Table D-6.1 (1/2) Initial Environmental Examination of Proposed Projects

No.	Classification	Name of Scheme		Natural Environment		Public Health / Pollution		Waste	Local Socio/Econo	Cultural Asset	Overall Evaluation
				water	others	constr.	operation				
1	Rehabilitation Improvement	1.1 Water Main Replacement		+/-	- L	- L	+ M	- L	+ L	- L	Low
		1.2 Water Meter Replaceme	Option 1: Dons meter	+/-	+/-	- L	+ M	- L	+ L	+/-	Low
			Option 2: Rotary Disk meter	+/-	+/-	- L	+ M	- L	+ L	+/-	Low
		1.3 Improvement in Meter Testing and Repairing	Option 1:Dons meter	+/-	+/-	- L	+ M	- L	+ L	+/-	Low
			Option 2: Rotary Disk meter	+/-	+/-	- L	+ M	- L	+ L	+/-	Low
		1.4 District Meter Area (DMA) System		+/-	- L	- L	+ M	- L	+ L	- L	Low
		1.5 Leakage Survey		+/-	+/-	- L	+ M	- L	+ L	+/-	Low
		1.6 Pressure Control		+/-	+/-	- L	+ M	- L	+ L	+/-	Low
		1.7 Improvement of Master Metering		+/-	- L	- L	+ M	- L	+ L	+/-	Low
		1.8 Water Quality Testing Improvement		+/-	- L	- L	+ H	- L	+ L	- L	Low
		1.9 Water Quality Contorl in South Damascus	Option 1:On-Site Blending	+ L	- L	- L	- M	- L	+ L	- L	Moderate
			Option 2:Off-Site Blending	+/-	- L	- L	- H	- L	+ L	- L	High
			Option 3;Water Treatment	- L	- L	- L	+ H	- H	+ L	- L	Moderate
			Option 4;Suspension of well operation	+ L	- L	- L	+ M	- L	+ L	- L	Low
			Option 5: No change	+/-	+/-	+/-	+/-	+/-	+/-	+/-	Moderate
		1.10 Reinforcement of Existing Water Resources	Ain Figeh Area Main Spring	- M	- M	- L	+ M	- L	- L	- L	Low
			Extend Side Spring	- M	- M	- L	+ L	- L	- L	- L	Moderate
			Extend Ain Haroush	- M	- M	- L	+ L	- L	- M	- L	Moderate
			Dier Moukaren	- M	- M	- L	+ L	- L	- M	- L	Moderate
			Barada & Al Sah Spring Wells	- M	- M	- L	+ L	- L	- L	- L	Low/Moderate
			Group 1 W.F	- M	- M	- L	+ L	- L	- M	- L	Low
			Group 2 W.F	- M	- M	- L	+ L	- L	- M	- L	Low
			Group 3 W.F	- M	- M	- L	+ L	- L	- M	- L	Low
			DamascusWells Mazzra	- M	- L	- L	+ L	- L	+ L	- L	Low
			Ibn Asaker	- M	- L	- L	+ L	- L	+ L	- L	Low
			Jobar	- M	- L	- L	+ L	- L	+ L	- L	Low
			Kadam Railway	- M	- L	- L	- H	- L	+ L	- L	High
			Oumawiyin	- M	- L	- L	- H	- L	+ L	- L	High
			Kaboon	- M	- L	- L	+ L	- L	+ L	- L	Low
			University	- M	- L	- L	- H	- L	+ L	- L	High
			KadamStore	- M	- L	- L	+ L	- L	+ L	- L	Low
			Dummar	- M	- L	- L	- H	- L	+ L	- L	High
			Fringe Site	- M	- L	- L	+ L	- L	+ L	- L	Low/Moderate
			Emergency Sites	- M	- L	- L	+ L	- L	+ L	- L	Low
2	On going and Planned Water supply Improvement	2.1 Distribution Improvemen for Informal Area	Esh Al Warwar	+/-	- L	- L	+ M	- L	+ H	- L	Low
			Kassion Mountains Foot	+/-	- L	- L	+ M	- L	+ H	- L	Low
			Tishreen	+/-	- L	- L	+ M	- L	+ H	- L	Low
			Jobar Surrounding-Al Aksab Mosque	+/-	- L	- L	+ M	- L	+ H	- L	Low
			East-West Tabbieh	+/-	- L	- L	+ M	- L	+ H	- L	Low
			Mokhayam Yarmouk	+/-	- L	- L	+ M	- L	+ H	- L	Low
			Naher Eshen-Dahadil & Asalie Kadam	+/-	- L	- L	+ M	- L	+ H	- L	Low

Table D-6.1 (2/2) Initial Environmental Examination of Proposed Projects

No.	Classification	Name of Scheme	Natural Environment		Public Health / Pollution		Waste	Local Socio/Econo	Cultural Asset	Overall Evaluation
			water	others	constr.	operation				
		Kafar Souse Lawan	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Al Qazzaz &Shaghour Basateen	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Mezze-Razy	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Mezze#86	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Somareyeh	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Dummar-Wadi Al Mashare	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Takadom	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Kudsaya	+/-	- L	- L	+ M	- L	+ H	- L	Low
	2.2 New Well Centers for Informal Areas	New Kaboon	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Jaramana	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Takadom	+/-	- L	- L	+ M	- L	+ H	- L	Low
	2.3 New Well Centers for Formal Area	Kafar Souseh	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Faculty of Agriculture	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Kywan & Tishreen	+/-	- L	- L	+ L	- L	+ H	- L	Low
	2.4 Water Resources Development Schemes in Hermon area	Rimeh/ Earneh	- M	- L	- L	+ L	- L	- L	- L	Moderate
		Wadi Marwan	- M	- L	- L	+ L	- L	- L	- L	Moderte
		Dier al Ashyer	- M	- L	- L	+ L	- L	- L	- L	Moderate
	2.5 Water Supply Dist'n Sch for New Development Ar	Kudsaya New Suburb	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Dummar Extension area (1st phase)	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Special Area Zone (State Factory)	+/-	- L	- L	+ L	- L	+ H	- L	Low
3	Proposed Water Supply 3.1 Rural Area	Maraba	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Assad Suburb (1st phase)	+/-	- L	- L	+ L	- L	+ H	- L	Low
	3.2 Distribution Schemes for New Development Area	Proposed Kudsaya New Suburb	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Dummar Extension area (2nd phase)	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Kassioun New Town	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Assad Suburb (2nd phase)	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Assad Suburb Extension Area	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Kaboon Green Area	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Assad City	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Proposed Assad City Exten. Area (1)	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Proposed Assad City Exten. Area (2)	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Proposed Assad City Exten. Area (3)	+/-	- L	- L	+ L	- L	+ H	- L	Low
	3.3 Water Resources Development Schemes Damascus (New Station	Shokrt al Qouwatly	+/-	- L	- L	+ L	- L	+ L	- L	Low
		Yalbuga Center	+/-	- L	- L	+ L	- L	+ L	- L	Low
		Kanawat Gardens	+/-	- M	- L	+ L	- L	+ L	- L	Low
	3.4 Water Resources Scher in Hermon and Zabadan	Beit Jenn	- H	- M	- L	+ L	- L	- M	- L	Moderate
		Talibeyeh	- M	- M	- L	+ L	- L	- M	- L	Moderate
		Sergaya	- M	- M	- L	+ L	- L	- H	- L	Moderate

Impact rating + H > + M > + L > +/- > - L > - M > - H

+ : positive impact / - : negative impact

Overall Evaluation (Negative) High > Moderate > Low

Table D-6.1 (1/2) Initial Environmental Examination of Proposed Projects

No.	Classification	Name of Scheme		Natural Environment		Public Health / Pollution		Waste	Local Socio/Econo	Cultural Asset	Overall Evaluation
				water	others	constr.	operation				
1	Rehabilitation Improvement	1.1 Water Main Replacement		+/-	-L	-L	+M	-L	+L	-L	Low
		1.2 Water Meter Replacement	Option 1: Doris meter	+/-	+/-	-L	+M	-L	+L	+/-	Low
			Option 2: Rotary Disk meter	+/-	+/-	-L	+M	-L	+L	+/-	Low
		1.3 Improvement in Meter Testing and Repairing	Option 1:Doris meter	+/-	+/-	-L	+M	-L	+L	+/-	Low
			Option 2: Rotary Disk meter	+/-	+/-	-L	+M	-L	+L	+/-	Low
		1.4 District Meter Area (DMA) System		+/-	-L	-L	+M	-L	+L	-L	Low
		1.5 Leakage Survey		+/-	+/-	-L	+M	-L	+L	+/-	Low
		1.6 Pressure Control		+/-	+/-	-L	+M	-L	+L	+/-	Low
		1.7 Improvement of Master Metering		+/-	-L	-L	+M	-L	+L	+/-	Low
		1.8 Water Quality Testing Improvement		+/-	-L	-L	+H	-L	+L	-L	Low
		1.9 Water Quality Contorl in South Damascus	Option 1:On-Site Blending	+L	-L	-L	-M	-L	+L	-L	Moderate
			Option 2:Off-Site Blending	+/-	-L	-L	-H	-L	+L	-L	High
			Option 3:Water Treatment	-L	-L	-L	+H	-H	+L	-L	Moderate
			Option 4:Suspension of well operation	+L	-L	-L	+M	-L	+L	-L	Low
			Option 5: No change	+/-	+/-	+/-	+/-	+/-	+/-	+/-	Moderate
		1.10 Reinforcement of Existing Water Resources	Ain Figeh Area Main Spring	-M	-M	-L	+M	-L	-L	-L	Low
			Extend Side Spring	-M	-M	-L	+L	-L	-L	-L	Moderate
			Extend Ain Haroush	-M	-M	-L	+L	-L	-M	-L	Moderate
			Dier Moukaren	-M	-M	-L	+L	-L	-M	-L	Moderate
			Barada & Al Sahl Spring Wells	-M	-M	-L	+L	-L	-L	-L	Low/Moderate
			Group 1 W.F	-M	-M	-L	+L	-L	-M	-L	Low
			Group 2 W.F	-M	-M	-L	+L	-L	-M	-L	Low
			Group 3 W.F	-M	-M	-L	+L	-L	-M	-L	Low
			DamascusWells Mazzra	-M	-L	-L	+L	-L	+L	-L	Low
			Ibn Asaker	-M	-L	-L	+L	-L	+L	-L	Low
			Jobar	-M	-L	-L	+L	-L	+L	-L	Low
			Kadam Railway	-M	-L	-L	-H	-L	+L	-L	High
			Oumawiyin	-M	-L	-L	-H	-L	+L	-L	High
			Kaboon	-M	-L	-L	+L	-L	+L	-L	Low
			University	-M	-L	-L	-H	-L	+L	-L	High
			KadamStore	-M	-L	-L	+L	-L	+L	-L	Low
			Oummar	-M	-L	-L	-H	-L	+L	-L	High
			Fringe Site	-M	-L	-L	+L	-L	+L	-L	Low/Moderate
			Emergency Sites	-M	-L	-L	+L	-L	+L	-L	Low
2	On going and Planned Water supply Improvement	2.1 Distribution Improvement for Informal Area	Esh Al Warwar	+/-	-L	-L	+M	-L	+H	-L	Low
			Kassion Mountains Foot	+/-	-L	-L	+M	-L	+H	-L	Low
			Tishreen	+/-	-L	-L	+M	-L	+H	-L	Low
			Jobar Surrounding-Al Aksab Mosque	+/-	-L	-L	+M	-L	+H	-L	Low
			East-West Tabbleh	+/-	-L	-L	+M	-L	+H	-L	Low
			Mokhayam Yarmouk	+/-	-L	-L	+M	-L	+H	-L	Low
			Naher Esheh-Dahadil & Asalie Kadam	+/-	-L	-L	+M	-L	+H	-L	Low

Table D-6.1 (2/2) Initial Environmental Examination of Proposed Projects

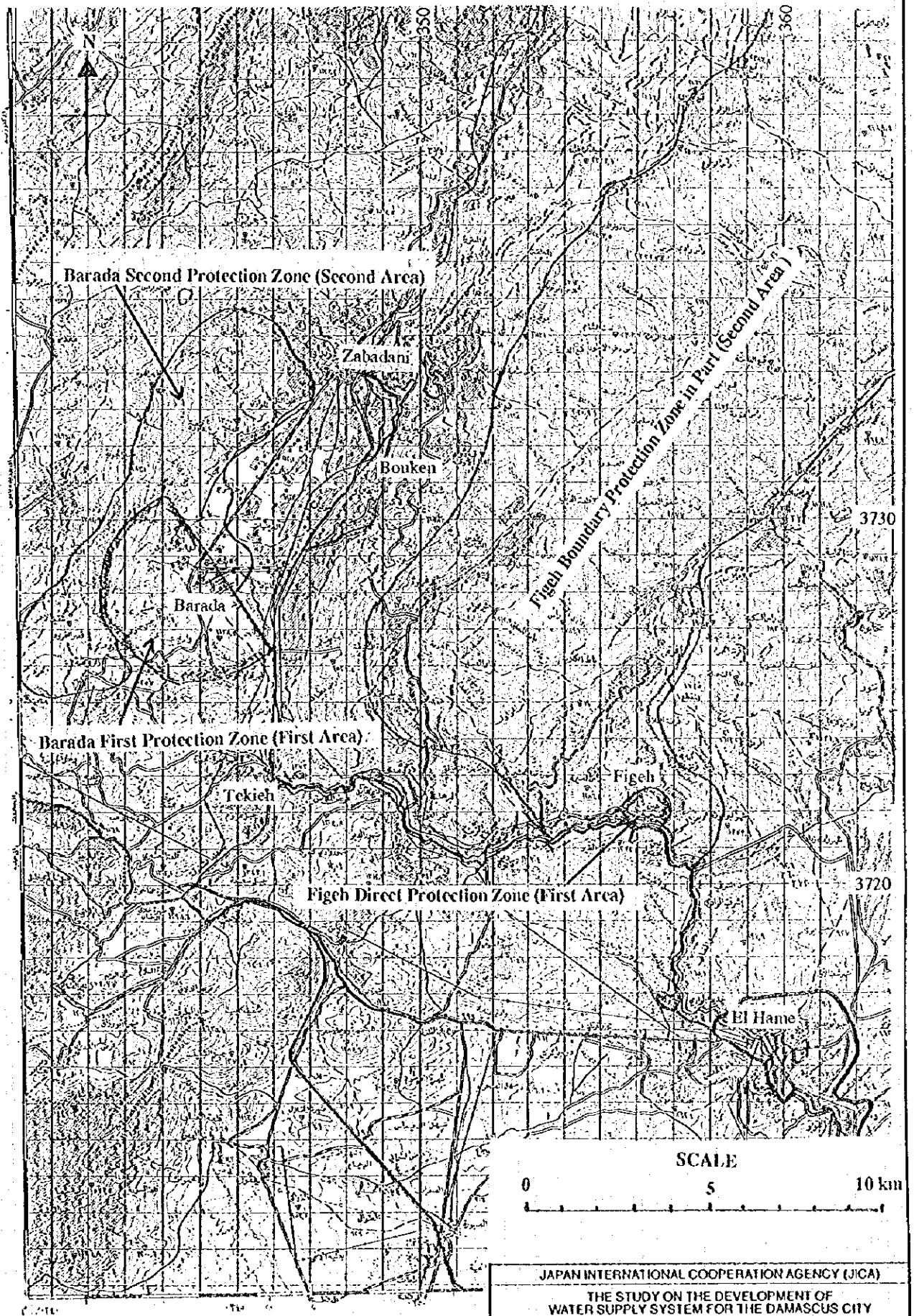
No.	Classification	Name of Scheme	Natural Environment		Public Health / Pollution		Waste	Local Socio/Econo	Cultural Asset	Overall Evaluation
			water	others	constr.	operation				
		Kafar Souse Lawan	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Al Qazzaz &Shaghour Basateen	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Mezze-Razy	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Mezze#86	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Somareyeh	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Dummar-Wadi Al Mashare	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Takadom	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Kudsaya	+/-	- L	- L	+ M	- L	+ H	- L	Low
	2.2 New Well Centers for Informal Areas	New Kaboon	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Jaramana	+/-	- L	- L	+ M	- L	+ H	- L	Low
		Takadom	+/-	- L	- L	+ M	- L	+ H	- L	Low
	2.3 New Well Centers for Formal Area	Kafar Souseh	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Faculty of Agriculture	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Kywan & Tishreen	+/-	- L	- L	+ L	- L	+ H	- L	Low
	2.4 Water Resources Development Schemes in Hermon area	Rimeh/ Earneh	- M	- L	- L	+ L	- L	- L	- L	Moderate
		Wadi Marwan	- M	- L	- L	+ L	- L	- L	- L	Moderte
		Deir al Ashayer	- M	- L	- L	+ L	- L	- L	- L	Moderate
	2.5 Water Supply Dist'n Schemes for New Development Areas	Kudsaya New Suburb	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Dummar Extension area (1st phase)	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Special Area Zone (State Factory)	+/-	- L	- L	+ L	- L	+ H	- L	Low
3	Proposed Water Supply 3.1 Rural Area	Maraba	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Assad Suburb (1st phase)	+/-	- L	- L	+ L	- L	+ H	- L	Low
	3.2 Distribution Schemes for New Development Area	Proposed Kudsaya New Suburb	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Dummar Extension area (2nd phase)	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Kassioun New Town	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Assad Suburb (2nd phase)	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Assad Suburb Extension Area	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Kaboon Green Area	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Assad City	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Proposed Assad City Exten. Area (1)	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Proposed Assad City Exten. Area (2)	+/-	- L	- L	+ L	- L	+ H	- L	Low
		Proposed Assad City Exten. Area (3)	+/-	- L	- L	+ L	- L	+ H	- L	Low
	3.3 Water Resources Development Schemes in Damascus (New Stations)	Shokri al Qouwatly	+/-	- L	- L	+ L	- L	+ L	- L	Low
		Yalbuga Center	+/-	- L	- L	+ L	- L	+ L	- L	Low
		Kanawat Gardens	+/-	- M	- L	+ L	- L	+ L	- L	Low
	3.4 Water Resources Schemes in Hermon and Zabadani	Beit Jenn	- H	- M	- L	+ L	- L	- M	- L	Moderate
		Talbeyeh	- M	- M	- L	+ L	- L	- M	- L	Moderate
		Sergaya	- M	- M	- L	+ L	- L	- H	- L	Moderate

impact rating + H > + M > + L > +/- > - L > - M > - H

+ : positive impact / - : negative impact

Overall Evaluation (Negative) High > Moderate > Low

FIGURES



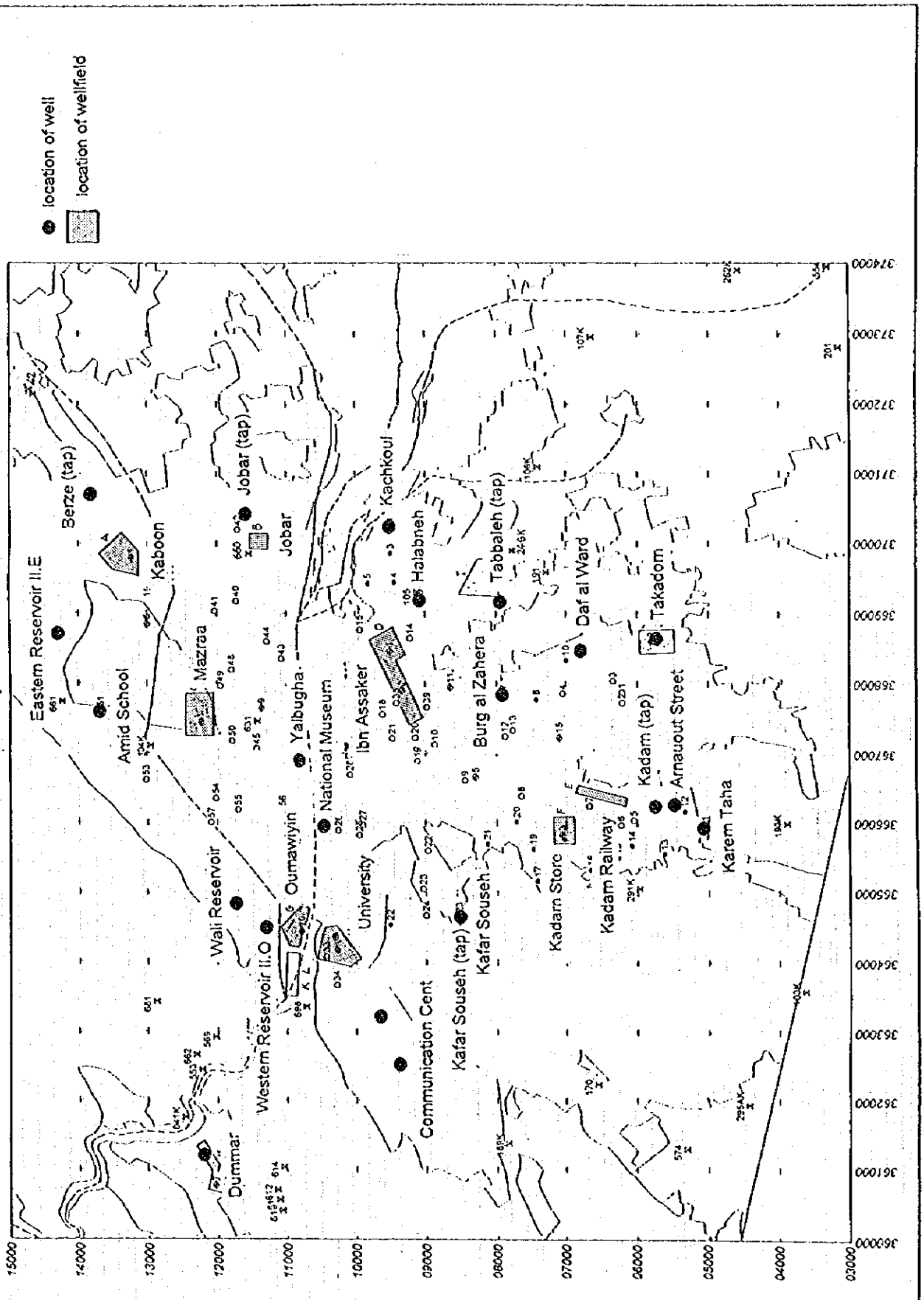
Source: DAWSSA, Ministry of Irrigation

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

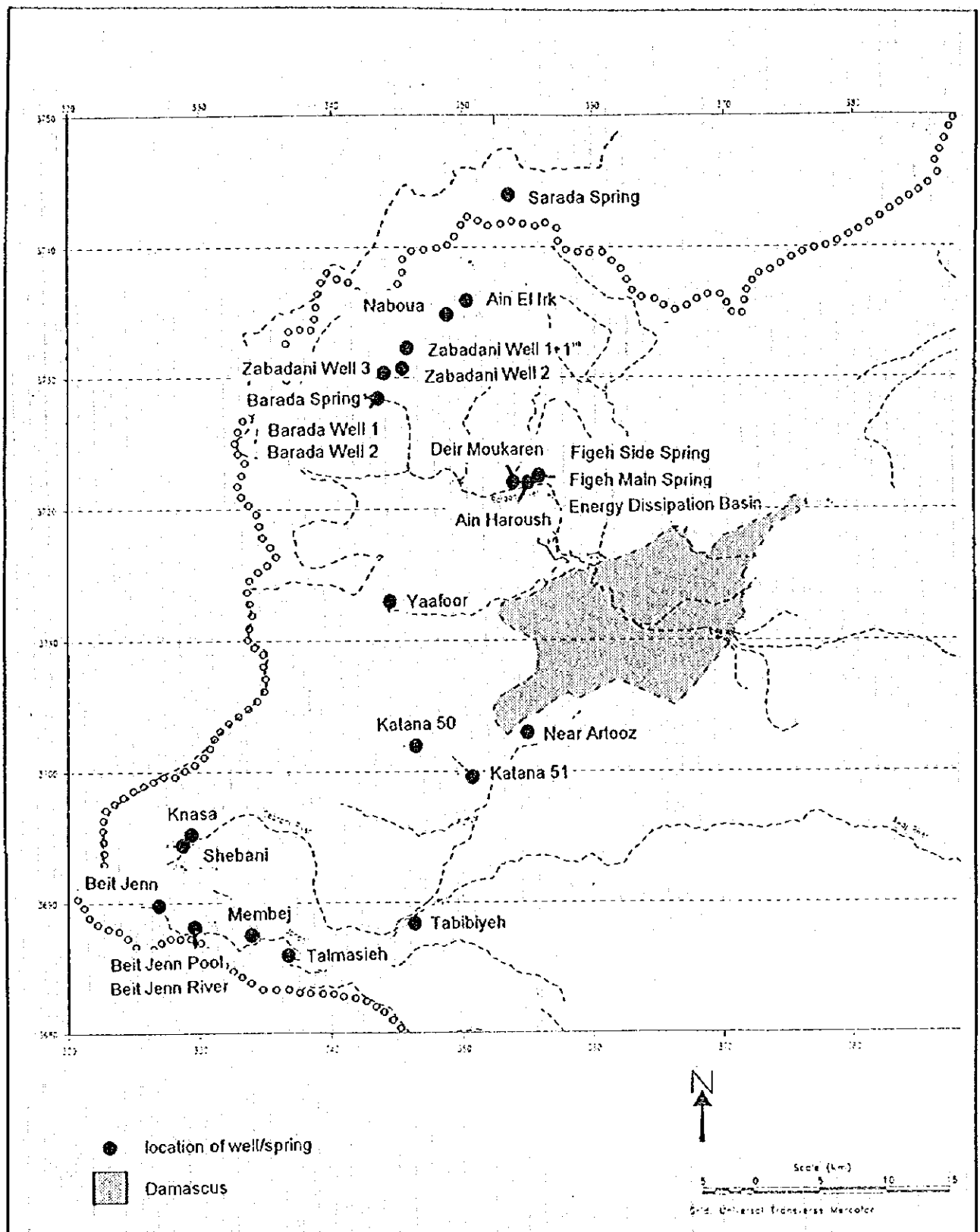
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY

Figure D-2.1
Location of Protection Zones

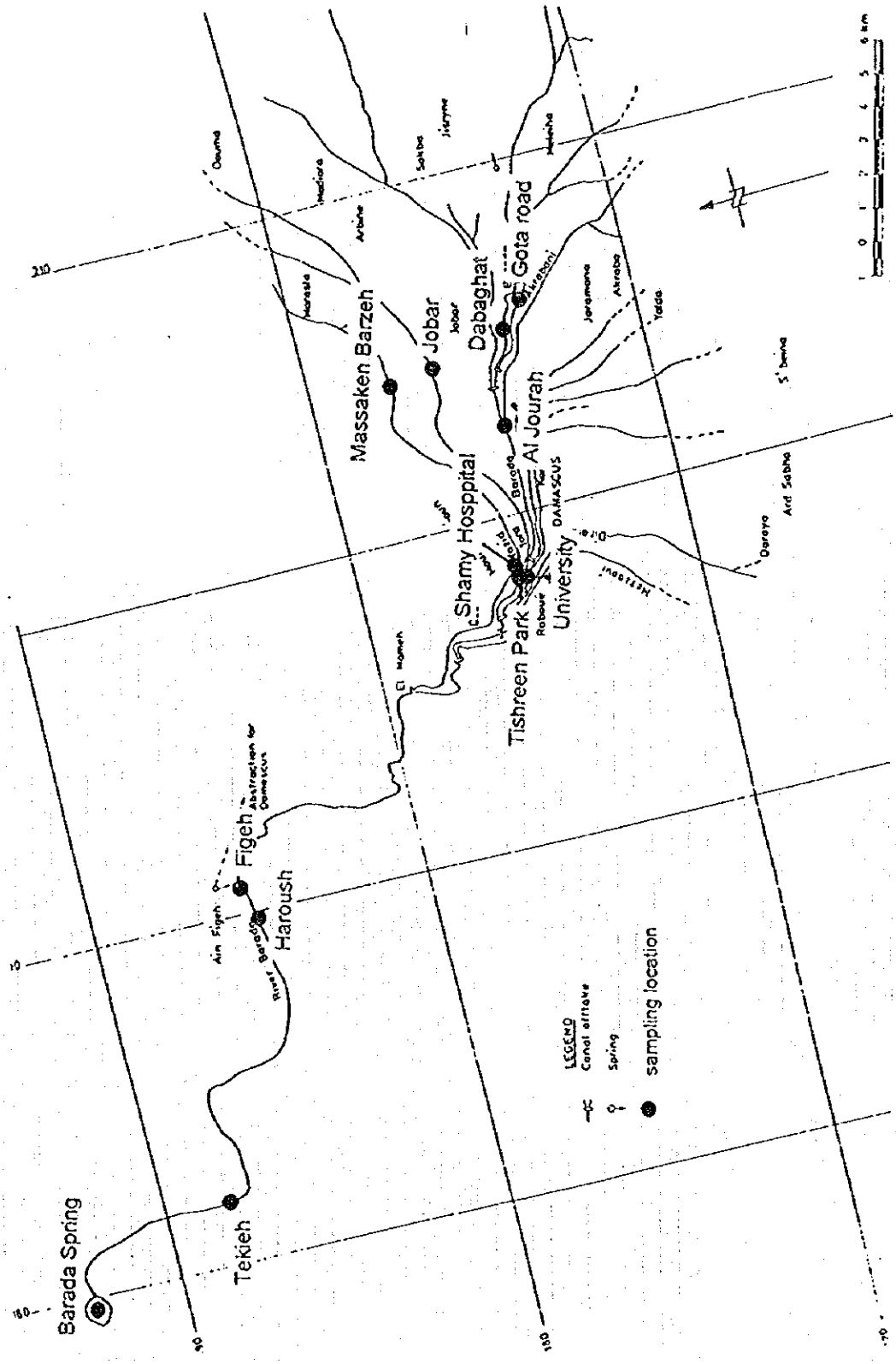
NIPPON KOEI CO., LTD.



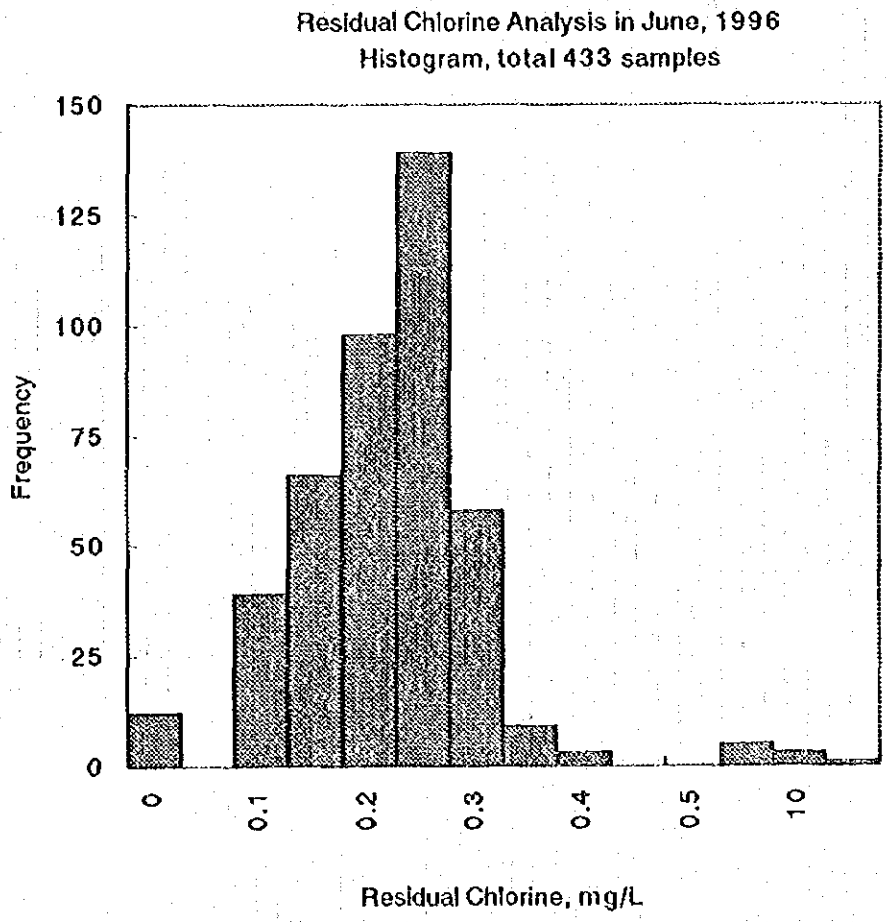
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure D-3.1a **Sampling Locations (Damascus)**
NIPPON KOEI CO., LTD.



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure D-3.1b Sampling Locations (Other Areas)
NIPPON KOEI CO., LTD.



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure D-3.1c **Sampling Locations (Rivers)**
NIPPON KOEI CO., LTD.



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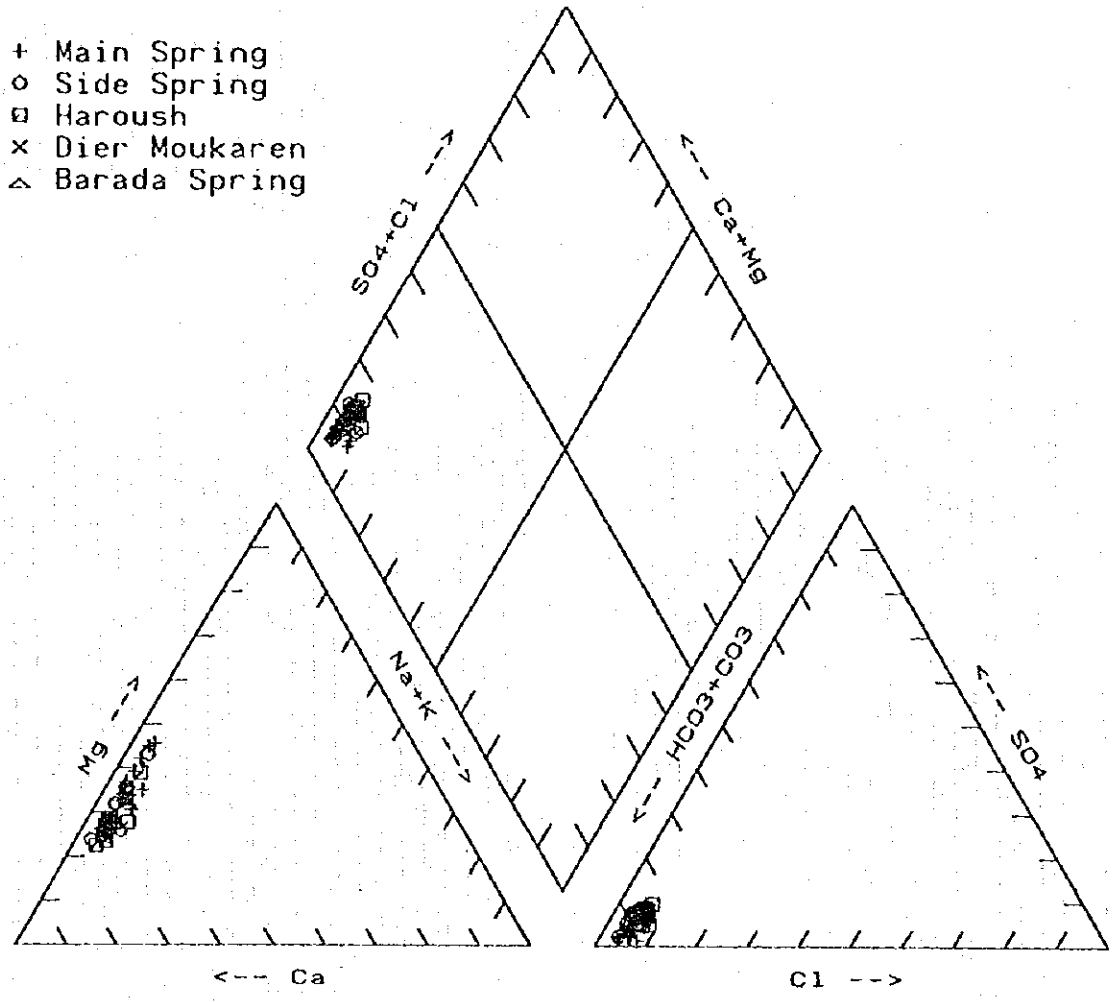
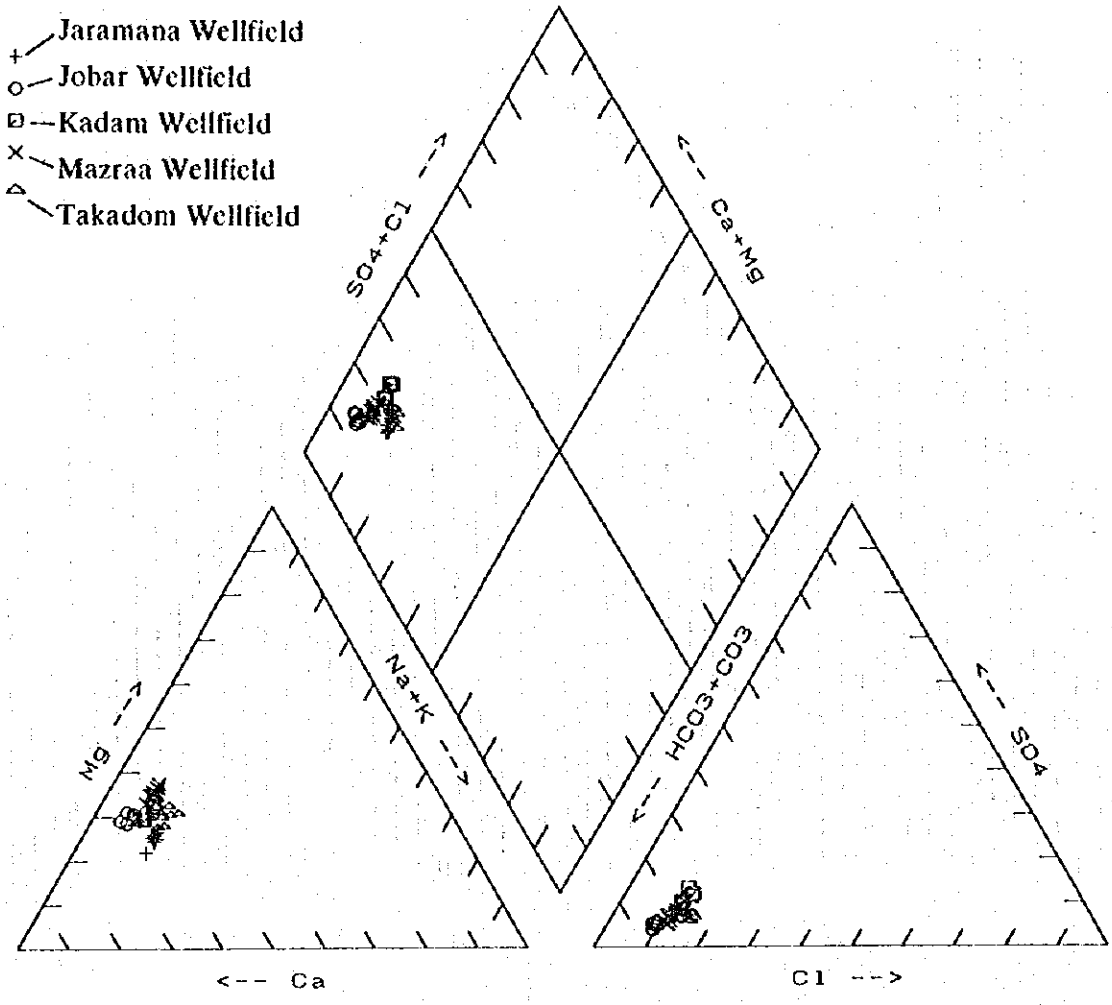
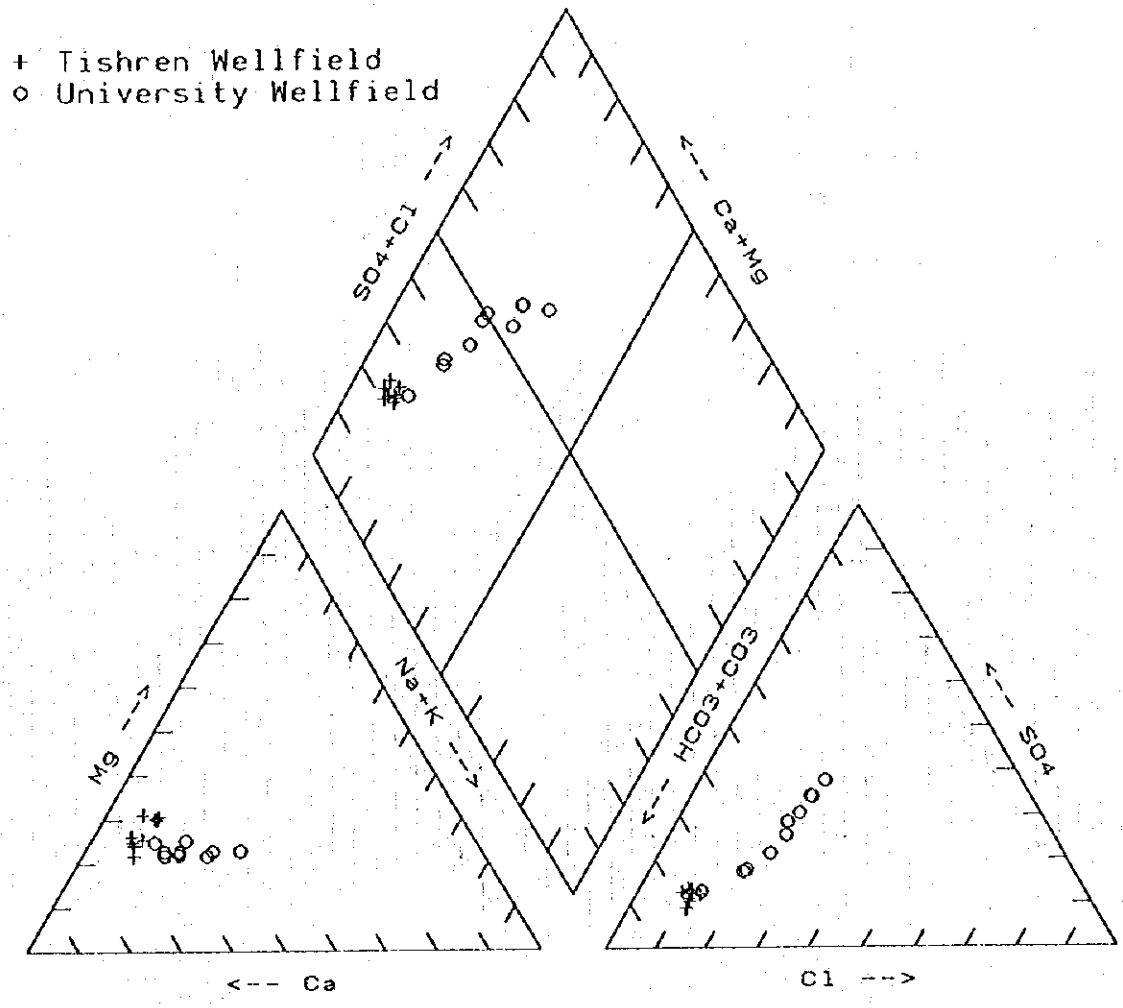
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure D-3.2 Residual Chlorine Concentrations
NIPPON KOEI CO., LTD.



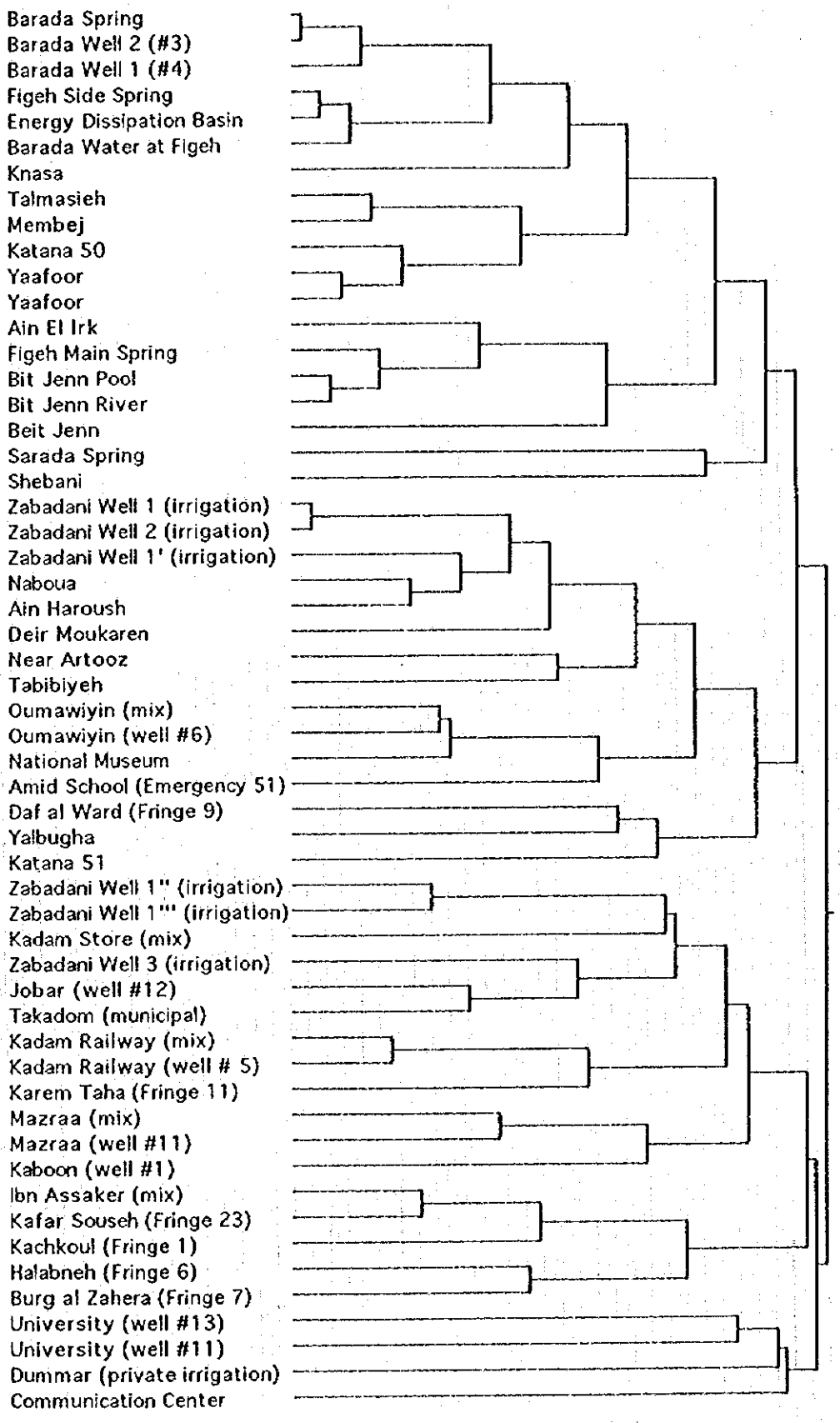
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure D-3.3a Trilinear diagram of Hydrochemistry (Barada and Figeh Areas)
NIPPON KOEI CO., LTD.



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure D-3.3b Trilinear diagram of Hydrochemistry (East Damascus)
NIPPON KOEI CO., LTD.



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure D-3.3c Trilinear diagram of Hydrochemistry (West Damascus)
NIPPON KOEI CO., LTD.



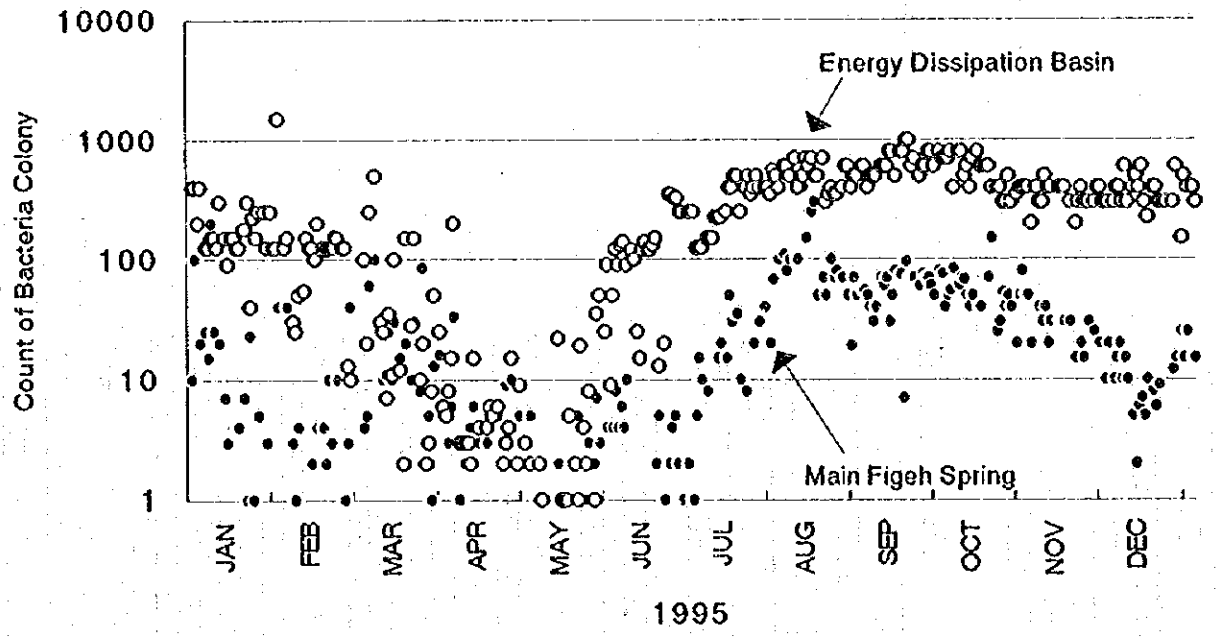
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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

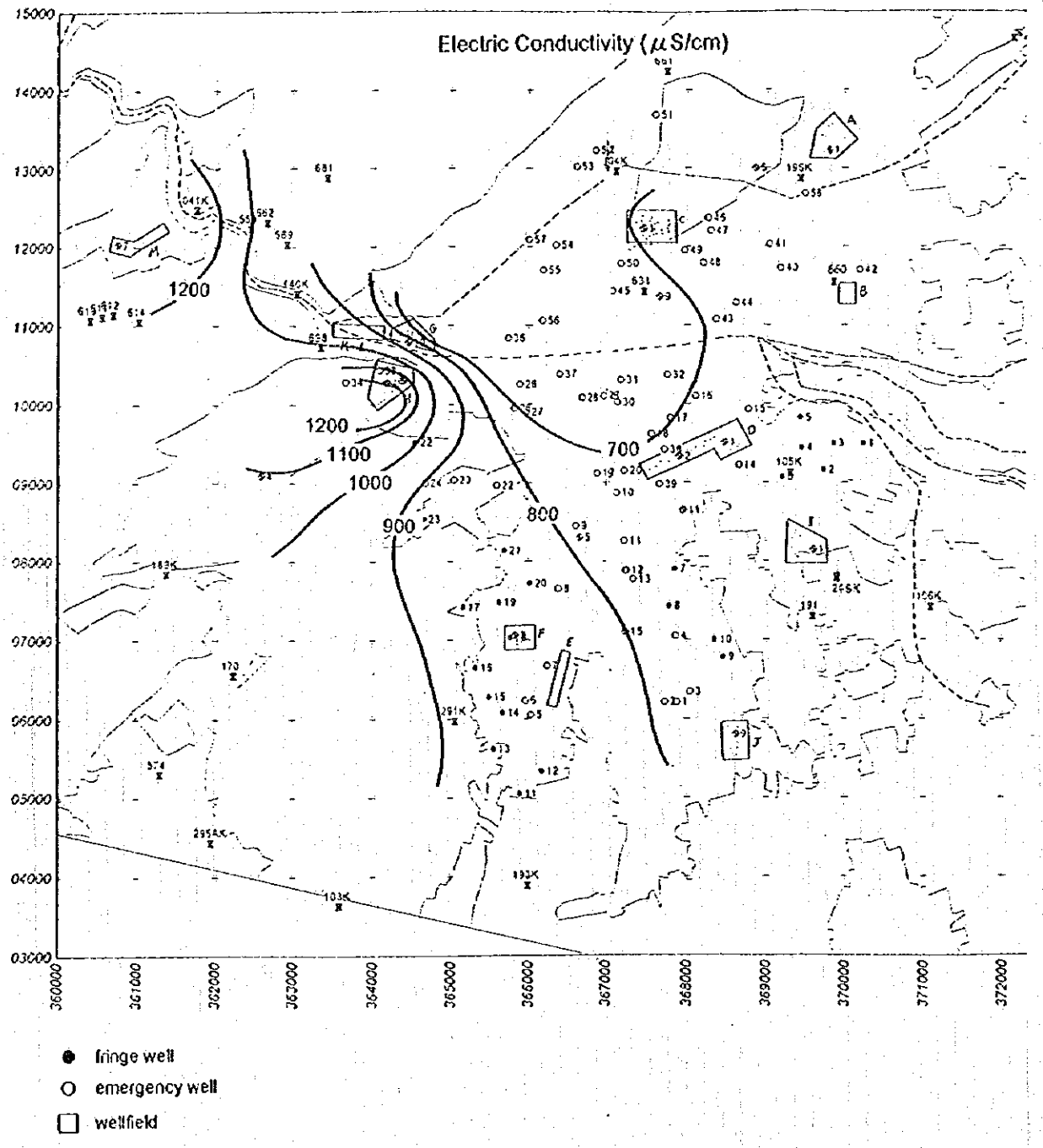
Figure D-3.4 Dendrogram (cluster analysis) of Hydrochemistry

NIPPON KOEI CO., LTD.

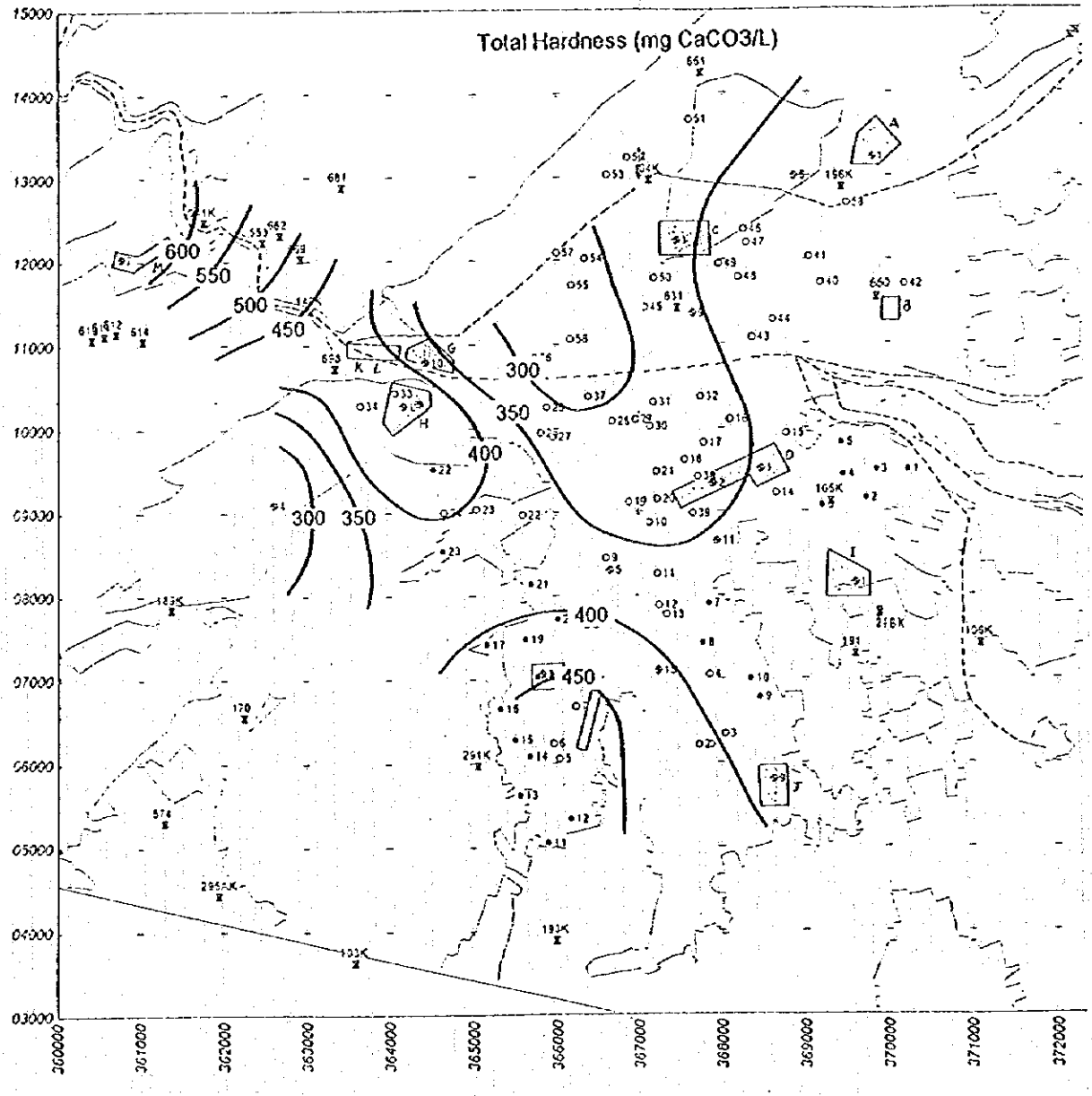
Bacteria of Main Figeh Spring and Energy Dissipation in 1995



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure D-3.5 Seasonal variation in Bacteria Counts
NIPPON KOEI CO., LTD.



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure D-3.6a Contour Diagram (Electric Conductivity)
NIPPON KOEI CO., LTD.



● fringe well
○ emergency well
□ wellfield

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
THE STUDY ON THE DEVELOPMENT OF WATER SUPPLY SYSTEM FOR THE DAMASCUS CITY
Figure D-3.6b Contour Diagram (Total Hardness)
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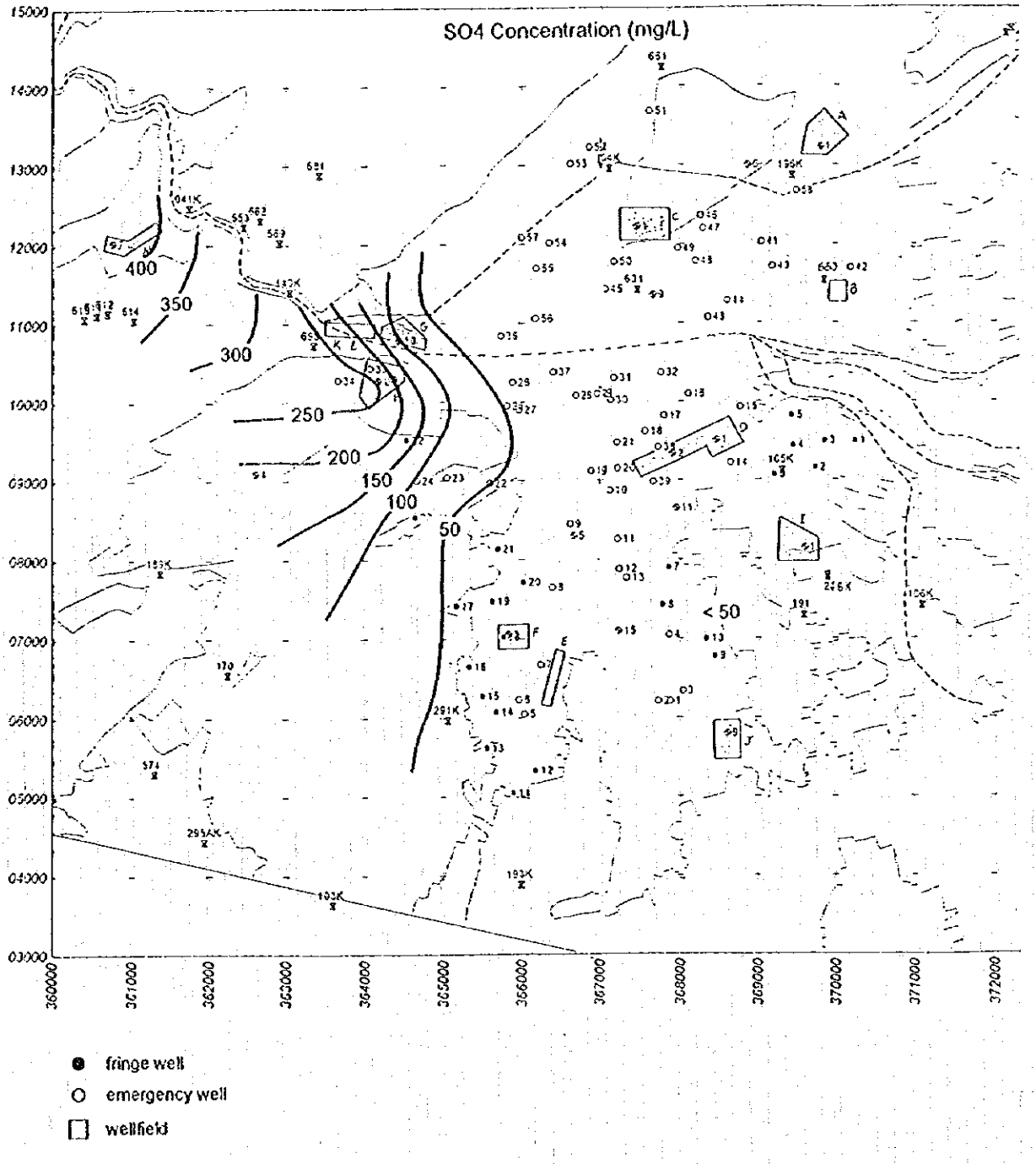

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
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Figure D-3.6c Contour Diagram (Sulfate)
NIPPON KOEI CO., LTD.

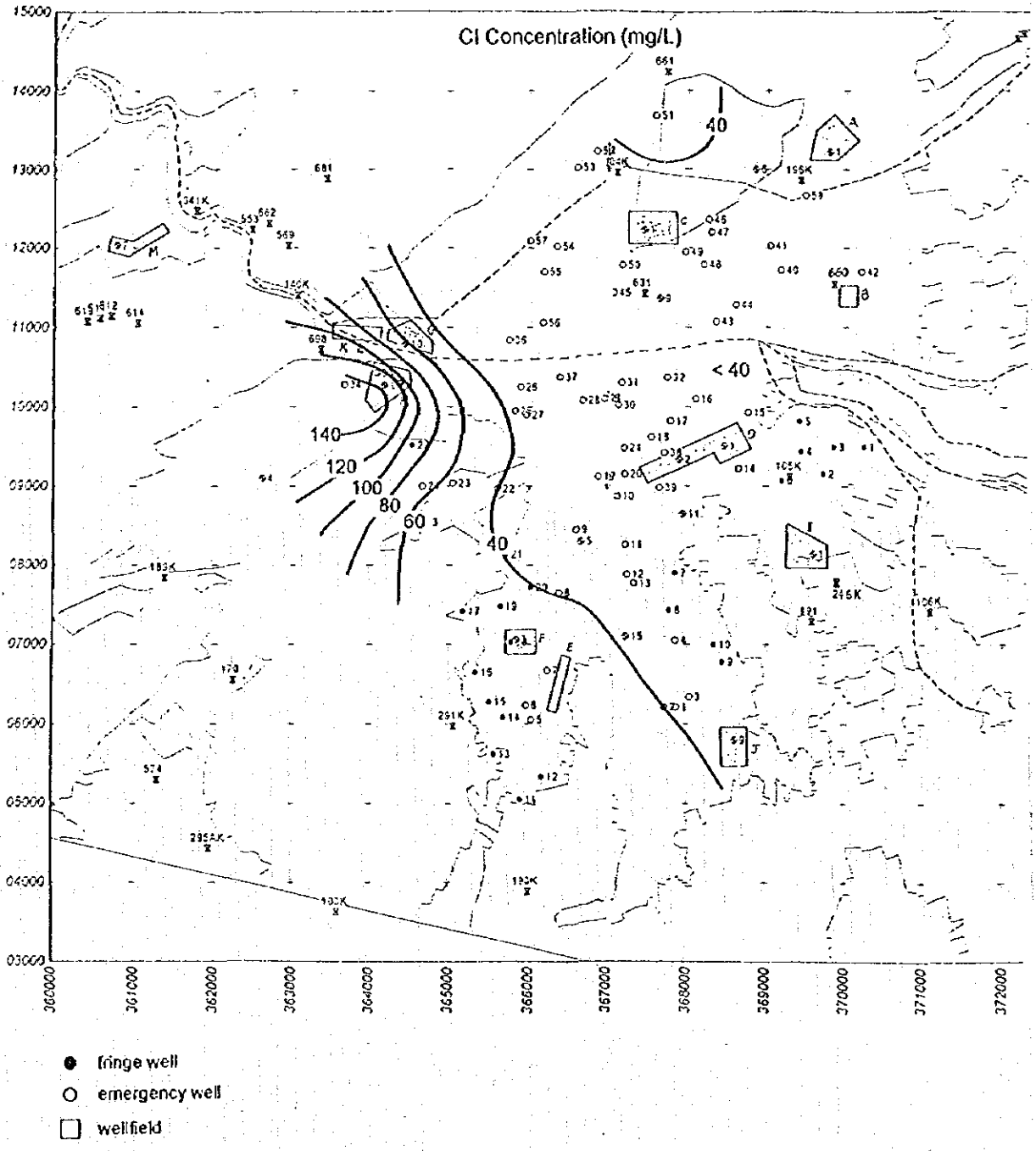

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Figure D-3.6d Contour Diagram (Chloride)
NIPPON KOEI CO., LTD.

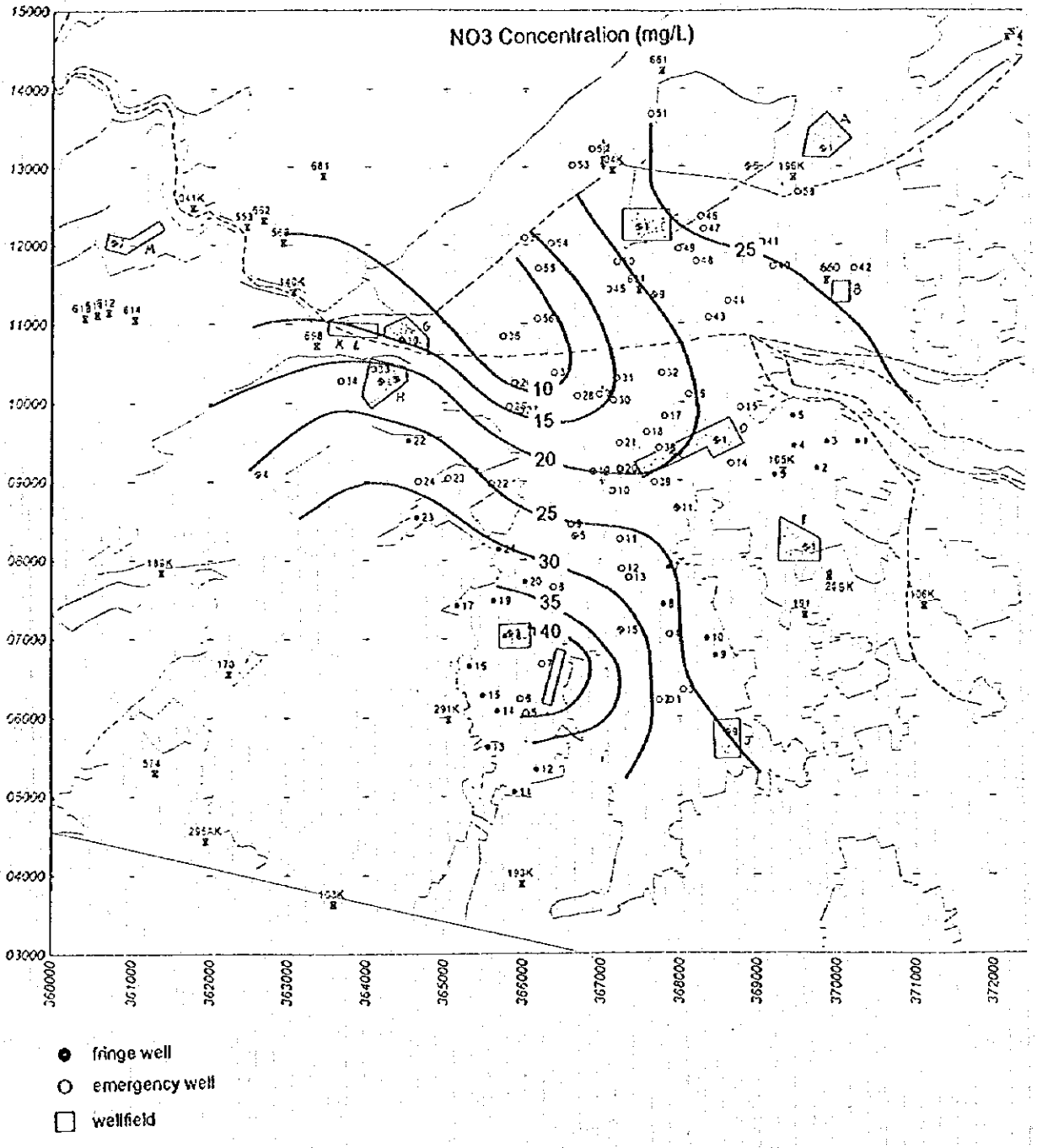

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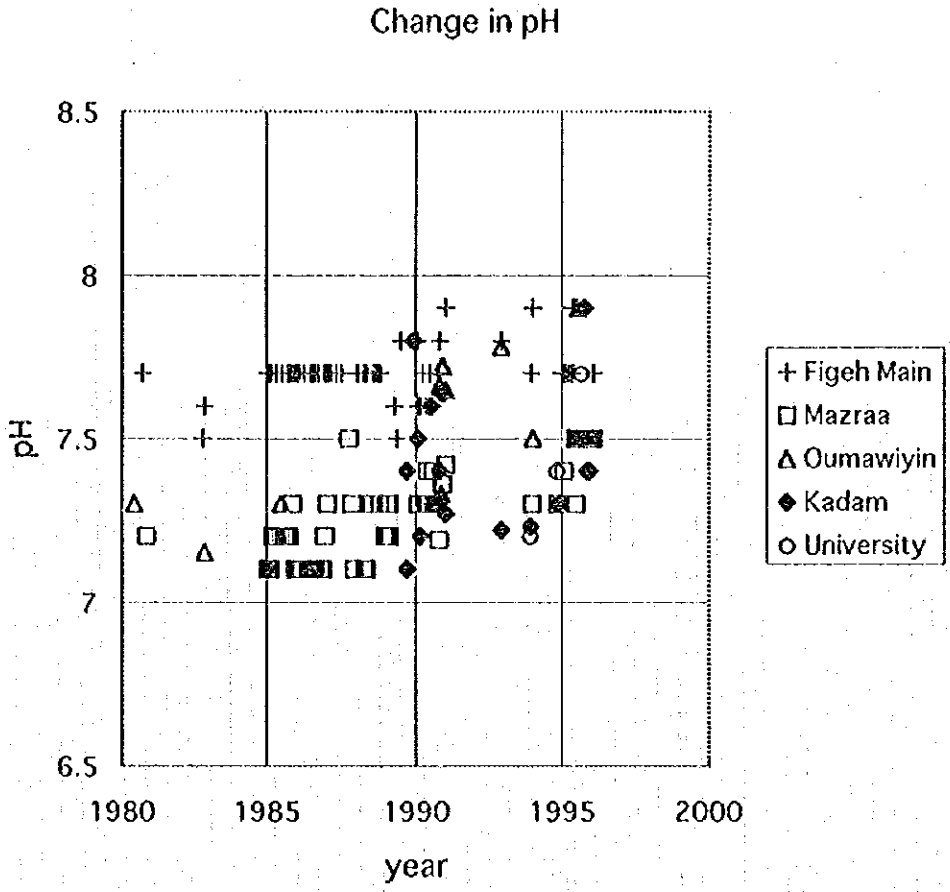
Figure D-3.6e Contour Diagram (Nitrate)
NIPPON KOEI CO., LTD.



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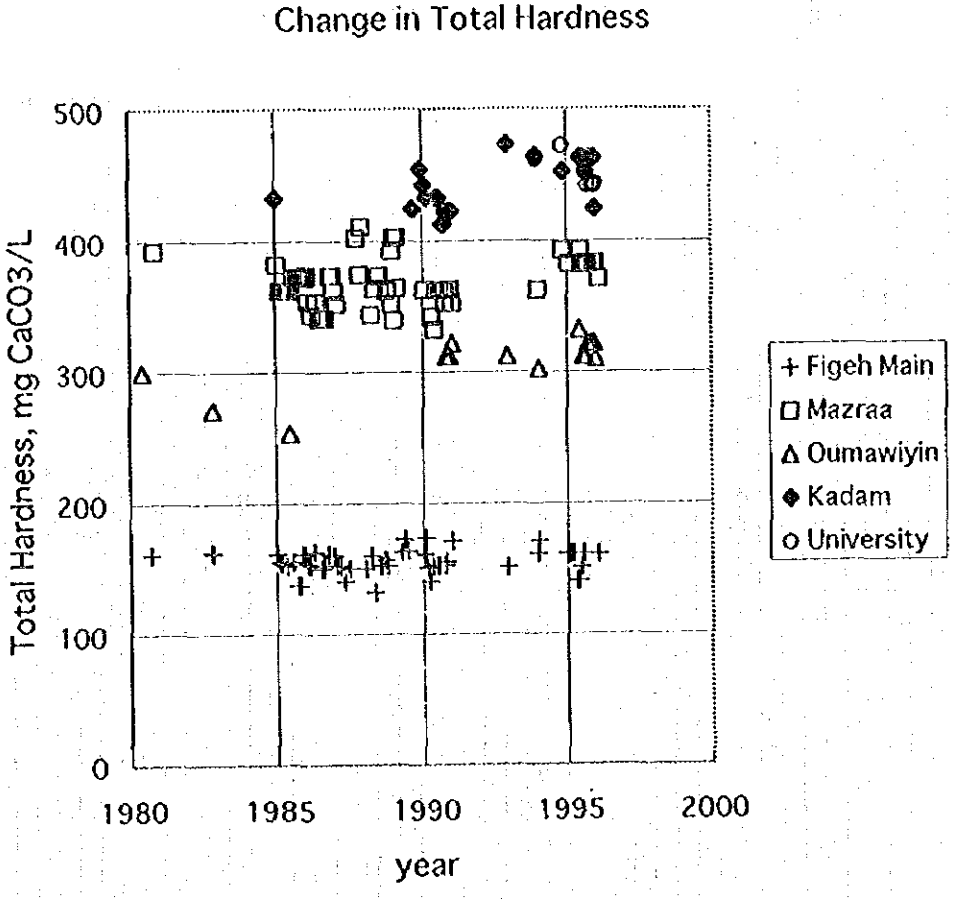
NIPPON KOEI CO., LTD.



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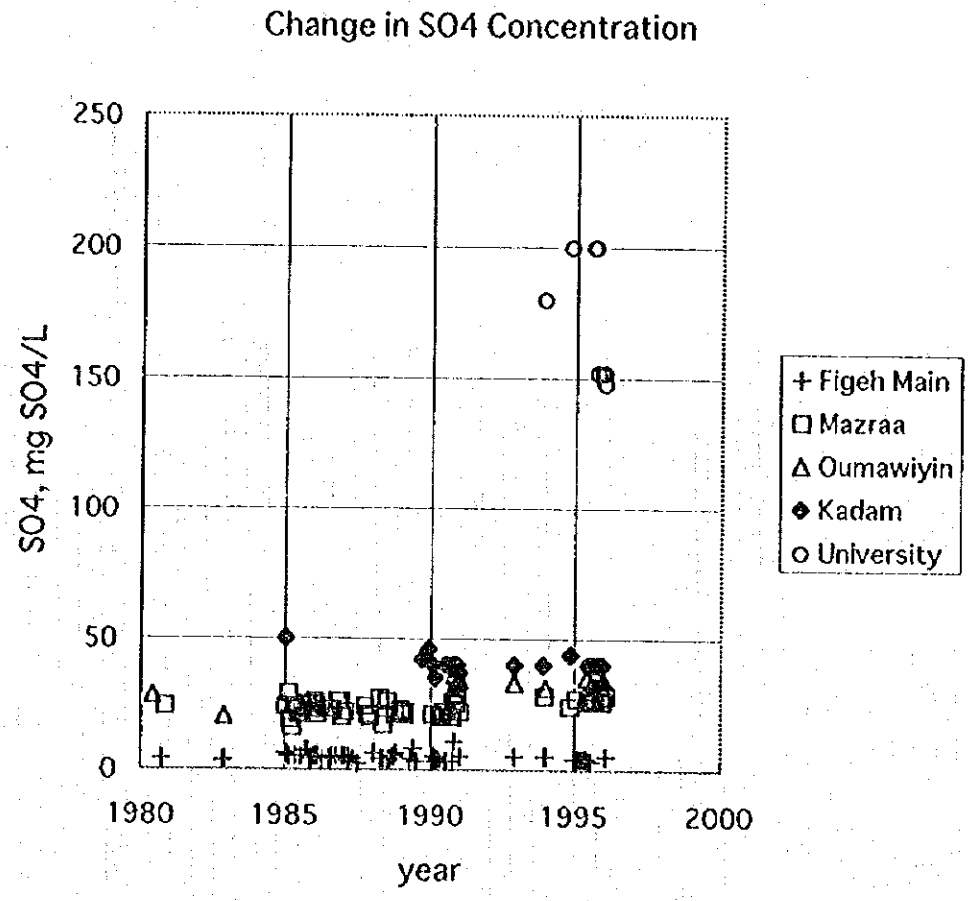
NIPPON KOEI CO., LTD.



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
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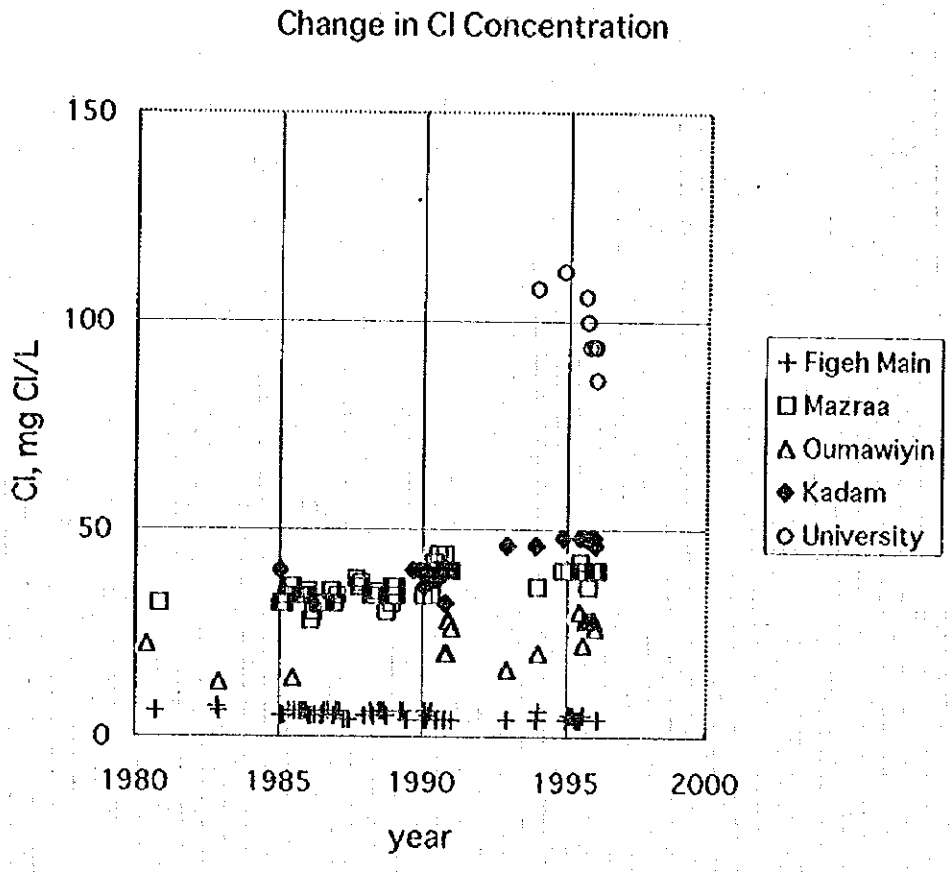
NIPPON KOEI CO., LTD.



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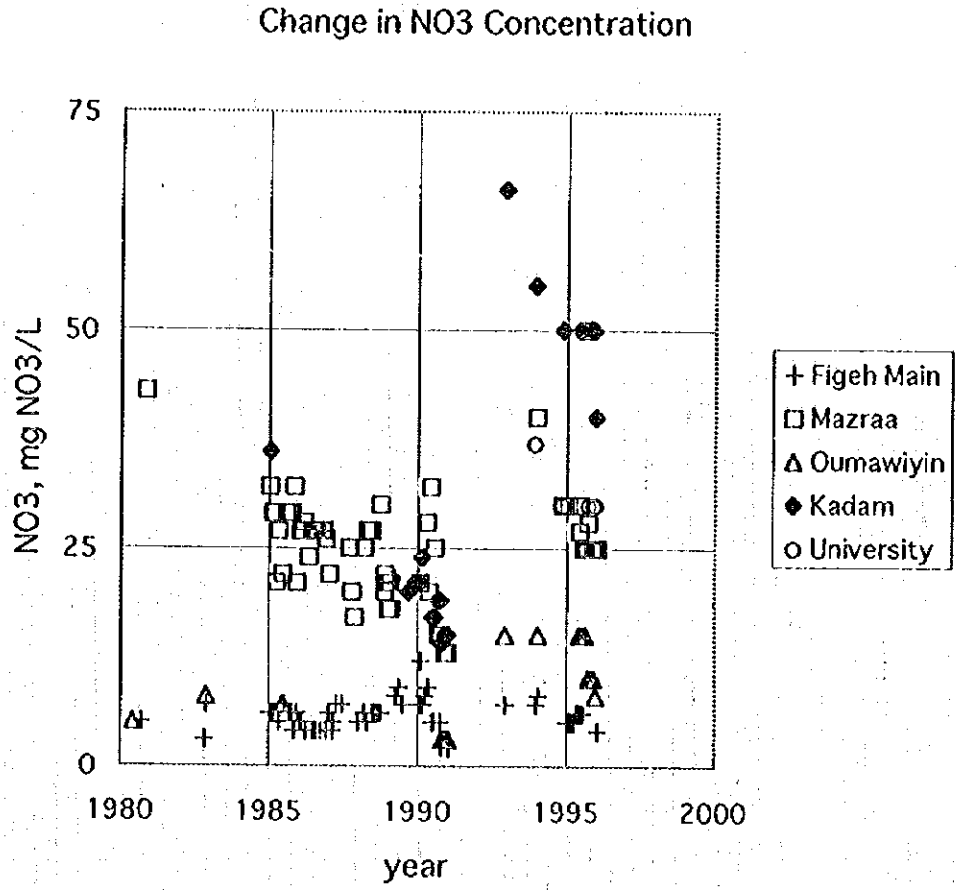

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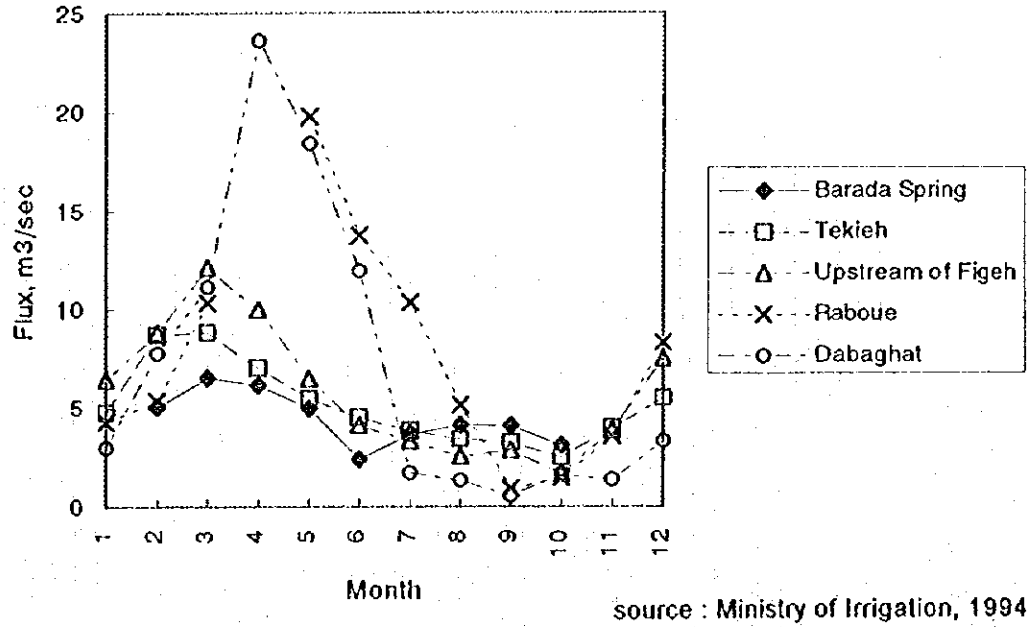
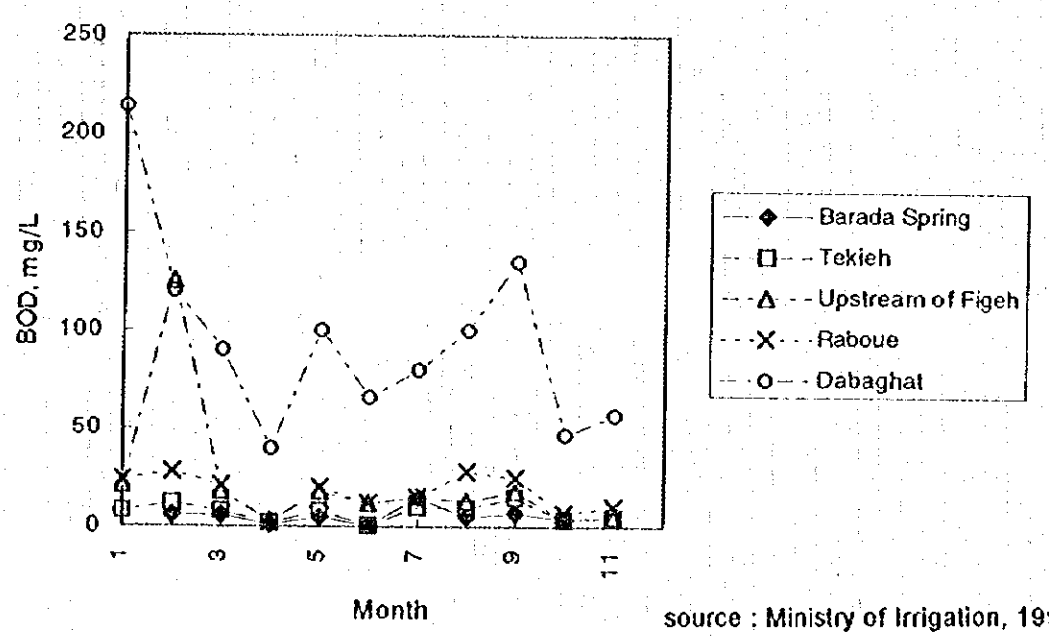
(a) Seasonal Change in Flux of Barada River in 1992



source : Ministry of Irrigation, 1994

(b) Seasonal Change in BOD of Barada River in 1992



source : Ministry of Irrigation, 1994

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
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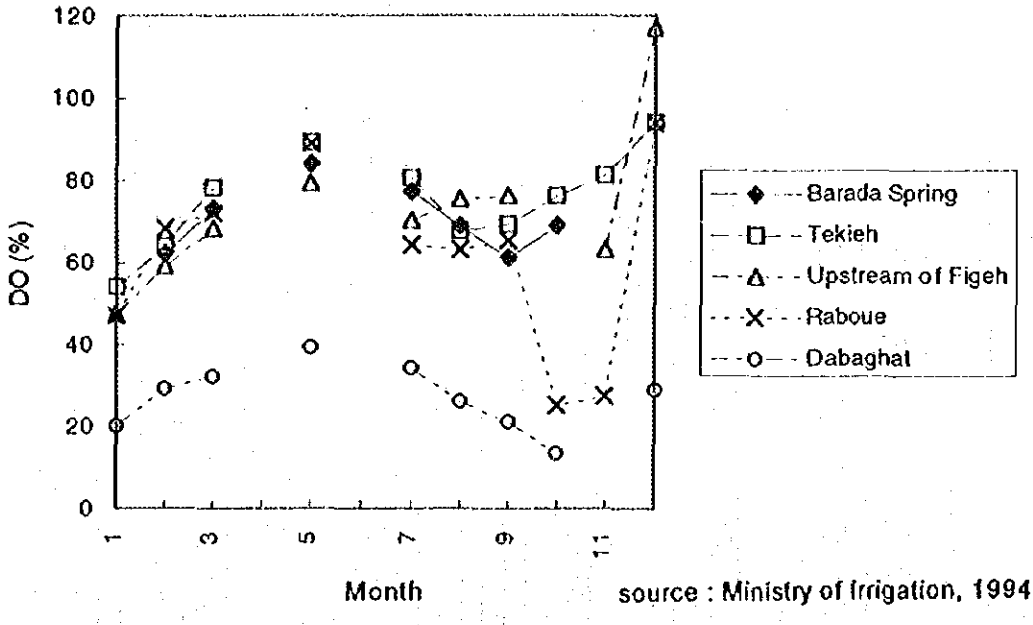
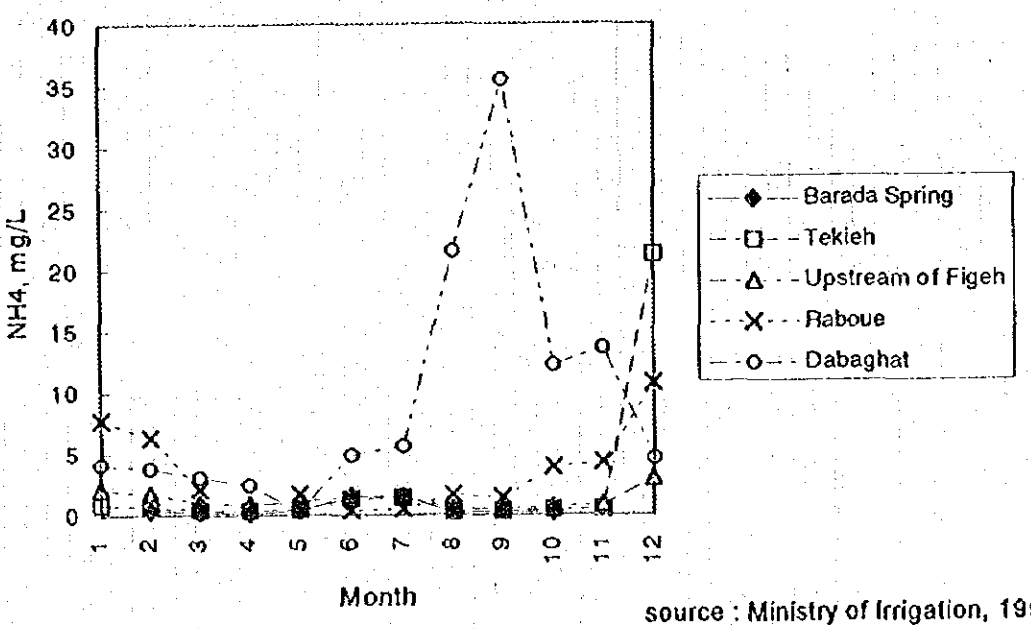
(c) Seasonal Change in DO (%) of Barada River in 1992



source : Ministry of Irrigation, 1994

(d) Seasonal Change in NH4 Concentration of Barada River in 1992



source : Ministry of Irrigation, 1994

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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

Figures D-3.8c&d Seasonal Change in Surface Water Quality (DO and NH4)

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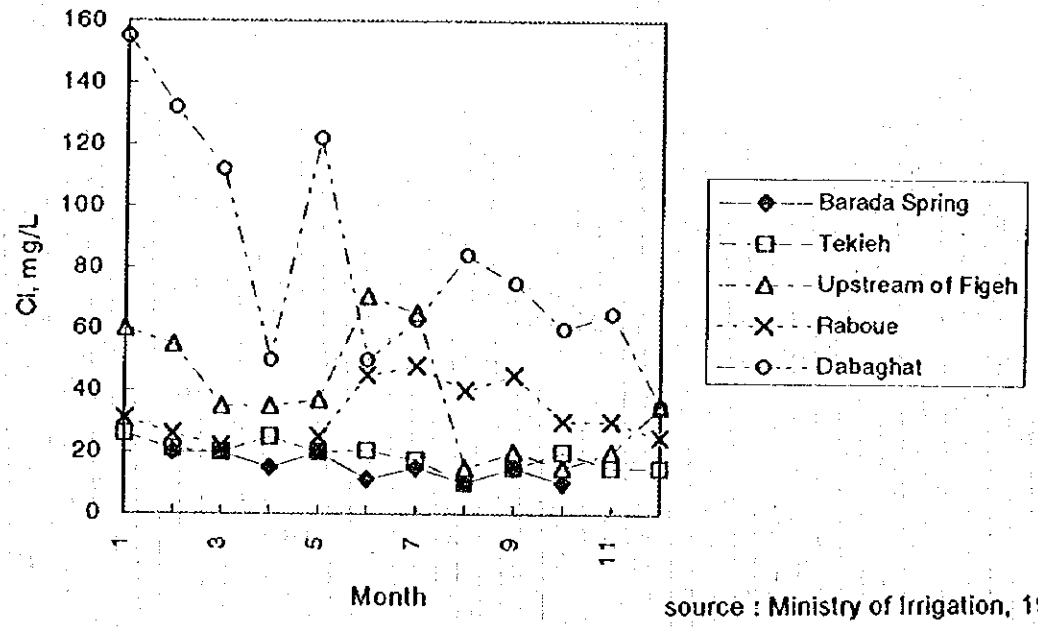
(e) Seasonal Change in Cl Concentration of Barada River in 1992



source : Ministry of Irrigation, 1994

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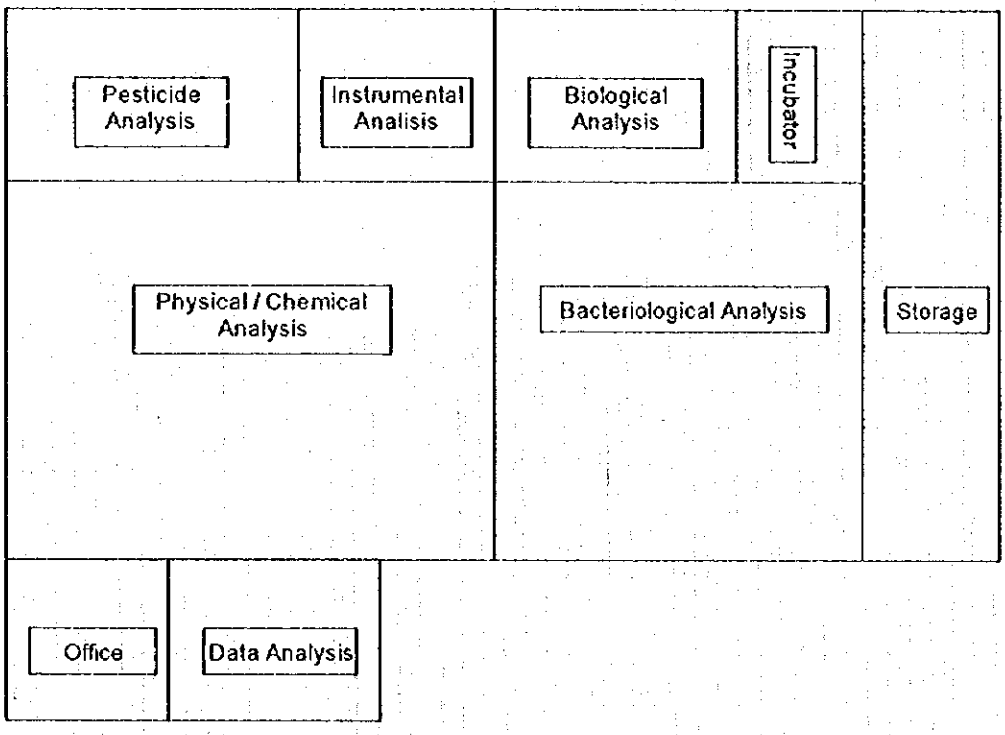

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
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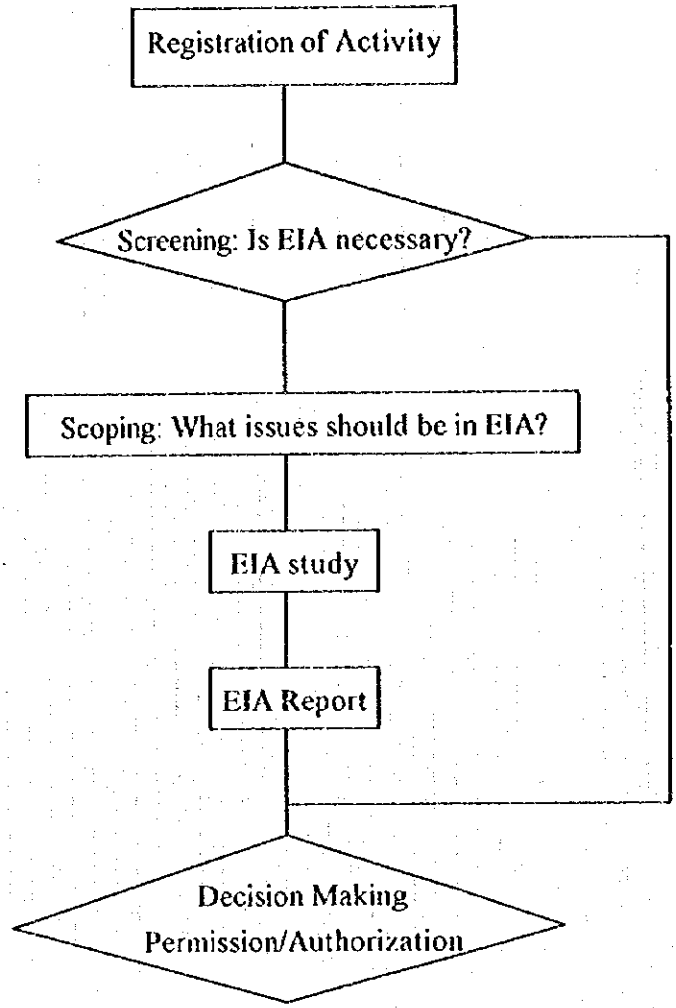

source : General Environmental Impact Assessment Guideline (1995), Ministry of State for the Environment, Syria

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
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REFERENCES

APHA (AWWA), Standard Methods for the Examination of Water and Wastewater, 18th edition, edit. Greenberg et al.,

BRGM, Protection des ressources en eau de la ville de Damas (Syrie), 1991

JICA, Report of preliminary study on the cooperation for increased food production in Syria Arab Republic, 1992

JICA, Environmental Consideration Guideline, IX Water Supply, 1994

JWWA, Guideline for water supply facility design, 1990

Ministry of Irrigation, Quality of Barada River, 1994

Ministry of State for the Environment, General Environmental Impact Assessment Guideline including Draft EIA Decree, 1995

Ministry of State for the Environment, Industrial Pollution Abatement Guideline, Wastewater Treatment Plants, 1994

World Health Organization, Guideline for drinking-water quality, Volume 1, Recommendations, 2nd Edition, WHO, 1993

APPENDIX E

WATER SUPPLY SYSTEM AND FACILITIES

APPENDIX E

WATER SUPPLY SYSTEM AND FACILITIES

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The region of Damascus is divided into two Mohafazas, namely Damascus rural and Damascus central. In Syria drinking water supply is managed by 14 water supply authorities throughout the country which work under the Ministry of Housing & Utilities. DAWSSA is one of the water supply authority responsible for Damascus central with fifteen districts and seven villages of the Barada river valley and four military areas with a bulk water supply system, in the total area of 105 km^2, as shown in Figure E-1.1. Suburban area of Damascus city is responsible by Establishment of Drinking Water Supply and Sewerage in the Rural Province of Damascus (EDWSSR) and bulk water supply of raw water for water supply bodies and irrigation are managed by the Ministry of Housing and Utilities (MOHU) and the Ministry of Irrigation (MOI).

The existing water supply system of Damascus is illustrated in Figure E-1.2. Main water source is the Figeh spring and other water sources, such as underground water in the Barada spring and Damascus city, are supplementary utilized. The water from springs is conveyed to Wali reservoirs in Damascus city and the villages along with Barada river through the tunnels and distributed to the consumers. The groundwater in the city is pumped up to a service reservoir in the wellfields and distributed through the net work.

2. SOURCE OF SUPPLY

The main source of water is Figeh spring. Other water sources include wells in the Barada spring area and wells in Damascus city. The total production for each main water source is shown 10 years record for 1986 to 1995 in Table E-2.1 and summarized as follows:

	Amount of Water Supplied (Million m^3/year)	Ratio (%)
Wells at Barada Spring	6.8	3.1
Ain Figeh area	177.4	81.3
Wellfields in Damascus	30.1	13.8
Fringe wells	4.0	1.8
Total	218.3	100.0

(Source : Data for 1995 from DAWSSA)

(a) Wells in the Barada spring area

DAWSSA operates 15 production wells and 1 well is used as an observation borehole. Three new wells are scheduled to construct. In 1995 a total of 6.8 MCM was produced. The wells have a total rated production capacity of 34 MCM per year. Any future increases beyond this rated capacity will require the permission of the Ministry of Irrigation which owns the rights to the water resources in this area.

(b) Ain Figeh area

Yields for Figeh spring and production quantities are summarized in Table E-2.1. Spring yields are directly affected by precipitation. In 1995, the water balance for Figeh spring was as follows:

	(unit : MCM / year)
Spring Yield	225
Amount of Water Supplied	184
Irrigation Use	4
Overflow to the Barada river	37

(Source : DAWSSA)

(c) Wells in Damascus City

There are 96 production wells in Damascus city located at 8 different well fields which are described in Table E-2.2. The total water produced from the wells in 1995 was 30.1 MCM with a daily maximum yield of 164,000 m^3/d. DAWSSA is planning to add 40 new wells by the end of 1996 to increase.

(d) Fringe wells & standby wells

As the name implies, fringe wells supply smaller isolated areas located along the peripheral boundary of the existing water distribution network where there is often insufficient flow capacity to meet water demands. There are 23 fringe wells which are connected to the distribution system. A total of 58 standby wells are located throughout the city. These wells are only put into service for fire fighting or medical emergencies.

(e) Others

There are many other private and municipally owned wells which are not under the jurisdiction of DAWSSA.

3. WATER SUPPLY FACILITIES

3.1 Production Wells

There are 3 existing production wells areas: Barada spring area, Figeh spring area and Damascus city well field. These production wells are for the purpose of supplementing water from the main Figeh spring. Pumped water from the wells of Barada and Figeh is conveyed into Wali service reservoirs through the two transmission tunnels by gravity flow. The wells in Damascus city are used mostly during water shortage periods from June to February. Well water is boosted into the distribution network by pumping stations located at the production well centers.

The annual average of operation rate of well pumps was 43 % and the operation period was mainly from July to February, according to the operation record in 1995, and details are shown in Table E-3.1 and Figures E-3.1 and E-3.2. During no pump operation period, the periodical maintenance for pumps and motors was well carried out by mechanical department of production directorate of DAWSSA. The mechanical department has a office and a workshop in Mazraa production well center. According to the field investigation, it seems that vehicle and necessary tools and equipment for maintenance works are shortage and are need to be renewal existing ones due to old model and style.

As of July 1996, the Number of well pumps and installed capacity in each well production area is summarized as follows. Details are shown in Tables E-3.2 and E-3.3.

Name of Production Well	Nos. of Well Pump	Installed Pump Capacity (m^3/h)	Operation Period (month)
Barada spring area	15	3,708	5 (Sep. - Jan.)
Figeh spring area			
Ain Haroush Spring	5	4,500	(Jun. - Feb.)
Deir Moukaren	7	1,104	(Jun. - Feb.)
Figeh main spring	4	14,400	(Jun. - Feb.)
Figeh side spring	13	11,700	(Jun. - Feb.)
Damascus city			
Mazraa	24	2,400	8 (Jun. - Jan.)
Ibn Assaker	19	1,640	9 (Jun. - Feb.)
Kaboon	5	300	6 (Aug. - Jan.)
Kadam Store	3	300	9 (Jun. - Feb.)
Oumawiyin	14	1,400	12 (Jan. - Dec.)
Jobar	14	1,400	9 (Jun. - Feb.)
University	12	1,500	5 (Aug. - Dec.)
Kadam Railway	10	1,000	8 (Jul. - Feb.)
Total	145	45,352	

Typical piping schematics and electrical single diagrams for production well centers are shown in Figure E-3.3.

(a) Barada spring area

The operation of well pumps in this area has been commenced in September 1995. Pumped water from each well is once storage into the collecting reservoir and conveyed to Wali service reservoir through Barada transmission main to Figeh energy dissipation cylinder and two tunnels. The operation rate of well pumps for ten months from commencement till June 1996 was 47 % in average.

As of July 1996, 15 wells located around the perimeter of Barada spring are serviced and operational. Another 3 wells are scheduled for construction, those have already been drilled. DAWSSA has already purchased submersible pumps for the three wells. Electrical power for the existing operating wells is supplied by both a transmission line from the national grid and a diesel generator with a rated capacity of 1000 KVA. DAWSSA has requested Ministry of Electricity to provide a additional transformer, but no action has been taken yet.

For future expansion, DAWSSA has a plan to develop 16 more wells in Zabadani valley. However DAWSSA faces a land acquisition problems with land owners.

(b) Figeh spring area

In Figeh area, there are four well groups such as Deir Moukaren, Ain Haroush, Figeh side spring and Figeh main spring. The well groups are operated from June to February during no gushing out period from Figeh spring. Pumped water from each well group is joined at Figeh energy dissipation cylinder and chlorinated in front of the entrance to the tunnels feeding Wali service reservoir.

Seven submersible pumps with a total capacity of 1,104 m^3/h are installed in the deep wells located at Deir Moukaren. A total of twenty-one submersible pumps are provided in the shallow wells located at Ain Haroush spring, Figeh main spring and Figeh side spring. Installed pumping capacity at Ain Haroush spring is 4,500 m^3/h with five pumps. Installed capacity at Figeh main spring and side spring is 26,100 m^3/h with a total of 17 pumps.

As of July 1996, three wells with a total pump capacity of 5,400 m^3/h and transmission main feeding Barada conduction main were under construction at Ain Haroush and scheduled to complete by end of year 1997.

(c) Damascus city

As of July 1996, there are 101 wells in total at 8 separate production well fields in Damascus city. In addition, there are 23 fringe wells and 58 emergency wells located in Damascus city as listed in Tables E-3.4 and E-3.5.

The production well fields are having with a total pump capacity of 9,940 m^3/h. Each well field is consisted of several deep wells and production well center which equipped with a collecting reservoir, several booster pumps, a hypo chlorite dosing equipment, control room, power receiving apparatus and stand-by diesel generator. Pumped water is collected to a reservoir in each production well center and feeding into the network by booster pumps.

The fringe wells are having with a total pump capacity of 1,160 m^3/h and each well is equipped with a motor driven vertical shaft type well pump, a stand-by diesel generator, a motor driven horizontal shaft type booster pump, a hypo chlorite dosing pump and a 25 m^3 steel made spherical elevated tank. The operation of the fringe wells feeding a network are carried out for 16 hours on an 8 hour shift per day with two operators, and the annual operation rate in 1995 was average 40 % as shown in Table E-3.6 and Figure E-3.4. DAWSSA has scheduled to replace all vertical shaft type well pump to submersible motor pumps for five years from starting this year.

The emergency wells are located in parks, schools and hospitals for back-up of main water supply system from Wali service reservoir and having with a total pump capacity of 2,320 m^3/h. The pump type is engine driven vertical shaft type pump. The periodical check of well pumps are made twice a week by pump set maintenance department of emergency well directorate and check operation is carried out for fifteen minutes to three hours at one time.

3.2 Pumping Stations

The two main functions of the existing pumping stations are to convey water from reservoir to reservoir, and to supply water into the distribution network. There are 16 pumping stations in total, 8 stations are located at service reservoirs and the others are located at the production well centers. A location of water supply facilities is shown in Figure E-3.5 and a schematic diagram showing pipe connections between pumping stations and reservoirs is illustrated in Figure E-3.6. The number of installed pumps and their capacity are as follows;

Location of Pumping Stations	No. of Stations	No. of Pumps	Installed Capa. (x 10^3 m^3/h)
Service Reservoirs	8	73	14.4
Production Well Centers	8	43	10.0
Total	16	116	24.4

All pumping stations are equipped with a step-down transformer and a stand-by diesel generator for emergency use. However some of the diesel generators installed do not have enough capacity for all pumps to operate at the same time. Chlorine dosing equipment is provided at the production well centers for disinfecting water before it is distributed. Pumping station operators are on site 24 hours on an 8 hour shift per day.

The two types of pumps installed in the existing system are single suction horizontal volute pump and submersible pump. The volute pumps are mainly used at service reservoirs for boosting water to other reservoirs and the submersible pumps are used at production well centers to supply water into the distribution network.

(1) Pumping stations at service reservoirs

The pumping stations at service reservoirs are located in mount Kassioun. The pumps are horizontal single/multi stage volute type with a rated head of 46 to 300 m and a capacity of 40 to 432 m^3/ h. The detail information for each pumping station is shown in Table E-3.7. According to the 1995 pumping stations operating records, it seems that the pumps operated continuously for the whole year at each station.

The monthly average pump operation rate and electrical consumption are summarized as follows and annual pump operating records and operation rate are shown in Table E-3.8 and Figure E-3.7.

(unit : 1,000)

Pumping Station Name	Pump Installed Capacity (m^3/h)	Monthly Average	
		Operation Rate (%)	Electricity (kwh)
Figeh	1.8	N/A	N/A
Jemarya	1.8	52	89
Wali New and Old	3.5	25	111
Kassioun High	0.4	19	65
Eastern reservoir	3.6	31	330
Mezze reservoir	2.8	8	266
Dummar	0.5	32	152
Total	14.4		1,013

(a) Figeh pumping station (825.00 m in elevation)

Six submersible pumps are installed just before the entrance of the tunnels to the Wali reservoirs. Two horizontal pumps are also installed in this station. Water pumped up from the entrance to the tunnels is boosted at this station and conveyed to the Figeh service reservoir located at 906.60 m in elevation and to the irrigation channel.

The installed pumping capacity at Figeh pumping station for the Figeh service reservoir is 936 m^3/ h with a total of 6 pumps and for the irrigation channel is 864 m^3/ h with a total of 2 pumps.

(b) Jemarya pumping station (785.00 m in elevation)

This pumping station is located at about 7.5 km in north-west from Damascus center. Water conveyed by gravity flow from the old and new transmission tunnels is boosted at this station and conveyed to Jemarya service reservoir located at 853.00 m in elevation. Installed pumping capacity is 1,766 m^3/ h with a total of 7 horizontal volute pumps.

(c) Wali old reservoir pumping station (800.53 m in elevation)

This pumping station is located at Kassioun mountain. Water fed into the reservoir from Figeh spring through the old and new transmission tunnels is boosted at this station and conveyed to K.3, Kassioun high service reservoir, located at 851.16 m in elevation and to K.1, Kassioun middle reservoir, located at 840.00 m in elevation. Installed pumping capacity for K.1 is 576 m^3/ h with 2 horizontal volute type pumps and for K.3 is 902 m^3/ h with 4 pumps of the same type.

(d) New Wali reservoir pumping station (800.53 m in elevation)

This pumping station is located inside Kassioun mountain and the access tunnel is about 500 m length. Water is fed into the reservoir from Figeh spring through the new transmission tunnel, and boosted to K.1 and K.3 service reservoirs. There is a possibility to feed water to the new Wali reservoir from the old transmission tunnel through the old reservoir. Installed pumping capacity for K.1 is 1,296 m^3/ h with a total of 3 horizontal volute type pumps. At K.3, 7 horizontal volute type pumps are installed, but not in service. The same situation exists at K.6.

(e) Kassioun high pumping station (881.16 m in elevation)

Water from the Wali pumping stations is boosted to supply the K.8 and K.7 service reservoirs. The K.8 service reservoir is located at 1155.00 m in elevation near the Television tower station located on the top of Kassioun mountain. The K.7 service reservoir is located at 995.73 m in elevation on the side of Kassioun mountain. Installed pumping capacity for K.7 reservoir is 325 m^3/ h with 6 horizontal volute pumps and for K.8 is 70 m^3/ h with 4 pumps of the same type.

(f) Eastern reservoir pumping station (749.38 m in elevation)

This pumping station is located at east side of Kassioun mountain in view from Damascus center. Water is fed into the Eastern reservoir from the new Wali reservoir by gravity flow. It is then boosted at this station and conveyed to B.1b Berze Bohooth and B.1v Berze village service reservoirs located at 831.24 m in elevation and B.2 Akrad high service reservoir located at 810.67 m in elevation in the Berze area. This station also supplies water to the Tishreen and Ibn Anafees hospitals. The pumps installed have a capacity of 3,640 m^3/ h with a total of 5 pumps for B.1b reservoir, 4 pumps for B.1v, 6 pumps for B.2 and 5 pumps for the hospitals.

(g) Mezze reservoir pumping station (772.25 m in elevation)

This pumping station is located at west side of Kassioun mountain in view from Damascus center. Water is fed from the Wali new reservoir by gravity flow through Western service reservoir. Water at this station is boosted to M.2 Mezze high service reservoir located at 817.24 m in elevation. As part of a future expansion, additional pumps will be installed at this station for supplying water to the M.5 service reservoir. Installed pumping capacity is 2,775 m^3/ h with a total of 9 horizontal volute pumps.

(h) Dummar pumping station (773.00 m in elevation)

This pumping station is located at about 4 km in north-west from Damascus center. Water is fed by gravity from the transmission main between Jemarya pumping station and the new transmission tunnel. A total of 3 horizontal volute pumps in this station boost water to D.1, Dummar high service reservoir, located at 900.00 m in elevation. Total installed pumping capacity is 450 m^3/ h.

(2) Pumping stations in production well centers

The pumping stations in production well centers have an underground reservoir for collecting water pumped up from the wells. The reservoirs are equipped with submersible type pumps for distributing water into the network and flow meter(s) on discharge side of the pump.

According to 1995 operating records, it appears that pumping operations were reduced or stopped completely during the six month period from January to June. Annual operating records for the pumps is shown in Table E-3.8. The average monthly pump operation rate and electrical consumption from July to December period are shown in Table E-3.1 and Figure E-3.8, and are summarized as follows:

(unit : 1,000)

Production Well Center	Installed Capacity (m3/h)	Monthly Average	
		Operation Rate (%)	Electricity (kwh)
Kadam Railway	1.8	41	244
Mazraa	1.9	51	498
Ibn Assaker	1.2	71	339
Kaboon	1.0	69	149
Oumawiyin	1.8	20	234
Jobar	1.5	52	380
University	0.8	90	277
Total	10.0		2,121

(a) Mazraa pumping station

This pumping station has 10 submersible type booster pumps. When normally supply water to the Ibn Alnafeas service reservoir located at Kassioun mountain side. During periods of water shortage from Figeh Spring, this station also supplies water into the main distribution network. Water quality monitoring instruments have been installed, with the assistance of a grant received from the Arab Fund, at the delivery pipe line after the confluence of discharge pipes from the booster pumps. These instruments consist of a conductivity meter, a P.H. meter, a turbidity meter, a chlorine meter and a recorder.

(b) Ibn Assaker pumping station

This pumping station is equipped with 6 submersible type booster pumps which distribute water collected from the well-fields.

(c) Kaboon pumping station

This pumping station is equipped with 6 horizontal volute type booster pumps which supply water received from both well-field and the main distribution network to isolated service areas, such as existing Tishreen network and Warwar network, currently under construction, which are not connected to the main network. During a suspension of water supply in the main network, especially night time in summer, this station collects water from the well-field for distribution to those service areas.

(d) Kadam Store pumping station

This pumping station is currently under construction. Except for the installation of electro-mechanical equipment, the pump house and collection reservoir are almost complete. DAWSSA plans to connect the station to the main distribution network once all work is complete and the station has been tested and properly commissioned.

(e) Oumawiyin pumping station

This pumping station is equipped with 7 submersible type booster pumps which normally supply water collected from the well-field to the Khorshead reservoir. During periods of water shortage from Figeh Spring, this station also supplies water into the main distribution network.

(f) Jobar pumping station

This pumping station is equipped with 5 submersible type booster pumps which distribute water collected from the well field into the small service network during periods of water shortage from Figeh Spring. The small network is connected with the main distribution pipeline network and normally fed from Figeh Spring.

(g) University pumping station

This pumping station is equipped with 5 submersible type booster pumps which supply water collected from the well-field into the Mezze reservoir during periods of water shortage from Figeh Spring.

(h) Kadam Railway pumping station

This pumping station is equipped with 5 submersible type booster pumps which supply water collected from the well-field into the main distribution network during water shortages from Figeh Spring.

4. DISTRIBUTION SYSTEM

4.1 Transmission and Distribution Mains

The total length of the existing transmission and distribution mains is around 1,221 km. DAWSSA has replaced a total of 479 km length (43 %) of transmission and distribution mains with ductile cast iron pipes during the period from 1982 to 1992.

(1) Transmission mains

Transmission mains between Figeh Spring and Wali reservoirs consist of a new tunnel about 15 km long with an inside diameter 2,550 mm and an older horseshoe-shaped tunnel about 16 km long, 1,360 mm wide and 1,880 mm most current height. Tunnel transmission capacities are 11.3 m^3/s (new) and 3.5 m^3/s (old) for a total combined capacity of 14.8 m^3/s. Transmission mains between reservoirs are mainly ductile cast iron pipes laid underground and their diameters vary between 80 mm to 1,200 mm. Ductile cast iron pipes are imported from abroad, usually French made.

As of July 1996, Ain Haroush pumping line is under construction which is between new wells and connection point with Barada transmission main and 410 m long with a nominal diameter 1,200 mm. Nazem Basha line between Wali service reservoir and Akrad low service reservoir is also under construction which is existing cast iron pipe replacement project and about 3 km long in total with a nominal diameter 800 mm.

Total lengths of the transmission main are summarized as follows and details are shown in Table E-4.1:

(unit : km)

Ductile iron	Cast iron	Steel	Concrete	Total
62.5 (61.0 %)	0.7 (0.7 %)	6.2 (6.1 %)	33.0 (32.2 %)	102.4

(Source : DAWSSA)

(2) Distribution main

The existing water distribution system covers the villages along Barada river valley and Damascus city as summarized in Table E-4.2. The system in Damascus city is divided into the four service districts of Damascus Center, Berze, Berze East and Mezze. Each service district is classified into pressure zones based on five pressure ranges as illustrated in Figure E-4.1. The pressure classifications are low, medium, high I, high II and superior high.

Pressures are regulated on the basis of the elevations of the district served. DAWSSA's design criteria specifies a minimum service pressure for distribution mains of 30 m (water head) and a maximum of 60 m.

Distribution mains are mostly made of ductile iron pipe and their diameters vary between 60 mm to 1,200 mm. Most of the water for the center of Damascus is supplied through one 800 mm line and one 600 mm line from the Eastern reservoir and two 1,200 mm lines from the Western reservoir. Distribution mains are provided with control and sectionalizing valves for optimizing distribution network operations. There are a total of 541 fire hydrants with a 4 inches bore. The hydrants are typically located in utility boxes below grade. The number of hydrants for each service area is shown in Table E-4.2.

About 124 km (12 %) of existing distribution mains, from nominal diameter 80 mm to 600 mm, are made of cast iron pipe and the connections are lead joint method. Many water leakage occur caused by these cast iron pipes and joints and valves. Therefore DAWSSA has been required to replace cast iron pipes to ductile iron pipes for the purposes of minimizing water leakage and utilizing limited water resources.

Total lengths of the distribution main are summarized as follows and details are shown in Table E-4.3:

(unit : km)

Ductile iron	Cast iron	Steel	Total
927.8	124.4	66.7	1,118.9
(82.9 %)	(11.1 %)	(6.0 %)	

(Source : DAWSSA)

As for improvement schemes for distribution mains in informal area, at present there are 14 informal connection areas in service area, a total of area, population and daily water consumption is estimated 1,050.5 ha, 407,000 persons and 78,580 m^3/d. The location of informal connection areas is illustrated in Figure E-4.2. The existing status of progress of changing to a formal connection is summarized as follows;

(a) Esh - Al Warwar area

This area is estimated 31.9 ha and its population is assuming 15,180 persons. The construction work of distribution and service pipes, a total 7,300 m length of 80 to 150 mm diameter pipe and 1,845 service pipes in accordance with the DAWSSA's contract specifications, is currently under construction.

(b) Kassioun Mountains Foot area

This area is estimated 30.9 ha and its population is assuming 33,977 persons. The trunk mains are existing however secondary main, service pipes and water meters are required to install.

(c) Tishreen area

Until last year, about 60 % of this informal connection area has been improved to a formal connection. The subscribers with a formal connection are charged a fixed rate with orifice, not a water meter, and its 2,500 numbers. Remaining informal connections in this area is estimated 36.2 ha in area and its population is assuming 15,448 persons.

(d) Jobar Surrounding - Al Aksab Mosque area

This area is same situation as Tishreen area and about 70 % of the area has been done. The formal connections are 9,400 numbers with a water meter. Remaining informal connections in this area is estimated 63.7 ha in area and its population is assuming 25,704 persons.

(e) East - West Tabbaleh area

This area is also same situation as Tishreen area and about 70 % of the area, 135.2 ha and 12,669 persons in overall, has been improved. The formal connections are used 2,400 orifices and 4,580 water meters. Remaining informal connections in this area is estimated 40.6 ha in area and its population is assuming 3,800 persons.

(f) Mokhayam Al Yarmouk (Tadamun & Zahera) area

This area is estimated 118.0 ha and its population is assuming 86,068 persons. Tadamun area in the part of this informal connection area has been improved to a formal connection and it seems to be 70 % of overall area. The formal connections are 17,500 numbers with a meter. Zahera area has been done the detailed design and expecting a commencement of improvement work within this three months. Therefore Yarmouk area is still required to improve to a formal connection.

(g) Naher - Eshah - Dahhadil & Asalie Kadam area

This area is estimated 170.4 ha and its population is assuming 37,005 persons. This informal connection area has been ready for starting a improvement work as Zahera in Mokhayam Al Yarmouk area.

(h) Al Qazzaz & Shagour Bassateen area

This area is estimated 64.2 ha and its population is assuming 10,692 persons. Shagour Bassateen area has been improved to a formal connection and it seems to be 30 % of

overall area. The improvement work is therefore required in the area of 44.9 ha with a population of 7,484 persons.

(i) Mezze - Razy & Kafar Souseh - Lawan area

This area is estimated 170.3 ha and its population is assuming 46,786 persons. The whole informal connections are required to improvement to formal connection, however DAWSSA has currently no plan for improvement.

(j) Mezze # 86 area

This area is estimated 95.7 ha and its population is assuming 46,390 persons. The construction work of distribution mains, a total 20,250 m length of 80 to 400 mm diameter pipe and a elevated service reservoir with a capacity of 500 m^3 in accordance with the DAWSSA's contract specifications, is currently under construction.

(k) Somareyeh area

This residential area in the special area zone is estimated 37.6 ha and its population is assuming 4,590 persons. The whole informal connections are required to improvement to formal connection, however DAWSSA has currently no plan for improvement.

(l) Dummar - Wadi Al Mashare area

This area is estimated 41.9 ha and its population is assuming 14,841 persons. The whole informal connections are required to improvement to formal connection, however DAWSSA has currently no plan for improvement.

(m) Takadom area

This area is also same situation as Tishreen area and about 25 % of the area, 54.5 ha and 36,750 persons in overall, has been improved under phase-1 project. The formal connections are used 2,000 water meters. Remaining informal connections in this area is estimated 40.9 ha in area and its population is assuming 27,563 persons.

(n) Kudsaya area

This area is estimated 50.0 ha and its population is assuming 20,800 persons. The whole informal connections are required to improvement to formal connection, however DAWSSA has currently no plan for improvement.

4.2 Service Reservoirs

There are 30 reservoirs providing a total capacity of about 0.2 million m^3. Details of service reservoirs are shown in Table E-4.4. Existing service reservoirs are classified into the following 8 different types:

- Reservoirs fed directly from the Figeh main spring	1 only.
- Reservoirs fed directly from the tunnels by gravity or by pumping	5 total
- Reservoirs fed from other reservoirs by gravity	3 total
- Reservoirs fed from other reservoirs by pumping	10 total
- Reservoirs feeding other reservoirs through the distribution network	2 total
- Reservoirs fed only from local wells, supplying distribution network	6 total
- Reservoirs fed only from local wells, supplying local networks	3 total
- Reservoirs for regulating the pressure of transmission mains	4 total

The reservoirs in Damascus city are allocated in twelve serviced sub-areas according to pressure ranges as shown in Figure E-4.1 and Table E-4.2. In generally, reservoirs are constructed under ground and provided with pumping station, control house, transformer house and diesel generator house. At production well centers, hypo chlorite dosing pumps are provided to disinfect stored water before distributing it into network. The dosing rate for hypo chlorite is determined by the results of water quality tests carried out with laboratory at DAWSSA headquarters. Water sampling is scheduled every morning except on Fridays and National holidays. Water from Figeh Spring, is a chlorinated at the plant located in a separate building in front of the entrance to the tunnels feeding Wali reservoirs. This chlorinating plant uses chlorine gas, with cylinders having a capacity of 800 kg each. According to the site investigation, safety equipment such as exhaust fans, chlorine neutralization equipment, leakage detector and alarm system has been installed in few years ago. As for the transformer and its operation, the house and cut-off switches are locked and only persons authorized by the Ministry of Electricity are allowed to operate them.

As for measuring water flow at a reservoir, flow measurment device is equiped with at Barada collecting reservoir, entrance of both tunnels, Western service reservoir and production well centers in Damascus city. Daily water flow at each measuring point is recorded in computer. However other service reservoir and principal distribution main is need to measure water flow for establishment of a plan of operation and analysis of water leakage. In the present condition, the water flow measurement is available at 28 % in total of required places and non-functional meter is 24 % and no meter is 48 %. The details are shown in Table E-4.5.

4.3 House Connection and Water Meters

According to the DAWSSA's standard specifications, the service pipe from the distribution main to the individual premises is generally made of polyvinyl chloride (PVC) pipe, or galvanized steel pipe. Saddles, brass union sockets and stop cocks are used for branch connection. A typical connection diagram is illustrated in Figure E-4.3. Various types of service pipes can be found in existing house connections. The size of the service line depends on the number of dwellings being serviced as follows;

(unit : inch)

Number of dwellings	Size of service pipe
1	1/2
2 ~ 3	3/4
4 ~ 6	1
6 ~ 11	1-1/4
11 ~ 16	1-1/2
16 ~ 50	2

(Source : DAWSSA)

These are two methods for connecting individual subscribers in multiple unit dwellings. The preferred method consists of individually metering each subscriber. A second more commonly used method consists of providing one metered connection for all consumers. DAWSSA is responsible for all aspects of the service from the distribution main to the meter box. The meter box is the responsibility of the subscriber. Water meters for individual house connection are generally of the multi jet type meter, half inch pipe size, and of Syrian make. Meters above a half inch diameter are imported from France, Germany and other countries. Meters made in Syria have analog indicators activated by the rotation of a turbine. According to DAWSSA's records for 1994 and 1995, there is a total of 1,832 water meters for large consumption users and 232,314 meters for normal subscribers. Detailed are shown in Table E-4.6 and E-4.7.

According to water meter reading in 1995, malfunctioning meters, less than 5 m^3 consumption per quarter, were 84,112 numbers and 36.5 % of all. DAWSSA has carried out replacement and install in total of 7,546 water meters of half inch pipe size. Meter checking department of consumer affairs directorate has a capable to carry out meter repair of 10 numbers a day at meter repair shop located at DAWSSA headquarters 2nd basement, and staff in charged is one technician for repairing and nine workers for dismantling/mounting meters. The meter repair shop equips with a meter test bench, a small size lathe and a drilling machine, and those are seemed to be in well operation condition. For more convenience of workmanship, a booster pumping equipment for the meter test bench is requested in order to keep stable water pressure instead of present water tap.

4.4 SCADA System

The SCADA system (Supervisory Control And Data Acquisition system) is to ensure optimum water production and distribution operations of the Damascus City Water Supply. The contract for supply and installation of the SCADA system, which started in 1994 is being carried out by the Italian contractor Nuovo Pignone. The total project cost is 12 million dollars including 7.5 million dollars in foreign currency covered by a loan from the Arab Fund (6 million dollars) and the Syrian Government (1.5 million dollars).

The project is scheduled to be completed in April 1997, however actual progress as of July 1996 is about 6 months behind the original schedule due to delay of supplying communication equipment of the project component. Overseas training of the DAWSSA operation and maintenance staff is started at the contractor's factory in Italy from this October and in total of 600 man-day according to the contract. After the completion of installation work, the contractor has a obligation to supervise the DAWSSA staff for operation and maintenance of the system during 30 months guarantee period.

The system consists of three control centers with Wali reservoir being the main control center, DAWSSA headquarters the alternative control center and Figeh Spring the secondary control center. Remote terminal units are provided at each reservoir, pumping station and control valve in the distribution network. The system has two main functions: firstly, to collect data from each facility through remote terminal units and secondly, to provide remote control capabilities for each facility from the main control center (or the alternative control center). The system schematic is shown in Figure E-4.4 and a summary of the main functions is provided as follows:

Data collection	Remote control
- Water level in reservoirs	- Pumps (on/off)
- Pump status (on/off)	- Valves (open/close)
- Valves status (open/close)	- Penstock gates (open/close)
- Penstock gate status (open/close)	
- Pressure	
- Water flow (velocity)	

In addition to the above covered area, DAWSSA has a plan to expand the SCADA system to Barada spring starting a production of water in November 1995.

5. IMPROVEMENT PLAN OF FACILITIES AND MAINTENANCE

5.1 Facility Maintenance

In consideration of the existing equipment for maintenance, it is recomendable that the maintenance group of distribution pipe will be provided with wireless communication system between office and each working group for a efficient operation and equipment as follows;

1. Wheel crane	25 ton	1 no.
2. Loader	0.75 m^3	1 no.
3. Loader	0.5 m^3	2 nos.
4. Dump truck	4 ton	3 nos.
5. Small excavator	0.02 m^3	3 nos.
6. Cargo truck with 3 ton crane	4 ton	2 nos.
7. Truck with telescopic hoist	Height 10 m	2 nos.
8. Workshop car		4 nos.
9. Double cabine pickup	1.5 ton	8 nos.
10. Manual winch for well pump	1.5 ton	1 no.
11. Hand tools		1 lot

5.2 Master Meters

The recording of water flow from reservoirs and pumps, daily water supply amount and hourly water supply amount, is helpful to grasp the water demand variation in yearly, seasonable and hourly. It is necessary for conducting overall optimal operation of water distribution and formulation of future operation plan.

A meter for water flow measurement is conceivable four types, (1) a turbine type flow meter, (2) a venturi tube type, (3) a electromagnetic and (4) a ultrasonic. These meters' features are summarized in Table E-5.1. It is therefore recommendable the electromagnetic flow meter will be installed on a pumped discharge pipe and the ultrasonic type for a gravity flow pipe from a service reservoir. The required number is 59 in total, 22 for electromagnetic type and 36 for ultrasonic type and 1 for level gauge at Figeh irrigation cannal. The detals are shown in Table E-5.2. The project is assuming to start in 1998 and the period is estimated 27 months for study, tender, supply and installation.

6. ALTERNATIVE PLAN OF IMPLEMENTATION SCHEDULE

6.1 General

A implementation schedule of Master Plan is proposed in Figure E-6.1. The schedule shows projects selected for the master plan as well as 13 projects currently identified in DAWSSA's five year plan and classified as "on-going". Most of the on-going projects were identified and started during the 1990-95 planning period. Works in progress have been transferred to the 1996-2000 plan. The master plan schedule assumes that DAWSSA's "on-going" projects to improve water supply conditions will be completed as planned.

Master Plan projects identified for the "rehabilitation and improvement" program will start in 1997 and be completed by the year 2006, with the exception of the water leakage survey project which will continue untill the year 2015. The construction of "expansion" program which include water supply projects for informal areas and the development of water resources with water right will be sequenced from 1997 to the year 2005.

Alternative Master Plan based on the option-2, option-3 and option-4 including the development of water resources without water right is presented in Figure E-6.2. This alternative plan corresponds to water demand of the year 2015. However it was not selected because DAWSSA has no water right at presence. For executing the plan, it is necessary for DAWSSA to be reallocated existing water right and to obtain it.

6.2 Outline of Master Plan Projects

(1) Rehabilitation and improvement program

This program consists of a rehabilitation of facilities, a leakage reduction and a reinforcement of water resources. The rehabilitation of facilities includes a water main replacement of about 98 km in 6 years, a water meter replacement of about 106,500 numbes in 7 years and a improvements in meter testing and repair facilities in one year. The leakage reduction program includes a establishing district meter area (DMA) system in 9 years, a pressure control program in 10 years and a master meter improvement of 59 numbers in 3 years. The reinforcement of water resources includes a reinforcement of water quality testing equipment in 3 years and a reinforcement of 3 Damascus city wells in 2 years.

(2) Expansion program

The program is basically classified two schemes, water supply projects in 11 informal areas and water resources development schemes of 6 areas. The water supply projects for informal areas are proposed to complete within 9 years. The water resources development projects are proposed to complete within 5 years.

6.3 Implementation Schedule

The proposed master plan projects are summarised as follows;

<u>Rehabilitation Program</u>	
- Rehabilitation Projects	US$ 36.9 million (1997 to 2003)
- Leakage Reduction Program	US$ 5.8 million (1997 to 2015)
- Reinforcement of Water Resources	US$ 5.8 million (1997 to 2002)
<u>Expansion Program</u>	
- Water Supply Projects for Informal Area	US$ 29.4 million (1997 to 2005)
- Water Resources Development Projects	US$ 17.5 million (1997 to 2001)

TABLES

Table E-2.1 Summary of Water Supply by DAWSSA (1986 - 1995)

Calendar Year	Figeh Spring Flow Yield (MCM/year)	Water Supplied from Figeh Spring (MCM/year)	Water Supplied from Damascus Wells (MCM/year)	Total Amount of Water Supplied (MCM/year)	Number of Subscribers (Connections)
1986	161.327	129.440	14.326	143.766	201,698
1987	257.800	166.255	12.600	178.855	205,406
1988	297.600	171.870	15.262	187.132	205,828
1989	147.600	131.214	30.317	161.531	206,188
1990	141.000	122.151	32.710	154.861	221,236
1991	178.400	139.552	34.183	173.735	226,099
1992	354.900	182.185	23.165	205.350	232,530
1993	270.700	188.489	23.858	212.347	237,941
1994	213.100	172.988	36.408	209.396	243,468
1995*	226.400	177.400	34.091	211.491 *	237,808
Average	224.883	158.154			

(Source : DAWSSA)

Remarks : - Population served is culculated by numbers of subscribers and average occupancy rate of persons per propert

* Includes 6.8 MCM from Barada Spring by DAWSSA and by a contractor.

Table E-2.2 Number & Water Yield of Existing Wells in Damascus City (1995)

Name of Wellfield	Production Wells	Wells not in service		Observation Wells	Total Number	Average Water Yield	
		New/ Uncommiss.	Previously in service			Daily Max. (x 1000 m3/d)	Annual Average (million m3/year)
1 Mazraa	24			1	25	31.200	6.580
2 Ibn Assaker	18			2	20	28.600	5.670
3 Kaboon	5		5	1	11	7.000	0.862
4 Kadam Store	3	7			3		
5 Oumawiyin	13			1	14	20.400	3.335
6 Jobar	14			2	16	30.700	5.838
7 University	9		3	1	13	18.500	2.544
8 Kadam Railway	10			1	11	28.200	5.274
9 Dummar		5	2	1	8		
10 Jaramana		10		1	11		
11 Kywan		5			5		
12 Tishrin		10			10		
13 Takadom		10		1	11		
Sub-total	96	47	10	12	158	164.600	30.103
14 Fringe							
Working Boreholes	23				23	11.000	4.012
Emergency Boreholes	58				58		
Miunicipal Boreholes	55				55		
Sub-total	136				136	11.000	4.012
Total	232	47	10	12	294	175.600	34.115

(Source : DAWSSA)

Table E-3.1 Pump Operation Rate in 1995

Station Name	Type	Number	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	AVERAGE
Mazraa PWC	Well	24	23%	0%	0%	0%	0%	41%	93%	86%	90%	98%	93%	94%	52%
	Booster	10	24%	0%	0%	0%	0%	50%	70%	59%	57%	55%	50%	46%	34%
Ibn Asaker PWC	Well	19	15%	5%	0%	0%	0%	44%	72%	75%	84%	88%	84%	84%	46%
	Booster	6	20%	7%	0%	0%	0%	62%	92%	88%	91%	94%	90%	91%	53%
Kaboun PWC	Well	5	9%	0%	0%	0%	0%	0%	0%	66%	94%	95%	98%	97%	38%
	Booster	2	71%	75%	75%	78%	78%	76%	71%	73%	60%	57%	56%	55%	69%
Kadam Store PWC	Well	3	0%	0%	0%	0%	0%	12%	90%	87%	91%	96%	85%	82%	45%
	Booster	2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Omawyya PWC	Well	14	12%	3%	4%	4%	4%	58%	92%	91%	92%	90%	93%	92%	53%
	Booster	7	5%	2%	3%	3%	3%	27%	42%	40%	35%	29%	27%	21%	20%
Jober PWC	Well	14	7%	2%	0%	0%	0%	40%	70%	83%	84%	87%	89%	95%	47%
	Booster	5	9%	6%	0%	0%	0%	40%	54%	77%	72%	73%	67%	72%	39%
University PWC	Well	12	0%	0%	0%	0%	0%	0%	0%	34%	49%	57%	58%	57%	21%
	Booster	5	0%	0%	0%	0%	0%	0%	0%	63%	88%	99%	99%	99%	37%
Kadam Railway PWC	Well	10	10%	0%	0%	0%	0%	0%	84%	79%	86%	91%	81%	82%	43%
	Booster	5	8%	0%	0%	0%	0%	0%	50%	46%	46%	49%	43%	43%	24%
Barada Spring	Well	6	0%	0%	0%	0%	0%	0%	0%	0%	47%	99%	98%	99%	29%
Figeh Spring	Well	4	33%	38%	0%	0%	0%	23%	97%	97%	77%	71%	72%	71%	48%
Side Spring	Well	13	30%	44%	0%	0%	0%	4%	77%	81%	78%	94%	78%	92%	48%
Ain Haroush Spring	Well	5	33%	38%	3%	0%	0%	28%	95%	81%	93%	98%	57%	100%	52%
Deir Moukaren Spring	Well	7	4%	0%	0%	0%	0%	25%	78%	90%	66%	62%	49%	66%	37%
J Jemarya SR	Booster	4	46%	47%	46%	49%	53%	59%	60%	58%	58%	51%	48%	47%	52%
K.3 Kassion High SR	Booster	10	17%	17%	17%	18%	18%	19%	17%	22%	24%	24%	20%	20%	19%
I A & I.S Wali SR	Booster	9	27%	27%	27%	28%	31%	32%	33%	34%	33%	32%	0%	0%	25%
II E Eastern SR	Booster	19	29%	28%	31%	31%	31%	32%	32%	34%	33%	32%	30%	33%	31%
M.1 Mezze SR	Booster	9	6%	9%	9%	9%	9%	9%	6%	7%	8%	7%	6%	6%	8%
D Dummar SR	Booster	6	29%	29%	28%	29%	31%	33%	35%	35%	36%	33%	28%	31%	32%
AVERAGE	Well		14%	10%	1%	0%	0%	21%	65%	73%	79%	87%	79%	86%	43%
	Booster		21%	18%	17%	17%	18%	31%	40%	45%	46%	45%	40%	40%	32%

(Source : DAWSSA)

Note : PWC means production well center.
SR means service reservoir.

Table E-3.2 Tube Well Pumps in the Suburban

Ref. No.	Area Name	Tube Well Pump per unit				Installed Capacity		Power Source		Completion Year
		Nos.	P (kw)	H (m)	Q (m3/h)	P (kw)	Q (m3/h)	D/G (KVA)	Tr. (KVA)	
1	Barada Spring Grp-4	6				662	1,548	1,000	1,600	1995
		5	125	90	288	(828 KVA)				
		1	37	90	108					
	Barada Spring Grp-5	6				505	1,584		1,600	
		5	90	90	288	(631 KVA)				
		1	55	90	144					
	Barada Spring Grp-6	3				200	576		630	
		2	55	90	144	(250 KVA)				
		1	90	90	288					
		3	55	90	144					Scheduled
2	Zabadani Valley Grp-1	6	-	-	-	-	-	-	(1,000)	Plan
3	Zabadani Valley Grp-2	5	-	-	-	-	-	-	(1,000)	Plan
4	Zabadani Valley Grp-3	5	-	-	-	-	-	-	(1,000)	Plan
5	Ain Haroush Spring	5				270	4,500	400	600	1985
		5	54	12	900	(338 KVA)				
6	Deir Moukaren	7				770	1,104		1,890	1990
		4	110	150	195	(963 KVA)			(630 x 3)	
		3	110	140	108					
7	Figeh Main Spring	4								1982
		4	95	4.7	3,600	1,082	26,100	400 + 1,000	1,000	
8	Figeh Side Spring	13				(1,353 KVA)			+	1981
		13	54	12	900				630	
									(also use for booster pump)	

(Source : DAWSSA)

Table E-3.3 Production Well Center in Damascus City

(as of August 1996)

Ref. No.	Name of Wells-field	Tube Wells					Reservoir	Pumping Station							Total Required Power (kw)	Power Source		Completion Year
			Tube Well Pump per unit			Installed Capacity		Booster Pump per unit					Installed Capacity			D/G (KVA)	Tr. (KVA)	
		Nos.	P (kw)	H (m)	Q (m3/h)	P (kw) / Q (m3/h)	(m3)	Type	Nos.	P (kw)	H (m)	Q (m3/h)	P (kw)	Q (m3/h)				
1	Mazraa Center	24				336 / 2,400	2,500		10				1,100	2,100	1,436 (1,795 KVA)	1,000	1,600 + 1,000	1985
		14	13.5	34	100			Submersible	1	110	102.7	250						
		4	13.5	30.7	100			Submersible	2	110	135	150						
		4	13	30	100			Submersible	5	110	102.7	250						
		1	18.5	39	100			Submersible	2	110	175	150						
		1	22.5	50	100													
2	Ibn Assaker Center	19				274 / 1,640	2,500		8				424	1,800	698 (873 KVA)	400	630 + 400 (booster pump)	1989
		3	22	50	100			Submersible	6	45	50	200						
		13	13	50	80				2	77	62	300						
		3	13	30	100													
3	Kaboon Center	5				170 / 300	* 387		6				430	1,065	600 (750 KVA)	100	600 + 400	1986
		5	34	120	60		(Not used)	Horizontal	2	75	59	250						
		(Additional 4 wells are under plan)						Horizontal	1	55	53	250						
								Horizontal	3	75	180	105						
4	Kadam Store Center	3				41 / 300	* 387	-	-	-	-	-	-	-	41 (51 KVA)	N/A	400	
		3	13.5	30.7	100													
5	Oumawiyin Center	14				158 / 1,400	2,500		7				620	1,800	778 (973 KVA)	437	1,600 x 2 (one for spare)	1991
		10	11	35	100			Submersible	2	110	150	150						
		4	12	30	100			Submersible	5	80	60	300						
6	Jobar Center	14				308 / 1,400	2,500		5				400	1,500	708 (885 KVA)	525 + 250	1,000	1988
		14	22	50	100			Submersible	5	80	60	300						
7	University Dormitories Cente	12				268 / 1,500	2,500		5				264	750	532 (664 KVA)	525	1,000	1994
		7	22.5	50	125			Submersible	4	55	70	150						
		5	22	50	125			Submersible	1	44	70	150						
8	Kadam Railway Center	10				169 / 1,000	2,500		5				400	1,750	569 (711 KVA)	437	600 + 400	
		4	22	50	100			Submersible	5	80	60	350						
		6	13.5	30	100													
9	Jaramana Center	10	-	-	-	- / -	-	-	-	-	-	-	-	-	-	-	-	Plan
10	Kywan (Oumawiyin Center)	5	-	-	-	- / -	-	-	-	-	-	-	-	-	-	-	-	Plan
11	Tishrin Center (Oumawiyin Center)	10	-	-	-	- / -	-	-	-	-	-	-	-	-	-	-	-	Plan
12	Takadom Center	15	-	-	-	- / -	-	-	7	77	62	300	-	-	-	-	-	Under constr.

Note : 1. Mark (*) shows a elevated tank.

2. Kadam store center is under construction for expansion of production capacity and new pumping station.

3. Wells in Kywan and Tishrin will be controlled from Oumawiyin center.

(Source : DAWSSA)

Table E-3.4 Fringe Wells

Ref.No.	Borehole Name	Motor output (kw)	Head (m)	Discharge (m3/h)	Depth installed (m)	Power Source (kw)		Reservoir V (m3)
1	Kashcool	2.5	40	50	30	D/G	30	25
2	Al Sabeil	2.5	40	50	30	D/G	40	25
3	Khsfain	2.5	40	50	30	D/G	30	25
4	Montasaf Al Hi	2.5	40	50	30	D/G	100	25
5	Hadaia	2.5	40	50	27	D/G	40	25
6	Halbneh	2.5	40	50	27	D/G	30	25
7	Burg Alzahera	2.5	40	50	30	D/G	40	25
8	Kat Al Nasha	2.5	40	50	30	D/G	100	25
9	Daf Alward	2.5	40	50	30	D/G	30	25
10	Daf Allose	2.5	40	50	30	D/G	40	25
11	Karm Taha	2.5	40	50	30	D/G	40	25
12	Goret Al Shrabati	2.5	40	50	30	D/G	100	25
13	Karm Fida	2.5	40	50	30	D/G	30	25
14	Al Wali	2.5	40	50	30	D/G	40	25
15	Nasbat Omar (Ladba Omar	2.5	40	50	30	D/G	40	25
16	Al Harmain	2.5	40	50	30	D/G	40	25
17	Alabara	7.5	60	50	30	D/G	30	30
18	Karm Noh	2.5	40	50	30	D/G	40	25
19	Al Kasr	2.5	40	50	30	D/G	40	25
20	Al Kisari	2.5	40	50	27	D/G	100	25
21	Halaweh	2.5	40	50	30	D/G	40	25
22	Maze Kabakbieh	2.5	40	50	27	D/G	30	25
23	Kafar Sousch School	2.5	40	50	30	D/G	40	25

(Souce : DAWSSA)

Note : 1. D/G means diesel generator set.

Table E-3.5 Emergency Wells

Ref.No.	Borehole Name	P (kw)	H (m)	Q (m3/h)	Depth installed (m)	Power Source (Hp)		Reservoir V (m3)
1	School Alyarmok		30	40	40	Engine	48	15
2	Hadiki Malga		30	40	40	Engine	48	15
3	Garden Moukayam		30	40	40	Engine	19	25
4	School Iskandaron		30	40	40	Engine	48	15
5	Mostaosaf Al Kadam		30	40	40	Engine	48	15
6	School Shikri Al Komvatlli		30	40	40	Engine	48	15
7	Muassaset Difa		30	40	40	Engine	48	25
8	Barid Al Midan		30	40	40	Engine	48	15
9	School Mustafa		30	40	35	Engine	18	25
10	Garden Sohaib		30	40	40	Engine	48	15
11	Eastern Midan		30	40	40	Engine	48	15
12	School Tawhidi		30	40	40	Engine	48	15
13	School Ansari		30	40	40	Engine	48	15
14	School Raslan		30	40	40	Engine	48	15
15	Garden Bab Sharki		30	40	40	Engine	48	15
16	Garden Al Amcen		30	40	40	Engine	48	15
17	Hammam Srouji		30	40	40	Engine	48	15
18	Maktab Dafn		30	40	40	Engine	48	15
19	School Damask		30	40	40	Engine	48	15
20	Garden Bab M.		30	40	40	Engine	48	15
21	Malia Khan		30	40	40	Engine	48	15
22	School Shafi		30	40	40	Engine	48	15
23	School Anas		30	40	40	Engine	48	15
24	School Lajin		30	40	40	Engine	48	15
25	School Mansour		30	40	40	Engine	48	15
26	Scientific Courage		30	40	40	Engine	48	15
27	National Leadership		30	40	40	Engine	48	15
28	Fire Center		30	40	44	Engine	25	25
29	Shrebishat	7.5	30	40	40	D/G (kw)	25	15
30	Malja Shaina		30	40	47	Engine	19	25
31	Justce Palace		30	40	45	Engine	19	25
32	Old Saga		30	40	30	Engine	19	25
33	School Neirabein		30	40	40	Engine	48	15
34	Mazzeh Awkaf		30	40	40	Engine	30	25
35	University		30	40	40	Engine	7.5	25
36	Hasan Mosque		30	40	40	Engine	48	15
37	Hospital Damascus		30	40	40	Engine	48	15
38	Shcool Shawki		30	40	40	Engine	48	15
39	Parking Center		30	40	40	Engine	48	25
40	Sport College		30	40	40	Engine	48	15
41	North Abbasyieen		30	40	40	Engine	48	15
42	School Jobar		30	40	40	Engine	48	15
43	School Omaya	7.5	30	40	40	D/G (kw)	25	20
44	French Hospital		30	40	40	Engine	48	15
45	Liberty College		30	40	40	Engine	48	15
46	School Hamsho		30	40	40	Engine	48	15
47	North Hamsho		30	40	40	Engine	48	15
48	School Dawood		30	40	40	Engine	48	15
49	School Kusour		30	40	40	Engine	48	15
50	School Zubeir		30	40	40	Engine	48	15
51	School Amid		30	40	40	Engine	48	15
52	West Amid		30	40	40	Engine	48	15
53	Sqare Shanchi		30	40	40	Engine	48	25
54	Ministry of Education		30	40	28	Engine	19	25
55	Italian Hospital		30	40	40	Engine	48	25
56	School Dar Salam		30	40	40	Engine	48	25
57	School Port		30	40	40	Engine	48	15
58	Karajat Kaboon		30	40	40	Engine	48	25

(Source : DAWSSA)

Note : 1. Engine means pump is driven by diesel engine through gear box directly.

2. D/G means diesel generator set.

Table E-3.6 Operation Rate of Fringe Wells in 1995

Ref.No	Borehole Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	AVERAGE
1.	Kashcool	58%	58%	58%	50%	58%	58%	58%	58%	58%	58%	58%	58%	58%
2.	Al Sabeil	50%	50%	50%	50%	58%	58%	58%	58%	58%	58%	58%	58%	56%
3.	Khsfain	33%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	41%
4.	Montasaf Al Hi	33%	42%	42%	42%	50%	50%	50%	50%	50%	50%	50%	50%	47%
5.	Hadaia	33%	42%	42%	42%	58%	58%	58%	58%	58%	58%	58%	58%	52%
6.	Halbneh	8%	17%	17%	17%	17%	0%	17%	33%	33%	33%	33%	33%	22%
7.	Burg Alzahera	58%	58%	58%	58%	67%	67%	58%	58%	58%	58%	58%	58%	60%
8.	Kat Al Nasha	8%	8%	25%	17%	33%	42%	42%	42%	42%	42%	33%	42%	31%
9.	Daf Alward	8%	8%	8%	17%	17%	25%	25%	25%	25%	25%	17%	0%	17%
10.	Daf Allose	50%	58%	58%	58%	58%	58%	50%	50%	50%	50%	50%	50%	53%
11.	Karm Taha	33%	33%	33%	33%	42%	50%	50%	50%	50%	50%	50%	50%	44%
12.	Goret Al Shrabati	33%	50%	50%	42%	42%	50%	50%	50%	50%	50%	50%	50%	47%
13.	Karm Fida	42%	42%	42%	42%	50%	67%	58%	58%	58%	58%	58%	58%	53%
14.	Al Wali	8%	17%	17%	8%	8%	17%	25%	25%	25%	17%	17%	17%	17%
15.	Nasbat Omar (Ladba Omar)	42%	42%	42%	33%	42%	50%	50%	50%	50%	50%	50%	50%	46%
16.	Al Harmain	42%	42%	42%	42%	50%	58%	58%	58%	58%	58%	58%	58%	52%
17.	Alabam	42%	0%	42%	42%	42%	42%	42%	42%	42%	42%	42%	42%	38%
18.	Karm Noh	25%	25%	25%	17%	25%	42%	42%	42%	42%	42%	42%	50%	35%
19.	Al Kasr	8%	8%	8%	8%	8%	25%	25%	25%	25%	25%	25%	25%	18%
20.	Al Kisari	8%	8%	8%	8%	8%	17%	25%	25%	25%	17%	17%	17%	15%
21.	Halaweh	75%	67%	67%	67%	67%	67%	58%	58%	58%	58%	58%	58%	63%
22.	Maze Kabakbieh	17%	17%	17%	17%	25%	42%	42%	42%	42%	42%	42%	42%	32%
23.	Kafar Souseh School	8%	17%	17%	17%	25%	25%	25%	25%	25%	17%	17%	17%	19%
AVERAGE		32%	33%	35%	33%	39%	44%	44%	45%	45%	43%	43%	43%	40%

(Souce : DAWSSA)

Table E-3.7 Pumping Stations at Reservoir

Code No.	Station Name	Location	Reservoir (m3)	Boost to	Pump per unit					Installed Capacity		Power Source		Completion Year
					Type	Nos.	P (kw)	H (m)	Q (m3/h)	(kw)	(m3/h)	D/G (KVA)	Tr. (KVA)	
F	Figeh	Figeh Spring	Box culvert			8				364	1,800	250	630	1980
				Figeh village reservoir	Submersible	3	60	100	162	(455 KVA)	486		(also use well pump)	
				Figeh village reservoir	Horizontal	3	55	100	150	(not working)	450			
				Irrigation channel	Horizontal	2	9.5	5	432		864			
J	Jemarya	Jemarya	2,100			7				547	1,766	525	400	
				Jemarya reservoir	Horizontal	3	65	73.3	200	(684 KVA)	600	(275)	+	
				Jemarya reservoir	Horizontal	1	90	70	300		300		1000	
				Jemarya reservoir	Horizontal	1	132	62	400		400		(plan)	
				Jemarya reservoir	Horizontal	1	55	80	250		250	(250)		
				Jemarya reservoir	Horizontal	1	75	65	216		216			
I.A	Wali Old	Mt. Kassioun	7,500			6				660	1,478	500	630	1982
				K.1 reservoir	Horizontal	2	80	56	288	(825 KVA)	576	+		
				K.3 reservoir	Horizontal	1	200	185	325		325	50		
				K.3 reservoir	Horizontal	1	160	100	325		325	(lighting)		
				K.3 reservoir	Horizontal	1	90	100	180		180			
				K.3 reservoir	Horizontal	1	50	125	72		72			
I.S	Wali New	Mt. Kassioun	61,440			10				870	2,086	-	630 + 315	
				K.1 reservoir	Horizontal	3	85	46.5	432	(1,088 KVA)	1,296			
				K.6 (cancelled)	Horizontal	4	90	160	130	(not working)	520			
				K.3 reservoir	Horizontal	3	85	88	90	(not working)	270			
K.3	Kassioun High	Mt. Kassioun	1,554			10				425	395	N/A	400	
				K.8 reservoir (T.V)	Horizontal	2	45	300	25	(531 KVA)	50		+	
				K.7 reservoir	Horizontal	3	40	130	50		150		1000	
				K.8 reservoir (T.V)	Horizontal	2	30	280	10		20		(plan)	
				K.7 reservoir	Horizontal	2	55	175	50		100			
				K.7 reservoir	Horizontal	1	45	125	75		75			
II.E	Eastern	Mt. Kassioun	28,240			20				1,956	3,640	400 + 500	1600	
				B.1b reservoir	Horizontal	4	132	95.6	315	(2,445 KVA)	1,260	(500)		1994
				B.2 reservoir	Horizontal	2	110	142	160		320			
				B.1b reservoir	Horizontal	1	110	105	300		300	(400)		1961
				B.1v reservoir	Horizontal	3	132	125	250		750			
				B.1v reservoir	Horizontal	1	75	110	150		150			
				B.2 reservoir	Horizontal	3	110	175	150		450			
				B.2 reservoir	Horizontal	1	132	160	180		180			
				Tishree hospital	Horizontal	3	45	150	50		150			
				Ibn Anafees hospital	Horizontal	2	15	55	40		80			
M.1	Mezze	Mezze	8,732			9				645	2,775	437	630	
				M.2 reservoir	Horizontal	2	75	56	300	(806 KVA)	600			1967
				M.2 reservoir	Horizontal	3	55	50	250		750			
				M.2 reservoir	Horizontal	1	90	60	375		375			
				M.2 reservoir	Horizontal	3	80	53	350		1,050			1994
D	Dummar	Dummar	1,294			3				276	450	525	1000	1995
				D.1 reservoir	Horizontal	3	92	175	150	(345 KVA)	450		+	
													400	
													(not used)	

(Source : DAWSSA)

Table E-3.8 1995 Annual Pump Operating Records

Type of Station		Production Well Center								Total
Code No. (Ref. No.)		(2.1)	(2.2)	(2.3)	(2.4)	(2.5)	(2.6)	(2.7)	(2.8)	
Station Name		Mazraa	Ibn Assaker	Kaboon	Kadam Store	Oumawiyin	Jobar	University	Kadam Railway	
Well Pumps	Operation (hr)	109,248	76,945	16,849	11,966	65,236	57,422	22,430	37,758	397,854
	Number	24	19	5	3	14	14	8	10	97
Booster Pumps	Operation (hr)	30,241	27,914	12,041	-	12,315	17,251	16,488	10,486	126,736
	Number	10	6	2	-	7	5	5	5	40
Electricity Consumption (x 10' kwh)		3,773	2,343	1,476	162	1,726	2,531	1,406	1,500	14,917
Diesel Generator	Operation (hr)	51	110	21	-	70	76	29	320	676
Hypochlorite Consumption (kg)		48,200	34,700	4,900	-	27,700	34,700	15,600	26,700	192,500

Type of Station		Pumping Station								Total
Code No.		J	K.3	I.A & I.S	II.E	M.1	D.1	F.1		
Station Name		Jemarya	Kassioun High	Wali Old & New	Eastern	Mezze	Dummar	Figeh		
Booster Pumps	Operation (hr)	18,205	17,046	19,925	52,109	36,766	16,616	16,841		177,508
	Number	4	10	9	19	9	3	5		59
Electricity Consumption (x 10' kwh)		1,928	778	1,109	4,941	2,502	1,820	-		13,078
Diesel Generator	Operation (hr)	214	62	520	42	41	90	-		969

Type of Station		Spring Production Well								Total
Code No. (Ref. No.)		(3.1)	(3.2)	(3.3)	(3.4)	(3.5)				
Station Name		Barada	Ain Haroush	Deir Moukaren	Figeh Side	Figeh Main				
Well Pumps	Operation (hr)	15,133	22,931	22,691	54,907	16,906				132,568
	Number	6	5	7	13	4				35
Electricity Consumption (x 10' kwh)		2,192	1,238	2,496	5,414					11,340
Diesel Generator	Operation (hr)	2,600	17	0	224	300				3,141
Hypochlorite Consumption (kg)		63,671								63,671

(Source : DAWSSA) Note : Barada production wells commenced in September 1995.

(Source: DAWSSA)

Table E-4.1 Transmission Mains

Ref. No.	Section					Head (m)	Type of Flow	Inside Dia. (m)	Length (m)	Material	Remarks
	Station Name	EL	Station Name	EL							
1	Barada	1,118.05	Figeh	821.00		297	Gravity	1,200	21,500	Ductile Cast Iron (DI)	
2	Ain Haroush spring	832.00	Figeh	821.00		11	Pump	650	700	Steel (S)	
3	Deir Moukaren	860.00	Figeh	821.00		39	Pump	650	1,500	S	
4	Figeh	821.00	F.1 Figeh village	902.96		82	Pump	250	200	DI	
5	Figeh	821.00	I.A Wali old	800.53		20	Gravity	w 1.2 x H 1.4	18,000	Culvert box	
6	Figeh	821.00	I.S Wali new	796.00		25	Gravity	2,550	15,000	Tunnel	
7	New tunnel	809.10	Jemarya P.S	785.00		24	Gravity	800-400-300	1,630+2,600+300	DI - DI - S	
8	Old tunnel	N/A	Jemarya P.S	785.00		N/A	Gravity	300	700+300	Cast Iron + S	
9	Jemarya P.S	785.00	G Jemarya	853.68		69	Pump	400	370	DI	
10	I.A Wali old	800.53	K.3 Kassioun high	881.16		81	Pump	300	1,025	DI	
11	I.A Wali old	800.53	I.E Akrad low	785.00		16	Gravity	600	4,850	DI	
12	I.S Wali new	796.00	K.1 Kassioun medium	840.00		44	Pump	500	778	DI	
13	I.S Wali new	796.00	K.3 Kassioun high	881.16		85	Pump	250-300	110+950	DI	
14	I.S Wali new	796.00	II.E Eastern	749.38		47	Gravity	1,200-1,000-800	1140+600+5775	S + DI + DI	
15	I.S Wali new	796.00	II.O Western	755.50		41	Gravity	1,200	1,140	S	
16	I.S Wali new	796.00	M.1 Mezze	772.25		24	Gravity	600	1140+1073	S + DI	
17	K.1 Kassioun medium	840.00	K.2 Akrad medium	832.00		8	Gravity	400-300-400-300-500	810+1680+928+230+1263+782	DI	
18	K.3 Kassioun high	881.16	K.7 Kassioun superior	995.73		115	Pump	150	225	DI	
19	K.3 Kassioun high	881.16	K.8 T.V	1,155.00		274	Pump	100-80	200+300	DI + GI	
20	II.E Eastern	749.38	B.1b Berze Bohooth	831.24		82	Pump	500	1,610	DI	
21	II.E Eastern	749.38	B.1v Berze village	831.24		82	Pump	250-300-500	675+745+895	DI	
22	II.E Eastern	749.38	B.2 Akrad high	880.67		131	Pump	300	1,250	DI	
23	II.E Eastern	749.38	Tishreen hospital	N/A		N/A	Pump	100	3,400	DI	
24	II.E Eastern	749.38	Ibn Nafees hospital	N/A		N/A	Pump	80	740	DI	
25	M.1 Mezze	772.25	M.2 Mezze high	817.24		45	Pump	500	950	DI	
26	J.A University Center	712.00	M.1 Mezze	772.25		60	Pump	500	710	DI	
27	A.2 Oumawiyin Center	694.10	R.k Khorshead	815.23		121	Pump	300	720+780	DI	
28	A.2 Oumawiyin Center	694.10	Main Network	-		N/A	Pump	600	170	DI	
29	K.s Kadom Railway	687.55	Main Network	-		N/A	Pump	500-300	50+	DI	
30	I.A Iben Asaker	675.83	Main Network	-		N/A	Pump	500	50	DI	
31	M.a2 Mazraa Center	694.38	N.1 Iben Alnafeas	805.42		111	Pump	300	1,734	DI	
32	M.a2 Mazraa Center	694.38	Main Network	-		N/A	Pump	500	100	DI	

(Source : DAWSSA)

Table E-4.2 Water Supply Facilities Ledger

Name of Reservoir	Name of Served Area	Type of Land Use	Area (ha)	Population (persons)	Distribution Pipe (m)	Valve (pcs)	Orifice (pcs)	Water Meter (pcs)	House Connection (pcs)	Hydrant (pcs)
Figeh	Figeh	Residential	44	3,975	5,015			726	726	2
	Al Khadra	Residential	12	2,231	7,718			378	378	
	Bassime	Residential	18	468	2,078			648	648	1
	Ashrafye Wadi	Residential	27	3,311	7,670			544	544	1
Jemarya	Judayde	Residential	53	4,464	14,490			689	689	2
	Hame		56	21,570	5,420			1,170	1,170	
	Jemarya		5	2,034	2,700					
	Kudsaya	Residential	158	43,398	15,760			2,356	2,356	
II.O Western II	Damas Center Low	Resid. & Comm. Industrial	3,726	873,600	399,237	2,073	4,583	137,775	142,358	461
II.E Eastern II	Damas Center Low	Resid. & Comm. Industrial	629	102,719	127,005	705		12,577	12,577	
	Berze Low	Resid. & Commercial	402	41,808				7,247	7,247	
I.A Wali	Damas Center Medium	Resid. & Commercial	507	94,912	165,902	921		23,796	23,796	35
I.E Akrad Low	Damas Center Medium	Resid. & Commercial	617	51,170	95,138	402		6,252	6,252	
	Berze Medium	Resid. & Commercial	246	27,742			2,444	1,982	4,426	19
K.1 & K.2 Kassioun Middle & Akrad Middle	Damas Center High I	Resid. & Commercial	289	61,451	71,048	473		12,393	12,393	4
K.3 Kassioun High	Damas Center High II	Resid. & Commercial	125	1,541	25,340	217		6,724	6,724	4
K.7 Kassioun Superior	Damas Center Superior High	Resid. & Commercial	38	485	3,794	24		2,050	2,050	
B.1b Berze Bohooth	Berze High I	Resid. & Commercial	116	6,543	6,536	83		2,087	2,087	4
B.2 Akrad High	Berze High II	Residential	93	390	4,946	12		1,677	1,677	2
B.1v Berze Village	Eastern Berze High I	Residential	103	433	1,286	4		1,864	1,864	
M.1 Mezze	Mezze Medium	Resid. & Commercial	443	56,135	96,883	268		5,454	5,454	7
M.2 Mezze High	Mezze High I	Resid. & Commercial	425	53,867	36,143	155		5,234	5,234	5
D.1 Dummar High	Dummar	Residencial	473	49,415	24,855			5,202	5,202	
Total			8,605	1,503,662	1,118,964	5,337	7,027	238,825	245,852	547

(Source : DAWSSA)

Table E-4.3 (1/2) Summary of Distribution Pipe Ledger

Reservoir	Materials	D25	D40	D50	D60	D80	D100	D125	D150	D200	D250	D300	D350	D400	D450	D500	D600	D700	D800	D1000	D1200	Total
Figeh	Ductile Iron Pipe	0	0	0	500	5,269	1,727	0	2,920	0	700	0	0	0	0	0	0	0	0	0	0	11,116 m
	Cast Iron Pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 m
	Steel Pipe	1,567	3,986	5,812	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11,365 m
																						0 no.
Jemarya	Ductile Iron Pipe	0	0	0	1,750	2,350	4,360	0	1,450	300	6,970	870	0	0	0	0	0	0	0	0	0	18,050 m
	Cast Iron Pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 m
	Steel Pipe	1,380	5,480	13,460	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20,320 m
																						0 no.
M.1	Ductile Iron Pipe	0	0	0	0	8,644	23,720	0	19,180	2,250	8,251	0	0	1,330	170	21,180	3,140	0	0	0	0	87,865 m
Mezze	Cast Iron Pipe	0	0	0	0	0	1,236	0	2,530	650	1,420	0	0	1,552	0	0	0	0	0	0	0	7,388 m
	Steel Pipe	0	0	1,630	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,630 m
	Valve	0	1	13	1	45	115	0	42	15	21	3	0	2	0	4	4	0	2	0	0	268 no.
M.2	Ductile Iron Pipe	0	0	0	0	10,603	3,225	0	5,170	1,657	3,358	1,790	0	2,070	0	0	480	0	0	0	0	28,353 m
Mezze	Cast Iron Pipe	0	0	0	0	0	950	0	450	2,900	2,900	0	0	200	0	0	0	0	0	0	0	7,400 m
High	Steel Pipe	0	0	390	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	390 m
	Valve	0	0	0	0	59	46	0	18	19	9	1	0	0	0	1	2	0	0	0	0	155 no.
K.1	Ductile Iron Pipe	0	0	0	0	818	40,631	0	2,714	2,020	2,940	2,648	0	3,007	0	125	1,634	0	2,066	0	0	58,603 m
Kassioun	Cast Iron Pipe	0	0	0	0	0	350	0	200	0	2,012	0	0	0	0	0	1,886	0	0	0	0	4,448 m
Middle	Steel Pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 m
	Valve	0	0	2	0	5	364	0	28	7	10	6	0	4	0	0	0	0	0	0	0	426 no.
K.2	Ductile Iron Pipe	0	0	0	0	50	3,099	0	0	0	0	0	0	488	0	0	0	0	0	0	0	3,637 m
Ahrad	Cast Iron Pipe	0	0	0	0	0	1,400	0	0	0	750	0	0	0	0	0	850	0	0	0	0	3,000 m
Middle	Steel Pipe	0	0	1,360	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,360 m
	Valve	0	0	4	0	0	39	0	0	3	0	0	0	1	0	0	0	0	0	0	0	47 no.
K.3	Ductile Iron Pipe	0	0	0	0	0	20,729	0	1,166	2,500	785	160	0	0	0	0	0	0	0	0	0	25,340 m
Kassioun	Cast Iron Pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 m
High	Steel Pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 m
	Valve	0	0	0	0	0	202	0	6	6	3	0	0	0	0	0	0	0	0	0	0	217 no.
K.7	Ductile Iron Pipe	0	0	0	0	0	2,448	0	1,116	0	90	140	0	0	0	0	0	0	0	0	0	3,794 m
Kassioun	Cast Iron Pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 m
Superior	Steel Pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 m
	Valve	0	0	0	0	0	19	0	4	0	1	0	0	0	0	0	0	0	0	0	0	24 no.
B.1b	Ductile Iron Pipe	0	0	0	385	2,446	2,064	0	0	966	40	635	0	0	0	0	0	0	0	0	0	6,536 m
Berze	Cast Iron Pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 m
Bohooth	Steel Pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 m
	Valve	0	0	0	10	22	17	0	18	7	5	2	0	0	0	2	0	0	0	0	0	83 no.
B.1v	Ductile Iron Pipe	0	0	0	0	0	306	0	140	0	0	0	416	0	0	424	0	0	0	0	0	1,286 m
Berze	Cast Iron Pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 m
Village	Steel Pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 m
	Valve	0	0	0	0	0	1	0	1	0	0	0	0	0	0	2	0	0	0	0	0	4 no.
Sub Total-1	Ductile Iron Pipe	0	0	0	2,635	30,180	102,309	0	33,856	9,693	23,134	6,243	416	6,895	170	21,729	5,254	0	2,066	0	0	244,580 m
	Cast Iron Pipe	0	0	0	0	0	3,936	0	3,180	3,550	7,082	0	0	1,752	0	0	2,736	0	0	0	0	22,236 m
	Steel Pipe	2,947	9,466	22,652	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35,065 m
	Valve	0	1	19	11	131	803	0	117	57	49	12	0	7	0	9	6	0	2	0	0	1,224 no.

(Source : DAWSSA)

Table E-4.3 (2/2) Summary of Distribution Pipe Ledger

Reservoir	Materials	D25	D40	D50	D60	D80	D100	D125	D150	D200	D250	D300	D350	D400	D450	D500	D600	D700	D800	D1000	D1200	Total
B.2 Akrad High	Ductile Iron Pipe	0	0	0	0	0	1,650	0	0	0	2,686	265	0	0	0	245	100	0	0	0	0	4,946 m
	Cast Iron Pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 m
	Steel Pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 m
	Valve	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12 no.
I.E Akrad Low	Ductile Iron Pipe	0	0	0	310	4,932	37,125	0	14,624	4,507	2,342	1,278	680	854	0	2,410	5,235	0	2,504	0	0	76,801 m
	Cast Iron Pipe	0	0	0	0	0	1,720	0	350	0	3,027	0	0	600	0	630	2,424	0	0	0	0	8,751 m
	Steel Pipe	0	0	9,586	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9,586 m
	Valve	0	0	78	0	11	201	0	53	36	16	1	0	4	0	0	2	0	0	0	0	402 no.
II.E Eastern	Ductile Iron Pipe	0	0	0	2,002	16,493	58,682	0	10,643	4,444	3,510	1,380	0	198	0	3,354	1,760	0	2,008	0	0	104,474 m
	Cast Iron Pipe	0	0	0	0	0	2,964	0	2,178	6,750	1,627	550	0	2,000	0	1,198	1,336	0	0	0	0	18,603 m
	Steel Pipe	0	0	2,228	0	0	0	0	0	1,700	0	0	0	0	0	0	0	0	0	0	0	3,928 m
	Valve	0	0	69	80	138	257	0	66	24	38	5	0	1	0	15	12	0	0	0	0	705 no.
II.O Western	Ductile Iron Pipe	0	0	0	5,334	68,352	196,387	0	25,125	15,077	9,457	4,302	0	1,889	0	3,586	5,040	902	771	880	1,197	338,299 m
	Cast Iron Pipe	0	0	0	0	680	9,152	250	7,162	9,028	11,772	0	0	3,755	0	3,703	4,062	0	0	0	0	49,564 m
	Steel Pipe	175	3,169	7,495	0	0	0	535	0	0	0	0	0	0	0	0	0	0	0	0	0	11,374 m
	Valve	0	27	173	108	689	719	2	99	92	76	23	0	13	0	25	22	0	3	0	2	2,073 no.
I.A & I.S Wali	Ductile Iron Pipe	0	0	0	0	37,960	51,557	0	11,573	4,716	13,146	2,884	0	1,936	430	4,787	6,218	0	2,840	205	0	138,252 m
	Cast Iron Pipe	0	0	0	0	211	4,806	0	3,464	2,700	8,392	0	0	1,480	0	1,302	2,905	0	0	0	0	25,260 m
	Steel Pipe	0	0	405	0	0	403	0	0	0	0	0	0	0	0	0	0	0	0	0	1,582	2,390 m
	Valve	0	0	14	7	386	308	0	55	43	67	5	0	14	0	12	7	0	2	1	0	921 no.
D.1 Dummar High	Ductile Iron Pipe	0	0	0	0	0	10,864	0	2,254	666	1,108	3,423	1,752	392	0	0	0	0	0	0	0	20,459 m
	Cast Iron Pipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 m
	Steel Pipe	0	0	0	200	1,140	1,646	1,220	190	0	0	0	0	0	0	0	0	0	0	0	0	4,396 m
	Valve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 no.
																						0 m
																						0 m
																						0 m
																						0 no.
																						0 m
																						0 m
																						0 m
																						0 no.
																						0 m
																						0 m
																						0 m
																						0 no.
Sub Total-2	Ductile Iron Pipe	0	0	0	7,646	127,737	356,265	0	64,219	29,410	32,249	13,532	2,432	5,269	430	14,382	18,353	902	8,123	1,085	1,197	683,231 m
	Cast Iron Pipe	0	0	0	0	891	18,642	250	13,154	18,478	24,818	550	0	7,835	0	6,833	10,727	0	0	0	0	102,178 m
	Steel Pipe	175	3,169	19,714	200	1,140	2,049	1,755	190	1,700	0	0	0	0	0	0	0	0	0	0	1,582	31,674 m
	Valve	0	27	334	195	1,224	1,497	2	273	195	197	34	0	32	0	52	43	0	5	1	2	4,113 no.
Total	Ductile Iron Pipe	0	0	0	10,281	157,917	458,574	0	98,075	39,103	55,383	19,775	2,848	12,164	600	36,111	23,607	902	10,189	1,085	1,197	927,811 m
	Cast Iron Pipe	0	0	0	0	891	22,578	250	16,334	22,028	31,900	550	0	9,587	0	6,833	13,463	0	0	0	0	124,414 m
	Steel Pipe	3,122	12,635	42,366	200	1,140	2,049	1,755	190	1,700	0	0	0	0	0	0	0	0	0	0	1,582	66,739 m
	Valve	0	28	353	206	1,355	2,300	2	390	252	246	46	0	39	0	61	49	0	7	1	2	5,337 no.
Total Pipe Length		3,122	12,635	42,366	10,481	159,948	483,201	2,005	114,599	62,831	87,283	20,325	2,848	21,751	600	42,944	37,070	902	10,189	1,085	2,779	1,118,964 m

(Source : DAWSSA)

Table E-4.4 Service Reservoirs

	Code No.	Name	Location	Elevation (m)	Nos. of Tank	Capacity (m3)	Surf. Area (m2)	Effec. Depth (m)	Type	Completion Year
		Barada	Barada spring	1,118.05	2	3,000	750	4.00	Ground	
	F.1	Figeh 1	Figeh village	902.96	3	1,030	258	4.00	Undergr.	
	F.2	Figeh 2	Figeh village	-	-	-	-	-	-	Plan
*	G	Jemarya	Jemarya village	853.68	2	2,100	516	4.00	Undergr.	1989
*	D	Dummar	Dummar new resid. area	773.00	2	1,294	-	-	Undergr.	Not used
	D.1	Dummar High	Dummar new resid. area	900.00	2	5,862	1,128	5.19	Undergr.	1988
	D.2	Dummar Regulation-1	Dummar new resid. area	870.00	1	100	49	2.50	Ground	1988
	D.3	Dummar Regulation-2	Dummar new resid. area	840.00	1	100	49	2.50	Ground	1988
	D.4	Dummar Regulation-3	Dummar new resid. area	805.00	1	100	49	2.50	Ground	1988
	D.5	-	Dummar new resid. area	-	-	-	-	-	-	Not used
	K.1	Kassioun Middle	Mt. Kassioun	840.00	2	4,045	508	7.95	Undergr.	1980
	K.2	Akrad Middle	Akrad	832.00	2	1,061	265	4.00	Undergr.	1980
*	K.3	Kassioun High	Mt. Kassioun	881.16	2	1,554	221	7.03	Undergr.	1955
	K.7	Kassioun Superior	Mt. Kassioun	995.73	3	550	137	4.00	Elevated	1964
	K.8	T.V	Mt. Kassioun	1,155.00	N/A	N/A	N/A	N/A	Elevated	1964
*	I.S	Wali New	Mt. Kassioun	796.00	4	61,440	7,680	8.00	Undergr.	1980
*	I.A	Wali Old	Mt. Kassioun	800.53	3	7,500	1,881	4.00	Undergr.	1958
	I.E	Akrad Low	Akrad	785.00	2	4,100	804	5.00	Undergr.	1983
*	II.E	Eastern	Berze	749.38	2	28,240	7,060	4.00	Undergr.	1963
	B.1v	Berze Village	Berze	831.24	1	569	144	3.95	Elevated	1965
	B.1b	Berze Bohooth	Berze pre fabricate	831.24	2	5,862	1,128	5.19	Undergr.	1983
	B.2	Akrad High	Akrad	880.67	2	1,872	488	3.84	Undergr.	1967
	II.O	Western	Shikar Sq. Mouhagerin	755.50	4	42,704	5,024	8.50	Undergr.	1982
*	M.1	Mezze	Mezze Jabal	772.25	2	8,732	2,183	4.00	Undergr.	1953
	M.2	Mezze High	Mezze Jabal	817.24	2	2,901	725	4.00	Undergr.	1960
	M.5	Mezze #86	Mezze	850.00	1	500	-	-	Elevated	Under const.
	N.1	Ibn Alnafeas	Berze	805.42	2	2,000	500	4.00	Undergr.	1983
	R.k	Khorshead	Mouhagerin	815.23	2	2,000	500	4.00	Undergr.	1968
	C.A	Abba Siim High	Abba Siin squar	686.22	1	387	82	4.85	Elevated	Not used
	C.a	Kadam High	Kadam DAWSSA store	688.27	1	387	82	4.85	Elevated	1975
	C.c	Bab Eastern	Bab Sharki	681.64	1	387	82	4.85	Elevated	Not used
	C.j	Jobar High	Jobar	700.92		500	100	5.00	Elevated	Not used
	C.k	Kaboon High	Kaboon street	728.99	1	387	82	4.85	Elevated	Not used
	C.m	Bab Mosallah	Midan	685.67	1	387	82	4.85	Elevated	Not used
	A	Ibn Assaker	Ibn Assaker street	675.83	2	2,470	625	4.00	Undergr.	1985
	A.1	Oumawiyin Old	Oumawiyin Sq. west park	696.67	1	530	228	2.32	Elevated	1973
	A.2	Oumawiyin	Oumawiyin Sq. west park	694.10	2	2,470	625	4.00	Undergr.	1990
	J	Jobar	Jobar Akkash	N/A	2	2,470	625	4.00	Undergr.	1981 - 90
	J.A	University City	Mezze	712.00	2	2,470	N/A	4.00	Undergr.	1993
	K.m	Kadam Store	Kadam DAWSSA store	689.00	2	2,470	N/A	4.00	Undergr.	1991
	K.s	Kadam Railway	Kadam Railway Station	687.55	2	2,470	N/A	4.00	Undergr.	1989
	M.a2	Mazraa	Mazraa eastern park	694.38	2	2,470	625	4.00	Undergr.	1981 - 89

Note : 1. Mark (*) shows a service reservoir with booster pumps.
2. The Dummar service reservoir is not used due to water leakage, but booster pumps operate with a by-pass connection.
3. The Kaboon High service reservoir is not used at present because well pumps have no enough capacity for lifting water into the reservoir due to groundwater level drop.

(Source : DAWSSA)

Table E-4.5 Existing Condition of Master Meter

(as of August 1996)

Code No.	Name	Facility	Supply to	Number of lines	Required meters	Number of meters			Total Requirement
						Installed	Functional	Non-functional	
SPRING AREA									
	Barada	Collecting reservoir	Figeh	1	1	1	1		0
	Deir Moukaren	Collecting main	Figeh	1	1	1	1		0
	Ain Haroush	Collecting main	Figeh	1	1	1	1		0
	Figeh Main Spring	Well pump	2-Collecting main	4	4	4		4	4
	Figeh Side Spring	Collecting main	1-Figeh	1	1	0			1
	Figeh	Tunnels (New & Old)	Wali reservoir	2	2	2	2		0
			Sub Total	10	10 100%	9 90%	5 56%	4 44%	5
SERVICE RESERVOIR									
F.1	Figeh 1	Discharge main	1-Network/1-Irrigation	2	2	1	1		1
G	Jemarya	Discharge main	1-Reservoir	1	1	0			1
		High reservoir	4-Network	4	4	0			4
D	Dummar	Discharge main	D.1 Reservoir	1	1	0			1
D.1	Dummar High	Discharge main	D.2 & Network	1	1	1	1		0
D.2	Dummar Regulation-1	Discharge main	D.3 & Network	1	1	0			1
D.3	Dummar Regulation-2	Discharge main	D.4 & Network	1	1	0			1
D.4	Dummar Regulation-3	Discharge main	Network	1	1	0			1
R.k	Khorshead	Reservoir	Garden	2	2	2	2		0
I A	Wali Old	Reservoir	1-Reservoir/4-Network	5	5	5		5	5
		Discharge main	2-Reservoir	2	2	0			2
I S	Wali New	Reservoir	2-Reservoir	2	2	2		2	2
		Discharge main	1-Reservoir	1	1	1	1		0
K.1	Kassioun Middle	Reservoir	1-Reservoir	1	1	0			1
			2-Network	2	2	0			2
K.2	Akrad Middle	Reservoir	Network	3	3	0			3
K.3	Kassioun High	Reservoir	2-Network	2	2	2		2	2
		Discharge main	4-Reservoir	4	4	4	2	2	2
K.7	Kassioun Superior	Reservoir	1-Network	1	1	0			1
K.8	T.V	Reservoir	1-Network	1	1	0			1
I.E	Akrad Low	Reservoir	1-Network	1	1	0			1
II E	Eastern	Reservoir	1-Network	1	1	0			1
		Discharge main	5-Reservoir	5	5	2	2		3
B.1v	Berze Village	Reservoir	1-Network	1	1	0			1
B.1b	Berze Bohooth	Reservoir	1-Network	1	1	0			1
B.2	Akrad High	Reservoir	1-Network	1	1	0			1
II.O	Western	Reservoir	2-Reservoir/3-Network	5	5	5	4	1	1
M.1	Mezze	Reservoir	4-Network	4	4	2		2	4
		Discharge main	1-Reservoir	1	1	1		1	1
M.2	Mezze High	Reservoir	Network & Air port Zone	4	4	0			4
N.1	Ibn Alnafeas	Reservoir	Network						0
			Sub Total	62	62 100%	28 45%	13 46%	15 54%	49
PRODUCTION WELL CENTER									
C.k	Kaboon Well Field	Collecting main	Booster pump/Network	1	1	0			1
A	Ibn Assaker	Dicharge main	1-Network	1	1	0			1
A.2	Oumawiyin	Discharge main	1-Network/1-Reservoir	2	2	2	2		0
J	Jobar	Discharge main	1-Network	1	1	1	1		0
J.A	University City	Discharge main	1-Network	1	1	1	1		0
K.m	Kadam Store	Collecting main	1-Collecting reservoir	1	1	0			1
K.s	Kadam Railway	Discharge main	1-Network	1	1	1	1		0
M.a2	Mazraa	Discharge main	1-Network/1-Reservoir	2	2	1		1	2
			Sub Total	10	10 100%	6 60%	5 83%	1 17%	5
			Total	82	82 100%	43 52%	23 53%	20 47%	59

Table E-4.6 Water Meter for Large Consumption

(as of August 1996)

Categories	13 mm	20 mm	25 mm	30 mm	40 mm	50 mm	60 mm	80 mm	100 mm	150 mm	300 mm	400 mm	Total
1. Governeotal Authority	34	133	206	9	87	66	19	27	4	1	0	1	587
2. Government Companies	9	12	34	0	6	1	0	2	0	0	0	0	64
3. Hotels	43	12	19	0	6	4	4	1	0	0	0	0	89
4. Restrant	37	1	3	0	0	0	0	0	0	0	0	0	41
5. Factories	8	5	8	2	11	2	0	2	0	0	0	0	38
6. Sport Facilities	1	2	1	0	12	1	1	0	0	0	0	0	18
7. Universities	2	8	7	6	11	4	2	2	0	0	0	0	42
8. Movie Theaters	2	5	4	1	0	2	0	0	0	0	0	0	14
9. Hospitals	11	4	14	0	4	7	2	3	0	1	0	0	46
10. Schools	10	125	85	1	10	3	1	0	0	0	0	0	235
11. Private Normal Users	46	40	356	12	128	65	12	0	0	0	0	0	659
Total	203	347	737	31	275	155	41	37	4	2	0	1	1,833

(Source : DAWSSA)

Table E-4.7 Water Meter for Normal Subsucribers

Areas	Numbers
1. Damascus Center Low	152,720
2. Damascus Center Medium	30,522
3. Damascus Center High I	12,588
4. Damascus Center High II	6,830
5. Damascus Center Superior High	2,082
6. Berze Low	7,361
7. Berze Midium	2,013
8. Berze High I	2,120
9. Berze High II	1,704
10. Eastern Berze High I	1,894
11. Mezze High I	5,540
12. Mezze High II	5,317
13. Dummar	5,284
Toatl	235,975

(Source : DAWSSA) Note : Meter size 1/2"

Table E-5.1 Comparison of Flow Meter

Turbine Type Flow Meter	Venturi Tube Type Flow Meter	Electro-magnetic Flow Meter	Ultrasonic Flow Meter
Accuracy : ± 4 %	± 2 %	± 0.5 ~ 1.0 %	± 1.5 ~ 2 %
Velocity : < ND 250 (0.5~2 m/s) ≥ ND 250 (0.25~1.5 m/s)		Velocity : (2 ~ 4 m/s)	
Range Ability : 1 : 10 ~ 1 : 30	Range Ability : 1 :3 ~ 1: 5	Range Ability : 1 : 10	Range Ability : 1 : 10
Pipe Diameter : ND 50 ~ 900	Pipe Diameter : ND 75 ~ 2500	Pipe Diameter : ND 6 ~ 3000	Pipe Diameter : ND 100 ~ 5000
Straight Pipe Length: Upstream: 10D Downstream:3D	Straight Pipe Length: Upstream: 5~10D Downstream:5D	Straight Pipe Length: Upstream: 3~5D Downstream:-	Straight Pipe Length: Upstream: 10D Downstream:5D
Pressure Loss : 0.2 kgf/cm2	Pressure Loss : 10~30% of diff. press.	Pressure Loss : none	Pressure Loss : none

Table E-5.2 Improvement Plan of Master Meter

Discharge Pipe Dia. (mm)	NO	Name of Station	Facility	Supply to	Remarks
ELECTRICMAGNETIC FLOW METER					
100	1	M.3 Kassioun High	Discharge main-3	K.8 (2 old pump)	Replace
	2	M.3 Kassioun High	Discharge main-4	K.8 (2 Kubota pump)	Replace
250	1	I.A Wali Old	Discharge main-1	K.1 reservoir	New
	2	II.E Eastern	Discharge main-2	B.1v Berze Village	New
	3	C.k Kaboon Booster	Discharge main-1	Tishreen	New
300	1	I.A Wali Old	Discharge main-2	K.3 reservoir	New
	2	C.k Kaboon Booster	Discharge main-2	Warwar	New
	3	M.a2 Mazraa	Discharge main-2	N.1	New
400	1	G Jemarya	Discharge main	Reservoir	New
	2	D Dummar	Discharge main	D.1 Reservoir	New
	3	II.E Eastern	Discharge main-3	B.2 Akrad High	New
	4	Kaboon Well Field	Collecting main	Booster pump/Network	New
500	1	M.1 Mezze	Discharge main	M.2 Mezze High	Replace
	2	II.E Eastern	Discharge main-1	B.1b Berze Bohoodh	New
	3	A Ibn Assaker	Dicharge main	Network	New
600	1	K.m New Kadam Store	Discharge main	Network	New
700	1	II.O Western	Reservoir	M.1 Mezze	Replace
	2	Figeh Main Spring	Well pump-1	Collecting main	Replace
	3	Figeh Main Spring	Well pump-2	Collecting main	New
	4	Figeh Main Spring	Well pump-3	Collecting main	New
	5	Figeh Main Spring	Well pump-4	Collecting main	New
1,200	1	Figeh Side Spring	Collecting main	Figeh	New
ULTRASONIC FLOW METER					
100	1	M.1 Mezze		Network-4 (Mezze #55)	New
150	1	G Jemarya	High reservoir	Koddsia	New
	2	K.7 Kassioun Superior	Reservoir	Network	New
	3	M.2 Mezze High	Reservoir	Villat	New
200	1	G Jemarya	High reservoir	Jemraya village	New
	2	G Jemarya	High reservoir	Jecliade village	New
	3	G Jemarya	High reservoir	Koddsia	New
	4	D.2 Dummar Regulation-1	Discharge main	D.3 & Network	New
	5	K.2 Akrad Middle	Reservoir	Network-1	New
250	1	D.4 Dummar Regulation-3	Discharge main	Network	New
	2	K.1 Kassioun Middle	Reservoir	Network-1	New
	3	K.1 Kassioun Middle	Reservoir	Network-2	New
	4	K.2 Akrad Middle	Reservoir	Network-2	New
	5	K.2 Akrad Middle	Reservoir	Network-3	New
	6	B.1v Berze Village	Reservoir	Network	New
	7	M.2 Mezze High	Reservoir	Mezze West	New
	8	M.2 Mezze High	Reservoir	Mezze West	New
300	1	K.3 Kassioun High	Reservoir	Network-1 (Mohajerin)	Replace
	2	K.3 Kassioun High	Reservoir	Network-2 (Akrad)	Replace
	3	D.3 Dummar Regulation-2	Discharge main	D.4 & Network	New
	4	M.2 Akrad High	Reservoir	Network	New
400	1	I.A Wali Old	Reservoir	Network-1	New
	2	I.A Wali Old	Reservoir	Network-2	New
	3	M.1 Mezze	Reservoir	Network-1 (Old Mezze)	New
	4	M.2 Mezze High	Reservoir	Network & Air port Zone	New
500	1	I.A Wali Old	Reservoir	Network-3	Replace
	2	I.A Wali Old	Reservoir	Network-4	Replace
	3	M.1 Mezze	Reservoir	Network-2 (Mezze Outstrad)	Replace
	4	M.1 Mezze	Reservoir	Network-3 (Mezze Jobal)	Replace
	5	K.1 Kassioun Middle	Reservoir	K.2 reservoir	New
	6	I.E Akrad Low	Reservoir	Network	New
600	1	I.A Wali Old	Reservoir	I.E Aklad Low	Replace
	2	II.E Eastern	Reservoir	Network	New
	3	B.1b Berze Bohoodh	Reservoir	Network	New
1,200	1	I.S Wali New	Reservoir	II.O Western-1	Replace
	2	I.S Wali New	Reservoir	II.O Western-2	Replace
WATER LEVEL GAUGE					
250	1	Figeh 1	Discharge main-2	Irrigation channel	New