DAMASCUS CITY WATER SUPPLY AND SEWERAGE AUTHORITY
SYRIAN ARAB REPUBLIC

THE IMPLEMENTATION REVIEW STUDY ON THE PROJECT FOR REHABILITATION OF WATER DISTRIBUTION PIPELINES IN DAMASCUS CITY IN SYRIAN ARAB REPUBLIC

MARCH 1998

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.

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PREFACE

In response to a request from the Government of the Syrian Arab Republic, the Government of Japan decided to conduct an implementation review study on the project for rehabilitation of water distribution pipelines in Damascus City and entrusted the study to the Japan International Cooperation Agency (JICA).

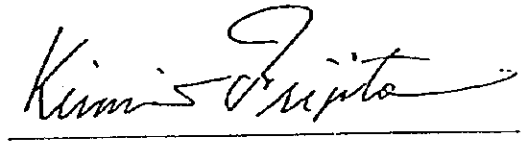
JICA sent to Syria a study team from January 9 to January 22, 1998.

The team held discussions with the officials concerned of the Government of Syria, and conducted a field study at the study area. After the team returned to Japan, further studies were made and as this result, the present report was finalized.

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

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

March, 1998



Kimio Fujita
President
Japan International Cooperation Agency

March, 1998

LETTER OF TRANSMITTAL

We are pleased to submit to you the implementation review study report on the project for rehabilitation of water distribution pipelines in Damascus City in Syrian Arab Republic.

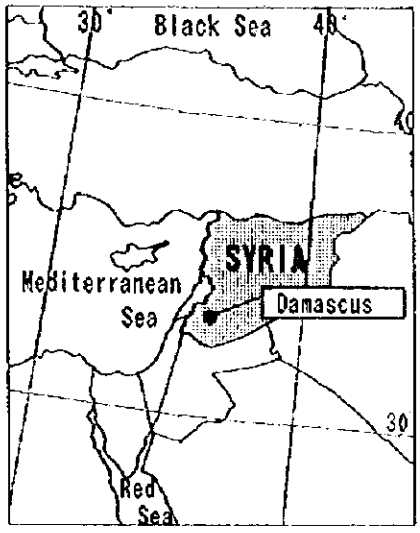
This study was conducted by Nippon Koei Co., Ltd., under a contract to JICA, during the period from December 19, 1997 to March 31, 1998. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Syria and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Masato Fujinami
Project Manager,
Implementation review study team on
the project for rehabilitation of water
distribution pipelines in Damascus City
Nippon Koei Co., Ltd.

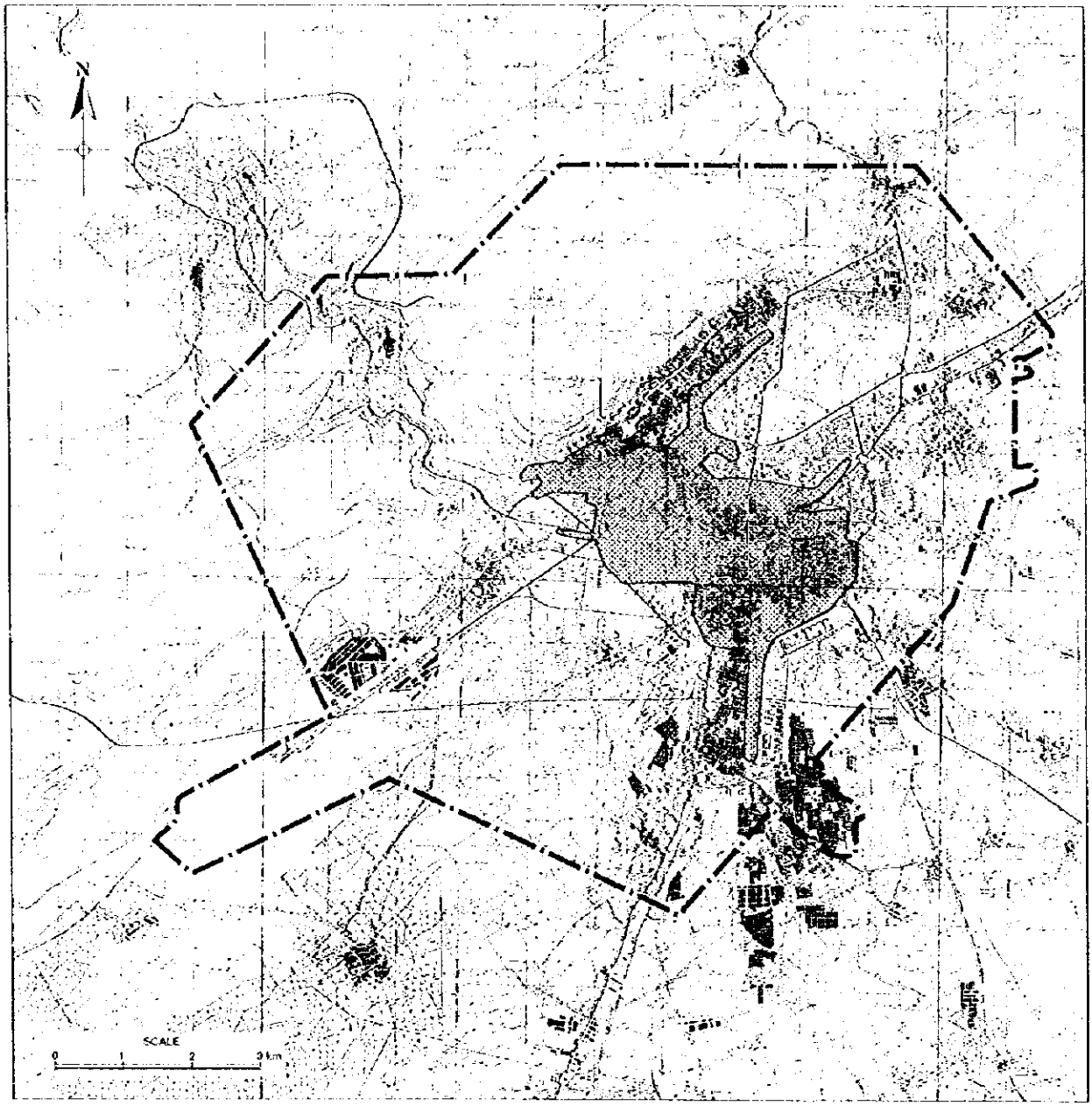
LOCATION MAP



LEGEND

Project Area

Existing Boundary of The City



THE IMPLEMENTATION REVIEW STUDY REPORT
ON
THE PROJECT
FOR
REHABILITATION OF WATER DISTRIBUTION PIPELINES
IN
THE DAMASCUS CITY

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ABBREVIATIONS

Organizations

DAWSSA	-	Damascus City Water Supply and Sewerage Authority
EDWSSR	-	Establishment of Drinking Water Supply and Sewerage in the Rural Province of Damascus
ISO	-	International Standard Organization
JICA	-	Japan International Cooperation Agency
MOHU	-	Ministry of Housing and Utilities
SAR	-	Syrian Arab Republic
SPC	-	The State Planning Commission
UNESCO	-	United Nations Educational, Scientific, and Cultural Organization

Others

DMA	-	District Meter Areas
E/N	-	Exchange Note
GDP	-	Gross Domestic Product
JIS	-	Japan Industrial Standard
SCADA	-	Supervisory Control and Data Acquisition (System)
UFW	-	Unaccounted for Water

Currency

US $ = US Dollar
SL = Syrian Pound
¥ = Japanese Yen

Currency Equivalent

(as of February 1998)
US$ 1 = SL 45.0 = ¥ 124

CHAPTER 1
BACKGROUND OF THE PROJECT

CHAPTER 1 BACKGROUND OF THE PROJECT

Damascus City is the national capital of the Syrian Arab Republic and is the economic and cultural center of the country. The Damascus City Water Supply and Sewerage Authority (DAWSSA) provides water mainly from Figeh Spring for Damascus City. However, water restrictions occur in Damascus during the dry season, in spite of supplementary groundwater pumped from deep wells in the City. Adequate reliable water supply in the dry season and measures to increase water available for consumption to meet future demand are the main problems which now confront DAWSSA. Only 36% of all water produced is billed and an estimated 64% is Unaccounted for Water (UFW). Aging water supply pipes, and informal pipe connections contribute to these high levels of UFW. In 1995, DAWSSA supplied a total of approximately 218 MCM, and there was an estimated 25 MCM demand which was not met.

It is expected that acute water deficit will occur after the year 2005, since the capacity of new water resources is limited by the existing water rights of DAWSSA. Therefore, urgent measures for reducing systems losses in the distribution network are required to save the precious water resources, and reduce the need to find new sources of water.

In February 1994, the Government of Syria requested the Government of Japan to carry out a Study of the Water Supply System for Damascus City. In response to the official request from the Government of Syria, the Government of Japan dispatched a JICA Study Team for the Study on the Development of Water Supply System for the Damascus City in January 1996. The Study confirmed that old cast iron pipes with lead joints are the major cause of system losses. The Master Plan report by the JICA study team recommended the renewal of old cast iron pipes and maintenance equipment as an immediate program for system improvement.

Accordingly, in January 1997, in response to the recommendations in the JICA Master Plan study, the Government of Syria requested the Government of Japan to conduct the procurement project under Japan's Grant Aid for rehabilitation of water distribution pipelines and reinforcement of the maintenance equipment for the distribution system in Damascus City.

CHAPTER 2
CONTENTS OF THE PROJECT

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2-1 Objectives of the Project

The Damascus Water Supply and Sewerage Authority (DAWSSA) provides water for Damascus City. However, aging cast-iron pipes result in high levels of system leakage. Therefore, DAWSSA plans to carry out urgent water main replacement and procurement of repair and maintenance equipment for the distribution system within a period of 3 years.

The objective of the Project is to provide the necessary materials and equipment to replace and repair the old leaking cast iron distribution pipes in order to urgently reduce the water losses in the distribution system.

2-2 Basic Concept of the Project

(1) Project Plan

In 1996 the JICA Master Plan study was carried out to solve the problems of systems losses in the distribution network; a target figure of 25% total UFW has been set for the year 2015 in the study report. Recommended counter measures are as follows:

a) Convert all informal housing areas to formal status by providing metered service connections,
b) Reduce system losses by a combination of the following different programs,
   - Intensive leakage detection efforts to achieve active control
   - Carry out a program to monitor leakage levels using the district meter area (DMA) method with pressure control
   - Carry out a mains renewal program to replace old distribution mains
   - Carry out a improvement program of maintenance equipment

Since 1994, DAWSSA in cooperation with Damascus City authority has started the construction of the water supply system into some informal areas.

The total length of the existing transmission and distribution mains is around 1,116 km. Approximately 124 km (11%) of the existing mains are cast iron with lead joints.

According to the JICA feasibility study on leakage reduction by the DMA system, existing cast iron mains with lead joints are the main cause for UFW.

On the basis of the JICA study report, the Government of Syria requested the following materials and equipment for the renewal of old cast iron pipes and maintenance equipment to initiate an immediate program for system improvement.

(i) Water main replacement plan (refer to Figure 2.2.1)

1st year	16,665 m
2nd year	18,030 m
3rd year	16,150 m
Total	50,845 m

(ii) Repair and maintenance equipment improvement plan

- Wheel crane 1 unit
- Loader 3 units
- Dump truck 3 units
- Small excavator 3 units
- Cargo truck with crane 2 units
- Workshop car 4 units
- Double cabin pickup 8 units
- Hand tools 1 lot

(2) Rehabilitation of Water Distribution Pipeline

i) Water main replacement plan

In the project, DAWSSA will carry out the pipe replacement works by using the procured pipe materials under Japan's Grant Aid.

The project for rehabilitation of water distribution pipelines targets priority areas where leakage problems occur frequently and pipes with a large diameter that have a high risk of unexpected large scale water losses from main breaks. The sequence of work is formulated by considering the work volume at each phase and the need to complete the rehabilitation works within each distribution unit of the distribution system. However, pipes with a small diameter of 150 mm or less will be provided by DAWSSA.

Ductile iron pipe with cement mortar lining is selected for pipe material on account of it's excellent durability and corrosion resistance. In addition to pipe replacement, fittings and accessories (air valves and stop valves) are also replaced since leakage from them is considerable. A restrained joint is used for connecting new pipe to old pipe

instead of using thrust blocks in order to minimize the duration of water restrictions during construction. Contingency is taken into account for planning the quantity of materials.

The project area consists of 5 sub-areas: Wali, Malki, Old City, Presidential area and Nasr as shown in Figure 2.2.2. Wali and Malki areas where leakage problems occur frequently will be carried out during Phase I. The Old City and Presidential area where it takes time to get permission for construction will be carried out during Phase II and Phase III respectively. The project implementation is divided into three phases, and the total pipe length scheduled for replacement is estimated at about 46 km.

ii) Improvement plan of repair and maintenance equipment

The improvement plan is formulated to procure equipment through the project on the basis of DAWSSA's existing equipment listed in Table 2.2.1 and according to the following basic concepts:

- Any equipment already in the possession of DAWSSA at present will be excluded from the project.
- Operation capability by the present staff of DAWSSA will be considered.
- Equipment for exclusive use by DAWSSA will be considered as a priority.
- Operation and maintenance structure of DAWSSA will be considered.
- Repair possibility of equipment in Syria will be considered.

According to the study results, the wheel crane, mini excavator, workshop car and hand tools will be procured by the project for direct use by DAWSSA to maintain the distribution pipelines. However a backhoe loader will be supplied instead of a mini backhoe requested by DAWSSA because of its greater mobility.

(3) Outline of the Project

Summary of Pipelines

	Area	Length (km)
Phase I	Wari	8
	Malki	8
Phase II	Old city	13
Phase III	Presidential area	5
	Nasr	12
	Total	46

Summary of Maintenance Equipment

Particular	Purpose	Q'ty
Wheel Crane	Handling pipe material & equipment at Adra stock yard	1
Backhoe loader	Excavation work for pipe repair	3
Workshop car	Repairing ferrule and service pipes	1
Hand Tools	Repairing works	1

2-3 Basic Design

2-3-1 Design Concept

(1) Natural conditions

The climate of Damascus City is Mediterranean, characterized by hot dry summers from April to October and humid cold winters from November to March. Mean annual rainfall from 1956 to 1995 is 512 mm in Figeh catchment area. There is a great variability in amount of rainfall between years with some drought years such as 1959/60 receiving 227 mm and wet years such as 1991/92 over 925 mm. In the mountains, the rainfall may exceed 1,200 mm above an altitude of 2,000 m, while on the plain east of Damascus the rainfall is about 200 mm. For the implementation of the project, influence of rainfall in Damascus may be disregarded.

The present land use in the area is classified into three categories: residential & commercial area, administrative area and special area zone. Slope inclines in the City are about 0 % to

10 %. The slope increases from 10 % to 30 % up to Kassioun Mountain and in mountain areas is more than 30%. Anchor block method or restrained joint method should be adopted for pipe replacement in the Kassioun Mountain foot area.

The urban area of Damascus, covers the thick alluvial fan created by the river where the Barada River leaves the Anti Lebanon Mountain Belt and flows east onto a plain of El-Arab Trough. Therefore, the surface geology in the area consists of unconsolidated Quaternary deposits. Since soil conditions in the City are normal, excavation work requires no special method.

(2) Economic and social conditions

Damascus is the nation's capital and an important administrative center. Most of the economic activity in the region centers around the tourism and trade industry. In the city, the residential and commercial land area is approx. 86km^2 of 48% of total land area of the City. The future land use patterns will likely not change significantly from the existing land use pattern.

Since 1970, the population growth rate has been declining steadily and has been lower than the growth rates experienced in the other large urban centers. According to the 1994 census, the total population in Damascus City was 1,394,000. On average there are 6.0 persons per dwelling. About 60% of the families surveyed for this study receive less than SL 10,000 per month which is classified as low income. Another 20% receive less than SL 25,000 per month but receive more than SL 10,000, classified as middle income. The average household income for all income groups is SL 16,254.

The average life expectancy in Syria was 66.6 years for men and 67.7 years for women while infant mortality was 37 per 1000. Estimates for Damascus Governate are not available but should be better than the national average given the better standard of living, and better health services coverage. Since 90 % of population believe Islam, religious issues, such as lifestyle and holiday, should be considered for the implementation schedule of the project.

There are many narrow roads with heavy traffic jams since the City has an old urban center including an ancient Old City area. The construction plan, therefore, should be formulated in consideration of local road conditions. In some area, especially Old City area and presidential area, a permission for construction work should be taken from Damascus City authority since there are many cultural assets and restricted access areas for security purpose.

(3) Present water supply conditions

As much as 80% (1995) of the water supplied by DAWSSA is available from Figeh Main Spring; a major spring which has been recognized for its superb water quality and abundant yield for centuries. The water from this spring is characterized by low conductivity (around 300 uS/cm), neutral pH (around 7.7), and low hardness (around 150 mg as CaCO3/L). The water satisfied the Syrian Drinking Water Standard for all criteria. There are numerous secondary water resources in the area. Barada well field, which provided approximately 7% of the water used by DAWSSA in 1995, produces water with good quality. It is judged that water quality of resources is satisfied for drinking water in the Project.

As for the sanitary conditions, over 97% of the tap water examined contained more than 0.1 mg/L of residual chlorine, and no bacteria was found in any potable water sample. However, there are concerns that low water pressures in some areas increase the risk of contamination by wastewater flowing into the network from leak points since leakage accidents break out frequently in the network. To avoid secondary contamination, replacement of damaged old pipes is strongly recommended.

From DAWSSA's experience, there are quite a number of mains which frequently leak and that cause problems each year. There are many instances where these pipes break and rapid attention is called for. However, the existing maintenance equipment is also inadequate to effectively maintain and repair the water distribution system. Therefore, maintenance equipment shall be improved in order to cope with urgent leakage accidents.

Many of the pipes are old cast iron mains with lead joints that frequently leak and by replacing these pipes the frequency of leakage can be reduced. The oldest pipes date back to the early part of this century. Cast iron pipes used from 1908 to the late 60s shall be replaced with ductile iron pipes in same diameter of the existing pipes, because the existing pipes have enough capacity to supply water as a result of network analysis. In addition to the pipes, other accessories such as sluice valves and air valves are constantly leaking and so the fittings also are replaced at the same time of pipe replacement.

(4) Procedure for tax exemption

The Syrian tax regulation is to impose taxes and duties at a total rate of about 8 % to 28 % on cost of imported goods and materials and half of transportation cost to be incorporated into any development project, even projects under the grant aid program. The taxes and duties are shown in Table 2.3.1. The Government of Japan's (GOJ's) Grant Aid scheme does not

include the cost for taxes and duties levied by the recipient country, therefore the recipient country has to make special budgetary arrangements to pay for all domestic taxes. Tax exemption procedures should be carried out in a timely manner. The implementation schedule for the Project will be prepared in due consideration of the expected time required for clearing for such tax exemption procedures.

(5) Usage of local contractor and available materials in Syria

The project is planned for the purpose of properly executing the work by taking into consideration: the conditions for the project, including contractors, procurement of construction materials and labor force; the manner of procurement of water supply equipment and materials; and the manner of construction.

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

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

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

First, second and third ranked contractors are nominated for tendering on DAWSSA's projects, in the each field. Fifteen (15) contractors are registered in the first rank, seven (7) contractors are in the second rank and nine (9) contractors are third rank (see Table 2.3.2.). DAWSSA has experienced contractor capabilities through many projects already executed. The local registered contractors have the capabilities and experience required for constructing the proposed projects without the use of internationally experienced contractors. Local contractors have sufficient construction machinery and equipment including heavy construction machines.

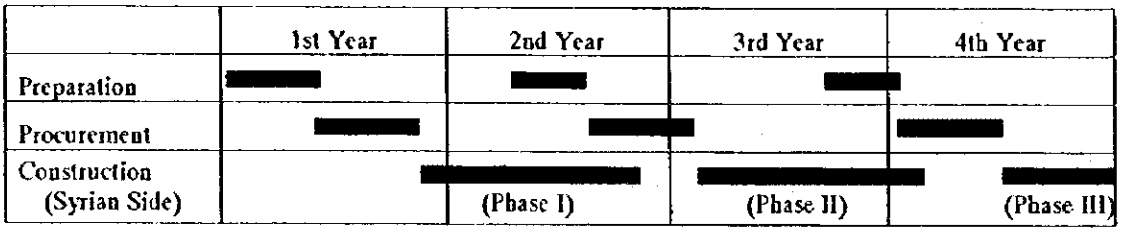
(6) Grade of materials for replacement

The average age of the existing cast iron pipes is estimated at 42 years, which greatly exceeds the service life of cast iron pipes generally considered to be 25 years. As a result, there are quite a number of old cast iron pipes which frequently leak from the lead joints and pipe breaks. Therefore, the materials for the replacement of the old cast iron pipes will be selected on the basis of considering future saving in maintenance expenditure by DAWSSA.

It has been observed that water leakage was almost never detected from the joints and trunk mains made of ductile iron pipe installed since 1970s. Ductile iron pipe has many advantages compared with the cast iron pipe. In general, service life of ductile iron pipes are estimated approximately 60 years which is longer than service life of cast iron pipes. Ductile iron pipes also have the advantage of large flexibility, strength and high impact coefficient. In addition, it is easy to carry out the pipe laying works due to use of push-on joint for jointing works, and DAWSSA has many experiences of ductile iron pipes laying works. Therefore, ductile iron pipe will be adopted for new replacement pipes due to long-life value and technical advantages.

(7) Construction schedule

The implementation of the project requires a 56 month period after first exchange of note (E/N) between Government of Japan(GOJ) and Government of Syria(GOS), taking into account the workable days in a year, required work volume, time required for materials production, tax exemption procedures, and coincidence with the financial system of GOJ. Construction Schedule is shown below:



Note: It is supposed that the Phase III construction work is completed on 5th year.

2-3-2 Basic Design

(1) Design conditions

The following design conditions are adopted:

(i) Location of the area : Damascus city (Total area is 106 km^2)
(ii) Land Preparation : All the necessary lands belongs to the Government.
(iii) All the necessary works for installation of supplied equipment and materials shall be done by DAWSSA.
(iv) Population : About 1.4 million persons living in Damascus City will benefit directly from the project.
(v) Estimated leakage per km of pipe is given below:

Average from the whole system	:	7 m^3/hr/km
Average from ductile iron pipe	:	4 m^3/hr/km
Average from cast iron pipe	:	30 m^3/hr/km

(vi) Procurement of new maintenance equipment will provide the maintenance and repair section with the ability to take adequate and prompt action for leakage prevention. Reduced leakage in distribution mains also reduces the risk of contamination and therefore enhances public health and safety. People will be supplied with a more stable and safer water supply service after the project.

(2) Design concept

The design concept given below is considered during the preparation of the basic design:

(i) Special conditions of the proposed site such as climate, lifestyle, traffic pattern, cultural asset protection, etc., are fully considered and incorporated into the design.
(ii) Plan of rehabilitation project is formulated to coordinate with the DMA system.
(iii) Improvement of equipment for leakage protection is planned to reduce maintenance and operation costs.
(iv) With consideration on the construction capabilities and local conditions, the materials and equipment are selected from viewpoints of construction ease and cost. Suppliers shall be certified by International Standard Organization (ISO) in compliance with ISO 9000 series.

(v) Workability and local conditions at sites are considered for the construction plan since the review study area is regulated for construction works as shown in Figure 2.3.1.

(vi) Construction work is planned to minimize blocking the street.

(vii) Replacement works are basically planned by each water unit respectively.

(3) Overall plan of rehabilitation project of distribution pipeline

The rehabilitation of the water distribution system in Damascus is the most urgent and important issue for the Syrian Government in order to sustain the stability of public welfare and economic development in the national capital. This project therefore has the highest priority among other projects. The overall rehabilitation plan for distribution pipeline is proposed in consideration of water unit, leakage frequency and construction work permission procedures. The project area of the proposed project consists of 5 areas: Wali, Malki, Old City, Presidential and Nasr areas as shown in Figure 2.2.2. Phasing of replacement pipe for the project implementation is summarized below:

(i) Phase I : Wali and Malki areas

(ii) Phase II : Old City area

(iii) Phase III : Presidential and Nasr areas

Total pipe length for replacement is summarized below:

Area		Pipe Diameter (mm)					Total
		200	250	400	500	600	(m)
Phase I	Wali		5,260	800	550	1,440	8,050
	Malki	1,240	3,260	800		3,000	8,300
Phase II	Old City	4,080	980	4,000	1,840	1,870	12,770
Phase III	Presidential		3,435	1,660			5,095
	Nasr	3,660	3,510	220	4,660		12,050
Total		8,980	16,445	7,480	7,050	6,310	46,265

The total pipeline length, pipe diameter and kinds are determined based on review of the distribution pipeline map (s=1/2,000) and topographic conditions. The detail of pipes for each street is listed in Table 2.3.3. After review of the mentioned table, appropriate pipelines will be selected for implementation in the capacity of Japan's Grant Aid project.

(4) Pipe installation plan

The following DAWSSA design criteria are adopted for the plan of Rehabilitation Project:

i)	Minimum effective head	: 30 m
ii)	Maximum velocity	
	▪ Water main (at least 250 mm in diameter)	: less than 2 m/s
	▪ Secondary & Tertiary	: less than 1 m/s
iii)	Quality of materials	
	▪ Water main (at least 300 mm in diameter)	: Ductile iron pipe
	▪ Secondary pipe (at least 100 mm in diameter)	: Ductile iron pipe
	▪ Tertiary pipe (less than 100 mm in diameter)	: Polyethylene pipe
iv)	Interval of hydrants	: 300 m to 400 m
v)	Type of hydrant	: French and USA (underground type)
vi)	Seasonal load factor	: 1.14
vii)	Hourly load factor	: 1.25

(5) Specification of pipe materials

General characteristics of ductile iron pipe are summarized below:

(i) Advantage
- High strength and excellent impact resistance.
- Corrosion resistant.
- Flexible joints.
- Jointing works is easily done without a skilled worker.
- For normal soil condition, no special bedding is required and is backfilled by excavated soil

(ii) Disadvantage
- The protection of pipe fitting is required where thrust force is generated. In case of using restrained joints, thrust block is not required or reduced in volume.
- Heavy weight.

Specifications of ductile iron pipe and fittings are proposed following the standard of ISO 2531 (JIS G5526-5527) and are listed below:

(i) Wall thickness

Nominal Diameter (mm)	Thickness (mm)
100	6.1
150	6.3
200	6.4
250	6.8
400	8.1
500	9.0
600	9.9

(ii) Hydrostatic test pressure

Nominal Diameter (mm)	Pipes	Fittings
100 to 250	50 bar	25 bar
400 to 600	40 bar	16 bar

(iii) Mechanical Properties

	Pipes (100 mm to 600 mm)	Fittings
Tensile strength	Min. 420 N/mm^2	Min. 420 N/mm^2
Elongation	Min. 10 %	Min. 5 %
Proof Stress	Min. 300 N/mm^2	Min. 300 N/mm^2
Hardness	Max. 230 HB	Max. 250 HB

(iv) Standard coating and lining

	Pipes	Fittings
Outside	Epoxy coating	Epoxy coating
Inside	Cement mortar lining	Epoxy coating

(v) Type of joint: Push-on joint type and restrained joint (coupling) type

(6) Maintenance equipment plan

The equipment, which is used for the project, was selected as follows in consideration of need and adaptability for the maintenance and operation of the distribution pipeline to be constructed.

Particular	Specification	Q'ty	Purpose
Wheel Crane	Max. lifting capacity: 25 ton at 3 m 4-section boom: 8.6 - 26.9 m	1	Handling pipe material & equipment at Adra stock yard
Small excavator (Backhoe Loader)	Hoe bucket capacity: 0.05 m^3	3	Excavation work for pipe repair
Workshop Car	Multi-compartment type utility car for plumbing	1	Repairing ferrule and service pipes
Hand Tools		1	Repairing works

CHAPTER 3
IMPLEMENTATION PLAN

CHAPTER 3 IMPLEMENTATION PLAN

3-1 Implementation Plan

3-1-1 Implementation Concept

This project is planned to reduce water leakage losses in the old cast iron distribution pipelines and to save water resources in Damascus city by procuring necessary equipment, such as ductile iron pipes and repair/maintenance equipment for the distribution system.

As this project covers procurement of equipment and materials, and laying of pipes are implemented by the Syrian side under advisory service of the consultant, the works should be carried out following procurement to have an early result. During the pipe laying works, the consultant is intermittently assigned to advise/assist the Syrian side for progress control and quality control. In addition, at the time of commencing the works, a guidance engineer from the pipe supplier transfers the method of push-on joints and restrained coupling to the Syrian side.

The responsible agency is the Ministry of Housing and Utilities, and the executing agency of the project is the Damascus City Water Supply and Sewerage Authority (DAWSSA). The engineering works of the project is covered by the new works & studies directorate of DAWSSA by contract with Syrian general contractors. DAWSSA will organize the project management groups for the project implementation, which are composed of four supervision groups and one liaison group as shown in Figure 3.1.1. Total staff member of the project management groups are eighteen persons, consisting of thirteen engineers and five assistants. The financial directorate will be responsible for unloading of equipment and materials from shipment at Tartus Port and transportation to DAWSSA's Adra stockyard shown in Figure 3.1.2.

3-1-2 Implementation Conditions

The requirement of this project is procurement of equipment and material, mainly pipes and valves and maintenance equipment/vehicles, such as a wheel crane and repair shop cars. Japan's Grant Aid covers procurement of the equipment and materials, and delivery of shipment at Tartus Port, the trading port in Syria.

As for the pipe laying works by the Syrian side, the project area is regulated by working hours defined by Damascus municipality in the following categories.

- whole day work area
- night time work area (PM 8:00 to AM 5:00)
- presidential area (Special permissions for construction is necessary)

The above classification of pipeline laying areas, is shown in Figure 2.3.1.
In the Old City area, pipe laying works are carried out by hand instead of heavy construction equipment due to very narrow road width and existence of many cultural assets. During the works, some roads are blocked completely but by-pass should be provided.

The project area is divided into five areas such as Wali, Malki, Old City, Nasr and Presidential areas. According to security regulation and the effectiveness of rehabilitation, the priority of works will basically conform to the following order.

Phase I : Wali and Malki areas
Phase II : Old City area
Phase III : Nasr and Presidential areas

For construction in wide road ways, new pipes will be connected with the existing pipe network after laying new pipes nearby existing pipes in parallel under one-way traffic. For a narrow road, temporary pipes are laid along the road prior to removing the existing pipes for the purpose of non-suspension of water.

3-1-3 Scope of Works

(1) Scope of works to be executed by the Japanese side
- To prepare the tender document for procurement of the rehabilitation project of water distribution pipelines and maintenance equipment,
- To undertake the supply and delivery at Tartus port of pipe materials and maintenance equipment, and
- To provide technical assistance to the Syrian side to implement pipe laying works.

(2) Undertaking by the Syrian side
- Provision of the necessary arrangement/procedure based on the regulation of Damascus Municipality for the pipe laying works,
- Transportation of the pipes and maintenance equipment from Tartus to Adra stock yard of DAWSSA,
- Storage of the pipes in Adra stock yard,

- Execution of the pipe laying works, and
- Budgetary arrangement and the prompt disbursement for tax exemption to the Japanese nationals regarding to the project implementation, especially on imported pipe materials and maintenance equipment.

3-1-4 Consultant Supervision

(1) Detailed design

Prior to the implementation of the project, the tender work will have to be carried out. Immediately after the signing of the exchange of note, the consultant will make contract with the Damascus Water Supply and Sewerage Authority (DAWSSA), and the consultant will start the preparation of tender documents. The consultant should discuss the specification and quantity of pipe materials and maintenance equipment, and implementation schedule of the works with DAWSSA at the detailed design stage.

(2) Procurement

The tender for selection of a contractor for the supply and delivery of pipe materials and maintenance equipment will be conducted after obtaining approval from DAWSSA for the tendering process. The notice of tender will be published in the major daily newspaper on construction and economy in Japan on behalf of DAWSSA.

The quoted tenders will be received by the consultant and opened in the presence of the representative of DAWSSA. After the opening, the tender evaluation will be carried out by the consultant in collaboration with the representative of DAWSSA, and the draft contract will be prepared by the consultant based on the tender evaluation result.

Once the contract has been conducted for the supply and delivery of pipe materials and maintenance equipment, the consultant will clarify and review/approve the specifications and time schedule from the contractor and inspect procured equipment and pipe materials before shipment and after arrival in Tartus port.

In this inspection, appearance, performance, number of the products and number of the required parts will be checked to conform with the contract, only the passed products are approved to be shipped. And in the arrival inspection, all packages shall be confirmed after arriving at Tartus port.

(3) Consultant supervision

This project is categorized as equipment project of Japan's Grant Aid project. Usually, consultant supervision of the equipment project is not carried out except to check and confirm shipping and delivery. However, the Project will require some intermittent consultant supervision including technical guidance, ensuring high performance of construction work and high quality of O & M in the future.

The construction record will be compiled as a pipe ledger for each area and pipe line route. The breakdown of the construction record for pipe replacement is summarized below:

- Location map: Pipeline route, I.D. number of pipeline, Pipe diameter, Special fittings, Start point of pipeline. Terminal point of pipeline, Valve, Hydrant
- List: I.D. number of pipe line, Completion date, Pipe diameter, Pipe material, Specification of pipe, Name of manufacturer, Special fittings, Valve, Hydrant
- Test sheet of Pipes: Copy of mill sheet, Results of field water pressure test
- Construction: Implementation Period, Construction methods, Depth of pipe, Soil condition, Groundwater level
- Condition of existing old cast iron pipe: Breakage condition, Leakage condition, Status of old cast iron pipe after replacement

The consultant's resident engineer will be assigned to supervise the construction works in an advisory capacity, and report the work progress at some interval to JICA Syria office in order to confirm the implementation schedule. The resident engineer will also advise DAWSSA on keeping proper construction records for smooth implementation of O & M in the future. Through this intermittent consultant supervision, the Project will be completed on schedule, with proper pipe ledger records.

3-1-5 Procurement Plan

(1) Ductile iron pipes

Ductile iron pipes and fittings should be procured in Japan, and be shipped to the port of Tartus at the expense of the Japanese side. The Syrian side should cover unloading of materials, custom clearance, inland transportation and storage at the Adra stockyard.

(2) Maintenance equipment/vehicles

In Syria, vehicles imported from Japan and Europe are found in a ratio of nearly 50%, and many Japanese manufacturers supply vehicles through trading companies. Japanese vehicles are less troublesome and economical as compared with those of other countries. Small vehicles such as excavator and wheel loader are only available from Japan. Procurement from Japan will secure the delivery period within schedule constraints.

3-1-6 Implementation Schedule

(1) Implementation Schedule of the Project

The implementation schedule after the E/N procedure conclusion of this project is as follows;

- Detailed Design

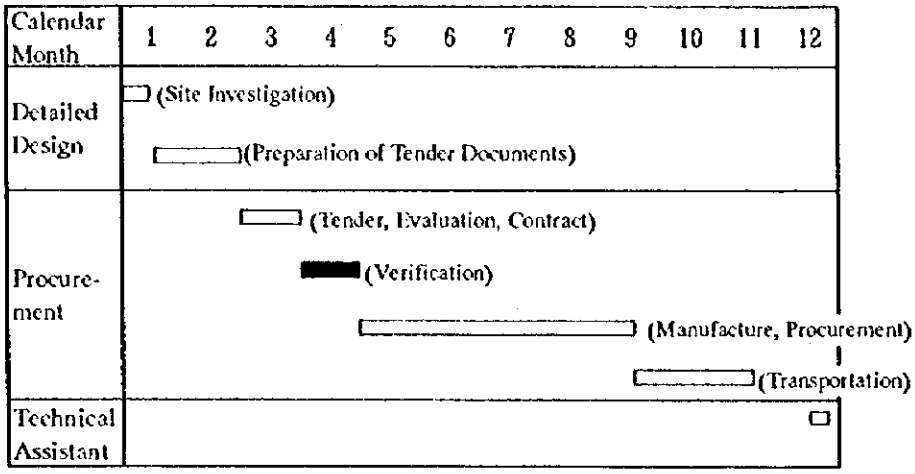
	Phase I	Phase II	Phase III
- Site investigation - Preparation of tender documents	2.0 months	2.0 months	2.0 months

- Procurement

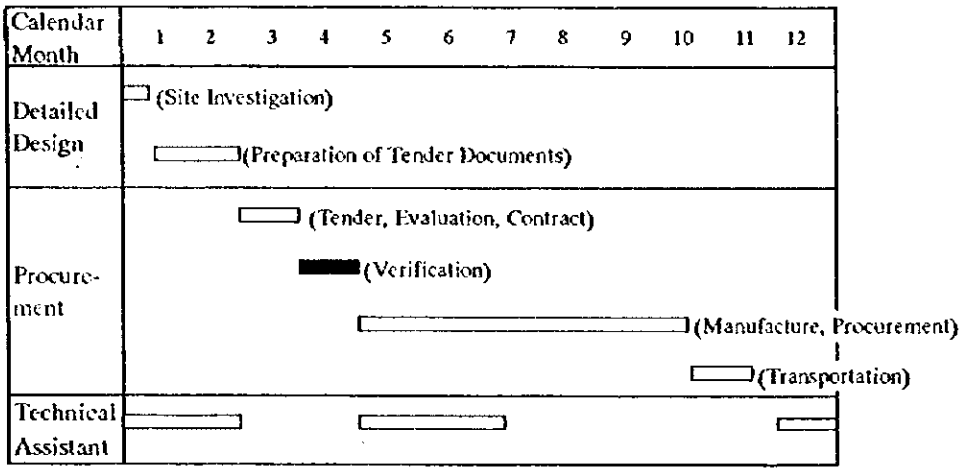
	Phase I	Phase II	Phase III
- Tender and tender evaluation - Contract for procurement of equipment and materials	1.0 month	1.0 month	1.0 month
- Manufacture and procurement	4.5 months	4.5 months	4.5 months
- Transportation	2.0 month	2.0 month	2.0 month

The implementation schedule is shown below,

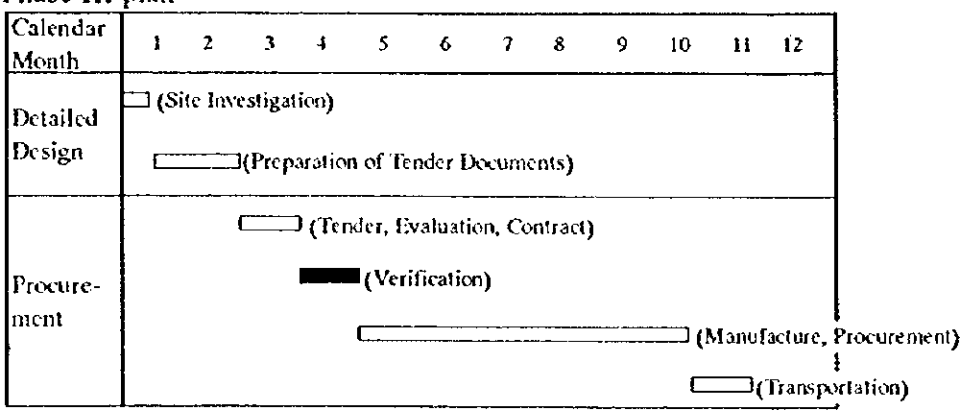
Phase I plan



Phase II plan

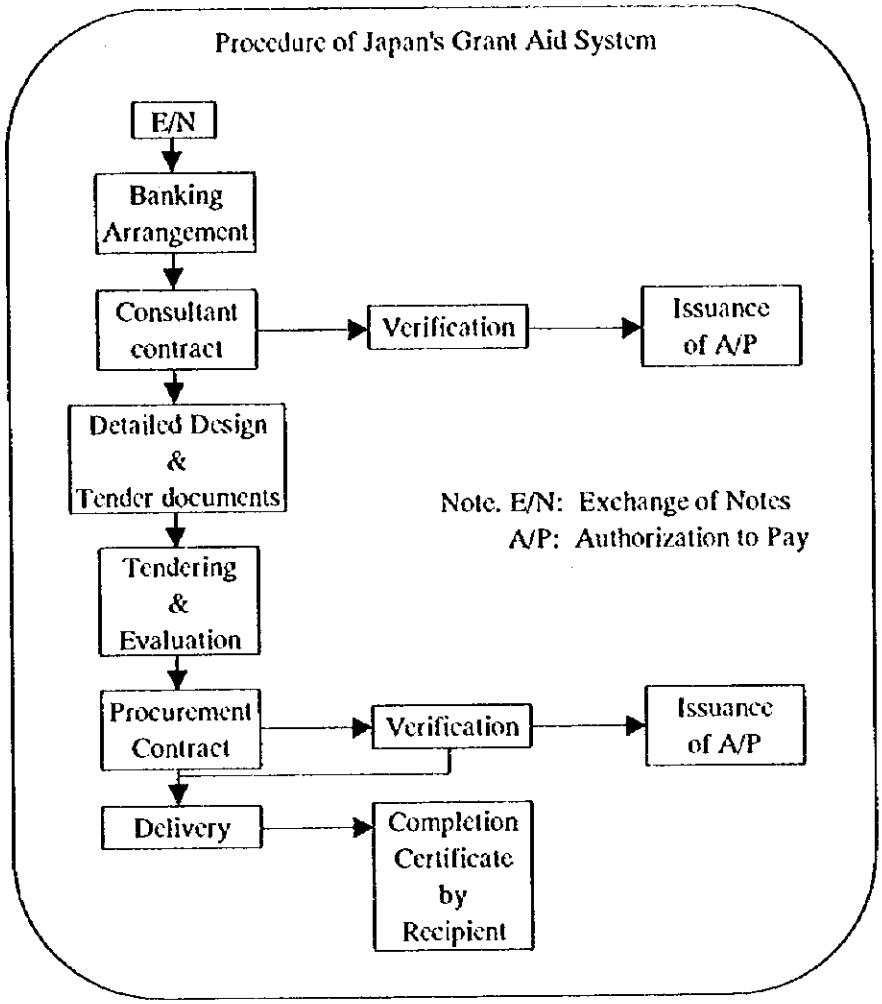


Phase III plan



(2) Implementation Procedure under Japan's Grant Aid system

The project shall be implemented as shown below, taking into consideration the procedure of Japan's Grant Aid system.



3-1-7 Obligations of Recipient Country

The Syrian side should carry out the following items when it accepts Japan's Grant Aid;

(1) To do the domestic duties concerning landing, customs clearance and inland transportation as for equipment and materials imported for this project,

(2) To lay pipe materials procured by this project rapidly according to the prescribed schedule of the project,

(3) To facilitate embarkation and disembarkation and staying procedures in Syria based on the law of the country for Japanese who offer services for the implementation of this project,
(4) To pay the bank commission based on the banking arrangement,
(5) To issue the authorization to pay based on the agreement between banks, and
(6) To take charge of all other expenses excluded from Japan's grant aid.

3-2 Project Cost Estimation

The breakdown of expenses by the Syrian side to implement this Project through grant aid from Japan is as given below.

Item	SL (1,000)
1) Replacement works of distribution pipelines	188,000
2) Inland transportation cost	7,000
Total	195,000

3-3 Operation and Maintenance Costs

The yearly costs of operation and maintenance management for DAWSSA's distribution system is estimated as follows:

Operation and Maintenance Cost (1995)

Items	SL (1,000)
1. Staff salary / Labor wage	20,000
2. Leakage detection costs	1,000
3. Leakage repair costs	8,000
4. Maintenance Equipment / Vehicles repair costs	4,000
5. Fuel for Equipment / Vehicles	5,000
Total	38,000

The annual operation and maintenance costs for DAWSSA's distribution system including existing facilities will be around SL 18 million excluding staff salary and labor wage.

CHAPTER 4
PROJECT EVALUATION AND RECOMMENDATION

CHAPER 4 PROJECT EVALUATION AND RECOMMENDATION

4-1 Project Effect

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

i) Reducing of leakage volume and leakage incidence in distribution mains
ii) Securing saved water to be used for water supply
iii) Reducing secondary contamination
iv) Cutting repair cost of the distribution network
v) Increasing revenues
vi) Improving leakage repair productivity

The implementation of the Project under the Japan's Grant Aid is judged viable for the following reasons:

(1) Reducing of leakage volume and leakage accidents in distribution mains

Leakage problems occur mainly on the cast iron pipes. Water saved by the project is estimated about 33,000 m^3/d since unit loss for cast iron pipe length is estimated as 30 $m^3/hr/km$. This amount is equivalent to 16% of the total leakage volume in 1995. About 124 km of the existing distribution mains are cast iron pipe with lead joint. As 46 km of cast iron pipes are replaced by ductile iron pipe by the Project, about 37% of the leakage problems can be reduced. Repair works of the distribution network are also reduced by the implementation of the Project, effectively improving DAWSSA's operation and maintenance system.

(2) Securing saved water to be used for water supply

DAWSSA is faced with water deficit problem every year, however it is difficult for DAWSSA to develop new water resources on account of restriction of the existing water rights of DAWSSA. Leakage reduction by the Project through replacement of pipes saves as much as about 33,000 m^3/d of the supplied water. The amount of saved water is enough to supply 171,000 persons without exploiting new water resources.

(3) Reducing secondary contamination

Leaking pipes and joints are important sources of secondary contamination. The Project improves any abnormally low-pressure conditions in the distribution system due to the leakage and helps reduce the incidence of secondary contamination. The beneficiaries of the Project are about 1.4 million persons living in Damascus City. Reduced leakage in distribution mains also reduces the risk of contamination and therefore enhances public health and safety. People will be supplied with a more stable and safer water supply service after the project. The Project is beneficial in improving people's livelihood and hygienic conditions.

(4) Cutting repair cost of the distribution network

Many of the pipes are old cast iron mains with lead joints which frequently leak and by replacing these pipes the frequency of leakage is reduced. The repair costs for the distribution network are cut by reducing the frequency of leakage and reducing the number of large scale leaks by replacement of large diameter pipes (diameter 400 mm to 600 mm). The existing repair cost consists of personnel expenses, material expenses and transporting expenses. The personnel expenses are not cut so much by reduction of the frequency of leakage. On the other hand, it is expected that material expenses and transportion expenses decrease in proportion to reduction in the frequency of leakage.

(5) Increasing revenues

Water saved by the project is about 33,000 m^3/d or equivalent to 16% of the total leak volume in the 1995 year. The amount of saved water is equivalent 11.9 million m^3 of yearly water yield enough to supply 171,000 persons. It presents approximately US$830,000 in additional revenue per year at current tariff levels if the saved water is regarded as revenue earning water.

(6) Improving leakage repair productivity

In addition to the poor conditions of water mains, the existing maintenance equipment is also inadequate to effectively maintain and repair the water distribution system. Procurement of new maintenance equipment consisting of a wheel crane, 3 units of backhoe loader, a workshop car and hand tools provides the maintenance and repair section with the ability to take adequate and prompt action for leakage prevention. The wheel crane is utilized at the Adra stockyard in order to take materials out easily all the time even in case of emergency.

The backhoe loaders make excavation and backfill works at site faster and easier with fewer workers. The workshop car and hand tools contribute to shorten repair working hours and carry out adequate repair.

4-2 Recommendation

Judging from the study result, it is expected that the Project will significantly increase the supply of safe drinking water to more inhabitants, without development of new water resources. Accordingly, it is concluded that the implementation of the Project is suitable and viable for Japan's Grant Aid. Furthermore, it is expected that the Project will be implemented smoothly and effectively with due consideration to and realization of the following commitment by the concerned parties.

- To prepare the budget and to establish the organization for the implementation stage with regards to the customs clearance of materials and the replacement of distribution pipes,
- To follow application procedures for construction permits for the pipe replacement in the road allowances to meet the implementation schedule, and
- To establish the data management system for the water distribution network for proper operation and maintenance in the future.

Tables

Table 2.2.1 Existing Maintenance Equipment/Vehicles

KADAM Emergency Center

(1) Equipment Maintenance Department

Type	Spec.	Puchase Year	Country Origin	Condition	Rate of Operation	Distance Traveled (km)
1. Pick up car	3 ton	1981	Japan	B	A	> 500,000
2. Pick up car	3 ton	1986	German	C	A	> 600,000
3. Pick up car	3 ton	1996	Japan	A	A	70,000
4. Pick up car		1985	Russia	C	A	> 600,000
5. Pick up car		1975	German	B	A	> 600,000
6. Workshop car		1980	Japan	A	A	> 500,000
7. Workshop car		1980	Russia	C	A	> 600,000
8. Workshop car		1980	Japan	B	A	> 700,000
9. Wheel loader	0.5 m^3		USA	C	No work	
10. Wheel crane	6 ton		England	C	No work	
11. Truck with crane		1969	Sweden	C	A	> 800,000
12. 4WD Wagon		1962	-	-	-	-
13. Folk-lift	3 ton	1973	France	B	A	-
14. Air compressor	-	1983	Japan	A	A	-
15. Drainage pump		-	Italy	A	A	-
16. Engine generator	50 KVA	1985	England	A	A	-
17. Diesel engine welder			France	A	A	-
18. Diesel engine welder			France	A	A	-
19. Diesel engine welder			France	A	A	-

(2) Large Diameter Pipe Repair Department

Type	Spec.	Puchase Year	Country Origin	Condition	Rate of Operation	Distance Traveled (km)
1. Pick up car	3 ton	1973	USA	C	A	> 1000,000
2. Pick up car	3 ton	1980	Japan	B	A	> 650,000
3. Pick up car	3 ton	1996	Japan	A	A	60,000
4. Wheel dumper	1 m^3	1976	England	C	A	-
5. Loader BoBcat	0.25 m^3	1976	England	C	A	-
6. 4WD Wagon		1974	Japan	B	A	> 900,000
7. Air compressor		-	England	C	A	-
8. Air compressor		-	England	C	A	-
9. Drainage pump	3 inch	-	Italy	B	A	-
10. Drainage pump	3 inch	-	Italy	B	A	-
11. Drainage pump	3 inch	-	Italy	B	A	-
12. Engine generator	3 KVA		Italy	B	A	-
13. Engine generator	3 KVA		Italy	B	A	-
14. Engine generator	3 KVA		Italy	B	A	-
15. Grinder		1985	Italy	A	A	-
16. Saw for asphalt pavemen	-	1996	Italy	A	A	-

(3) Small Diameter Pipe Repair Department

Type	Spec.	Puchase Year	Country Origin	Condition	Rate of Operation	Distance Traveled (km)
1. Pick up car	3 ton	1980	Japan	A	A	> 600,000
2. Pick up car	2 ton	1886	Russia	B	A	> 500,000
3. Pick up car	2 ton	1986	Russia	B	A	> 500,000
4. Pick up car	2 ton	1986	Russia	B	A	> 500,000
5. Pick up car	1 ton	1974	France	B	A	> 700,000
6. Loader BoBcat		1976	Italy	C	No work	
7. Air compressor		1979	England	B	A	-
8. Air compressor		1979	England	B	A	-
9. Drainage pump		-	Italy	B	A	-
10. Drainage pump		-	Italy	B	A	-
11. Engine generator	3 KVA		Italy	C	No work	

MAZZRA Emergency Center

(1) Small Diameter Pipe Repair Department

Type	Spec.	Puchase Year	Country Origin	Condition	Rate of Operation	Distance Traveled (km)
1. Pick up car	0.8 ton	1981	Japan	B	A	> 650,000
2. Pick up car	0.8 ton	1981	Japan	B	A	> 650,000
3. Pick up car	0.5 ton	1974	France	B	A	> 800,000
4. Pick up car	0.5 ton	1974	France	B	A	> 800,000
5. Pick up car	0.5 ton	1986	Russia	C	A	> 350,000
6. Pick up car	0.5 ton	1986	Russia	C	A	> 350,000
7. Pick up car	0.5 ton	1986	Russia	C	A	> 350,000
8. Loader BoBcat						
9. Air compressor		1985	France	B	A	
10. Air compressor		1985	England	B	A	
11. Air compressor		1985	England	B	A	
12. Air compressor		1993	German	A	A	
13. Air compressor		1993	German	A	A	
14. Air compressor		1986	France	B	A	
15. Drainage pump		1981	Italy	B	A	
16. Drainage pump		1981		B	A	
17. Drainage pump		1981		B	A	
18. Drainage pump		1981		B	A	
19. Engine generator	5 KVA		Italy	A	A	
20. Grinder		1985	Italy	A	A	-

Note :

1. Condition — Good : A; Bad : B; Useless/Bad : C (necessary of repair and spare parts)
2. Rate of operation — Daily use : A; Few days a week : B; Rare case : C
3. Distance traveled should be shown a indicated figure with distance meter or in operation record.

Table 2.3.1 Tax and Duty in Syria

(29th, June, 1997)

Descriptions	Custom Duty (%)	Under Loan	Under Own Fund
1. Import Materials		by DAWSSA (Exchange Rate SL35 / US$)	by DAWSSA
- Steel Pipe, elbow, joint	13		
- Valve	21		
- Water meter	9		
- Flow meter	9		
- Ductile cast iron pipe	28		
- Pump sets	8		
- Generator sets	8		
2. Stamp Duty - 1.248% Contract amount		by DAWSSA (Ex. Rate SL35 / US$)	by DAWSSA (Pay by US$)
3. Tax for Installation Work *3 -18% of such items amount (both L.C. and F.C.)		by DAWSSA (Ex. Rate SL35 / US$)	by Contractor*2 (Pay by US$)

Note:

1) *1 marked is foreign contractor.
2) *2 marked is local and foreign contractor.
3) *3 marked is "General services tax for manpower supply and administration work".
4) L.C. is local currency portion, F.C. is foreign currency portion.

Table 2.3.2 Local Registered Companies

Local registered companies should be registered / high-class rank, by DAWWSA. Under the provisions of the contractors law, all Syrian contractors are legally to be classified in accordance with the government works by law.

The classifications is from grade First to grade Third with grade First the highest. as follows;

	Descriptions	Local Registered Companies	Classifications
1	Supply and Execution of	1. OMER SHANBUOR	Third
	Pipes and Metals works	2. HOJA & ZARABANI	First
		3. KHALED BARAKAT	Second
		4. ANTRANIC BOGOSYAN	First
2	Pump Installations	1. RIMA COMPANY	First
		2. GADIR COMPANY	Second
		3. ANTRANIC BOGOSYAN	First
3	Mechanical & Electrical	1. KHALED BARAKAT	Second
	Installations	2. MOUFID TAMIM	Third
		3. HAMZE FARRA	Third
4	Pipe Laying	1. SAFFA COMPANY	First
	for Transmission Lines	2. GENERAL COMPANY RIMA	First
		for Irrigation and Water supply	
		3. HOJA & ZARABANI	First
		4. RAMIZ RESLAN	First
		5. M.C.E	First
5	Laying of House Connections	1. SAMIR AL AHDAB	Second
		2. GENERAL COMPANY RIMA	First
		for Irrigation and Water supply	
		3. M.C.E.	First
		4. BASSAM ZUHAILI	Third
6	Road Constructions	1. GENERAL COMPANY RIMA	First
		for Irrigation and Water supply	
		2. MOUHAMAD MAHMOUD	Third
		RAMADAN	
		3. RAMIZ RESLAN	First
		4. BASSAM ZUHAILI	Third
		5. KASSOUN COMPANY	First
		6. FOUAD TAKLA COMPANY	First
7	Fitting Castings	1. GORG MASMANYAN	Second
		2. HAGOB ARWSHYAN	Third
		3. ABED AL MAJED YASSIN	Second
8	Electric Board works	1. RAFFI HAWAKIMYAN	Second
		2. MOUFID TAMIM	Third
		3. MOUHAMAD ABED	Third
		AL- KADIR BABIL	

* M.C.E. : Military Construction Establishment

Table 2.3.3 List of Pipelines for Review Study (1/4)

PIPE I.D. AREA CODE	DATA Sht/No.	Dia. (mm)	Length (m)	Dwg. No.	Key Map	Street Name	Installed year	Priority
M	10	- 600	840	03,06	12,18	Al-Asad library, Omawiyin square till Al-Tora river	1950 55	A
M	11	- 150	780	03,06	12,18	Al-Asad library, Omawiyin square till Al-Tora river	1950 55	B
M	14	- 250	400	06	18	The Oumawiyin square, Beirut street till the pumping station of Al-Oumawiyin	1960 65	A
M	23	- 250	460	04	13	Al Moysat square till Al-Shahkandar	1950 60	A
M	25	- 400	800	04	13	Tarbieh square till Sabah Bahrat square	1950 55	A
M	26	- 600	1,380	04,06,07	13,18,19	Oumawiyin square, Mahadi Bin Baraka street, Arnous square	1945 50	A
M	27	- 200	400	07	19	From Bawobet Al-Salkia till Sabah Bahrat, 29 May street	1950 55	A
M	28	- 100	400	07	19	From Bawobet Al-Salkia till Sabah Bahrat, 29 May street	1950 55	B
M	29	- 250	720	07	19	Al-Najma square to Al-Sham hotel, Brazil street	1940 45	A
M	30	- 250	1,000	07	19	Guest Palace upward Meridien-Beirut street till Al-Asad library	1950 55	A
M	31	- 100	300	07	19	AABED (Sabaa Barat / Salhia) (Note: Data sheet indicates Key map 25)	1955 60	B
M	32	- 200	600	09	25	Sabah Bahrat Dar Al-Salam school	1955 60	A
M	33	- 200	240	09	25	From Dar Al-Salam till Al-Najima square	1950 55	A
M	35	- 250	680	07	19	Opposite Guest Palace, Al-Argantein street, Al-Teeighez, Al-Fardoss street till Boureg Al-Salhia	1940 45	A
M	45	- 600	780	04	13	Sabah Bahrat-Arnoos square	1950 55	A
	Sub-total		9,780					

Total Length of Priority "A" is 8,300 m.

Table 2.3.3 List of Pipelines for Review Study (2/4)

PIPE I.D. AREA CODE	DATA Sht/No.	Dia. (mm)	Length (m)	Dwg. No.	Key Map	Street Name	Installed year	Priority
N	34	- 250	410	07	19	The war mureum till Semirames hotel	1950 55	A
N	36	- 150	1,100	07	19	From Justice Palace to Hizaz Habbuni till obstetric hospital - university amphitheater	1950 55	B
N	37	- 250	160	07	19	Tkia Sultan Salim	1950 55	A
N	38	- 250	1,240	07,09	19,25	From Heizoz till Muytahed passing Kaled Ibn Al-Walleed street	1955 60	A
N	39	- 200	820	07,09	19,25	Al-Nasser street, Khaled Ibn Al-Waled street, Bab Srejeh, Al-Zeim mosque	1955 60	A
N	40	- 500	1,760	07,09	19,25	Justice Palace, Al-Nasser street, Khaled Ibn Al-Waled street-Mojtahed	1965 70	A
N	41	- 200	580	07	19	Beginning of Al-Nasser street till the DAWSSA Al-Hizaz square till behind the Ministry of Interior	1965 70	A
N	42	- 100	200	09	25	From Zeiel Ibn Thaket mosque till Fahhameh	1940 45	B
N	43	- 150	880	07,09	19,25	Al-Fahhameh-Al-Abas street	1940 45	B
N	44	- 500	620	09	25	Mojtahed-Bab Mousala	1965 70	A
N	53	- 100	520	07	19	Halbouni	1950 55	B
N	77	- 250	1,700	06,07	18,19	Palestine	1950 55	A
N	78	- 400	220	06	18	Omawiyin square till the custom square	1955 60	A
M	46	- 500	1,500	04,8	13,20	Sabah Bahrat - Bagdad street Al-Thoura Tunnel till Abbasiyin square	1950 55	A
M	51	- 200	1,460	04,05	13,14	Bagdad street	1960 65	A
M	52	- 150	1,520	04,05	13,14	Bagdad street	1950 55	B
M	74	- 200	800	05,08	14,20	Aleppo		A
M	76	- 500	780	05,08	14,20	Allepo		A
	Sub-total		16,270					

Total Length of Priority "A" is 12,050 m.

Table 2.3.3 List of Pipelines for Review Study (3/4)

PIPE I.D. AREA CODE	DATA Sht/No.	Dia. (mm)	Length (m)	Dwg. No.	Key Map	Street Name	Installed year	Priority
C	54	- 200	660	08	20	Al-Amen street, Modhad Basha, South-Al-Khadra (Vegetable market) (Note: DAWSSA Map indicates 200 mm)	1940 45	A
C	55	- 400	1,440	08	20	Al-Amen street, Bagdad street	1940 45	A
C	56	- 100	4,500	08	20	South-Al-Hamedia (Note: Existing 100 and 80 mm)	1950 55	B
C	57	- 200	1,720	08	20	Modhad Basha Bab-Al-Jabea till Bab Sharki	1920	A
C	58	- 500	660	08,10	20,26	Al-Amen street till Modhad Basha, Nakkashat	1960 65	A
C	59	- 400	2,560	10	26	From Ibn Assaker street till Bab Mosallah to the airport	1950 55	A
C	60	- 250	980	10	26	From Al-Amen street till Bab Mosallah	1955 60	A
C	61	- 600	990	10	26	From the airport round about till Bab Mosallah	1965 70	A
C	62	- 200	900	07,09	19,25	Bab Al-Jabea-Al-Sanenia mosque-Al-Badri street till Al-Amen street	1920	A
C	63	- 250	1,200	10	26	Industrial Zone	1950 55	B
C	64	- 100	2,840	10	26	Industrial Zone	1950 55	B
C	65	- 150	540	07,10	19,26	From Bab Masallah till the Souweiha	1940 45	B
C	66	- 150	1,060	07,10	19,26	Bab mosallah square till the Souweiha and Bab Al-Jabea	1940 45	B
C	67	- 500	1,180	08,10	20,26	From the entrance of Al-Amen street, round about the airport, Shake-Reslan	1975 80	A
C	68	- 100	6,800	08	20	Azaria-Bab Touma (Note: Existing 100 and 80 mm)	1930	B
C	69	- 250	1,520	10	26	From the airport round about till the Faculty of Electrical engineering	1960 65	B
C	70	- 200	860	12	32	New Zahera	1960 65	B
C	71	- 600	880	11	31	Old Zahera till Al Ka'aa (Midan) from the High road bridge to the end of Masaken Zahera	1960 65	A
C	72	- 200	1,520	11	31	Old Zahera	1960 65	B
C	73	- 400	440	11,12	31,32	Moukhaygam Palastine street, from Al Basheer Al Basheer Mosque till Vegetable market	1950 55	B
C	75	- 200	800	08	20	Amara-Malek Faisel street till Al Roos Tower	1950 55	A
	Sub-total		34,050					

Total Length of Priority "A" is 12,770 m.

Table 2.3.3 List of Pipelines for Review Study (4/4)

PIPE I.D. AREA CODE	DATA Sht/No.	Dia. (mm)	Length (m)	Dwg. No.	Key Map	Street Name	Installed year	Priority
P	7	- 250	225	03	12	Al-Mourakit till Nazem basha	1950 55	A
P	8	- 250	870	03	12	Aki-Alaa square, American embassy, Al-Malki square, Al-Mansoor street	1950 55	A
P	9	- 400	1,660	03,06	12,18	From Toura river toward Al-Malki square	1940 45	A
P	12	- 250	1,080	03	12	Crossing Al-Toura river with Malki street, Al-Hanano street, The Residence of the president downhill Mourakets	1950 55	A
P	13	- 250	520	03	12	The British embassy, Abdu-Moneim Riad street, Al-Malki	1950 55	A
P	15	- 150	600	03	12	The presidential palace-Afeef till the beginning of Jeser-Al-Abyad	1955 60	B
P	16	- 100	400	03	12	Al-Shoura street, opposite the Prazedency Palace	1955 60	B
P	17	- 250	740	04	13	Abi-Alaa square-Abu Roumane, the Presency Palace, Shoura	1955 60	A
	Sub-total		6,095					
	Total Length of Priority "A" is 5,095 m.							
W	1	- 400	800	03	12	Wali reservoir - Third alley - Ibn Ayyad - Al Fawakheer (Shamdeen)	1940 45	A
W	2	- 150	700	03	12	Al-Mouhamadi mosque till Huda Shaarawi	1940 54	B
W	3	- 500	550	03	12	Al-Wali, Third street till Mourakit-Al-Rais street	1950 55	A
W	4	- 250	460	03	12	Al-Mourakit - Nazem basha - Huda Sherawi	1950 55	A
W	5	- 100	680	03	12	Al-Satta anvenve, Al-ker mosque, (Nazem Basha street)	1940 54	B
W	6	- 150	1,720	03	12	Al-Khorshead square, Nazem Basha road till Al-Rawda palace, Haroon Al-Rasheed street	1955 60	B
W	18	- 250	1,760	03,04,06	12,13,18	From Al-Asad library, towards Al-Malki the parallel strret to Al-Toura river, below Bader mosque- Aki-Alaa-Jesre Abyad towards president street	1950 55	A
W	19	- 250	1,100	03,04	12,13	The Vatican embassy, Abi-Al-Alaa square-Al-Hizaz road till Jesre Abyad square square-Nuri Basha	1950 55	A
W	20	- 250	420	04	13	Bustan Al-Rais strret, Al-Hizaz street till the Tarbieh square	1950 55	A
W	22	- 250	1,040	04	13	Al-Tarbieh square, Al-Moysat square, Seti Hafiza till the Russian embassy	1950 60	A
W	24	- 150	280	04	13	Seti Hafiza till Al-Moysat square	1950 60	B
W	47	- 600	1,440	01,02	7,8	Sheemden square Ibn-Al-Amed-Al-Sham school till the bakeries to Al-Thoura tunnel	1955 60	A
W	48	- 250	480	01,04	7,13	Al-Maisat square St-Al-Sham school	1955 60	A
W	49	- 150	820	01,04	7,13	Al Mesat square till Shamden square Abu-Al-Nour mosque	1955 60	B
	Sub-total		12,250					
	Grand Total		78,445					

Total Length of Priority "A" is 8,140 m.

Note: Symbol in Area Code

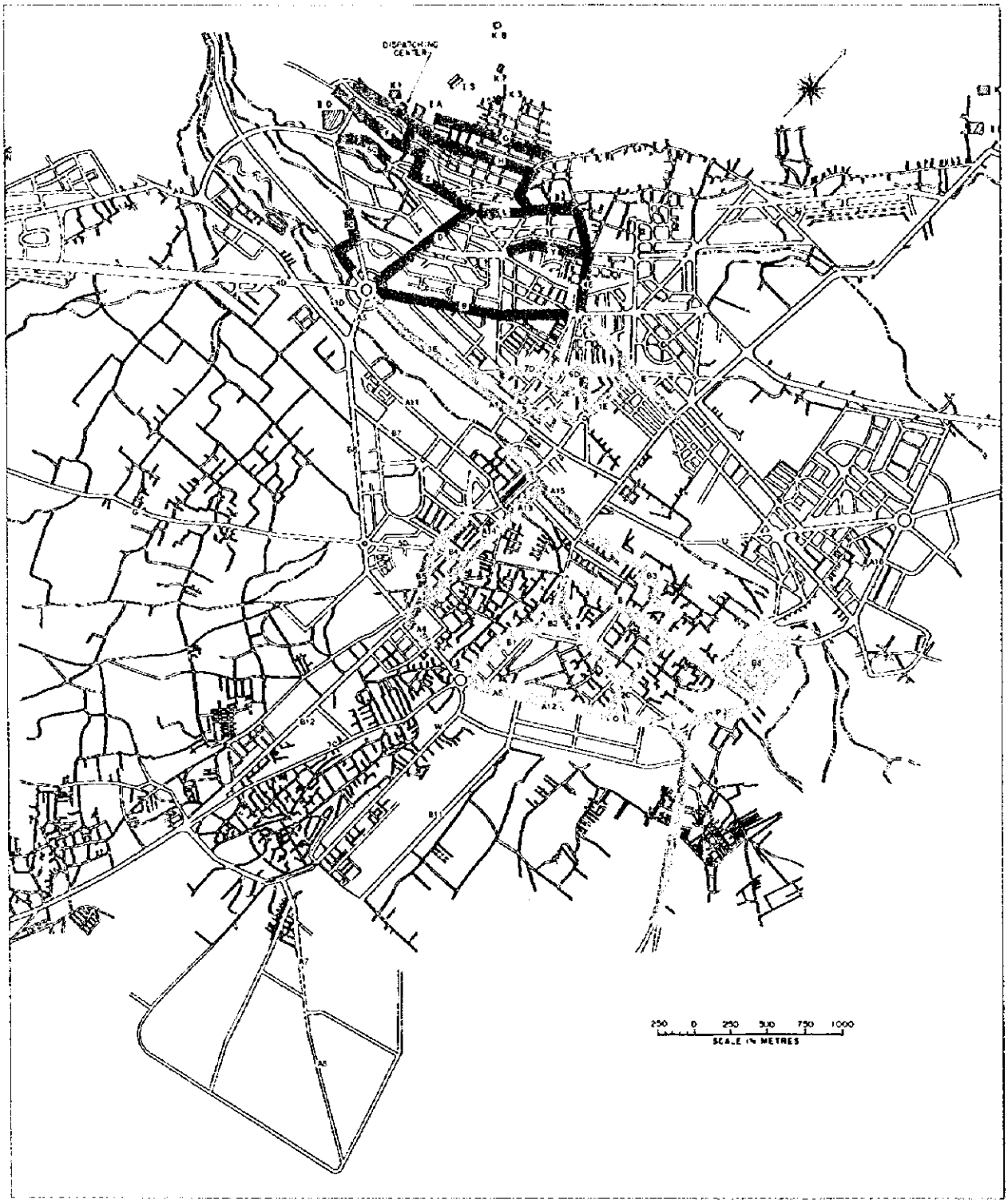
M : Malki Area, N : Nasr Area, C : Old city area, P : Presidential area, W : Wali area

Priority

"A" is an object of the Project.

"B" is not an object of the Project.

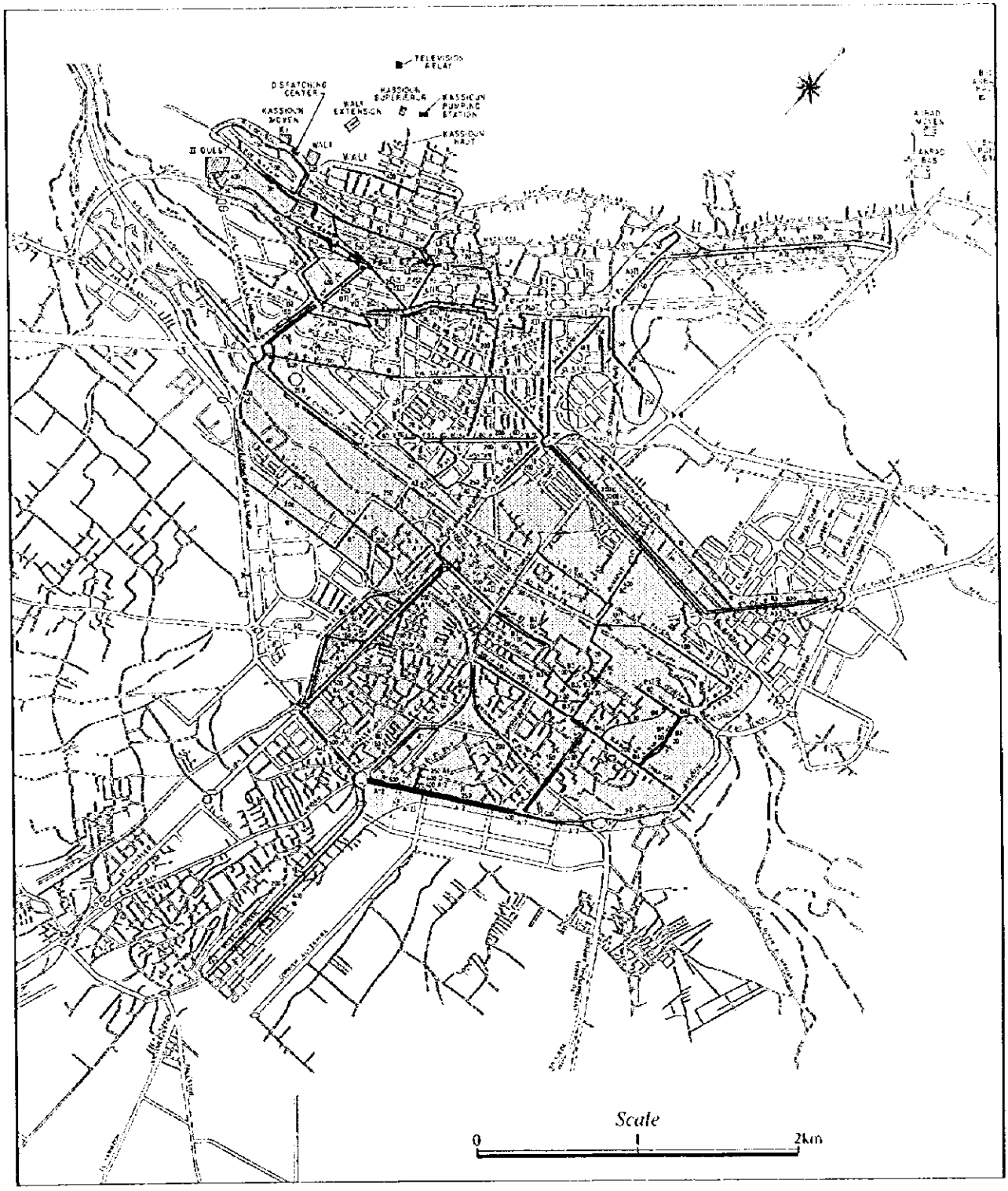
Figures



Replacement Schedule

1st year	16,665m
2nd year	18,030m
3rd year	16,150m
Total	50,845m

Figure 2.2.1
Proposed Project



Legend

Stage		Area
I		Wali Area
		Malki Area
II		Old City Area
III		Presidential Area
		Nasr Area

Figure 2.2.2 Project Areas

Legend

—— : Whole day work area

—— : Night time work area

—— : Presidential area

Figure 2.3.1
Classification of Regulation for Construction Works

Figure 3.1.1 Execution Structure of DAWSSA

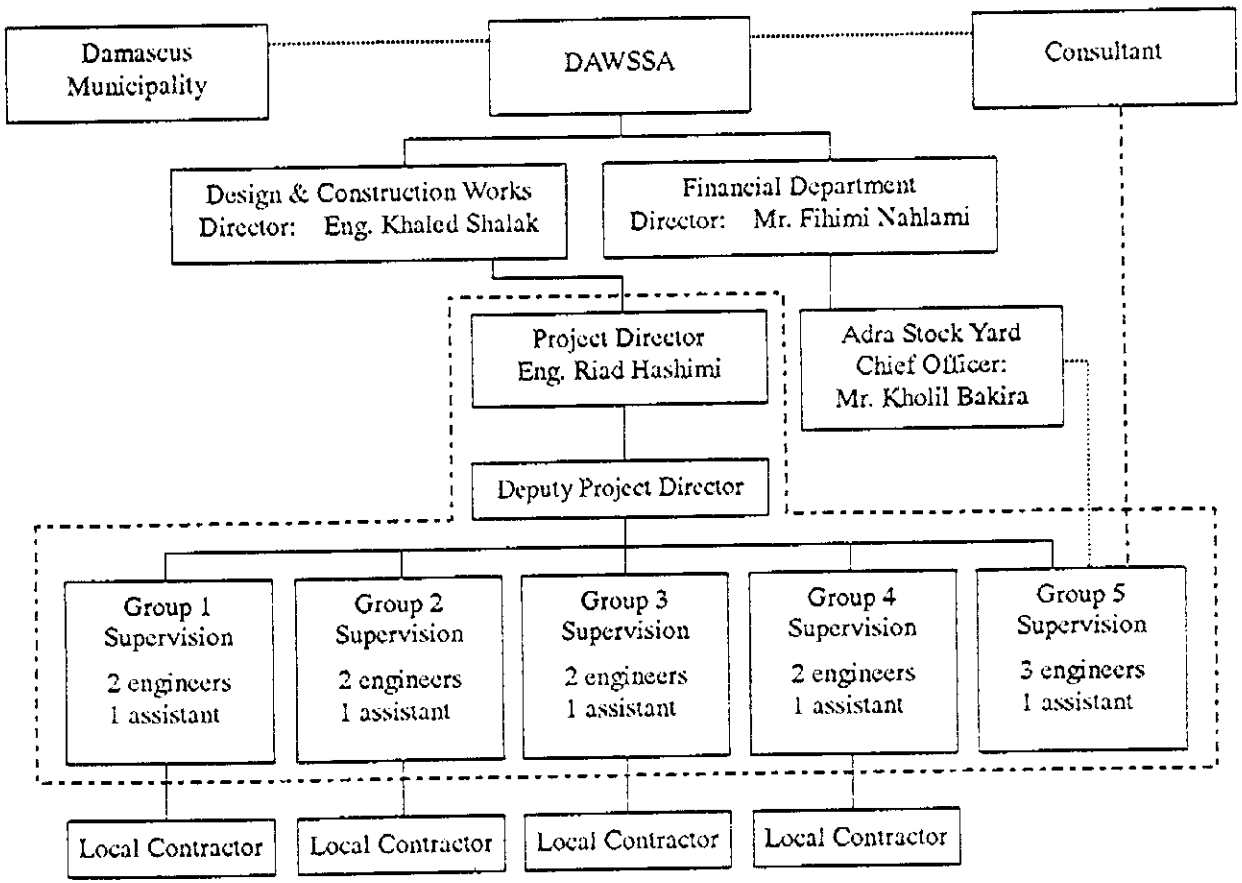


Figure 3.1.2 Adra Stock Yard