to an outside private sector lab for testing. In both instances, the analyses were conducted based on WHO water quality standards. In the present project, water quality tests for existing wells in both states were conducted with pack testing. Most of the existing wells are either artesian or hand pump wells. The results of the water quality tests showed values that met or exceeded standard values. In samples from Bauchi State, iron, fluorine, manganese, nitric acid and colon bacilli were detected, while iron, manganese, nitric acid and colon bacilli were detected in samples from Katsina. It is thought that the nitric acid and colon bacilli originated from contaminants such as farm chemicals used near the wells, and excrement from livestock raising that flowed into the well water.

In contrast, the people in charge of the water quality analysis in WATSAN Project stated that their results indicated that in the past, nitric acid, iron, etc., exceeding the standard levels had been detected but there is nothing that exceeds standard values at the present time. In addition, interviews with testers of Katsina samples confirmed that in the past, groundwater had contained nitric acid, iron, etc., but that water quality surveys taken in recently-drilled wells detected no problematic substances.

While discrepancies in the two types of water quality tests described above have been acknowledged, no particularly anomalous component has been detected in water quality tests conducted when wells were new. However, the worsening of water quality can probably be attributed to a combination of factors, such as the passage of time after a well is built, the deterioration of water supply facilities, the lack of repair/maintenance of wells, etc., as well as improper treatment of livestock wastes, fertilizers, household wastewater, etc., that either permeate through the soil into the groundwater or flow directly into wells. In the future, water quality issues will likely be discussed as water supply rates increase, so it was decided to conduct the minimum required water quality tests of the items previously tested in the two states as shown in Table 2-2-5. In addition, pH, water temperature, dissolved oxygen, and electrical conductivity were measured using water quality analysis equipment that was provided on site.

Table 2-2-5 Water Quality Inspection Items

No.	Item	Water quality standard (WHO)	No.	Item	Water quality standard (WHO)
1	Chromaticity	No standard	7	Odor	No standard
2	Electrical conductivity	1000us/cm	8	Iron	0.3mg/ℓ
3	Water temperature	No standard	9	Fluorine	1.5mg/ℓ
4	pH	6.8 - 8.5	10	Manganese	0.2mg/ℓ
5	Turbidity	5NTU	11	Nitrates	50mg/ℓ
6	Taste	No standard	12	Colon bacilli	0cfu/mℓ

(6) Facility Construction

RUWASSA and WATSAN Project have responsibility for the construction of facilities. The specifications of the facilities are as follows:

- Since there are no problems in terms of the size and structures of conventional platforms, and personnel are well experienced with them, the conventional specifications of RUWASSA and WATSAN Project (identical to those of UNICEF) will be basically applied.
- Although the distance of drainage channels from the boreholes is 3 m for existing facilities constructed under RUWASSA and WATSAN Project, it is recommended to have longer distances than the existing facilities in consideration of water contamination.
- According to the results of the existing borehole survey, average drilling depth is inferred

as 49m in Bauchi State and 45m in Katsina State. According to the results of the field surveys and the electrical sounding, the drilling depth of hand pump boreholes in the target villages is 35~70 m in Bauchi State and 45~65 m in Katsina State. Although the final decision of drilling depth for each site will be determined based on geological features and groundwater conditions at the drilling stage, design depth will be set as 45m on average.

- The casing program will be decided based on the observation and level of groundwater in the drilling stage and electrical logging results.
- Drilling diameter is to be 10" for the surface layer, which is prone to collapse and requires guide pipes, and 6" below the guide pipe end. The diameter of casing and screen pipes will be 4". Gravel packing in the screen portion is necessary to avoid plugging of screen slits by silt.
- Cementing and sealing in the shallow extent of the borehole is necessary to prevent infiltration of contaminated water.
- Since some villages do not have drainage channels for rainwater and wastewater, and pools of water were observed near the boreholes, a soakage pit is to be installed at the end of drain to infiltrate wastewater into the ground. The size of soakage pit is 1m (width) × 1m (length) × 1m (depth) in line with the UNICEF standard.
- Installation of fences around the borehole will be instructed to prevent cattle from entering borehole areas.
- Proper operation and maintenance of facilities will be instructed through the soft component during the implementation stage.

(7) Success Rate of Borehole Construction

Table 2-2-6 shows the success rates of well construction in various formations in Bauchi and Katsina States

Table 2-2-6 Success rate of wells by Geological Formation

Geological formation	Well success rate (%)		Drilling depth (m)		Depth of aquifer (m)	
	Bauchi	Katsina	Bauchi	Katsina	Bauchi	Katsina
Alluvial	90-95	95	25	40	10-15	10-15
Chad	85	90	35	55	20-25	20
Gundumi	-	85	-	45-50	-	16
Kerri-Kerri	60	-	45	-	25-35	-
Gombe	75-80	-	65	-	20-30	-
Basement	60	70-80	30-40	45	10-15	18

Alluvial formations are derived from the sedimentation of sand, silt, gravel, etc. They are easily permeated by rainwater, which is stored deep underground. As a result, the success rate in these areas was a high 90% or better. The Chad formation also consists of sand, mud, silt and gravel, so hydrogeologically it has high potential for groundwater, and the well success rate was about the same as that of the alluvial formations. The Gundumi formation is a sedimentary feature consisting of clays, sandstone, sand and gravel, etc., which are conducive to the formation of aquifers, so the well success rate was high.

The Kerri-Kerri formation occurs only in Bauchi State. It is composed of sandstone, agglomerate, clays, etc., giving it high development potential in hydrogeological terms, but the well success rate was a rather low 60%. The Gombe formation occurs partially in the Alkaleri LGA of southern Bauchi and is composed of banded sandstone, shale, mudstone, etc. The groundwater potential of this geology is high, and the well success rate was high. The basement rock formations, which are composed of granites, gneiss, schist, quartzite, migmatite, clay slate, etc., had the lowest well success rate. The groundwater in this basement rock formation is promising in areas where there are fissures in the basement rock and/or weathered belts.

If we consider the success rate of targeted villages that drilled wells in the first two years, we can see that about 70% of the villages in the 8LGA of Bauchi State were in the basement rock formation (46

in the basement rock formation, 13 in the Chad formation, and 5 in the Kerri-Kerri formation). Furthermore, about 90% of the targeted villages of the 5LGA of Katsina State were in the basement rock formation (68 in the basement rock formation, 6 in the Gundumi formation, and 4 in the basement rock/Gundumi formation). The respective well success rates in Bauchi and Katsina States were a little more than 60% and 70%, somewhat lower than the other formations. The success rate in these geological formations was also affected by numerous failed attempts at drilling directly without conducting a geophysical survey. However, the current RUWASSA and WATSAN Project both include geophysical prospecting teams, who select well-drilling sites based on the results of geophysical surveys, helping to increase the success rate. In the future, the selection of well-drilling sites will be made using geophysical survey equipment that will be provided, and this should help to increase the success rate even further. There is no particular problem with the well construction.

2-2-2-2 Equipment Plan

(1) Procurement Equipment

a) WATSAN Project in Bauchi State

WATSAN Project had independently constructed 217 boreholes by the end of 2008 after it was established in 1995, using one drilling rig donated by UNICEF. For eight years from 2009 to 2016, the project plans the construction of 1,676 hand pump boreholes and 520 power pump boreholes. In this plan, the equipment and materials procured by this project will be used for 76 hand pump boreholes that are to be constructed in 2011 and 2012. After that, WATSAN Project plans to construct 40 boreholes per year for the next four years by the procured drilling rig. Judging from the present situation in WATSAN Project, the team for new drilling rigs can be organized with the present staffs and drilling of 40 boreholes per year is possible.

Accordingly, one borehole drilling rig and the related equipment and materials shall be procured for WATSAN Project in this Project.

b) RUWASSA in Katsina State

RUWASSA owns two drilling rigs, one of which was offered by UNDP in 1996 and the other by the state government in 2004. RUWASSA has constructed 254 boreholes with these two drilling rigs after it was established in 2004 through to the present. For eight years from 2009 to 2016, the organization plans the construction of 868 hand pump boreholes and 474 solar system pump boreholes. In this plan, the equipment and materials procured by this Project will be used for 92 hand pump boreholes to be constructed in 2011 and 2012. After that, RUWASSA will continue to construct 50 boreholes per year for the next four years with the procured drilling rig. Judging from the present situation of RUWASSA, the team for new drilling rigs can be organized with the present staffs, and drilling of 50 boreholes per year is possible. Accordingly, one borehole drilling rig and the related equipment and materials shall be procured for RUWASSA in this Project.

c) Contents of the equipment and materials to be procured

As a result of existing borehole and hydrogeological surveys, the drilling capacity of the rig shall be set to more than 100m, and the drilling diameter shall be 10" for the surface layers and 6" for deeper layers. The equipment and materials related to the rig shall have the minimum specifications necessary for a hand pump-type borehole. These specifications shall be common in both organizations.

The equipment to be procured in the project shall consists of the following: a) borehole drilling equipment and materials (drilling rig, tools, accessories and compressor), b) support vehicle (crane truck), c) pump test equipment, d) water analysis equipment (water quality analyzers), e) geophysical survey equipment (electrical survey equipment), and f) borehole construction equipment and materials (hand pumps, screen pipes, casing pipes, maintenance kits).

Table 2-2-7 shows the equipment and materials to be procured, taking into account the purpose of use, the types, quantities and operating conditions of owned equipment and future plans of

use, etc.

Table 2-2-7 Procured Equipment and Materials

No.	Name of Equipment	Specification/Description	Unit	Quantity
1	Drilling Rig	Type : Hydraulically powered machine. Truck mounted rig (including standard spare parts) Top head drive type Drilling Method : Mud circulation rotary and DTH drilling methods. Capable Drilling Depth : Not less than 100m Capable Drilling Diameter : Mud Drilling : 10 - 5/8″ DTH : 6 - 1/4″ Mobilization Method : Truck mounted. Truck Specification : 4 x 4 or 6 x 4 (2 axis drives)	Lot	Bauchi : 1 Katsina : 1
2	Drilling Tools	Drill pipe, hammer bits, work casing and all other necessary tools for the rig above described.	Set	Bauchi : 1 Katsina : 1
3	High Pressure Air Compressor	Supply Air Pressure : More than 2.01MPa (=20.5kg/cm^2) Supply Air Volume : 11.3m^3/min or more. Mobilization Method : Truck mounted Truck Specification : 4 x 4 or 6 x 4 (2 axis drives)	Lot	Bauchi : 1 Katsina : 1
4	Cargo Truck with Crane	Specification : 4 x 4 or 6 x 4 (2 axis drives) Load Capacity : 6.0tons or more Engine : Gasoline (water cooling) Length Carrier : 6.0m or more Crane Capacity : 2.9tons (3.0tons)	Lot	Bauchi : 1 Katsina : 1
5	Pumping Test Equipment	Submersible motor pump : Discharge of 30Lit./min. 70m head (1.5kW/50Hz) Engine Generator : 5kVA or more Groundwater Level Meter : Measurable Depth of 100m	Set	Bauchi : 1 Katsina : 1
6	Water Analysis Equipment	Measurement Items : pH, DO, EC, T.D.S, Chlorides, and Water temperature	Lot	Bauchi : 1 Katsina : 1
7	Geophysical Survey Equipment	Electrical Sounding Instrument : Measurable depth 100m Measuring Item : Apparent resistivity and spontaneous potential Measurable range : 0.1mV～10V Accessory : Software for interpretation Others : Applicable for logging work for 100m depth borehole (with cable and probe)	Lot	Bauchi : 1 Katsina : 1
8	Hand Pump and Tools	VLOM type, India Mark III	Lot	Bauchi : 76 Katsina : 92
		Repair tools for hand pump : Tools used by villagers for simple repair work	Set	Bauchi : 76 Katsina : 92
		Repair tools for hand pump : LGA mechanics for serious repair such as parts replacement	Set	Bauchi : 8 Katsina : 5
9	Casing Pipe	Materials : uPVC (Un-plasticised polyvinyl chloride) Dimension : φ4″ ,O.D.114.4mm, Length 3.0m Wall thickness : 5.5mm or more Connection : Threading Method	Piece	Bauchi : 1,013 Katsina : 1,227
10	Screen Pipe	Materials : uPVC (Un-plasticised polyvinyl chloride) Dimension : φ4″ , O.D.114.4mm, Length 3.0m Wall thickness : 5.5mm or more Connection : Threading Method Screen type : Slit type (0.8-1.0mm in width) Opening Ratio : 3% or more	Piece	Bauchi : 253 Katsina : 307

(2) Necessity of the Equipment for Procurement and Basis for Quantities

Table 2-2-8 shows the necessity and basis for quantities of the Project equipment.

Table 2-2-8 Necessity and Basis of Quantity for Equipment and Materials

No.	Item	Purpose	Basis of Quantity
1	Drilling rig	For drilling new boreholes	In order to construct 92 boreholes planned by RUWASSA and 76 boreholes planned by WATSAN Project over two years, procurement of one new drilling rig for each organization is planned. The yard area in the office of RUWASSA is about 1,550m^2 and that in WATSAN Project is about 1,500m^2. These safekeeping spaces are considered to be enough. Furthermore, judging from the past drilling experiences and achievements of organization staff, they have fundamental skills required to drill boreholes and can implement the Project.
2	Drilling tools and accessories	Tools and accessories for drilling with the above rig	The quantity of tools and accessories such as drilling rods, hammer bits and casing shall be the minimum amount required to dig with the above rig. The quantity of consumable materials shall be 102 drillings for RUWASSA and 84 for WATSAN Project, in consideration of the damage rate (10%).
3	High pressure air compressor	To supply compressed air to DTH hammer of drilling rig and remove cutting skim.	The existing compressors cannot be shared with the new rig. Therefore, the procurement of air compressors is planned in such a way that one compressor is supplied to every organization as a DTH hammer exclusively for the procured drilling rig.
4	Cargo truck with crane	For transportation of drilling tools and materials such as casing pipes, etc.	RUWASSA owns two cargo trucks (Load capacity: 6t, crane capacity: 5t, 4-wheel-drive type) offered by UNDP in 1996 and given from the state government in 2004. The trucks are used as a vehicle for exclusive use of the existing rig. And WATSAN Project owns one cargo truck (Load capacity: 6t, crane capacity: 3t, 4-wheel-drive type) offered by UNICEF in 1993. The truck is used as a vehicle for exclusive use of the rig offered by UNICEF. The existing cargo truck, as it is supplied as a vehicle exclusively for each rig, cannot be shared with the new rig considering long mileage and time due to the extensive plan area. Therefore, one cargo truck with crane is planned to be procured for each organization as a support vehicle of new drilling rigs.
5	Pumping test equipment	To confirm safe yield and whether drilled borehole is successful or not.	RUWASSA owns one set of pumping test equipment, including submersible motor pump and ground water level meter (measurable depth of 100m), which were given by the state government. RUWASSA carried out the pumping test last year in 90 drilled boreholes. Thus, the staffs have enough experience for the pumping examination. There are many boreholes to be drilled over two years from 2011 to 2012; 92 boreholes by the procured new drilling rig and 155 by other methods. Therefore, one set of pumping examination machine parts shall be procured in order to quickly determine the success or failure of boreholes drilled by the new rigs and enable the boreholes to be completed quickly. In addition, WATSAN Project carried out pumping tests last year in 38 drilled boreholes using borrowed test equipment from the Water Board. The Water Board owns only one set of pumping test equipment, and it uses this equipment by itself. Because the Water Board has precedence in use, WATSAN Project cannot borrow the equipment while the Board uses it. Therefore, one set of pumping test equipment for each organization shall be procured for drilling new rigs.
6	Water analysis equipment	To confirm groundwater quality and whether drilled borehole is successful or not from the viewpoint of water quality	RUWASSA performs water analysis in correspondence with borehole drilling, but outsources the analysis to a private laboratory because it does not hold independent water analysis equipment. The person in charge of the water quality testing of RUWASSA strongly hopes for the supply of water analysis equipment such as an electric conductivity meter, pH meter and water thermometer. Therefore, one set of temporarily-shaped mobile water analysis equipment shall be procured for new rigs of RUWASSA. WATSAN Project has the water analyser (TDS/ electric conductivity meter, titration analyser, spectrophotometer, pH meter) given in 1995 by UNICEF in the office laboratory. However, it does not own on-site water analysis equipment. Therefore, for the on-site water quality judgments, one set of simple mobile water analysis equipment shall be procured for new rigs. The on-site simple water measurement is important for judging the water quality of wells, and the necessity of the equipment is very high.

No.	Item	Purpose	Basis of Quantity
7	Geophysical Survey Equipment	For investigating geological features, depth, width of the aquifer and its depth.	The geophysical survey equipment of RUWASSA was offered by UNDP in 1995. Because its model is old, it is easy to break down, and the handling of the equipment is inconvenient. The person in charge of geophysical surveys earnestly desires the introduction of new equipment. Therefore, one set of geophysical survey equipment is planned for new rigs. On the other hand, because WATSAN Project does not own geophysical survey equipment such as an electrical sounding instrument, it has to borrow equipment from the state government and hopes to possess its own equipment. Therefore, one set of geophysical survey equipment is planned for new rigs. The people in charge of the geophysical survey in both organizations have little on-site experience, but they can perform computer analysis and have enough technical ability.
8	Hand Pump and Tools	For groundwater extraction from boreholes and for daily maintenance by village and LGA levels.	The hand pump and repair tools for community level (used for daily maintenance) are planned according to the number of boreholes to be drilled (92sets by RUWASSA and 76 sets by WATSAN Project) over two years. As for the LGA level standard tools (used by LGA mechanics for mobile repairs and serious repairs that cannot be handled by villagers), five sets for RUWASSA and eight sets for WATSAN Project shall be procured depending on the number of planned LGA.
9	Casing pipe	For securing borehole and retaining groundwater.	The casing pipe is planned based on the 10% damage rate of the materials. The average depth of the borehole shall be 45 m, and the average casing length shall be 36 m. The casing length in RUWASSA is 3,680m (=36m x 92 sites / 0.9), thus, the number is 1,227 (=3,680m /3m). On the other hand, the casing length in WATSAN Project is 3,040 m (= 36m x 76 sites / 0.9), thus, the number is 1,013 (=3,040m /3m).
10	Screen pipe	For groundwater extraction from aquifer	The screen pipe is planned based on 10% damage rate of the materials. The average depth of the borehole shall be 45 m, and the average casing length shall be 9m. The screen length in RUWASSA is 920 m (=9 m x 92 sites / 0.9), thus, the number is 307 (=920m / 3m). The screen length in WATSAN Project is 760m (= 9 m x 76 sites / 0.9), thus, the number is 253 (=3,040m /3m).

(3) Specifications of Major Equipment and Materials

1) Borehole Drilling Equipment

a) Drilling Rig

The specifications of the drilling rig are defined based on the following requirements:

i) Drilling method

In Bauchi and Katsina States, the geology of the area consists of very hard crystalline bedrock (granites) and layers of comparatively soft sedimentation (an alluvial layer, Chad layer). The drilling method is DTH drilling for the bed rock layer (hard rock such as gneiss and granite), and mud rotary drilling for sedimentary layers (Chad, etc.).

ii) Drilling diameter

The drilling diameter shall be 10" for the weathered layers near the surface, and 6" for deeper layers. Tri-cone bits of 10-5/8" shall be used for mud rotary drilling, and 6-1/4" hammer bits shall be used for DTH drilling.

iii) Drilling depth

As the result of the survey for the existing boreholes, the maximum average borehole depth of planned LGA is about 67m in Bauchi State and about 56m in Katsina State. However, in sedimentary area the drilling depth can be more than 90m. Thus, the drilling rig is planned to have drilling capability of more than 100m.

iv) Truck mounted with rig

On the local roads away from main roads, normal vehicles cannot run because the roads are unpaved, rough and muddy in the rainy season. Accordingly, 4-wheel-drive (4x4 or 6x4) vehicles

shall be adopted.

b) High Pressure Air Compressor

The necessary air pressure and volume is decided based on the following conditions:

i) Calculation of necessary air pressure
Necessary pressure of compressor is calculated by the sum of the minimum operating pressure and water head.

- Minimum operating pressure : 10.5 kg/cm^2 (1.03MPa)
- Water head pressure : 10.0 kg/cm^2 (0.98MPa : maximum drilling depth of 100m)
  Necessary air pressure = Lowest operation pressure + Water head pressure
  = 10.5+10.0 = 20.5 kg/cm^2 (2.01MPa)

ii) Calculation of necessary air volume
The necessary air volume is calculated by using the following formula.

- Flow velocity in the space between rod and drilled wall in borehole (V) = Necessary air volume (m^3/min)(Q)/ Space between the rod and the wall of the borehole (m^2)(A)
- Space between the rod and the wall of the borehole (m^2)(A) = 1/4× π ×{(Borehole diameter (m) (D))^2 - (Rod diameter (m) (D))^2}
- The flow velocity in the space between rod and drilled wall in borehole is generally from 1,200 to 1,500 m/min. The average value of 1,350 m/min is used for this calculation in the Project.
- Borehole diameter : 6"(0.159m)
- Rod diameter : 4-3/4"(0.121)
- The necessary air volume(Q) = Flow velocity in the space between rod and drilled wall in borehole (V)×Space between the rod and the wall of the borehole (m^2)(A)= 1,350m/min×1/4× π ×{ (0.159)^2 - (0.121)2}= 11.3m^3/min

Thus the air compressor is planned as a high pressure type (necessary air pressure 2.01 MPa or more) with supply air volume of 11.3 m^3/min or more.

iii) Truck
The air compressor requires the same mobility as the drilling rig. Therefore the drive form is planned as 4-wheel-drive type (4x4 or 6x4), the same as the drilling rig.

c) Cargo Truck with Crane (drilling support vehicle)

i) Specifications
Considering road conditions, driving conditions, travelling distance and weight of cargo, the cargo truck shall be 4-wheel-drive type (4x4 or 6x4) with high durability.

ii) Load capacity
Considering the weight of necessary drilling tools and casing pipes, etc., the load capacity of the cargo truck shall be no less than 6 tons.

iii) Crane Capacity
The load capacity of 2.9 tons (nearly 3 tons) shall be planned in consideration of the general capacity of the trucks manufactured.

d) Pumping test equipment

i) Submersible pump
The planned amount of extraction from the borehole is 30 liters per minute and the maximum dynamic water level is 40~60m below ground level. Thus the specification of the pump shall be established as follows.

- Specification : 30 ℓ/min×70m×1.5kW×50Hz

ii) Generator
Considering the load capacity (submersible pump: 1.5kW), 5kVA is planned.

iii) Groundwater Level Indicator
The indicator shall be capable of measuring up to the maximum drilling depth of 100m.

e) Water analysis equipment

A portable testing set shall be planned to confirm water quality on site. The items to be tested are: pH, DO, EC, T.D.S, chlorines, and water temperature.

f) Geophysical Survey Equipment

Considering manoeuvrability, the equipment shall have the same maximum investigable depth of 100m as the existing equipment, and shall be usable for electrical logging with an additional 100m cable and sonde.

g) Hand Pump and Tools

Indian Mark III (VLOM type), which is the standard promoted by the Federal Government, shall be selected for hand pumps.

h) Casing and screen pipe

Based on on-site borehole survey and the marketing research, the specifications of each pipe are as follows.

Casing pipe Materials：uPVC (Un-plasticized polyvinyl chloride)
Dimension： ϕ 4″ ,O.D.114.4mm, Length 3.0m
Wall thickness：5.5mm or more
Connection：Threading method
Screen pipe Materials：uPVC (Un-plasticized polyvinyl chloride)
Dimension： ϕ 4″ ,O.D.114.4mm, Length 3.0m
Wall thickness：5.5mm or more
Connection：Threading method
Screen type：Slit type (0.8-1.0mm in width)
Opening Ratio：3％ or more

(4) Main Equipment and Materials Procurement Sources

The main equipment and materials shall be procured from the sources shown in the following table. The procurement prices shall be decided by comparing the cost estimates from these procurement sources.

Table 2-2-9 Procurement Sources of Main Equipment and Materials

Item		Supply classification			Means
		Japan	Third Country	Nigeria	
Drilling Equipment and Tools	· Drilling Rig	●	●		These items are not produced in Nigeria. Therefore, they shall be procured from Japan or a third country.
	· Drilling Tools	●	●		
	· High Pressure Air Compressor	●	●		
Supporting Vehicle	· Cargo Truck with Crane	●	●		This item is not produced in Nigeria. Therefore, this shall be procured from Japan or a third country.
Instrument and Materials	· Pumping Test Equipment	●	●		This item is not produced in Nigeria. Therefore, this shall be procured from Japan or a third country.
Survey Equipment	· Water Analysis Equipment	●	●		These items are not produced in Nigeria. Therefore, they shall be procured from Japan or a third country.
	· Geophysical Survey Equipment	●	●		
Materials for construction boreholes	· Hand Pump			●	These items are produced in Nigeria. In this project, it is planned to procure in Nigeria.
	· Casing Pipe			●	
	· Screen Pipe			●	

2-2-3 Basic Design Drawings

The design drawings for the basic design are shown as follows:

- Figure 2-2-3 Standard Structure of Borehole
- Figure 2-2-4 Hand Pump Platform
- Figure 2-2-5 Soakage Pit

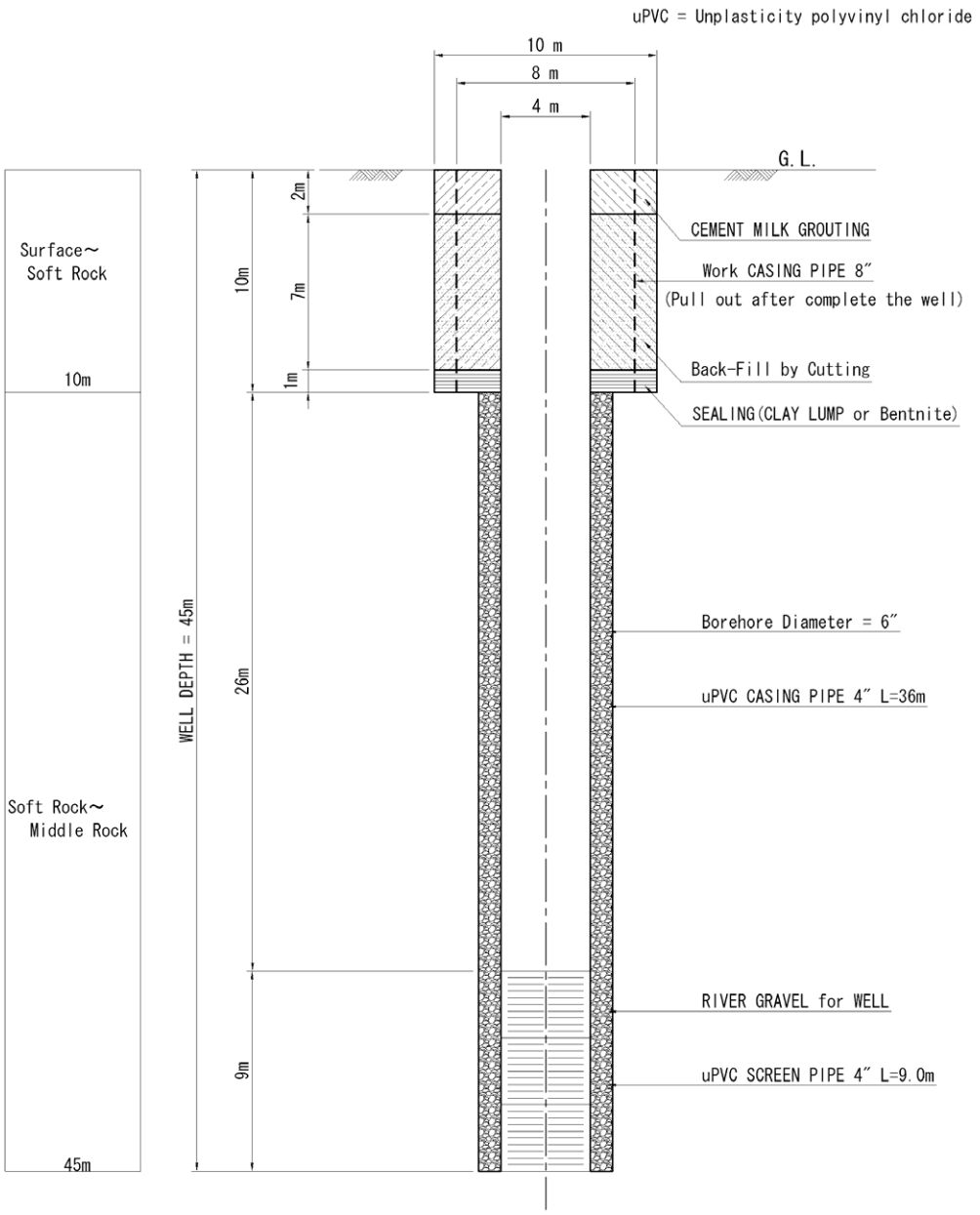


Figure 2-2-3 Standard Structure of Borehole

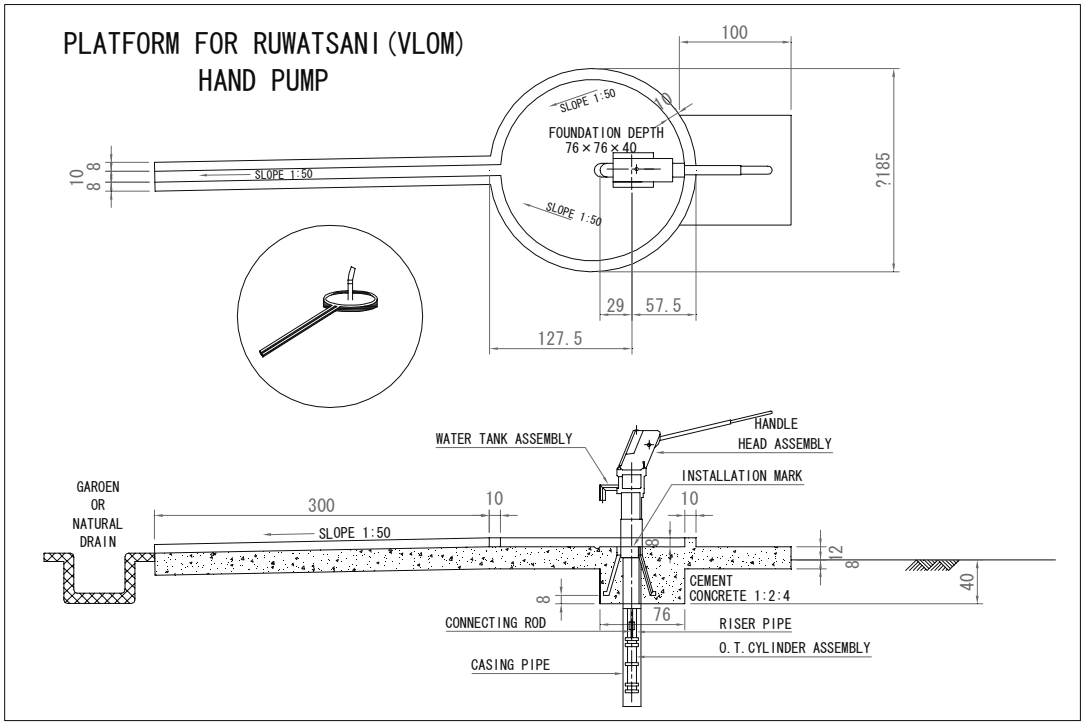


Figure 2-2-4 Hand Pump Platform

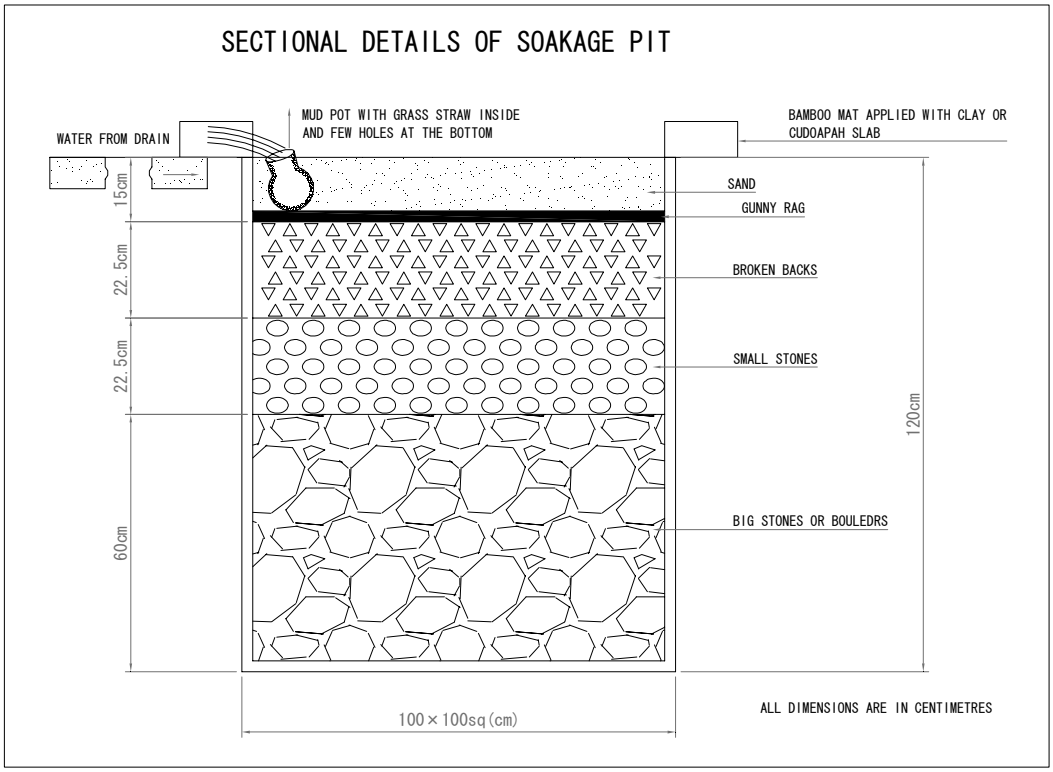


Figure 2-2-5 Soakage Pit

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The procurement plan shall be planned based on the following policy.

1) The procurement plan of equipment and materials shall be suited to the construction schedule of RUWASSA and WATSAN Project.
2) The equipment and materials shall be selected considering the availability and supply sources of spare parts and consumables, usage environment in Nigeria and maintenance system.
3) The most advantageous equipment and materials for Nigeria shall be selected out of Nigeria, third countries and Japan in consideration of technical levels and operation and maintenance conditions in RUWASSA and WATSAN Project.
4) The equipment and materials shall be selected under the international standards of BS, DIN, ASTM, JIS and so on, considering easier quality control and schedule management in the construction of boreholes. However, materials that have been approved under local standards shall be included in the procurement scope.
5) RUWASSA and WATSAN Project shall have responsibility for the operation and maintenance of procured equipment and materials.
6) Each community shall have responsibility for the operation and maintenance of boreholes to be constructed with the procured equipment and materials.

2-2-4-2 Implementation Conditions

In regard to the procurement of equipment and materials, the following points shall be fully considered.

1) Procedures of import, customs clearance of equipment and materials and registration of vehicles by the Nigerian side for commissioning in regard to inspection, operation and maintenance of the equipment by the engineers dispatched from the supplier.
2) Approval of import and customs clearance, and other trade procedures by the Nigerian side.
3) Confirmation of transportation conditions of the supplier, customs clearance and any troubles during and after handover and storage.
4) Confirmation of conditions regarding complex procedures at the port of unloading (Lagos) in Nigeria.

2-2-4-3 Scope of Works and Responsibilities

The Japanese side shall have responsibility for the procured equipment and materials until handing over them to RUWASSA and WATSAN Project. The Nigerian side shall have responsibility for operation and maintenance of equipment and materials after handover, management of construction works, and operation and maintenance of the completed water supply facilities using the equipment and materials.

The Japanese side shall carry out technical transfer concerning quality control, construction method, schedule management and work management to RUWASSA and WATSAN Project through the soft component. However, the Japanese side shall not be responsible for supervising the construction works. The responsibility for procurement of necessary materials for construction of water supply facilities shall be allocated as shown in the following table.

Table 2-2-10 Allocation of the Responsibility for Procurement

Materials	Nigerian side	Japanese side
Casing pipe		○
Screen pipe		○
Hand pump		○
Consumable materials for drilling such as bentonite, cement, gravel, sand, steel bars and fuel	○	

2-2-4-4 Consultant Supervision

Consultant and Contractor shall collaborate and execute the following procurement supervision to secure the smooth implementation of tendering, design, procurement/manufacture, transportation, delivery and installation, etc. of the equipment and materials.

1) Consultant (Procurement Supervisor)
   - Preliminary discussions with contractors
   - Checking of approval documents, etc.
   - Confirmation of the ordering contents
   - Inspection and checking at the plant
   - Pre-shipping inspection
   - Checking and witnessing of the handover of equipment and materials
   - Checking of technical transfer (OJT), user manuals and maintenance manuals, etc. provided by the contractor

2) Contractor
   - Dispatch of procurement supervisors to Nigeria for checking of equipment and materials when they arrive at Lagos port
   - Contractor shall give explanations to the engineering staffs of RUWASSA and WATSAN Project concerning the operation and usage of rigs, trucks, and geophysical survey equipment, etc.

2-2-4-5 Procurement Plan

In principle, the procurement plan for equipment and materials shall consider the possibility of procurement from Nigeria, Japan and third countries so as to secure aftercare services and to reduce cost.

1) Drilling rig and related tools

Drilling rigs are neither manufactured nor assembled in Nigeria. Therefore, drilling rigs and related tools shall be procured from Japan or a third country. The procurement shall be done from a rig manufacturer which is capable of providing local aftercare service.

2) Equipment and Materials for Construction of Boreholes

- Hand Pumps

In Nigeria, the Federal Government is currently standardizing hand pumps, and repair skills are high. Acquisition of spare parts is easy, and thus the same type of product shall be procured in this Project. Since hand pumps are manufactured in Nigeria, and there are local importers, they will be procured from Nigeria or a third country.

- Casing and Screen Pipes

Casing pipes and screen pipes made of un-plasticized polyvinyl chloride (uPVC) can be procured in Nigeria. Some companies are capable of producing pipes that meet international standards. Therefore, these pipes shall be procured in Nigeria

2-2-4-6 Quality Control Plan

The quality control plan for the Project is described below in reference to schedule control and quality control.

(1) Schedule control

As the proposed grant aid project consists of only the procurement of equipment, the important work for maintaining the pre-determined process shall be the manufacture of equipment in the factory. In principle, process control shall be based on the factory management by the Equipment Supplier (suppliers). Meanwhile, the Consultant shall check progress relying on reports submitted by the

Equipment Supplier and shall issue warnings, etc. if necessary. The following work is planned as the Consultant's process control.

1) In consideration of the project period to be required in the grant aid assistance and for the manufacture of the equipment, the Consultant shall establish a necessary and sufficient project implementation schedule and shall also prepare a project schedule sheet which will form a part of the equipment supply contract.
2) At the time of the tender, the Consultant shall check that the schedule indicated by the bidders is appropriate to meet the requirements of the grant aid scheme.
3) The Consultant shall check the progress of the work by comparing the actual progress made by the Equipment Supplier with the planned schedule.
4) When the work progress of the Equipment Supplier significantly falls behind the planned schedule, the Consultant shall issue a warning to remind the Equipment Supplier of meeting the original schedule. Moreover, the Consultant shall examine and propose measures to maintain the planned schedule where necessary.

(2) Quality control

The equipment to be procured in the planned grant aid assistance shall be manufactured at suitable factories. Accordingly, the quality of such equipment shall, in principle, be controlled by the Equipment Supplier and the Consultant shall verify the equipment quality based on the performance test results, etc. at the time of completion. In addition, the Consultant shall conduct the following work related to the quality control.

1) The Consultant shall include the equipment specifications based on the basic design in the tender documents.
2) The Consultant shall verify that the equipment proposed by the bidders at the time of the tender meets the specifications set in the relevant tender documents.
3) When necessary, the Consultant shall check the specifications in more detail by means of checking the approved documents, etc. of the Equipment Supplier.
4) The Consultant shall confirm the quality of the equipment prior to its shipment by witnessing the quality inspection at the time of completion of manufacturing equipment at the factory, and/or reviewing reports on the inspection results, etc. The Consultant shall instruct the Equipment Supplier to adjust the manufactured equipment where necessary.

(3) Quality control of the borehole construction

In Nigeria, the National Water Resources Institute has compiled the "Draft National Code of Practice for Borehole Drilling in Nigeria" for quality control of borehole construction. This is applied to quality control of the borehole construction in this plan.

2-2-4-7 Soft Component (Technical Asssitance) Plan

There would appear to be no problem regarding the willingness and capability of Bauchi and Katsina State Governments, RUWASSA and WATSAN Project and local residents to operate and maintain the Project equipment and materials. Therefore, in order to ensure the sustained operation and maintenance of water supply facilities through the efficient operation of procured equipment, technical support shall be conducted in the following two areas under the "Soft Component" of the Project.

1) Technical training for borehole construction and data management
2) Technical training for operation and maintenance system for water supply facilities

The above soft component shall be kept to a minimum in terms of scale. Concerning the implementation method, the Japanese consultant shall conduct overall supervision and guidance, while the local consultant shall be responsible for some of the activities. The soft component will be completed before the handover of procured equipment and materials.

(1) Necessity for Introduction of the Soft Component

1) Technical training for borehole construction and data management

In the Project, construction of 76 boreholes under RUWASSA and 92 boreholes under

WATSAN Project is planned over two years. The training of management in areas such as preparation of implementation plans for construction, as well as the strengthening of the technical side regarding handling of equipment, operation and maintenance of equipment, drilling technique of boreholes and capacity of supervision, is essential for effective implementation of borehole construction through the efficient utilization of equipment and materials procured in this project. Such training will enable the effective utilization of the limited human and financial resources of RUWASSA and WATSAN Project for borehole construction and data management. Through implementing construction based on a planned and controlled construction period, the Project will be smoothly implemented with minimum time loss due to idling, insufficiency of equipment and accidents, thereby enabling the Project effect to be realized to the full.

Regarding to the maintenance situation of existing equipment in RUWASSA and WATSAN Project, there is a repetitive pattern of breakdowns and repairs. RUWASSA/WATSAN Project has no systematic maintenance inventory (record) and there are no routine maintenance activities for the prevention of breakdowns. For these reasons, equipment breakdowns occur frequently, disturbing the progress of drilling. Thus, it is necessary to provide technical assistance on the preparation of maintenance records based on an appropriate plan for maintenance and renewal of equipment. It is sure that equipment breakdowns can be prevented to a certain extent through implementing daily inspections and preventive maintenance. This assistance plans to carry out to both RUWASSA and WATSAN Project.

2) Technical training for operation and maintenance system for water supply facilities

Rural water supply and sanitation service of RUWASSA and WATSAN Project consists of the following: request of construction of boreholes, securing of budget for implementation, site survey (natural conditions, social conditions), construction of water supply facilities, water quality testing, and community mobilization immediately after construction. After handing over of the water supply facilities to the community, a WASHCOM is organized by residents of the community, and WASHCOM carries out the operation and maintenance of the water supply facility. The LGA WASH Unit, which belongs to Water Supply Department of LGA, assists WASHCOM. This system is not appropriately functioning, as it is not well understood by the staff of RUWASSA and WATSAN Project, LGAs and residents of the communities.

The causes of these problems are namely: insufficient cooperation among relevant stakeholders, inadequate management due to insufficient technical knowledge and skill of RUWASSA and WATSAN Project staff, and absence of guidance and training for RUWASSA and WATSAN Project staff. In particular, WATSAN Project staff in Bauchi State have less experience of O/M system for water supply facilities compared to RUWASSA staff in Katsina State. In addition to that, WATSAN Project does not have a proper manual concerning the O/M system for water supply facilities.

In order to establish a sustainable operation and maintenance system for water supply facilities, it is necessary to review the system of water supply and sanitation services in WATSAN Project and to strengthen the cooperation system between relevant stakeholders. Furthermore, in order to aid the establishment of resident organizations and ensure the proper implementation of community mobilization activities, capacity building for WATSAN staff shall be promoted through supporting their acquisition of specialist know-how and skills

(2) Soft Component Targets

1) Technical training for construction management
   a) Borehole construction will be implemented continuously based on the construction plan.
   b) Operation and maintenance system for water supply and sanitation services will be established through development of a borehole inventory.
   c) Borehole management capacity will be enhanced.

2) Technical training for operation and maintenance system for water supply facilities
   a) In WATSAN Project The system and contents of operation and maintenance work will be clarified, thereby enabling the sustained operation and maintenance of facilities to be

implemented in WATSAN Project.

b) Educational activity toward WASHCOM and support for establishment of resident organizations through cooperation between WATSAN Project and LGA WASH units will be implemented continuously.
c) WASHCOM will be established in each community for the autonomous operation and maintenance of water supply facilities.
d) Capacity building of LGA WASH unit staff will be conducted by WATSAN Project employees.

(3) Outputs of the Soft Component

The direct outputs of the soft component in the Project will be as follows.

1) Technical training for borehole construction and data management
   a) Construction periods of boreholes will be adhered to and borehole construction plans will be formulated.
   b) Borehole inventories will be developed.
2) Technical training for operation and maintenance system for water supply facilities
   a) Comprehensive system for water supply and sanitation services will be established, and work contents will be made clear.
   b) Work management rules will be established for support of WASHCOM by WATSAN Project and LGA WASH Units, and the role of support responsibilities will be clarified.
   c) WASHCOM will be established in model community, while at the same time WATSAN Project and model LGA Unit employees will acquire know-how on organizing residents and conducting mobilization activities.

(4) Soft Component Activities

Contents of Activities

The support activities will consist of the following two items.

1) Technical training for borehole construction and data management

Before start of borehole construction, the Japanese consultant will provide support on formulation of borehole construction plans to the staffs of the Drilling Section and Planning Section of Water Supply Department of WATSAN Project in Bauchi State and staff of Water Supply Unit of Water Supply & Sanitation Department of RUWASSA in Katsina State, with a view to strengthening the works management capacity of RUWASSA and WATSAN Project.

Moreover, the Japanese consultant will carry out capacity building for RUWASSA and WATSAN Project personnel through conducting guidance on borehole database management to staffs of the local water supply department hydrogeology sections.

2) Strengthening of operation and maintenance system for water supply facilities

It is necessary to strengthen the operation and maintenance system to ensure the long-term use of water supply facilities. Support will be provided in order to consolidate the water supply and sanitation services of WATSAN Project and to strengthen the organizations of WATSAN Project, LGA WASH Units and WASHCOM and cooperation between the stakeholders.

Table 2-2-11 shows the contents of activities. Also Table 2-2-12 shows the input plan of human resources and equipment and materials, etc. required in the soft component.

Table 2-2-11 Contents of Soft Component Activities

1) Technical Training for Construction and Data Management (to RUWASSA and WATSAN Project)

Activities	Contents	Detail contents	Output
1.Planning of borehole construction	1-1. Scheduling of engineers and management plan for the construction 1-2. Planning of a work schedule for the construction. 1-3. Planning of safety management	a) To organize a construction planning team in RUWASSA b) To make a working plan for the construction c) To share related construction work as reference, and then to make a list of quality control d) To make a work schedule of the construction e) To make safety management plan for the construction work （see Note 1 for detail）	1. Construction period of borehole will be kept on the basis of the established borehole construction plan. 2. Borehole inventory will be constructed.
2. Borehole data management	2-1. Preparation of borehole inventories	a)To collect existing boreholes data、create data format b)To input existing borehole data into a computer. （see Note 2 for detail）	Inputs / Equipment 1. Japanese Consultant (1person) Local Consultant (1person) 2. Vehicle rent： for Japanese consultant x 55 days 3. Preparation of documents 1 set
Facilitator 1.Japanease Consultant (1 person) 2.Local Consultant (1person) Target group : Staff of RUWASSA and WATSAN Project 1.Construction Planning team： Water supply section 4 persons 2. Borehole inventory team： Planning and evaluation section 4 persons	Note 1.Training for borehole construction planning (a) Explanation of outline of the project, importance of responsibility of personnel in charge and cooperation among related departments (b) Preparation of a list of the contents in the construction plan (c) Questions and answers (d) Instruction on quality, work period and safety management (e) Advice on organization of borehole team (f) Advice on the construction period (g) Preparation of a check list of quality control (h) Sharing related constructions as examples among participants (i) Making construction plan 2.Training for borehole data management (a) Explaining the importance of data management (b) Understanding data management problem in RUWASSA and WATSAN Project and its possible solutions (c) Questions and answers (e) Preparation of borehole data format (f) Borehole data management method at the implementation stage		

2) Strengthening of O & M System for Water Supply Facility (to WATSAN Project)

Activities	Contents	Detail contents	Out put
1. Reviewing and arrangement of the Water supply and sanitation service by WATSAN Project	1-1. Verification of water supply and sanitation service system	1) To select a LGA as model and organize a working team (see Note 1) 2) To review the existing service of water supply and sanitation in WATSAN Project 3) To clarify work of O/M system 4) To define demarcation of work among WATSAN Project, LGA Units and WASHCOM	1. Contents of water supply and sanitation services will be made clear within WATSAM Project 2. Demarcation of responsibility on supporting WASHCOM between WATSAN Project and LGA will be made clear by the regulations of work management. 3. WASHCOM will be established in a model community and WATSAN Project staffs will learn know-how of community organization. 4. O&M manual for water supply system including criteria of community selection and implementation method of monitoring O&M system will be prepared.
2. Strengthening of cooperation between WATSAN Project and LGAs	2-1. Verification of role between WATSAN Project and LGA in the service.	1) To hold a meeting with selected LGA Units (Introduction of the project, request of cooperation and confirmation of LGA unit)	
	2-2. Setting up regulations for O&M of work	1) Consideration of regulation for O/M work, such as system to supply spare parts, regular meeting, supporting to WASHCOM 2) Setting up regulation for O/M work	
3. Organization of WASHCOM, and activity of community mobilization in model community (see Note 2)	3-1. Verification of work sharing	1) To select one targeted village as model community of LGA 2) To introduce the water supply and sanitation service of WASHCOM to the targeted community.	
	3-2. Setting up WASHCOM	1) To explain necessity and role of WASHCOM, and O&M of water supply facility. 2) To select relevant members of WASHCOM, and prepare the member list	
	3-3. Community mobilization for O&M cost	1) To explain O&M cost for water supply facility 2) To discuss about O&M cost (cost of water charge, frequency of payment, the method of payment, the way of collecting and keeping money in the committee, etc.) 3) To make a rule for O&M cost in WASHCOM through workshop in the community	Inputs / Equipment 1. Japanese Consultant (1 person) 2. Vehicle rent : for Japanese consultant x 32 days 3. Preparation of documents 1 set
	3-4. Promotion of hygiene education（see Note 3）	1) To promote hygiene education on environment around water supply facilities and households, etc	
	3-5. Training for maintenance and technique of water supply facility (see Note 4)	1) To explain how to cope with broken boreholes (demarcation of roles and communication system) 2) To train local borehole engineers how to check and maintain boreholes (including distribution of manuals)	
<Working team> 1. Japanese consultant: Facilitator (1 person) 2. Staff of WATSAN Project 4 persons 3. Staff of LGA WASH Unit 2 persons Total 7 persons <Adviser> 1.Staff of UNICEF (Rural water supply system, Hygiene education) Target group：Staff of WATSAN Project Participation：1 model LGA, 1 model community	Notes: 1. Working team is composed of 4 members from selected each department in WATSAN Project, 2 members of model LGA Unit, and Japanese consultant (1 person) : totally 7 members. 2. Interviewees of the survey are members of WASHCOM constructed by WATSAN Project and members of LGA Units. 3. Promotion activities of hygiene education are carried out twice, and one of the project targets encourages participation of women. 4. Training of maintenance technique is conducted to local hand pump mechanics and WASHCOM members in community of model LGA that have existing water facility constructed by WATSAN Project		

Table 2-2-12 Detailed Assignment Plan

	Supporting item	Activities	Contents	Place	Output	Documents
Technical Training for Construction and Data Management	Guidance of Construction Mangagement (Katsina)	Preparation	Preparation of text	Japan		・Training text
		Mobilization		Mobilization		
		Planning of borehole construction	Planning of personel and management program	Katsina	・To comply with the construction period of the water supply facility is preserved. ・Construction plan for borehole is prepared accordingly.	・Borehole construction managenent manual (Construction plan) ・Safety control manual (Safety control plan)
			Planning of construction program			
			Planning of safety control program			
		Report preparation for RUWASSA				・Final report of activity to RUWASSA ・Activity record photo
	Moving from Katsina to Bauchi					
	Guidance of Construction Mangagement (Bauchi)	Planning of borehole construction	Planning of personel and management program	Bauchi	・To comply with the construction period of the water supply facility is preserved. ・Construction plan for borehole is prepared accordingly.	・Borehole construction managenent manual (Construction plan) ・Safety control manual (Safety control plan)
			Planning of construction program			
			Planning of safety control program			
		Administrative procedure of borehole inventories (facilitated by local engineer)	Preparation of hand pump wells records		・Borehole inventories record is arranged.	・Format of borehole inventory record
		Report preparation for WATSAN Project				・Final report of activity to WATSAN Project ・Activity record photo
		Mobilization		Mobilization		
Strengthening O/M system for water supply facility	Cooperation of Strengthening O/M System for Water Supply Facility (Bauchi)	Preparation	Preparation text	Japan		・Training text
		Mobilization		Mobilization		
		Reviewing and arrangement of the Water supply and sanitation service by WATSAN Project	Preparation, establishment of working team	Bauchi、Model 1LGA, Model 1 community	・The system of water supply and sanitation sevice is prepared and the contents is defined.	・Regulations of management to assist WASHCOM
			Preparing manual for water supply and sanitation institution			
		Stengthening of cooperation between WATSAN Project and LGA	Verfication of work sharing, and Preparing regulation for O&M of work.		・The regulations of management to assist WASHCOM by WATSAN Project and LGA is made and burden sharing is defined.	
		Organization of WASHCOM, and activity of community mobilization in model community	Strengthening of WASHCOM and Training for Community mobilization activity		・WASHCOM is established in a model commnunity. Also staffs of WATSAN Project and LGA are lean the know how of commnunity mobolization acitivity.	・Member list of WASHCOM, Regulations of management for WASHCOM ・Hand pump maintenance manual ・Community mobilization manual
		Report preparation for WATSAN Project				・Final report of activity to WATSAN Project ・Activity record photo
		Mobilization				
Evaluation	Evaluation for accomplishment of output about soft component	Mobilization		Mobilization		
		Evaluation for accomplishment of Output in Bauchi & Katsina States		Bauchi & Katsina		・Final report of soft component(JICA)

Assignment Plan	Human resource		Quantity	Note
	Japanese side	Techinical Training for Construction and Data Management: Japanese consultant (1)	2.25M/M	In Japan：0.23M/M In Nigeria：2.02M/M
		Techinical Training for Construction and Data Management: Local consultant (1)	7 days	
		Strengthening of O&M System for Water Supply Facility: Japanese consultant (1)	1.43M/M	In Japan：0.23M/M In Nigeria：1.20M/M
	Nigerian side	Working team of construction management (4～8 in each activit		Water supply section、Planning and evaluation section、hydrogeology section 4～8 persons
		Working team for strengthening of O/M system for water supply facility (6)		WATSAN Project：4 persons LGA：2 persons（Hand pump mechanics and Mobilization）
		Adviser from UNICEF	2 days	
	Vehicle		Quantity	Note
	Japanese side	4WD	55 days	For Japanese consultant: Techinical Training for Construction and Data Management
		4WD	32 days	For Japanese consultant: Strengthening of O&M System for Water Supply Facility
	Working space, meeting room and others		Quantity	Note
	Nigerian side	Working room	3 month	
		Meeting room	2 days	Meeting with LGA
		Others (transport if necessary)		

(5) Procurement of Implementation Resources for the Soft Component Activities

The support items and methods of procurement for implementation resources under the soft component in the Project are as indicated below.

Table 2-2-13 Implementation Resources for Soft Component

Assistance Item	Activity	Formation	Implementation Resource
1)Technical Training for Borehole Construction Management	Guidance of Borehole Construction and Data Management	Management Assistance	Japanese consultant (a part of activities will be carried out by local consultant resource)
2)Technical Training of O&M System for Water Supply Facilities	Cooperation Strengthening of O&M System for Water Supply Facility	Management Assistance	Japanese consultant

1) The Japanese consultant and local consultant will implement the technical training for borehole construction management with respect to RUWASSA and WATSAN Project employees, i.e. staff of the Drilling Section and Planning Section of Water Supply Department of WATSAN Project, and Water Supply Unit of Water Supply & Sanitation Department of RUWASSA

The main support areas will be items directly relating to the practical work of borehole construction planning and borehole inventory preparation. The support will be conducted with the goal of promoting the efficient construction of facilities within time constraints by utilizing the equipment procured in the Project. The local consultant will implement support for the borehole inventory preparation.

2) The Japanese consultant and local consultant will implement guidance on the strengthening of operation and maintenance system for water supply facilities with respect to WATSAN project employees of Water Supply Department, Sanitation Department and Community Mobilization Department prior to the procurement of new equipment and materials and construction of water supply facilities.

The main support areas will be items directly relating to establishment of operation and maintenance system of water supply facilities in WATSAN project, strengthening of links between WATSAN Project and LGA, organization of WASHCOM and mobilization of residents in villages.

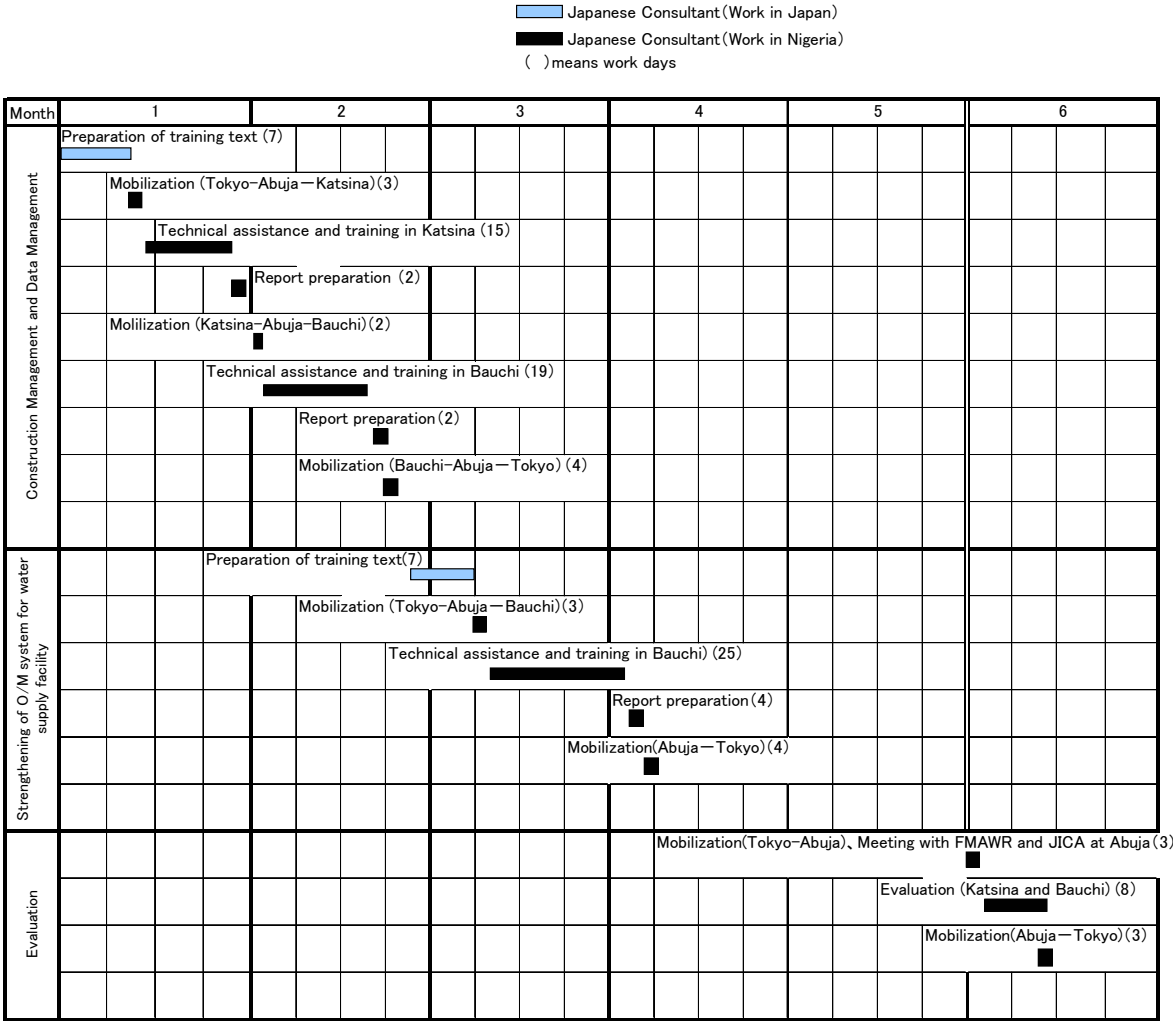
(6) Soft Component Implementation Process

The soft component will be implemented before the start of borehole construction. The assistance will be conducted in the two areas of technical training for construction management and strengthening of operation and maintenance system for water supply facilities, but not during Ramadan so that RUWASSA and WATSAN Project staffs can participate.

It is planned to implement the technical assistance for borehole and data management for 1.8 months from nine months after conclusion of the consultant agreement. Immediately after that, technical training for operation and maintenance system for water supply facilities will be implemented for 1.4 months. Confirmation of the degree of achievement of the overall soft component outputs will be implemented for 0.5 months approximately two months after completion of the soft component activities. When implementing the soft component, local consultants shall be utilized and the most rational instruction method shall be adopted with a view to minimizing involvement by Japanese engineers. The training for borehole and data management will be provided to both RUWASSA and WATSAN Project personnel in Bauchi and Katsina States. Care will be taken to tailor the contents to augment the areas that are lacking in each state and thereby avoid spending excessive time on the soft component.

Table 2-2-14 shows the implementation schedule of the soft component.

Table 2-2-14 Soft Component Implementation Schedule (Draft)



2-2-4-8 Implementation Schedule

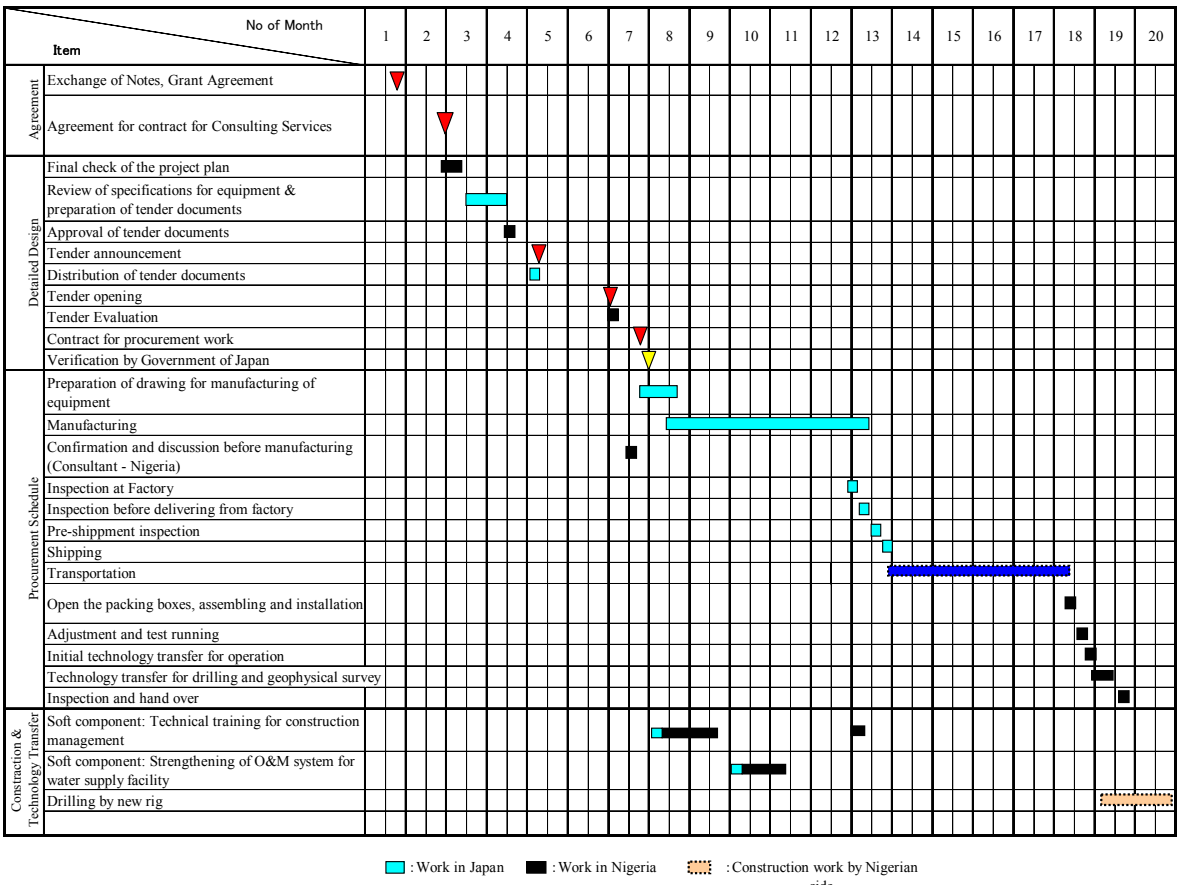
The equipment and materials will be procured from Japan, a third country or in Nigeria. If procuring from Japan, it will require approximately 11 months comprising six months to manufacture the equipment (drilling rig) and five months for transportation including customs clearance.
The newly procured rigs will be used to drill the 76 boreholes in Bauchi State and 92 boreholes in Katsina State. The standard construction schedule for one borehole is as follows.

- Drilling work (4.0~6.0 days)
- Pumping test (4.0 days)
- Platform construction (2.0 days)
- Hand pump installation (4.0~6.0 days)
- Handover and fence installation (by residents)

Separate teams will be organized to implement each item of work. Taking into account the drilling period during which the rigs are in use, it will be possible to construct between 60~84 boreholes per year using each new rig. Taking into account the rainy season, the actual figure will be more like 50~70.
In other words, conservatively assuming the drilling capacity of each new rig to be 50 boreholes per year, it should be amply possible to drill 100 new boreholes over two years.

Table 2-2-15 shows the draft implementation schedule.

Table 2-2-15 Implementation Schedule (Draft)



2-3 Obligations of the Government of Nigeria

The scope of works of the Japanese side in the Project covers the procurement of equipment and materials for construction of borehole water supply facilities and technical support via the soft component. As for the construction of water supply facilities including the selection of sites, both governments have agreed that the Nigerian side will take responsibility. The specific scope of works of the Nigerian side is as indicated below.

(1) Construction of Borehole Facilities

Item	Obligations of Nigerian Side
Borehole construction work	・ Mobilization of drilling rig, setting and dismantling, ・ Drilling, electrical logging, casing pipe installation, gravel packing, backfilling, cementing, pumping test, water quality analysis, finishing ・ Hand pump installation, platform construction ・ Necessary equipment & materials for construction such as fuel, bentonite, chemical agent, sand and gravel, reinforcement steel bar, lubricant, water, and cost of other consumables etc. ・ Vehicle and labor expense for construction work. ・ Common temporary work expense ・ Site expenditure, etc.
Borehole construction cost	・ The cost for construction work and management.
Construction period	・ Preparation of construction schedule. ・ Completion of 76 boreholes construction in Bauchi State and 92 borehole construction in Katsina State within the period of two years. After that, continuous construction for four years. If the construction will not be completed, Nigerian side will take up the responsibility to complete the construction.

Siting	・ Prior to commencement of construction, the siting of the drilling points will be conducted by Nigerian side.
Quantities of construction materials	・ Nigeria side will be responsible for construction materials such as PVC casing & screen and hand pumps exceeding 76 sites in Bauchi and 92 sites in Katsina.
The method of delivery materials	・ Transportation of equipment & materials from RUWASSA office in Katsina and WATSAN Project office in Bauchi to each drilling site. ・ Management of the equipment and materials.
Exemption of taxes	・ Nigeria side will prepare the necessary documents for custom clearance before arrival of the equipment and materials at Lagos Port, and Nigeria side will carry out customs clearance.
Quality control and Inspection	・ Nigeria side will undertake the responsibility of quality control and compliance to specifications, etc.
Safety/ Security measures	・ Responsible for any accident during construction. ・ Anti-theft measures of the equipment and materials at the sites.
Special attention	・ The progress report of the work shall be reported monthly to Japanese side.
Others	・ Improvement of access roads ・ Construction of fences around the boreholes.

(2) Others

- To provide necessary data and information for the implementation of the Project
- To secure the construction sites for the Project, and to clear, level and reclaim them prior to the commencement of the construction.
- To provide office and counterparts free of charge to Japanese consultant.
- To bear the following fees to arising in accordance with the Banking Arrangement (B/A) and the Authorization to Pay (A/P)
- To ensure prompt unloading and customs clearance of the materials and equipment procured by the Project on arrival in Nigeria.
- To exempt Japanese officials from customs duties, internal taxes and other fiscal levies, which may be imposed in Nigeria with respect to the supply of products and services under the verified contracts
- To acquire number plate registration numbers for the vehicles procured in the Project
- To maintain and use properly and effectively the facilities constructed and equipment provided under the Project.
- To take the measures necessary for the safety and security of the Japanese engineers.
- To provide counterparts to the soft component activities as a working team, and to participate in the training workshop for RUWASSA and WATSAN Project staff.

In order to effectively utilize and operate the drilling equipment procured by the Nigerian side so as to improve the rural water supply coverage and ensure safe water supply to residents in rural areas, it is necessary for Bauchi and Katsina States to secure the water supply utility budget and to sustain the organization and technical capability of RUWASSA and WATSAN Project, which are in charge of the regional water supply service.

2-4 Project Operation Plan

2-4-1 Operation and Maintenance of Borehole Drilling Equipment

< Management >
The construction procedure of boreholes utilizing the equipment to be procured in this Project is composed of geophysical survey, drilling, pumping test, and construction of apron and hand pump installation. RUWASSA and WATSAN Project are responsible for the implementation of these construction works, and the procured equipment and materials are to be set up in RUWASSA and WATSAN Project offices. The necessary staffs for the operation and maintenance of these equipment and materials, which are shown in Table 2-4-1 and Table 2-4-2, can be covered by the present RUWASSA and WATSAN Project staff.

Table 2-4-1 Necessary Staff for the Implementation of the Project (WATSAN Project)

Work contents	Team component		No of present staff	Necessary staff for the Project	Remark
1)Geophysical survey (Siting)	Geophysicist Assistant	1 3	4	4	Water Supply Department Survey Team (4)
2)Drilling	Chief driller Assistant driller Mechanical engineer Electrical engineer	1 4 1 1	14	7	Water Supply Department Drilling Team
3)Pumping test	Engineer Plumber Assistant technicians	1 1 2	4	4	Water Supply Department. Pumping Test Team
4)Hand pump Installation	Engineer Assistant technicians	1 2	4	3	Water Supply Department. Pump Installation Team

Table 2-4-2 Necessary Staff for the Implementation of the Project (RUWASSA)

Work contents	Team component		No of present staff	Necessary staff for the Project	Remark
1)Geophysical survey (Siting)	Geophysicist Assistant	1 3	10	4	Water Supply & Sanitation Department Hydrogeology Section
2)Drilling	Chief driller Assistant driller Mechanical engineer Electrical engineer	1 4 1 1	27	7	Water Supply & Sanitation Department Water Supply Section
3)Pumping test	Engineer Plumber Assistant technicians	1 1 2	5	4	Water Supply & Sanitation Department Water Supply Section
4)Hand pump Installation	Engineer Assistant technicians	1 2	7	3	Water Supply & Sanitation Department Water Supply Section

(1) Geophysical survey equipment
An electrical sounding instrument, which can be used for logging work in combination, will be introduced in this Project. That is because WATSAN Project currently borrows an electrical sounding instrument from water board of the state government and implements geophysical sounding in site selection. The geophysical survey equipment of RUWASSA, which was offered by UNDP in 1995, is old and prone to breaking down. Therefore, one set of new geophysical survey equipment is necessary for this project. The sections in charge of the equipment are the Survey Team of Water Supply Department in WATSAN Project and the Hydrogeology Section of Water Supply & Sanitation Department in RUWASSA.

Because the staffs of the responsible sections mentioned above have good computer skills and solid knowledge in geophysical sounding, it is considered that they can implement electrical sounding. It will be necessary to make up for their lack of experience in the field through providing technical

guidance in electrical sounding instrument operation via on-the-job training.

(2) Borehole drilling
The drilling engineers in RUWASSA and WATSAN Project are considered to have basic drilling skills, considering the results of the field study. Therefore, the staff of RUWASSA will be able to operate the new rig and drilling equipment procured in the Project. However, technical assistance will be necessary regarding mud circulation rotary drilling using the new rig, guide pipe installation and removal, and DTH drilling.

(3) Hand pump installation
RUWASSA and WATSAN Project engineers are considered to possess enough experience and ability to install hand pumps. However, regarding the maintenance of facilities after construction, support will need to be provided under the soft component in order to improve sustainable operation and maintenance by the WASHCOM.

< Maintenance System >
The scope of maintenance work pertaining to drilling equipment, support vehicles and geophysical sounding instruments, etc. to be procured in the Project is as follows.

- Daily and regular inspection of the equipment
- Maintenance, inspection and repair of the equipment on the construction sites
- Maintenance and storage of construction tools
- Repair of breakdowns
- Management and inventory control of the materials
- Keeping of manuals and technical documents

The Survey Team and the Water Quality Section of the Water Supply Department in WATSAN Project and the Hydrogeology Section of the Water Supply & Sanitation Department in RUWASSA shall be responsible for the maintenance of the geophysical sounding equipment and simple water analysis equipment, whereas the Maintenance Department in WATSAN Project and the Workshop Section of the Water Supply & Sanitation Department in RUWASSA shall be in charge of the other procured equipment and materials. As is shown in Table 2-4-3, the repair departments of RUWASSA and WATSAN Project have personnel capable of conducting simple vehicle repairs, welding work, and maintenance of compressor engines and generators, etc. Although RUWASSA and WATSAN Project will own more equipment due to procurement in the Project, they will be able to handle the extra maintenance by doing the operation and maintenance training.

Table 2-4-3 Staff of Workshop in RUWASSA and WATSAN Project

Section	No of staff	Contents
Management of stored materials	1 (RUWASSA and WATSAN Project)	Safekeeping of the procured material (Hand pump, PVC casing, Screen)
Mechanics	7 (RUWASSA) 5 (WATSAN Project)	Check and repair for rig, trucks and compressor. Assembling and processing simple machines
Electrician	3 (RUWASSA) 2 (WATSAN Project)	Welding works, Electricity-related repair
Operator for the equipment	3 (RUWASSA) 3 (WATSAN Project)	Maintenance of compressor and generator, etc.

2-4-2 Operation and Maintenance of Water Supply Facilities

Communities are required to perform daily checks and minor repairs of the new boreholes and to bear costs. A maintenance kit will be provided to each borehole when the boreholes are handed over to the communities so that the communities do not need to ask RUWASSA and WATSAN Project and LGs to conduct minor repairs. RUWASSA and WATSAN Project or LGs will assist members of WASHCOM in instructing how to maintain a hand pump by explaining necessary parts, exchange of consumable parts and technical skills for repairs. This will enable communities to establish an autonomous structure for operation and maintenance.

As for the operation and maintenance costs, it is necessary for a WASHCOM to collect a certain amount of money from a community and manage the money. It is expected to accumulate sufficient funds to avoid delay of repair as the required amount is not always collected immediately after a breakdown. Therefore, RUWASSA and WATSAN Project or LGA will provide accounting training on how to collect water charges and how to manage the collected money.

"The National Rural Water Supply and Sanitation Programme: A Strategic Framework" stipulates the division of roles at three levels in operation and maintenance of boreholes, that is, state level, LGA level, community level as follows.

Table 2-4-4 Division of Roles in Operation and Maintenance of Hand Pump Borehole

		RUWASSA and WATSAN Project	Local Government Area	Community	Remarks
Daily check & cleaning				✓	
Collection and management of operation and maintenance costs				✓	
Exchange of consumable parts and minor repairs	Repair work			✓	
	Cost burden			✓	
Major repairs beyond the capability of community	Repair work	✓(in practice)	✓ (in practice)		The strategic framework ensures that major repairs beyond the capability of communities are undertaken by the private sector and the costs of them are borne by the community. In practice, however, RUWASSA and WATSAN Project and LGs repair major breakdowns and bear the cost of them.
	Cost burden	✓ (in practice)	(✓in practice)	✓ (in the framework)	
Operation and maintenance of ancillary facilities	Repair work			✓	Repair of platforms or installation of fences.
	Cost burden			✓	

As the principle in the national strategic framework is different from the practice, it is recommended to act in a flexible manner with consultations of stakeholders. However, the participation and involvement of communities will be encouraged.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

(1) Cost burden of the Nigerian side: approx. 46 million Japanese yen

1) The facilities construction cost for 2 years in Bauchi State (76 borehole construction)

Approx. NGN 30 million (approx. Yen 21 million) (approx. NGN 0.4 million per borehole)

2) The facilities construction cost for 2 years in Katsina State (92 borehole construction)

Approx. NGN 37 million (approx. Yen 25 million) (approx. NGN 0.4 million per borehole)

(2) Borehole construction cost in Bauchi and Katsina States after Project period

1) 160 borehole construction for 4 years in Bauchi State (approx. NGN 0.6 million per borehole)

Approx. NGN 96 million (approx. Yen 65 million)

2) 200 borehole construction for 4 years in Katsina State (approx. NGN 0.6 million per borehole)

Approx. NGN 120 million (approx. Yen 81 million)

(3) Calculation Conditions

a) Estimation point: April 2009

b) Exchange rates: 1US$＝95.78 yen

1NGN＝0.674 yen

c) Procurement period: Single fiscal year

d) Others: The Project shall be implemented according to the grant aid scheme.

2-5-2 Operation and Maintenance Cost

(1) Maintenance Cost of Procured Equipment and Materials

The maintenance plan for the procured equipment and materials shall be carried out as follows.

Name of equipment	Contents of the maintenance
Drilling rig	Implementation of the services for every 10 boreholes (engine oil exchange, filter exchange, oil exchange, tire replacement (twice a year)
High pressure air compressor	
Cargo truck with crane	
Pumping test equipment	Generator servicing (engine oil exchange), pumping pipe replacement
Geophysical survey equipment	Main body servicing

According to the results of the field study and the fact-finding survey in RUWASSA/WATSAN Project, the average maintenance cost (including fuel and oil charges) of these new procured drilling equipment will be about 3.5 million naira/year. Therefore, the maintenance cost of procured equipment for constructing the planned boreholes will be 7 million naira in two years. There will be no problems regarding this maintenance cost because it will be contributed by Bauchi and Katsina State governments.

(2) Maintenace Cost of Water Supply Facilities

The hand pumps to be provided by the Project are India MarkIII, which is the type the Federal Government is trying to adopt as standard in village level operation and maintenance (VLOM). RUWASSA/WATSAN Project have constructed many boreholes with the India MarkIII hand pumps.

Communities are expected to perform daily checks and minor repairs as well as bear the cost of maintenance. The necessary operation and maintenance cost of India MarkIII is summarized in the next table. Currently, communities are required to bear the cost of “A” in the next table, while the

cost of "B" is borne by RUWASSA/WATSAN Project or LGAs. It is proposed that communities should collect and reserve necessary money to bear the cost of minor repairs, while major repairs and replacement are carried out by LGA and States.

Table 2-5-1 Annual Maintenance Cost of Hand Pump Borehole

(Unit: Naira)

		Unit Price	Frequency	Quantity	Required money per year
A	Maintenance kit	30,000	Once every ten years	0.1	3,000
	Replacement of spare parts	30,000	Once every two years	0.5	15,000
	A Total				18,000
B	Borehole flushing	60,000	Once every ten years	0.1	6,000
	Major repairs（replacement of hand pump or pipe etc）	110,000	Once every ten years	0.1	11,000
	B Total				17,000
	A+B Total				35,000

The operation and maintenance cost of hand pump bore holes varies depending on the geological conditions, water volume, etc. The cost above is the average cost given as a guide.

It is estimated that the annual cost of operation and maintenance of a hand pump is NGN 35,000. As the number of beneficiaries in this Project is about 300 people per hand pump borehole, the annual operation and maintenance cost which should be borne by one person is NGN 120 (NGN 10/month). This should be collected as a water charge.

The results of the social conditions survey show that people prefer to pay water charges as a household, and the percentage of people who answered they were willing to pay NGN 100-200/month as a water charge is high (the average amount of willingness to pay is NGN150/month). This amount is the same if the above monthly payment/person of the operation and maintenance cost, i.e. NGN 10/month, is multiplied by the average number of people per household, 10-20, that is NGN 10/month×10-20 people = NGN 100-200.

As the number of beneficiaries in this Project is about 300 people per hand pump borehole, when the average number of people per household is 10, the water charge per household is NGN 100/month. But, when the average number of people per household is 20, water charge per household is raised to NGN 200/month. The average monthly household income in both states is different. Whereas it is about NGN 16,000 and the average number of people per household is 11 in Katsina State, it is about NGN 31,000 and the average number of people per household is 20 people in Bauchi State. Therefore, since the water charge NGN 100-200/month is less than 3-5% of average monthly household income, which is used as an indicator showing the water charge a household can afford, this amount can be paid by households. However, there is a range in the average number of people per household from 2 to 90 according to the social condition survey. So, it is necessary for communities to discuss how to set water charges, for instance, whether it should be a fixed rate for all households or adjusted according to the number of people per household.

2-6 Other Relevant Issues

(1) Exemption of Taxes

Regarding the procedure that needs to be followed on the Nigerian side to secure exemption of taxes for the Project equipment and materials, the contractor needs to submit an application form to the Federal Ministry of Agriculture and Water Resources, and this is processed through the NPC (National Planning Commision)) before approval is granted by the Ministry of Finance. Care will be required to ensure that delays in the granting of exemption do not impact the progress of the Project.

(2) Others

An issue of concern in Project implementation is whether or not the procured equipment and materials can be promptly unloaded and processed through customs upon arrival in Nigeria. In past grant aid projects implemented by Japan in Nigeria, holdups in the unloading and customs clearance stage have greatly impacted the implementation schedule. In order to prevent this and ensure the smooth passage of equipment and materials through customs, it will be important to make sure the necessary procedures are taken in advance.

CHAPTER 3

PROJECT EVALUATION AND RECOMMENDATIONS

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PROJECT EVALUATION AND RECOMMENDATIONS

3-1 Project Effects

The expected effects of the Project are described as follows.

(1) Direct Effects

Current Situation and Problems	Remedial Measures under the Project (Requested Japanese Assistance)	Positive Effects and Degree of Improvement
Most people in target villages depend on ponds and shallow wells for drinking water which are often contaminated. Therefore, there are many cases of water-borne diseases and poor sanitation conditions.	・ Procurement of drilling equipment and materials and technical assistance for construction of 168 hand pump boreholes.	・ Provide safe drinking water to 50,400 people to be covered under the Project. ・ Raise water supply rate by 0.67% in Bauchi and 0.59% in Katsina.
Due to the deterioration of existing drilling rigs owned by RUWASSA/WATSAN Project, the efficiency of drilling work is low.	・ Procurement of one drilling rig, high pressure compressor and crane truck for borehole construction in each state.	・ RUWASSA/WATSAN Project will have the drilling rig of the latest model with high drilling efficiency. This rig can be used by RUWASSA/WATSAN Project to continue the rural water supply project in Bauchi and Katsina states after the completion of the Project.
RUWASSA/WATSAN Project doe not have geophysical survey equipment, and has to determine the drilling point by own field experience. This causes low borehole success rate.	・ Procurement of one set of geophysical survey equipment.	・ Groundwater investigation technique will be improved in RUWASSA/WATSAN Project.
RUWASSA/WATSAN Project do not have borehole logging and pumping test equipment, and has to carry the casing program depending on their experience only.	・ Procurement of one set of borehole logging and one set of pumping test equipment. ・ Methodology of pumping test analysis will be instructed during the soft component program.	・ Upgrade the capability of borehole construction by RUWASSA/WATSAN Project.
The operation and maintenance system of borehole construction equipment is very unreliable and borehole construction work is not efficient in RUWASSA/WATSAN Project	・ To conduct the soft component program on borehole construction an data management.	・ Management skill of borehole construction in RUWASSA/WATSAN Project will be improved. ・ Operation and maintenance skill for the drilling equipment will be improved. ・ Borehole inventory will be prepared.

Awareness of operation and maintenance of water supply facility by community is very low. Relationship between community, LGA and WATSAN Project in operation and maintenance system is inadequate. Monitoring system of water supply facilities is not established.	・ To conduct the soft component programs on the operation and maintenance of water supply facilities.	・ The role of works among WATSAN Project, LGA and community will be shared more clearly and their mutual cooperation will be promoted and strengthened. ・ Technical knowledge and techniques which are necessary for water supply project will be enhanced in WATSAN Project.

(2) Indirect Effects

Current Situation and Problems	Remedial Measures under the Project (Requested Japanese Assistance)	Positive Effects and Degree of Improvement
Women and children have to draw and carry water from distant water source, sometimes even from a distance of several km away from their residence. They are forced to spend considerable time and effort to obtain water.	Procurement of drilling equipment and materials and technical assistance for 168 hand pump borehole construction by Nigerian side.	The average distance to carry water will be reduced than the existing condition in target villages.

3-2 Recommendations

3-2-1 Recommendations to be Taken by Recipient Country

In order to execute the maintenance of procured equipment and materials related to the borehole drilling and constructed water supply facilities under the Project sustainable and smoothly, and to execute the water supply project by RUWASSA/WATSAN Project efficiently, it is indispensable to consider the following aspects.

(1) Securing budget for rural water supply and enforcement of organization structure of RUWASSA/WATSAN Project

It is necessary for Bauchi and Katsina States to secure the budget for the water supply project and for RUWASSA/WATSAN Project in charge of rural water supply project to maintain its organization and techniques to operate the procured equipment and materials efficiently related to the borehole construction.

(2) Improvement of operation & maintenance and monitoring systems of water supply facilities

Operation and maintenance system of water supply facilities is important factor to use the constructed water supply facilities for a long period. Therefore, cooperation between the communities, LGA and RUWASSA/WATSAN Project shall be required for the operation and maintenance. It is also important for communities to establish WASHCOM for water sanitation and the communities themselves operate and maintain it on their own initiatives. RUWASSA/WATSAN Project will be required to establish the monitoring system of water supply facilities by which they can continuously do periodic check of water supply facilities, guide repairing skills, and monitor water quality periodically through LGA which directly supports the communities.

(3) Establishment of collection system of water charge by community

Once the management system of water supply facilities by WASHCOM is established, an extra expenditure will be required for any unforeseen breakdown or obsolescence of the boreholes by usage of long period, flushing boreholes, cleaning of sediments deposit, and so on. To cope up with such situation, it is important for WASHCOM to collect water fee properly and completely as well as to pay enough attention to the reserve fund and bookkeeping. In particular, the accounting system must be independent and transparent to prevent embezzlement and/or misappropriations.

3-2-2 Collaboration with Technical Assistance (NWRI Training)

In this project, soft component programs on borehole construction and data management and operation and maintenance system for water supply facilities will be carried out for RUWASSA/WATSAN Project. To compliment this activity, implementation of technical assistances with NWRI training is recommendable. After the completion of 76 boreholes I Bauchi State and 92 boreholes in Katsina State, both agencies will continue to construct the boreholes by the procured drilling rigs at least for four years. Borehole construction materials such as hand pumps and PVC casing & screen are only procured for the first two years. It is necessary, therefore, to carry out the technical assistance continuously after the completion of the first two years of borehole construction in order to assist management of borehole construction and the water supply facilities.