No.

THE FEASIBILITY STUDY
ON
BAGHDAD WATER SUPPLY SYSTEM
IMPROVEMENT PROJECT

FINAL REPORT
VOLUME II

MAIN REPORT

NOVEMBER 2006

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
GLOBAL ENVIRONMENT DEPARTMENT

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LIST OF FINAL REPORTS

PREFACE

In response to a request from the Government of the Republic Iraq, the Government of Japan decided to conduct a feasibility study on The Feasibility Study on Baghdad Water Supply System Improvement Project and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Masasto FUJINAMI Nippon Koei CO., LTD. and consists of Nippon Koei Co., LTD. and Tokyo Engineering Consultants Co., LTD. to Amman of Jordan between February, 2006 and September, 2006.

The team held discussions with the officials concerned of the Government of the Republic Iraq at Amman, collected data and discussed with the related persons of Iraq and other international donors. Upon returning to Japan, the team conducted further studies and prepared this final report.

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

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Iraq for their close cooperation extended to the study.

November 2006

Ariyuki Matsumoto,
Deputy Vice President
Japan International Cooperation Agency

November 2006

Mr. Ariyuki Matsumoto
Dupty Vice President
Japan International Cooperation Agency (JICA)
Japan

Letter of Transmittal

Dear Sir,

We have the pleasure of submitting to you the Final Report of "The Feasibility Study on Baghdad Water Supply System Improvement Project" in accordance with the Scope of Work agreed upon between the Baghdad Water Authority (BWA) and Japan International Cooperation Agency (JICA).

The study was conducted by Nippon Koei Co., LTD. and Tokyo Engineering Consultants Co., LTD. under a contract to JICA, during the period from February 2006 and November 2006, through the discussions with the officials of the BWA, aiming to formulate water supply system improvement plan for the Baghdad City in Iraq.

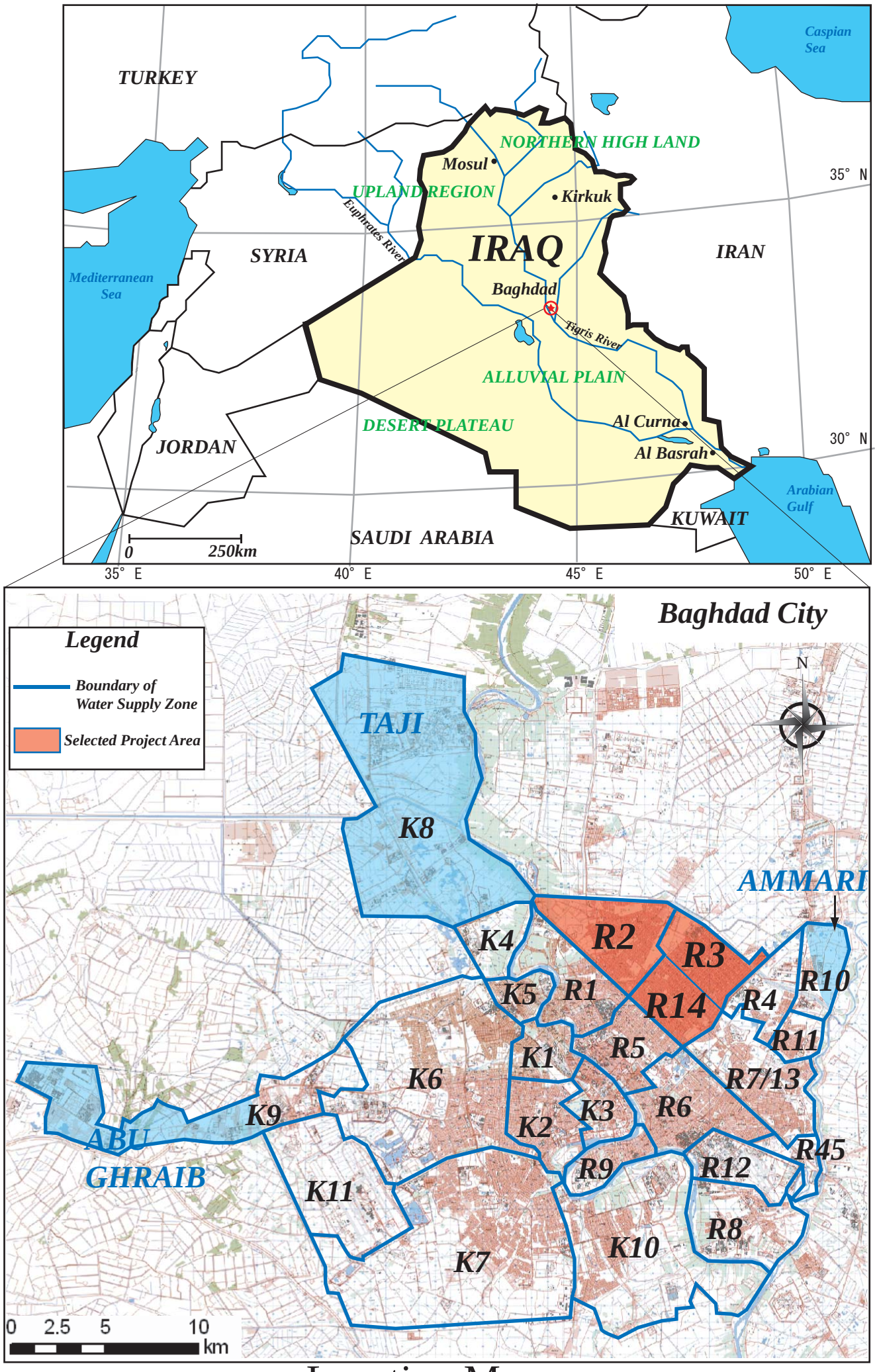
In conducting the study, which was carried out based in Amman Jordan, we have examined the present conditions of water supply system in the Baghdad City and the logistic, procurement and construction conditions, and formulated the appropriate water supply improvement plan for the Baghdad City in Iraq.

The study team sincerely hopes that the study results would contribute to the implementation of the water supply system improvement project in the Baghdad City.

Finally, we wish to express our deep appreciation and gratitude to the personnel concerned of your Agency, Ministry of Foreign Affairs and Japan Bank for International Cooperation (JBIC), as well as officials concerned of BWA.

Sincerely yours,

Masato Fujinami
Project Manger,
The Feasibility Study on Baghdad Water Supply System Improvement Project



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ABBREVIATIONS

Organization

BWA	Baghdad Water Authority
CERP	Commander's Emergency Response Program
COSIT	Iraqi Central Organization for Statistics and Information Technology
CPA	Coalition Provisional Authority
CSO	Central Statistical Organization
EPID	The Environmental Protection and Improvement Directorate
GRD	Gulf Region Division of the U.S. Army Corps of Engineers
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
ILO	International Labor Organization
MOB	Mayoralty of Baghdad
MOCH	Ministry of Construction and Housing
MOE	Ministry of Environment
MOF	Ministry of Finance
MOT	Ministry of Transportation
MPDC	Ministry of Planning & Development Cooperation
MWT	Ministry of Works and Transportation
OPEC	Organization of the Petroleum Exporting Countries
PCO	Project & Contracting Office
UNICEF	United Nations Children's Fund
USACE	U.S. Army Corps of Engineers
USAID	United States Agency for International Development
WB	The World Bank

Others

ACP	Asbestos Cement Pipe
ADF	Average Daily Flow
ATP	Affordability to Pay
BS	Booster Station
CIP	Cast Iron Pipe
CSO	Central Statistical Organization
CU	Compact Unit
DIP	Ductile Iron Pipe
DMA	District Meter Area
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rete of Return

FIRR	Financial Internal Rate of Return
GDP	Gross Domestic Product
GIS	Geographical Information System
GSP	Galvanized Steel Pipe
IEE	Initial Environmental Examination
LDPE	Low Density Polyethylene Pipe
MDF	Maximum Daily Flow
MIS	Management Information System
NDS	National Development Strategy
ODA	Official Development Assistance
PEP	Polyethylene Pipe
PHF	Peak Hourly Flow
PMT	Project Management Team
PVC	Polyvinyl Chloride Pipe
RPS	Raw Water Pump Station
RWN	Raw Water Network
SCADA	Supervisory Control and Data Acquisition
SDMA	Sub District Meter Area
SR	Service Reservoir
STP	Steel Pipe
UFW	Unaccounted for Water
WCM	Water Consumption Meter
WSZ	Water Supply Zone
WTP	Water Treatment Plant

Units

Length

mm	=	millimeter
cm	=	centimeter
m	=	meter
km	=	kilometer

Area

cm^2	=	square centimeter
m^2	=	square meter
km^2	=	square kilometer

Volume

cm^3	=	cubic centimeter
m^3	=	cubic meter
l or lit	=	liter
MCM	=	million cubic meter

Weight

mg	=	milligram
g	=	gram
kg	=	kilogram

Time as denominator

/s or /sec	=	per second
/min	=	per minute
/hr.	=	per hour
/d	=	per day
/y	=	per year

Derived measures

lpcd	=	Liter per capita per day
m^3/s	=	Cubic meter per second
m^3/d	=	Cubic meter per day
mg/l	=	milligram per liter

Others

%	=	percent
°C	=	Celsius degrees
ppm	=	parts per million

Currency

JPY	Japanese Yen
US$	US Dollar
ID	Iraq Dinar

Transliterations of Arabic Place Names

9 Nisan	٩ نيسان
Abu Gharib	ابو غريب
Abu Nowas	ابو نواس
Adhamiyah	الاعظمية
Al Salam	السلام
Amin	الأمين
Army Canal	قناة الجيش
Boaitha	البوعيثة
Doura	الدورة
Ekhaa	الاخاء
Fahama	الفحامة
Hamediya	حميدية
Hussian Al Safi	حسن الصافي
Jomhuriya	الجمهورية
Kadhemiyah	الكاظمية
Kamaliya	الكمالية
Kanat	القناة
Karada	الكرادة
Karama	الكرامة
Karkh North	شمال الكرخ
Karkh South	جنوب الكرخ
Karkh	الكرخ
Kasra	الكسرة
Makaseb	المكاسب
Mansour	المنصور
Mendly	مندلي
Montadher	حي المنتظر
Nasser	النصر
New Akad	اكد الجديد
New Ammari	العماري الجديد
New Orfally	أورفلي الجديد
Obaidi	العبيدي
Obour	العبور
Old Akad	اكد القديم
Old Ammari	العماري القديم
Old Orfally	أورفلي القديم
Otaifiya	العطيفية
Jaderiya Bridge	جسرالجادرية
Jaderiya	الجادرية
Qadessia	القادسية
Rasafa	الرصافة
Rashad	الرشاد
Rasheed	الرشيد
Rostamia	الرستمية
Saba Kosour	سبع قصور
Sadr	الصدر
Saidiya	السيدية
Salam	السلام
Salehiya	الصالحية
Senak	السناك
Shaab	الشعب
Shark Dijla	شرق دجلة
Shola	الشعلة
Swaib	صويب
Taji	التاجي
Tal Aswad	تل أسود
Tarik	طارق
Um Al Asafier	ام العصافير
Wahda	الوحدة
Wathba	الوثبة
Zafaraniya	الزعفرانية
Zaiuna	زيونة

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CHAPTER 1 INTRODUCTION

1.1 Background

Iraq is located at river basin of Tigris and Euphrates rivers which flow into Arabian Gulf. The total land area of Iraq is about 438,000km^2 and the total population of Iraq is estimated at 28.8 million as of 2005. Baghdad city is located on the alluvial plain of the Tigris River about 700 km upstream from the Arabian Gulf. The potable water supply of Baghdad is pumped from the Tigris river.

The water treatment and distribution facilities of the Baghdad water supply system are generally old due to limited investment in new facilities and a lack of maintenance of the existing facilities. This is mainly due to international economic sanctions on Iraq after the Gulf War of 1991.

A Master Plan for the water supply network development for the Mayoralty of Baghdad (MOB) was prepared in 1984 in which the population in 2001 was estimated to reach 3.5 million. However, the actual population in MOB is estimated to be about 5.6 million in 2005.

The high ratio of Unaccounted for Water (UFW), which is estimated at about 50%, is also remarkable. Records would indicate that half of the treated water does not reach water users due to leakage from the pipes, illegal connections and lack of maintenance. As a result, the current water deficit to the demand is estimated at about 1.25 million m^3/day.

The cost of operation and maintenance must be subsidized by the government because of the low price policy for public services, which are well below the cost recovery level.

The Government of Iraq settled on "Iraq's National Development Strategy (NDS)" in 2005. One of the urgent problems in Iraq is to improve the water supply and hygiene diffusion systems.

The Japanese government committed a total of US$150 million in grant aid as emergency assistance at the Iraq reconstruction donor’s committee meeting in Madrid in October 2003. In addition, a yen loan of US$350 was committed as mid-term reconstruction assistance. As a result, the total amount of assistance was US$500 million.

Under the above circumstances, JICA undertook a Preliminary Study for the Iraq Reconstruction Project in the Hashemite Kingdom of Jordan as the grant aid project in 2004.

In addition, in Amman from 2004 software assistance for the improvement of the level of UFW has been carried out as part of the water supply plan, operations and maintenance, and GIS, under the Third Country Training Program of JICA.

Based on the above results, the Government of Iraq have requested the Government of Japan to provide a feasibility study for a yen loan project for the reduction of UFW through the improvement of the water supply system.

1.2 Objectives

The objectives of the Study are summarized as follows:

1) To justify the selection of the priority area, and
2) To verify feasibility of the project for rehabilitation and replacement of distribution pipes and installation of meters in the priority area including eligibility for Japan Bank for International Cooperation (JBIC) financing.

1.3 Study Area

The Study area covers the water supply system of Baghdad Water Authority (BWA) in MOB. A Feasibility Study will be carried out on the selected priority area Water Supply Zones (WSZs) R2, R3 and R14 inside Rasafa area.

1.4 Phasing of the Study and General Work Progress

The Study consists of three phases of study as follows.

- 1st Study: Preparatory Work February 2006
- 2nd Study: Data Collection & Analysis March - June 2006
- 3rd Study: Feasibility Study July - November 2006

The study was carried out in Japan and neighboring country Jordan, because the Japan International Cooperation Agency (JICA) Study Team could not enter Iraq due to security reasons. Several meetings with the Iraqi side counterparts were held periodically in Amman during the 1st and 2nd Study as follows.

(1) S/W and Inception Report Meeting (from February 18 to 23, 2006)

The Inception Report was submitted to the BWA on February 21, 2006. BWA was briefed regarding the Inception Report by the JICA Study Team and comments were written in the minutes of meeting dated February 23, 2006. Both side agreed contents of S/W during the meeting on the technical items other than VII. Undertaking of the Government of Iraq on items 1, 2 and 4(1). The member of the Iraqi delegation explained that the highly authorities' approval on the VII. Undertaking of the Government of Iraq is required. Therefore S/W was signed on June 4, 2006, after receiving approval.

(2) The First Technical Meeting (from March 15 to 16, 2006)

The project planning: The study team and BWA counterparts discussed the following items: Area of Water Supply Zones, Population to be served, Population growth rate, Consumer categories, Unit water demand, UFW ratio, Peak factor of water demand, and Inhabitants per service connection.

Water Leakage Control: The team requested an inventory survey of the present leakage condition.

Environmental Impacts: The study team checked the screening format with the counterparts. As a waste problem has arisen, the project is classified partially under category B.

(3) The Second Technical Meeting (from April 18 to 20, 2006)

The project planning: The study team and BWA counterparts discussed the following items and BWA counterparts agreed upon the following: Base map for the whole area of Baghdad with a scale of 1/60,000, Base map for the project area (R2, R3 and R14) should be prepared based on the scale of 1/2,500, Required drawings for the Feasibility Study shall be provided based on BWA's standards and criteria.

Project Target Year: Both teams agreed the year 2014 is the Project Target Year.

Tariff and Billing System: BWA counterparts explained the Tariff and Billing System of BWA and its issues.

Data collection: The study team requested and agreed with BWA to provide the following data before the end of April 2006: Distribution system maps for small diameter lines, Design criteria, Technical specifications, Geological and metrological data, Reply to questionnaire related to the cost estimate, The latest data on the activities of other donors, Socioeconomic data, and others.

(4) The Third Technical Meeting (from May 19 to 20, 2006)

The study team and BWA counterparts discussed and confirmed the following items:

The project planning: The present operation status of BWA facilities, Base maps of all of Baghdad and the project area (R2, R3 and R14), Location of distribution mains in the project area, and BWA typical standard designs and specifications.

Water leakage control: Results of the water leakage inventory survey and Criteria of District Meter Area (DMA).

Environmental issues: Review of IEE/EIA which were prepared by MOB, Confirmation of environmental examination process, and Clarification of the EIA process of other donors.

Cost Estimate: Cost estimate items and their definitions, Specification of pipes and valves, and Specification of hydrants.

Institutional issues: Latest organizational chart of BWA and Classification of Tariffs.

Data collection: The study team requested and agreed with BWA to provide the following data before the end of May 2006: Classification of pipe diameter and material, Design standards and typical drawings for excavation for large pipes, Geological data and rainfall data of Baghdad, Work volume of pipe replacement projects, Report of network efficiency survey conducted by United Nations Children's Fund (UNICEF), Specifications for water meters, Detailed staffing information, Latest financial statement, Annual Budget Allocation.

(5) Interim Report Meeting

The Interim Report was prepared by the JICA Study Team for BWA at the end of the 2nd Study, and covers the results of the 2nd Study. The Interim Report meeting was held on June 13 in Amman.

Interim Report (IT/R): The team submitted the IT/R to the Iraqi side and explained the present conditions and the plan formulation for the proposed projects. The Iraqi side understood the contents of the report in principle and were to submit questions on the detailed points of the report by the end of June, 2006.

Priority projects: The team mentioned that the priorities would be set in order of the present condition of the water supply system; that is R3, R14 and R2.

Yen loan projects: The team explained that the concept, contents and project plans for the yen loan projects would be finalized through a series of procedures such as discussions between the relevant ministries in Japan, discussions between the Iraqi and Japanese governments and appraisal mission studies conducted by the Japan Bank for International Cooperation (JBIC).

Environmental and social considerations: An assessment of the study in terms of the environmental and social impacts was carried out by the Environmental Department of MOB as an Environmental Impact Assessment (EIA) and was reported to the Ministry of Environment (MOE). MOB explained that the MOE had approved the EIA and MOB reported it to the team with the report.

(6) Preliminary Meeting with JBIC for the Japanese Loan

The preliminary meeting with JBIC for the Japanese loan was held from the 24 June to the 26 June in Amman.

The study team and the BWA counterparts discussed and confirmed the following items:

The priority WSZs: The priority WSZs are R3, R14 and R2. The project shall concentrate on completing each WSZ. The WTP for R3 has already been constructed. Construction of the reservoir for R14 has already been announced.

Water tanker: MOB provides a water tanker for the areas with water shortages.

Environmental issues: Old asbestos pipes shall leave buried in situ after the Project implementation.

Water consumption meters: The water consumption meters belong to the BWA

Required actions and information: The Study Team confirmed that the BWA provides the following information for the preparation of the Draft Final Report by 10th August 2006: environmental laws and/or guidelines on asbestos pipes; operations records for water tankers in water shortage areas; typical drawings of underground facilities; location and diameter of large consumption subscribers; average incomes of the subscribers; financial and accounting issues.

(7) Draft Final Report Meeting

The Draft Final Report, which covers all of the study results, was prepared by the JICA Study Team for the BWA at the end of the 3rd Study. The Draft Final Report meeting was held from 10 September to 12 September 2006 in Amman.

Draft Final Report (DF/R): The team explained the present conditions and the plan formulation for the proposed projects. The Iraqi side agreed on the contents of the report in principle and were to submit comments on the detailed points of the report by 12 October 2006.

Proposed projects for the JICA F/S and implementation schedule: Both parties, the team and the Iraqi side, agreed that the 18 Mahalas in WSZs R3, R14 and R2 were selected as the proposed project sites and agreed on the schedule for project implementation.

DMA: The Iraqi side requested that the team include equipment for the DMA pilot project, and study the selection of the DMA pilot areas during the detailed design stage. The team responded that this request would be reflected in the Final Report.

CHAPTER 2 GENERAL BACKGROUND OF THE STUDY

2.1 The Past National Development Plans

The first National Development Plan of Iraq was the First 6-year-plan (1951~1956) under the administration of the monarchy, and thereafter a total of six National Development Plans were formulated until the Fourth 5-year-plan (1976~1980) by the Bakr administration.

The objectives of these plans changed from agricultural development to industrialization, and reduction of economic dependency on the oil industry.

However, none of these long-term development plans had advanced well due to political instability and external factors. The plans had been discontinued by the change of administration. The exception was the third 5-year plan (1970~1974), which ran its full course under the Bakr regime with a budget of 6.5 billion dollars. This plan was completed for the first time in Iraq history. The Gross Domestic Product (GDP) growth rate of the third 5-year plan exceeded 7.5%. However, after 1980, Saddam's administration (1981~2003) did not execute any long-term National Development Plans due to the Iraq -Iran war (1980~1988) and Gulf war (1991).

2.2 National Development Strategy

Iraq's National Development Strategy (NDS) 2005-2007 is a priority development program of the democratically elected government of Iraq. NDS 2005-2007 is the first strategy of the Iraqi Interim Government's (IIG) policies for national development. The interim NDS was submitted to the World Bank and United Nations Development Group for comment and was discussed with these two organizations over a series of meetings in Amman in early September 2004 to incorporate their comments. The strategy was approved by the Iraqi Strategic Review Board and by the Iraqi Government's Council of Ministers as the program for reconstruction and reform of the Iraqi economy for the next three years.

This consultative process has continued under the Iraqi Transitional Government (ITG). The revised NDS 2005-2007 was endorsed by the Economic High Committee and the Cabinet. It will be discussed at the Iraqi Reconstruction Fund for Iraq (IRRFI). A donor's Committee Meeting was held at the Dead Sea, Jordan on July 18-19, 2005. The National Development Strategy will be endorsed by the National Assembly, which represents the voice of the Iraqi people.

The revised NDS (July 2005) is established on four major pillars that will govern strategic public actions for reconstruction and development as follows:

1) Strengthening the foundations of economic growth.

2) Revitalizing the private sector.

3) Improving the quality of life.

4) Strengthening good governance and security.

Pillar three, "Improving the quality of life", is a core pillar of the NDS. Pillar three consists of six elements for improving the quality of life. "Improving access to clean water and sanitation." is shown as the first priority of the requirements for quality of life.

The internationally agreed Millennium Development Goals (MDGs) provide the framework for setting Iraq's National Development Goals which are shown in Box 2, Iraq's National Development Goals in the revised NDS. Iraq's National Development Goals are composed of eight Goals and 14 Targets. The Goal and Target of safe and stable drinking water supply is proposed at Goal 6 and Target 8 as follows:

Goal 6: Achieve universal access to safe water and sanitation:

According to the Iraq Living Condition Survey, only 54 percent of households have access to a safe and stable supply of water. Improved sanitation had dropped from almost 100 percent to only 67 percent in 2004.

Target 8: Ensure that all people have sustainable access to safe drinking water and improved sanitation

Indicators of the proportion of urban and rural populations with sustainable access to an improved water source for Iraq's Development Goals & Expected Achievements for Target Years are as follows:

Table 2.2.1 Indicators for Iraq's Development Goals (%)

Indicators	Recent Figures	Base Year	Expected Achievement by 2007	Target by 2015
Proportion of population with sustainable access to an improved water source, urban and rural	54/ avg	2004	59	75
	60/urban		65	80
	33/rural		40	65

Source: National Development Strategy 2005-2007, June 30th 2005

Taking the above into consideration, this project aims at improving the quality of life in urban areas through the improvement of water supply facilities in the Mayoralty of Baghdad.

2.3 Foreign Assistance Activities

2.3.1 International Donors

The international donors' conference on the reconstruction of Iraq was held to coordinate the international donors' community at Madrid on October 24th 2003. The international donors' community agreed to assist in the reconstruction of Iraq at the international Madrid Donors' Conference. The total pledged amounts are about US $33 billion for the period from 2004 to 2007. The United States pledged about US$18.4 billion for the Iraqi Relief and Reconstruction Fund (IRRF). World Bank pledged about $3 billion to $5 billion in loans over the next five years. The Japanese government pledged about US$1.5 billion for grant aid projects and 3.5 billion for loan projects.

The main donors for the potable water sector of the Mayoralty of Baghdad consist of the World Bank, United States Agency for International Development (USAID), United Nations Children's Fund (UNICEF) and Japan. The activities of the main donors, except Japan, are as follows.

World Bank: The water supply projects of the World Bank in Baghdad city are as follows.

Table 2.3.1 World Bank Grant Aid Water Supply and Sanitation Projects in Baghdad

The outline of the "Water Supply and Sanitation Project" Financed by the World Bank Iraq Trust Fund (status as of May 23, 2006)			
Project Name	Emergency Baghdad Water Supply and Sanitation Project		
Objectives	1. Restore basic water supply and sanitation services for the capital city of Baghdad 2. Build capacity through training and TA.		
Project Area	Baghdad		
Project Cost	Total： US $ 65million on grant terms Breakdown：US $ 51.1million （civil works and goods） US $ 6.9million （consulting services） US $ 7million （price and physical contingencies）		
Beneficiary	Mayoralty of Baghdad		
Implementing Agencies	Mayoralty of Baghdad (BWA)		
Project components and Costs			
Components	Status*	Target/ Completed (Month/Year)	Revised Costs (US$ million)
1. Rehabilitation of chlorine and chemical units at al-Karkh water treatment plant	detailed design (in progress)**	By June 2006	4.1 [Original = 2.8]
2. Rehabilitation of 2B pumping station in Shark Dijla water treatment plant	detailed design (in progress)**	By June 2006	5.62 [Original = 4.5]
3. Extension and rehabilitation of the al-Rashed water treatment plant	detailed design (in progress)**	By June 2006	17.0 [Original = 7.2]
4. Rehabilitation of the Abu Nawas raw water pumping stations	detailed design (in progress)**	By June 2006	3.95 [Original = 6.2]
5. Rehabilitation and renewal of the Sadr City sewerage network	detailed design (about to begin)***	By May 2006	15.0
6. Rehabilitation and renewal of the drinking water network in Za'afarania	detailed design (detailed design completed)****	In Progress	15.3 [Original = 15.4]
7. Capacity building, including system design and implementation, feasibility studies, and audits	Preparation of detailed design, tender documents and construction supervision	Beginning of 2008	3.9
8. Development of a comprehensive city development plan for Baghdad (Master Plan Study)	Preparation of TOR		3.0 [Original = 7.0]
Price and physical contingencies	-	-	7.0

Source: World Bank (Status as of May 23, 2006)

Notes: Status* (completed, in progress, detailed design, tendering, contract, others)

** This relates to the completion of detailed design (for components 1, 2, 3, and 4. As for construction, it is expected to be completed by April 2007 for components 1, 2, and 4; and August 2008 for component 3.

*** Draft design is completed, with the construction expected to be completed by May 2008.

**** Construction expected to be completed by March 2008.

Consultant: Components from 1 to 4 is Binnie & Partners consultant, components 5 and 6 is Al-Ani & Al- Shamma'a (Iraqi company)

USAID: The current water supply projects of USAID in Baghdad city are as follows.

Table 2.3.2 USAID Grant Aid Potable Water Sector Projects in Baghdad

The outline of the "Water Sector Projects" Financed by USAID (status as of August 2006)			
Project name	Iraq Infrastructure Reconstruction Program Phase II Potable Water Sector		
Objectives	Rehabilitating and repairing essential water infrastructure to provide potable water		
Project Area	Baghdad		
Beneficiary	Mayoralty of Baghdad		
Implementing Institution	Mayoralty of Baghdad (BWA)		
Project components and costs			
Components	Status	Target/ Completed (Year)	Costs (US$ million)
1. Hydraulic Model Potable Water Distribution System Baghdad Water Authority (Prepared by Parsons)	Completed	January 2006	
2. Expansion of Shark Dijla WTP (expansion Phase -1): Constructed a new 189,000m^3/day water treatment plant adjacent to existing 556,000 m3/day water treatment plant serving eastern Baghdad.	Completed	March 2005	31.18
3. Rehabilitation of Shark Dijla WTP: Rebuild existing water treatment processes for eastern Baghdad.	In progress	Forecast completion September 2006	32.59
4. Construct Sadr City Water Treatment Plant (R3) Capacity 90,000 m^3/day	In progress	Forecast completion September 2006	46.69
5. Water Distribution Mains Rehabilitation Project in Sadr City Replaced 99km of potable water lines and completed over 15,000 house connections.	Completed (14sectors), Completed (5 sectors*), Contracting(38 sectors*)		20.43
6. Water Sector Institutional Strengthening (WSIS): Provided O&M support, preventative maintenance, on-the-job training, and critical spares and equipment for 11 facilities nation wide, including Rustimyah North and South WTPs and Shark Dijla Expansion in Baghdad	Completed	April 2006	35.45

Source: USAID (Status as of August 2006)

Note: * These projects are managed by the Gulf Region Division (GRD) of the U.S. Army Corps of Engineers and Project & Construction Office (PCO).

UNICEF: The main water supply projects of UNICEF in Baghdad city are as follows.

Table 2.3.3 UNICEF Water Supply Projects in Baghdad

The outline of the "Water Supply Project" Financed by UNICEF (status as of May, 2003)		
Objectives	Cleaning up neglected and damaged water systems	
Project Area	Baghdad	
Beneficiary	Mayoralty of Baghdad	
Implementing Agencies	Mayoralty of Baghdad (BWA)	
Project Components		
Components	Status	Target/ Completed (Year)
1. Iraqi Water and Sanitation Sector Assessment project (prepared by SAFEGE)	Completed	January 2003
2. Rehabilitation of al-Karma WTP by local contractors funded by UNICEF (stream3)*1	Completed*1	2005
3. Construction of compact unit at 701 in R12 *1	In progress *1	August 2006
4. A local company to repair the breaks in the water networks, which consist of hundreds of kilometers of pipes	Completed*1	2003
5. UNICEF is distributing a total of 800,000 litters of water a day within Baghdad. Most of the water is going to the districts of Hai Tariq, Al-Urfall. Hai Rasheed, and Bowiya	Finished*1	May 2006
6.Supply and install 33/11 Kv electric subsystem to Shark Dijla WTP	In progress*1	December 2007
7. Al Karkh WTP pipe line valve chamber buildings	In progress*1	December 2006

Source: UNICEF (Status as of May, 2003), *1 source by BWA (Status as of May 2006)

2.3.2 Commander's Emergency Response Program

The Gulf Region Division of the U.S. Army Corps of Engineers (GRD of USACE) is also conducting pipe replacement work in several sectors in Sadr City that were designed by USAID. The GRD has completed five Sectors and has contracted to do 38 Sectors by the end of August 2006, all funded through the Commander's Emergency Response Program (CERP).

The Commander's Emergency Response Program (CERP) was an instrumental part of the U.S. government's efforts to secure and stabilize Iraq. In June 2003, the Coalition Provisional Authority (CPA) authorized the operation of the CERP. The CERP was used to respond to urgent humanitarian relief and reconstruction requirements by allowing military commanders to carry out programs and projects that would immediately assist the Iraqi people and support the reconstruction of Iraq.[1]

The GRD (Gulf Region Division of the U.S. Army Corps of Engineers) and PCO (Project & Contracting Office) have managed the CERP projects in Sadr City.

The GRD provides engineering and construction services to the Multi–National Force-Iraq and the Iraqi government in support of military and civil construction. The PCO is a temporary Department of Defence organization whose staff was assigned under the authority of the Chief of the U.S Mission in Iraq. It provides program management services for Department of Defence contracts and for contracts managed by the Department of State and other department agencies. The responsibilities of the PCO were consolidated with those of the GRD on December 4, 2005.[2]

[1] Source: Management of Commanders' Emergency Response Program for Fiscal Year 2004: Special Inspector General for Iraq Reconstruction (SIGIR-05-014)October 13, 2005
[2] Source:GRD-PCO Management of the Transfer of IRRF-funded Assets to the Iraqi Government: Special Inspector General for Iraq Reconstruction (SIGIR-05-028)January 24, 2006

CHAPTER 3 GENERAL OUTLINE OF THE STUDY AREA

3.1 Natural Conditions

Iraq is divided into four regions by geographic conditions. The main region in the centre of the country consists of alluvium made by the Tigris and Euphrates Rivers that originate in the mountains in the eastern part of Turkey. The upland region between the Tigris and Euphrates Rivers is located in the north west of Iraq. The west and southwest is a desert plateau region that continues on across to Syria and Saudi Arabia. The upstream of the Tigris River and the borderline with Iran are the Northern Highland. The Tigris and Euphrates Rivers are joined at Al Curna and become the Shatt-al-Arab River that flows into the Arabian Gulf. Total land area of Iraq is about 438,000 km^2.

The Tigris River is 1,800 km in length. Baghdad is located on the alluvial plain of the Tigris River about 34 m above sea level and about 700 km upstream from the Arabian Gulf. Irrigation systems have been developed in the alluvial plain of Baghdad along the Tigris River to augment the limited rainfall amounts. The main irrigation water is taken from the Tigris River. The potable water supply of Baghdad is also pumped from the Tigris River.

The water level of the Tigris River increases in April from the melting of snow in the Turkish mountainous region. There used to be many floods. However, no severe flood has occurred in Baghdad since 1988 because many flood control dams were constructed in the upstream reaches of the Tigris River in Iraq. On the other hand, the water quality of the Tigris River has deteriorated due to the salinity of the agricultural effluents, industrial waste water, and domestic waste water. Therefore, the water intake point of the Baghdad water supply system is planned to be as far upstream of Baghdad city as possible.

The climate of Iraq is divided into three types. The northern mountain area has a Mediterranean climate with 400 to 1,000 mm annual rainfall. The area between the mountain area and the desert has a steppe type climate with 200 to 400 mm annual rainfall. The desert and semi-arid area have 50 to 200 mm annual rainfall.

The climate of Baghdad is semi-arid. Annual average rainfall is 135.7 mm (50 year average). There are two seasons. The rainy season is from November to April. The dry season is from May to October. The maximum monthly average rainfall is 26.1 mm in January. The amount of rainfall in the dry season is almost nil. Moreover, the highest temperature exceeds 40 ℃ in the dry season. Consequently, the water demand in the dry season increases compared with the rainy season.

3.2 Socio-economic Conditions

Currently, Iraq's socio-economic situation is still struggling to recovery due to the difficulties in quelling the violence engulfing this unstable country. In this circumstance, various socio-economic indicators show that the living standards of the Iraqi people have sharply deteriorated from 25 years ago.

3.2.1 Demography

The total population of Iraq was estimated at 28.8 million as of 2005[1]. Baghdad, the capital city and also the economic and political centre of this country, currently has almost 23% of the total population of Iraq. Regarding the ethnic structure, it is projected that approximately 80% of the people are Arab, which consist of Shiites, numerically the largest group at about 60%, and Sunni. A little less than 20% are Kurds, while Turkomans, Assyrians, Armenians, and other small groups make up the rest.

Some demographic data shown in Table 3.2.1 indicate Iraq's population is quite young. More than 40% of the total population is estimated to be younger than 15 years old. It seems that this juvenile population structure will continue supported by the continuous high population growth. The statistical information shows that Baghdad has almost the same demographic character as the rest of the country.

Table 3.2.1 Demographic Data as of the Year 2005 (Estimated)

Item	Iraq	Baghdad City
Population (thousand)	28,807 [a]	6,726 [b]
Population growth rate (%) (Avg. 2000-2005)	2.78 [a]	2.6 [b*]
Total number of households (thousand)	4,252[c**]	1,145 [c**]
Average household size	6.4 [c**]	5.7 [c**]
% of Population aged below 15	41.0 [a]	41.8 [b]

(Source: a. World Population Prospects 2004 Revision (Medium Variant), b. JICA[2], c. COSIT[3])

Note: *The figure is the average population growth rate in the period from 2000 to 2003.

**These figures are as of 2004 from COSIT estimate.

3.2.2 Macro Economic Situation

Iraq's Gross Domestic Product (GDP) per capita of 2005 was estimated at USD 1,237. The country's economic size is categorized between the middle income level and the lower middle income level. Iraq's economy historically has been characterized by a heavy dependence on

[1] UN World Population Prospects: The 2004 Revision Population Database estimates that the total population of Iraq would be 28,807 thousand on medium variant base. This figure is the same even on both higher and lower variant bases.

[2] Source: Engineering Services for the Social and Economic Survey for Iraq Reconstruction, Final report for Baghdad, March 2005, Iq0505-RPT-Baghdad-Rev2, Dar Al-Handash

[3] COSIT(Iraqi Central Organization for Statics and Information Technology)

oil industries. The economic activity of the oil sector is still overwhelming in Iraq's economy. This sector's share of GDP in recent years has been quite high at over 65%. The World Bank reports that the oil sector accounts for over 95% of exports and revenue for the country.

The country's economy seemed to revive after the worst situation of the Gulf War. GDP figures for 2004 and 2005 are growing favourably. GDP growth ratios of these two years are estimated at 46.5% and 3.7% respectively.

However, these figures were not raised by actual economic activities but rather propped up by the boost in world oil prices (See Table 3.2.2). In fact, even the recovery of the oil production is still at less than the expected levels of production. It is estimated that oil production recovered to 1.9 million barrels per day (mbpd) in 2004 from 1.3 mbpd in 2003. However, those figures are still lower than the average production of 2.7 mbpd from 1976 to 1980, and do not even achieve the projected sustainable level of oil production of 2.5 mbpd[4].

Table 3.2.2 Economic Indicators

Item	2002	2003	2004*e	2005*e
Nominal GDP (US$ billion)[a]	18.97	12.6	25.71	34.54
Oil sector (% of GDP) [a]	68.0	68.9	67.8	65.8
Basket oil price (US$/b) [b]	24.36	28.10	36.05	50.64
Oil production (mbpd) [a]	--	1.3	1.9	1.4
GDP per capita (US$) [a]	743	479	947	1,237
Real GDP growth (%)[a]	-7.8	-41.4	46.5	3.7
Consumer price index (%)[a]	19.3	34.0	31.7	32.8
Exports (US$ million) [a]	9,990	9,711	16,543	--
Imports (US$ million) [a]	9,817	9,934	21,680	--
Estimated debt stock (US$ billion) [a]	--	125.0	78.2	51.2
Exchange rate, ID per US$1 (period average) [a]	1957	1957	1455	1467
Unemployment ratio (%)[c]	--	28.1	26.8	--

(Source: a. World Bank, b. OPEC, c. ILO)

Note: *e=Estimated figures.

Unemployment is one of the most serious socio-economic problems in Iraq. There was an environment under the previous regime in which private sector development was suffocated. In addition, Iraq's economy has deteriorated through the Iraq -Iran War in the 1980's, the Gulf War and many years of economic sanctions in the 1990's. Although Baghdad has a wide variety of industries producing leather goods, furniture, wood products, chemicals, electrical equipment, textiles, clothing, bricks, cement, tobacco, processed food and beverages[5], the economic situation of this city has been in deep recession. Annual house income in Baghdad at median level recorded ID 2,123,348 in 2003 and the figure was lower than those of the

[4] Source: The Economist Intelligence Unit (EIU) and World Bank (2004: Reconstructing Iraq: Year One, 2006 Rebuilding Iraq: Economic reform & Transition)

[5] Source: The Central Intelligence Agency (CIA): Fact book.

other main regions, namely South, Centre (except Baghdad City) and North, of Iraq[6]. Iraqi Central Organization for Statistics and Information Technology (COSIT) estimated that unemployment ratios of Baghdad in 2003 and 2004 exceeded the average unemployment ratios of the country by 3.6 points and 3.0 points, respectively.

3.2.3 Issues in the Current Socio-economic Situation

Many years of conflict and economic sanctions have deteriorated the living standards of Iraqis by inhibiting investment in socio-economic infrastructure development. Furthermore, job opportunities were quite limited and labour intensive industries, which are expected to absorb those employable people, have not been developed sufficiently. Therefore, maintenance and development of the socio-economic infrastructure and diversifying the monocultural economy under a transparent governance and market friendly economic policy are necessary for Iraq's sustainable development.

However, Iraq faces two serious issues in regard to the current socio-economic structure, which it has to cope with for achieving the above goals. One is the youthful population structure and the other is escalation of urbanization.

The population has more than doubled between 1980 and 2005 and is currently some 28.8 million. These figures will further increase to 1.6 times that figure in the quarter century from 2005 to 48.8 million. Especially, the youthful population structure is outstanding. The World Bank estimates that the trend toward a youthful population structure in this country will continue. For instance, 25 years from now the median age of Iraq is projected to still be 25.4 years, and the working age group is expected to rise to 64.5% of the total population from the current 56.2%.

Table 3.2.3 Transition of Population in Iraq: Past and Future

Item	1980	2005e	2030e
Population (thousand)	14,093	28,807	48,797
Population growth Rate (%)	2.9*	2.78**	1.77***
Urban population (thousand)	9,234	19,255	34,812
Urban population as % of total population	65.5	66.8	71.3
Population Density (per km^2)	32	66	111
Median age (years)	16.3	19.1	25.4
Working population (age 15-64) as % of total population	51.1	56.2	64.5
% of Population aged below 15	47.1	41	30.7

(Source: World Population Prospects 2004 Revision)

Note: *The figure is the average population growth rate for the period from 1980 to 1985.

**Avg. from 2000 to 2005, ***Avg. from 2025 to 2030, e=Estimated figures

[6] Source: Iraq Living Conditions Survey 2004, UNDP

The intense urbanization is also a serious problem which weighs on Iraq's socio-economic revival. The urban population ratio in urban areas 25 years from now will reach 71.3%. Although no future demographic statistics for Baghdad are available, the population growth rate of the city shall be higher than the country's average level due to an influx of population into the city. At the same time, rehabilitation and development of socio-economic infrastructures in urban areas are urgent, especially in the case of Baghdad. For instance, currently, access to stable electric supply, improved sanitation and safe and stable water supply remain at 4%, 62% and 63% respectively. These figures are worse than the average conditions of all urban areas by 9 points, 4 points and 3 points[7] , respectively. This means that Iraq has to face an intensively urbanized social mechanism for many coming years while seriously lacking socio-economic infrastructure development.

[7] Source: Iraq Multiple Indicator Rapid Assessment, COSIT (2004)

CHAPTER 4 PRESENT CONDITIONS OF WATER SUPPLY SYSTEM

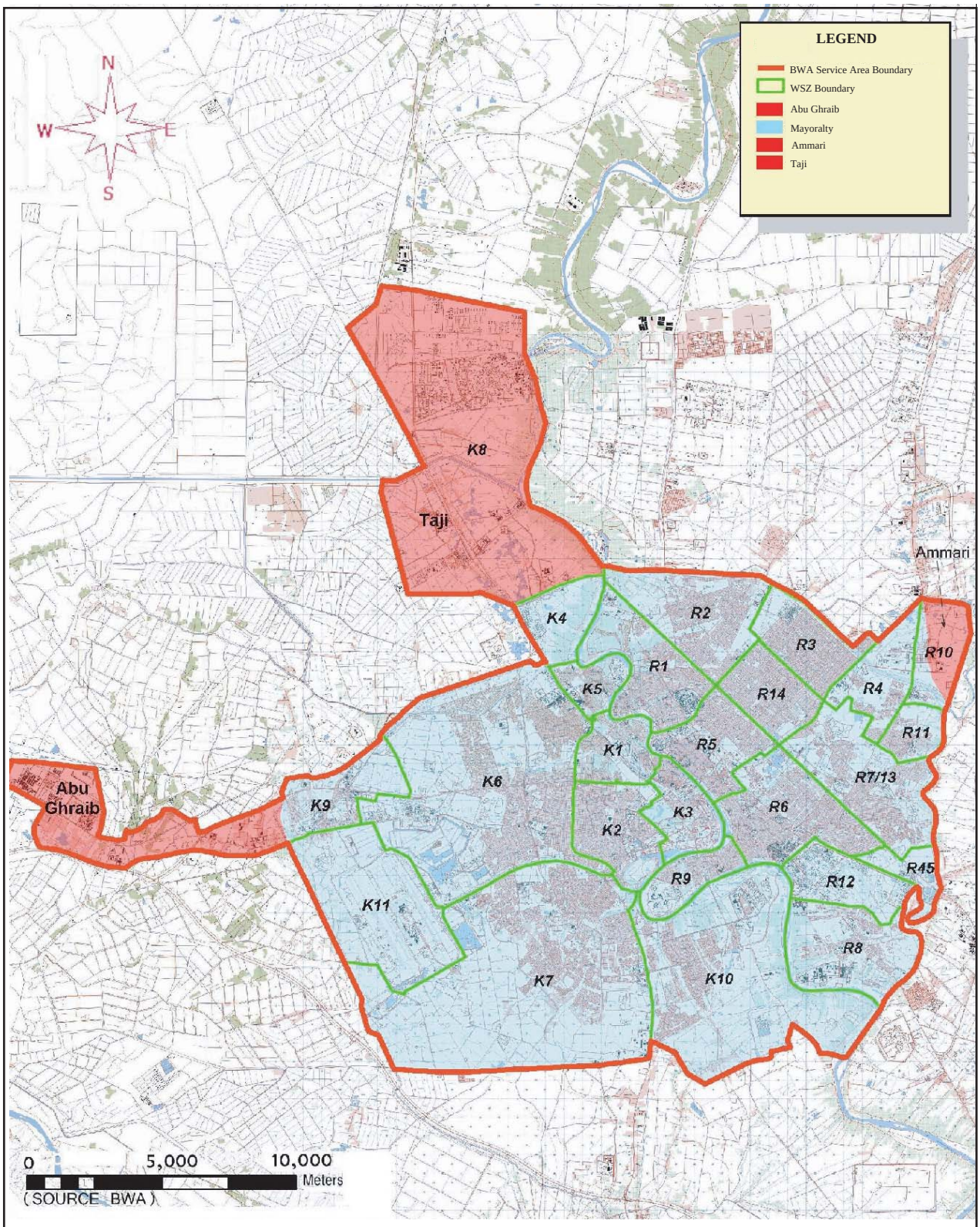
4.1 General

Baghdad Water Authority (BWA), was established in 1924 under the Mayoralty of Baghdad and, is responsible for providing water to Baghdad city consisting of 13 municipalities. BWA supplies water to Baghdad city through two systems, a potable water supply network and a raw water supply network. The current BWA service area is estimated at 917.5 km^2 which includes not only the whole area of Baghdad city, but also suburbs of Baghdad city including Abu Gharib, Taji and Ammari as shown in Figure 4.1.1. The BWA population served was estimated at approximately 5.6 million in 2005. The service coverage ratio in the Baghdad city is 100%.

The only water source for Baghdad city is the Tigris River. Water is directly pumped into Water Treatment Plants (WTP) and delivered to Water Supply Zones (WSZs). There are eight water treatment plants for potable water use, and eight raw water pump stations for irrigation and miscellaneous use along the Tigris River. The average daily production for potable water and raw water in 2005 was about 2.5 million m^3/d and 0.1 million m^3/d respectively.

To grasp the present conditions of the water supply system, the following reports were referred:

- JICA Basic Study Report, March 2005,
- Integrated Study on Improvement of the Baghdad Water Supply System (Basic Study Report), March 2005,
- Third Country Training Programme of JICA, March 2005 and
- USAID Report: Hydraulic Model Potable Water Distribution System Baghdad Water Authority, USAID, Iraq Infrastructure Reconstruction Program, Phase II Potable Water Sector, January 2006.



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: BWA SERVICE AREA Figure 4.1.1

4.2 Service Area and Population Served

4.2.1 Service Area

Baghdad City is divided by the Tigris River into two sides, the Karkh side (to the west of the Tigris River) and Rasafa side (to the east of the Tigris River). Total area of Baghdad city is approximately 734 km^2, while the BWA served area is about 917.5 km^2 including a suburban area of 183.5 km^2 as presented in Table 4.2.1. The elevation varies from 32m to 37m above mean sea level. BWA service area is summarized in Table 4.2.2.

Table 4.2.1 Area and Population Served at Water Supply Zone in 2005

Water Supply Zone (WSZ)	Administrative Area (Municipality)	WSZ Area (km^2)	WSZ Developed Area (km^2)	Present Year: 2005*		
				Population	Population Density	Population Density at Developed Area
Rasafa Side						
R1	Adhamiyah	27.39	20.46	276,380	10,091	13,508
R2	Shaab	30.74	22.03	363,437	11,823	16,497
R3	Sadr 1 & 2/Shaab	18.48	16.54	657,803	35,595	39,770
R4	9 Nisan	16.98	10.45	112,206	6,608	10,737
R5	Rasafa	20.49	19.15	223,255	10,896	11,658
R6	Karadah	31.87	30.29	327,158	10,265	10,801
R7/R13	9 Nisan	34.55	24.65	321,266	9,299	13,033
R8	Karadah	30.09	17.13	136,750	4,545	7,983
R9	Karadah	11.96	9.72	54,764	4,579	5,634
R10 (Ammari)	9 Nisan/Suburban	14.43	11.87	41,823	2,898	3,523
R11	9 Nisan	8.06	4.77	86,335	10,712	18,100
R12	Karadah	17.09	16.79	885	52	53
R14	Sadr 1 & 2	16.40	15.49	503,083	30,676	32,478
R45	Karadah/9 Nisan	7.65	3.90	175	23	45
Sub Total		286.18	223.24	3,105,320	10,851	13,910
Karkh Side						
K1	Karkh/Shola/Kadhemiyah/Mansour	13.83	11.02	148,287	10,722	13,456
K2	Karkh/Mansour	21.64	18.78	138,467	6,399	7,373
K3	Karkh	14.64	13.44	137,548	9,395	10,234
K4	Kadhemiyah	14.17	3.81	37,644	2,657	9,880
K5	Kadhemiyah	8.92	7.19	89,064	9,985	12,387
K6	Shola/Mansour	106.46	81.49	735,845	6,912	9,030
K7	Rashid	127.21	59.41	624,716	4,911	10,515
K8: Taji Center	Suburban	134.7	75.79	133,838	994	1,766
K9: Abu Ghraib	Mansour/Suburban	56.67	36.65	139,374	2,459	3,803
K10	Doura	85.33	39.66	305,144	3,576	7,694
K11: Airport	Mansour	47.72	47.72	0	0	0
Sub Total		631.29	394.96	2,489,928	3,944	6,304
TOTAL		917.47	618.20	5,595,247	6,099	9,051

(Remark *) Population and density are estimated based on data from the following reports:

Source 1: Draft Technical Report Volume 1 Hydraulic Model Potable Water Distribution System Baghdad Water Authority
Iraq Infrastructure Reconstruction Program Phase II Potable Water Sector, USAID, Jannuary 2006

Source 2: Integrated Study on Improvement of The Baghdad Water Supply System (Basic Study Report)
JICA, March 2005

Table 4.2.2 Service Area

	Baghdad City	Suburban Area	Total
Rasafa Side	271.8km²	14.4km²	286.2km²
Karkh Side	462.2km²	169.1km²	631.3km²
Total	734.0km²	183.5km²	917.5km²

(Source: BWA)

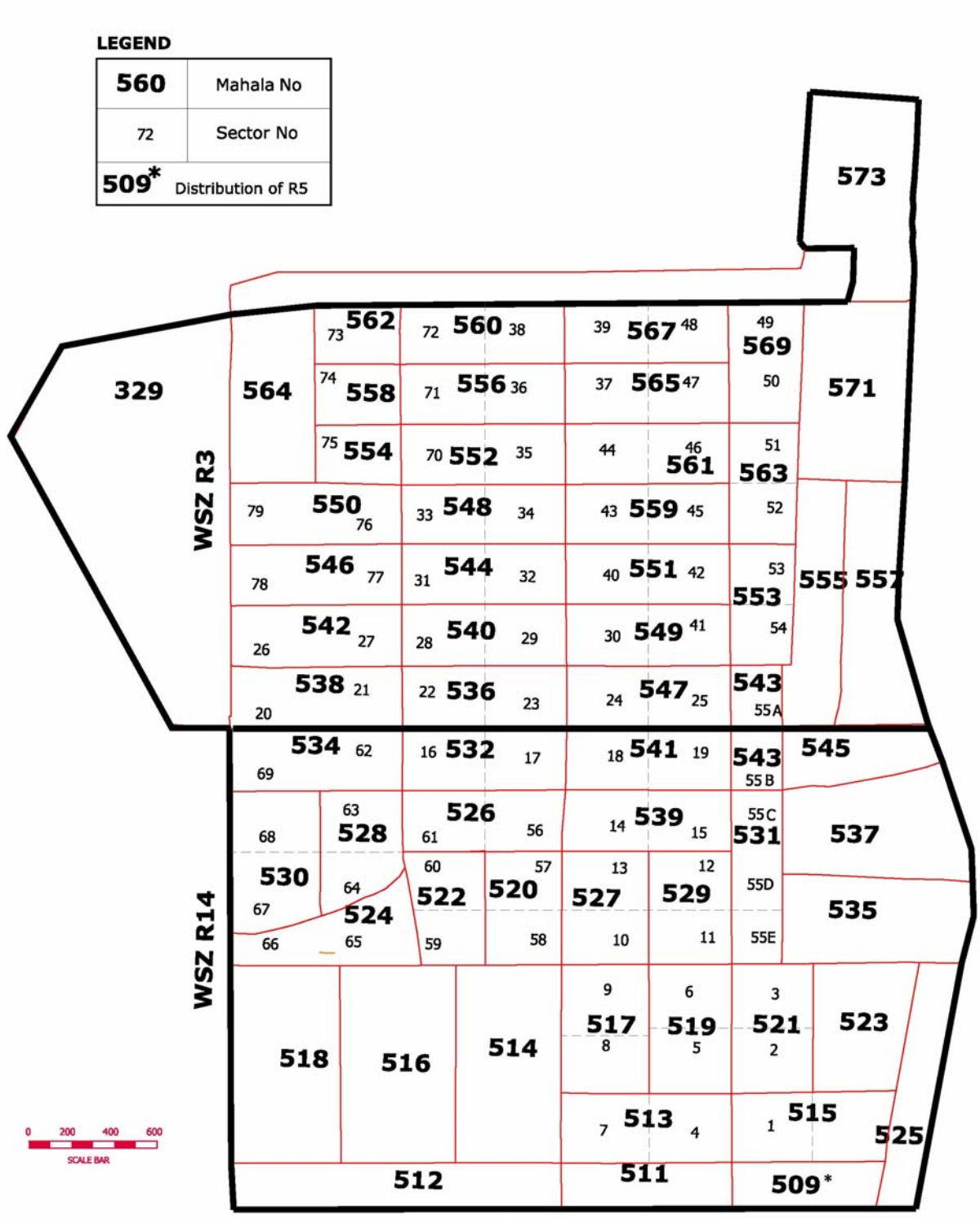
The service area of BWA is divided into 25 water supply zones (WSZs) for network improvement, such as pressure control systems and system wide master metering, as shown in Figure 4.1.1. It is planned that each WSZ will include a service reservoir with a booster pump station. The service area of the WSZs is estimated as shown in Table 4.2.1. Baghdad city administrative areas and WSZs are shown in Table 4.2.3.

Table 4.2.3 Administrative Area and BWA Zones

	Municipality	Mahalah	WSZ*	Sector*
Rasafa Side	Sadr 1	27	R3/R14	R3: 25 R14: 16
	Sadr 2	31	R3/R14	R3: 21 R14: 21
	Adhamiyah	28	R1	-
	Shaab	19	R2/R3	-
	Rasafa	44	R5	-
	9 Nissan	74	R4/R7/13/R10/R11/R45	-
	Karadah	44	R6/R8/R9/R12/R45	-
Sub-total	7	265	14	83
Karkh Side	Karkh	26	K1/K2/K3	-
	Kadhemiyah	13	K4/K5	-
	Shola	27	K1/K6	-
	Mansour	54	K6/K9/K11	-
	Rashid	46	K7/K11	-
	Doura	29	K10	-
Sub-total	6	200	11	-
Total	13	465	25	83

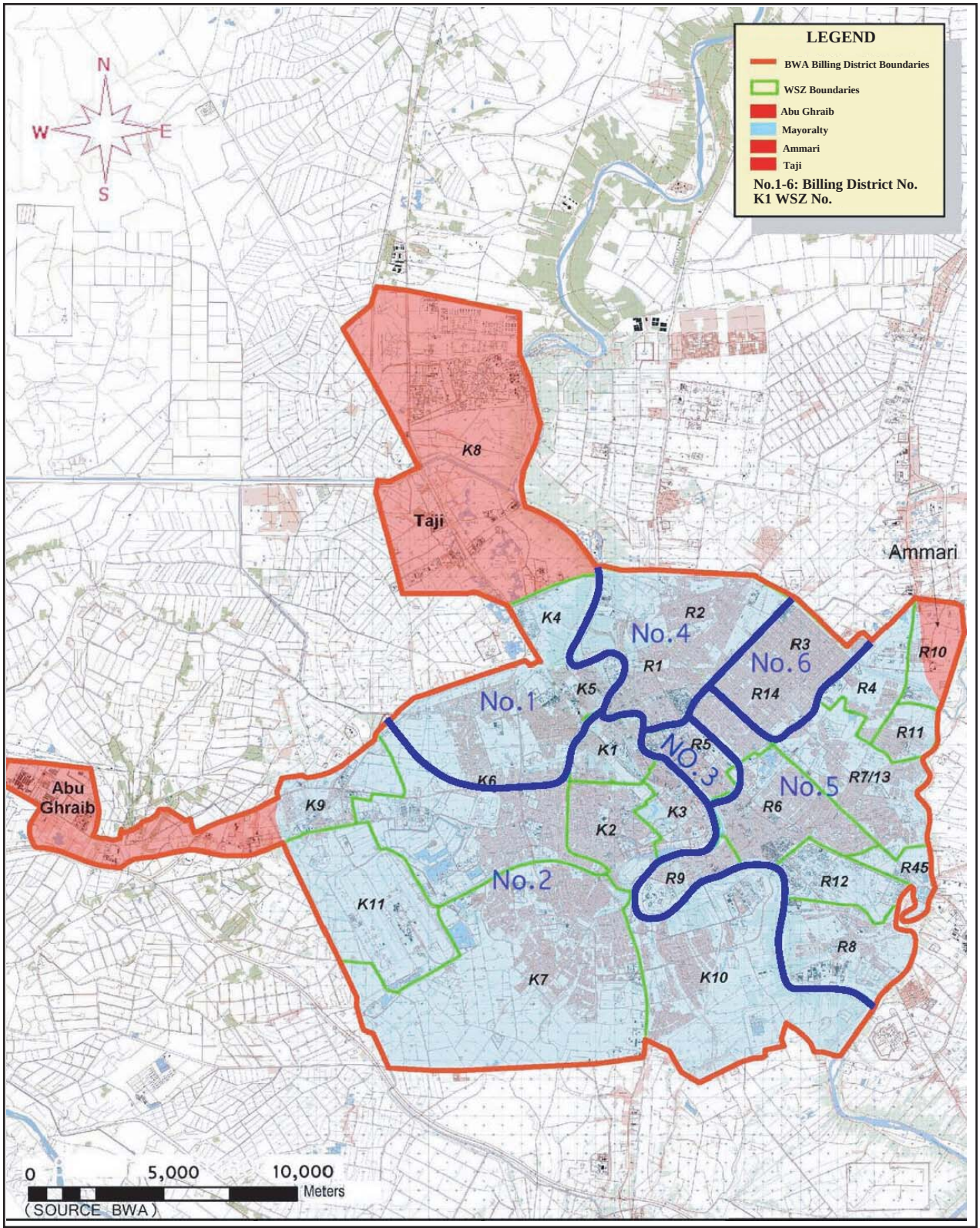
(Source: BWA, as of April 2006) *: Management areas classified by BWA

In addition, only WSZs R3 and R14 are divided into 46 sectors and 37 sectors respectively as shown in Figure 4.2.1. For metering and billing processes, BWA sectionalizes the service area into 6 service districts as shown in Figure 4.2.2.



(Original source: USAID)

Figure 4.2.1 Mahalahs and Sectors at Zone R3 and R14



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: BWA BILLING DISTRICT
			Figure 4.2.2

4.2.2 Population Served

According to the census, the total population of Baghdad City in 1997 was 4.4 million and the rate of population increase had been about 2.19 % from 1977 to 1997. The population served by BWA in 2005 was estimated at 5.6 million based on the 2004 BWA customer base projected by the USAID Report and 1997 Census as presented in Table 4.2.4. Annual population growth rate was assumed to be 2.10% for Baghdad city and 2.20% for suburban areas from 1997 to 2005.

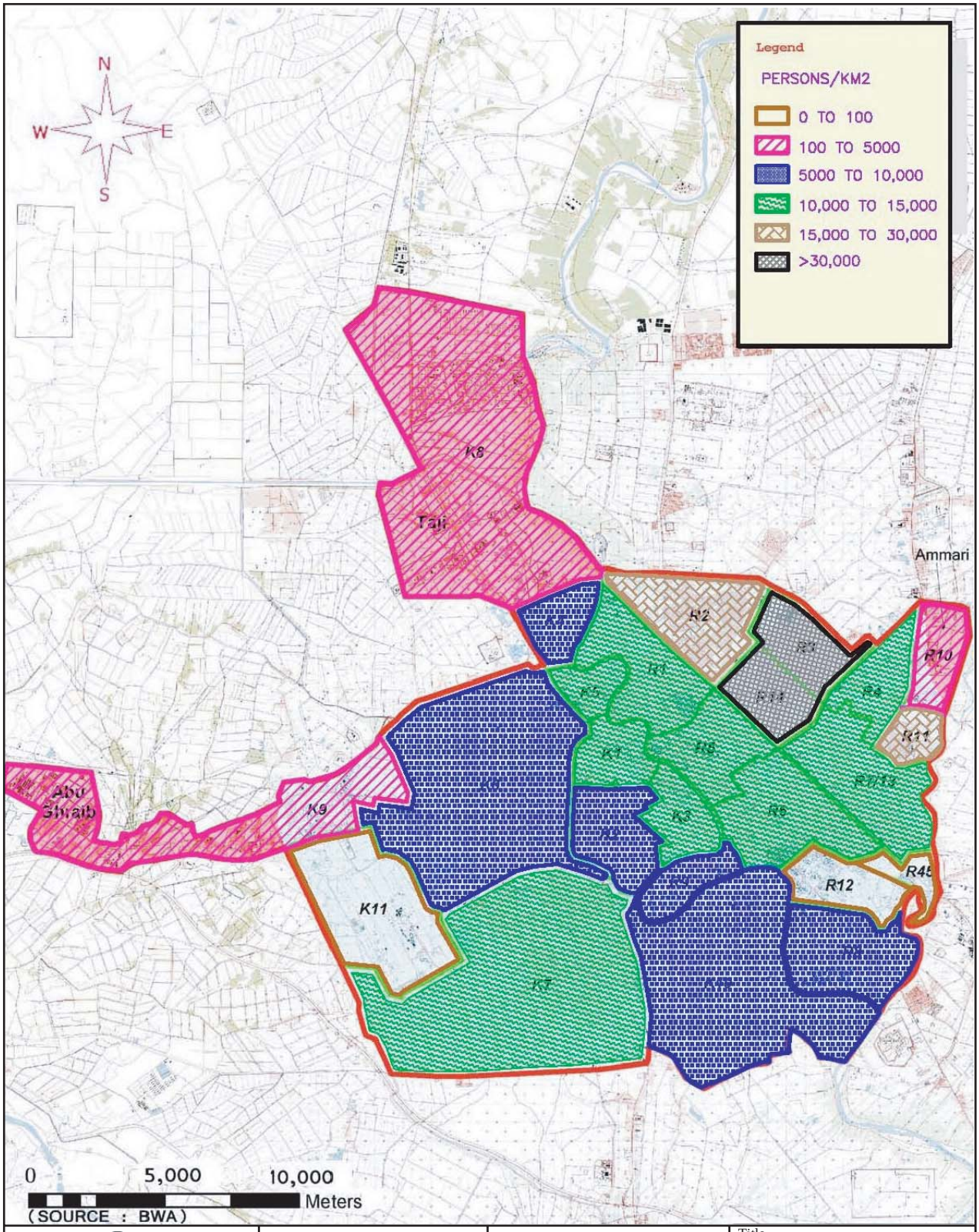
Table 4.2.4 2005 Population Served in Present Service Area

(Unit: 1000 persons)

	Baghdad City		Suburban Area		Total	
	Population	Density	Population	Density	Population	Density
Rasafa Side	3,063	11.3/ km²	42	2.9/km²	3,105	10.9/km²
Karkh Side	2,217	5.0/ km²	273	1.4/ km²	2,490	3.9/ km²
Total	5,280	7.4/ km²	315	1.5/ km²	5,595	6.1/ km²

(Source: BWA)

About 55% of the population lives in the Rasafa side and the remaining in the Karkh side. The BWA water supply system provided 100% coverage for Baghdad city in 2005. The population density at each WSZ is shown in Figure 4.2.3.



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: 2005 POPULATION DENSITY
			Figure 4.2.3

4.3 Present Water Use

4.3.1 Water Consumption Rate

It is noted that the quantity of treated water and water consumption within the BWA service area is estimated rather than metered since most flow meters for the water treatment plant and reservoirs are out of service and only 52% of the recorded 555,600 subscribers are equipped with water consumption meters. Daily water supply is estimated as in Table 4.3.1.

Table 4.3.1 Present Water Supply and Consumption

Item	2000*1	2004*2	2005*2
Average Water Supply (MCM/d)	1.775	1.980	2.490
Amount billed (MCM/d)	0.860	-	-
Population Served	4,769,072	5,479,862	5,595,247
Average per capita Water Supply (lpcd)	372	354	445
UFW (%)	52	47	46
Average per capita Water Consumption (lpcd)	180	190	240
Number of Households	-	-	483,478
Average Water supply per Household including UFW (m^3/Household day)	-	-	5.150

(Source: *1UNICEF Report 2003, *2BWA)

In 2005, the average daily water consumption per capita was estimated at 240 lpcd and the average daily water consumption per household was estimated at 5.2 m^3/d including UFW. The net daily water consumption per household was assumed to be 2.8 m^3/d considering the UFW ratio. Although BWA produced treated water to meet the present water demand, the BWA customers are unsatisfied with the BWA water supply considering the seasonal fluctuations, restricted water supply and actual UFW of more than 50%.

4.3.2 Family Size and Number of Households

The average family size based on the USAID Report is 12.6 persons per family. The number of households is estimated at 483,478 based on BWA billing data as shown in Table 4.3.2 on the assumption that the number of BWA subscribers is equal to the number of households. The number of subscribers in BWA service districts for metering and billing is summarized in Table 4.3.3.

Table 4.3.2 Number of Subscribers with and without Water Consumption Meters

(up to December 31, 2005)

BWA District	Category	No. of Subscribers without meters	No. of Subscribers with meters			Total Number of Subscribers
			Accessed	Not Accessed	Sub-Total	
1	Domstic	22,172	15,323	17,586	32,909	55,081
	Non-Domestic	1,612	3,558	2,870	6,428	8,040
	Total	23,784	18,881	20,456	39,337	63,121
2	Domstic	95,760	37,273	29,466	66,739	162,499
	Non-Domestic	5,800	4,065	5,869	9,934	15,734
	Total	101,560	41,338	35,335	76,673	178,233
3	Domstic	8,907	5,081	7,636	12,717	21,624
	Non-Domestic	2,502	5,946	7,067	13,013	15,515
	Total	11,409	11,027	14,703	25,730	37,139
4	Domstic	28,774	18,792	19,218	38,010	66,784
	Non-Domestic	2,501	2,842	3,119	5,961	8,462
	Total	31,275	21,634	22,337	43,971	75,246
5	Domstic	50,309	18,637	27,465	46,102	96,411
	Non-Domestic	5,100	5,266	7,385	12,651	17,751
	Total	55,409	23,903	34,850	58,753	114,162
6	Domstic	43,993	9,577	27,509	37,086	81,079
	Non-Domestic	1,671	1,622	3,327	4,949	6,620
	Total	45,664	11,199	30,836	42,035	87,699
Gross Total	**Domstic**	**249,915**	**104,683**	**128,880**	**233,563**	**483,478**
		51.7%	21.7%	26.7%	48.3%	100.0%
	Non-Domestic	**19,186**	**23,299**	**29,637**	**52,936**	**72,122**
		26.6%	32.3%	41.1%	73.4%	100.0%
	Total	**269,101**	**127,982**	**158,517**	**286,499**	**555,600**
		48.4%	23.0%	28.6%	51.6%	100.0%

* Non-Domestic: Industrial / Commercial
* Districts: 1-Kadhemiyah, 2-Karkh, 3-Rasafa, 4-Adhamiyah, 5-Others, 6-Sadr City
* Source: BWA, 20/04/2006

Table 4.3.3 Number of Households in BWA Service Districts

Service District	Households	WSZs	Estimated Family Size
Karkh Side			
No.1 Kadhemiyah	55,081	K4, K5, K6, K8	9.18
No.2 Karkh	162,499	K1, K2, K3, K6, K7, K9, K10, K11	12.21
Sub-total/Average	217,580		11.44
Rasafa Side			
No.3 Rasafa	21,624	R5	10.32
No.4 Adhamiyah	66,784	R1, R2	9.58
No.5 9 Nissan/ Karadah	96,411	R4, R6, R7/13, R8, R9, R10, R11, R12, R45	11.22
No.6 Sadr City	81,079	R3, R14	14.32
Sub-total/Average	265,898		11.68
Total/Average	483,478		11.57

(Source: Billing Section of BWA, as of 31/12/2005)

The overall average family size as estimated by the number of households and population was 11.57 persons per family in 2005. The average family size for the Karkh side was 11.4 and for the Rasafa side was 11.68.

4.3.3 Domestic Use and Non Domestic Use

Categories of users connected to the BWA distribution system for the year of 2005 are broken down in Table 4.3.2. The consumer categories in the BWA service area are summarized in Table 4.3.4.

Table 4.3.4 Consumer Categories

Consumer Category	Service Connections (Subscribers)	Ratio (%)	Meter Equipped	Not Meter equipped
Domestic Use	483,478	87	233,563	249,915
Non Domestic Use	72,122	13	52,936	19,186
- Governmental	6,500			
- Public, Industrial & Commercial	65,622			
Total	555,600	100	286,499	269,101

(Source: Billing Section of BWA, as of December 2005)

Daily water consumption patterns were observed by BWA. Peak water consumption occurs from 7:00 to 14:00 and again from 18:00 to 21:00 on an average day. All households with storage reservoirs use them regardless of the season and all of those households use their reservoirs daily. According to information from BWA, the average capacity of individual household reservoirs ranges from 1.0m^3 to 2.0m^3.

4.4 Existing Water Supply System and Facilities

At present, the Baghdad potable water supply system encompasses eight water treatment plants, eight service reservoirs with booster pump stations, over 8,000 km of trunk and distribution lines ranging in diameter from 2,300 mm to 100 mm and 34 compact unit sites, of which 16 unit sites are directly connected with the potable water supply network.

The water supply facilities of the Baghdad water supply system, such as Water Treatment Plants (WTPs) and distribution pipelines, are generally old due to limited investment in new facilities and suffer from a lack of maintenance of the existing facilities. The existing conditions of the water supply system components, such as water source, WTPs, network and facilities are described below.

4.4.1 Water Source

As described in Section 4.1 the only water source for Baghdad is the Tigris River. The Tigris River arises in the mountains of Turkey and flows 1,800 km to the Arabian Gulf as shown in Figure 4.4.1. The potable water is produced through the existing eight WTPs and 34 Compact Units (CUs) sites, the package WTPs. The existing raw water supply system supplies water to the CUs and most of the CUs deliver treated water to house connections through isolated distribution systems. In 2005, the amount of water abstracted from the Tigris River was estimated at approximately 900 MCM/y. The production of WTPs represents about 94% of the total water production. About 50% of the total water produced was unaccounted for.

The Tigris River has abundant stream flow and the present average flow of the Tigris is as much as 400 m^3/s. It is professed that the river flow will be totally sufficient to satisfy the entire water demand of Baghdad up to 2027. However, the recent decrease in the river flow is rather acute. Extensive construction of dams on major tributaries of the Tigris River for flood control and irrigation purposes has decreased the flow to southern Iraq as shown in Figure 4.4.1. The existing Samara dam and Himreen dam located in the upstream portion of the Tigris River serve as flood control for Baghdad.

The water quality of the Tigris River for drinking use is gradually deteriorating. There are three sewage treatment plants with a total capacity of 489,000 m^3/d, more than 260 sewerage pump stations, and over 17,000 km of sewerage network in Baghdad. However the existing sewerage system is not functioning properly and about 50,000 m^3/d of untreated wastewater is thought to be discharged directly into the river. In proportion with urban population growth in Baghdad, untreated wastewater discharge and increasing agricultural runoff have a major influence upon the concentration and seasonal variations of organic pollution and salinity in the Tigris River. Water quality of the Tigris River downstream reaches have deteriorated more than the upstream reaches of the river because of discharge of different kinds of wastewater into the river basin. It is recommended to take raw water from the Tigris River as far upstream as possible.

Original Source: BWA

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: TIGRIS RIVER AND DAMS Figure 4.4.1

4.4.2 Raw Water Supply System and Pump Stations

As shown in Figure 4.4.2, Baghdad city is served by an extensive raw water supply system to satisfy the following demands:

(1) Irrigation use associated with farms surrounding Baghdad city

(2) Gardening use for public green areas

(3) Supply to CUs as source

(4) Non-potable use for residential, commercial and public buildings

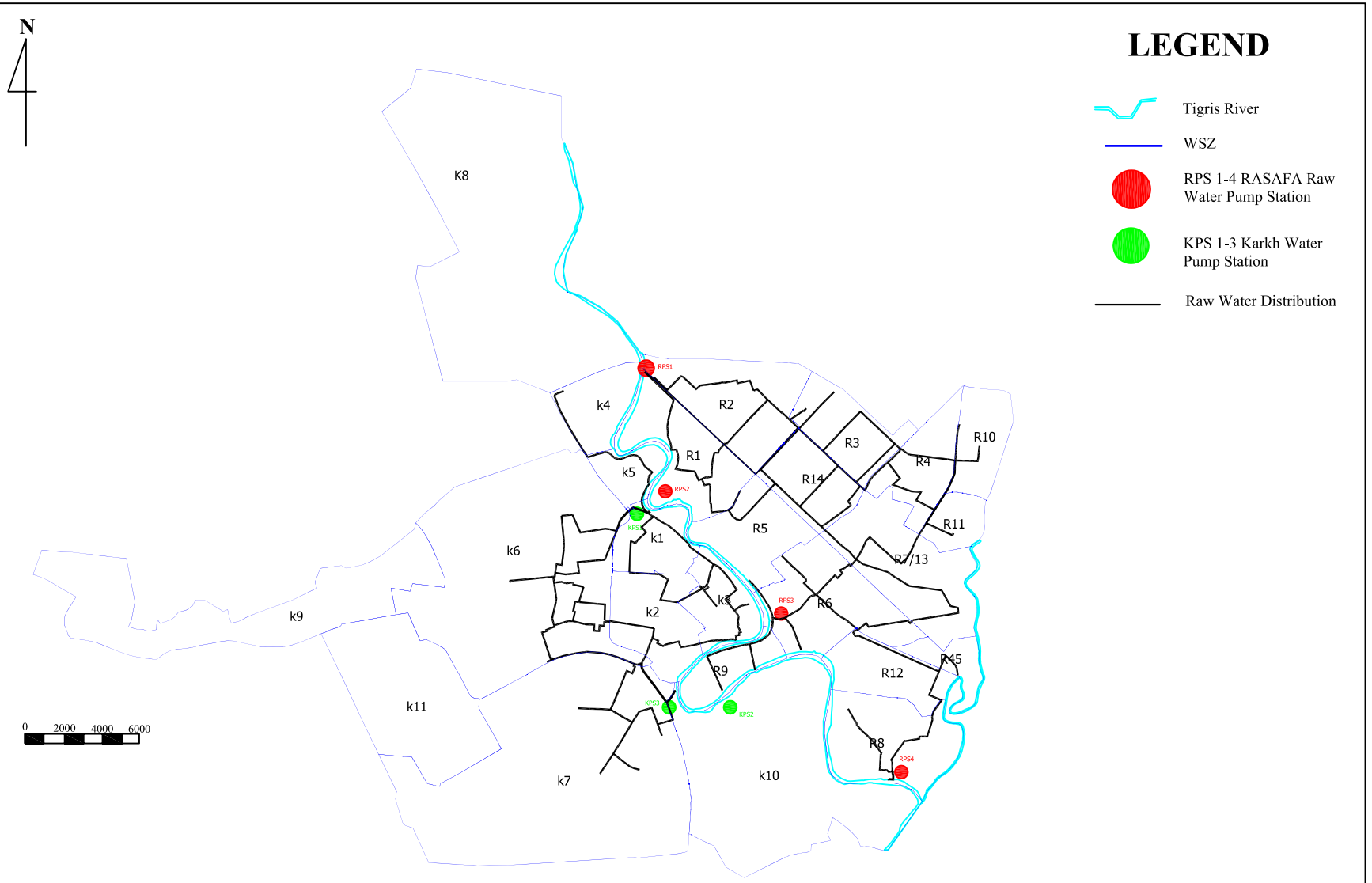
The following Raw water Pump Stations (RPSs) deliver water from the Tigris River through a raw water distribution network about 4,500 km long. The existing raw water supply system with pipeline sizes varying from 400 mm to 1600 mm in diameter is summarized in Table 4.4.1.

Table 4.4.1 Raw Water Pump Stations and BWA Service Area

Raw Water Pump Station	Capacity (m^3/d)	Service Area (WSZs)
Rasafa Side		
RPS 1 Al Kanat	23,400	R1, R2, R3 & R14
RPS 2 Al Kasra	1,200	R1
RPS 3 Abu Nowas	12,600	R4, R5, R6, R10, R11 & R7/13
RPS 4 Al Zafaraniya	16,200	R8, R12 & R45
Army Canal	3,000	Not used due to contamination
Sub-total	56,400	
Karkh Side		
KPS 1 Al Atefiyah	23,400	K1, K2, K3, K4, K5 & K6
KPS 2 Al Jaderiya	23,400	K10
KPS 3 Al Saidiya	1,500	K7 & K11
Sub-total	48,300	
Total	104,700	

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

The pumping capacity of the raw water pump stations has been severely reduced by equipment failure due to a lack of long-term maintenance and availability of spare parts. The pump station in Al Zafaraniya in RPS 4 was scheduled for abandonment by BWA since it is located down stream of a chemical plant and a wastewater treatment plan which is not operational and discharging raw sewerage into the river, and the raw water is extremely polluted. The Army canal had been used for irrigation but at present the canal is only used for drainage due to the high degree of contamination.



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: RAW WATER SUPPLY SYSTEM	
			Scale: As-Shown	Date: FIGURE 4.4.2