JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
GOVERNMENT OF SOUTHERN SUDAN

EMERGENCY STUDY ON THE PLANNING AND SUPPORT FOR BASIC PHYSICAL AND SOCIAL INFRASTRUCTURE IN JUBA TOWN AND THE SURROUNDING AREAS IN THE SOUTHERN SUDAN

SUPPLEMENTARY REPORT

OCTOBER 2007

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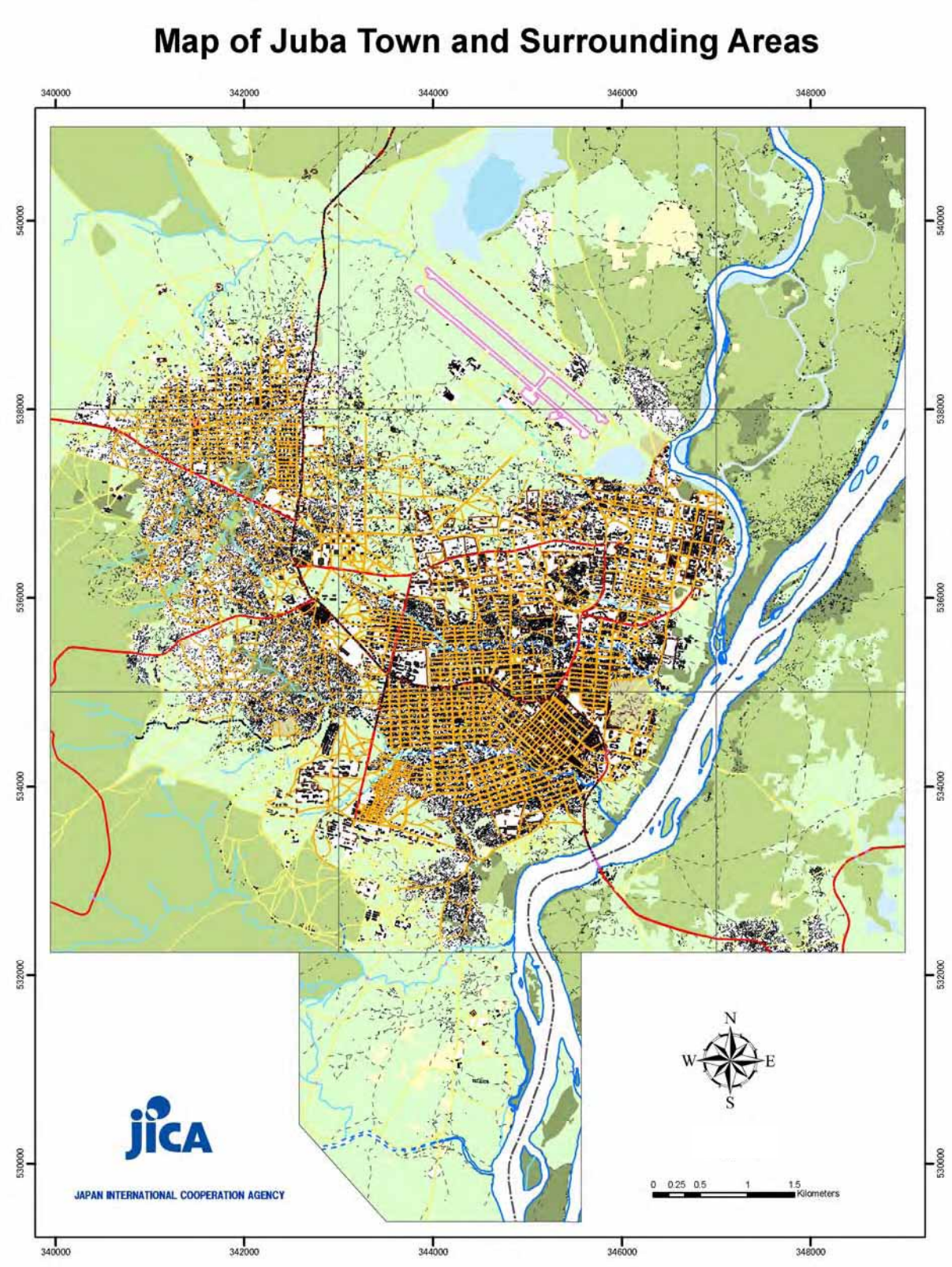

Location Map

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ABBREVIATIONS

ACF-USA	:	Action Contre le Faim-United States of America
ACORD	:	Agency for Co-operation and Research in Development
ADRA	:	Adventist Development and Relief Agency
CAA	:	Civil Aviation Authority
CBS	:	Central Bureau of Statistics
CES	:	Central Equatoria State
CPA	:	Comprehensive Peace Agreement
CRS	:	Catholic Relief Services
DBST	:	Double Bituminous Surface Treatment
DDR	:	Disarmament、Demobilization and Reintegration
DOS	:	Department of Survey
ERWJ	:	Emergency Rehabilitation Work in Juba
GONU	:	Government of National Unity
GOSS	:	Government of Southern Sudan
GPS	:	Global Positioning System
GZT	:	Gesellschaft fur Technische Zusammenarbeit
HIPC	:	Heavy Indebted Poor Country
ICRC	:	International Committee of the Red Cross
IDP	:	Internally Displaced Person
IOM	:	International organization for Migration
JAM	:	Joint Assessment Mission
LGF	:	Local Government Framework
LRA	:	The Lord's Resistance Army
MDGs	:	Millennium Development Goals
MDTF	:	Multi Donor Trust Fund
MHLU	:	Ministry of Housing, Land and Utilities
MOSTE	:	Ministry of Education, Science and Technology
MSL	:	Mean Sea Level
MT	:	Metric Ton
NCA	:	Norwegian Church Aid
NGO	:	Non-Governmental Organization
NMT	:	Non-Motorized Transport
NPA	:	Norwegian People Aid
OFDA	:	US Office for Foreign Disaster Assistance
PHC	:	Primary Health Care
QIP	:	Quick Impact Project
RRR	:	Return, Reintegration and Recovery
RTC	:	River Transport Corporation
SCC	:	Sudanese Council of Churches
SFM	:	Swedish Free Mission
SMPI	:	State Ministry of Physical Infrastructure

SOLUS	:	Southern Sudan SPLM areas
SPLM	:	Sudan People's Liberation Movement
SRRC	:	Sudan Relief and Rehabilitation Commission
SWM	:	Solid Waste Management
UNDP	:	United Nations Development Programme
UNEP	:	United Nations Environment Programme
UNHCR	:	United Nations High Commissioner for Refugees
UNICEF	:	United Nations International Children's (Emergency) Fund
UNMIS	:	United Nations Mission in Sudan
UNOPS	:	United Nations Office for Project Service
UPHSD	:	Umbrella Program for Health System Development
USAID	:	United States of America Agency for International Development
UTM	:	Universal Transverse Mercator
WFP	:	United Nations World Food Programme
WGS	:	World Geotech System

INTRODUCTION

This report is the Supplementary Report for the "Emergency Study on the Planning and Support for Basic Physical and Social Infrastructure in Juba Town and the Surrounding Areas in the Southern Sudan". The report compiles the results of the two Pilot Projects, namely water supply project and port rehabilitation project after the Final Report and includes the advices and suggestions for the sound maintenance and operation of the facilities/equipment.

Despite many difficulties in implementing conditions, completion of the Pilot Projects within the Study had a significant meaning as an example for the following projects to advance to a next stage from reconstruction to development.

I PILOT PROJECT IN TRANSPORT SECTOR

1. OUTLINE OF THE PROJECT

1.1 Selection of the Project

As per the "Minutes of Meeting on Scope of Work for Emergency Study on the Planning and Support for Basic Physical and Social Infrastructure in Juba Town and the Surrounding Areas in Southern Sudan Agreed upon between the Government of Southern Sudan and Japan International Cooperation Agency" dated on November 24, 2005, Juba Port Improvement Project is selected as a Pilot Project in the transport sector.

This project is considered to be a short-term-project in the infrastructure development plan in the river transport sector.

1.2 Design Policy

(1) Location

There are three alternative locations; present port, old port and another new location. Their applicability is evaluated as follows:

- Old Port : Earth has been deposited on the place where 11 barges had sunken, causing the change in river channel to make the stream a tributary of the White Nile River having insufficient width and water depth for navigation. Under such situation, the rehabilitation of the old port is not appropriate for the Pilot Project which needs to be urgently implemented.
- Present Port: Vessels moor alongside the riverbank directly in about 370m long section. The present port area is suitable place for construction of new port facilities since it is possible not to suspend the operation of the present port and there exits an access road to the arterial road network in Juba Town.
- New Location: There are two candidate locations: one is the point about 20 kilometers south of the urban area of Juba and another is the riverbank area on the east side of the river. Since either location has no access road connecting to the urban area at present, the construction of new port therein is not appropriate for the Pilot Project.

Considering the above, the present port area was selected as the location of the Pilot Project.

(2) Scale of Port Facilities

Factors in Deciding the Scale of Port

The major factors to decide the scale of the port are as follows:

- Size of Vessels: Major vessels utilizing the port are barges with the following dimensions:

  Tonnage: 500 D.T. Length: 35 m

  Width: 10 m Height: 2.7 m
- Full Load Draft : 2.1 m
- Transport Demand:

  7,400-9,000 tons/month in 2015 (7,100-8,600 tons/month of incoming and 300-400 tons/month of outgoing cargo)

Cargo Handling Capacity

Considering the size of the barges, length of the berthing facility and cargo handling yard is set at a multiple number of 35 in meter. In four cases: combined two cases of length of berth (35 and 70 m) and two cases of loading/unloading means (manpower and gantry crane), cargo handling capacities are estimated as shown in Table I.1-1, and is summarized in Table I.1-2.

Table I.1-1 Estimated Cargo Handling Capacity

Handling Type		Manpower		Gantry Crane	
Berth Length		35 m	70 m	35 m	70 m
Assumption	Workable Hours for Loading / Unloading & Handling Rate	10 hours/day	12 hours/day	10 hours/day	12 hours/day
		25 days/month		25 days/month	
		Number of Workers = 60		Loading / Unloading Cycle = 3 minutes (1-min.hoisting + 1-min. traversing + 1-min. rolling down)	
		Handling Volume per Worker = 250 kg/hr (50 kg/bag x 5 times/hour)		Loading Volume per Wire Basket = 1,500 kg/hr (50 kg/bag x 30 bags)	
		Total Handling Volume per Hour = 15,000 kg/hr (250 kg/worker x 60 workers)		Total Handling Volume per Hour = 30,000 kg/hr (1,500 kg / 3 min. x 60 min.)	
Cargo Handling Capacity per Month		3,750 tons/month	4,500 tons/month	7,500 tons/month	9,000 tons/month
		= 15 tons/hr x 10 hrs/day x 25 days/month	= 15 tons/hr x 12 hrs/day x 25 days/month	= 30 tons/hr x 10 hrs/day x 25 days/month	= 30 tons/hr x 12 hrs/day x 25 days/month

Table I.1-2 Summary of Estimated Cargo Handling Capacity

Unit: tons/month

	In case of 35-m Berth	In case of 70-m Berth
Loading/Unloading by Man Power	3,750	4,500
Loading/Unloading with Gantry Crane	7,500	9,000

Scale of Port

A 35 m berth with a gantry crane will meet the low estimated demand in 2015 (7,400 tons/month) but not enough for the high estimated demand in 2015 (9,000 tons/month). Therefore, a 70 m berth equipped with gantry crane is desirable to be constructed as soon as possible,

at least well ahead of year 2015. For the Pilot Project, however, 35 m berth with a crane is proposed as an urgent measure, expecting that the berth will be extended in near future.

(3) Design Condition

Design Vessels:

Major vessels utilizing the port are taken as design vessels, which are barges with tonnage of 500 DT, length of 35 m, width of 10 m, height of 2.7 m and full load draft of 2.1 m.

Length of Berthing Facility:

Based on the discussion stated in (2) above, length of the berthing facility was set at 35 m.

Water Depth:

Based on the full load draft of the design vessels, the minimum water depth is 2.2 m.

Area of Cargo Handling Yard:

Length: 35 m in accordance with the length of the berthing facility.

Width: 30 m, for accommodating a gantry crane and allowing trucks to turn.

Design Load: 25 tons (Traction load to bollard)

Vehicle Load: 25 tons

Geometric Design of Access Road:

Cross Sectional Element: Carriageway = 3.5m / lane x 2 lanes, Shoulder = 1.5m x 2

Horizontal Alignment: Minimum Radius = 15 m (after review)

Vertical Alignment: Maximum Grade = 3.0 % (after review)

(4) Scope of the Project

The project includes the following items:

Construction of Berthing Facility (Jetty)

Since the water depth near the riverbank is not enough in dry season, a piled pier is constructed up to the place where the required water depth is secured. The size of the pier is 35 m long (based on the length of barge) and 16 m wide (to secure the required water depth in dry season).

Provision of Cargo Handling Yard

A flat area of 35 m in length and 30 m in width is provided for the cargo handling yard, including the 16 m wide pier area and excavating the shore behind the pier for the remaining width of 14 m. The shore portion is paved with cement / lime treated base (CLTB) and double bituminous surface treatment (DBST).

Installation of Pier Facility

A gantry crane equipped with generator is installed for the use of loading/unloading operation.

Installation of Mooring Facility

Two bollards (mooring posts) are installed.

Construction of Storage Facility

A fuel storehouse and a tools storehouse of 4 m x 4 m each in size are constructed adja-

cent to the cargo handling yard.

Improvement of Access Road

The access road from the cargo handling yard to the arterial road network of the town with a length of about 680 m is improved with pavement and drainage. The road width is 10.0 m composed of 7.0 m carriageway and 1.5 m shoulders on both sides. The road is paved with cement / lime treated base (CLTB) and double bituminous surface treatment (DBST).

(5) Issue of Land

The shore area has been the properties of the State Government and the riverside strip with a width of about 150 to 200 m were leased to private sectors, divided into several lots with various lengths, each of which is called by the Plot Number. The conditions of the lease are as follows:

- The purpose of using the land is limited to gardening.
- The Government has a right to cancel the lease agreement at any time when the land is necessary for public use.
- It is not allowed to sublease the land.

Despite the above conditions, many gardens have been subleased to developers and surrounded by fences. Many of them are developed for the other purposes than the gardening such as hotel accommodations, restaurants, inland port terminal and so on. Plot No. 24, one of these fenced plots, where the piled pier in the Pilot Project is initially planned to be located, is subleased to one branch of logistics company group based in France, for the purpose of construction of an inland port terminal in Juba. This plan was also reported in a Kenyan newspaper on 9 May 2006. Container offices have already been installed and materials and equipment also stocked inside the fence line. Such fenced plots have been rapidly increasing since around April 2006 and open places are diminishing accordingly.

For the land for the Pilot Project to be made for public use officially, a state decree was issued by the Governor of Central Equatorial State on 28 September 2006 and announced through radio on 9 October 2006, decreeing the withdrawal of title of the Plots from No. 23 to No. 27 from each lease holder. This was the very first actual Government's action to clearing the lands for the public projects in Juba, hence in Southern Sudan.

However, it was highly expected that it would take long time to reach agreement with the lease holder and developer and for the land to be completely cleared, then removing all container offices, materials and equipment from the site. Therefore, the Pilot Project which was initially planned to be located in Plot No.24 is shifted to Plot No.25 where at that time was vacant. The access road was planned to be located at the west end of Plot No.24, expecting that the west side of the fence is removed or set back by the time of construction of the last section of the access road. However, if no progress of land clearance was made until the time of construction of the

access road and it was difficult for the contractor to enter the inside of the fence[*1], the location of the access road might be forced to be changed to the route passing the outside of the fence.

The final location of the project is shown in Figure I.1-1 after clearing of Plot No.24 and considering future arterial road (mid ring road or river side road) alignments and available road reserve in adjacent area which was designated as a light industrial zone in the north.

[*1] State Government spent about 6 months to clear all plots of No.23~27 from November 2006 to April 2007, after physical conflict between the lease holders and the Japanese/Thai contractor at the end of October 2006.

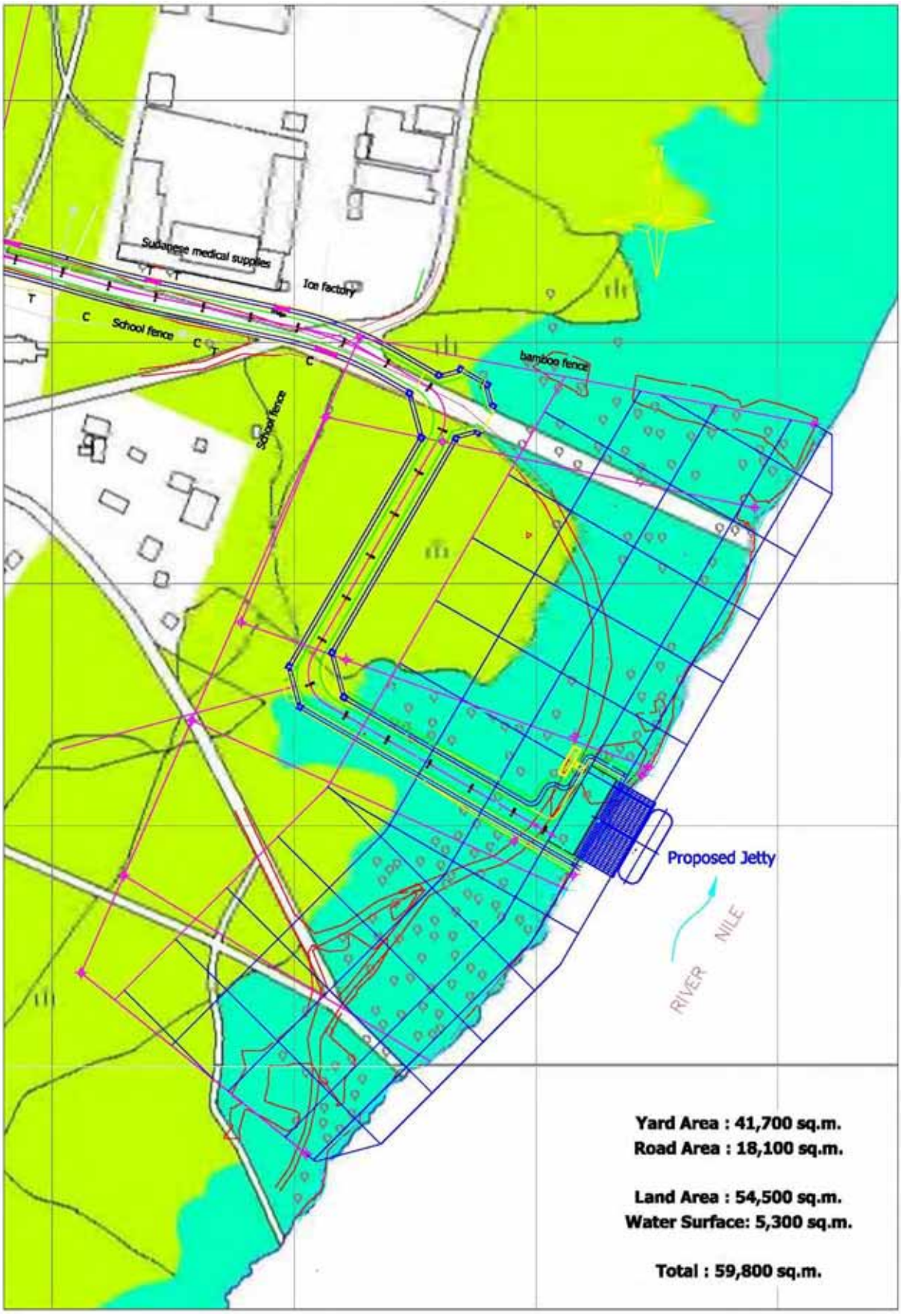


Figure I.1-1 Location of the Project

2. DESIGN

(1) Berthing Facility

The piled pier, having a floor system on piles, is adopted for berthing facility. Main reasons for selecting this type are as follows:

- Construction is easy.
- Construction period is short.
- Vessels moor easily having less influence by wave compared with wall type pier.

(2) Cargo Handling Yard

Size of the cargo handling yard is as follows:

- Length : 35 m
- Width : 30 m (12 m on the land, 2 m as apron, and 16 m as steel deck of the jetty)

The riverbank portion behind the pier is protected by gabion mat and paved with 20 cm thick cement / lime treated base (CLTB) and double bituminous surface treatment (DBST).

(3) Gantry Crane

Specifications of the crane are as follows:

- Rated Load : 1.25 ton
- Span : 15.4 m
- Lift : 4.0 m
- Cantilever Length : 6.5 m (effective length : 6.0 m to reach the center of barges)

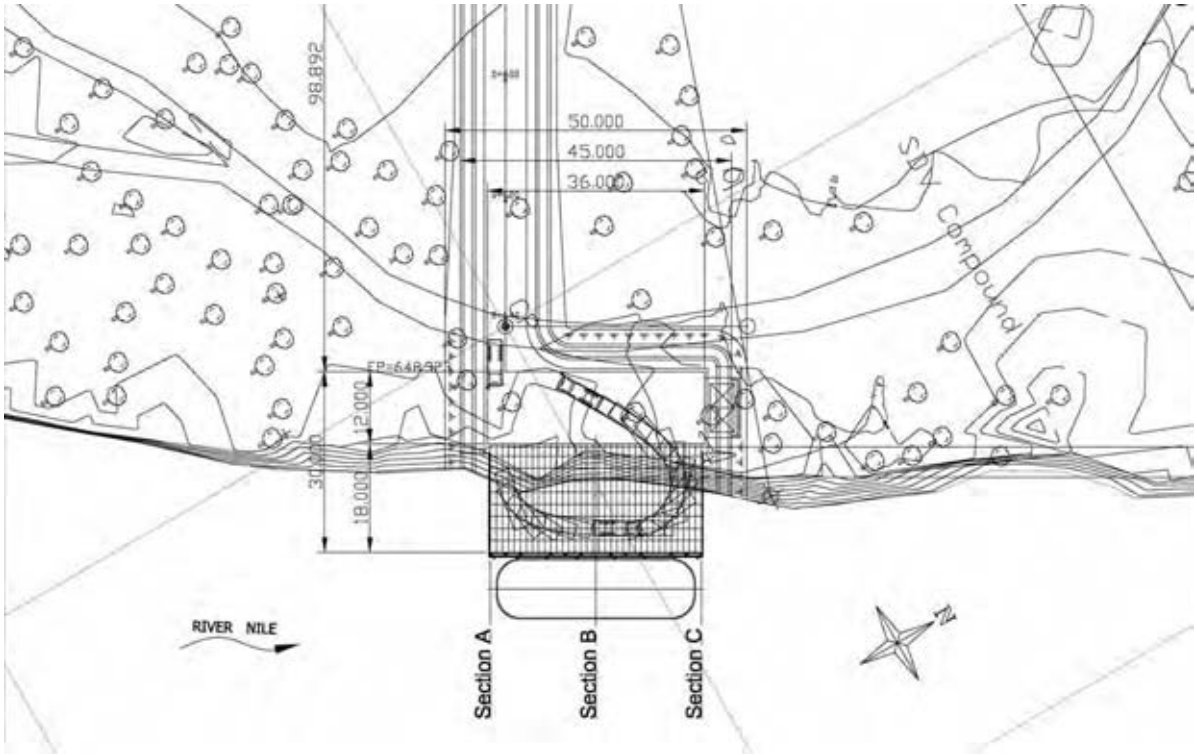


Figure I.2-1 Layout Plan

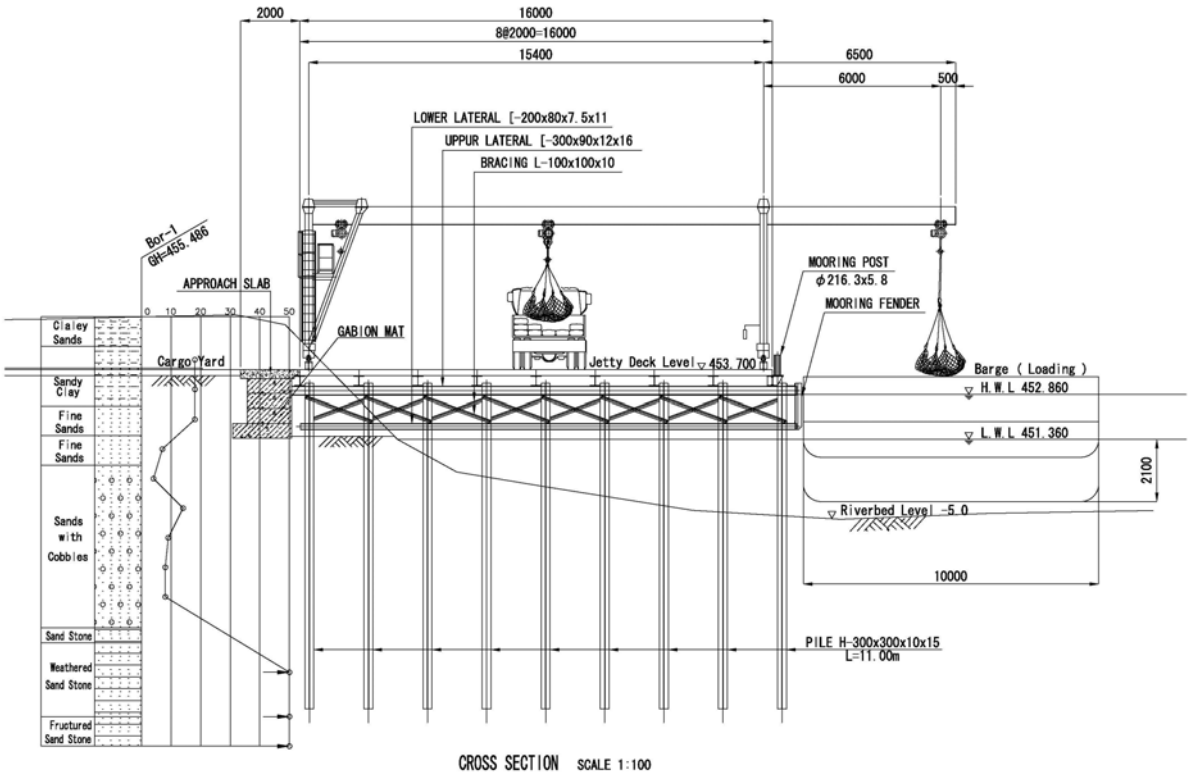


Figure I.2-2 Cross Section

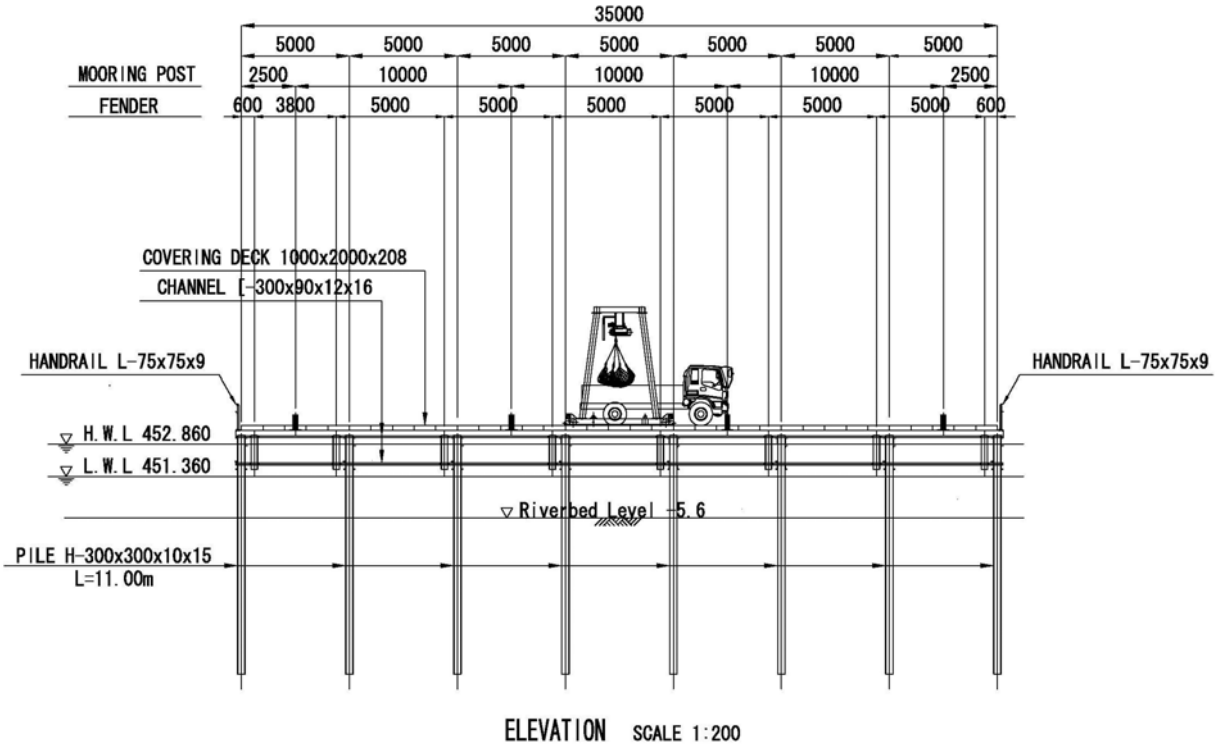


Figure I.2-3 Elevation

(4) Access Road

The access road is paved with 20 cm thick cement / lime treated base (CLTB) and double bituminous surface treatment (DBST).

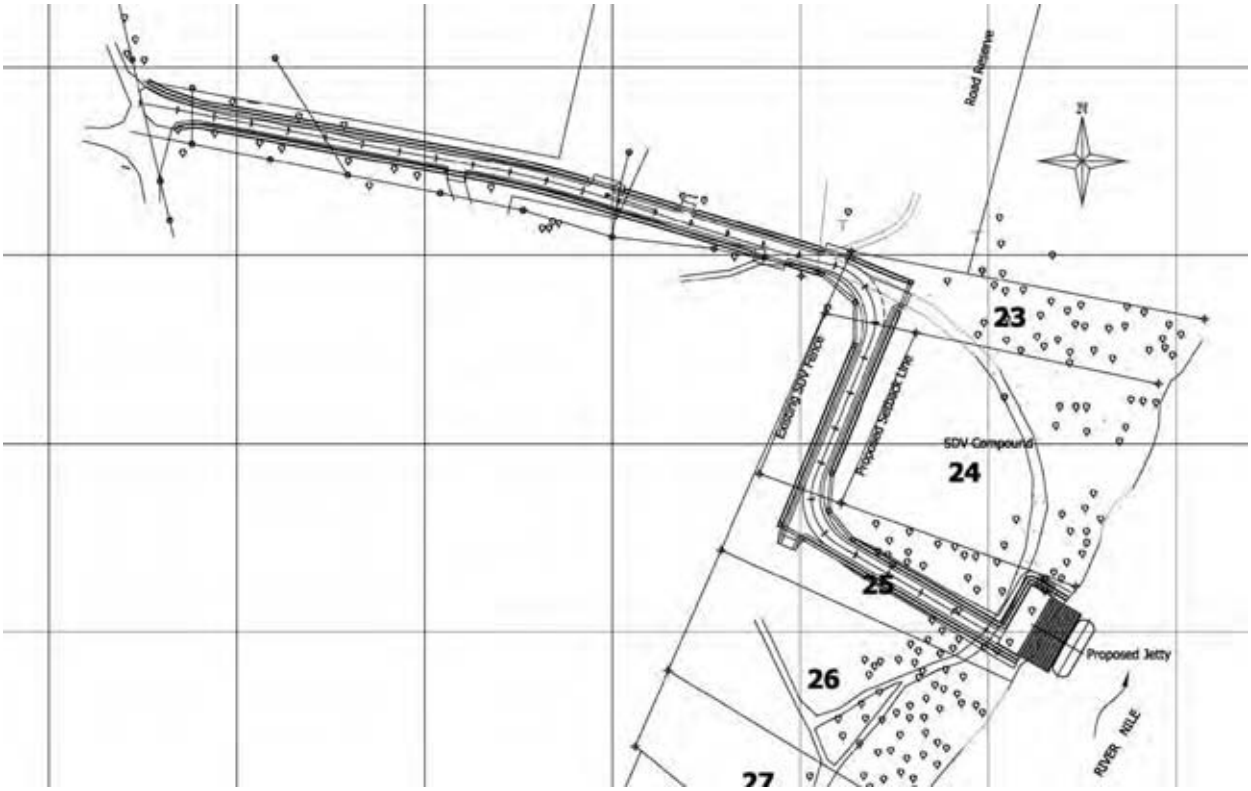


Figure I.2-4 Plan of Access Road

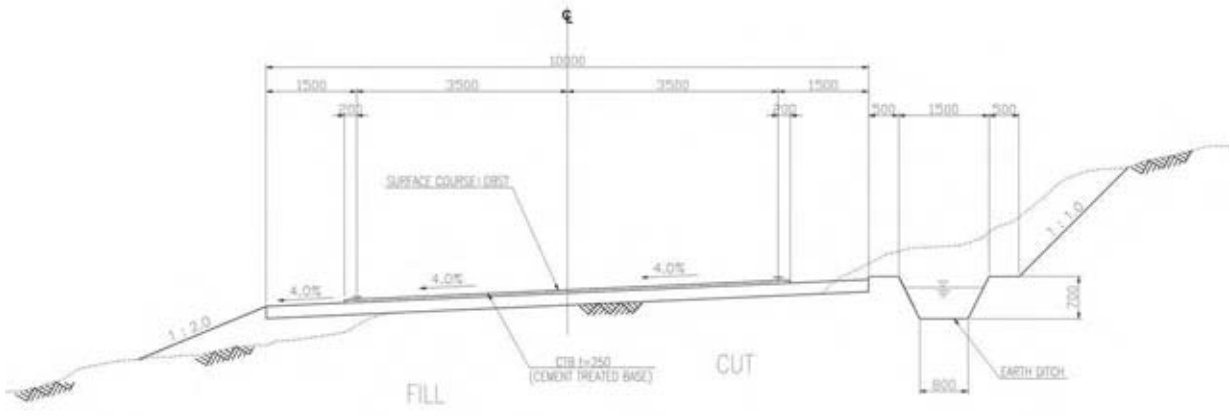


Figure I.2-5 Typical Cross Section

3. CONSTRUCTION PLAN

3.1 Procurement and Logistics Plan

(1) Equipment and Materials Procurement Plan

(Refer final report, main text)

(2) Equipment and Materials Transportation Plan

(Refer final report, main text)

(3) Implementation Schedule

The revised implementation schedule at that time is shown in Table I.3-1. Although this schedule had never realized until the end of April 2007 after initial survey works was stopped by local people due to land issues as described in 1.2 (5) at the end of October 2006.

Since then all engineers and technicians of the contractor and their equipment and material were held in their camp near the project site for following 6 months without knowing when they can resume the works nor when they can go back home, although they have done some preparation works in their camp yard, such as connecting piles and beams, and drilling bolt holes for piles and beams and concentrating water works in Munuki during those time being.

Table I.3-1 Revised Implementation Schedule

Work Item	Year	2006											2007		
	Month	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Planning															
Preparation of Detailed Design and Bidding Documents															
Bidding and Contract						Bidding	Contract								
Procurement of Equipment and Materials															
Transportation of Equipment and Materials															
Construction Work															
Mobilization															
Survey															
Excavation and Earth Retaining															
Piling for Pier															
Election of Structure															
Deck Installation															
Installation of Crane															
Earth Work of Access Road															
Pavement of Cargo Yard & Access Road															
Side Ditch Excavation															
Miscellaneous Works															
Technical Transfer for Maintenance															
Demobilization															

3.2 Bidding and Contract

(1) Preparation of Bidding Documents

(Refer final report, main text)

(2) Bidding and Contract

(Refer final report, main text)

4. CONSTRUCTION

4.1 Work Progress

Jetty Works

Jetty works was resumed on 25 April 2007, after former occupants in Plot No. 24 cleared all their properties and MPI in cooperation with State Ministry of Agricultures cut some affected trees along the river bank for the project.

During the first week since the recommencement of the project, clearing the construction site by leveling the ground down to about 1.5 m from the existing ground level to meet proposed jetty deck level was carried out by using 0.4-qu.m excavator. Then, 50-ton crawler crane was mobilized and piling works were finally started in the beginning of May 2007.

First forty (40, [= 8 x 5]) steel piles (H-300) near the river bank were installed within following week by driving five (5) piles in each line per day in average by setting guide beams and controlling piling position by observing through the total station all the time.

After driving first 40 piles and adjusting the positions each other, lower and upper lateral beams ([-200 & [-300)with diagonal vertical braces (L-100) were installed. And then, main girder beams (H-350) with horizontal braces (L-100) and first one hundred twenty (120, [= 5 x 3 x 8]) deck plates were installed accordingly by the end of May 2007.

After above descried 1st stage works, utilizing this structure as a base deck, 50-ton crawler crane transferred above this new space and remaining thirty two (32, [= 8 x 4]) piles were installed as same manner as first 40 piles, but using last piles of first 40 piles as guide posts. Then also remaining lower and upper lateral beams with diagonal vertical braces as well as main girder beams with horizontal braces and last two hundred (200, [= 5 x 5 x 8]) deck plates and four (4) mooring posts with eight (8) fenders were finally installed correspondingly by the end of June 2007 as scheduled.

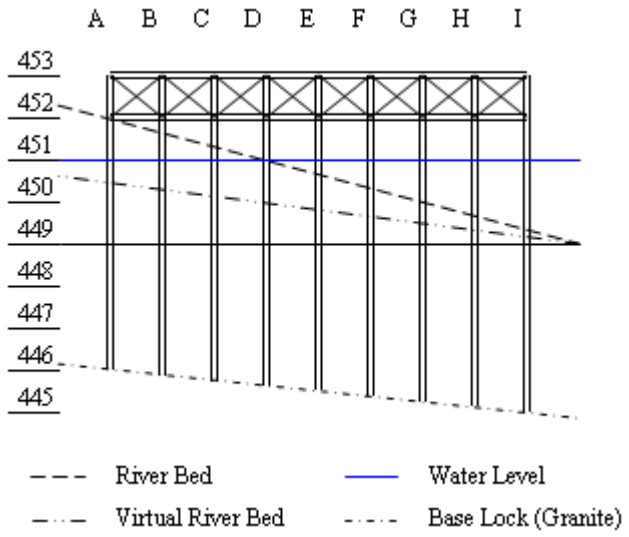
As shown in the Table I.4-1 most of piles penetrated upto 7~8m down of proposed pile head level, which is about 5~6 m down of average water level, and actual penetration of each pile under the bottom of river bed was about 4~6 m with 1~4 m free edge. Since base rock is weathered granite rock with N-value over 50, therefore, even vibration hummer attached to 50-ton crawler crane cable was not able to drive steel piles (H-300) into the bed rock which is situated around 445.5m ASL as predicted by the previous test drilling works carried out in April 2006 under this Study.

Table I.4-1 Average Pile Driving Length by Position from the River Bank

Pile Lines	Pile Head Elevation	Bed Rock Elevation	Ave. Pile Length	Free Length	Embedded Depth
A-Piles Average	453.307	445.969	7.273	1.242	6.031
B-Piles Average	453.242	445.558	7.684	1.742	5.942
C-Piles Average	453.307	445.585	7.657	3.242	4.415
D-Piles Average	453.242	445.478	7.764	2.742	5.022
E-Piles Average	453.502	445.705	7.537	3.242	4.295
F-Piles Average	453.242	445.362	7.880	3.341	4.539
G-Piles Average	453.502	445.342	7.900	3.500	4.400
H-Piles Average	453.242	445.302	7.940	3.904	4.036
I-Piles Average	453.502	445.332	7.910	3.883	4.028
All Piles Average	453.343	445.515	7.727	2.982	4.745

Note; Elevation is indicated by Above Sea Level (ASL)

After rechecking structure design by using actual pile driving length, jetty structure is confirmed as safe as planned.



During the following month in July, gantry crane assemble and installation works were taken place, followed by gabion matt installation and storage room construction works during the early August 2007.

Access Road Works

On the other hand, access road works started on 20 May 2007 after waiting for appointment of road engineer and road alignment re-survey works for about 4 weeks after remobilization of civil works for civil works in the project area in late April 2007 as described in previous section.

For first one month during, late May to late June 2007, road works, such as excavating existing access road surface soil down to meet proposed sub grade level together with temporary drainage works, and dumping base course material for further stabilization works for section between Sta. 0+020 m and 0+420 m, were implemented relatively smoothly mainly owing good weather conditions.

Although this civil works was not continued like before after rainy season actually started and road works entered section between Sta. 0+420 m and 0+560 m, where former swampy area situated along proposed river side (middle ring road) road alignment from late June 2007.

As shown in the chapter I.4.3, this section together with following section between Sta. 0+560

and 0+680 and cargo handling yard along river bank showed presence of relatively weak soils, such as sand clay and/or black cotton soil, suggesting Alluvium of River Nile.

Therefore, during the following one month from late June to late July, most of civil works were spent for replacing those weak soils to relatively better soil, in this case it is maram, obtained from the borrow pit near the Juba International Airport by excavating existing weak soil up to 1.5~1.8 m down from ground level and total volume of replacing soil was reached six thousand cubic m.

From late June, cement/lime stabilization works were also started along first section between Sta. 0+020 m and 0+420 m, followed by section between Sta. 0+420 m and 0+680 m with cargo handling yard beside the Jetty from late July after compaction of above described problematic sections were confirmed, although such stabilization works were repeatedly interrupted by sudden heavy rain, and caused additional repair works and further delay of other remaining works, such as double bitumen surface treatment works and road marking works which were rescheduled to be implemented during August 2007.

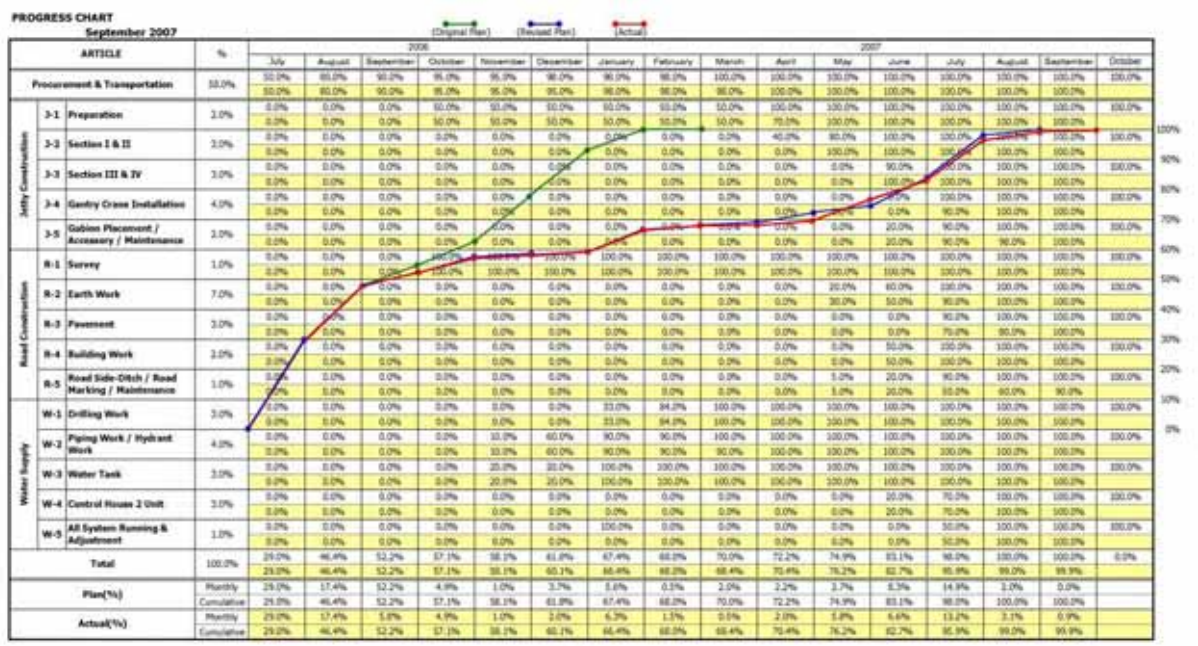


Figure I.4-1 Work Progress Chart

By the day of official handover ceremony dated 21 August 2007, which was scheduled based on the optimistic plan in June before heavy rainy season continued, DBST works were only completed in the cargo handling yard, followed by section between Sta. 0+420 m and 0+680 m in late August, and section between Sta. 0+020 m and 0+420 m by mid September 2007.

Figure I.4-1 shows progress of the all works since September 2006 as a whole. In this chart, green, blue, and red color lines represent original schedule, revised schedule, and actual progress, correspondingly.

As of the end of September 2007, progress of work was reached almost 100%, but road marking works are still on the way for implementation due to mechanical trouble of makeshift applicator for the thermoplastic traffic paint. And after the delivery of the other applicator from Japan and completion of all remaining civil works was completed by early October 2007.

4.2 Quality Control

Following tests were taken place in mostly in Juba and partially in Nairobi;

- Jetty Construction
  - Pile (Pile Driving Test)
  - Jetty Deck (Torque Test)
  - Concrete (Slump Test, Compressive Strength Test, Trial Mix Test)
- Road Construction
  - Base Course (Proof Rolling Test, CBR Test, Static Penetration Test, Mix Proportion Test)
  - Surface Course (Abrasion Test)

Port and Gantry Crane

Access Road

Fuel Storehouse

First Operation of Gantry Crane at Opening Ceremony (21st Oct. 2007)

5. OPERATION, MAINTENANCE AND MANAGEMENT PLAN

5.1 General Issue of Operation, Maintenance and Management Plan

(1) Inspection Plan toward Reservation of the Soundness

- Regular Inspection
  - General Inspection
  - Detail Inspection
- Irregular (Provisional) Inspection

(2) Identification of Cause of Detects Function of the Cargo Handling Facility and Contents of the Inspection

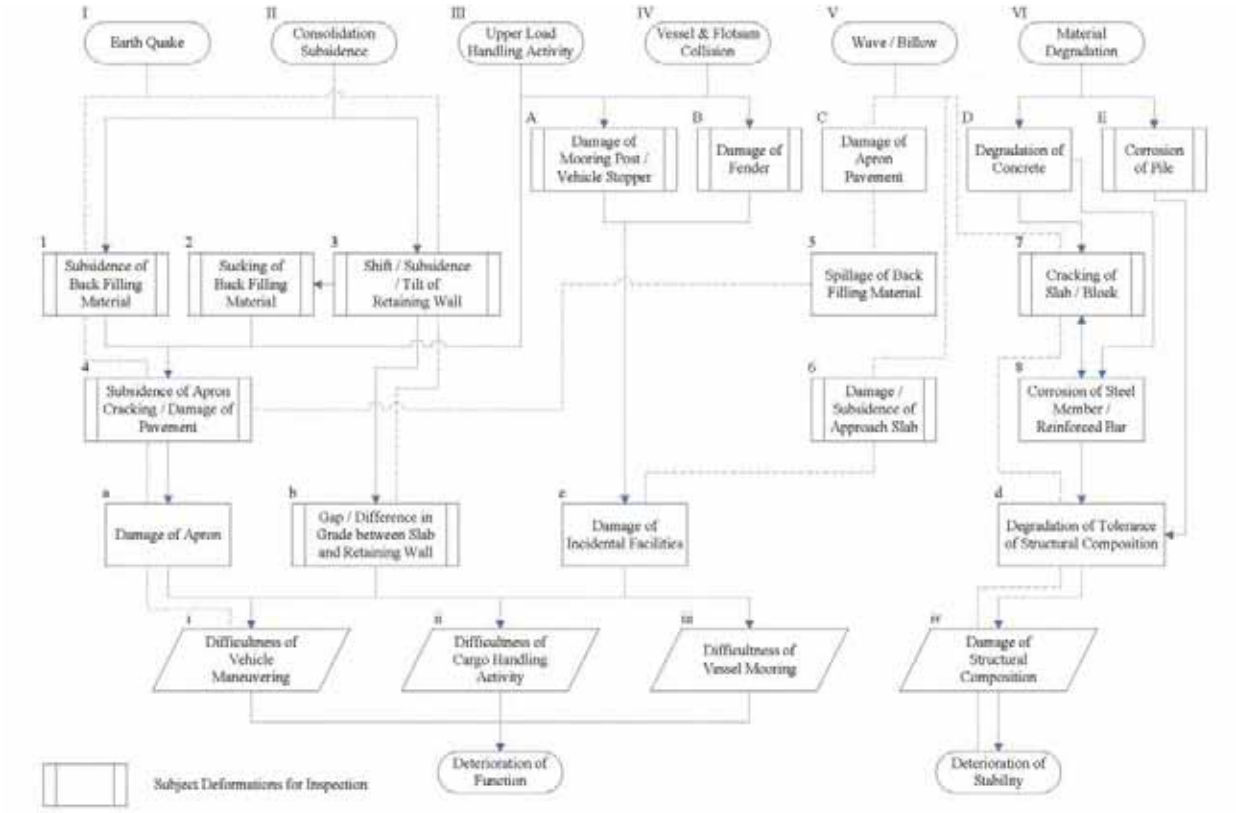


Figure I.5-1 Major Chain Link of Deformation of Typical Pier Type Mooring Facility

(3) Structures of Piled Pier and Retaining Wall

Table I.5-1 Inspection Contents of the Pier Type Mooring Facility

Target Deformations	Location	Contents
Corrosion	Pile	Condition of Corrosion Thickness of Material
Cracking	Apron	Condition of Cracking (Exfoliation / Damage)
Damage / Subsidence	Approach Slab	Condition of Subsidence, Shift, Damage

Table I.5-2 Contents and Frequencies of Regular Inspection of the Pier Type Mooring Facility

Location	Contents	Frequency
Pile	Condition of Corrosion Thickness of Material	Every 2 Years Every 5 Years
Apron	Condition of Cracking	Every 2 Years

(4) Crane Equipment with Hoist

- Structure components, such as a support, a beam, etc. which forms the gantry frame
- The wheels and their power component for moving a gantry crane
- Hoist which lifts cargos
- Control unit

(5) Securing Required Draft for the Mooring Vessels

- Periodical inspection of water depth
- Maintenance dredging at the time of sedimentation

(6) Examination of Inspection Contents in Maintenance and Management of the Facility

- Contents of Inspection
- Method of Inspection
- Frequency of Inspection
- Maintenance & Management of Draft in front of Pier
- Required Number of Staff for Inspection
- Expected Contents of Repair Works

Table I.5-3 Contents and Frequencies of Inspections for Crane Equipment with Hoist

Contents of Inspection for Structures of Gantry Crane

Inspections	Contents		Frequency
Pre-Starting Inspection	Post (include Joints)	No - Corrosion, and Degradation	Daily
	Beam (include Joints)	No - Corrosion, and Degradation	
	Rails & Wheels	No - Corrosion, Degradation, and Crunching by Foreign Substances	
	Warning System, Brake, Clutch, and Controller	Functions Affirmation	

Contents of Inspection for Gantry Crane with Rated Capacity of 0.5~3.0 ton

Inspections	Contents		Frequency
Periodical Duty Inspections	Anti Over Rolling System, Other Safety System, and Brake & Clutch	No Irregularities	Once A Year
	Over Loading Warning System, and Other Warning System	No Irregularities	
	Wire Rope, and Sling Chain	No Damage	
	Hook, and Grab Bucket,	No Damage	
	Wiring, Distribution Board, and Controller	No Irregularities	
	Loading Test (No Difficulties of Maneuvering by Standard Loading and Speed)		
Periodical Self Inspections	Anti Over Rolling System, Other Safety System, and Brake & Clutch	No Irregularities	Once A Month
	Over Loading Warning System, and Other Warning System	No Irregularities	
	Wire Rope, and Sling Chain	No Damages	
	Hook, and Grab Bucket,	No Damages	
	Wiring, Distribution Board, and Controller	No Irregularities	
Pre-Starting Inspections	Anti Over Rolling System	Functions Affirmation	Daily
	Over Loading Warning System	Functions Affirmation	
	Other Warning System, Brake, Clutch, and Controller	Functions Affirmation	

Contents of Inspection for Hoist

Classifications	Components	Conditions of Replacement	Replacement Method
Consumable Parts	Wire Rope Break Lining, and Shoe Brake Coil, and Iron Core Seals, O-Rings, and Lubricants Buffer, Magnetic Contacts, and Push Button Switches	Cut, Wear & Tear, Crack Deformation, Exfoliation, Looseness Corrosion, Degradation	Replacing Parts based on the Limited Life Span
Semi-Consumable Parts	Wire Drum, Hook, and Sheep Key, Wheel, and Axle Couplings, Opened Gears, and Grease External Cable, and Over Rolling Limit Switch Inverter	Wear & Tear Crack Corrosion Deformation Degradation	Replacing Parts based on the Total Operation Hours
Permanent Parts	Frames, and Casing Closed Gears, and Coils	Fatigue Crack, Corrosion, Wear & Tear Deformation, Isolate Degradation	-

(Source: The Japan Electrical Manufacturers' Association, http://www.jema-net.or.jp)

Table I.5-4 Inspection Contents in Maintenance and Management of the Mooring Facility

Facilities / Equipment		Components	Phenomenon of Deformations	Contents of Inspections and Judgments	Classification of Inspections: Regular Inspections: Every Week or Month	Regular Inspections: Method	Regular Inspections: No. of Staff	Regular Inspections: Remarks	Detail Inspections: Periodical	Detail Inspections: Method	Detail Inspections: No. of Staff	Detail Inspections: Remarks	Irregular (Provisional) Inspections: Immediately after Incident *4	Irregular (Provisional) Inspections: Method	Irregular (Provisional) Inspections: No. of Staff	Irregular (Provisional) Inspections: Remarks	Expected Repair Works
Mooring Facility	Pier	Quay Wall Alignment	Difficulties of Vessel Moorings	No Irregular Alignment of Quay Wall	Yes	Visual	1 Man per Day	Inspections of Front and Both Sides of Pier from Boat and/or Berge Shall Be Carried Out.	Yes *2	Visual	3 Men per Time	Partial Affirmation of Deformation of the Structures by Removing Deck Plates Between 2~3 Lines of Piles Shall Be Carried Out. In Case of Recognition of Any Deformations by Above, Full Scale Affirmation by Removing All Deck Plates Shall Be Required.	Yes	Visual	1 Man per Times	Inspections of Front and Both Sides of Pier from Boat and/or Berge Shall Be Carried Out.	-
		Main Girders *1	Deterioration of Stress & Stability of the Structures	No Deformation (Bending / Twisting)	Yes	Visual			Yes *2	Visual			Yes	Visual			Partial Reinforcement, Reconstruction
				No Damage (Cutting / Missing)	Yes				Yes *2				Yes				Repair
				No Corrosion	Yes				Yes *2				-				Repair
				No Cracking at Welding Points	Yes				Yes *2				Yes				
		Laterals / Bracings *1 (Fender Base)	Deterioration of Stress & Stability of the Structures	No Deformation (Bending / Twisting)	Yes	Visual			Yes *2	Visual			Yes	Visual			Partial Reinforcement, Reconstruction
				No Damage (Cutting / Missing)	Yes				Yes *2				Yes				Repair
				No Corrosion	Yes				Yes *2				-				Repair
				No Cracking at Welding Points	Yes				Yes *2				Yes				
		Other Major Members *1	Deterioration of Stress & Stability of the Structures	No Deformation (Bending / Twisting)	-	-			Yes *2	Visual			-	-			Partial Reinforcement, Reconstruction
				No Damage (Cutting / Missing)	-	-			Yes *2				-	-			Repair
				No Corrosion	-	-			Yes *2				-	-			Repair
				No Cracking at Welding Points	-	-			Yes *2				-	-			
		Bolts & Nuts	Deterioration of Structures' Stress & Stability	No Omission	Yes	Visual			Yes *2	Visual			Yes	Visual			Repair, Replacement
				No Damage (Cutting / Missing)	Yes				Yes *2				Yes				
				No Corrosion	Yes				Yes *2				-				
		Deck Plates *1	Deterioration of Stress of Deck Plates	No Deformation (Bending / Twisting)	Yes	Visual			Yes *2	Visual		Inspections from the Surface of the Pier Shall Be Carried Out, As Much As Possible. In Case Of Irregularities Observed, Affirmation of Deformations of the Structures by Removing Deck Plates & Approach Slabs Shall be Carried Out.	Yes	Visual		Inspections from the Surface of the Pier Shall Be Carried Out, As Much As Possible.	Repair, Replacement
				No Damage (Cutting / Missing)	Yes			Inspections from the Surface of the Pier Shall Be Carried Out, As Much As Possible.	Yes *2				Yes				
				No Corrosion	Yes				Yes *2				Yes				
			Difficulties of Cargo Handling Works & Vessel Moorings	No Loose	Yes	Visual			Yes *2	Visual			Yes	Visual			
				No Gap (Horizontal & Vertical)	Yes				Yes *2				Yes				
		Fender	Difficulties of Cargo Handling Works & Vessel Moorings	No Deformation (Bending / Twisting)	Yes	Visual			Yes *2	Visual			Yes	Visual			Replacement
				No Damage (Cutting / Missing)	Yes				Yes *2				Yes				
		Mooring Posts	Difficulties of Cargo Handling Works & Vessel Moorings	No Deformation (Bending / Twisting)	Yes	Visual			Yes *2	Visual			Yes	Visual			Repair, Replacement
				No Damage (Cutting / Missing)	Yes				Yes *2				Yes				
		Approach Slab	Difficulties of Cargo Handling Works & Vehicle Maneuverings	No Damage (Cutting / Missing)	Yes	Visual			Yes *2	Visual			Yes	Visual			Repair, Replacement
				No Loose	Yes				Yes *2				Yes				
				No Gap (Horizontal & Vertical)	Yes				Yes *2				Yes				
	Apron	Pavement	Difficulties of Cargo Handling Works & Vehicle Maneuverings	No Subsidence	Yes	Visual			Yes *2	Visual			Yes	Visual			Repair
				No Cracking	Yes				Yes *2				Yes				
				No Gap (Horizontal & Vertical)	Yes				Yes *2				Yes				
Cargo Handling Facility	General Facilities		Difficulties of Cargo Handling Works	No Difficulties of Maneuvering by Standard Loading and Speed	-	-		-	Yes *3	Visual	3 Men per Time	In Case Of Irregularities Observed, Repair Works by Maintenance Agents Shall Be Carried Out.	-	-	1 Man per Times	Visual & Physical Inspections Shall Be Carried Out. In Case Of Irregularities Observed, Repair Works by Maintenance Agents Shall Be Carried Out.	Repair
	Gantry Crane Structures	Wheels & Rails	Difficulties of Cargo Handling Works & Crane Maneuverings Deterioration of Crane's Stability	No Deformation (Bending / Twisting)	Yes	Visual		Visual & Physical Inspections Shall Be Carried Out. In Case Of Irregularities Observed, Repair Works by Maintenance Agents Shall Be Carried Out.	Yes *3	Visual			Yes	Visual			Repair, Replacement
				No Damage (Cutting / Missing)	Yes				Yes *3				Yes				
				No Corrosion	Yes				Yes *3				-				
				No Crunching Foreign Substances	Yes				Yes *3				-				
		Posts & Beams	Deterioration of Crane's Stress & Stability	No Deformation (Bending / Twisting)	Yes	Visual			Yes *3	Visual			Yes	Visual			Partial Reinforcement, Replacement
				No Damage (Cutting / Missing)	Yes				Yes *3				Yes				
				No Corrosion	Yes				Yes *3				-				
				No Cracking at Welding Points	Yes				Yes *3				Yes				
		Bolts	Deterioration of Crane's Stress & Stability	No Loose	Yes	Visual			Yes *3	Visual			Yes	Visual			Replacement
				No Omission	Yes				Yes *3				Yes				
				No Damage (Cutting / Missing)	Yes				Yes *3				-				
				No Corrosion	Yes				Yes *3				Yes				
	Crane Equipment	Hoist	Irregular Vibration	No Irregular Vibration	Yes	Visual / Physical			Yes *3	Visual / Physical			Yes	Visual / Physical			Partial Replacement
			Irregular Noise	No Irregular Noise	Yes				Yes *3				Yes				
			Irregular Temperature Increases	No Irregular Temperature Increases	Yes				Yes *3				Yes				
		Anti Over Rolling Devise	Malfunctions	No Malfunctions by Operation Affirmations	Yes	Visual			Yes *3	Visual / Insulation Resistance Measurement			Yes	Visual			Replacement
		Over Loading Warning Device & Other Warning Devices	Malfunctions	No Malfunctions by Operation Affirmations	Yes				Yes *3				Yes				
		Wire Rope & Sling Chain	Break / Wear & Tear / Crack / Damage	No Damage	Yes				Yes *3				Yes				
		Hook, Grab Bucket, etc.	Crack / Damage	No Damage	Yes				Yes *3				Yes				
		Power Cable, Control Panel, and Controller	Malfunctions	No Malfunctions by Operation Affirmations	Yes				Yes *3				Yes				
Water Surface		River Bed in front of Pier	Difficulties of Mooring by Sedimentations	No Sedimentations (Affirmation of Design Draft by Soundings)	-	-	-	-	Yes *2	Water Depth Soundings	Carried Out With Mooring Facility Inspections	Boat Shall Be Arranged	Yes	Water Depth Soundings	Carried Out With Mooring Facility Inspections	Boat Shall Be Arranged	Maintenance Dredging

*1 In Case Of Rust-Proof Paints Are Applied to the Pier Structures, Damage of Paints Also Shall Be Inspected.
*2 Every Bi-Annual
*3 According to the Crane Regulation in Japan, Annual Inspection Shall Be Required, Therefore Same Manner Is Applied for This Facility.
*4 Incidents Shall Be Varied, Such As Flood, Collision to Pier, And/Or Severe Weather, Therefore Contents of Inspections Also Shall Be Varied. In This Table, Flood & Collision Are Considered.

5.2 Operation, Maintenance and Management Organization

Followings are proposed as a reference based on the typical organization in Japan, and operation conditions for further operation cost estimate. Detailed operation, maintenance and management plan shall be determined by the Government of Southern Sudan and relevant governmental organizations.

(1) Organization

Figure I.5-2 and Table I.5-6 shows typical organization structure and required number of staff in case of private sector participation to the loading and unloading activities.

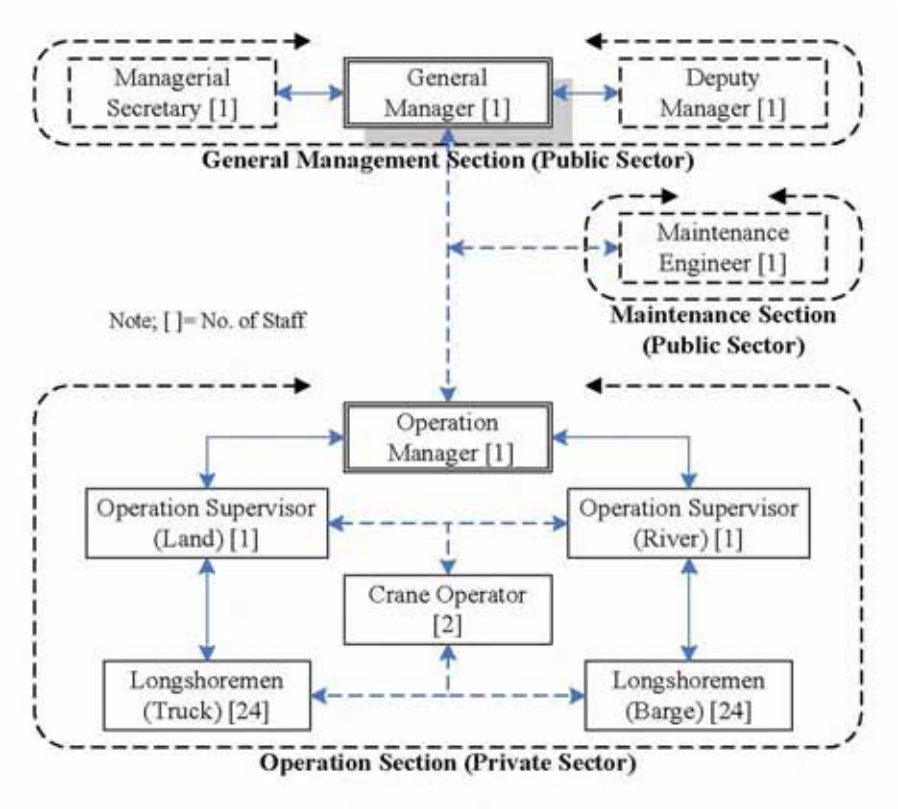


Figure I.5-2 Proposed Operation, Maintenance and Management Organization

Due to shortage of proper private sector to operate newly provided facility and less readiness of outsourcing of such operation to the private sector, State Ministry of Physical Infrastructure has appointed 7 staff from its own Department of Mechanical Transport under the Directorate of Road and Bridges. According to these actual appointments, operation and maintenance is under control of the department although management is still under control of the RTC and both are under control of the State Ministry. 7 staff is consisting of 1 operation manager, 1 operation supervisor, 1 crane operator, and 4 assistant staff, although operation supervisor is able to operate the crane, and crane operator and other assistant staff are able to switch their roles each other.

Table I.5-5 Proposed Operation, Maintenance and Management Organization

Position	Role	No. of Staff		Remarks
		(Proposed)	(Actual)	
Director	General Manager	1	1	River Transport Corporation (Public Sector)
Deputy Director	Assistant Manager	1	-	
Secretary	Managerial Secretary	1	-	
Manager	Operation Manager	1	1	Department of Mechanical Transport (Public Sector) and/or Logistics Company (Private Sector)
Supervisor	Operation Supervisor	2	1	
Operator	Crane Operator	2	1	
Staff (Land)	Longshoremen (Truck)	24 (8 x 3)	-	
Staff (River)	Longshoremen (Berge)	24 (8 x 3)	4	
Total		56	8	

(2) Operation Cost

Conditions

Followings are revised operation conditions based on the actual circumstances;

Working days per month : 25 days per month
Handling cargo volume per month : 5,000 tons per month
Working hours per day : 8 hours per day
Handling cargo volume per day : 200 tons per day
Handling cargo volume per hour : 25 tons (25,000 kg = 500 bags) per hour
Cargo handling cycle : 3 min. (Loading, travel, unloading: 1 min. each)
Handling cargo volume per cycle : 25 bags (1.25 ton) per cycle (50 kg per bag)

Current Operation Cost[*3]

- Unloading Charge (RTC)
  USD 79,500 per barge or USD 265 per ton
- Unloading Charge (Local Logistics Company)
  USD 124,500 per barge or USD 415 per ton

Required Operation Cost[*3]

- Operation & Management (Personnel)
  USD 2,250 per barge or USD 7.50 per ton
- Maintenance (Reserve & Consumption)
  USD 450 per barge or USD 1.50 per ton

[*3] Assumed each barge carrying 300 ton of cargos

Revised breakdowns of above descried required cost estimate are shown in Table I.5-6a and I.5-6b. It is recommendable that repair works including procurement of materials be contracted out to the private sector.

Table I.5-6a Breakdown of Maintenance Cost

Reserve

(Unit: USD)

Facilities	Composition	No. of Item	Life Span	Unit Cost	Amount	Annual Reserve	Required Budget	Charge per Ton	Charge per Barge	By Facility
Number						12	150	5,000	300	
Unit			Year				%	Ton	Ton	
Mooring Facility	Rope	4	0.67	625	2,500	3,750	5,625	0.09	28.20	
	Fender	8	5.00	180	1,440	288	432	0.01	2.10	33.90
	Mooring Post	4	10.00	1,200	4,800	480	720	0.01	3.60	
Gantry Crane	Structure	1	10.00	48,000	48,000	4,800	7,200	0.12	36.00	
	Generator	1	3.33	12,000	12,000	3,600	5,400	0.09	27.00	
	Hoist	1	5.00	16,000	16,000	3,200	4,800	0.08	24.00	115.80
	Wire	1	2.00	150	150	75	113	0.00	0.60	
	Wire Basket	4	0.67	625	2,500	3,750	5,625	0.09	28.20	
Water Surface	Dredging	1	1	9,000	9,000	9,000	13,500	0.23	67.50	67.50
Total							43,415	0.72	217.20	217.20

Consumption

(Unit: USD)

Facilities	Composition	Daily Consumption		Unit Cost	Monthly Cost	Annual Cost	Required Budget	Charge per Ton	Charge per Berge	By Facility
Number					25	12	150	5,000	300	
Unit					Days	Month	%	Ton	Ton	
Gantry Crane	Generator Fuel	30	Litter	1.00	750	9,000	13,500	0.23	67.50	68.00
Administration Building	Generator Fuel	30	Litter	1.00	750	9,000	13,500	0.23	67.50	
	Water	2	Cubic Meter	5.00	250	3,000	4,500	0.08	22.50	138.00
	Sewer	0.1	Cubic Meter	60.00	150	1,800	2,700	0.05	13.50	
	Telecom	15	Min	1.00	375	4,500	6,750	0.11	33.90	
Total							40,950	0.68	204.90	206.00

Table I.5-6b Breakdown of Operation & Management Cost

Personnel

(Unit: USD)

Position	Role	No. of Staff	Remarks	Daily Allowance	Monthly Payment	Annual Payment	Required Budget	Charge per Ton	Charge per Barge	By Sector
Number					25	15	150	5,000	300	Round-Up
Unit					Days	Months	%	Ton	Ton	Figures
Director	General Manager	1	River Transport Corporation (Public Sector)	36	900	13,500	20,250	0.34	102	
Deputy Director	Assistant Manager	1		30	750	11,250	16,875	0.28	84	260
Secretary	Managerial Secretary	1		24	600	9,000	13,500	0.23	69	
Manager	Operation Manager	1	Logistics Company (Private Sector)	30	750	11,250	16,875	0.28	84	
Supervisor	Operation Supervisor	2		24	600	9,000	27,000	0.45	135	
Operator	Crane Operator	2		18	450	6,750	20,250	0.34	102	1,950
Staff (Land)	Longshoremen (Truck)	24		12	300	4,500	162,000	2.70	810	
Staff (River)	Longshoremen (Berge)	24		12	300	4,500	162,000	2.70	810	
Total		56					438,750	7.32	2,196	2,210
								7.50	2,250	

Considering current tariff by RTC and practical charge by logistics companies, even after installation of new mooring facility, maintenance and management cost would be absorbed within the current charges without further surcharge since required operation cost (operation & management as well as maintenance) is only 3.4% of RTC charge.

5.3 Port Facility & Ship Security Plan

Based on the requirements of the International Convention for the Safety of Life at Sea, 1974, (SOLAS 1974), although Juba River Port and vessels in the port are not governed by this requirements yet, following issues shall be taken into account to improve current security conditions as well as for further expansion of the port facilities and increase of river transport demand in the near future;

- Prevent unauthorized access to the port facility, to vessels in the port and any other security restricted areas;
- Prevent the introduction of weapons or other dangerous devices into the port facility and on to the vessels;
- Prevent the movement of illegal drugs or other restricted substances within the port facility and on to the vessels;
- Prevent the movement of contraband within the port facility and on or off the vessels;
- Prevent the sabotage of property and/or equipment within the port facility and on board the vessels;
- Prevent the theft of cargo, equipment or supplies;
- Raise alarm in reaction to security threat or incident;
- Ensure familiarity with Security Plan and procedures.

Guiding principles of above described measures are follows;

- The fundamental principle of security is Access Control;
- The Plan will allow Juba River Port and vessels in the port to comply with the IMO's SOLAS Chapter XI-2 and the annexed International Ship and Port Facility Security Code;
- The safety and security of port workers, vessel's crew and its cargo is vital;
- The safety and security of passengers and visitors to the port and vessels is paramount;
- Improved general security of the port and the vessels is a good investment and has sound commercial incentives.
- Timely and efficient exchange of information between stakeholders, such as the port master, the vessel's security officer, the vessel's crew, the company security officer and port and river transport authorities, improves security.

Details of port facility security plan as well as ship security plan and their general instructions and standard operating procedures formats obtained from SOLAS 1974 are attached in the appendix.

5.4 Operation and Maintenance Manual

Jetty & Gantry Crane

During the mid August before official handover ceremony, technical transfer regarding operation and maintenance of port facility was carried out to the appointed seven (7) technocrats from the Department of Mechanical Transport of MoPI, CES.

Maintenance inspection sheets for jetty and operation manual for gantry crane are attached in the appendix.

Floating Debris Control

In addition to above, installation of floating debris barriers is highly recommended to keep port facility clean from the floating debris which coming from upstream side of River Nile, meanwhile. Otherwise, periodical debris removal becomes critical issue in the course of operation and maintenance of jetty, although major portion of them are empty plastic bottles dumped everywhere in Juba Town, therefore improvement of public disposal collection system would be much more vital from the point of view of environmental consideration aspect.

Current Situation of Floating Debris

II PILOT PROJECT IN WATER SUPPLY SECTOR

1. OUTLINE OF THE PROJECT

1.1 General

The northern part of Munuki area where the water supply for domestic use is especially tight has been selected as the target area for the Pilot Project in water supply sector. As this district has a large potential for housing development, the development of a stable water supply system can be expected to greatly contribute to the progress of the government policy to facilitate the return and permanent settlement of refugees within the country and from neighbouring countries and to cope with the population shift from rural areas.

The principal policy of the Goss regarding water supply is the development of a piped water supply system in urban areas while relying on groundwater from boreholes in rural areas.

In accordance with this policy, the construction of piped water supply facilities was planned for the Pilot Project as the Munuki area is included in a planned urban zone. As the source of water supply, the intake of surface water from the River Nile was initially planned. However, as the large scale of such an undertaking was found to be beyond the scope of the Pilot Project with a short implementation period, it was decided to install boreholes to use groundwater, of which the relatively rich existence in the Munuki area was suggested by the hydrogeological survey results.

As the land readjustment work for urban planning has been completed in Munuki area, it was hoped that the Pilot Project would act as a model case for urban water supply.

1.2 Options of the Project

In accordance with the plan described in 1.1, six deep boreholes were dug. Although a sufficient yield of groundwater was confirmed with two boreholes, the water quality analysis found that the salt content far exceeded the relevant standard. Moreover, the analysed groundwater contained arsenic at a level of nearly 10 times of the standard (see Appendix II for the water quality analysis results).

While salt can be dealt with by means of the installation of a desalination device, the removal of arsenic requires facilities which cost much more than a desalination device. In addition, there will be a major problem of disposal of the highly concentrated arsenic removed from the groundwater. The use of groundwater was, therefore, found to be inappropriate. As an

alternative, the pipeline linkage between the elevated water tank constructed under the Pilot Project and the elevated water tank of the existing water supply system in Juba at John Garang Memorial Place is proposed so that water can be supplied from the existing system to the water supply facilities under the Pilot Project. As rehabilitation work by GOSS is in progress for the existing water supply system, including the water purification plant, clean water can be supplied to the Munuki area once the work has been completed. For the pipeline connection between the elevated water tank of the Pilot Project and the elevated water tank of the existing system, a pipeline is already available up to the Kuwait area in the Munuki Area. However, this pipeline has been neither used nor properly maintained for a long time, requiring complete rehabilitation or reconstruction.

For this reason, the construction of a link-up pipeline has two components. One is the construction of a new pipeline from the elevated water tank of the Pilot Project to the terminal point of the existing pipeline. The other is the rehabilitation of the existing pipeline. Three options based on different treatment of the existing pipeline were examined.

- Option 1: Inclusion of the rehabilitation of the existing pipeline in the Pilot Project
- Option 2: Supply of the materials required for the rehabilitation of the existing pipeline for the implementation of the actual rehabilitation work by GOSS
- Option 3: Construction of a new pipeline only and exclusion of the rehabilitation of the existing pipeline

Option 1 is judged to be unrealistic in view of the severe budgetary constraints and short remaining work period of the Project. This judgement is also justified by many uncertain factors, including the necessary negotiations with many households built along almost the entire route of the existing pipeline and adjustment with the road plan.

Option 2 is also judged to be unsuitable because the lack of proper facilities to store the materials, etc. to be provided is likely to cause deterioration of materials prior to the commencement of the construction work.

Moreover, in the light of the insistence of the GOSS that the rehabilitation of the existing pipeline is included in the scope of the rehabilitation project, the Pilot Project is planned based on Option 3 through consultations with the MPI, CES and GOSS. For the rehabilitation/reconstruction of the existing pipeline, the self-help efforts of the GOSS are hoped for.

Fig. II.1-1 shows the plan for the pipeline extension section to link the two elevated water tanks.

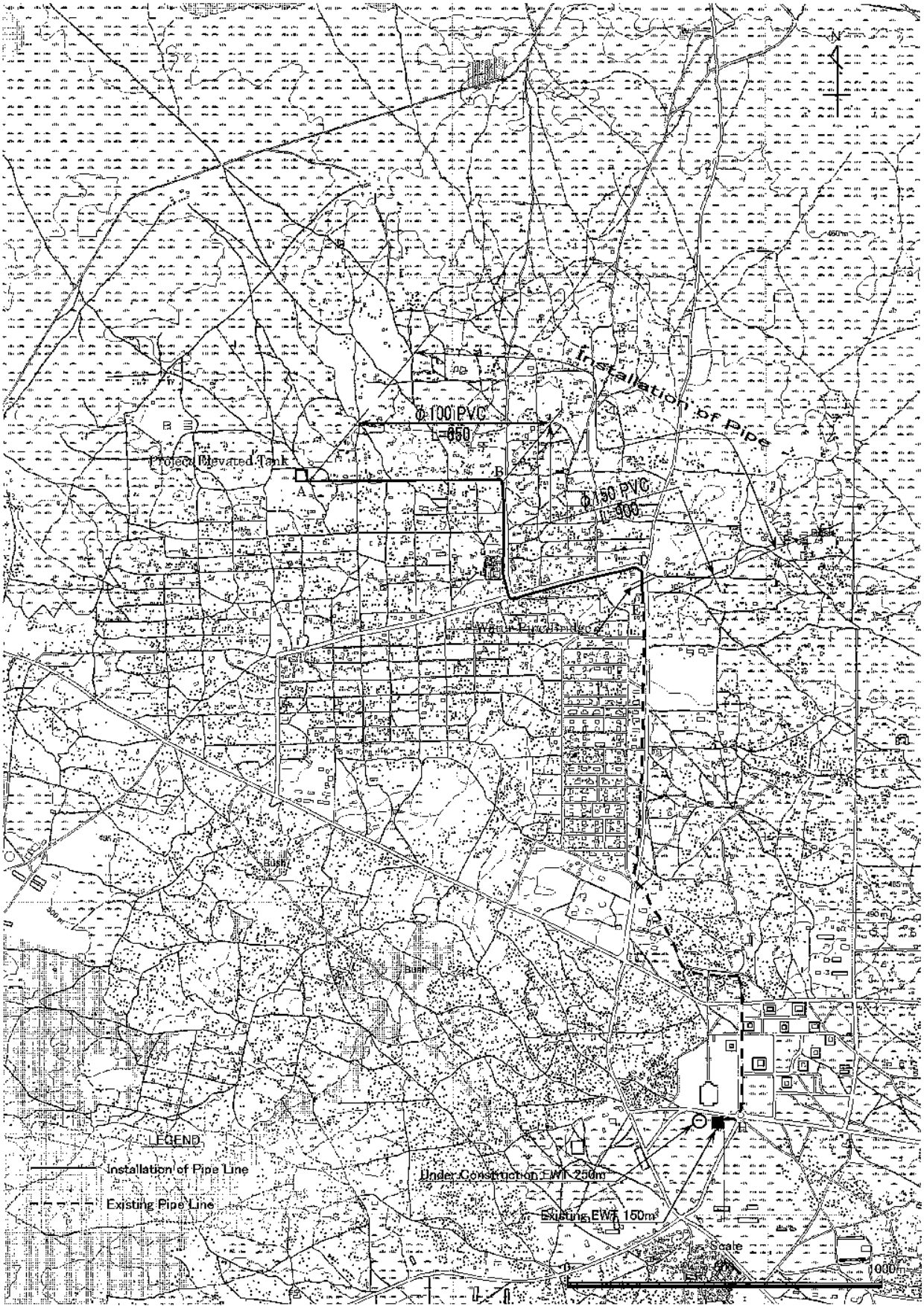


Figure Ⅱ.1-1 Location Map of Connecting Pipe Line

2. DESIGN

2.1 Target Water Supply Facilities of the Project

The target facilities of the present Study with a view to connecting the water supply facilities of the Pilot Project to the existing water supply system in Juba consist of a new pipeline and an auxiliary pipe bridge and valve boxes related to this new pipeline.

(1) Connecting Pipes

As the Munuki area is designated a subject area for future urban water supply development, the design discharge for the pipeline is determined based on the forecast population size in the master plan. The following formula is used for hydraulic calculation for the pipeline to determine the pipe diameter.

$Hl = 10.666 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85} \times L$

Where,

Hl : Friction (head) loss in the pipeline (m)

C : Discharge coefficient = 110

D: Pipe diameter (m)

Q: Design discharge (m^3/sec)

L : Length of pipeline (m)

Table II.2-1 shows the forecast water supply population, water supply volume, pipe diameter and hydraulic calculation results, etc. for each section.

Table Ⅱ.2-1 Calculation of Connecting Pipe Line

Point	Water Supply Population	Amount of Water Supply m3/day	Diameter of Pipe mm	Length of Section m	Friction Loss (hl) m	Elevation of Water Head m	Elevation of Ground Surface m	Head for Water Supply m
JGPEWT						524	514	
MECP	32,307	4,652	250	1100	12.053	511.947	490	21.947
KANEP	16,154	2,326	200	1200	10.813	501.134	474	27.134
MBCP	8,077	1,163	150	911	9.243	491.892	468	23.892
PEWT	4,038	582	100	667	13.523	478.368	464	14.368

Re: JGPEWT = Elavated Water Tank at Jon Gyarang Memorial Place
MECP = Munuki Entrance Crossing Point
KANEP = Northern End Point of Existing Pipe to Kwait Area
MBCP = Crossing Point in Munuki Block
PEWT = Project Elavated Water Tank

Out of those sections, the bottom two sections (MBCP and PEWT) will be the subject sections of the construction work under the Study and the following pipes shall be installed.

ϕ 150 mm L = 911 m

ϕ 100 mm L = 667 m

Table II.2-2 calculates the water supply volume (discharge) through the new pipeline based on the water head difference between the existing elevated water tank at John Garang Memorial Place and the elevated water tank introduced under the Pilot Project.

Table Ⅱ.2-2 Hydraulic Calculation of Discharge in Connecting Pipe Line

Point	Water Supply Population	Amount of Water Supply m3/sec	Diameter of Pipe mm	Length of Section m	Friction Loss (hl) m	Elevation of Water Head m	Elevation of Ground Surface m	Head for Water Supply m
JGPEWT		0.016	250			524	514	
MECP		0.016	250	1100	0.714	523.286	490	33.286
KANEP		0.016	200	1200	2.310	520.975	474	46.975
MBCP		0.016	150	911	7.120	513.855	468	45.855
Valve Box		0.016	100	667	37.554	476.301	464	12.301
PEWT		0.016	65	10	4.588	471.713	464	7.713

As the storage capacity of the elevated water tank of the Pilot Project is 25.6 m^3, this tank will be completely filled in approximately 30 minutes (25.6 ÷ 0.016 ÷ 60 = 30). Based on a daily water supply volume per capita of 20 litres, the total water supply volume required to serve the design service population of 2,300 is 46 m^3/day, making twice-daily water conveyance operation to be sufficient.

The standard material to be used for the pipeline is PVC. However, SGP (Steel Gass Pipe) pipes protected by sand will be used at those sites where the pipeline crosses a trunk road in view of the passing of heavy vehicles above.

(2) Pipe Bridge

A local small stream runs along the boundary between Block A of Munuki and the Kuwait area and this stream crosses the road on the eastern edge of the Kuwait area near the northern end of the existing pipeline. As the new pipeline runs across this stream, a pipe bridge is planned to prevent a situation where the new pipeline becomes a hindrance to the future development of a drainage channel in the area.

The length of this pipe bridge will be approximately 11 m and the pipe bridge will be made of φ150 GSP. The pipes at the abutment sections will be protected by concrete. One end of the pipeline will incorporate an expansion joint to allow movement to deal with the expansion and contraction of the pipeline due to temperature changes of the exposed section.

(3) Valve Boxes

A valve box will be introduced at the connection point between the existing pipeline and the new pipeline and also at road crossing points for the purposes of maintaining the pipeline and of accommodating connection with the existing pipeline and future extension of the pipeline

network. Two valves will be installed in each valve box and one valve will be a reserve for the future connection of another pipeline or the future extension of the pipeline network.

2.2 Originally Planned Equipment, Materials and Facilities

For the design of the water supply facilities, it was originally planned to use groundwater as the water supply source. Because of the change of the planned water supply source, however, there are some materials and equipment not used. In addition, there are facilities built in accordance with the original plan. Such equipment, materials and facilities are outlined below.

Equipment and materials not used because of the change of the water supply source

Borehole ϕ 100 mm Depth: 50 – 60 m	2 sites
Submersible motor pump 30 litres/min	2 sets
Generator 5 KVA	2 sets
Control panel	2 sets
Pump house	2 sites
Water pipes ϕ 75 mm PVC	120 m
ϕ 50 mm PVC	1,270 m

Six boreholes were actually drilled and casing pipes were installed at two of these. However, thee two boreholes have been subsequently refilled because of the adverse water quality.

Facilities constructed in accordance with the original plan

Elevated water tank FRP; some 5 m in height; water storage capacity of 25.6 m^3	1 sites
Water supply pipes ϕ 75 mm PVC	1,060 m
ϕ 50 mm PVC	370 m
ϕ 40 mm PVC	700 m
Stand pipes with three taps each	8 sites

The layout plan for the water supply facilities and the structure of the pipe bridge planned for the Pilot Project are shown in Figure II.2-1 and Figure II.2-2 respectively.

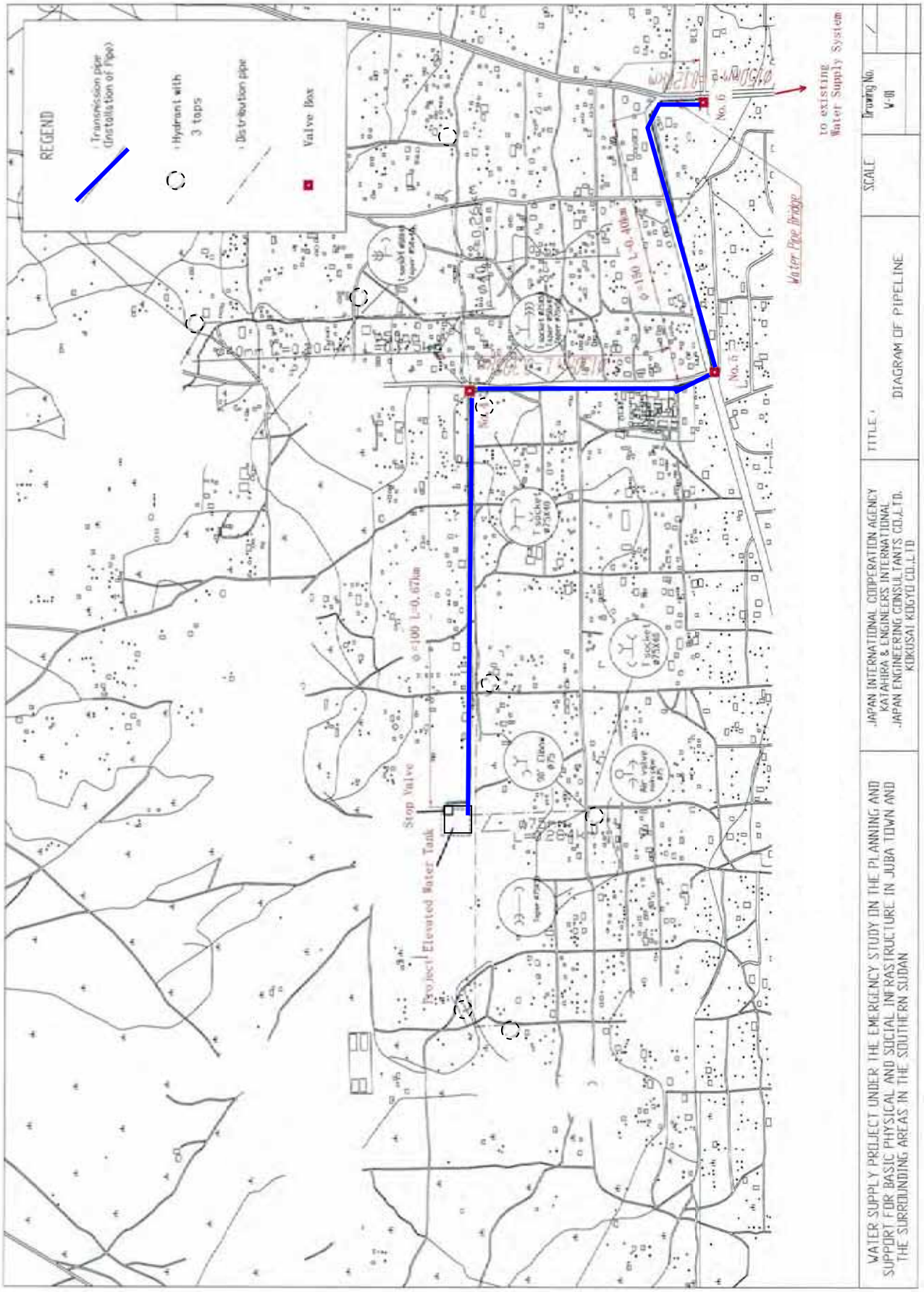


Figure Ⅱ.2-1 Layout Plan of Water Supply Facility

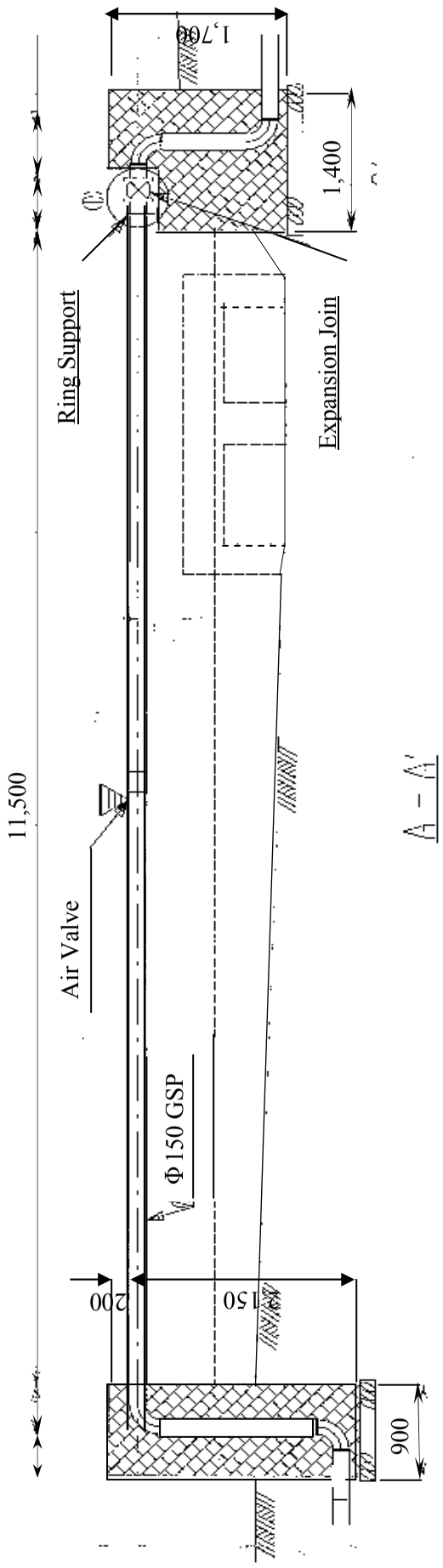


Figure Ⅱ.2-2 Structure of Pipe Bridge

3. CONSTRUCTION PLAN

3.1 Equipment and Material Procurement Plan

The design contents of the equipment and materials for the construction of the new pipeline were finalised at the end of May. As their procurement required completion by around the end of June, procurement from neighbouring third countries was necessary. The procurement plan in this Study is shown in Table II.3-1.

Table II.3-1 Material Procurement Plan

Materials	Specifications	Quantity	Transport Volume	Procurement Place
Transmission Pipe	PVC ϕ 150	1000 m	22.5. m^3	Third Country
	PVC ϕ 100	740 m	7.4 m^3	Third Country
	SGP ϕ 150	30 m	0.7 m^3	Third Country
Stop Valve	ϕ 150	6	0.6 m^3	Third Country
Other		1 lot	3.1 m^3	Third Country
Total			34.3 m^3	

3.2 Implementation Schedule

The implementation of the facilities construction has the following four components.

① Pipeline installation work
② Water conveyance test
③ Valve box construction work
④ Pipe bridge construction work

The implementation schedule of facility construction work, including material procurement, is shown in Table II.3-2.

Table II.3-2 Implementation Schedule for Water Supply Facilities

Works	Remarks	March	April	May	June	July	August
Tank,Distribusyon Pipe,Stand Pipe		Completion					
Aditinal Survey, Design							
Procurement of Materials							
Instlation of Pipe							
Construction of Valve Box 3places							
Construction of Pipe Bridge							

4. CONSTRUCTION

4.1 Construction Work

(1) Procurement of Materials

The materials to be used for the pipeline extension and connection work were ordered from a company based in Kampala, Uganda and were delivered to the Project site on 9th July.

(2) Elevated Water Tank, Water Supply Pipes and Stand Pipes

The construction of these facilities was fully completed by the end of March.

(3) Pipeline Connection Work

Water pipe installation work	:	completed on 23rd July
Valve box construction work	:	completed on 6th August
Pipe bridge construction work	:	completed on 18th August

(4) Quality Control

The following quality control work was conducted.

① Material control

Refer to Trial Mix Report and Site Test Results (slump test).

Concrete: The suitable strength was checked on-site.

② Inspection

Water conveyance test: water pressure resistance test for the pipeline using compressed air of 10 kg/m^2

(5) Work Completion Inspection

The completion inspection was conducted on 20th August and acceptable work results were certified.

(6) Work Completion Ceremony

The work completion ceremony was held on 21st August.

Transmission Pipe Line Under Installation

Distribution Pipe Line under Installation

No1 Valve Box under Construction

Pressure Test of Distribution Pipe Line

5. OPERATION AND MAINTENANCE PLAN

The operation and maintenance plan described below is proposed to provide a reference framework for the establishment of an efficient and adequate operation and maintenance system. The detailed contents of such plan, however, should be determined by the GOSS/CES.

5.1 Organization

As the new water supply facilities are connected to the existing water supply system, their operation and maintenance will be conducted by the Urban Water Corporation (UWC) which is responsible for the operation and maintenance of the existing water supply facilities and which is a subordinate organization of the CES. Since its establishment in the 1930's, the UWC has accumulated much experience and currently has 158 staff members.

Given the domestic confusion caused by the continual civil strife for more than 20 years, the limited budget, insufficient number of skilled workers and insufficient mobility of the staff, etc., the UWC cannot be expected to provide the around the clock operation and maintenance work of the new water supply facilities which are located far from its head office. Moreover, the water service charge for the use of the stand pipes is not properly collected at present because of the lack of smooth collaboration between the UWC and the local communities/residents benefiting from the existing water supply service.

Under those circumstances, the establishment of a system among local residents to cooperate with the UWC is essential for the efficient and sustainable operation and maintenance of the new water supply facilities. To be in detail, a water use association should be established by the users of each stand pipe. These associations should have the following officers which have been mutually elected.

- Head of the association : Overall control of the association activities
- Administrator : General administrative work relating to the association activities
- Accountant : Collection of the water charge from users and forwarding it to the UWC Head Office
- Hygiene care worker : Guidance on and monitoring of the hygienic use of water; leader of the standpipe site cleaning activities
- Water watchman : Monitoring of water use to ensure the fair distribution of water; operation of the standpipe valve; reading of the meter and recording of the reading; routine visual checking of the water supply facilities

The operation and maintenance of the new water supply facilities will, therefore, be conducted under the leadership of these officers who will perform their respective duties in cooperation with the UWC. As the activities of these associations must have compelling power to a certain extent, legal backing is desirable. If there is no legal system for the establishment of water use associations, one idea is the establishment of these associations with the cooperation of the UWC under the supervision of the Munuki Council.

Figure II.5-1 show the collaborative operation and maintenance system of the UWC and 8 water use associations for the new water supply facilities.

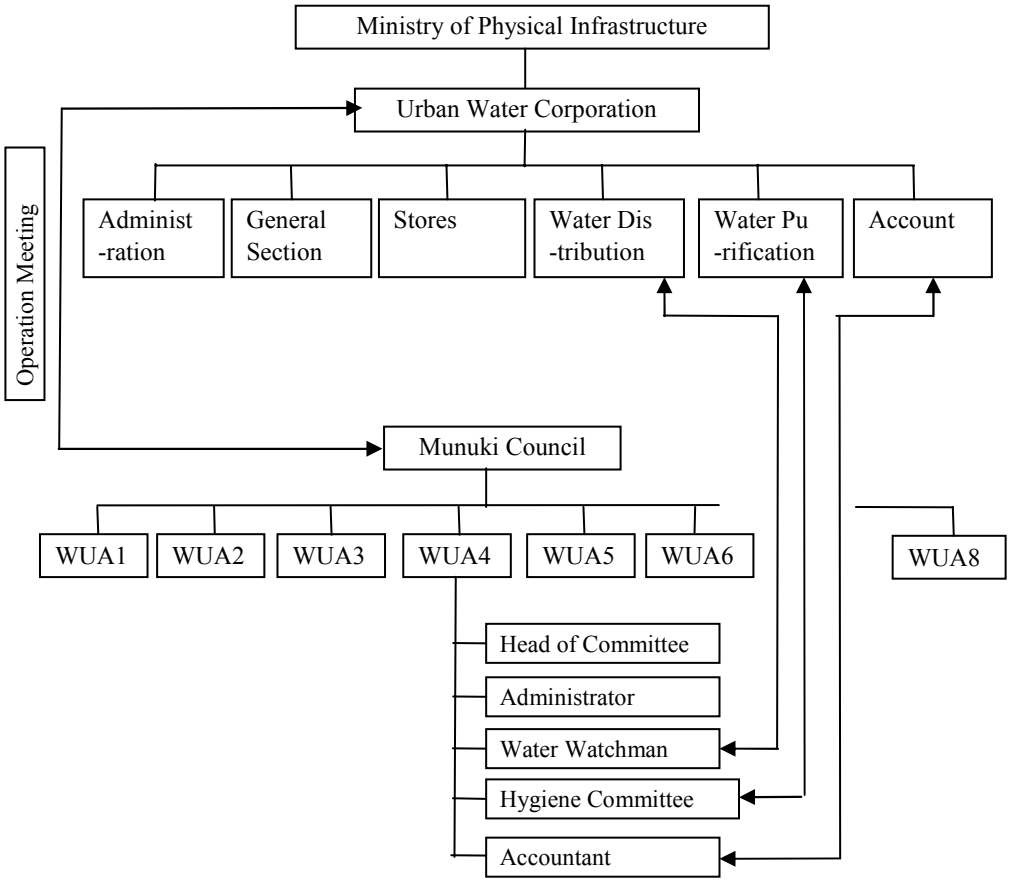


Figure Ⅱ.5-1 Organization Chart for Operation and Maintenance

5.2 Operation Plan

As the new water supply system can meet the required daily water volume of the service population of 2,300 if the new elevated water tank (25.6 m^3) is filled twice a day, water will be conveyed to the new elevated water tank from the existing water supply system once early in the morning and once in the afternoon when the water demand level of the existing system is low so that water supply by the existing system is not affected. The entrusted water watchman of a

water use association will completely shut off the inlet valve of the elevated water tank after confirming that the tank is full.

The water watchman of each water use association will also monitor the behaviour of water users to ensure the fair distribution of water so that no conflict arises regarding the order of using the stand pipes and payment of the water charge among users.

The accountant of each water use association will collect the water charge in accordance with the amount of water used and will forward it to the Account Section of the UWS. The Account Section of the UWS will keep the paid water charge in a responsible manner and will be responsible for payment of the operation and maintenance cost of the water supply system, including the existing water supply facilities, and remuneration for association officers.

5.3 Maintenance Plan

The maintenance matters and activities for which the UWC and water use associations are responsible are listed below.

UWC

- General Matters
  - Procurement and storage of the materials and parts required for maintenance work based on the annual plan
  - Transfer of maintenance skills to the maintenance staff of the water use associations
  - Publicity and education to facilitate the participation of local residents, i.e. beneficiaries of the water supply system, in maintenance work
- Checking of the Water Supply System
  The following maintenance checks will be conducted approximately once a year.
  - Checking of the need for backfilling and water leakage points by means of patrolling the pipeline route and more detailed water leakage checking using a detector
  - Inspection of the valve boxes and cleaning of the movable sections of the valves for effortless valve operation
  - Inspection of dirt inside the pipes
  - Checking of the exposed metal portions of the pipe bridge and elevated water tank, etc.
  - Checking of the proper functioning of the automatic shut off valve
  - Cleaning, repair and/or replacement of any necessary parts in relation to any of the above items

Water Use Associations

- Reading of the meter and recording
- Routine visual checking of the water supply facilities, especially the equipment, etc. around the stand pipes, and informing of any need for more detailed checking or repair to the Head Office of the UWC
- Cleaning of each stand pipe site approximately once a week

It is predicted that the new facilities will not receive any water for a fairly long time until the completion of the rehabilitation/reconstruction of the existing pipeline which is to be conducted by the government of the recipient country. As the functions of these facilities will be significantly damaged without their intended operation for a long time, regular inspection and cleaning of all sections of the facilities is essential even during the period of awaiting the commencement of their actual use. Trial operation of the two valves per standpipe, which have moving parts, approximately once every month and the removal of any sand and rubbish trapped in the moving parts is particularly important.

5.4 Water Charge

When water use associations are established to participate in the operation and maintenance of the new water supply facilities, the payment of remuneration for association officers may be necessary. It is likely that the beneficiaries of the new water supply system will face a similar water charge to that under the existing water supply system. The following water charge is set for each class for the use of a stand pipe under the existing water supply system.

Low Class : 6 pounds (600 SDs)/family/month
Middle Class : 9 pounds (900 SDs)/family/month

(The Government of South Sudan conducted a currency devaluation in January, 2007 and made the pound (so-called second pound: SDG) the only legal tender as of 1st July, 2007 at a rate of 1 pound = 100 Sudan dinars.)

6. OPERATION AND MAINTENANCE MANUAL

6.1 Pipeline

(1) Outline of the Facilities

Existing pipeline section	ϕ 250	PVC	1,100 m
	ϕ 200	PVC	1,200 m
New pipeline section	ϕ 150	PVC	910 m
	ϕ 100	PVC	670 m
	Valve box		3 sites

(2) Operation Method

Commencement of Water Supply

- Full opening of the shut off valve located on the inlet side of the elevated water tank
- Permanent full opening of other valves except those valves for future extension connection which are fully shut

Stoppage of Water Supply

- Full closure of the shut off valve located on the inlet side of the elevated water tank after the confirmation of complete filling of the elevated water tank by the operation of the automatic shut off valve
- Preservation of the open state of all other valves

Drainage from the Pipeline

- Full closure of the outlet valve of the elevated water tank at Jon Gyarang Memorial Place
- Full opening of the valves for future extension connection

6.2 New Elevated Water Tank

(1) Outline of the Facility

Tank size	:	4.0 m x 4.0 m x 2.00 m
Maximum storage water depth	:	1.8 m
Water storage capacity	:	25.6 m^3
Height from ground surface	:	5.0 m

(2) Operation Method

When the water depth inside the elevated water tank reaches 1.8 m, the automatic shut off valve is triggered to stop the inflow of water. The water depth in the tank should be kept between 0.3

m and 1.8 m as the excessive outflow of water inside the tank may create air pockets inside the outlet pipe leading to the water distribution pipeline.

Completed Elevated Water Tank

Water Pipe Bridge

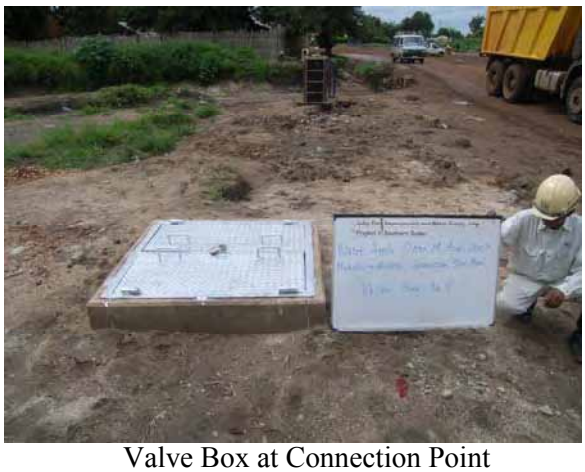
6.3 Pipelines and Stand Pipes

(1) Outline of the Facilities

Water pipes	φ75 mm	1,060 m
	φ50 mm	370 m
	φ40 mm	700 m
Stand pipes	8 sites	

(2) Operation Method

The water consumption volume will be read from the meter. The water consumption will be controlled to prevent the occurrence of air pockets inside the outlet pipe of the elevated water tank due to the excessive use, i.e. outflow, of water.



Valve Box at Connection Point with Existing Pipe Line

Drain Box for Elevated Water Tank

One of Hydrant

One of Hydrants

RECOMMENDATIONS

< Transport Sector >

(1) Application of Urban Controlling Methods for the Project

The main reason for the delay of construction work is ascribed to the land acquisition. The Project was continued after many twists and turns and finally completed within the duration of the Study. However it should be noted that the long time suspension of the construction work leads to the expansion of the project cost and cancellation as the case may be. Strategic socio-environmental assessment and land acquisition procedures shall be formulated to avoid such unfavourable situation, though arrangement and rectification of many conditions are required.

Identification of details of land rights, compensation standards, land expropriation process, and strategic socio-environmental assessment method are enumerated as such example. However none of those requirements is easy, nevertheless efforts practicable at an early stage shall be made step by step to meet those requirements.

In Juba and its surrounding areas enclosure of the land with fence became active for the protest of their own land rights and investors made contracts for their development without legal background. However without controlling those arbitral activities implementation of public investment in line with the development policy becomes difficult and leads to the expansion of project cost if any.

As urban development including public facilities construction should be carried out by projects and controlling of development and construction activities, urgent introduction of controlling method especially prohibition of any development/construction activities at the places where public facility is planned and permission system is necessary in this regard.

(2) Proper Tariff System Setting for Sound Operation and Management

It is well assumable that sand silt and floating debris and weeds adhering to port facility may hider sound operation. Therefore, careful maintenance work as proposed in the Final Report will be indispensable to avoid the mal-functioning of facility. Proper maintenance works and Training of staffs can be achieved in line with the manual shown in the Report, and necessary cost for operation and maintenance shall be secures by proper tariff system for the use of port facilities.

Though determination of tariff system is the issue on the Southern Sudan side, beneficiary-pay principle is well persuasive. Namely, benefits from the curtailment of labour cost by loading and unloading machine, reduction of standing costs by shortening of mooring duration, indirect effects by the change in economic potential of the lands near the port, etc. shall be properly

evaluated and the system to ask beneficiaries to bear their own benefits proportionally shall be devised. And it shall be operated at a reasonable tariff system for the port users because it is a grant aid Project designed for stable freight transport and lowering the commodity prices for the reconstruction and economic development.

(3) Accommodation to the Future Quantitative and Qualitative River Transport Demand

According the study results of river transport demand forecast, the port capacity will be insufficient in not distant future. Also port facility is not designed to handle container transport demand. Expansion of port facility is necessary and applicable for the imminent river transport demand expansion. However river port development master plan geared to the urban development for the expansion of river transport demand in medium and distant future and container transport demand and for the industrial development shall be formulated.

< Water Supply Sector >

(4) Implementation of Rehabilitation/Reconstruction Work for Existing Pipeline by GOSS/CES

In regard to the connecting (i.e. extension) pipeline required for water supply to the target water supply area in the Munuki area, the construction of a new pipeline from the terminal point of the existing pipeline in the Kuwait area to the newly constructed elevated water tank in the Munuki area is proposed in the Study and the GOSS is expected to be responsible for the rehabilitation/reconstruction of the existing pipeline. As the non-use of facilities specially constructed with Japanese assistance for a long period of time not only contradicts the principal idea of Japan's ODA but also considerably damages the functions of such facilities, it is highly desirable for the rehabilitation/reconstruction of the existing pipeline to be reliably conducted without delay as part of the rehabilitation project of the GOSS which is currently in progress.

(5) Finalisation of Operation and Maintenance Plan

The existence of a reliable maintenance plan is imperative for the efficient long-term use of the newly constructed facilities. In the case of the water supply facilities newly constructed under the Pilot Project and those to be constructed as a result of the present Study for their communal use, the participation of the communities and local residents benefiting from these facilities in their operation and maintenance is essential. The maintenance of water supply facilities for communal use tends to be difficult because of conflict over the distribution of water and the individual share of the payable water charge and also because of failure to collect an appropriate water charge. To overcome those problems, the GOSS/CES must urgently finalise a detailed operation and maintenance plan to facilitate sufficient collaboration with communities and local residents, including the possible establishment of the water use associations proposed by the JICA Study Team.

(6) Effective Utilization of Provided Equipment and Materials

Water supply facilities using groundwater as the water supply source were originally planned under the Pilot Project and the equipment and materials required for the construction of suitable facilities were procured in accordance with the procurement plan for the Pilot Project. However, the water supply source was changed because of a problem with the groundwater quality (presence of arsenic) and the equipment and materials listed in the Appendices were left unused in the Project area. It was subsequently decided to offer the equipment and materials to the GOSS/CES because of a request for their use for the development of the water supply system in rural areas.

The GOSS/CES must decide a person responsible for the safe storage of the equipment and materials and a proper storage place and should promptly formulate a utilisation plan to ensure their effective utilisation.

(7) Necessity to Develop a Database for Hydrogeological and Water Quality Information and Detailed Survey

Groundwater is an extremely precious source of water supply for people in Juba and its surrounding area and 365 boreholes have been constructed in the area. However, hardly any hydrogeological data and water quality test results for these boreholes has been properly compiled and it is practically impossible to access such data for the planning of the construction of new boreholes. In fact, the borehole construction plan to establish the sources of water supply for the pilot water supply project was based on fragmented hydrogeological and water quality data and electric prospecting results for a limited area. A sufficient water yield was confirmed for two of the six boreholes drilled but the extracted groundwater contained a much higher concentration of salt than the relevant standard as well as a high concentration of arsenic of which the treatment would be quite difficult. Accordingly, these two boreholes were abandoned as possible water supply facilities. For the formulation of an efficient as well as reliable plan for the construction of new boreholes to respond to the expected increase of the water demand in the coming years, the development of a database containing a register of boreholes and their hydrogeological and water quality data is essential to provide easy access to such data. Moreover, when new deep boreholes (depth of 50 m or more) are planned to meet the likely rapid increase of the water demand in the coming years, a carefully planned and detailed survey must be conducted in view of the high likelihood of the presence of an excessively high concentration of salt and possibly arsenic which is difficult to treat in some cases.

APPENDICES

Appendix 1 Pavement Design

Classification of Roadways by Traffic Flow Volume

Pavement standard shall be determined from the estimated one-way daily traffic volume of heavy vehicles in the fifth year of operation. Following table shows typical classifications in case of Japan.

Classification	One-way Daily Traffic Volume of Heavy Vehicles
L	100 or Less
A	101 to 250
B	251 to 1,000
C	1,001 to 3,000
D	More Than 3,000

Source; Manual for Asphalt Pavement, Japan Road Association, 1989

Based on the river transport demand forecast, heavy vehicle demand in 2012 (fifth year of operation since 2007) would be as follows and this level of heavy vehicle volume is classified as still L-Traffic from the table shown above.

On the other hand, traffic volume counts carried out between 25 and 27 May 2006 indicated that average daytime heavy vehicle volume for both in and out bounds was 191 (Cargo Truck; 114, Trailer Truck; 43, and Bus; 34) along the port access road, and taking 6% annual growth rate and considering one-way traffic, it will be classified as A-Traffic.

Category		Demand in 2012		Equivalent Daily Heavy Vehicle Volume in 2012
		Volume	No. of Vessels	
Cargo	In	7,200	24	80 (20 days per month, 10 ton / truck, 20 pax / bus)
	Out	300	-	
Passenger	In	800	2	
	Out	800	-	

Unit; Cargo (ton / month) & 300 ton / vessel, Passenger (pax / month) & 400 pax / vessel

Number of 5 Ton Equivalent Wheel Load Applications

Followings are calculations of number of 5-ton equivalent wheel load applications based on the traffic volume as described above with assumed wheel loads of various classes of the vehicles, especially heavy vehicle, since light vehicle's damage factors are very small and their 5-ton equivalent wheel loads are neglectable. In this case the port access road is classified as B-Traffic after taking into account of traffic demand in the 5th year of operation.

Suffix	Li	Wi	Pi = Li/Wi	ni = Ni x Wi	ai = $(Pi/5)^4$	N_5 = ni x ai
Vehicle Type	Typical Vehicle Load	Typical Number of Wheels	Value of Wheel Load	Number of Wheels Counted	Damage Factor	Number of 5 Ton Wheel Load Appli-cations
Unit	ton	wheel	ton/wheel	wheel/day/direction	-	wheel/day/direction
Sedan	1	4	0.25	208	0.0000	0
4WD	2	4	0.50	188	0.0001	0
Mini Van	4	4	1.00	224	0.0016	0
Micro Bus	8	6	2.00	180	0.0256	5
Bus	16	6	2.67	102	0.0809	8
Truck	32	10	3.20	570	0.1678	96
Trailer	64	18	3.56	396	0.2557	101
Total				1,868		210

Design CBR (California Bearing Ratio) Value

The design CBR value is determined by sampled sub grade soils to design the thickness of the pavement. Followings are the results of the equivalent CBR values obtained from field DCPT (Direct Corn Penetration Test) along the access road sub grade soil before replacement.

	Sta. 0+000~0+420	Sta. 0+420~0+680
Average CBR	26.40	11.33
Std. Deviation	12.95	4.38
Section CBR	13.45	6.96
Design CBR	12	6

Pavement Design

Next 10 years total number of 5-ton equivalent wheel loads applications (N) will be 1.07×10^6 (wheel/direction) considering 6% annual growth. Therefore recommended thickness of pave-ment (H) and design thickness of the pavement using hot asphalt mixtures (Ta) are follows;

		Design CBR		
		6	12	20
H	$28.0N^{0.10}/CBR^{0.6}$	38	25	19
Ta	$3.84N^{0.36}/CBR^{0.3}$	21	17	14

After several trials of stabilization experiments in Juba and Nairobi, optimum stabilization method was formulated as follows;

Maram: Gravel: Sand: Cement: Lime = 50: 25: 25: 8: 4

And its conversion coefficient for the calculation of Ta is estimated as 0.78.

Case-1

Considering DBST surface course with 3cm and cement/lime stabilized base course with 15cm, design Ta is calculated as;

$Ta = 1.0 \times 3.0 + 0.78 \times 15 = 14.3cm > Ta_{CBR20} = 14cm$

This design value is only acceptable when design CBR is 20 or above, but not below 20.

Case-2

Considering DBST surface course with 3cm and cement/lime stabilized base course with 20cm, design Ta is calculated as;

$$Ta = 1.0 \times 3.0 + 0.78 \times 20 = 18.0cm > Ta_{CBR12} = 17cm$$

This design value is acceptable when design CBR is 12 or above, but not below 12.

Case-3

Considering DBST surface course with 3cm and cement/lime stabilized base course with 25cm, design Ta is calculated as;

$$Ta = 1.0 \times 3.0 + 0.78 \times 25 = 22.5cm < Ta_{CBR6} = 21cm$$

This design value is acceptable when design CBR is 6 or above, but not below 6.

Due to limitation of equipment and procurement cost for material, especially cement and lime, the Study Team has selected Case-2 by replacing sub grade level soil with natural maram obtained from borrow pit near the airport with CBR of 30 to achieve section CBR of 12 or above with proper compactions for the section between Sta. 0+420 and 0+680 as well as cargo handling yard beside the river bank where sub grade soil is not hard enough and showed design CBR of 6, since those sections are consisting of sand-clay and/or black cotton soil which reduced average CBR drastically.

On the other hand, soil replacement of sub grade level for above described section with cargo handling yard from existing weak soil to newly obtained good soil required more than 6,000[*1] cubic meter earth work each, and such earth works increased construction cost and period considerably. In addition, those earth works were taken place during the rainy season due to delay of commencement of the project and caused further delay of official handover.

[*1] 12m wide x 1m deep x (260+2x40)m long x 1.5 (loosen vs. compaction ratio)

Appendix 2 Drainage Design

Proper drainage design is one of the vital components of any classification of roads. To determine the capacity of drainage, mainly 2 variables are considered under this sections namely;

- Intensity of Rainfall
- Area of Catchments

Intensity of Rainfall

Due to lack of historical records of precipitation in Juba, we have used 75 millimeters per hour (mm/hr), which is relatively strong rainfall, for further calculation based on the rainfall tendency in Juba.

$$Q_r = 1 / (3.6 \times 10^6) \times C \times I \times A \quad \text{..... (1)}$$

Where; Q_r : *volume of rainfall handled (cubic meter per hour, m^3/hr)*
C : *coefficient of runoff (0.95 for road surface and embankment)*
I : *intensity of rainfall (75 mm/hr for this calculation)*
A : *area of catchments (square meter, m^2)*

Area of Catchments

Total of 30m wide area, including road surface and adjacent area, is considered as area of catchments, since a lot of runoff rainwater comes into the subject road from the adjacent areas, such as market, mosque, school's playing grounds, and other plots, and area of catchments is increased based on the drainage length, or the road length.

Capacity of Drainage

Followings are summary of capacity of drainage (ditch and culvert) by each section with 100m interval. Under this project, 3 types of drainages are introduced namely;

- Open Ditch (Trapezoid)
- Pipe Culvert (Circle)
- Portal Culvert (Rectangle)

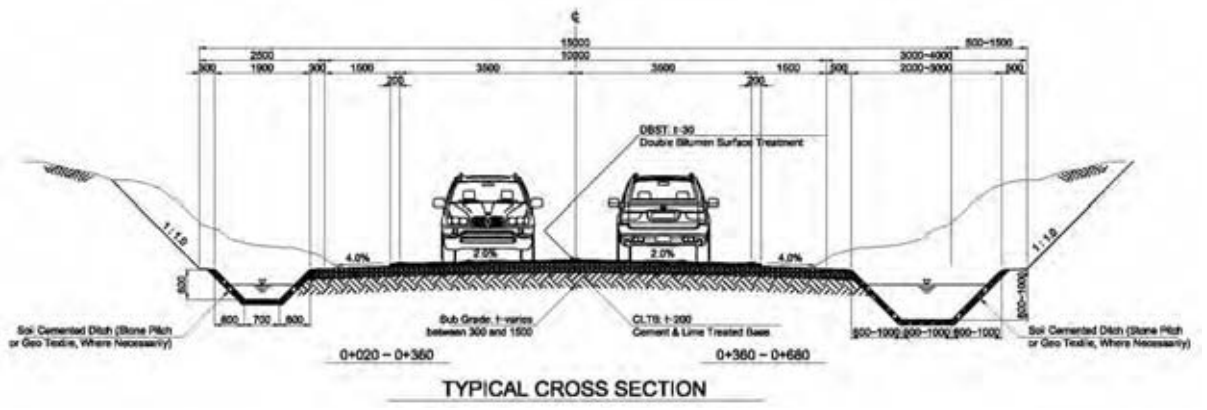
$$v = 1/n \times R^{2/3} \times i^{1/2} \quad \text{..... (2)}$$

Where; v : *velocity of runoff rainwater in the ditch/culvert (meter per second, m/sec)*
n : *coefficient of roughness (0.033 for rough surface ditches)*
R : *hydraulic mean depth (A_d / P)*
i : *hydraulic gradient*
A_d : *hydraulic area of the ditch/culvert (square meter, m^2)*
P : *wetted perimeter (meter, m)*

Station	Volume of Runoff Water Q_{75}	Hydraulic Gradient	Capacity of Drainage					
			Open Ditch (Trapezoid) Q_t		Pipe Culvert (Circle) Q_c		Portal Culvert (Rectangle) Q_r	
unit	cu.m/sec	%	cu.m/sec	Q_{75}/Q_t	cu.m/sec	Q_{75}/Q_c	cu.m/sec	Q_{75}/Q_r
0+100	0.06	3.00	0.40	0.15	0.21	0.28	0.66	0.09
0+200	0.12			0.30		0.57		0.18
0+300	0.18			0.45		0.85		0.27
0+400	0.24	0.50	0.16	1.46	0.09	2.78	0.27	0.88
0+500	0.30			1.83		3.48		1.10
0+600	0.36			2.19		4.18		1.32

Note: Capacity of open ditch is based on the water depth is 30cm with bottom width of 70cm and 1:1.0 side walls.
For pipe culvert, diameter is 50cm, and angle from the center to water surface is 150 degree.
For portal culvert, bottom width is 155cm and water depth is 30cm.
Capacities of all type of drainages are 80% figures under consideration of sand segmentation.

Based on the above table, upstream side (first half section between Sta. 0+000 and 0+360) requires relatively smaller cross section and downstream side (second half section between Sta. 0+360 and 0+680) requires relatively larger cross section of drainage as shown in Figure, because not only total area of catchments is increased, but also gradient of drainage is reduced from 3.0% to 0.5% due to vertical alignment design of the subject road after Sta. 0+360. Especially in case of pipe culvert, even triple pipe setting is not enough to handle such huge amount of runoff rainwater, therefore much deeper portal culverts are introduced where pipe culverts are not suitable.

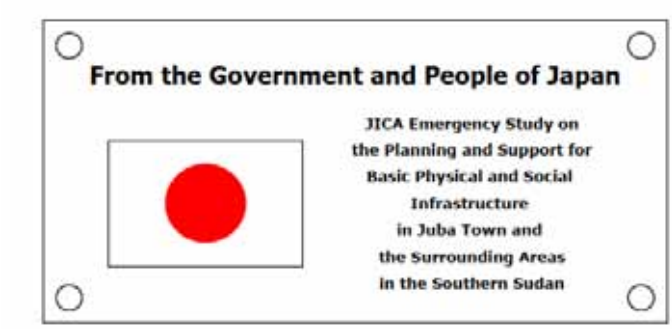


Applied Pavement & Drainage Design

Note that deeper drainage also contributes reduction of risks of overflow in case of excess runoff water more than expected due to rainfalls over 75 mm/hr and/or near future improvements of connecting road surface conditions as well as pushing water level down well under the stabilized base course level and keep road conditions as dry as possible.

GANTRY CRANE

OPERATION MANUAL



August-2007

URBAN TONE CORPORATION

Contents

SAFETY

For your protection, Please read these safety instructions completely before operating the appliances, and keep this manual for future reference

DANGER	This symbol is intended to alert the user to the presence of death or serious injury by operating incorrectly. Extremely Dangerous
WARNING	This symbol is intended to alert the user to the presence of death or serious injury by operating incorrectly. Dangerous
CAUTION	This symbol is intended to alert the user to the presence of minor inury by operating incorrectly
IMPORTANT	This symbol is intended to alert the use to the presence of importance operating and instruction in the literature accompanying the appliances.

SAFETY

1. Caution on Operation

WARNING

Carefully observe all warning, precautions and instruction on the appliances, or the one described in the operating instructions and adhere to them.

Please understand system before start operating..

Please DO NOT adapt any sytem.

To perform routine safety check on system and wiring.

WARNING

Wear the SAFETY BELT when climb up to perform routine safety check.

NO TRESPASSING to facilities.

To LOCKED facilities all the time.

WARNING

DO NOT carry article exceed capacity (Maximum 1.25 TON)

To use only slinging equipments which are fixed.

DO NOT come under the suspended articles.

WARNING

To wear proper cloths during operation to avoid catching in machines.

To wear protection during operation. (Helmet, Gloves, and Safety Belt etc.)

To set fire extinguisher.

2. Caution on Operation

WARNING

Please read the generator's manual and safety instruction completely before operating.

CAUTION ELECTRIC SHOCK. (DO NOT TOUCH electric storage part)

To TURN OFF MAIN BREAKER, when replace

When reparings are required for electic ploblems let electric technician to deal with them.

Please check oils and each filters regularly. Please replace them when it is necessary.

IMPORTANT

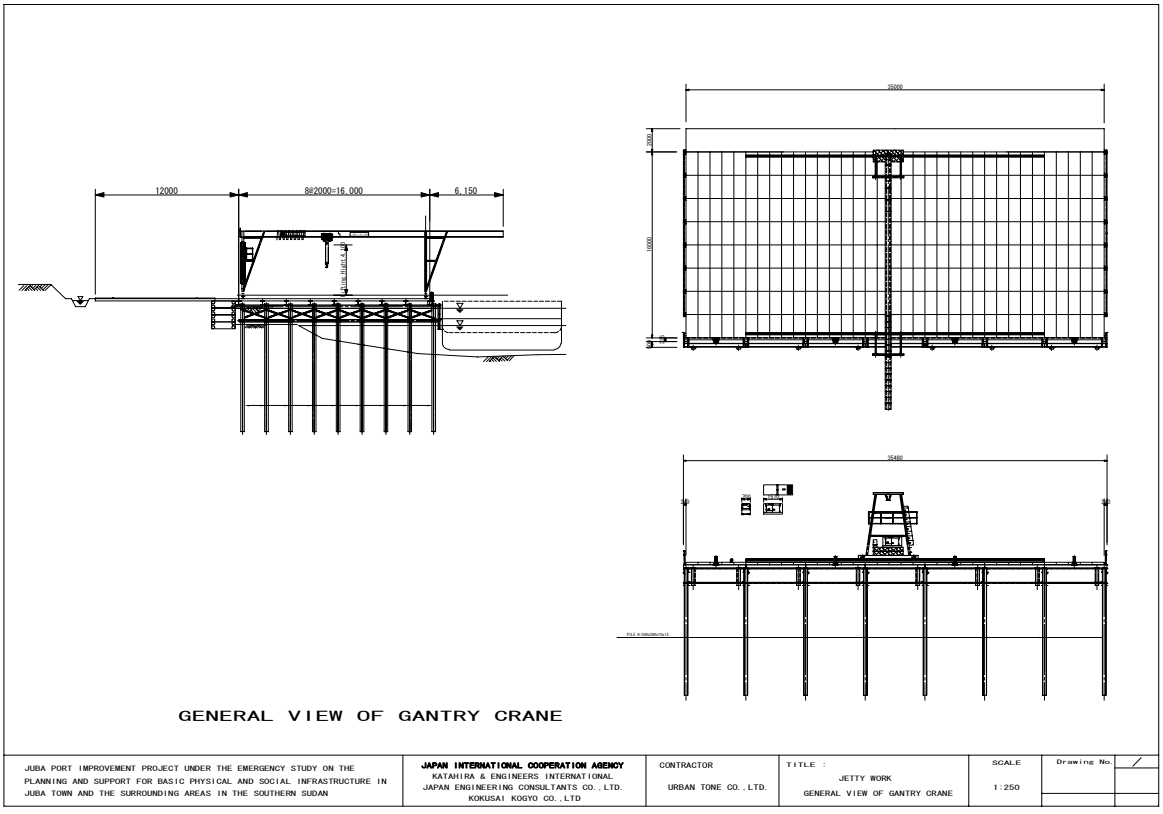
To keep clean facilities.

DO NOT PLACE FLAMMABLES near generators.

Please check bolt on jetty and welding condition regularly.

2. GANTRY CRANE-1

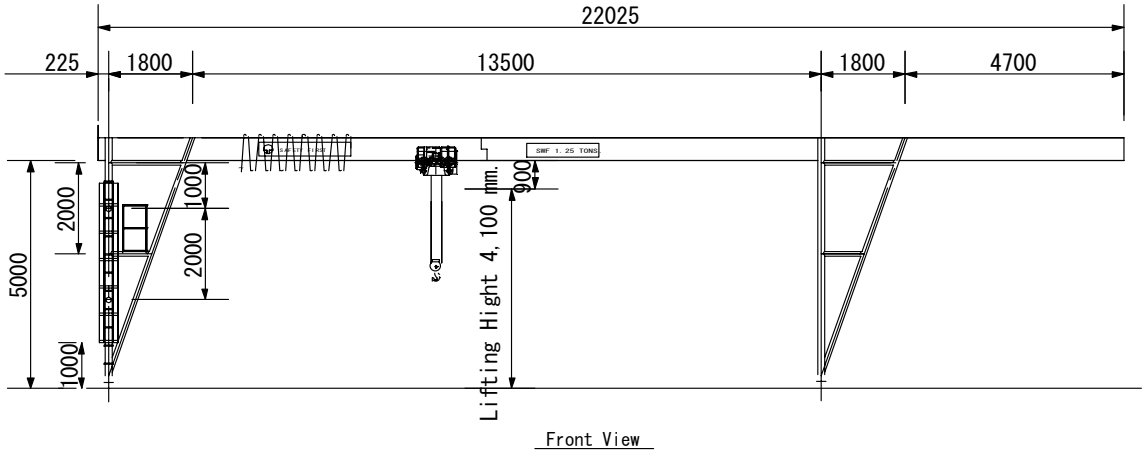
2-1 General Figure



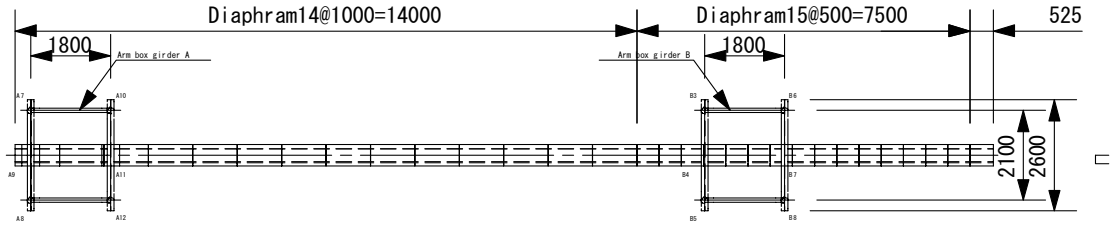
SPECIFICATION

RATED LOAD			1.25 ton			
SPAN			15.3 m			
LIFT			4.1m			
MOTION	SPEED		MOTOR		RATING	BRAKE
	(m/s)	(m/min)	KW-PCE	POLE		
HOIST	0.100	6.0	2.2×1	4	25%ED	MAGNET
CROSS TRAVEL	0.350	21.0	0.5×1	4	25%ED	MAGNET
LONG TRAVEL	0.283	17.0	1.1×4	4	40%ED	MAGNET
LONG TRAVEL RAIL			15 kg/m-RAIL			
HOIST MODEL			MITSUBISHI R-2-LM3			
WIRE ROPE			6XFi(29)8 C9.0X 2FALLS			
OPERATION			FIXED PENDANT CONTROL			
CROSS TRAVEL WIRING			FLAT CABLE			
LONG TRAVEL WIRING			DYNAMO			
POWER SOURCE			3C 380V 50 HZ			
PAINTING COLOUR			YELLOW			
REMARKS			1. LONG TRAVEL LENGTH 23m			
			2. CONTROL VOLTAGE 48V			
			3. LOAD LIMITTING DEVICE FOR HOISTING			

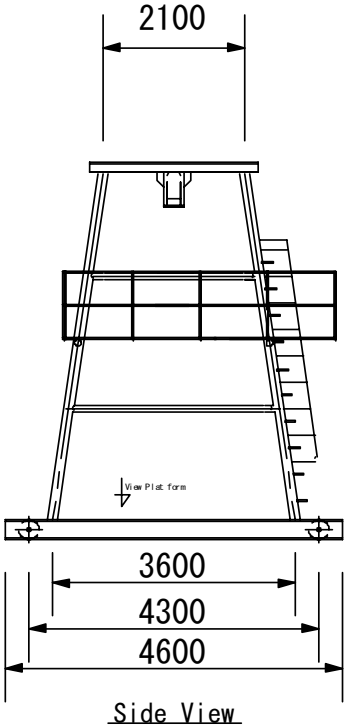
2-2 Detail OF GANTRY CRANE



Front View



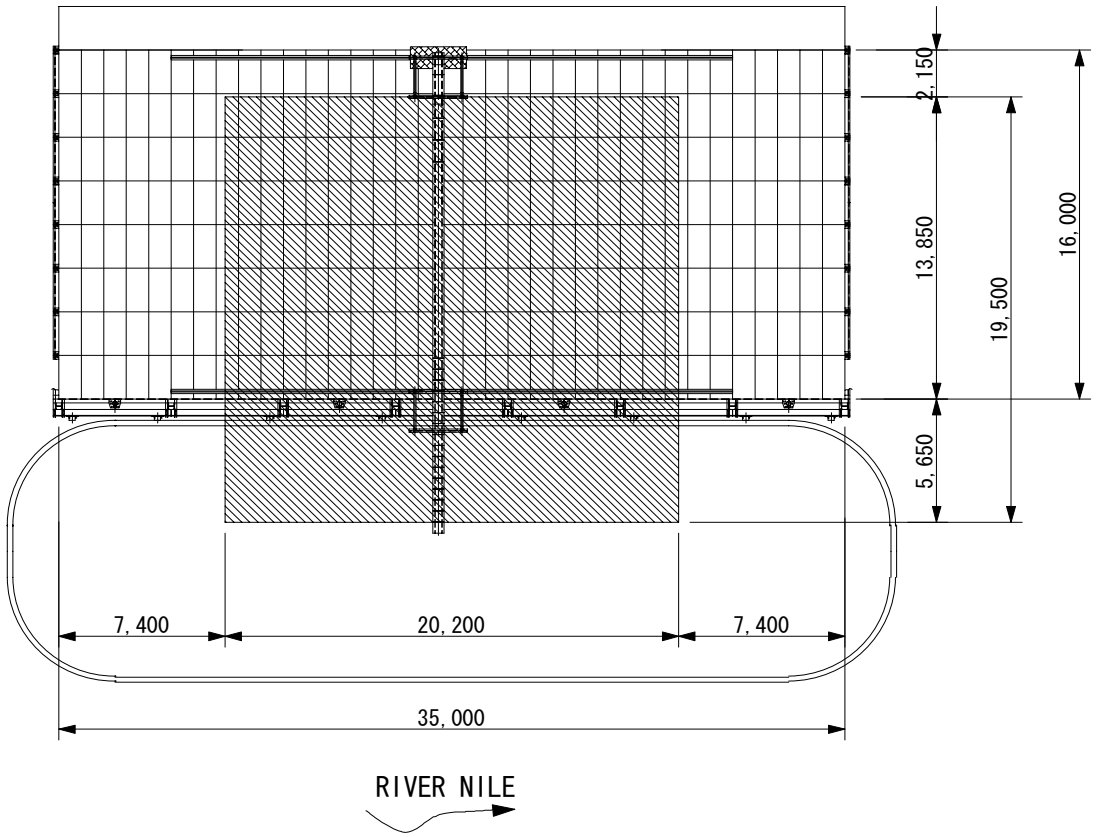
Top View



Side View

2-3 Operation Range OF GANTRY CRANE

Operation range of gantry crane is indicated below. (Oblique line)



3. OPERATION

3-1 Operating Generator

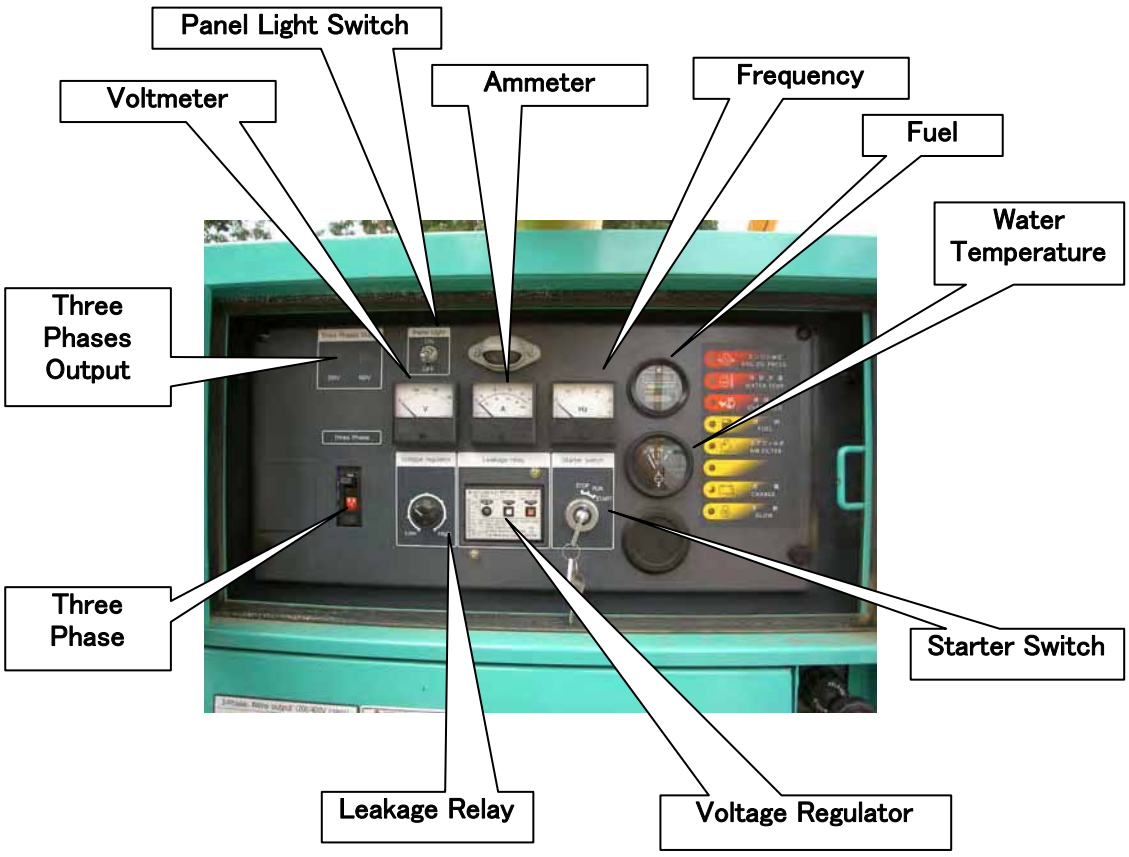
WARNING

Please read the generator's manual and safety instruction completely before operating.

Please do routine inspection according to the manual.

Please check oils and each filters regularly. Please replace them when it is necessary.

Genrator Control Pannel



3-2 Switch Box

WARNING

This system's voltage is 380V. If need to touch electric storage during the maintenance, the main breaker MUST TURN OFF to avoid electric shock.

DO NOT ORERATE WITH WET HANDS.
CAUTION ELECTRIC SHOCK

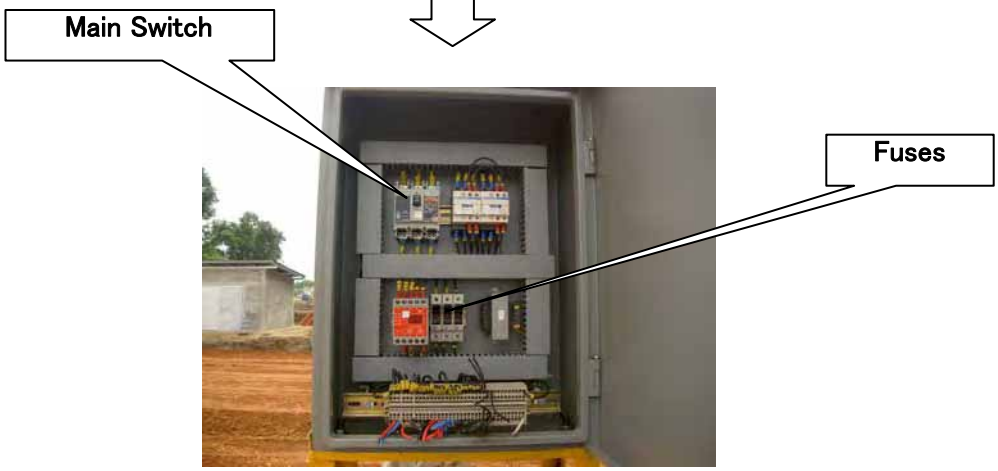
To keep clean inside the switch box.

Do not place anything in front of the switch box.

To check the voltage reguraly. If it is different from the prescribed, it may damage machines.

Switch Box

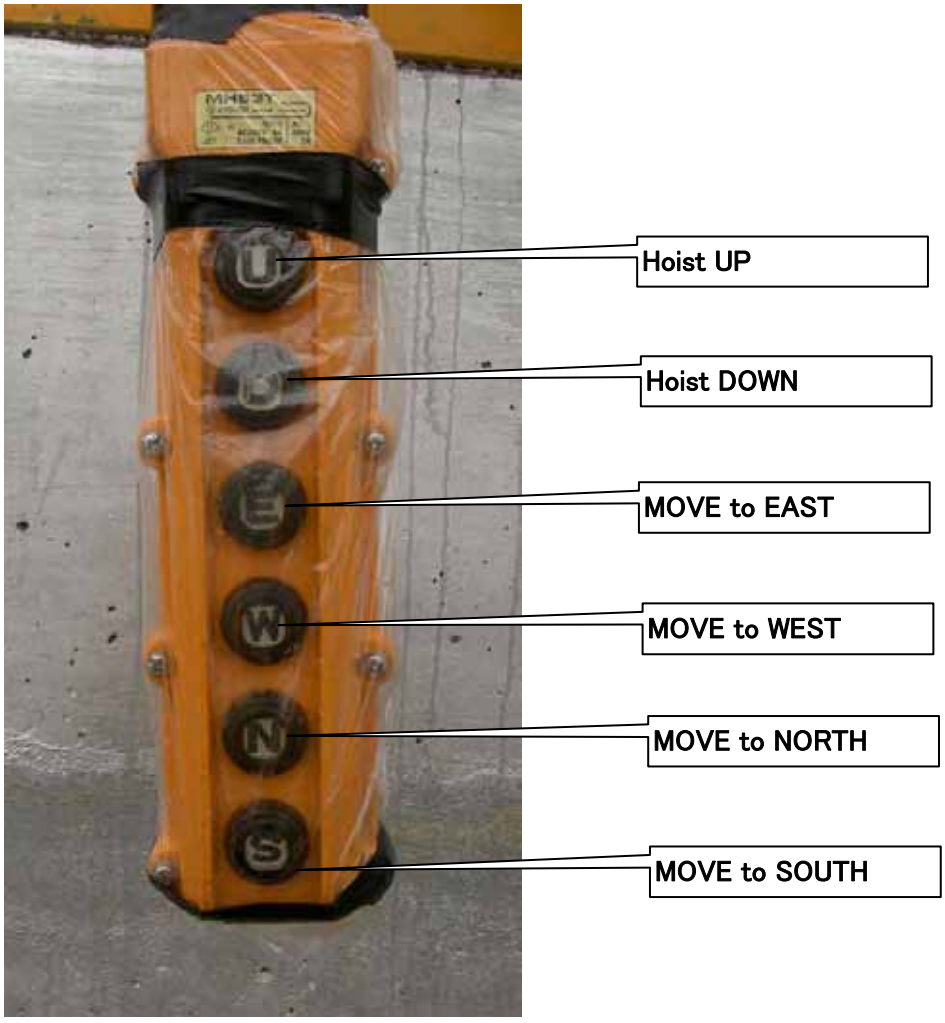
open

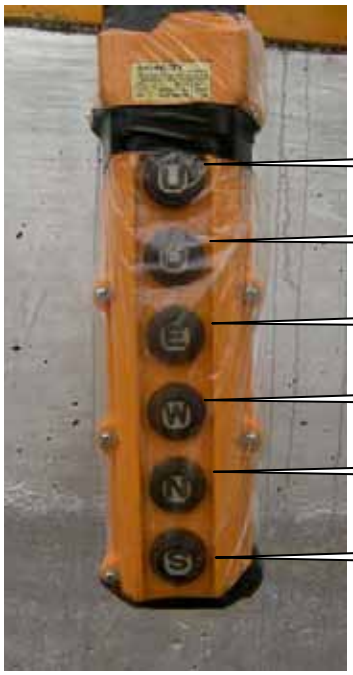


3-3 GANTRY CRANE Operation

WARNING

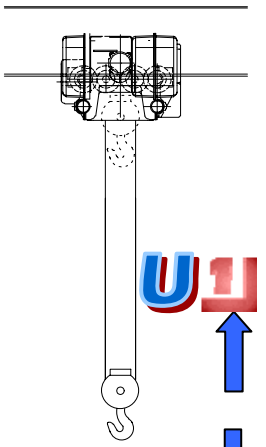
Persons without compulsory or statutory qualification MUST NOT operate the hoist crane or sling an article.
To use switch with care.
DO NOT exceed the capacity.

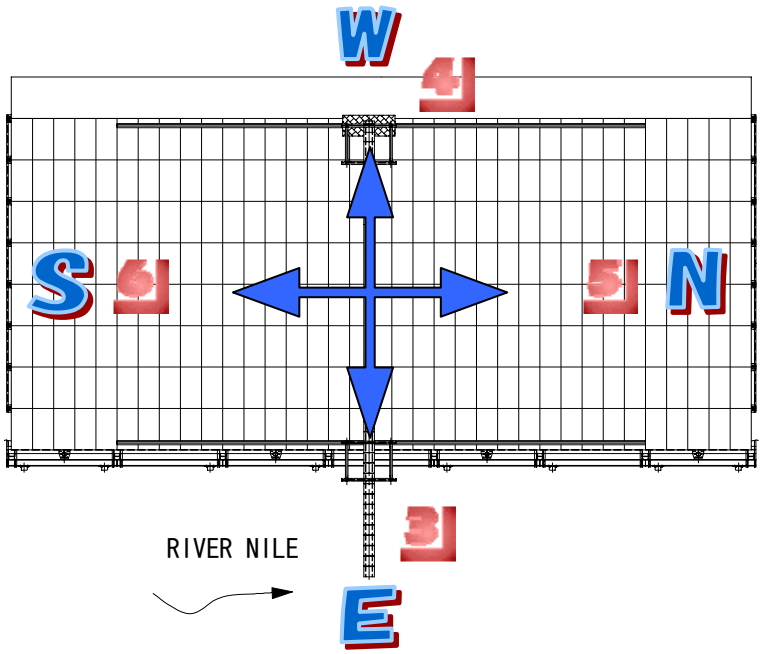



Hoist UP
Hoist DOWN
MOVE to EAST
MOVE to WEST
MOVE to NORTH
MOVE to SOUTH
1
2
3
4
5
6

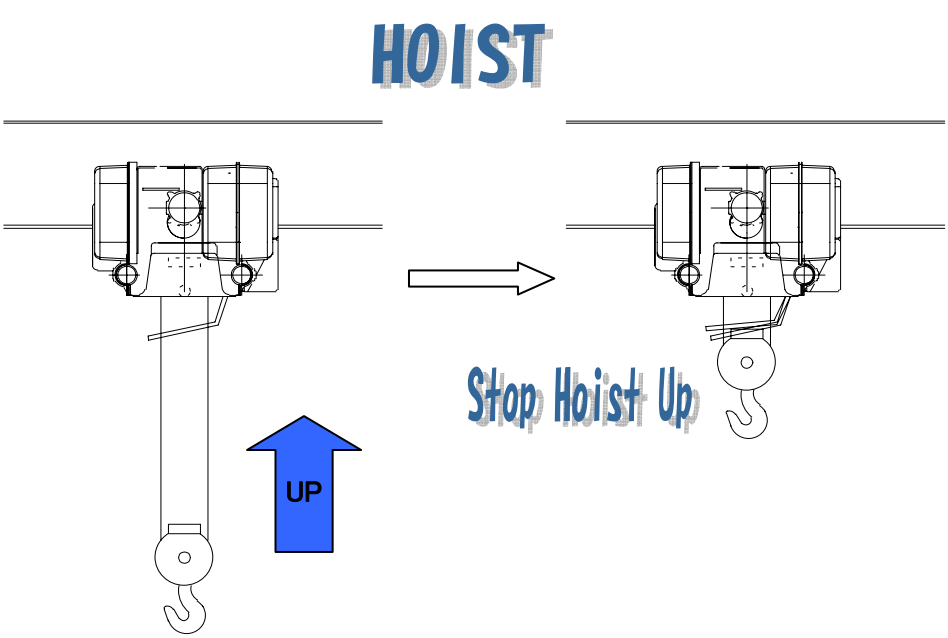
HOIST

MOVE


U 1
D 2


W
4
S
6
5
N
3
RIVER NILE
E

3-5 Hoist Safeguard

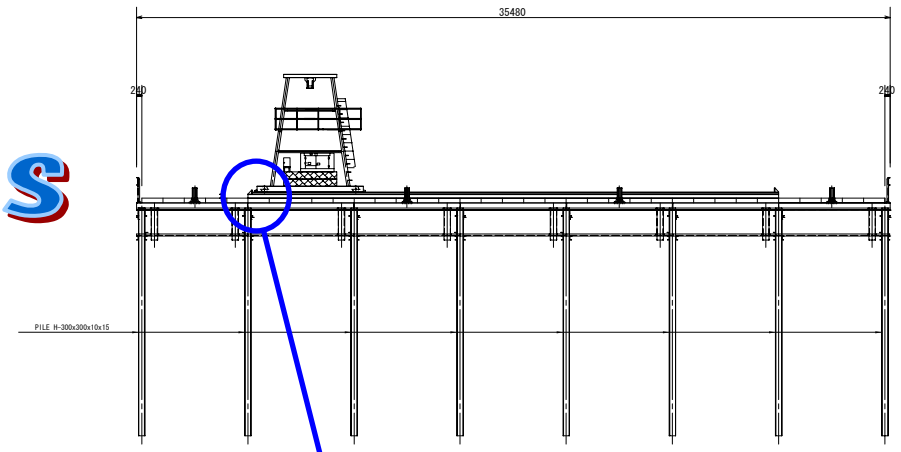


WARNING

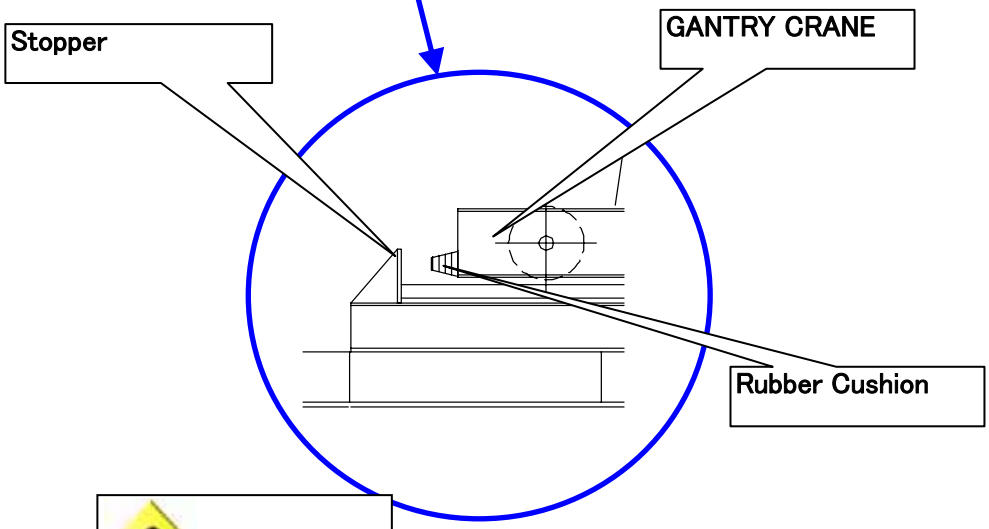
When the hook touch safety bar it will stop automatically. Please check the safeguard system everyday. If the safeguard system does not work properly it has to be repared immediately. DO NOT operate the crane untill it is repared.

3-5 GANTRY CRANE Safeguard

MOVE



DETAILS



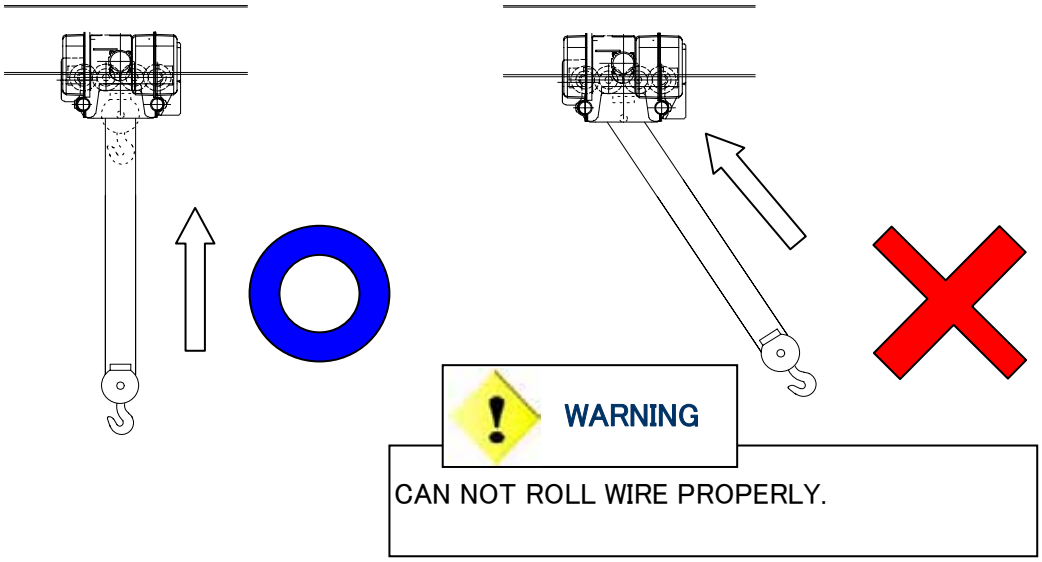
WARNING

Please stop the Gantry Crane before it contact to the stopper.
DO NOT frequently contact the Gantry Crane to the stoppers to stop the Gantry Crane.

4. VERBOTEN

4-1 VERBOTEN OF GANTRY CRANE

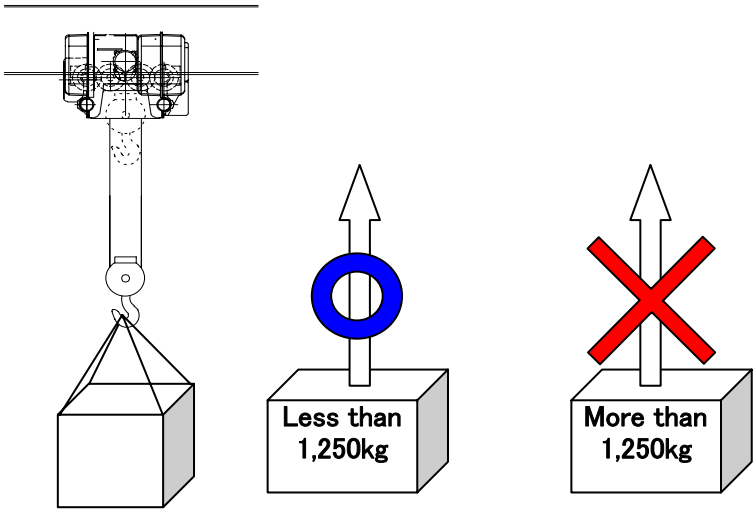
1. Must hoist straight up. DO NOT hoist up on one's side.



WARNING

CAN NOT ROLL WIRE PROPERLY.

2. DO NOT exceed its capacity (Maximun 1.25 TON).



WARNING

Maximun capacity of the crane is 1.25 TON.
It will cause accident and/or damage the crane if it is overloaded.

4-2 VERBOTEN OF GANTRY CRANE

WARNING

DO NOT place anything on rails.
DO NOT bring vehicle into contact with the crane. If the crane is moved it is very dangurous to operate.

WARNING

Hoist wire must be rolled properly. Unless you roll properly, it will damage the wire and cause accident.
Please check wires regularly. Please replace them when it is necessary.
NEVER operate the hoist if the wire stopper on the hook is left broken.
Please check hoist safeguard regularly to make sure of operation. It is danger to over rolled.

5. REFERENCE

5-1 Criteria for Scrapping Wires

Please scrap wire which are applicable to belows.

Kink

Transformation

Corrosion, Rust

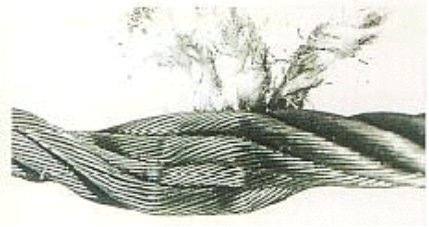
Wearing

Twine badly

Looping

5-2 Criteria for Scrapping Wires

Broken lines



Core protrusion or broken core

WARNING

Please check the wire condition regularly.
NEVER use bad wires. (Bad wires fall off quality. They might break during operation.)

Appendix 4 Water Quality Test Results

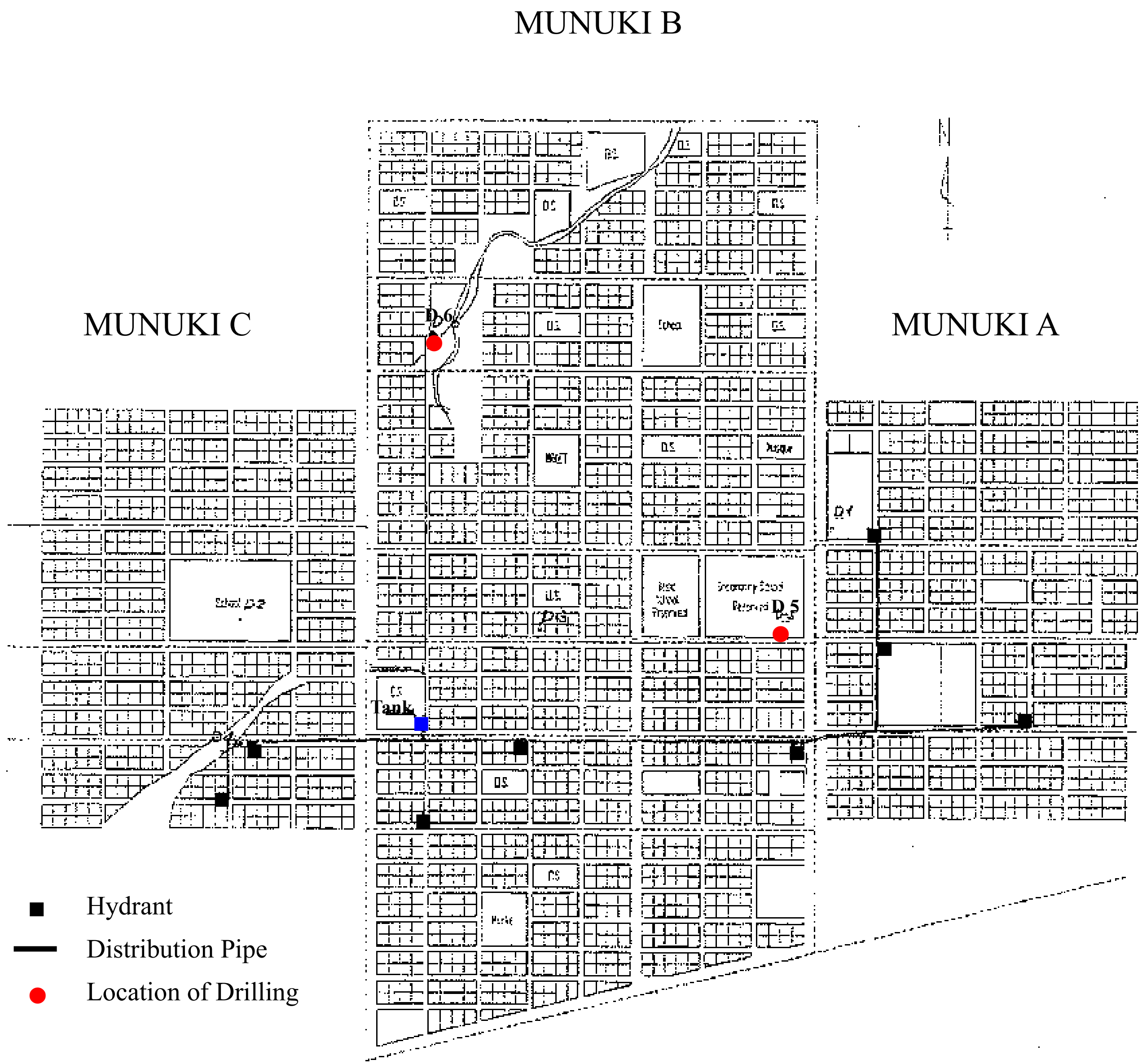
6 Bore halls have been drilled as resource for water supply in Munuki area. It was found that out of those, two bore halls have quantitatively enough potency. The water quality test results of water from the two bore halls and drilling site of the 2 bore halls are shown in the following Tables and Figure.

Water Quality Test Result at D5

Parameters	Unit	Result of Water Quality Test			Standard	
		NWSC(Uganda)	Thai	Japan	Spec	WHO
pH	--	7.2	6.59		6.5 - 8.5	
Electrical Conductivity	S/cm	6,960	6,650			
Colour: apparent	PtCo	34	15		15	
Turbidity	NTU	0.3	2.4		5	
Total Suspended Solids	mg/L	1				
Total Dissolved Solids (TDS)		-	4,750			
Odour		Unobjectionable			Not unpleasant	
Taste		Salty			Not unpleasant	
Alkalinity: total as CaCO3	mg/L	-	4,010			
Hardness: total as CaCO3	mg/L	100	105		500	300
Non Carbonate Hardness as CaCO3			0			
Sodium; Na	mg/L	-	1,830			
Potassium; K	mg/L	-	58			
Calcium: Ca2+	mg/L	30	24		-	
Magnesium: Mg2+	mg/L	6	11		-	
Manganese: Mn2+	mg/L	0	0.14		0.1	
Chloride: Cl-	mg/L	0.4	352		250	
Fluoride: F-	mg/L	1.18	2.4		1.5	
Iron: total	mg/L	0.02	0.06		0.3	
Sulphate: SO42-	mg/L	395	396		250	
Nitrate	mg/L	0	0.7		11	
Nitrite (NO2)	mg/L	-	0.002			
Silica (SiO2)	mg/L	-	95			
Chromium: hexavalent	mg/L	0	-		0.05	
Copper	mg/L	<0.01	0		1	
Zinc	mg/L	0.02	-		3	
Arsenic	mg/L	0.15	-		0.05	0.01^{P}
(Arsenic in Nairobi)	mg/L					
Ammonia	mg/L	0	-		1.5	
Faecal Coliforms	CFU/100mL	0	-		0	
Drilling date		2007/25/2				
Reporting date of Test result		2007/3/2	2007/3/13	2007/4/19		

Water Quality Test Result at D-6

Parameters	Unit	Result of Water Quality Test			Standard	
		NWSC(Uganda)	Thai	Japan	Spec	WHO
pH	--	7.5	6.53		6.5 - 8.5	
Electrical Conductivity	S/cm	7280	5380			
Colour: apparent	PtCo	0	10		15	
Turbidity	NTU	0.3	2.2		5	
Total Suspended Solids	mg/L	0				
Total Dissolved Solids (TDS)		-	3800			
Odour		Unobjectionable			Not unpleasant	
Taste		Salty			Not unpleasant	
Alkalinity: total as CaCO3	mg/L	2788	3350			
Hardness: total as CaCO3	mg/L	200	125		500	300
Non Carbonate Hardness as CaCO3			0			
Sodium; Na	mg/L	-	1,450			
Potassium; K	mg/L	-	53			
Calcium: Ca2+	mg/L	40	32		-	
Magnesium: Mg2+	mg/L	24	11		-	
Manganese: Mn2+	mg/L	0	0.31		0.1	
Chloride: Cl-	mg/L	0.2	221		250	
Fluoride: F-	mg/L	1.04	2.6		1.5	
Iron: total	mg/L	0.02	0.03		0.3	
Sulphate: SO42-	mg/L	249	294		250	
Nitrate	mg/L	0	0.9		11	
Nitrite (NO2)	mg/L	-	0.003			
Silica (SiO2)	mg/L	-	83			
Chromium: hexavalent	mg/L	0	-		0.05	
Copper	mg/L	<0.01	0		1	
Zinc	mg/L	0.02	-		3	
Arsenic	mg/L	0.15	-	0.16※	0.05	0.01^{P}
(Arsenic in Nairobi)	mg/L			※ (0.03)		
Ammonia	mg/L	0	-		1.5	
Faecal Coliforms	CFU/100mL	0	-		0	
Drilling date		2007/25/2				
Reporting date of Test result		2007/3/2	2007/3/13	2007/4/19		



Location of Drilling

Appendix 5 Equipments and Materials Transferred

In accompany with the change of water resource, equipment and materials which were not used for construction of water supply facilities in the Pilot Project has been transferred to GOSS/CES in response to their request. The equipments and materials transferred are listed in the Table below.

Equipments and Materials Transferred

Items	Quantities	Remarks
Generators	2 sets	
Submersible Pumps	2 sets	
Control Panel	1 lot	
Cables	1 lot	
Pipes and Valves	1 lot	Transmission Pipe Line