CHAPTER 2

CONTENTS OF THE PROJECT

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2-1 Basic Concept of the Project

In 1995, DAWSSA supplied a total of approx. 218 MCM of water, and there was an estimated 25 MCM demand which was not met. It was found out that one of the main reasons for the shortage of water supply was a high level of UFW, estimated at 64%. For this reason, DAWSSA has set a target figure of 25% total UFW for the year 2015. Further, it was also found out that another major reason for the water shortage was a high level of system leakage occurring due to the aging of the water supply pipes. In order to cope with these problems, DAWSSA has planned to carry out urgent water mains replacement over 6 years. This program includes a project carried out under Japan's Grant Aid to replace 46 km of water supply pipes in a central part of Damascus City.

The Government of Syria requested the Government of Japan to conduct the procurement project (phase II) of replacement of the remaining 51 km of old pipes in the outskirts of the central part of the City with new ductile iron. After this implementation review study, however, an additional 24 km of old pipelines found necessary to replace. As a result of the study, a total length of pipelines, 75 km, plans to be replaced in the project (phase II). The necessary piping materials will be procured under Japan's Grant Aid while the pipe laying will be carried out by the Syrian side. By implementing the program, which includes replacement of water mains and water supply works in informal areas, DAWSSA is expecting to reduce the rate of system leakage from the present 29 % to a target rate of 25 %.

The objective of the Project described here is to provide 75 km of ductile iron pipes and related materials, and to provide technical assistance in the field of pipe installation management as well as data collection/arrangement methods to support effective maintenance/repair procedures. By providing technical assistance it is expected that the DAWSSA engineers will develop the ability to manage construction projects properly, especially in the area of schedule control, and be able to cope with future pipe accidents properly and promptly.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Natural conditions

The climate of Damascus City is Mediterranean, characterized by hot summers from April to October and humid winters from November to March. Mean annual rainfall from 1956 to 2001 was 468 mm in Figeh catchment area of the Anti Lebanon Mountain Belt. Wide fluctuation in annual rainfall was experienced during the above years. In the drought year from 1959 to 1960, the annual rainfall was 227 mm, while in the year from 1991 to1992, 925 mm of rainfall was recorded. In the mountains, the rainfall generally exceeds 1,200 mm above an altitude of 2,000 m. On the plains east of Damascus the mean annual rainfall is around 200 mm. In view of the past rainfall record in Damascus City, counter measures to rainfall are not considered necessary.

The present land use in the area is classified into three categories: residential & commercial areas, administrative areas and a 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 the mountain area is more than 30 %. A restrained joint method should be adopted for pipe replacement in the Kassioun Mountain foot areas, such as Berzeh and Mezze, where the slopes are steep.

The urban area of Damascus covers the thick alluvial fan created by the Barada River where it leaves the Anti Lebanon Mountain Belt and flows east onto a plain of the 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 methods.

(2) Economic and social conditions

Damascus is the nation’s capital and administrative center. Most of the economic activity in the region centers on tourism and trade. The residential area of Damascus is approx. 86 km2, 48% of the 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 leveled off and has been lower than the growth rates experienced in the other large urban centers. According to the 2000 census, the total population in Damascus City was 1,510,000. On average there are 6.0 persons per dwelling. About 60% of the families 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 is 69.0 years, while infant mortality is 32 per 1000. Estimates by the Damascus City Authority 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 the population are Islamic, religious issues, such as lifestyle and holiday, should be considered in the implementation schedule of the Project.

There are many narrow roads with heavy traffic jams, since land readjustment has not been done in many areas, including an ancient Old City area and the Yarmouk area where many Palestinian refugees are living. The construction plan, therefore, should be formulated in consideration of local road conditions. In some areas, permission for construction work must be obtained from Damascus City Authority.

(3) Present water supply conditions

As much as 70% (1995) of the water supplied by DAWSSA is drawn from Figeh Main Spring; a major spring which has been recognized for its superb water quality and abundant yield for centuries. The water from the spring is characterized by low conductivity (around 300 uS/cm), neutral PH (around 7.7), and low hardness (around 150 mg as $CaCO_3$/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 17% of the water used by DAWSSA in 2001, produces good quality water which satisfies the drinking water requirements of 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 were 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 net work from leak points since leakage accidents break out frequently in the net work. To avoid secondary contamination, replacement of damaged old pipes is strongly recommended.

Many of the pipes are old cast iron mains with leaded 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 of the same diameter of the existing pipes. Network analysis was used to establish that the existing pipes have enough capacity to meet the supply water requirements. In addition to the pipes, other accessories and fittings also need to be replaced at the same time.

(4) Procedure for tax exemption

Tax exemption is available according to the tax regulations of the Syrian Arab Republic when goods are to be imported into the country under the Japan's Grant Aid scheme. DAWSSA will undertake to perform this procedure successfully as they are experienced in tax exemption applications.

(5) Project execution organizations

It has been confirmed that DAWSSA will assign responsibility for Project execution to the same Directorates as in the initial project (phase I). When the water supply equipment and materials arrive at the Tartus seaport, the Finance Directorate is in charge of receiving them and transporting them to the Adora stockyard in Damascus. The Study/Design Directorate is responsible for the preparation of tender documents to be used for the procurement of contractors/suppliers. Once construction contracts are signed, it falls within the area of the Construction/Supervision Directorate's responsibility to supervise the construction activities. After completion of the construction, the responsibility for maintaining the facilities, as for the existing water supply facilities, rests with the Distribution Directorate.

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

Contractors and suppliers who intend to undertake the construction works and 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 Metal works, 2) Pump Installations, 3) Mechanical & Installations, 4) Pipe Laying for Transmission Lines, 5) Laying of House Connections, 6) Road Constructions, 7) Fitting Castings and 8) Electric Board works.

The first, second and third ranked contractors in each field are nominated for tendering on DAWSSA's projects. Twenty-one (21) contractors are registered in the first rank, eight (8) contractors are in the second rank and nine (9) contractors are in third rank.

DAWSSA has experience of contractor capabilities through many projects already executed, including the project (phase I).

(7) Scope of material replacement and selection of material

The materials to be procured are pipe materials for the replacement of the old distribution pipelines, including accessories such as snap tap with saddle and stop valves, which are connected to house connection lines, and fire hydrants. Manhole covers, which are installed over sluice valves and air valves, are to be cast with Japan's ODA mark on its surface. This will ensure that the people in Damascus recognize that the Project is implemented under Japan's Grant Aid scheme.

There are quite a number of old cast-iron pipes, which frequently leak from the lead joints and pipe breaks, while it has been observed that water leakage was almost never detected from the joints and trunk mains made of ductile iron pipe installed since the 1970s. Ductile iron pipe has many advantages compared with cast iron pipe. In general, the service life of ductile iron pipes is approximately 60 years, compared to 25 years for 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 joints for straight pipes and mechanical joints for fittings, and DAWSSA has experiences in ductile iron pipe laying works. Therefore, ductile iron pipes will be used for new replacement pipes due to their long-life and technical advantages.

(8) Source of material for procurement and construction schedule

According to the basic Japanese Government's procurement rules, procurement scheduled for a single fiscal year must be completed within the fiscal year. In consideration of these conditions, high reliability in delivery period and quality of materials are essential. Based on previous experience in the project (phase I), Japanese manufacturers, which are generally reliable with regard to delivery time and quality of materials, should be employed. The procurement schedule, in view of DAWSSA's previous experience and of local contractor's construction ability, is divided into two phases.

2-2-2 Basic Plan

(1) Overall plan of rehabilitation project of distribution pipelines

Japan's Grant Aid for this Project is intended to provide the Government of the Syrian Arab Republic with the necessary funds for the procurement of materials and the provision of the Technical Assistance services under the Project for Rehabilitation of Water Distribution Pipelines in Damascus City. The materials are ductile iron pipes, 75 km, for water distribution mains ranging from 100 mm to 600 mm in diameter, together with fittings. The materials are to be laid in the five (5) areas of Berzeh, Mezze, Bagdad, Kafar Sousa and Midan. The Technical Assistance will be conducted to facilitate smooth pipe laying and efficient maintenance activities after construction completion, providing construction supervision from time to time, and techniques/know-how related to the preparation of construction supervision manuals and data digitization.

Pipe replacement in the areas of Berzeh, Bagdad and Kafar Sousa, where new pipes are to be connected to the pipes installed at the time of the initial project (phase I), and Midan, a part of which is the Yarmouk area containing Palestinian refugee camps, take priority over the Mezze area. Material lists should be prepared to cover all the necessary components needed to complete the replacement of each pipeline, including straight pipes, fittings, accessories, and other associated items. Ductile iron pipe with internal mortar lining will be adopted for the new replacement pipes because of its advantages in terms of high durability and the corrosion proofing mortar lining which prevents rust discoloration of the water and corrosion related reductions in water flow. Accessories such as snap taps with saddle, stop valves and air valves are also to be replaced with new ones during pipe renewal works. A restrained joint method is to be adopted instead of the anchor block method in order to minimize the period of water suspension during construction. Contingency quantities are also to be taken into account to allow for additional materials needed when avoiding existing obstructions and when materials are damaged during handling.

The Government of the Syrian Arab Republic originally requested a total length of pipe materials of 51 km, together with associated materials: 24 km for the first year and 27 km for the second year. Afterwards, however, an additional pipeline of 24km was found out to be in urgent need of replacement. It is recommended that a packaged assistance providing a total length of 75 km of pipe materials (50 km for the first year and 25 km for the second year) and Technical Assistance services is the most suitable arrangement. This arrangement should ensure an early completion of the pipeline renewal project and build on the positive effects realized in the initial project (phase I).

(2) Piping plan and specification of pipe materials

Ductile iron pipes, fittings and valves are the main materials to be procured for the pipeline rehabilitation project. Total pipe length for replacement is summarized below:

Table 2.1 Pipe Replacement Length

Year	Area	Pipe Diameter (mm)								Total
		100	150	200	250	300	400	500	600	(m)
1	Kafar Sousa	2,400	2,000		1,400					5,800
	Bagdad	10,500	5,100	2,600	1,900	500		1,300	1,100	23,000
	Berzeh	3,400	500		2,600	3,200				9,700
	Midan	200	1,700	4,900	570		2,920		1,200	11,490
	Subtotal	16,500	9,300	7,500	6,470	3,700	2,920	1,300	2,300	49,990
2	Mezze	8,500	5,000	6,600	2,900		2,100			25,100
Total		25,000	14,300	14,100	9,370	3,700	5,020	1,300	2,300	75,090

Proposed specifications of ductile iron pipe, to the standard of ISO 2531 (JIS G5526-D3, JIS G5527), are listed below. The length of a straight pipe is 6 m according to ISO 2531:

1) Wall thickness

Table 2.2 Pipe Wall Thickness

Nominal Diameter (mm)	Thickness (mm)
100	6.1
150	6.3
200	6.4
250	6.8
300	7.2
400	8.1
500	9.0
600	9.9

2) Hydraulic test pressure

Table 2.3 Hydraulic Test Pressure for Water Pipes

Nominal Diameter (mm)	Pipes	Fitting
100 to 300	50 bar	25 bar
400 to 600	40 bar	16 bar

3) Mechanical properties

Table 2.4 Mechanical Properties of Pipe Materials

	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

4) Standard coating and lining

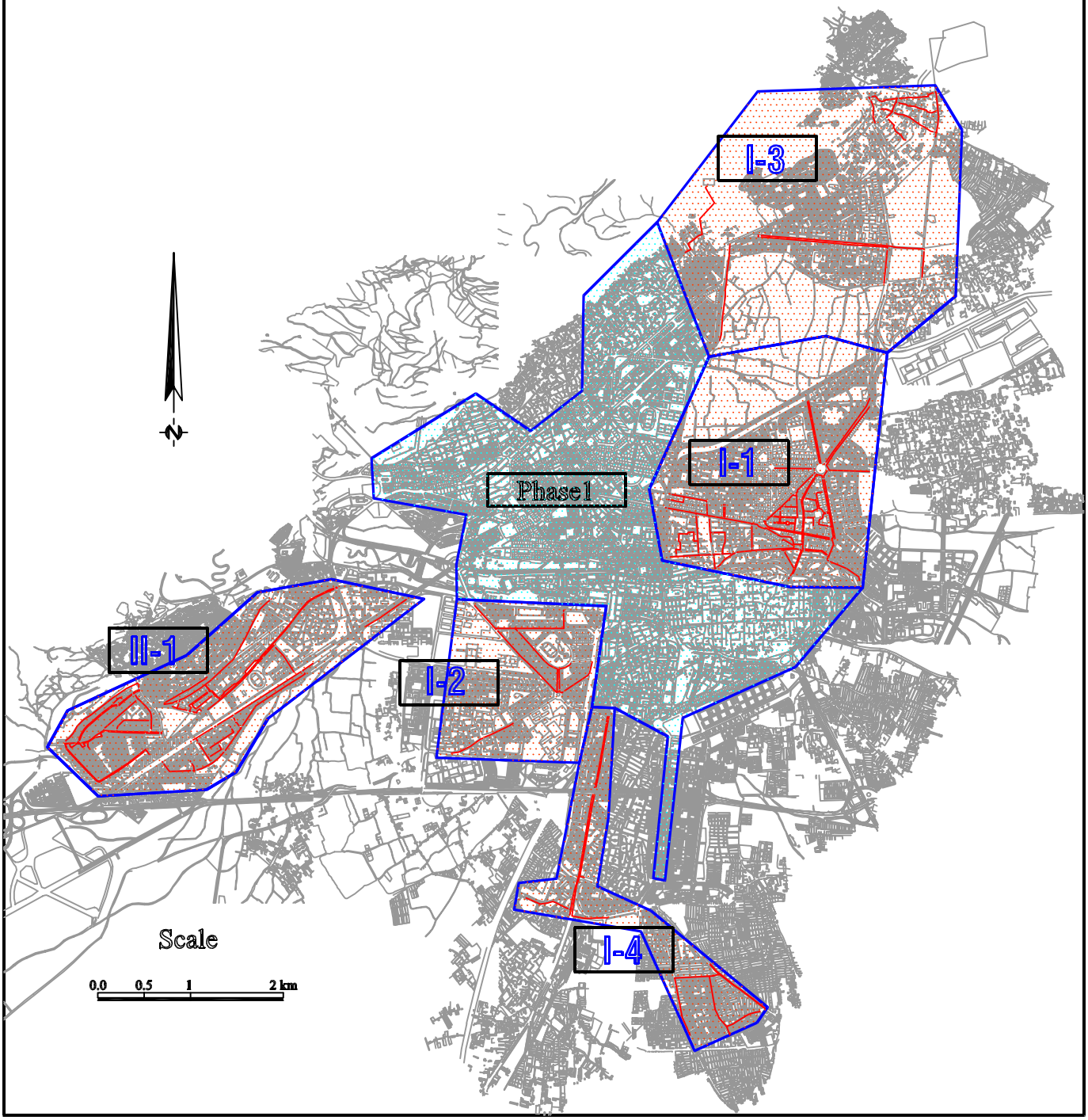
Table 2.5 Pipe Standard Coating and Lining

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

5) Type of joint

Table 2.6 Type of Pipe Joint

Descriptions	Joint Type
Straight pipes	Push-on type
Fittings	Mechanical type
Valves	Flange type



Legend

	Phase1 Area
	Phase2 Area
	Replacement Pipeline
I-1	Bagdad Area
I-2	Kafar Sousa Area
I-3	Berzeh Area
I-4	Midan Area
II-1	Mezze Area

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

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 ductile iron pipes and accessories for the distribution system.

Materials to be procured will be straight pipes, fittings, valves, etc., which are necessary for the rehabilitation works. Procurement of the house connection pipes and water meters and laying of all pipes are implemented by the Syrian side. Since the specifications of the materials/equipment being procured for this project are the same as the ones for materials/equipment used in the initial project (phase I), the engineers of DAWSSA and contractors are familiar with the handling of the materials/equipment. For these reasons, a guidance engineer from the pipe supplier to provide training in assembling push-on joints, restrained coupling and repair of broken pipes, and the non-suspension water during the installation of snap tap with saddle fittings, will not be assigned.

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 responsible directorates for this Project under DAWSSA are: 1) the Finance Directorate to arrange importation and transport the materials/equipment from the Tartus seaport to Adaro stock yard, 2) the Study & Design Directorate to prepare design and tender documents, 3) the Construction & Supervision Directorate to supervise the construction activities, and 4) the Distribution Directorate to perform maintenance and repair works.

2-2-4-2 Implementation Conditions

The requirement of this Project is procurement of materials, mainly pipes and valves. Japan's Grant Aid covers procurement of materials, and delivery of shipment at Tartus Port, the trading port in Syria. In view of the smooth import procedures experienced in the initial project (phase I), no serious problems regarding importation into Syria are anticipated. DAWSSA is adopting the international standard ISO 2531 for the use of ductile iron pipes. In these circumstances it is wise to adopt the same standard as that of DAWSSA with regard to the connection of new pipes and valves with flanges to the existing pipes, and future repair works.

2-2-4-3 Scope of Works

(1) Scope of works to be executed by the Japanese side

- To prepare tender documents for procurement of the rehabilitation project of water distribution pipelines,
- To undertake the supply and delivery at Tartus port of pipe materials, and
- To provide technical assistance to the Syrian side.

(2) Undertaking by the Syrian side

- Provision of the necessary arrangements/procedures, based on the regulations of the Damascus Municipality, for the pipe laying works,
- Transportation of the pipes from Tartus to Adra stock yard of DAWSSA,
- Storage of the pipes in Adra stock yard,
- Execution of the pipe laying works.

2-2-4-4 Consultant Supervision

(1) Procurement policy

Following the contract signing between DAWSSA and the consultant, the consultant will make a site survey to check whether there are any changes in site conditions of the pipe laying areas since the establishment of the basic design. If any changes in the site conditions are found which would affect the specifications or the quantities of materials, these will be incorporated into the detailed design. The notice of tender will be published in the major daily newspapers 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 consultant will carry out the tender evaluation in collaboration with the representative of DAWSSA, and will then prepare the draft contract, based on the tender evaluation result.

Once the contract has been issued for the supply and delivery of pipe materials, the consultant will clarify and review/approve specifications and drawings submitted by the contractor. Under the Japan's Grant Aid scheme, it is important to keep to a time schedule (delivery time). The consultant will make sure that the pipe materials are being manufactured and delivered on schedule by monitoring the fabrication process from time to time.

(2) Procurement control

There will be two members of the consultant team, one is a leader and the other a material/equipment planner. The leader is responsible for overall management with regard to: 1) The contract between DAWSSA and the consultant, 2) Preparation of the tender document for procurement of the pipe materials, 3) The pipe supply contract, 4) Shipment/delivery of the materials, and 5) Confirmation of the materials at the Syrian port.

Duties of the material/equipment planner are: 1) Confirmation of the specifications and quantities of the materials proposed in the implementation review study report, in collaboration with DAWSSA, 2) Preparation of the tender document for procurement of the pipe materials, 3) Execution of the tender, 4) Review/approval of drawings for the materials, 5) Inspection of the materials and attendance at the testing.

At the pre-shipment inspection, in accordance with the materials supply contract, appearance, performance, number of products and their specifications will be inspected, referring to the shipment documents. The consultant will entrust this inspection to an independent inspection institution.

2-2-4-5 Procurement Plan

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

Since a variety of pipe materials are required for the project, it is recommended that an experienced trading firm be used to deal with this kind of business. There are a number of Japanese trading firms with some Japanese staff in Syria. These firms can offer prompt service to cope with problems in shipment, to find insurance and provide service during the warranty period (one-year).

Contingency in quantities for pipes and fittings should be considered. The additional materials will be needed if damage to pipes/fittings occurs during pipe laying, or a if detour is needed to avoid underground obstructions.

2-2-4-6 Quality Control Plan

Quality control for the materials will be conducted mainly through factory inspection, pre-

shipment inspection and post-shipment inspection at Tartus port. Items for inspection are listed as follows:

(1) Factory inspection

- Appearance inspection
- Size measurement
- Hydraulic test
- Mechanical property test
- Quantity inspection

(2) Pre-shipment inspection

- Material inspection before packing
- Packing inspection

(3) Post-shipment inspection

- Packing appearance inspection
- Quantity of packing inspection

2-2-4-7 Implementation Schedule

The implementation schedule is shown below:

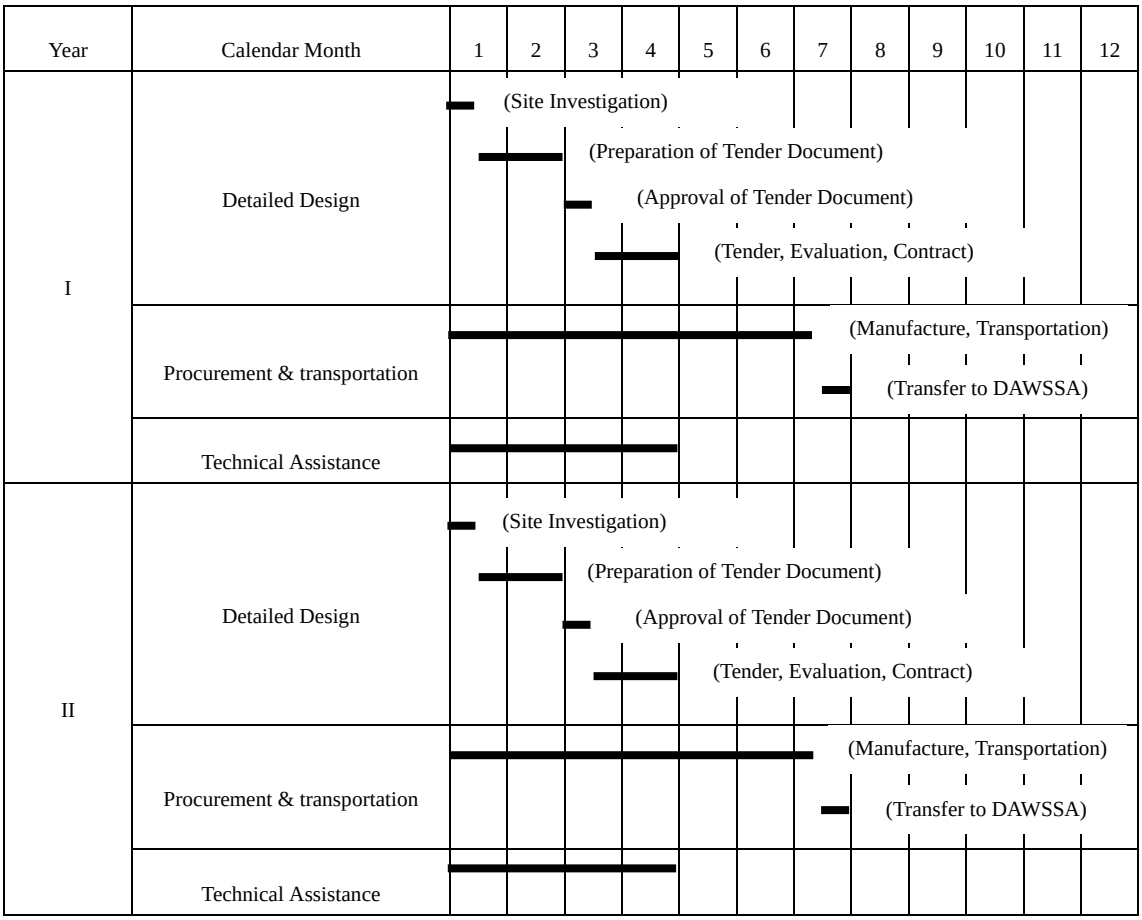


Fig. 2.1 Implementation Schedule

2-3 Obligations of the Government of Syria

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

(1) Provide documents, data and information necessary for implementation of the Project,
(2) Secure land necessary for the Project,
(3) Secure official permissions/licenses necessary for the Project,
(4) Exempt Japanese nationals from custom duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contracts.
(5) Carry out the domestic duties concerning landing, customs clearance and inland transportation for materials imported for this Project,
(6) Lay pipe materials procured by this project rapidly according to the prescribed schedule of the Project,
(7) 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,
(8) Pay the bank commission based on the banking arrangement,
(9) Issue the authorization to pay, based on the agreement between banks,
(10) Secure necessary personnel and budget for effective use of the products provided under Japan's grant aid,
(11) Maintain, use properly and effectively the facility after construction, and
(12) Take charge of all other expenses excluded from Japan's Grant Aid.

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

Table 2.7 DAWSSA's Budget for the Project

Item	SL (1,000)
1) Replacement works of distribution pipelines	204,500
2) Inland transportation cost	4,500
Total	209,000

2-4 Project Operation Plan

DAWSSA has been executing the project (phase I) of replacement for the water pipeline procured under the project, a total length of 46 km, under the Japan's Grant Aid. Syrian contractors experienced in the project (phase I), selected through tendering, will also

undertake the construction works of this Project. The construction directorate of DAWWSA, which has 4 supervising groups, is responsible for construction supervision. Under the director of the Construction/Supervision Directorate, who is also the project manager, there are 10 personnel (6 engineers and 4 technical assistants) working in the Directorate. The Finance Directorate is in charge of receiving materials at the Tartus port and transportation to Adra stockyard, including banking arrangements and tax exemption applications. The Study and Design Directorate will prepare the tender documents for procurement of contractors and design changes. The Distribution Directorate is responsible for maintenance of the pipelines after the construction.

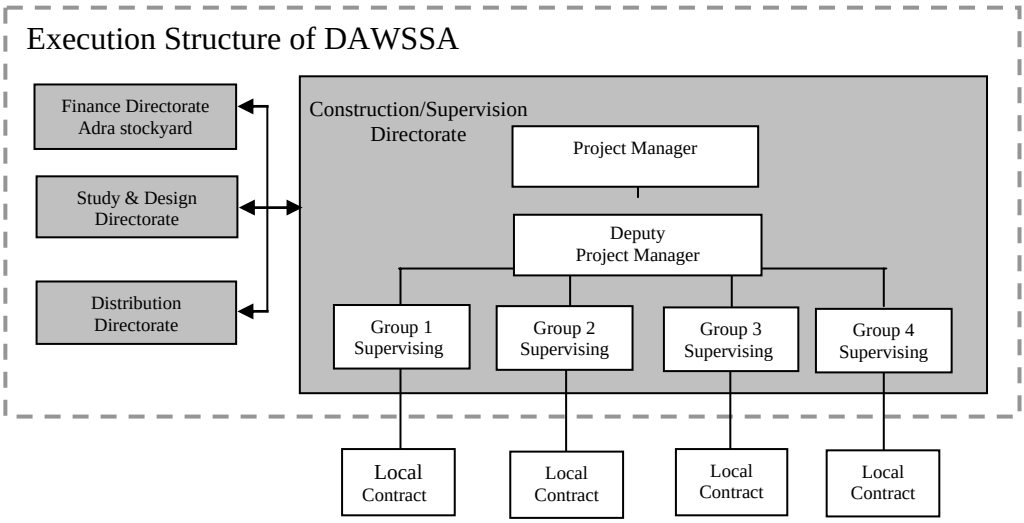


Fig. 2.2 Execution Structure of DAWSSA

The Distribution Directorate has established its repair/maintenance groups in both Mazerra well fields and Kadam Store well fields. These groups are supposed to perform their repair works according to instructions from the leakage survey teams and respond to urgent requests for repair.

Table 2.8 DAWSSA's Maintenance Groups

Locations	Maintenance Groups	Number of workers
Mazrra well fields center	A maintenance group for small pipes (less than dia.100 mm)	150 persons (engineer:5, workers:145)
Kadam Store well fields center	A maintenance group for large pipes (more than dia.125 mm)	31 persons (engineer:1, workers:30)
	A maintenance group for small pipes (diameter 13~100 mm)	27 persons (engineer:2, workers:25)

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

Table 2.9 Operation and Maintenance Cost of DAWSSA (Year 2000)

Items	SL (1,000)
1. Staff salary / Labor wage	26,400
2. Leakage detection costs	1,200
3. Leakage repair costs	9,600
4. Maintenance Equipment / Vehicles repair	5,000
5. Fuel for Equipment / Vehicles	6,000
Total	48,200

The annual operation and maintenance costs for DAWSSA's distribution system, including existing facilities, will be around SL 21.8 million, excluding staff salary and labor wages, accounting for about 4.8% of the total administration cost in 2000.

2-5 Other Relevant Issues

The Technical Assistance required in the Project (phase II).

(1) Background

DAWSSA has been carrying out pipeline repair works and water leakage surveys in Damascus City, but the works have not always been performed effectively. The necessary

data, such as the existing pipeline's installation records, specifications and operation records are not available in a timely manner. These data are not classified systematically, although the data are kept by each section. During the execution of the project (phase I), therefore, technical assistance was provided in order to ensure high performance of the construction work and high quality of O & M in the future. The consultant's resident engineer advised DAWSSA on keeping proper construction records using a consistent format.

As the project (phase I) was the first equipment supply project of Japan's Grant Aid to DAWSSA, the resident engineer was intermittently assigned to supervise the construction works in an advisory capacity. At the same time, DAWSSA was required to report monthly on the work progress to the Japanese side in order to confirm the implementation schedule.

As a result of the technical assistance in the project (phase I), a variety of data are being reported and accumulated, including lists of facilities, drawings and leakage survey reports in unified formats. DAWSSA also provides progress reports to both the Japanese embassy in Damascus and the JICA office, also in Damascus.

DAWSSA aims to establish a digital database to improve database management and provide access to data across all their facilities. The database is to be centrally managed and data presently recorded in analogue format will be collected digitally.

Construction in the Old City, where there are maze-like narrow roads, was carried out after the consultant engineer had left Damascus. There were delays in the schedule due to the complexity of the situations encountered. These delays seem to have occurred because some of the DAWSSA engineers did not have the technical skills to control the schedule in such a challenging environment. In view of the above, further technical assistance is sought in the Project (phase II).

(2) Expected results

The objectives of providing technical assistance are as follows:

1) Improvement of construction management in pipe renewal works
   - ♦ To establish a reporting system based on the monthly report preparation program,
   - ♦ To standardize and up-grade the method of construction schedule control,
   - ♦ To complete works within a specified period by means of schedule control,
   - ♦ Proper handling and construction of the provided pipes and accessories.

2) Improvement in maintenance activities

- ♦ To set up a quick data reference system based on digitized data,
- ♦ To ensure quick and proper action in case of pipe accidents through the use of common data/records,
- ♦ To set up an optimum plan of water leakage survey and effective performance,
- ♦ To up-grade the quality of services offered to customers by taking quick action in case of accidents,

(3) Contents of activities

1) Intermittent construction management

During the procurement period of pipe materials for stage 1 of the Project (phase II), the remaining pipes supplied for the project (phase I) are scheduled to be laid. Progress of the works will be supervised by the engineer through advice and suggestions to DAWSSA's engineer on-site. This site supervision will be continued during stage 2.

2) Preparation of construction management manual

A manual for the construction management will be prepared through periodical discussions with an engineer assigned by DAWSSA, referring to the agenda prepared in advance by the consultant.

3) Transfer of construction schedule control techniques

Using the construction management manual prepared in Stage 1, the consultant will conduct a weekly seminar on the subject of schedule control for the engineers of the Construction Directorate of DAWSSA.

4) Recommendations on digitization of various data

The first step: During the stage 1 period, lists of data will be prepared after classifying the data being kept in various sections. Then, an interview based survey as to purposes of the data usage and frequency of the usage will be conducted. Based on the results of this survey the data will be classified into two categories; data for common use and for separate use.

The second step: An action plan, including study/review of methods/procedures of data digitization, and software, will be established.