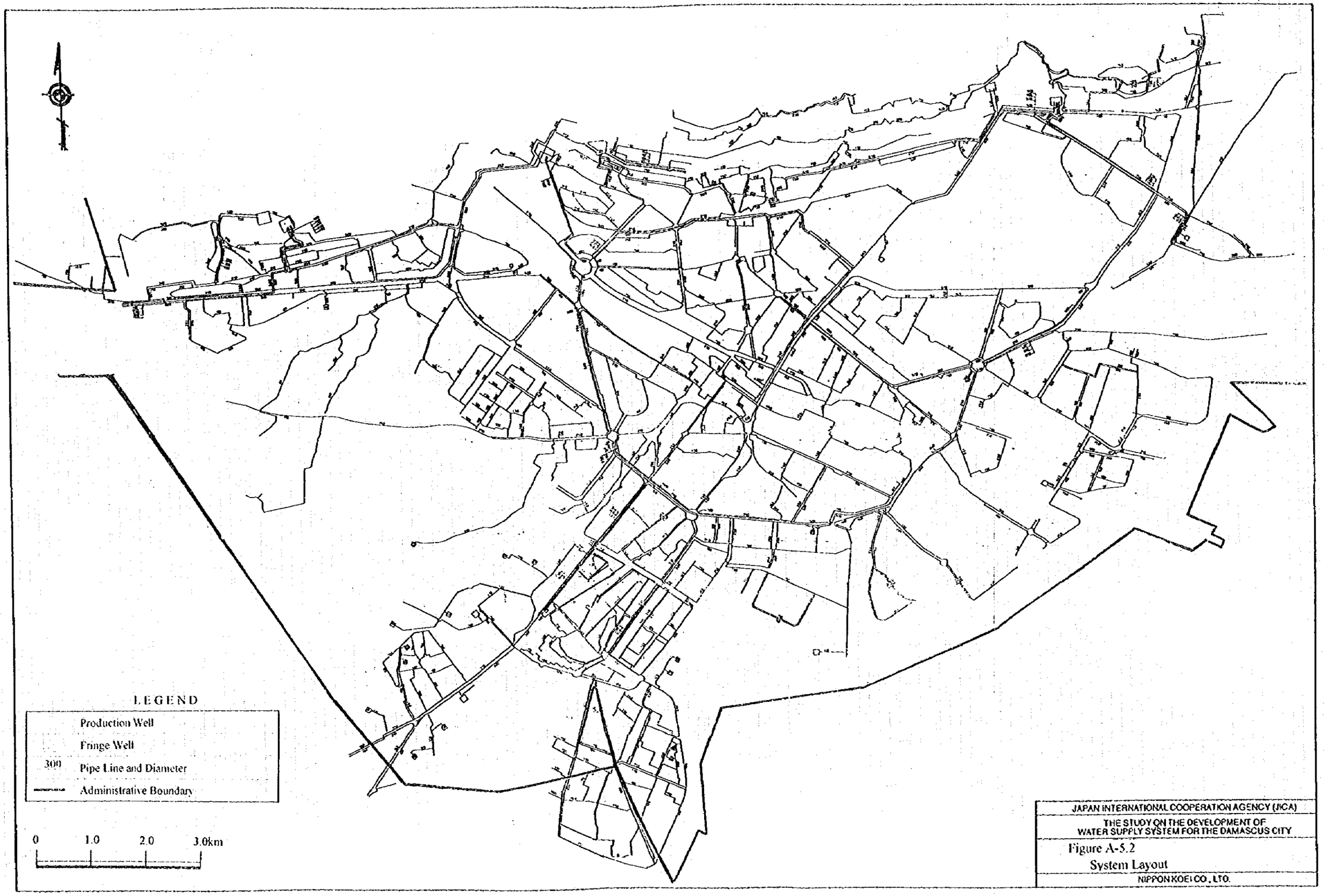
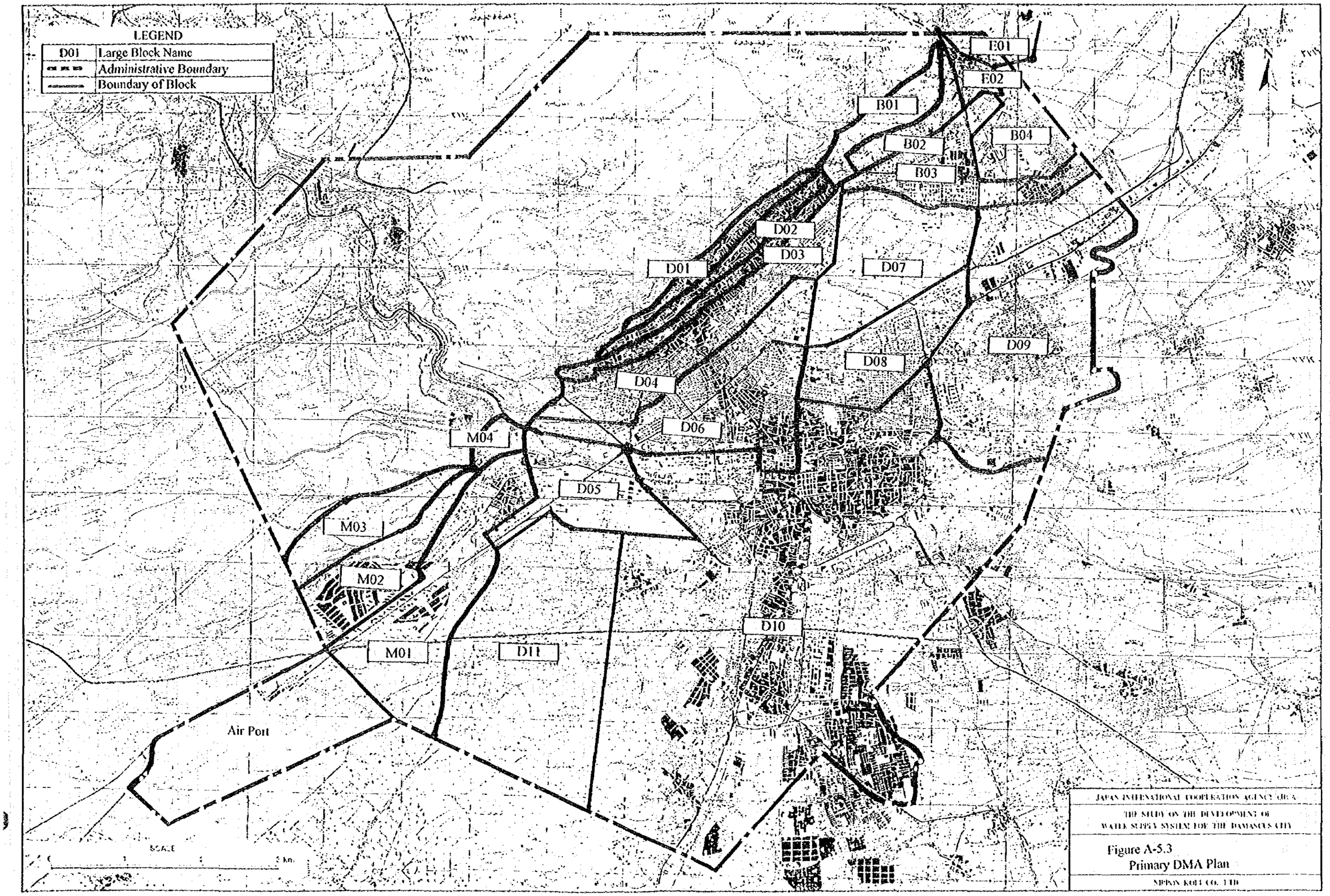


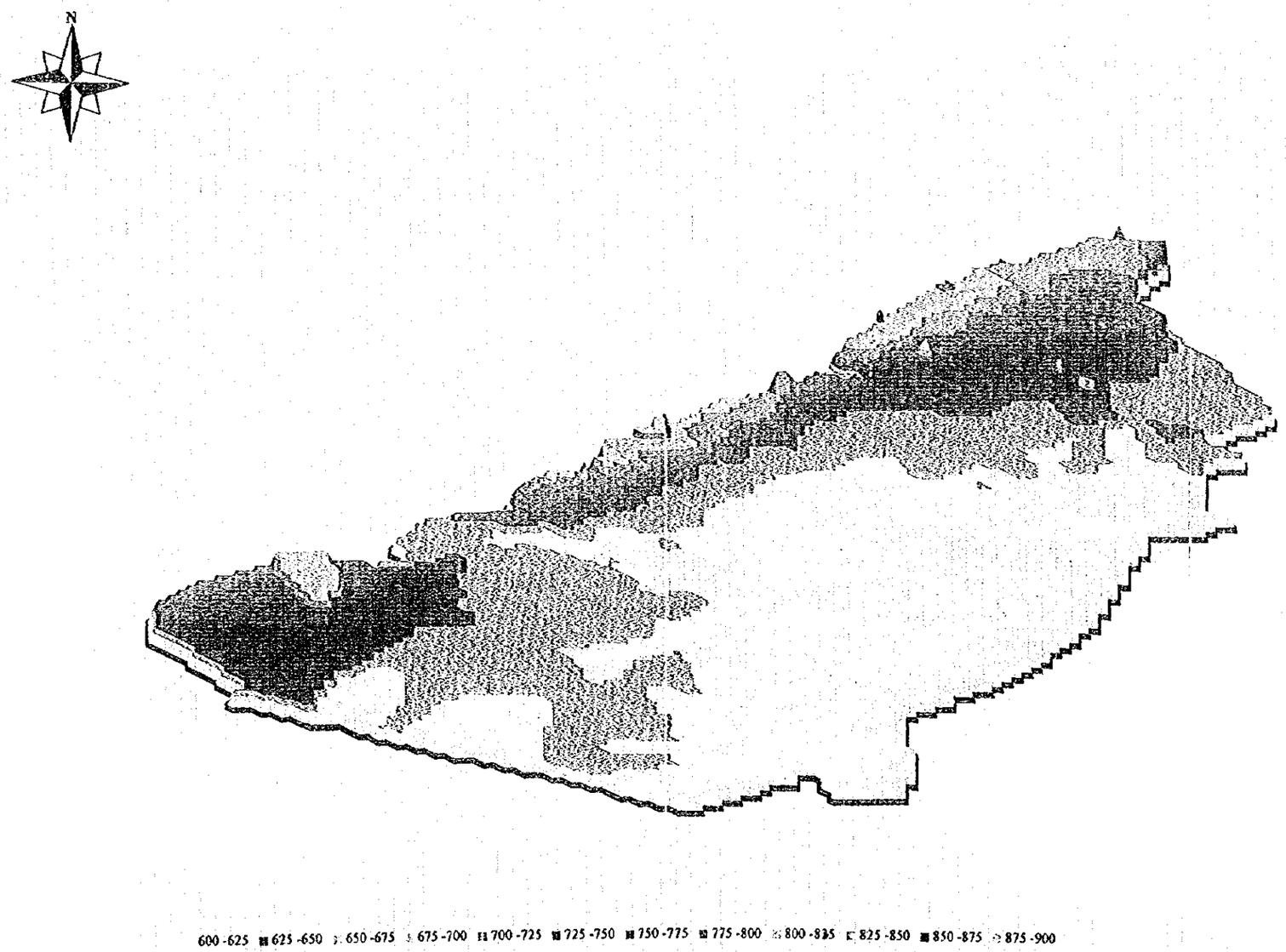
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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

Figure A-5.2
System Layout

NIPPON KOEI CO., LTD.


LEGEND
D01 Large Block Name
Administrative Boundary
Boundary of Block
E01
E02
B01
B02
B03
B04
D02
D03
D01
D07
D09
D08
D04
D06
M04
D05
M03
M02
M01
D11
D10
Air Port
SCALE
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure A-5.3
Primary DMA Plan
NIPPON KOEI CO., LTD.



0 1.0 2.0 3.0km

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

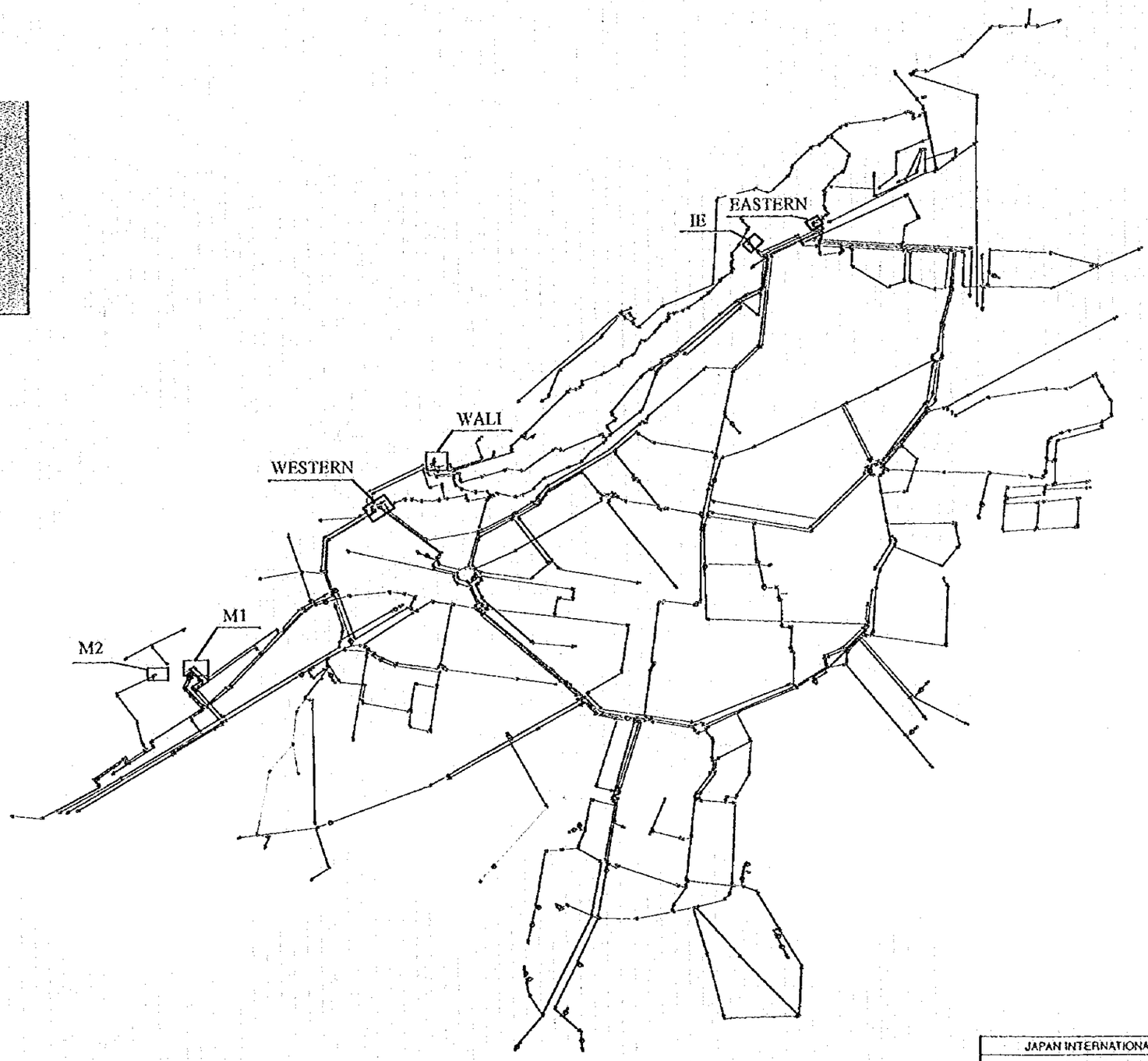
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure A-5.4
Topographic Survay Map

NIPPON KOEI CO., LTD.

LEGEND

- Under 100mm
- Over 100mm
- Over 200mm
- Over 300mm
- Over 400mm
- Over 500mm



0 0.5 1.0 1.5km

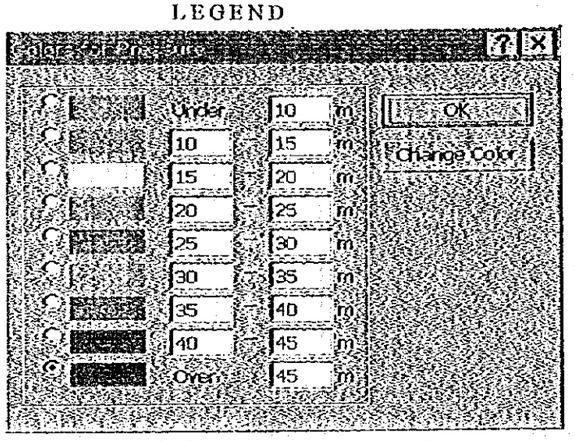
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

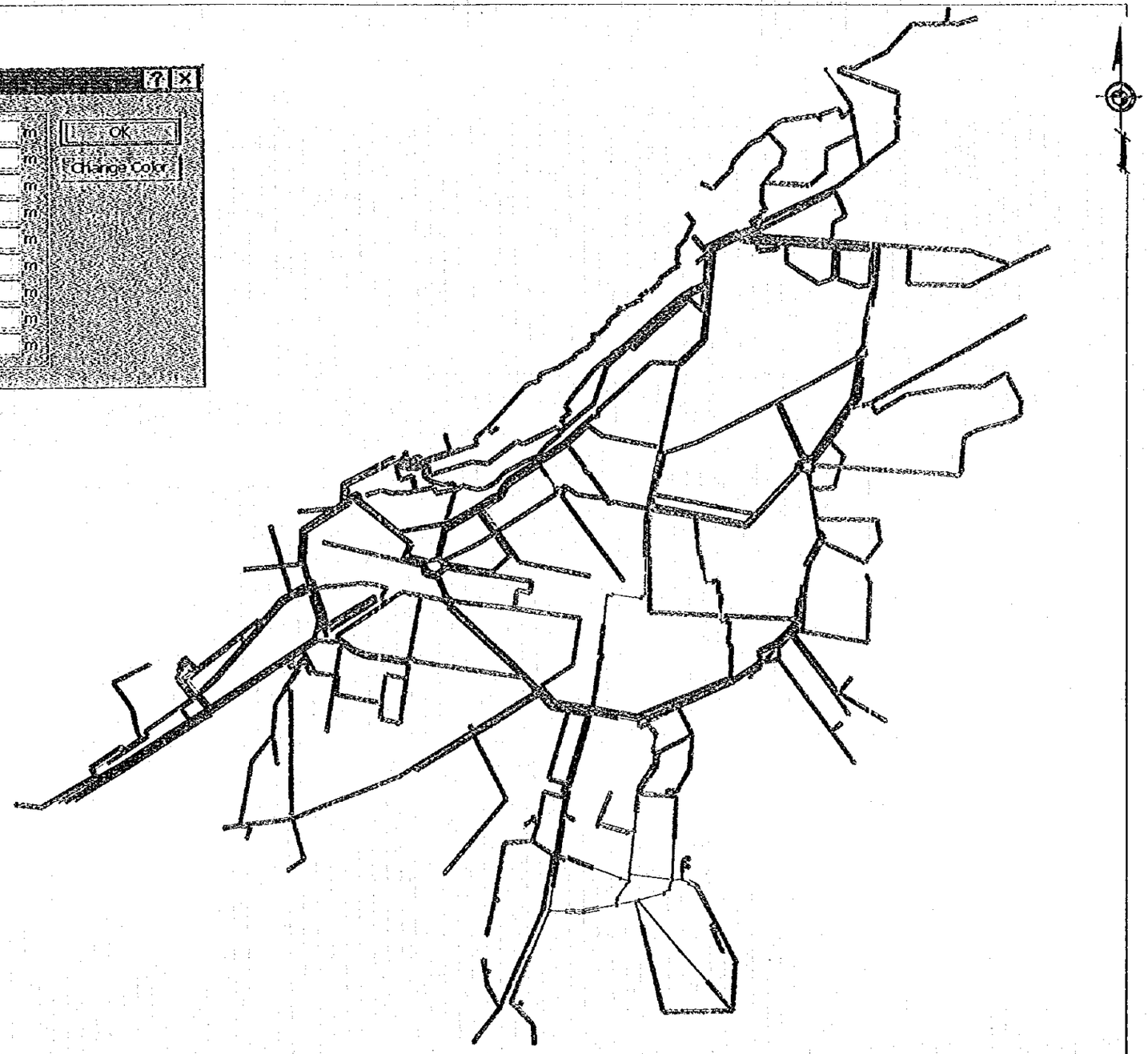
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure A-5.5
Net Work Model

NIPPON KOEI CO., LTD.

LEGEND





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 A-5.6 Preliminary Simulation (pressure)
NIPPON KOEI CO., LTD.

LEGEND

Flow (m^3/sec) and Direction

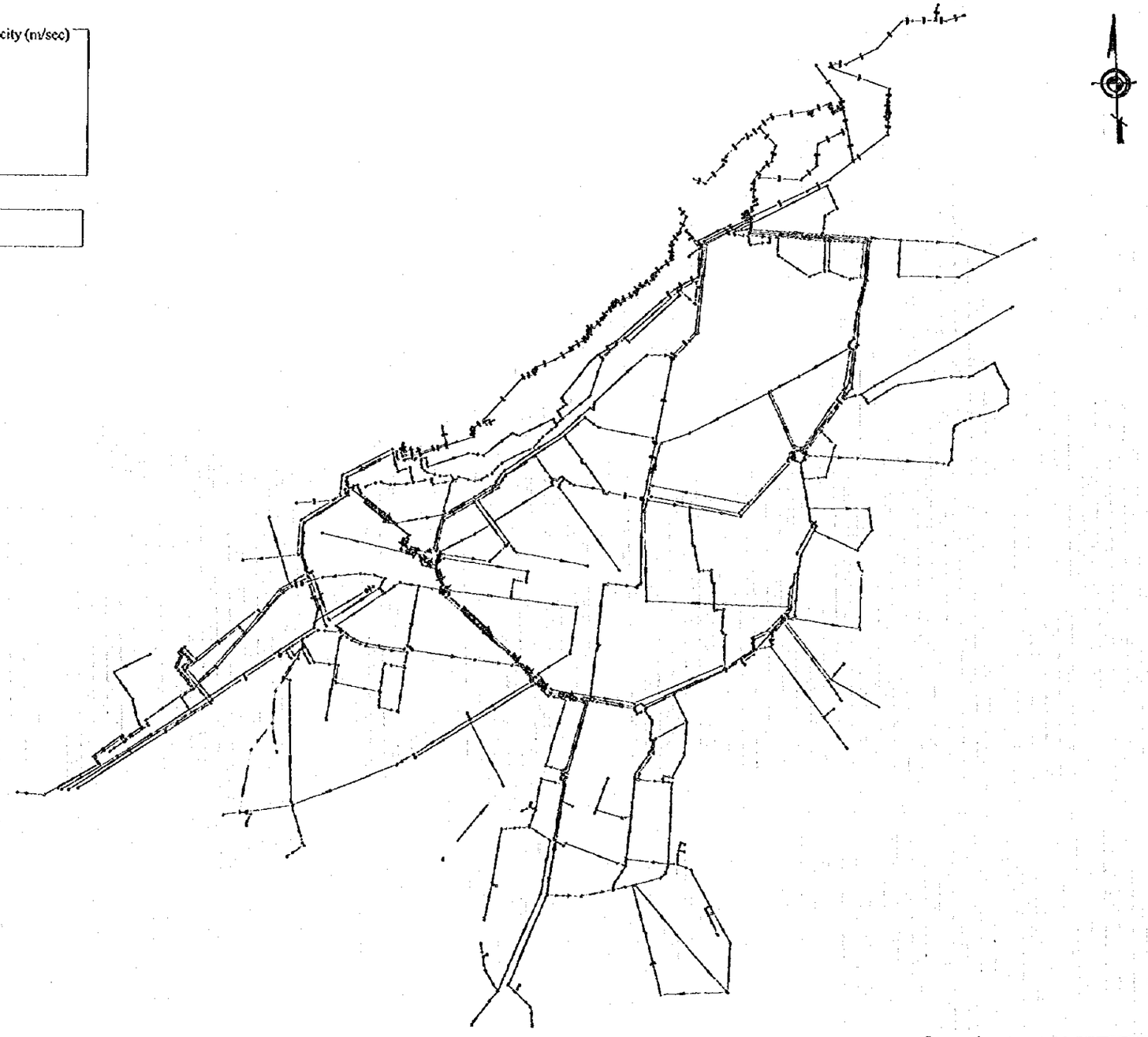
- 0.18916
- 0.09473
- 0.04736
- 0.02368

Stagnant Water Velocity (m/sec)

- 0.030-0.015
- 0.015-0.007
- 0.007-0.000

Flow Velocity(m/s)

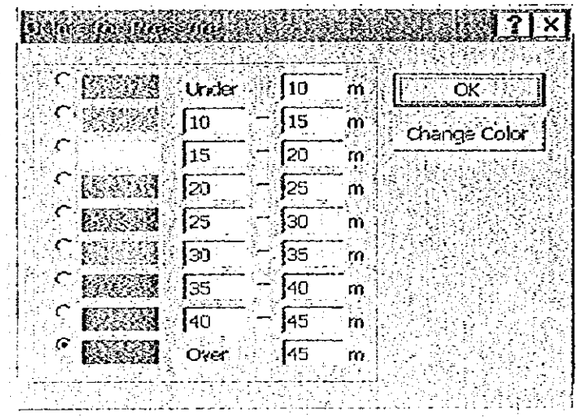
0.6 m/s

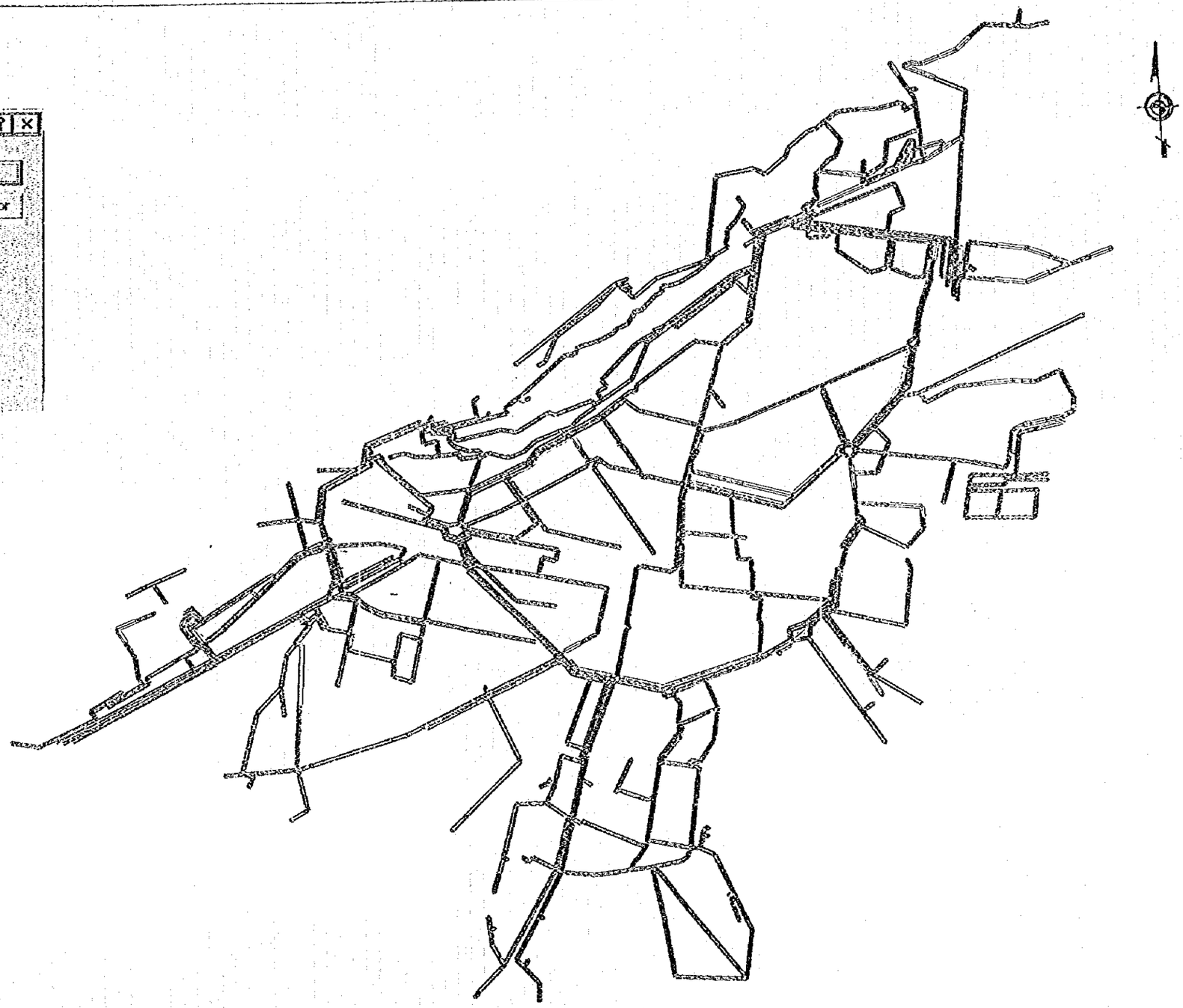


0 0.5 1.0 1.5km

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure A-5.7 Preliminary Simulation (Flow & Velocity)
NIPPON KOEI CO., LTD.

LEGEND





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 A-5.8 Pressure (Wet Season :Max.)
NIPPON KOEI CO., LTD.

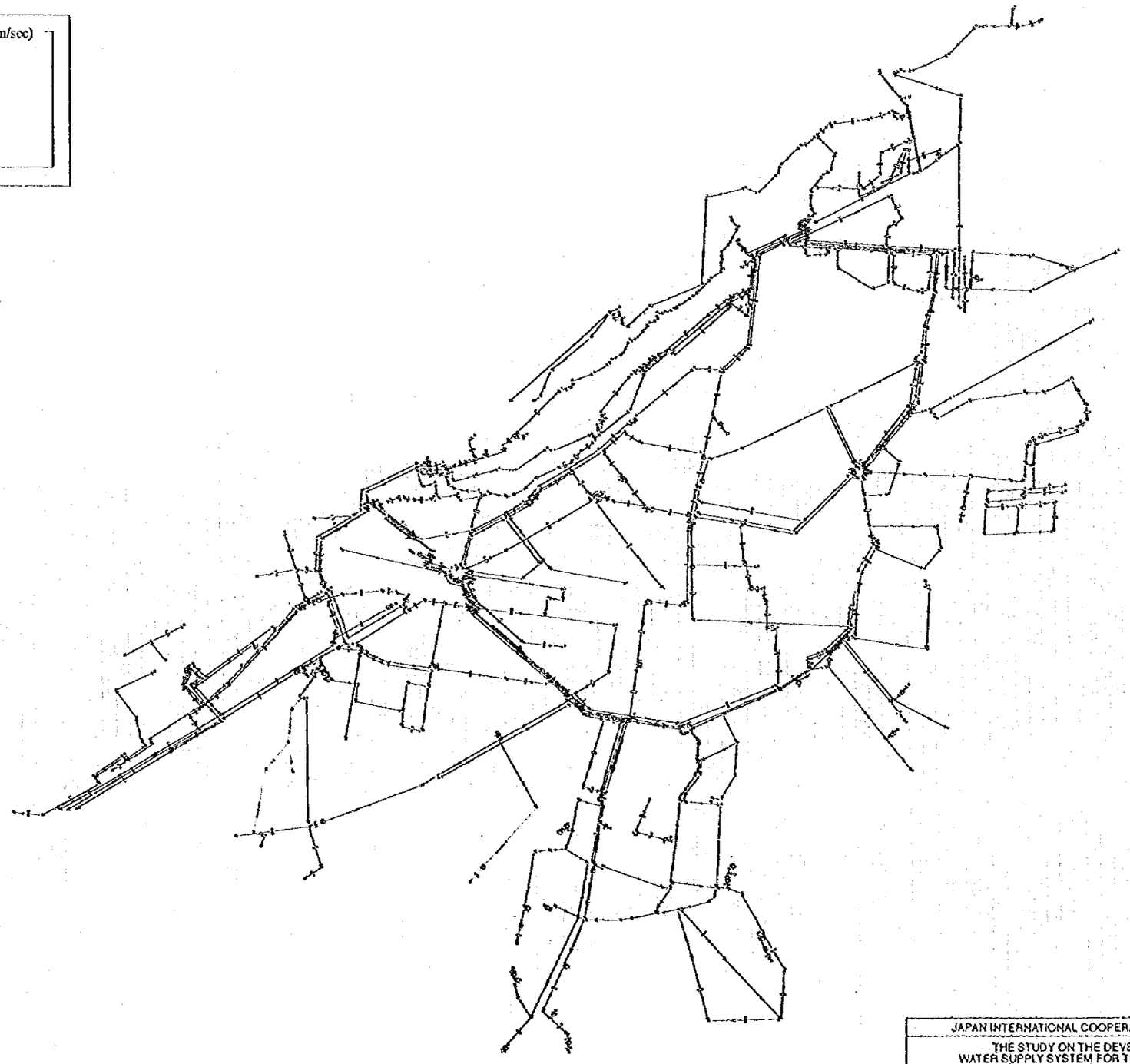
LEGEND

Flow(m^3/sec) and Direction

- 0.18916
- 0.09473
- 0.02368
- 0.04736

Stagnant Water Velocty(m/sec)

- 0.030-0.015
- 0.015-0.007
- 0.007-0.000



0 0.5 1.0 1.5km

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

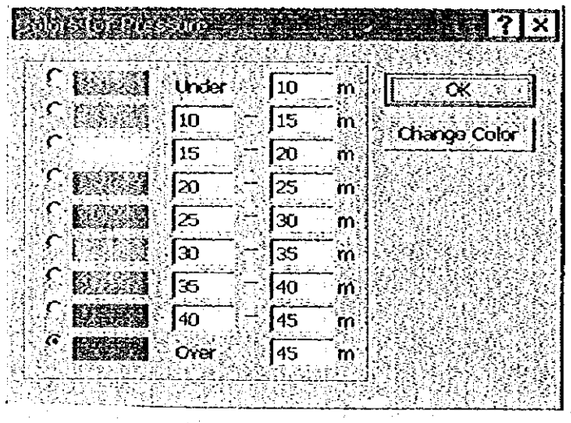
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

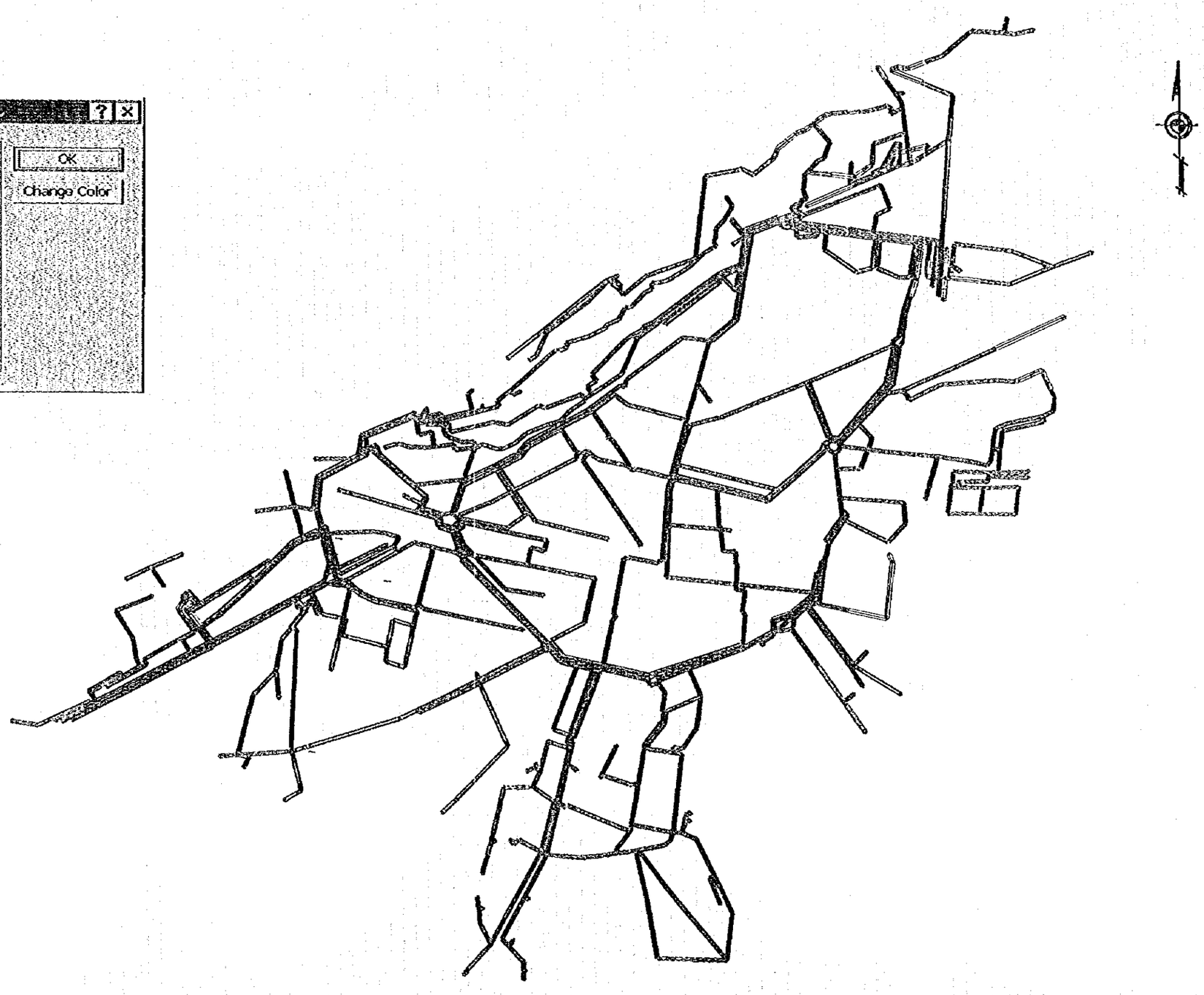
Figure A-5.9

Flow & Velocity (Wet Season: Max.)

NIPPON KOEI CO., LTD.

LEGEND





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 A-5.10 Pressure (Wet Season: Min.)
NIPPON KOEI CO., LTD.

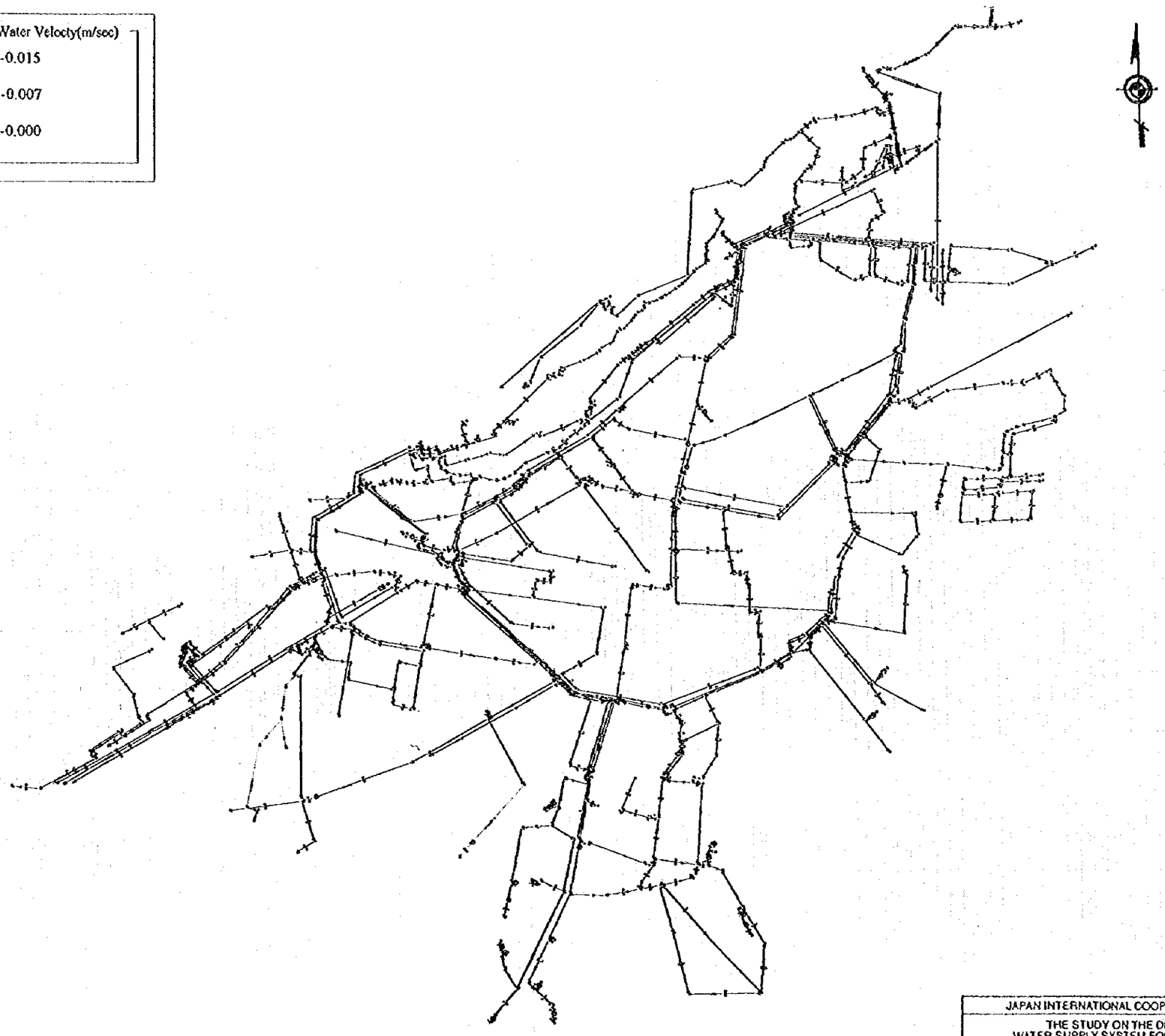
LEGEND

Flow(m^3/sec) and Direction

- 0.18916
- 0.09473
- 0.02368
- 0.04736

Stagnant Water Velocty(m/sec)

- 0.030-0.015
- 0.015-0.007
- 0.007-0.000



0 0.5 1.0 1.5km

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

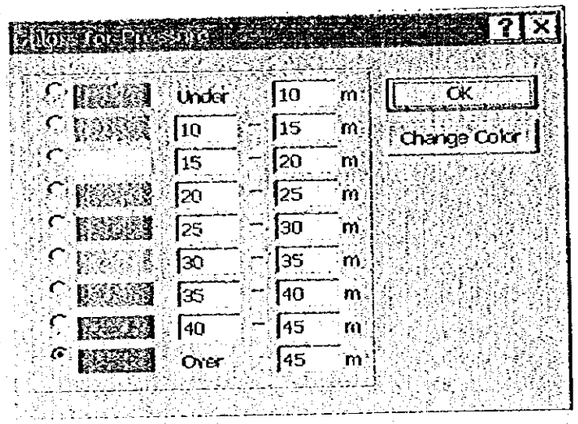
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

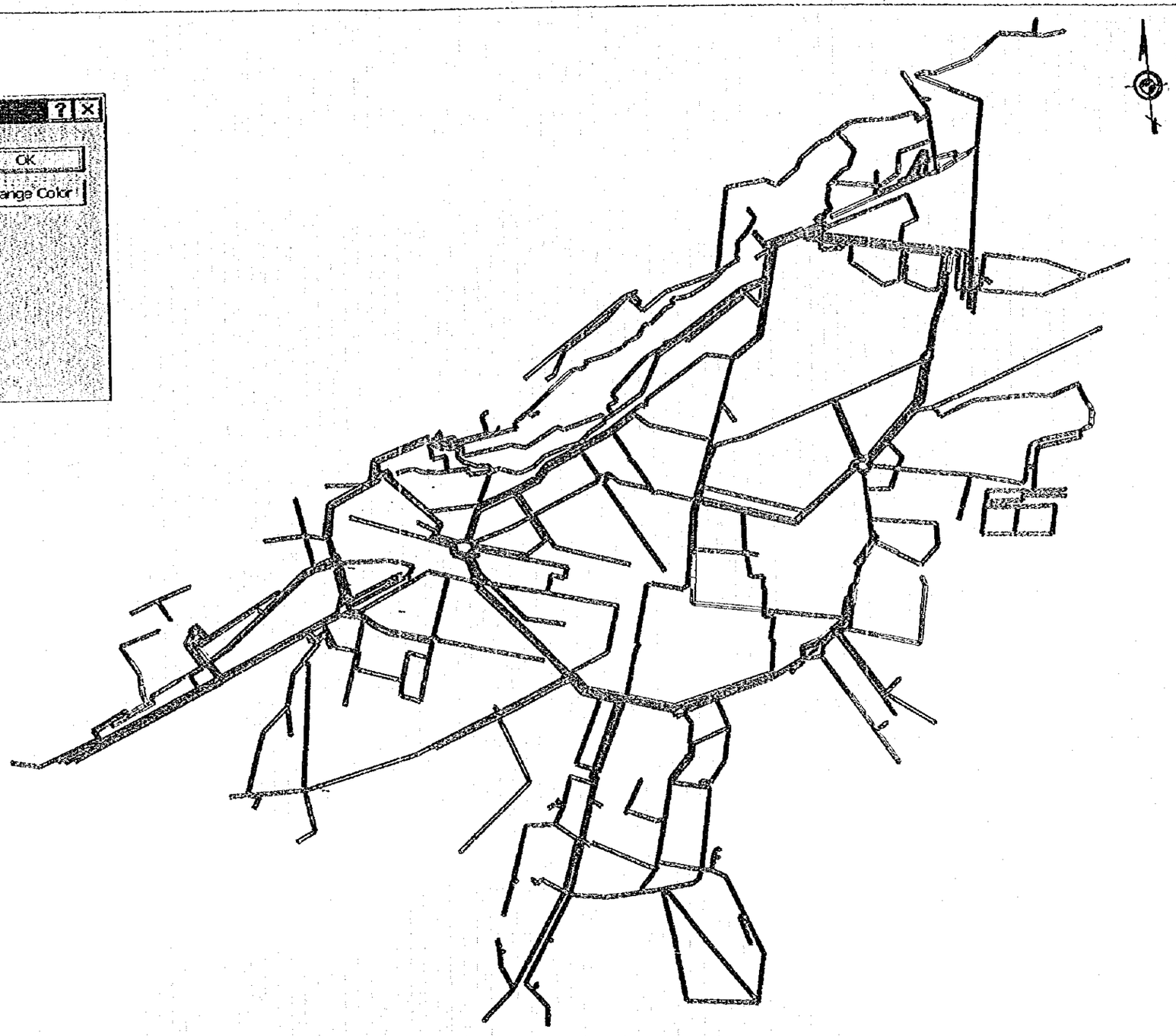
Figure A-5.11

Flow & Velocity (Wet Season: Min.)

NIPPON KOEI CO., LTD.

LEGEND





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 A-5.12 Pressure (Dry Season:Max.)
NIPPON KOEI CO., LTD.

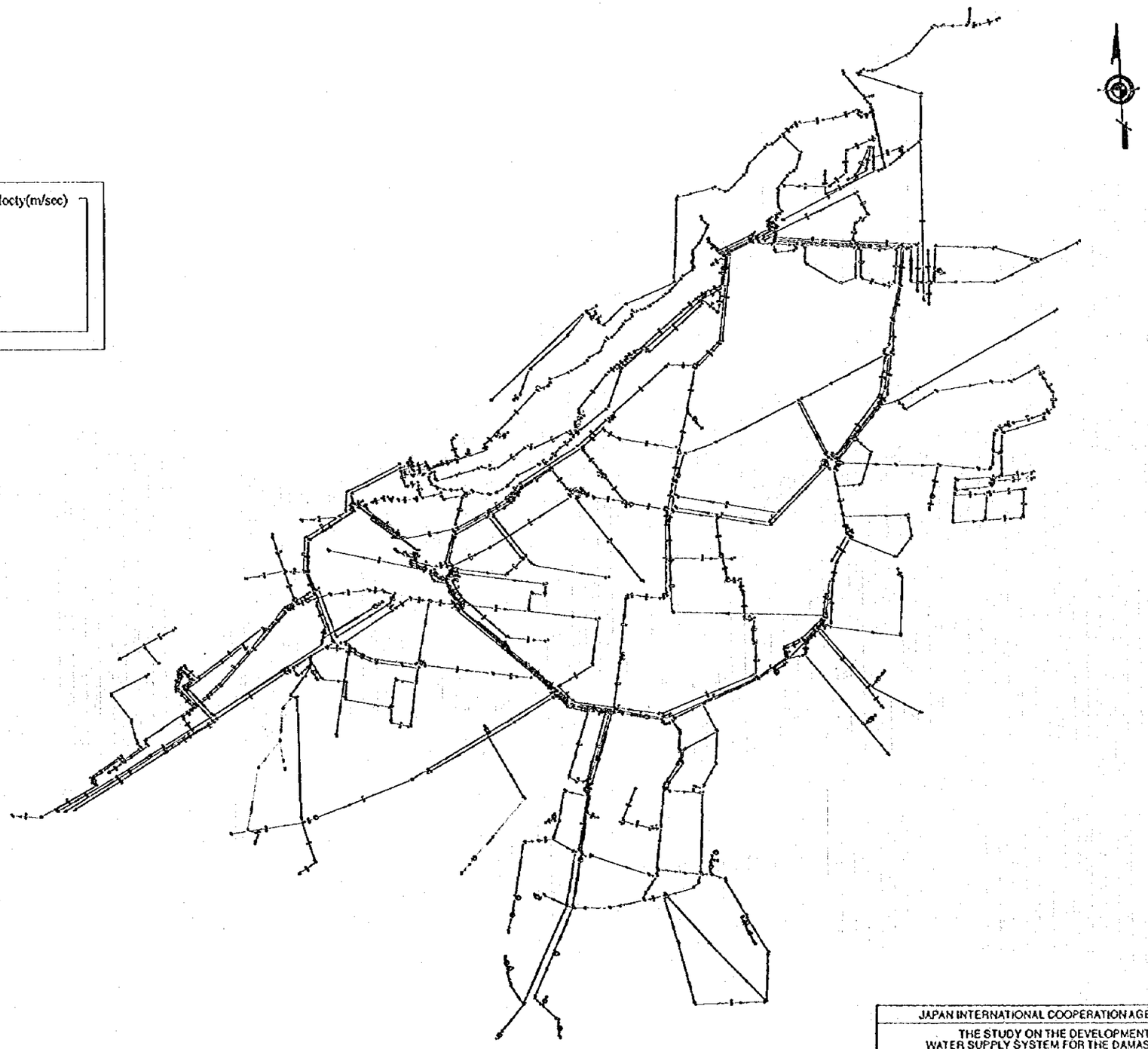
LEGEND

Flow(m^3/sec) and Direction

- 0.18916
- 0.09473
- 0.02368
- 0.04736

Stagnant Water Velocity(m/sec)

- 0.030-0.015
- 0.015-0.007
- 0.007-0.000



0 0.5 1.0 1.5km

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

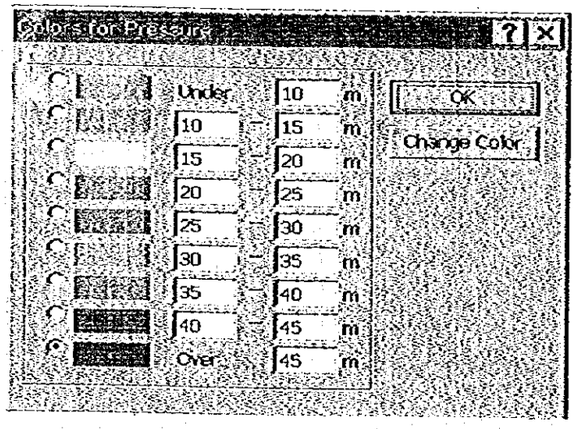
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

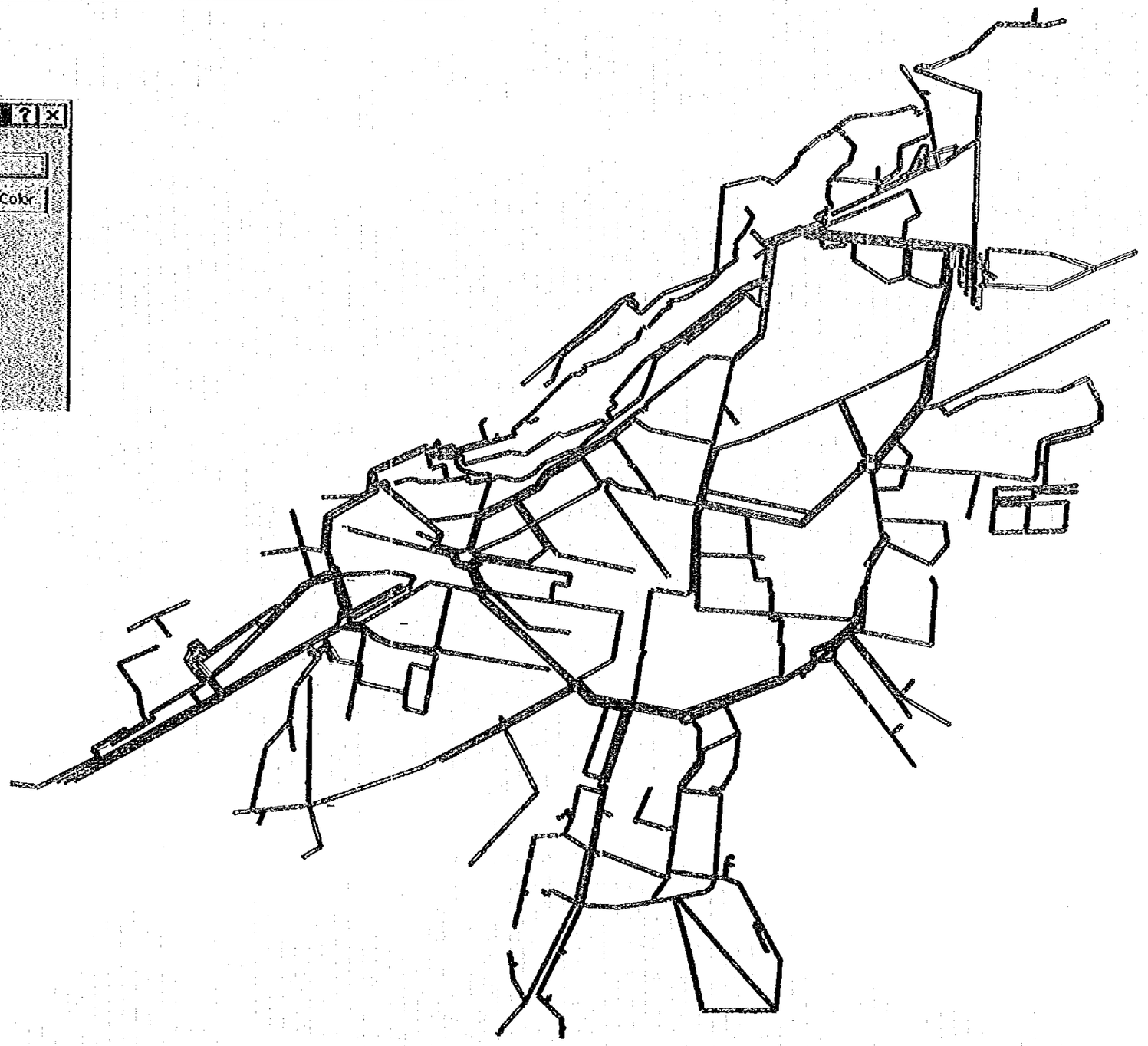
Figure A-5.13

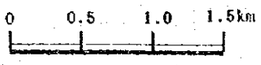
Flow & Velocity (Dry Season :Max.)

NIPPON KOEI CO., LTD.

LEGEND







JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure A-5.14 Pressure (Dry Season: Min.)
NIPPON KOEI CO., LTD.

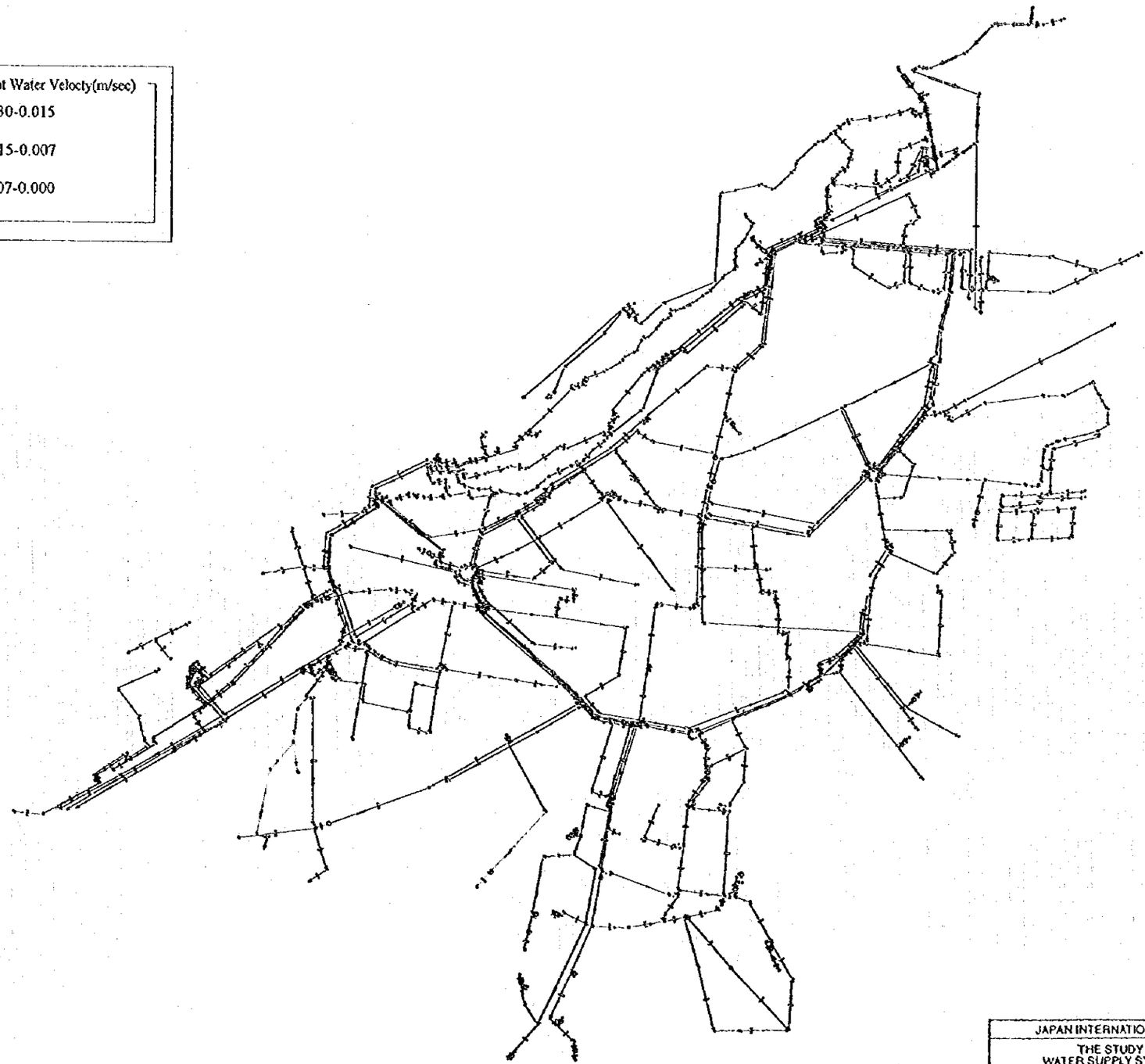
LEGEND

Flow(m^3/sec) and Direction

- 0.18916
- 0.09473
- 0.02368
- 0.04736

Stagnant Water Velocity(m/sec)

- 0.030-0.015
- 0.015-0.007
- 0.007-0.000



0 0.5 1.0 1.5km

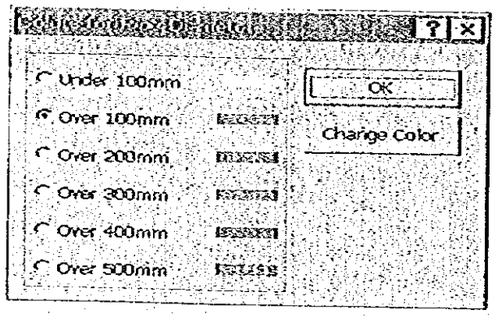
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

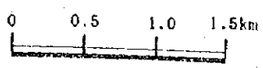
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure A-5.15
Flow & Velocity (Dry Season :Min.)

NIPPON KOEI CO., LTD.

LEGEND





JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure A-5.16 Pressure (Fire Accident)
NIPPON KOEI CO., LTD.

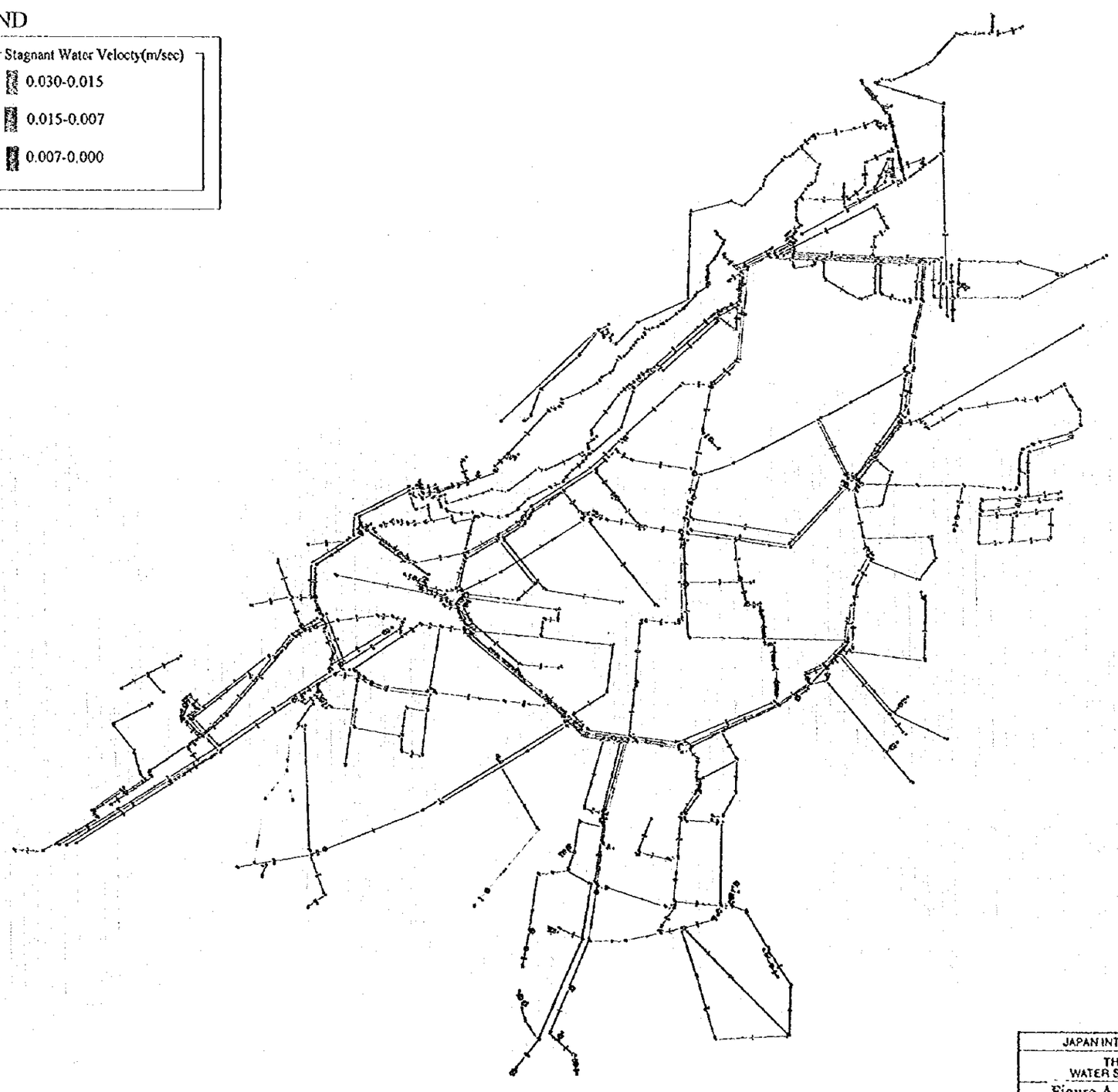
LEGEND

Flow(m^3/sec) and Direction

- 0.18916
- 0.09473
- 0.02368
- 0.04736

Stagnant Water Velocty(m/sec)

- 0.030-0.015
- 0.015-0.007
- 0.007-0.000



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 A-5.17
Flow & Velocity (Fire Accident)

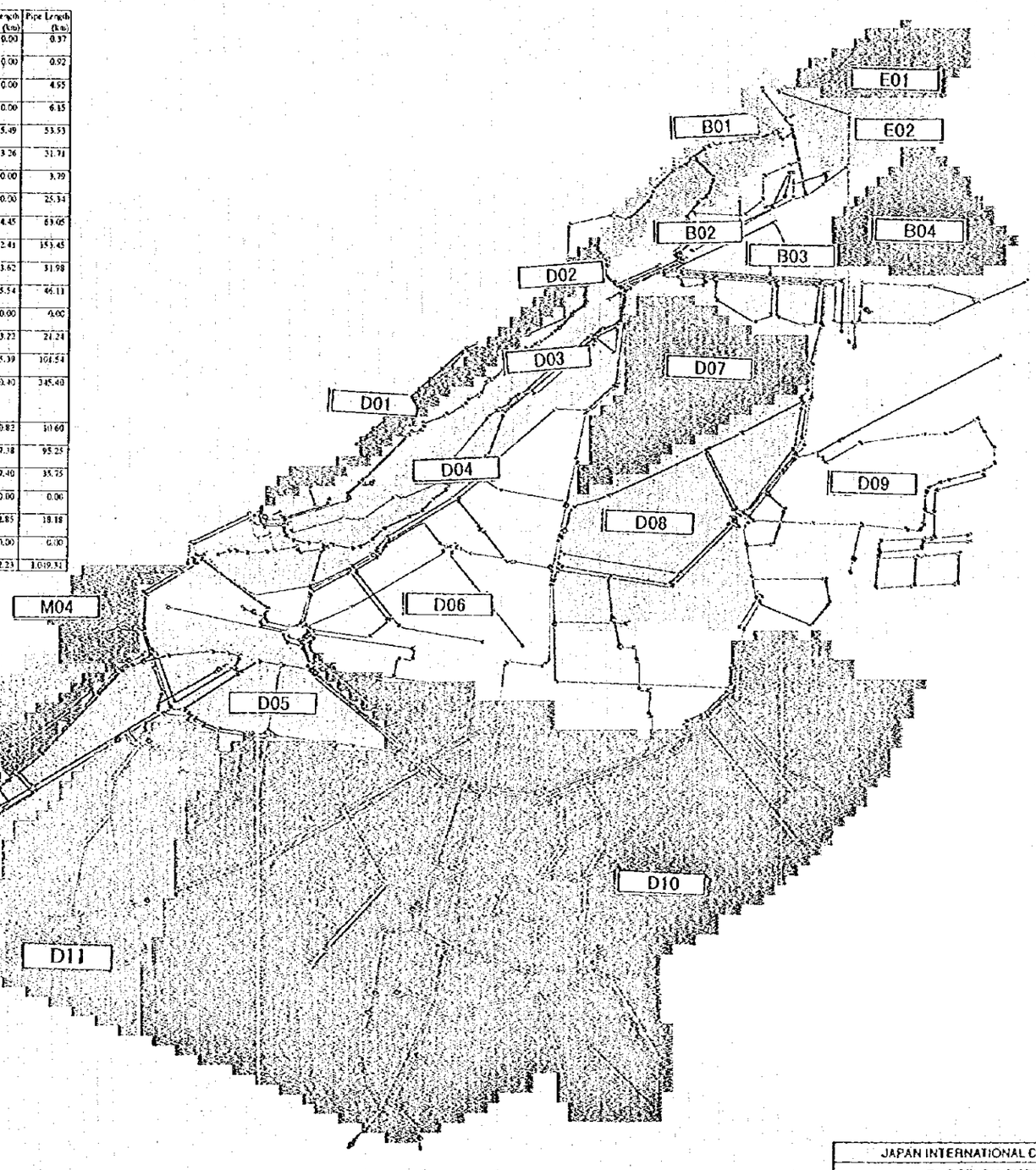
NIPPON KOEI CO., LTD.

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	3,670	10	0.00	0.37
E02	Eastern Berze High I	Berze Village S.R. (B.Iv)	68	7,900	4,300	25	0.00	0.92
B01	Berze High II	Akrad High S.R. (B.2)	39	4,500	2,410	136	0.00	4.95
B02	Berze High I	Berze Bchoob S.R. (B.Ib)	115	13,800	7,300	169	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	104	0.00	3.39
D02	Damas Center High II	Kassioun High S.R. (K.3)	78	26,830	11,240	695	0.00	25.34
D03	Damas Center High I	Kassioun Middle S.R. (K.1)	96	33,830	14,180	2,522	4.45	69.05
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. (LA)	227	13,700	15,280	1,522	3.62	31.98
D06		Western S.R. (LO) Qunawiyin P.W.C. (LA-2)	632	157,900	69,830	2,254	5.54	46.11
D07	Damas Center Low	Ibn Al-Nafeas S.R. (N.1) Mazraa P.W.C. (M.2a)	580	32,400	17,200	0	0.00	0.00
D08	Damas Center Low	Eastern S.R. (LE)	280	95,200	39,850	1,156	3.23	21.24
D09	Damas Center Low	Eastern S.R. (LE)	821	113,300	48,820	5,528	15.39	104.54
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) Takiadeen P.W.C (4)	2,159	584,400	254,220	16,676	40.40	345.40
D11	Damas Center Low	Wali S.R. (LA)	586	67,200	21,670	437	0.82	10.60
M04	Mezze Medium	Mezze S.R.(M.1)	323	19,300	22,540	3,030	7.38	95.25
M03	Mezze High I & II	Mezze High S.R. (M.2)	154	9,500	11,330	2,300	7.40	35.75
M02	Mezze High I & II	Mezze Hach S.R. (M.2)	177	46,400	9,280	0	0.00	0.00
M01	Mezze High I & II	Wali S.R. (LA)	35	2,900	3,580	3,007	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			7,218	1,375,200	614,590	50,574	122.23	1,019.81

(Source: DASSA & 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 A-6.1 Large Block System
NIPPON KOEI CO., LTD.

Pipe Line of SCADA 01

LEGEND

	Pipe Line of SCADA 01
300	Pipe Line and Diameter
	Administrative Boundary

0 1.0 2.0 3.0km

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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

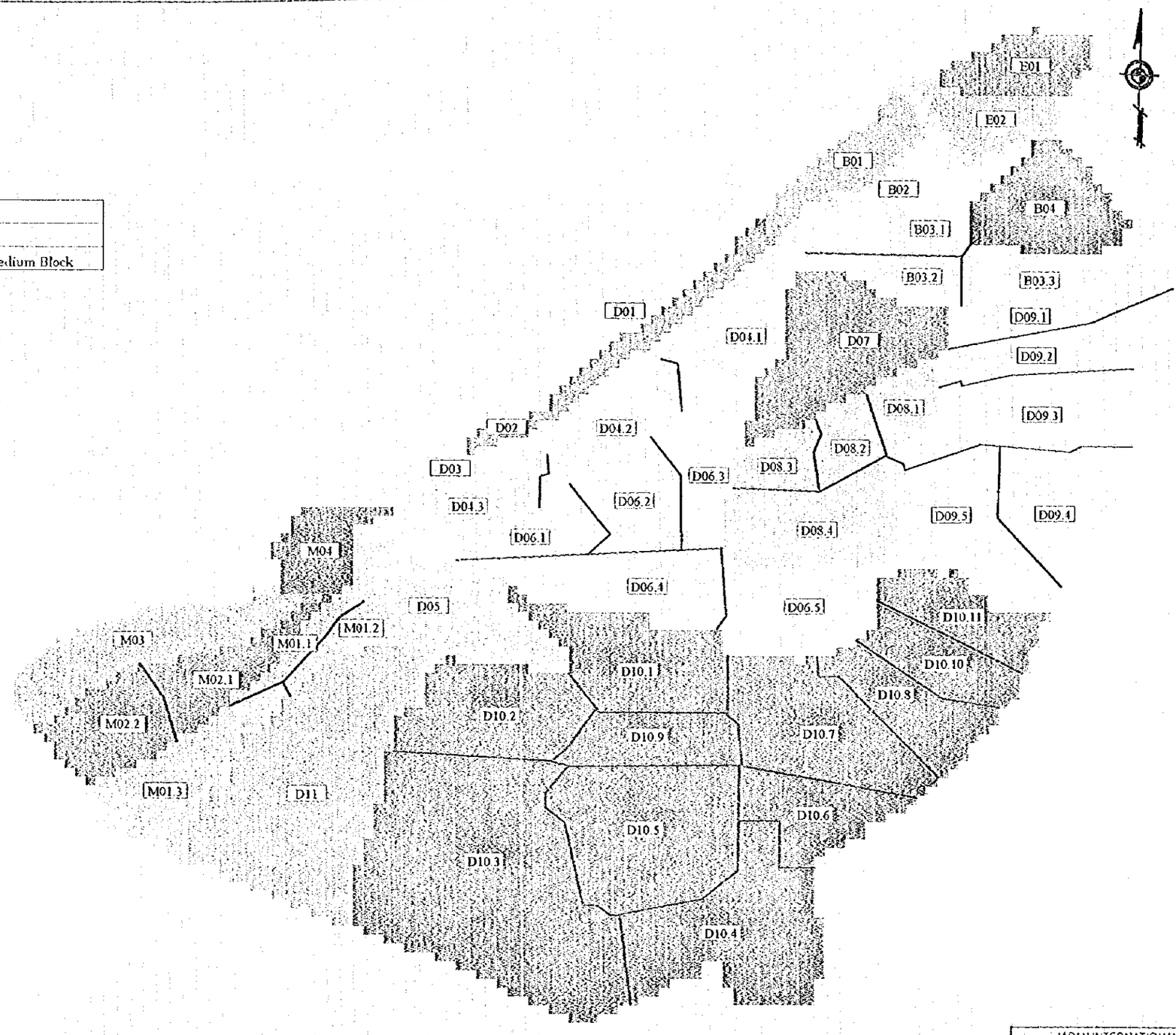
Figure A-6.2

Large Block SCADA 01

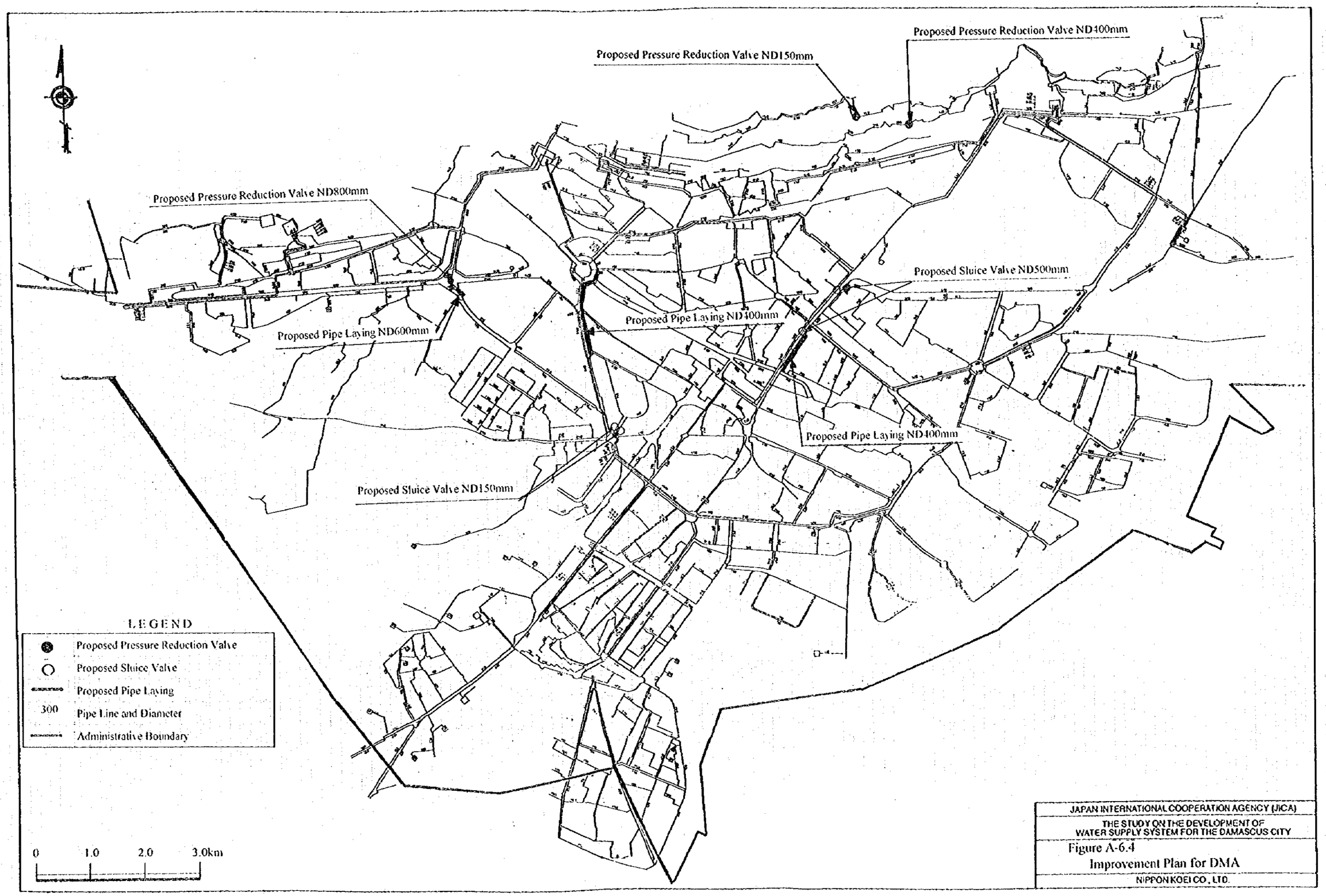
NIPPON KOEI CO., LTD.

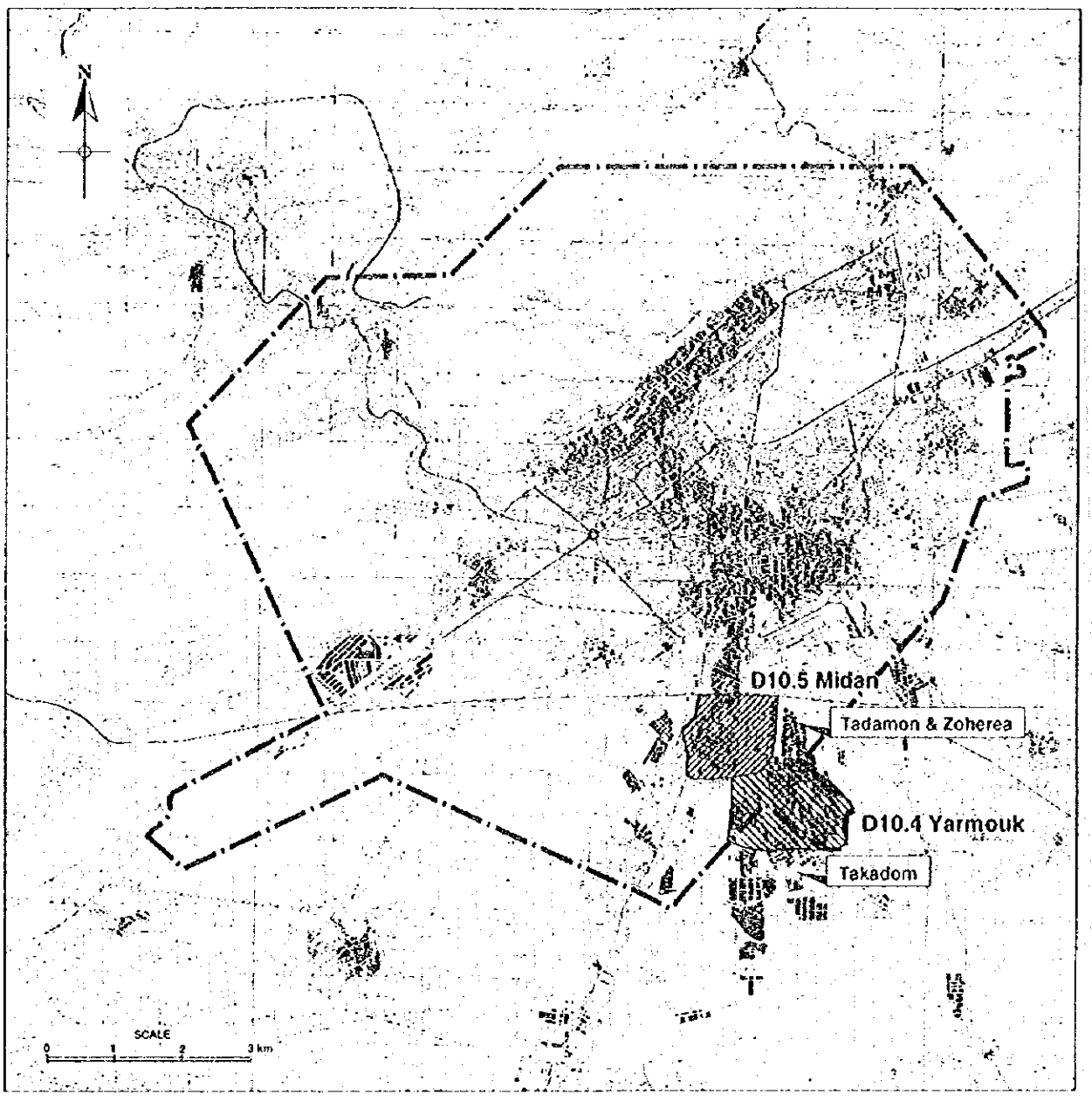
LEGEND

D07	Large Block
D10.1	Medium Block
———	Boundary of Medium Block



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure A-6.3 Proposed Block System
NIPPON KOEI CO., LTD.


Proposed Pressure Reduction Valve ND400mm
Proposed Pressure Reduction Valve ND150mm
Proposed Pressure Reduction Valve ND800mm
Proposed Sluice Valve ND500mm
Proposed Pipe Laying ND600mm
Proposed Pipe Laying ND400mm
Proposed Pipe Laying ND400mm
Proposed Sluice Valve ND150mm
LEGEND
Proposed Pressure Reduction Valve
Proposed Sluice Valve
Proposed Pipe Laying
300 Pipe Line and Diameter
Administrative Boundary
0 1.0 2.0 3.0km
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure A-6.4
Improvement Plan for DMA
NIPPON KOEI CO., LTD.



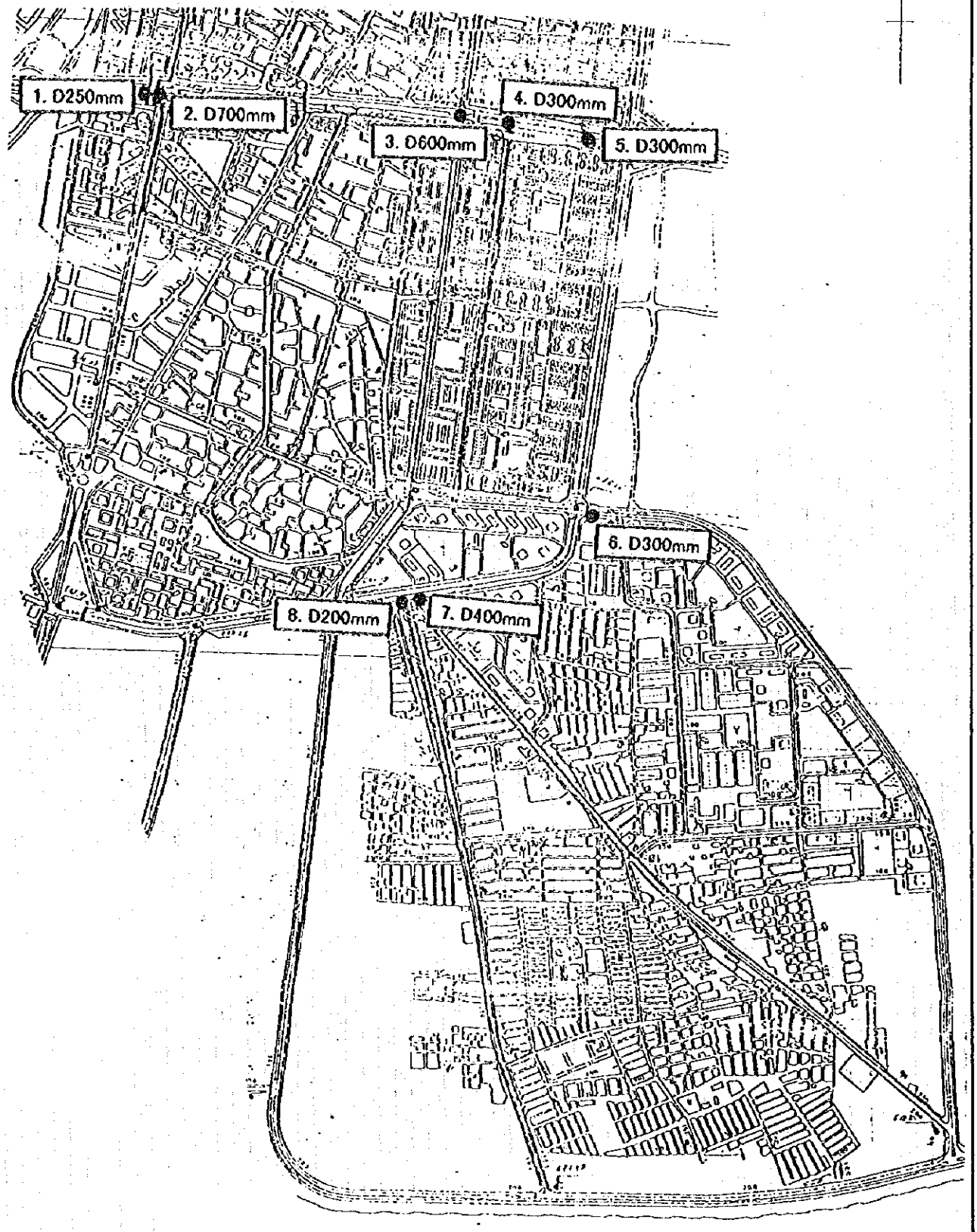
LEGEND

:D10.5 Midan

:D10.4 Yarmouk

:Intormal Connection Area

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure A-6.5 Pilot Area
NIPPON KOEI CO., LTD.



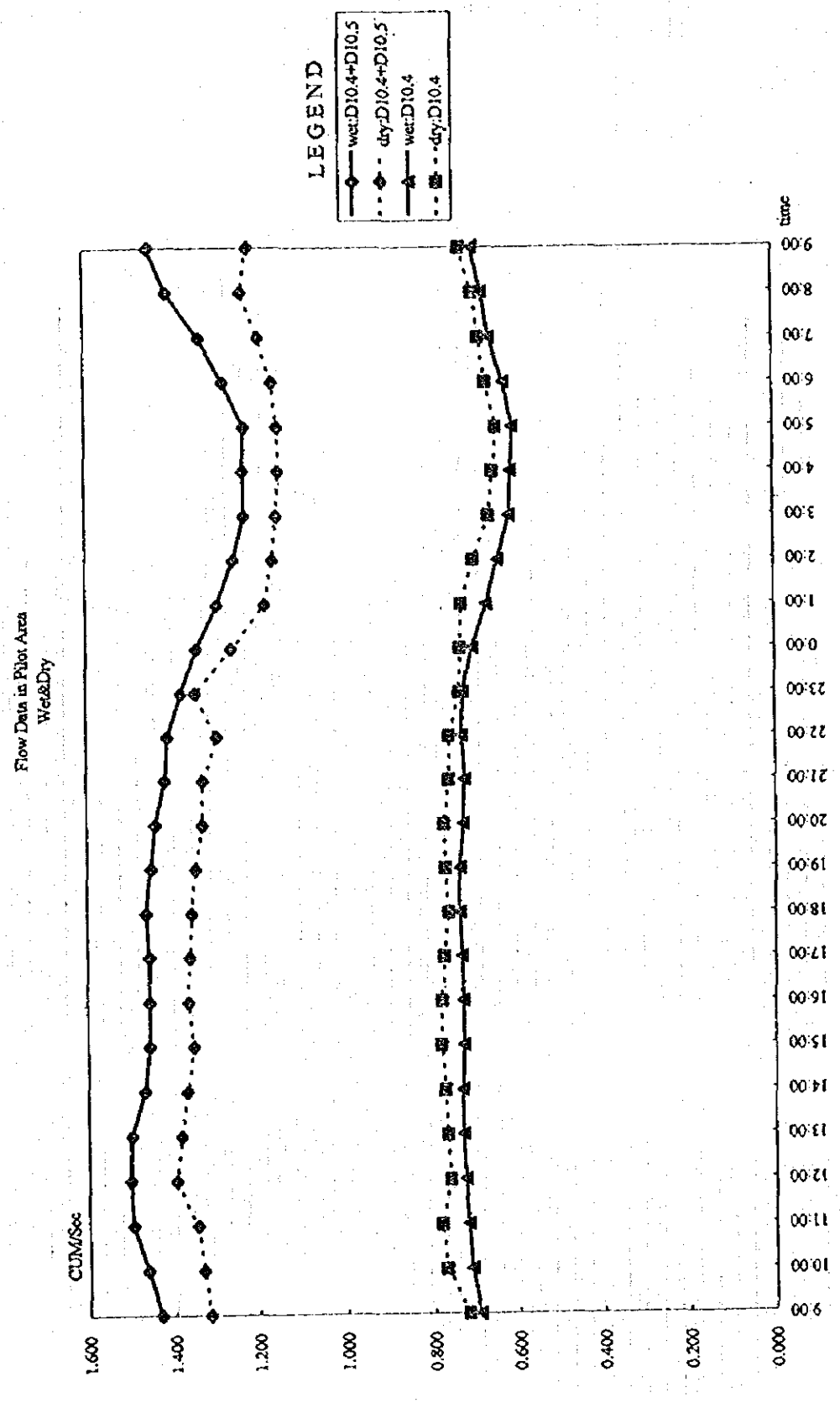
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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

Figure A-7.1

Measurement Point at Pilot Area

NIPPON KOEI CO., LTD.



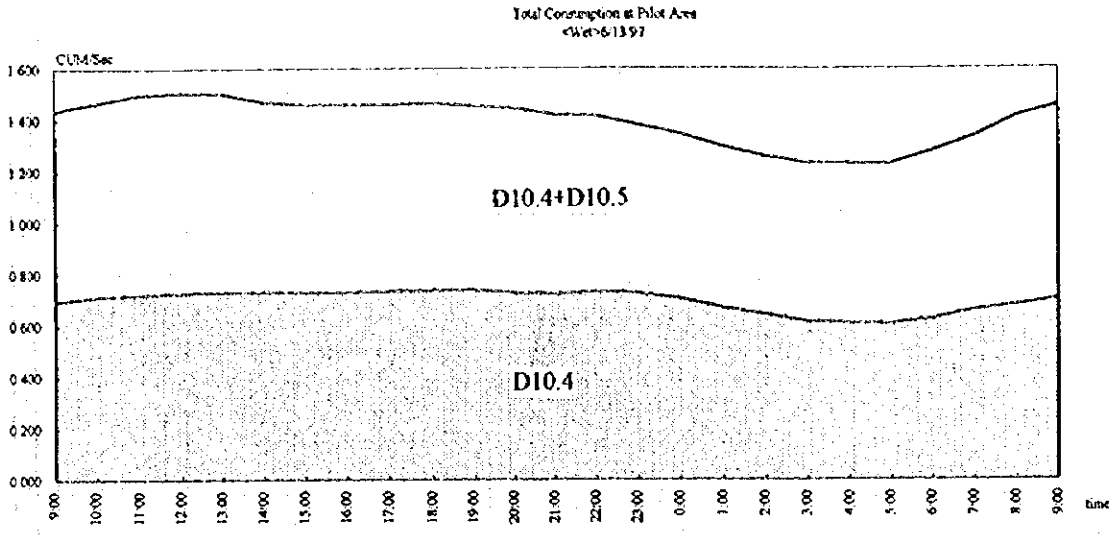
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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

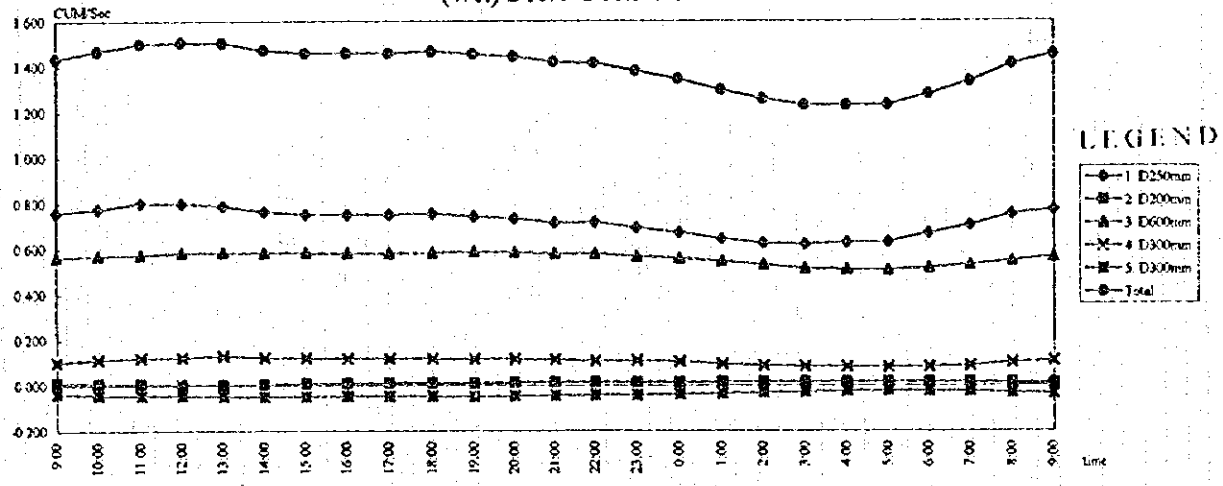
Figure A-7.2(1/3)

Flow Data at Pilot Area

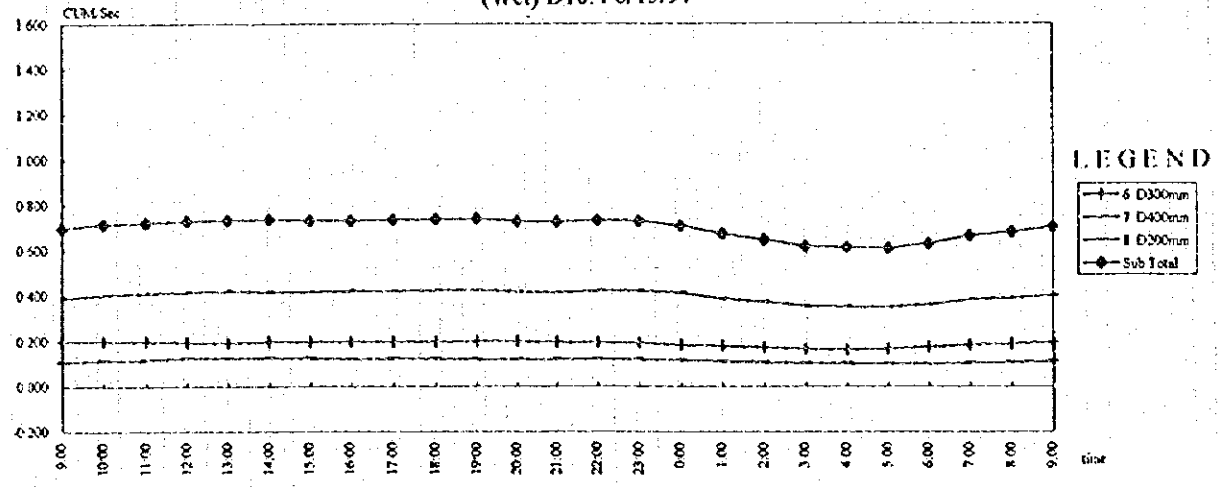
NIPPON KOEI CO., LTD.



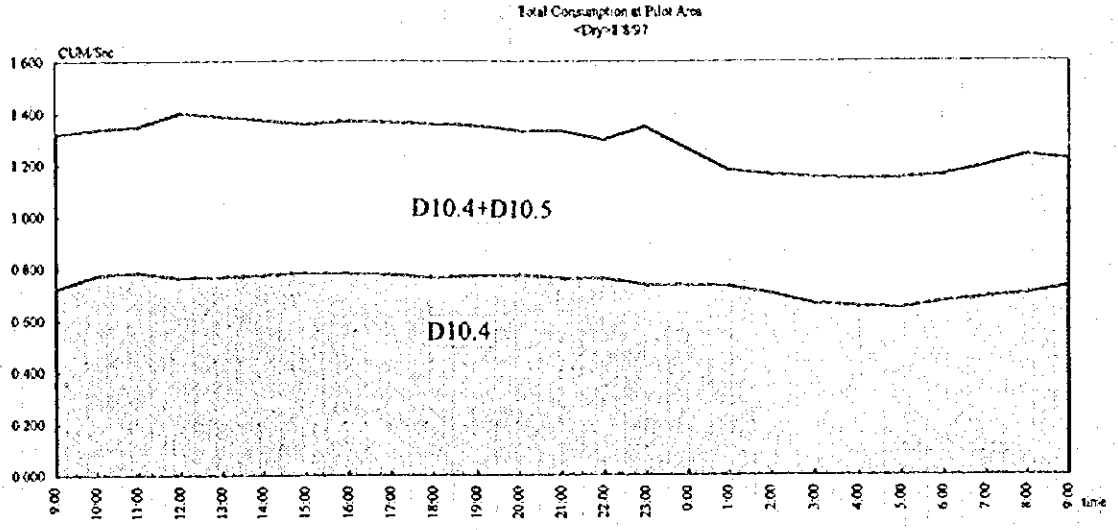
Flow Data in Pilot Area
(Wet) D10.4+D10.5 6/13/97



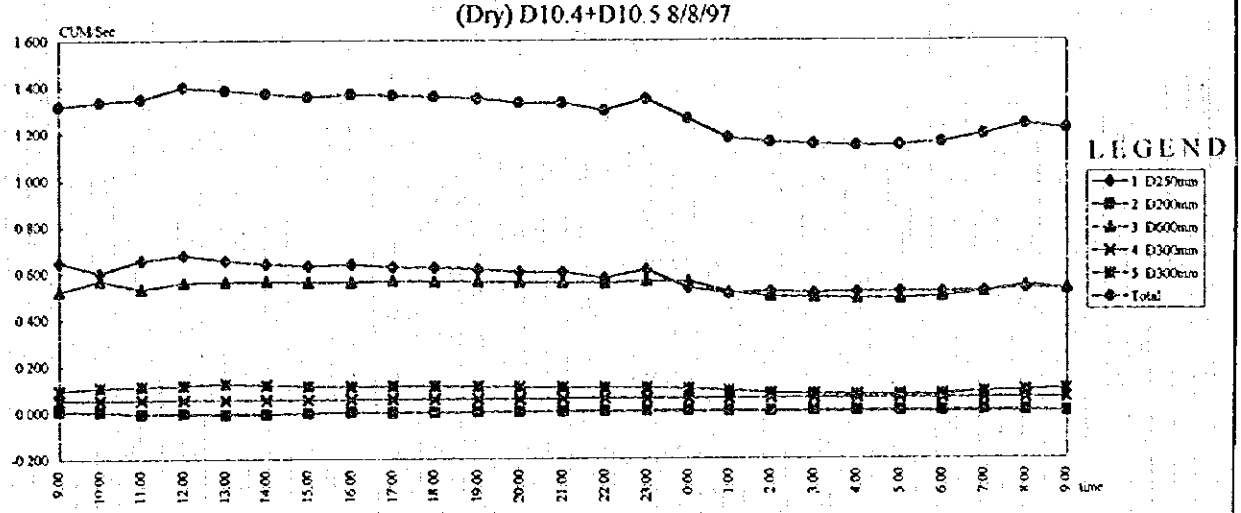
Flow Data in Pilot Area
(Wet) D10.4 6/13/97



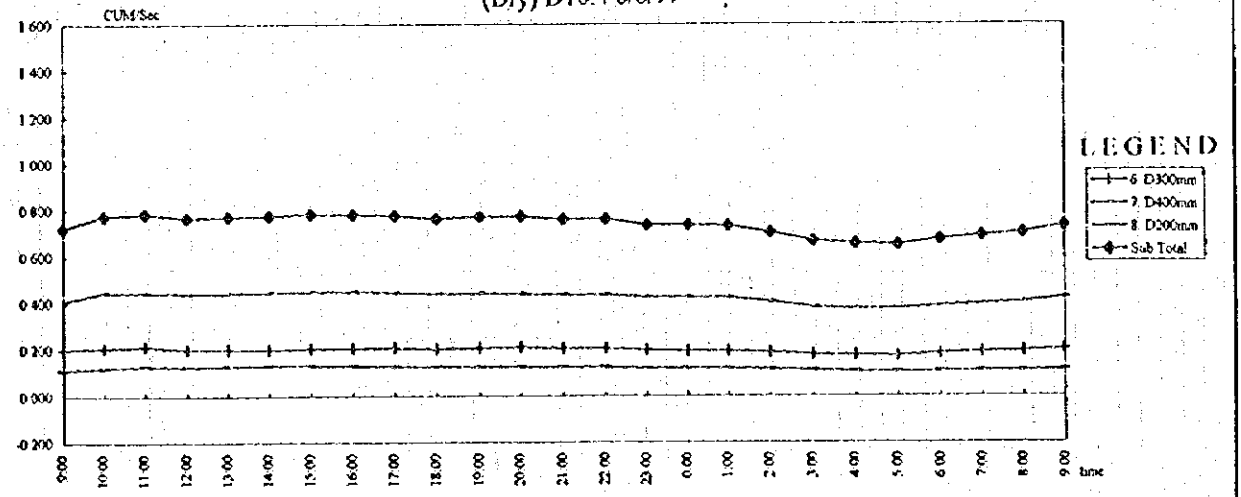
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure A-7.2(2/3) Flow Data at Pilot Area
NIPPON KOEI CO., LTD.



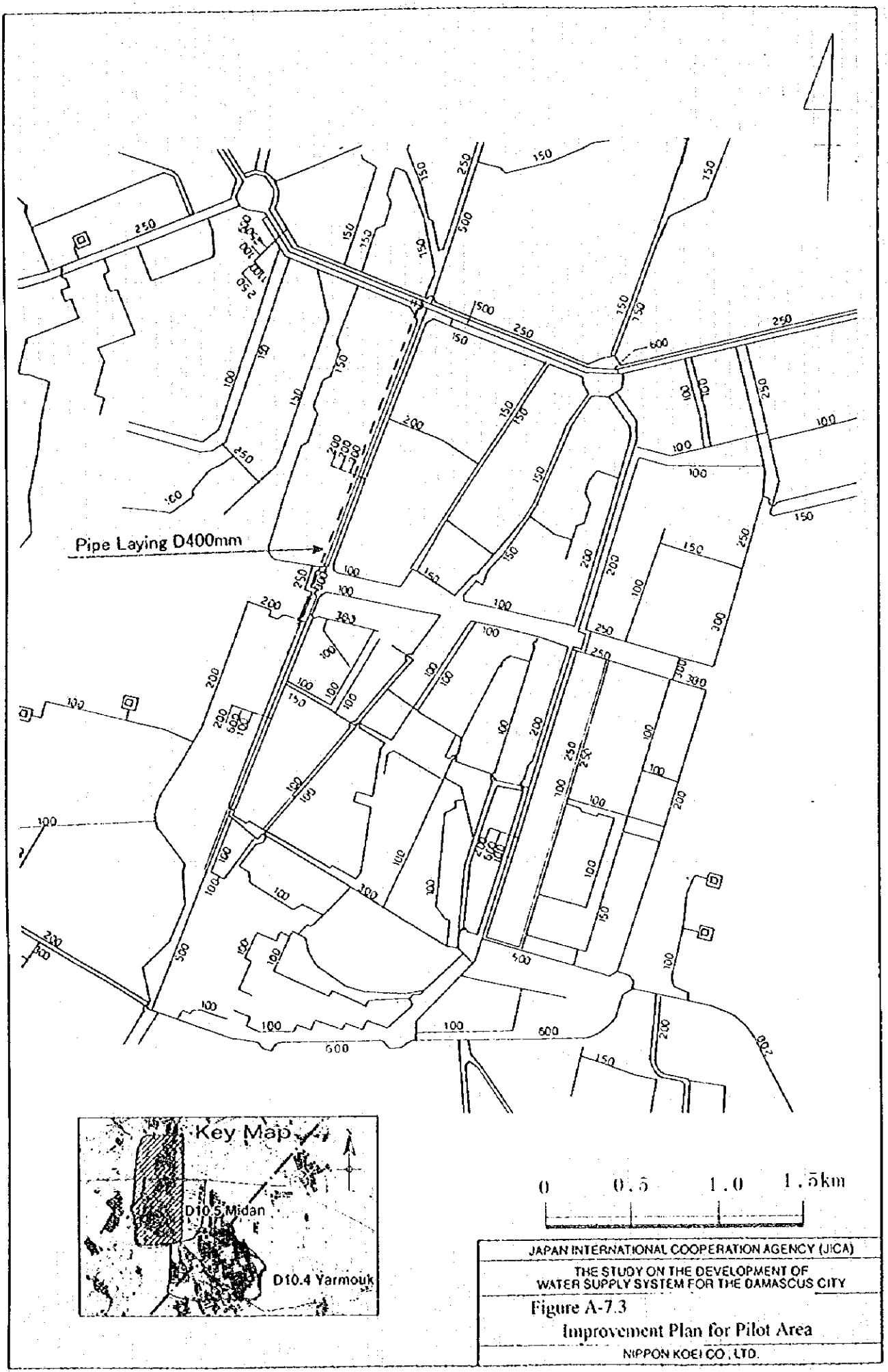
Flow Data in Pilot Area
(Dry) D10.4+D10.5 8/8/97



Flow Data in Pilot Area
(Dry) D10.4 8/8/97



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure A-7.2(3/3) Flow Data at Pilot Area
NIPPON KOEI CO., LTD.



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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

Figure A-7.3

Improvement Plan for Pilot Area

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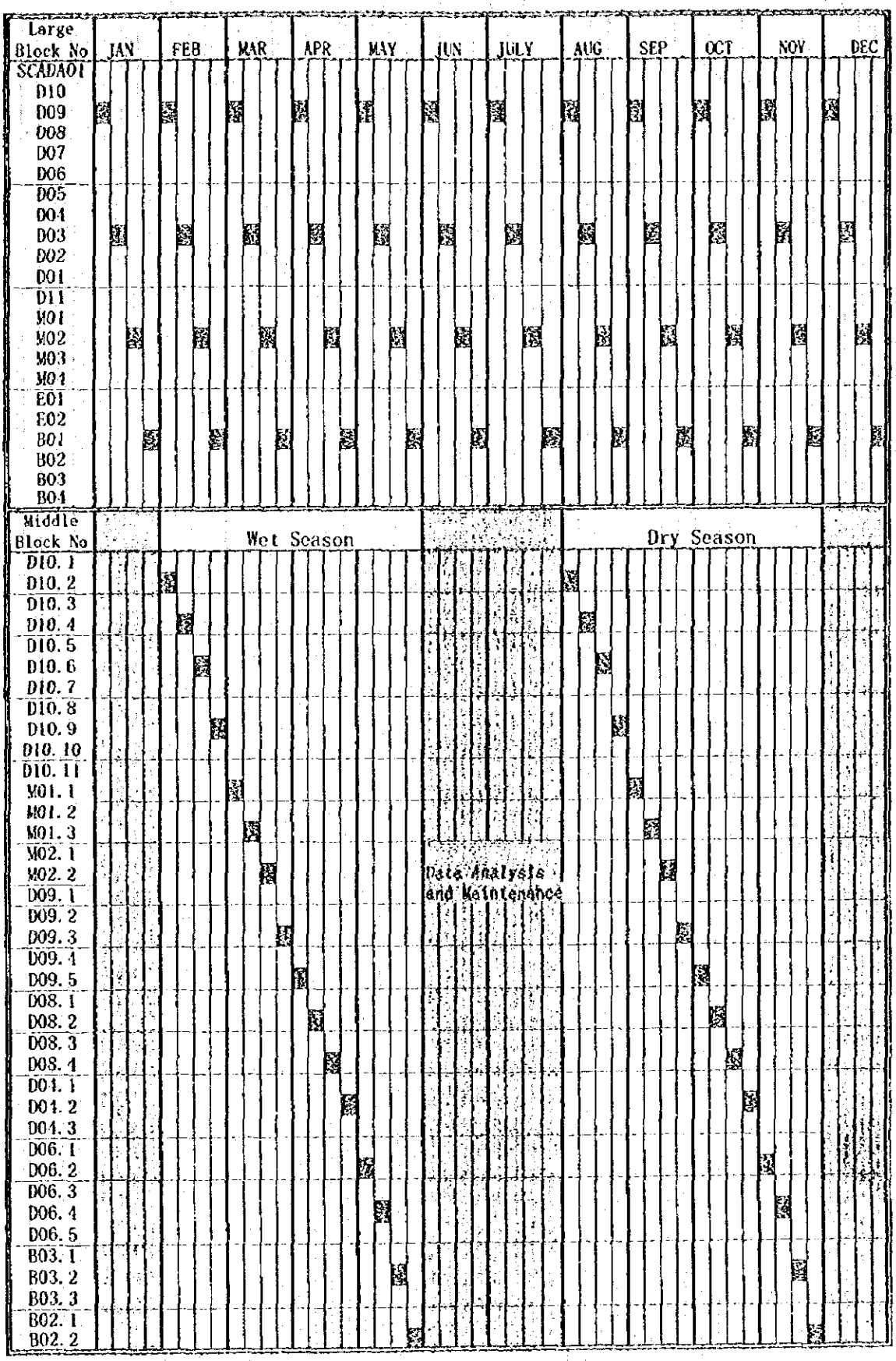


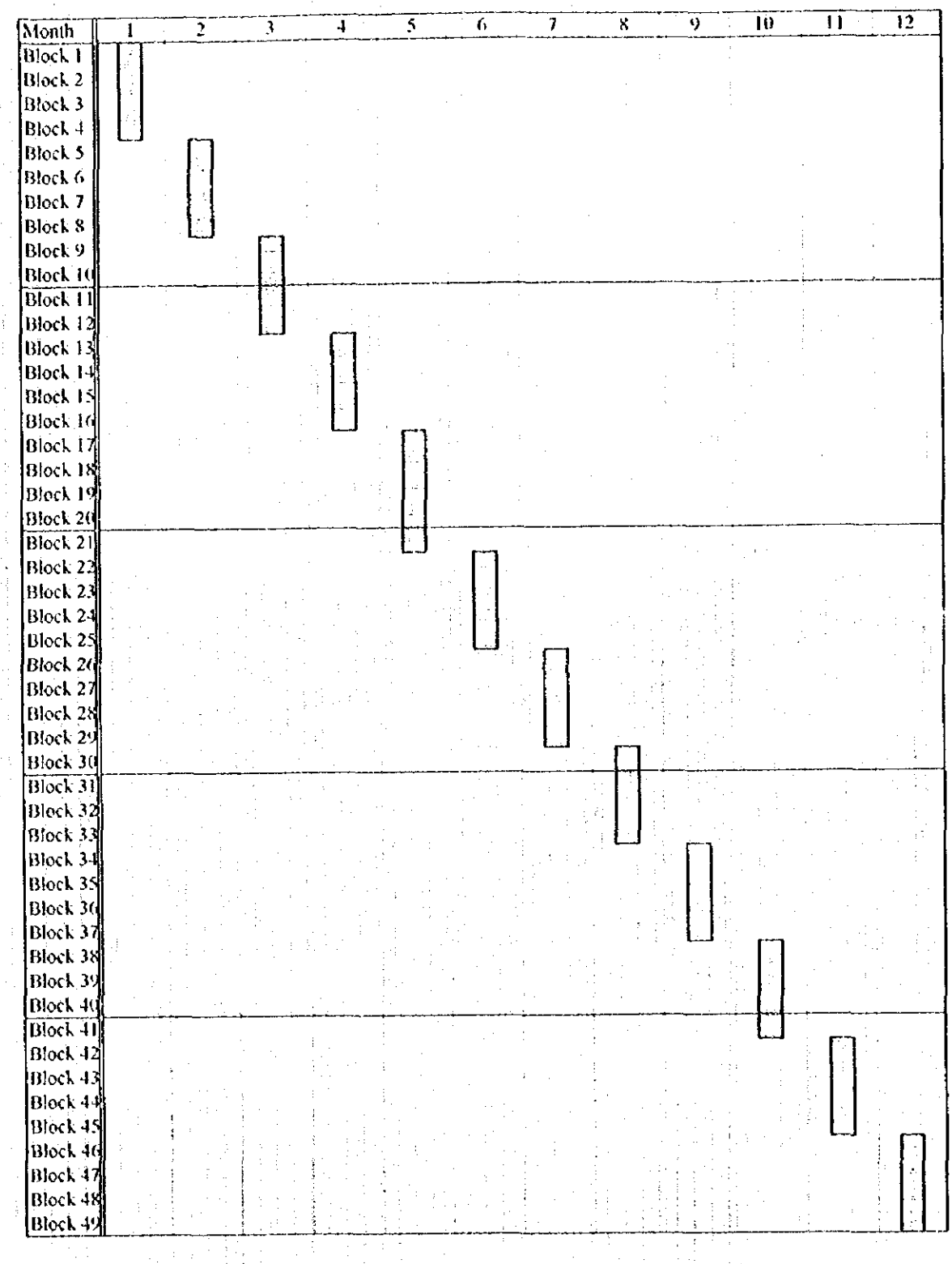
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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

Figure A-8.1

Flow Monitoring Schedule

NIPPON KOEI CO., LTD.



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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

Figure A-8.2

Leakage Detection Schedule

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LEGEND

Standing Monitoring Chamber

Seasonal Monitoring Chamber

Administrative Boundary

0 1.0 2.0 3.0km

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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

Figure A-9.1

Location of Flow Monitors

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Implementation Schedule of District Meter Area

Items	1998	1999	2000	2001	2002	2003	2004	2005	2006
1. Financing Arrangements									
2. Consultant Selection									
3. Detailed Design									
4. Approved of Tender Documents									
5. International Tendering									
6. Tender Evaluation and Award of Contract									
7. Construction Works									
1) Supplying Pipes and Equipment									
2) Local Tendering									
3) Local Tender Evaluation and Award of Contract									
4) Pipe Laying Works		(No. of Large Block)	D10	D04-D06 D11	D01-D03 D07-D09	M02	M01 M03-M04	B01-B04	E01-E02
5) Equipment Installation Works									

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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

Figure A-11.1
Implementation Schedule of DMA

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APPENDIX B

MEZZE-RAZY & KAFAR SOUSEH-LAWAN SYSTEM

APPENDIX B
MEZZE-RAZY & KAFAR SOUSEH-LAWAN SYSTEM

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1. INTRODUCTION

Plan formulation for the development of the distribution network in the Mezze-Razy & Kafar Souseh-Lawan area consists of the following tasks:

i) To review the results of the interview survey and understand the water needs of the residents in the Mezze-Razy & Kafar Souseh-Lawan area, and then to confirm the requirements of the water supply system,

ii) To understand 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,

iii) To collect and analyze the physical characteristics of the study area with specially focus on topographic conditions,

iv) To design the water supply system using the DMA method for leakage detection,

v) To evaluate the financial impact on DAWSSA and affordability to consumers, and

vi) To consider the implications to the SCADA system of expanding the distribution network.

Although the study area is categorized as an informal residential area, the development plan identifies connections to and extension of DAWSSA's water supply system. Environmental aspects and integration with existing infrastructure are essential requirements for this plan.

2. URBAN DEVELOPMENT PLAN

2.1 Existing Urban Developments

The Mezze-Razy & Kafar Souschh-Lawan areas are within the Kafar Souschh administrative district. The existing urban developments in the Kafar Souseh district are described as follows:

(1) Residential development

One of the key factors affecting the rapid urbanization of the study area is the increase in residential development. The area between the Faez Mansour Motorway and the Hafez Al Assad Motorway, shown in Figure B-2.1, has seen intensive development. DAWSSA is currently redeveloping the water distribution network in the residential development area in the northwest sector of the Kafar Souseh district.

(2) Informal settlements

The informal settlements continue to grow uncontrolled as shown in Figure B-2.2. The total population and area of the informal settlements in the City were estimated at 508,200 and 1,273 ha respectively in 1994 (JICA-1997). In the Kafar Souseh district, the informal population and area are estimated at 60,500 and 206 ha. The number of informal residents corresponds to 63 % of the total population in the district, and the informal area corresponds to 17.2 % of the total area of the district. Damascus Municipality is in the process of improving the civil infrastructure in some of the informal areas, such as Mezze and Tabbaleh areas, but work in the Kafar Souseh district has not yet started.

(3) Industrial development

There are small-scale industries and manufactures, such as workshop and food processing, dispersed throughout the district. The total area occupied by the small-scale industries and manufactures is estimated at 12 ha approximately.

(4) Agricultural development

The Kafar Sousch district is one of three intensively farmed areas in the city (Shaghour and Kaboon areas are the others). Approximately 605 ha are farmed corresponding to 50 % of total area. Damascus municipality intends to expand the farmland in rural areas surrounding Damascus city, since the availability of land for farming within the city is limited.

(6) Others

Most of the existing infrastructure, for instance water supply and transportation network systems, is not meeting average demands and there is no capacity for growth in the district. Some modifications will be required in order to meet the demands of a growing population and maintain appropriate levels of service.

2.2 Future Urban Development Plan

The Municipality of Damascus is currently working on a new master plan for Future Damascus City and Regional Area (hereinafter called the New Urban Development M/P) to promote sustainable growth to the year 2020. The planning exercise was started in 1992 and has been delayed because of the difficulty in collecting necessary data ; especially population data in the informal areas. The conceptual plan for the New Urban Development M/P was expected by the middle of 1997, but has been delayed. The Future Urban Development M/P for the Damascus City should be approved by the Syrian Government by early of 1998.

The report for the third stage study of the New Urban Development M/P was prepared on March, 1997. The third stage study was done based on data from the 1994 census. The main findings of the report are briefly outlined as follows;

(1) Study area and population projections

The existing area of the City is estimated at 106 km^2 and total population is 1,394,000 in 1994. Population projections are determined as follows:

Year	1995	2000	2005	2010	2015	2020
Population (1000 persons)	1,468	1,621	1,772	1,878	1,934	2,000
Area (km^2)	106	-	-	-	-	180

(Source: Damascus Municipality)

(2) Number of workers in 2020

The percentage of workers to the total population in 2020 is forecasted at 31% (number of workers is 620,000).

(3) Sector classification of workers in 2020

Workers in 2020 are classified into three economic sectors; Agriculture (4.5%), Industry (27.5%) and Service (68%).

(4) Classification of service activities in 2020

The service activities in 2020 consist of Transport of 12 %, Commerce of 20 %, Administration of 27 % and Other sectors of 31%.

(5) Classification of income levels in 2020

The population is classified into three income categories; High Income (20%), Medium Income (40%) and Low Income (40%). The income levels are defined as follows:

- High class : more than SL50,000
- Middle class : SL 10,000 to 50,000
- Low class : less than SL 10,000

(6) Informal residents

The population of informal areas in 1994 is estimated at 508,000 corresponding to 36 % of total population in the City and the M/P forecasts that informal residents will either be resettled or completely normalized (formal water connection, electrical service) by 2020.

The location of existing informal areas in the City is identified in Figure B-2.2 and the population for each informal area is presented in Table B-2.1. Informal residents in the Kafar Souseh district are summarized below:

Reference No.	Location	Area (ha)	Population
15	Behind Alrazi Hospital	45	9,400
16	Kafar Souseh	35	7,000
17	Lawan	33	11,600
18	Dahadil Naher Eicheh	93	32,500
Total		206	60,500

(Source: Damascus Municipality)

The above reference number corresponds to the identification number given to informal areas indicated in Figure B-2.2.

(7) Future land use

The future land use patterns in the City and the surrounding areas are assumed to be the same as the existing land use patterns. New development areas in the City are planned for residential and commercial use in Kudsaya New Suburb, Dummar Extension Area and Assad Suburb. The composition of future land use in the City (2020) is estimated as follows:

Major Land Use Type	Land Area (km^2)	%
Residential & Commercial Area	86.01	47.8
Industrial Zone	2.39	1.3
Agricultural & Residential Area	4.14	2.3
Agricultural Area	10.06	5.6
Special Area Zone	3.55	2.0
Green & Park	10.33	5.7
Kassioun Mountain	26.46	14.7
Reserved Area & Others	37.06	20.6
Total	180.00	100.0

The detailed development plan for the area of Kafar Sousch district, is not yet available since the future land use plan has not been completed by Damascus Municipality. However, it is assumed that there will not be much change in the existing Kafar Sousch district area according to the Damascus and Regional Master Plan for 2020.

3. PHYSICAL AND SOCIAL CONDITIONS

3.1 Topography and Geology

There are no detailed topographic and land register maps of this area because it has developed informally. Accordingly a survey was carried out to confirm the present topographic and residential conditions to assist in formulating the development plan .

The Mezze-Razy informal area is located to the south of the Faez Mansour Motorway. Total area is 136.0 ha and population is estimated at 32,786. The elevation varies from 701 m to 715 m above mean sea level as shown in Figure B-3.1. The area slopes down to the south with incline of 1.1%.

The Kafar Souseh-Lawan informal area is located in the south of the Hafez Al Assad Motorway. Total area is 55.0 ha and population is estimated at 14,000. The elevation varies from 697 m to 707 m above mean sea level as shown in Figure B-3.2. Average slope incline is about 1.5 % in this area.

Results of the survey are summarized as follows:

	Mezze-Razy	Kafar Souseh-Lawan
Total Area (ha)	136.0	55.0
Classification of Elevation (m)		
Maximum	714.89	707.10
Minimum	701.21	696.64
Average	710.21	701.90

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-Arof trough. Therefore, the surface of geology in the Mezze-Razy & Kafar Souseh-Lawan area consists of unconsolidated Quaternary deposits.

3.2 Land Use

The Mezze-Razy & Kafar Sousch-Lawan area belongs to the Kafar Souseh district. The Kafar Souseh district has a total area of 1,200 ha mainly consisting of agricultural area of 605 ha, residential area with farmland of 256 ha, residential and commercial area of 281 ha, and others of 70 ha.

The present land use in the area is classified into two categories; Residential & Commercial Area and Farmland/Green Area as presented below (the area for each type of land use is estimated roughly by measurement on the topographic map with a scale of 1/2,000, prepared by the JICA Study Team);

(Unit: ha)

	Mezze-Razy	Kafar Sousch-Lawan
Residential & Commercial Area	106	34
Farmland/ Green Area	30	21
Total	136	55

3.3 Road and Water Supply

The conditions of roads, drainage and public property in the area are illustrated in Figures B-3.1 and B-3.2. The public roads are classified as follows:

	Mezze-Razy	Kafar Sousch-Lawan
Total Area (ha)	136.0	55.0
Length of Road (km)		
▪ less than 4 m of Wide	0.509	0.394
▪ 4m to 6 m of Wide	5.641	1.060
▪ 5m to 7m of Wide		0.828
▪ 6 m to 8 m of Wide	3.035	0.668
▪ more than 8 m of Wide		1.017
Total Length (km)	9.185	3.967

The water supply in The Mezze Razy area and Kafar Sousch-Lawan area is provided partially by DAWSSA as shown in Figures B-3.3 and B-3.4 respectively. Water in the area is supplied from water mains fed from the Wali service reservoir and the Western service reservoir. The existing water mains are listed in Table B-3.1 and summarized as follows:

Pipe Diameter (mm)	Type of Materials	Age (Year)	Pipe Length (m)
50	GIP	> 10 years	1,990
80	GIP	> 30 years	2,550
100	DIP	> 4 years	3,420
150	DIP	> 4 years	360
150	CIP	> 20 years	1,260
Total			9,580

(Source: DAWSSA) >: more than

3.4 Housing and Social Conditions

The cadastral survey in the Mezze-Razy and Kafar Sousch-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 Sousch-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 conditions 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: 8 persons per family

ii) Average house hold income: SL 3,500 to SL 6,000 (Low Class)

iii) Classification of income source: Public sector (18%), Private sector (73%), Agricultural sector (7%), Other (2%)

iv) Average possession rate of automobile: 12%

v) Average possession rate of flush toilet: 100%

vi) Average possession rate of bath: 100%

vii) Average daily water consumption per capita:	172 lpcd
viii) Water source of formal residents:	DAWSSA (95%), Communal well (5%)
Water source of informal residents:	DAWSSA (95%), Bottled water (4%), Others (1%)
ix) Customer satisfaction with present water supply conditions	
• Insufficient water quantity:	26% in Mezze-Razy, 67% in Kafar Souseh-Lawan
• Low pressure:	26% in Mezze-Razy, 56% in Kafar Souseh-Lawan
x) Use of water storage device:	97 % (average capacity is 1 m^3), Used every day (69%), Automatic control (76%)
xi) Willingness to pay water charge:	96 % agreed to the existing tariff
xii) Awareness of environmental issues:	Lack of safe drinking water (30%) Pollute driver/canal (66%) Odor (57%)

4. PRESENT WATER USE

4.1 Domestic Use (formal & informal)

Based on the results of the interview survey, the average family size in the Mezze-Razy and Kafar Sousch-Lawan informal areas is estimated at 8 persons per family according to the results of the interview survey. The family size of informally connected household is 6.4 persons and the family size of formally connected household is 10.2 persons. A total of 3,347 households were surveyed: 2,402 in Mezze-Razy and 945 in Kafar Sousch-Lawan.

The average daily water consumption in the area is estimated at 172 lpcd and 95% of residents including informally connected residents use water supplied from DAWSSA according to results of the interview survey. As for water costs per formal household, an average monthly payment of water is 125 S.L. per month and this water cost corresponds to 2.5% of average income (about 5,000 S.L.). While 96% of informal residents show their willingness to pay with the existing tariff for water if provided supply of water adequately from DAWSSA.

The results of the interview survey in the Feasibility Study are almost similar to the results of the survey carried out for the Master Plan Study except the average family size. In the Master Plan Study, the average family size in the City was 6 persons and the figure in Kafar Sousch was 7 persons. For planning the distribution network in Mezze-Razy & Kafar Sousch-Lawan area, 170 lpcd is adopted as the present domestic water use in the area in accordance with the estimates in the Master Plan Study.

4.2 Non-domestic Use (formal connections)

In the Master Plan Study, water consumption for non-domestic use was projected based on the analytical results of records, questionnaires survey and information provided by DAWSSA and other relevant data collected, such as the urban development plan, land use plan and statistical data. 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

5. WATER REQUIREMENT

5.1 Service Area

(1) Informal connection areas

Informal connection areas are dispersed widely in the southern part of the Kafar Souseh district. According to information from Damascus Municipality, the total informal area is estimated at 206 ha. Informal areas in 1994 and 1995 are summarized respectively as follows:

Location	District	Area (ha)	
		1994*	1995**
Mezze-Razy (Behind Alrazi Hospital)	Kafar Souseh	45	68
Kafar Souseh	Kafar Souseh	35	43
Kafar Souseh-Lawan	Kafar Souseh	33	60
• Kafar Souseh-Lawan			25
• Lawan			35
Dahadil Naher Eicheh	Kafar Souseh & Kadam	93	92
Total		206	263

(Source: * Damascus Municipality, **DAWSSA & JICA Study Team)

The above informal areas include not only informal residents but also formal residents since informal residents are scattered throughout the Kafar Souseh district. In the Master Plan Study (JICA-1997), Dahadil Naher Eschah was included into the Kadam district and the total informal area for Kafar Souseh was estimated at 170 ha representing approximately 14 % of total area of the Kafar Souseh district.

(2) Present DAWSSA service area

DAWSSA supplies water to formal residents and public facilities (schools, hospitals and offices; etc.) along the Faez Mansour Moterway and the Hafez Al Assad Motorway. The service area along the Faez Mansour Motorway is supplied from the Wali reservoir, while the area along the Hafez Al Assad Motorway is supplied from the Western reservoir. The Mezze-Razy & Kafar Souseh-Lawan informal area is taking water from the service area by the Wali reservoir and the Dahadil Naher Eshah area takes water from the service area by the Western reservoir.

(3) Areas designated under the DMA plan

According to the proposed DMA plan, Mezze-Razy & Kafar Sousch-Lawan informal areas are within large block D11 supplied from the Western reservoir. The Dahadil Naher Eicheh area is within large block D10 supplied from the Western reservoir.

(4) Areas based on field survey

A supplementary topographic survey for house quantities and location and an interview survey on living conditions for 100 households were carried out during this study. The total surveyed area was 191 ha consisting of 136 ha in Mezze-Razy and 55 ha in Kafar Sousch-Lawan. The results of the topographic survey are summarized below:

(Unit: ha)

	Mezze Razy	Kafar Sousch-Lawan
Residential & Commercial Area	106	34
• Formal	38	9
• Informal	68	25
Farmland/Green Area	30	21
Total	136	55

(5) Service area to be improved

The service area to be improved is determined based on the above mentioned topographic survey as follows:

i) Service area to be improved : 191 ha
   - Formal area : 47 ha
   - Informal area : 93 ha
   - Farmland/Green area : 51 ha

ii) Additional area to be considered for total water demand : 395 ha

iii) Total area for water requirement : 586 ha
- Formal area : 450 ha
- Informal area : 136 ha

5.2 Population Served

The service population adopted for this study is based on population projections estimated in the JICA Master Plan Study as follows:

i) Population served in improvement areas : 46,800
- Formal : 14,800
- Informal : 32,000

ii) Additional population served to be considered for total water demand : 20,400

iii) Total population served for determining the water requirement : 67,200
- Formal : 20,400
- Informal : 46,800

5.3 Water Demand Projection and Water Requirements

Daily water demand and water requirement projections for the total Kafar Souseh district are estimated in the JICA Master Plan Study and summarized below:

Classification of Water Use	Water Consumption (m^3/d)
Domestic use	7,800
Governmental use	1,670
Commercial use	480
Industrial/Manufacturing use	140
Water Right use	2,750
Public utility use	650
Total Demand	13,490
Water Requirement	40,800

The water use for the smaller informal areas within the district are estimated by applying population and area rates to the above noted consumption. The results are as follows:

i) Water requirements of Mezze-Razy and Kafar Sousch-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 Sousch-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 M05 : 21,670 (m^3/d)
   - Daily average supply : 251 l/s
   - Peak day supply : 286 l/s
   - Peak hour supply : 358 l/s

6. DESIGN CRITERIA

The following design criteria are adopted for the preliminary design for the distribution system in Mezze-Razy & Kafar Souseh-Lawan areas.

(1) Fluctuation in water demand

Peak day factor is determined as 1.14 on the basis of the actual results of the seasonal water supply quantities in the dry season and the wet season. A peak hour factor of 1.25 is applied based on the actual measurement of flow-rates for a 24 hour period from the service reservoirs. The results of hourly flow-rate measurements are shown in Table B-6.1.

- Peak day factor : 1.14 × daily average supply
- Peak hour factor : 1.25 × hourly average flow rate for the peak day

(2) Water Pressure at the end of distribution pipelines

In accordance with DAWSSA's standards, a minimum residual pressure of 30 m head is adopted to meet the need for supplying water to roof tanks of 5-story residential buildings.

(3) Pipe materials

In accordance with DAWSSA's standards, pipe materials are employed as follows:

- Distribution main of more than 250 mm in diameter : ductile iron pipe
- Distribution sub-main : ductile iron pipe
  (Secondary pipes for 100 mm to 200 mm in diameter)
- Distribution sub-main : polyethylene pipe
  (Tertiary pipes and service pipes for 50 mm to 65 mm in diameter)

(4) Fire-hydrants

- Type of the fire-hydrant : underground type
- Fire-hydrant spacing : 300 m to 400 m

(5) Network analysis

The distribution network in the area was analyzed by the Hazen and Williaam's formula for pipe diameters and flow rates. The following criteria are applied:

- Velocity coefficient, C : 110 for new pipes
- Minimum pipe diameter of the network : 100 mm
- Hydraulic gradient : < I = 10/1,000 for 250 mm in diameter
  < I = 6/1,000 for 200 mm in diameter
  < I = 4/1,000 for 100 mm to 150 mm in diameter
- Maximum velocity
  - Distribution main : less than 2 m/s (at least ND 250 mm)
  - Secondary & Tertiary : less than 1 m/s

7. OVERALL WATER SUPPLY IMPROVEMENT PLAN

The overall water supply improvement plan was formulated as shown in Figure B-7.1, 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 Sousch-Lawan area but also for the areas adjacent to the study area where informal residents have settled and connected to the distribution system as described in the Section 5.

The analysis of the water distribution network follows i) analyze the existing system to identify difficulties, ii) address the existing system difficulties (e.g. increase diameters, add loop distribution network, etc.) and analyze impact of improvements, iii) identify ways of increasing the supply and extending the distribution network. Technical approach and method for planning is described below.

(1) Analysis of the existing water supply system

The existing water supply system in the study area is shown in Figures B-3.3 and B-3.4 (refer to Section 3). Water is supplied in the area 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 Sousch-Lawan.

An analysis of the existing water supply system is used in order to evaluate potential differences such as insufficient flow, low pressure, etc. and compare with the results of the interview survey as described in the Section 3. The analysis is based on the following assumptions:

i) Service reservoir : Wali service reservoir (LWL: +800.17 m)

ii) Elevation of effective head at measured point of water main (D05-P1) : 31.50 m (measured)

iii) Combined ND150 mm and ND100 mm : Equivalent diameter is 169 mm

iv) Daily average water requirements : only formal residents in the area

The above head loss of 31.5 m was measured during this study on the 250 mm inlet pipe at the pressure measurement point (D05-P1) about 2,000 m away from point (M3-381). The analysis of the looped network is presented at Table B-7.1 and the summary of flow network analysis including branched network is shown in Table B-7.2. Problems with the existing system identified by the analysis are presented as follows:

i) The result of the looped network analysis indicates that conditions in the existing system are normal, however head loss and velocity are presumed to be extremely high when water requirements for informal use are included.

ii) As for the branch system (see Table B-7.2), effective head in the Kafar Sousch-Lawan area supplied through pipeline connected with Mezze-Razy shows negative head. This indicates that flow capacity in the existing pipe is insufficient to supply the needs of the residents.

iii) Analysis of the city wide network indicates that the ND250 mm feeder main from the Wali reservoir has insufficient capacity to supply the existing service area plus the informal areas in Kafar Sousch district. The effective head at the end of the ND250 mm (M3-381) main is calculated at less than 10 m.

iv) The results of the analysis coincide with the results of the interview survey carried out by the JICA Study Team in collaboration with DAWSSA. For instance, 67 % and 56 % of residents in the Kafar Sousch-Lawan area complained about insufficient water quantity and low pressure respectively.

It, therefore, is necessary that the improvement of Mezze-Razy & Kafar Sousch-Lawan distribution systems including informal areas be planned taking into consideration not only the existing distribution system in the area but also providing new distribution trunk mains to increase supply capacity and supplying water from other service reservoirs to improve available quantities.

(2) Improvement plan frameworks

Proposed improvements to correct deficiencies in the Mezze-Razy & Kafar Sousch-Lawan system are shown in Figure B-7.1 and B-7.2. Capacity of the new distribution trunk is

determined to meet the total water requirements of block D11 recommended by the DMA plan. The existing water main (ND800 mm) from Wali service reservoir is selected to become a dedicated feeder main, since the flow capacity of the exiting feeder mains (ND250 mm and ND150 mm) from the Wali and Western service reservoirs are not enough to supply the residents. The existing water main (ND800 mm) is located at the Facz Mansour Moterway on the north of the block D11.

The plan is formulated based on the following factors:

	Factor	Service Area (ha)	Population Served	Water Requirements including UFW (m^3/d)
i)	Mezze- Razy & Kafar Sousch-Lawan area	191	46,800	15,070
	• Formal area	47	14,800	4,770
	• Informal area	93	32,000	10,300
	• Farmland/Green area	51		
ii)	Large Block: D11 considered for plan of distribution trunk main	395	20,400	6,600
	• Formal area including farmland	395	5,600	1,820
	• Informal area	43	14,800	4,780
	Total	586	67,200	21,670

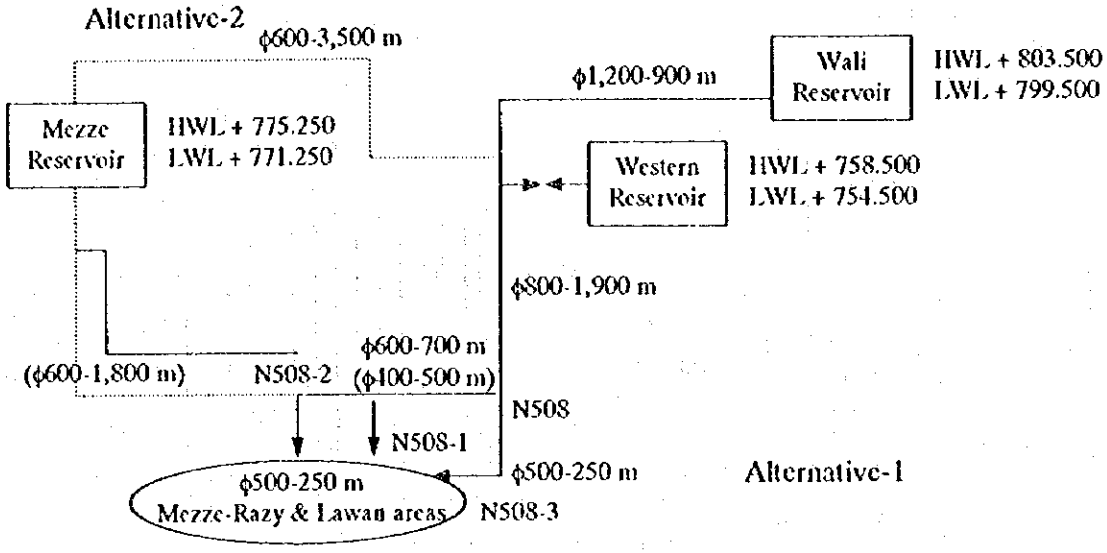
(3) Alternatives for improvement plan

The DMA plan recommends that the Mezze-Razy & Kafar Sousch-Lawan area be grouped into large block D11 and be supplied from the Wali service reservoir. These areas are supplied from the Wali service reservoir and the Western service reservoir at present. The Western service reservoir feeds almost 70% of the service areas in the City and is not affordable for supplying to new service areas. The flow capacity of the exiting feeder mains (ND250 mm) from the Wali service reservoirs are insufficient to meet existing needs. For these two reasons, the following alternatives are proposed:

i) Alternative 1: construction of a new distribution main from the existing trunk main (ND800 mm) connected to Wali service reservoir

ii) Alternative 2: construction of new trunk main from the Mezze service reservoir

A schematic diagram sharing the two alternatives is illustrated below:



Note: Figure in a parenthesis indicates for Alternative-2.

Network analysis based on the above framework was conducted with the same assumptions used for the analysis of the existing network, in order to evaluate each alternative of transmission pipeline and distribution service reservoir. The looped distribution network was analyzed tentatively as presented in Table B-7.3. The result of flow network analysis in case of the Wali service reservoir is summarized in Table B-7.4 and in Table B-7.5 in case of the Mezze service reservoir.

Alternative-1 Wali service reservoir system

At present the existing trunk main of ND800 mm from Wali service reservoir (I.S) supplies water to large block D05 through a branch pipe of ND250 mm. In the case where this ND800 mm trunk main supplies both D05 and D11 areas, the total required distribution quantity is estimated at 850 liter per second for hourly peak as shown below:

Served area	Daily Flow Rate (m^3/d)	Daily Flow Rate (l/s)	Hourly Peak (l/s)
D05 area	29,616	343	493
D11 area	21,670	250	357
Total	51,286	593	850

According to the result of the network analysis for the proposed DMA plan, the effective head at N508 branch point is expected to be 50 m. A summary of the hydraulic calculations is shown as follows:

Section			D (mm)	L (m)	Q (l/s)	I (0/00)	Head Loss(m)	Effective Head (m)
N508					357			50.0
N508	-	N508-1	600	550	249	1.60	0.9	48.7
N508-1	-	N508-2	600	150	198	1.10	0.2	49.1
N508	-	N508-3	500	250	109	0.90	0.2	52.3

Note: 1. N508 : EL 714.90 , N508-1 : EL 715.17 , N508-2 : EL 715.00 , N508-3 : EL 712.20
2. N508 is located at branch point of ND 800 mm from Western reservoir.

Therefore, the existing trunk main of ND800 mm would have enough capacity for conveying additionally water required by D11.

Alternative-2 Mezze service reservoir system

At present M.1 reservoir in Mezze is receiving water from Wali new service reservoir from the existing trunk main (ND600 mm) passing through Western reservoir and is supplying water to M01, M02 and M03 areas. In the case where M.1 reservoir also supplies to D11, the total required distribution quantity is estimated at 1,272 liter per second for hourly peak as shown below:

Served area	Daily Flow Rate (m3/d)	(l/s)	Hourly Peak (l/s)
M01 *	23,572	273	340
M02 *	29,990	347	441
M03	9,280	107	134
D11 Mezze-Razy	15,070	174	248
D11 Other area	6,600	76	109
Total	84,512	977	1,272

According to the result of network analysis, the capacity of the exisitng 600 mm trunk main from Western reservoir to Mezze reservoir is insufficient to convey the additional amounts for D11. The existing trunk main should, therefore, be changed from ND600 mm to ND1000 mm. A summary of the hydraulic calculation is shown below:

Section	D (mm)	L (m)	Q (l/s)	I (0/00)	Head Loss (m)	Effective Head (m)
Western R. - M.1 R.	600	3,500	1,272	33.51	117.3	-93.05
Western R. - M.1 R.(plan)	1000	3,500	1,272	2.78	9.7	14.55

Note: 1. Wali R.: Wali new reservoir LWL 799.500
2. M.1 R. : Mezze reservoir HWL 775.250
3. Effective head = (Wali LWL - M.1 HWL) - Head loss

A comparison of the length of pipe for the two alternatives is summarized as follows:

	Name of Service Reservoir	Length of New Feeder Pipe
Alternative 1	Wali	ND600 mm: 700 m ND500 mm: 250 m
Alternative 2	Mezze	ND600 mm: 1,800 m ND400 mm: 500 m

Alternative 1 is the cheapest for initial investment cost and on-going O&M cost, and more reasonable from a technical feasibility aspect. Alternative 1 is proposed for the water supply improvement plan of Mezze-Razy & Kafar Sousch-Lawan system as shown in Figure B-7.1. The network of the proposed plan is analyzed in Table B-7.6. The proposed network plan considers the re-utilization of existing pipe where possible.

(4) Summary of improvement plan

An outline of the improvement plan is presented as follows:

i) Planned service area : 191 ha
ii) Planned population served : 46,800 persons
iii) Service reservoir : Wali New service reservoir
iv) DMA system block : D11
v) Improved informal population : 32,000 persons
vi) Water requirement for service area
Daily mean water demand : 15,070 m^3/d (174 l/s)
Daily maximum water demand : 17,180 m^3/d (200 l/s)
Peak hourly water demand : 21,475 m^3/d (249 l/s)

vii) Water requirements for D11

Daily mean water demand	: 21,670 m^3/d (251 l/s)
Daily maximum water demand	: 24,700 m^3/d (286 l/s)
Peak hourly water demand	: 30,875 m^3/d (357 l/s)
viii) Distribution system	: Looped network

Required materials for the improvement plan based on Alternative 1 are estimated in Table B-7.7 according to the proposed plan shown in Figures B-7.1 and B-7.2.

8. PROJECT DESCRIPTION

(1) Water Transmission Pipeline

The existing trunk main of ND800 mm from Wali reservoir through Western reservoir is re-used as a water transmission pipeline for supplying water to the Mezze-Razy and Kafar Souseh-Lawan area. A branch pipe connected at N508 point on the existing trunk main is provided for water transmission to the area.

(2) Distribution Main

The distribution mains from branch point N508 are extended to point N508-2 via point N508-1 by ND 600 mm pipes, 700 m in length, and to point N508-3 by ND 500 mm pipe, with 250 m in length. Considering the possible future expansion of the pipe network in D11, both distribution mains are provided with sufficient capacity to meet the required distribution quantity of 248 l/s for Mezze-Razy and Kafar Souseh-Lawan area and 109 l/s for other area. The existing pipelines of ND150 mm and ND100 mm from point N508-1 should be joined with a new distribution pipeline of ND200 mm extending to the network. A new distribution pipeline ranging in size from ND500 mm to 100 mm is planned from point N508-2 in the Mezze-Razy area to the end of the Kafar Souseh-Lawan area. A new distribution main of ND 300 mm branching from point N508-3 is joined to the network.

A flow meter of the ultrasonic type is to be installed on the ND600 mm distribution main for the permanent measurement of flow-rate for the DMA system. Thus, the existing pipelines of ND100 mm and ND150 mm ductile iron pipes (DIP) at the entrance of network are changed to be connected with the new ND600 mm distribution main of extension.

(3) Distribution Pipelines

The network is composed of the distribution mains ranging in size from ND250 mm to ND400 mm DIP and secondary pipelines ND100 mm to ND200 mm DIP as polyethylene pipe (PE) are installed as tertiary pipelines and service pipes ND50 mm to ND65 mm. The total

length of new distribution pipeline is approximately 35 km. The existing DIP of ND100 mm and ND150 mm, totaling 8 km in length, are integrated into the network and used as distribution pipelines. Two pipes of ND400 mm and ND200 mm extending from Mezze-Razy area, cross the highway for connection with the distribution network in the Kafar Sousch-Lawan area.

Sectional valves are planned to be installed at the downstream sides of branch points and arranged to minimize the areas affected by water supply suspension for repairing damaged pipeline by providing 2 to 4 valves, per quadrant. Fire hydrants, 100 mm in diameter, are arranged with spacing of 300 m to 400 m at the junction of roads.

To effectively monitor flow rate conditions, ND400 mm and ND200 mm DIP, which are main supply lines for the Lawan and western growth areas, are to be equipped with flow meter sensor on the pipelines for portable flow monitoring equip. Thus enabling, the flow rate conditions to be periodically checked in the future by connecting the flow meter to the sensor and calibrating the meter in DMA system.

The required distribution facilities under the present scheme are summarized in Table B-8.1. Typical distribution facilities are illustrated in Figures B-8.1, B-8.2, B-8.3, B-8.4, B-8.5 and B-8.6.

(4) Service Connections and Water Meters

As for the service connections from secondary and tertiary pipeline to the individual premises, a polyethylene pipe (PE) is used for branch connection with saddle, brass union sockets and stop cock. DAWSSA is responsible for all aspects of the service from the pipeline to the meter box. The meter box is the responsibility of the subscriber. Water meters for individual house connection is of the turbine type meter, 3 cubic meter, 15 mm pipe size, and of Syrian make. The typical house connection is illustrated in Figure B-8.7.

9. COST ESTIMATE

9.1 Construction Cost

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

(Unit: US$ 1,000)

	Items	L.C.	F.C.	Total
1.	Direct Construction Cost (1998 to 2001)	1,951	2,210	4,161
	1) Ductile cast iron pipes (DIP)	401	1,417	1,818
	2) PE pipes	382	328	710
	3) Valves	17	164	181
	4) Valve & Meter Chambers	2	1	3
	5) Water meter	1,149	300	1,449
2.	Tax and Duty	787	0	787
3.	Administration Cost 10% of Direct cost	195	0	195
4.	Engineering Cost 10% of Direct cost	195	221	416
	Sub-Total (Item 1 to 4)	3,128	2,431	5,559
5.	Physical Contingency	234	243	477
	Sub-Total (Item 1 to 5)	3,362	2,674	6,036
6.	Price Contingency	157	90	247
	Total	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.

9.2 Operation and Maintenance Costs

Operation and maintenance costs are considered insignificant for the Mezze-Razy & Kafar Souseh-Lawan System project and are not included.

10. IMPLEMENTATION SCHEDULE

The implementation of the Mezze-Razy & Kafar Sousch-Lawan System project is planned to be completed by the year 2001. The implementation of the projects is planned for the purpose of properly executing the work by taking into consideration: the conditions for the projects, including contractors, procurement of construction materials and labor force; the manner of procurement of water supply equipment and materials; and the manner of construction.

10.1 *Capability of Local Contractor*

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

DAWSSA pre-qualifies contractors by classifying them into eight (8) fields of engineering activities and ranking them into one of three groups depending on their financial strength, equipment capability, the number of qualified engineers and experience in the field.

These eight fields are 1) Supply and Execution of Pipes and Metals works, 2) Pump Installations, 3) Mechanical & Electrical Installations, 4) Pipe Laying for transmission Lines, 5) Laying of House Connections, 6) Road Constructions, 7) Fitting Castings and 8) Electric Board works.

First, second and third ranked contractors are nominated for tendering on DAWSSA's projects, in the each field. Fifteen (15) contractors are registered in the first rank, seven (7) contractors are in the second rank and nine (9) contractors are third rank.

DAWSSA has experienced contractor capabilities through many projects already executed. The local registered contractors have the capabilities and experience required to construct the proposed projects without the use of internatinally experienced contractors.

Local contractors have sufficient construction machinery and equipment including heavy construction machines.

10.2 Construction and Procurement Methods

The methods of construction and procurement of equipment and materials are executed in Syria. Projects with a high technology component are procured through international competitive tendering, and civil works are procured by local competitive tendering procedure in accordance with the guideline of DAWSSA.

(1) Alternatives:

a) Turn-key contract: for the entire construction works through international tendering

b) Several contract packages: for construction works including pipe materials and pipe laying works, mechanical and electrical equipment and installation, and civil and secondary works through international tendering.

c) Separated contracts: contracts separated into international tendering for procurement of flow meters and pipe materials (DIP) and local tendering for pipe materials (PE) and construction works.

For the above mentioned alternatives, a) and b) are usually applied for large scale works and or project with advanced high technology construction methods. However, the ability of local contractors is deemed suitable for the implementation of the proposed projects. Because the proposed projects consist of ordinary civil works without any advanced high technology. Therefore alternative c) is selected as the recommended tendering procedure.

(2) The manner of procuring the materials and civil works will be as follows;

(a) International tendering

- Pipe materials and accessory for pipelines (DIP)

- Supply of mechanical and electrical equipment including supervision of installation
- All water meters, except 1/2" diameter

(b) Local tendering

Civil engineering works are grouped into multiple-packages by area or contract period for local tendering by the registered contractors.

- Pipe materials (PE)
- Pipe laying works of distribution pipe lines
- Construction civil works include flow meter chambers
- Execution of mechanical and electrical works with DAWSSA supervisor, assisted by foreign supervisor
- Water meters 1/2" diameter

10.3 Implementation Schedule

In preparing a realistic schedule for the implementation of the project, DAWSSA will organize the construction activities. Most construction works will be conducted by contractors and supervised by DAWSSA or it's designated consultant.

The project is expected to start in 1998 and be completed in 2001with financing signed in June of 1998, detailed design starting in January of 1999 and pipes procured in January of 2000, as shown in Figure B-10.1.