KASSALA STATE WATER CORPORATION
THE REPUBLIC OF THE SUDAN

THE PREPARATORY SURVEY REPORT
ON
THE PROJECTS FOR IMPROVEMENT OF WATER SUPPLY FACILITIES AT KASSALA CITY
IN
THE REPUBLIC OF THE SUDAN

JUNE 2011

JAPAN INTERNATIONAL COOPERATION AGENCY

TOKYO ENGINEERING CONSULTANTS CO., LTD
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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey of the Projects for the Improvement of Water Supply Facilities at Kassala in the Republic of the Sudan, and organized a survey team headed by Mr. Makoto Homma of the consortium consisting of Tokyo Engineering Consultants Co., Ltd., Eight-Japan Engineering Consultants INC. and OYO International Corporation between March, 2010 to December, 2010.

The Survey team held a series of discussions with the officials concerned of the Government of Sudan, and conducted field investigations. As a result of further studies in Japan, 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.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Sudan for their close cooperation extended to the survey team.

June, 2011

Shinya Ejima
Director General,
Global Environment Department
Japan International Cooperation Agency

SUMMARY

1. Country Profile

The Republic of the Sudan is located in north-east of the African continent. The area of the country is approximately 2.376 million km^2 (2008, World Bank), which is the largest in Africa. Total population of Sudan is approximately 42.20 million (2009, World Bank). Northern part of the country experiences desert dry climate while the southern part has humid tropical climate. After conflict between the north and south of Sudan for more than 20 years, Comprehensive Peace Agreement (CPA) was concluded in 2005. Southern Sudan, being composed of ten states, was granted administrative autonomy. As a result of the referendum which took place in January 2011 for independence of Southern Sudan, 98.8% of voters supported for independence. Southern Sudan is expected to become an independent country in July 2011.

The conflict in Eastern Sudan was also settled by signing the East Sudan Peace Agreement (ESPA) in October 2006. Since then, efforts have been made to enhance basic services toward stabilization and restoration of the three states of the Easter Sudan (namely, Red Sea, Kassala, and Gadaref States).

GNI (Gross National Income) per capita is US$1,220 (2009, World Bank). Composition of industrial structure is; primary: 25.8%, secondary: 34.1%, and tertiary: 40.1% (2008, World Bank). Agriculture remains major industry, as Sudan is one of the leading countries producing cotton and sesame. Recently, the national economy recorded high growth rate supported by oil export. However, due to huge foreign debts, the national economy is facing difficult situation. While economic recovery is urgently needed, stabilization of economy is also required by developing non-oil industry, since current industrial structure depends entirely on oil sector that accounts for more than 90% of total exports. Poverty rate is estimated to be 40% (2004 est., World Bank). Therefore, diversifying industrial structure as well as increasing income of agricultural sector, in which most labor population are engaged, is essential. For this purpose, converting subsistence crop into cash crop and improvement of transport infrastructure in order to reduce logistics cost is essentially required.

2. Background of the Project

In June 2006, the Poverty Reduction Strategy Paper (PRSP) (draft version) was formulated within the framework of JAM* (Joint Assessment Missions). The PRSP treats the securing of safe water and enhancement of public hygiene among the top priorities for poverty reduction, and places the water sector as one of the critical sectors for achieving MDGs. For the urban water sector, a roadmap has been established for achieving 93% access rate to safe water in 2015 and raising the rate to 100% by 2025. Development plans for the water sector are formulated based on the roadmap.

Note (*) JAM was conducted by the Sudanese government and SPLM (Sudan People's Liberation Movement) in cooperation with World Bank, UN and other international donors. The JAM provided an assessment of rehabilitation and transitional recovery needs focused on the six transitional years (2005-2011) determined by CPA.

Water Sector Roadmap (Access rate to safe water)

	Total	Urban	Rural
2006	58.7%	69.4%	51.6%
2011		85.0	75.0
2015(MDGs Goal)	82.0	93.0	79.0
2020	90.0	—	—
2025	100.0	—	—

Source: PRSP (draft version)

Specific development plans for the water sector are formulated on the state level, whereas formulation of national water policies, assistance to and supervision of development plans, financing, etc. are carried out on the national level.

In February 2010, the Sudanese government announced a national water strategic plan titled "National Water Sanitation and Hygiene (WASH) Sector Strategic Plan (2010-2016)," following which the government of Kassala State established a 7-year water strategic plan titled "Water Sanitation and Hygiene (WASH) Sector Strategic Plan (2010-2016)." For the urban water sector, a target water use of 90 L/c/d (household + other uses) was established for 2016, and 14 specific programs were created to reach the target.

In August 2005, the Sudanese government requested the Japanese government to implement a grant aid project titled "the Project for Improvement of Water Supply Facilities in Kassala City" (hereinafter referred to as "the Project") in order to develop new water resources, expand water supply facilities, and install new water supply pipes in East District of Kassala City. Construction of new water supply facilities and rehabilitation of existing facilities, requested by the Sudanese government, are included in the 14 programs mentioned above.

The Project sets the target year at the final year of a 7-year water strategic plan of Kassala State and aims to achieve the water use target of 90 L/c/d and 100% household water service coverage in East District, thereby contributing to the achievement of the overall plan and MDGs that aim to provide equal and reliable water services for the residents.

In response to the above request, the Preparatory Survey (Part-1) was conducted in August 2009 to collect information about the target area's water source development potential, socio-economic conditions, status of water supply, the capacity of Kassala State SWC(State Water Corporation) that administers waterworks projects, availability/procurement of equipment and supplies, security situation, and so forth in order to evaluate the contents of the request to determine the components of the proposed assistance project. As a result of the survey, it was confirmed that the necessity of the requested items was high for improving the extremely poor water supply conditions of the area resulting from insufficient water supply, and agreement was reached between JICA and the Sudanese government on the basic policy that the Project would aim to develop new water sources and expand water supply facilities. At the same time, it was also confirmed that the existing water service piping network and water supply facilities were so severely deteriorated that they needed to be surveyed as part of the Preparatory Survey (Part-2), in which groundwater survey, including test pitting, should also be carried out to assess the area's groundwater development potential, which would form the foundation of the Project.

Based on the findings of the Preparatory Survey (Part-1), the Preparatory Survey (Part-2) (hereinafter referred to as "the Survey") began in March 2010. The Survey reexamined the contents of the request to determine the appropriate components of the Project, drafted an outline design, and estimated the rough project cost. During the course of the Survey, it was led to the conclusion that the existing water treatment plant (WTP) and reservoir needed urgent rehabilitation, as they were severely deteriorated and at constant risk of bursting on account that the existing reservoir of the WTP in East District burst on November 2009. Thus, it was decided to survey these facilities including the WTP located in West District, which was in a similar condition, as different components.

Based on the outline design of urgent rehabilitation project, JICA dispatched the Draft Report Explanation Team on December 2010 to explain and discuss the draft report of the outline design with PWC (Public Water Corporation) as a responsible agency, SWC of Kassala State as an implementing agency and other government agencies. After discussions the contents of a grant aid

project by the Japanese government, specified as “Rehabilitation Project”, was agreed upon between the Draft Report Explanation Team and such agencies belonging to the Sudanese government.

As for components related to expanding water supply facilities except for rehabilitating existing WTPs, based on the outline design of expansion project, JICA dispatched the Draft Report Explanation Team on May 2011 to explain and discuss the draft report of the outline design with PWC, SWC and other government agencies. After discussions the contents of a grant aid project by the Japanese government, specified as “Expansion Project”, was agreed upon between the Draft Report Explanation Team and such agencies belonging to the Sudanese government.

Specific components that were agreed upon are shown as below.

Contents of Request Verified by the Survey

Contents confirmed at the beginning of survey (M/D dated March 10, 2011)	Contents of Rehabilitation Project (M/D dated Dec 16, 2010)	Contents of Expansion Project (M/D dated May 18, 2011)
Construction of 20 new wells and well houses.	–	Construction of 11 new water wells and well houses, and rehabilitation of 10 existing wells.
Installation of conveyance piping (new wells – water treatment plant)	–	Installation of conveyance piping (new/existing wells – water treatment plant)
Construction of new water treatment plant: -Reservoir (1000m^3x2) -Distribution pump house -Distribution pump -Chlorine dosing system -Electrical panel -Auxiliary facilities -Indoor piping -Administration building	–	Construction of new water treatment plant: -Receiving well -Reservoir (2600m^3x2) -Distribution pump building -Distribution pump -Chlorine dosing system -Electrical panel -Auxiliary facilities -Indoor piping
Installation of distribution main (water treatment plant – service water piping network)	–	Installation of distribution main (water treatment plant – service water piping network)
Rehabilitation of existing Mahta WTP	Rehabilitation of existing Mahta WTP	–
Provision of piping materials to replace existing asbestos pipes.	–	Not to be provided.
Provision of equipment for maintenance.	–	Not to be provided.
Technical transfer for constructing GIS database for existing service water piping network.	–	To be implemented during Preparatory Survey.
Technical transfer for the maintenance of water supply facilities.	–	Technical transfer for the operation and maintenance of new water treatment plant (soft component).
–	Rehabilitation of existing Garb WTP in West District	–

3. Summary of the Survey Results and Contents of the Project

(1) Preparatory Survey Process

The Preparatory Survey (Part-2) of the Project, which is premised on developing new water sources, was carried out in two phases. The 1st Survey was conducted on March 2 – 31, May 14 – July 12, and August 2 – September 30, 2009. Based on such basic surveys as groundwater development potential survey, test pitting, social conditions survey, existing water supply facilities survey, and building of GIS database of existing water distribution pipe networks, we drafted a basic waterworks plan for the entire target area of the Project. Based on the basic waterworks plan, multiple discussions were held with the Sudanese side to finalize and agree upon the contents of the Project.

During the course of the survey, it was also agreed with the Sudanese side that the severely deteriorated reservoirs of the existing water treatment plants (WTPs) were on the verge of breakage and needed urgent repair work, which should be implemented as a separate component of the Project. Based on this agreement, a preparatory survey was conducted for rehabilitating these existing WTPs. After the analysis of the outline design and rough cost estimation in Japan, JICA dispatched the Draft Report Explanation Team to Sudan in December 2010 to give briefing on the outline design of "Rehabilitation Project" to PWC and SWC. As a result of discussions based on the outline design report with PWC and SWC, the contents of this portion of the Project were basically agreed upon.

With regard to the components for expanding the waterworks facilities, the 2nd Survey was conducted from November 18 to December 17, 2010 to determine the appropriate project contents, draft an outline design, and estimate rough project cost based on the results of field surveys and the analysis thereof in Japan. In May 2011, JICA dispatched the Draft Report Explanation Team to Sudan to explain the outline design of "Expansion Project". As a result of briefing to and discussions with PWC and SWC based on the outline design report, the contents of this portion of the Project were basically agreed upon by the Sudanese government.

This Final Report was prepared based on the above studies, analysis, and discussions.

(2) Overall Plan and Project Purpose

The government of Kassala State has formulated a 7-year water strategic plan titled "Water, Sanitation and Hygiene (WASH) Sector, Strategic Plan (2010-2016)," the number one objective of which for the water sector is to supply safe and stable water supply to urban residents.

The overall goal of the Project is to improve water supply services in Kassala City and enhance the living environment for the residents of the target area. If implemented, the Project will be able to contribute to the achievement of Kassala State's 7-year water strategic plan. By developing new water sources and upgrading the water distribution facilities to increase water supply, the Project aims to achieve the "90 liters per capita per day" target of the overall plan for the residents of East District. In addition, emergency repairs will be performed on the deteriorated reservoirs of the existing WTPs in East and West Districts in order to give a sense of security about water services to 90,000 residents, who are exposed to the risk of water outage in case of reservoir breakage, by actualizing safe and reliable water services.

(3) Basic Policy

The basic policy of the Grant Aid Project is to benefit the residents of the target area by upgrading the water service facilities for the purpose of supplying safe and uninterrupted water to the residents

in order to contribute to the Sudanese waterworks project that aims to improve the country's water supply situations.

(4) Overall Plan

1) Water supply area	:	existing water supply areas in Kassala City (East and West Districts)
2) Target year	:	2016
3) Water service population	:	204,739 (East District), 28,888 (West District)
4) Water use per capita per day	:	90 L/c/d

(5) Facility Plan

The facility outline of the Project is shown in the following tables.

1) Rehabilitation Project

Facility Outline of Mahta WTP (East District)

Facility Specification	Quantity
1. Receiving well Capacity: 48.0m^3/2 wells Dimension: 2.0m (width) x 3.0m (length) x 4.0m (depth)	2 wells
2. Reservoir (reinforced concrete) Capacity: 3,686.0m^3/2 reservoirs Dimension: 16.0m (width) x 32.0m (length) x 3.6m (effective water depth)	2 reservoirs
3. Distribution pump building Dimension: 9.5m (width) x 30.0m (length) No. of stories: 1 story each below and above ground	1 tower
4. Piping in the premise φ100-φ250: 325m φ300-φ500: 76m	401m
5. Distribution pump equipment Model type: Single suction horizontal centrifugal pump Capacity: 2.88m^3/min Lifting height: 50.0m Output: 45.0kw	5 units (of which 1 is spare)
6. Chlorine dosing equipment Dose rate: 0.5～2.0mg/litre	1 set
7. Electric facility & instrumentation Switch panel: 1 Incoming panel: 1 Distribution pump panel: 5 Instrumentation panel: 1	8 panels
8. Emergency power generator Model type: diesel engine Capacity: 500kVA	1 unit

Facility Outline of Garb WTP (West District:)

Facility specification	Quantity
1. Receiving well Capacity: 26.3m^3/2 wells Dimension: 1.5m (width) x 2.5m (length) x 3.5m (depth)	2 wells
2. Reservoir (made of concrete) Capacity: 1,728.0m^3/2 reservoirs Dimension: 12.0m (width) x 24.0m (length) x 3.0m (effective water depth)	2 reservoirs
4. Piping in the premise φ100-φ250：　381m φ300-φ350：　160m	541m

2) Expansion Project

Facility plan (East District)

Item	Facility	Description	Quantity	Remarks
1.Water intake facility	Existing wells	7,537 m^3/day	10	
	New wells (converted from test wells)	Casing diameter $10^3/_4$inch, 720 m^3/day (average)	4	Drilled during BD
	New wells	Same as above	7	Drilled during DD
	Existing well facilities	Renewal of submersible motor pump, Electric equipment (incoming panel, control panel), well shed	10	
	New well facilities	Submersible motor pump (3.7-5.5 kW), Electric equipment (incoming panel, control panel), Diesel generator (12.5-17kVA), well shed	10	
2. Conveyance pipes facility		DN100-DN300,uPVC pipes	12.11km	
3.Khatmia WTP 15,400 m^3/day	Receiving well	Reinforced concrete construction Dimensions: Width 2.0 m, length 3.0 m, effective water depth 4.0 m Capacity: 48.0 m^3/ 2 basins Retention time: 4.5 minutes	2	With shed
	Reservoir	Reinforced concrete construction Dimensions: Width 24.0 m, length 32.0 m, effective water depth 3.4 m Capacity: 5,200 m^3/ 2 basins Retention time: 8.1 hours	2	
	Distribution pump building	Reinforced concrete construction Dimensions: Width 9.5 m, length: 30.0 m Basement 1; above ground 1 story	1	
	Plant connection pipes	conveyance pipes, treated water pipes, discharge pipes, service pipes	1 set	
	Maintenance within premises	Roads in premises, drainage in premises	1 set	
	Distribution pump equipment	Type: Single suction horizontal centrifugal pump Capacity: 4.01 m^3/minute Head: 55.0 m Motor output: 75 kW	5 pumps (incl. one stand-by)	
	Chlorine dosing equipment	Disinfectant: Liquid chlorine Maximum dosing rate: 2 mg/L Maximum feed rate：1.28 kg/hour Vacuum type chlorinator: 2 units Dosing pump: 2	1 set	
	Electric Facilities & Instrumentation	Power specifications: 3-phase, 4-wire, 415 V, 50 Hz Switch panel: 1 Incoming panel: 1 Distribution pump control panel: 5 Instrumentation panel: 11 Water level gauge, flow meter	1 set	
	Emergency generator equipment	Type: Diesel engine Output: 500kVA	1 set	
4. Distribution main		DN500, DN600 mm, ductile cast iron pipe	6.3 km	

4. Implementation Schedule and Project Cost

(1) Rehabilitation Project

It is estimated to take about 7 months for the detail design and tender processes and about 15 months for the construction work. The project cost to be borne by the Sudanese side is estimated to be SDG 487.2 thousand (equivalent to JPY 19.5 million).

(2) Expansion Project

It is estimated to take about 9 months for detail design, about 3.5 months for the tender process, and about 18 months for the construction work. The project cost to be borne by the Sudanese side is estimated to be SDG 777.3 thousand (equivalent to JPY 29 million).

5. Project Evaluation

(1) Rehabilitation Project

1) Relevance

a. Beneficiaries

People who are possibly affected by the accident of the reservoir burst are regarded as beneficiaries.

East District (population served by Mahta WTP)	West District (population served by Garb WTP)
61,388 persons	28,888 persons

b. Project Objectives and Basic Human Needs (BHN)

The Project aims to improve the living environment of the residents by ensuring uninterrupted supply of safe water disinfected with chlorine and, therefore, contributes to the satisfaction of basic human needs of the residents of the target area.

c. Operation and Maintenance Technique

The equipment configuration of the WTPs to be rehabilitated or newly constructed will be the same as that of the existing WTPs, which are basically operated manually on site. In regards to the operation of new WTPs, the two technical cooperation projects, “Capacity Development Project for Water Sector” and “Capacity Development Project for Provision of Services for Basic Human Needs in Kassala”, are being implemented concurrently with the Project, which includes soft components related to facility operation, in order to develop the recipient’s capacity for water facility operation/maintenance and organizational management before the completion of these facilities. Therefore, it is possible for the current personnel to properly operate and maintain the facilities provided by the Project.

d. Mid- to Long-Term Plans and Goals

In its 7-year plan (2011 – 2016) for the water sector, the Kassala State government lists the rehabilitation of the existing water supply facilities and expansion of new facilities in the East and West Districts of Kassala City among the specific targets of its own projects. Therefore, the Project is in alignment with the policy of the Kassala State government.

e. Profitability

Profitability of a waterworks project is greatly dependent on the appropriate setting of water rates and collection method, which are being investigated and analyzed as part of the technical cooperation projects currently in progress. In this survey, we estimated the increase in the maintenance cost and the increase in water charges after the completion of the facilities, and confirmed that the latter would be more than enough to cover the former.

f. Environmental and Social Consideration

As a result of the environmental scoping conducted as part of the Survey, it was determined that the implementation of the Project would not cause serious environmental or social impact (see Appendix-6). Mitigation measures against possible negative environmental impact during construction and after the startup of the facilities have already been clearly established, and SWC is in the process of obtaining an environmental permit from Kassala State for the implementation of the Project on condition that such mitigation measures will be taken (the environmental permit is scheduled to be granted at the end of June 2011).

g. Feasibility of Japan's Grant Aid

No particular difficulties are expected in implementing the Grant Aid Project unless the security situations in Sudan dramatically change for the worse.

2) Effectiveness

a. Quantitative Evaluation

< Kassala East District >

As the reservoir of the Mahta WTP will be rehabilitated and the water from the existing wells will be able to be sent during 24 hours, the capacity of the Mahta WTP will increase from 9,200m^3/day to 11,050 m^3/day.

b. Qualitative Evaluation

< Kassala East District >

① Emergency repair on the existing Mahta WTP will remove the risk of breakage of the reservoir, giving a better sense of security about water services to about 61,388 residents, who are assumed to fall victims if breakage occurs.

② SWC will be able to measure flow rates at the receiving wells and use the data for managing water sources and controlling water distribution. This will set up an environment for SWC to operate the WTP in an efficient manner.

③ Construction of receiving wells at Garb WTP will enable chlorine dosing to ensure disinfection of water.

< Kassala West District >

① Emergency repair on the existing Garb WTP will remove the risk of breakage of the reservoir, giving a better sense of security about water services to about 28,888 residents, who are assumed to fall victims if breakage occurs.

② Construction of receiving wells at Garb WTP will enable chlorine dosing to ensure disinfection

of water.

③ SWC will be able to measure flow rates at the receiving wells and use the data for managing water sources and controlling water distribution. This will set up an environment for SWC to operate the WTP in an efficient manner.

(2) Expansion Project

1) Relevance

a. Beneficiaries and Population

Of about 170,000 people (2009 estimation) living in East District, about 125,000 persons (73%) have access to water services through house-connected water supply pipes. However, due to lack of supply water, only about 86,000 people (50%) are receiving household water services without outage all year round. The remaining 23% or about 39,000 people have to buy water from private water carriers (donkey water vendors) during the peak months even though they are connected to water service pipes.

The Project aims to provide uninterrupted household water services to all residents throughout the year. The design population to receive water services in the target year of 2016 is estimated at 204,739 persons.

b. Project Objectives and Basic Human Needs (BHN)

The Project aims to improve the living environment of the residents by ensuring uninterrupted supply of safe water disinfected with chlorine and, therefore, contributes to the satisfaction of basic human needs of the residents of the target area.

c. Operation and Maintenance Technique

The equipment configuration of the Khatmia WTP to be newly constructed will be the same as that of the existing WTPs, which are basically operated manually on site. In regards to the operation of new WTP, technical cooperation projects, "Capacity Development Project for Water Sector" and "Capacity Development Project for Provision of Services for Basic Human Needs in Kassala", are being implemented concurrently with the Project, which includes soft components related to facility operation, in order to develop the recipient's capacity for water facility operation/maintenance and organizational management before the completion of these facilities. Therefore, it is possible for the current personnel to properly operate and maintain the facilities provided by the Project.

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2) Effectiveness

a. Quantitative Evaluation

Index	Reference (2009)	Target (2016)
Average daily production of water	21,300 m^3/day	33,300 m^3/day
Population receiving household water services	125,479 persons	204,739 persons
Percentage of population receiving household water services	73%	100%
Water use per capita per day in the target area	62 L/c/d	90 L/c/d
Percentage of chlorine dosed water	43%	80%

b. Qualitative Evaluation

① Supply shortage of water relative to demand will be resolved. Also, if the existing water pipe network is upgraded by the Sudanese side, all districts will equally receive water services, and water outage areas will be eliminated.

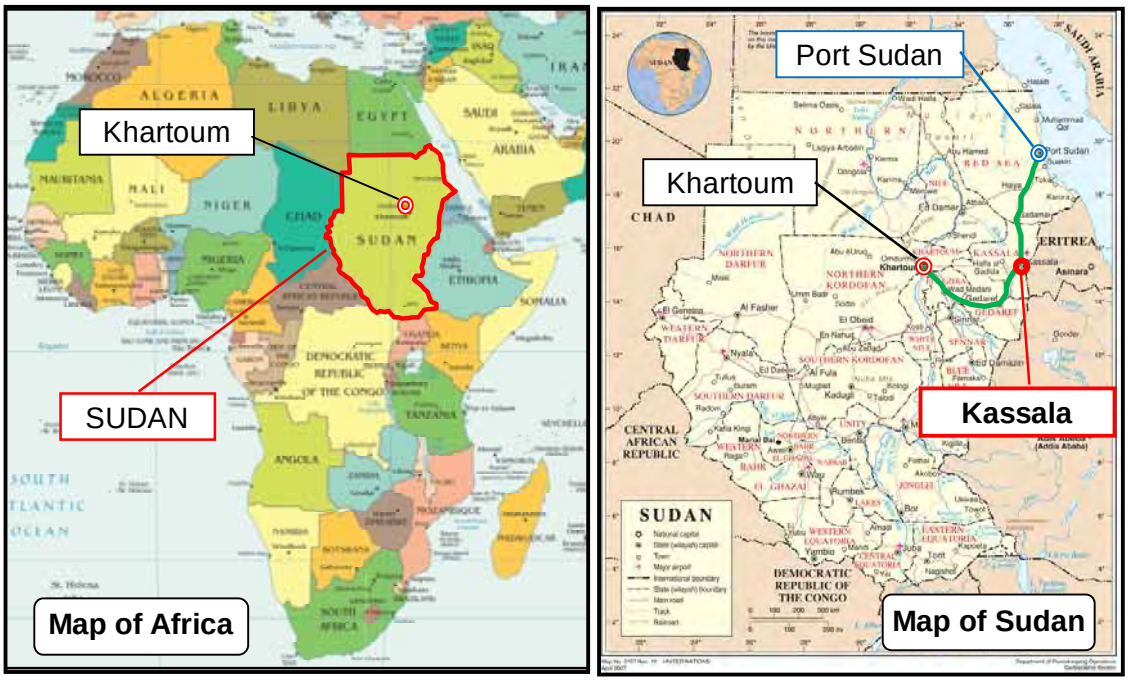
② All residents will receive household water services and no longer need to purchase expensive water from private vendors. Increased convenience in water use will improve the residents' living standards.

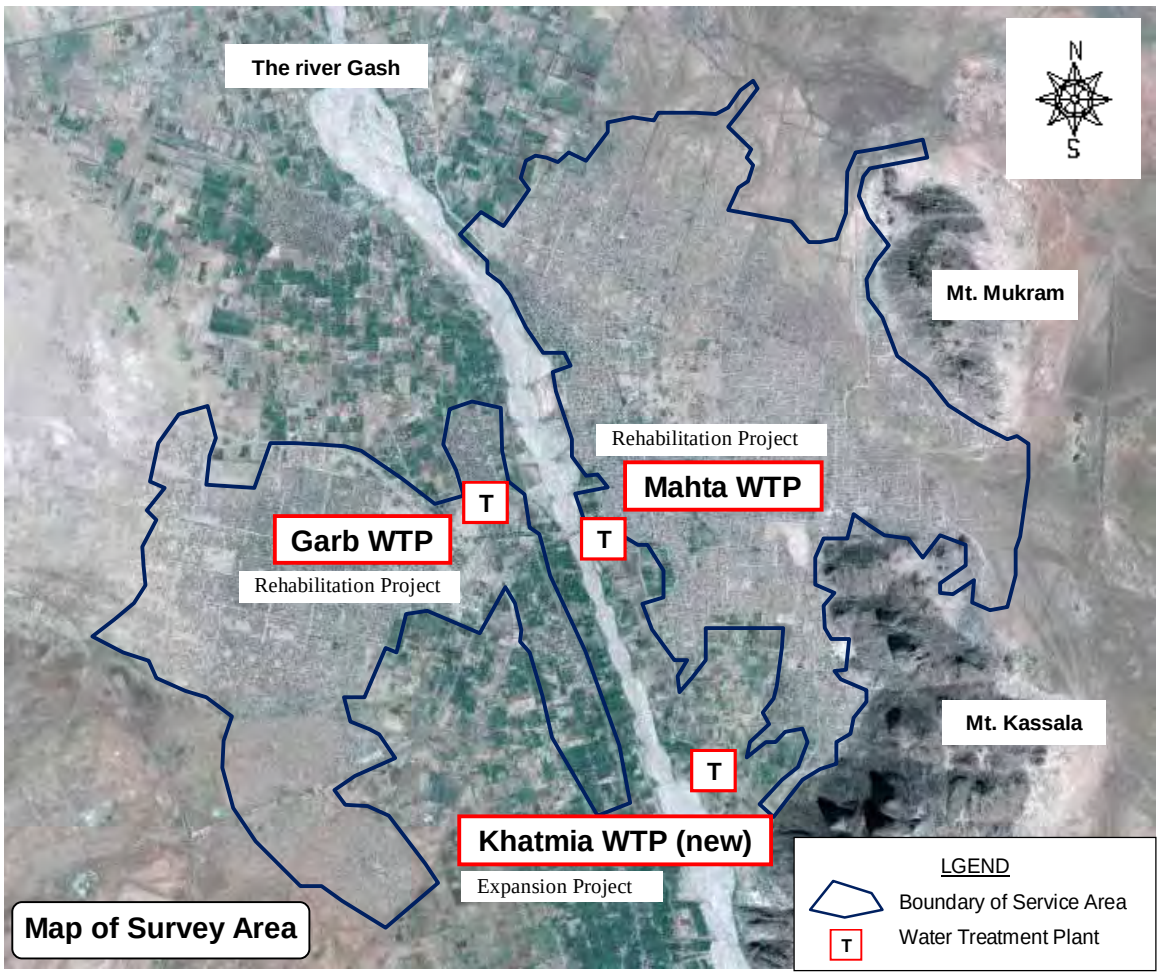
③ Increased percentage of chlorine dosed water, as well as decreased risk of contamination because of 24-hours/day continuous water supply, will put the residents at ease about the quality of municipal water and increase their sense of trust in the water supply services.

④ Increased revenue from water charges as a result of increased number of subscribers to water services will contribute to SWC's financial wellbeing and stabilize its waterworks operations.

⑤ More detailed data on water production and distribution will become available from the flow meters to be installed at the water source wells and new WTP, enabling SWC to manage water sources and control water distribution more efficiently.

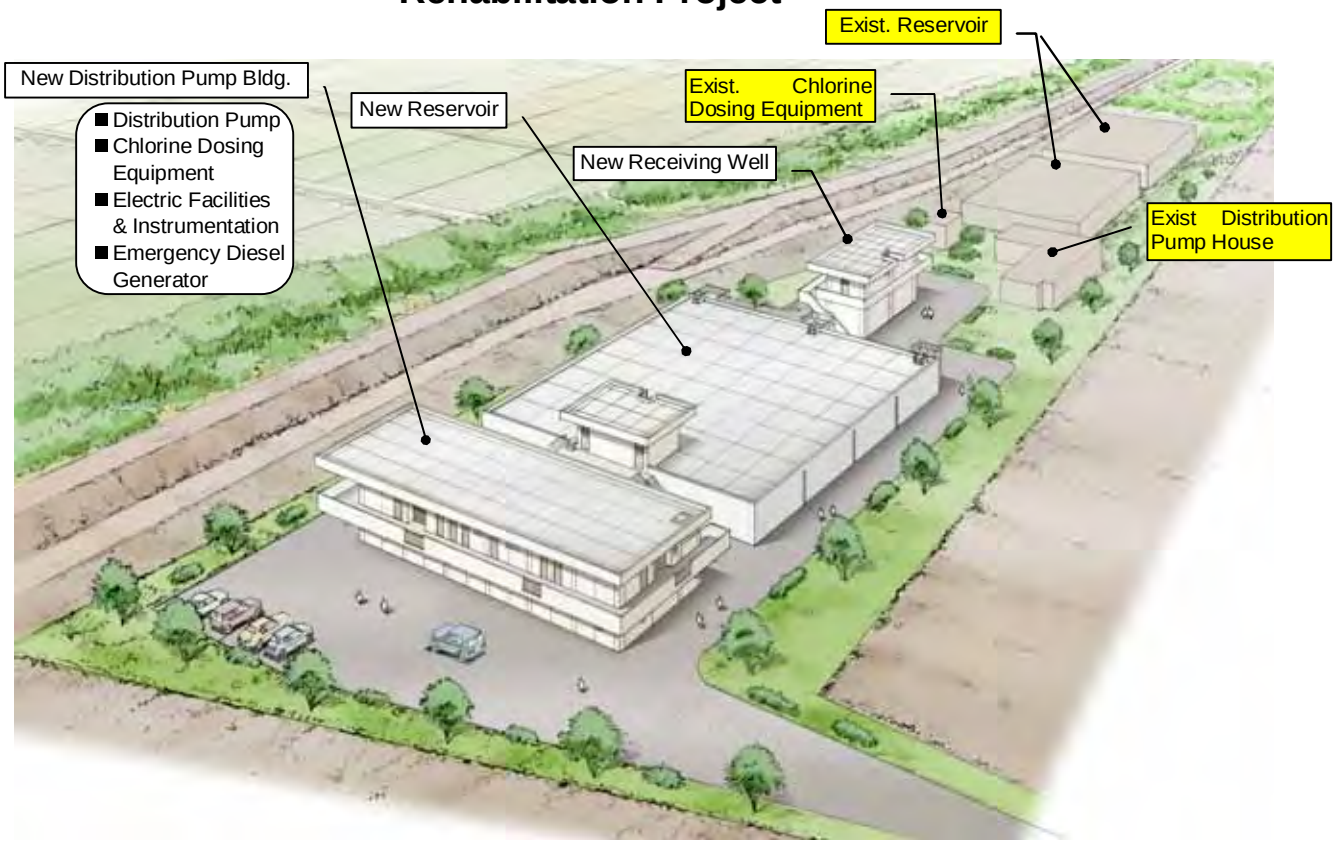
In view of the foregoing, the appropriateness of implementing the Project as a grant aid project and the effectiveness thereof are deemed high, as it will contribute to the improvement of the living environment for about 210,000 people living in Kassala City East District, as well as protecting about 29,000 residents in West District from the risk of water service stoppage caused by breakage of the existing reservoir.



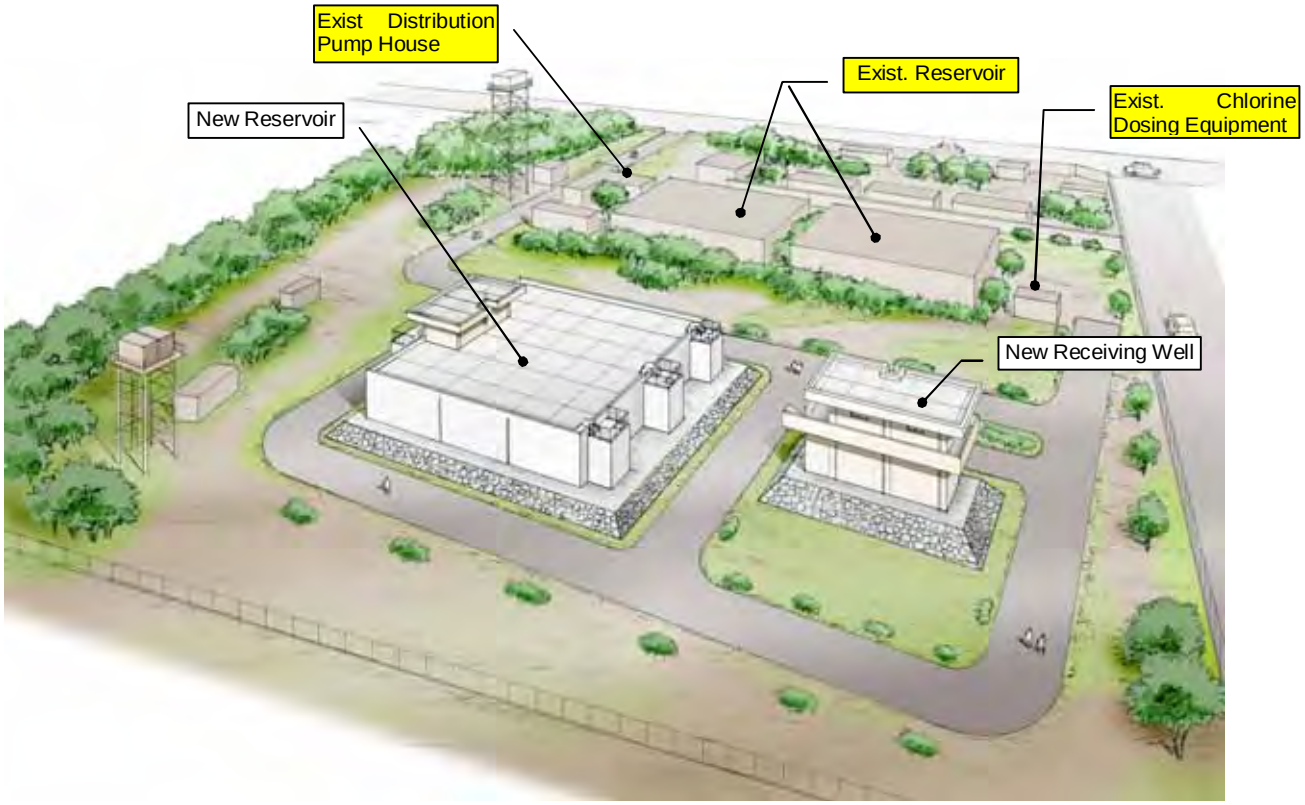


Location Map of the Project Site

Rehabilitation Project

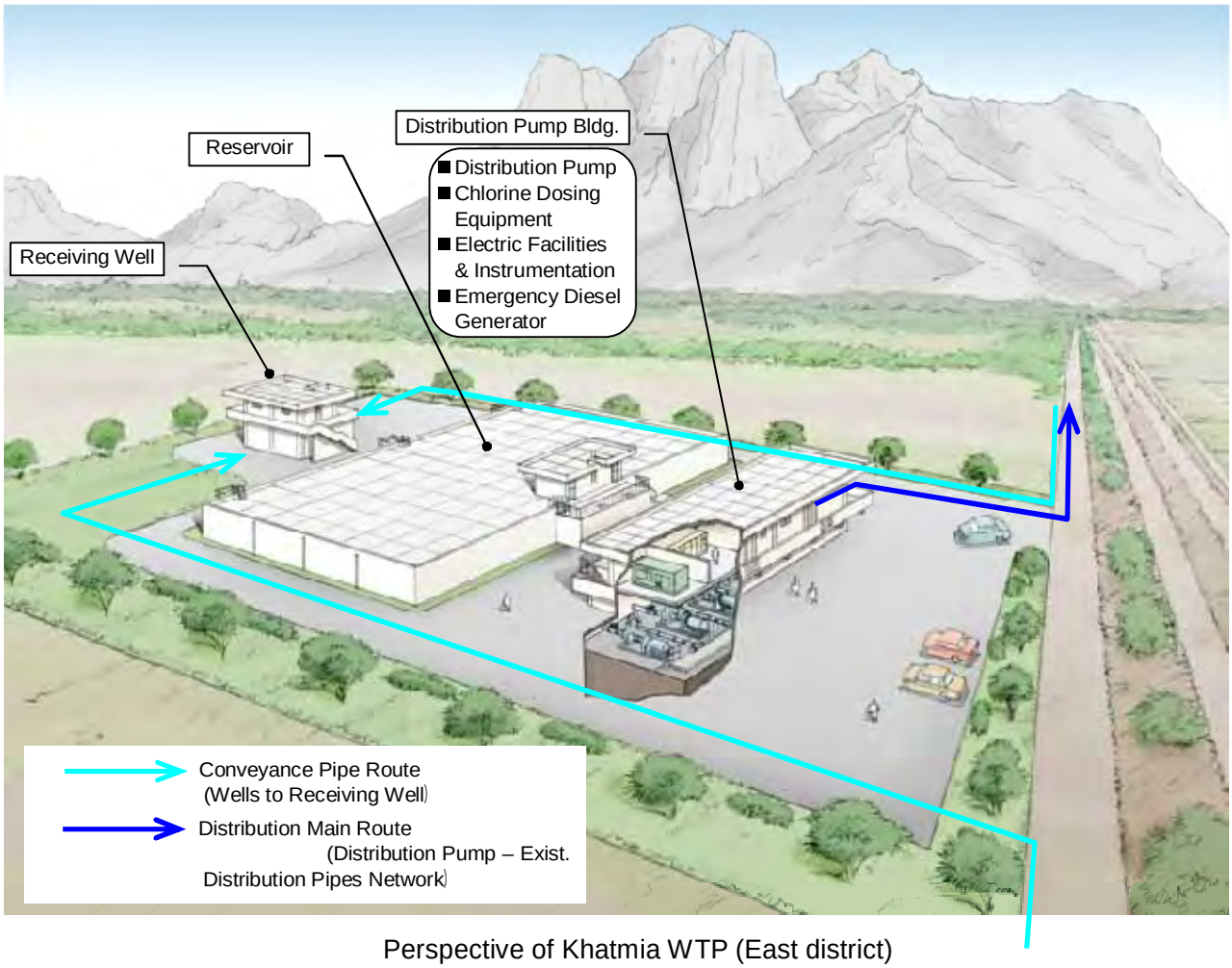


Perspective of Mahta WTP (East district)



Perspective of Garb WTP (West district)

Expansion Project



Perspective of Khatmia WTP (East district)

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ABBREVIATIONS

ACP	: Asbestos Cement Pipe
CBS	: Central Bureau of Statistics
CPA	: Comprehensive Peace Agreement
DN	: Diameter Nominal
EIA	: Environmental Impact Assessment
EPSA	: East Sudan Peace Agreement
ERDP	: Eastern Recovery Development Program
EU	: European Union
FRP	: Fiber Reinforced Plastics
DG	: Diesel Generator
GIS	: Geographic Information System
GL	: Ground Level
GPS	: Global Positioning System
HAC	: Humanitarian Aid Commission
IDPs	: Internally Displaced Persons
IEE	: Initial Environmental Examination
JAM	: Joint Assesment Mission
JICA	: Japan International Cooperation Agency
LCC	: Life Cycle Cost
L/c/d	: Liter per Capita per Day
MDGs	: Millenium Development Goals
Mpa	: Mega Pascal
Mm^3/year	: Million Cubic Meter per year（MCM）
MW	: Mega Watt
N-value	: Blow count
NTU	: Nephelometric Turbidity Unit
PE	: Polyethylene
PRSP	: Poverty Reduction Strategy Papers
uPVC	: Unplasticized Polyvinyl Chloride Pipe
PVC	: Polyvinyl Chloride
PWC	: Public Water Corporation
SDG	: Sudanese Pound
SP	: Steel Pipe
SSMO	: Sudanese Standard and Metrology Organization
SWC	: State Water Corporation
TCU	: True Color Unit
TOC	: Total Organic Carbon
UNDP	: United Nations Development Program
UNESCO	: United Nations Educational, Scientific and Cultural Organization
WASH program	: Water and Sanitation & Hygiene program
WES UNIT	: Water, Environment and Sanitation
WTP	: Water Treatment Plant

CHAPTER 1 BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

1-1 Background of the Project

In August 2005, the Sudanese government requested the Japanese government to implement a grant aid project titled "the Project for Improvement of Water Supply Facilities in Kassala City" (hereinafter referred to as "the Project") in order to develop new water resources, expand water supply facilities, and install new water supply pipes in East District of Kassala City.

In response to the above request, the Preparatory Survey (Part-1) was conducted in August 2009 to collect information about the target area's water source development potential, socio-economic conditions, status of water supply, the capacity of Kassala state SWC(State Water Corporation) that administers waterworks projects, availability/procurement of equipment and supplies, security situation, and so forth in order to evaluate the contents of the request to determine the components of the proposed assistance project. As a result of the survey, it was confirmed that the necessity of the requested items was high for improving the extremely poor water supply conditions of the area resulting from insufficient water supply, and agreement was reached between JICA and the Sudanese government on the basic policy that the Project would aim to develop new water sources and expand water supply facilities. At the same time, it was also confirmed that the existing water service piping network and water supply facilities were so severely deteriorated that they needed to be surveyed as part of the Preparatory Survey (Part-2), in which groundwater survey, including test pitting, should also be carried out to assess the area's groundwater development potential, which would form the foundation of the Project.

Based on the findings of the Preparatory Survey (Part-1), the Preparatory Survey (Part-2) (hereinafter referred to as "the Survey") began in March 2010. The Survey reexamined the contents of the request to determine the appropriate components of the project, drafted an outline design, and estimated the rough project cost. During the course of the Survey, it was led to the conclusion that the existing water treatment plant (WTP) and reservoir needed urgent rehabilitation, as they were severely deteriorated and at constant risk of bursting on account that the existing reservoir of the WTP in East District burst on November 2009 Thus, it was decided to survey these facilities including the WTP located in West District, which was in a similar condition, as different components.

Based on the outline design of urgent rehabilitation project, JICA dispatched the Draft Report Explanation Team on December 2010 to explain and discuss the draft report of the outline design with PWC (Public Water Corporation) as a responsible agency, SWC of Kassala State as an implementing agency and other government agencies. After discussions the contents of a grant aid project by the Japanese government, specified as "Rehabilitation Project", was agreed upon between the Draft Report Explanation Team and such agencies belonging to the Sudanese government.

As for components related to expanding water supply facilities except for rehabilitating existing WTPs, based on the outline design of expansion project, JICA dispatched the Draft Report Explanation Team on May 2011 to explain and discuss the draft report of the outline design with PWC, SWC and other government agencies. After discussions the contents of a grant aid project by the Japanese government, specified as "Expansion Project", was agreed upon between the Draft Report Explanation Team and such agencies belonging to the Sudanese government.

Specific components that were agreed upon are shown in Table 1-1.

Table 1-1 Contents of Request Verified by the Survey

Contents confirmed at the beginning of survey (M/D dated March 10, 2011)	Contents of Rehabilitation Project (M/D dated Dec 16, 2010)	Contents of Expansion Project (M/D dated May 18, 2011)
Construction of 20 new wells and well houses.	–	Construction of 11 new water wells and well houses, and rehabilitation of 10 existing wells.
Installation of conveyance piping (new wells – water treatment plant)	–	Installation of conveyance piping (new/existing wells – water treatment plant)
Construction of new water treatment plant: -Reservoir (1000m^3x2) -Distribution pump house -Distribution pump -Chlorine dosing system -Electrical panel -Auxiliary facilities -Indoor piping -Administration building	–	Construction of new water treatment plant: -Receiving well -Reservoir (2600m^3x2) -Distribution pump building -Distribution pump -Chlorine dosing system -Electrical panel -Auxiliary facilities -Indoor piping
Installation of distribution main (water treatment plant – service water piping network)	–	Installation of distribution main (water treatment plant – service water piping network)
Rehabilitation of existing Mahta WTP	Rehabilitation of existing Mahta WTP	–
Provision of piping materials to replace existing asbestos pipes.	–	Not to be provided.
Provision of equipment for maintenance.	–	Not to be provided.
Technical transfer for constructing GIS database for existing service water piping network.	–	To be implemented during Preparatory Survey.
Technical transfer for the maintenance of water supply facilities.	–	Technical transfer for the operation and maintenance of new water treatment plant (soft component).
–	Rehabilitation of existing Garb WTP in West District	–

1-2 Natural Condition (Groundwater Development Potential)

The survey results of the groundwater development potential are shown in the Appendix-7.

1-3 Environmental and Social Considerations

The details are shown in the Appendix 10.

CHAPTER 2 CONTENTS OF THE PROJECTS

Chapter 2 Contents of the Projects

2-1 Basic Concept of the Projects

2-1-1 Overall Goal and Projects Objective

Kassala State government has formulated a 7-year water strategic plan titled ”Water, Sanitation and Hygiene (WASH) Sector, Strategic Plan (2010-2016),” the number one objective of which for the water sector is to supply safe water to urban residents on a stable basis.

The overall goal of the Projects is to improve water supply services in Kassala City and enhance the living environment of the residents of the target area. If implemented, the Projects will be able to contribute to the achievement of Kassala City’s 7-year water strategic plan. By developing new water sources and upgrading the water distribution facilities to increase water supply, the Projects aim to achieve the “90 liters per capita per day” target of the overall plan for the residents of East District. In addition, it will perform emergency repairs on the deteriorated existing WTPs and reservoirs in the East and West Districts in order to relieve 90,000 residents from the fear of accidental breakage and resulting water outage, as well as to give them a sense of security about water supply, by actualizing safe and reliable water services.

2-1-2 Outline of the Projects

The Projects plan to rehabilitate and construct waterworks facilities in order to achieve the above-mentioned overall goal. As a result of the Projects, the existing WTP facilities will be rehabilitated, and the East District will have increased water production and upgraded waterworks facilities. More specifically, the Projects will rehabilitate the existing WTP, construct new well facilities and WTP plant, and install conveyance pipes and distribution main in the East District, and rehabilitate the existing WTP in the West District.

The Projects will be carried out through the implementation of the rehabilitation and expansion projects,

Fig. 2-1 and Table 2-1 show the Projects outline.

Outline of the Projects

Target District	Rehabilitation Project	Expansion Project
Kassala East District	- Rehabilitation of Mahta WTP	- Development of new water resource wells - Rehabilitation of existing wells - Construction of conveyance pipes - Construction of new Khatmia WTP - Construction of distribution mains - Technical transfer (Soft Component)
Kassala West District	- Rehabilitation of Garb WTP	–

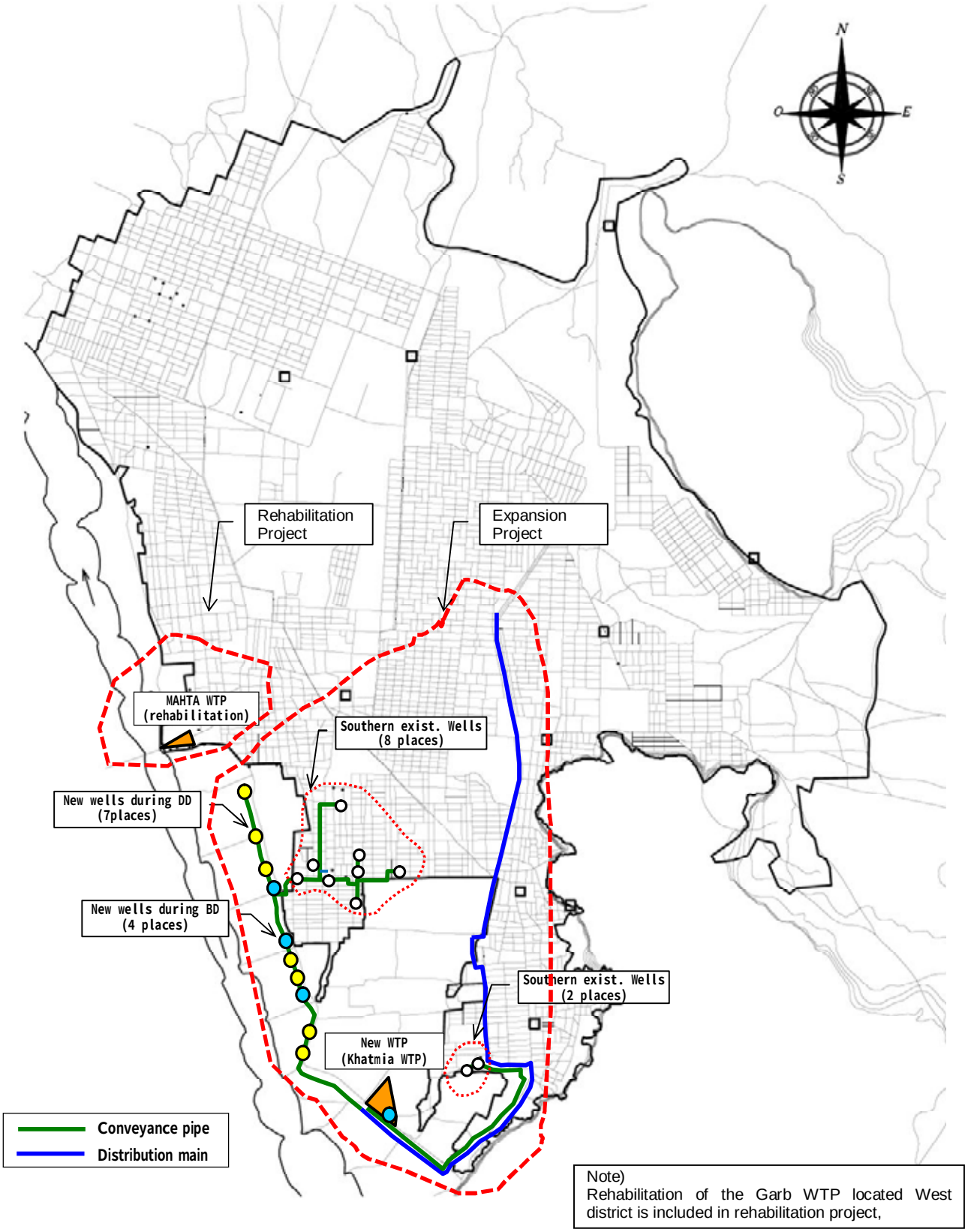


Fig. 2-1 Outline of the Projects (East District)

Table 2-1 Overview of the Projects

Summary of project	Indices	Means of acquiring data on indices	External conditions
Top targets ✓ Quality of water supply services enhanced so that living environment of inhabitants of the project area is improved.	✓ Satisfaction level of inhabitants ✓ Tariff non-payment rate	✓ Customer satisfaction level studies ✓ SWC sales report	✓ Abrupt changes do not occur in the economic and social conditions.
Project targets ✓ Safe and adequate supply of water is continuously supplied to the inhabitants of the project area.	✓ Residual chlorine concentration ✓ Water supply time ✓ Water supply amount ✓ Water supply pressure	✓ Results of water quality studies ✓ Operation records of WTP	✓ SWC to continue management of the WTP
Outcomes Ⅰ. Rehabilitation of existing waterworks facilities ✓ Existing WTP in East District is rehabilitated. ✓ Existing WTP in West District is rehabilitated. Ⅱ. Expansion of waterworks facilities (East District) ✓ New wells will be constructed. ✓ Wells in the southern part will be rehabilitated. ✓ Conveyance pipes will be laid. ✓ New WTPs will be constructed. ✓ Distribution water mains will be laid.	✓ Pump discharge from new well facilities ✓ Pump discharge from existing well facilities ✓ Treatment capacity of WTP	✓ Pumping test records ✓ Work records	✓ Site for construction of new well facilities is properly acquired
Activities Ⅰ. Rehabilitation of existing waterworks facilities ✓ Construction of new WTP inside the premises of existing WTP in East District. ✓ Construction of new WTP inside the premises of existing WTP in West District. ✓ Switch over from old to new facilities. Ⅱ. Expansion of waterworks facilities (East District) ✓ Development of new water sources ✓ Construction of new well facilities ✓ Pumping tests of existing wells ✓ Rehabilitation of existing well facilities ✓ Conveyance pipes (new wells to WTP) ✓ Conveyance pipes (existing wells to WTP) ✓ Construction of new WTP ✓ Laying of distribution mains ✓ Connection of distribution mains and existing distribution pipelines ✓ Soft components	Investment Japanese side ✓ Funds for construction ✓ Design and construction engineers ✓ Lecturer on soft components Sudan side ✓ Construction expenses and management expenses ✓ Design and construction engineers, drivers		Pre-conditions ✓ Security situation does not worsen. ✓ Budget appropriation is made by the Sudanese side. ✓ Undertakings of the Sudanese side are carried out without omission

The effects anticipated by implementing the present project are as given below.

(1) Rehabilitation Project

1) Quantitative Evaluation

< Kassala East District >

As the reservoir of the Mahta WTP will be rehabilitated and the water from the existing wells will be able to be sent during 24 hours, the capacity of the Mahta WTP will increase from 9,200m^3/day to 11,050 m^3/day.

2) Qualitative Evaluation

< Kassala East District >

① Emergency repair on the existing Mahta WTP will remove the risk of breakage of the reservoir, giving a better sense of security about water services to about 61,388 residents, who are assumed to fall victims if breakage occurs.

② SWC will be able to measure flow rates at the receiving wells and use the data for managing water sources and controlling water distribution. This will set up an environment for SWC to operate the WTP in an efficient manner.

③ Construction of receiving wells at Garb WTP will enable chlorine dosing to ensure disinfection of water.

< Kassala West District >

① Emergency repair on the existing Garb WTP will remove the risk of breakage of the reservoir, giving a better sense of security about water services to about 28,888 residents, who are assumed to fall victims if breakage occurs.

② Construction of receiving wells at Garb WTP will enable chlorine dosing to ensure disinfection of water.

③ SWC will be able to measure flow rates at the receiving wells and use the data for managing water sources and controlling water distribution. This will set up an environment for SWC to operate the WTP in an efficient manner.

(2) Expansion Project

1) Quantitative Evaluation

Index	Base (2009)	Target (2016)
Average daily production of water	21,300m^3/day	33,300m^3/day
Population receiving household water services	125,479 persons	204,739 persons
Percentage of population receiving household water services	73%	100%
Water use per capita per day in the target area	62 L/c/d	90 L/c/d
Percentage of chlorine dosed water	43%	80%

2) Qualitative Evaluation

① Supply shortage of water relative to demand will be resolved. Also, if the existing water pipe network is upgraded by the Sudanese side, all districts will equally receive water services, and water outage areas will be eliminated.

② All residents will receive household water services and no longer need to purchase expensive water from private vendors. Increased convenience in water use will improve the residents' living standards.

③ Increased percentage of chlorine dosed water, as well as decreased risk of contamination because of 24-hours/day continuous water supply, will put the residents at ease about the quality of municipal water and increase their sense of trust in the water supply services.

④ Increased revenue from water charges as a result of increased number of subscribers to water services will contribute to SWC's financial wellbeing and stabilize its waterworks operations.

⑤ More detailed data on water production and distribution will become available from the flowmeters to be installed at the water source wells and new WTP, enabling SWC to manage water sources and control water distribution more efficiently.

In view of the foregoing, the appropriateness of implementing the Project as a grant aid project and the effectiveness thereof are deemed high, as it will contribute to the improvement of the living environment for about 210,000 people living in Kassala City East District, as well as protecting about 29,000 residents in West District from the risk of water service stoppage caused by breakage of the existing reservoir.

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Rehabilitation Project

(1) Natural Environmental Conditions

①The project site has a desert arid climate. The temperature is the highest in April and May with the monthly average high exceeding 40℃. The area is also hit by tornadoes and sandstorms. The annual average rainfall is low at 230mm and it is concentrated in July and August when rain falls heavily with thunders. Under such a harsh weather condition, equipment is housed indoors in principle in order to protect it from high temperatures, sandstorms and rainfall. In addition, necessary countermeasures should be taken to protect electric equipment and instrumentation from thunderbolts or lightning surges in principle.

②The Gash River flooded in 2003 and Mahta WTP was also flooded to be covered with soil and the equipment was damaged seriously. It required much time and work for its recovery. Because the construction site of the Project also has a possibility to be flooded, the equipment is planned to be installed at a higher place than the height of the flood level of GL+1m.

③The yearly groundwater level fluctuation is observed up to 10m, recharged and affected by Gash River. For facilities design such as a submergible motor pumps, it is required for them to be designed considering such groundwater fluctuation and work adequately throughout year.

(2) Socio-economic Conditions

①Since the rehabilitation work of the existing WTPs will take place inside their respective premises, it will have no direct impact on the surrounding environment. Noise, etc. associated with the construction work will not likely have a significant impact on the surrounding buildings, as they are located away from the construction sites.

②The rated voltage of electricity network in the project site is 430V, which is not global standard and applied in very few countries. From this reason, electrical equipment for 430V is rarely produced and distributed in the world. Although almost all electrical equipment is for 415V in the project site, no problems occur in using these equipment. Because the difference between both voltages of 15V is within allowable voltage drop of 10% (=43V). The Project sets the design voltage at 415V in consideration of actual situation of the project site.

(3) Construction/Procurement Conditions

①The structure of existing buildings is reinforced concrete for columns and beams and bricks for the wall. Although the new buildings are planned to be built in accordance with the existing structure, such facility as the reservoir that requires strength and water tightness will have reinforced concrete structure. Regular construction machinery is

procured locally as no special construction machinery is needed because no special construction method is used.

②Because the existing WTPs were built with Japanese Grant Aid, many equipments are made in Japan. In the project, however, equipments supplied by local agencies are planned to be procured in order to facilitate easier procurement of consumables and replacements.

(4) Utilization of Local Contractors

①There are quite a number of construction companies in Sudan and they are experienced in and familiar with construction in such harsh weather conditions as severe heat, sand storms and torrential rains. Thus, local construction companies are to be utilized for the construction of WTPs in order to ensure smooth implementation of the project.

(5) Capacity of Executing Agency for Operation and Maintenance

①SWC possesses certain technical skills and has a track record of operating and maintaining the existing WTPs in East and East Districts for over 22 years. No problem is foreseen in the operation and maintenance of the existing WTPs after rehabilitation, as they will be operated and maintained by the current personnel.

(6) Scope and Grade of Facilities and Equipment

①The facilities of existing Mahta and Garb WTPs will be designed as below.

- Installation of receiving wells for measuring flow and sampling water for quality analysis from resource wells, and dosing chlorine reliably
- Reservoirs made of reinforced concrete having longer life span than FRP made ones

②Monitoring instruments necessary for operation and maintenance will be installed in the Mahta and Garb WTPs. Measurements taken at the Mahta WTP will be displayed on the instrumentation panel in the electric room. The instrumentation will consist of the following items:

<u>Mahta WTP</u>
- Water level indicator (receiving well and reservoir)
- Flow meter and water pressure gauge (distribution pump discharge pipe)

<u>Garb WTP</u>
- Mechanical type water level indicator (receiving well)

③Based on the inundation record of the flooding of Gash River in 2003, the facilities to be rehabilitated in Mahta WTP will be designed by setting the design water level at GL + 1m.

④As for rehabilitation of Mahta WTP, the distribution pumps do not employ automatic operational method considering its O&M by SWC in future. However, the semi-automatic operational method, i.e. the distribution pump and the motor operated valve sequentially work, is used to avoid malfunction. In addition, in order to protect from no-flow operation,

the distribution pump equips with the system that automatically shutdown the distribution pump when the water level falls to the LWL(Low Water Level).

⑤Based on the assumption that each WTP will operate at about half their capacity during power outage, the emergency power generators for Mahta WTP will have capacities at 50% of their respective design power reception.

(7) Construction/Procurement Method and Implementation Period

①Because the soil bearing capacity as the facility foundation at Mahta and Garb WTP are insufficient from the geological boring survey results, such a fixation agent as cement is mixed in the soil and stirred in order to improve the foundation and strengthen the soil bearing capacity.

②As the temperature in the project site exceeds 40℃ in April and May, the inducting cracking method is applied in the construction of the reservoir for complex cracks not to grow resulting from high temperatures. Concrete curing is also considered.

2-2-1-2 Expansion Project

(1) Natural Environmental Conditions

①The project site has a desert arid climate. The temperature is the highest in April and May with the monthly average high exceeding 40℃. The area is also hit by tornadoes and sandstorms. The annual average rainfall is low at 230 millimeters and it is concentrated in July and August when rain falls heavily with thunders. Under such a harsh weather condition, equipment is housed indoors in principle in order to protect it from high temperatures, sandstorms and rainfall. In addition, necessary countermeasures should be taken to protect electric equipment and instrumentation from thunderbolts or lightning surges in principle.

②The Gash River flooded in 2003 and Mahta WTP was also flooded to be covered with soil and the equipment was damaged seriously. It required much time and work for its recovery. Because the construction site of the Project also has a possibility to be flooded, the equipment is planned to be installed at a higher place than the height of the flood level of GL+1m.

③The yearly groundwater level fluctuation is observed up to 10m, recharged and affected by Gash River. For facilities design such as a submergible motor pumps, it is required for them to be designed considering such groundwater fluctuation and work adequately throughout year.

(2) Socio-economic Conditions

①The site for the facility already acquired by SWC for the new Khatmia WTP has adequate area. Therefore, work facilities such as plants for construction materials, material storage site, site office and temporary sites can all be accommodated within the acquired site area, and a work environment that enables work to be performed efficiently will be created.

Although unpaved locations exist in a part of the access roads, paved trunk roads may be used; therefore, there are no issues of access to the construction site. On the other hand, agricultural land extends around the work site. The effects of noise and vibrations due to construction work on the inhabitants in the surroundings are minimal, and special considerations for the social environment are not necessary.

②For the construction of new well facilities and laying of major conveyance pipes, the public land within 10m long from the edge of the Gash River bank slope is planned to be used. The land use permission for the Project has been already given by the Kassala State government. In some places of the land, lots of bushes grow or no access to the sites is available. Although provision of site and ensuring access are the responsibility of the Sudanese side, these become pre-requisites for starting the construction work; therefore, detailed discussions through close contact are necessary with the Sudanese side and efforts will be made to ensure that the Sudanese side completes the work quickly.

③A major part of the distribution main from the Khatmia WTP to the existing distribution pipeline network takes routes avoiding the trunk roads, therefore the effect on road traffic is considered to be small. However, at one location the pipeline will traverse a trunk road. At this location a method will be employed to restrict to a minimum the effect on the road traffic due to work on the pipeline traversing the road.

④The electricity supply situation in the project site is extremely poor, with electricity failures occurring almost every day. From this reason, almost all existing wells equip with emergency diesel generators, and full-time operators are staffed at the well facilities in order to start and/or stop the diesel generators. The Sudanese government is now implementing the project for the improvement of the electricity facilities in cooperation with China, and the construction works of the electrical transmission line from Khartoum to east states are scheduled to be completed by the year 2011. At the same time, the project for improvement for electricity distribution network in Kassala city is under implementation and electricity situation will be getting much better after completion of the Project. From such a background, new well facilities are planned to be no-operator facilities despite of equipping with emergency diesel generators as same as existing ones. The operation and maintenance of emergency diesel generators will be carried out by the staffs of Khatmia WTP.

⑤The rated voltage of electricity network in the project site is 430V, which is not global standard and applied in very few countries, as such, electrical equipment for 430V is rarely produced and distributed in the world. Although almost all electrical equipment is for 415V in the project site, no problems occur in using these equipment. Because the difference between both voltages of 15V is within allowable voltage drop of 10% (=43V). The Project sets the design voltage at 415V in consideration of actual situation of the project site.

(3) Construction/Procurement Conditions

①The structure of existing buildings is reinforced concrete for columns and beams and bricks for the wall. Although the new buildings are planned to be built in accordance with the existing structure, such facility as the reservoir that requires strength and water tightness will have reinforced concrete structure. Regular construction machinery is procured locally as no special construction machinery is needed because no special

construction method is used.

②Because the existing WTPs were built with Japanese Grant Aid, many equipments are made in Japan. In the project, however, equipments supplied by local agencies are planned to be procured in order to facilitate easier procurement of consumables and replacements.

③uPVC pipes are essentially used in the Project based on the actual utilization status, but uPVC pipes can not be applied to distribution main pipes of 500mm, 600mm in diameter because the maximum diameter of the uPVC pipe is 300mm and less. In the Project, ductile cast iron pipes (DCIP) will be used for those over 300mm in diameter, based on the examination on pipe type selection described later, and the DCIP will be procured from vendors considering future operation and maintenance by SWC.

(4) Utilization of Local Contractors

①A Japanese consultant company is supposed to develop new source wells and conduct pumping tests on existing southern existing wells during detail design stage. There are quite a number of survey companies, drilling company, etc. in Sudan. Thus, such local companies are to be utilized for the survey and drilling works in order to ensure smooth implementation of the Project.

②There are quite a number of construction companies in Sudan and they are experienced in and familiar with construction in such harsh weather conditions as severe heat, sand storms and torrential rains. Thus, local construction companies are to be utilized for the construction of WTPs in order to ensure smooth implementation of the project.

(5) Capacity of Executing Agency for Operation and Maintenance

①SWC possesses certain technical skills and has a track record of operating and maintaining the existing WTPs in East and East Districts for over 22 years. No problem is foreseen in the operation and maintenance of the existing WTPs after rehabilitation, as they will be operated and maintained by the current personnel. As for the new Khatmia WTP, although its equipment configuration is the same as that of the existing WTPs and the personnel have the basic skills, technical transfer by the Consultant (soft component) in addition to initial operation training by the contractor will be implemented to enhance their capacities especially for the items listed below. Technical transfer will be carried out effectively by coordinating with the two technical cooperation projects by the Japanese Government that will be implemented concurrently with the Project.

- Technical transfer of adequate chlorine dosing method and water quality management
- Technical transfer of water distribution management by controlling the number of operational distribution pumps according to water demand
- Technical transfer of management of new well facilities under control of the Khatmia WTP
- Technical transfer of planned O&M approach

②The Project plans to use DCIP(Ductile Cast iron Pipe) for the distribution main. Because SWC has no experience in the use of DCIP, the contractor will transfer technical skills of

DCIP to SWC throughout the Project for SWC to be able to operate & maintain them continuously after completion of the Project.

(6) Scope and Grade of Facilities and Equipment

① The facilities of new Khatmia WTP will be designed as below.

- Installation of receiving wells for measuring flow and sampling water for quality analysis from resource wells, and dosing chlorine reliably
- Reservoirs made of reinforced concrete having longer life span than FRP made ones

②Monitoring instruments necessary for operation and maintenance will be installed in the Khatmia WTP in East District. Measurements taken at the WTP will be displayed on the instrumentation panel in the electric room. The instrumentation will consist of the following items:

- Flow meter and water pressure gauge (discharge pipe of new wells)
- Flow meter and water pressure gauge (discharge pipe of existing wells)
- Flow meter and water level indicator (receiving well)
- Water level indicator (reservoir)
- Flow meter and water pressure gauge (distribution pump discharge pipe)

③Based on the inundation record of the flooding of Gash River in 2003, the facilities to be rehabilitated or newly constructed will be designed by setting the design water level at GL + 1m. However, since the existing well facilities are located away from Gash River and still functioning after experiencing the 2003 flood, only the electric instrumentation panel to be newly installed will be set up above the design water level in consideration of possible inundation.

④The distribution pumps do not employ automatic operational method considering its O&M by SWC in future. However, the semi-automatic operational method, i.e. the distribution pump and the motor operated valve work sequentially, is used to avoid malfunction. In addition, in order to protect from no-flow operation, the distribution pump will be equipped with the system that automatically shuts down the distribution pump when the water level falls to the LWL(Low Water Level).

⑤Emergency diesel power generators will be installed in Khatmia WPT and the new well facilities to ensure continuous operation during power outage. The existing well facilities will basically use their existing diesel generators. Based on the assumption that each WTP will operate at about half their capacity during power outage, the emergency power generators for Mahta and Khatmia WTPs in East District will have capacities at 50% of their respective design power reception.

(7) Construction/Procurement Method and Implementation Period

①Because the soil bearing capacity as the facility foundation at Khatmia WTP is insufficient from the geological boring survey results, such a fixation agent as cement is mixed in the soil and stirred in order to improve the foundation and strengthen the soil bearing capacity.

②As the temperature in the project site exceeds 40℃ in April and May, the inducting

cracking method is applied in the construction of the reservoir for complex cracks not to grow resulting from high temperatures. Concrete curing is also considered.

2-2-2 Basic Plan

The Project area involves two areas of Kassala City, each of which is served by water through individual water supply system. The Project aims at improving the entire water supply system in the east area, while rehabilitating only existing Garb WTP in the west district. Therefore, the basic plan will be formulated in the east and west districts respectively.

2-2-2-1 East District

(1) Overall Plan

The overall plan is to expand the existing water supply system through the urgent repair on the existing Mahta WTP, construction of new well facilities, rehabilitation of existing well facilities in the south, installation of conveyance pipes, construction of new Khatmia WTP, and construction of the distribution main.

1) Design Service Area

The existing service area on the east side of the Gash River is set at the design service area of the Project (see Fig.2-1). Water is supplied from multiple supply points including the Mahta WTP to the design service area, but the zoning method by which the entire service area is divided into areas with each water supply point and managed, has not been adopted. Therefore, the distribution area by water supply point cannot be clearly identified. Here is an overview of the existing service area. The old city distinct near the Mahta WTP is the main distribution area of the WTP. The water supply is likely to decrease from the WTP and increase from other water supply points with the distance from the Mahta WTP.

2) Water Demand Estimates

a. Design Target Year

The final year 2016 of the Project, the Kassala State's water strategic plan. "Water, Sanitation and Hygiene(WASH), Strategic Plan(2010-2016))", is taken as the design target year. The target year corresponds to about 4 years after completion of the Project.

b. Design Daily Water Consumption per Capita

The water policy of Kassala State mentioned above estimates 90 L/c/d of water consumption in 2016 and as such, the design daily average water consumption is set at 90 L/c/d. The survey also gives the estimated the non-domestic water consumption to the domestic water one in the target year as about 20%, so the design consumption is set as given below.

Design domestic water consumption	:	75 L/c/d
Design non-domestic water consumption	:	15 L/c/d (75 L/c/d x 20%)
Design water consumption (daily average)	:	90 L/c/d

c. Design Leakage Ratio and Design Effective Water Ratio

< Current estimated leakage ratio >

From repair records of conduits at the SWC East Office, the current leakage ratio of the existing distribution pipeline network of the east service area was estimated at approximately 35%. The total length of distribution pipelines in the east service area is 148 km, of which asbestos pipes (AC pipes) account for 82 km or 56%; while the remaining pipes used are of uPVC or steel pipes. The current leakage ratio by pipe type in the Survey was estimated at given in Table 2-2. The leakage from asbestos and service pipes is considerably high. To reduce this leakage, renewal of both asbestos and service pipes is deemed necessary.

Table 2-2 Estimated leakage ratio

Type of pipe	Service pipe (PE pipe)	Distribution pipe				Total
		AC pipe	Steel pipe	Seal	uPVC pipe	
Leakage ratio (%)	11.1	13.7	3.6	3.9	3.6	35.0

Notes: Seal indicates coupling of a valve and an asbestos pipe

< Design leakage ratio >

After technical discussions with Sudan, the design leakage ratio was agreed to be considered as 28%. This means deducting 7% from the existing estimated leakage ratio of 35%. To achieve the design value, about 16 km of asbestos pipes has to be renewed, and the service pipes connected to these asbestos pipes must also be renewed. The renewal of asbestos pipes is to be implemented as part of the Kassala State government project.

< Effective water ratio >

The design effective water ratio is calculated from the design leakage ratio as shown below.

Design effective water ratio = 1 - design leakage ratio = 1 - 0.28 = 0. 72 (72%)

d. Design Rate of Loading and Design Hourly Factor

The design daily average water supply and the design daily maximum water supply are required to be determined on actual records basis. However, it is impossible because there are no flow meters at the existing water supply facilities and no water meters in the households are available. For the plan, the design rate of loading was set at 0.7692 (76.92%) and the design hourly factor was set at 1.5 in reference to the Japanese Guidelines on the Design of Water Supply Facilities and the values adopted in past project (ICARA II) in Kassala City.

e. Design Served Population

The served population of the target year is taken as 204,739 persons using the value estimated by the Kassala branch of the Statistics Department. This estimated value has been determined by adding 2.53% of the population growth rate to the population of the 2008 census. Since the plan is 100% as the percentage of connected households in the target year, the design served population is set at 204,739, which is equal to the population in the service area.

Table 2-3 Population of East Water Supply District

Name of service area	2008 (census survey)	2016 (Static Dep. estimation)
Kassala town locality (east side of Gash River)	165,915	202,620
Kassala rural locality (Musa area)	1,735	2,119
Total	167,650	204,739

f. Design Water Consumption and Design Water Supply

The design water consumption and the design water supply of the east water supply area are as given below.

Table 2-4 Design Water Consumption and Design Water Supply (East District)

Item		Design value	Remarks
a. Design daily consumption per capita		90 L/c/d	
b. Design served population		204,739 persons	
c. Design daily average consumption	= a x b/1000	18,427 m^3/day	water demand
d. Design leakage ratio		0.28	
e. Design effective water ratio	= 1-d	0.72	
f. Design daily average water supply	= c / e	25,593 m^3/day	
g. Design rate of loading		0.7692	
h. Design daily maximum water supply	= f / g	33,272 m^3/day	Necessary water supply

g. Design Water Supply

As shown in Table 2-4, daily maximum water supply in the east water supply area amounts to 33,272m^3/day and is supplied from the Mahta WTP, northern existing wells and new Khatmia WTP. Waters supply from the three water points is shown in Table 2-5, of which Khatmia WTP accounts for 46% of the total water supply of the east supply area. Water is conveyed to the Khatmia WTP from the southern existing wells and new wells.

Table 2-5 Design daily maximum water supply from the new WTP (Khatmia WTP)

Water supply point	Daily max. water supply	remark
Mahta WTP	11,050 m^3/day	
Northern existing wells	6,832 m^3/day	
New WTP (Khatmia WTP)	15,392 m^3/day	Water production of southern existing wells and new wells
Total	33,274 m^3/day	

3) Water Quality of the Water Source

21 wells are planned to be provided for the water source of the new WTP, including 11 new wells and 10 existing wells. On the other hand, 7 test wells have been already drilled during the Preparatory Survey (Part-2). Of the 7 test wells, 4 wells are planned to be utilized as new source wells for the new WTP on account of their sufficient water yield. The safety of drinking water was verified by water quality tests. Regarding the existing 10 wells, SWC has been periodically performing water quality inspection and ensuring the safety of drinking water; therefore, this was verified in the present survey by simple water quality test.

< Water quality of the new wells >

Statutory regulations related to water quality control in the project are included in the "Law of Environmental Health for the State of Kassala (2006)" and this law stipulates water quality inspection of the water source and the tap water. However, there are no clauses related to water quality inspection; therefore, from the safety side, water quality inspection of as large a number of items as possible was carried out, including tests on agricultural chemicals. The water quality standard values for drinking water specified by the Sudanese Standards and Metrology Organization (SSMO) were used. The results of water quality tests confirmed for all the inspected items that the standard values of the SSMO were satisfied.

Table 2-6 Water quality test of the new wells

	Item		SSMO standard	Test results mg/l (lower step: well number and sampling date)			
				TW-1 (11Aug)	TW-4 (18Aug)	TW-5 (15Aug)	TW-6 (20Sep)
Organism	E-coli	E-coli	Not detected	N/D	N/D	N/D	N/D
Inorganic Chemical	Antimony (Sb)	Antimony	0.013 mg/l	>0.0002	>0.0002	>0.0002	--
	Arsenic (As)	Arsenic	0.007 mg/l	>0.001	>0.001	>0.001	--
	Barium (Ba)	Barium	0.5 mg/l	>0.05	>0.05	>0.05	--
	Boron (B)	Boron	0.33 mg/l	0.03	0.03	0.02	--
	Cadmium (Cd)	Cadmium	0.002 mg/l	>0.0005	>0.0005	>0.0005	>0.0005
	Chromium(Total) (Cr)	Chromium (total)	0.033 mg/l	>0.002	>0.002	>0.002	>0.002
	Copper (Cu)	Copper	1.5 mg/l	>0.001	>0.001	>0.001	>0.001
	Cyanide	Cyanide	0.05 mg/l	>0.001	>0.001	>0.001	--
	Fluoride (F)	Fluoride	1.5 mg/l	0.44	0.24	0.56	0.52
	Lead (Pd)	Lead	0.007 mg/l	>0.001	>0.001	>0.001	--
	Manganese (Mn)	Manganese	0.27 mg/l	0.030	0.028	0.024	0.026
	Mercury (for inorganic Mercury)	Mercury (inorganic)	0.004 mg/l	>0.00005	>0.00005	>0.00005	--
	Molybdenum (Mo)	Molybdenum	0.05 mg/l	>0.007	>0.007	>0.007	--
	Nickel (Ni)	Nickel	0.05 mg/l	>0.004	>0.004	>0.004	>0.004
	Nitrate (NO_3)	Nitrate (NO_3)	50 mg/l	2.42	7.52	6.5	6.0
	Nitrite (NO_2)	Nitrite (NO_2)	2 mg/l	0.03	0.00	0.00	0.013
	Selenium (Se)	Selenium	0.007 mg/l	0.001	>0.001	>0.001	--
	Uranium	Uranium	0.01 mg/l	0.0016	0.0005	0.0004	--
Organic chemical	Carbon tetrachloride	Carbon tetrachloride	0.0027 mg/l	>0.0002	>0.0002	>0.0002	--
	Dichloroethane	Dichloroethane	0.014 mg/l	>0.001	>0.001	>0.001	--
	1,2-Dichloroethane	1,2-Dichloroethane	0.020 mg/l	>0.0004	>0.0004	>0.0004	--
	1,2 Dichloroethene	1,2 Dichloroethene	0.033 mg/l	>0.001	>0.001	>0.001	--
	Trichloroethene	Trichloroethene	0.013 mg/l	>0.001	>0.001	>0.001	--
	Tetra chloroethene	Tetra chloroethene	0.027 mg/l	>0.0005	>0.0005	>0.0005	--
	Benzene	Benzene	0.007 mg/l	>0.001	>0.001	>0.001	--
	Benzene	Benzene	0.470 mg/l	>0.001	>0.001	>0.001	--
	Xylene	Xylene	0.330 mg/l	>0.001	>0.001	>0.001	--
	Ethyl benzene	Ethyl benzene	0.200 mg/l	>0.001	>0.001	>0.001	--
	Styrene	Styrene	0.013 mg/l	>0.0002	>0.0002	>0.0002	--
	1,2 Dichlorobenzene	1,2 Dichlorobenzene	0.700 mg/l	>0.001	>0.001	>0.001	--
	1,4 Dichlorobenzene	1,4 Dichlorobenzene	0.200 mg/l	>0.001	>0.001	>0.001	--
	Di (2-ethylexyl) phthalate	Di (2-ethylexyl) phthalate	0.0054 mg/l	>0.0025	>0.0025	>0.0025	--
	Acrylamide	Acrylamide	0.0003 mg/l	>0.00005	>0.00005	>0.00005	--
	Epichlorohydrine	Epichlorohydrine	0.0003 mg/l	>0.0002	>0.0002	>0.0002	--
	Edetic acid (EDTA)	Edetic acid (EDTA)	0.400 mg/l	>0.0005	>0.0005	>0.0005	--
	Hexachlorobutadiene	Hexachlorobutadiene	0.0004 mg/l	>0.0001	>0.0001	>0.0001	--
	Dioxane	1,4-Dioxane	0.033 mg/l	>0.005	>0.005	>0.005	--
Physical Parameters	Turbidity	Turbidity	5NTU	0.35	1.15	2.15	0.39
	Color	Color	15TCU	Colorless	Colorless	Colorless	Colorless

	Item		SSMO standard	Test results mg/l (lower step: well number and sampling date)			
				TW-1 (11Aug)	TW-4 (18Aug)	TW-5 (15Aug)	TW-6 (20Sep)
	Odor	Odor	Acceptable	Odorless	Odorless	Odorless	Odorless
	Taste	Taste	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
	Temperature	Temperature	Acceptable	29.8℃	28.9℃	28.3℃	29.1℃
	pH	pH	6.5-8.5	7.7	7.8	7.9	8.0
	Electric conductivity	Electric conductivity	---	362	335	288	328
Inorganic Constituents	Aluminum	Aluminum	0.13 mg/l	>0.01	0.07	0.06	--
	Ammonia	Ammonia	1.5 mg/l	0.00	0.00	0.00	0.00
	Chloride (Cl)	Chloride (Cl)	250 mg/l	1.60	2.20	1.80	14.22
	Hydrogen sulfide	Hydrogen sulfide	0.05 mg/l	>0.05	>0.05	>0.05	--
	Iron (Total)	Iron (Total)	0.3 mg/l	0.067	0.019	0.067	0.013
	Sodium (Na)	Sodium (Na)	250 mg/l	20.24	15.88	20.86	45.00
	Sulfate (SO4)	Sulfate (SO4)	250 mg/l	22.0	15.2	13.9	15.4
	TDS	TDS	1000 mg/l	220	196	178	196
	Zinc (Zn)	Zinc (Zn)	3 mg/l	0.261	0.010	0.153	0.030
Organic Constituents	2-Chlorophenol	2-Chlorophenol	0.005 mg/l	>0.0005	>0.0005	>0.0005	--
	2,4-Dichlorophenol	2,4-Dichlorophenol	0.002 mg/l	>0.0005	>0.0005	>0.0005	--

Tests on agricultural chemicals were carried out mainly for the groundwater of TW-5 located at a well at the most downstream position among the test boring wells. The agricultural chemicals to be inspected were selected from the four types most typically used in the service areas in the project. As shown in Table 2-7, all the agricultural chemicals satisfied the detection limits, verifying that there were no effects on the groundwater.

Table 2-7 Water quality tests for agricultural chemicals for the new wells

Type of agricultural chemical	Test well number	Test results	Analysis method
Carbaryl	TW-5	Less than 0.0005mg/l	Solid phase extraction – LC/MS method
Benomyl	TW-5	Less than 0.0002mg/l	Solid phase extraction – LC/MS method
Malathion	TW-5	Less than 0.0005mg/l	Solid phase extraction – LC/MS method
Diazinon	TW-5	Less than 0.00005mg/l	Solid phase extraction – LC/MS method

< Water quality of the existing wells >

Simple water quality test was performed on water samples taken from the existing wells and WTPs in the target area of the Project to determine their suitability for drinking. Because well no. 42 (southern well group) had nitrate content higher than the standard indicating possible sewage contamination, SWC put the well No.42 out of commission.

Table 2-8 Result of Simple Water Quality Test on Existing Pumping Wells in East District

	No.	Well no.	Nitrate, NO_3^- (mg/L)	Coliform (/100ML)	Hydrogen ion concentration (pH)	Conductivity (mS/m)	Water temp. (℃)	remarks
			50	0	6.5-8.5	--	--	WHO standard
			50	3	6.5-8.5	--	--	SSMO standard
Central wells	1	5	20	Not detected	7.4	74.5	32.0	
	2	6	-	-	-	-	-	sample unobtainable
	3	7	-	-	-	-	-	sample unobtainable
	4	8	-	-	-	-	-	sample unobtainable
	5	9	-	-	-	-	-	sample unobtainable
	6	10	10	Not detected	7.5	46.0	28.5	
	7	11	5	Not detected	7.7	22.0	28.5	
	8	12	-	-	-	-	-	sample unobtainable
	9	13	-	-	-	-	-	sample unobtainable
	10	14	-	-	-	-	-	sample unobtainable
	11	15	-	-	-	-	-	sample unobtainable
	12	16	45	Not detected	7.3	141.3	30.0	
	13	17	-	-	-	-	-	sample unobtainable
	14	18	-	-	-	-	-	sample unobtainable
	15	23	2	Not detected	7.6	33.5	29.0	
Mahta WTP reservoir			10	Not detected	7.8	41.0	29.7	
Southern wells	1	1	10	Not detected	7.4	66.1	32.0	
	2	2	5	Not detected	7.6	42.5	31.0	
	3	3	10	Not detected	7.4	77.0	32.0	
	4	4	20	Not detected	7.5	62.6	33.0	
	5	21	10	Not detected	7.6	44.4	31.0	
	6	22	5	Not detected	7.5	47.1	30.5	
	7	24	20	Not detected	7.3	94.1	32.0	
	8	32	5	Not detected	7.6	44.7	30.5	
	9	33	5	Not detected	7.5	53.0	31.0	
	10	41	-	-	-	-	-	sample unobtainable

(2) Facility Plan

Described below are the facility plans for the expansion of waterworks facilities and the rehabilitation of the existing facilities.

Ⅰ. Expansion of Waterworks Facilities

1) Water Intake Facilities

a. Water Source Wells

The Khatmia WTP takes the groundwater from the new wells and the 10 southern existing wells as the source water. Based on the flow measurements during the Survey, the groundwater production of the southern existing wells was identified as 7,536 m^3/day (See Table 2-9) . The four production wells converted from the seven test wells that were drilled during the Survey, and the wells that are scheduled to be developed during the detailed design stage by the Japanese consultant are to be utilized as the new water source wells. The groundwater production of the four converted existing wells is shown in Table 2-10. For the Project, the required water amount is planned to be secured before the beginning of the Project.

Table 2-9 Groundwater production of the existing wells

No.	Well No.	Groundwater production	
		m^3/hour	m^3/day
1	41	16	384
2	33	52	1,241
3	32	25	596
4	21	38	909
5	22	45	1,080
6	2	37	888
7	1	30	720
8	3	35	840
9	24	14	336
10	4	23	543
	Total	314	7,536

Table 2-10 Groundwater production of the four converted wells

No.	Well No.	Groundwater production	
		m^3/hour	m^3/day
1	TW-1	30	720
2	TW-4	34	816
3	TW-5	30	720
4	TW-6	30	720
	Total	124	2,976

Notes: TW-2, 3, 7 are failed wells.

The groundwater production of the four converted wells is 2,976m^3/day. And, it is possible to develop the new wells corresponding to total groundwater production of 7,856 m^3/day in the allowable drilling site in consideration of the groundwater development potential of 8,016 m^3/day. Therefore, the water production of newly developed wells during detailed design stage is set at 4,880 m^3/day. As the possible groundwater production per a well is 720 m^3/day (30 m^3/hour), the required number of wells is estimated as seven.

Table 2-11 Water production total of water source wells

Item			Water quantity	Remarks
Capacity of the Khatmia WTP			15,400 m^3/day	> groundwater production total
Groundwater production	Southern existing wells (10)		7.536 m^3/day	
	New wells	Converted wells (4)	2,976 m^3/day	
		Newly developed wells during detail design (7)	4,880 m^3/day	=720 m^3/hour x 7 wells
		Sub-total	7,856 m^3/day	< 8,016m^3/day (Max. groundwater development potential in the development area)
	Total		15,392 m^3/day	

b. New Well Facilities

The configuration of new well facilities is as given below and an overview of the facilities is shown in Fig. 2-2.

- ✓ Water source well (developed at the detailed design stage)
- ✓ Submersible motor pump
- ✓ Electric measuring equipment (instrumentation)
- ✓ Emergency generator
- ✓ Well building
- ✓ Accessory equipment

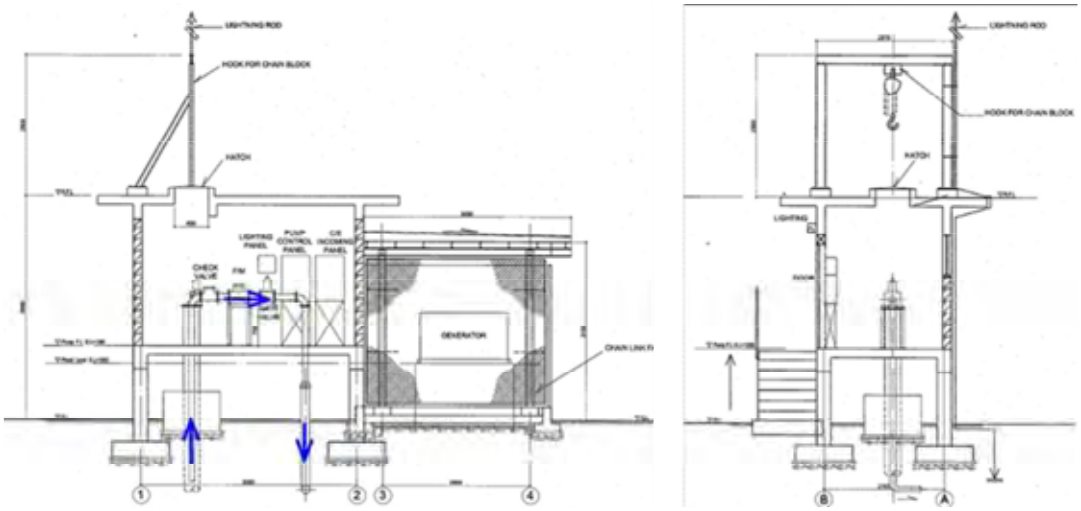


Fig. 2-2 Outline of new well

Plans for new well facilities are as below.

①Should be an unmanned facility operating round the clock (with no operators); staff of the Khatmia WTP to perform periodic facility management and operation of emergency generator in the event of a power failure.

②The change in groundwater level per year is estimated to be about 10 m maximum. So the rated head of the submersible motor pump is to be decided based on the groundwater level in the dry season. Considering the wide range of fluctuation of groundwater level, the submersible motor pump should possess a control function to prevent idle operation.

③Breakdowns of the existing submersible motor pump occur frequently, and most of the breakdowns are probably because of inadequate cooling function of the submersible motor. Therefore, the measures below are to be adopted according to this plan.

- Measures to ensure minimum flow velocity for cooling submersible motor (fit skirt-type cover all around, etc.)
- Abnormal temperature rise trip function of submersible motor

④Assuming flooding of the Gash River, the design flood level of GL + 1 m is to be considered in the facility plan. The well casing is erected up to a height of GL + 1 m, and a high floor used in the well building. Machinery and equipment such as electric measurement panels are to be protected from flooding. The foundation level of the emergency generator is also to be above the design flood level.

⑤To protect the water source, the water source well is to be accommodated in the well building, and all machinery and equipment except the emergency generator are to be installed in the same building considering theft prevention, protection against dust, etc. A fence is to be erected all around the well facility to prevent theft. This work is to be carried out by the Sudan side.

⑥The facility design should account for lightning in the rainy season. Lightning rod is to be installed on the roof of the well building, and lightning arrester is to be installed in the incoming panel to protect the electric measuring equipment in the premises against lightning.

c. Existing Well Facilities

The configuration of existing well facilities is as given below and an overview of the facilities is shown in Fig. 2-3.

- ✓ Water source well (pumping tests to be carried out at the detailed design stage)
- ✓ Submersible motor pump (renew existing pump)
- ✓ Electric measuring equipment
- ✓ Emergency generator (use existing equipment; if renewal is necessary, it is to be carried out by SWC)
- ✓ Well building
- ✓ Piping within premises
- ✓ Accessory equipment

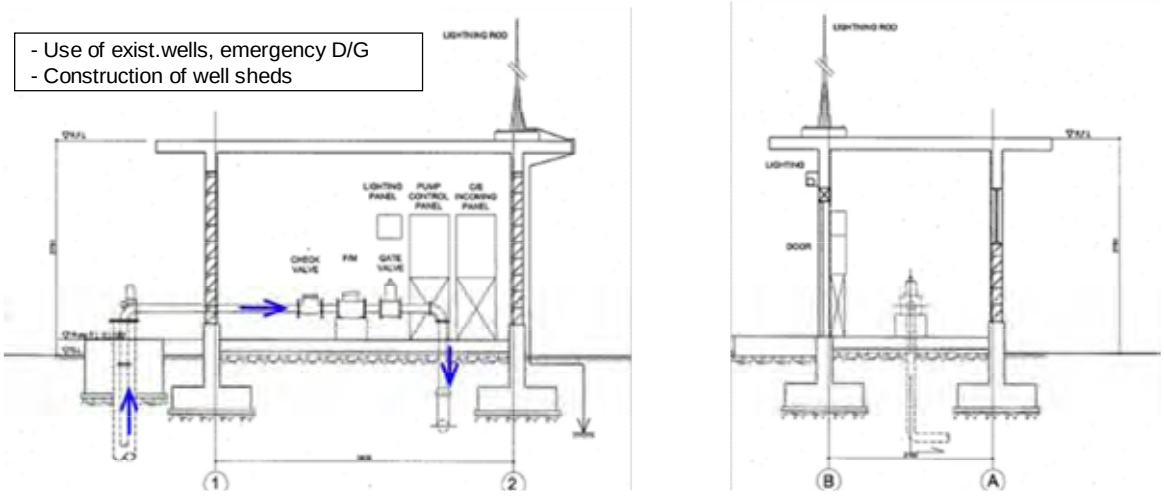


Fig. 2-3 Outline of existing well

Plans for existing well facilities are as below.

①Continue with the existing system in operation with permanent station operators and switch over to 24-hour continuous operation.

②In the renewal plan of the submersible motor pump, the rated head of the submersible motor pump is decided based on the estimated groundwater level in the dry season similar to the new well facility, and a control function to prevent idling operation is also to be accounted for in the plan.

③Similar to new well facilities, measures are to be adopted to ensure appropriate cooling function of submersible motor.

- Measures to ensure minimum flow velocity for cooling submersible motor (skirt, etc.)
- Tripping function when temperature of submersible motor rises to an abnormally high level

④Electric measurement panels to be installed GL + 1 m above the design flood level assuming flooding.

⑤Install all machinery, equipment and instruments except emergency generator within the building to prevent thefts and to prevent dust, etc. A fence is to be erected all around the well facility to prevent theft. This work is to be carried out by the Sudan side.

⑥The facility design should account for lightning in the rainy season. Lightning rod is to be installed on the roof of the well building, and lightning arrester is to be installed in the incoming panel to protect the electric measuring equipment in the premises against lightning.

2) Conveyance Pipes

The conveyance pipes are meant for conveying water from the new wells and the existing wells to the receiving well of the Khatmia WTP. As shown in Fig.2-1, the piping route of is along the bank of the Gash River. Although for the economical and rational operation of well pumps, each well and each receiving well should be ideally connected by an independent pipe, considering reduced construction cost and limited piping space (within 10 m from the toe of the bank slope), a unified piping system will be used.

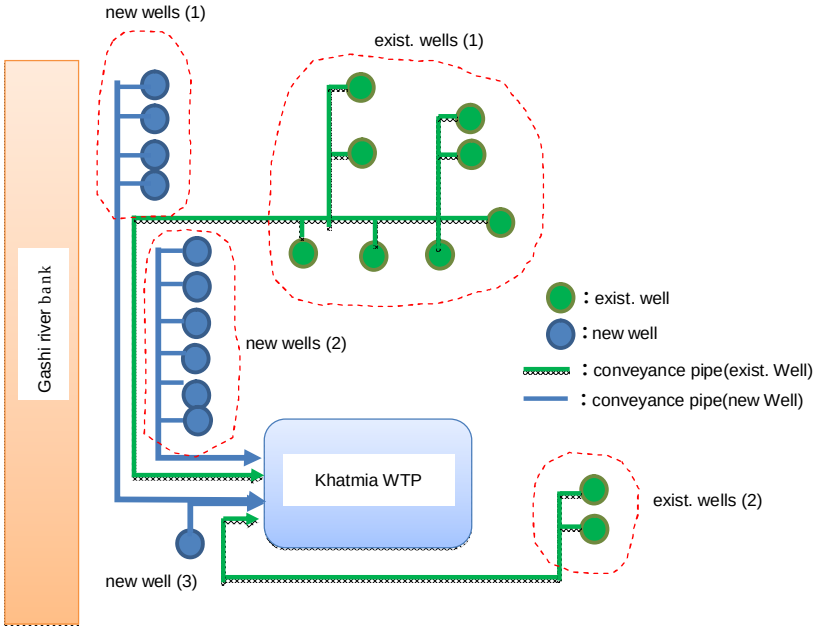
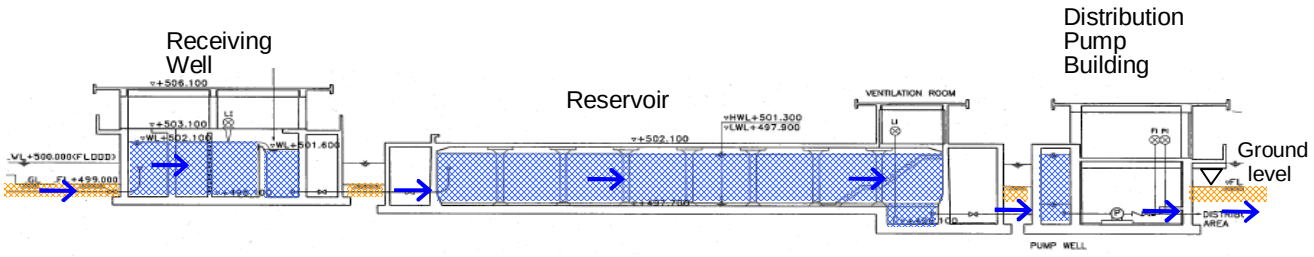


Fig. 2-4 Conveyance piping system

As shown in Fig. 2-4, the water is conveyed from the water source wells through five conveyance piping routes. The conveyance pipes from new wells are to be reviewed together with the results of the development of water sources during detailed design, and if necessary, design changes may be implemented. There will be a maximum of three sets of conveyance pipes along the Gash River bank, and the pipes can be laid within the space of 10 m. The conveyance pipes will be uPVC with the pressure rating of PN10.

3) Water Treatment Plant



a. Receiving Well

Receiving wells are installed with the objectives listed below.

①To receive water 10 existing wells, 4 test wells, and 7 new wells

②To have a functional role against pressure changes of well pumps.

③To measure the total water volume from the source wells (install the overflow weir and water level gauge).

④Sampling point of water from the source wells.

⑤To grasp inflow water volume and quality for proper chlorine dosage.

⑥To use it for chlorine dosage for proper disinfection of drinking water.

⑦To put chlorine in the receiving well and utilize the mixing in the outflow pipe to eliminate construction of chlorine dosing well.

⑧To conduct daily check of flow rate, water level and quality of well water in operation and maintenance of WTPs.

The receiving well volume is designed based on Design Criteria for Waterworks Facilities (2000, JWWA), because there is no such guideline in Sudan.

Width	:	2.0m
Length	:	3.0m
Water depth	:	4.0m
Capacity	:	48.0m^3/2receiving wells
Quantity	:	2 receiving wells
Convection time	:	4.5minutes(water facility design guidelines: 1.5minutes or longer)

b. Reservoir

In the Project, the reservoir shall be made of reinforce concrete that has a longer life span (60 years) and better strength than the FRP material (20 years of life span) based on the lesson learned from the burst accident of the FRP made reservoir of the Mahta WTP.

The capacity of the reservoir is applied Design Criteria for Waterworks Facilities (2000, JWWA) as design of the receiving well. The guidelines set the standard retention time as 12 hours in consideration of the hourly fluctuation adjustment volume, volume for handling of the upper stream of the reservoir (drought, quality accident, facility accident, etc.), volume for handling of the lower stream of the reservoir (water supply for emergency, facility accident, etc.) and water volume for firefighting. Because of no distribution record by hour, week or season throughout a year, the hourly fluctuation adjustment volume cannot be calculated. However, the water source is the well and it is relatively stable and the facility is simple, no serious accident is likely to occur and thus the retention time is shortened to eight hours.

Width	: 24.0m
Length	: 32.0m
Effective water depth	: 3.4m
Capacity	: 5,200 m^3/2 reservoirs
Quantity	: 2 reservoirs
Retention time	: 8.1 hours (standard water facility design guidelines: 12 hours)

c. Distribution Pump Building

The 2003 Gash River flood damaged to the facilities of Mahta WTP, with the distribution pump building, power generation room and chlorine dosing house being buried with soils. After the flood the ground level rose 60cm before flood and as such, the floor level of the buildings got lower than that of ground. This seems to cause rainwaters flowing into the buildings. As bank raising works of the Gash River was carried out after the flood, repaired bank had an effect on heavy rain in 2007. However, there is still possibility that the bank would be broken due to flood, because it is not so strong structure by being constructed with soils only despite some places are protected by stones.

With no record of the flood level in 2003, the trace of the flood remaining on the distribution pump building is used as reference to measure the flood level being ＋500.0m (floor height of the distribution pump building + 2 meters as the height of the trace of the flood = 499.0m).

All the entrances to the distribution pump building of the project are built higher than the flood level and the distribution pump room is built underground and the electricity room, power generator room, chlorine dosing room and office are built on higher than the ground level in consideration of the flood level of 2003 (refer to Fig. 2-5).

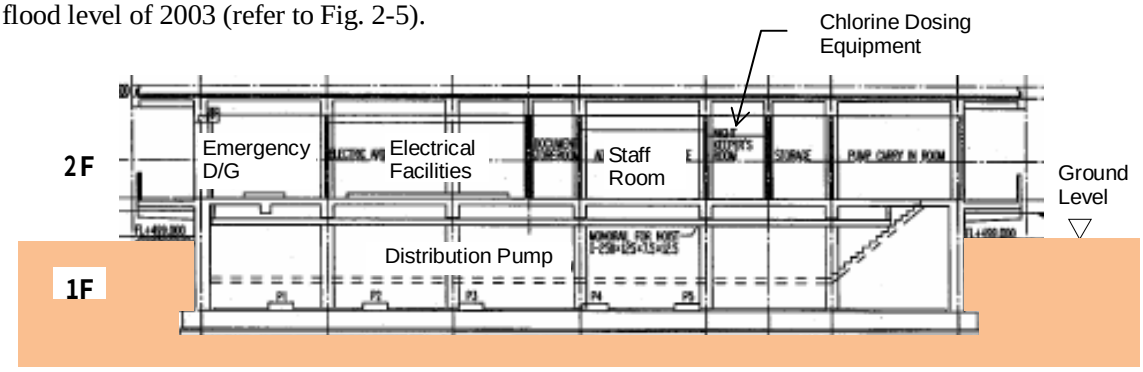


Fig. 2-5 Distribution pump building

Width	:	9.5m (including pump well)
Length	:	30.0m
Number of stories	:	1 underground floor and 1 floor above ground
Number of building	:	1 building

d. Distribution Pump Equipment

Type	:	Horizontal shaft single suction centrifugal pump
Capacity	:	4.01 m^3/minute (23,100m^3/day÷1,440minutes/day÷4units = 4.01m^3/minute)
Head	:	55m (from the pipe network analysis results)
Motor output	:	75kW (from motor output calculation)
No. of units	:	5 sets (one stand-by); (from the unit control examination)

Pump output calculation

$P=(0.163\times\gamma\times Q\times H\div\eta p)\times(1+\alpha)$

Where,

P	:	Motor output (kW)
ν	:	Specific mass (kg/L)
Q	:	Capacity (m^3/minute)
H	:	Total head (m)
ηp:		Pump efficiency (%)
α	:	Margin (0.1 to 0.15)

$P=0.163\times1kg\times4.01m^3/minute\times55\ m\div0.7\times(1+0.15)=59$ => 75 kW (rated capacity)

< Operational Control of Distribution Pump >

Because water distribution is directly connected to consumers, operational control of water distribution pumps is needed in accordance with the fluctuation of the consumption. Since the distribution volume changes in accordance with the day of the time (daytime, late at night, etc.) and season (summer, winter, etc.), their control is needed accordingly.

There are two control approaches as shown in Table 2-12: (A) controlling the number of operating pumps and (B) controlling the revolving speed of the pump. In the project, (A) is adopted because its method is simple and does not require control devices and its operation and maintenance is easy.

Table 2-12 Comparison of the operational control methods

Control Method	A. Controlling the number of operating pumps	B. Controlling the revolving speed of pump
1. The type of control apparatuses and control methods.	Controlling the number of pumps only, without a control apparatuses.	Secondary resistance control methods, Thruster Seherbius control method and Primary frequency control method.
2. Control range	Make fly cent the flow rate control with increase in number of pump in the control range of the controlling the number of pumps. △	To select the appropriate control method is possible to control the flow rate corresponding to the demand. ○
3. Energy saving effect	More pumps makes a wider control range and it has a profound effect on the energy saving. But economic efficiency decrease in proportion to it. △	The secondary resistance control convert from the secondary sliding power into heat and it cause an unrecoverable loss. Other control method produce extensive effects in the energy saving to trance duce from the secondary sliding power to power. ○
4. Operation and Maintenance	Require inspection and maintenance of a pump only, since it has no control apparatuses. ○	Require periodic inspection and, in some methods, need daily maintenance. ×
5. Economic efficiency	The cost increases in proportion to the number of pump. △	The equipment is expensive. ×
6. Comprehension comparison	Conventional control method is simple but it is controllable function for seasonal variation or hourly fluctuation and, it has no control apparatuses and it is easy to operate and maintain. Therefore, it plans to apply this method. ○	This method has wide flow rate control range and produce extensive effects in the energy saving but cost of equipment is expensive and require periodic inspection. This method is adopted many case in Japan. △

< Number of Distribution Pump >

Because the changes in distribution volume by time and season are unknown, the design distribution water amount and the number of pumps are set as shown in Table 2-13. Comparison with the minimum, average and maximum distribution amount per day, four pumps are deemed appropriate for the distribution volume and thus four pumps are planned.

Table 2-13 Design distribution amount and number of distribution pumps

Item	Design amount	Two pumps (m^3/day)		Three pumps (m^3/day)		Four pumps (m^3/day)	
Pump capacity	Per pump	P	11,550	P	7,700	P	5,775
Minimum distribution amount	5,775 m^3/day	1	11,550	1	7,700	1	5,775
Daily average distribution amount	11,850 m^3/day	1	11,550	2	15,400	2	11,550
Daily maximum distribution amount	15,400 m^3/day	2	23,100	3	15,400	3	17,325
Hourly maximum distribution amount	23,100 m^3/day	2	23,100	3	23,100	4	23,100

Note:

1) It is the unrecorded distribution amount because the existing system has not a flow meter. Therefore, the minimum distribution amount is evaluated as a quarter of the maximum distribution amount per hour.

2) P: Pump operating number.

e. Chlorine Dosing Equipment

Chlorine dosing has being conducted since 1988 in the Mahta WTP. As no problems have occurred until today, chlorine will be used for disinfection. The design chlorine dosage is shown in Table 2-14 and the chlorine is planned to be dosed in the newly built receiving well.

Table 2-14 Design chlorine dosage and feed rate

Item	Minimum	Average	Maximum
Dosing rate	0.5 mg/L	1.0 mg/L	2.0 mg/L
Feed rate	0.32 kg/hour	0.64 kg/hour	1.28 kg/hour

Feed rate calculation

$Vw = Q \times R \times 10\text{-}3$

Where, Vw : Mass feed rate (kg/hour)
Q : Treated water quantity (m^3/hour)
R : Liquid chlorine feed rate (mg/L)

Vw = 15,400 m^3/day ÷ 24 hours x 2.0 mg/L x 10-3═1.28 kg/ hour

f. Electric Facilities and Instrumentation

Sudanese side will be responsible for the wiring works up to the transformer for receiving electricity. The incoming panel, distribution board, distribution pump panel and instrumentation panel after the transformer will be installed by the Project.

Electricity : 3 phase, 4 wires, 415V, 50 Hz
Incoming panel : 1 set
Distribution board : 1 set
Distribution pump panel : 5 sets
Instrumentation panel : 1 set

As for instrumentation, the following detecting items are needed for operation and maintenance.

① Intake volume
An overflow dam and a water level gauge are installed in the receiving well to understand the intake water volume. The flow volume obtained based on the overflow water depth is used as the intake volume. The ultrasonic water level gauge is used to enable measurement close to the overflow dam.

② Distribution volume
A flow meter is installed in the outflow header pipe after the distribution pump in order to understand the distribution volume. Although the flow meter is available in the ultrasonic and electromagnetic types, the ultrasonic type is used as it does not require a bypass pipe and the installation is simple.

③ Water level of reservoir
Three types of water level-gauge are available: mechanical float gauge, immersion pressure

type, and ultrasonic meter. The immersion pressure type is introduced as it allows water level monitoring in the electricity room and in consideration of the corrosion resistance and electric signal.

g. Emergency Generator

Although it is expected that electricity situation of the completion year of the Project will be by far improved, the Project plans to install an emergency generator for power supply during power shortage considering importance of the WTP, which is required to keep continuous water supply service. The generating power is required for two distribution pumps to work on condition that 50 percent of distribution water can be supplied.

Type : Diesel engine
Capacity : 500kVA
Number of unit: 1 unit

Generator capacity calculation

$$PG3 = \{(PL-Pn)/nL + Pm \times K \times C \times Pfs\} \times (1/\cos f)$$
$$= \{(167.85-75)/0.85 + 152.85 \times 7.2 \times 0.65 \times 0.4\} \times (1/0.8) = 494kVA \rightarrow 500\ kVA$$

Where,	PG3 :	Generator capacity (kVA)		
	Pm :	Motor loads (kW)	=	152.85kW
		- Distribution pump (75kW×2)	=	150kW
		- Chlorine pressure pump	=	0.65kW
		- Service water supply	=	2.2kW
	Pms :	- Lighting panel	=	15kW
	PL :	Total load (Pm+Pms)	=	167.85kW
	Pn :	Motor load with max. difference of (starting-steady) currency	=	75kW
	Pfs :	Power factor at the starting of Pn motor	=	0.4
	nL :	Total load efficiency	=	0.85
	Cosφ:	Rated power factor of generator	=	0.8
	K :	Value determined by motor start-up degree	=	7.2 (if unknown)
	C :	Factor determined by motor start-up system	=	0.67

4) Distribution Main (Distribution Pipe)

a. Receiving Well

The diameter of new distribution pipes has been determined by computation of the water supply network in the east water supply area based on the water demand in target year 2016. Fig. 2-6 shows its computation result. To send water from the Khatmia WTP to the existing water distribution network with the rate of 15,400m^3/day corresponding to daily maximum water supply, the distribution main of 6.3km long, DN500 and DN600, is required to be laid. In addition, the computation shows that new pipes are necessary to be added and laid in north-east and north-east areas. However, the Project includes distribution main only and excludes such additional pipes because of insufficient reliable data of the existing water distribution network. As for additional

pipes, it is recommended that the examination on it be done after sufficient data will be collected.

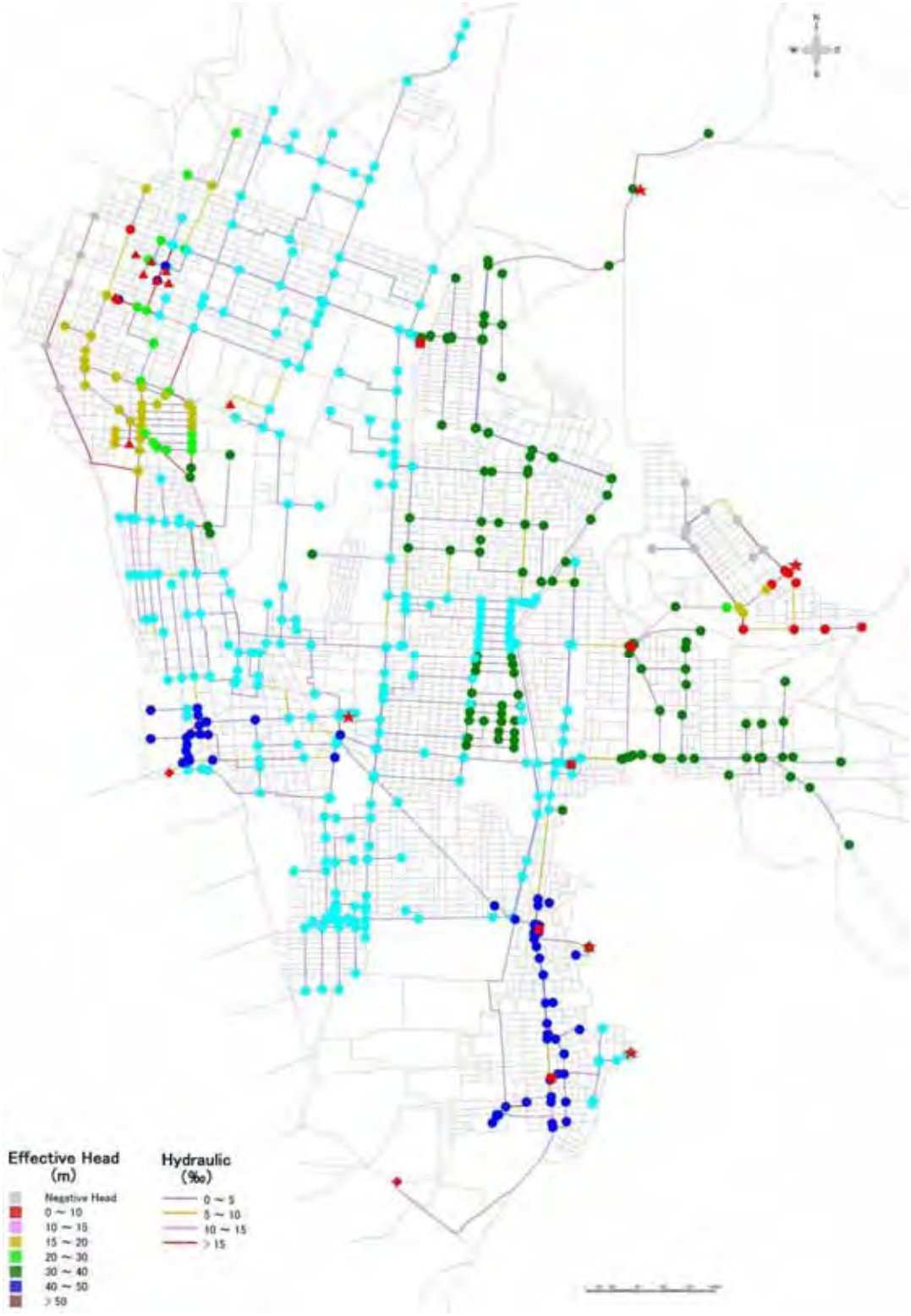


Fig. 2-6 Computation of the water supply network in the east water supply area

Asbestos cement and uPVC (rigid polyvinylon chloride) pipes are used for the existing distribution pipes in the east water supply area. uPVC pipes are available only in DN300mm and less. For pipes with larger diameter than the above, SP and DCIP are generally used. DCIPs are used in the Project because of the followings.

①Joints in steel pipes are welded joints and welding is not technically easy; experienced welders are necessary and considerable time is required for welding. Inspection of welded location is also important. Inspection methods include X-rays and ultrasonic method, which are not easy to perform. The average temperature in April and May exceeds 40℃ in this area; sandstorms, snow, heavy rains also occur, and the natural environment is severe. Thus, the weather and environment is unsuitable for welding work.

②The joints in ductile cast iron pipes are push-on joints, and only rubber ring is inserted into the socket of the pipe, and pipe is inserted and welded, so experienced pipe fitted is not required. The confirmation of welding is also easy, because only the mark at the inserted position has to be checked in the inserted pipe. Connections can be made easily even under the weather conditions mentioned above, so the workability is far superior to that of steel pipes.

③After completion of construction in the project, operation and maintenance are to be implemented by the Sudanese side. During the maintenance of distribution pipelines accompanying the replacement of asbestos cement pipes, trucks with crane and pipe cutter may be used by the Sudan side to easily lay pipes, if they are ductile cast iron pipes. On the other hand, steel pipes require experienced welders, and also X-ray or ultrasonic weld testing equipment; the weather too would make it difficult for the Sudan side to lay the pipes. Even if the pipes were laid, leakage of water is a cause for concern.

In the east water supply area, fire hydrants have not been installed. One fire truck is provided in the west water supply area. In the east water supply area, provisions have been made for donkeys carrying water to be used instead of fire engines for fire fighting activities. The south distribution pipeline in the project is an important distribution main extending from the new WTP to the south and central regions. It differs from the distribution pipeline that has a close relationship with water consumers, so fire hydrants will not be installed.

5) Summary of Facility Plan

Table 2-15 shows a summary of the facility plan.

Table 2-15 Facility plan (East District: Expansion)

Item	Facility	Description	Quantity	Remarks
1.Water intake facility	Existing wells	7,537 m^3/day	10	
	New wells (converted from test wells)	Casing diameter $10^3/_4$inch, 720 m^3/day (average)	4	Drilled during BD
	New wells	Same as above	7	Drilled during DD
	Existing well facilities	Renewal of submersible motor pump, Electric equipment (incoming panel, control panel), well shed	10	
	New well facilities	Submersible motor pump (3.7-5.5 kW), Electric equipment (incoming panel, control panel), Diesel generator (12.5-17kVA), well shed	10	
2. Conveyance pipes facility		DN100-DN300,uPVC pipes	11.6km	
3.Waer Treatment plant	Receiving well	Reinforced concrete construction Dimensions: Width 2.0 m, length 3.0 m, effective water depth 4.0 m Capacity: 48.0 m^3/ 2 basins Retention time: 4.5 minutes	2	With shed
	Reservoir	Reinforced concrete construction Dimensions: Width 24.0 m, length 32.0 m, effective water depth 3.4 m Capacity: 5,200 m^3/ 2 basins Retention time: 8.1 hours	2	
	Distribution pump building	Reinforced concrete construction Dimensions: Width 9.5 m, length: 30.0 m Basement 1; above ground 1 story	1	
	Plant connection pipes	conveyance pipes, treated water pipes, discharge pipes, service pipes	1 set	
	Maintenance within premises	Roads in premises, drainage in premises	1 set	
	Distribution pump equipment	Type: Single suction horizontal centrifugal pump Capacity: 4.01 m^3/minute Head: 55.0 m Motor output: 75 kW	5 pumps (incl. one stand-by)	
	Chlorine dosing equipment	Disinfectant: Liquid chlorine Maximum dosing rate: 2 mg/L Maximum feed rate：1.28 kg/hour Vacuum type chlorinator: 2 units Dosing pump: 2	1 set	
	Electric facilities & Instrumentation	Power specifications: 3-phase, 4-wire, 415 V, 50 Hz Switch panel: 1 Incoming panel: 1 Distribution pump control panel: 5 Instrumentation panel: 11 Water level gauge, flow meter	1 set	
	Emergency generator equipment	Type: Diesel engine Output: 500kVA	1 set	
4. Distribution main		DN500, DN600 mm, ductile cast iron pipe	6.3 km	

Ⅱ. Rehabilitation of Mahta WTP (Water Treatment Plant)

1) Water Source Wells

Since the existing wells are in good condition, the Project will use them without rehabilitation work. Based on the flow rate measurements taken by the Survey Team, the design intake flow of each well will be set as follows.

Table 2-16 Design Intake Flow

Well no.	Intake flow (m^3/hour)	WTP capacity
5	29	11,050m^3/day÷24 hrs = 460m^3/hr
6	29	
7	37	
8	38	
9	39	
10	65	
17	30	
11	22	
13	28	
14	21	
12	15	
18	34	
16	41	
23	14	
15	19	
Total	461	460

2) Water Treatment Plant

The equipment configuration will be the same as that of Khatmia WTP. Specification of each item will be as follows.

a. Receiving Well

Width	:	2.0m
Length	:	3.0m
Water depth	:	4.0m
Capacity	:	48.0m^3/2receiving wells
Quantity	:	2 receiving wells
Convection time	:	6.3minutes (water facility design guidelines: 1.5minutes or longer)

b. Reservoir

Width	:	16.0m
Length	:	32.0m
Effective water depth	:	3.6m
Capacity	:	3,686.0m^3/2 reservoirs
Quantity	:	2 reservoirs
Retention time	:	8.0hours (standard water facility design guidelines: 12 hours)

c. Distribution Pump Building

Width	:	9.5m (including pump well)
Length	:	30.0m
Number of stories	:	1 underground floor and 1 floor above ground
Number of building	:	1 building

d. Distribution Pump Equipment

Type	:	Horizontal shaft single suction centrifugal pump
Capacity	:	2.88 m^3/minute (16,600m^3/day÷1,440minutes/day÷4units = 2.88m^3/minute)
Head	:	50m (from the pipe network analysis results)
Motor output	:	45kW (from motor output calculation)
No. of units	:	5 sets (one stand-by); (from the unit control examination)

Pump output calculation

$P=(0.163\times\gamma\times Q\times H\div\eta p)\times(1+\alpha)$

Where,
- P : Motor output (kW)
- ν : Specific mass (kg/L)
- Q : Capacity (m^3/minute)
- H : Total head (m)
- ηp: Pump efficiency (%)
- α : Margin (0.1 to 0.15)

$P=0.163\times1kg\times2.88m^3/minute\times50\ m\div0.6\times(1+0.15)=45$ => 45 kW (rated capacity)

< Number of Distribution Pump >

Because the changes in distribution volume by time and season are unknown, the design distribution water amount and the number of pumps are set as shown in Table 2-17. Comparison with the minimum, average and maximum distribution amount per day, four pumps are deemed appropriate for the distribution volume and thus four pumps are planned.

Table 2-17 Design distribution amount and number of distribution pumps

Item	Design amount	Two pumps (m^3/day)		Three pumps (m^3/day)		Four pumps (m^3/day)	
Pump capacity	Per pump	P	8,300	P	5,333	P	4,150
Minimum distribution amount	4,250 m^3/day	1	8,300	1	5,333	1	4,150
Daily average distribution amount	8,500 m^3/day	1	8,300	2	10,666	2	8,300
Daily maximum distribution amount	11,050 m^3/day	2	16,600	3	16,600	3	12,450
Hourly maximum distribution amount	16,600 m^3/day	2	16,600	3	16,600	4	16,600

Note:
1) It is the unrecorded distribution amount because the existing system has not a flow meter. Therefore, the minimum distribution amount is evaluated as a quarter of the maximum distribution amount per hour.
2) P: Pump operating number.

e. Chlorine Dosing Equipment

The design chlorine dosage is shown in Table 2-18.

Table 2-18 Design chlorine dosage and feed rate

Item	Minimum	Average	Maximum
Dosing rate	0.5 mg/L	1.0 mg/L	2.0 mg/L
Feed rate	0.23 kg/hour	0.46 kg/hour	0.92 kg/hour

Feed rate calculation

$Vw = Q \times R \times 10\text{-}3$

Where, Vw : Mass feed rate (kg/hour)
Q : Treated water quantity (m^3/hour)
R : Liquid chlorine feed rate (mg/L)

$Vw = 11{,}050\ m^3/day \div 24\ hours \times 2.0\ mg/L \times 10\text{-}3 = 0.92\ kg/\ hour$

f. Electric Facilities and Instrumentation

Electricity	:	3 phase, 4 wires, 415V, 50 Hz
Incoming panel	:	1 set
Distribution board	:	1 set
Distribution pump panel	:	5 sets
Instrumentation panel	:	1 set

As for instrumentation system, the following items are needed for operation and maintenance.

①Intake volume
②Distribution volume
③Water level gauge of reservoir

g. Emergency Generator

The generating power is required for operation and maintenance of two distribution pumps.

Type	:	Diesel engine
Capacity	:	500kVA
Number of unit	:	1 unit

Generator capacity calculation

$PG3 = \{(PL\text{-}Pn)/nL + Pm \times K \times C \times Pfs\} \times (1/cosf)$
$= \{(140.85\text{-}45)/0.8 + 132.85 \times 7.2 \times 0.67 \times 0.4\} \times (1/0.8) = 453kVA \rightarrow 500\ kVA$

Where, PG3 : Generator capacity (kVA)
Pm : Motor loads (kW) = 125.85kW
- Distribution pump (45kW×2) = 90kW

		- Exist. Well pumps (11kWx3)	=	33kW
		- Chlorine pressure pump	=	0.65kW
		- Service water supply	=	2.2kW
Pms	:	- Lighting panel	=	15kW
PL	:	Total load (Pm+Pms)	=	142.75kW
Pn	:	Motor load with max. difference of (starting-steady) currency	=	45kW
Pfs	:	Power factor at the starting of Pn motor	=	0.4
nL	:	Total load efficiency	=	0.85
Cosφ	:	Rated power factor of generator	=	0.8
K	:	Value determined by motor start-up degree	=	7.2 (if unknown)
C	:	Factor determined by motor start-up system	=	0.67

3) Facility Plan Summary

Table 2-19 summarizes the facility rehabilitation plan of Mahta WTP.

Table 2-19 Facility Outline (East District: Rehabilitation)

Facility Specification	Quantity
1. Receiving well Capacity: 48.0m^3/2 wells Dimension: 2.0m (width) x 3.0m (length) x 4.0m (depth)	2 wells
2. Reservoir (reinforced concrete) Capacity: 3,686.0m^3/2 reservoirs Dimension: 16.0m (width) x 32.0m (length) x 3.6m (effective water depth)	2 reservoirs
3. Distribution pump building Dimension: 9.5m (width) x 30.0m (length) No. of stories: 1 story each below and above ground	1 tower
4. Piping in the premise φ100-φ250: 325m φ300-φ500: 76m	401m
5. Distribution pump equipment Model type: Single suction horizontal centrifugal pump Capacity: 2.88m^3/min Lifting height: 50.0m Output: 45.0kw	5 units (of which 1 is spare)
6. Chlorine dosing equipment Dose rate: 0.5～2.0mg/litre	1 set
7. Electric facility & instrumentation Switch panel: 1 Incoming panel: 1 Distribution pump panel: 5 Instrumentation panel: 1	8 panels
8. Emergency power generator Model type: diesel engine Capacity: 500kVA	1 unit

2-2-2-2 West District

(1) Overall Plan

The overall plan is to perform emergency repair on the existing Garb WTP, the reservoir of which is at a high risk of bursting.

1) Design Water Supply Area

The design water supply area is the existing water supply area on the west bank of Gash River. The population of the area is as follows.

Table 2-20 Population in West District

	2008 (census)	2016
Total population	132,614 persons	161,961 persons
Water service population*	Approx. 80,000 persons	–

*Note: water service population is estimated based on the customer ledger of SWC West Office.

2) Design Conditions

Design conditions used for East District are applied.

Table 2-21 Design Conditions (West District)

Factor	Design value
Target year	2016
Design daily water consumption per capita	90 L/c/d
Design leakage rate	0.28
Design efficacy rate	0.72

3) Target Population

Since the water supply rate of Garb WTP will remain unchanged after the implementation of the Project, the target population of this subproject will equal to the service population, which is obtained from the water supply rate of Garb WTP and by applying the design factors. Based on the design water use per capita per day, design leakage rate, and design efficacy rate, the target population is calculated as shown below. The target population means the number of people who will be cut off from water supply in case of bursting of the reservoir.

Target population (West District)

= Water supply rate from Garb WTP ÷ (water use/c/d ÷1,000) × efficacy rate x load factor

= 5,200m^3/d ÷ (90 L/c/d÷1,000) × 65% × 76.92% = 28,888 persons

(2) Facility Plan

Since the existing wells have the pump discharge rates greater than the initial design discharge rates, as confirmed by the measurements taken by the Survey Team, they will be used without rehabilitation work. Design intake flow of each well will use the initial design value as shown

below.

Table 2-22 Design Intake Flow

Well no.	Measurement taken by Survey Team (m^3/hour)	Initial design intake flow (m^3/hour)	WTP capacity
6	36	30	5,200m^3/day÷24hrs = 217m^3/hr
7	47	30	
14	36	30	
4	28	30	
8	30	30	
11	41	30	
12	30	30	
Total	248	210	217

1) Water Treatment Plant

The equipment configuration will be the same as that of Mahta and Khatmia WTPs in East District. Specification of each facility will be as follows.

a. Receiving Well

Width : 1.5m
Length : 2.5m
Water depth : 3.5m
Capacity : 26.3m^3/2receiving wells
Quantity : 2 receiving wells
Convection time : 7.3minutes(water facility design guidelines: 1.5minutes or longer)

b. Reservoir

Width : 12.0m
Length : 24.0m
Effective water depth : 3.0m
Capacity : 1,728 m^3/2 reservoirs
Quantity : 2 reservoirs

2) Facility Plan Summary

Table 2-23 Facility Outline (West District: Rehabilitation)

Facility specification	Quantity
1. Receiving well Capacity: 26.3m^3/2 wells Dimension: 1.5m (width) x 2.5m (length) x 3.5m (depth)	2 wells
2. Reservoir (made of concrete) Capacity: 1,728.0m^3/2 reservoirs Dimension: 12.0m (width) x 24.0m (length) x 3.0m (effective water depth)	2 reservoirs
4. Piping in the premise φ100-φ250： 381m φ300-φ350： 160m	541m

2-2-3 Outline Design Drawing

The outline design drawings of the Project are shown in Appendix-11.

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

< Project Implementation system >

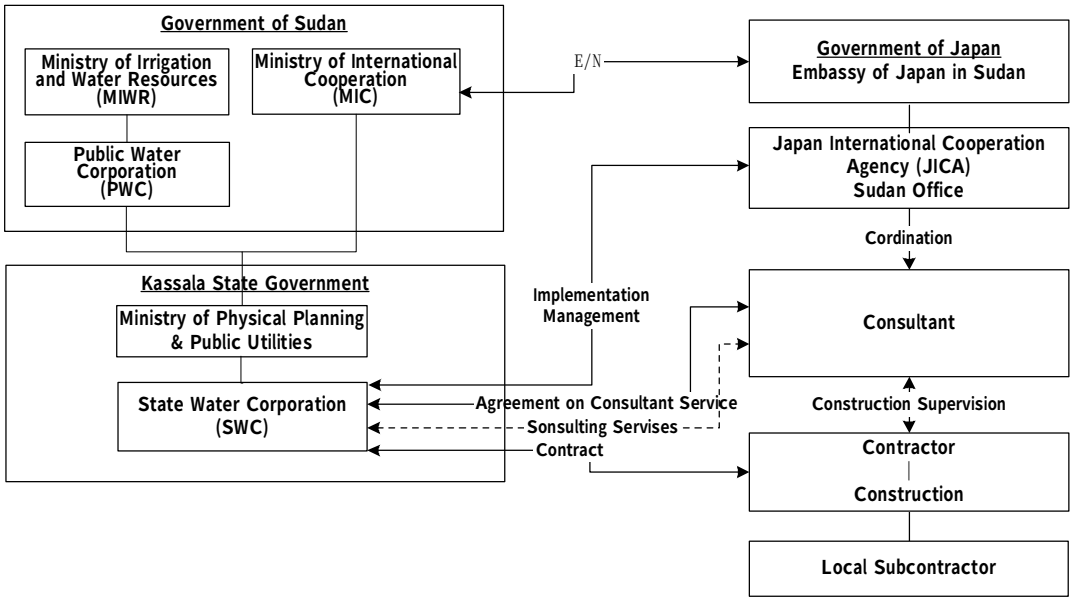


Fig. 2-7 Project implementation system

The project is to be implemented according to the conditions stipulated in the Exchange of Notes between the Sudanese government and the Japanese government. The Kassala State Water Corporation (SWC), under the control of the Ministry of Physical Planning & Public Utilities of Kassala State Government, is the implementing organization on the Sudanese side. The operation and maintenance of the facilities after project implementation will be continued by the SWC. The SWC will employ a consulting firm to receive services such as detailed design, preparation of tender documents, assistance related to tenders, construction supervision, and so on, for implementing the project. For the implementation of construction work in the project, local contractors may be utilized as the persons in charge of the construction work. The various organizations and their relationships in regard to the project are shown in Fig. 2-7.

2-2-4-2 Implementation Conditions

< Construction plan in the dry season >

The Survey area is very hot throughout the year; the maximum monthly average temperature in April-May exceeds 40℃ especially in the dry season. Precautions are to be taken to ensure that quality does not degrade when carrying out work in hot weather, such as concreting work, and

measures on site are to be adequately reflected in the construction plan.

< Power for works >

There is no distribution network near the construction site, and it is difficult to use commercial power for the work. It is also not certain whether the rehabilitation work on the power facilities by the Sudanese side will be completed before the start of implementation of the construction work. Accordingly, the power required for the work will be supplied by generators arranged for by the contractor.

2-2-4-3 Scope of Works

The responsibilities of Japanese and the Sudanese sides when implementing the project are as shown in Table 2-24 (1)(2).

(1) Rehabilitation Project

Table 2-24 (1) Work responsibilities/installation responsibilities of the Sudanese side and the Japanese side (Rehabilitation Project)

Item	Japanese side	Sudanese side
1. Rehabilitation of Mahta WTP		
(1) Ensuring site for facility		○
(2) Ground leveling at site for the facility		○
(3) Slope protection works		○
(4) Removal of trees and guard house		○
(5) Construction of facility (planning and design, procurement of materials and equipment, construction)	○	
(6) Cabling works up to the WTP for power supply		○
(7) Construction of fences and gates		○
(8) Cleaning and disinfection	○	
(9) Tests	○	
2. Rehabilitation of Garb WTP		
(1) Ensuring site for facility		○
(2) Removal of trees		○
(3) Construction of facility (planning and design, procurement of materials and equipment, construction)	○	
(4) Cleaning and disinfection	○	
(5) Tests	○	
3. Others		
(1) Offer of temporary site (part of new WTP facility site in the south)		○
(2) Provision of water for water filling tests		○

(2) Expansion Project

Table 2-24 (2) Work responsibilities/installation responsibilities of the Sudanese side and the Japanese side (Expansion Project)

Item	Japanese side	Sudanese side
1. Provision of temporary site (part of new WTP facility site in the south)		○
2. Water intake facilities		
(1) Ensure test boring site and access		○
(2) Development of new well water sources (physical prospecting, test boring, pumping test)	○	
(3) Offer of site for new well facilities		○
(4) Construction of new well facilities	○	
(5) Construction of fences and gates for new well facilities		○
(5) Pumping tests of existing wells (at detail design stage)	○	
(6) Rehabilitation of existing wells (replacement of well pumps, construction of well sheds)	○	
(7) Renewal of emergency generator in existing wells (if necessary)		○
3. Conveyance pipes		
(1) Removal of obstacles on the raw water main routes (cut down trees and shrubs)		○
(2) Laying conveyance pipes	○	
(3) Cleaning and disinfection	○	
(4) Water pressure tests	○	
4. WTP		
(1) Ensuring site for facility		○
(2) Land leveling for the facility		○
(3) Construction of access roads (if necessary)		○
(4) Construction of facility (planning and design, procurement of materials and equipment, construction)	○	
(5) Construction of fences and gates		○
(5) Cleaning and disinfection	○	
(6) Tests	○	
5. Distribution mains		
(1) Removal of obstacles on the distribution main routes (cut down trees and shrubs)		○
(2) Laying of distribution mains	○	
(3) Connections with existing distribution pipelines	○	
(3) Cleaning and disinfection	○	
(4) Water pressure tests	○	
6. Cabling works for power supply (up to the WTP and the new well facility)		○
7. Others		
(1) Offer of temporary site (part of new WTP facility site in the south)		○
(2) Provision of water for water filling tests		○

2-2-4-4 Construction Supervision

The project is to be implemented under the Japanese Grant Aid program. The consultant will perform the detailed design study and construction supervision for implementing the project.

Detailed design

During this phase of detailed design, development of new water source wells, survey of existing wells (pumping test), detailed design, tender documents and other documents necessary for implementing the project will be prepared.

Tendering

The consultant will assist the SWC with tendering formalities. The contract between SWC and the successful tenderer will be verified by the Japanese Government.

Construction supervision

The consultant will assist the SWC to complete the project by the scheduled date mentioned in the Exchange of Notes (E/N), by holding meetings with the contractor prior to the commencement of the construction work, by witnessing inspections at plants and after shipment of the materials and equipment to the project sites, and by providing the contractor with guidance and supervision with the focus on process and quality controls related to construction work, equipment installation, tests and trials, final inspections, etc.

2-2-4-5 Quality Control Plan

Resident construction supervision engineers will be dispatched, and construction supervision procedures will be prepared based on quality control plans. Quality control, progress control, safety control and environment management will be implemented according to these plans. The major items of quality control on site are as given below.

- Foundation work	:	Load tests, etc.
- Compaction	:	Material tests, density tests, etc.
- Concrete work	:	Material tests (sand, gravel cement), mixing tests, strength tests, slump tests
- Reinforcement	:	Tensile and bending tests (Factory shipment certificate)
- Pipes in the premises and distribution main	:	Hydraulic tests

Besides the above, the rate of progress of construction will be measured and confirmed at each stage. During the commissioning stage, schedule will be controlled such that the WTP can be handed over to SWC after rehabilitation after ensuring the performance of the facilities.

Regarding the equipment/materials to be procured, the procurement contractor will be made to carry out performance tests witnessed by the consultant for the distribution pump, equipment in the chlorination facility, etc., before shipment from the factory. At the time of installation of machinery and equipment, the installation work supervision procedure will be kept ready similar to civil and building work procedures, and the required inspections will be carried out based on these procedures. Performance tests will also be carried out after installation of equipment and machinery, the quality of the equipment will be confirmed, and subsequently, the equipment will be commissioned.

The inspection code and/or standards related to quality control will comply with JIS, ISO or other international codes/standards.

2-2-4-6 Procurement Plan

In principle, the procurement of materials and equipment for work in the project are to be procured from Sudan, Japan or a third country. The third country may be an EU state, Egypt, Saudi Arabia or a neighboring country. Table 2-25 shows the countries from which materials and equipment are scheduled to be procured for the project.

Table 2-25 Scheduled procurement countries for major materials and equipment (for Rehabilitation and Expansion projects)

Item		Country		
		Japan	Sudan	Third Country
Distribution pump		○		
Electric equipment and instrumentation		○		
Chlorination materials	Flow meter	○		
	Chlorination equipment	○		
	Chlorine cylinders, etc.		○	
Piping materials	uPVC pipes	○	○	
	Ductile cast iron pipes (for Expansion project only)			○
	Steel pipes and fittings	○		
	Valves and instruments	○		

The materials and equipment for work will be delivered to a storage area which will form part of the site where the WTP will be constructed. Equipment/materials procured in Japan will be unloaded at Port Sudan through Hong Kong and Gitta and transported by land to the project site. The time for transporting equipment or materials from Japan to the project site is about 1.5 months.
The Ministry of Physical Planning and Public Utilities of Kassala State is required to arrange the budget equivalent to import tax and value added tax in advance for custom clearance and duty exemption for these equipment/materials.

Materials other than the above to be used in the construction of WTP are shown in Table 2-26.

Table 2-26 Scheduled procurement of construction materials (for Rehabilitation and Expansion projects)

No.	Item	Country		
		Japan	Sudan	Third Country
1	Cement		○	
2	Reinforcement		○	
3	Formwork materials		○	
4	Wood for construction		○	
5	Fuels		○	
6	Gravel and sand		○	
7	Fixtures such as window frames		○	
8	Indoor and outdoor light fittings		○	
9	Polyethylene pipes		○	

2-2-4-7 Initial Operation Guidance

In principle, guidance for initial operation and management guidance are to be implemented for all facilities to be renewed. Operation guidance is to be implemented at the time of handing over the facilities, and will be based on instruction manuals and repair manuals, etc., in the Arabic language. The guidance by equipment is summarized in Table 2-27 (1)(2) below.

Table 2-27 (1) Initial operation guidance (Rehabilitation Project)

Equipment/facility		Guidance
Mahta WTP	Receiving well, Reservoir, Distribution pump, etc.	・ Distribution pump operating method ・ How to use accessory equipment such as pressure gauge, valves, etc. ・ How to use water level gauge, flow meter, etc. ・ Daily inspection and repair methods of distribution pump including instruments and valves ・ How to use, repair and inspect pump panels and operation panels ・ How to use, repair and inspect emergency power supply equipment
	Chlorination equipment	・ How to use chlorination equipment and accessory ・ Measures against accidents and precautions to avoid accidents ・ Daily inspection and repair methods of chlorination equipment
Garb WTP	Receiving well and Reservoir	・ How to use mechanical water level gauge ・ Daily inspection and maintenance methods of reservoirs

Table 2-27 (2) Initial operation guidance (Expansion Project)

Equipment/facility		Guidance
Khatmia WTP	Reservoir, Distribution pump, etc.	・ Distribution pump operating method ・ How to use accessory equipment such as pressure gauge, valves, etc. ・ How to use water level gauge, flow meter, etc. ・ Daily inspection and repair methods of distribution pump including instruments and valves ・ How to use, repair and inspect pump panels and operation panels ・ How to use, repair and inspect emergency power supply equipment
	Chlorination equipment	・ How to use chlorination equipment ・ How to use other accessory equipment ・ Measures against accidents and precautions to avoid accidents ・ Daily inspection and repair methods of chlorination equipment
New well facilities		・ How to use accessory equipment such as pressure gauge, valves, etc. ・ How to use water level gauge, flow meter, etc. ・ How to operate emergency generator

2-2-4-8 Soft Component (Technical assistance) Plan

Kassala State Water Corporation (SWC), which is the implementing organization for the Project, has operated and maintained the water supply facilities, equipment and machinery installed as part of the Grant Aid Program from 1985 to 1987 without major problems. The SWC also has experience in responding to emergencies such as floods and ruptures of the distribution reservoir. Thus, it is considered to have some degree of implementation as well as operation and maintenance ability, but these methods are based on experience and it is difficult to state unequivocally that SWC has made use of rational and scientific methods using data. Moreover, because of the disorganization due to the civil war, there are facilities where rehabilitation and operation and maintenance have not been performed adequately. In such facilities, the original functions have not been fully realized. To transfer technology for scientific and rational operation and management for the new water supply

facilities to be constructed is significant even for the overall operation and maintenance of the water supply system of Kassala City; therefore, the project includes plans to transfer technology related to operation and maintenance of water supply facilities through soft components. The transfer of technology will consider the existing status of operation and maintenance at the existing WTPs and its components include the following topics. The details of soft component plan are shown in Appendix-6.

(1) Objectives

Guidance is to be given mainly to the staff in charge of management, operation and maintenance of WTPs to be newly constructed, and the staff of the concerned departments of SWC. For this purpose, the objectives of the soft components are set as below.

- ✓ To implement water distribution appropriately to suit the water demand in the Khatmia WTP in order to use energy effectively and efficiently.
- ✓ To operate the chlorination equipment in the Khatmia WTP efficiently in order to supply safe water
- ✓ To continuously operate and maintain new well facilities that deliver water to the Khatmia WTP
- ✓ To establish a system for management, operation and maintenance of the Khatmia WTP in a planned manner, and to implement continuous management, operation and maintenance of the plant.

(2) Soft Components Activities (Introduction Plan)

Soft components activities may be broadly divided into activities related to equipment and planned operation and maintenance; the former consists of lectures related to overview and handling of equipment and on-the-job training (OJT) implemented while practically operating the equipment and machinery. The training and lectures are to be implemented for distribution pumps, chlorination equipment, receiving wells, and reservoirs. Tests and trials of equipment complete the activities, and these are implemented at the stage when handing over preparations have been made.

a. Distribution pump
- ✓ Preparations for operation management manual
- ✓ Seminars on operation of distribution pumps according to the demand
- ✓ OJT on the operation of distribution pumps

b. Chlorination equipment
- ✓ Seminar on functions and operation of chlorination equipment
- ✓ OJT on operation of chlorination equipment

c. New well facilities
- ✓ Seminar on new well facilities
- ✓ OJT on operations of new well facilities

d. Planned operation and maintenance
- ✓ Periodic inspection of equipment
- ✓ Inventory control of spare parts
- ✓ Equipment renewal plan

2-2-4-9 Implementation Plan

The rehabilitation of the two exiting WTP, Mahta WTP and Garb WTP, are expected to be implemented in advance apart from other components because their rehabilitation is considered to be urgent needs.

The implementation schedule of the project will be as shown in Fig. 2-8 and 2-9 respectively.

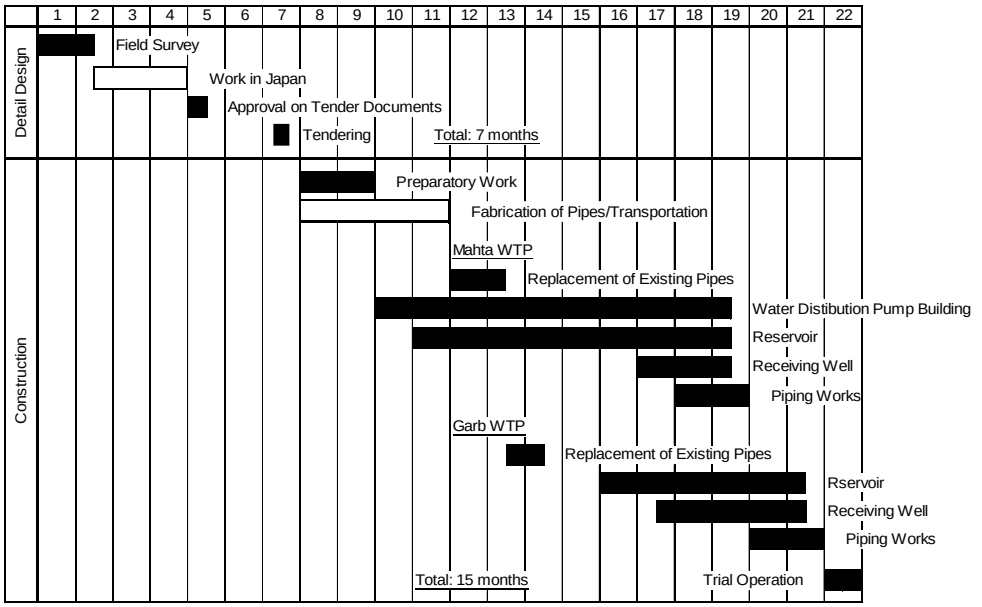


Fig. 2-8 Schedule of project implementation stages (Rehabilitation Project)

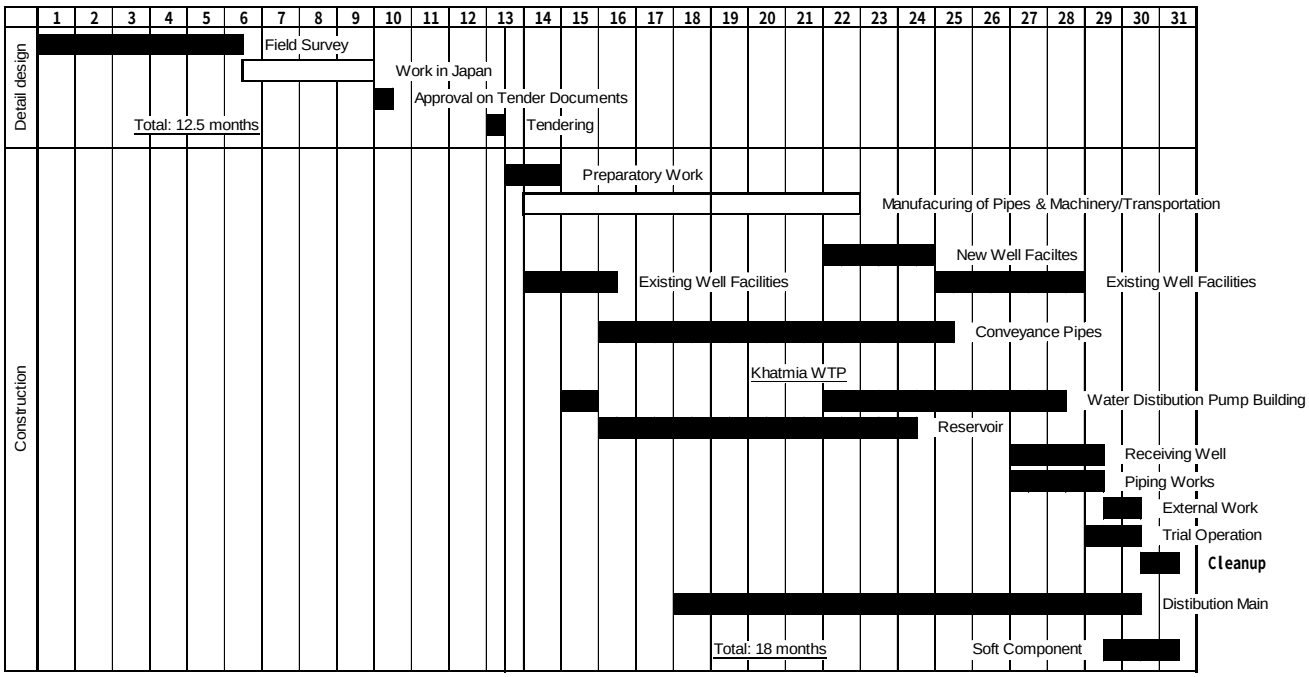


Fig. 2-9 Schedule of project implementation stages (Expansion Project)

2-3 Obligations of Recipient Country

The obligations of the Sudanese side with relation to the implementation of the Project are as follows:

① Provision of necessary data and materials for the project

② Ensuring safety at the project sites

③ Payment of commissions for Banking Arrangements (B/A) and Authorization to Pay (A/P)

④ Quick loading and unloading, and customs clearance procedures for the materials and equipment for construction procured for the project

⑤ Adoption of measures for exemption from taxation for the materials and equipment to be brought into Sudan by Japanese personnel, taxes on subcontracts for the procurement of the materials and equipment, and the execution of services based on the approved contract

⑥ Appropriate use and operation and maintenance of facilities constructed in the project

⑦ In addition, ensuring required human resources for implementing the project, such as engineers for SWC listed below, and bearing the expenses for the land and spaces belonging to the SWC which will not be appropriated from the Japanese Grant Aid.

Table 2-28 Overview of obligations of the Sudanese side (rehabilitation)

Items	Remarks
(1) Provision of temporary yard (partial area of construction land for south WTP)	The spaces belong to SWC, and they will be free of charge.
(2) Secure lands for facilities including construction lands and access roads.	The land acquisition will be necessary only for the construction of water supply facilities for the areas, but all the facilities are planned to be constructed in the public lands. It is not difficult to acquire such lands.
(3) Land leveling and removal of the trees and existing facilities inside the construction area	SWC will carry out by dispatching engineers and technical staff of SWC.
(4) Preparation of a disposal site for the surplus soil generated at construction work	The disposal site is appropriate area instructed by SWC.
(5) Provision of the electric power line to the project area (415V)	The existing transformer of Mahta WTP is required to be upgraded due to lack in capacity. In contrast, the existing transformer of Garb WTP can be used.
(6) Removal and disposal of existing facilities after changeover of the existing and renewal constructed facilities	Existing facilities do not affect on renewal facilities. SWC will carry out this work if necessary.
(7) Cooperation for connection work between the existing facilities and renewal facilities (witness during the connection work and coordination for the stop of water supply, if required)	SWC will dispatch engineers and technical staffs for this.
(8) Construction of the fence and gate (Mahta WTP)	SWC will dispatch engineers and technical staffs for this.
(9) Water supply for leakage test	Water for leakage test will be supplied from the existing WTP.
(10) Personnel Assignment for Project Implementation	SWC will dispatch engineers and technical staffs for this.

Table 2-29 Overview of obligations of the Sudanese side (expansion)

Item	Timing of execution	Remarks
1. Existing wells		
(1) Ensuring site	Boundary verification: Within one month after contract with the Japanese Consultant firm. Land use permission: Before construction start at latest	Since there are existing wells for which the site boundaries are not clear, site should be ensured by establishing the site boundaries.
(2) Soil preparation in site and removal of trees, etc.	Before construction start at latest	Prepare the soil within the site area, and remove trees, shrubs, etc.
(3) Replacement of power supply equipment on the primary side	Before electric construction start at latest	Renew power supply equipment on the primary side that has deteriorated.
(4) Emergency generator equipment	Before electric construction start at latest	Replace existing well pumps, and renew generators that have deteriorated or have inadequate power generating capacity.
(5) Installation of fences and gates	Before handing over	Install fences and gates to ensure and maintain safety of well facilities.
2. New wells		
(1) Ensuring site	Boundary verification: Within one month after contract with the Japanese Consultant firm. Land use permission: Before construction start at latest	Although the scheduled site for well is public land, the boundaries should be established and the necessary site should be ensured.
(2) Soil preparation in site and removal of trees, etc.	Before construction start at latest	Prepare the soil within the site area, and remove trees, shrubs, etc.
(3) Drawing power and installing power supply equipment on the primary side	Before electric construction start at latest	Since power is not being supplied to the area containing new wells, install power supply equipment on the primary side for drawing power.
(4) Install fences and gates	Before handing over	Install fences and gates to ensure and maintain safety of well facilities.
3. New WTP		
(1) Ensuring site	Boundary verification: Within one month after contract with the Japanese Consultant firm.	Site for new WTP has already been ensured, but erect strong side stakes to demarcate the site boundaries.
(2) Soil preparation in site and removal of trees, etc.	Before construction start at latest	Soil preparation at the site is already completed; remove trees, shrubs, etc.
(3) Provision of temporary sites for work	Before construction start at latest	Provide temporary site for work within the new WTP.
(4) Access roads	Before construction start at latest	Although access roads have been ensured along the dike, there are locations where trees project on to the public roads. The projecting branches must be pruned or the trees removed.
(5) Drawing power and installing power supply equipment on the primary side	Before construction start at latest	Since power is not being supplied to the area containing WTP, install power supply equipment on the primary side for drawing power.
(6) Provision of water for water filling tests	Before water filling test	Water is ensured and provided by conveying it to the WTP from the water source wells.
(7) Installation of fences and gates	Before handing over	Install fences and gates to ensure and maintain safety of the WTP.
4. Conveyance pipes and distribution mains		
(1) Cooperation related to request for exclusive use of roads and rivers	Before construction start	Before the work of laying raw water and distribution mains, cooperate to complete formalities of the organization that manages roads and rivers for their exclusive use.
(2) Pruning and removing trees, shrubs, etc., in roads	Before construction start at latest	Trees, shrubs, exist in roads on the raw water and distribution pipeline routes. If these obstruct pipe laying work, prune or remove them.
(3) Clearing objects on the road	Before construction start at latest	Clear concrete blocks or other objects such as signboards remaining on roads.
(4) Suspension of water supply because new pipe or existing pipe connections	Before and during connection works	Cooperate with the residents during suspension of water supply when new pipes or existing pipes are to be connected by notifying the residents and witnessing the connection work.
5. Others		
(1) Disposal area for surplus soil from the work	Before all construction start	SWC to specify the disposal location after discussion with Kassala City.
(2) Project implementation	During all construction works	SWC to station engineers and to cooperation in the project implementation.

2-4 Project Operation Plan

The WTPs in Kassala East and West will be operated and maintained by the east office and the west office respectively after completion of the project. The total number of staffs in the east office is 159 and 57 in the west office. The number of operational staff for WTP in the east office is 16 and 8 in the west office. The existing facilities have been maintained under the 24-hour duty system in both offices. From the satisfactory result of actual achievement in the past, it is understood that they have acquired sufficient experiences and skills of O&M work concerning to the WTP. It is expected that SWC with the present system can smoothly carry out O&M work for the WTP after the completion of the project.

(1) Existing WTPs to be rehabilitated

1) Mahta WTP (East District)

The O&M staffs in Mahta WTP consist of one supervisor, 4 senior staffs 1 engineer, 9 operators and 1 driver. The 4 rotating - shift is applied in which one shift is made from one senior staff and 2 operators. The items of O&M include O&M of pumps, control of water level in reservoirs, O&M of chlorination equipment and generators. The O&M of 4 wells' every day operation (start and stop) is included additionally. Although the existing facilities are degraded due to aging, the fact of having been operated continuously indicates that the considerable operational capability has been maintained. After completion of the project, the maintenance of new reservoir's water level becomes easier and new distribution pump makes it easy to operate. Under this condition, it is considered that the changing of existing O&M system concerning number of staff and shift performance is not necessary to change. On top of that, the reconstruction of water station makes it possible to operate water source pumps to operate 24 hours instead of 20 hours in old system. Due to this change, surrounding pump's O&M works including every day's start and stop is not required anymore and thus only the O&M of wells becomes necessary. The O&M of the water station will be implemented without problems as far as the staff understands the O&M procedure through the explanation and on the job training at the time of commissioning.

2) Garb Water Station (West District)

The O&M team in Garb Water Station consists of one supervisor, 4 senior staff and 4 operators. The 3-shift rotation is applied. One senior staff and one operator are allocated for one shift and another one team is standing by for any emergency situation. The items of O&M work are same as the east office. Even if the scale of the facility is smaller than that of east office, the duty of staff in the east office may be heavier when compared with the one in the east office. As is same with east office, although the existing facilities are degraded due to aging the continuous operation has been implemented. The actual result mentioned above tells that the level of capacity for O&M work fulfills the basic requirement. Under the project, the reservoir will be reconstructed but the renewal of pumps is not included, therefore the basic O&M situation is not changed.

Under the status quo environment regarding O&M practices as mentioned above, it is recognizable that additional maintenance staffs are not required for the new water station. In Table 2-30, O&M practices at present and after the completion of the project are shown.

Table 2-30 Number of O&M staff (present & additional) in Mahta and Garb WTPs

Facility	Present	After completion of the project	Additional Staff
Mahta WS (East Area)	16 persons (Day time:5、Night:3) Start and Stop of 4 wells(every day)	16 persons (Day time: 5、Night:3) supervising only	-
Garb WS (west Area)	8 persons (Day time: 3、Night : 2)	8 persons (Day time: 3、Night : 2)	-

(2) Khatmia WTP to be newly constructed

1) Operation Formation

The rehabilitated Mahta WTP is expected to be operated by the present staff who will shift to the plant as 14 staff members working in 4 shifts. Although the Mahta WTP and the Khatmia WTP differ in scale, the equipment configurations in both plants are basically the same. Therefore, the operating system of the Khatmia WTP has the same form as that of the Mahta WTP. However, the Khatmia WTP is expected to manage the new well facilities (new well facilities will be unmanned and no permanent staff will be stationed there). One member will be increased in each team so that four new members will be added to form a system consisting of 18 staff members.

After completion of the project, water will be supplied for full 24 hours instead of 20 hours of water supply (no supply late night). Each shift will be of 8 hours duration with three shifts in a day in the WTP. Accordingly, the staff of the WTP will work for 3 days and take one day off, so that the rotation is every 4 days.

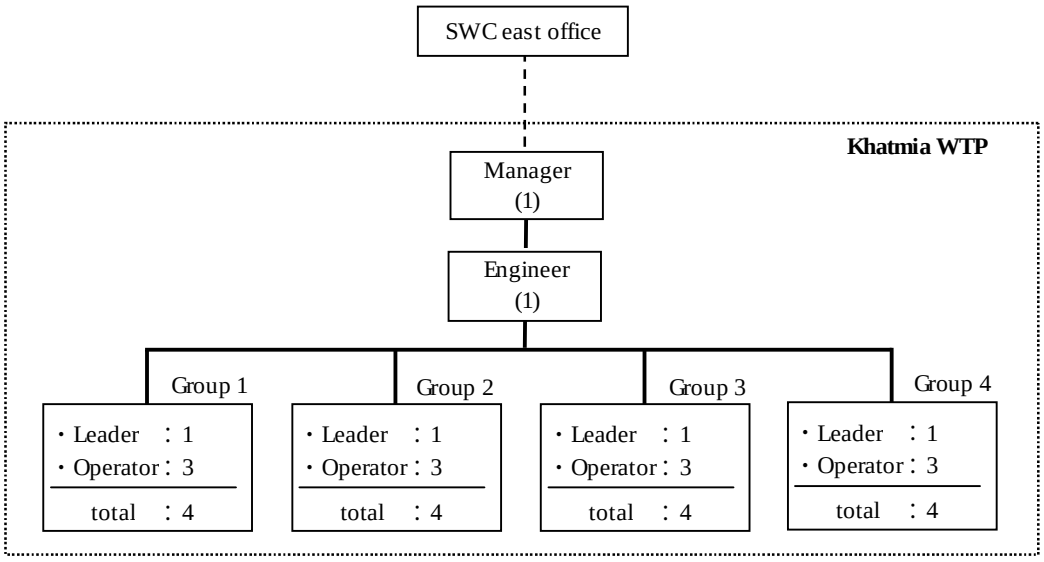


Fig. 2-10 O&M formation of the Khatmia WTP

2) Technical Transfer of O&M

As there is a possibility that the staffs belonging to the Khatmia WTP have no experience in working at the WTP, the necessary lectures and training for O&M of WTPs will be charged to the said staffs. The lectures and training will be planned so that the two technical cooperation programs being

implemented by Japanese side in Sudan, will be linked. Initial operational guidance on equipment by the contractors implementing the project and soft components by the Japanese consultants will be combined, and efforts will be made to ensure effective transfer of O&M techniques.

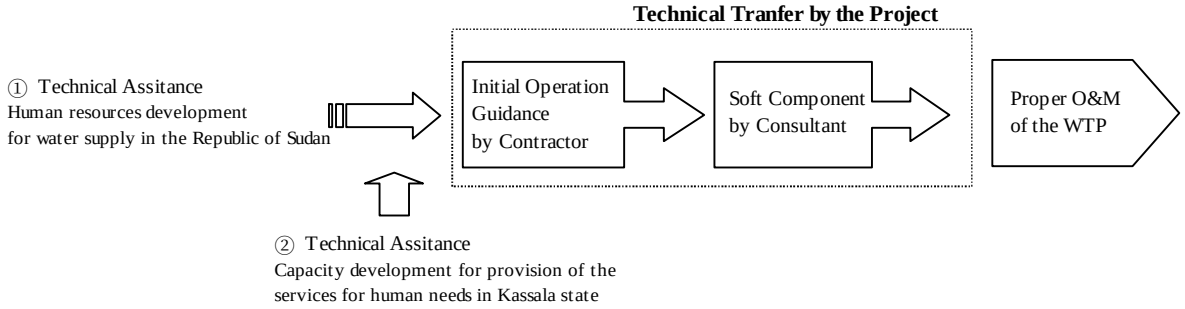


Fig. 2-11 Technical assistance flow to the staffs of the Khatmia WTP

An overview of the technical programs is given below.

① Technical Program "Capacity Development Project for Water Sector"

The purpose is to develop human resources related to the water sector in each state of Sudan. The personnel will be assembled at the Research Center in Khartoum and training will be given to them. SWC has also dispatched personnel, and henceforth too, SWC's participation will be proposed. Past trainees included many from the management cadre; therefore, this time young staff members responsible for the actual work will be selected for training.

② Technical Program "Capacity Development Project for Provision of Services for Basic Human Needs in Kassala"

The capacity development is aimed at the 4 sectors of water, agriculture, sanitation, and occupational training. The program is scheduled to be implemented for a period of 3 years from November 2010 to October 2013 for the administrative organizations of Kassala State. The water sector items include: 1. Improving operation and maintenance technologies for the distribution network; 2. Improving operation and maintenance technologies of WTP for village water supply; 3. Improving the financial management performance. Items 1. and 3. above are relevant to the project. The said technical programs and the project overlap over a fairly long period; therefore, as far as possible, the technical programs must be linked with the project so that activities are implemented efficiently.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

2-5-1-1 Cost Estimation of the Rehabilitation Project

(1) Costs covered by Sudanese Side (487.2 thousand SDG (19.5 Million JPY)

The costs covered by Sudanese side are listed in Table 2-31.
According to the taxation system of the recipient country, the value-added tax (VAT) and import duties imposed on industrial materials to be procured with Grant Aid.

Table 2-31 Costs covered by Sudanese Side (Rehabilitation Project)

(Unit: Thousand SDG)

Items	Costs	Remarks
1. Mahta WTP		
(1) Provision of temporary yard (partial area of construction land for south WTP)	-	The spaces belong to SWC, and they will be free of charge.
(2) Secure lands for facilities including construction lands and access roads.	-	As construction lands belong to SWC, it is not necessary to acquire new land.
(3) Land leveling inside the construction area	168.3	
(4) Slope protection	121.5	
(5) Moving work of trees	0.9	
(6) Provision of the electric power line to the project area (415V)	55.8	Upgrading existing transformer
(7) Construction of the fence and gate	87.0	
(8) Water supply for leakage test	17.3	
(9) Personnel and other expenses	19.6	
Sub total	470.4	
2. Garb WTP		
(1) Provision of temporary yard (partial area of construction land for south WTP)	-	The spaces belong to SWC, and they will be free of charge.
(2) Secure lands for facilities including construction lands and access roads.	-	As construction lands belong to SWC, it is not necessary to acquire new land.
(3) Land leveling inside the construction area	-	
(4) Moving work of trees	1.6	
(5) Provision of the electric power line to the project area (415V)	-	The existing transformer is available
(6) Construction of the fence and gate	-	
(7) Water supply for leakage test	7.7	
(8) Personnel and other expenses	-	Including that of Mahta WTP
Sub total	9.3	
3. Charge of B/A	7.5	
Total	487.2	-

(2) Conditions of Cost Estimate

<Time of Cost Estimate>
The project cost estimate is based on prices and exchange rates as of September 2010.

<Exchange Rates>
The exchange rate of the average from March 2010 to August 2010 is applied for the cost estimate.

- 1 USD = 90.90 JPY
- 1 USD = 2.28 SDG
- 1 SDG = 39.8684 JPY

2-5-1-2 Cost Estimation of the Expansion Project

(1) Costs covered by Sudanese Side (777.3 thousand SDG (29 Million JPY)

The costs covered by Sudanese side are listed in Table 2-32.
According to the taxation system of the recipient country, the value-added tax (VAT) and import duties imposed on industrial materials to be procured with Grant Aid.

Table 2-32 Costs covered by Sudanese Side (Rehabilitation Project)

(Unit: thousand SDG)

Item	Cost	Remarks
1. Existing wells		
(1) Ensuring site	-	This is site owned by SWC.
(2) Soil preparation in site and removal of trees, etc.	5.6	
(3) Replacement of power equipment on the primary side	12.5	Renew deteriorated and old equipment.
(4) Emergency generator equipment	125.0	Renew deteriorated and inadequate capacity generators.
(5) Installation of fences and gates	122.2	
Sub-total	265.3	
2. New wells		
(1) Ensuring site	-	Free because this is public land.
(2) Soil preparation in site and removal of trees, etc.	5.9	
(3) Drawing power and installing power supply equipment on the primary side	-	Included in the WTP.
(4) Installation of fences and gates	134.4	
Sub-total	140.3	
3. New WTP		
(1) Ensuring site	-	This is site owned by SWC.
(2) Soil preparation in site and removal of trees, etc.	1.6	
(3) Provision of temporary sites for work	-	This is site owned by SWC.
(4) Access roads	0.6	Prune and remove trees on roads.
(5) Drawing power and installing power supply equipment on the primary side	241.9	Including new wells
(6) Provision of water for water filling tests	23.0	
(7) Installation of fences and gates	64.7	
Sub-total	331.8	
4. Conveyance pipes and distribution main		
(1) Pruning and removing trees, shrubs, etc., in roads	0.6	
(2) Clearing objects on the road	-	To be borne by owner
Sub-total	0.6	
5. Others		
(1) Project implementation cost	24.3	
(2) Bank commission	15.0	
Sub-total	39.3	
Total	777.3	

(2) Conditions of Cost Estimate

<Time of Cost Estimate>
The project cost estimate is based on prices and exchange rates as of December 2010.

< Exchange rate >
The exchange rate of the average from June to November 2010 is applied to the cost estimate.

- 1 USD = 86.61 JPY
- 1 USD = 2.28 SDG
- 1 SDG = 36.71 JPY

2-5-2 Operation and Maintenance (O&M) Cost

The O&M cost of Garb WTP in the west district will not be changed because of any rehabilitation of mechanical & electrical facilities. Therefore, this clause describes the O&M cost of the water supply facilities in the east district.

1) Increase in O&M cost due to rehabilitation of Mahta WTP

The rehabilitation works of the Mahta WTP includes increasing the capacity of the reservoir, rehabilitating aged facilities and increasing operation time of the existing wells from 20 hours to 24 continuous hours. In addition, the number of water distribution pumps increases from three to five. Such a rehabilitation of the facilities results in increase in O&M cost of 435,075 SDG (equivalent to JPY 16 million).

Table 2-33 Increase in O&M cost of due to rehabilitating Mahta WTP

SDG/year

Expense item	Before rehabilitation	After rehabilitation	Difference	Remarks
Personnel	62,224	62,224	0	Staffs at present continue to work
Electricity	619,107	1,045,024	425,917	Incl. 15 source wells
Fuel for power generator	150,822	150,822	0	Actual cost before rehabilitation
Chlorine gas	1,350	14,506	13,156	
TOTAL	833,523	1,272,576	439,075	

Note) Fuel expense after rehabilitation uses same cost as before rehabilitation although it seems to be greatly decreased by the improvement of electricity condition.

2) Increase in O&M cost due to expansion of the facilities

After completion of the Project, the Khatmia WTP and new well facilities at 11 locations will be ready, and the O&M costs will increase. Existing well facilities at 10 locations will operate for 24 hours instead of 20 hours; the operating cost for this increasing time will increase. As shown in the following table, the increase in the O&M costs because of implementing the Project is 788,429 SDG, which is equivalent to approximately 31 million Japanese yen.

Table 2-34 Increase in O&M cost due to expansion of the facilities

SDG/year

Item		Cost increase (SDG/year)	Percentage (%)	Remarks
Personnel expenses		80,000	10	for staffs of the Khatmia WTP
Electricity charge	Khatmia WTP	476,982	60	75 kW per distribution pump
	New wells (11)	148,876	19	51.5 kW of 11 new wells
	Existing wells (10)	29,582	4	due to operating time from 20 to 24 hours
	Sub-total	655,440	83	
Fuel charge (generator)		32,772	4	5% of the total electricity charge
Chlorine gas charge		20,217	3	Average chlorine dosing rate of 1 mg/L
Total		788,429	100	

Notes: Significant improvements are anticipated in the power situation in the target year. For this reason, the cost of fuel used in emergency generator is likely to decrease considerably from the present cost; however, the electricity charges have been appropriated as 5%.

As shown in the table above, electricity charges account for 83% of the operation and maintenance cost, and a major part of the electricity charges is incurred for operating the distribution pumps of the Khatmia WTP. To reduce the operation and maintenance cost, it is important to reduce the electricity charges. In the project, the system of controlling the number of distribution pumps in operation is adopted, and pump operation at high efficiency is planned according to the fluctuation in demand.

3) Revenue and expenditure

The O&M cost increases about 1,227,588 SDG (equivalent to 45 million yen). The population of connected households will increase to 79,260 persons (population and percentage connected will increase) in the target year 2016. This corresponds to approximately 14,410 persons subscribing to the water supply system (1 household taken as 5.5 persons). If the class of the majority of the persons subscribing to the water supply is considered as Class 3, and the established water tariff of 1/2 inch size water supply connection is taken as 17 SDG/ month-household, the increase in annual revenue from water tariff by implementing the project becomes 2,940,000 SDG (about 117 million yen), and this can adequately cover the increase in operation and maintenance cost of 1,227,588 SDG (equivalent to 45 million yen).

CHAPTER 3 PROJECT EVALUATION

Chapter 3 Project Evaluation

3-1 Preconditions

(1) Securing Land for Construction and Temporary Facilities

There are no problems concerning construction site, as the rehabilitation work of the existing WTP will take place within its premises, and the land, on which the new Khatmia WTP is to be constructed, has already been acquired by SWC from its previous owner. In addition, the 11 new wells will be constructed on public land owned by the Kassala State Government, which has approved the use of the land. The construction site of Khatmia WTP is large enough to enclose temporary facilities, construction office, storage space of materials, workshop, and other facilities needed for the construction work. However, the State Water Corporation (SWC) needs to put boundary stakes in order to prevent potential border dispute with the owners of the adjacent lots after the start of the operation.

(2) Responsibility of the Recipient Country

Budget appropriation needs to be made to ensure that the undertakings of the Sudanese side will be carried out without delay.

(3) Security Situation

As a result of the referendum held in January 2001, Southern Sudan will become independent as of July 2011, which will likely cause instability in the security situations. Thus, no violent change in the country's security is a prerequisite for the implementation of the Project.

3-2 Necessary Inputs by Recipient Country

Listed below are the tasks, which the Sudanese side needs to perform as prerequisites for achieving the overall goal of this Project.

(1) Harnessing the Operation/Maintenance Capacity Enhanced by Technical Cooperation

In parallel to the Project, two technical cooperation projects (namely, "Capacity Development Project for Water Sector" and "Capacity Development Project for Provision of Services for Basic Human Needs in Kassel") are being implemented. The former intends to develop the capacity of personnel engaged in waterworks administration in northern states of Sudan, and the latter aims to enhance the administrative capacity of the Kassala State personnel in four sectors. Both projects are closely related to SWC. The latter, especially, aims to enhance SWC's capacity for maintaining the water distribution network and managing financial affairs, and, together with the soft components of the Projects for transferring techniques to operate and maintain WTPs, is designed to strengthen SWC's capacity for administering waterworks projects. The waterworks facilities, after their completion, need to be properly operated and maintained on a continuous basis by these organizations and personnel who will be receiving technical training.

(2) Installation of New Electric Service Cables

Since there are no electric service cables around the wells facilities and WTP to be newly constructed, new ones need to be installed to connect to the new facilities. Installation of service

cables is a prerequisite for the operation of the water supply facilities and takes up a large portion of the cost to be borne by the Sudanese side, which, therefore, needs to make sufficient budget appropriation to ensure that the electric infrastructure is in place prior to the start of the electric work by the Japanese side.

(3) Upgrading of Existing Water Pipes

The main task is to replace the asbestos-cement pipes. Upgrading of the existing water pipe network will be carried out under a Sudanese project that aims to improve the water supply facilities by developing water sources and constructing WTP and distribution mains. In order to improve the water supply situations in East District, the two projects need to take their effects in a similar manner. Thus, in implementing these projects, communication should be established between the two to share information especially concerning construction schedule, which needs to be discussed at periodic meetings.

(4) Financial Wellbeing

Financial strengthening of SWC is essential for ensuring the sustainability of waterworks projects. One of the programs of the technical cooperation project titled "Capacity Development Project for the Provision of Services for Basic Human Needs in Kassala State" is transition to the water charge system based on meter size. Also, SWC needs to develop a capacity to prepare its financial statements according to the International Financial Reporting Standards and implement other measures to improve its financial wellbeing. Since training on preparing a customer ledger and basic financial statements is to be conducted under the currently ongoing technical cooperation project, SWC is expected to utilize these programs to actively engage in the strengthening of its financial standing.

3-3 Important Assumptions

(1) Subsidy from the State Government

SWC is required to use a self-supporting accounting system and did not receive any subsidy from the state government until 2008. This forced SWC to run the waterworks business only with the revenues from water charges, which were barely enough to pay for the personnel and O&M costs, but not enough to cover the facility repair/upgrading costs, which contributed to the deterioration of the water supply facilities. The state government began providing subsidies in 2009, enabling SWC to appropriate budget for facility upgrading. Normally, waterworks projects are expected to run on revenues from water charges alone. For SWC to become self sufficient, it needs to consider adopting a water meter system and revising the water rates, the actualization of which needs to wait until the currently implemented technical cooperation projects take their effect. Therefore, subsidies from the state government need to continue until SWC builds its financial strength as a result of the technical cooperation.

(2) Continuity of Organizations and Personnel

In order for the water supply facilities to be operated and maintained on a sustainable basis after the completion of the Project, they need to be maintained by the same organizations and personnel (without reorganization or personnel transfer) that received the soft components of the Project and technical training under the technical cooperation projects.

3-4 Project Evaluation

3-4-1 Rehabilitation Project

(1) Relevance

a. Beneficiaries

People who are possibly affected by the accident of the reservoir burst are regarded as beneficiaries.

East District (population served by Mahta WTP)	West District (population served by Garb WTP)
61,388 persons	28,888 persons

b. Project Objectives and Basic Human Needs (BHN)

The Project aims to improve the living environment of the residents by ensuring uninterrupted supply of safe water disinfected with chlorine and, therefore, contributes to the satisfaction of basic human needs of the residents of the target area.

c. Operation and Maintenance Technique

The equipment configuration of the WTPs to be rehabilitated or newly constructed will be the same as that of the existing WTPs, which are basically operated manually on site. In regards to the operation of new WTPs, technical cooperation projects are being implemented concurrently with the Project, which includes soft components related to facility operation, in order to develop the recipient's capacity for water facility operation/maintenance and organizational management before the completion of these facilities. Therefore, it is possible for the current personnel to properly operate and maintain the facilities provided by the Project.

d. Mid- to Long-Term Plans and Goals

In its 7-year water strategic plan (2011 – 2016) for the water sector, the government of Kassala State lists the rehabilitation of the existing water supply facilities and expansion of new facilities in the East and West Districts of Kassala City among the specific targets of its own projects. Therefore, the Project is in alignment with the policy of the government of Kassala.

e. Profitability

Profitability of a waterworks project is greatly dependent on the appropriate setting of water rates and collection method, which are being investigated and analyzed as part of the technical cooperation projects currently in progress. In this survey, we estimated the increase in the maintenance cost and the increase in water charges after the completion of the facilities, and confirmed that the latter would be more than enough to cover the former.

f. Environmental and Social Consideration

As a result of the environmental scoping conducted as part of this survey, it was determined that the implementation of the Project would not cause serious environmental or social impact (see Appendix-6). Mitigation measures against possible negative environmental impact during construction and after the startup of the facilities have already been clearly established, and SWC is in the process of obtaining an environmental permit from Kassala State for the implementation of the Project on condition that such mitigation measures will be taken (the environmental permit is scheduled to be granted at the end of June 2011).

g. Feasibility of Japan's Grant Aid

No particular difficulties are expected in implementing this Grant Aid Project unless the security situations in Sudan dramatically change for the worse.

(2) Effectiveness

a. Quantitative Evaluation

< Kassala East District >

As the reservoir of the Mahta WTP will be rehabilitated and the water from the existing wells will be able to be sent during 24 hours, the capacity of the Mahta WTP will increase from 9,200m^3/day to 11,050 m^3/day.

b. Qualitative Evaluation

< Kassala East District >

① Emergency repair on the existing Mahta WTP will remove the risk of breakage of the reservoir, giving a better sense of security about water services to about 61,388 residents, who are assumed to fall victims if breakage occurs.

② SWC will be able to measure flow rates at the receiving wells and use the data for managing water sources and controlling water distribution. This will set up an environment for SWC to operate the WTP in an efficient manner.

③ Construction of receiving wells at Garb WTP will enable chlorine dosing to ensure disinfection of water.

< Kassala West District >

① Emergency repair on the existing Garb WTP will remove the risk of breakage of the reservoir, giving a better sense of security about water services to about 28,888 residents, who are assumed to fall victims if breakage occurs.

② Construction of receiving wells at Garb WTP will enable chlorine dosing to ensure disinfection of water.

③ SWC will be able to measure flow rates at the receiving wells and use the data for managing water sources and controlling water distribution. This will set up an environment for SWC to operate the WTP in an efficient manner.

3-4-2 Expansion Project

(1) Relevance

a. Beneficiaries and Population

Of about 170,000 people (2009 estimation) living in East District, about 125,000 persons (73%) have access to water services through house-connected water supply pipes. However, due to lack of supply water, only about 86,000 people (50%) are receiving household water services without outage

all year round. The remaining 23% or about 39,000 people have to buy water from private water carriers (donkey water vendors) during the peak months even though they are connected to water service pipes.

The Project aims to provide uninterrupted household water services to all residents throughout the year. The design population to receive water services in the target year of 2016 is estimated at 204,739 persons.

b. Project Objectives and Basic Human Needs (BHN)

The Project aims to improve the living environment of the residents by ensuring uninterrupted supply of safe water disinfected with chlorine and, therefore, contributes to the satisfaction of basic human needs of the residents of the target area.

c. Operation and Maintenance Technique

The equipment configuration of the Khatmia WTP to be rehabilitated or newly constructed will be the same as that of the existing WTPs, which are basically operated manually on site. In regards to the operation of new WTP, technical cooperation projects are being implemented concurrently with the Project, which includes soft components related to facility operation, in order to develop the recipient's capacity for water facility operation/maintenance and organizational management before the completion of these facilities. Therefore, it is possible for the current personnel to properly operate and maintain the facilities provided by the Project.

d. Mid- to Long-Term Plans and Goals

In its 7-year water strategic plan (2011 – 2016) for the water sector, the government of Kassala State lists the rehabilitation of the existing water supply facilities and expansion of new facilities in the East and West Districts of Kassala City among the specific targets of its own projects. Therefore, the Project is in alignment with the policy of the government of Kassala State.

e. Profitability

Profitability of a waterworks project is greatly dependent on the appropriate setting of water rates and collection method, which are being investigated and analyzed as part of the technical cooperation projects currently in progress. In the survey, we estimated the increase in the maintenance cost and the increase in water charges after the completion of the facilities, and confirmed that the latter would be more than enough to cover the former.

f. Environmental and Social Consideration

As a result of the environmental scoping conducted as part of the survey, it was determined that the implementation of the Project would not cause serious environmental or social impact (see Appendix-6). Mitigation measures against possible negative environmental impact during construction and after the startup of the facilities have already been clearly established, and SWC is in the process of obtaining an environmental permit from Kassala State for the implementation of the Project on condition that such mitigation measures will be taken (the environmental permit is scheduled to be granted at the end of June 2011).

g. Feasibility of Japan's Grant Aid

No particular difficulties are expected in implementing the Grant Aid Project unless the security situations in Sudan dramatically change for the worse.

(2) Effectiveness

a. Quantitative Evaluation

Index	Reference (2009)	Target (2016)
Average daily production of water	21,300m^3/day	33,300m^3/day
Population receiving household water services	125,479 persons	204,739 persons
Percentage of population receiving household water services	73%	100%
Water use per capita per day in the target area	62 L/c/d	90 L/c/d
Percentage of chlorine dosed water	43%	80%

b. Qualitative Evaluation

① Supply shortage of water relative to demand will be resolved. Also, if the existing water pipe network is upgraded by the Sudanese side, all districts will equally receive water services, and water outage areas will be eliminated.

② All residents will receive household water services and no longer need to purchase expensive water from private vendors. Increased convenience in water use will improve the residents' living standards.

③ Increased percentage of chlorine dosed water, as well as decreased risk of contamination because of 24-hours/day continuous water supply, will put the residents at ease about the quality of municipal water and increase their sense of trust in the water supply services.

④ Increased revenue from water charges as a result of increased number of subscribers to water services will contribute to SWC's financial wellbeing and stabilize its waterworks operations.

⑤ More detailed data on water production and distribution will become available from the flow meters to be installed at the water source wells and new WTP, enabling SWC to manage water sources and control water distribution more efficiently.

In view of the foregoing, the appropriateness of implementing the Project as a grant aid project and the effectiveness thereof are deemed high, as it will contribute to the improvement of the living environment for about 210,000 people living in Kassala City East District, as well as protecting about 29,000 residents in West District from the risk of water service stoppage caused by breakage of the existing reservoir.

Appendix-1 Member List

Appendix-2 Study Schedule

Appendix-3 List of Persons Concerned

Member List of the Survey Team

1. Preparatory Survey

Name	Title	Organization	Mission Period
Mr.SASAKI Yosuke	Team Leader	Visiting Senior Advisor, Water Resources Management Division 2, Water Resources and Disaster Management Group, Global Environment Department, JICA	Mar 2 to Mar 12, 2010
Mr.MATSUZAKI Terumasa	Planning management	Water Resources Management Division 2, Water Resources and Disaster Management Group, Global Environment Department, JICA	Mar 2 to Mar 12, 2010
Mr.HOMMA Makoto	Chief Consultant/Water Supply Planning/O&M Planning	Tokyo Engineering Consultants Co., LTD.	Mar 2 to Mar 31, 2010 May 14 to Jul 12, 2010 Aug 2 to Sep 30, 2010 Nov 18 to Dec 24, 2010
Mr.OZAKI Komei	Hydro-geological Survey/Groundwater Simulation/ Facility Design 2	Tokyo Engineering Consultants Co., LTD.	Mar 2 to Mar 31, 2010 May 14 to Jul 12, 2010 Aug 2 to Sep 30, 2010 Nov 28 to Dec 17, 2010
Mr.ISHIDA Yasunori	Geophysical survey	Eight-Japan Engineering Consultants INC.	May 15 to Jul 13, 2010
Mr.KITA Takaho	Test drilling/Groundwater quality analysis	OYO International Corporation	May 14 to Sep 10, 2010
Mr.IWASAKI Katsutoshi	Social survey1/Environmental and Social Consideration	Tokyo Engineering Consultants Co., LTD.	May 14 to Jul 27, 2010 Aug 16 to Sep 14, 2010 Nov 28 to Dec 17, 2010
Mr.SUGAYA Masahiro	Economic and Financial survey	Tokyo Engineering Consultants Co., LTD.	Aug 17 to Sep 15, 2010
Mr.NAKATAKE Syunichi	Facility Design1	Tokyo Engineering Consultants Co., LTD.	May 14 to Jun 28, 2010 Aug 17 to Sep 15, 2010 Sep 5 to Sep 24, 2010
Mr.KAWACHI Masahiro	Pipe Facility Design/GIS	Tokyo Engineering Consultants Co., LTD.	May 14 to Jul 5, 2010

			Aug 17 to Sep 30, 2010 Nov 18 to Dec 17, 2010
Mr.IWASHIGE Hiroto	Construction and Procurement Planning1/Cost Estimation1	Tokyo Engineering Consultants Co., LTD.	Nov 18 to Dec 17, 2010
Mr.KUBOSAKI Yoshikata	Coordinator/Social Survey2/Construction and Procurement Planning2/Cost Estimation2	Tokyo Engineering Consultants Co., LTD.	Mar 2 to Mar 31, 2010 May 14 to Jul 12, 2010 Aug 8 to Sep 1, 2010

2. Explanation of the Draft Report 1

Name	Title	Organization	Mission Period
Mr.SASAKI Yosuke	Team Leader	Visiting Senior Advisor, Water Resources Management Division 2, Water Resources and Disaster Management Group, Global Environment Department, JICA	Sep 10 to Sep 22, 2010
Mr.SAHARA Jyuichiro	Planning management	Assistant Director, Water Resources Management Division 2, Water Resources and Disaster Management Group, Global Environment Department, JICA	Sep 10 to Sep 22, 2010
Mr.HOMMA Makoto	Chief Consultant/Water Supply Planning/O&M Planning	Tokyo Engineering Consultants Co., LTD.	Sep 14 to Sep 24, 2010
Mr.KUBOSAKI Yoshikata	Construction and Procurement Planning2/Cost Estimation2	Tokyo Engineering Consultants Co., LTD.	Sep 10 to Sep 24, 2010

3. Explanation of the Draft Report 2

Name	Title	Organization	Mission Period
Mr.SASAKI Yosuke	Team Leader	Visiting Senior Advisor, Water Resources Management Division 2, JICA	May 13 to May 24, 2011
Mr.SAHARA Jyuichiro	Planning management	Assistant Director, Water Resources Management Division 2, Water Resources and Disaster Management Group, Global Environment Department, JICA	May 13 to May 24, 2011

Mr.HOMMA Makoto	Chief Consultant/Water Supply Planning/O&M Planning	Tokyo Engineering Consultants Co., LTD.	May 13 to May 24, 2011
Mr.IWASHIGE Hiroto	Construction and Procurement Planning1/Cost Estimation1	Tokyo Engineering Consultants Co., LTD.	May 13 to May 24, 2011

Study Schedule 1st stage (1)

No.	Date in 2010		[1] JICA Team Leader	[2] JICA Planning Coordinator	[3] Chief Consultant/Water Supply Planning/O&M Planning	[4] Hydro-geological Survey/Groundwater Simulation	[5] Coordinator/Social Survey 2
1	2-Mar	Tue	Tokyo→Dubai				
2	3-Mar	Wed	Dubai→Khartoum				
3	4-Mar	Thu	JICA Sudan Office, Courtesy call to Embassy of Japan, MIC, PWC				
4	5-Mar	Fri	Khartoum→Kassala				
5	6-Mar	Sat	Courtesy call to SWC/explanation of the Project/Site Visit (Existing Facility)				
6	7-Mar	Sun	Discussion on M/D / Courtesy call to Kassala Governor				
7	8-Mar	Mon	Discussion on M/D / Signing on M/D（SWC)/Water supply facility survey				
8	9-Mar	Tue	Existing Treated Water Plant Survey/Procurement survey of Implements				
9	10-Mar	Wed	Kassala→Khartoum		facility Land survey Water supply facility survey relative organization survey		
10	11-Mar	Thu	Signing on M/D（MIC) Report to Embassy of Japan・JICA				
11	12-Mar	Fri	Dubai→Tokyo		Preparation of Local Contract TOR		
12	13-Mar	Sat			Existing Treated Water Plant Survey Meeting for Technical Note		
13	14-Mar	Sun					
14	15-Mar	Mon			Kassala→Khartoum		
15	16-Mar	Tue			Report to Embassy of Japan, PWC		
16	17-Mar	Wed			Local Contractor Survey/Groundwater quality analysis Laboratory Survey/Meeting for Groundwater Simulation）	Test drilling Contractor Survey/Preparation of Test drilling Local Contract TOR	Test drilling Contractor Survey
17	18-Mar	Thu					Social Survey Local Contractor Survey
18	19-Mar	Fri					team meeting
19	20-Mar	Sat					
20	21-Mar	Sun				Drilling Contractor Nomination	Material Survey
21	22-Mar	Mon				Tendering for Test drilling （hand out TOR/interest in written form/ inquiries）	Tendering for Test drilling
22	23-Mar	Tue					SSMO
23	24-Mar	Wed					Procurement Survey
24	25-Mar	Thu					Report to PWC
25	26-Mar	Fri					team meeting
26	27-Mar	Sat					
27	28-Mar	Sun					
28	29-Mar	Mon			Report to Embassy of Japan, JICA, PWC		
29	30-Mar	Tue			Khartoum→Dubai		
30	31-Mar	Wed			Dubai→Tokyo		

Study Schedule 1st stage (2)

No.	Date in 2010		[1] Chief Consultant/Water Supply Planning/O&M Planning	[2] Hydro-geological Survey/Ground water Simulation	[3] Geophysical survey	[4] Test drilling/Ground water quality analysis	[5] Social survey1/Environmental and Social Consideration	[6] Facility Design	[7] Pipe Facility Design/GIS	[8] Coordinator/ Social Survey 2
1	14-May	Fri	Tokyo→Bangkok			Tokyo→Bangkok				
2	15-May	Sat	Bangkok→Addis Ababa→ Khartoum		Tokyo→ Dubai	Bangkok→Addis Ababa→Khartoum				
3	16-May	Sun	JICA Sudan Office, Courtesy call to Embassy of Japan, PWC		Dubai→ Khartoum	JICA Sudan Office, Courtesy call to Embassy of Japan, PWC				Project Coordination
4	17-May	Mon	Preparation for Survey	Test drilling Local Contract Coordination	Preparation for Survey	Test drilling Local Contract Coordination	Social survey Local Contract Coordination	Khartoum→ Kassala	Preparation for Survey	
5	18-May	Tue					Khartoum→ Kassala	Meeting with SWC・Field survey		Khartoum→ Kassala
6	19-May	Wed	Khartoum→ Kassala				Local Contract Coordination			Project Coordination
7	20-May	Thu	Meeting with SWC		Khartoum→ Kassala		Meeting with SWC		Khartoum→ Kassala	Meeting with SWC
8	21-May	Fri	team meeting	team meeting	team meeting	team meeting	team meeting	team meeting	Pipe Facility Survey	team meeting
9	22-May	Sat	Meeting with SWC	Test drilling Local Contract Coordination	Field survey	Test drilling Local Contract Coordination				
10	23-May	Sun	Existing Water Supply Survey		Meeting with SWC		Social survey Local Contract Coordination	Collection of SWC Financial Data/O&M Survey		Preparation for Local Contract
11	24-May	Mon			Preparation for Survey					
12	25-May	Tue			electric ／ analysis					
13	26-May	Wed		Khartoum→ Kassala	seismic prospecting	Khartoum→ Kassala				Meeting for Local
14	27-May	Thu		Existing Agri well Suvey Local Contract		Field survey	Social survey Local Contract			Project Coordination
15	28-May	Fri			team meeting	team meeting		team meeting		team meeting
16	29-May	Sat		Test drilling surveyExisting Well Survey	seismic prospecting	Meeting with Test drilling Contractor	team meeting			
17	30-May	Sun			seismic ／ analysis		Field survey	Workshop/Existing Machinery Survey		Preparation for Local Contract
18	31-May	Mon	Measuring flow rate （Reservoir/ Booster Pump/Existing Well）		electric prospecting ／analysis	Existing Well Survey				Project Coordination
19	1-Jun	Tue		Existing Well Survey			Locality Office	Machinery Survey(Past flood damage)		
20	2-Jun	Wed			seismic prospecting		UNDP			
21	3-Jun	Thu			Field Preparation		Central Bureau of Statistics	Machinery Survey		
22	4-Jun	Fri	team meeting		team meeting	team meeting	team meeting	team meeting		team meeting
23	5-Jun	Sat	Measuring flow rate （Reservoir/Booster Pump/Existing Well）		seismic prospecting	Existing Well Survey				
24	6-Jun	Sun					WES	O&M Servey （Eastern office）		Project Coordination
25	7-Jun	Mon		Existing Well Survey/Analysis of Geophysical survey/ Test drilling site survey/Collection of Groundwater Simulation			Central Bureau of Statistics			
26	8-Jun	Tue			seismic ／ analysis		CFCI			
27	9-Jun	Wed			electric ／ analysis	Preparation for Test drilling	Social survey	customer data/Financial data survey		
28	10-Jun	Thu			seismic prospecting					
29	11-Jun	Fri			team meeting	team meeting	team meeting	team meeting		team meeting
30	12-Jun	Sat	Water consumption survey		seismic prospecting					
31	13-Jun	Sun					Ministry of	Ministry of		

No.	Date in 2010		[1] Chief Consultant/Water Supply Planning/O&M Planning	[2] Hydro-geological Survey/Groundwater Simulation	[3] Geophysical survey	[4] Test drilling/Groundwater quality analysis	[5] Social survey1/Environmental and Social Consideration	[6] Facility Design	[7] Pipe Facility Design/GIS	[8] Coordinator/ Social Survey 2
32	14-Jun	Mon		Collection and analysis of Groundwater Simulation/ Analysis of Geophysical survey/Existing Agri well Suvey/Past flood damage survey	seismic ／ analysis	Preparation for Test drilling	Finance	Finance		Project Coordination
33	15-Jun	Tue			electric ／ analysis		Physical Planning	O&M Servey （customer/ Water Fee）		
34	16-Jun	Wed			seismic prospecting		Meeting with SWC			
35	17-Jun	Thu								
36	18-Jun	Fri			team meeting	team meeting	team meeting	team meeting		team meeting
37	19-Jun	Sat	Meeting with Technical Cooperation Project Team		seismic prospecting	Preparation for Test drilling				
38	20-Jun	Sun			seismic ／ analysis	Meeting with SWC	Environmental and Social Consideration Survey	Financial data survey		Project Coordination
39	21-Jun	Mon	Garb WTP, West Exsiting well	Collection and analysis of Groundwater Simulation/Analysis of Geophysical survey/Past flood damage Survey,/West side Existing Well Survey	electric prospecting ／analysis	Preparation for Test drilling				
40	22-Jun	Tue						Analysis of the data		
41	23-Jun	Wed	Water consumption survey		seismic prospecting			Kassala→ Khartoum	Development of the GIS database of the existing piping	
42	24-Jun	Thu				Test drilling	Ministry of Health	Analysis of the data		
43	25-Jun	Fri			seismic prospecting／ analysis	team meeting	team meeting			team meeting
44	26-Jun	Sat	Electric Power supply Survey		electric ／ analysis	Test drilling		Khartoum→ Addis Ababa		
45	27-Jun	Sun			seismic prospecting		Social survey	Addis Ababa →Bangkok		Project Coordination
46	28-Jun	Mon	O&M Servey （customer/ Water Fee）					Bangkok→ Tokyo		
47	29-Jun	Tue			seismic ／ analysis					
48	30-Jun	Wed			electric ／ analysis					
49	1-Jul	Thu		Collection of Meteorogical Data/ Existing Well Survey	Survey Report				Kassala→ Khartoum	
50	2-Jul	Fri	Preparation of Technical Note		team meeting	team meeting	team meeting		GIS database	team meeting
51	3-Jul	Sat			Existing Well Survey	Test drilling			Khartoum→ Addis Ababa	
52	4-Jul	Sun			Survey Report		Social survey		Addis Ababa →Bangkok	Project Coordination
53	5-Jul	Mon	Meeting for Technical Note						Bangkok→ Tokyo	
54	6-Jul	Tue								
55	7-Jul	Wed	Kassala→Khartoum							Kassala→ Khartoum
56	8-Jul	Thu	Report to Embassy of Japan, JICA, PWC							Report to Embassy of Japan, JICA, PWC
57	9-Jul	Fri	Analysis of the data	Analysis of the data	Analysis of the data	team meeting	team meeting			Analysis of the data
58	10-Jul	Sat	Khartoum→Addis Ababa		Survey Report					Khartoum→ Addis Ababa
59	11-Jul	Sun	Addis Ababa→Bangkok				Social survey			Addis Ababa →Bangkok
60	12-Jul	Mon	Bangkok→Tokyo		Khartoum→ Dubai					Bangkok→ Tokyo

No.	Date in 2010		[1] Chief Consultant/Water Supply Planning/O&M Planning	[2] Hydro-geological Survey/Ground water Simulation	[3] Geophysical survey	[4] Test drilling/Ground water quality analysis	[5] Social survey1/Environmental and Social Consideration	[6] Facility Design	[7] Pipe Facility Design/GIS	[8] Coordinator/ Social Survey 2
61	13-Jul	Tue			Dubai→ Tokyo	Test drilling				
62	14-Jul	Wed								
63	15-Jul	Thu								
64	16-Jul	Fri					team meeting			
65	17-Jul	Sat								
66	18-Jul	Sun					Social survey Analysis			
67	19-Jul	Mon								
68	20-Jul	Tue								
69	21-Jul	Wed								
70	22-Jul	Thu					Kassala→ Khartoum			
71	23-Jul	Fri				Analysis of the data	Social survey Analysis			
72	24-Jul	Sat				Test drilling				
73	25-Jul	Sun					Khartoum→ Addis Ababa			
74	26-Jul	Mon					Addis Ababa →Bangkok			
75	27-Jul	Tue					Bangkok→ Tokyo			
76	28-Jul	Wed								
77	29-Jul	Thu								
78	30-Jul	Fri				Analysis of the data				
79	31-Jul	Sat				Test drilling				
80	1-Aug	Sun								

Study Schedule 1st stage (3)

No.	Date in 2010		[1] Chief Consultant/Water Supply Planning/O&M Planning	[2] Hydro-geological Survey/Ground water Simulation	[3] Test drilling/Ground water quality analysis	[4] Social survey1/Environmental and Social Consideration	[5] Economic and Financial survey	[6] Facility Design	[7] Pipe Facility Design/GIS	[8] Construction and Procurement Planning2/Cost Estimation2
1	2-Aug	Mon	Tokyo→Dubai		Test drilling					
2	3-Aug	Tue	Dubai→Khartoum							
3	4-Aug	Wed	JICA Sudan Office							
4	5-Aug	Thu	Preparation for Survey (Locl contractor)	Land Survey/Boring Locl contractor Survey						
5	6-Aug	Fri			Analysis of the data					
6	7-Aug	Sat			Test drilling					
7	8-Aug	Sun								Tokyo→ Dubai
8	9-Aug	Mon								Dubai→ Khartoum
9	10-Aug	Tue	Khartoum→ Kassala							Material Cost Survey
10	11-Aug	Wed	Water Supply Planning Survey (Northern Area)							
11	12-Aug	Thu								
12	13-Aug	Fri			Analysis of the data					
13	14-Aug	Sat			Test drilling					
14	15-Aug	Sun								Khartoum→ Kassala
15	16-Aug	Mon		Khartoum→ Kassala		Tokyo→ Dubai				Material Cost Survey Construction Planning Survey
16	17-Aug	Tue		Collection of Meteorogical Data/Land Survey/Boring/Land boundary Survey		Dubai→ Khartoum	Tokyo→Dubai			
17	18-Aug	Wed	Water Supply Planning Survey			Preparation for Survey	Dubai→Khartoum			
18	19-Aug	Thu								
19	20-Aug	Fri				Khartoum→ Kassala	Preparation for Survey	Preparation for Survey	Preparation for Survey	
20	21-Aug	Sat			Kassala→ Khartoum	team meeting				Kassala→ Khartoum
21	22-Aug	Sun		Collection of Meteorogical Data/Land Survey/Boring/Land boundary Survey/Existing Treated water Plant Survey	water quality analysis	Western Office				Material Cost Survey
22	23-Aug	Mon			Khartoum→ Kassala		Khartoum→Kassala			
23	24-Aug	Tue			Test drilling	Garb TWP Site Survey	Economic and Financial survey	Collection of SWC Financial Data/Western Office Data		
24	25-Aug	Wed				Locality Office				
25	26-Aug	Thu				Western Office				
26	27-Aug	Fri				team	team meeting	team meeting		
27	28-Aug	Sat				Southern TWP Site Survey				
28	29-Aug	Sun				Test drilling Site Survey	Economic and Financial survey	Material Yard (West) Survey/Collectio		
29	30-Aug	Mon				SSMO				
30	31-Aug	Tue				Eastern Office		ERDP		Khartoum→ Dubai
31	1-Sep	Wed		Test drilling/Land Survey/Boring/Land boundary Survey/Existing Treated water Plant Survey/Distribution Main route Survey		Ministry of Health		O&M Survey (Mahta)		Dubai→ Tokyo
32	2-Sep	Thu				School of Health				
33	3-Sep	Fri				team meeting	team meeting	team meeting		
34	4-Sep	Sat				Southern WTP Site Survey	Economic and Financial survey			
35	5-Sep	Sun						O&M Survey (Mahta)		
36	6-Sep	Mon				Conbeyance route Survey				
37	7-Sep	Tue				Distribution route Survey		Material Yard (West) Survey		

No.	Date in 2010		[1] Chief Consultant/Water Supply Planning/O&M Planning	[2] Hydro-geological Survey/Ground water Simulation	[3] Test drilling/Ground water quality analysis	[4] Social survey1/Environmental and Social Consideration	[5] Economic and Financial survey	[6] Facility Design	[7] Pipe Facility Design/GIS	[8] Construction and Procurement Planning2/Cost Estimation2
38	8-Sep	Wed	Meeting with SWC		Khartoum→ Addis Ababa	Meeting with SWC		Lab. Groundwater quality analysis Survey	Water Supply Planning	
39	9-Sep	Thu	O&M Planning/Achievements Survey	Collection of Data/Land Survey/Boring/Test drilling	Addis Ababa →Bangkok	Analysis of the data	Economic and Financial survey	Western Office		
40	10-Sep	Fri			Bangkok→ Osaka			Analysis of the data		
41	11-Sep	Sat				Kassala→ Khartoum				
42	12-Sep	Sun				Analysis of the data				
43	13-Sep	Mon	Preparation of Technical Note			Khartoum→ Dubai	Kassala→Khartoum			
44	14-Sep	Tue		Test drilling/Land Survey/Boring/Preparation for Stakeholder		Dubai→ Tokyo	Khartoum→Dubai			
45	15-Sep	Wed					Dubai→Tokyo			
46	16-Sep	Thu								
47	17-Sep	Fri								
48	18-Sep	Sat								
49	19-Sep	Sun	Meeting for Technical							
50	20-Sep	Mon	Preparation for Stakeholder Meeting							
51	21-Sep	Tue								
52	22-Sep	Wed	Stakeholder Meeting							
53	23-Sep	Thu	Meeting with SWC	Meeting with SWC/Land Survey						
54	24-Sep	Fri	Analysis of the data							
55	25-Sep	Sat	Kassala→Khartoum						Kassala→ Khartoum	
56	26-Sep	Sun	Report to Embassy of Japan, JICA						Report to JICA	
57	27-Sep	Mon	Analysis of the data	Collection of Test drilling/Land Survey/Boring/data					Water Supply Planning	
58	28-Sep	Tue								
59	29-Sep	Wed	Khartoum→Dubai						Khartoum→ Dubai	
60	30-Sep	Thu	Dubai→Tokyo						Dubai→ Tokyo	

Study Schedule 2nd stage

No.	Date in 2010		[1] Chief Consultant/Water Supply Planning/O&M Planning	[2] Pipe Facility Design/GIS	[3] Construction and Procurement Planning1 /Cost Estimation1	[4] Hydro-geological Survey/Facility Design 2	[5] Facility Design	[6] Social survey1/Environmental and Social Consideration
1	18-Nov	Thu	Tokyo→Dubai					
2	19-Nov	Fri	Dubai→Khartoum					
3	20-Nov	Sat	JICA Sudan Office Courtesy call to Embassy of Japan, PWC					
4	21-Nov	Sun						
5	22-Nov	Mon	Preparation for Survey					
6	23-Nov	Tue	Khartoum→Kassala					
7	24-Nov	Wed	Meeting of Project component Conveyance Pipes route Survey O&M Planning Survey		Suvey of the Existing Facility and New pipe line route			
8	25-Nov	Thu						
9	26-Nov	Fri			Kassala→Khartoum			
10	27-Nov	Sat			Material Cost Survey			
11	28-Nov	Sun				Tokyo→Dubai		
12	29-Nov	Mon	O&M Planning Survey	Conveyance Pipes route Survey		Dubai→Khartoum		
13	30-Nov	Tue				Preparation for Survey		
14	1-Dec	Wed	Conveyance Pipes route Survey			Collection of Test drilling Data/ Land survey Local Contract	Khartoum→Kassala	
15	2-Dec	Thu					Meeting of Groundwater quality analysis /Meeting with Technical Cooperation Project Team	
16	3-Dec	Fri			Khartoum→Kassala			
17	4-Dec	Sat			Existing and New pipe line Survey	Inspection for Test drilling well/Collection of pumping test data		
18	5-Dec	Sun	Electric development plan survey	Existing pipe line Survey				Tokyo→Dubai
19	6-Dec	Mon				Existing Well Survey	Meeting of Groundwater quality analysis	Dubai→Khartoum
20	7-Dec	Tue	Preparation for Stakeholder Meeting			Preparation for Stakeholder Meeting		Preparation for Survey
21	8-Dec	Wed	Stakeholder Meeting			Stakeholder Meeting	Stock Material Survey	
22	9-Dec	Thu	Electric development plan survey	Pipe route Survey		Conveyance Pipes / Existing Distribution main route Survey		Khartoum→Kassala
23	10-Dec	Fri		Meeting of GIS data	Kassala→Khartoum			Environmental and Social Consideration Survey (New Conveyance Pipes route)
24	11-Dec	Sat			Material Cost Survey	Existing Well Survey	Implements and Machinery Survey	
25	12-Dec	Sun		Kassala→Khartoum		Kassala→Khartoum		
26	13-Dec	Mon	Implements and Machinery Survey	Pipe material Survey		Procurement Survey for Test drilling/Geophysical survey		Environmental and Social Consideration Survey (Existing Pipe route)
27	14-Dec	Tue	Discussion on M/D				Stock Material Survey	
28	15-Dec	Wed		Analysis of the Land surveydata		Collection of Test drilling Data	Analysis of the data	
29	16-Dec	Thu		Khartoum→Dubai				Stakeholder Meeting Report
30	17-Dec	Fri	Implements and Machinery Survey	Dubai→Tokyo				
31	18-Dec	Sat						
32	19-Dec	Sun	Meeting with Technical Cooperation Project					
33	20-Dec	Mon	Meeting for Technical Note					Meeting for Technical Note
34	21-Dec	Tue	Kassala→Khartoum					Kassala→Khartoum
35	22-Dec	Wed	Report to JICA, PWC					Report to JICA, PWC
36	23-Dec	Thu	Khartoum→Dubai					Khartoum→Dubai
37	24-Dec	Fri	Dubai→Tokyo					Dubai→Tokyo

Explanation of the Draft Report (1)

No.	Date in 2010		[1] JICA Team Leader	[2] JICA Planning Coordinator	[3] Chief Consultant/Water Supply Planning/O&M Planning	[4] Construction and Procurement Planning 2 /Cost Estimation 2
1	10-Dec	Fri	Tokyo→Dubai			Tokyo→Dubai
2	11-Dec	Sat	Dubai→Khartoum			Dubai→Khartoum
3	12-Dec	Sun	JICA Sudan Office, Courtesy call to			Preparation for MD
4	13-Dec	Mon	Khartoum→Kassala			Khartoum→Kassala
5	14-Dec	Tue	Courtesy call to SWC, explanation of the Project			
6	15-Dec	Wed	Site visit・Discussion on M/D			
7	16-Dec	Thu	Discussion on M/D・Signing on M/D（SWC）			
8	17-Dec	Fri	Kassala→Khartoum		Implements and Machinery Survey	
9	18-Dec	Sat	team meeting			
10	19-Dec	Sun	Signing on M/D（MIC・PWC) Report to Embassy of Japan		Meeting with Technical Cooperation Project Team	
11	20-Dec	Mon	Report to JICA		Meeting for Technical Note (SWC)	
12	21-Dec	Tue	Khartoum→Dubai		Kassala→Khartoum	
13	22-Dec	Wed	Dubai→Tokyo		Report to JICA, PWC	
14	23-Dec	Thu			Khartoum→Dubai	
15	24-Dec	Fri			Dubai→Tokyo	

Explanation of the Draft Report (2)

No.	Date in 2011		[1] JICA Team Leader	[2] JICA Planning Coordinator	[3] Chief Consultant/Water Supply Planning/O&M Planning	[4] Construction and Procurement Planning /Cost Estimation
1	13-May	Fri	Tokyo→Doha			
2	14-May	Sat	Doha→Khartoum			
3	15-May	Sun	JICA Sudan Office, Courtesy call to Embassy of Japan, MIC, PWC			
4	16-May	Mon	Khartoum→Kassala			
5	17-May	Tue	Courtesy call to SWC, explanation of the Project			
6	18-May	Wed	Discussion on M/D・Signing on M/D（SWC）			
7	19-May	Thu	Kassala→Khartoum		Meeting with Consulting Services Contract (SWC)	
8	20-May	Fri	team meeting		team meeting	
9	21-May	Sat	team meeting		team meeting	
10	22-May	Sun	Signing on M/D（MIC・PWC)		Kassala→Khartoum	
11	23-May	Mon	JICA Office Khartoum→Doha	JICA Office	JICA Office	Khartoum→Doha
12	24-May	Tue	Doha→Tokyo	Khartoum→Nairobi	Doha→Tokyo	

List of Persons Concerned

1. Sudanese side

Government of Sudan

Public Water Corporation

Mr. Mohamed Hassan Amar, Director General

Mr. Mohamed Hassab-Elrasal Ahmed, Planning Director

Mr. Hamad Abdallah, Civil Engineer

Mr. Mohamed Widaa, Civil Engineer

Mr. Hassan Babiker, Consultants (former D.G.)

Ministry of International Cooperation

Mr. Mekki Merghani, Acting Undersecretary

Mr. Mahmoud Haroun, Director. F. B. Cooperation

MIWR, Kassala

Mr. Eltayb Mohamed Yousif, Executive Director

Mr. Saied Magzoub Saied, Research Engineer GASH River Training Unit

Mr. Habim Abdelgadir M. Toam, Research Engineer GASH River Training Unit

Mr. Rahamed, Survey Unit

Static Department of Central Government Kassala Branch

Mr. Yosef Hassan, Director of Branch Office

Mr. Bokhary, Static Officer

Kassala Meteorological Station

Mr. El Khazin Ahmed, Station Chief

Sudanese Standards & Metrology Organization (SSMO)

Mr. Ahmed Ebd El-Magid, Chief of Division in Kassala SSMO

Dr. Omer Abdalla Ibrahim, Laboratories Manager

Mr. Elkhatab Osman, Engineer

Humanitarian Aid Commission

Mr. Hafis, Director General

CBS (Central Bureau of Statistics, Kassala)

Mr. Yousif Hussein, Director General of CBS in Kassala

KMOH (Ministry of Health in Kassala)

Dr. Al Gadir Artoli, Deputy Director General

Mr. Mansour Hoshim, Stuff of Information Department of KMOH

Kassala State

Governor Office

Mr. Ali Awad. M. Musa, Kassala Governa State

Mr. Mohamed Osman Mohamed, State government Sec.

Ministry of Finance

Mr. Musa M.Oshaik, General director for Planning &Development

Ministry of Physical Planning & Public Utilities

Ms. Basumul El iman, Director General

Mr. Abuzaid Moh Ali, Technical Adviser

Mr. Isam Gnder Hassim, Director of Planning Department

State Water Corporation, Kassala

Mr. Mustafa Mohameddin Lduis, Director General

Mr. Hasim Mohamed Ab Dladef, Director General

Mr. ohamed Armed Yousif, D. Manager Engineering and Operation

Mr. Abd Algadir Ohaj Mohamed, Technical Department

Mr. Yousif Mohd Ali, Chief Engineer East-P

Mr. Isam Eldin Khogali, Project Engineer

Ms. Amal Osman, Manager of Water Analysis

East Office of SWC

Mr. Ali Hassab Alla, Director General

Mr. Mehammed Haroon, Mechanical and Electrical Engineer

West Office of SWC

Mr. Ali, Director General

Mr. Ismail Alzibaidy, Pipeline

Survey Department

Mr. Da Abd Elahliem Balla, Survey Engineer

Others Concerned

Groundwater Research Kassala

Mr. Mohammed Abd El Hai Ali, Director General

Mr. Abdelgadir Mohamed Ahmed, Information center manager of water research

Ministry of Agriculture, Forestry and Irrigation

Mr. Abdel Hakeem Ahmed Elhassan, Director General

Mr. Abd Elhafeez, Agriculture Engineer TTEA

Commissioner For refugees (COR)

Mr. Hamad Elgizouli Morowa, Project manager

AL-Neelain University Khartoum

Dr. Adil Balla Elkrail, Professor Hydrology & Water resources

Dr. Abdalla Elhag Ibrahim, Professor Exploration Geophysicist

WASH Program

Mr. Fatouma Mahmoud Ismael, Manager

WES (Water, Environment and Sanitation)

Ms. Fatima Mahmoud Ismael, Project Manager of WES

Ms. Sara Mohammed, Stuff of WES project

UNDP Resident Coordinator's Office

Mr. Hayder Hamadnalla, Coordinator in Kassala State

CFCI (The Child-Friendly Community Initiative)

Mr. Haj Osman, Stuff of CFCI Project

Kassala Town Locality Office

Mr. Shmmy El deen mustaf, Locality Engineer

Eng. Omera Al Aziz, Locality Engineer

2. Japanese side

Embassy of Japan

Mr. YISHII uichi, Ambassador of Japan

Mr. WADA Akinori, Ambassador of Japan

Mr. MURAKAMI Yasuhito, First Secretary

Ms. SUGINO Chie, Second Secretary

Mr. NAKAJIMA Yoichi, Counselor and Deputy Chief of Mission

Ms. YAMAZAKI Haruka, Economic Coordinator

JICA Sudan Office

Mr. SHISHIDO Kenichi, Resident Representative

Mr. MORI Hiroyuki, Resident Representative

Mr. ABE Yukio, Deputy Resident Representative

Mr. IMAI Fumio, Deputy Resident Representative

Mr. MURAKAWA Daishiro, Assistant Resident Representative

Mr. MATSUOKA Hideaki, Project Formulation Advisor

Ms. YAMADA Sachi, Project Formulation Advisor

Technical Cooperation Project : Human Resources Development for Water Supply

Mr. UEMURA Mituro, Earth System Science Co.,Ltd.

Mr. ONODERA Jun, Earth System Science Co.,Ltd.

Mr. SAITO Masakazu, Earth System Science Co.,Ltd.

Technical Cooperation Project : Improving Basic Government Services and Reconstruction Projects in Sudan

Mr. TANAKA Kiyohumi, Chief

Mr. SHICHIJO Kan, Water Facility

Appendix-4 Minutes of Discussion (M/D)

(1) Inception Report (10 March 2010)

(2) Revision of Project Area (15 August 2010)

(3) Scope of the Project (28 November 2010)

(4) Explanation on Draft Report (Rehabilitation) (16 December 2010)

(5) Explanation on Draft Report (Extension) (18 May 2011)

MINUTES OF DISCUSSIONS
ON
THE PREPARATPRY SURVEY
ON
THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY FACILITIES
AT
KASSALA CITY
IN
SUDAN

In response to the request from the Government of Sudan (hereinafter referred to as "Sudan"), the Government of Japan (hereinafter referred to as "Japan") decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Project for Improvement of Water Supply Facilities in Kassala City (hereinafter referred to as "the Project") and entrusted the Study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to Sudan the Second Preparatory Survey Team (hereinafter referred to as "the Team"), which is headed by Eng. Yosuke SASAKI, Senior Advisor of JICA, and is scheduled to stay in the country from 3rd March 2010 to 30th March 2010.

The Team held the series of discussions with the officials concerned of the Sudan and conducted a field survey in the Project area.

In the course of discussions and field survey, both parties have confirmed the main items described in the attached sheets. The Team will proceed to further works and prepare the Preparatory Survey Report.

Khartoum, 10th March 2010

佐々木 達介

Eng. Yosuke SASAKI
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Eng. Mohamed H.M. AMMAR
Director General
Public Water Corporation
Government of National Unity
Sudan

9.3.2010

Eng. Mustafa Mohamaddin Idris
Director General
Kassala State Water Corporation
Kassala State
Government of National Unity
Sudan

Witnessed by

Mr. El-Fatih Ali Siddiq
Undersecretary
Ministry of International Cooperation
Government of National Unity
Sudan

ATTACHMENT

1. Objective of the Project

The objective of the Project is to provide and improve drinking water services in Kassala City.

2. Project Site

The site of the Project is located at the east bank of Gash River in Kassala city. Site map is shown in Annex-1.

3 Responsible and Implementing Agency

The Responsible Agency is Public Water Corporation (PWC) in Sudan. The Implementing Agency in the implementing stage is Kassala State Water Corporation (SWC). Organization chart is shown in Annex-2.

4. Objective of the Second Preparatory Survey

The Team explained that the objective of the Second Preparatory Survey (hereinafter referred to as "the Survey") is collecting information to confirm the appropriateness of the requested components, and the enforcement of the components is not guaranteed by Japanese side in this stage. Sudanese side understood that. If all or some of the components are found feasible as a result of the Survey, JICA will continue the Survey for the Outline Design of the Project.

5. Items requested by the Government of Sudan

After discussions with the Team, the items described in Annex-3 were finally requested by the Government of Sudan. JICA will assess the appropriateness of the request and will recommend to the Government of Japan for approval after the Study.

6. Japan's Grant Aid Scheme

6-1. The Sudanese side understood the Japan's Grant Aid Scheme explained by the Team, as described in Annex-4 and 5.

6-2. The Sudanese side promised to take the necessary measures, as described in Annex-6, for smooth implementation of the Project, as a condition for the Japanese Grant Aid to be implemented.

6-3. JICA will report to the Sudanese side if there are any other undertakings based on the result of the Survey.

7. Schedule of the Survey

7-1. Consultant members will proceed to further studies in Sudan by 30th March 2010. They will resume the Survey Phase I from May 2010 after the completion of the general election of the Sudan and continue until the end of September 2010.

7-2. JICA will send the Survey Phase II Team for the outline design of the Project based on the result of the Survey from the middle of November to the end of December 2010.

7-3. JICA will prepare the draft report in English and dispatch another mission in order to explain its contents at around the early May 2011.

7-4. In case of that the contents of the report is accepted in principle by the Government of Sudan, JICA will complete the final report and send it to the Government of Sudan in around June 2011.

7-5. The Team explained that implementation of the Preparatory Survey is not a commitment of the approval of the Project

8. Other relevant issues

8-1. Priority of the Project

The Sudanese side explained that provision of safe water supply is one of the top priority projects based on the first stage of "Development of Plan on Strategies, Targets anf Ivestment for Water and Sanitation & Hygiene (2010-2016)."

8-2. Scope of the Project

The Team explained that the Project will be expected to complete on the end of 2014, if its implementation is approved by the Government of Japan. Sudanese side explained that the year 2016 is the target year of the National Strategies which above mentioned. Both sides agreed that the target year of the Project will be set as the year 2016 and, therefore, water supply facilities of the Project will be planned so as to meet the water demand in 2016. Both sides confirmed that the water demand should be examined in detail through the Survey.

8-3. Components of the Project

Both sides agreed that the water supply plan will be proposed by the Team and the project components and demarcation between Sudanese side and Japanese side will be discussed on the basis of the result of the Survey Phase I at the end of September 2010. The Team explained and Sudanese side understood that the draft of project components to be proposed by both sides will be discussed by the Government of Japan and JICA, and project components may be changed according to the result of the discussion.

8-4. Priority Components of the Project

Both sides agreed that the construction of water supply facilities for new service areas (IDP's, refugees and new extensions) has higher priority than the rehabilitation of the existing service areas because the target of the Project is to increase the coverage of water supply in conformity to the national water policy in Sudan.

8-5. Quantity of Water Supply

Both sides agreed that the quantity of water supply will be decided on the basis of the groundwater potential which is examined during the Survey Phase I in the end of September 2010. Both sides also agreed that it may be less than standard water supply amount per capita stipulated in Sudanese water policy in case that groundwater potential is not enough to supply for all beneficiaries.

8-6. Location of new boreholes

Both sides confirmed that the location of the boreholes will be decided during the Survey Phase I based on the results of geophysical survey, test drilling and so on.

8-7 Installation of Water Meters

Both sides agreed that the Team will prepare 30 water meters (1/2 inch*10, 3/4 inch*10, 1.0 inch*10) . SWC shall install those meters for 30 customers to measure and grasp the quantity of water consumption of households.

8-8. Specific Undertakings by the Sudanese Side

The Team requested to the Sudanese side to allocate necessary budget and to abide by the following undertakings if needed in addition to major understandings described in Annex-6.

(1) Additional land acquisition to construct new water supply facilities, such as boreholes, pipelines, reservoir and so on by April 2011, if necessary
(2) Secure the permission for entering survey sites from landowners to implement geophysical survey, test drilling and others by the end of April 2010
(3) Demolition of existing facilities to construct new water supply facilities, if necessary
(4) Assign counterpart personnel for each Study member
(5) Assign counterpart personnel in addition to above mentioned such as a person in charge of GIS, mechanics and electricians for measuring flow rate and a person who has information of existing pipe network
(6) Provide necessary information such as Housing plan in Northern district and IDP/refugee area
(7) Secure the permission to take picture in the survey sites
(8) Provide office space for the Team in SWC
(9) Protect flow meters to be installed in some household connection pipes
(10) Construct water supply facilities such as the distribution pipes to be undertaken by the Sudanese side by 2016

The Sudanese side understood and accepted.

8-9. Tax Exemption

Both sides confirmed that import tax, customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services will be exempted. Both sides agreed that the Sudanese side will take necessary measures to exempt taxes.

8-10. Operation and Maintenance of the Facilities

The Japanese side will propose necessary operation and maintenance plan based on the results of the Survey. The Sudanese side agreed to take any necessary measures and to allocate necessary budget to operate and maintain the facilities in response to Japanese proposal. In addition, the Sudanese side promised to secure necessary personnel for the Operation and Maintenance of facilities to be constructed by the completion of the Project.

8-11. Overlapping with Other Project

The Sudanese side explained that this project would not be overlapped with any other projects extended by the other donor agencies, NGOs and Sudanese official organizations.

8-12. Environmental and Social Considerations

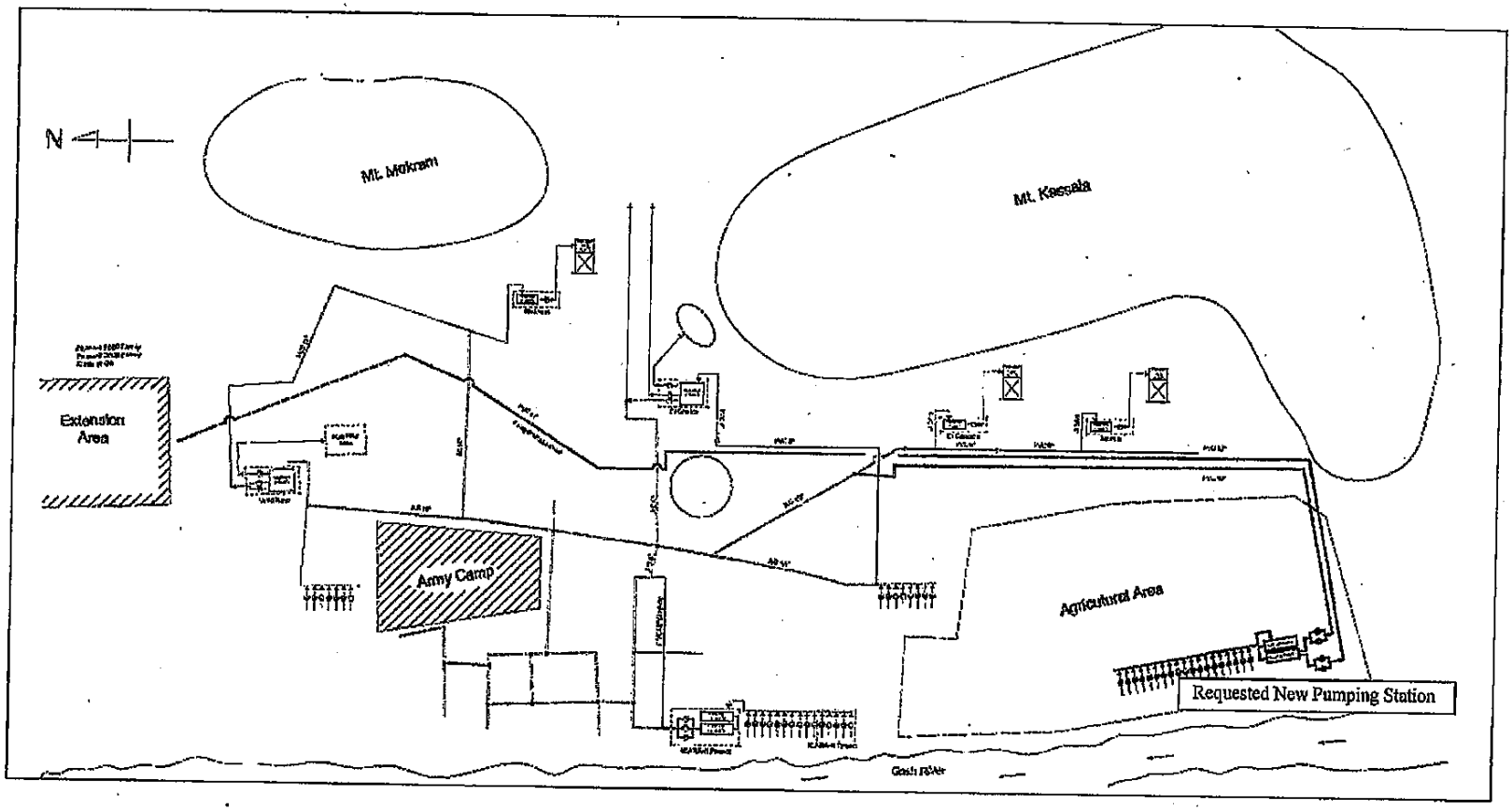
Both sides agreed that the Sudanese side will take necessary measures regarding Environmental Impact Assessment (EIA) for implementation of the Project according to the relative laws and acts in Sudan by middle of November 2010, and the Team will assist Sudanese side to prepare the documents, if necessary.

8-13. Rehabilitation of the Existing Reservoir

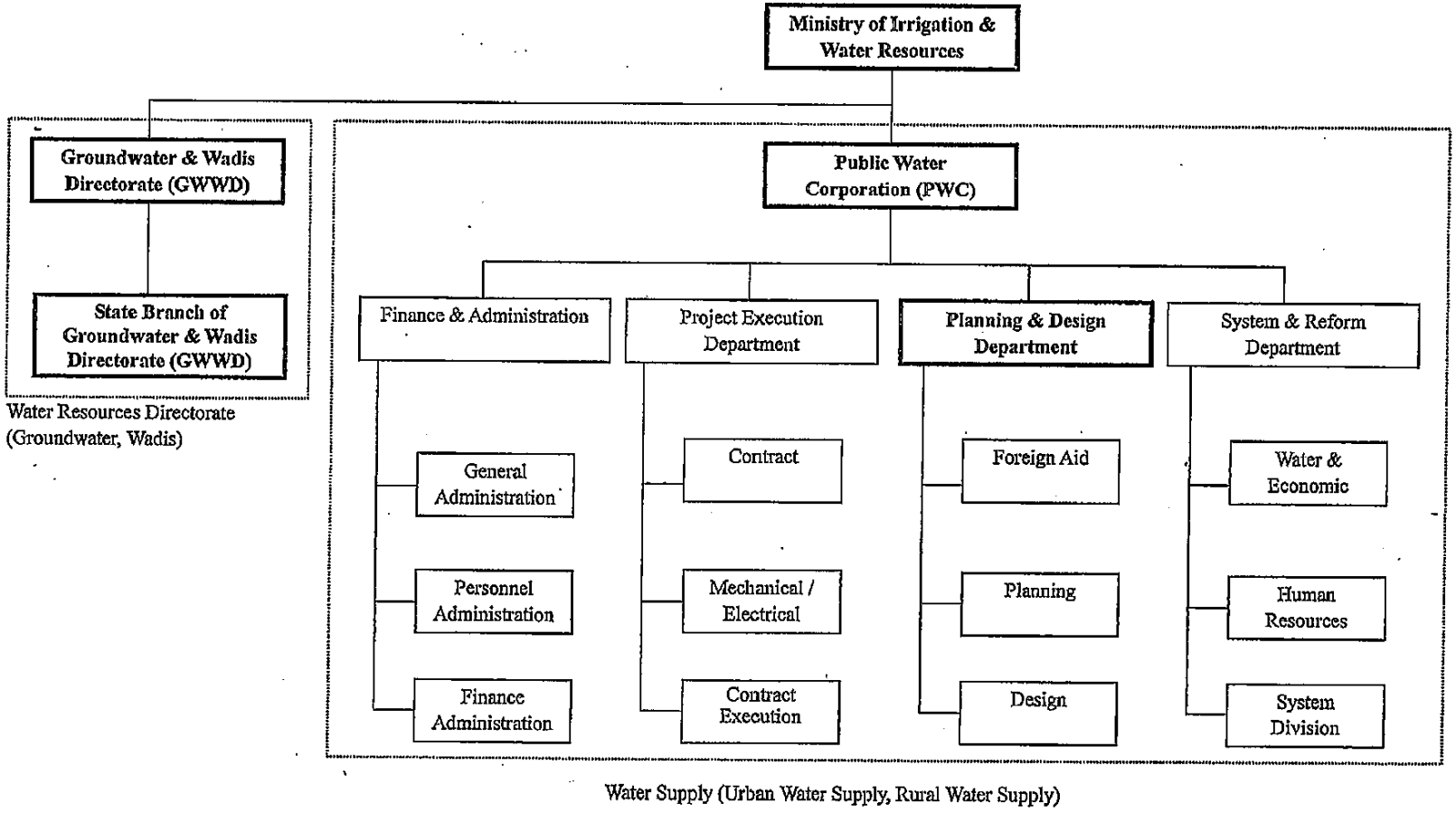
Sudanese side explained that the existing reservoirs on eastern and western sides of the Gash River are in deteriorated condition and requested emergency repairs to the Team apart from the Project as soon as possible. Both sides agreed that the Team will survey the existing reservoirs during Step 1 of the Survey Phase I and will report the current situation of the reservoirs to the Government of Japan. Both sides also agreed that JICA will discuss countermeasures for the problem with the Government of Japan and inform Sudanese side the results of the discussion in the beginning of May 2010 when the Team will resume the Survey.

Annex-1 Project Site
Annex-2 Organization Chart
Annex-3 Contents of the Request
Annex-4 Japan's Grant Aid Scheme
Annex-5 Flow Chart of Japan's Grant Aid Procedures
Annex-6 Undertakings by Each Government

Annex-1

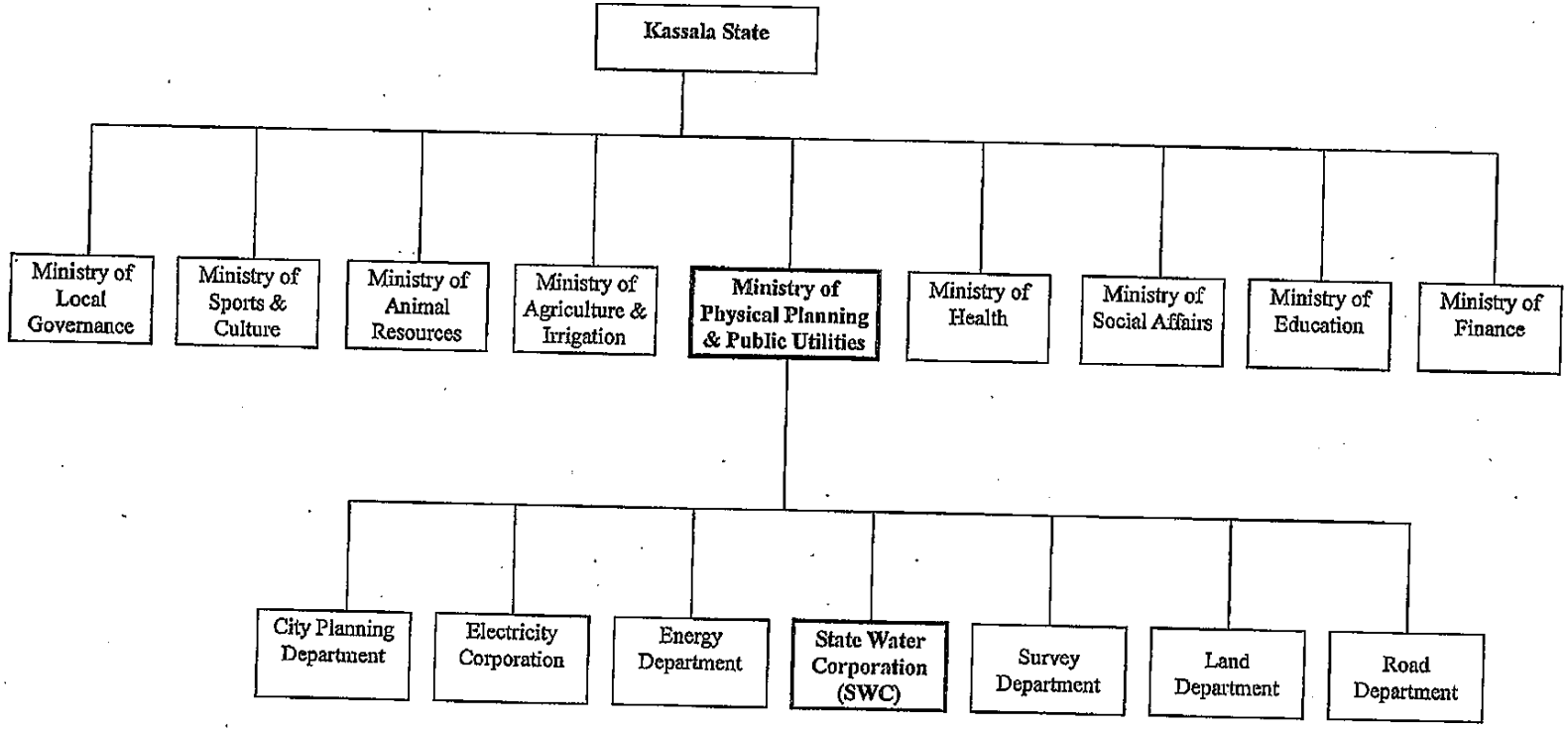


Project Site



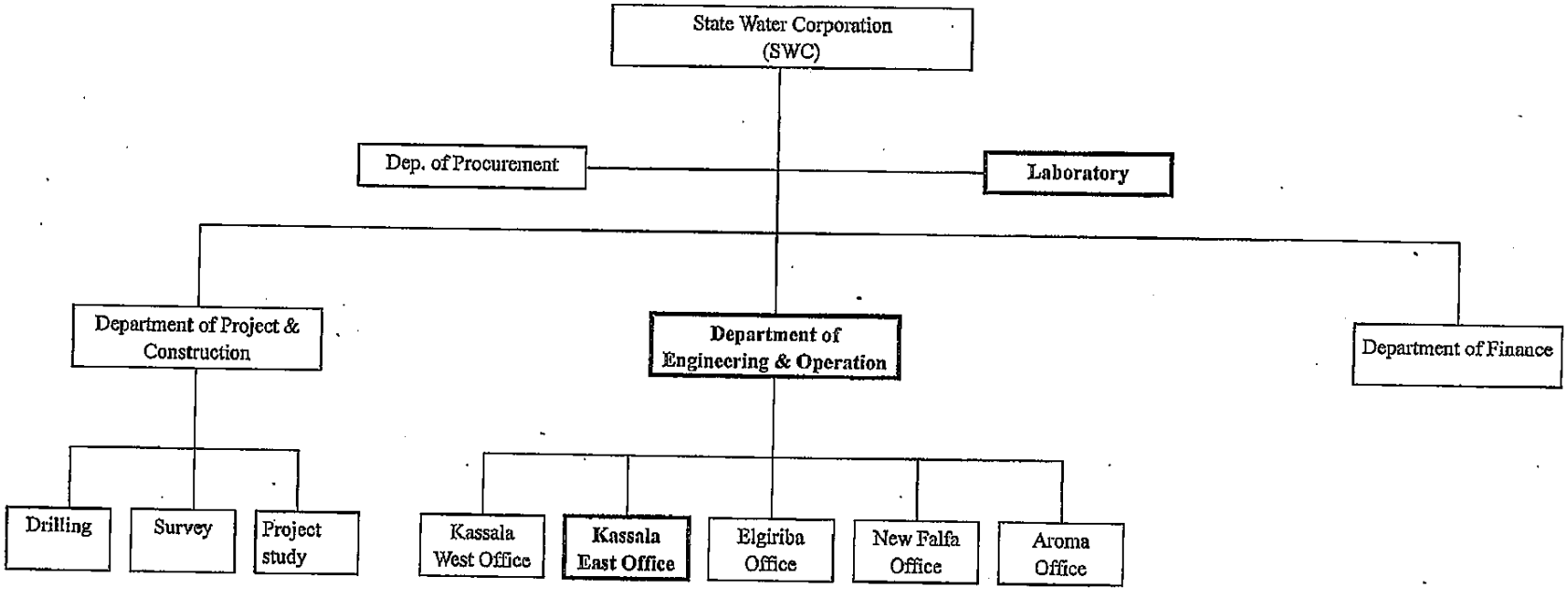
Organization Chart of Public Water Corporation

Annex-2B



Organization Chart of Kassala State

Annex-2C



Organization Chart of State Water Corporation

Contents of the Request

i. Construction of Source Wells and Sheds	
- Source Well (750m^3/day) with a Flow Meter	20 nos.
- Well Shed	20 nos.
ii. Construction of Conveyance Pipe and Water Distribution Facility	
- Conveyance Pipe (Wells to Reservoir)	1 lot
- Reservoir (1000m^3)	2 nos.
- Water Distribution Pump (350m^3/h)	4 units
- Chlorinator	1 no
- Electrical Panels	1 lot
- Piping and Instruments	1 lot
- Administration Building	1 no
- Incidental Facility	1 lot
iii. Supply Materials and Construction of Distribution Main	
- Distribution Main (water distribution pumps to terminal points of zones in new service area)	1 lot
iv. Rehabilitation of Existing Water Supply Facility	
- Source Wells	1 lot
- Water Distribution Pump (350m^3/h)	3 units
- Chlorinator	1 no
- Electrical Panels	1 no
- Installation of New Flow Meter	1 no
v. Piping Material	
- Piping Materials for replacement of main or major asbestos pipes in the existing service area	1 lot
vi. Maintenance Equipment	
- Construction Machine	1 lot
- Machine Tools for Piping	1 lot
vii. Technical Assistance for Development of Piping Database using GIS	1 lot
viii. Technical Assistances for capacity building of operation and maintenance of the State Water Corporation of Kassala State, if necessary	1 lot

JAPAN'S GRANT AID

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of ODA operations, and as a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on this law and the decision of the GOJ, JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

The Grant Aid is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

1. Grant Aid Procedures

The Japanese Grant Aid is supplied through following procedures:

- Preparatory Survey
  - The Survey conducted by JICA
- Appraisal &Approval
  - Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet
- Authority for Determining Implementation
  - The Notes exchanged between the GOJ and a recipient country
- Grant Agreement (hereinafter referred to as "the G/A")
  - Agreement concluded between JICA and a recipient country
- Implementation
  - Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.

- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Outline Design of the Project is confirmed based on the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

3. Japan's Grant Aid Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant Aid, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant Aid.

(7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making

payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

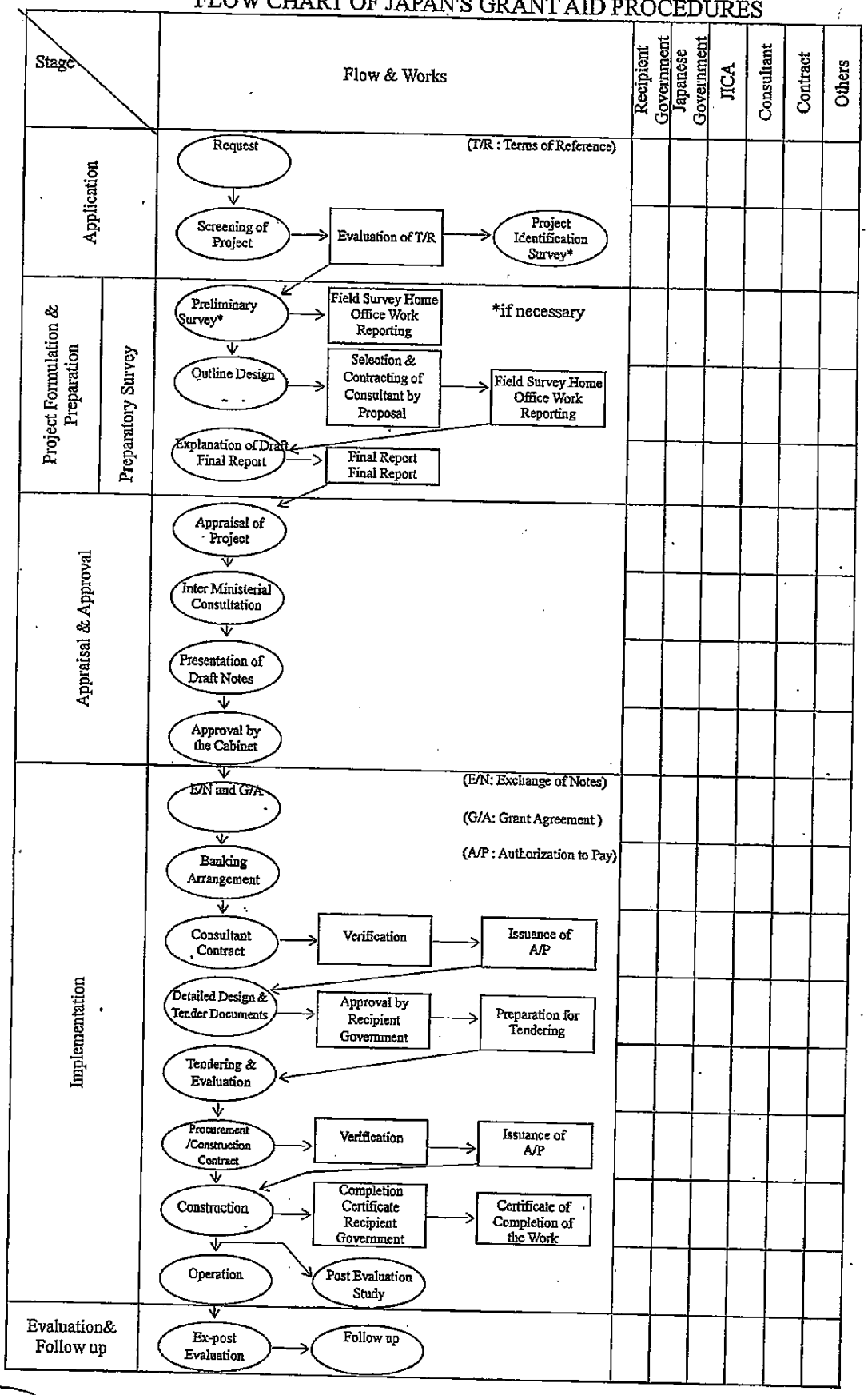
The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

(10) Social and Environmental Considerations

A recipient country must carefully consider social and environmental impacts by the Project and must comply with the environmental regulations of the recipient country and JICA socio-environmental guidelines.

Annex-5

FLOW CHART OF JAPAN'S GRANT AID PROCEDURES



Annex-6

Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	to secure lots of land necessary for the implementation of the Project and to clear the sites;		•
2	To construct the following facilities		
	1) The building	•	
	2) The gates and fences in and around the site		•
	3) The parking lot	•	
	4) The road within the site	•	
	5) The road outside the site		•
3	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the sites		
	1) Electricity		
	a. The distributing power line to the site		•
	b. The drop wiring and internal wiring within the site	•	
	c. The main circuit breaker and transformer	•	
	2) Water Supply		
	a. The city water distribution main to the site		•
	b. The supply system within the site (receiving and elevated tanks)	•	
	3) Drainage		
	a. The city drainage main (for storm sewer and others to the site)		•
	b. The drainage system (for toilet sewer, common waste, storm drainage and others) within the site	•	
	4) Gas Supply		
	a. The city gas main to the site		•
	b. The gas supply system within the site	•	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		•
	b. The MDF and the extension after the frame/panel	•	
	6) Furniture and Equipment		
	a. General furniture		•
	b. Project equipment	•	
4	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products.		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	•	
	2) Tax exemption and custom clearance of the Products at the port of disembarkation		•
	3) Internal transportation from the port of disembarkation to the project site	(•)	(•)

5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services are exempted		•
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		•
7	To ensure that the Facilities and the products are maintained and used properly and effectively for the implementation of the Project		•
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		•
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		•
	2) Payment commission		•
10	To give due environmental and social consideration in the implementation of the Project.		•

(B/A : Banking Arrangement, A/P : Authorization to pay)

MINUTES OF DISCUSSIONS
ON
THE PREPARATPRY SURVEY
ON
THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY FACILITIES
AT
KASSALA CITY

In response to the request from the Government of Sudan (hereinafter referred to as "Sudan"), the Government of Japan (hereinafter referred to as "Japan") decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Project for Improvement of Water Supply Facilities in Kassala City (hereinafter referred to as "the Project") and entrusted the Study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to Sudan the Second Preparatory Survey Team (hereinafter referred to as "the Team"), which is supervised by Mr. Kenichi SHISHIDO, Resident Representative of JICA Sudan Office, and is scheduled to stay in the country from 3rd August 2010 to 30th September 2010.

The Team held the series of discussions with the officials concerned of the Sudan and conducted a field survey in the Project area.

In the course of discussions and field survey, both parties have confirmed the main items described in the attached sheets, while other items are in accordance with Minutes of Discussions dated 10th March 2010 (hereinafter referred to as "the Original M/D"). The Team will proceed to further works and prepare the Preparatory Survey Report.

Khartoum, 15th August 2010

Mr. Kenichi SHISHIDO
Resident Representative
Sudan Office
Japan International Cooperation Agency

Eng. Mohamed H.M. AMMAR
Director General
Public Water Corporation
Government of National Unity
Sudan

Witnessed by

Eng. Mustafa Mohamaddin Idris
Director General
Kassala State Water Corporation
Kassala State
Government of National Unity
Sudan

Mr. Mekki Mirghani Osman
Acting Undersecretary
Ministry of International Cooperation
Government of National Unity
Sudan

ATTACHMENT

1. Survey Site

The site of the Survey is expanded to include the existing reservoirs at both east and west banks of Gash River in Kassala City.

2. Scope of the Survey

In response to the request from the Sudanese side, the Japanese side intended to include the existing reservoirs at both banks of Gash River in the scope of the Survey. These newly included components will be examined and conducted separately from the other components. However, same as the other components mentioned in the Original M/D, the enforcement of the new components is not guaranteed by Japanese side during the Survey Phase.

3. Schedule of the Survey

3-1. The Team will proceed to further studies in Sudan by 30th September 2010.

3-2. JICA will send a mission at the beginning of November to agree with the Sudanese side on the scope of the Survey Phase II, which is aimed for the outline design of the Project.

3-3. JICA will prepare the draft report on the newly included components in English and dispatch another mission in order to explain it in the first half of December 2010.

3-4. Same as item 3-3, JICA will prepare the draft final report on the other components and dispatch another mission in the first half of May 2011.

3-5. In case of that the contents of the reports are accepted in principle by the Government of Sudan, JICA will complete the final reports respectively and send them to the Government of Sudan one month later.

MINUTES OF DISCUSSIONS
ON
THE PREPARATPRY SURVEY
ON
THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY FACILITIES
AT
KASSALA CITY
IN
SUDAN

In response to the request from the Government of Sudan (hereinafter referred to as "Sudan"), the Government of Japan (hereinafter referred to as "Japan") decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Project for Improvement of Water Supply Facilities in Kassala City (hereinafter referred to as "the Project") and entrusted the Survey to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to Sudan the Third Preparatory Survey Team (hereinafter referred to as "the Team"), which is supervised by Mr. Kenichi SHISHIDO, Resident Representative of JICA Sudan Office, and is scheduled to stay in the country from 19th November 2010 to 23rd December 2010.

The Team held series of discussions with the officials concerned of the Sudan and in the course of discussions, both parties have confirmed the main items described in the attached sheet, while other items are in accordance with Minutes of Discussions dated 10th March 2010 (hereinafter referred to as "the Original M/D") and Minutes of Discussions dated 15th August 2010 (hereinafter referred to as "the Second M/D"). The Team will proceed to further works and prepare the Basic Design Study Report.

Khartoum, 28th November 2010

Mr. Kenichi SHISHIDO
Resident Representative
Sudan Office
Japan International Cooperation Agency

Eng. Mohamed H.M. AMMAR
Director General
Public Water Corporation
Government of National Unity
Sudan

Witnessed by

Eng. Hashim Mohamed Abdulatief
Acting Director General
Kassala State Water Corporation
Kassala State
Government of National Unity
Sudan

Mr. Mekki Merghani Osnan
Undersecretary
Ministry of International Cooperation
Government of National Unity
Sudan

ATTACHMENT

1. Objective of the Project

The objective of the Project is to provide and improve drinking water services in Kassala City.

2. Project Site

The site of the Project is located at the east bank of Gash River in Kassala City.

3. Components of the Project

Based on the discussions and information gathered from the Survey, the components of the project were considered by the Japanese side. The Team explained that the result of the consideration of the components as listed below, which were selected from the basic plan of the improvement of the water supply facilities at east bank of Gash River in Kassala City (hereinafter referred to as "the Basic Plan") presented by the Team at the end of last survey, and that the rehabilitation of the existing asbestos pipes is not included in the components. Both sides agreed on the project components and for the Team to continue to work on the preparation of the Basic Design Study Report based on the agreed components.

Components of the Project selected from the Basic Plan

1. Construction of new source wells in South; necessary numbers of source wells for required groundwater development amount
2. Construction of a new water treatment plant in South
3. Construction of new conveyance pipes from source wells (incl. existing and newly constructed ones) to reservoirs in South
4. Construction of distribution main from new water treatment plant in South to the existing water supply network

In addition to the above components, both sides agreed that the Team will conduct further survey on the necessity and justification for possible realization of the following components including their demarcation of both sides as well as with other existing projects and discuss it after the survey.

5. Construction of distribution pipes where required for keeping adequate water supply service based on the pipe network analysis
6. Procurement of necessary and justifiable construction equipment and machines and tools for workshop with rehabilitation of the workshop
7. Technical Assistance for capacity building of operation and maintenance of the State Water Cooperation of Kassala State

MINUTES OF DISCUSSIONS

ON THE PREPARATORY SURVEY

ON

THE PROJECT FOR URGENT REHABILITATION OF WATER SUPPLY FACILITIES

AT KASSALA CITY,

IN THE REPUBLIC OF THE SUDAN

(EXPLANATION ON DRAFT REPORT)

In March 2010, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Preparatory Survey Team on the Project for Improvement of Water Supply Facilities in Kassala City (now the relevant components mentioned here is referred to as "the Project for Urgent Rehabilitation of Water Supply Facilities at Kassala City" and hereinafter referred to as "the Project") to the Government of the Republic of the Sudan (hereinafter referred to as "Sudan") and through discussion, field survey and technical examination of the results in Japan, JICA prepared a draft report of the study.

In order to explain and consult with the Government of Sudan on the components of the draft report, JICA sent to Sudan the Draft Report Explanation Team (hereinafter referred to as "the Team"), which was headed by Eng. Yosuke Sasaki, Senior Advisor, JICA, from 12th to 21st December 2010.

As a result of discussions, both parties confirmed the main items described in the attached sheets.

Kassala, 16th December, 2010

Eng. Yosuke SASAKI
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Eng. Mohamed H.M. AMMAR
Director General
Public Water Corporation
Government of National Unity
Sudan

Witnessed by

Eng. Hashim Mohamed Abdulatief
Acting Director General
Kassala State Water Corporation
Kassala State
Government of National Unity
Sudan

Mr. Mekki Merghani Osnan
Undersecretary
Ministry of International Cooperation
Government of National Unity
Sudan

ATTACHMENT

1 Components of the Draft Report

The Sudan side agreed and accepted in principle the components of the draft outline design explained by the Team. The components of the project are shown in Annex-1.

2 Japan's Grant Aid Scheme

The Sudan side understood the Japan's Grant Aid Scheme and would take the necessary measures and allocate budget properly for smooth implementation of the Project, as a condition for the Japanese Grant Aid to be implemented. The Grant Aid Scheme and necessary measures mentioned above are described in the Annex-4 and Annex-6 of the Minutes of Discussions signed by both parties on 10th March 2010 (hereinafter referred to as "the previous minute").

3 Responsible and Implementing Agency

3.1 The Responsible Agency is the Public Water Corporation (hereinafter referred to as "PWC").

3.2 The Implementing Agency is Kassala State Water Corporation (hereinafter referred to as "SWC").

4 Schedule of the Study

JICA will complete the final report in accordance with the confirmed item and send it to the Government of Sudan by the end of June 2011.

5 Other Relevant Issues

The following issuers were discussed and confirmed by the both sides.

5.1 Component of the Project

Both sides agreed that draft technical specification of equipment listed in Annex-1 is strictly confidential and should never be duplicated or released to other parties.

5.2 Project Cost Estimate and Budgetary Arrangement

The Team explained to the Sudan side the estimated project cost as attached in Annex-1. Both side confirmed that this estimated cost was provisional and would be examined further by the Government of Japan for its final approval.

The Sudan side reconfirmed to secure necessary counterpart budget for the project timely and adequately to cover the required amount of the cost, as promised in the previous minutes.

Furthermore, both sides confirmed that this estimated project cost is strictly confidential, and should

never be duplicated or released to other parties.

5.3 Other undertaking of the Sudan side

The Team explained to the Sudan side its obligations and their timelines and the costs to be covered by the Sudan side as listed in Annex-2 and Annex-3, and the Sudan side understood and promised to execute them by the date mentioned in the Annex-3.

The Sudan side promised that PWC and SWC shall take necessary measures to facilitate project implementation, such as exemption of Value Added Tax, custom duties, and any other taxes and fiscal levy charges in Sudan arising from the Project activities.

Both sides confirmed that the procured equipment and materials for construction should be kept in adequate storage and SWC shall be responsible for the operation and maintenance. Both sides confirmed that equipment and materials shall be stored in warehouse in the premises of the headquarters office of SWC in Kassala City.

5.4 Operation & Maintenance (O&M) Issues

The Team explained to the Sudan side the obligations during operation and maintenance, as listed below, and the Sudan side understood and promised to execute them and facilitate necessary measures to enforce them.

- Perform periodic water quality tests.
- Regarding water intake volume, distribution volume, reservoir water level, consumed electricity volume, chlorine use volume, and etc, record the data and make weekly, monthly, and annual reports.
- Based on the O&M manual, perform daily and periodic inspections.
- (for Mahta WTP) After completion, it should operate continuously for 24 hrs, instead of 20hrs.
- (for Mahta WTP) Secure budget for cost of chlorine and electricity.
- (for Garb WTP) As specified in Annex-1, JICA will only assist receiving well, reservoirs, and piping at Garb WTP. Any further renewals of distribution pump, Chlorine dosing facility, and power supply and instrumentation facilities are the responsibilities of the Sudan side.
- (for Garb WTP) Chlorine should be placed in receiving well, instead of reservoir.

5.5 Safety and Security

The Sudan side will ensure that necessary measures are taken for the safety and security of the Japanese national involved in the Project.

5.6 Submission of Official Request

The Team requested for the Official Request for the Project to be submitted before the end of December, 2010 to the Embassy of Japan. The Sudan side agreed to this and ensured that it will be submitted without delay.

5.7 Tentative Schedule

The team explained the tentative schedule as shown below.

December, 2010	Agreement on the outline design and submission of Official Request
February, 2011	A cabinet approval by the Government of Japan on the Project
In case the Project is officially approved as above	
March, 2011	Signing of the agreements on the project implementation -Exchange of Notes: Agreement between both governments -Grant Agreement: Agreement between Authority of the Sudan and JICA
April, 2011	Service contract between the Government of Sudan and Japanese consulting firm, referring to the recommendation by JICA
May, 2011	Detailed design work by the Consultant
November, 2011	Tendering and Contracting with a Japanese construction firm
December, 2011	Commencement of the construction work
February, 2013	Completion of the construction work

The Sudan side understood the above basic schedule, but requested for faster implementation whenever possible, as the Project is an urgent rehabilitation. The Team took note of this of request for future consideration.

Annex-1 Components of the Project
Annex-2 Obligations of the Sudan Side
Annex-3 Project Cost Estimation of the Sudan Side

CONFIDENTIAL

This page is closed to the confidentiality.

OBLIGATIONS OF THE SUDAN SIDE

The obligations required for the Government of Sudan for the project implementation are as follows:

① Provision of necessary data and materials for this project.
② Security at the project sites.
③ Payment of commissions for Banking Arrangements (B/A) and Authorization to Pay (A/P)
④ Quick loading and unloading, and customs clearance procedures for the equipment and materials for construction use.
⑤ Make action of exemption from taxation for the equipment and materials to be brought in Sudan by the Japanese personnel and taxes of subcontracts for the procurement of the equipment and materials, and the execution of services based on the approved contracts.
⑥ Appropriate use and maintenance of constructed facilities in this project.
⑦ Other provisions, as listed below, such as the expenses for the engineers and technical staff necessary for the Project and the use of lands and spaces belonging to the SWC, which will not be financed by the Japanese Grant Aid.

Obligations of the Sudan Side

Items	Remarks
(1) Provision of temporary yard (partial area of construction land for south WTP)	The spaces belong to SWC, and they will be free of charge.
(2) Secure lands for facilities including construction lands and access roads.	The land acquisition will be necessary only for the construction of water supply facilities for the areas, but all the facilities are planned to be constructed in the public lands. It is not difficult to acquire such lands.
(3) Land leveling and removal of the trees and existing facilities inside the construction area	SWC will carry out by dispatching engineers and technical staff of SWC.
(4) Preparation of a disposal site for the surplus soil generated at construction work	The disposal site is appropriate area instructed by SWC.
(5) Provision of the electric power line to the project area (415V)	The existing transformer of Mahta WTP is required to be upgraded due to lack in capacity. In contrast, the existing transformer of Garb WTP can be used.
(6) Removal and disposal of existing facilities after changeover of the existing and renewal constructed facilities	Existing facilities do not affect on renewal facilities. SWC will carry out this work if necessary.
(7) Cooperation for connection work between the existing facilities and renewal facilities (witness during the connection work and coordination for the stop of water supply, if required)	SWC will dispatch engineers and technical staffs for this.
(8) Construction of the fence and gate (Mahta WTP)	SWC will dispatch engineers and technical staffs for this.
(9) Water supply for leakage test	Water for leakage test will be supplied from the existing WTP.
(10) Personnel Assignment for Project Implementation	SWC will dispatch engineers and technical staffs for this.

PROJECT COST ESTIMATION OF THE SUDAN SIDE

Costs to be Covered by the Sudan Side

(Unit: Thousand SDG)

Items	Completion Date(Plan)	Costs	Remarks
1. Mahta WTP			
(1) Provision of temporary yard (partial area of construction land for south WTP)	Nov, 2011	-	The spaces belong to SWC, and they will be free of charge.
(2) Secure lands for facilities including construction lands and access roads.	Nov, 2011	-	As construction lands belong to SWC, it is not necessary to acquire new land.
(3) Land leveling inside the construction area	Nov, 2011	168.3	
(4) Slope protection	Nov, 2011	121.5	
(5) Moving work of trees	Nov, 2011	0.9	
(6) Provision of the electric power line to the project area (415V)	Nov, 2011	55.8	Upgrading existing transformer
(7) Construction of the fence and gate	Nov, 2012	87.0	
(8) Water supply for leakage test	Jan, 2013	17.3	
(9) Personnel and other expenses (incl. chlorine)	-	19.6	
Sub total		470.4	
2. Garb WTP			
(1) Provision of temporary yard (partial area of construction land for south WTP)	Nov, 2011	-	The spaces belong to SWC, and they will be free of charge.
(2) Secure lands for facilities including construction lands and access roads.	Nov, 2011	-	As construction lands belong to SWC, it is not necessary to acquire new land.
(3) Moving work of trees	Nov, 2011	1.6	
(4) Provision of the electric power line to the project area (415V)	Nov, 2011	-	The existing transformer is available
(5) Water supply for leakage test	Jan, 2013	7.7	
(6) Personnel and other expenses (incl. chlorine)	-	-	Including that of Mahta WTP
Sub total		9.3	
3. Charge of B/A		7.5	
Total		487.2	-

Conditions of Cost Estimate

<Time of Cost Estimate>

The project cost estimate is based on prices and exchange rates as of September 2010.

<Exchange Rates>

The exchange rate of the average from March 2010 to August 2010 is applied for the cost estimate.

- 1 USD = 90.90 JPY
- 1 USD = 2.28 SDG
- 1 SDG = 39.8684 JPY

MINUTES OF DISCUSSIONS

ON THE PREPARATORY SURVEY

ON

THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY SYSTEM

AT KASSALA CITY,

IN THE REPUBLIC OF THE SUDAN

(EXPLANATION ON DRAFT REPORT)

In March 2010, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Preparatory Survey Team on the Project for Improvement of Water Supply Facilities in Kassala City (now the relevant components mentioned here is referred to as "the Project for Improvement of Water Supply System at Kassala City" and hereinafter referred to as "the Project") to the Government of the Republic of the Sudan (hereinafter referred to as "Sudan") and through discussion, field survey and technical examination of the results in Japan, JICA prepared a draft report of the study.

In order to explain and consult with the Government of Sudan on the components of the draft report, JICA sent to Sudan the Draft Report Explanation Team (hereinafter referred to as "the Team"), which was headed by Eng. Yosuke Sasaki, Senior Advisor, JICA, from 14th to 23rd May 2011.

As a result of discussions, both parties confirmed the main items described in the attached sheets.

Kassala, 18th May, 2011

Eng. Yosuke SASAKI
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Eng. Mohamed H.M. AMMAR
Director General
Public Water Corporation
Government of National Unity
Sudan

Witnessed by

Eng. Hashim Mohamed Abdulatief
Director General
Kassala State Water Corporation
Kassala State
Government of National Unity
Sudan

for / Elgaili Mohamed ElBashir
Undersecretary
Ministry of International Cooperation
Government of National Unity
Sudan

ATTACHMENT

1 Components of the Draft Report

The Sudan side agreed and accepted in principle the components of the draft outline design explained by the Team. The components of the Project are shown in Annex-1.

2 Japan's Grant Aid Scheme

The Sudan side understood the Japan's Grant Aid Scheme and would take the necessary measures and allocate budget properly for smooth implementation of the Project, as a condition for the Japanese Grant Aid to be implemented. The Grant Aid Scheme and necessary measures mentioned above are described in the Annex-4 and Annex-6 of the Minutes of Discussions signed by both parties on 10th March 2010 (hereinafter referred to as "the previous minute").

3 Responsible and Implementing Agency

3.1 The Responsible Agency is the Public Water Corporation (hereinafter referred to as "PWC").

3.2 The Implementing Agency is Kassala State Water Corporation (hereinafter referred to as "SWC").

4 Schedule of the Study

JICA will complete the final report in accordance with the confirmed item and send it to the Government of Sudan by the end of June 2011.

5 Other Relevant Issues

The following issues were discussed and confirmed by the both sides.

5.1Component of the Project

The Team explained the components of the Project and noted that the additional distribution pipes, equipment, machines and tools and rehabilitation of workshop will not be a component of this project. Based on the above explanation, both sides agreed on the components and confirmed that the draft technical specifications listed in Annex-1 is strictly confidential and should never be duplicated or released to other parties.

5.2 Project Cost Estimate and Budgetary Arrangement

The Team explained to the Sudan side the estimated project cost as attached in Annex-1. Both side confirmed that this estimated cost (including contingency) was provisional and would be examined further by the Government of Japan for its final approval. The contingency would cover the additional costs against natural disaster, unexpected natural conditions, etc.

The Sudan side reconfirmed to secure necessary counterpart budget for the project timely and adequately

to cover the required amount of the cost, as promised in the previous minutes.

Furthermore, both sides confirmed that this estimated project cost is strictly confidential, and should never be duplicated or released to other parties.

5.3 Other undertaking of the Sudan side

The Team explained to the Sudan side its obligations and timelines and costs to be covered by the Sudan side as listed in Annex-2 and Annex-3, and the Sudan side understood and promised to make available the necessary funding in a timely manner and execute them by the period mentioned in the Annex-3.

The Sudan side promised that PWC and SWC shall take necessary measures to facilitate project implementation, such as exemption of Value Added Tax, custom duties, and any other taxes and fiscal levy charges in Sudan arising from the Project activities.

Both sides confirmed that the procured equipment and materials for construction should be kept in adequate storage and that SWC shall be responsible for providing adequate space as the stockyard.

5.4 Soft Component Issues

The Team explained to the Sudan side the contents of the Soft Component and the obligations during its implementation. The Team also stressed that ownership, careful planning and continuous cooperation are necessary for sustainability of transferred knowledge and experience. The Sudan side understood and promised to execute and facilitate necessary measures to implement them.

5.5 Safety and Security

The Sudan side will ensure that necessary measures are taken for the safety and security of the Japanese nationals as well as other staffs involved in the Project.

5.6 Environmental and Social Considerations

The Team explained the importance of environmental and social considerations during construction and operation. Also, the Team explained the environmental and social impacts and the mitigation measures to be taken in the Project based on Environmental Checklist (Annex 4) and stated that the Monitoring Form should be used to monitor the impacts of the Project. Further, although EIA report is not necessary, "Environmental Feasibility Study" specified in Environment Protection Act needs to be submitted. The Sudan side understood and agreed to submit the study in a timely manner.

5.7 Tentative Schedule

The team explained that cabinet approval by the Government of Japan on the Project for Detailed Design is still under consideration and explained that overall tentative schedule will be notified as soon as it is approved by the Government of Japan.

Annex-1 Components of the Project
Annex-2 Obligations of the Sudan Side
Annex-3 Project Cost Estimation of the Sudan Side
Annex-4 Environmental Check List, Monitoring Form

This page is closed to the confidentiality.

Annex-2 Obligations of the Sudan Side

① Provision of necessary data and materials for the project

② Ensuring safety at the project sites

③ Payment of commissions for Banking Arrangements (B/A) and Authorization to Pay (A/P)

④ Quick loading and unloading, and customs clearance procedures for the materials and equipment for construction procured for the project

⑤ Adoption of measures for exemption from taxation for the materials and equipment to be brought into Sudan by Japanese personnel, taxes on subcontracts for the procurement of the materials and equipment, and the execution of services based on the approved contract

⑥ Appropriate use and operation and maintenance of facilities constructed in the project

⑦ Other obligations listed below..

Item	Timing of execution	Remarks
1. Existing wells		
(1) Ensuring site	Boundary verification: Within one month after contract with the Japanese Consultant firm. Land use permission: Before construction start at latest	Since there are existing wells for which the site boundaries are not clear, site should be ensured by establishing the site boundaries.
(2) Soil preparation in site and removal of trees, etc.	Before construction start at latest	Prepare the soil within the site area, and remove trees, shrubs, etc.
(3) Replacement of power supply equipment on the primary side	Before electric construction start at latest	Renew power supply equipment on the primary side that has deteriorated.
(4) Emergency generator equipment	Before electric construction start at latest	Replace existing well pumps, and renew generators that have deteriorated or have inadequate power generating capacity.
(5) Installation of fences and gates	Before handing over	Install fences and gates to ensure and maintain safety of well facilities.
2. New wells		
(1) Ensuring site	Boundary verification: Within one month after contract with the Japanese Consultant firm. Land use permission: Before construction start at latest	Although the scheduled site for well is public land, the boundaries should be established and the necessary site should be ensured.
(2) Soil preparation in site and removal of trees, etc.	Before construction start at latest	Prepare the soil within the site area, and remove trees, shrubs, etc.
(3) Drawing power and installing power supply equipment on the primary side	Before electric construction start at latest	Since power is not being supplied to the area containing new wells, install power supply equipment on the primary side for drawing power.
(4) Install fences and gates	Before handing over	Install fences and gates to ensure and maintain safety of well facilities.
3. New WTP		
(1) Ensuring site	Boundary verification: Within one month after contract with the Japanese Consultant firm.	Site for new WTP has already been ensured, but erect strong side stakes to demarcate the site boundaries.
(2) Soil preparation in site and removal of trees, etc.	Before construction start at latest	Soil preparation at the site is already completed; remove trees, shrubs, etc.

Item	Timing of execution	Remarks
(3) Provision of temporary sites for work	Before construction start at latest	Provide temporary site for work within the new WTP.
(4) Access roads	Before construction start at latest	Although access roads have been ensured along the dike, there are locations where trees project on to the public roads. The projecting branches must be pruned or the trees removed.
(5) Drawing power and installing power supply equipment on the primary side	Before construction start at latest	Since power is not being supplied to the area containing WTP, install power supply equipment on the primary side for drawing power.
(6) Provision of water for water filling tests	Before water filling test	Water is ensured and provided by conveying it to the WTP from the water source wells.
(7) Installation of fences and gates	Before handing over	Install fences and gates to ensure and maintain safety of the WTP.
4. Conveyance pipes and distribution mains		
(1) Cooperation related to request for exclusive use of roads and rivers	Before construction start	Before the work of laying raw water and distribution mains, cooperate to complete formalities of the organization that manages roads and rivers for their exclusive use.
(2) Pruning and removing trees, shrubs, etc., in roads	Before construction start at latest	Trees, shrubs, exist in roads on the raw water and distribution pipeline routes. If these obstruct pipe laying work, prune or remove them.
(3) Clearing objects on the road	Before construction start at latest	Clear concrete blocks or other objects such as signboards remaining on roads.
(4) Suspension of water supply because new pipe or existing pipe connections	Before and during connection works	Cooperate with the residents during suspension of water supply when new pipes or existing pipes are to be connected by notifying the residents and witnessing the connection work.
5. Others		
(1) Disposal area for surplus soil from the work	Before all construction start	SWC to specify the disposal location after discussion with Kassala City.
(2) Project implementation	During all construction works	SWC to station engineers and to cooperation in the project implementation.

Annex-3 Project Cost Estimation of the Sudan Side

(Unit: thousand SDG)

Item	Cost	Remarks
1. Existing wells		
(1) Ensuring site	-	This is site owned by SWC.
(2) Soil preparation in site and removal of trees, etc.	5.6	
(3) Replacement of power equipment on the primary side	12.5	Renew deteriorated and old equipment.
(4) Emergency generator equipment	125.0	Renew deteriorated and inadequate capacity generators.
(5) Installation of fences and gates	122.2	
Sub-total	265.3	
2. New wells		
(1) Ensuring site	-	Free because this is public land.
(2) Soil preparation in site and removal of trees, etc.	5.9	
(3) Drawing power and installing power supply equipment on the primary side	-	Included in the water treatment plant.
(4) Installation of fences and gates	134.4	
Sub-total	140.3	
3. New water treatment plant		
(1) Ensuring site	-	This is site owned by SWC.
(2) Soil preparation in site and removal of trees, etc.	1.6	
(3) Provision of temporary sites for work	-	This is site owned by SWC.
(4) Access roads	0.6	Prune and remove trees on roads.
(5) Drawing power and installing power supply equipment on the primary side	241.9	Including new wells
(6) Provision of water for water filling tests	23.0	
(7) Installation of fences and gates	64.7	
Sub-total	331.8	
4. Conveyance pipes and distribution main		
(1) Pruning and removing trees, shrubs, etc., in roads	0.6	
(2) Clearing objects on the road	-	To be borne by owner
Sub-total	0.6	
5. Others		
(1) Project implementation cost	24.3	
(2) Bank commission	15.0	
Sub-total	39.3	
Total	777.3	

Annex-4 Environmental Check List, Monitoring Form

(1) Environmental Check List

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) N (b) N (c) N (d) Y	(a) , (b), (c), Although EIA report is unnecessary, "Environmental Feasibility Study" specified from Environment Protection Act needs to be submitted. The contents of "Environmental Feasibility Study" are included in the contents of the initial environmental examination survey. (d) The approvals about construction of source wells and raw water mains were acquired.
	(2) Explanation to the Public	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design	(a) Y (b) Y	(a) , (b) Two stakeholder meetings were held. Suitable explanations for the local resident and stakeholders who participated in the meeting were given, and participant's understandings have been obtained. Moreover, participant's opinions are made to reflect in the project.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	Examination of alternatives is only two cases of "With project" and "Without project."

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Are any mitigating measures taken? (b) Do chlorine concentrations within the working environments comply with the country's occupational health and safety standards?	(a) N (b) N	(a) Although gaseous chlorine is used for disinfection in the existing institution, the considered storage facility is planned. (b) Chlorine is not specified although there is law which specifies labor environment in the Sudan.
	(2) Water Quality	a) Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country's effluent standards?	(a) N	(a) There is no drainage from WTP.
	(3) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed in accordance with the country's regulations?	(a) N	(a) There is no generating of the water purifying sludge.
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?	(a) Y	(a) The machines which generate noise and vibration are installed in a building, and it takes noise control measures. Therefore, it is presumed that adverse impacts by noise and vibration are not generated in the operation stage.
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a) N	(a) It was decided upon the pumping plan based on the detailed existing well investigation. Therefore, it is judged that land subsidence does not occur.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
3 Natural Environment	(1) Protected Areas	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) There is no protected area appointed by the Sudan government, an international treaty, etc. in the survey area.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site or discharge area encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(a) N (b) N (c) N (d) N	(a) , (b), (c), (d) There are no primeval forests, tropical rain forests, ecologically valuable habitats in the survey area. No adverse impact on the ecosystem is envisaged.
	(3) Hydrology	(a) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect surface water and groundwater flows?		(a) The detailed existing well investigation was conducted and it has decided upon the pumping plan which does not have adverse impact on the existing well.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N (b) N (c) N (d) N (e) N (f) N (g) N (h) N (i) N (j) N	(a) , (b), (c), (d), (e), (f), (g), (h), (i), (j) The construction site of WTP is already acquired, acquisition of new land is unnecessary. Involuntary resettlement of residents does not occur.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses?	(a) N (b) N	(a) The influence on the water vender by the improvement of water supply service is expected. Employment by SWC and adequate measures by the state government, the locality government and SWC are expected. (b), The detailed existing well investigation was conducted and it has decided upon the pumping plan which does not have adverse impact on the existing well.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) There is no possibility that the project will damage the archeological, historical, cultural and religious heritage.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) The surrounding area of the planned site (South WTP) is mainly agricultural land and empty land, and there is no scene which should be considered.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N (b) N	(a), (b) Ethnic minorities and indigenous people are not settled in the project area and no serious impact of project activities are expected on culture and lifestyle of ethnic minorities and indigenous people.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) N (b) N (c) N (d) N	(a) , (b), (c), (d) It is required to make safe consideration through the technical cooperation project concerning operation and management of WTP.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a) N (b) N (c) N (d) N	(a) , (b), (c), (d) In the construction stage, in order to mitigate noise, vibration, and particulates, it is necessary to take suitable measures. Serious impacts on the natural environment are not anticipated.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) N (b) N (c) N (d) N	(a) , (b), (c), (d) Monitoring plans on both construction stage and operation stage have been prepared. Monitoring is to be conducted based on these plans. Detailed environmental monitoring plan is also prepared and monitoring framework is to be established by SWC. These monitoring results are periodically reported to Ministry of Physical Panning and Public Utilities of the state government which is the higher organization of SWC. In particular, about the monitoring result of the groundwater level, the consultation with the Water Resources Department is required.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.		(a) , None
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) Y	(a) , The impacts to transboundary or global issues are not assumed.

(2) Monitoring Form (Draft)

1) Monitoring Form for Surrounding Environment (Construction Stage)

Monitoring Item	Monitoring Results during Report Period
Number of requests and complaints	
Content of requests/complaints	

2) Monitoring Form for Noise (Construction Stage)

Item	Unit	Measured Value (Max.)	Country's Standards	Standards for Contract	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level	dB				85 dB*	

* The regulation value in Japan (during construction work period)

3) Monitoring Form for Supplied Treated Water (Operation Stage)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Standards for Contract	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
pH	-			6.5 – 8.5			
Turbidity	NTU			5 NTU			
Residual Chlorine	mg/l			0.1*		5**	
E. Coli	n/100 ml			ND			
Fluoride	mg/l			1.5 mg/l			
NO_2-N	mg/l			2 mg/l as NO_2			
NO_3-N	mg/l			50 mg/l as NO_3			

* Usually, 0.1 mg/l is secured in order to maintain disinfection property.
** In the WHO guideline, 5 mg/l is shown as upper limit.

4) Monitoring Form for Noise (Operation Stage)

Item	Unit	Measured Value (Max.)	Country's Standards	Standards for Contract	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level	dB				40 dB*	

* The regulation value in Japan (during night time)

5) Monitoring Form for Noise (Operation Stage)

Item	Unit	Measured Value	Country's Standards	Standards for Contract	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Groundwater Level	m					