CHAPTER 6 THE PROPOSED PROJECTS

6.1 General

The first priority areas for Unaccounted for Water (UFW) reduction have already been proposed as the Water Supply Zones(WSZs) R3 and R14, and WSZs R2 and R7 were selected for the second priority areas in the Basic Study Report (JICA, March 2005). R3, R14 and R2 were selected as the priority areas for the distribution system rehabilitation and improvement project based on the discussions of the Inception Report on February 2006.

The proposed project is a distribution system improvement project addressing the water leakage condition in R2, R3, and R14 in Baghdad. The improvement project will be carried out at an early stage. The project consists of distribution system rehabilitation and improvement aimed at reducing UFW.

6.2 Countermeasures for Reduction of UFW

6.2.1 Alternative Plan for Reduction of UFW

In order to reduce the unaccounted for water in the Project Areas (WSZs R2, R3 and R14), various countermeasures have been proposed and are listed below:

(1) Replacement of distribution tertiary

Since the Gulf War and the international sanctions on Iraq, malfunctioning of the aging pipe network has been common place in the Mayoralty of Baghdad (MOB). Many of the pipes are old cast iron and asbestos cement pipes which frequently leak and by replacing these pipes the leakage will be reduced. Therefore, it is necessary to carry out immediate rehabilitation of the pipe network. The replacement of the distribution network in R2, R3, and R14 areas was selected as a priority project in response to the request of BWA. Replacement of distribution tertiary has been conducted in R3 and R14 by USAID, GRD and BWA since 2004. Therefore, the JICA Feasibility Study was carried out for the Mahalas which were nominated by BWA for the JICA Study to avoid duplication. The program for replacement of distribution tertiary is explained in chapter 6.3, the Rehabilitation and Improvement Program.

(2) District Meter Area

The second countermeasure is to measure the leakage of the system. The measurement of the system would be executed through a policy and plan of District Meter Area (DMA) which is explained in chapter 6.2.2, the DMA System. However, there will be a need to carry out a pilot study including a field survey to confirm the viability of execution of the DMA program in the future. A DMA system will be introduced after the completion of replacement of distribution program, installation of water consumption meter and implementation of the pilot study at the selected sector.

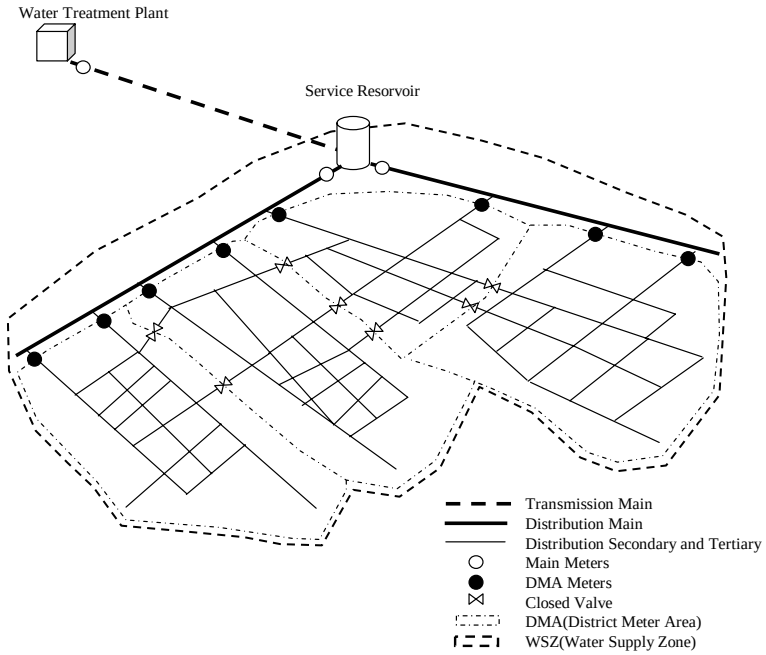
(3) Leak Detection Activity

At present, there are no leakage survey teams for any of BWA's distribution system. This makes it impossible to detect invisible leaks. The reducing of UFW will not be attained without organically combining and carrying out continuous inspections. The proposed leak detection activity is explained in chapter 6.2.3, "Leakage Detection and Control".

6.2.2 DMA System

(1) Leakage Control Policy

A DMAs method is proposed as one of the countermeasures for reduction of UFW for the BWA water supply system. The concept of DMA management was first introduced to the United Kingdom water industry in the early 1980's. The concept of DMA is illustrated in Figure 6.2.1



(Source: JICA Study Team)

Figure 6.2.1The concept of DMA

1) Water Supply Zone

Water is transmitted to several service reservoirs from water treatment plants and distributed from each service reservoir. The area which becomes independent by use of some valves and to which water is supplied from one or more service reservoirs is defined as a "Water Supply Zone (WSZ)". If necessary, a control valve can be installed in the Distribution Main inlet just behind the service reservoir or distribution pump, along with a flow meter, and control of flow and pressure could be carried out.

2) Water Supply Sub-Zone

A sub-zone is divided along geographical boundaries, for example a hill, a river, a railroad, a trunk road, etc. and by the pipe network. It will consist of aggregates of some DMA's and will be used for water supply control in a large unit.

3) District Meter Area (DMA)

A DMA is the minimum area which can be isolated from adjoining DMAs by use of valves and therefore, the consumption within the DMA can be measured.

After implementation of DMA, the following results are expected:

- Adequate hydraulic pressure is assured.
- Leakage points and amount of water leakage can be grasped easily.
- When carrying out water rationing, it becomes an independent unit.
- The area of influence due to the occurrence of an accident, repair work, etc can be limited at the time of the suspension of the water supply.
- Restoration after a disaster becomes easy.

(2) Proposed DMA Plan

1) Application to the project area

The project area covers three WSZs, R2, R3, and R14, and has the following topographic features:

- Ground surface is almost flat and ground level at about 35m±2m above MSL.
- There are no geographical boundaries such as rivers or hills that divide the area.
- The road networks are designed as grid pattern

From the above it can be seen that it is not necessary to set up Water Supply Sub Zones in the project area. In addition, in a part of R3 and R14, USAID and GRD have already performed rehabilitation of the distribution pipelines in a sector that is, in principle, half the size of a Mahalah. Each sector area is divided by arterial roads with distribution secondary buried beneath them.

Therefore, the size of each DMA area would be determined by the boundary of arterial roads of the sector. In addition, the size of each area is considered to be manageable.

A summary of proposed DMAs is shown in Table 6.2.1. DMAs and sectors which were named by the USAID project in WSZ R3 and R14 are shown in Table 6.2.2. Locations of proposed DMAs are shown in Figure 6.2.2.

Table 6.2.1 Summary of Proposed DMAs

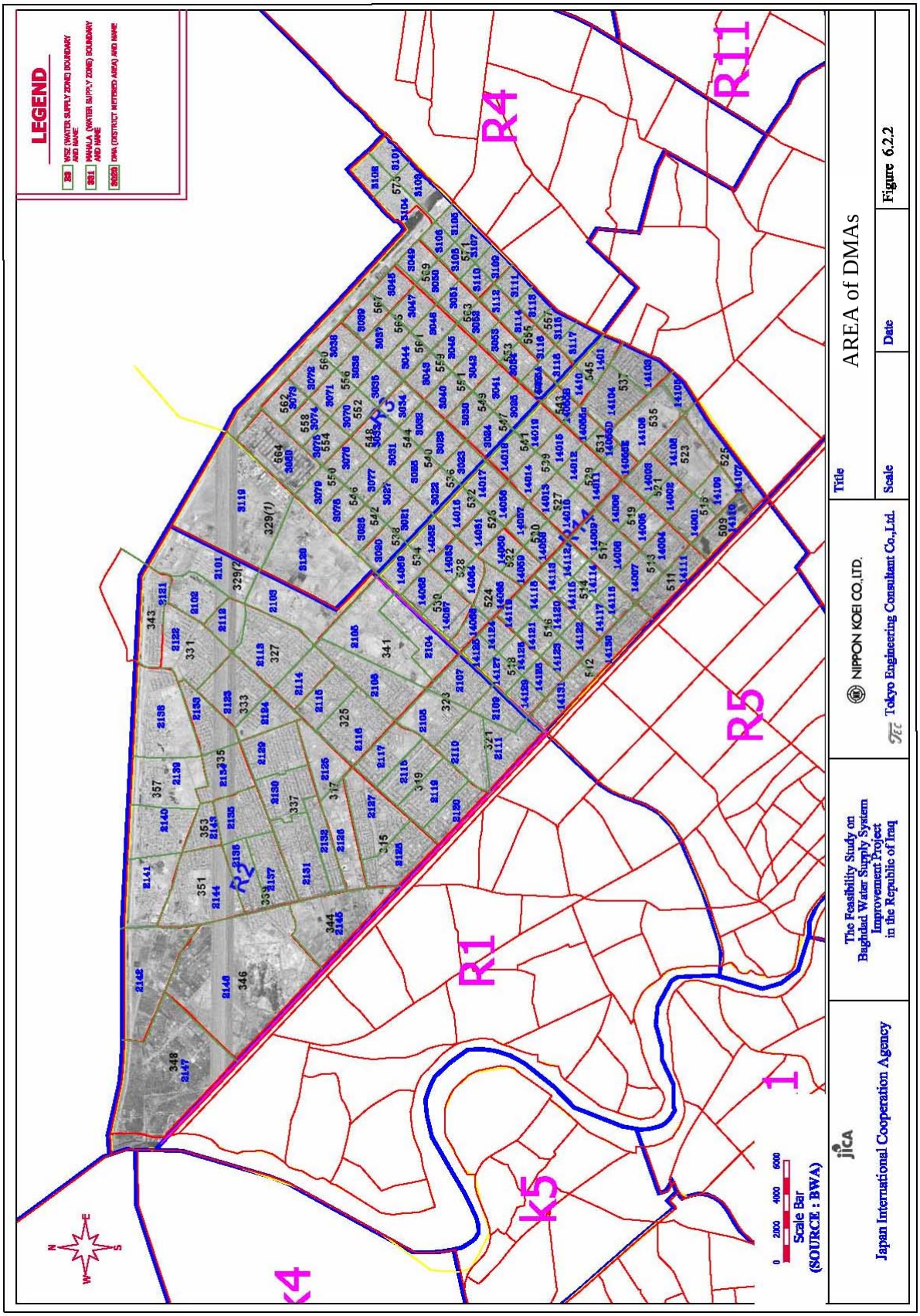
WSZ	Number of Maharhs	Number of DMAs
R2	21	47
R3	31	67
R14	30	68
Total	82	182

Table 6.2.2 DMAs and Sectors in each Mahalah

Water Supply Zone (WSZ)	Maharh No.	Sector No.	DMA No.
R2	315		2127
			2128
	317		2125
			2126
	319		2117
			2118
			2119
			2120
	321		2109
			2110
			2111
	323		2107
			2108
	325		2115
			2116
	327		2112
			2113
			2114
	329		2101
			2102
			2103
	331		2122
	333		2123
			2124
	335		2133
			2134
	337		2129
			2130
			2131
			2132
	339		2135
			2136
			2137
	341		2104
			2105
			2106
	343		2121
	344		2145
	346		2146
	348		2147
	351		2144
	353		2143
	357		2138
			2139
			2140
			2141
			2142

Water Supply Zone (WSZ)	Maharh No.	Sector No.	DMA No.
R3	329		3119
			3120
	536	22	3022
		23	3023
	538	20	3020
		21	3021
	540	28	3028
		29	3029
	542	26	3026
		27	3027
	543	55A	3055A
	544	31	3031
		32	3032
	546	78	3077
		77	3078
	547	24	3024
		25	3025
	548	33	3033
		34	3034
	549	30	3030
		41	3041
	550	79	3079
		76	3076
	551	40	3040
		42	3042
	552	35	3035
		70	3070
	553	53	3053
		54	3054
	554	75	3075
	555		3112
			3114
			3116
			3118
	556		3036
			3071
	557		3111
			3113
			3115
			3117
	558	74	3074
	559	43	3043
		45	3045
	560	38	3038
		72	3072
	561	44	3044
		46	3046
	562	73	3073
	563	51	3051
		52	3052
	564		3080
	565	37	3037
		47	3047
	567	39	3039
		48	3048
	569	49	3049
		50	3050
	571		3105
			3106
			3107
			3108
			3109
			3110
	573		3101
			3102
			3103
			3104

Water Supply Zone (WSZ)	Maharh No.	Sector No.	DMA No.
R14	509		14110
	511		14111
	512		14130
			14131
	513	4	14004
		7	14007
	514		14112
			14113
			14114
			14115
			14116
			14117
	515	1	14001
		9	14109
	516		14118
			14119
			14120
			14121
			14122
			14123
	517	8	14008
		9	14009
	518		14124
			14125
			14126
			14127
			14128
			14129
	519	5	14005
		6	14006
	520	57	14057
		58	14058
	521	2	14002
		3	14003
	522	59	14059
		60	14060
	523		14108
	524	65	14065
		66	14066
	525		14107
	526	56	14056
		61	14061
	527	10	14010
		13	14013
	528	63	14063
		64	14064
	529	11	14011
		12	14012
	530	67	14067
		68	14068
	531	55C	14055C
		55D	14055D
		55E	14055E
	532	16	14016
		17	14017
	534	62	14062
		69	14069
	535		14105
			14106
	537		14103
			14104
	539	14	14014
		15	14015
	541	18	14018
		19	14019
	543	55B	14055B
	545		14101
			14102


LEGEND
MSE (WATER SUPPLY ZONE) BOUNDARY AND NAME
MAHALA (WATER SUPPLY ZONE) BOUNDARY AND NAME
DMA (DISTRICT METERED AREA) AND NAME
R1
R2
R3
R4
R5
R11
K4
K5
Scale Bar
(SOURCE : BWA)
Japan International Cooperation Agency
The Feasibility Study on Baghdad Water Supply System Improvement Project in the Republic of Iraq
NIPPON KOEI CO.,LTD.
Tokyo Engineering Consultant Co.,Ltd.
Title
AREA of DMAs
Scale
Date
Figure 6.2.2

(3) Pipeline Arrangement Requirements

1) Distribution mains

A distribution main study has already been carried out by USAID based on a hydraulic analysis. In this project, a review was performed based on the DMA plan for the project.

As a rule, it is recommended that at least two distribution mains be connected to each DMA for water supply.

2) DMA inlet

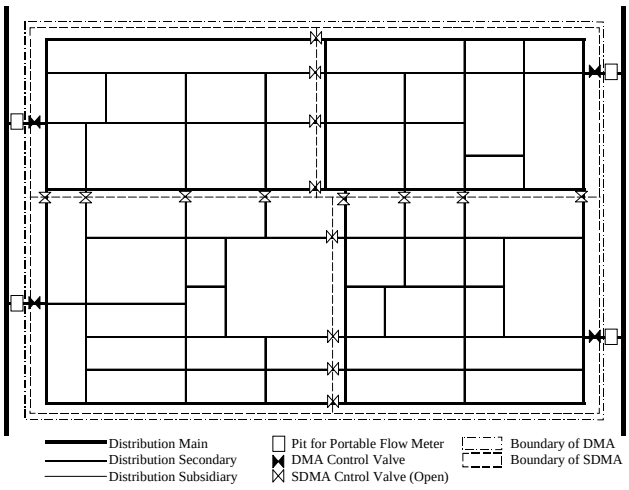
As a rule, four inlets, two for each of the two distribution mains are to be installed.

The diameter of each inlet, although based on consumption and the number of branches, is set in general between 400 to 250mm. In addition, a valve for flow control in the DMA and a flow meter pit should be provided for each DMA.

3) Sub District Meter Area (SDMA)

A Sub District Meter Area (SDMA) is the minimum unit that can be made independent by use of valves in case of water failure caused by accidents or repair works. In addition, a SDMA is principally planned so that one DMA inlet is provided for each SDMA and, therefore, the number of inlets is the same as the number of SDMAs. Inlet valves are usually fully open. According to the arrangement of the SDMA, about 250mm – 300mm diameter pipelines are placed as secondary pipes, and 150mm diameter pipelines are planned as tertiary pipes for each road.

A model of a proposed typical DMA in the project area is shown in Figure 6.2.3.



(Source: JICA Study Team)

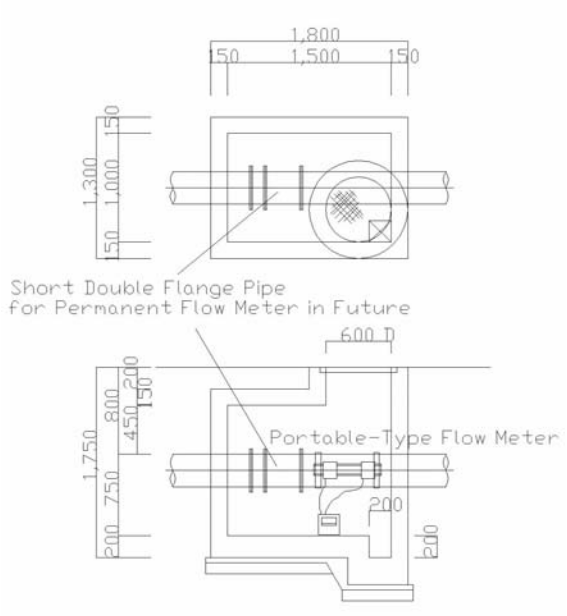
Figure 6.2.3 Proposed Typical DMA in the Project Area

(4) Installation of Flow Meters and Valves

1) Flow meters

Although it is necessary to consider introduction of a SCADA System in the future, it is adequate to simply provide a flow meter for only the outlet of the service reservoirs.

Each DMA will also require a meter chamber and a meter. Installing a permanent flow meter for each DMA inlet is not practical considering economic efficiency and maintenance. Therefore, a chamber is to be prepared so that a portable type flow meter can be easily installed at the time of water flow investigation. In addition, more than 10D upstream and 5D downstream straight sections are to be provided in pit. A general drawing of a flow-meter chamber is shown in Figure 6.2.4.



(Source: JICA Study Team)

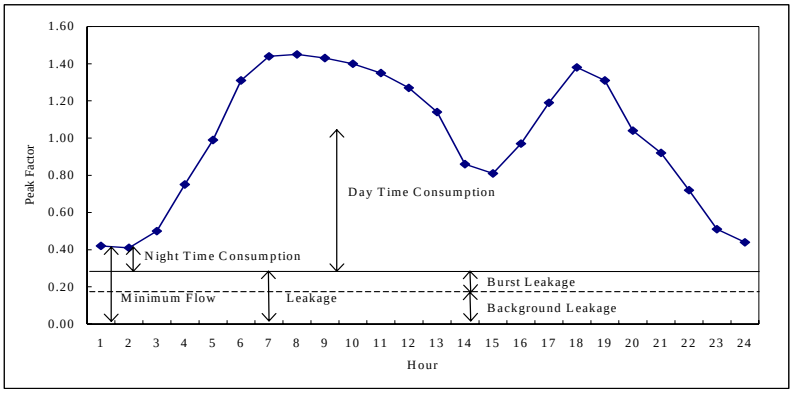
Figure 6.2.4 General Drawing of a Flow Meter Chamber

2) Valves

Generally, leakage is proportional to the 2nd power of hydraulic pressure, and supplying water that does not exceed proper hydraulic pressure is very effective in reduction of leakage. Therefore, Hydraulic-pressure control valves, such as a pressure reducing or pressure control valve, are generally installed in the inlet of each DMA, and controlling the hydraulic pressure is a prevalent solution. This approach is very effective for a WSZ with significant differences in elevation. However, the project area is almost flat and, therefore, it is judged that control of the hydraulic pressure by a control valve is unnecessary.

(5) Monitoring and Inspection of DMAs

Monitoring and leakage inspection are to be carried out considering the DMA as a unit. This unit can also be used for carrying out a pilot plan, especially an action plan for UFW reduction. Water supply meters should be installed for all consumers, in principle, and this would enable the supplier to grasp the amount of water consumed. UFW figures in the DMA can be grasped by a comparison between the inlet flow measured by the portable flow meter and the total metered consumption. Moreover, leakage can also be quantified by measuring the flow during the night time and daytime. A typical 24 hour flow profile of the components of leakage and customer use is shown in Figure 6.2.5.



(Source: JICA Study Team)

Figure 6.2.5 Typical 24 Hour Flow Profile of the Components of Leakage and Consumption

This system has the advantage that it can detect leakage more efficiently and its technique provides increased productivity of the leakage detection field work.

6.2.3 Leakage Detection and Control

At the present, there are no leakage detection teams for any of BWA service areas. Pipe repair works are only carried out based on the reports of visible leaks. There is an immediate need for programs to organize a leakage detection team to detect unknown invisible leaks. In addition to leakage, illegal connections are a huge problem in the BWA systems, but the current situation can not be accurately observed by BWA. Leakage detection and control will be realized through organically combining related sections within BWA. However, a policy of leakage detection and control has not yet been established, and neither trained people nor materials to conduct the above tasks are available in sufficient quantities in BWA, at present. Therefore, a UFW reduction action plan for the effectiveness of the rehabilitation and improvement program shall be required in the future.

6.2.4 Necessity of an Action Plan

The UNICEF report proposed a UFW reduction action plan for Iraq in January 2003 to reduce the water system losses. The UNICEF report suggested that conducting "the implementation of the pilot area program will be governed by a specific procedure involving the setting up of teams dedicated to UFW reduction."

BWA will select the pilot area and conduct the UFW reduction action plan based on the suggestion of the UNICEF report. However, BWA has no experience or equipment for water leakage surveys. JICA has been performing mass training of BWA staff in a water leakage survey course, GIS course, and operation & management course in Jordan to support the BWA UFW reduction program since the beginning of 2005. The JICA training program will provide the required various leakage detection equipment for BWA after the leakage survey training. Consequently, BWA has an opportunity to conduct the action plan by themselves with the fruits of the JICA training program.

The leakage detection and control work is generally composed of leak detection and repair but also includes responding to illegal connections and meter malfunctions. In addition, proper management of the pipe networks is required. Therefore, BWA needs to set up functional units for the action plan. The concept of the functional units for the action plan in the UNICEF report can be applied to the BWA organization as follows:

- UFW Unit: Monitor UFW and other actions in coordination with
  - Leak Detection Unit (To be set up in the Implementation Section, Water Section of the Municipality)
  - Pipe Repair Unit (Implementation Section, Water Section of the Municipality)
  - Consumer Survey Unit (To be set up in the Computer Billing Section)
- GIS Unit: Produce maps from data furnished by field surveys. Building of hydraulic models and analysis. (Design Section)
- MIS Unit: Collect operational and billing data to be incorporated in the MIS database. (To be set up to cooperate with the Planning and Follow Up Section, Administration and Financial Affair Section, and Computer Billing Section)

But UFW reduction will not be attained without organically combining each unit and carrying out the work continuously. Therefore, the action plan needs to be executed by the Implementation Section of BWA as coordinator of the program with cooperation of the Water Section of the Municipality, Planning and Follow Up Section, Computer Billing Section, Administration and Financial Affair Section, Computer Billing Section, and Design Section.

6.2.5 DMA Pilot study

There is a requirement to carry out a pilot study to confirm the viability of an extended DMA program. It is therefore proposed that at least two pilot areas are set up in WSZ R3. The details of the pilot study are outlined below.

(1) Study for pilot DMA

The aim of the study is to identify an area where a pilot DMA can be set up and where continuous monitoring can be accomplished. In the future, it is expected that a program for extending DMAs to the whole of R3 will be considered.

In order to effectively manage the operation of a pilot study, the following program should be carried out during the detailed design stage and the construction stage by a consultant involved in the implementation project with the cooperation of the BWA:

Step1 (Preparation/Detailed Design Stage)

- Preparation of plans and drawings of the pilot DMAs
- Arrangement of DMA data for the distribution system
- Selection of meter chamber sites for portable flow meters
- Identification of large demand subscribers and industrial night use

Step2 (Preparation/Construction Stage)

- Construction of meter chambers for portable flow meters
- Inspection of water consumption meters
- Service reservoir and master meter inspection (overflow and leakage)

Step3 (Monitoring)

- Carry out flow and pressure measurements in the pilot DMA
- Carry out analysis of water consumption meter reading records for the pilot DMA
- Analysis of the operational use of fire hydrants in the pilot DMA

Step4 (Evaluation)

- Prepare flow and pressure profiles for the pilot DMA
- Calculation of water balance for the pilot DMA
- Prepare recommendations for a detailed leakage survey
- Carry out the leakage survey in the recommendation areas
- Calculation of cost savings
- Prepare detailed recommendations for the DMA plan for the whole of R3

There is no continuous, all-year-round, water supply in Baghdad. Water shortages occur during the dry season. Therefore, the monitoring period should be carefully selected to ensure that reliable results are achieved from the DMA pilot study.

(2) Required equipment for the study

The equipment for the study should comprise the following:

- Portable ultrasonic flow meters with accessories: 5 units
- Portable pressure gauge: 10 units
- Electronic leakage detector: 10 units
- Magnetic locator: 10 units
- Acoustic rod: 10 units

(3) Construction of meter chambers for portable flow meters and implementation schedule

Ten meter chambers should be constructed for the portable flow meters in the two pilot DMAs after the pipe replacement. A general drawing of a flow meter chamber is shown in Figure 6.2.4. The implementation schedule for the pilot study is shown in Figures 5.6.1 and 6.5.1.

6.3 Rehabilitation and Improvement Program

6.3.1 Implementation Approach

The current water supply system in the Study area has not been managed or operated satisfactorily due to deterioration of the water supply facilities through age, lack of water treatment in regards to quality and quantity, financial problems and international economic sanctions on Iraq. Reviewing and screening of the project alternatives, which were formulated by the previous studies, the "Integrated Study on Improvement of The Baghdad Water Supply System, March 2005 (JICA Basic Study Report)" and the "Iraq Infrastructure Reconstruction Program, Phase II Potable Water Sector, January 2006 (USAID Report)" that have been recognized as being the current Baghdad water supply master plan, was carried out as discussed in Section 5.2.

As described in Chapter 5, priority projects were considered and selected as shown in Figure 5.6.1. Based on the results of the screening, the distribution network rehabilitation and improvement projects for WSZs have been selected. The selected projects, namely the distribution network rehabilitation and improvement program, are divided into three program streams, WSZ R3, WSZ R14 and WSZ R2, according to the urgency identified by the water demand forecast and assessment of the water supply system for Baghdad. Projects in this program will be carried out in the early stages of the long term water supply improvement plan presented by the JICA Basic Study Report.

6.3.2 Objectives and Scope of the Program

The program is to be conducted in three WSZs, R2, R3 and R14, which were selected as priority areas. The Program consists of a distribution system rehabilitation project and improvements aimed at reducing UFW and reinforcement of the existing billing system for the three WSZs. Objectives of the Program are:

1) To secure safe and stable water supply for residents of the three WSZs,
2) To reduce the present high 50% rate of UFW,
3) To avoid chronic water shortage and disrupted water supply,
4) To prevent illegal connections which are estimated at about 10% of total subscribers at present, and
5) To grasp the actual water consumption of BWA customers by means of equipping them all with water consumption meters.

Projects in the distribution network rehabilitation and improvement program to improve the water supply system are classified into the following three categories:

1) Distribution tertiary replacement
2) Water consumption meter Installation and service pipe replacement
3) Water supply system reinforcement

A feasibility study was conducted by the JICA study team from February to September, 2006 aiming at UFW reduction and securing stable water supply considering the viewpoints of urgency and effectiveness for the improvement of the Baghdad water supply system. In order to realize the above mentioned objectives in the Project areas (WSZs R2, R3 and R14), the following scope of the program is envisaged:

1) Replacement of distribution tertiary: The work includes, not only replacement of aging ACP and CIP, but also replacement of newer pipe if required to meet water demand as indicated by the results of a hydraulic analysis,
2) Rehabilitation of water supply facilities: The facilities related to the distribution network include valves, hydrants, thrust blocks and washouts, and
3) Installation of water consumption meters: The work includes replacement of the existing service connections.

6.3.3 Concepts and Design Criteria for the Plan

For planning the rehabilitation and improvement program, the following concepts and design criteria were adopted.

(1) Planning concepts

The Project area of WSZs R2, R3 and R14 is located in the Rasafa side. Total area is about 66 km^2 and population was estimated at 1.5 million in 2005. Population of the Project area is 27% of the total population of the BWA service area, while its area represents only 7% of the total area of Baghdad. Sadr City, where R3 and R14 are located, is mostly urbanized and overpopulated with a population density of more than 30,000 per km^2 while R2 in Shaab Municipality is moderately developed with a population density of 11,823 per km^2. The

Project area is largely populated, which results in high water consumption and the UFW ratio is higher than 50%. The projects for the rehabilitation and improvement program are planned according to the following concepts as presented in Table 6.3.1.

Table 6.3.1 Planning Concepts

WSZ	Area (km^2)	Medium Term Target Year: 2014			Long Term Target Year: 2027		
		Population	Average Daily Requirement (m^3/d)	Maximum Daily Requirement (m^3/d)	Population	Average Daily Requirement (m^3/d)	Maximum Daily Requirement (m^3/d)
R2	30.74	440,769	199,057	257,182	648,713	311,382	389,228
R3	18.48	820,240	370,431	478,597	1,095,379	525,782	657,227
R14	16.40	619,674	279,853	361,570	827,534	397,217	496,521
Total	65.62	1,880,683	849,341	1,097,348	2,571,626	1,234,381	1,542,976
UFW Ratio		38%			25%		
Water saved		12% of Average Daily Requirement			25% of Average Daily Requirement		
Family Size		12.60 persons per family					
Load Factor		Peak Hourly Factor : 2.25					

(Source: BWA and JICA Study Team)

(2) Design criteria and standard design

The following design criteria are adopted for planning of the water supply system and facilities:

1) Trunk main and distribution networks

Pipe Material:	
• DIP	400mm or more in diameter
• DIP or PVC	350mm or less in diameter
Load Factors	
• Peak Daily Factor	1.25 to 1.40
• Peak Hourly Factor	2.25
Allowable maximum velocity	Less than 2.5 m/s
Allowable water pressure	
• Maximum Water Pressure for Trunk Main	70 m
• Maximum Water Pressure for Distribution Main	30 m
• Minimum Water Pressure for Distribution Main	10 m
• Residual Water Pressure at end of Service Connection	5 m
Location and Earth Covering:	
• Trunk Main located under vehicular roads	Minimum 3.0 m
• Distribution networks of 400mm or more in diameter located under the vehicular roads	Minimum 1.0 m
• Distribution networks of 400mm or less in diameter located under the sidewalk	Minimum 0.8 m

(Source: BWA)

2) Service Reservoirs and Booster Stations

Storage Capacity:	
• Operating Storage	20% of Average Daily Supply or equivalent to 5 hours duration
• Fire Demand	3 hours duration with a flow of 150 l/s
• Emergency	25% of operating storage or equivalent to 8 hour pumping period
Total Storage Capacity:	10 hours of Maximum Daily Supply or 14 hours of Average Daily Supply
Pump Pressure	
• Mean Pressure	33 m
• Minimum Pressure	20 m

(Source: BWA)

3) Fire Hydrants are installed as follows:

• Interval of fire hydrants on Distribution Main:	200m diametrically
• Hospital:	One hydrant at least
• School:	One hydrant at least
• Market:	One hydrant at least
• Complex Building:	One hydrant at least
• Government Building:	One hydrant at least

(Source: BWA)

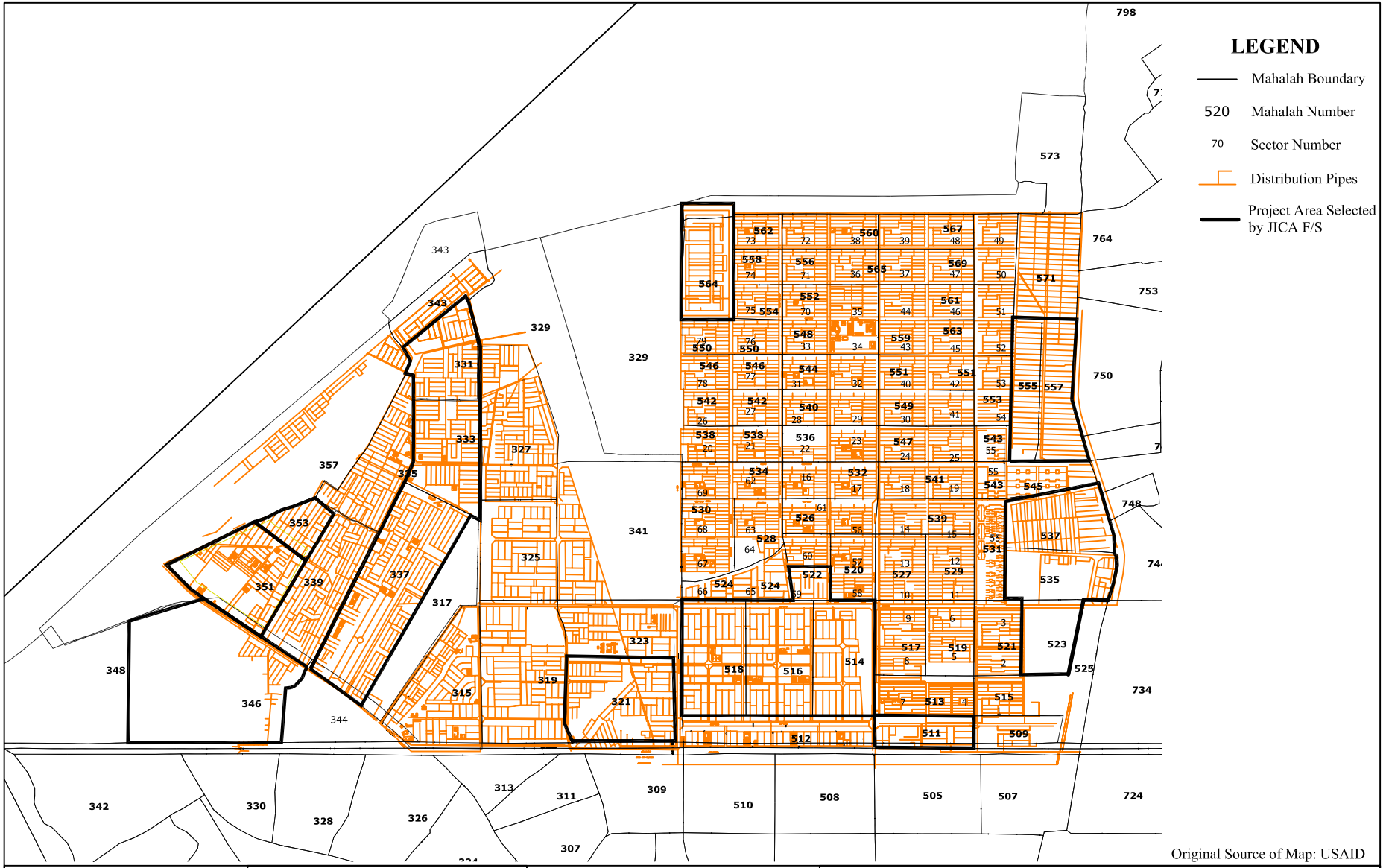
4) BWA standard designs for water supply facilities (refer to DATA BOOK 2):

DATA BOOK 2 presents BWA standard designs consisting of house connections, pipe laying, thrust blocks, chambers, fire hydrants, washouts, and service reservoirs.

6.3.4 Proposed Projects for the Rehabilitation and Improvement Program

(1) Composition of the projects

The project area consists of 3 WSZs: R2, R3 and R14 as shown in Figure 6.3.1. At present, the total length of distribution pipeline is around 1,300 km in this priority area. About 49% of the total pipe length is aged ACP and CIP which have been in use more than 20 years. Frequency of leakage in the distribution system is supposed to be more than 5 leaks per day on average according to the leak repair record in 2006 and unit loss for aged pipe length is estimated at 95 m^3/km/day (UNICEF, 2000). Aged ACP and CIP result in high levels of system leakage. Total house connections in the project area are estimated at 149,200 based on BWA billing records. More than 77% of house connections are not equipped with water consumption meters or have meters that are unreadable. Water consumption meter installation is urgently required for a proper meter reading and billing system. Therefore, BWA plans to urgently carry out the rehabilitation and improvement of the water supply system by 2014.



JICA Japan International Cooperation Agency	The Feasibility Study on Baghdad Water Supply System Improvement Project in the Republic of Iraq	NIPPON KOEI CO.,LTD. Tokyo Engineering Consultants Co.,Ltd.	Title: PROJECT AREA (MAHALAHS AND SECTORS)	
			Scale: As-Shown	Date:
				Figure 6.3.1

The rehabilitation and improvement program is composed of i) distribution tertiary replacement, ii) water supply facilities improvement related to the distribution system and iii) water consumption meter installation. It is noted that a detail design stage is necessary in the initial stages for the implementation of the Project since during the feasibility study, data and information obtained by the JICA Study Team were unsatisfactory for the realistic formulation of the project. An outline of the proposed projects is described below.

(2) Distribution tertiary replacement and improvement

The objective of this Project is to provide the necessary materials and fittings and to replace the old leaking distribution pipes in order to urgently reduce the water losses in the distribution system. The total length of the existing transmission and distribution networks is around 1,300 km and their diameters vary from 75mm to 1,600mm as shown in Table 6.3.2.

Table 6.3.2 Pipe Length in Project Areas

(Unit: km)

Pipe Length	R2	R3	R14	Total
1. Existing Distribution Pipes	455	437	420	1,312
a) Secondary: 500≧Diameter ≧300mm	35	65	46	146
DIP				
b) Tertiary: Diameter ≦250mm	420	372	374	1,166
ACP	237	210	211	658
CIP	51	45	46	142
Others (DIP/PVC)	132	117	117	366
2. Distribution Pipes Renewed/to be Renewed	283	333	256	842
a) Secondary: 500≧Diameter≧300mm	0	0	0	0
b) Tertiary: Diameter ≦250mm	283	333	256	842
3. Required Pipe Replacement	137	39	118	294
a) Secondary: 500≧Diameter≧300mm	0	0	0	0
b) Tertiary: Diameter ≦250mm	137	39	118	294

(BWA & JICA Study Team)

Required pipe length to be replaced is classified by pipe diameters below:

Table 6.3.3 Pipe Length Classified by Diameter

Pipe Diameter (mm)		R2 (km)	R3 (km)	R14 (km)	Total (km)
Existing	Improved				
≧75	150	73	25	90	188
≧110	200	6	-	-	6
≧150	250	34	9	17	60
200 - 250	300	24	5	11	40
Total (km)		137	39	118	294

(BWA & JICA Study Team)

Approximately 800 km (61%) of the existing mains are asbestos cement pipe (ACP) or cast iron pipe (CIP) with lead joints and their diameters vary from 75mm to 225mm. The rehabilitation of the water distribution system in the priority area is the most urgent and important issue for Baghdad Mayoralty(MOB) in order to sustain the stability of public welfare and economic development in Baghdad. This project therefore has the highest priority among the projects. The overall rehabilitation plan for the distribution pipelines is proposed in consideration of water units, leakage frequency and construction work permission procedures.

Distribution pipe replacement works have been conducted by BWA, GRD-PCO and USAID in the priority areas. The numbers of Mahalahs for distribution pipe replacement works are to be apportioned as Table 6.3.4 and Figure 5.5.1.

Table 6.3.4 Apportionment of Mahalahs for Pipe Replacement Works

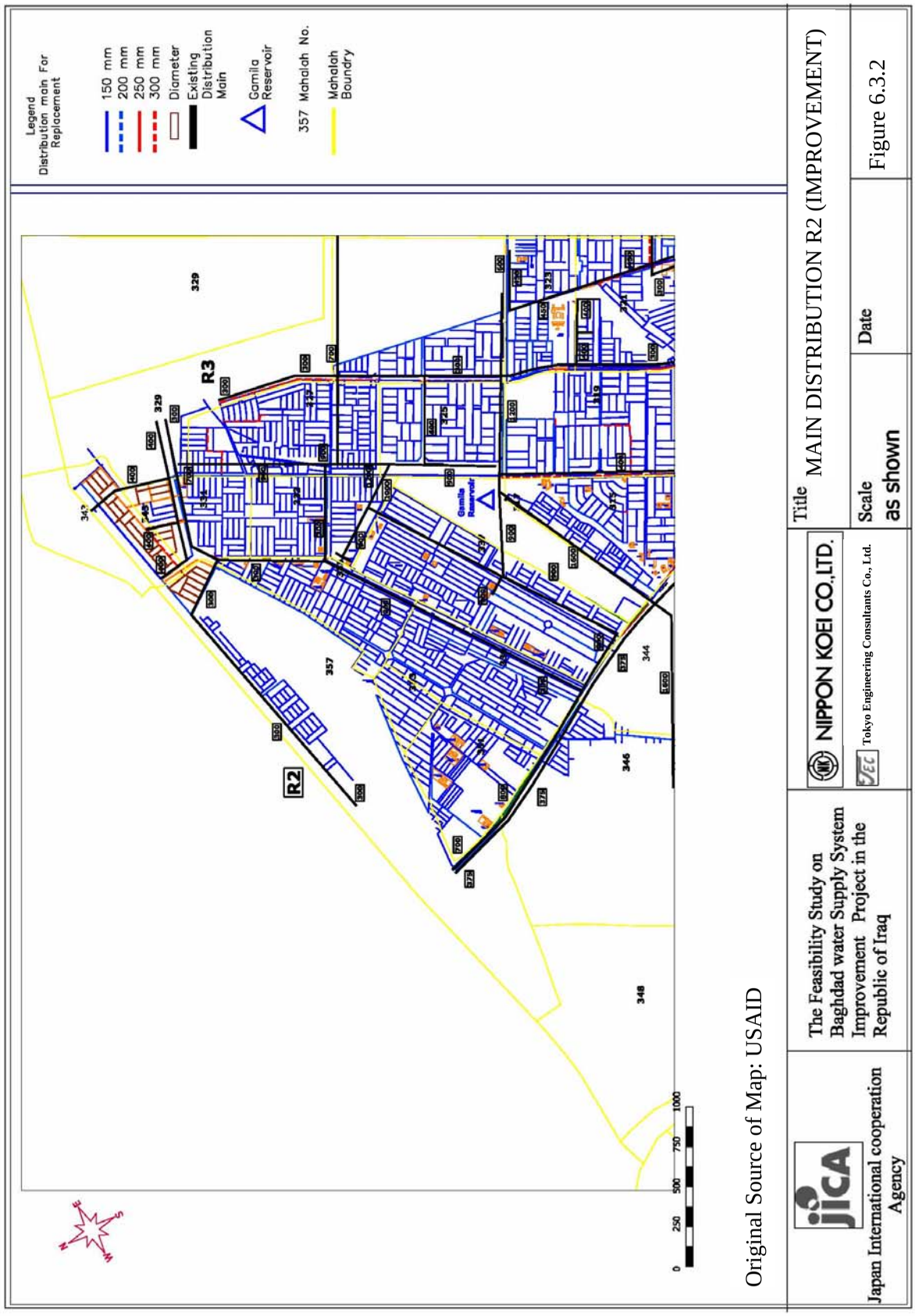
WSZ	BWA	USAID	GRD-PCO	JICA F/S	Others*	Total
R2	13	-	-	7	1	21
R3	9	4	13	3	2	31
R14	7	3	11	8	1	30
Total of Mahalahs	29	7	24	18	4	82

(Source: BWA & GRD-PCO) *: No need for replacement work due to no network or CU areas

Total distribution pipe length replaced or to be replaced is estimated at 843 km in total in 47 Mahalahs including 83 sectors of WSZs R3 and R14 and in 13 Mahalahs of R2 as shown in Tables 6.3.2 and 6.3.3. In the remaining areas, distribution main replacement work is required in the rehabilitation and improvement program as the most urgent project. The distribution tertiary lines to be replaced by the Project in the three WSZs R2, R3 and R14 are presented in Figures 6.3.2, 6.3.3 and 6.3.4 respectively. Pipe replacement works are divided into the following schemes for the project implementation:

1) Scheme 1 : WSZ R3 in Sadr City 1 and 2 Municipalities
(Mahalah Nos. 555, 557 and 564)
2) Scheme 2 : WSZ R14 in Sadr City 1 and 2 Municipalities
(Mahalah Nos. 511, 514, 516, 518, 535, 537, 523 and 522: Sector 59)
3) Scheme 3 : WSZ R2 in Shaab Municipality
(Mahalah Nos. 321, 331, 333, 337, 346, 351 and 353)

The project for replacement of distribution sub-mains (tertiary) targets the priority areas where leakage problems occur frequently and pipes are installed with a high density that have a high risk of unexpected large scale water losses from main breaks. The sequence of work was formulated by considering the work volume at each scheme and the need to complete the replacement works within each distribution unit of the distribution system. Total pipe length required for replacement in each WSZ is summarized in Table 6.3.5 below.


Legend
Distribution main For Replacement
150 mm
200 mm
250 mm
300 mm
Diameter
Existing Distribution Main
Gamila Reservoir
357 Mahalah No.
Mahalah Boundry
R1
R2
R3
Gamila Reservoir
Original Source of Map: USAID
JICA
Japan International cooperation Agency
The Feasibility Study on Baghdad water Supply System Improvement Project in the Republic of Iraq
NIPPON KOEI CO.,LTD.
Tokyo Engineering Consultants Co., Ltd.
Title
MAIN DISTRIBUTION R2 (IMPROVEMENT)
Scale
as shown
Date
Figure 6.3.2


Legend
Distribution main For Replacement
150 mm
200 mm
250 mm
300 mm
Diameter
Existing Distribution Main
Reservoir (Planned)
Sadr WTP (Under construction)
357 Mahalah No.
Mahalah Boundry
R3
R14
R2
R3 Reservoir
SADR WTP
329
Original Source of Map: USAID
Japan International cooperation Agency
The Feasibility Study on Baghdad water Supply System Improvement Project in the Republic of Iraq
NIPPON KOEI CO.,LTD.
Tokyo Engineering Consultants Co., Ltd.
Title MAIN DISTRIBUTION R3 (IMPROVEMENT)
Scale as shown
Date
Figure 6.3.3

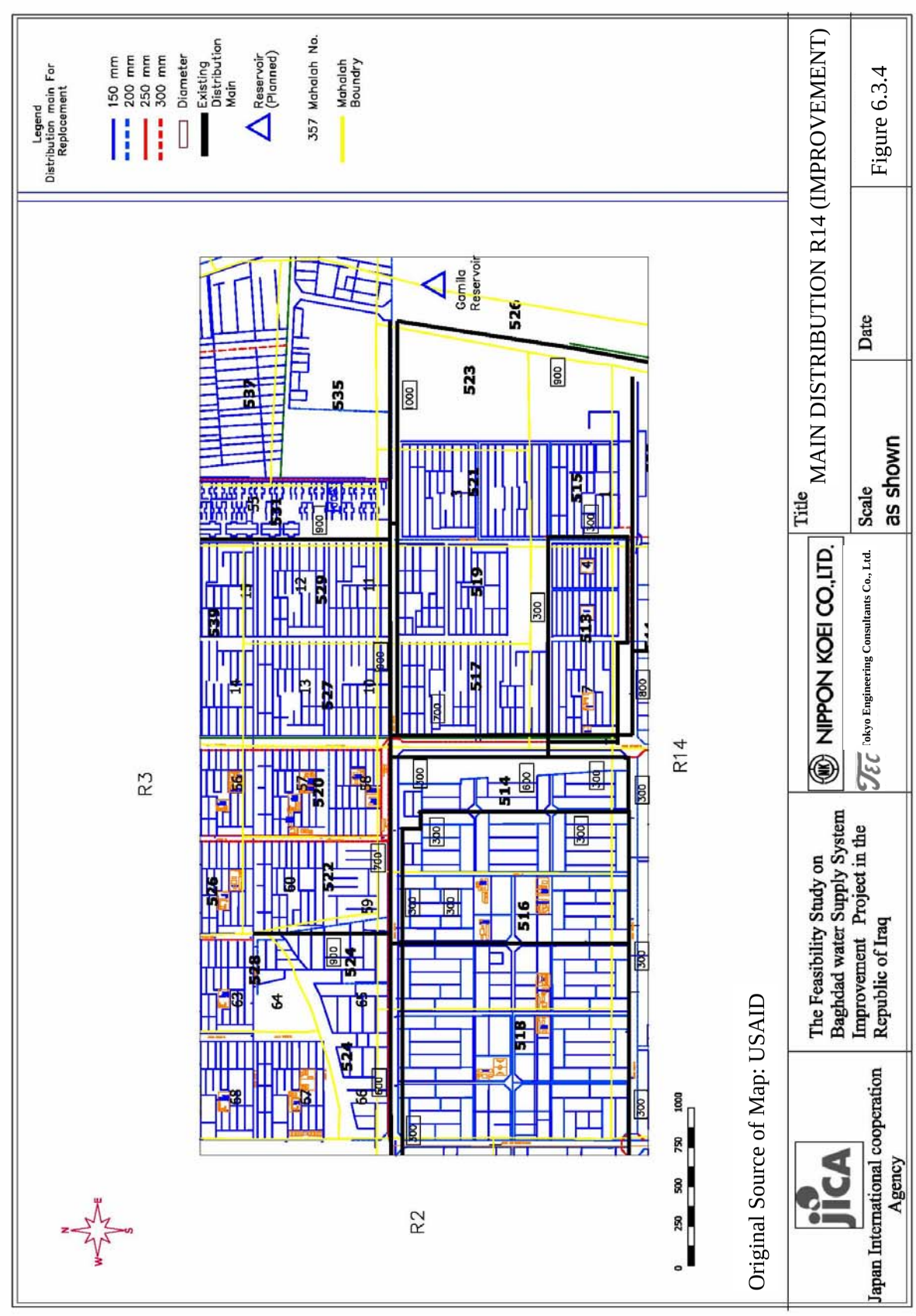

Legend
Distribution main For Replacement
150 mm
200 mm
250 mm
300 mm
Diameter
Existing Distribution Main
Reservoir (Planned)
357 Mahalah No.
Mahalah Boundry
Gamila Reservoir
R3
R2
R14
Original Source of Map: USAID
Japan International cooperation Agency
The Feasibility Study on Baghdad water Supply System Improvement Project in the Republic of Iraq
NIPPON KOEI CO.,LTD.
Tokyo Engineering Consultants Co., Ltd.
Title
MAIN DISTRIBUTION R14 (IMPROVEMENT)
Scale
as shown
Date
Figure 6.3.4

Table 6.3.5 Summary of Pipe Replacement

Priority Area		Range of Pipe Diameters (mm)	Total(km)	Implementation Period
Detailed Design Stage				2007
Scheme 1	R3	150mm to 300mm	39	2008 to 2010
Scheme 2	R14	150mm to 300mm	118	2009 to 2010
Scheme 3	R2	150mm to 300mm	137	2010 to 2011
Total		150mm to 300mm	294	2007 to 2011

Ductile iron pipe with cement mortar lining was selected on account of its excellent durability and corrosion resistance. In addition to pipe replacement, fittings and accessories (air valves and shut-off valves) are also to be replaced since leakage from them is considerable. Water supply facilities related to the water supply system are to be rehabilitated in scheme with the distribution tertiary replacement. The following water supply facilities, which are to be replaced or newly constructed, and their quantities to be improved are summarized in Table 6.3.6.

Table 6.3.6 Number of Water Supply Facilities

Priority Area		Gate Valves (pcs)	Fire Hydrants (pcs)	Air Valves (pcs)
Scheme 1	R3	180	196	8
Scheme 2	R14	500	589	23
Scheme 3	R2	260	685	28
Total		940	1,470	59

Thrust blocks shall be constructed based on the BWA design criteria for the distribution tertiary replacement. Other civil works related to the distribution tertiary replacement also follow the BWA's design criteria, such as pipe connections and road/sidewalk restoration (refer to DATA BOOK 2). Typical pipe replacement work in the Mahalah in each WSZ is presented in DATA BOOK 2.

Before excavation works for pipe laying, protection methods for the existing underground structures shall be examined where ever there are other utility lines near water pipes to be replaced. A typical road section is presented in DATA BOOK 2 to indicate configuration of the underground utility lines, such as water pipelines, sewers, electric cables and telephone lines. BWA reported that there were no big problems between pipe replacement and other underground utilities judging from the past replacement works. It, however, is recommended that an inventory survey for the existing underground structures shall be conducted during the detailed design stage since the exact locations of the existing underground structures are not identified. BWA shall collaborate with the following institutions for identification of the existing underground structures:

- Sewerage system: General Directorate of Sewerage, MOB
- Electric supply system: Baghdad Electricity Board, Central Region, General Directorate of Electricity, Ministry of Electricity
- Communication system: General Directorate for Communications and Post, Ministry of Communications

Consultations with the above organizations, especially the General Directorate of Sewerage, are necessary to produce proper construction plans, since the MOB has a plan of sewer system improvements in Sadr City.

After the pipe installation work, disinfection of the distribution tertiary is to be conducted. Concentration of chlorine ranges from 1.0 ppm to 2.0 ppm and hypochlorous acid powder are to be used for disinfection of the distribution mains. Chlorine waste water is to be discharged to the existing storm sewer without any treatment such as deacidification.

(3) Water consumption meters installation

The improvement plan is formulated to procure water consumption meters through the project on the basis of BWA's existing installation ratio and functional ratio of water consumption meters as described in Chapter 4 and according to the following basic concepts:

- Any water consumption meters already in the possession of BWA at present will be excluded from the project.
- Any service pipes in Mahalahs in which pipe replacement works were covered by BWA, USAID or GRD-PCO will be excluded from the project.
- Required length of service pipe will be estimated at a unit length of 10 m per connection.
- A meter reading and billing system for exclusive use by BWA will be considered a priority.
- The operation and maintenance structure of BWA will be considered.
- The possibility of repair and calibration of existing water meters in Baghdad will be considered

According to the study results, water consumption meters will be procured for the project for direct use by BWA to grasp the exact water consumption amount and to improve the revenue of BWA. However it is noted that the feasibility of water consumption meter installation in the priority areas should be confirmed by BWA first because it is not clear whether the residents in the priority areas will be willing to accept water consumption meters or not.

Phasing of water consumption meters will be conducted on the same implementation schedule as the distribution replacement project. USAID and GRD-PCO, that have been conducting pipe replacement project in Sadr City, didn’t supply water consumption meters for domestic users, therefore, water consumption meters will be provided by the priority project. Provision of water consumption meters for domestic use is divided into the following two categories: meters with service pipe and meters without service pie:

Table 6.3.7 Categories of Water Consumption Meters

Category	Number of Water Consumption Meters for Domestic Users			
	12mm	18mm	25mm	Total
1. WSZ: R2	28,700	3,200	3,100	35,000
a) Meters without Service Pipe	20,500	2,300	2,200	25,000
b) Meters with Service Pipe	8,200	900	900	10,000
2. WSZ: R3	53,400	5,800	5,900	65,100
a) Meters without Service Pipe	44,600	4,900	4,900	54,400
b) Meters with Service Pipe	8,800	900	1,000	10,700
3. WSZ: R14	40,300	4,400	4,400	49,100
a) Meters without Service Pipe	29,400	3,200	3,200	35,800
b) Meters with Service Pipe	10,900	1,200	1,200	13,300
Total	122,400	13,400	13,400	149,200
a) Meters without Service Pipe	94,500	10,400	10,300	115,200
b) Meters with Service Pipe	27,900	3,000	3,100	34,000

(Source: BWA and JICA Study Team)

An outline of the Project is presented in Table 6.3.8 below.

Table 6.3.8 Outline of the Project

Water Consumption Meter Installation	R2	R3	R14	Total
Water Consumption Meters (pcs.)				
a) 12 mm (1/2") Meters	28,700	53,400	40,300	122,400
b) 18 mm (3/4") Meters	3,200	5,800	4,400	13,400
c) 25 mm (1") Meters	3,100	5,900	4,400	13,400
Total (pcs.)	35,000	65,100	49,100	149,200
PEP Service Pipe (km)				
a) DN 20mm (3/4") PEP	82	88	110	280
b) DN 25mm (1") PEP	18	20	25	63
Total (km)	100	108	135	343
Snap Tap with Saddle (set)				
a) 20mm (3/4") x DN150 – DN300	8,200	8,800	10,900	27,900
b) 25mm (1") x DN150 – DN300	1,800	1,900	2,400	6,100
Total (set)	10,000	10,700	13,300	34,000

(Source: BWA and JICA Study Team)

Diameters of PEP service pipes in the above Table 6.3.8 are recommended in consideration of practical difficulties in the field since the actual number of house connections per service point was not identified exactly. PEP service pipes of DN 20mm and DN 25mm are selected for 12 mm meters and 18 mm meters respectively. For installation work, reducers shall be used at each site.

Snap taps with saddles are recommended for the connection between the distribution branch and the service pipe for leakage protection and the required numbers of snap taps with saddles are estimated at 34,000 pieces (pcs). For the program, water consumption meters, PEP service pipes and snap taps with saddles are to be provided. Stop cocks and GIP for house connections shall be provided by each subscriber.

(4) Project Effects

The effects to be expected from the implementation of the Project are summarized below:

1) Reducing of leakage volume and leakage accidents in distribution tertiary

Leakage problems occur mainly in the aged ACP and CIP pipes. Water saved by the pipe replacement works is estimated in WSZs R2, R3 and R14 as shown in Table 6.3.9.

Table 6.3.9 Water Saved in Priority Areas

WSZ	Water Saved (m^3/year)		
	BWA/USAID/GRD-PCO Replacement Area	Project Area	Total
R2	9,841,528	4,750,473	14,592,001
R3	11,546,263	1,358,384	12,904,647
R14	8,861,065	4,083,236	12,944,301
Total	30,248,855	10,192,093	40,440,948

(Source: BWA & JICA Study Team)

Water saved by the project proposed by the F/S is estimated at about 10 MCM per year (or equivalent 28,000 m^3/d) since unit losses for the existing pipe length of 294 km are estimated at 95 m^3/km/day (UNICEF). This amount is equivalent to 2.4% of the total leakage volume in 2005. Total length of the existing distribution mains in Baghdad is about 10,000 km. As 294 km of existing pipes are to be replaced by the Project, about 3.0% of the leakage problems can be eliminated. On going maintenance and repair work for the distribution network will also be reduced by the implementation of the Project effectively improving BWA's operation and maintenance system.

2) The water saved can be used to increase the water supply

BWA is faced with a water deficit problem. Leakage reduction by the Project through replacement of pipes saves as much as 28,000 m^3/d of water as indicated in Table 6.3.9. The amount of water saved is enough to supply 114,000 persons at the unit water demand of the 2005 level without exploiting new water resources.

3) Reducing secondary contamination

Leaking pipes and joints are dangerous sources of secondary contamination. The Project will improve any abnormally low-pressure conditions in the distribution system due to leakage and helps reduce the incidence of secondary contamination. The beneficiaries of the Project are estimated to be about 319,000 in 2005 and 391,000 in 2014 on condition that population is demarcated uniformly at each Mahalah in WSZs as presented in Table 6.3.10.

Table 6.3.10 Beneficiaries of the Project

	Population		Beneficiaries of the Project	
WSZ	2005	2014	2005	2014
R2	363,437	440,769	127,203	154,269
R3	657,803	820,240	65,780	82,024
R14	503,083	619,674	125,771	154,918
Total	1,524,323	1,880,683	318,754	391,211

(Source: BWA & JICA Study Team)

Reduced leakage in distribution mains also reduces the risk of contamination and therefore enhances public health and safety. People will be supplied with a more stable and safer water supply service after the Project. The Project is beneficial in improving people's livelihood and hygienic conditions. Therefore, indirect beneficiaries in 2014 are to be about 1.9 million persons living in the priority area.

4) Cutting repair cost

Many of the pipes are aged mains which frequently leak and by replacing these pipes the frequency of leakage will be reduced. The repair costs for the distribution network will be cut by reducing the frequency of leakage. The existing repair costs consist of personnel expenses, material expenses and transportation costs. The personnel expenses will be reduced by the reduction of the frequency of leakage. Additionally, it is expected that material expenses and transportation costs will decrease in proportion to the reduction of the frequency of leakage.

5) Increasing revenues

The amount of water saved is equivalent to 10 MCM of the water annually, which is enough to supply 114,000 persons. This produces approximately ID76.5 million or equivalent to US$52,000 in additional revenue per year at current tariff levels (assuming an average water tariff of 7.5 ID/m^3) if the water saved is regarded as revenue earning water. In addition to the poor condition of distribution mains, the existing water consumption meters are also inadequate to permit an effective meter reading and billing system. It is supposed that new installation of meters will provide proper revenue growth and improvement of water management.

6) Cutting operation cost of water service tankers

The project area consisting of Shaab and Sadr Municipalities is supplied daily by BWA water service tankers at present. An average water supply is estimated at 969 m^3 daily and 25,000 m^3 monthly. The operation costs for the water service tanker will be cut by reducing UFW and improving the water supply conditions.

6.3.5 System Operation and Maintenance

(1) Organization

The MOB organization is described in Section 7.2. Within MOB, Baghdad Water Authority (BWA) is responsible for the management and operation of the water supply issues of the City. As subordinate organizations under the management of MOB, 13 Municipalities will be specifically responsible for the management and the operation of the social service issues of each Municipality. The agency responsible for the proposed project is MOB, which will have the final responsibilities for setting direction and decision making preceding the implementation of the Project, with important matters being referred to the Government when necessary. BWA is the executing agency of the Project for the technical issues, supervision and operation and maintenance (O&M).

As described in Section 7.2, BWA is mainly divided into two offices; technical and administrative and the technical office is divided into six sections. From among the six sections, the Implementation Section is in charge of the transmission and distribution system, including the raw water supply system, and the Operation and Maintenance Section deals with the eight water treatment plants, compact units, service reservoirs, booster stations and raw water stations. The Computer/Billing Section in the administrative office is responsible for customer service and affairs. At present, the number of staff for the Implementation Section is 260, for the Operation and Maintenance Section it is 1,023 and for the Computer/Billing Section it is 326. Vehicles and equipment of BWA are listed in Table 6.3.11.

Table 6.3.11 BWA List of Vehicles and Equipments, March 2006

N0.	Type of Equipment	Under Use	To Be Repaired	Dismissed	Total
1	Field Vehicle	76	5	1	82
2	Excavator	3	1		4
3	Dump Truck	3	1		4
4	Fuel Tanker	3	1		4
5	Bucket Crane	1	_		1
6	Mobile Crane	5	3		8
7	Fork Lift	4	4		8
8	Diesel Compressor	3	3		6
9	Bus	1	_		1
10	Loader Truck				
11	Mobile Work Shop	4			4
12	2Ton lorry	2			2
13	Trucktor	1			1
14	Trailor				
15	Mobile Water Jetter		1		1
16	Shovel Car	7	2		9
17	Saloon Car	1			
18	Bus	1			
19	Pick Up	55	3		
20	Land Cruser	18	3		
21	Field Vehicles	1			
22	Mobile Workshop	4			
23	Lorry				
24	Dump Truck	3	1		
25	Water Tanker	10			
25	Fuel Tanker	3	1		
26	Shovel Car	7	2		
27	Bucket Crane	1			
28	Hydrulic Excavator	3	1		
29	Drudger		2		
30	Mobile Crane	5	3		
31	Fork Lift	4	4		
32	Mobile Water Jetter		1		
33	Tractor	1			
34	Air Compressor	3	3		
35	Welding Machine	2	3		
35	Motorcycle	11	3		

(2) Operation and maintenance organization for the distribution networks

After the completion of the project construction works, all the distribution mains and related facilities, including water consumption are transferred to BWA, which is to be designated as the agency responsible for operation and maintenance (O&M) of the completed project facilities. The Implementation section will take responsibility for O&M of the distribution system and the Billing section will be in charge of meter reading and billing. For O&M of the distribution system, coordination with each Municipality is important, particularly for distribution mains of less than 300mm in diameter and service pipes.

For O&M of the distribution mains, MOB divides the distribution mains into two systems based on the pipe diameters; large diameter distribution mains of 300mm or more and small diameter of less than 300mm. Distribution networks of large diameter are managed by the Implementation section of BWA, while distribution networks of small diameter are maintained by the Water section of each Municipality.

The Implementation section is divided into 4 units: the Rasafa network, the Karkh network, the civil works and services unit, and the control unit. The Rasafa network of the Implementation section covers the O&M of the distribution system in the Project area. O&M for small distribution mains in R2 is the responsibility of the Water section of Shaab Municipality, and the responsibility for R3 is shared by three water sections, Shaab, Sadr 1 and Sadr 2. O&M for the small distribution main in R14 is also shared by two water sections, Sadr 1 and Sadr 2. About 40 staff members work at each Municipality daily for O&M of distribution tertiary. A typical organizational structure of the Water section for each Municipality is presented in Figure 6.3.5 below.

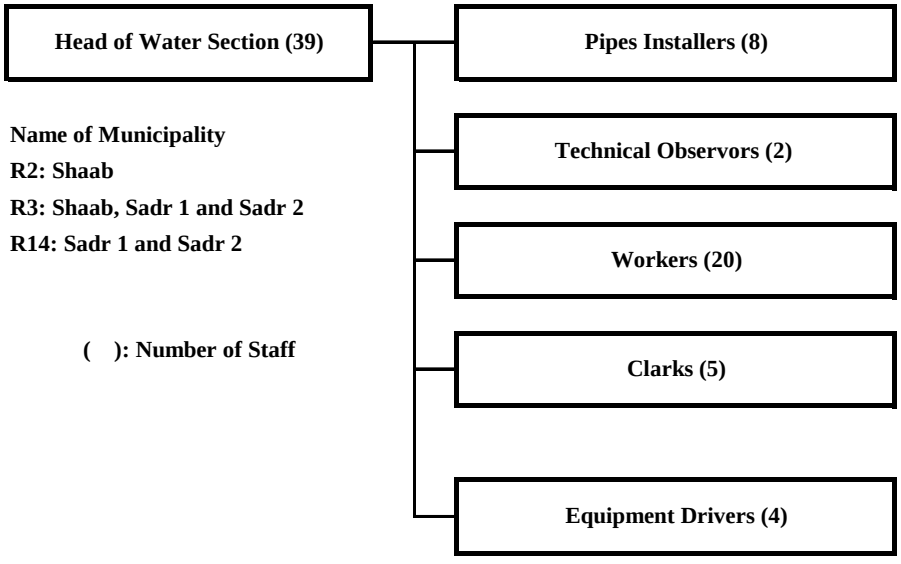


Figure 6.3.5 Typical Organization of Water Section

The Computer/Billing section is directly involved in the execution of water consumption meter installation. Rapid urban growth has increased the demand for services and created new pressures on the existing organization. Although many new engineering projects have been initiated to deal with the increasing demand for water, little had been done to improve the business side of the organization. With regards to the Computer/Billing section, two areas in need of urgent improvement were identified: 1) the meter reading and billing process; and 2) measuring and reporting of water consumption meter performance to head office. After installation of meters, it is initially proposed that in order to prevent unauthorized use and to ensure that all meters are functional: (i) the meter reading cycle should be reduced to 2 months and (ii) the ability for repairing and calibrating meters should be improved.

As for the Implementation section, it is proposed that: (iii) leakage detection and repair teams are organized within the Section in order to reduce leakage and promptly take any required action, and (iv) the repair work is associated with the Water section of each Municipality. It is of paramount importance to BWA that UFW be reduced as quickly as possible as previously explained. The renewal of distribution mains to be undertaken as capital investment projects plus the above-mentioned approaches should effectively improve the existing distribution system.

6.4 Cost Estimates

6.4.1 Cost Estimates for the Project

(1) Composition of the project costs

The project costs are composed of direct construction costs, administration costs, taxes and duties, engineering costs, physical contingency and price escalation. The foreign currency portion (F.C.) includes the cost in CIF price of materials to be imported. The local currency portion (L.C.) includes the costs of labour, equipment and materials procured locally, custom clearance costs and mobilization and remobilisation.

The summary of the structure of each cost item and the cost involved therein are specifically described in Figure 6.4.1

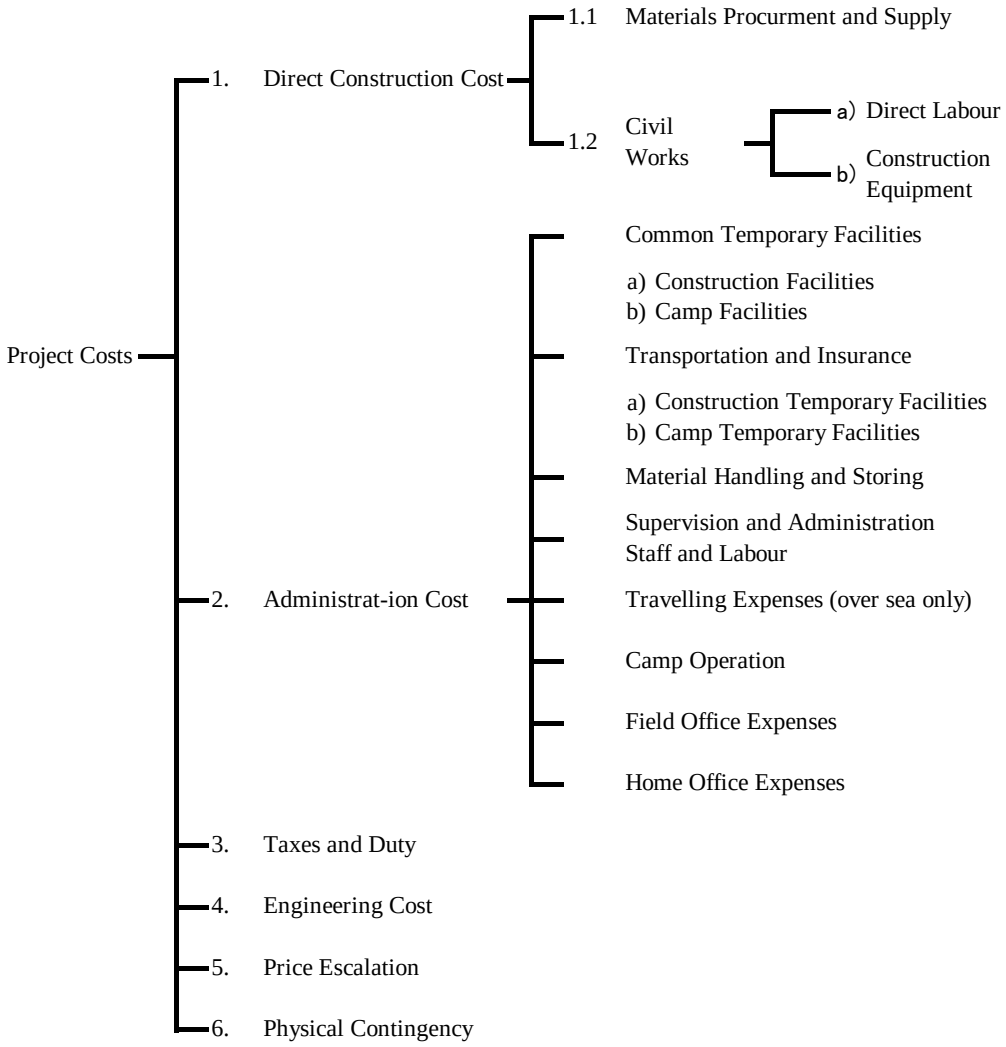


Figure 6.4.1 Composition of Project Costs

(2) Conditions and assumptions for cost estimates

1) Price level: June 2006

2) Exchange rates used in the cost estimates are as follow;
US$ 1.0 = ID1475.262 = JPY112.264 as 1st of June 2006.

3) Unit costs: The unit construction costs used in the local currency portion (L.C.) are taken as the unit costs recently used in BWA contracts.
The unit costs used in the foreign currency portion (F.C.) are taken as the CIF prices of imports from foreign countries, in Baghdad.

4) Land acquisition and compensation: executed by BWA

5) Administration expenses: 10 % of the direct construction cost

6) Tax and Duty is 10 % of the direct construction cost and administration cost and 5 % of CIF Baghdad prices of the costs of foreign procurements for Import duty.

7) Security issue cost is 43 % of and included sum of administration cost

8) Insurance for transportation and construction is 15 % of and included in administration cost.

9) Engineering service expenses: 11 % of the direct construction cost. Price escalation and physical contingency of the consulting service shall be included in the cost of the consulting services.

The estimated costs for the proposed project are summarized as follows;

(Unit: US$ 1,000)

	Items	L.C.	F.C.	Total
1.	Direct Construction Cost			
1-1	Material Procurement and Supply			
	1) Ductile Cast Iron Pipes (DIP) with Fittings	0	18,588	18,588
	2) Gate Valves and Air Valves	0	3,694	3,694
	3) Fire Hydrants	0	2,967	2,967
	4) Water Consumption Meters with Service Pipes	0	9,976	9,976
	5) Equipment for DMA Pilot Study		129	129
	Sub-Total (1)	0	35,354	35,354
1-2	Civil Works			
	1) Pipe Replacement Works	15,983	0	15,983
	2) House Connection Works	5,404	0	5,404
	3) Meter Chambers for DMA Pilot Study	15	0	15
	Sub-Total (2)	21,402	0	21,402
	Sub-Total (1) + (2)	21,402	35,354	56,756
2.	Administration Cost 10% of Direct cost	6,951	6,452	13,403
3.	Tax and Duty	8,783	0	8,783
4.	Engineering Cost 11% of Direct cost	3,655	4,858	8,513
5.	Price Escalation	12,163	2,365	14,528
6.	Physical Contingency	8,103	8,834	16,937
	Total	61,057	57,863	118,920

Note:

1. Price escalation is 9 % of L.C. and 1.7 % of F.C. portion of items 1 and 2.
2. Physical contingency is 20% of L.C. and F.C. portion of the sum of items 1, 2 and 5.

The estimated cost for each WSZs (R3, R14 and R2) in the proposed project is summarized in Table 6.4.1.

Table 6.4.1 Project Cost for each WSZ

(Unit: US$ 1,000)

Cost Item	Total			Scheme: R3			Scheme: R14			Scheme: R2		
	L.C.	F.C	Total	L.C.	F.C	Total	L.C.	F.C	Total	L.C.	F.C	Total
1 Direct Construction Cost	21,402	35,354	56,756	3,964	7,643	11,607	8,303	13,371	21,674	9,135	14,340	23,475
1.1 Material Procurement and Supply	0	35,354	35,354	0	7,643	7,643	0	13,371	13,371	0	14,340	14,340
1) Ductile Cast Iron Pipes (DIP) with Fittings	0	18,588	18,588	0	2,481	2,481	0	6,814	6,814	0	9,293	9,293
2) Gate Valves, Air Valve and Others	0	3,694	3,694	0	721	721	0	1,890	1,890	0	1,083	1,083
3) Fire Hydrants	0	2,967	2,967	0	396	396	0	1,182	1,182	0	1,389	1,389
4) Water Comsumption Meters with Service Connection Pipes	0	9,976	9,976	0	3,916	3,916	0	3,485	3,485	0	2,575	2,575
5) Equipment for DMA Pilot Study in WSZ R3	0	129	129	0	129	129						
1.2 Civil Works	21,402	0	21,402	3,964	0	3,964	8,303	0	8,303	9,135	0	9,135
1) Pipe Replacement Works	15,983	0	15,983	2,156	0	2,156	6,237	0	6,237	7,590	0	7,590
2) House Connection Works	5,404	0	5,404	1,793	0	1,793	2,066	0	2,066	1,545	0	1,545
3) Meter Chambers for DMA Pilot Study in WSZ R3	15	0	15	15	0	15						
2 Administration Cost	6,951	6,452	13,403	974	1,255	2,229	2,350	2,393	4,743	3,627	2,804	6,431
3 Tax and Duty	8,783	0	8,783	1,766	0	1,766	3,310	0	3,310	3,707	0	3,707
4 Engineering Cost	3,655	4,858	8,513	630	1,037	1,667	1,385	1,834	3,219	1,640	1,987	3,627
1)Engineering Cost 11% of Direct cost	2,354	3,888	6,242	436	840	1,276	913	1,471	2,384	1,005	1,577	2,582
2)Price Contingency (Escaration) (9.0% of LC, 1.7% of FC)	692	160	852	89	24	113	241	57	298	362	79	441
3)Physical Contingency (20.0% of LC and FC of 1) & 2) of Item 4)	609	810	1,419	105	173	278	231	306	537	273	331	604
5 Price Escalation (9.0% of LC, 1.7% of FC of Item 1and 2)	12,163	2,365	14,528	1,378	316	1,694	3,996	834	4,830	6,789	1,215	8,004
6 Physical Contingency (20.0% of LC and FC of Item 1, 2 & 5)	8,103	8,834	16,937	1,263	1,843	3,106	2,930	3,319	6,249	3,910	3,672	7,582
Total	61,057	57,863	118,920	9,975	12,094	22,069	22,274	21,751	44,025	28,808	24,018	52,826

6.4.2 Operation and Maintenance Cost for UFW

It is difficult to estimate a specific necessary annual cost for operation and maintenance (O&M) in the distribution network system which will be replaced in the selected Mahalah. The O&M cost consists mainly of staff salary, leakage detection cost, leakage repair cost, maintenance equipment cost and fuel for equipment so on. It assumes that leakage repair cost will be less drastically, though leakage detection cost for UFW deduction will be required after completion of the Project. Therefore, O&M cost for selected Mahalahs can be decrease by implementation of the Project.

6.5 Implementation of Program

The Baghdad Water Supply System Improvement Project is planned to be completed by 2011. The implementation of the Project is planned in a manner to ensure proper execution of the work by taking into consideration the conditions for the Project including the contractors and suppliers, procurement of materials and labour force, the manner of procurement of water supply materials, and the manner of construction.

Comprehensive implementation schedules, mainly for such items as material procurement and supply, pipe replacement works and house connection works are presented in Figure 6.5.1.

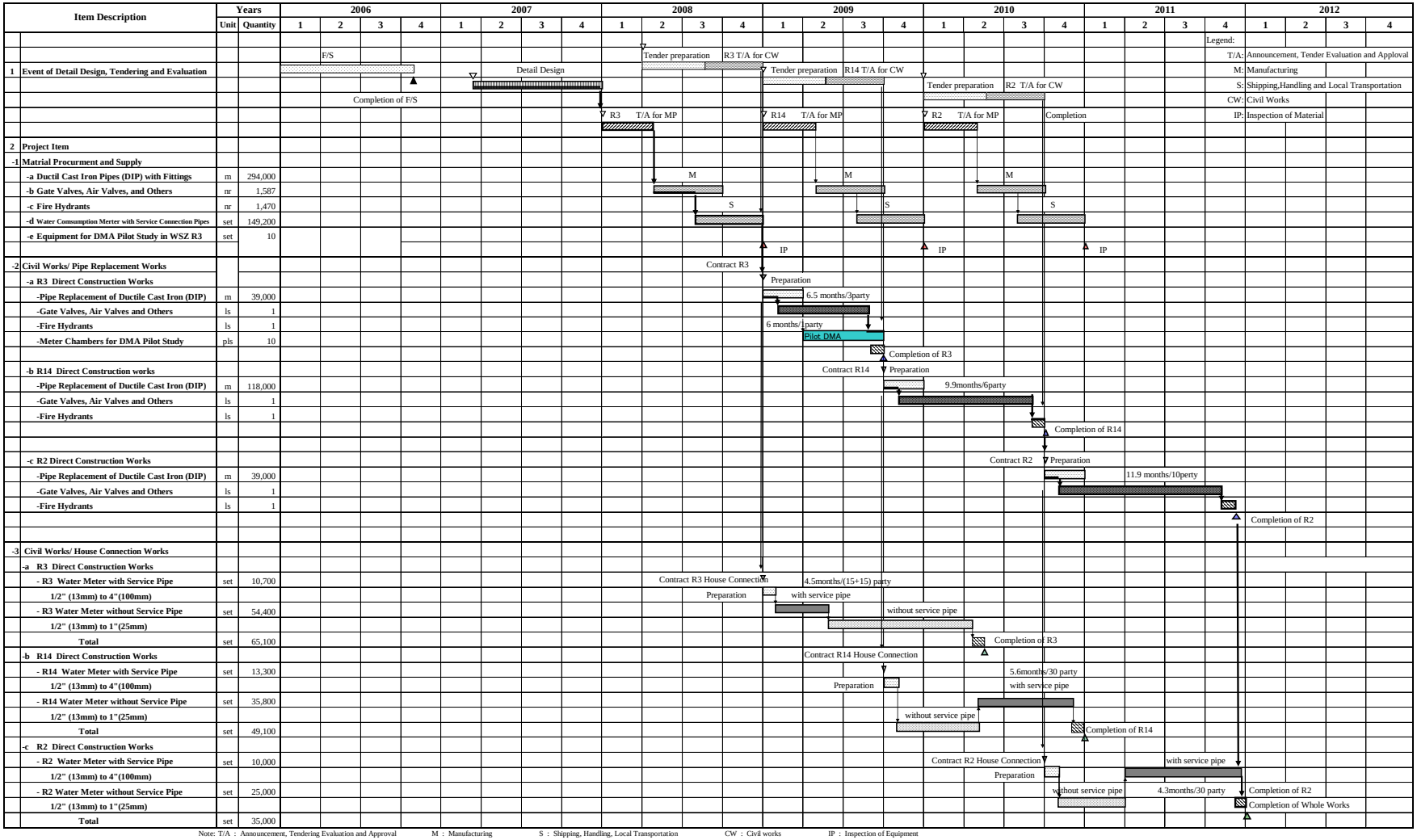


Figure 6.5.1 Implementation Schedule

6.5.1 Availability of Materials

(1) Local materials

In the local market, aggregate, concrete blocks, bricks, asphalt, cement, and lumber are available. Cement is produced in Iraq, but the quantity is insufficient compared with demand. Therefore, the shortfall in supply is to be covered by imported cement from neighbouring countries such as Turkey, Jordan, and Egypt. At present, the market price has stabilized.

The reinforcing steel bars, which were previously imported from neighbouring countries, can be procured from the local market. The cost estimate in the study is based on the local market price.

The market price of light oil and gasoline is as much as 10-20 times the official price. The market price of fuel fluctuates day to day. Therefore, local contractors cannot prepare correct fuel cost estimates.

(2) Imported materials for construction

Water pipes, fittings, water consumption meters, construction equipment, submersible water pumps and the spare parts for the construction and engineering tools are not available in the local market. Consequently, those materials and equipment should be imported from foreign countries.

(3) Transportation route to the project site

There are various transportation routes into Baghdad for materials imported from neighbouring countries. Therefore, alternative transportation routes from neighbouring countries to Baghdad city are nominated as follows:

- Turkish route (Mersin Port or Iskanderun Port)
- Kuwaiti route (Shuwaikh Port or Shuaiba Port)
- Jordanian route (Aqubah port)
- Syrian route (Ladhiqiyah Port or Tartous Port)

The materials to be transported consist of huge amounts of pipes, fittings and water consumption meters. The present condition of each route is summarized in Table 6.4.2. The criteria for selection of the routes are as follows:

- To provide adequate security for transportation
- To ensure the freight schedule

The Turkish route was selected as the first priority route based on the above criteria of the study. Actual transportation routes to the project sites shall be selected by the contractor and/or suppliers as his sole responsibility in consideration of the origin of procurement and the security situation in Iraq.

Table 6.5.1 Criteria for Selection of the Routes

Route	Turkish Route		Kuwaiti Route		Jordanian Route		Syrian Route	
Main Port	Morsin Port, Iskanderun port		Shuwaikh Port, Shuaiba Port		Aqabah Port		Ladhiqiyah Port, Tartous Port	
Distance to Iraqi Border	800km		180km		590km		450km(Al Waleed)	
Distance to Baghdada	1,330km		770km		1,192km		1,040km	
Port Conditions	A	<Mcrsin Port> Borths: 20, Draft: 9-12.75m, 50T Gantry Crane: available <Iskandorun Port> Borths: 10, Draft: 9-9.25m	A	lraq-bound cargo for US and British Mdllaly units land at Shuaiba Port.	A	Berths: 13, Draft: 10.3-20m, 40Tx2 Gantry Crane: Available	B	<ladhiqiyah Port> Berths: 23, Draft: 9-10m <Tartous Port> Borths:22.Draft:13m
Road Conditions to Iraqi Border	A	Around 500km is a single lane. Max. cargo weight is 110T. Several river crossings.	A	A fully paved roadway with 3 lanes. Max. height is 4.3m.	B	A fully paved roadway. Harf of way is a single lane.	B	A paved roadway with single lane. Max 85-90 Ton due to bridges over Euphrates river
Conditions of Border Crossing	A	No gates for Governmental cargos, so takes 4 - 5 days to clear customs	A	Gate tor Govemmental cargos available	A	Gate tor Govemmental cargos available	C	Gate for Govemmental cargos not available and harder to cross
Transit Clearance	A	Tax & Duties Exemption Certificate be obtained.	C	Tax & Duties Exemption Certificate be obtained.	A	Due to Mutual Tax Treaty, Trans Customs Clearance is easy, but meantime. a forwarder be require to provide a bank guarantee.	C	Easy to get transit clearance
Provide adequate security and route	A	Good and many alternative route	C	Reladvely good Few alternative route	B	Relatively good Few alternative route	C	Not relatively good Few alternative route
Ensure the freight schedule	A	Pcsitive good many actual result	B	good many actual result	B	good	B	Few positive actual results
Cost for Transportation	B	Expensive	A	Relatively reasonable	A	Relatively reasonable	B	Expensive
Recommendable Route at this moment	Recommendable, safer than other route		Not recommendable, many unsafe zones		Not recommendable, little unsafe zones		Not recommendable, little unsafe zones	
Evaluation	A		C		B		C	

Note:
Evaluation base
A Good
B Suitable
C Unsuitable

6.5.2 Capability of Local Contractors and Labour Force

(1) Capability of local contractors

Contractors and suppliers who intend to undertake the construction works and/or the supply of construction equipment and materials shall be registered with the government agencies concerned. The Iraqi Contractors Association is responsible for contractor classification and registration.

Iraqi contractors are divided into state owned national construction companies and private companies. The technical levels of the state owned national construction companies, which are subsidiaries of the Ministry of Construction and Housing (MOCH), the Ministry of Transportation (MOT), and the Ministry of Water Resources are comparatively high. They are currently in a period of transition from nationally owned companies to private companies due to a change in government policy. The number of staffs in the national construction companies range from 600 to 1000 employees. However, their work efficiency is not very satisfactory.

The private contractors generally employ from 30 to 200 persons with the average size of a private construction company being around 50 employees. Bechtel has registered several hundred companies as subcontractors for Iraq development programs. In addition, there are

some foreign private contractors from neighbouring countries which are contracting some projects in Iraq although they have security problems.

BWA pre-qualifies contractors by classifying them into fields of activities and ranking them into groups depending on their financial strength, equipment capability, the number of qualified engineers and experience in the field. These fields are 1) Supply and procurement of pipes and fittings, 2) Pipe laying for distribution pipelines, and 3) House connection works. First, second and third ranked contractors are nominated for tendering on BWA's projects.

The local registered contractors have the capability and experience required to construct the proposed projects without the use of international contractors. Local contractors have sufficient construction machinery and equipment, including heavy construction machines for the water supply project.

(2) Labor Force

The skilled workers, which are necessary for the pipe work projects, are available in the project area because there are numerous workers who have experience in relation to manual excavation and backfilling pipe projects implemented by BWA, USAID and PCO in Sadr City. These new projects will promote employment of the local people, thus reducing the present unemployment rate, which will also contribute to increasing the value of the Project to the people of Baghdad.

6.5.3 Construction and Procurement Plans

Construction and procurement of equipment and materials will be executed in Iraq as follows. Projects with foreign components are to be procured through international competitive bidding, and civil works are to be procured by local competitive bidding procedures in accordance with the guidelines of BWA through study of the following alternatives.

(1) Alternatives:

1) Turn-key contract: contracts are for the entire construction works and material procurement and supply through international bidding
2) Contract packages: contracts are divided into smaller project packages including pipe replacement works, civil works and material procurement and supply through international bidding.
3) Separated contracts: contracts for international bidding are divided into procurement of pipe materials (DIP), fittings and water consumption meters with service pipes, and local bidding for pipe installation works, civil works and house connection works.

Alternatives 1) and 2) are usually applied for large-scale works and projects with advanced high risk contract methods. However, the ability of local contractors is deemed suitable for

the implementation of the proposed projects because the proposed projects consist of ordinary pipe replacement works without any advanced high technology. Therefore alternative 3) is selected as the recommended bidding procedure.

(2) The manner of procuring the materials and civil works are proposed as follows;

1) International bidding for material procurement and supply including:

- Pipe materials and fittings for pipelines (DIP)
- Water consumption meters with service pipes

2) Local bidding for civil works[1] for pipe replacement and house connections

- Civil works are grouped into multiple packages by area or contract period for local bidding by the contractors registered with the BWA.
- Pipe replacement works for distribution pipes
- House connections works with water consumption meters

(3) Construction method for pipe installation

1) Where the existing pipes are under vehicular traffic roads

The method of construction to be adopted as the simplest is the open cut method as shown in DATA BOOK 2 in Volume IV.

For excavation depths deeper than 1.5m adequate shoring and dewatering must be employed.

The new pipeline should be installed in parallel with the existing pipe without removal of the existing pipe to maintain water supply service to the sector. All house connections shall be carried out after installation of all other pipes is completed. One lane of the traffic road will be closed during the construction period.

2) Where the existing pipes are under a side walk

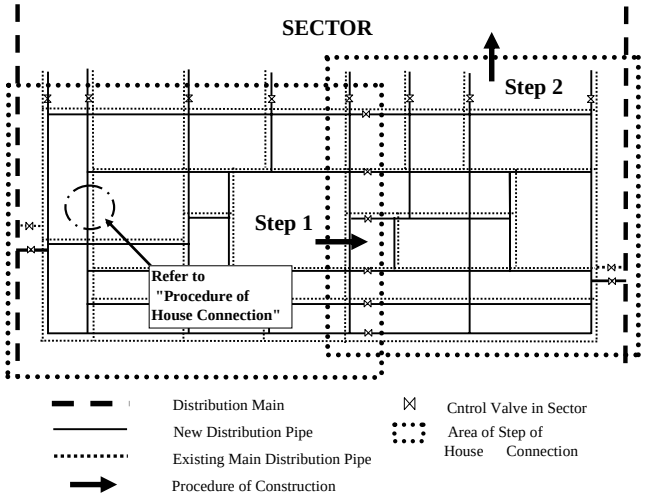
The new pipeline should be installed in parallel with the existing pipe without removal of the existing pipe to maintain water supply service to the sector. The excavation and back filling should be done manually and on a schedule that ensures the completion of the works within the contract period. Manual trench excavation is adopted for pipe diameters less than DN300mm. The adjacent road is to be closed during the construction period and a by-pass road is to be used around the construction area until the completion of the work.

3) Period of suspension of water supply

(i) Replacement pipes are to be installed in parallel with the existing pipes.

[1] Reference: Bidding procedure for BWA projects is to be implemented in compliance with "*The Conditions of Contractors for Civil Engineering Works 1987*" which were prepared by the Ministry of Planning and Development Cooperation.

(ii) The new water supply network is to be closed by valves on the completion of replacement work of one-third of the sector. And then, the new network is to be connected to the existing main distribution pipe in order to charge it with water. During this time, both the new and existing water supply network are able to supply water in the sector, refer to procedure of house connection in a sector below:



Procedure of House Construction in Sector

(iii) Installing the service pipes that connect to the new networks is to be carried out close to the existing house connection points.

(iv) Then the existing pipeline is to be closed by valves when all house connections works in a sector are completed.

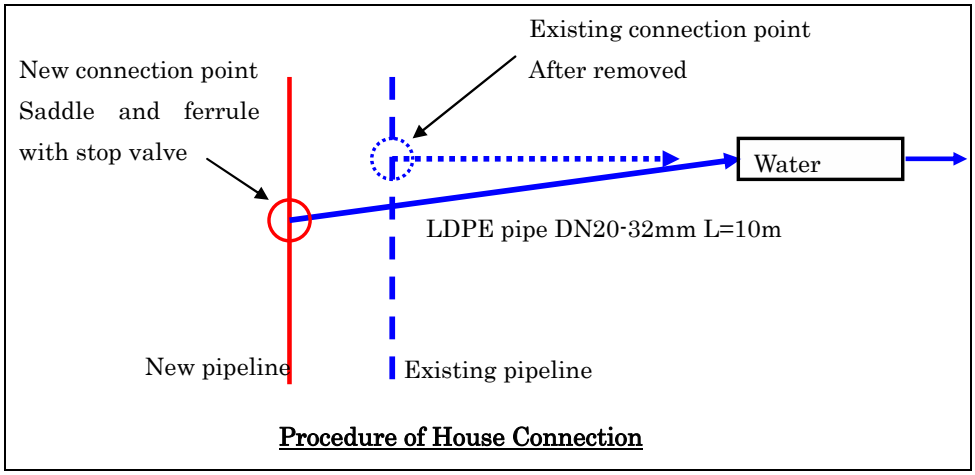
The above procedures shorten construction time for each house connection. This reduces the period of suspension of the water supply.

4) House connections with water consumption meters

a) Steps to follow in the installation of a house connection

1. Completion of installation of new distribution pipe line
2. Pavement removal around new and old house connection points as necessary
3. Excavation of new and old connection points
4. Saddle installation on new DIP
5. Install ferrule service connection with stop valve
6. Lay Low Density Polyethylene Pipe (LDPE) pipe to house, length =10m
7. Install new water meter
8. Remove old house connection material

9. Connect line from house to new water meter
10. Back fill and re-pave road
11. Hand over to house owner



Procedure of House Connection

(4) Technical specifications for pipe replacement works, pipe materials and fittings

The civil works technical specifications for pipe replacement works, pipe materials and fittings, which are referred to BWA specifications and drawings (see DATA BOOK 4 and 2 in Volume IV respectively), are listed below:

Civil Works for Pipe Replacement	Earthworks, Bedding, Side Filling and Surrounding, Backfill and Reinstatement, Pipe Installation and Joints, House Connections, Test Procedures, Commissioning of Supply Mains, Operation and Maintenance
Pipe Materials and Fittings	Pipe material, Poly Sleeves, Bends, Valves, Fire Hydrants, Air Valves, Washout Valves, Manhole Covers

(5) Security issues

Transportation of equipment and materials and the construction site itself are assumed to be at high risk due to terrorism, riots, and disorder that cannot be predicted at present. Security measures that can respond quickly when some threat or attack occurs will be required in order to successfully implement the Project.

1) Transportation Security

Security measures are required for the drivers and trucks transporting imported equipment and materials into Iraq. The cost for security measures shall be included in the transportation cost of equipment and materials. Transportation in Iraq is no safer than it was two years ago. Transported cargo is moved in convoys and is continuously escorted by private security companies. However, the level of security in Iraq changes with the

place and time. Therefore, security companies must look for the best transportation route to promote the safety of the transported materials based on the most current security information.

2) Site Security

The local contractors who will carry out pipe installation and/or house connection works shall engage a local security company that is very familiar with the circumstances in the Project area. Security measures for the main temporary yard and each temporary stock yard, including materials stockyards, warehouses and temporary site offices should be carried out 24 hours a day, seven days a week.

6.5.4 Implementation Schedule

In preparing a realistic schedule for the implementation of the Project, BWA will organize the construction activities. Most of the construction works will be conducted by contractors and will be supervised by BWA and/or designated consultants.

The implementation schedule is presented in Figure 6.5.1, "Implementation Schedule of the Baghdad Water Supply System Improvement Project". The project is expected to start in 2008 and be completed in 2011 with a loan agreement to be signed in March of 2007, detailed design shall be started in April of 2007 and material procurement shall be started in January of 2008. Civil works for pipe replacement and house connections will be commenced in parallel from January 2009 and completed by 2011. The implementation schedules for each WSZ, R3, R14 and R2 are as follows:

	Scheme1: R3	Scheme2: R14	Scheme3: R2
Detail Design	April 2007 – December 2007		
Material Procurement and Supply	January 2008 – December 2008	January 2009 – December 2009	January 2010 – December 2010
Pipe Replacement Works	January 2009 – September 2009	October 2009 – September 2010	October 2010 – December 2011
House Connection Works	January 2009 – May 2010	October 2009 – December 2010	October 2010 – December 2011

(1) Detail design / Bidding process

1) Detail design

The selected consultants will carry out the detailed design for distribution tertiary replacement in 18 Mahalahs and water consumption meters in WSZs R3, R14 and R2 in three schemes. The detailed designs of the structures and pipelines will be made based on the preliminary designs as shown in DATA BOOK 2 of Volume II, and specifications and tender documents from which suppliers and contractors are able to estimate their costs

properly for material procurement and supply, civil works. Planning for executing the work in their design shall be prepared in detail by the consultants.

2) Bidding procedure

Material procurement and supply will be, in principle, through international competitive bidding, and civil works will be carried out by local competitive bidding. The procedure for the bidding will generally be (i) pre-qualification of the prospective bidders for material procurement, where required, (ii) bid announcement in accordance with the guidelines of the lending agency, (iii) bidding, (iv) evaluation of the bids received, (v) negotiations with the lowest evaluated bidder, and finally (vi) award of contracts. During these series of proceedings, approvals of the lending agency shall be obtained, as required.

3) Bid evaluation

Evaluation of the bids shall be made mainly on three aspects, namely, compliance with administrative requirements, technical standards and bid prices. Regarding the administrative requirements, the bids must meet the requirements set forth in the general conditions in the bid documents and the instructions to the bidders. Materials, equipment and works offered by the bidders must meet the specified requirements. Finally, with regard to the bid price, all unit prices, calculations and totals will be checked for their appropriateness.

(2) Material procurement and supply

Bidding for the material procurement and supply will begin six months before the civil works.

The selected supplier of the international competitive bidding will supply the material required for construction. After conclusion of the Loan Agreement, the schedule will proceed as shown in Figure 6.5.1.

(3) Civil works for pipe replacement and house connections with water consumption meters

The project for pipe replacement, including the above mentioned material procurement and supply, is scheduled in all three schemes, and it is expected that the terms of the loan agreement will be concluded circa December 2011. The local contractors selected by the local competitive bidding will do the installation work.

The implementation schedule will be arranged in the detailed design phase as execution of the civil works of pipe replacement works and house connection works are to progress in parallel.

(4) Pilot study of DMA

Study for pilot DMA and requirement equipment of the study will be carried out at detail design stage and construction stage on pilot study of DMA in WSZ R3 as mentioned in Section 6.2.5. Total number of 10 meter chambers shall be constructed in WSZ R3 for after

the pipe replacement. The implementation schedule shall be completed in civil works of WSZ R3 as shown in Figure 6.5.1 Implementation Schedule.

(5) Project management

The management of various portions of the Official Development Assistance (ODA) loan project will be carried out by the MOB/BWA, the funding agency, international consultants along with local consultants, and contractors/suppliers. The management organizational structure for the project implementation is presented in Figure 6.5.2. In this case BWA should establish a Project Management Team (PMT) to supervise and control all relevant stakeholders. The PMT should be headed by a Team Leader/ Project Manager who is to be nominated by the mayor of the MOB. The recommended organization is also shown in Figure 6.5.2.

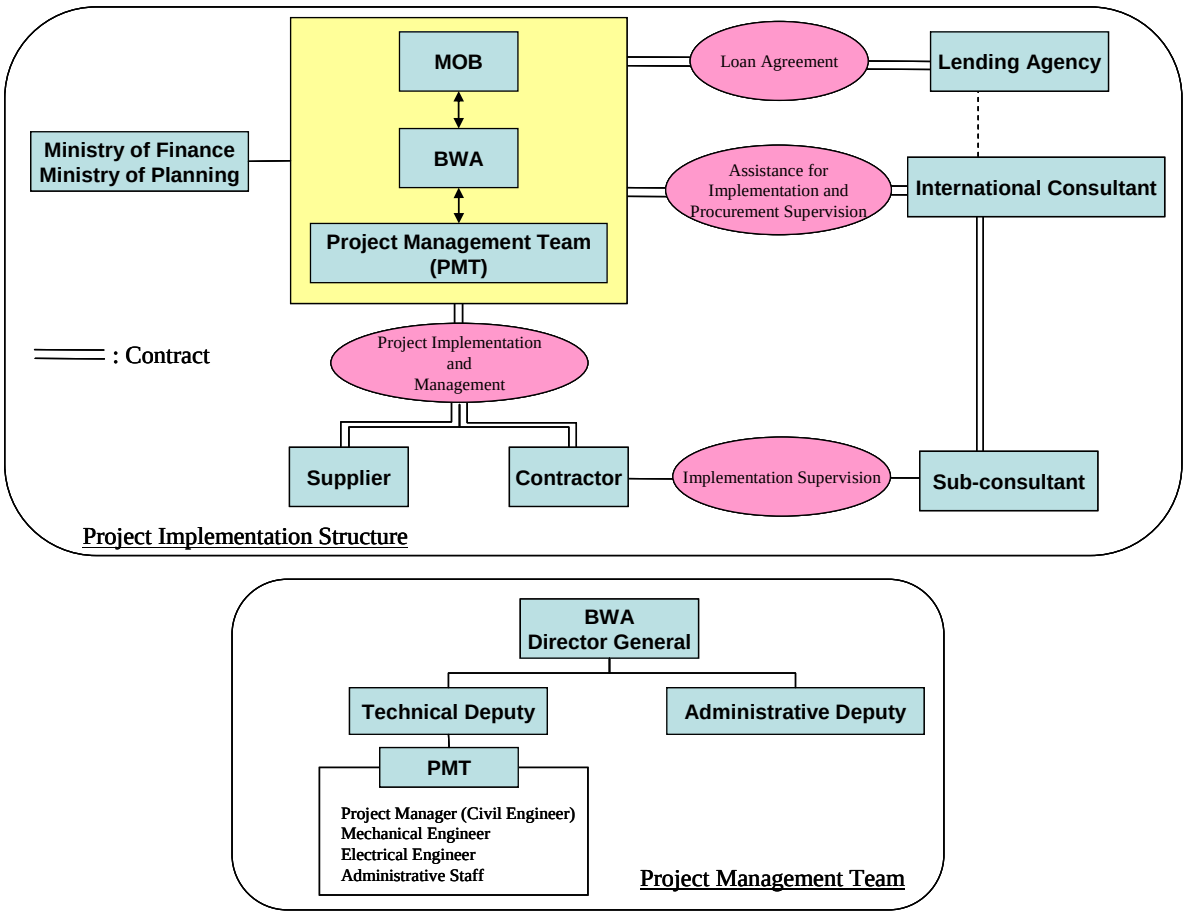


Figure 6.5.2 Management Organizational Structure for the Project Implementation

Implementation of the Project is to be executed through the different stages such as detailed design, material procurement and supply and civil works for pipe replacement and house connections with water consumption meters as follows:

1) Detailed design / preparation of tender documents and evaluation

Detailed design works are to be carried out by the international consultant at Amman in association with the local consultant. The field survey in Baghdad is to be carried out by a local consultant with cooperation of BWA staff and PMT. The main field survey is to be composed of survey work, and investigation of exiting pipes and related structures. The international consultant will carry out the water pipe design works, construction plan, cost estimates, preparation of bid documents, and P/Q work in Amman based on the field survey. The bid evaluation, and negotiation of tendering will be carried out in Amman with the cooperation of BWA staff.

The bid documents shall clearly mention the responsibilities of the owner and contractors in order to prevent any problems since, for instance, the material imported for the pipe replacement works will be managed by BWA after they are handed over.

2) Materials procurement and supply

The supplier selected in the international competitive bidding will supply the material required for construction. It will be necessary to check the quality, quantity and condition of the material and verify that it meets all relevant specifications. It will be impossible for the international consultant to do this directly. Therefore, the materials must be made available for inspection by the international consultant before they are transported into Iraq. Additionally, the local consultant will inspect the materials at the site in Baghdad in preparation for handover to the BWA.

3) Civil works for pipe replacement and house connections with water consumption meters

The local contractors selected in the local competitive bidding will do the onsite installations. It is impossible for the international consultant to supervise the work at the site in Baghdad. Therefore, the civil works will be supervised by BWA with the local consultant's assistance. The international consultant will provide support for technical requirements, meeting claims, quality control, construction management, evaluation of monthly progress, design changes and so on, out of their Amman office.

6.5.5 Consultant Service

The Consultant will not be able to work in Iraq due to the ongoing security problems. Therefore, it is recommended that a consulting office be established in Amman Jordan from detailed design stage to construction stage in order to carry out the necessary consulting services for the Project. It may be proposed that a BWA officer be stationed full time at the consultants' Amman office in order to coordinate the consulting service with the BWA office in Baghdad for smoothing and confirming tasks related to the Project.

In addition, a local consultant in Baghdad could conduct on site investigations, surveys, and data collection at the detailed design period under the instructions of the Consultants' Amman office.

(1) Supervision of procurement of equipment and materials

The Consultants' Amman office will carry out the supervision of procurement of equipment and materials for the Project. The local consultant will supervise and follow up on the transportation process in Iraq and deliveries to BWA and report on progress to the Consultants' Amman office.

(2) Construction Supervision

The Consultants' Amman office will assist the construction supervision of the Project for BWA. The Consultants' Amman office will assist with the review and approval of the construction plans and consultation with the resident representative of BWA to ensure proper progress of the construction schedule. The construction supervision shall be carried out by BWA. BWA shall report the progress of the construction work to the Consultants' Amman office through weekly progress reports. A monthly task meeting is to be held with BWA and local contractors in Amman. Quarterly progress meetings will be held with the participation of JBIC and MOB.

CHAPTER 7 INSTITUTIONAL ISSUES AND FINANCIAL AFFAIRS

7.1 Legislation

(1) 1924-1994: Management by the Ministry of Works and Transportation

In accordance with Law number 50 of the Year 1924, water service works in Baghdad were carried out under the supervision of a committee appointed by the Ministry of Works and Transportation. The Chairperson of the committee was appointed from among the staff of the Ministry of Works and Transportation. Other members of the committee consisted of a staff member of each of the Ministry of Finance, the Ministry of Interior, Baghdad City Health Director, or a Mayoralty committee member and a notable businessman from Baghdad to be nominated by the Mayor. When the committee decided on the following tasks, an authorization from the Ministry of Works and Transportation was required.

- Planning of water distribution in the city of Baghdad
- Determining water tariff and methods of charges and payment
- Working conditions of the administrative officers of the committee
- Scope of works of the committee

The committee would prepare an annual budget before the end of the financial year to be approved by the Minister of Finance and the Minister of Works and Transportation.

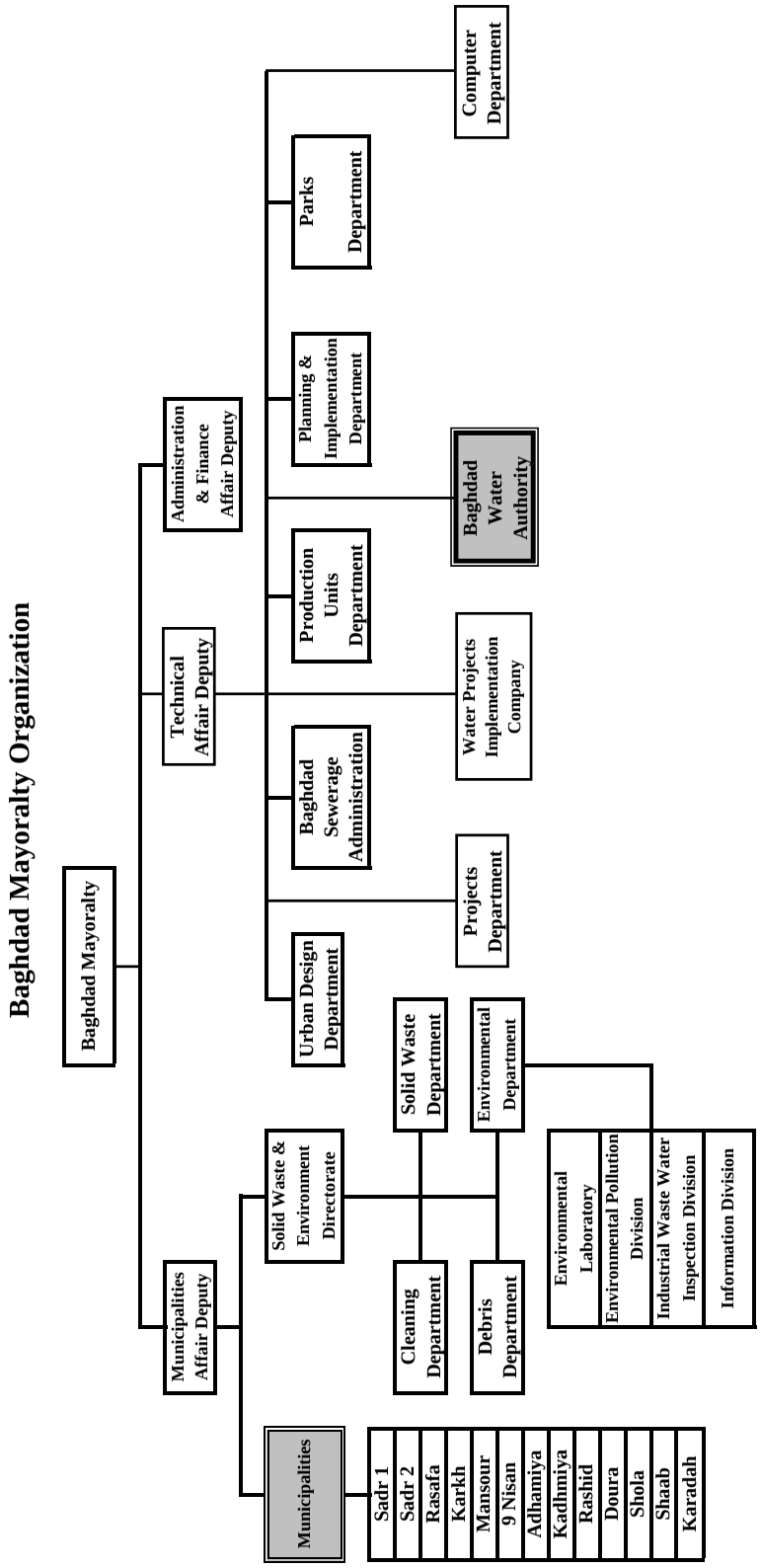
(2) From 1995: Management by Baghdad Water Authority (BWA)

Law number 16 of the Year 1995 provided for the organization of the Mayoralty of Baghdad, which, according to the law, manages BWA. BWA renders water supply services for Baghdad City at present based on this law.

Law number 16 consists of four Chapters and 22 Articles that define the administration of the Mayoralty of Baghdad. The first Article of the First Chapter provides that the Mayoralty shall provide the municipal services in Baghdad. Three Deputy Mayors support the Mayor in his duties. BWA is assigned under the Deputy Mayor of Technical Affairs. Article 8 provides that the water supply system for Baghdad City shall be managed and operated by BWA.

7.2 Institutional Issues

As shown in Figure 7.2.1, the Mayoralty of Baghdad incorporates three Deputies, namely the Municipality Affairs Deputy, Technical Affairs Deputy and Administration & Finance Affairs Deputy. BWA is one of the main administrations under the responsibility of the Technical Affairs Deputy of the Mayoralty of Baghdad.

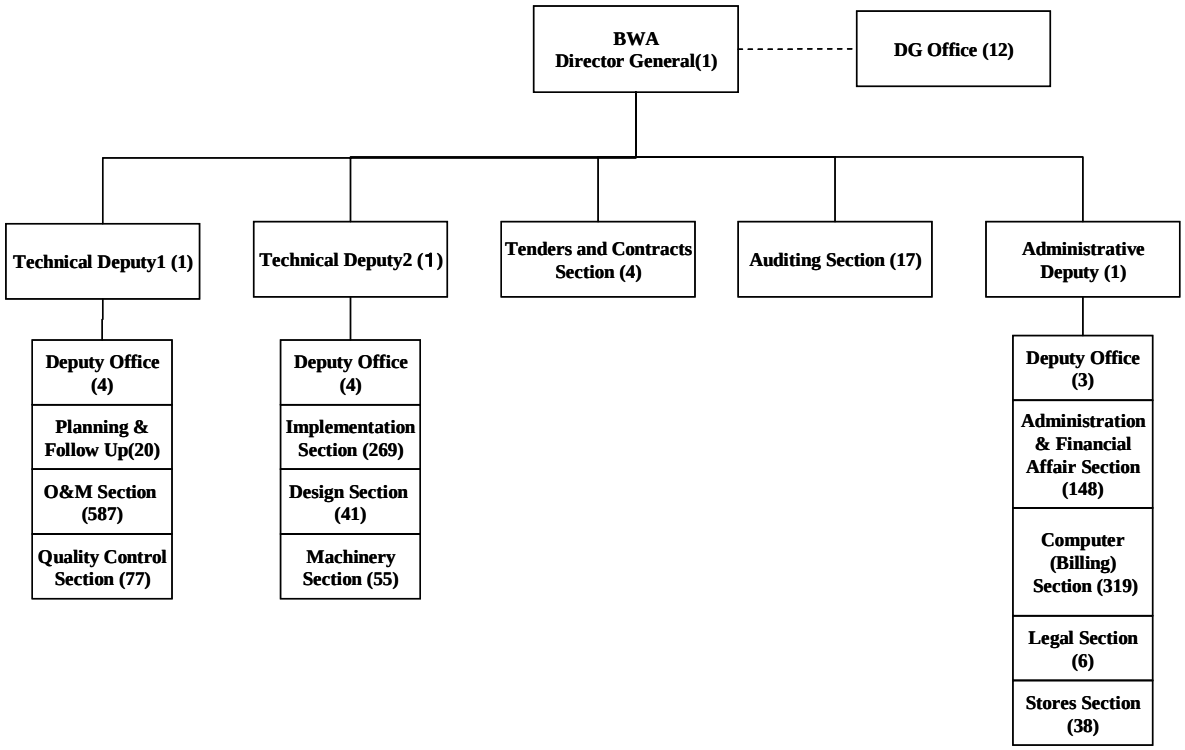


(Source: BWA, as of May 2006)

Figure 7.2.1 Organizational Chart of the Mayoralty of Baghdad

BWA is the sole entity responsible for operation and maintenance of the main water intakes, treatment plants, transmission lines, storage reservoirs, and water distribution network pipes of diameter 300 mm and above[1] in Baghdad. Operation and maintenance of water distribution network pipes of diameter less than 300 mm were transferred to the responsibility of the respective 13 Municipalities, which was legitimatized in 1995. The Municipality Affairs Deputy of the Mayoralty of Baghdad manages these Municipalities.

Regarding the organizational structure of BWA, firstly the Director General (DG) incorporates three Deputy Offices and two sections. Secondly, 10 sections are located under the three Deputy Offices. Totally six technical sections are under the responsibility of the two Technical Deputies, and four sections are under the Administrative Deputy. (See Figure 7.2.2)



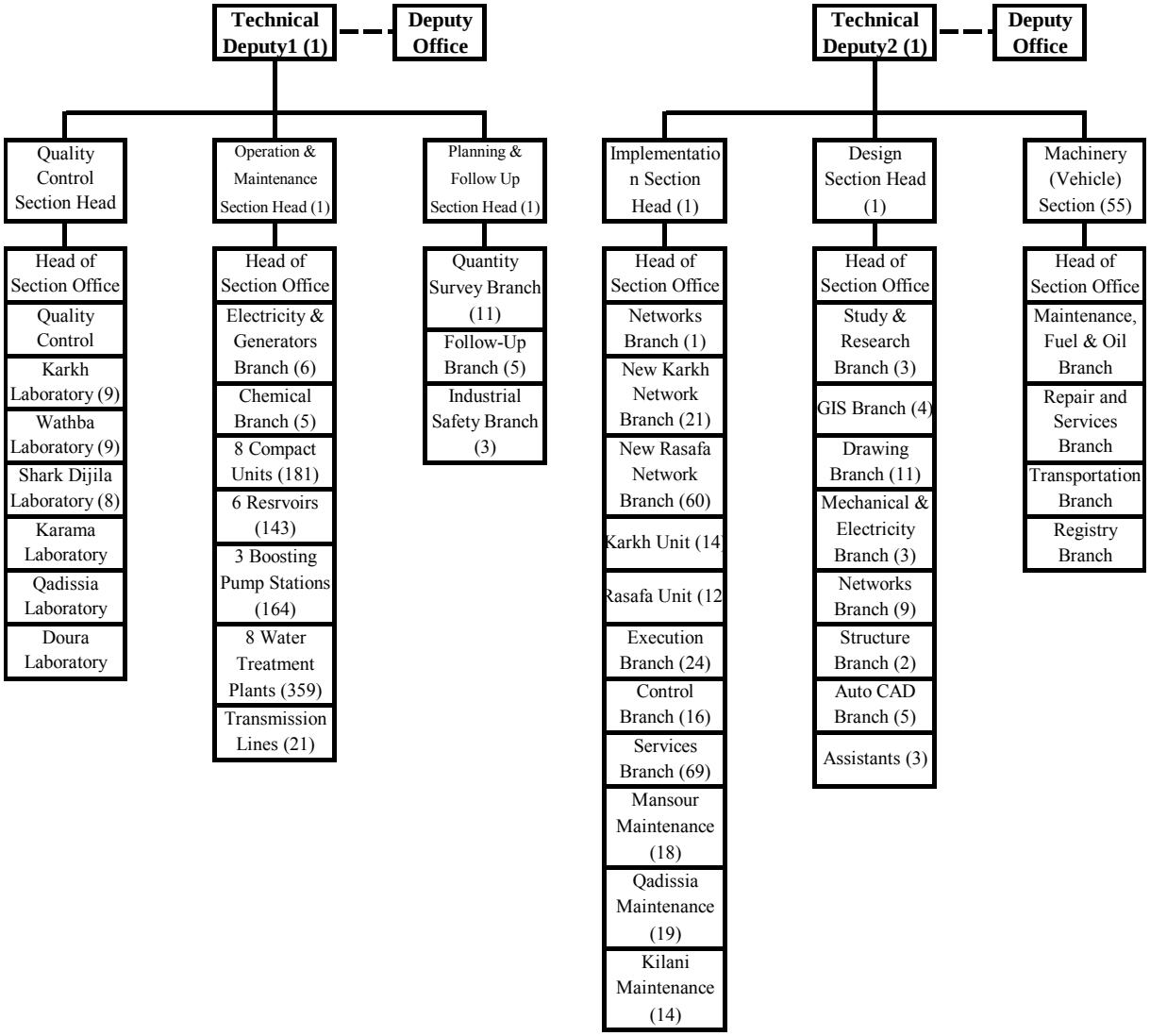
(Source: BWA, as of May 2006)

Note: Digits show the number of staff.

Figure 7.2.2 Organizational Chart of BWA

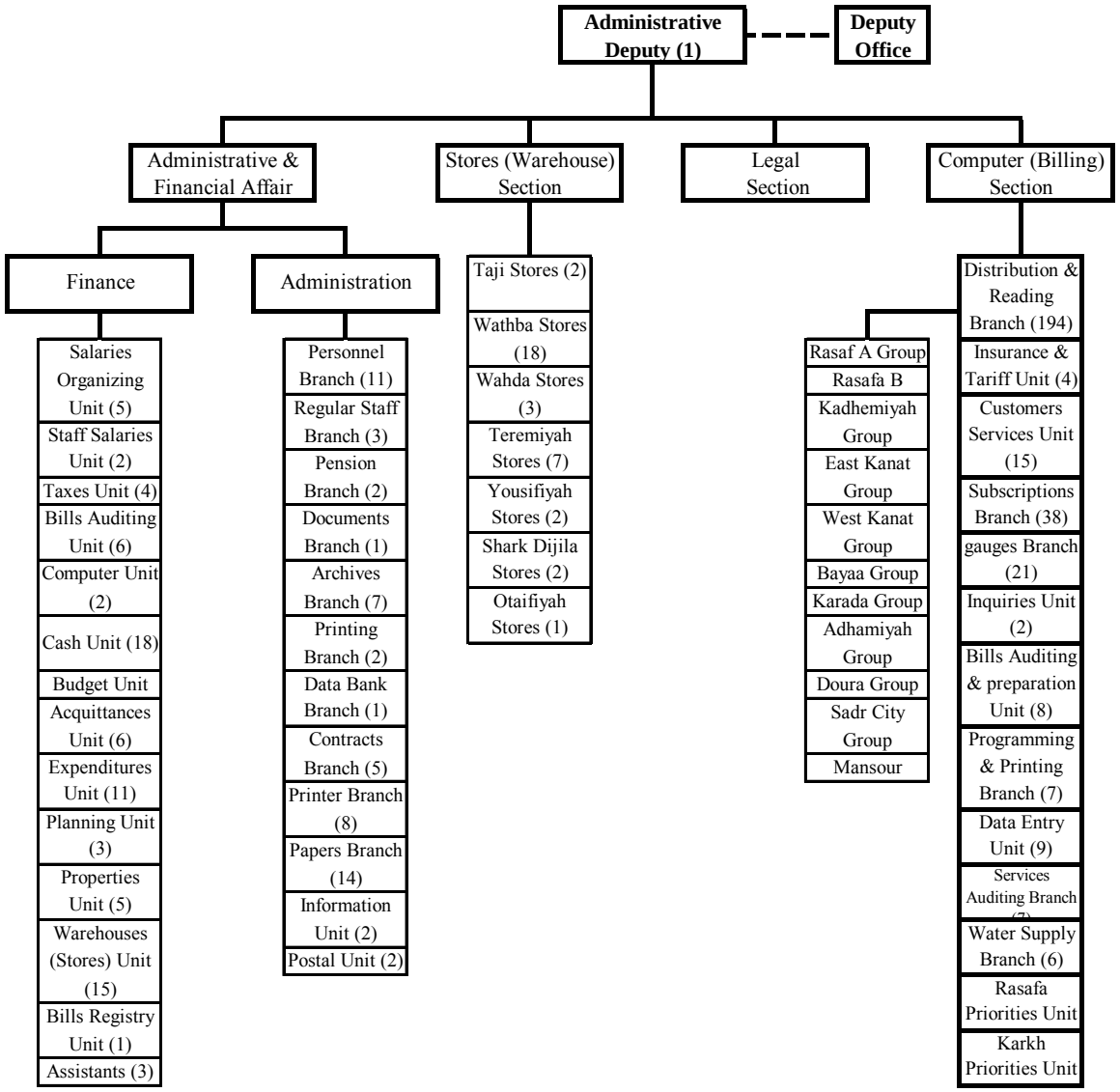
Detailed organizational structures of the 10 sections, consisting of six technical sections and four administrative sections, are shown in Figures 7.2.3 and 7.2.4.

[1] The water distribution network pipes with diameter smaller than 250mm. were transferred to the Municipality directorates of Mayoralty of Baghdad, in 1995. However, according to the third technical meeting dated on 10-12 September, 2006, the Study Team confirmed that currently 13 Municipality directorates manage pipes with diameter smaller than 300mm.



(Source: BWA, as of May 2006)

Figure 7.2.3 Organizational Chart of the Technical Sections of BWA

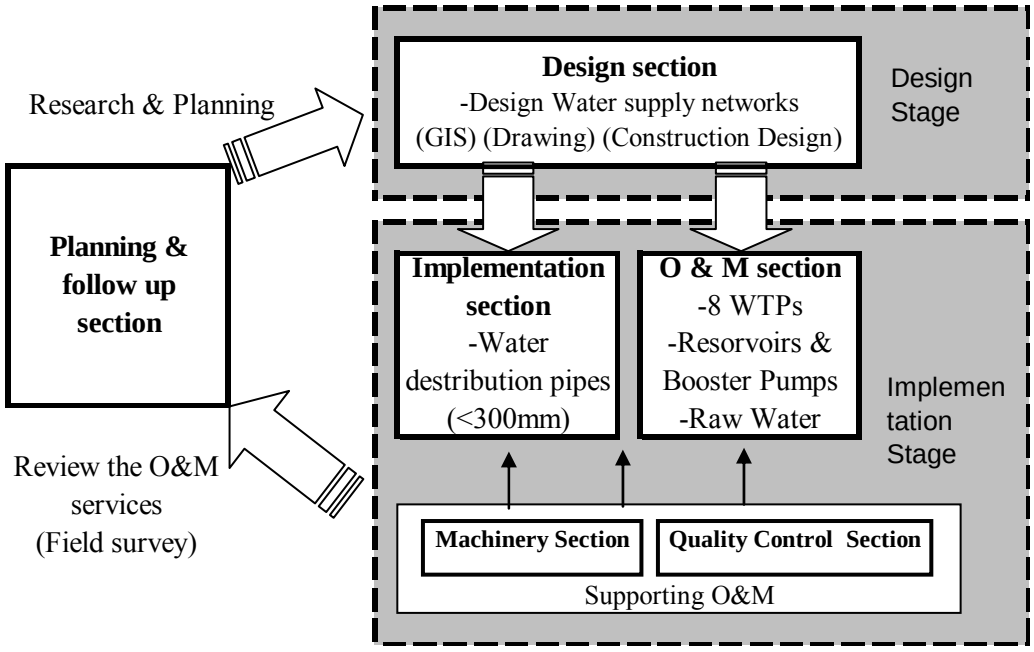


(Source: BWA, as of May 2006)

Figure 7.2.4 Organizational Chart of the Administrative Sections of BWA

The institutional mechanism for water supply services by BWA is shown in Figure 7.2.5.

Firstly, the Design section has the responsibility for designing the entire water supply network in Baghdad. And then, the Implementation section, whose main duty is to carry out operation and maintenance services for water distribution pipes and the Operation and Maintenance section, which deals with operation and maintenance of eight Water Treatment Plants (WTPs), eight reservoirs, booster pump stations, and raw water supply, are responsible for all technical services regarding water supply. The Vehicle (Machinery) section and Quality control section support the above two executing sections' works. As a research and development institution, The Planning and follow up section plays an important role in both the design and implementation stages. Through field research, this section feeds back the operating issues and solutions based on the customer needs analysis to the Design section.



(Source: BWA, as of September 2006)

Figure 7.2.5 Institutional Mechanism of the Water Supply System

Currently, BWA employs about 1,900 staff. The total number of BWA staff in each section and also classifications by technical skills are shown in Table 7.2.1. Only 17% of total are skilled engineers having a bachelor's degree. Because recently BWA had to increase the number of staff drastically, from 600 up to about 2,000 according to the governmental policy.

Table 7.2.1 BWA Staffing

No.	Category	MS.C.	High Diplom	BS.C.	Diploma	Junior High	Mediu m	Elementar y School	Literate*	Total
1	**Director General**			1						**1**
2	Director General Office			5	2	2	2		1	**12**
3	Auditing Section			4	4	9				**17**
4	Tenders & Contracts Section		1	1	1	1				**4**
5	**Administrative Deputy**			1						**1**
6	Deputy Office			1			2			**3**
7	Computer Section			25	44	123	73	54		**319**
8	Administration & Financial Affair Section		1	14	29	57	22	18	7	**148**
9	Legal Section			5	1	0	0	0	0	**6**
10	Stores Section			3	11	8	6	7	3	**38**
11	**Technical Deputy**			2						**2**
12	Deputy Office			4	2	2				**8**
13	Implementation Section	3	4	41	30	47	29	92	23	**269**
14	Machinery (Vehicle) Section			4	2	3	6	33	7	**55**
15	O & M Section		1	132	154	116	135	265	84	**887**
16	Planning and Follow-Up Section			12	5	2			1	**20**
17	Design Section	2		16	13	6	1	3		**41**
18	Quality Control Section	3		45	7	9	6	5	2	**77**
Total		**8**	**7**	**316**	**305**	**385**	**282**	**477**	**128**	**1908**

(Source: BWA, as of June 2006)

Note: *Literate means staff that can read and write but have no academic attainments

7.3 Water Tariffs

Present water tariff regulations were set in 2000 and have not been revised since. According to information from the JICA Integrated Study on Improvement of the Baghdad Water Supply System (Basic Study Report) and comments from BWA staff in the Technical Meeting, the BWA water tariff regulations, shown in Table. 7.3.1, are confirmed as correct.

Table 7.3.1 BWA Water Tariff Regulations

Categories			Rate year 2000* (Iraqi Dinar/ m^3)
Domestic	House hold	1 to 30 m^3/month	2
		31 to 60 m^3/month	5
		61 to 90 m^3/month	7.5
		> 91 m^3/month	20
Non domestic	Governmental subscriber		20
	Private subscriber (Commercial use)		30

(Source: Computer Section, BWA, as of April 2006)

Note: *Exchange rate to US$ had been fixed at 1US$=0.311 ID, from 1983 till 2003.

The ratio of domestic subscribers to non domestic subscribers is about 7 to 1. Although there is no reliable statistical data, more than 50% of all domestic subscribers belong to the

minimum use category of up to 30m^3 per month, according to BWA staff. No information regarding household income or willingness to pay of the people in Baghdad is currently available[2]. However, the above tariff rates are quite low, even if based on the past fixed exchange rate.

As mentioned in a previous section of this chapter, at present only 52 % of the total number of service connections have meters installed. However, 55 % of these meters are malfunctioning. This means that only 23% of the total number of service connections are metered properly. In order to charge water fees to the subscribers without water consumption meters, BWA also sets criteria in accordance with the size of the accommodation as shown in Table 7.3.2.

Table7.3.2 Water Tariff Regulation for Subscribers without Meters

Domestic User (Flat House)			
	Size of Housing	Estimated Consumption (per day)	Monthly Rate (Iraqi Diner/m^3)
1	100 m^2 or less	1 m^3	2
2	100 m^2 to 200 m^2	1.5 m^3	5
3	200 m^2 to 400 m^2	2 m^3	5
4	more than 400 m^2		
	Surface Pipe φ12mm	2.5 m^3	7.5
	Surface Pipe φ18mm	5 m^3	20

Domestic User (Apartment)			
	Type of Housing	Estimated Consumprion (per day)	Monthly Rate (Iraqi Diner/m^3)
5	Located in Drinking Water Shortage Area	1 m^3	2
6	Small Apartment in normal Area	1 m^3	2
7	Large Apartment in normal Area	1.5 m^3	5

Commercial User[a]			
	Type of Housing	Estimated Consumprion (per day)	Monthly Rate (Iraqi Diner/m^3)
8	Company needing much drinking water	4 m^3 to 6 m^3	20
9	Company needing medium drinking water	1.5 m^3	5
10	Company needing little drinking water	1 m^3	2

Note:
a: Company having surface pipe of φ18mm should be estimated twice as the above consumption.

Governmental User
*No Water Charge

(Source: BWA, as of May 2006)

Note: Statistics of the Year 2005.

If BWA continues to rely upon this fixed charge rate, it may lead subscribers to waste water and also to escalate the water shortage. On the other hand, some subscribers intend to install

[2] JICA report on the Engineering Services for the Social and Economic Survey for Iraq Reconstruction: Final Report for Baghdad (JICA Socio-economic reports) estimates avg. per capita household income in 2001 was US$770-US$1,020.

their own meters, since they currently have to pay the fixed rate even though they have frequent suspensions in the water supply due to the lack of water pressure. Under this circumstance, BWA plans to meter all the service connections and replace malfunctioning old water consumption meters thorough the Project.

Raw water tariffs are still at the level of 1995. There are only three categories for raw water, governmental gardens, house gardens and irrigated farms, and tariffs are set for increments of 100 m^3. Respective water rates per 100 m^3 are set at 0.1 ID, 0.05 ID and 1 ID.

According to the water consumption and population data, current average water tariff per m^3 is estimated at 12.6 ID, which converts into USD 0.009. This figure is extremely lower than the average water tariffs of the other neighbour countries. The average water tariff for a typical household in those countries is more than USD 0.50 per m^3, and this figure is almost 55 times higher than the current average water tariff for domestic subscribers of BWA[3]. The water tariff levels of BWA have been quite low because water supply was heavily subsidized under the control of Saddam's administration. This was possible since the excessively centralized government was earning a huge amount of oil revenue. However, the Iraqi's economy has started to shift from being centralized into a market oriented mechanism. It is highly required for BWA, as a water supplying entity, to revise the current unreasonable tariff system on the basis of the real socio-economic level of the citizens.

New registration fee is currently set at 2,600 ID. It consists of 2,500 ID for house connection service cost and 100 ID for registration cost.

As mentioned in Section 7. 1, according to Article 8 under Law Number 16 of the Year 1995, BWA has full responsibility to operate and maintain the water supply services in Baghdad. However, tariff setting is currently the responsibility of the Head of Council of the Prime Minister. If tariff remains unchanged and improvements in efficiency are not applied, fiscal management of BWA will only be worsened, since operating cost in the future is projected to be higher than the current level. In order to establish the sustainable tariff systems based on cost recovery principle, BWA should have certain autonomy to have the responsibility of tariff setting.

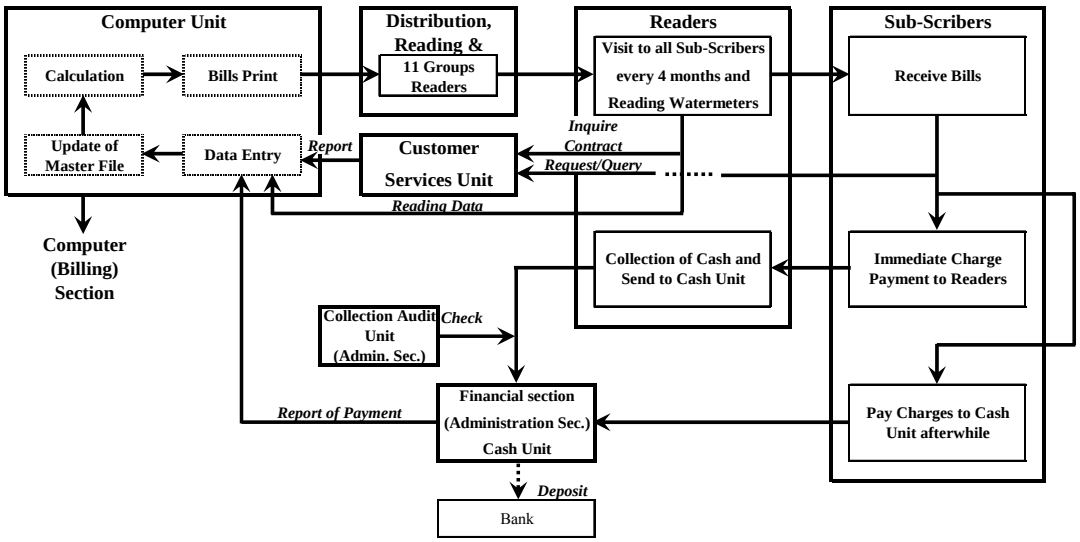
7.4 Billing and Collection

The Computer section and some units of the Administration section have responsibility for the entire chain of tasks from water meter reading to billing and collecting of water charges.

[3] Source: a) World Bank web site of the MENA:
http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/MENAEXT
b) Tariff Study for Syrian Water Sector Final Report, HYDRATEC Consortium (2006),
c) Water Pricing Reform for the Kingdom of Saudi Arabia, Sale Al-Mogrin & Abdulaziz Al-Maziad (2002)

The billing and collection has been carried out every 4 months in principle. Methods for billing and collection are explained as follows[4] (See also Figure 7.4.1):

- Meter readers belonging to the Distribution, Reading and Cash unit are directly visiting all subscribers and reading the consumption meters of each. They are divided into 11 groups according to the distribution area. The each group has a group leader.
- After receiving the information of each subscriber from the meter readers, the computer unit enters the data for each subscriber into the master file of their computer system, and then issues bills. (A copy of a bill slip is shown in Figure 7.4.2) If a subscriber's type of use is changed or illegal use is confirmed, the information is reported to the customer services unit.
- When the meter readers visit the subscribers for reading the water consumption meters, they also collect the water fees for the previous use. Subscribers can either pay the charge directly to the meter readers or visit the cash unit of the Administrative section to pay the charge later.
- Cash collected by the meter readers and that brought in by the subscribers is lodged in the cash unit while the collection and audit unit under the Administrative section compares the money collected by meter readers with the records.
- Finally, the cash unit deposits the revenues in the bank and also reports the payment situation of each subscriber to the computer unit for updating the master file.



(Source: BWA, as of May 2006)

Figure 7.4.1 Billing and Collection Cycle of BWA

[4] In the case of subscribers without meters, meter readers directly visit subscribers and hand them the fixed charge bill. Others are same system as metered subscribers.

The Study team also confirmed the following situation regarding the billing and collection system, according to reports from BWA staff:

- Actual collection ratio remains around 50%.
- Approximately 90% of the subscribers who received the water bills pay their water fees directly to the meter readers. Most of the rest 10% also can complete the payment by the next announcement, since the water fees are very low even for the poorest.
- Time delays occur, although it is almost impossible to estimate the actual time taken for completing the cycle of issuing bills and collecting the water fees since this matter varies with each subscriber.
- Most water consumption meters are inside subscribers' houses. It is very difficult for meter readers to find and read water consumption meters and also collect money during their absence.
- The current security situation surely makes it very difficult to collect water charges.
- In principle, BWA should cut off the water supply to long-term unsettled subscribers. However, under the current unstable social condition, it is quite difficult to suspend water supply services[5].

(Source: BWA, as of May 2006)

Figure 7.4.2 Sample of Bill Slip

7.5 Financial Management

Realistically, there is no concept of financial "Management" in BWA. This is because the financial structure of this entity is entirely dependant upon the annual budget from the Mayoralty of Baghdad. In the technical aspect, BWA is a legally approved entity which operates and manages water supply services in Baghdad. However, since this organization is

[5] However, at present almost 1,000 unsettled subscribers are under the procedure for suspension of water supply.

still one of the administrations of the Mayoralty of Baghdad, BWA does not provide a solid self-management system, such as how to recover its expenditures by increasing revenues, how to provide better and more efficient services for customers, and so forth.

Annual budget allocation to each Ministry is decided at the beginning of the fiscal year in January. The budgeting cycle of BWA is confirmed by BWA staff, as follows:

- Annual expenses are roughly estimated by each technical section (Technical sections are shown in Figures 7.2.3 and 7.2.4). The Design section arranges the total sum.
- The Finance branch under the Administrative and Finance Affairs section receives the budget request from the Design section, for comments and consultations.
- The Technical Deputy contacts the DG of BWA to formally request the planned budget from the Mayoralty of Baghdad.
- After receiving the budget requests from each Administration, the Baghdad Mayoralty allocates the funds to each Administration out of the total budget of the Mayoralty which was allotted by the Ministry of Planning and Development Cooperation and the Ministry of Finance.
- The budget allocated to BWA is reported to both the Technical and Administrative Deputies via the DG.
- The Planning and Follow up section receives the budget information and instructs the other technical sections to readjust their expenditures to the sum of allocated budget from the Mayoralty of Baghdad.

According to information from BWA staff, at present there are two budget schemes allocated by the Mayoralty of Baghdad.

- O&M Budget: this budget is allotted for expenses regarding the wages, the office expenses and daily operation and maintenance. This budget is funded by the Ministry of Finance.
- Investment Development Budget: this budget is disbursed to the each region of Iraq and financed by the Ministry of Planning, Development and Cooperation. It is allotted for project implementation, such as rehabilitation of WTPs, booster stations, compact units, distribution water pipes and so forth. Expenses for purchasing materials and land are also managed by this budget. From the fiscal year 2006, Strategic (Construction Expedition) Investment budget scheme are introduced. This budget is aiming to carry out the huge construction or rehabilitation projects. For instance, the reconstruction projects for the three reservoirs in R5, R7, and R14 are to be financed by this budget. Since these budgets are project based, they are eliminated from the BWA's financial system.

The Annual Budget allocations of recent years are shown as Table 7.5.1. It is obvious that the Iraqi Government limited the allocation of budgets during the economic sanctions and the war. The lack of maintenance and rehabilitation budgets resulted in the deterioration of water supply services.

Table 7.5.1 Annual Budget Allocations of BWA

(ID)

	2002	2003	2004	2005	2006
O&M Budget	3,958,700,000	3,512,250,000	3,204,000,000	6,000,000,000	16,292,250,000
Investment Development Budget	34,470,000,000	130,464,000	66,000,000,000	47,186,000,000	209,520,000,000
Development Plan of Regions	34,470,000,000	130,464,000	66,000,000,000	47,186,000,000	41,000,000,000
Construction Expedition Plan (Strategic Plan)	-	-	-	-	146,020,000,000

(Source: BWA, as of Aug. 2006)

As a basic approach to fiscal analysis, investigating and analyzing financial status by formulating a profit and loss statement for comparing annual revenues with expenditures should be carried out. However, total annual operating expenditures are generally covered by the annual O&M budget. Accordingly, annual operating revenues are not linked to the expenditures in the actual accounting system.

Although there is no reliable fiscal data provided by BWA, the Study Team managed to compile the latest annual expenditures and revenues. Information, although scarce and unreliable, was obtained from UNICEF report [6] and information from BWA staff in the Technical Meetings.

Table 7.5.2 indicates the annual expenditures of BWA in 1999, 2004 and 2005. Operating costs for each year 2004 and 2005 increased drastically compared with 1999. The operating cost was 3,512 million ID in 2004 and 3,282 million ID in 2005. This was because BWA could obtain a larger budget for their capital investment than before due to the lifting of economic sanctions.

Table 7.5.2 Annual Expenditures of BWA

	1999*	2004**	2005**
	ID Million	ID Million	ID Million
Expenditures			
Total Salaries & Wages	324.0	877.6	776.4
Total Materials	610.9	907.4	1,801.3
Total Service Requirements	145.5	319.8	516.6
Total Miscellaneous Expenses[a]	4.8	29.4	143.0
Total Other Expenditures	78.3	1,377.7	44.7
Total Depreciations	58.2	N/A	N/A
Grand Total Expenditures	1,221.8	3,511.9	3,282.0

Note: a, Including Capital Expenses

(Source: *UNICEF Report, **BWA, as of May 2006)

Annual operating revenues are also shown in Table 7.5.2. Water sales in 1999 were quite low, since the minimum water rate for domestic subscribers, which was water use of 1 to 30m^3 per month, was only 0.66 ID per m^3 and the next categories of 31 to 60 m^3 per month, 61 to 90 m^3 per month, and above 90 m^3 per month were respectively set at 1.50, 1.50 and 10 ID per m^3.

6 "Assessment Project of the Water and Sanitation Sector in Iraq". January 2003.

As for the non domestic subscribers, rates of governmental subscribers and private subscribers also remained quite low at 5 ID and 15 ID per m^3 respectively. In 2004, conflicts after the War heavily affected the financial figures.

Table 7.5.3 Annual Revenues of BWA

	1999*	2004**	2005**
	ID Million	ID Million	ID Million
Revenues			
Water Sales	1,288.1	1,137.9	3,103.6
Total Income from Services Provided	36.3	53.3	24.9
Revenues from Operating for Others	0.0	0.0	0.0
Rentals of Land	13.1	N/A	N/A
Transferred Revenues, Penalties	3.6	N/A	N/A
Total Other Income	33.0	0.0	0.1
Grand Total Revenues	1,374.3	1,191.2	3,128.6

(Source: *UNICEF Report, 2003, **BWA, as of May 2006)

Since BWA has no requirement to cover total operating expenditures by its revenues, operating revenues are actually neglected to increase. All revenues obtained by its services are transferred to the Mayoralty of Baghdad. The comparison of O&M budget with total revenues of BWA, therefore, shows the efficiency of operation and management of BWA. Total revenues of BWA in 2004 and 2005 were much less than the amounts of O&M budget allocation, respectively.

Finally, although there is no actual link between annual expenditures and annual revenues in the current financial management system of BWA, the Study Team compiled a profit and loss statement which is shown as Table 7.5.4. The 1999 accounts showed that net operating income somehow achieved 11% of the total operating income, estimated at 152.5 million ID due to the restraint on capital investment under the economic sanctions. Annual Operating Ratio was estimated at 89%. Whereas, the financial statement of 2005 recorded a net deficit of 153.4 million ID, and accordingly the operating ratio was lifted to 105 %.

Table 7.5.4 Profit and Loss Statement of BWA

	1999*		2004**		2005**	
	ID Million	%	ID Million	%	ID Million	%
Expenditures						
Total Salaries & Wages	324.0	24%	877.6	25%	776.4	24%
Total Materials	610.9	44%	907.4	26%	1,801.3	55%
Total Service Requirements	145.5	11%	319.8	9%	516.6	16%
Total Miscellaneous Expenses[a]	4.8	0%	29.4	1%	143.0	4%
Total Other Expenditures	78.3	6%	1,377.7	39%	44.7	1%
Total Depreciations	58.2	4%	N/A	0%	N/A	0%
Grand Total Expenditures	1,221.8	89%	3,511.9	100%	3,282.0	100%
Revenues						
Water Sales	1,288.1	94%	1,137.9	32%	3,103.6	95%
Total Income from Services Provided	36.3	3%	53.3	2%	24.9	1%
Revenues from Operating for Others	0.0	0%	0.0	0%	0.0	0%
Rentals of Land	13.1	1%	N/A	0%	N/A	0%
Transferred Revenues, Penalties	3.6	0%	N/A	0%	N/A	0%
Total Other Income	33.0	2%	0.0	0%	0.1	0%
Grand Total Revenues	1,374.3	100%	1,191.2	34%	3,128.6	95%
Net Income (Deficit)	152.5	11%	-2,320.7	66%	-153.4	5%
Working Ratio		85%		295%		105%
Operating Ratio		89%		295%		105%
Profit Margin		0.11		-1.95		-0.05

(Source: *UNICEF Report 2003, **BWA, as of April 2006)

BWA employs a unified government accounting system similar to the other governmental entities. Different to the general commercial accounting system with a double entry, the accounting system of BWA has no direct link between the actual expenditures and revenues. Although BWA introduces double entry balance sheets for keeping accounts, the system is only linked to the budget from the Mayoralty of Baghdad. This system is frequently used by many non-profit government entities in developing countries.

If the current financial management system and skills of the concerned staff are unchanged, no financial improvement is expected. Total budget received from MOB is generally much lower than the budget planned by BWA. Therefore, BWA can not carry out sufficient operation and maintenance works, for as long as it is relying upon the budget.

CHAPTER 8 PROJECT EVALUATION

8.1 Economic Evaluation

The economic evaluation of projects generally requires an Economic Internal Rate of Return (EIRR) calculation, Net Present Value (NPV) and Cost-benefit analysis. However, since the Study Team cannot access enough information regarding the living conditions in the Baghdad City due to the security issues, it is almost impossible to properly evaluate the economic feasibility, as it is difficult to quantify of all the economic benefits.

It should be recognized that the Project will bring significant economic impacts to the socio-economic situations which has been worsening due to the water supply limitations. For instance, people will be able to save the costs and time taken for securing clean water. Currently, many people in Baghdad City suffer from chronic disruptions to their water supply. The water supply suspensions frequently occur during the daytime in the dry season due to the use of water-cooled air conditioners. Although the BWA supplies water by water tankers in some parts of the Project area, the non-domestic subscribers, especially hospitals and schools, are priorities in terms of receiving the water from the tankers. Consequently, many people have to secure clean water by purchasing the water at markets or by other methods[1]. The improvement of public health will also be expected. Breakages in the deteriorated pipes cause the mixing of contaminated water and clean water. This aggravates the public health situation in Baghdad City[2]. UNICEF also mentioned that the mortality rate in Iraq over the past five years has drastically increased and diarrhoea was one of the main reasons for this mortality rate[3]. The Project will also create a large number of employment opportunities for local people, as the civil works components of the pipe replacements and house connections for the water consumption meters need a huge number of unskilled labours. Due to security reasons the BWA plans to employ local people in the Project area to fulfil this requirement for a large number of unskilled labours.

In addition, improving quality of life is mentioned as a core pillar in the NDS (National Development Strategy). The NDS also strongly asserts that “improving access to clean water and sanitation” is the first priority for improving the quality of life.

Finally, it is concluded that the Project will provide essential impacts for the improvement of living conditions in the Project areas. Based on the overall discussion, it is evaluated that the Project deserves to be executed.

[1] Typical market price of a 20L bottle of water is US$2 in Baghdad City, as of September 2006.
[2] Source: The water supply and sanitation sector study report, JBIC,April 2005 (Japanese Only)
[3] Source: Working Paper, United Nations/World Bank Joint Iraq Needs Assessment-Water and Sanitation, UNICEF, October 2003

8.2 Financial Evaluation

8.2.1 General

A financial evaluation has been conducted by means of a Financial Rate of Return (FIRR) calculation. However, since the current water tariff level is too low to recover even the current operating costs, calculating a positive level of FIRR is almost impossible. The current water tariff level is much lower than the average water tariff level of the neighbouring countries. The figure is also much lower than the water tariff level which the World Bank and other donor agencies recommended[4]. In addition, the ultimate goal of the Project is to reduce the Unaccounted for Water (UFW). Therefore, the Project itself does not generate a huge amount of water revenue by increasing the water supply.

The financial evaluation period for calculating the FIRR is set at 40 years.

8.2.2 Financial Benefits and Costs

(1) Financial Benefits

1) An increase in water revenue due to the pipe replacements

The increase in water revenues is firstly generated due to selling the additional quantity of water equal to the demand level due to the Project implementation. The current annual water consumption of the subscribers of the Project is estimated at about 29.3 $x10^6$ m^3, whereas the annual water demand is estimated at about 29.75 $x10^6$ m^3. This means that the demand of the subscribers is higher than the available water supply due to the inability of the deteriorated water distribution pipes to deliver the required amount. Therefore, the difference of 450,000 m^3 should be the increase in the amount of water that can be delivered by the replacement of the water pipes, at present. If the Project is not executed, it is assumed that the future water consumption will marginally decrease due to the deterioration of the water distribution facilities (without case)[5]. However, the future water demand will increase gradually based on the unit water demand (with case). The annual estimated water demand will reach about 74.7 $x10^6$ m^3 in the target year of 2027, while the annual estimated water consumption will reach about 32.0 $x10^6$ m^3. Finally, the total incremental water supply about by the Project will be about 1,200 $x10^6$ m^3 over the financial evaluation period[6]. The incremental water sales as a result of the Project implementation are calculated to be about US$10.8 million on the basis of the current average water tariff per m^3.

[4] Appendix C.2 of the Supporting Report (Vol.III) explains the current water tariff problem in detail.
[5] In the FIRR calculation, the water consumption for the 'without case' will be decreased by 2% every year until 2027 due to the deterioration of the pipes.
[6] For the calculation, from the year 2027 to the end of financial evaluation period, both the water demand volume and the water consumption volume are consistently set at the level in 2027 due to uncertainties.

2) An increase in water revenue due to the installation of water consumption meters

The installation of about 150,000 water consumption meters for domestic subscribers will also increase the water revenues. This is because the water consumption charges for these newly metered subscribers will be shifted from the flat rate system to the quantitative system. It is projected that the current average flat rate water charge for domestic subscribers is 108 ID[7] per month. At present, the average monthly water consumption per household is estimated at 84.6m^3. This volume of water is sold at 394.5 ID according to the current quantitative tariff system. Therefore, the total incremental water sales by the installation of water consumption meter will be calculated at 512.9 million ID[8] per year.

However, it is understood that currently the BWA can only bill 26.6% of the total number of metered subscribers in Sadr City. As long as the security problems remain unsettled and no additional NRW (Non Revenue Water) improvement activities are conducted by the BWA, the bill collection ratio will remain at this level. As the scope of the Project does not currently include a NRW improvement program[9], the financial benefits of the installation of water consumption meters is accordingly limited to 26.6% of the above figure. Finally, the incremental water sales due to the installation of water consumption meters during the financial evaluation period are calculated at about US$6.1 million.

3) Cost reduction of O&M for leakage loss

The calculation of the reduction in operation and maintenance costs due to the reduction in leakage losses allows for the O&M costs of the water tankers. The annual O&M costs are currently estimated at about US$535,000. The price of a single water tanker, which will be replaced every 10 years, is assumed at US$87,000. The O&M costs of the water tankers are assumed to increase by 2% up untill the year 2027, due to the deteriorated distribution pipes. The total financial benefit of reducing the O&M cost of the water tankers during the financial evaluation period is estimated at about US$31.4 million. The financial benefit of reducing the repair costs for the leaks[10] is excluded from the calculation due to the lack of information.

The financial benefits of the Project are summarized in Table 8.2.1

[7] The average monthly flat rate, 108 ID per month, is calculated based on the weighted average as following; 60 ID (Housing size less than 100m^2) x 80%, 225 ID (from 100m^2 to 200m^2) x 10%, 300 ID (from 200m^2 to 400m^2) x 5%, and 450 ID (more than 400m^2) x 5%

[8] The figure is calculated from the following formula;
286.5 ID (monthly incremental revenue per HH) x 12 month x 149,200 (number of newly metered subscribers).

[9] The improvement of billing and collection is essential for the BWA to achieve the sustainable management. The Study Team strongly recommends that additional assistance for institutional strengthening should be conducted in parallel with project implementation. (See Chapter 9 and Appendix C)

[10] The UNICEP Report mentioned that the average number of leaks repaired was about 1,000 per month on the distribution network and about 200 per month on the trunk mains in 2003. However, the JBIC water sector study report mentioned that the actual number of leaks repaired would be higher.

Table 8.2.1 Financial Benefits

Estimated Financial Benefit (Base Case)

1USD= 1475.262 ID(as of 1st Jun. 2006) In thousand USD/ at 2006 constant price

Project Year	Year	1) Incremental Water Revenues					2) Incremantal revenues by Water meter installation				3) Cost Reduction of Leakage Loss meintenance				Total 1)+2)+3)			
		Unit rate	R2	R3	R14	Total	R2	R3	R14	Total	R2	R3	R14	Total	R2	R3	R14	Total
1	2007	0.009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	2008	0.009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2009	0.009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	2010	0.009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	2011	0.009	-	14	28	42	-	49	37	85	-	10	53	62	-	72	117	189
6	2012	0.009	30	16	33	79	27	50	38	115	645	10	54	709	702	76	124	903
7	2013	0.009	35	19	39	93	28	52	39	119	658	10	55	723	721	81	133	935
8	2014	0.009	40	22	45	107	29	54	40	123	671	10	56	737	740	86	141	968
9	2015	0.009	51	25	51	127	30	55	42	127	685	11	57	752	765	91	150	1,006
10	2016	0.009	57	28	57	143	31	57	43	131	698	11	58	767	786	97	159	1,041
11	2017	0.009	64	32	64	159	32	59	45	136	712	11	59	783	808	102	168	1,077
12	2018	0.009	71	35	71	178	33	61	46	141	727	11	61	798	830	108	178	1,117
13	2019	0.009	79	39	79	197	34	64	48	146	741	11	62	814	854	114	189	1,157
14	2020	0.009	87	43	87	217	35	66	50	151	756	12	63	830	878	121	200	1,198
15	2021	0.009	95	47	95	237	37	68	51	156	771	12	64	847	902	127	211	1,240
16	2022	0.009	103	51	104	258	38	70	53	161	786	12	66	864	927	134	222	1,283
17	2023	0.009	113	56	113	282	39	73	55	167	802	12	67	881	954	141	235	1,330
18	2024	0.009	122	61	123	306	40	75	57	173	818	13	68	899	981	149	248	1,378
19	2025	0.009	132	66	133	332	42	78	59	178	835	13	70	917	1,009	157	261	1,427
20	2026	0.009	143	71	144	358	43	80	61	184	851	13	71	935	1,037	165	275	1,477
21	2027	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
22	2028	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
23	2029	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
24	2030	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
25	2031	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
26	2032	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
27	2033	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
28	2034	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
29	2035	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
30	2036	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
31	2037	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
32	2038	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
33	2039	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
34	2040	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
35	2041	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
36	2042	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
37	2043	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
38	2044	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
39	2045	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
40	2046	0.009	154	77	154	385	45	83	63	190	868	13	72	954	1,067	173	289	1,529
TOTAL			4,292	2,161	4,355	10,808	1,410	2,671	2,014	6,095	28,523	449	2,428	31,400	34,225	5,281	8,797	48,303

(2) Financial Costs

1) Investment costs, including pipe replacement and water consumption meter installation

The investment costs for pipe replacement and water consumption meter installation are estimated at US$99 million. This figure is calculated based on the project costs which were explained in Chapter 6. The price contingency is excluded from the FIRR calculation.

2) Replacement costs for the water consumption meters

The water consumption meters are assumed to be replaced every 10 years after the installation. The replacement costs for the water consumption meters are estimated at US$15.4 million. The replacement work will occur three times during the financial evaluation period.

3) O&M costs

The annual O&M costs for pipe replacements are not expected to be significant. The Study Team have assumed that 0.5% of the civil work component of the construction costs will be sufficient, which was estimated at about US$80,000.

Finally, the total financial costs of the Project are estimated at US$147.9 million, as shown in Table 8.2.2.

Table 8.2.2 Estimated Financial Costs

Estimated Financial Cost

1USD= 1475.262 ID(as of 1st Jun. 2006) In thousand USD/ at 2006 constant price

Project Year	Year	1) Replacement & installation Costs				2) Replacement of water meters				3) O&M cost for Pipe Replacement				Total 1)+2)+3)			
		R2	R3	R14	Total	R2	R3	R14	Total	R2	R3	R14	Total	R2	R3	R14	Total
1	2007	962	471	888	2,321				-				-	962	471	888	2,321
2	2008	-	12,557	-	12,557				-				-	-	12,557	-	12,557
3	2009	-	5,829	24,755	30,584				-				-	-	5,829	24,755	30,584
4	2010	25,960	699	11,751	38,410				-				-	25,960	699	11,751	38,410
5	2011	15,253			15,253				-				-	15,253	-	-	15,253
6	2012				-				-	38	11	31	80	38	11	31	80
7	2013				-				-	38	11	31	80	38	11	31	80
8	2014				-				-	38	11	31	80	38	11	31	80
9	2015				-				-	38	11	31	80	38	11	31	80
10	2016				-				-	38	11	31	80	38	11	31	80
11	2017				-				-	38	11	31	80	38	11	31	80
12	2018				-		3,916		3,916	38	11	31	80	38	3,927	31	3,996
13	2019				-		1,372	3,539	4,911	38	11	31	80	38	1,383	3,570	4,991
14	2020				-	2,629	421	2,012	5,062	38	11	31	80	2,667	432	2,043	5,142
15	2021				-	1,491			1,491	38	11	31	80	1,529	11	31	1,571
16	2022				-				-	38	11	31	80	38	11	31	80
17	2023				-				-	38	11	31	80	38	11	31	80
18	2024				-				-	38	11	31	80	38	11	31	80
19	2025				-				-	38	11	31	80	38	11	31	80
20	2026				-				-	38	11	31	80	38	11	31	80
21	2027				-				-	38	11	31	80	38	11	31	80
22	2028				-		3,916		3,916	38	11	31	80	38	3,927	31	3,996
23	2029				-		1,372	3,539	4,911	38	11	31	80	38	1,383	3,570	4,991
24	2030				-	2,629	421	2,012	5,062	38	11	31	80	2,667	432	2,043	5,142
25	2031				-	1,491			1,491	38	11	31	80	1,529	11	31	1,571
26	2032				-				-	38	11	31	80	38	11	31	80
27	2033				-				-	38	11	31	80	38	11	31	80
28	2034				-				-	38	11	31	80	38	11	31	80
29	2035				-				-	38	11	31	80	38	11	31	80
30	2036				-				-	38	11	31	80	38	11	31	80
31	2037				-				-	38	11	31	80	38	11	31	80
32	2038				-		3,916		3,916	38	11	31	80	38	3,927	31	3,996
33	2039				-		1,372	3,539	4,911	38	11	31	80	38	1,383	3,570	4,991
34	2040				-	2,629	421	2,012	5,062	38	11	31	80	2,667	432	2,043	5,142
35	2041				-	1,491			1,491	38	11	31	80	1,529	11	31	1,571
36	2042				-				-	38	11	31	80	38	11	31	80
37	2043				-				-	38	11	31	80	38	11	31	80
38	2044				-				-	38	11	31	80	38	11	31	80
39	2045				-				-	38	11	31	80	38	11	31	80
40	2046				-				-	38	11	31	80	38	11	31	80
TOTAL		42,175	19,556	37,394	99,125	12,360	17,127	16,653	46,140	1,328	377	1,091	2,797	55,863	37,060	55,138	148,062

8.2.3 FIRR

The resulting FIRR is -9.5% on the basis of the current water tariff level, as shown in Table 8.2.3. Since the Project does not aim to generate the increase of the water sales but to rehabilitate the deteriorated distribution pipes, the fiscal benefits are basically not expected as much by the Project implementation. Of course, the current water tariff level is also the main factor to diminish the financial benefit greatly. The FIRR result shows that there is a huge gap of financial feasibility between R2 and R3. The FIRR of R2 is -3.3% whereas the FIRR of R3 is -25.9%. The number of beneficiaries of R2 is much larger than that of R3, whereas the number of water consumption meters installed in R3 is almost twice that of R2. This is because water supply improvement projects have been ongoing in many Mahalas in R3.

For the future reference, if the bill collection ratio is improved gradually up to 80% in 2027[11], because of the efforts by BWA, the FIRR is slightly improved at -7.1% (Table 8.2.4). The figure indicates that even the efforts for improving NRW does not generate so much financial benefit if the revision of water tariff is not conducted.

[11] After 2027 till the Project year-end, the bill collection ratio is assumed as consistent at 80%.

Table 8.2.3 FIRR (Base Case)

FIRR (Base case)

1USD= 1,475 ID(as of 1st Jun. 2006) In thousand USD/ at 2006 constant price

Project Year	Year	Financial Costs				Financial Benefits				Benefit - Cost			
		R2	R3	R14	Total	R2	R3	R14	Total	R2	R3	R14	Total
1	2007	962	471	888	2,321	0	0	0	0	-962	-471	-888	-2,321
2	2008	0	12,557	0	12,557	0	0	0	0	0	-12,557	0	-12,557
3	2009	0	5,829	24,755	30,584	0	0	0	0	0	-5,829	-24,755	-30,584
4	2010	25,960	699	11,751	38,410	0	0	0	0	-25,960	-699	-11,751	-38,410
5	2011	15,253	0	0	15,253	0	72	117	189	-15,253	72	117	-15,064
6	2012	38	11	31	80	702	76	124	903	664	66	93	823
7	2013	38	11	31	80	721	81	133	935	683	70	101	855
8	2014	38	11	31	80	740	86	141	968	702	75	110	888
9	2015	38	11	31	80	765	91	150	1,006	727	81	119	926
10	2016	38	11	31	80	786	97	159	1,041	748	86	128	961
11	2017	38	11	31	80	808	102	168	1,077	770	91	137	997
12	2018	38	3,927	31	3,996	830	108	178	1,117	793	-3,819	147	-2,879
13	2019	38	1,383	3,570	4,991	854	114	189	1,157	816	-1,269	-3,381	-3,834
14	2020	2,667	432	2,043	5,142	878	121	200	1,198	-1,789	-311	-1,844	-3,944
15	2021	1,529	11	31	1,571	902	127	211	1,240	-627	116	179	-331
16	2022	38	11	31	80	927	134	222	1,283	889	123	191	1,203
17	2023	38	11	31	80	954	141	235	1,330	916	130	204	1,250
18	2024	38	11	31	80	981	149	248	1,378	943	138	217	1,298
19	2025	38	11	31	80	1,009	157	261	1,427	971	146	230	1,347
20	2026	38	11	31	80	1,037	165	275	1,477	999	154	244	1,397
21	2027	38	11	31	80	1,067	173	289	1,529	1,029	162	258	1,449
22	2028	38	3,927	31	3,996	1,067	173	289	1,529	1,029	-3,754	258	-2,467
23	2029	38	1,383	3,570	4,991	1,067	173	289	1,529	1,029	-1,210	-3,281	-3,462
24	2030	2,667	432	2,043	5,142	1,067	173	289	1,529	-1,600	-259	-1,754	-3,613
25	2031	1,529	11	31	1,571	1,067	173	289	1,529	-462	162	258	-42
26	2032	38	11	31	80	1,067	173	289	1,529	1,029	162	258	1,449
27	2033	38	11	31	80	1,067	173	289	1,529	1,029	162	258	1,449
28	2034	38	11	31	80	1,067	173	289	1,529	1,029	162	258	1,449
29	2035	38	11	31	80	1,067	173	289	1,529	1,029	162	258	1,449
30	2036	38	11	31	80	1,067	173	289	1,529	1,029	162	258	1,449
31	2037	38	11	31	80	1,067	173	289	1,529	1,029	162	258	1,449
32	2038	38	3,927	31	3,996	1,067	173	289	1,529	1,029	-3,754	258	-2,467
33	2039	38	1,383	3,570	4,991	1,067	173	289	1,529	1,029	-1,210	-3,281	-3,462
34	2040	2,667	432	2,043	5,142	1,067	173	289	1,529	-1,600	-259	-1,754	-3,613
35	2041	1,529	11	31	1,571	1,067	173	289	1,529	-462	162	258	-42
36	2042	38	11	31	80	1,067	173	289	1,529	1,029	162	258	1,449
37	2043	38	11	31	80	1,067	173	289	1,529	1,029	162	258	1,449
38	2044	38	11	31	80	1,067	173	289	1,529	1,029	162	258	1,449
39	2045	38	11	31	80	1,067	173	289	1,529	1,029	162	258	1,449
40	2046	38	11	31	80	1,067	173	289	1,529	1,029	162	258	1,449
TOTAL		55,863	37,060	55,138	148,062	34,225	5,281	8,797	48,303	-21,638	-31,780	-46,341	-99,759
										FIRR			
										-3.3%	*-25.9%*	*-22.1%*	***-9.5%***

Table 8.2.4 FIRR (Bill collection 80% in 2027)

FIRR (Achieving bill collection ratio (BCR) 80% in 2027)

1USD= 1,475 ID(as of 1st Jun. 2006) at 2006 constant price

Project Year	Year	Financial Costs				Financial Benefits				Benefit - Cost			
		R2	R3	R14	Total	R2	R3	R14	Total	R2	R3	R14	Total
1	2007	962	471	888	2,321	0	0	0	0	-962	-471	-888	-2,321
2	2008	0	12,557	0	12,557	0	0	0	0	0	-12,557	0	-12,557
3	2009	0	5,829	24,755	30,584	0	0	0	0	0	-5,829	-24,755	-30,584
4	2010	25,960	699	11,751	38,410	0	0	0	0	-25,960	-699	-11,751	-38,410
5	2011	15,253	0	0	15,253	0	92	132	225	-15,253	92	132	-15,028
6	2012	38	11	31	80	716	102	144	961	678	91	113	881
7	2013	38	11	31	80	738	113	157	1,008	700	102	125	928
8	2014	38	11	31	80	761	124	170	1,055	723	114	139	975
9	2015	38	11	31	80	789	136	184	1,109	751	126	153	1,030
10	2016	38	11	31	80	814	149	198	1,161	776	138	167	1,081
11	2017	38	11	31	80	840	162	213	1,214	802	151	182	1,135
12	2018	38	3,927	31	3,996	867	176	230	1,273	829	-3,751	198	-2,723
13	2019	38	1,383	3,570	4,991	895	191	247	1,333	857	-1,192	-3,323	-3,658
14	2020	2,667	432	2,043	5,142	924	207	265	1,395	-1,743	-225	-1,779	-3,747
15	2021	1,529	11	31	1,571	954	223	283	1,460	-575	212	252	-111
16	2022	38	11	31	80	984	240	302	1,526	946	229	271	1,446
17	2023	38	11	31	80	1,017	258	323	1,598	979	247	292	1,518
18	2024	38	11	31	80	1,050	278	345	1,673	1,012	267	314	1,593
19	2025	38	11	31	80	1,085	298	368	1,750	1,047	287	336	1,670
20	2026	38	11	31	80	1,120	318	391	1,829	1,082	307	360	1,749
21	2027	38	11	31	80	1,156	340	415	1,911	1,118	329	384	1,831
22	2028	38	3,927	31	3,996	1,156	340	415	1,911	1,118	-3,587	384	-2,085
23	2029	38	1,383	3,570	4,991	1,156	340	415	1,911	1,118	-1,043	-3,155	-3,080
24	2030	2,667	432	2,043	5,142	1,156	340	415	1,911	-1,511	-92	-1,628	-3,231
25	2031	1,529	11	31	1,571	1,156	340	415	1,911	-373	329	384	340
26	2032	38	11	31	80	1,156	340	415	1,911	1,118	329	384	1,831
27	2033	38	11	31	80	1,156	340	415	1,911	1,118	329	384	1,831
28	2034	38	11	31	80	1,156	340	415	1,911	1,118	329	384	1,831
29	2035	38	11	31	80	1,156	340	415	1,911	1,118	329	384	1,831
30	2036	38	11	31	80	1,156	340	415	1,911	1,118	329	384	1,831
31	2037	38	11	31	80	1,156	340	415	1,911	1,118	329	384	1,831
32	2038	38	3,927	31	3,996	1,156	340	415	1,911	1,118	-3,587	384	-2,085
33	2039	38	1,383	3,570	4,991	1,156	340	415	1,911	1,118	-1,043	-3,155	-3,080
34	2040	2,667	432	2,043	5,142	1,156	340	415	1,911	-1,511	-92	-1,628	-3,231
35	2041	1,529	11	31	1,571	1,156	340	415	1,911	-373	329	384	340
36	2042	38	11	31	80	1,156	340	415	1,911	1,118	329	384	1,831
37	2043	38	11	31	80	1,156	340	415	1,911	1,118	329	384	1,831
38	2044	38	11	31	80	1,156	340	415	1,911	1,118	329	384	1,831
39	2045	38	11	31	80	1,156	340	415	1,911	1,118	329	384	1,831
40	2046	38	11	31	80	1,156	340	415	1,911	1,118	329	384	1,831
TOTAL		55,863	37,060	55,138	148,062	36,675	9,858	12,250	58,784	-19,188	-27,202	-42,889	-89,278
										FIRR			
										-2.8%	*-14.5%*	*-14.3%*	***-7.1%***

As a criterion for judging the execution of a loan project, more than 10% of FIRR is generally recommended by International donor agencies[12]. Therefore, the Study Team finally calculated the necessary water tariff level in order to achieve 10% of FIRR. The simulation of FIRR calculation indicates that the unit water revenue per m^3 must be US$0.493 as shown in Table 8.2.5. This figure is almost 55 times higher than the current level. Even though the bill collection ratio is improved same as above 80% by 2027, US$0.485 for the unit water revenue per m^3, 53.9 times higher than the current level, is required to achieve 10% of FIRR as shown in Table 8.2.6.

Above figures are provisional and calculated based on the cost-recovery principle. However, it is impossible to revise into such the high levelled figures in practice. Therefore, subsidiary scheme from MOB should be considered to implement the water supply project. In this regard, it is necessary for the BWA to conduct willingness to pay survey for the actual water tariff setting in the future. (See Appendix C)

Table 8.2.5 FIRR (Base Case) to achieve 10%

Estimated Financial Benefit (FIRR=10% unit water revenue)

1USD= 1475.262 ID(as of 1st Jun. 2006) In thousand USD/ at 2006 constant price

Project Year	Year	1) Incremental Water Revenues					2) Incremantal revenues by Water meter installation				3) Cost Reduction of Leakage Loss meintenance				Total 1)+2)+3)			
		Unit rate	R2	R3	R14	Total	R2	R3	R14	Total	R2	R3	R14	Total	R2	R3	R14	Total
1	2007	0.4925	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	2008	0.4925	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2009	0.4925	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	2010	0.4925	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	2011	0.4925	-	758	1,528	2,286	-	49	37	85	-	10	53	62	-	817	1,617	2,434
6	2012	0.4925	1,629	896	1,805	4,330	27	50	38	115	645	10	54	709	2,301	956	1,896	5,153
7	2013	0.4925	1,914	1,053	2,121	5,089	28	52	39	119	658	10	55	723	2,600	1,115	2,215	5,930
8	2014	0.4925	2,209	1,215	2,448	5,873	29	54	40	123	671	10	56	737	2,910	1,279	2,545	6,733
9	2015	0.4925	2,771	1,383	2,786	6,941	30	55	42	127	685	11	57	752	3,486	1,449	2,885	7,820
10	2016	0.4925	3,119	1,557	3,136	7,811	31	57	43	131	698	11	58	767	3,848	1,625	3,237	8,710
11	2017	0.4925	3,478	1,736	3,497	8,711	32	59	45	136	712	11	59	783	4,222	1,806	3,601	9,629
12	2018	0.4925	3,883	1,938	3,904	9,725	33	61	46	141	727	11	61	798	4,642	2,010	4,011	10,663
13	2019	0.4925	4,301	2,147	4,325	10,773	34	64	48	146	741	11	62	814	5,077	2,222	4,434	11,733
14	2020	0.4925	4,734	2,363	4,760	11,857	35	66	50	151	756	12	63	830	5,525	2,440	4,873	12,838
15	2021	0.4925	5,182	2,586	5,210	12,978	37	68	51	156	771	12	64	847	5,989	2,666	5,325	13,981
16	2022	0.4925	5,644	2,817	5,675	14,137	38	70	53	161	786	12	66	864	6,469	2,899	5,794	15,162
17	2023	0.4925	6,160	3,074	6,194	15,428	39	73	55	167	802	12	67	881	7,001	3,159	6,315	16,476
18	2024	0.4925	6,694	3,341	6,730	16,764	40	75	57	173	818	13	68	899	7,552	3,428	6,855	17,836
19	2025	0.4925	7,245	3,616	7,285	18,146	42	78	59	178	835	13	70	917	8,122	3,707	7,413	19,241
20	2026	0.4925	7,816	3,901	7,858	19,575	43	80	61	184	851	13	71	935	8,710	3,994	7,990	20,694
21	2027	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
22	2028	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
23	2029	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
24	2030	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
25	2031	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
26	2032	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
27	2033	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
28	2034	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
29	2035	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
30	2036	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
31	2037	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
32	2038	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
33	2039	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
34	2040	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
35	2041	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
36	2042	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
37	2043	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
38	2044	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
39	2045	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
40	2046	0.4925	8,406	4,195	8,451	21,052	45	83	63	190	868	13	72	954	9,318	4,291	8,586	22,196
TOTAL			234,892	118,280	238,289	591,461	1,410	2,671	2,014	6,095	28,523	449	2,428	31,400	264,824	121,400	242,731	628,956

[12] This figure is NOT a condition for the decision of a loan project.

Table 8.2.6 FIRR to achieve 10% (Billing collection 80% in 2027)

Estimated Financial Benefit (FIRR10%, achieving BCR 80% in 2027)

1USD= 1475.262 ID(as of 1st Jun. 2006)

In thousand USD/ at 2006 constant price

Project Year	Year	1) Incremental Water Revenues					2) Incremantal revenues by Water meter installation				3) Cost Reduction of Leakage Loss meintenance				Total 1)+2)+3)			
		Unit rate	R2	R3	R14	Total	R2	R3	R14	Total	R2	R3	R14	Total	R2	R3	R14	Total
1	2007	0.485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	2008	0.485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2009	0.485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	2010	0.485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	2011	0.485	-	747	1,505	2,252	-	69	52	120	-	10	53	62	-	825	1,609	2,434
6	2012	0.485	1,604	882	1,778	4,264	41	76	57	173	645	10	54	709	2,290	968	1,888	5,146
7	2013	0.485	1,885	1,037	2,089	5,011	45	84	63	192	658	10	55	723	2,588	1,131	2,207	5,926
8	2014	0.485	2,176	1,197	2,411	5,784	49	92	69	211	671	10	56	737	2,896	1,299	2,536	6,732
9	2015	0.485	2,729	1,362	2,744	6,835	54	101	76	230	685	11	57	752	3,468	1,473	2,877	7,818
10	2016	0.485	3,071	1,533	3,088	7,692	59	110	83	251	698	11	58	767	3,829	1,653	3,229	8,711
11	2017	0.485	3,425	1,709	3,444	8,578	64	119	90	273	712	11	59	783	4,201	1,839	3,593	9,634
12	2018	0.485	3,824	1,908	3,844	9,576	70	130	98	297	727	11	61	798	4,620	2,049	4,003	10,672
13	2019	0.485	4,236	2,114	4,259	10,609	76	140	106	322	741	11	62	814	5,052	2,266	4,427	11,745
14	2020	0.485	4,662	2,327	4,687	11,676	82	152	115	348	756	12	63	830	5,500	2,490	4,865	12,855
15	2021	0.485	5,103	2,547	5,131	12,780	88	164	124	375	771	12	64	847	5,962	2,722	5,318	14,003
16	2022	0.485	5,559	2,774	5,589	13,921	95	176	133	403	786	12	66	864	6,440	2,962	5,787	15,189
17	2023	0.485	6,066	3,028	6,099	15,193	102	190	143	435	802	12	67	881	6,971	3,230	6,309	16,509
18	2024	0.485	6,592	3,290	6,627	16,509	110	204	154	467	818	13	68	899	7,519	3,506	6,849	17,875
19	2025	0.485	7,135	3,561	7,174	17,869	118	219	165	501	835	13	70	917	8,087	3,792	7,408	19,287
20	2026	0.485	7,697	3,841	7,739	19,276	126	234	176	536	851	13	71	935	8,674	4,088	7,986	20,748
21	2027	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
22	2028	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
23	2029	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
24	2030	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
25	2031	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
26	2032	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
27	2033	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
28	2034	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
29	2035	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
30	2036	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
31	2037	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
32	2038	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
33	2039	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
34	2040	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
35	2041	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
36	2042	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
37	2043	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
38	2044	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
39	2045	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
40	2046	0.485	8,278	4,131	8,323	20,731	134	250	188	572	868	13	72	954	9,280	4,394	8,583	22,257
TOTAL			231,315	116,479	234,660	582,454	3,860	7,248	5,467	16,575	28,523	449	2,428	31,400	263,698	124,176	242,555	630,429

8.3 Technical Evaluation

The main scope of the Project includes the replacement of water distribution pipes and the installation of approximately 150,000 water consumption meters. Meter installation works will be carried out by contractors. The maintenance work on the water consumption meters is less difficult and can be handled by the BWA mechanics. As for the replacement of the water distribution pipes, the BWA and related Municipalities have already carried out rehabilitation of the distribution pipelines in some parts of R3 and R14 under the assistance of USAID.

Accordingly, the Project is considered viable in terms of a technical evaluation. An issue that causes apprehension is that the BWA would have to increase the number of mechanics in the existing maintenance units for both the water consumption meters and distribution pipes, since the BWA and the Municipalities have almost no experience with such large volumes of work at once.

A District Meter Area (DMA) system will be introduced after the completion of the replacement of the water distribution pipes and the installation of the water consumption meters to measure the leakage from the system for the reduction of UFW. JICA has been performing mass training of BWA staff on UFW reduction program since 2005. The BWA will need to set up functional units for an action plan for UFW reduction and conduct of a pilot study of the DMAs based on the JICA training.

8.4 Institutional Evaluation

Unlike the typical cases of Governmental departments in developing countries, the staff of the BWA seems reasonable. For instance, the number of staff members per 1,000 connections and per 1,000 people served are typically used as indicators to reflect the operational efficiency of water supply entities. The World Bank criteria set the target at five staff per 1,000 connections and fewer than 0.94 staff per 1,000 people served for developing countries. In the case of the BWA, the number of staff per 1,000 connections is currently 3.4[13]. This figure is much better than the average staffing level for developing countries that have more than 20 staff per 1,000 connections. The number of staff per 1,000 people served is calculated at 0.33[14]. As mentioned in the previous chapter, the BWA also allocates the work tasks effectively in each section. The technical skills of the BWA staff are generally high, even though the country has had a difficult situation for human resource development during the economic sanctions and wartime. In particular, the senior engineers of each section are quite excellent.

However, the current monitoring and management systems in the BWA are still weak. The financial management of the BWA is inefficient due to the high dependence on the budget provided by the Mayoralty of Baghdad (MOB). As long as they are financially relying on the MOB, it will not be possible to secure income to cover the O&M costs. In order to provide a sustainable and reliable water supply service, the 'cost recovery management' rule should be prevalent among all of the BWA staff. In this context, the BWA should have a certain level of autonomy which enables them to set and revise the water tariff regulations.

Personnel management also should be improved. At present, unaccountable personnel transfers occur frequently. As an executing agency of the Project, the BWA should have a substantial and transparent personnel management system. Finally, establishing a monitoring system is essential for the smooth execution of the Project. If the newly installed water consumption meters are not used properly or the water fee collection works are not carried out completely, the expected project impacts will not be attained.

From the foregoing discussions it is apparent that if no improvements are made in the current institutional issues the Project can not be justified institutionally. Therefore, the Study Team recommends that an additional institutional strengthening project, for the purpose of the improvement of the financial management systems and also legislative strengthening, should be carried out by foreign consultants in parallel with the project implementation.

[13] The total number of service connections as of 2005 was estimated at 555,600, whereas the current total number of staff is approximately 1,900.
[14] The total number of people served as was estimated at 5,595,000 in 2005. The BWA assumes that 100% of the population in Baghdad city can access the potable water via the water distribution services of the BWA.

8.5 Environmental Impacts of the Proposed Projects

8.5.1 Overall Environmental Impacts of the Proposed Projects

(1) Environmental Examination Process in Iraq

1) Screening and Scoping

Screening and scoping for the planning of the project were conducted in compliance with the Iraqi environmental law and JICA guidelines. The results of these processes are shown in the SUPPORTING REPORT in Volume III. The proposed project was rated as category 'B' according to the screening conducted by the Environmental Department of the Mayoralty of Baghdad (MOB).

2) Initial Environmental Examination (IEE)

An initial environmental Examination (IEE) was conducted by the Environmental Department of the MOB. The main items on the IEE affecting the environment either positively or negatively that could be caused by the implementation of the proposed projects are as follows;

Positive impacts	Negative impacts
• Reducing UFW leads to reducing the cost of the operation and maintenance of the water supply network	• Fine fibres of Asbestos Cement Pipes (ACP) affect human health • Blocking traffic during construction • Noise from heavy machines • Generating waste soil • Possibility of damaging underground utilities

3) Disclosure of Information and Stakeholder Meetings

The process for disclosure of information and stakeholder meetings basically occurs after screening. However, as the project under study has no severe negative affect on the citizens, therefore BWA participated alone in the discussion and information exchange with the Environmental department in the MOB, which is in charge of preparing the Environmental Impact Assessment (EIA) report.

(2) Important Environmental Factors

The environmental examination identified that the following potential environmental factors are related to the implementation of the proposed projects.

1) Social Environment

It is supposed that no new land acquisition, resettlement or damage to cultural assets will take place in the proposed project area because the new pipe installation work will be carried out along the same path as the existing pipes, which are installed under the roads.

There is a possibility that the noise and vibration caused by using heavy machines during construction works of excavating the ground or cutting of pipes could affect the psychological health of the people.

Blocking the traffic during the construction has to be minimized to affect usual daily life or commercial activities although the replacement works are unlikely to have a significant impact around the proposed area.

2) Natural Environment

Flora and Fauna will not be affected because new Ductile Iron Pipes (DIP) are to be installed along the same paths as the old pipes, which are under the roads.

3) Pollution

There is a possibility of health problems to the persons engaging in the removal or cutting of old ACP due to absorbing fine fibres of asbestos.

There is a possibility that the chlorinated water discharged to the river could affect the environment negatively.

It is possible to contaminate the waste soil if sewage or drainage pipes lying near the old ACP are broken by the excavating machine during construction.

8.5.2 EIA for the Proposed Project

An EIA was conducted by the Environmental Department of the MOB in cooperation with the JICA study team through discussions in the technical meeting in Amman. The main impacts due to the proposed project implementation as listed in section 8.5.1 are considered in detail as follows;

(1) Noise and Vibration

The level of noise and vibration due to the use of heavy machines such as excavators and compactors during removal or cutting of old ACP have to be minimized, although construction work will not be carried out during the night time due to the current security problems in Iraq. The expected level of noise and vibration is not hazardous to the general health of the people since it is supposed that the level of noise will be the same as traffic noise during the daytime.

(2) Effect on Health by Disposal of old Asbestos Cement Pipes

The released dust has to be minimized during the construction.

The replacement of old ACP will be done without cutting as much as possible. Old ACP will be left buried in situ after replacement with the new DIP. When cutting old ACP, workers will use masks to protect themselves against fine fibres of ACP and spray water on the construction site in order to keep it wet during construction.

USAID published a Weekly update dated July 28, 2005, in which disposal of old ACP was mentioned. The article concluded that the form of disposal currently being proposed would be suitable. It was proposed that the old ACP was also to be left buried in that project.

(3) Discharged Water

Disinfection of the inside of pipes is necessary after installation of new pipes. Normally a 10ppm concentration of chlorinated water is used for disinfection of pipes in Japan. The location where the chlorinated water is to be discharged must be investigated from the viewpoint of negative environmental effects.

According to the technical specifications of the USAID project dated February 8, 2005, the environment to which the chlorinated water is to be discharged shall be inspected. If there is any possibility that the chlorinated discharge will cause damage to the environment, then a neutralizing chemical shall be applied to the water to be wasted to thoroughly neutralize the residual chlorine.

(4) Waste Soil

Excavated soil shall be used mainly as backfill material. The sewer and drainage locations must be identified before pipe replacement work begins in the project. A typical section of the underground facilities such as sewer, telecommunication and electricity is shown in DATA BOOK 2 of Volume IV. It seems that they will not be affected during construction.

8.5.3 Conclusions

IEE and EIA were conducted by the Iraqi side through the Environmental Department of the MOB in cooperation with the JICA study team through discussions in the technical meeting in Amman.

The EIA report (see attached in DATA BOOK 3 in Volume IV) was approved by the Ministry of Environment (MOE). It was confirmed that no Environmental Law and/or Guideline in Iraq prescribes the elimination of ACP as shown in the attached letter in DATA BOOK 3 in Volume IV. The MOE approved the proposal that the ACP will be left buried in situ after the Project implementation.

CHAPTER 9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions and Recommendations

(Proposed Project)

1. It is recommended that the following projects proceed immediately to the implementation stage and that they follow the proposed schedule to minimize Unaccounted for Water (UFW) figures and reduce chronic water shortage problems :
    a) Replacement of distribution tertiary in the 18 Mahalahs in Water Supply Zones (WSZs) R3, R14 and R2

        A program for replacement of tertiary distribution to reduce the leaking in the older damaged Asbestos Cement Pipe (ACP) and Cast Iron Pipe (CIP) and thus improve the existing distribution system and ensure a secure water supply.

    b) Installation of water meters for all subscribers in WSZs R3, R14 and R2

        The purpose of installation of water meters is to observe the water consumption of R3, R14 and R2 for monitoring the water supply losses in the distribution systems.

2. The priority areas, which are located on the Rasafa Site, were selected because of their high population density and critical shortage water. The distribution networks of R3, R14 and R2 serve an area of 65.6 km^2 and a population of 1.5 million persons. Daily maximum water supply and peak hourly supply are 10.9 m^3 and 18.1 m^3 respectively.
3. The proposed improvement plan for R3, R14, R2, which is outlined following, will be carried out starting in 2007 and be completed by the year 2011. The total length of distribution pipeline is 294 km with diameters varying from DN 150 mm to DN 300 mm. Distribution tertiary replacement and water consumption meter installation are proposed to be implemented as priority projects. The pipe replacement project consists of a total of 294 km of pipe replacement work at selected Mahalahs in R3, R14, and R2. The water consumption meter installation project consists of a total of about 149,200 meters in all Mahalahs in R3, R14, and R2, including Mahalahs where older distribution pipes were replaced by BWA and foreign assistance activities.
4. Recommendations for implementation schedules
    - Completing the R3-Sadr Water Treatment Plant (WTP), by 2006 as scheduled

- Completing the new service reservoir for R14 by 2008
- Commencing the UFW action plan in 2007
- Replacing old and defective meters and installing new meters on un-metered service connections starting in 2008 and providing a yearly program for implementation.
- Replacing old distribution pipelines and related service connections at R3 starting in 2008.

5. Comprehensive city development plan for Baghdad city (master plan) which will be carried out by the World Bank shall be considered the Study for the proposed project.

(Project management)

6. Establishing a project management team to supervise and control the Project that is to be implemented with financial support from lending agencies is recommended. Coordination among stakeholders concerned is required for smooth execution of the projects. The following arrangements will be necessary to achieve this goal.
   - Establishing a project management team in BWA to supervise and control all relevant contracts and works to be implemented by different contractors and suppliers.
   - International consultants should coordinate and manage the project from Amman.
   - Detailed Design and International Bidding should be carried out by the international consultants in Amman
   - Local consultants should be stationed in Baghdad and assist the BWA and international consultants.
   - The implementation progress in other Mahalahs should be reviewed to properly conduct the water consumption meter installation program.

(Consulting Service)

7. It is recommended to set up an international consulting office in Amman Jordan during the detailed design stage in order to carry out the necessary consulting service for the Project due to security problems in Iraq. It may be proposed that a BWA officer be stationed full time at the consultants' Amman office to coordinate the consulting service with the BWA head office in Baghdad for smoothing and confirming tasks related to the Project.
8. In the detailed design stage the following should be carried out:
   - Locations of underground facilities should be confirmed based on detailed drawings prepared by related agencies such as Baghdad Sewerage Authority

- Selection of new replacement pipeline routes should be carried out by means of a detailed survey in the field based on the detailed drawings of the existing pipelines and underground facilities.
- An inventory survey of existing house connections and any illegal connections should be completed.
- A pilot study of District Meter Area (DMA) should be carried out to confirm the viability of an extended DMA program in WSZ R3.

(Action plan for UFW reduction)

9. An action plan for reduction of the UFW that will enable BWA to monitor the distribution system by establishing DMAs and identifying areas of high leakage should be implemented. But reduction of the UFW will not be attained without organically combining all units and carrying out inspection and repair continuously. Therefore, the action plan needs to be executed with the Implementation Section of BWA as the coordinator of the program with cooperation of the Water Section of the Municipality, the Planning and Follow Up Section, Computer Billing Section, Administration and Financial Affairs Section, and the Design Section.
10. Leakage detection survey teams should be established with appropriate tools and equipment based on the action plan recommendations for efficient operation and maintenance of the proposed DMA system. It will be a requirement to carry out a pilot study of DMA to confirm the viability of an extended DMA program for reduction of UFW.

(Environment)

11. It was confirmed through the EIA that the old ACPs shall be left buried under in situ. The potential for asbestos pollution should be monitored during pipe replacement work since ACPs have been used widely in Baghdad. The following work procedure will be needed. Sadr City is one of the highest population density areas in Baghdad and protection of public health is going to be an important issue in the efforts to carry out the proposed leakage control projects. A set of laws and guidelines for construction works for replacing the older ACP was reviewed to assess and minimize any potential environmental impacts to resident's health from the proposed projects.

(Evaluation)

12. Financial analysis resulted in negative figures due to very low water tariff. It is hardly to justify the project from financial viewpoint. However, the project will contribute to the improvement of the public health and cutting the costs and time for securing clean for households, since access to the safe and stable water is one of the Basic Human Needs

(BHN). It has been concluded that the proposed project is viable from the economic viewpoint. Accordingly, it is concluded to implement the Project

13. The local contractors have enough capability and experience required to construct the proposed projects, since they had experiences of construction for pipe replacement works implemented by USAID project.
14. It is highly recommended that the Consultants should review and carry out the financial and institutional survey in the early stage of implementation of the Project. If a soft component was not included in the scopes of the Project, additional assistance or an intensive capacity development program should be carried out. In this case, it is highly recommended that an Official Development Assistance (ODA) loan donor assist the Consultant to ensure that the proper staffs of both BWA and the MOB are involved in the project during the proper period.

9.2 Issues and Risks

The implementation of the proposed project must be undertaken in a manner that will minimize the issues and risks that could arise due to the fact that the Study was carried out in Amman Jordan without any onsite investigations because of the security and safety difficulties in Iraq. These issues and risks are listed below:

1. In general, collection of data and information required for the study was a most formidable task because it was supposed that the data and information in BWA and related authorities were missing or damaged during the political unrest of recent years.
2. Water demand was forecast based on the JICA Basic Study Report and USAID Report due to lack of a water supply master plan and water demand is allocated evenly to each Mahalah in the WSZs since there is no detailed information about land use patterns, type of subscribers or type of buildings.
3. It is recommended that the preliminary hydraulic analysis for the future water supply be reviewed after formulation of a Baghdad city plan since the water supply network was analyzed in this study on the above mentioned assumptions such as population and water demand projections.
4. As for pipe replacement schemes, length and size of pipes consisting of aged ACP and CIP are assumed to be the same in each Mahalah in the WSZs due to lack of detailed information about the existing distribution system.
5. The number of water consumption meters that will be required had to be estimated by assuming that the average family size was 12.6 persons per subscriber as proposed by the 2006 USAID Report owing to lack of an updated census.

6. There is a lack of information on the existing underground structures, such as sewers, electric cables and telephone lines that need to be protected during construction. It is proposed that an inventory survey of the existing underground structures by carried out during the detailed design stage in order to identify the exact locations of the existing underground structures.
7. The Turkish route was selected as the first route for project implementation based on the current security information and experience of past projects. Actual transportation routes to the project sites shall be selected by the contractor and/or suppliers as their sole responsibility in consideration of the origin of procurement and the security situation in Iraq.