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JAPAN INTERNATIONAL COOPERATION AGENCY

DAMASCUS CITY WATER SUPPLY AND SEWERAGE AUTHORITY
SYRIAN ARAB REPUBLIC

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

PHASE II

VOLUME I

FINAL REPORT
EXECUTIVE SUMMARY

DECEMBER 1997

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ESTIMATE OF PROJECT COST

Estimate of Base Cost : as of July 1997 Price Level

Currency Exchange Rate: US$1 = SL45 = Yen 115

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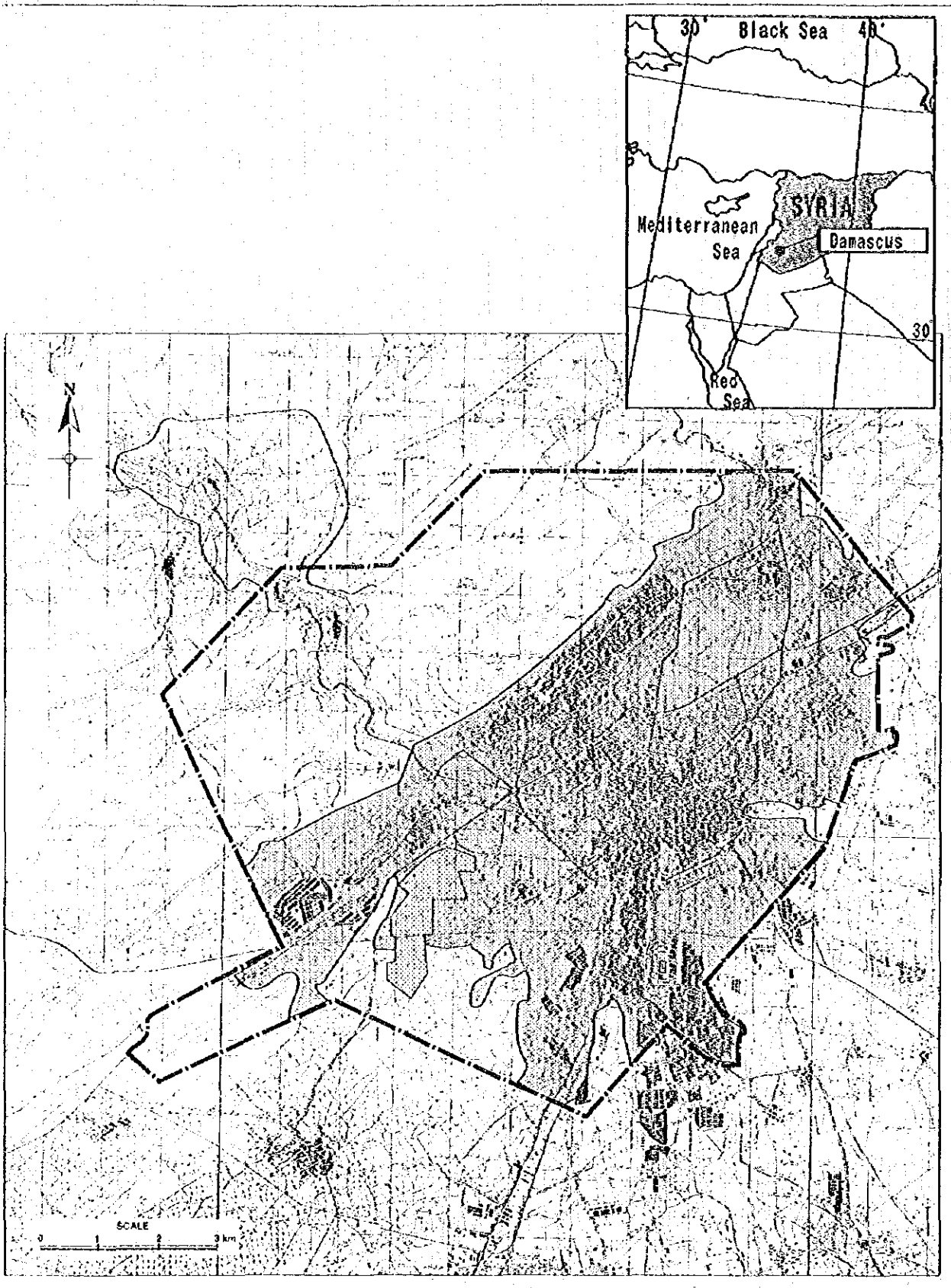

Legend

- Mezze-Razy & Kafar Souseh Informal Area
- Leakage Reduction Program Area
- Existing Boundary of The City

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Location Map of the Study Area

NIPPON KOEI CO., LTD.

PREFACE

In response to a request from the government of the Syrian Arab Republic, the Government of Japan decided to conduct a study on the Development of Water Supply System for the Damascus City (Phase II) and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Syria a study team headed by Mr. Masato Fujinami Nippon Koei Co., Ltd. two times between April and November 1997.

The team held discussions with the officials concerned of the Government of Syrian Arab Republic, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and present report was prepared.

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

I wish to express my sincere appreciation to the officials concerned of the Government of Syrian Arab Republic for their close cooperation extended to the team.

December, 1997

Kimio Fujita
President
Japan International Cooperation Agency

December, 1997

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir,

We have the pleasure of submitting to you the Final Report of "The Study on the Development of Water Supply System for the Damascus City (Phase II)", in accordance with the Scope of Work agreed upon between the Damascus City Water Supply and Sewerage Authority and Japan International Cooperation Agency. The study was carried out for a total period of 10 months from March to December 1997, aiming to formulate water supply plan for the Damascus city.

The report consists of four volumes. The Executive Summary (Volume I) contains the summary of the study result. The Main Report (Volume II)presents the formulation of overall and strategic master plan for the water supply system in Damascus city. The Supporting Report (Volume III) describes the analysis and discussion in the sector of DMA system, Mezze-Razy & Kafar Sousch-Lawan system, water quality and environment, economic and financial evaluation, financial management, topographic survey, and leakage record of distribution mains to support the main report. Data Book (Volume IV) contains basic data of the study.

The study team sincerely hopes that the study result would contribute to the future water supply plan in Damascus city.

We wish to express our deep appreciation and gratitude to the personnel concerned of your Agency and Office in Syria, the Embassy of Japan in the Syrian Arab Republic, as well as officials concerned of the Government of Syrian Arab Republic.

Sincerely yours,

藤井正人

Masato Fujinami
Team Leader
The Study on the Development of Water
Supply System for the Damascus City (Phase II)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY PHASE II

Study Period: March 1997 - December 1997
Counterpart Agency: Damascus City Water Supply and Sewerage Authority, Syrian Arab Republic

OUTLINE OF THE STUDY

1. BACKGROUND

The Damascus Water Supply and Sewerage Authority (DAWSSA) provides water for Damascus City. However, DAWSSA now faces two important challenges: i) providing adequate, reliable water supply in the dry season; and ii) finding measures to increase water available for consumption to meet the future demand of a growing population. Existing distribution facilities must also be reviewed since only 36% of all water supplied is accounted for. Therefore in addition to securing new water resources, measures for reducing losses in the distribution network are proposed in the Phase I study. Among them, the District Meter Area (DMA) plan and the development of the distribution network into informal area were selected for Feasibility Study projects in Phase II.

2. OBJECTIVES

The Study's objectives are: (1) to formulate a plan for the DMA system to enhance leakage detection efforts for the water distribution network system in (Damascus City); (2) to formulate a development plan for the extension of the water distribution network in the Mezze-Razy & Kafar Souseh-Lawan informal area; and (3) to formulate the improvement plan for revenue management based on automation and integration of billing and collection functions, and to transfer technology on planning methods and skills to DAWSSA counterpart personnel.

3. STUDY AREA

The Study area for Phase II (Feasibility Study) covers the existing water distribution network system operating within DAWSSA's in the administrative area of Damascus City and Mezze-Razy & Kafar Souseh-Lawan informal area.

4. OUTLINE OF THE PROPOSED PROJECTS

4.1 Basic Concepts for the Formulations of Projects

The basic concepts for the formulations of projects are as follows:

i) The DMA system is established as a countermeasure to alleviate water shortage problems by improving leakage detection through the regional control of water supply amounts.

ii) The distribution system is divided into appropriate DMA blocks based on the character and size of the service area that are well maintained and simple to operate.

iii) The plan for developing the distribution network in the Mezze-Razy & Kafar Souseh-Lawan informal areas is consistent with the urban development plan and the municipality's plans to normalize informal residential areas in Damascus city.

iv) The distribution system for the Mezze-Razy & Kafar Souseh-Lawan informal area is planned as an extension of DAWSSA's existing water supply system, and considers the implications of integration with the Supervisory Control and Data Acquisition (SCADA) system.

4.2 The Proposed Projects

The projects proposed by the Feasibility Study consist of the DMA system to enhance leakage detection efforts, and the extension of the distribution network into the Mezze-Razy & Kafar Souseh-Lawan in informal area. A brief outline of the projects is described as follows:

<u>District Meter Area (DMA) System Project</u>

Location: Distribution network in Damascus City area except Kassioun mountain and Dumar

Total number of DMA : Development of 50 blocks with flow meters by 2006

(Large block system 22: SCADA 01 of the superior district and 21 large blocks of the distribution district, Medium block system 36)

Total number of monitoring chambers : 165

(32 standing monitoring chambers and 133 seasonal monitoring chambers)

Type of meter and numbers : 52 portable ultrasonic meters and 165 sensors of flow meter

Newly installed sluice valves : ND150 mm x 3, ND500 mm x 2
Pressure Reduction Valve : ND800 mm x 1, ND400 mm x 1, ND150 mm x 1
Proposed pipes (DIP) : ND 200 - 600 mm x 2,000 m

Mezze-Razy & Kafar Souseh-Lawan System Project

Location : Kafar Souseh district
Planned service area: 191 ha
Planned population served: 46,800
Improved informal population : 32,000
DMA system block : D11
Daily maximum water demand for D11 : 24,700 m^3/d (286 l/s)
Service reservoir : Wali service reservoir
Distribution main (DIP): ND 500 - 600 mm x 1,800 m
Distribution submain (Secondary) (DIP): ND 100 - 400 mm x 13,700 m
Distribution submain (Tertiary & Service Pipe) (PE): ND 50 - 63 mm x 20,700 m

4.3 Project Cost

The total project costs for each proposed project are summarized as follows:

(Unit: US$ 1000)

Project Name	DMA System			Mezze-Razy & Kafar Souseh-Lawan System		
Items	L.C.	F.C.	Total	L.C.	F.C.	Total
1. Direct Construction Cost	628	2,647	3,275	1,951	2,210	4,161
2 Tax and Duty	411	0	411	787	0	787
3. Administration Cost	63	0	63	195	0	195
4. Engineering Cost	63	265	328	195	221	416
5. Physical Contingency	75	291	366	234	243	477
6. Price Contingency	64	125	189	157	90	247
Total	1,304	3.328	4,632	3,519	2,764	6,283

Note:
1. L.C. means local currency portion and F.C. means foreign currency portion.
2. Physical contingency is 10% of sum of items 1, 3, and 4.
3. Price contingency is 5% of local currency portion and 3% of foreign currency portion of items 1, 3, 4, and 5.

4.4 Project Implementation

The District Meter Area (DMA) System Project is expected to start in 1998 and be completed in 2006. The Mezze-Razy & Kafar Souseh-Lawan System Project is expected to start in 1998 and be completed in 2001.

5. EVALUATION

(1) Economic Evaluation

The resulting EIRR for the DMA project is 9% while the extension of distribution system of Mezze-Razy & Kafar Souseh-Lawan has an EIRR of 8%. Both projects are considered worthwhile investments and the extension of distribution network into the informal areas will have significant health benefits. The sensitivity tests indicate that both projects are only marginally viable under varying cost and benefit parameters. Under the worst case scenario the DMA project has an EIRR of 5% and the informal area project has an EIRR of 6%.

(2) Financial Evaluation

The resulting FIRR for the project is 16% clearly demonstrating that the project is financially viable. It is assumed that the DMA and the Mezze-Razy & Kafar Souseh-Lawan system will proceed concurrently, following the planned phasing of the proposed investment program from the year 2000 to 2006. The financial projections show the accumulated net cash flow remains positive throughout the life of the project indicating the project is financially viable, providing DAWSSA with cash reserves for financing subsequent investments.

(3) Environmental Examination of the Proposed Projects

The proposed project will significantly improve the environmental conditions in Damascus by providing safe drinking water in larger quantity (saving of 18.5 MCM/year by leakage control programs) to more people (new service population of 32,000 in Mezze-Razy & Kafar Souseh-Lawan area) without exploiting new water resources. The inevitable environmental consequence of water supply project is the generation of wastewater. To deal with the wastewater problem, Damascus Municipality is currently developing a central water treatment facility in Damascus suburb, and the generated wastewater will be treated at this facility which is expected to become operational by the end of 1997 before the implementation of the proposed water supply project. Other negative environmental impacts of the proposed projects, such as construction related environmental problems (e.g., noise, traffic), will be

minor.

6. FINANCIAL MANAGEMENT IMPROVEMENT PLAN

Automation of billing and financial management processes is required. However, it is recognized that DAWSSA does not currently have the financial resources to embark on an extensive automation program. Therefore DAWSSA's first and immediate priority will be to optimize the billing and collection processes by:

i) Implementing meter installation standards to increase meter reading productivity.

ii) Improving efficiency of the billing process by: a) forwarding meter readings for data entry as soon as meter readings are complete; b) reduce the number of error verification processes to only one before printing the bills; c) issue the bills directly to the cashiers from the computer center when the bills are printed.

iii) Adopting a four (4) month meter reading and billing cycle to improve cash flow. Prepare and issue bills for meter districts in the same sequence as the meter readings.

iv) Implementing a new payment policy to speed up collection of revenue. Change the payment period to 30 days, and implement active follow-up of delinquent accounts on a monthly basis, disconnecting delinquent accounts after six (6) months.

DAWSSA should carry out a detailed planning study to assess computer needs across the organization, and develop a strategy for implementing integrated information systems. The result will be beneficial to the organization, and customers will benefit because the long-term costs of providing information technology will be reduced. Before implementing new client server applications DAWSSA will need to create an Information Technology Directorate to plan and support the development of information technology throughout the organization.

The implementation of the above recommendations will set the stage for implementing the computer systems that are required to complete the change strategy for improved financial management: 1) an automated Customer Information System (CIS) including meter reading, billing, and customer accounting functions; and 2) an automated financial management information system (FMIS) including budget preparation, cost accounting, and reporting. The CIS is considered the most urgent because it directly affects the collection of revenue. After implementation of the CIS is underway, and cash flow begins to improve, management can turn it's focus to developing the financial management information system it needs to control expenditures and optimize the use of its financial resources.

7. RECOMMENDATIONS

(1) It is recommended that the following projects proceed immediately to the implementation stage following the proposed schedule to reduce Unaccounted For Water figures as a means of alleviating water shortage problems:

- District Meter Area (DMA) system Projects
- Mezze-Razy & Kafar Souseh-Lawan System Projects

(2) For efficient operation and maintenance of the proposed District Meter Area (DMA) system, leakage detection survey should be reinforced including improvements to survey teams, outfitting tools and equipment as recommended.

(3) It is recommended that the Mezze-Razy & Kafar Souseh-Lawan System Projects be implemented to include informal and formal areas of DAWSSA's distribution system in Mezze-Razy & Kafar Souseh-Lawan area.

(4) It is recommended that DAWSSA implement the financial management improvement plan starting with the first priority which is to streamline the billing and payment collection process to increase revenues.

(5) It is recommended that DAWSSA proceed as soon as possible with a detailed planning study to assess computer needs across the organization and to create a new Directorate of Information Technology Directorate in the medium term.

(6) It is recommended that DAWSSA implement automated customer information and financial management information systems to improve the accuracy and speed of customer service, and provide the accurate and timely financial information required to control expenditures and improve budget preparation.

THE STUDY
ON
THE DEVELOPMENT OF WATER SUPPLY SYSTEM
FOR
THE DAMASCUS CITY
PHASE II
EXECUTIVE SUMMARY

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ABBREVIATIONS

Organizations

ACSAD	-	The Arab Center for the Studies of Arid Zone and Dry Lands
BRGM	-	Bureau de Reche rche Geologique et Miniere, France
CBS	-	Central Bureau of Statistics
CGE	-	Compaginie Generale des Eaux, France
DAWSSA	-	Damascus City Water Supply and Sewerage Authority
EDWSSR	-	Establishment of Drinking Water Supply and Sewerage in the Rural Province of Damascus
EPEF	-	Establishment Public Des Eau De Damas (Figeh)
HIAST	-	Higher Institute of Applied Sciences and Technology
IED	-	Industrial Establishment for Defense
JICA	-	Japan International Cooperation Agency
MHU	-	Ministry of Housing and Utilities
MOI	-	Ministry of Irrigation
MOF	-	Ministry of Finance
SAR	-	Syrian Arab Republic
SPC	-	The State Planning Commission
STE	-	Syrian Telephone Exchange
WHO	-	World Health Organization

Others

CIP	-	Cast Iron Pipe
CIS	-	Customer Information System
DBMS	-	Data Base Management System
DIP	-	Ductile Iron Pipe
DMA	-	District Meter Areas
EIA	-	Environmental Impact Assessment
EIRR	-	Economic Internal Rate of Return
FLS	-	Financial Ledger System
FMIS	-	Financial Management Information System
GDP	-	Gross Domestic Product
GIS	-	Geographical Information System
HDET	-	Hand-held Data Entry Terminals
H/W	-	Hardware
IEE	-	Initial Environmental Evaluation
LAN	-	Local Area Network
LIMS	-	Laboratory Information Management System
MIS	-	Management Information System
MMS	-	Maintenance Management System
ND	-	Nominal Diameter
NPV	-	Net Present Value
O&M	-	Operation and Maintenance
OS	-	Operating System
PE	-	Polyethylene
PVC	-	Polyvinyl Chloride
SGP	-	Steel Galvanized Pipe
S/W	-	Software
SCADA	-	Supervisory Control and Data Acquisition (System)
UAS	-	Unified Accounting System
UFW	-	Unaccounted for Water
UPS	-	Uninterrupatble Power Supply System
VAT	-	Value Added Tax

ABBREVIATIONS OF MEASUREMENT

Length

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

Area

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

Volume

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

Weight

mg	=	milligram
g	=	gram
kg	=	kilogram

Time

s	=	second
min	=	minute
h	=	hour
d	=	day
y	=	year

Electrical Measurement

V	=	Volt
A	=	Ampere
Hz	=	Herz
W	=	Watt
kW	=	kilowatt
MW	=	Megawatt

Other Measures

%	=	percent
HP	=	horsepower
°C	=	Celcius degree

Derived Measures

l/s	=	liter per second
m^3/s	=	cubic meter per second
m^3/h	=	cubic meter per hour
m^3/d	=	cubic meter per day
lpcd	=	liter per capita per day
kgf/cm^2	=	kilogram forceper square centimeter
kWh	=	kilowatthour
MWh	=	megawatthour
kVA	=	kilovolt ampere
mg/l	=	milligram per liter
$\mu g/l$	=	microgram per liter
meq/l	=	milliequivalents per liter
$\mu S/cm$	=	microsiemens per centimeter

Currency

US$	=	US Dollar
SL	=	Syrian Pound

CURRENCY EQUIVALENT

(as of July 1997)

US$ 1 = SL 45.0

TRANSLITERATIONS OF ARABIC PLACE NAMES (1/2)

عباسيين	Abasiyin	بيت جن	Beit Jenn
أبو زاد	AbuZad	بيت تيما	Beit Tima
أشرفية	Achrafye	برزة	Berze
عين عوينات	Ain Awenad	بلودان	Bloudan
عين بدا	Ain Beda	بقين	Boukein
عين حبيب	Ain Habib	دحاديل	Dahadil
عين حداد	Ain Hadad	دار المعلمات	Dar al Moalimat
عين حاروش	Ain Haroush	داريا	Daraya
عين حور	Ain Hour	دير مقرن	Deir Moukaren
عين عيسى	Ain Issa	دير العشاير	Deir al Ashayer Shahour
عين نورية	Ain Nourieh	حوض التشتيت	Dissipation Basin
عين رضوان	Ain Roudwan	دربل	Dourbol
عين صبا	Ain Saba	دمر	Dummar
عين صالح	Ain Saleh	عسالي	El Esaly
عين البارة	Ain el Baradeh	الفوار	El Fawar
عين الخضرة	Ain el Khadra	الفيض	El Feid
عين المالحة	Ain el Malha	حفيرية	El Hafirieh
عين الصاحب	Ain el Saheb	الحامة	El Hame
عين التينة	Ain el Tineh	العرق	El Irk
أكراد	Akrad	الشواط	El Shuwhat
جامع القصاب	Al Aksab Mosque	عش الورور	Esh al Warwar
الضاحية	Al Dahia	فاسرّيا	Fasraya
الخضرة	Al Khadra	نبع الفيجة	Figeh Spring
المشارع	Al Mashare	فراسكن	Fraskin
القزاز	Al Qazzaz	الغوطة	Ghouta
السهل	Al Sahl	حفير الفوقة	Hafir el Foka
عرطوز	Artooz	حاليا	Halaya
قدم عسالي	Asalic Kadam	حسيبة	Hassibeh
الاعوج	Awaj	حسينية	Huseiniyeh
باب مصلى	Bab Mosallah	ابن النفيس	Ibn Alnafeas
باب شرقي	Bab Sharki	ابن عساكر	Ibn Assaker
باب السلام	Bab el Salam	جناني	Janani
شارع بغداد	Baghdad Street	جرمانا	Jaramana
بردى	Barada	جمرايا	Jemarya
بساتين	Basateen	جوبر	Jobar
بسيمة	Bassime	جوبر عكاش	Jobar Akache

TRANSLITERATIONS OF ARABIC PLACE NAMES (2/2)

جوبر عمادية	Jobar Imadye	قطيفة	Qutayfeh
جوبر قباني	Jobar Kabani	رنكوس	Rankous
جرجانية	Jourjaniyeh	رأس الحاجب	Ras Hasib
قابون	Kaboon	رأس الوادي	Ras el Wadi
قدم	Kadam	الرازي	Razy
كفرسوسة	Kafar Souseh	ريمة	Rimeh
كفر العواميد	Kafar el Awamid	ركن الدين	Rukn Aldyn
قنوات	Kanawat	سعسع	Saasaa
قاسيون	Kassioun	صفصافة	Safsafi
قطنا	Katana	سردا	Sarada
الكرش	Kersh	ساروجة	Sarouja
خان الفندق	Khan el Founduk	صيافي	Sayafeh
خورشيد	Khorshead	سبيراني	Sebrani
قدسيا	Kudsaya	صيدنايا	Sednaya
كيوان	Kywan	شاغور	Shaghour
لوان	Lawan	شخاب	Shakhab
معلولا	Maaloula	ينابيع جانبية	Side Spring
معرونة	Maaroune	سومرية	Somareyeh
مضايا	Madaya	سيرونكس	Syronics
مهدي بن بركة	Mahadi Bin Baraka	طبالة	Tabbaleh
شارع المالكي	Malki street	طبية	Tabibiyeh
مزرعة	Mazraa	تضامن	Tadamoun
ميسلون	Meisaloun	تقدم	Takadom
ممبج	Membej	تلمذية	Talmasieh
مزة	Mezze	تكية	Tekieh
ميدان	Midan	المدينة القديمة	The Old City
منين	Mnin	تشرين	Tishreen
مخيم	Mokhayam	المدينة الجامعية	University City
مهاجرين	Mouhajreen	وادي مروان	Wadi Marwan
النبوع	Naboua	الوالي	Wali
نهر عيشة	Naher Esheh	يعفور	Yaafoor
ناظم باشا	Nazem Basha	يرموك	Yarmouk
النبك	Nebk	زبداني	Zabadani
أمية	Omayad		
أمويين	Oumawiyin		
منطقة الرئاسة	Presidential Area		

1. INTRODUCTION

1.1 Background

This report describes the results of Phase II (Feasibility Study) of "The study on the development of water supply system for the Damascus City". Certain projects have been identified in the Phase I study as priority projects for the Phase II study because they are urgently required for public health or operational reasons such as reducing water losses. The study area is located in the southwest of the Syrian Arab Republic and covers the existing water distribution network system operating the Damascus Water Supply and Sewerage Authority (DAWSSA) and Mezze-Razy & Kafar Souseh-Lawan informal area in the administrative area of Damascus City (See Location Map of the Study Area).

DAWSSA provides water for Damascus City. In 1992, DAWSSA supplied a total of approximately 210 million m^3, however water restrictions occurred during the dry season, in spite of supplemental groundwater pumped from deep wells in the City. Existing distribution facilities must also be reviewed since only 36% of all water supplied is accounted for. This unacceptably high level of unaccounted for water is due mostly to leakage from an aging infrastructure, and unmetered use from informal pipe connections. Therefore in addition to securing new water resources, measures for reducing losses in the distribution network are required.

As a first step to improving the above mentioned conditions, the Government of the Syrian Arab Republic (hereinafter referred to as "the Government of Syria") in February 1994 requested the Government of Japan to conduct a Study on the Development of the Water Supply System for Damascus City. In response to the official request from the Government of Syria, the Government of Japan dispatched in March 1995 a JICA Preparatory Study Team to prepare the Scope of Works for the Project. The JICA Preparatory Study Team and the Government of Syria discussed the operation of the Study and signed the Scope of Work for the Study on March 23, 1995.

1.2 The Scope of Works

The Study consits of two phases, according to the tentative schedule outlined in the "Scope of Work" for the study. Phase I is the Mater Plan Study which was carried out from January 1996 to February 1997. Phase II is the Feasibility Study on priority projects which were selected by mutual consent from the Master Plan formulated during Phase I. The objectives of the Phase II Study are summarized as follows:

1) to formulate the plan for the District Meter Area (DMA) system to enhance leakage detection efforts for the distribution network system in Damascus City,

2) to formulate the development plan for the distribution network in the Mezze Razy/Kafar Sousch-Lawan informal area,

3) to formulate the improvement plan for revenue management based on automation and integration of billing and collection functions, and

4) to transfer technology on planning methods and skills to DAWSSA counterpart personnel.

Phase II consists of two field investigation periods and two home work periods as follows:

A. Preparatory work in Japan
(March 1997)
B. The First Filed Investigation
(Study and Analysis; April - August 1997)
C. The First Home Work
(Formulation and Evaluation of Projects; August - October 1997)
D. The Second Filed Investigation
(Explanation and Discussion of Draft Final Report; October - November 1997)
E. The Second Home Work
(Preparation and Submitting of Final Report; December 1997)

The JICA study team dispatched its engineers to the study area according to the schedule described in the Inception Report, for the execution of the study. The study went smoothly under the supervision of JICA's Advisory Committee. Engineers of the JICA study team enjoyed excellent cooperation from DAWSSA's team of counterpart personnel. Throughout the study DAWSSA has participated in the field operations and in the office work, thereby learning the technology and the knowledge required. One counterpart was also invited to Japan by JICA to obtain training in distribution network management.

2. GENERAL BACKGROUND OF THE STUDY AREA

2.1 Land and Socio- economy

Syria is located on the Eastern Mediterranean. It's total land mass is 185,180 square kilometers. The country's capital city is Damascus. The Study Area which is located inside of the City of Damascus. The City of Damascus is located at the point where the Barada River leaves the Anti-Lebanon Mountain Belt and flows east onto a plain of the El-Arab Trough. The urban area of Damascus, covers the alluvial fan created by the Barada river.

The GDP was 496,504 million SL in 1994 and the per capita GDP was 35,866. According to census information, the total population of the country in 1994 was 13.8 million and the rate of population increase has been about 3.3 % from 1981 to 1994. About 51% of the population lives in urban areas and the remaining in rural areas. The population of the Study Area was 1.39 million in 1994 and the growth rate was 2%.

2.2 Water Supply System

DAWSSA, under the Ministry of Housing and Utilities, provides water to Damascus City since 1985. The existing population served by DAWSSA is estimated at approximately 1.2 million. Potable water is mainly abstracted from the Barada spring wells and the Figeh spring located at the upper reach of Barada river and conveyed to Damascus City , through the transmission pipeline consisting of a 16 km box culvert and a 15 km tunnel from the Figeh. The water is stored at Wali reservoir and then distributed to several service reservoirs located throughout the city. Groundwater from Barada spring and under Damascus city, are used to meet peak demands.

In 1995, the amount of water abstracted from the wells at the Barada spring and the Figeh spring sites was approximately 184.2 million cubic meter. This represents about 84% of the total water production. Groundwater located under the city is pumped at various well sites to small service reservoirs located near each borehole and delivered to house connections throughout the network. The quality of the Barada and Figeh spring waters is generally good

for drinking use without any water treatment. The quality of water from most other resources also meets the Syrian drinking quality standards.

There was an estimated 25 million m^3 demand which was not met in 1995. About 64% of the total water produced was unaccounted for. The main components of UFW are attributed to: leakage (34.7%), meter malfunctions (14.4%), informal use (13.6%), and religious and public fountain use (1.7%).

3. PRESENT CONDITIONS OF THE STUDY AREA

3.1 Existing Distribution Network Systems

Main water sources of DAWSSA are the Figeh spring and groundwater from the well fields in the Barada spring and the Damascus city areas. The water from the springs is conveyed to Wali reservoirs through tunnels by gravity flow and transmitted to the service reservoirs from Wali reservoir either by gravity flow or booster pumps. The groundwater in the city area is pumped up to a service reservoir at the well fields and distributed in the network during the water shortage period from June to February.

Flow meters are provided at the entrance of both tunnels and Barada collecting reservoir, the outlet pipe of the service reservoirs and the delivery pipe of the pump stations although no meter is installed in some reservoirs. About half of the existing meters are working in good condition but the others are malfunctioning. Bulk metering is required on the outlet pipe of service reservoirs for operation and maintenance, and the analysis of leakage in the distribution system.

The total length of the existing distribution mains is approximately 1,116 km. Distribution mains are mostly ductile iron pipe DIP ranging from ND 60 mm to ND 1200 mm. About 124 km (11 %) of existing distribution mains are cast iron pipe (CIP) with lead joint ranging in single from ND 80 mm to ND 600 mm. According to the leakage survey carried out by the JICA Study Team from June to July 1997, the leakage of CIP was estimated at 30.3 m^3/h and 3.8 points detected, respectively, per linear km of distribution pipeline.

Leakage problems occur mainly on the cast iron pipes, which form 11% of the total length of the distribution mains in the network. Leakage of ductile iron pipes occurs rarely and usually only due to accidents with construction machinery, improperly seated rubber joints and connections made by informal water users. Only 30 - 50% of pipes can be repaired immediately after detecting leakage. The recorded frequency of repair works on distribution mains and service pipes has remained unchanged for the last 4 years, see Figure 3.1.1. This indicates that, the condition of leakage on the cast iron pipes has not been improved in spite of continuous repair efforts. The frequency of leakage on service pipes per house connection is

estimated at about 1.46 leaks per 1,000 connections/month. It is assumed that service pipes connected to the cast iron pipes probably account for the majority of the all of leaking service pipes, simply because the service pipes are as old as the cast iron pipes.

DAWSSA entered into a turn-key contract agreement with Italian contractor Nuovo Pignone for providing a SCADA and Telecommunication System in 1994. The Project was scheduled to be completed in April 1997, however construction works have not yet been started. The system consists of a supervisory control and a communication system. The remote control valves, the flow meters and the pressure meters will be installed by the project for controlling and monitoring of the water distribution conditions in the network.

3.2 Mezze-Razy & Kafar Souseh-Lawan Area

(1) Physical Conditions

The Mezze-Razy area is located on the south of the Faez Mansour Motorway and the Kafar Souseh-Lawan area is situated in the south of the Hafez Al Assad Motorway. Population in Mezze-Razy and Kafar Souseh-Lawan areas is estimated at 32,786 and 14,000 respectively. The elevation varies from 697 m to 715 m above mean sea level. Average slope incline is about 1.1 % in Mezze-Razy and 1.5 % in Kafar Souseh-Lawan. The present land use in the area is classified into two categories; Residential & Commercial Area (140 ha) and Farmland/Green Area (51 ha).

The urban area of Damascus, covers the thick alluvial fan created by the river where the Barada River leaves the Anti Lebanon Mountain Belt and flows east onto a plain of the El-Arab Trough. The surface geology in the Mezze Razy & Kafar Souseh-Lawan area consists of unconsolidated Quaternary deposits.

(2) Housing and social conditions

A cadastral survey in the Mezze-Razy and Kafar Souseh-Lawan informal areas was carried out, in order to know roughly the location of houses and the type of buildings. The results are summarized as follows:

(Unit: Properties)

Type of Building	Mezze-Razy	Kafar Souseh-Lawan	Total
Resident	2,402	945	3,347
School	4	2	6
Mosque	4	3	7
Store & Workshop	77	148	225
Public Bath	-	3	3
Nursery	4	2	6
Total	2,491	1,103	3,594

In this study, the interview survey on living environment in the area was also conducted during June, 1997. Based on the results of the interview survey, social conditions in the area are summarized below;

i) Average family size is 8 persons per family and average household income varied from SL 3,500 to SL 6,000 (Low Income Class).

ii) Average daily water consumption per capita is 172 lpcd and 95% of water sources are DAWSSA.

iii) 67% residents in Kafar Souseh-Lawan and 26% residents in Mezze-Razy claimed insufficient water quantity, and as for low pressure 56% and 26% respectively.

iv) 97% residents use water storage devices with 1 m^3 of average capacity. 96% informal residents show willingness to pay for water charges with the existing tariff.

(3) Present Water Use

The water supply in the Mezze Razy area and Kafar Souseh-Lawan area is provided partially by DAWSSA. Water in the area is supplied from a water main connected with the Wali service reservoir and the Western service reservoir. For planning the distribution network in Mezze-Razy & Kafar Souseh-Lawan area, the present domestic water use in the area is estimated at 170 lpcd as adopted by the Master Plan Study.

The present water consumption for non-domestic use is estimated based on the unit water consumption per connection adopted by the Master Plan Study as follows:

Type of Connection	Unit	unit water consumption (m^3/connection)	water consumption (m^3/d)
School	6	24	144
Mosque	7	4	28
Store & Workshop	225	0.6	135
Public Bath	3	15	45
Nursery	6	15	90
Total	247		442

3.3 Water Quality and Environment

(1) Pesticide analysis

Water samples from three wells (#1, 4 and 13) in Oumawiyin wellfield, where potential pesticide pollution (aldrin, dieldrin, heptachlor, and fenitrothion) had been suspected in the Master Plan study, were taken in May, 1997, and were analyzed independently at two analytical institutes for cross-examination. Pesticides were not found in any well water samples examined this time. Based on this result, there is no pesticide pollution problem at Oumawiyin. However, pesticides including illegal ones banned by Decision 10 (1980) are widely used in Syria. Therefore, regular monitoring of pesticides in potable water, which is currently not practiced at all, is strongly recommended.

(2) Water quality in the network

The quality of water supplied by DAWSSA is generally high (see Master Plan report). However, it is not uniform in dry season when city wells are in operation to supplement the shortage of supply from the Figeh Spring. To analyze the distribution of water quality in the network, a water quality module was developed and incorporated into the network simulation model. Based on this water quality simulation (Figure 3.3.1), it was possible to pinpoint the areas in the network where water quality is low (e.g., Kadam). The result was in good agreement with the result of the field water quality study in the Master Plan.

(3) Environmental issues in Mezze-Razy & Kafar Souseh-Lawan area

To identify important environmental issues in the Mezze-Razy & Kafar Souseh-Lawan area, an interview survey with 100 local residents was conducted in May-June, 1997. 30 % of the residents claim that lack of clean, safe drinking water is one of the most serious environmental problems of the area. Another very significant environmental issue in the area

is the surface water pollution problem, which nearly 70 % of the residents expressed concerns about. The lack of waste water collection and treatment is the main reason for this. Fewer people complained about air pollution (4 %) and noise (6 %). The study areas are less urbanized than central Damascus, and sources of air pollution and noise are limited. 80 % of the residents expressed no environmental concern about the proposed project. The local residents are aware of the direct benefit of the water supply project, and they are anticipating large long-term benefits from the project in comparison to the minor short-term adverse impacts of the construction works, although they want the construction works to be done as fast as possible to minimize inconvenience.

3.4 Organization and Financial Management

(1) Organization

The organizational structure is presented in Figures 3.4.1 and 3.4.2. The process of generating revenue begins in the Consumer Affairs Directorate responsible for making service connections, meter reading, and payment collection centers. The Consumer Affairs Directorate is almost twice as large in terms of staff (276) as other directorates and has a rather broad mandate dealing with customer services and operation of payment collection centers. The task of managing budgets and daily financial transactions are the responsibility of the Finance Directorate which also has a very broad mandate including non-financial functions such as store keeping, procurement and some expenditure control functions that would be more appropriately managed by the Accounting Directorate. The Accounting Directorate is responsible financial accounting of all revenue and expenditures and preparing customer billing statements using the existing computer system.

There is an overlap in functions between these three Directorates and a general need to clarify roles and responsibilities. Decisions regarding managerial and fiscal issues are vested with the Directors and the Director General with no approval authority delegated to other levels in the chain of command. As a result, senior management positions must deal with many micro management issues and have little time for strategic planning.

(2) Financial performance

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 supply, little has been done to improve the business side of the organization.

Data on financial performance is presented in Tables 3.4.1 and 3.4.2. In terms of revenue growth, DAWSSA's financial performance has apparently improved considerably from a pre-tax net income of SL 5.5 million in 1990 to SL 74.8 million in 1995. However, these improvements are misleading since the volume of water production has increased substantially over the same period while the percentage of water that was actually sold decreased steadily from 34% in 1990 to 29% in 1995. The improvement of financial management was selected from the master plan (JICA 1997) as a priority project for the present feasibility study recognizing the need for DAWSSA to generate the revenues required to develop, own and operate an ever growing water supply system. Two areas in need of urgent improvement were identified: (1) the billing and collection process; and (2) measuring and reporting financial performance to senior management.

The existing billing schedule for a typical cycle is shown in Table 3.4.3. The delay in collecting revenue is on average 12.5 months (10.5 months for issuing and 2 months for collecting). This delay seriously hampers financial performance as well as financial management processes throughout the organization. Although the billing process was partly computerized in 1982, the administrative procedures remain manual, labor intensive and do not permit the analysis of calling data for operational needs. The inability to control expenditures and identify the component costs of producing water and providing support services makes it impossible for management to plan budgets based on the true needs of the organization. The inability to breakdown the operating costs for each part of the organization also makes it impossible to identify potential operating problems and control spending for various activities.

The profile that emerges is one of an organization whose administrative and management processes have not evolved to keep pace with a rapidly growing population and the increasing complexity of the systems and information it must manage. While DAWSSA

is a "Public" utility and should be perceived as a commercially viable operation, it is recognized that it operates at a loss, generating sufficient funds to meet day to day operating expenses but not enough to cover the growing capital contributions required to finance new works.

(3) Computer applications

Computer system development began with COBOL applications for billing, accounting, stores inventory, and payroll implemented in the early 80's. These are still in operation, supported by a UNIX based network with limited capacity. More recently, PC based engineering applications for CAD and office applications such as Spread Sheet and Word processing have been introduced on a stand alone basis. DAWSSA is currently implementing a local area network to link existing PC's and provide a client server environment at headquarters. In general, existing information systems and applications have evolved at different rates and have been implemented at different times without an overall plan or strategy. As the result of this development regime there are now several small "islands of automation" throughout the organization and integration between systems is either non existent or impossible.

Organizational responsibility for computer systems is not clearly identified. The New Works and Studies Directorate, is one of the most advanced computer users, and has created a special section dedicated to the development of information systems. By default, this section also provides technical support for other DAWSSA users. A review of DAWSSA's existing computer application needs and the status of their development is presented in Table 3.4.4.

Table 3.4.1 - Operating Income & Expenditure Statement
(Source DAWSSA accounting directorate)

	1990	1991	1992	1993	1994	1995
Water Produced (000 m3)	154,680	172,900	201,490	212,000	209,000	222,080
Water Sold (000 m3)	53,280	64,515	66,328	70,000	69,582	63,596
Water Sold (% of total production)(1)	34%	37%	33%	33%	33%	29%
Water delivered to water rights (000 m3)(2)	14,020	15,750	15,154	15,750	15,028	14,859
Total accounted for water (000 m3)	67,300	80,265	81,482	85,750	84,610	78,455
Unnaccounted for Water (% of total production)	56%	54%	60%	60%	60%	65%
Average Cost (SL/m3 produced)(3)	0.63	0.66	0.69	0.69	0.86	0.97
Average Tariff (SL/m3 sold)(3)	2.17	3.00	2.70	2.67	4.61	4.37
Operating Revenues						
Water Sales	115,657,868	193,306,344	179,126,281	187,163,513	320,991,221	278,191,915
Cost Recovery Services & Fees	13,352,711	21,422,020	23,233,802	24,690,816	48,426,323	55,229,006
Sale of Connection Materials	2,219,513	2,507,869	3,215,977	4,230,948	3,450,660	3,348,949
Other Revenue	4,339,884	3,390,899	3,446,209	5,377,817	6,654,672	8,241,847
Bank Interest	39,176	114,414	160,222	318,931	320,690	315,122
Previous Year's Adjustments	-	1,036,641	-	3,356,824	-	-
Total Revenues	135,609,152	221,778,187	209,182,491	225,138,849	379,843,566	345,326,839
Operating Expenses						
Salaries & Wages	40,365,378	43,370,708	52,721,801	57,313,006	74,336,324	83,344,723
Benefits	7,970,999	8,563,920	11,925,133	12,116,067	17,914,417	22,941,860
Sub-total	48,336,377	51,934,628	64,646,934	69,429,073	92,250,741	106,286,583
Energy & Utilities	22,077,927	29,130,575	36,898,942	27,356,795	32,018,654	45,841,074
Chemicals	1,861,063	3,619,879	3,579,510	4,075,856	3,727,908	5,442,000
Purchase of service connection materials for re-sa	781,410	1,227,297	1,632,034	2,821,856	3,068,393	2,939,940
Materials	2,455,063	1,931,080	3,432,293	5,470,420	2,798,561	2,758,720
Service fees	18,979,171	24,059,394	25,290,988	28,501,920	31,624,374	36,511,580
Other Expenses	395,658	561,914	441,249	384,844	290,522	1,293,726
Previous Year's Expenses	2,710,021	1,313,215	2,603,988	8,093,270	13,830,897	15,352,013
Total Direct Expenses	97,596,690	113,777,982	138,525,938	146,134,034	179,610,050	216,425,636
Depreciation	32,449,648	36,137,223	40,019,431	39,749,619	50,234,879	54,100,434
Net Income (deficit)	5,562,814	71,862,982	30,637,122	39,255,196	149,998,637	74,800,769
Profit tax	4,664,141	53,221,000	29,305,275	33,721,759	87,535,873	48,338,215
Net Income (deficit) after taxes	898,673	18,641,982	1,331,847	5,533,437	62,462,764	26,462,554
Financial Indicators						
Working ratio (direct expenses/revenue)	0.72	0.51	0.66	0.65	0.47	0.63
Operating ratio (total expenses/revenue)	0.96	0.68	0.85	0.83	0.61	0.78
Profit margin (before taxes)	0.04	0.32	0.15	0.17	0.39	0.22

(1) based on metered billings
(2) based on metered billings, but no revenue collected
(3) equal to income from water sales divided by volume of water sold

Table 3.4.2 Source & Use of Funds

	1990	1991	1992	1993	1994	1995
Source of Funds						
Operating IncomeBefore Taxes	5,562,814	71,862,982	30,637,122	39,255,196	149,998,637	74,800,769
Depreciation	32,449,648	36,137,223	40,019,431	39,749,619	50,234,879	54,100,434
Loans Received	127,897,417	147,653,462	178,604,884	613,720,042	359,577,715	585,899,631
Grant Aid			1,501,319			
Increase in Capital						750,806,933
Increase in Payables	85,069,595	90,030,062	26,290,126	206,992,610	146,154,451	(93,870,388)
Total Sources	250,979,474	345,683,729	277,052,882	899,717,467	705,965,682	1,371,737,379
Uses of Funds						
Capital Investments	70,544,102	74,458,203	76,767,380	334,161,986	264,051,482	240,639,313
Foreign Loans Repayment	14,741,655	15,905,054	-	67,944,821	37,855,453	38,900,000
Loans Interest	76,325,174	85,103,348	81,197,520	143,496,345	150,804,247	258,630,013
Increase in receivables	(24,492,565)	121,977,844	62,451,454	298,041,267	(35,745,886)	758,833,713
Increase in inventories	(3,903,507)	174,171	22,732,739	60,674,664	19,108,430	(15,754,784)
Income Taxes	4,664,141	53,221,000	29,305,275	33,721,759	87,535,873	43,562,410
Transfer to Ministry of Finance	-	2,000,000	-	-	-	
Total Use of Funds	137,879,001	352,839,620	272,454,368	938,040,842	523,609,598	1,324,810,665
Net working capital (SL)	113,100,473	(7,155,891)	4,598,514	(38,323,375)	182,356,084	46,926,714
SUS @ official exchange rate of 45 SL/USS	2,692,868	(170,378)	109,488	(912,461)	4,341,812	1,042,816
Financial indicators						
Income/total sources	2.2%	20.8%	11.1%	4.4%	21.2%	5.5%
Loans/total sources	51.0%	42.7%	64.5%	68.2%	50.9%	42.7%
Capital investment/total sources	28.1%	21.5%	27.7%	37.1%	37.4%	17.5%
Capital investment/ loans rec'vd	55.2%	50.4%	43.0%	54.4%	73.4%	41.1%
Debt service/total sources	36.3%	29.2%	29.3%	23.5%	26.7%	21.7%

Table 3.4.3 Existing Billing Schedule
(Source DAWSSA - billing cycle No. 269 - final quarter 1996)

				Consumer Affairs Directorate				Accounting Directorate								Consumer Affairs Directorate					
No.	District name	Collection centre		Read Meters				Enter Data			Verify &	Produce Bills				Correct Statements				Issue Statement	Total Time
			No. of Bills	start	end	duration	delay	start	end	duration	Correct	print	issue	duration	delay	Receive bills	Back to Actg	duration	delay	To cashier	lapse [3]
1	Kanawat	A-Kanawat	15,987	25-Jul-96	11-Aug-96	17	94	13-Nov-96	22-Nov-96	9	9	1-Dec-96	16-Dec-96	15	3	19-Dec-96	24-Jan-97	36	5	29-Jan-97	188
		B- DAWSSA		25-Jul-96	11-Aug-96											19-Dec-96	24-Jan-97	36	113	17-May-97	296
2	Zifta	Bab Musala	6,294	4-Sep-96	28-Sep-96	24	44	11-Nov-96	12-Nov-96	1	39	21-Dec-96	22-Dec-96	1	0	22-Dec-96	24-Jan-97	33	59	24-Mar-97	201
3	Akrad	A- Akrad	11,031	28-Jul-96	20-Aug-96	23	80	8-Nov-96	13-Nov-96	5	26	9-Dec-96	16-Dec-96	7	10	26-Dec-96	20-Jan-97	25	101	30-Jan-97	186
		B-Al jeser Al Abiad		28-Jul-96	20-Aug-96											26-Dec-96	20-Jan-97	25	101	30-Jan-97	186
4	Janoub Yazd	Janoub Yazd	6,587	10-Aug-96	25-Aug-96	15	75	8-Nov-96	9-Nov-96	1	32	11-Dec-96	16-Dec-96	5	4	20-Dec-96	20-Jan-97	31	101	30-Jan-97	173
5	Salhia Sharkia	A-Al jeser Al Abiad	8,731	4-Aug-96	21-Aug-96	17	93	22-Nov-96	29-Nov-96	7	5	4-Dec-96	16-Dec-96	12	13	29-Dec-96	20-Jan-97	22	101	30-Jan-97	179
		B- DAWSSA		4-Aug-96	21-Aug-96											29-Dec-96	20-Jan-97	22	117	17-May-97	286
6	Salhia Gharbia	Salhia Gharbia	9,094	4-Aug-96	21-Aug-96	17	112	11-Dec-96	11-Dec-96	0	37	17-Jan-97	19-Jan-97	2	0	19-Jan-97	3-Feb-97	15	12	15-Feb-97	195
7	Mohajreen	Mohajreen	13,923	18-Aug-96	18-Sep-96	31	47	4-Nov-96	29-Nov-96	25	66	3-Feb-97	4-Feb-97	1	1	5-Feb-97	20-Feb-97	15	17	9-Mar-97	203
8,9,10	Kimana	A-Shagour	22,294	22-Aug-96	18-Sep-96	27	66	23-Nov-96	11-Dec-96	18	66	15-Feb-97	19-Feb-97	4	1	15-Feb-97	26-Feb-97	11	4	2-Mar-97	192
		B-Baghdad st.		22-Aug-96	18-Sep-96											16-Feb-97	26-Feb-97	10	4	2-Mar-97	192
		C-Bab Touma		22-Aug-96	18-Sep-96											19-Feb-97	26-Feb-97	7	39	6-Apr-97	227
		D-Abasyin		22-Aug-96	18-Sep-96											19-Feb-97	26-Feb-97	7	39	6-Apr-97	227
11	Sharky Al Tijara	Abasyin	1,835	19-Oct-96	31-Oct-96	12	10	10-Nov-96	13-Nov-96	3	57	9-Jan-97	19-Jan-97	10	0	19-Jan-97	13-Feb-97	25	52	6-Apr-97	169
12	Barza Al Balad	Masaken Barza	3,012	15-Oct-96	6-Nov-96	22	52	28-Dec-96	30-Dec-96	2	10	9-Jan-97	16-Jan-97	7	3	19-Jan-97	3-Feb-97	15	34	9-Mar-97	145
13	Shagour	A-Shagour	1,001	18-Aug-96	3-Sep-96	16	71	13-Nov-96	17-Nov-96	4	44	31-Dec-96	2-Jan-97	2	0	2-Jan-97	20-Jan-97	18	41	2-Mar-97	196
		B- DAWSSA		18-Aug-96	3-Sep-96											2-Jan-97	20-Jan-97	18	117	17-May-97	272
14	Mudan	A-Al Ashmar	15,141	23-Sep-96	15-Oct-96	22	64	18-Dec-96	8-Jan-97	21	4	12-Jan-97	16-Jan-97	4	3	19-Jan-97	16-Feb-97	28	45	2-Apr-97	191
		B-Bab Masala		23-Sep-96	15-Oct-96											19-Jan-97	16-Feb-97	28	36	24-Mar-97	182
15	Sarouja	A-Baghdad st.	14,241	1-Sep-96	22-Sep-96	21	43	4-Nov-96	9-Nov-96	5	54	2-Jan-97	4-Jan-97	2	1	5-Jan-97	25-Jan-97	20	36	2-Mar-97	182
		B- DAWSSA		1-Sep-96	22-Sep-96											5-Jan-97	25-Jan-97	20	112	17-May-97	258
16	Mezze [2]	Mezze 1	16,127	10-Nov-96	30-Nov-96	20	39	8-Jan-97	13-Jan-97	5	12	25-Jan-97	27-Jan-97	2	0	27-Jan-97	16-Feb-97	20	113	9-Jun-97	211
		Mezze 2		10-Nov-96	30-Nov-96											27-Jan-97	16-Feb-97	20	113	9-Jun-97	211
17,18	Kiwan, Doumar [2]	Doumar	12,701	2-Nov-96	12-Nov-96	10	82	2-Feb-97	2-Feb-97	0	23	25-Feb-97	2-Mar-97	5	0	2-Mar-97	30-Mar-97	28	71	9-Jun-97	219
19	Masaken Barza	Masaken Barza	7,182	8-Oct-96	31-Oct-96	23	84	23-Jan-97	27-Jan-97	4	20	16-Feb-97	16-Feb-97	0	1	17-Feb-97	2-Mar-97	13	7	9-Mar-97	152
20	Kaboun	Kaboun	5,492	17-Oct-96	29-Oct-96	12	82	19-Jan-97	30-Jan-97	11	4	3-Feb-97	4-Feb-97	1	1	5-Feb-97	15-Mar-97	38	11	26-Mar-97	160
21	Joubar	Joubar	9,801	17-Sep-96	5-Oct-96	18	72	16-Dec-96	18-Dec-96	2	47	3-Feb-97	12-Feb-97	9	19	3-Mar-97	20-Mar-97	17	17	6-Apr-97	201
22	Tabala	Tabala	2,826	23-Sep-96	17-Oct-96	24	62	18-Dec-96	19-Dec-96	1	18	6-Jan-97	19-Jan-97	13	0	19-Jan-97	3-Feb-97	15	51	26-Mar-97	184
23	Moukhaiam [2]	Moukhaiam	18,813	13-Nov-96	3-Dec-96	20	78	19-Feb-97	27-Feb-97	8	12	11-Mar-97	12-Mar-97	1	0	12-Mar-97	22-Mar-97	10	79	9-Jun-97	208
24	Kadam	A-Kafersousse	4,900	24-Oct-96	14-Nov-96	21	66	19-Jan-97	20-Jan-97	1	6	26-Jan-97	27-Jan-97	1	0	27-Jan-97	3-Feb-97	7	49	24-Mar-97	151
		B-Al Ashmar		24-Oct-96	14-Nov-96											27-Jan-97	3-Feb-97	7	58	2-Apr-97	160
25	Kafersousse [2]	A-mezze	9,332	21-Oct-96	15-Nov-96	25	74	28-Jan-97	1-Feb-97	4	24	25-Feb-97	1-Mar-97	4	0	1-Mar-97	15-Mar-97	14	86	9-Jun-97	231
		B-Kafersousse		21-Oct-96	15-Nov-96											1-Mar-97	15-Mar-97	14	9	24-Mar-97	154
26	Kassioun	A-Akrad	9,599	14-Sep-96	2-Oct-96	18	42	13-Nov-96	27-Nov-96	14	26	23-Dec-96	28-Dec-96	5	0	28-Dec-96	30-Jan-97	33	0	30-Jan-97	138
		B-Mohajreen		14-Sep-96	2-Oct-96			13-Nov-96	27-Nov-96	14	26	23-Dec-96	28-Dec-96	5	0	28-Dec-96	30-Jan-97	33	38	9-Mar-97	176
		Total	225,944		Average *	20	67		Average *	7	28		Average *	5	3		Average *	21	44	Average *	197
				Time to complete one cycle		131						Time to complete one cycle		128							

Notes

1. Days = calendar days, seven calendar days=six working days, 1 day= .86 work days
2. Bills have not been delivered to collection centres as of June 9 1997, but meters have been read for next billing cycle.
3. Time from last meter reading until bill issued to payment collection centre
4. Averages are for completing one district

Table 3.4.4 Computer Application Needs and Status of Development

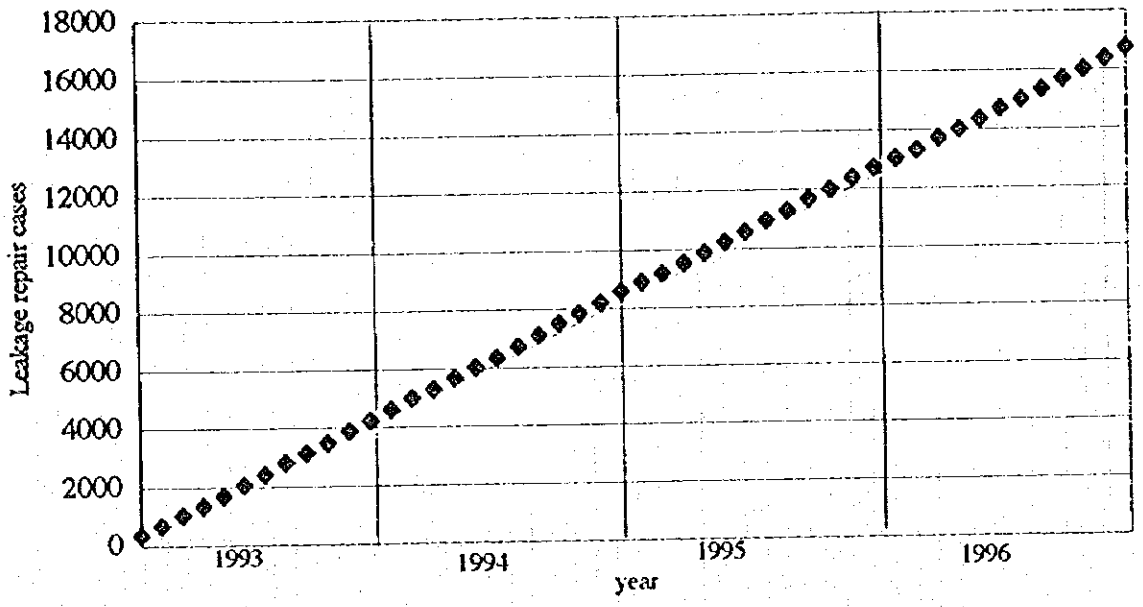
Applications	Functional Areas: Production Centers	Distribution Network	Engineering	Customer Service	Finance	Accounting	Administrative Services	Human resources
Office automation	○	○	○	○	○	○	○	○
Budgeting	○	○	○		○			
Meter Reading			○	○		○		
Billing				◐	○	◐		
Customer Information				○	○	◐		
General Ledger						●		
Cost Accounting						○		
Expenditure Control					○	○		
Cash Management					○			
Inventory Management						◐		
Purchasing					○	○		
Project Management			○		○	○		
Laboratory Information	◐	◐	○	○				
Production Operations	◐	◐						
Maintenance Management	○	○	○	○		○		
Human Resources Management					●	◐	○	
Geographic Information	○	○	○	○				
Computer Aided Drawing	○	○	◐	○				

Partially Developed ◐

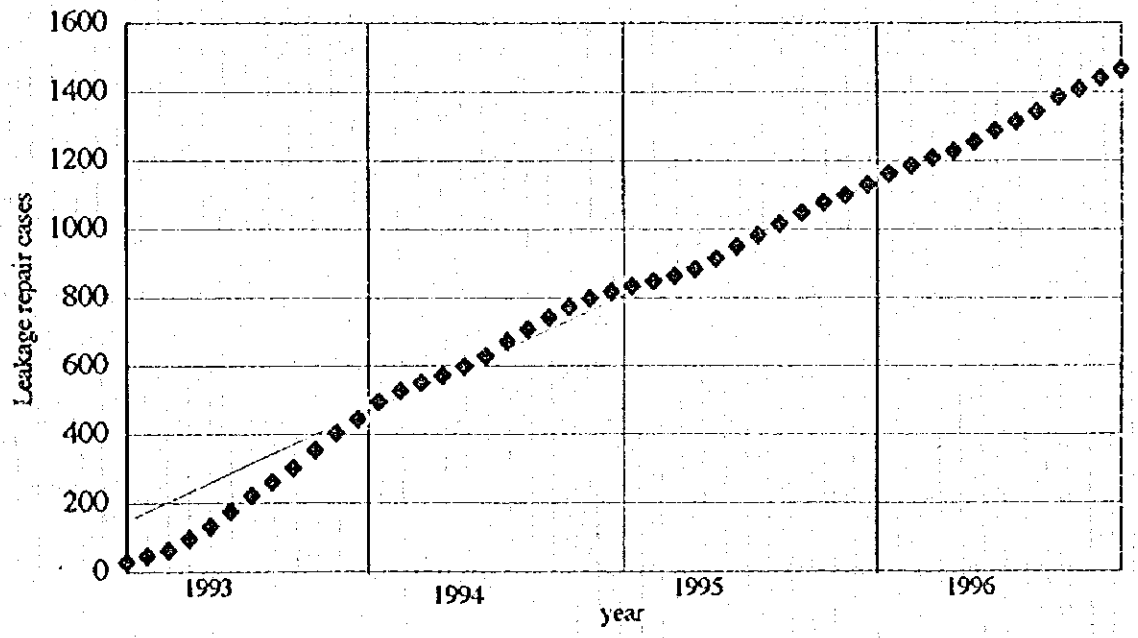
Exists ●

Needed ○

Cumulative monthly repair record from January 1993 to December 1996
for leakage on service pipes



Cumulative monthly repair record from January 1993 to December 1996
for leakage on distribution pipes



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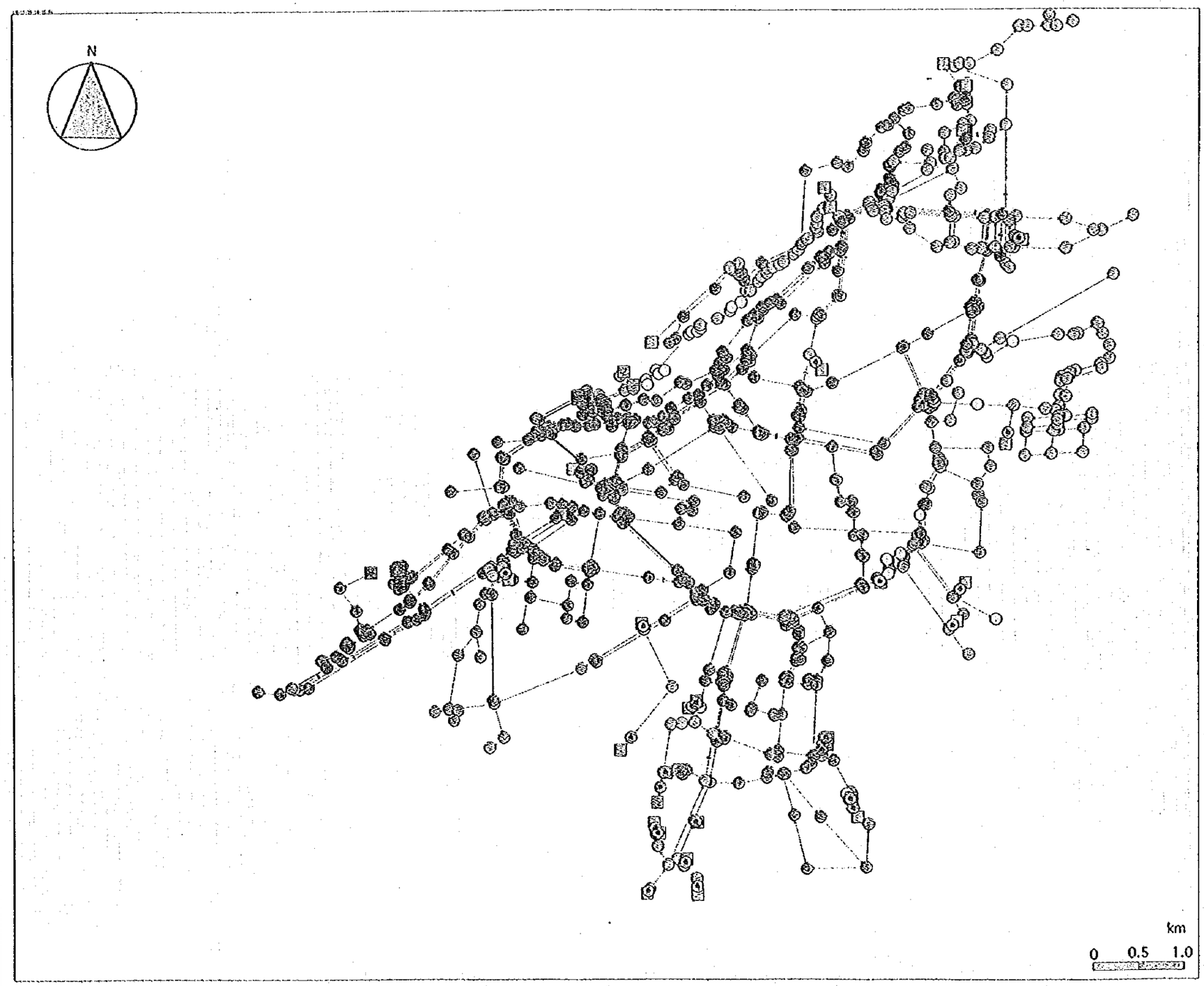
THE STUDY ON THE DEVELOPMENT OF
WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 3.1.1
Cumulative Monthly Leakage Repair Record

NIPPON KOEI CO., LTD.



NO3 Concentration

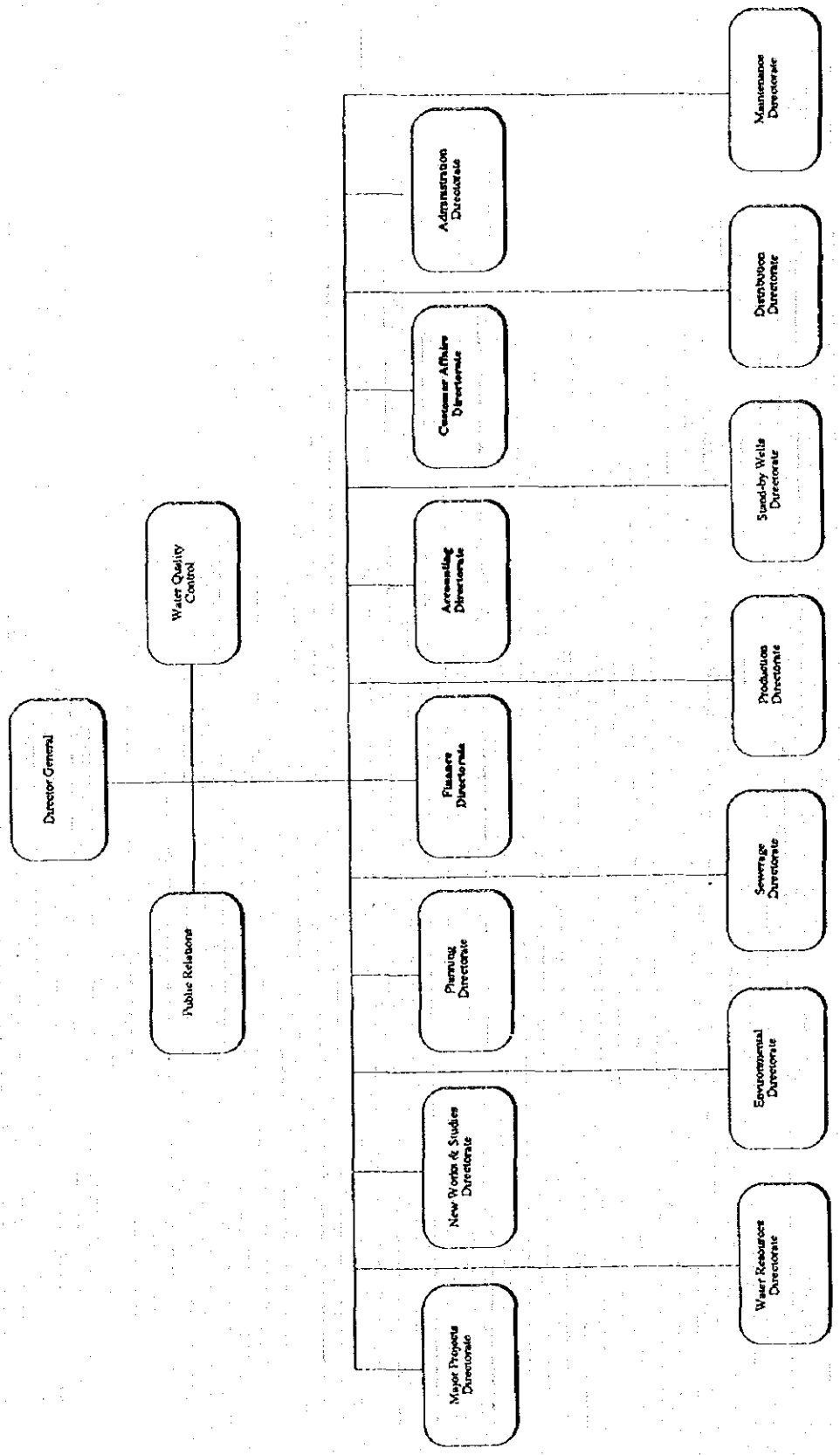
- < 5 mg/l
- 5 - 10 mg/l
- 10 - 15 mg/l
- 15 - 20 mg/l
- 20 - 25 mg/l
- 25 - 30 mg/l
- 30 -35 mg/l
- 35 - 40 mg/l
- 40 - 45 mg/l

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 3.3.1 Predicted Supplied Water Quality in Dry Season (Present)

NIPPON KOEI CO., LTD.



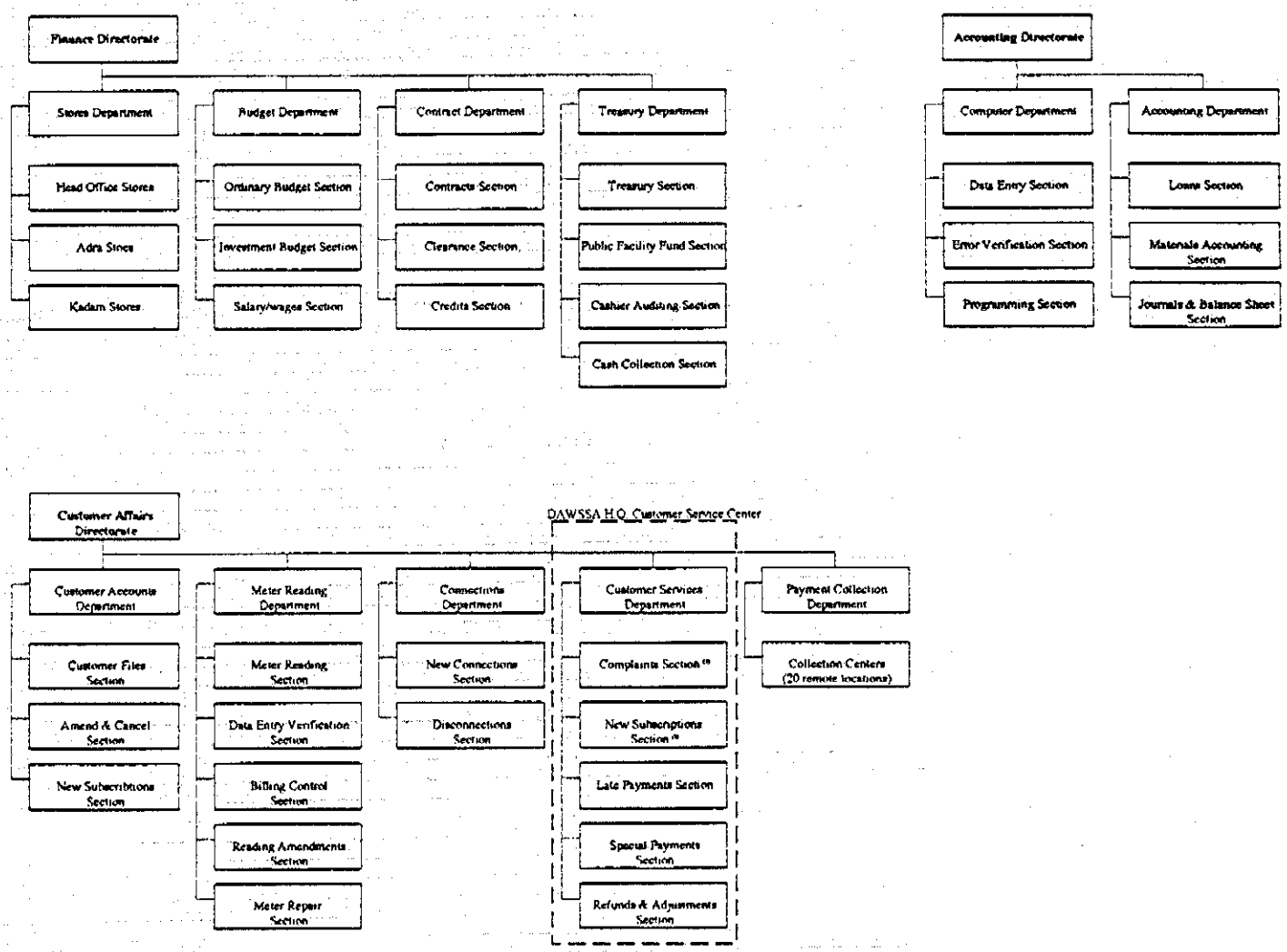
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 3.4.1

Exiting Organizational Structure

NIPPON KOEI CO., LTD.



(1) Customer service representatives for new subscribers and complaints are located at three payment collection centers

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THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 3.4.2 Organizational Structure Directorates Involved In Financial Management

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4. PLAN FORMULATION

4.1 Basic Concepts for the Formulations of Plans

The study consists of three major tasks. These are 1) formulate the plan for the DMA system to enhance leakage detection efforts in the distribution systems of Damascus City, 2) formulate the development plan for the distribution network in the Mezze-Razy & Kafar Souseh-Lawan in informal area, 3) formulate the organizational and management improvement plan for the automation and integration of financial management functions.

The basic concepts for the formulation of plans are briefly described as follows:

1) Plan for the DMA system

a) To establish the DMA system as a countermeasure to alleviate water shortage problems,
b) To establish the DMA system as appropriate on distribution systems that are well maintained and simple to operate,
c) To divide the distribution system into appropriate DMA blocks based on the character and size of the service area,
d) To minimize the number of inflow and outflow points for each block and,
e) To coordinate the relation with SCADA system.

2) Plan for developing the distribution network in the Mezze-Razy & Kafar Souseh-Lawan

a) To grasp the present status of the urban development plan and normalization of informal residential areas in Damascus city, and to confirm the intention of City officials for the Mezze-Razy & Kafar Souseh-Lawan area and,
b) To establish the development plan as an extension of DAWSSA's water supply system, and to consider the implications to the SCADA system.

3) Improvement plan on financial management functions

a) To improve the water charge collecting system by structuring a computerized database to manage metering data and customer accounts.

b) To develop a strategy for the automation of the billing, customer accounting and financial management information systems and,

c) To prepare the recommendation plans on organizational changes, manpower and training required to support automation and provide greater integration of DAWSSA's financial management functions.

4.2 DMA Planning

(1) Present conditions

The average daily flow rate as measured in this study is 479,537 m^3/d. The results of flow measurement indicate that, the instantaneous maximum flow velocity in most pipelines is just less than 2.0 m/s. Minimum night flow in the measurement area is estimated at 4.34 m^3/sec from the measurement results. Water pressure of more than 6.0 kgf/cm^2 was measured at some water mains in Mouhajreen, Ruku Aldyn and Berze districts. However, in Kadam, Yarmouk, Shaghour and Jobar water pressure in water mains was less than 3.0 kgf/cm^2.

Daily water consumption patterns were observed through measurement and interview survey. In the case where houses have storage reservoirs, peak water consumption occurs from 10:00 to 14:00 and again from 20:00 to 24:00. In the case where houses do not have individual storage reservoir, water is used continuously with peak consumption all day. The survey results indicate that 100 % of households with storage reservoirs use them regardless of the season and at least 21 % of household operate their reservoirs daily.

Frequency of leakage per CIP pipe length is 3.8 leakage locations per km and unit loss for CIP length is estimated as 30.3 $m^3/hr/km$ by leakage detection survey in July 1997.

(2) Network analysis

A network analysis is the important first step for implementing the DMA planning. The network analysis was carried out using a simplified computer model as shown in Figure 4.2.1. The specific parameters of the distribution network such as pipe length, diameter and elevation are converted into links and nodes of the computer model. Preliminary simulation was carried out based on the network model using field data and water demands from the Master Plan study. After the preliminary simulation the model was calibrated based on field measurements taken during the wet season. Results of the analysis suggest changing the network to incorporate and re-group block D10 to neighboring D06 and D08 blocks (see Figure 4.2.2). These changes require installation of connecting pipes and isolation valves. Some regions in B03 and D10 blocks are showing low pressure problems due to insufficient pipe capacity. Several pipes need to be replaced with larger diameter mains.

(3) DMA planning

The installation of a DMA system is proposed to optimize water distribution and facilitate leakage control as shown in Figures 4.2.2 and 4.2.3. The size of the blocks for the DMA system were planned according to the following scale definitions:

Classification	Scale
Large block system	A service zone of an individual reservoir, Total length of distribution main: 50-300 km
Medium block system	Total length of distribution main: 30-50 km
Small block system	Total length of distribution main: 10-15 km, Population served: 15,000-20,000

Integration with DAWSSA's new SCADA system is also taken into consideration for planning the DMA. Because the SCADA system focuses on the transmission pipes and distribution mains, the DMA system is designed in two layers. The first layer contains, transmission pipelines that connect reservoirs, and distribution mains. These are grouped as SCADA 01 block. The second layer consists of 21 large blocks which define each service area. A total of 8 large blocks among 21 large blocks were further subdivided into 36 medium blocks according to administrative boundary, road, elevation and pressure stabilization criteria determined by network analysis.

Further subdivision to smaller blocks was also examined but is not proposed, since the small block system should only be introduced after the general monitoring system of the distribution system has been installed and sufficient data is available to evaluate the need for smaller blocks.

The proposed DMA system is summarized below:

Classification of Block	Number of Blocks
i) Large Block System	22
SCADA01 of the superior district	1
Large blocks of the distribution district without medium blocks	13
Large blocks of the distribution district with medium blocks	8
ii) Medium Block System	36
iii) Total Number of Proposed Blocks	50

Priority for implementation of DMA system blocks were determined by evaluation factors, such as population served, informal population, water demand, saved water and cast iron pipe used ratio from a viewpoint of necessity of leakage detection and control. The areas with the highest priority are the medium blocks located to the south D10 and D06.3 in the Mouhajreen, Ruku Aldyn district, and D06.4 in the Mouhajreen and D11 in the Kafar Souseh districts.

4.3 DMA Pilot Area Study

The selected Pilot area consists of medium block D10.5 (Midan district) and medium block D10.4 (Yarmouk district) in the southern part of Damascus city which are within large block D10 which was selected as the highest priority for DMA implementation. Like most of the City, the Midan and Yarmouk districts are located in a low pressure service area that have many informally connected users. Therefore, the selected pilot area is considered typical of water consumption patterns found in most residential areas throughout of the City.

(1) Outline of pilot area

The statistics in the pilot areas are described as follows;

Medium Block Number	D10.5	D10.4
Name of District	Midan	Yarmouk
Area (ha)	181	227
Population	88,300	214,700
Total Population	303,000	
Water Demand (m^3/day)	37,270	65,900
Water Demand (m^3/day) for Informal Residents	0	24,560
Sub total (m^3/day)	37,270	90,460
Percentage (%)	29	71
Total Demand (m^3/day)	127,730	

(2) Present water use and water pressure

The measured daily water consumption in wet season and elevation in the Pilot Area are as follows;

	Medium Block D10.5	Medium Block D10.4
Water Consumption (m^3/day)	56,865	60,382
Percentage (%)	49	51
Surface Elevation (m)	688.67 - 678.87	682.00 - 670.40

The area is supplied with water from the Western service reservoir (HO) located at elevation of 755.50 m. Minimum water pressures in the Pilot Area, measured at five hydrants, show between 2.5 and 1.0 kgf/cm^2 except for one point. These figures do not meet DAWSSA's minimum criteria of 3.0 kgf/cm^2. According to the interview survey, the average capacity of individual household reservoirs is 0.8 m^3. The replenishment of household reservoirs is usually carried out between 8 p.m. to 7 a.m. (11 hours) at 19% of the households. The water use measured at one (1) house between 0:30 a.m. to 4:30 a.m. was 0.0179 m^3/hr. The minimum night flow in the Pilot Area was measured at 1.19 m^3/sec(4,280 m^3/hr) in June 1997.

(3) Minimum night flow

Minimum night flow and UFW in the pilot area is estimated based on the results of the field surveys:

	(m^3/hr)	(l/property/hr)	(%)
Minimum Night Flow	4,280	113	100
Storage Tanks	720	14	12
Other Water Use	550	15	13
UFW*	3,010	84	75

* : UFW (unaccounted-for-water) includes leakage and informal use.

4.4 Water Requirement of the Mezze Razy & Kafar Souseh-Lawan Area

(1) Service Area and Population Served

According to the proposed DMA plan, Mezze-Razy & Kafar Souseh-Lawan informal areas are part of the large block D11 supplied from the Wali sevice reservoir. The service area to be improved and population served are determined based on the results of supplemental topographical survey and population projection adopted by the JICA Master Plan Study as follows:

	Area (ha)	Population
i) Service area to be improved	191	46,800
- Formal area	47	14,800
- Informal area	93	32,000
- Farmland/Green area	51	
ii) Additional area to be considered for total water demand (D11)	395	20,400
iii) Total area for water requirement	586	67,200
- Formal area	450	20,400
- Informal area	136	46,800

(2) Water Demand Projection and Water Requirements

The water requirements are as follows:

i) Water requirements of Mezze-Razy and Kafar Souseh-Lawan areas including UFW

- Domestic requirements : 8,740 (m^3/d)
- Non domestic requirements : 6,330 (m^3/d)

ii) Total water requirements of Mezze-Razy and Kafar Souseh-Lawan including UFW :15,070 (m^3/d)

iii) Additional water requirements of other areas in D11 to be considered for plan of distribution trunk main : 6,600 (m^3/d)

iv) Total water requirement of D11 :21,670 (m^3/d)

- Daily average supply : 251 l/s
- Daily maximum supply : 286 l/s

4.5 Financial Management Change Strategy

Creating an organization that is financially self supporting, and cost-effective is clearly the long term goal. The present feasibility study is aimed at developing a change strategy that will: (a) Improve financial management processes; (b) Increase revenues; and (c) Improve management's ability to budget and control costs.

DAWSSA needs to maximize the use of it's limited financial resources to provide better, and more cost effective services. Today's modern utility is meeting similar challenges through the use of computers. The implementation of information technology is at the heart of the change strategy required to improve DAWSSA's future financial well being. Opportunities for improvement were discussed with DAWSSA's senior management team, and the recommended changes are summarized in the following paragraphs.

Organizational changes are needed to: (a) streamline decision making; and (b) clarify roles and responsibilities. These objectives can be achieved by consolidating the organizational structure along functional lines. The recommended organizational structure is presented in Figure 4.5.1. and consist of: 1)moving the payment collection functions from Consumer Affairs to the Finance Directorate; 2)moving all store keeping functions from the Finance Directorate to the New Works & Studies Directorate which is the largest user and specifier of materials; and 3) creating an Information Technology Directorate to support the planning, implementation and operation of new computer systems, SCADA systems and data communications systems.

A well organized customer information system is needed to support the billing functions that generate revenue. The objectives are to: (a) improve access to account information; (b) improve accuracy and speed of customer service transactions; and (c) improve retrieval and archiving of customer information. These objectives can be met by providing a computerized customer information system complete with a document management system interfaced to the database management system for archiving historical legal documents. All remote payment collection centers should be connected to the database to have access to current account information.

Changes in the customer billing and payment collection process are required to reduce inefficiencies and increase annual revenues. The overall objectives are to: (a) reduce time delays and duration of billing activities; (b) reduce billing errors; and (c) accelerate the collection of late payments. These objectives can be met firstly by reducing inefficient administrative processes and secondly by implementing appropriate technology for automating metering and billing. Specific recommendations are: 1) implementing meter installation standards to improve meter reading productivity; 2) automating meter reading with the use of hand held data entry terminals; 3) reducing the waiting period between steps in the billing process; 4) consolidating error detection and correction activities; 5) changing the meter reading and billing cycle from 3 months to 4 months; 6) implementing a modern computer system for customer accounting and billing complete with automatic data validation features; and 7) issuing late payments notices monthly and a final notice with warning of impending disconnection should be issued after no more than 6 months.

The existing accounting systems that are supposed to support financial management need to be changed to provide the information required to control costs, analyze trends and plan for budget needs. The overall objectives are to: (a) provide accurate and timely financial information; (b) provide the cost information required to control expenditures; (c) provide the information required to improve budget preparation. These objectives can be met by firstly implementing cost accounting codes and secondly by implementing financial reporting through the use of an automated financial management system.

4.6 Computer Systems

The configuration of the recommended Customer Information System (CIS) and the Financial Management System (FMIS) is illustrated in Figure 4.6.1. The main system will be located at DAWSSA headquarters with file servers located in the existing computer center. It is essential that remote payment collection and customer service centers continue to operate even if communications fail. Therefore the 20 remote payment collection centers should have their own separate systems for stand alone operations. The master database will reside centrally at DAWSSA headquarters and be distributed to remote sites where it will be used, updated and returned to the central database.

The process of entering meter readings, and calculating bills will be carried out centrally at DAWSSA headquarters. The process of printing bills, collecting payments and recording customer account transactions will be carried out at the remote payment collection locations where the customer pays in person. Complete customer account information will be available at each payment collection location to answer customer inquiries.

Within DAWSSA headquarters, on-line access for real time processing of data can be achieved by extending the recently installed Local Area Network (LAN). Remote payment collection centers can be connected to each other and to the central headquarters system via the public X.25 packet switching network service operated by the Syrian Telephone Exchange (STE).

The most critical software decision involves selecting an operating system that is widely used, well supported by vendors, and compatible with recently implemented applications and hardware. Although large client server applications are usually UNIX based, recent improvements in technology have seen the development of several PC based utility management applications that can satisfy DAWSSA's needs. All future network applications should be therefore be PC based and compatible for use in a network environment. A modern relational database with query language capabilities is recommended for information management and reporting.

There are various alternatives for application software - either packages can be purchased and modified for use, or customized applications can be developed from scratch. Customization however should be minimized if at all possible in favor of commercially available packages to reduce long term costs. The customer information system should consist of four integrated modules:

(a) the customer accounting module will maintain the database of relevant information about customers, such as consumption and billing history, meter and service information, address, account status, accounts receivable and transaction summaries.

(b) the billing module will take data from the customer's meters, the customer accounting system and customer service system and produce bills, process payments, track accounts receivable and direct the collection process.

(c) the customer service module will take information from customers regarding special needs, e.g. high billing complaints, inquiries, interruption of service, transactions or changes in accounts, initiation of services, water rights. The module will be interfaced to a document management system capable of providing digital images of the relevant customer application documents kept on file.

(d) the management information module will provide management with trend reports, financial reports related to billings issued, unpaid, accounts receivable, and engineering/service reports regarding distribution network management such as number of service connections, and type.

The FMIS will consist of three fully integrated modules completely integrated with the Customer Information System:

(a) the financial accounting module will be a fully automated system based on the existing chart of accounts and the introduction of an appropriate chart of cost accounting codes. Data will be captured only once, as an accounting transaction progresses through the system. It will enable expenditures and revenues to be recorded at a detail

level and related to specific programs, projects and activity centers throughout the organization

(b) the budget preparation module will support the process of preparing and monitoring both investment and operating (ordinary) budgets. The module will receive from the various Directorates (spending units) the details of their programs and projects, consolidate them and produce from them a budget document for review and discussion. The module will facilitate the iterative process of budget submission, consolidation, review/negotiation and documentation until the budget is finalized and approved. After approval, the system will produce the approved budget estimates in a format suitable for budget implementation and accounting purposes.

(c) the management information module will produce the financial reports required by the various users. This will include, monthly financial reports on revenue and expenditure accounts, budget reports showing amounts remaining until fiscal year end and accounts were expenditures will potentially exceed the budgeted amount. The system will have capabilities for search and query to facilitate interaction with the users for easy retrieval, analysis and reporting of data by the users.

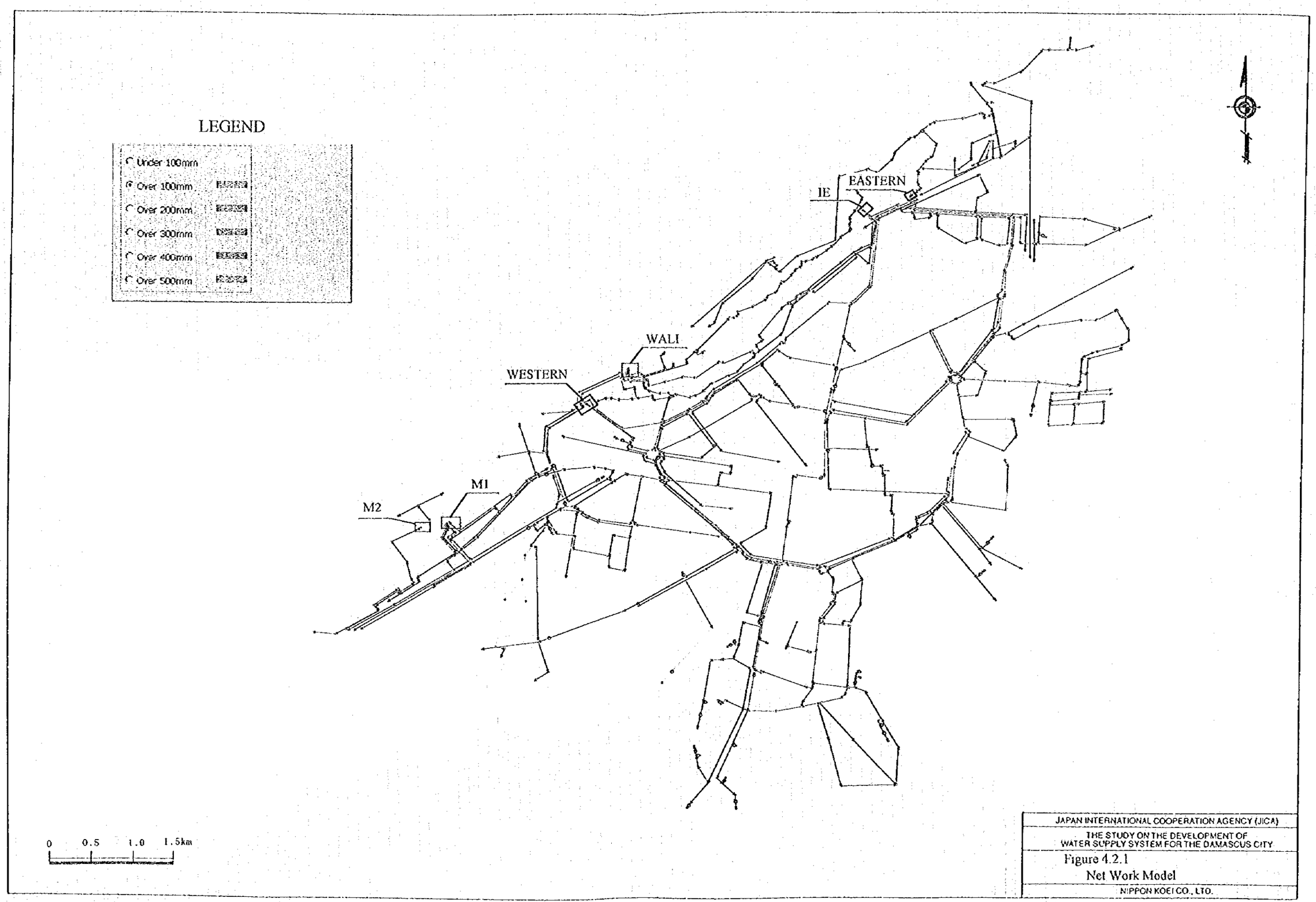
LEGEND
Under 100mm
Over 100mm
Over 200mm
Over 300mm
Over 400mm
Over 500mm
EASTERN
IE
WALI
WESTERN
M1
M2
0 0.5 1.0 1.5km
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Figure 4.2.1
Net Work Model
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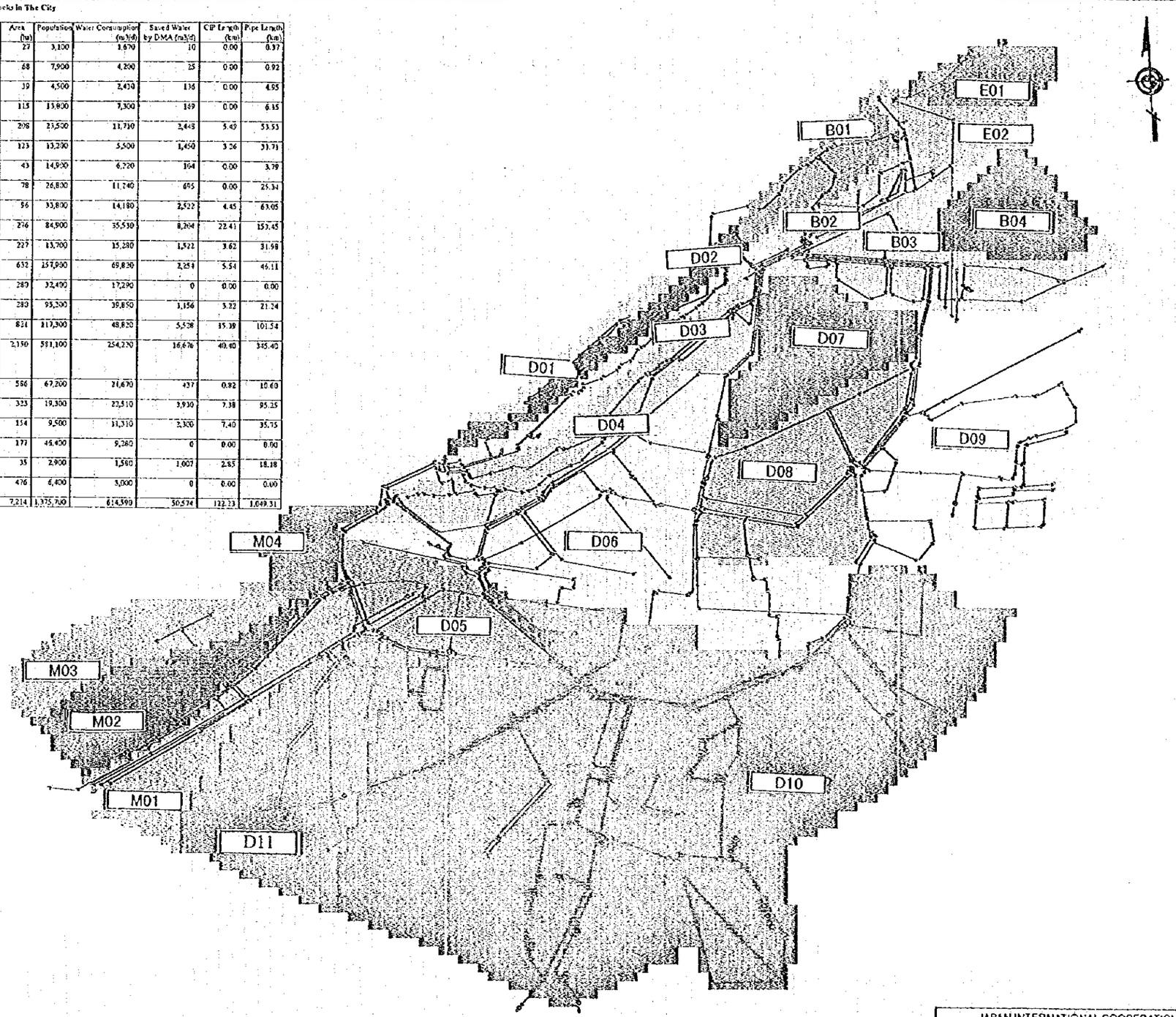
Characteristic of Large Blocks in The City

No. of Large Block	Pressure Zone	Name of Water Source (Service Reservoir and Production Well Center)	Area (ha)	Population	Water Consumption (m3/d)	Saved Water by DMA (m3/d)	CIP Length (km)	Pipe Length (km)
E01	Eastern Berze High I	Kaboon Booster Pumping Station & High S.R. (C.k)	27	3,100	1,670	10	0.00	0.37
E02	Eastern Berze High I	Berze Village S.R. (B.1v)	68	7,900	4,200	25	0.00	0.92
B01	Berze High II	Akrad High S.R. (B.2)	39	4,500	2,430	136	0.00	4.95
B02	Berze High I	Berze Bohooth S.R. (B.1b)	115	13,800	7,300	189	0.00	6.15
B03	Berze Medium	Akrad Low S.R. (LE)	208	23,500	11,710	2,448	5.49	53.53
B04	Berze Medium	Kaboon Booster Pumping Station & High S.R. (C.k)	123	13,200	5,500	1,450	3.26	31.71
D01	Damas Center Superior High	Kassioun Superior S.R. (K.7)	43	14,900	6,720	164	0.00	3.79
D02	Damas Center High II	Kassioun High S.R. (K.3)	78	26,800	11,240	695	0.00	25.34
D03	Damas Center High I	Kassioun Middle S.R. (K.1)	56	33,800	14,180	2,522	4.45	63.05
D04	Damas Center Medium	Wali S.R. (LA)	276	84,900	35,530	8,204	22.41	153.45
D05	Damas Center Medium	Western S.R. (LO) University P.W.C. (J.A)	227	13,700	15,280	1,522	3.62	31.98
D06		Western S.R. (LO) Qunaiaiy in P.W.C. (A.2)	632	257,900	69,830	2,254	5.54	46.11
D07	Damas Center Low	Ibn Al Nafeas S.R. (N.1) Mazzea P.W.C. (M.2a)	289	32,400	17,290	0	0.00	0.00
D08	Damas Center Low	Eastern S.R. (LE)	280	95,200	39,850	1,156	3.22	21.24
D09	Damas Center Low	Eastern S.R. (LE)	831	317,300	48,830	5,528	35.39	101.54
D10	Damas Center Low	Western S.R. (LO) Ibn Assaker P.W.C (A) Kadam Store (K.M) & Kadam Railway P.W.C(K.s) Takadom P.W.C (4)	2,150	551,100	254,230	16,676	40.40	345.40
D11	Damas Center Low	Wali S.R. (LA)	586	67,200	21,670	437	0.92	10.40
M01	Mezze Medium	Mezze S.R.(M.1)	323	19,300	22,510	3,930	7.38	95.25
M02	Mezze High I & II	Mezze High S.R. (M.2)	154	9,500	11,310	3,300	7.40	35.75
M03	Mezze High I & II	Mezze High S.R. (M.2)	177	46,400	9,280	0	0.00	0.00
M04	Mezze High I & II	Wali S.R. (LA)	35	2,900	1,560	1,007	2.85	18.18
Airport	Mezze Medium	Mezze S.R. (M.1)+ Bulk water supply	476	6,400	3,000	0	0.00	0.00
Total			7,214	1,375,700	614,590	50,574	122.23	1,049.31

(Source : DAWSA & JICA)

Remarks
1) System loss is estimated based on the existing water demand (1995).
2) Existing percentage of system loss is 35 %.
3) Target percentage of system loss is 25 %.



0 0.5 1.0 1.5km

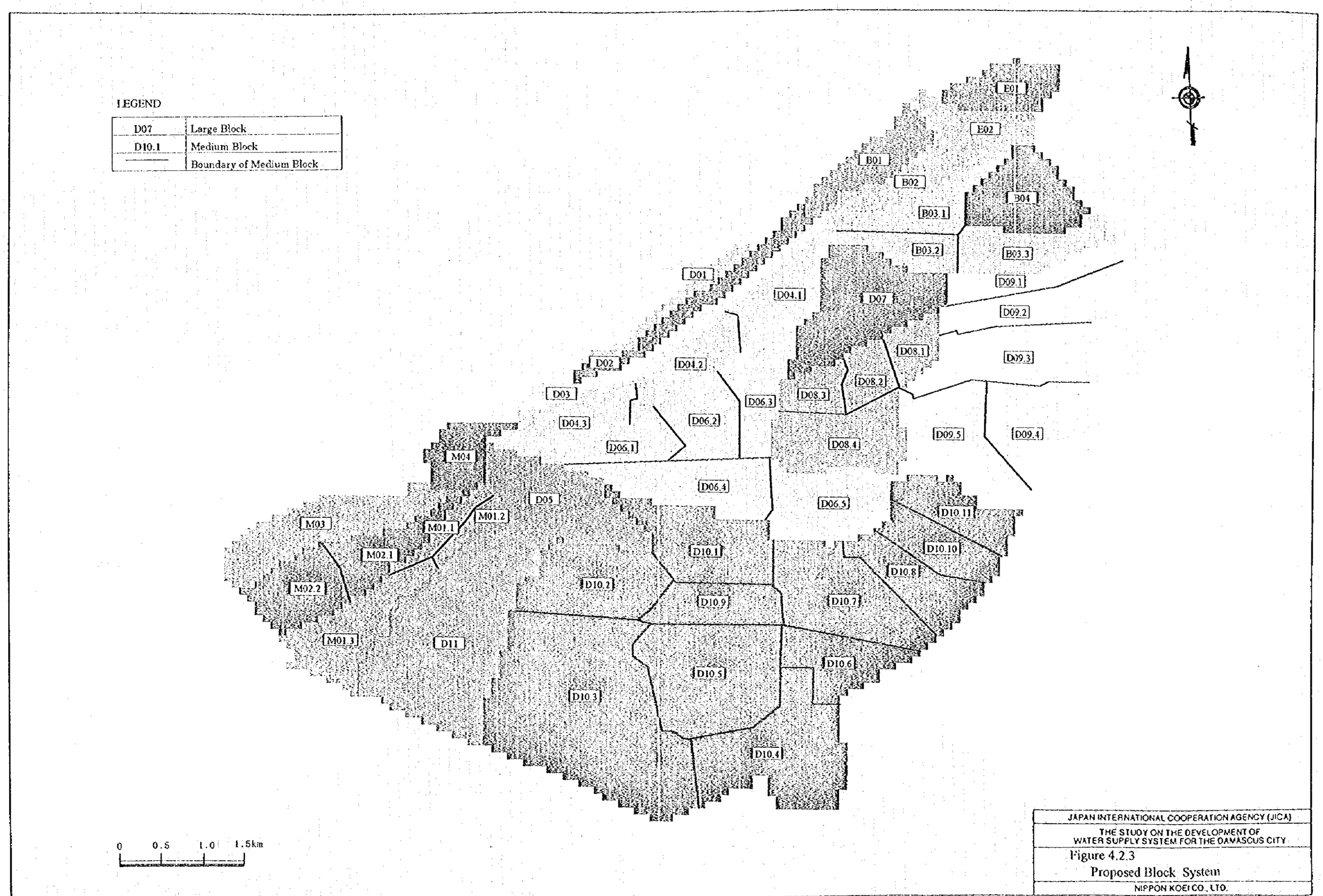
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 4.2.2

Large Block System

NIPPON KOEI CO., LTD.

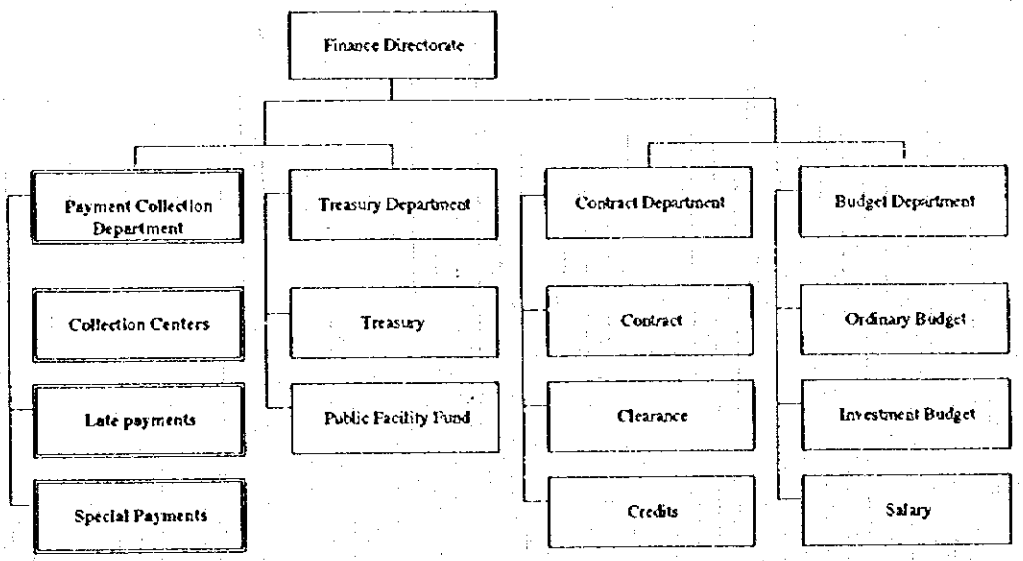


JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

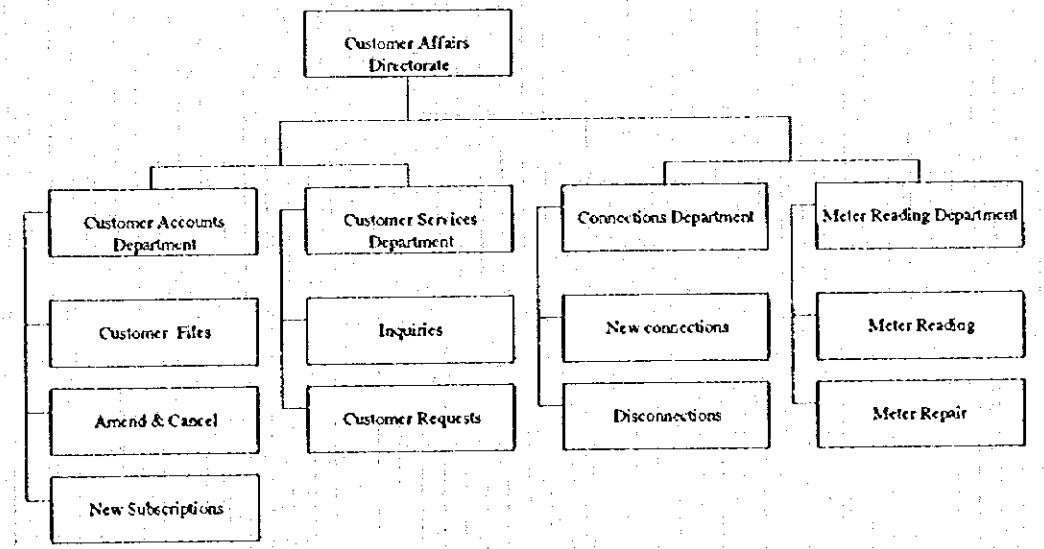
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 4.2.3
Proposed Block System

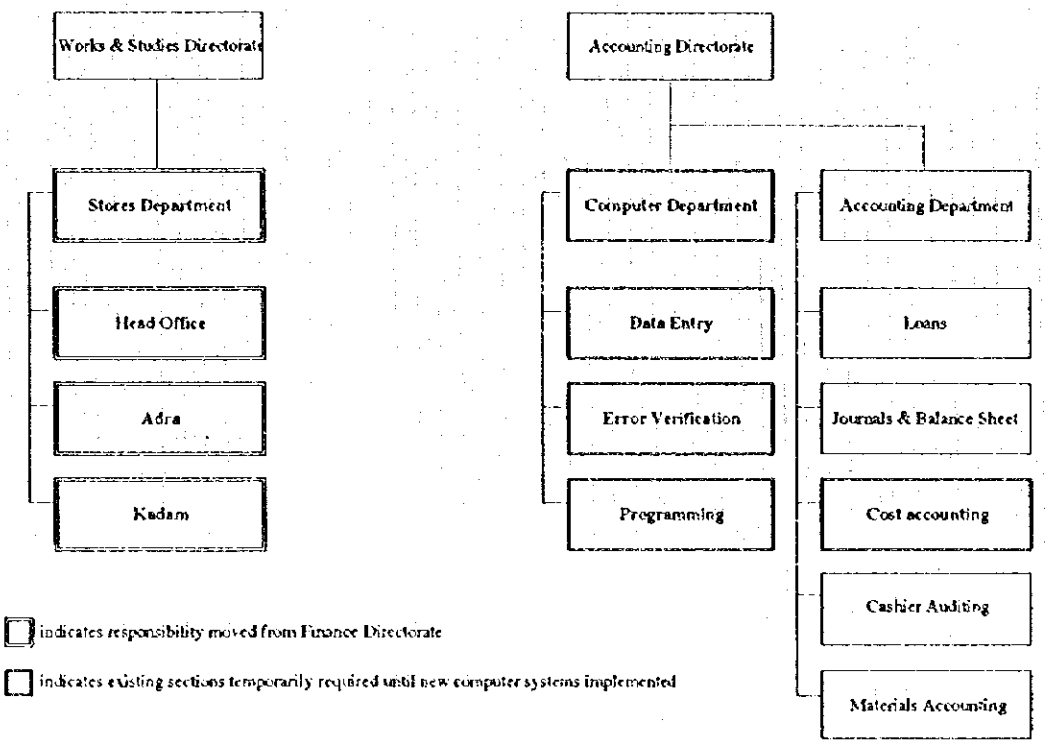
NIPPON KOEI CO., LTD.

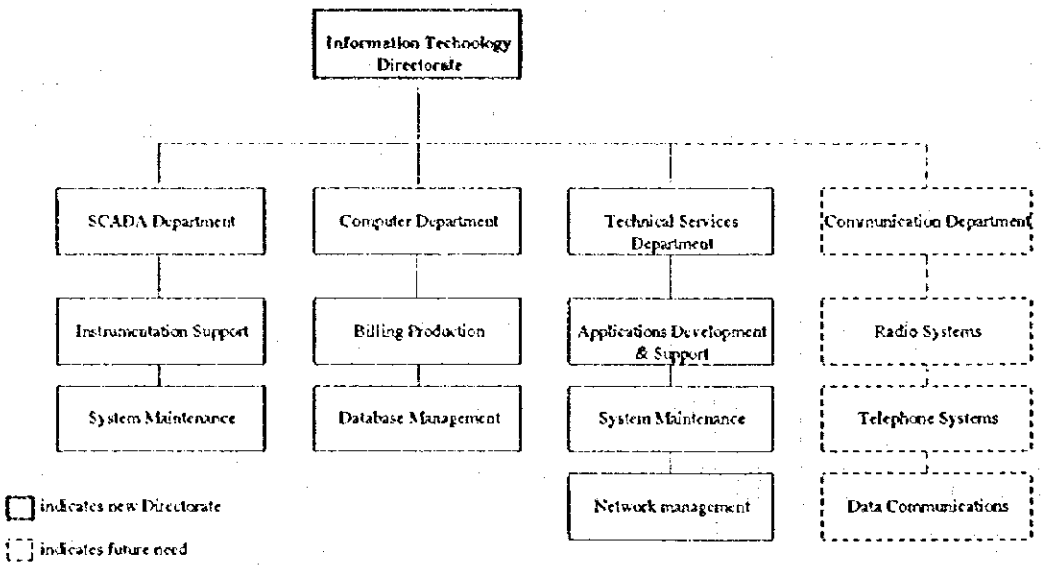


☐ indicates responsibility moved from Customer Affairs Directorate

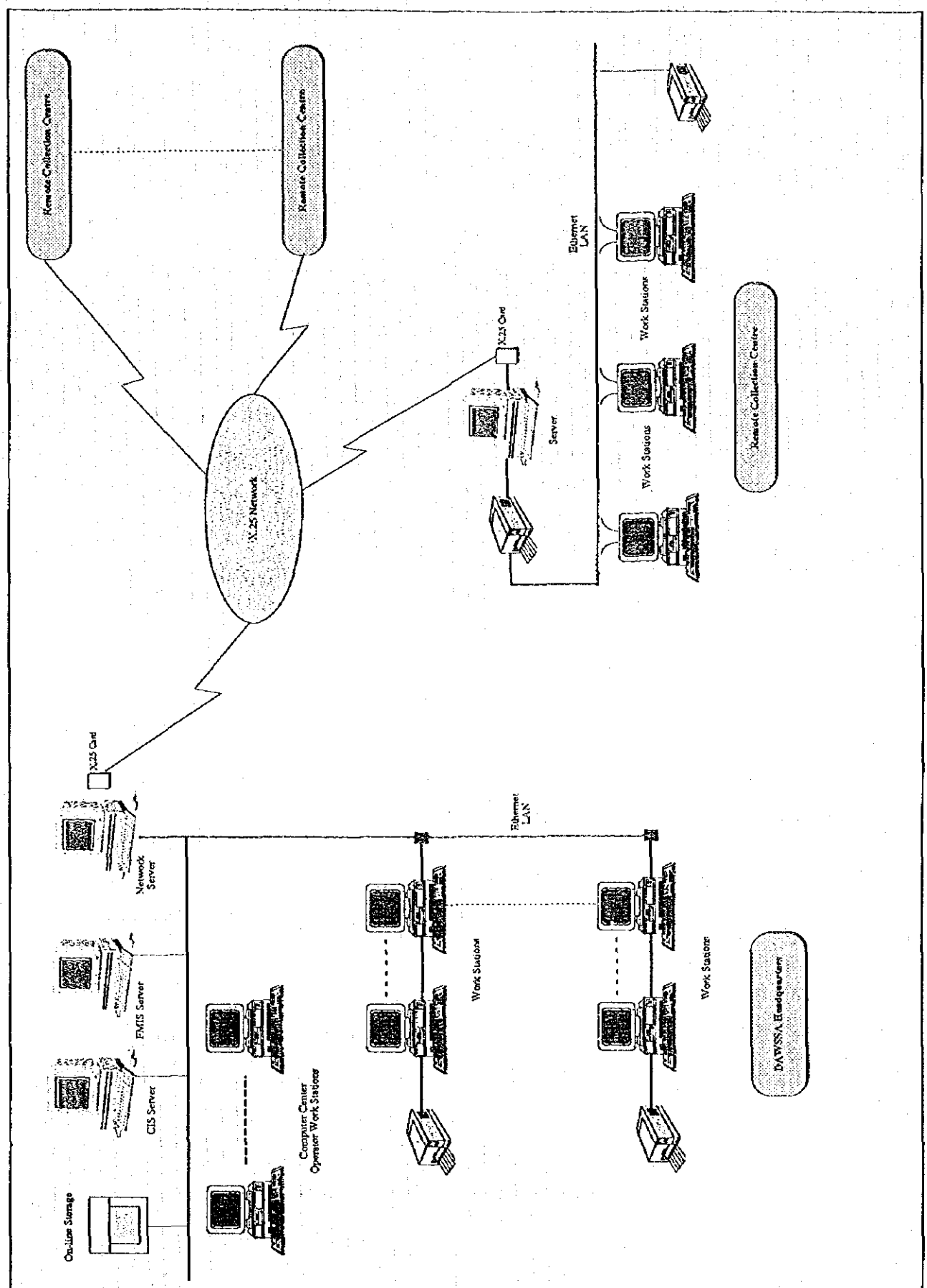


JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure 4.5.1 (1/2) Proposed Organizational changes
NIPPON KOEI CO., LTD.





JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure 4.5.1 (2/2) Proposed Organizational changes
NIPPON KOEI CO., LTD.



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 4.6.1

Computer System Configuration

NIPPON KOEI CO., LTD.

5. THE PROPOSED PROJECTS

5.1 Objectives

The main physical objectives of the project are to provide an adequate reliable water supply in the dry season and to increase water available for consumption to meet future demand by reduce the unaccounted for water (UFW) of the DAWSSA's distribution network. In order to reduce the unaccounted for water figure, DMA system and water supply project for the Mezze-Razy & Kafar Souseh-Lawan informal area have been proposed in the Main Report of Phase I, as priority projects proceed immediately to the Feasibility Study stage. Concurrently, an indispensable objective for DAWSSA's management activities is to strengthen the collection of water charges and financial information systems as described in Chapter 7.

5.2 DMA System

(1) Proposed leakage detection and control plans

Based on study results the following improvements are proposed

i) A program of mains replacement to reduce the level of leaking lead joints on CIP and reinforce the existing distribution system thus safeguarding supplies.

ii) A program for setting up the DMA system that will enable DAWSSA to monitor the distribution system and identify areas of high leakage.

iii) A program for reinforcement of regular acoustic sounding surveys for leak detection at the distribution system in cooperation with the DMA system.

iv) A program for setting up regulated pressure zones that will reduce the levels of leakage in high pressure zones. This program supports the DMA system.

v) A program for water supply improvement with establishment of DMA system in informal areas like the Mezze-Razy & Kafar Souseh-Lawan System planned in this stage.

(2) DMA system

The DMA system was proposed and formulated to provide DAWSSA with an active leakage control program, as shown in Figures 4.2.2 and 4.2.3. The DMA system requires a set of sluice/pressure reduction valves, flow rate monitoring chambers, and/or pressure monitoring chambers to be installed at the intersections of pipes with the DMA borders taking into account the cost of installation and O&M, in addition to the general operational requirements as shown in Figures 5.2.1 and 5.2.2.

All DMA blocks shall be monitored for 24 hours once per season (wet and dry), and large blocks are to be monitored and inspected monthly. A monitoring program based on the DMA system for the distribution system in the City was proposed as shown in Figure 5.2.3.

The ground in Damascus is hard, and sound of leakage is easily transmitted to the ground surface. Therefore, leakage survey based on leak sound method appears to be the most suitable choice. Assuming these pipes (total length: 1,220 km) are investigated once a year, and 200 working days per year, the survey distance is about 6.1 km/day, or 30.5 km/week (5 days). This workload requires at least two teams with two surveyors per team, or a total of 4 surveyors. The teams need to be coordinated and their works have to be scheduled. A full-time active leakage detection system is recommended. The schedule for the program of reinforcing regular acoustic sounding surveys is presented in Figure 5.2.4.

The program for setting up regulated pressure zones was included in the DMA program. The water main replacement program proposed as an urgent priority, is described in detail in the Section 3.1.7, because it is closely linked to the implementation of the DMA system.

5.3 Mezze-Razy & Kafar Souseh-Lawan System

(1) Design Criteria

The following DWSSA design criteria are adopted for the improvement plan of Mezze- Razy & Kafar Souseh-Lawan system:

i)	Minimum effective head	: 30 m
ii)	Maximum velocity	
	. Distribution main (at least ND250 mm)	: less than 2 m/s
	. Distribution sub-main (Secondary & Tertiary)	: less than 1 m/s
iii)	Quality of materials	
	. Distribution main (at least ND250 mm)	: Ductile iron pipe
	. Secondary pipe (at least ND100 mm)	: Ductile iron pipe
	. Tertiary pipe and service pipe (less than ND63 mm)	: Polyethylene pipe
iv)	Interval of hydrants	: 300 m to 400 m
v)	Type of hydrant	: French/USA (underground type)
vi)	Seasonal load factor	: 1.14
vii)	Hourly load factor	: 1.25

(2) Overall Water Supply Improvement Plan

The overall water supply improvement plan was formulated as shown in Figures 5.3.1 and 5.3.2, in consideration of the existing conditions in the area, results of network analysis for the whole distribution system, the DMA plan, the water requirements and the above stated design criteria. The improvement plan covers water demand not only for the Mezze-Razy & Kafar Souseh-Lawan area but also for the areas adjacent to the study area where informal residents have settled and connected to the distribution system.

The existing water supply system in the study area is fed by a 250 mm diameter feeder main from the Wali service reservoir and a 150 mm diameter feeder main from the Western service reservoir. The existing distribution network consists of a looped distribution network in Mezze- Razy and a branched distribution system in Kafar Souseh-Lawan.

The capacity of the new distribution trunk was calculated to meet the total water requirements of block D11 as recommended by the DMA plan. The improvement plan was formulated based on the water demand estimated by the Master Plan (JICA-1996) for Mezze-Razy & Kafar Souseh-Lawan area and the medium block D11.

The proposed improvement plan is outlined as follows:

i) The existing trunk main (ND800 mm) from Wali service reservoir is used as a transmission pipeline.

ii) A new 700 m Distribution main of ND 600 mm is installed branching from the existing trunk main to two connection points at a head of the distribution network. A new 250 m distribution main of ND 500 mm is extended from the branch point to a third connection point located at the 17th April Street. New distribution mains of ND 200 and 500 and 300 mm will be branched and joined to the network at connection point respectively (see Figure 5.3.2(1/2)).

iii) A number of new distribution mains will be provided to modify the existing branched distribution system into a looped network. The total length of distribution pipeline is about 13.7 km with a diameter varying from ND 100 mm to ND 400 mm.

iv) The distribution network will serve an area of 191 ha and a population of 46,800 persons including 32,000 existing informal residents.

v) The area will be included in the DMA medium block D11. The daily average water supply is estimated at 21,670 m^3/d (257 l/s). Daily maximum water supply and peak hourly supply is 286 l/s and 357 l/s respectively based on the DAWSSA's design criteria.

5.4 Cost Estimates

(1) Construction costs

The estimated total construction costs for the District Meter Area (DMA) System and Mezze Razy & Kafar Sousch-Lawan System Projects are as follows:

(Unit: US$ 1,000)

Project Name	DMA System			Mezze Razy&Kafar Sousch-Lawan System		
Items	L.C.	F.C.	Total	L.C.	F.C.	Total
1. Direct Construction Cost	628	2,647	3,275	1,951	2,210	4,161
2. Tax and Duty	411	0	411	787	0	787
3. Administration Cost	63	0	63	195	0	195
4. Engineering Cost	63	265	328	195	221	416
5. Physical Contingency	75	291	366	234	243	477
6. Price Contingency	64	125	189	157	90	247
Total	1,304	3,328	4,632	3,519	2,764	6,283

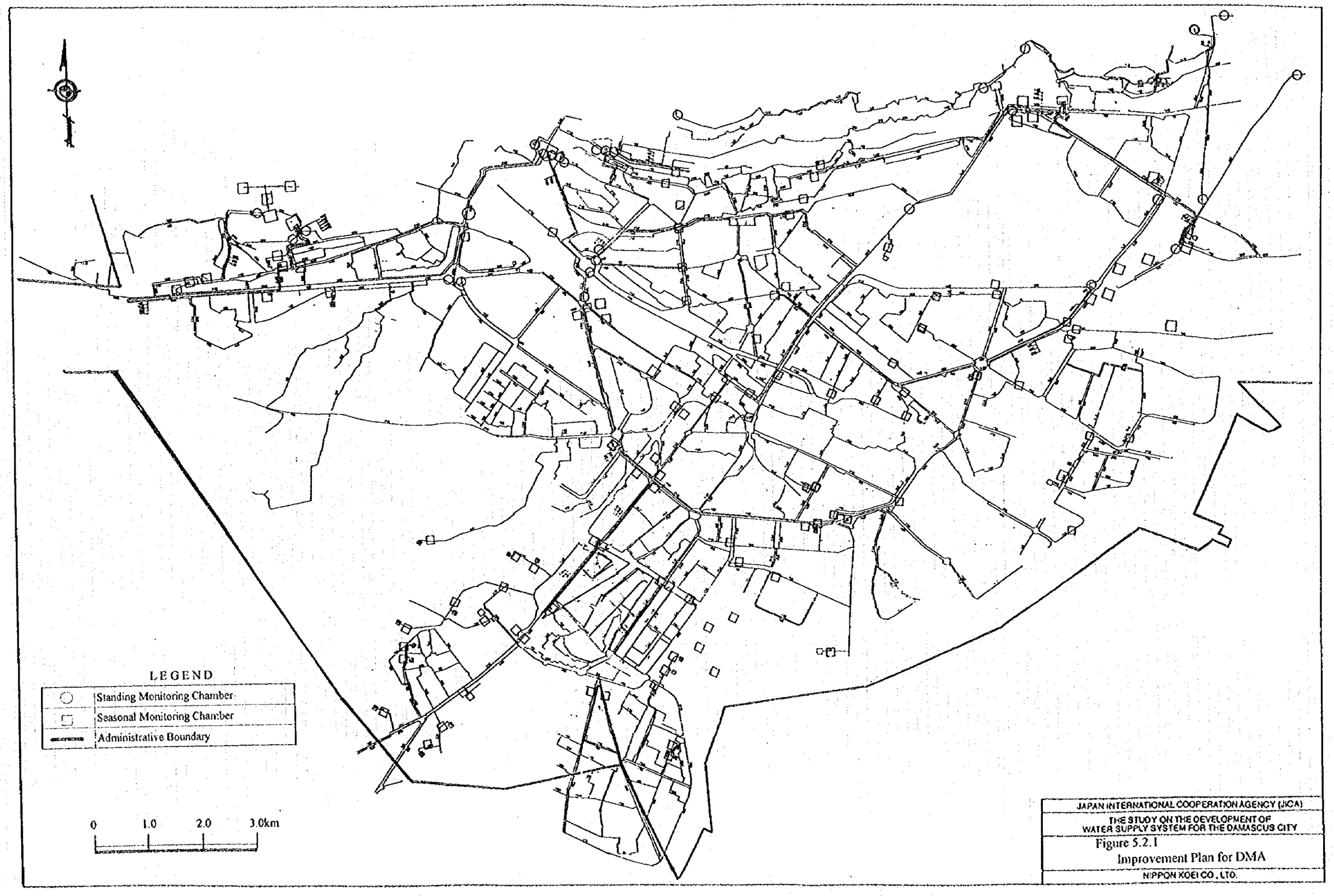
Note: 1. Physical contingency is 10% of sum of items 1, 3 and 4.
2. Price contingency is 5% of local currency portion and 3% of foreign currency portion of items 1, 3, 4 and 5.

(2) Operation and Maintenance costs

	Items	(US$1,000)
1.	O&M costs of District Meter Area (DMA) System Project :	36 / year
2.	Water leakage repair costs after the DMA system is fully implemented:	250 / year
3.	Flow meter replacement for DMA System Project :	3,014
4.	Mezze Razy & Kafar Sousch-Lawan System Project :	are insignificant not included.

5.5 Implementation Program

District Meter Area (DMA) System Project is expected to start in 1998 and be completed in 2006. The Mezze Razy & Kafar Sousch-Lawan System Project is expected to start in 1998 and be completed in 2001. The implementation schedules for both projects are shown in Figure 5.5.1.



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 5.2.1
Improvement Plan for DMA

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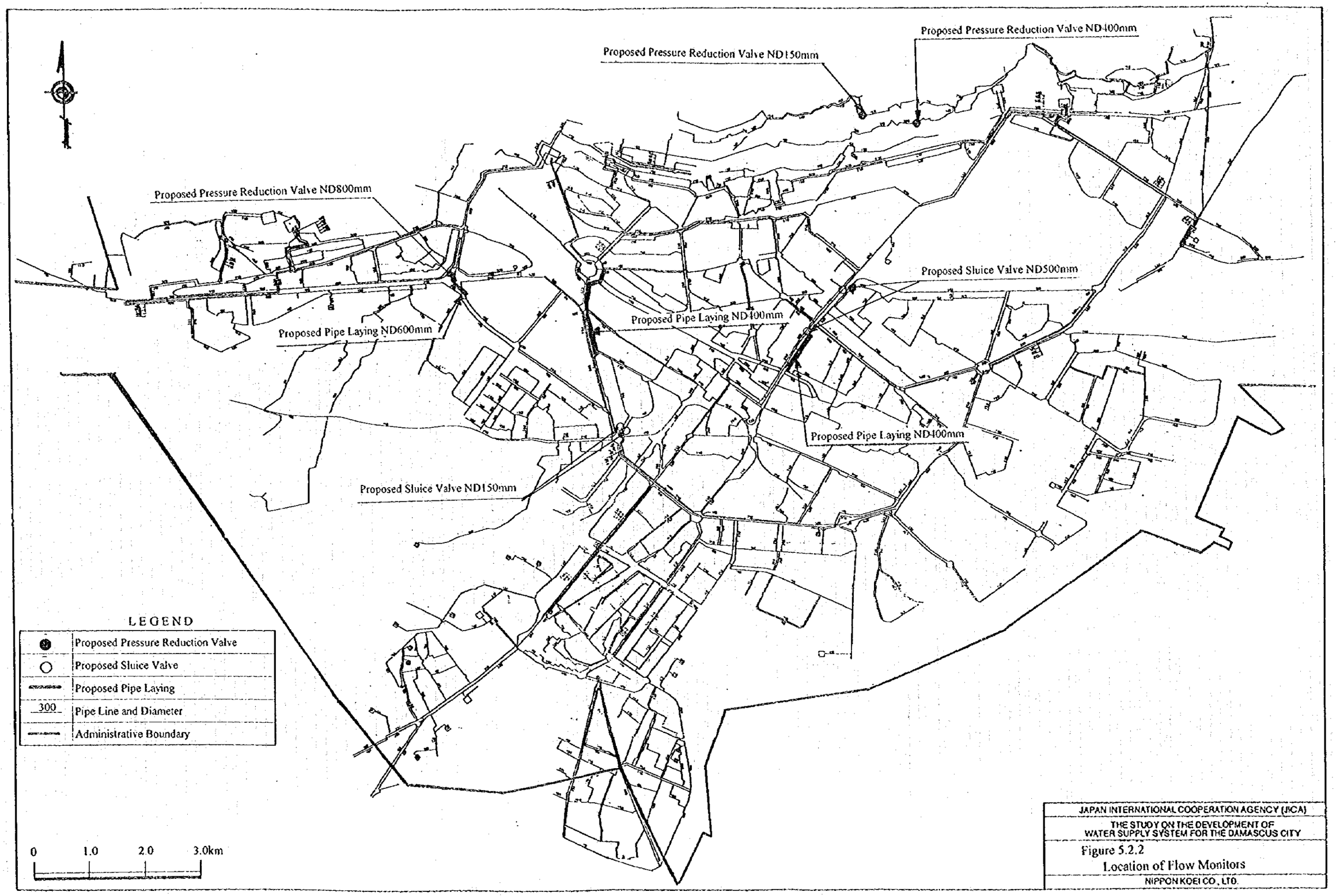
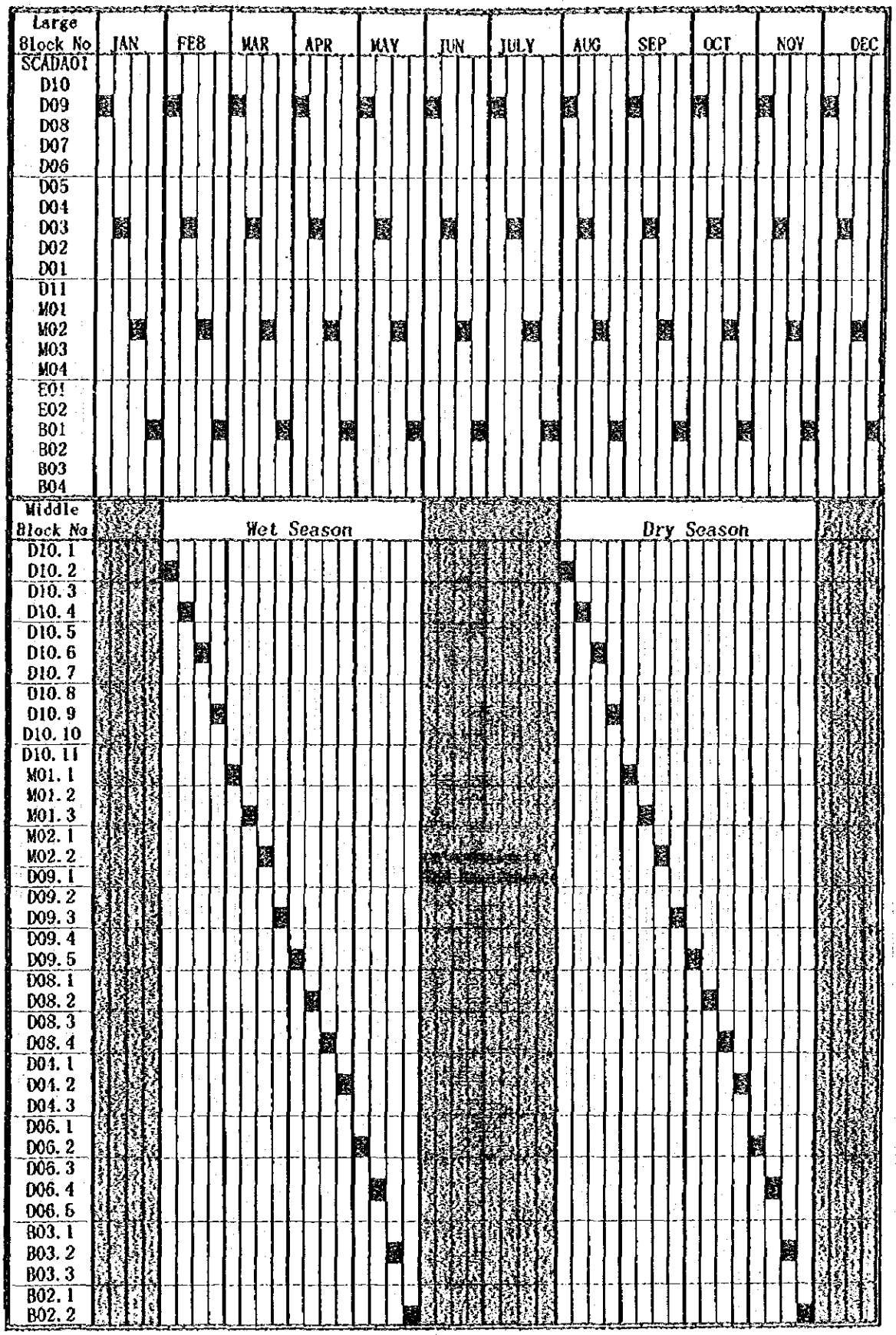


JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 5.2.2
Location of Flow Monitors

NIPPON KOEI CO., LTD.



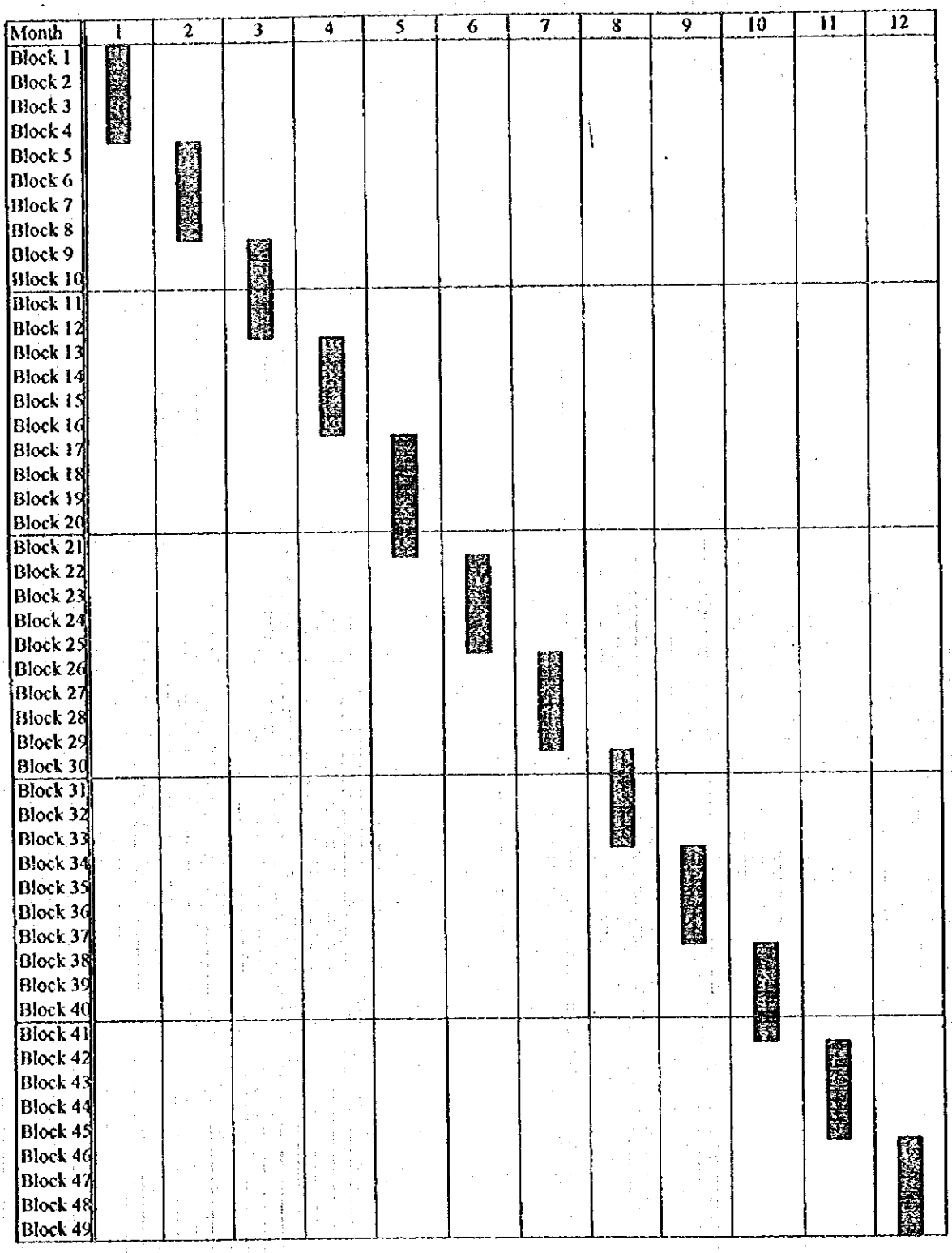
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 5.2.3

Monitaring Schedule of DMA System

NIPPON KOEI CO., LTD.



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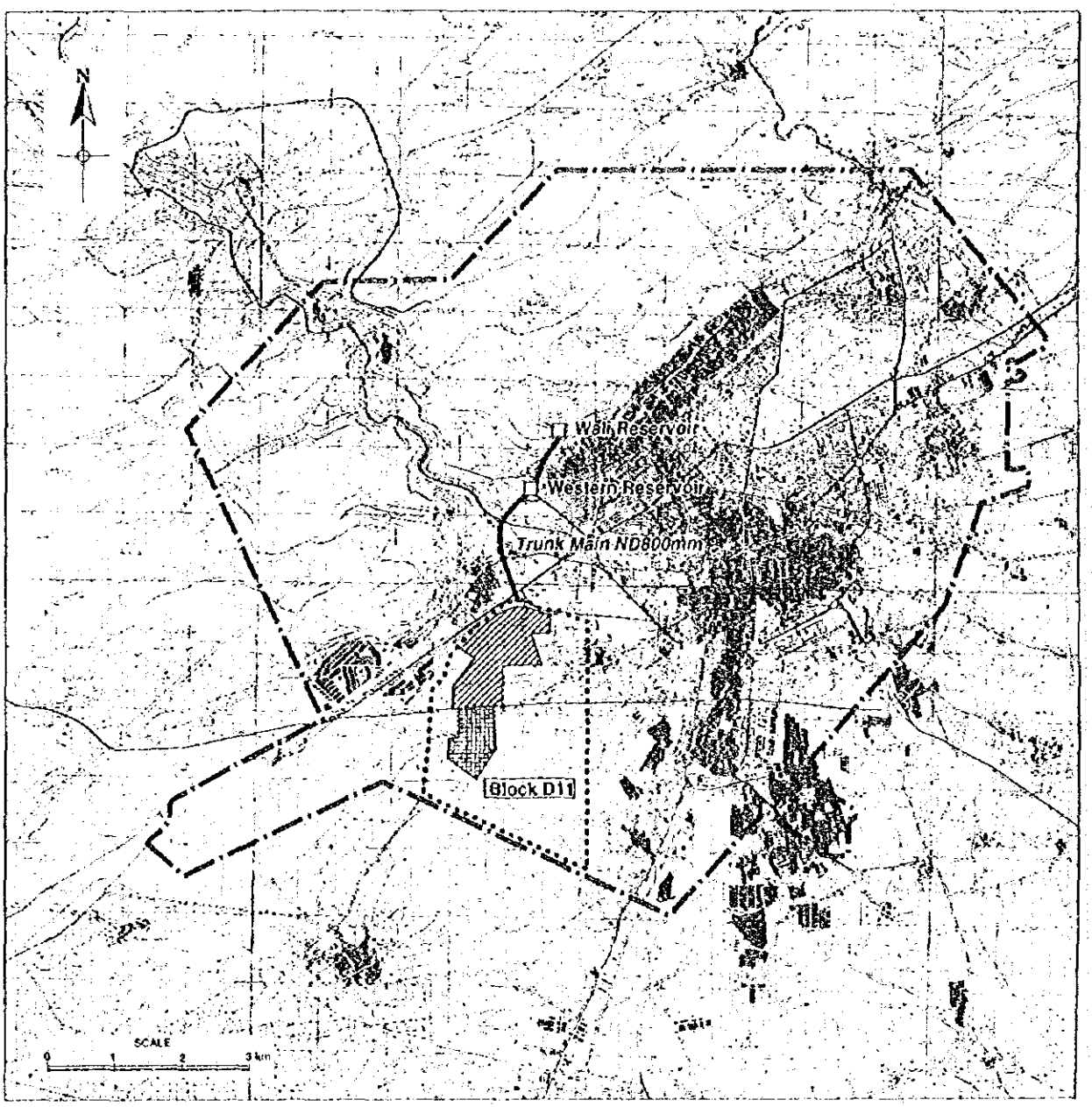
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure 5.2.4

Leakage Survay Schedule

NIPPON KOEI CO., LTD.



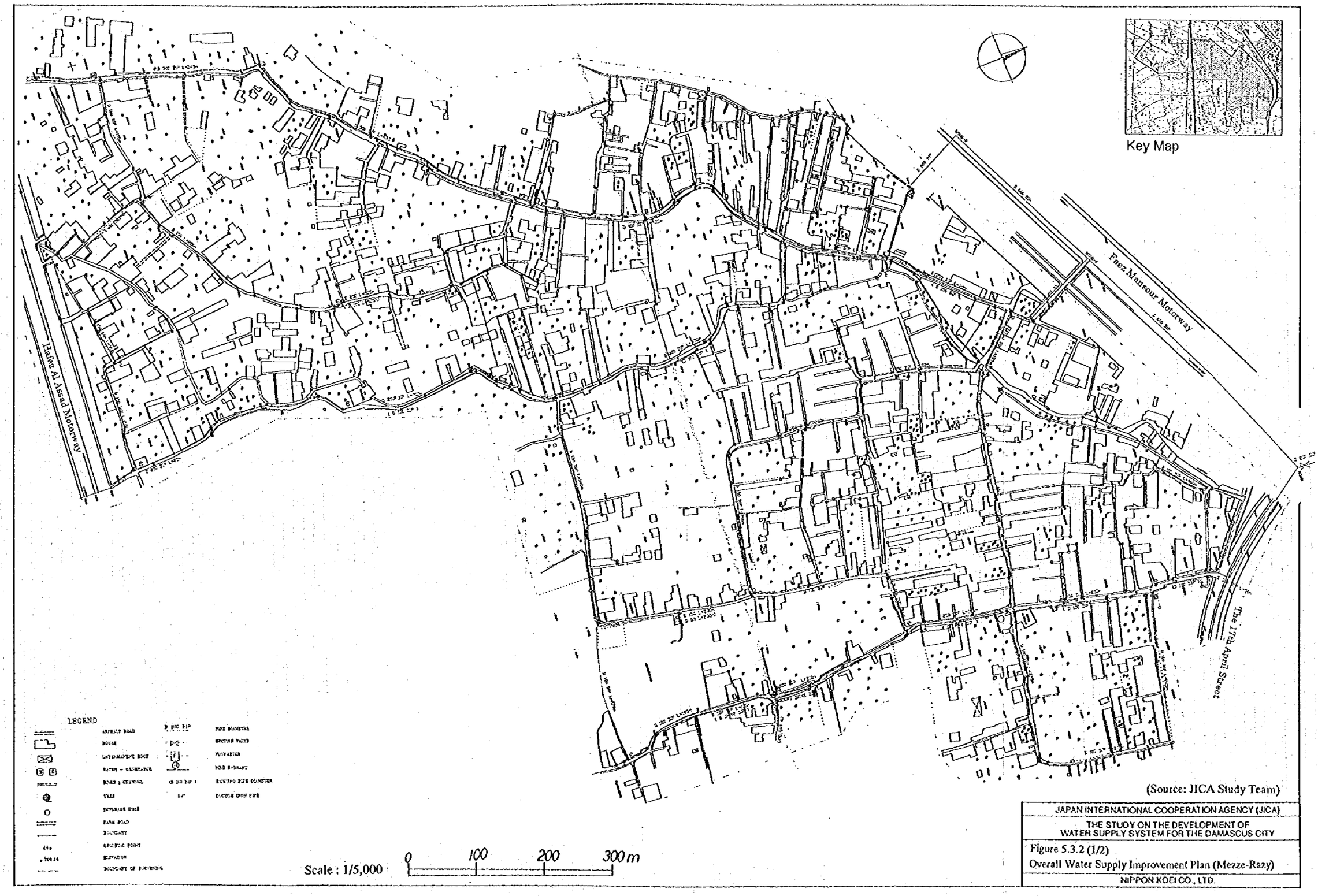
LEGEND

:Mezze-Razy Area

:Kafar Souseh-Lawan Area

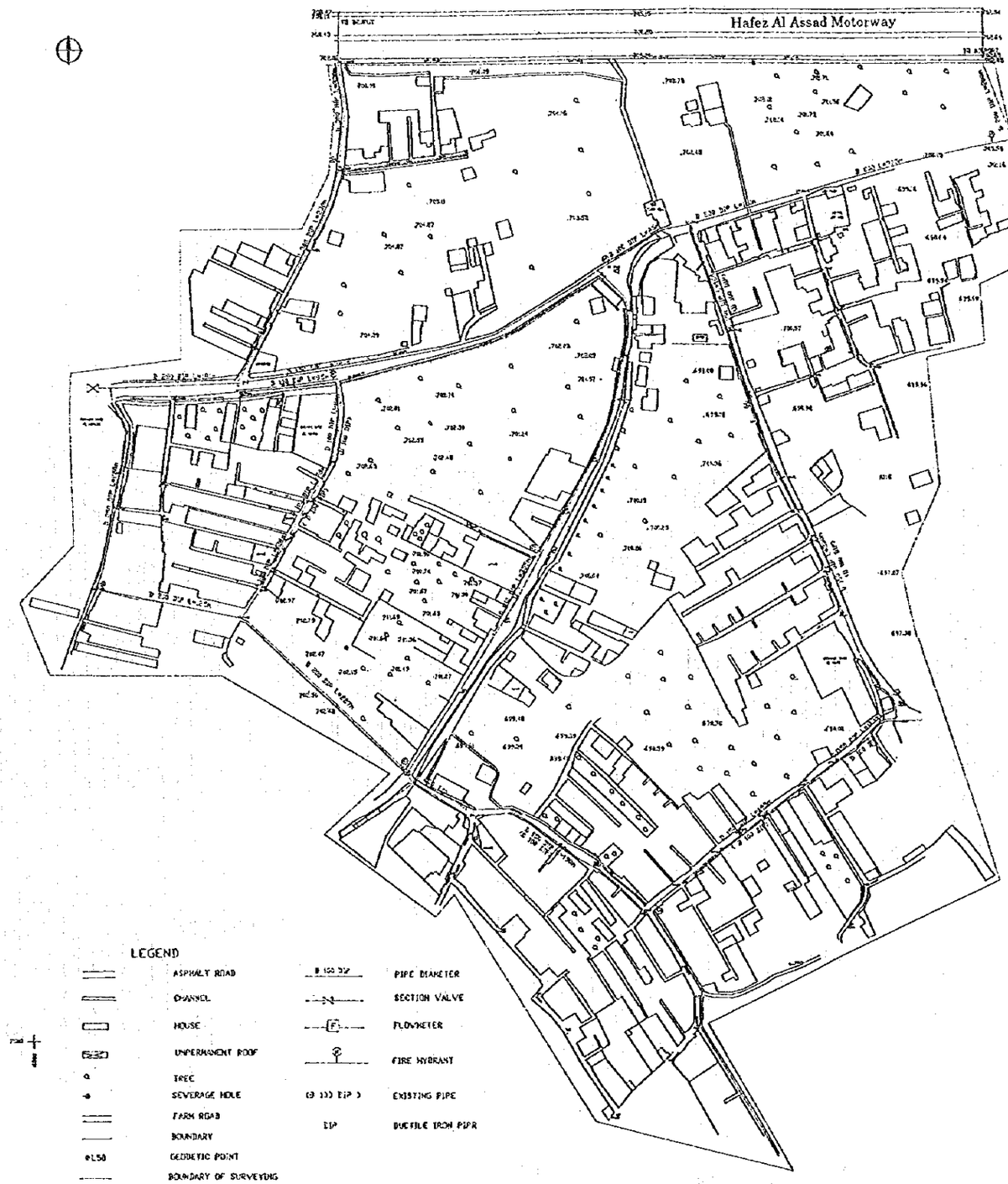
:Boundary of DMA Block D11

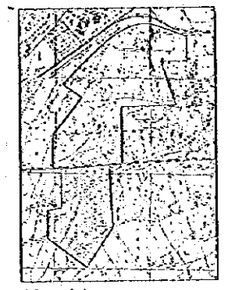
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure 5.3.1 Trunk Main for Mezze-Razy & Kafar Souseh- Lawan Area
NIPPON KOEI CO., LTD.



(Source: JICA Study Team)

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure 5.3.2 (1/2) Overall Water Supply Improvement Plan (Mezze-Razy)
NIPPON KOEI CO., LTD.

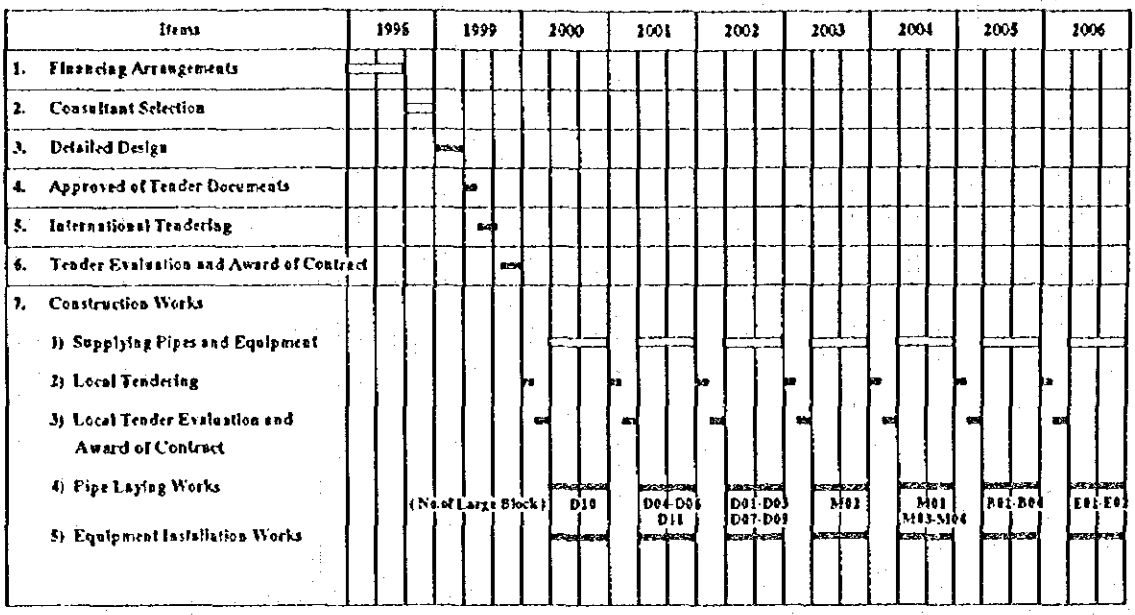



Key Map

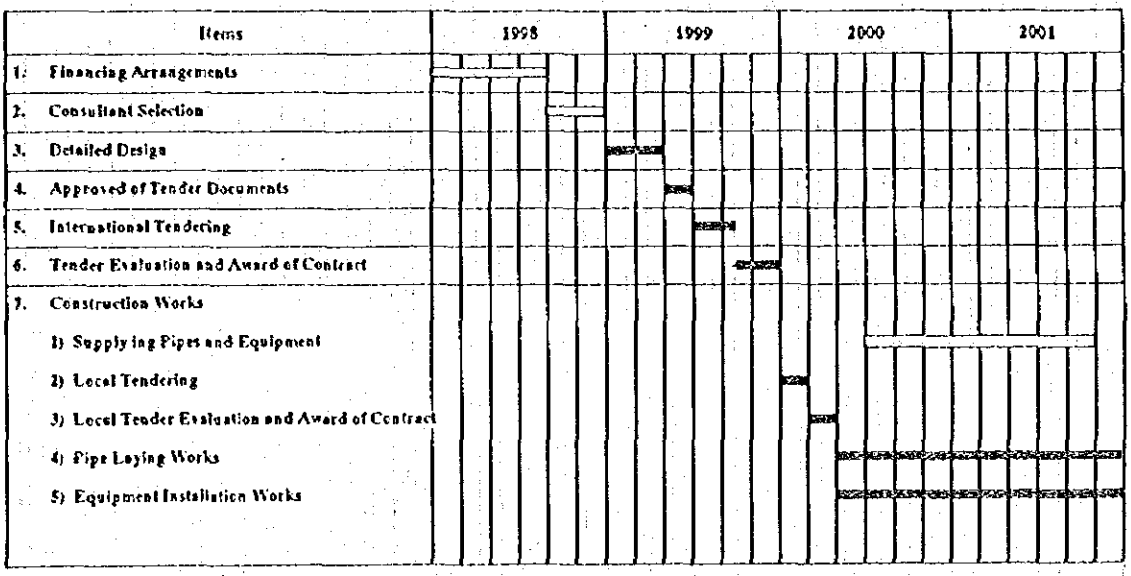
(Source: JICA Study Team)

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure 5.3.2 (2/2) Overall Water Supply Improvement Plan (Kafar Souseh-Lawan)
NIPPON KOEI CO., LTD.

District Meter Area (DMA)



Mezze Razy & Kafar Sousch - Lawan System



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THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Fig.- 5.5.1 Implementation Schedule

NIPPON KOEI CO., LTD.