No. 1

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR IMPROVEMENT OF WASTE DISPOSAL EQUIPMENT IN ALEPPO CITY IN THE SYRIAN ARAB REPUBLIC

MARCH, 1998

JAPAN INTERNATIONAL COOPERATION AGENCY
YACHIYO ENGINEERING 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 a basic design study on the Project for Improvement of Waste Disposal Equipment in Aleppo City and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Syria a study team from November 11 to December 10, 1997.

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. Then, a mission was sent to Syria in order to discuss a draft basic design, 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 the 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

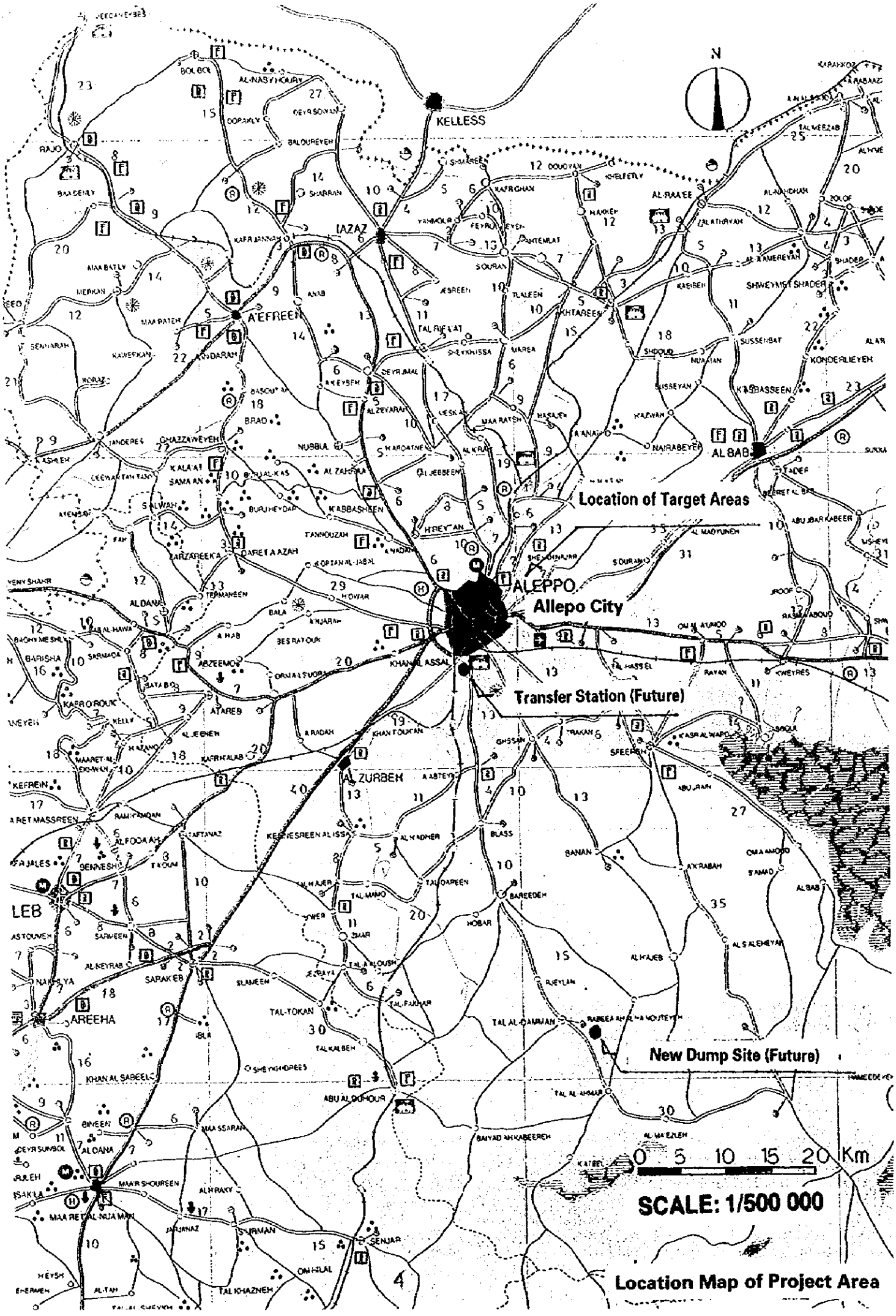
We are pleased to submit to you the basic design study report on the Project for Improvement of Waste Disposal Equipment in Aleppo City in the Syrian Arab Republic.

This study was conducted by Yachiyo Engineering Co., Ltd., under a contract to JICA, during the period from November 5, 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,

三戸 紀之
Kango Mito
Project manager,
Basic design study team on
the Project for Improvement of
Waste Disposal Equipment
in Aleppo City
Yachiyo Engineering Co., Ltd.


N
KELLESS
IAZAZ
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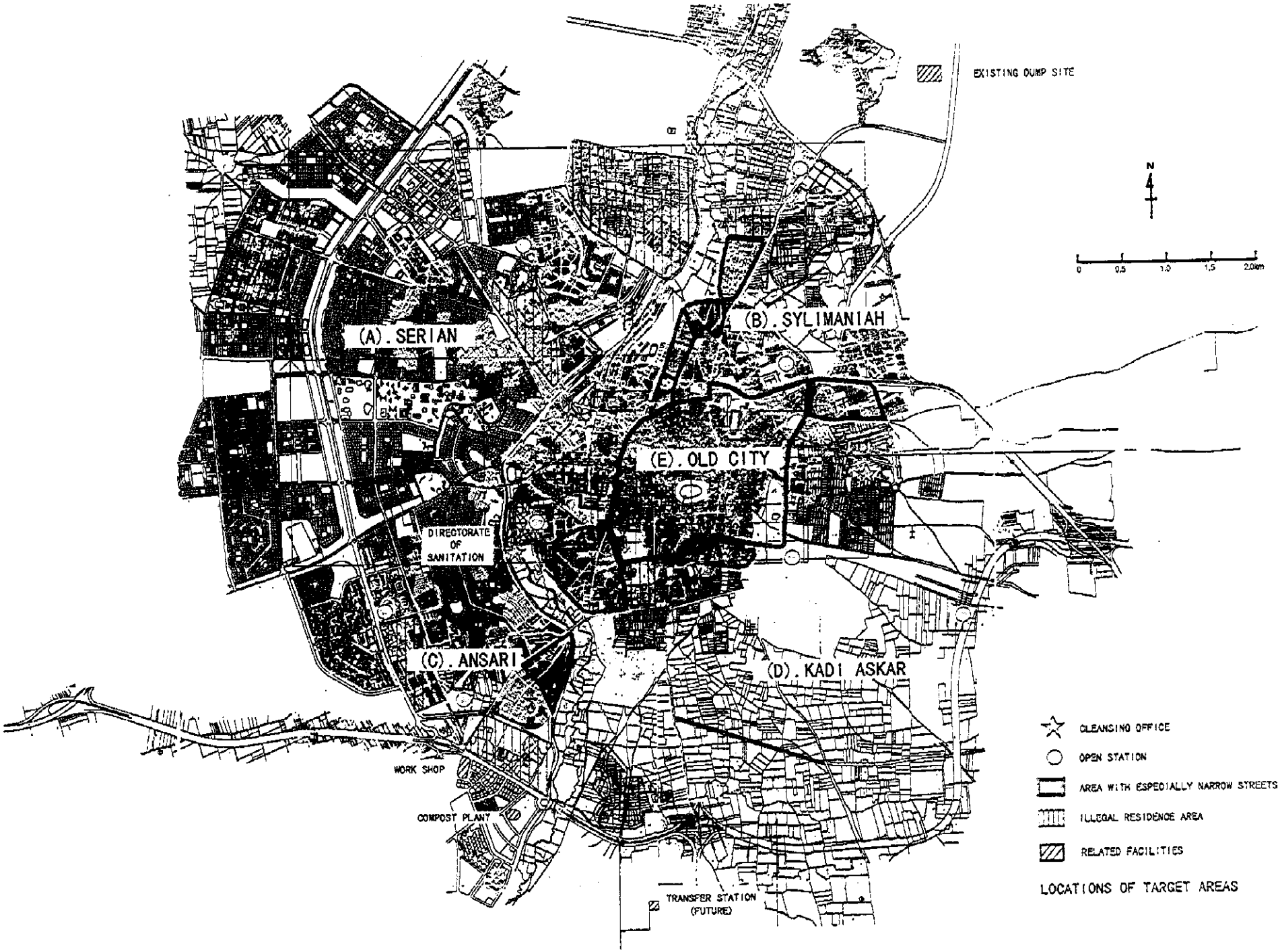
ALEPPO
Allepo City
Location of Target Areas
Transfer Station (Future)
New Dump Site (Future)
AL ZURBEH
AREEHA
LEB
0 5 10 15 20 Km
SCALE: 1/500 000
Location Map of Project Area



LOCATIONS OF TARGET AREAS

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ABBREVIATIONS

B H N	Basic Human Needs
C E C	Commission of the European Communities
D S R	Dead Service Ratio
E A P	Environmental Action Plan
E U	European Union
E／N	Exchange of Notes
G D P	Gross Domestic Product
G N P	Gross National Product
G T Z	Deutsche Gesellshaft Technische Zusammenarbeit
J I C A	Japan International Cooperation Agency
O &M	Operation and Maintenance
O J T	On the Job Training
O P E C	Organization of Petroleum Exporting Countries
S £	Syrian Pound
U N C E D	United Nations Conference for Environment and Development
U N R W A	United Nations Relief and Works Agency for Palestine Refugees in the Near East
W F P	World Food Programme

CHAPTER 1 BACKGROUND OF THE PROJECT

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1-1 Background of the Project

The Syrian Arab Republic (hereinafter referred to as Syria), located east of the Mediterranean Sea and sharing its borders with Turkey, Iraq, Jordan, Israel and Lebanon, has an area of 185,000 square kilometers and a population of 16.1 million (as of 1996) and is a member nation of the Mediterranean states. The climate varies greatly according to the region: areas on the Mediterranean coast have relatively high rainfall and possess fertile soil, whereas inland areas have little rainfall and contain belts of semi-desert land. The national economy has achieved a good balance between the agriculture, mining, industry and service sectors and levels of education and technology are high compared to those in neighboring Arab states. As a result, the per capita GNP has reached US $ 1,110 (1995).

Aleppo, located approximately 350 km north of the capital, Damascus, and 70 km from the border with Turkey, has the longest history of any city in Syria, a population of 1.7 million (1997) and is the second largest city in Syria. Concerning the urban environment, because of its long history, infrastructure development in Aleppo has not progressed with the times and these deficiencies have been made more conspicuous by the rapid urbanization and industrial development of recent years. In particular, the daily amount of solid waste generated in the city, 1,130 tons on average, and the collection and disposal of this amount has become a serious problem. Furthermore, since the population of the city has been increasing at a high rate of 3.6% in recent years, further increases in the amount of solid waste are unavoidable in the future.

Currently, about 1,700 staff of the Aleppo Cleansing Affairs Department carry out the collection and disposal of solid waste. However, of the 117 solid waste collection vehicles currently owned by the department, 47 7-ton compactor trucks were purchased in 1977 and 30 2-ton and 3-ton compactor trucks were purchased in 1985, and operating levels have declined as a result of advancing deterioration. Moreover, because equipment capacity has not been strengthened to deal with the increasing amounts of solid waste, and equipment that is suited to working in districts of narrow roads (which are a feature of Aleppo) has not been purchased, deterioration of the living environment is occurring due to the generation of odor and disease and pest damage caused by the scattering of uncollected waste and illegal dumping.

Furthermore inadequate operation of the final disposal site by simple open dumping causes air pollution and odor rising from spontaneous combustion and seriously damages the environment in the surrounding areas.

Aleppo City Council, in an effort to rectify the above-mentioned situation, is independently advancing plans for the construction of a new disposal site 60 km south of the city and a transfer station, which will be required as a result of the distant location of the disposal site. However, since the country as a whole is confronted with a shortage of foreign currency, it is not in a position to procure new equipment.

For this reason, the Government of Syria made a request to the Government of Japan for the provision of grant aid for supply of the said solid waste management equipment.

1-2 Outline of the Request

The contents of the Request from the Syrian Side are shown in Table 1-2-1.

Table 1-2-1 Contents of the Request

Equipment	Unit	Requested Quantity
Supply of solid waste collection and transportation equipment		
Garbage dump truck (16 m^3)	Vehicle	2
Road sprinkler (8 kl)	Vehicle	2
Vacuum tank truck (10 kl)	Vehicle	2
Compactor truck (2 ton)	Vehicle	20
Compactor truck (3 ton)	Vehicle	20
Compactor truck (7 ton)	Vehicle	8
Supply of final disposal site equipment		
Bulldozer (320 HP)	Unit	1
Solid waste compactor (165 HP, 18 ton)	Unit	1
Dozer shovel (200 HP, 22 ton)	Unit	1
Motor grader (135 HP)	Unit	1
Excavator (120 HP, 0.7 m^3)	Unit	1
Wheel loader (130 HP, 1.8 m^3)	Unit	2
Other		
Mobile workshop	Vehicle	1

CHAPTER 2 CONTENTS OF THE PROJECT

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2-1 Project Objectives

Based on the national strategy and policy on environmental protection the Ministry of State for Environmental Affairs has compiled the Environmental Action Plan (EAP). This project falls contributes to the EAP implementation through improving urban solid waste management in Aleppo City.

In specific terms, the Project intends to improve the collection rate through strengthening solid waste equipment, introducing sanitary landfilling through the provision of final disposal site equipment, and raising the capacity for repairing deteriorated vehicles through the provision of maintenance equipment.

2-2 Basic Concept of the Project

The present system of solid waste management is composed of primary collection, which involves the manual hauling of waste to open stations and containers, and secondary collection, which involves the vehicular transportation of solid waste from containers, etc. to the final disposal site.

In the Project, with a view to resolving the various problems that confront the solid waste management system and as a result of holding joint consultations with the Syrian side, the basic concept outlined below has been compiled.

(1) Improvements Regarding Collection

1) Increase the number of containers and distribute them appropriately.

2) Abolish the current method of loading collection vehicles parked at specific stations on the road, refered to as "waiting station" method.

3) Procure new containers for use with small compactor trucks, which are to be introduced to replace the said waiting station method.

4) Retain the current method of solid waste discharge at open stations, while reducing the amount of waste as much as possible.

5) Renewal and strengthening of collection vehicle fleet. In addition to renewing deteriorated vehicles in order to stabilize the collection service, reinforce the fleet with additional vehicles to raise collection capacity.

6) Improvement of the operating rate of deteriorated vehicles. Introduce a mobile workshop to deal with road breakdowns of deteriorated vehicles.

(2) Improvements Regarding Transportation

Since the new final disposal site is located some 60 km distant from the city center, it is necessary to construct a new transfer station in order to introduce a relay transportation system that relies on large vehicles (40 m^3 class).

(3) Intermediate Treatment

The existing compost plant shall be closed because its treatment capacity has fallen to below 10% of its rated value and its income and expenditure balance is deteriorating.

(4) Improvements Regarding the Final Disposal Site

1) The existing final disposal site shall be closed.

2) A new large final disposal site shall be constructed to operate as a 60 km south of the city, sanitary landfill site with daily earth covering.

(5) Strengthening of Solid Waste Collection Management

A weigh bridge shall be installed at the new transfer station to enable the recording and analysis of various technical data.

Figure 2-2-1 illustrates the above improvement concept in terms of the flow of solid waste.

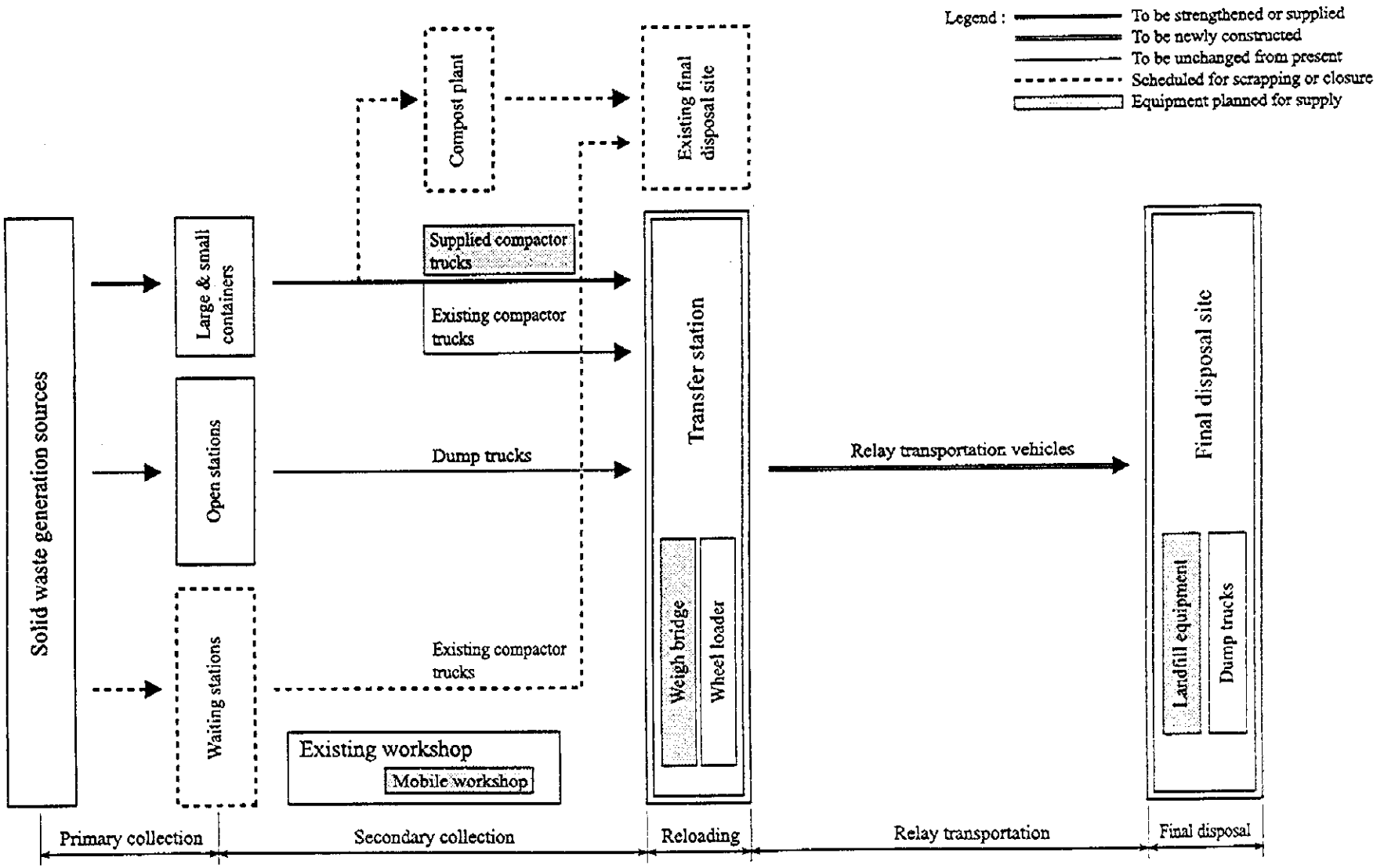


Figure 2-2-1 Basic Conceptual Drawing of Solid Waste Management System Improvement

The equipment plan based on this concept is outlined below.

① Collection and Haulage Equipment

Concerning collection and haulage equipment, small vehicles (2 ton and 3 ton), which are suited for narrow roads, shall be supplied in order to raise the collection rate in districts with narrow roads, and large vehicles (7 ton) shall be supplied to handle other districts.

② Landfill Equipment

Concerning landfill equipment, equipment that can handle the landfilling of all generated solid waste in 2002 shall be supplied with the aim of introducing sanitary landfill. The implementation of sanitary landfilling through the provision of such equipment will mitigate the environmental impact placed on areas around the disposal site.

③ Maintenance Equipment

Since it will be necessary to continue using existing deteriorated equipment even following provision of the Project equipment, maintenance equipment that can respond to breakdowns on roads shall be supplied in order to sustain a stable solid waste collection service.

④ Transfer Station Management Equipment

By installing a weigh bridge at the new transfer station being constructed by the city council in order to record and control various information (entry times, solid waste collection loads by vehicle and collection area, etc.), a contribution will be made to the daily operation of the solid waste management utility and the compilation of medium and long-term plans necessary for improving solid waste management system.

2-3 Basic Design

2-3-1 Design Concept

(1) Natural Conditions

1) Temperature and Humidity

The average air temperature in the Project target area is 17.4 °C, with the maximum temperature being 40 °C and the minimum temperature -3 °C. There is no particular need to take temperature into account in the design. Furthermore, since humidity ranges between 50% to 60% and is not high, there is no need to take humidity into account.

2) Rainfall

The average annual rainfall is around 300 mm and snow hardly ever falls, so these conditions will not hinder the design or transportation of the equipment.

3) Districts of Narrow Roads

Concerning the collection and haulage vehicles to be procured to deal with districts where roads are narrow, consideration shall be given to the wear and tear of clutches, and so on.

4) Final Disposal Site Working Environment

In carrying out the design of landfill equipment to be procured under the Project, care will need to be taken to protect operators from methane gas and odor generated in the final disposal site.

(2) Social Conditions

Around 85% of the population of Syria are Moslems and holidays and working times, etc. are generally set according to Islamic standards, including Ramadan (the month of fasting). Therefore, it is necessary to carry out design regarding holidays and working times, etc. upon giving ample consideration to the customs and culture of the country. In Syria, Friday is the weekly holiday and there are a further 15 public holidays throughout the year as indicated in Table 2-3-1.

Incidentally, the existence of scavengers is often regarded as a problem when implementing solid waste management projects in developing countries, however, in Syria, scavengers are prohibited by law.

Table 2-3-1 Public Holidays in Syria

No.	Date	Public Holiday
1	January 1	New Years Day
2	March 8	Corrective Revolution Day
3	March 21	Mother's Day
4	March 30	Easter (Western)
5	April 7	The Party's Birthday
6	April 27	Easter (Eastern)
7	May 1	World Labour Day
8	May 6	Remembrance of Independence's Martyrs
9	October 6	Remembrance of the October War
10	November 16	Remembrance of National Renewal
11	December 25	Christmas
12	Islamic calendar (February 8)	Festival Al-Fitr Day (Ramadan festival)
13	Islamic calendar (April 17)	Festival Al-Addha Day (Al Hajj Day)
14	Islamic calendar (May 8)	Prophet's Immigration to Medina
15	Islamic calendar (July 17)	Prophet's Birthday

(Note) Dates for the Islamic calendar public holidays are those from 1997.

(3) Utilization of Local Contractors and Equipment

The equipment to be procured under the Project consists of compactor trucks (2 ton, 3 ton and 7 ton) for solid waste collection and bulldozers, wheel loaders and back hoes necessary for carrying out landfilling at the final disposal site. The compactor trucks are special vehicles which are not produced in Syria. Regarding the landfilling equipment, as a result of carrying out estimates and comparative examination, it is considered best to procure such equipment in Japan in terms of both price and post-sale service.

(4) Operation and Maintenance Capacity of Implementing Agencies

The workshop that belongs to the Vehicle Maintenance Section of the Engineering Department of Aleppo City Council is responsible for maintaining all the equipment owned by the city, ranging from heavy machinery to motor cycles and containers. In organizational terms, the workshop is composed of the Repair Department made up of five sub-workshops and the Management Department made up of eight sections, and it is

run by a total work force of 254 consisting of 17 managerial staff, 169 core managers and engineers and 68 technical staff. The workshop complex including garage space and refueling facilities covers approximately three hectares.

Concerning the operation and maintenance capacity of the workshop, in view of the fact that it repairs and keeps in service 23 of the 48 large compactor trucks which were procured in 1977 and have already been in use for 20 years and these vehicles collect 180 tons or approximately 20% of the daily collection amount, the workshop can be said to possess satisfactory capacity. That is to say, because the equipment to be procured under the Project does not differ greatly from existing equipment in terms of technical specifications, there should be no problems regarding operation and maintenance.

(5) Concept Regarding the Design Range and Level of Equipment

Taking into account the conditions described above, the following basic concept shall be adopted with regard to the supply range and technical specifications of the Project equipment.

1) Supply Range of Equipment

Equipment necessary for carrying out solid waste collection and haulage in target districts and sanitary landfilling at the final disposal site shall be planned. Furthermore, a mobile workshop to carry out maintenance of new and existing equipment and a weigh bridge to be installed at the transfer station currently being planned by the city shall also be included.

2) Technical Specifications

Care shall be taken to ensure that equipment specifications comply with the operation and maintenance capacity of Aleppo City Council. Vehicles shall as far as possible be manually operated types that are easy to operate and maintain. Moreover, giving priority to compatibility of operation and maintenance know-how and spare parts, equipment shall as far as possible be procured from a single manufacturer and be based around a single vehicle type, and the additional provision of unnecessary operation and maintenance systems shall be avoided.

Also, manuals shall be prepared to aid the introduction of periodic inspections and overhauls.

(6) Equipment Procurement Conditions

Concerning the procurement of collection equipment and operation and maintenance of equipment following procurement, as a result of the site survey, it was found that there is no possibility of supply by local agents of third country products that can offer high equipment performance and possess service centers capable of providing spare parts, etc., and that, even if the necessary equipment is produced in third countries, these products are not subject to export to Syria and have not been exported in the past. Consequently, when viewed in terms of spare parts supply and provision of service following initial equipment procurement, it is considered that equipment made in Japan is more advantageous.

Moreover, in Syria, following relaxation of the import ban on automobiles, Japanese-made and Korean-made vehicles have increased greatly. Concerning vehicles made in Japan, agents and service centers of major Japanese makers have been established, meaning that small and medium-size trucks and all vehicles ranging from light cars to large trucks and their spare parts are supplied and maintenance and repair services are offered locally. Concerning vehicles made in Korea, although the number of vehicles being imported has increased greatly, imports mainly consist of private cars and minibuses but do not include special purpose vehicles such as collection trucks.

With regard to landfill equipment, almost all of the makers of construction machinery that possess local agents and service centers capable of offering stable supply and high equipment performance are either based on the capital funding or under the joint management of Japanese manufacturers, and the same models are exported whether they be procured from third countries or from Japan. Therefore, as it is considered that third country products and Japanese products will be the same in terms of operation and maintenance know-how and spare parts, the country of procurement shall be selected based on consideration of the purchase price, etc. Concerning dump trucks that will be necessary for landfilling, those that are currently used for collection and haulage shall be diverted for use at the final disposal site.

Concerning the additional necessary solid waste collection containers, these shall all be procured within Syria at the expense of the Syrian side.

(7) Implementation Period

Following the Exchange of Notes, the Project shall be implemented over a period of 11.5 months, comprising approximately 2.5 months for the detailed design, 1.2 months for the

tender and conclusion of contractor contracts, 5.3 months for factory manufacture and 2.5 months for transportation and inspections, etc.

2-3-2 Basic Design

(1) Project Preconditions

1) Target Year

The target year of the Project shall be 2002.

2) Population

Table 2-3-2 shows the estimated population to be served by type of collection vehicle in each cleansing district in the target year of 2002.

Table 2-3-2 Population by Cleansing District (2002)

Population (1,000)

Cleansing District	Small Compactor	Large Compactor	Total
Al Serian	-	595	595
Sylimanah	78	330	408
Ansari	93	453	546
Kadi Askar	33	357	390
Madina Qadima	101	-	101
Total	305	1,735	2,040

3) Amount of Generated Solid Waste and Amount Requiring Collection

The amount of generated waste and amount requiring collection in the target districts in the target year of 2002 were estimated based on the actual amount generated in 1997 and the following assumptions (results are shown in Table 2-3-3).

① The rate of increase in the amount of domestic solid waste shall be 0.5% per year, based on consideration of the national rate of increase in Japan between 1970 and 1991 (0.5%) and the design value that has been adopted in the 1996 JICA study in Damascus (0.5%).

② The rate of increase in the amount of commercial solid waste shall be 4.5% per year, which is the same as the rate of increase that has been observed in the past 10 years in cities with a population of between one and two million in Japan.

③ Concerning the recyclable amount of solid waste, a rate of increase of 5% per year is adopted as slightly high as increase rate of commercial waste.

④ Concerning the amount of solid waste that is directly transported to the disposal site by generating parties, since this is limited to commercial solid waste only, the rate of increase shall be assumed to be the same as the rate of increase in the amount of commercial solid waste, i.e. 4.5%.

Table 2-3-3 Amount of Generated Solid Waste and Amount Requiring Collection (2002)

(Unit: ton/day)

Cleansing District	Domestic Solid Waste	Commercial Solid Waste	Total	Recyclable amount	Directly transported amount	Amount of solid waste requiring collection
Al Serian	286	51	337	31	22	284
Sylimanah	196	69	265	25	17	223
Ansari	262	105	367	34	24	309
Kadi Askar	187	120	307	29	20	258
Medina Qadima	48	59	107	10	7	90
Total	979	404	1,383	129	90	1,164

Solid waste collection by small vehicles shall be carried out in the Old City districts, i.e. all of Madina Qadima and part of Sylimanah, Ansari and Kadi Askar. Upon calculating the total amount of solid waste generated in these districts based on population ratio and deducting the amount of solid waste collected by dump truck from the total, the amount of solid waste to be handled by large collection vehicles was calculated. Incidentally, it is assumed that the amounts of solid waste collected by dump truck and privately consigned operators will remain the same in the future. Table 2-3-4 shows the amount of solid waste requiring collection by each district and each vehicle type and in terms of the amount collected by the municipal authorities or privately consigned operators.

Table 2-3-4 Amount of Solid Waste Requiring Collection by District and Vehicle Type

(Unit: ton/day)

Cleansing District	Small Compactor		Large Compactor		Dump Truck		Total
	Municipal Collection	Private Collection	Municipal Collection	Private Collection	Municipal Collection	Private Collection	
Al Serian	--	--	241	19	24	-	284
Sylimanah	43	-	29	127	24	--	223
Ansari	57	-	106	80	24	42	309
Kadi Askar	23	-	94	93	48	-	258
Madina Qadima	90	-	-	-	-	-	90
Total	213	-	470	319	120	42	1,164

(2) Collection and Haulage Equipment

1) Concept Regarding Selection of Collection and Haulage Equipment

Design of the basic specifications and quantity of collection and haulage equipment shall be carried out based on the following concept, with consideration given to the specifications, quantity and state of operation of equipment currently owned by Aleppo City Council.

① Deteriorated vehicles that will have reached their renewal period by the target year of 2002 shall be scrapped. As a general guide, vehicles that will have been in use for 15 years or more shall be scrapped.

Toyota 2 ton (commencement of use in 1985, 17 years of service) : 3 units
Toyota 4 ton (commencement of use in 1985, 17 years of service) : 18 units
Mack 7 ton (commencement of use in 1977, 25 years of service) : 23 units
Dump (Fiat) (commencement of use in 1979, 23 years of service) : 1 units
Dump (Maz) (commencement of use in 1985, 17 years of service) : 1 units

② Of the above currently owned vehicles, the following will be operable in the Project target year of 2002.

Man 7-ton (start of use in 1993, 9 years of use) : 24 vehicles
F. Linner 10-ton (start of use in 1996, 6 years of use) : 6 vehicles
Volvo 16 m^3 (start of use in 1993, 9 years of use) : 5 vehicles

Concerning privately owned vehicles, current capacity shall be retained.

③ Concerning the operating rate and load rate by years of use with consideration given to deterioration, the operating rate and load rate have been obtained as shown in Figure 2-3-1 and Figure 2-3-2 judging from the site survey results and general trends of vehicle deterioration over time. Moreover, the operating rate of vehicles that have been in use for less than seven years has been set at 85% in consideration of days required for periodic inspections and minor repairs.

④ The average daily number of trips made by each vehicle type shall be as follows based on the findings of the fact finding survey on current collection operation (time and motion study) and in consideration of the improvement in work efficiency that will result from location of the new transfer station, progress in construction of the ring road and additional distribution of containers, etc.

Small compactor trucks (2 ton) : 4 trips
Small compactor trucks (3 ton) : 3 trips
Large compactor trucks (7 ton) : 2 trips
Dump trucks 16 m^3 (10 ton) : 4 trips

2) Planned amount of solid waste to be collected by existing collection equipment in 2002

The amount of solid waste to be collected by each type of vehicle is calculated using the following expression.

(Daily collection amount) = (load capacity) × (number of vehicles) × (operating rate) × ((load rate) × (number of trips)

Man 7-ton : 7 tons × 24 vehicles × 0.75 × 0.88 × 3 trips = 333 tons
F. Linner 10-ton : 10 tons × 6 vehicles × 0.85 × 0.90 × 2 trips = 92 tons
Volvo 16 m^3 : 8 tons × 5 vehicles × 0.75 × 1.00 × 4 trips = 120 tons
Chevrolet (privately owned vehicles, current capacity shall be retained) = 14 tons
Dump (privately owned vehicles, current capacity shall be retained) = 42 tons

From the above, the amount of solid waste that can be collected by the existing collection and haulage equipment in 2002 is 600 tons per day.

3) Required Number of New Collection and Haulage Vehicles

As is shown in Table 2-3-3, the design amount of solid waste collection in the target year of 2002 is 1,164 tons per day, of which the existing collection and haulage vehicles will be able to collect 601 tons. Therefore, the design amount of solid waste that will need to be collected by the collection and haulage vehicles supplied under the Project is 563 tons per day.

As is shown in Table 2-3-4, the amount of solid waste that can be collected by the 2 ton and 3 ton compactor trucks to be supplied is 213 tons. The 2 ton compactor trucks shall be used to collect 90 tons of solid waste in Madina Qadima (Old City) where the roads are particularly narrow, while the 3 ton compactor trucks shall be used to collect the remaining 123 tons. Consequently, the amount of solid waste that will need to be collected by the 7 ton compactor trucks is 350 tons.

In view of this, the number of vehicles that need to be supplied are calculated as shown below according to the following equation.

(Number of vehicles to be supplied) = (amount to be collected by new vehicles) ÷ (load capacity) ÷ (operating rate) ÷ (loading rate) ÷ (number of trips)

Here, the operating rate and load rate of supplied vehicles in 2002 are assumed to be 0.85 and 0.9 respectively.

(2-ton compactor trucks) = 90 t/d ÷ (2 t/unit × 0.85 × 0.9 × 4 trips) = 15 vehicles
(3-ton compactor trucks) = 123 t/d ÷ (3 t/unit × 0.85 × 0.9 × 3 trips) = 18 vehicles
(7-ton compactor trucks) = 350 t/d ÷ (7 t/unit × 0.85 × 0.9 × 3 trips) = 22 vehicles

To sum up, the basic specifications and required numbers of equipment to be supplied under the Project are as shown in Table 2-3-5.

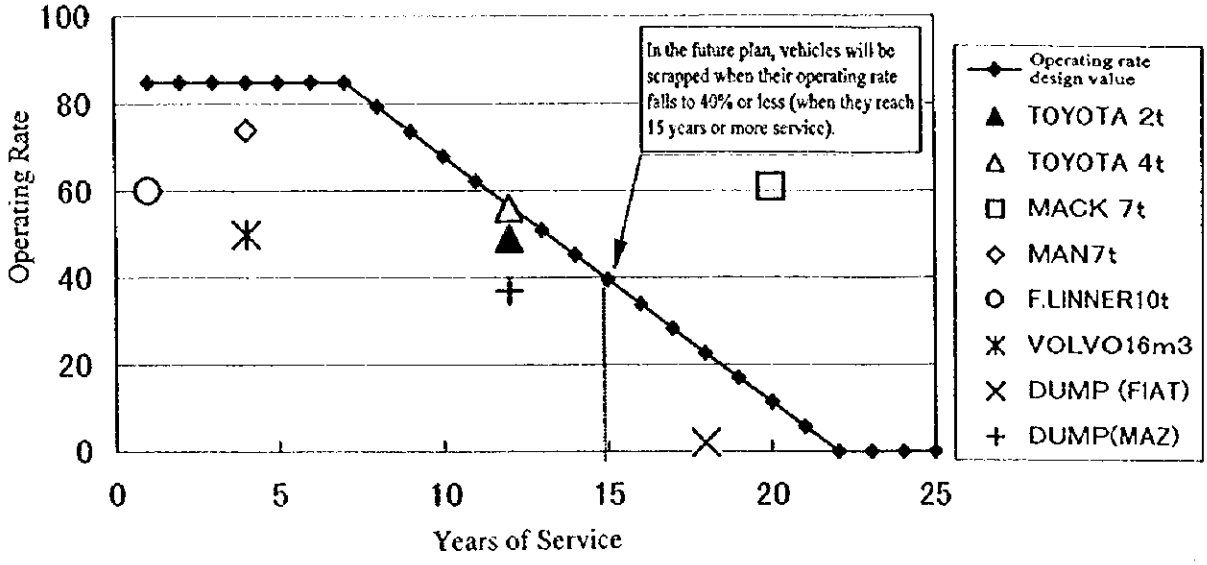


Figure 2-3-1 Relationship Between Operating Rate and Years of Service

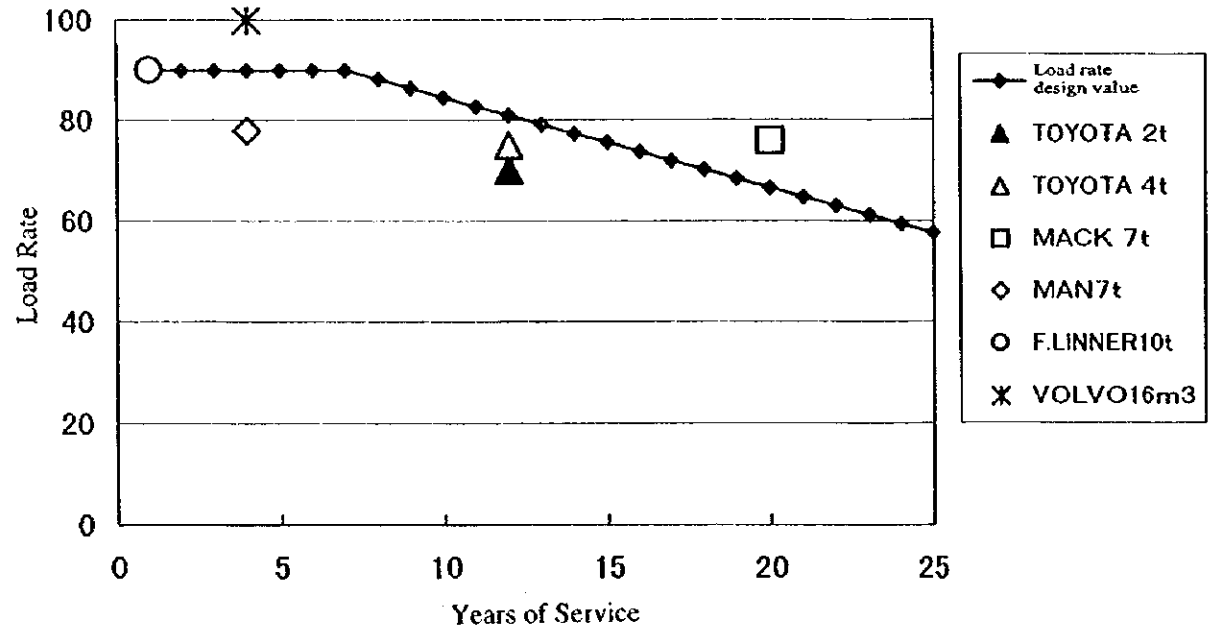


Figure 2-3-2 Relationship Between Years of Service and Load Rate

Table 2-3-5 Collection and Haulage Equipment to be Supplied under the Project

Model	Basic Specifications	Quantity (units)
Compactor truck	2-ton	15
Compactor truck	3-ton	18
Compactor truck	7-ton	22

(3) Landfill Equipment

1) Concept Regarding Selection of Landfill Equipment

Equipment that is necessary in order to carry out sanitary landfilling at the new final disposal site in the target year of 2002 shall be supplied according to the following concept.

① The amount of solid waste that will be accepted by the new final disposal site (treatment amount) in 2002 is 1,254 tons per day as shown in Figure 2-3-3.

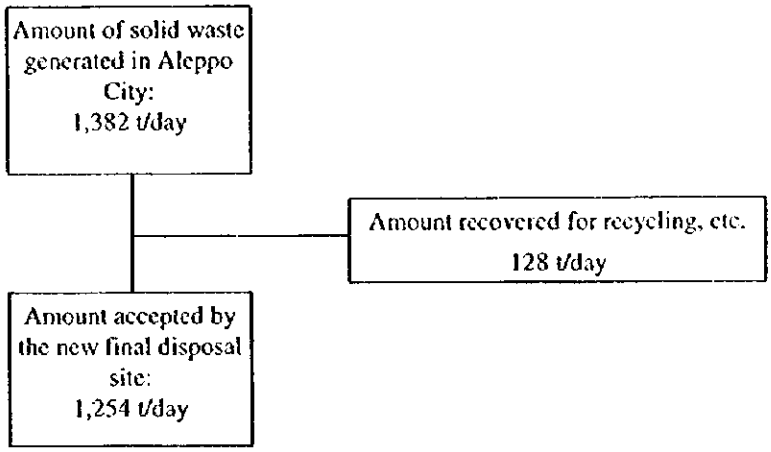


Figure 2-3-3 Amount of Solid Waste at Final Disposal Site in 2002

② Sanitary landfilling shall be carried out, and earth covering to a depth of 0.3 m shall be performed for every 3 m of land-filled solid waste.

③ The annual operating rate of landfill equipment shall be 85%.

④ The specific gravity of solid waste before and after compaction shall be 0.35 ton/m^3 and 0.7 ton/m^3 respectively.

⑤ The rate of change in the earth volume shall be 1.4 for loose/compacted earth and 1.25 for loosened/ground earth.

2) Landfill Equipment Workload

① Volume of solid waste after leveling and compaction

The volume of solid waste before compaction is as follows.

1,254 t/day ÷ 0.35 = 3,580 m^3/day

The volume of solid waste after compaction is as follows.

1,254 m^3/day × 0.7 ton/m^3 = 1,790 m^3/day

② Necessary volume of covering earth (loose earth)

The volume of earth required every day following compaction is as follows.

1,790 m^3/day × 0.3 m/3.0 m = 180 m^3/day

The volume of earth in the loose state is as follows.

180 m^3/day × 1.4 = 250 m^3/day

③ Volume of excavated earth for covering (ground volume)

The volume of ground required in order to secure 250 m^3 of loose earth is as follows.

250 m^3/day ÷ 1.25 = 200 m^3/day

Summing up the above results, the daily amount of work that needs to be carried out by each type of equipment is as indicated below.

Solid waste disposal volume (before compaction)	3,580 m^3 : Bulldozers
Covering earth volume (loose earth)	250 m^3 : Bulldozers
Excavation volume (ground volume)	200 m^3 : Back hoes
Earth load volume (loose earth)	250 m^3 : Wheel loaders
Earth carrying volume (loose earth)	250 m^3 : Dump trucks

3) Basis for Calculation of the Quantity of Landfill Equipment

① Bulldozers (21 ton) for use in solid waste leveling, compaction and earth covering

i) Work capacity of one bulldozer

• Solid waste leveling capacity

The hourly work capacity of a bulldozer is calculated by the following equation.

$$\text{Earth volume} = \frac{60 \times q \times E_1 \times E_2 \times f}{Cm} \quad (m^3/h)$$

q: earth excavation and pushing volume per cycle (m^3)

The bucket size is assumed to be a standard size for the case where a trash rack is attached.

$q = 0.457 \times B \times H^2 (m^3)$

B: bucket width (3.6 m)

H: bucket height (2.2 m)

$= 0.457 \times 3.6 \times 2.2^2 = 7.96$

E_1 : work efficiency (0.85)

E_2 : operating rate (0.85)

Cm : cycle time (min.), obtained by the following expression

$Cm = 0.038 \times L + 0.20$ (min.)

L : average excavation and pushing earth leveling distance (= 30 m)

$= 0.038 \times 30 + 0.20$

$= 1.34$

f : factor of earth volume change (= 1.0)

$$\text{Earth volume} = \frac{60 \times 7.96 \times 0.85 \times 0.85 \times 1.0}{1.34}$$

$= 258 m^3/h$

• Solid waste compaction capacity

The volume of compacted earth obtained by the following expression expresses the compacted earth volume after finishing.

$$\text{Volume of compacted earth} = \frac{V \times W \times D \times E_1 \times E_2 \times f}{N} \quad (m^3/h)$$

V : compaction velocity (3,500 m/h)

W : effective compaction width per cycle (0.9 m)

D : finished thickness (0.9 m)

N : compaction cycles (4)

E_1 : work efficiency (0.8)

E_2 : operating rate (0.85)

f : factor of earth volume change (2)

$$\text{Volume of compacted earth} = \frac{3{,}500 \times 0.9 \times 0.9 \times 0.8 \times 0.85 \times 2.0}{4}$$

$= 964 m^3/h$

• Covering earth pushing and leveling capacity

The hourly earth moving capacity of a bulldozer is calculated by the following equation.

$$\text{Earth volume} = \frac{60 \times q \times E_1 \times E_2 \times f}{Cm} \quad (m^3/h)$$

q : earth excavation and pushing volume per cycle (m^3)

Type	q (m^3)
21t	2.85
32t	4.64
16t	2.03

E_1 : work efficiency (=0.85)

E_2 : operating rate (0.85)

Cm: cycle time (min.), obtained by the following equation

Cm = 0.038 × L + 0.65 (min.)

L : average excavation and pushing earth leveling distance (= 30 m)

= 0.038 × 30 + 0.65

= 1.79

f : factor of earth volume change (= 1.0)

$$\text{Earth volume} = \frac{60 \times 2.85 \times 0.85 \times 0.85 \times 1.0}{1.79}$$

$$= 69 m^3/h$$

• Covering earth compaction capacity

The volume of earth that can be compacted by a bulldozer per working hour is calculated by using the following expression. The volume of compacted earth obtained by this equation expresses the compacted earth volume after finishing.

$$\text{Volume of compacted earth} = \frac{V \times W \times D \times E_1 \times E_2 \times f}{N} \quad (m^3/h)$$

V : compaction velocity (3,500 m/h)

W : effective compaction width per cycle (0.9 m)

D : finished thickness (0.3 m)

N : compaction cycles (4)

E_1 : work efficiency (0.8)

E_2 : operating rate (0.85)

f : factor of earth volume change (= 1.2 / 0.9=1.33)

$$\text{Volume of compacted earth} = \frac{3{,}500 \times 0.9 \times 0.3 \times 0.8 \times 0.85 \times 1.33}{4}$$

$$= 214 m^3/h$$

ii) Calculation of working time

• Workload of one bulldozer

Assuming that three bulldozers perform the above workload, the workload of one bulldozer is calculated as follows.

Solid waste pushing volume: 3,580 m^3 ÷ 3 bulldozers = 1,200 m^3
Solid waste compaction volume: 3,580 m^3 ÷ 3 bulldozers = 1,200 m^3
Covering earth pushing volume: 250 m^3 ÷ 3 bulldozers = 85 m^3
Covering earth compaction volume: 250 m^3 ÷ 3 bulldozers = 85 m^3

• Working time

Solid waste pushing: 1,200 m^3 ÷ 253 m^3/h = 4.7 h
Solid waste compaction: 1,200 m^3 ÷ 964 m^3/h = 1.2 h

Working time 5.9 h

Earth covering treatment

Earth pushing: 85 m^3 ÷ 69 m^3/h = 1.2 h
Covering earth compaction: 85 m^3 ÷ 214 m^3/h = 0.4 h

Working time 1.6 h

As a result, the operating time per bulldozer comes to 7.5 hours (5.9 + 1.6 hours).

② Excavation (1 back hoe × 0.7 m^3)

i) Work capacity of the back hoe

The volume of earth that can be excavated by the back hoe per working hour is calculated by the following equation.

$$\text{Earth volume} = \frac{3{,}600 \times q \times E_1 \times E_2 \times f}{Cm} \quad (m^3/h)$$

q : earth excavation volume per cycle (ground volume) (m^3)
$q = q_0 \times K$
q_0 : average standard bucket capacity (0.7 m^3)

K : bucket factor (0.98)

q = 0.7×0.98

= 0.69

E_1 : work efficiency (0.75)

E_2 : operating rate (0.85)

Cm: required time per cycle (30 sec)

f : factor of earth volume change (1.0)

$$\text{Earth volume} = \frac{3,600 \times 0.69 \times 0.75 \times 0.85 \times 1.0}{30}$$

$$= 53 m^3/h$$

ii) Calculation of Working time

Since 200 m^3 of ground earth needs to be excavated every day, the working time is calculated by the following equation.

Excavation : 200 m^3 ÷ 53 m^3/h = 3.8 h

Working time 3.8 h

③ Excavated earth loading (1 wheel loader × 1.5 m^3)

i) Work capacity of the wheel loader

The volume of excavated earth that can be loaded by the wheel loader per working hour is calculated by the following equation.

$$\text{Earth volume} = \frac{3,600 \times q \times E_1 \times E_2 \times f}{Cm} \quad (m^3/h)$$

q : excavated earth loading volume per cycle (m^3)

$q = 0.84 \times q_0 - 0.03$

q_0 : nominal bucket holding capacity (1.5 m^3)

$q = 0.84 \times q_0 - 0.03$

= 1.23

E_1 : work efficiency (0.65)

E_2 : operating rate (0.85)

Cm: required time per cycle (40 sec)

f : factor of earth volume change (1.0)

$$\text{Earth Volume} = \frac{3,600 \times 1.23 \times 0.65 \times 0.85 \times 1.0}{40}$$

$$= 62 m^3/h$$

ii) Calculation of Working time

Since 250 m^3 of ground earth needs to be loaded every day, the working time is calculated by the following equation.

Excavation : $250\ m^3 \div 62\ m^3/h = 4.0\ h$

Working time 4.0 h

④ Earth carrying (3 dump trucks × 8 m^3)

i) Work capacity of the dump trucks

The volume of earth (ground earth) that can be carried by the dump trucks per working hour is calculated by the following equation.

$$\text{Earth volume} = \frac{3{,}600 \times q \times E_1 \times E_2 \times f}{Cm} \quad (m^3/h)$$

q : volume of loaded earth (m^3)

$$q = \frac{W}{w} \quad (m^3)$$

W : allowable dead weight of dump truck (8 t)

w : unit volumetric weight of ground (1.8 t/m^3)

$$q = \frac{8}{1.8} \quad (m^3)$$

$$= 4.4$$

Cm: cycle time, obtained by the following expression

$Cm = 5.3 \times L \times \beta + \alpha$ (min.)

L : carrying distance (0.3 km)

ß : correction factor for traffic congestion and number of signals (0.85)

α : correction factor for loading equipment, etc. (18 min.)

$Cm = 5.3 \times 0.3 \times 0.85 + 18$

$= 19$

E_1 : work efficiency (0.9)

E_2 : operating rate (0.85)

f : volume change rate of soil (= 1.25)

$$\text{Earth volume} = \frac{60 \times 4.4 \times 0.9 \times 0.85 \times 1.25}{19}$$

$$= 13 m^3/h$$

ii) Calculation of Working time

Since 250 m^3 of earth needs to be carried every day, the working time is calculated by the following equation.

Carrying : 250 m^3 ÷ 13 m^3/h ÷3 trucks × 7.5 h = 6.4 h

Working time 6.4 h

4) Quantity of Landfill Equipment

Table 2-3-6 sums up the results of the above-mentioned examination.

Table 2-3-6 Landfill Equipment to be Supplied under the Project

Model	Basic Specifications	Quantity (units)	Working Time per Vehicle	
Bulldozer	200HP	3	Solid waste pushing	4.7 h
			Solid waste compaction	1.2 h
			Earth pushing	1.2 h
			Covering earth compaction	0.4 h
			Total	7.5 h
Back hoe	0.7m^3	1	Excavation	3.8 h
Wheel loader	1.5m^3	1	Loading	4.0 h
Dump truck	8m^3	3	Carrying	6.4 h

Remark: three dump trucks currently used for collection and haulage shall be diverted for use at the final disposal site.

(4) Maintenance Equipment

1) Mobile Workshop

The design concept of the mobile workshop is set based on consideration of the following various conditions.

① Most of the solid waste collection vehicles currently in operation are deteriorated vehicles that were purchased in 1977 and 1985 and have been in service for 20 and 12 years respectively.

② Between the handing-over of the Project equipment and the target year of 2002, all these existing vehicles shall be scrapped, however, repairs will need to be carried out up until the scrapping of each.

③ Of the existing vehicles that can still be used from the target year onwards, the oldest vehicles will have been in service for nine years by the target year, from which time they will enter into a period of frequent breakdown occurrence. Judging from the standard rate of decrease in the operating rate, it is estimated that each of these vehicles will experience around one breakdown per month on the road, and since there are 24 such vehicles, a total of at least 20 breakdowns on the road will occur every month.

④ Viewed in terms of maintaining the daily solid waste collection amount, i.e. maintaining the operating rate of collection vehicles, it is necessary to repair such breakdowns immediately where they occur.

⑤ Since breakdowns on the road usually occur when vehicles are loaded with solid waste, it is not desirable to haul such vehicles back to the workshop to undergo repairs.

⑥ In the case of densely built-up areas, in particular the Old City area, since the narrow width of roads makes it is difficult to haul away vehicles that break down, there is no choice but to carry out repairs on the road.

⑦ The maintenance tools that are in place at the workshop are limited in terms of number of types and are deteriorated, and there are hardly any tools here which can be used onboard the mobile workshop.

In consideration of the above, the design concept shall be as follows.

① Vehicles to be targeted for repair by the mobile workshop shall be solid waste collection vehicles.

② From the viewpoint of achieving immediate return to service, breakdowns that occur on roads shall be repaired on the spot.

③ Repair tools that are capable of dealing with breakdowns on roads shall be supplied. Tools that allow emergency repairs to be performed on hydraulic systems, engines, breaks, suspension and electrical systems, etc. shall be selected.

④ The range of movement of the mobile workshop shall be the solid waste collection districts.

2) Spare Parts

The design concept regarding spare parts shall be as follows.

① Judging from procurement conditions within Syria, the procurement of new spare parts is extremely difficult, however, after a certain amount of time has passed following the initial supply, spare parts shall as a rule be procured through the self efforts of the local side.

② As a rough guide, enough spare parts shall be supplied for the first 50,000 km of running of collection and haulage vehicles, etc., and for the first 5,000 hours of operation of construction machinery used for landfilling.

③ Spare parts shall not be supplied for the mobile workshop.

Based on the above design concept and design conditions, the maintenance equipment to be supplied under the Project shall be as shown in Table 2-3-7.

Table 2-3-7 Maintenance Equipment to be Supplied under the Project

Model	Basic Specifications	Quantity	Remarks
Mobile workshop	Van Body Type	1 unit	
Spare parts		1 set	For vehicles other than the mobile workshop

(5) Weigh Bridge

Information that can be obtained through installing a weigh bridge is basically the times of entry to the transfer station and the weight of loaded solid waste for each collection vehicle. The ownership, collection area and vehicle number of each vehicle carrying solid waste into the transfer station will first be registered on computer, meaning that non-registered vehicles will not be allowed to enter.

Information recorded by the weigh bridge is basically composed of the following five items.

a) Vehicle ownership (city, consigned subcontractor, carrying operator, etc.)
b) Vehicle registration number and dead weight
c) Time of entry
d) Collection area
e) Loaded weight

The information that is recorded by the weigh bridge is then compiled and output by computer according to the following items.

a) Time spent by each vehicle on each trip
b) Daily, weekly, monthly and annual collection amounts of each vehicle
c) Daily, weekly, monthly and annual collection amounts according to vehicle ownership
d) Daily, weekly, monthly and annual collection amounts according to each collection area

Data compiled in this manner can be used to achieve the short-term improvement and future planning of the solid waste treatment utility in terms of everyday management and utility running. In specific terms, the following is made possible.

a) Under the existing everyday management setup, 16 inspectors patrol areas under their charge every day to survey collection conditions and give instructions on emergency measures if problems exist. However, if the amount of solid waste collected by each vehicle can be output by 3.00 p.m. every day based on information from the weigh bridge, it would be possible to know immediately which areas are experiencing problems.

b) As the weekly, monthly and annual operating conditions of collection vehicles can be grasped from the duration spent on collection trips, improvement issues concerning collection routes and primary collection as well as deficiencies in vehicle maintenance can be understood, thus making it possible to address issues at appropriate times.

c) As the amount of solid waste collected from each sector every month can be accurately understood, the advance compilation of vehicle assignment plans that comply with the monthly characteristics of each area is possible.

d) As the annual amount of solid waste collected from each area can be understood, from changes in area population, preparation of collection plans that comply with solid waste generation characteristics is possible.

e) Since the amount of solid waste collected can be grasped according to vehicle ownership, it is possible to find out whether or not, for example, consigned subcontractors are producing collection results in accordance with plans and, therefore, introduce a payment system that is based on actual performance.

f) Regarding the independent carrying in of solid waste by generating parties, because qualification for registration can be confirmed upon checking the nature of the solid

waste concerned, it is possible to control the entry of harmful or hazardous solid waste products.

g) A charge system that is based on the amount of solid waste that is independently carried in can be introduced.

h) As the amount of waste collected in each year can be accurately understood, medium-to-long-term solid waste collection plans can easily be compiled.

Data from the weigh bridge are input into a computer and necessary information can immediately be output through using a software program that is pre-installed. It is planned for the weigh bridge to be managed by two staff members.

(6) Basic Specifications and Necessary Quantity of Equipment to be Supplied

The equipment to be supplied under the Project as a result of the examination described above is compiled into Table 2-3-8 below. Figure 2-3-4 illustrates, in the form of the flow of solid waste, the solid waste management system in the Project target year of 2002, when it will be composed of the existing equipment and the new transfer station.

Table 2-3-8 List of the Equipment to be Supplied

Model	Basic Specifications	Quantity (units)
Collection and Haulage Equipment		
Compactor truck	2 ton	15
Compactor truck	3 ton	18
Compactor truck	7 ton	22
Landfill Equipment		
Bulldozer	200 HP	3
Wheel loader	1.5 m^3	1
Back hoe	0.7 m^3	1
Maintenance Equipment		
Mobile workshop		1
Spare parts		1 set
Transfer Station Equipment		
Weigh bridge	40 ton	1

The basic specifications and outline drawings of the equipment to be supplied under the Project are indicated in the Table 2-3-9 and Figures 2-3-5～12.

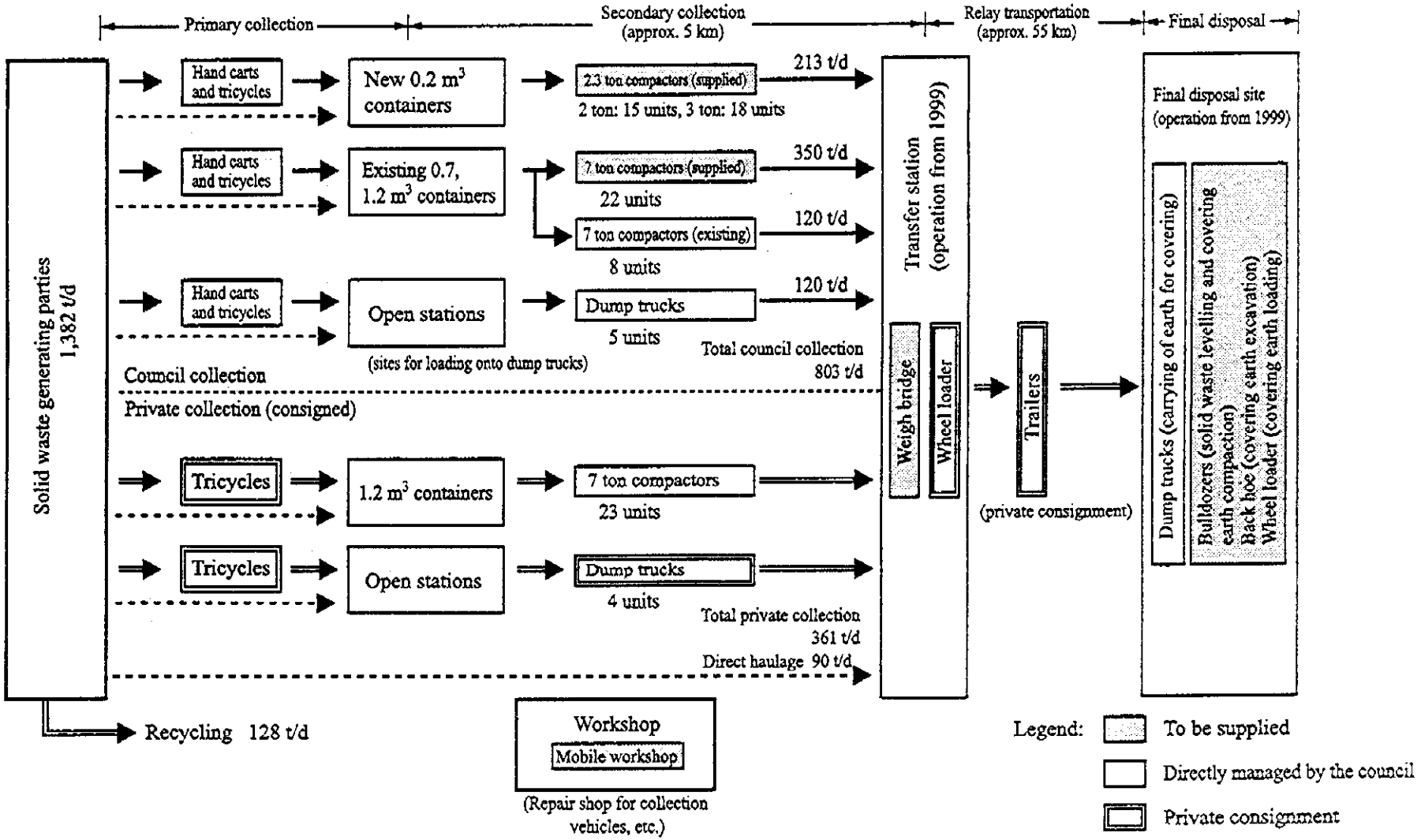


Figure 2-3-4 Solid Waste Management System in the Target Year (2002)

Table 2-3-9 (1) Specifications of Equipment to be Supplied

Item	Specifications	Remarks
I. Collection and Haulage Equipment		
1. Compactor truck (2 ton)	4 m^3 load class	
(1) Main specifications		
- Vehicle specifications	4 m^3 compactor truck for solid waste collection and haulage	
- Steering wheel position	Left steering wheel, front	Because traffic runs on the right side in Syria
- Drive method	4 × 2 rear drive	
- Maximum load capacity	Approx. 1,700 kg	
- Vehicle total weight	Approx. 5,500 kg	
(2) Main specifications		
- Total length	Approx. 5,300 mm	
- Total width	Approx. 2,000 mm	
- Total height	Approx. 2,300 mm	
- Wheel base	Approx. 2,500 mm	
- Minimum turning radius	Approx. 5,100 mm	
(3) Engine		
- Type	Direct injection, water cooling 4 cycle diesel engine	
- Maximum output	Approx. 100 ps or more	
(4) Special fittings		
- Body capacity	Approx. 4 m^3	Fitted with exhaust
- Hopper capacity	Approx. 0.6 m^3	
2. Compactor truck (3 ton)	7 m^3 load class	
(1) Main specifications		
- Vehicle specifications	7 m^3 compactor truck for solid waste collection and haulage	
- Steering wheel position	Left steering wheel, front	Because traffic runs on the right side in Syria
- Drive method	4 × 2 rear drive	
- Maximum load capacity	Approx. 3,000 kg	
- Vehicle total weight	Approx. 9,000 kg	
(2) Main specifications		
- Total length	Approx. 6,700 mm	
- Total width	Approx. 2,100 mm	
- Total height	Approx. 2,900 mm	
- Wheel base	Approx. 3,300 mm	
- Minimum turning radius	Approx. 6,300 mm	
(3) Engine		
- Type	Direct injection, water cooling 4 cycle diesel engine	
- Maximum output	Approx. 160 ps or more	
(4) Special fittings		
- Body capacity	Approx. 7 m^3	Fitted with exhaust
- Hopper capacity	Approx. 1.0 m^3	
- Container lift	Capable of lifting a 0.7 m^3 iron container	

Table 2-3-9 (2) Specifications of Equipment to be Supplied

Item	Specifications	Remarks
3. Compactor truck (7 ton)	15 m^3 load class	
(1) Main specifications		
- Vehicle specifications	15 m^3 compactor truck for solid waste collection and haulage	
- Steering wheel position	Left steering wheel, front	Because traffic runs on the right side in Syria
- Drive method	4 × 2 rear drive	
- Maximum load capacity	Approx. 7,000 kg	
- Vehicle total weight	Approx. 24,000 kg	
(2) Main specifications		
- Total length	Approx. 8,400 mm	
- Total width	Approx. 2,500 mm	
- Total height	Approx. 3,400 mm	
- Wheel base	Approx. 4,500 mm	
- Minimum turning radius	Approx. 7,500 mm	
(3) Engine		
- Type	Direct injection, water cooling 4 cycle diesel engine	
- Maximum output	Approx. 300 ps or more	
(4) Special fittings		
- Body capacity	Approx. 15 m^3	Double hinged door
- Hopper capacity	Approx. 2.0 m^3	
- Container lift	Capable of lifting a 1.2 m^3 iron container	
II. Landfill Equipment		
1. Bulldozer (200 HP)	200 HP class bulldozer	
(1) Main specifications		
- Total length	Approx. 5,300 mm	
- Total width	Approx. 2,600 mm	
- Total height	Approx. 3,200 mm	
- Minimum ground clearance	Approx. 350 mm	
(2) Blade	Straight tilt, trash rack	
(3) Weight	Approx. 20,000 kg	
(4) Engine		
- Type	Water cooling 4 cycle diesel engine	
- Maximum output	Approx. 200 HP	
(5) Track		
- Type	Shield lubricate	
- Width	Approx. 550 mm	
(6) Special fittings		
- Cab	ROPS canopy, steel cab (with air conditioner)	
- Radiator guard		
- Engine enclosure		

Table 2-3-9 (3) Specifications of Equipment to be Supplied

Item	Specifications	Remarks
2. Wheel loader	1.5 m^3 class wheel loader	
(1) Main specifications		
- Total length	Approx. 6,500 mm	
- Total width	Approx. 2,400 mm	
- Total height	Approx. 3,000 mm	
- Wheel base	Approx. 2,600 mm	
- Minimum turning radius	Approx. 5,000 mm	
- Minimum ground clearance	Approx. 300 mm	
(2) Bucket	1.5 m^3	
(3) Weight	Approx. 7,500 kg	
(4) Engine		
- Type	Water cooling 4 cycle diesel engine	
- Maximum output	Approx. 120 HP	
- Running speed	Maximum approx. 30 km/h	
(5) Special fittings		
- Cab	Steel cab (with air conditioner)	
3. Back hoe	0.7 m^3 class back hoe	
(1) Main specifications		
- Total length	Approx. 5,300 mm	
- Total width	Approx. 2,600 mm	
- Total height	Approx. 3,200 mm	
- Minimum ground clearance	Approx. 350 mm	
- Maximum excavation depth	Approx. 6,500 mm	
- Maximum arrival speed	Approx. 9,500 mm	
- Maximum cutting height	Approx. 9,400 mm	
- Maximum loading height	Approx. 6,500 mm	
(2) Bucket	0.7 m^3 or more	
(3) Weight	Approx. 20,000 kg	
(4) Engine		
- Type	Water cooling 4 cycle diesel engine	
- Maximum output	Approx. 130 HP	
(5) Track		
- Type	Shield lubricate	
- Width	Approx. 600 mm	
(6) Special fittings		
- Cab	Steel cab (with air conditioner)	

Table 2-3-9 (4) Specifications of Equipment to be Supplied

Item	Specifications	Remarks
III. Maintenance Equipment		
1. Mobile workshop		
(1) Main specifications		
- Vehicle specifications	Box-shape body mobile workshop	
- Steering wheel position	Left steering wheel, front	Because traffic runs on the right side in Syria
- Drive method	4 × 2 rear drive	
- Vehicle total weight	Approx. 9,000 kg	
(2) Main specifications		
- Total length	Approx. 7,000 mm	
- Total width	Approx. 2,200 mm	
- Total height	Approx. 3,400 mm	
- Wheel base	Approx. 3,700 mm	
- Minimum turning radius	Approx. 6,500 mm	
(3) Engine		
- Type	Direct injection, water cooling 4 cylinder diesel engine	
- Maximum output	Approx. 170 ps	
(4) Body dimensions		
- Body length	Approx. 4,700 mm	Doors on both sides and rear
- Body width	Approx. 2,200 m	
- Body height	Approx. 2,100 mm	
(5) Jib crane	Approx. 500 kg, floor fixed, manual	
(6) Main tools onboard		
- Electric welder	10 KVA, engine output approx. 15 HP	
- Air compressor	Approx. 15 kg/cm^2, motor output approx. 2 KW	
- Grinder	Approx. 200 mm	
- Silicon charger	Approx. 1.5 KW	
- Electric drill	Drill cap approx. 13 mm	
- Bench press	10 ton	
- Hydraulic jack	10 ton	
- Fire extinguisher	Powder type, approx. 3.5 kg	
- Oxygen cylinder	47 L type	
- Acetylene cylinder	7 kg type	
- Gas welder	Including oxygen regulator and other accessories	
- Tool box	Approx. 450 mm × 300 mm × 120 mm	
2. Weigh bridge		
(1) Type	Load cell type	
(2) Capability		
- Capacity	40 ton	
- Minimum scale grade	10 kg	
- Platform dimensions	Approx. 3 m × 8 m	
(3) Display		
- Type	Digital display (with printer)	
- Display	17 inch	

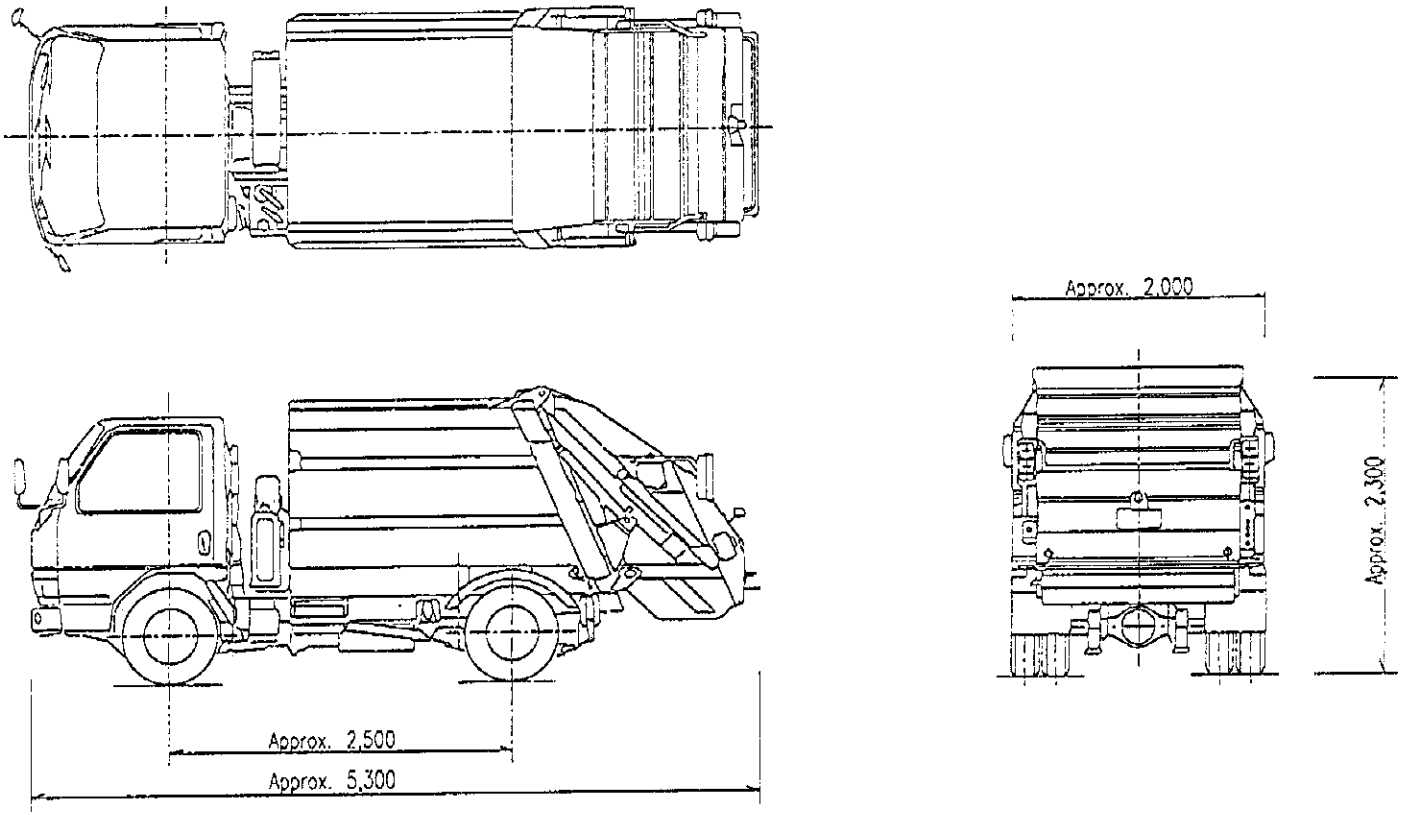


Figure 2-3-5 Compactor Truck (2 ton)

THE PROJECT FOR IMPROVEMENT OF WASTE DISPOSAL EQUIPMENT IN ALEPPO CITY IN THE SYRIAN ARAB REPUBLIC			
Compactor Truck(2 ton)			
DATE	SCALE	DWG.NO.	REVISION
'98.3	Non	351-0956-CT-2-4	0
yec	YACHIYO ENGINEERING CO., LTD. CONSULTING ENGINEERS AND ARCHITECTS		

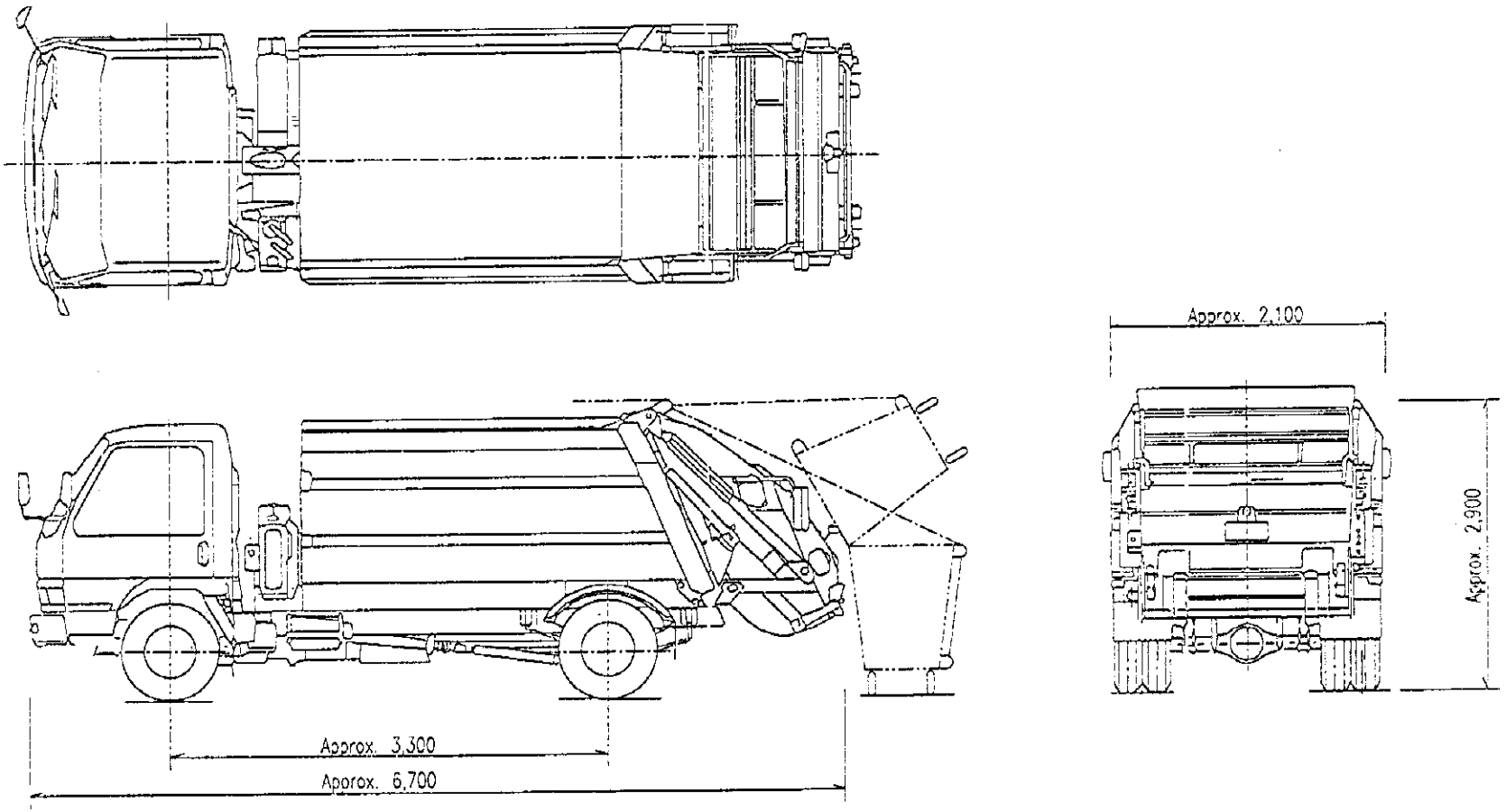


Figure 2-3-6 Compactor Truck (3 ton)

THE PROJECT FOR IMPROVEMENT OF WASTE DISPOSAL EQUIPMENT IN ALEPPO CITY IN THE SYRIAN ARAB REPUBLIC			
Compactor Truck(3 ton)			
DATE	SCALE	DWG.NO.	REVISION
'96.3	Non	351-0956-CT-3-7	0
yec	YACHIYO ENGINEERING CO., LTD. CONSULTING ENGINEERS AND ARCHITECTS		

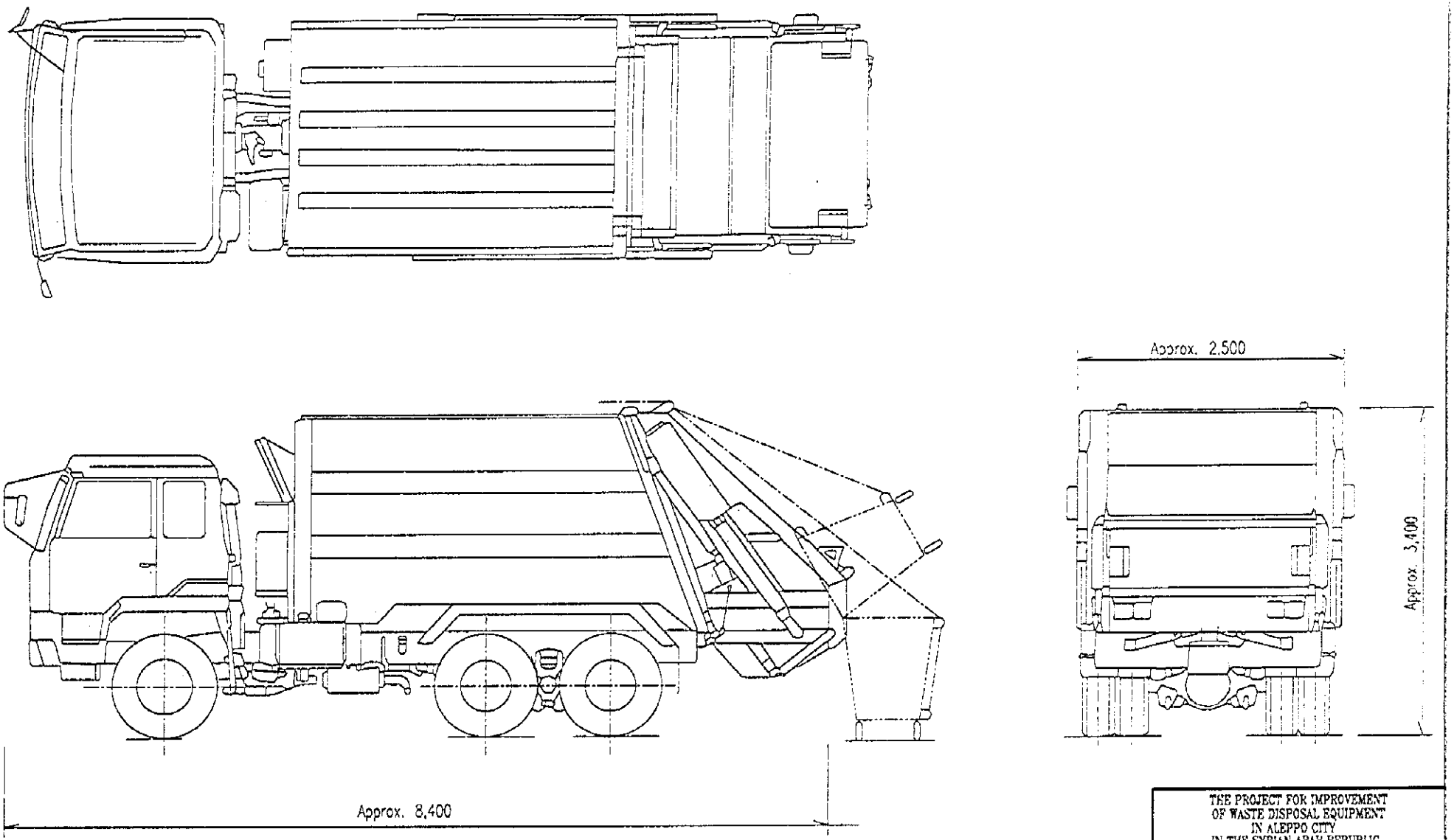


Figure 2-3-7 Compactor Truck (7 ton)

THE PROJECT FOR IMPROVEMENT OF WASTE DISPOSAL EQUIPMENT IN ALEPPO CITY IN THE SYRIAN ARAB REPUBLIC			
Compactor Truck(7 ton)			
DATE	SCALE	DWG.NO.	REVISION
'98.3	Non	351-0956-CT-7-15	0
yec	YACHIYO ENGINEERING CO., LTD. CONSULTING ENGINEERS AND ARCHITECTS		

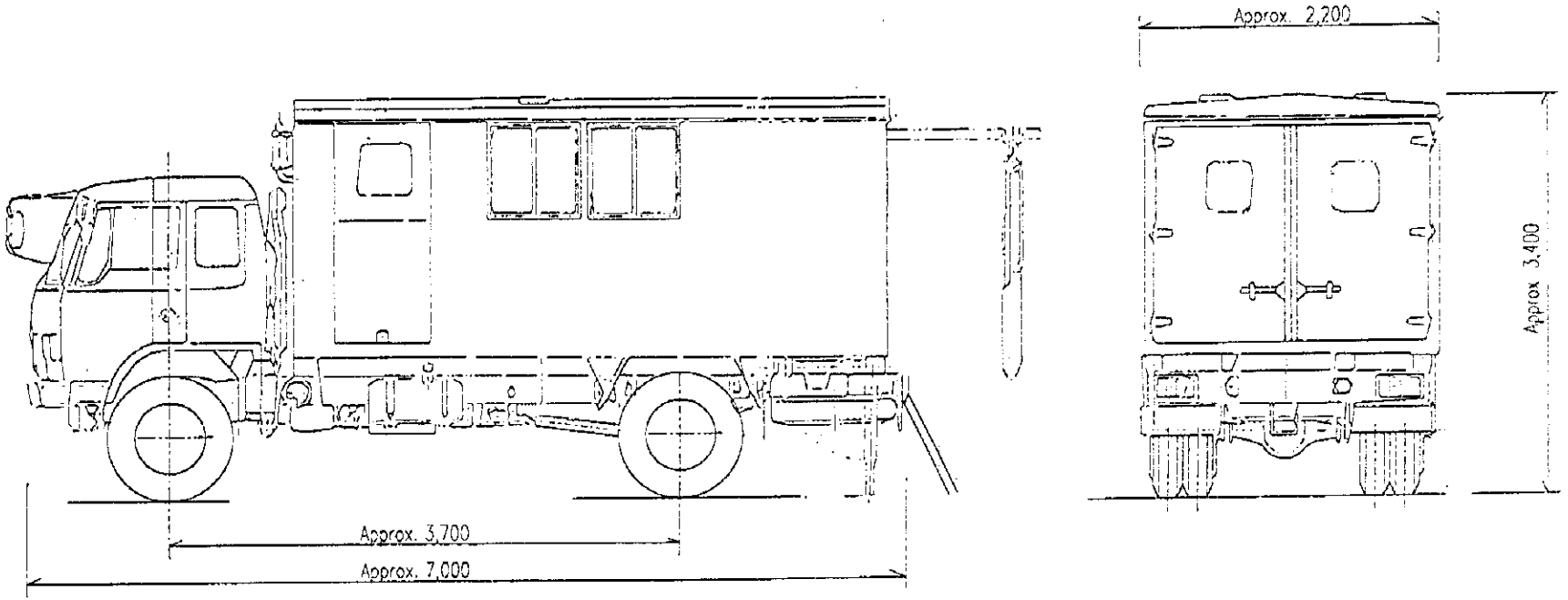
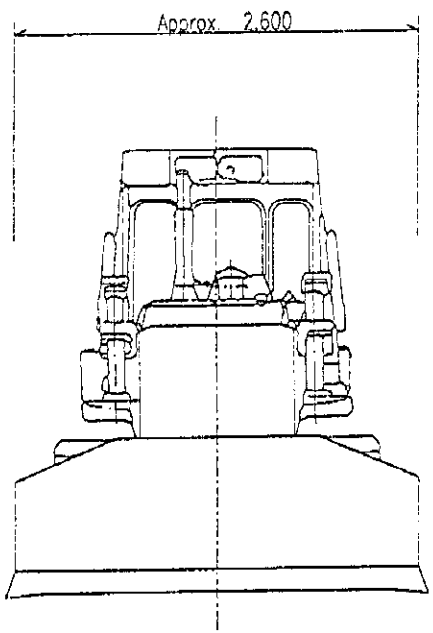


Figure 2-3-8 Mobile Workshop

THE PROJECT FOR IMPROVEMENT OF WASTE DISPOSAL EQUIPMENT IN ALEPPO CITY IN THE SYRIAN ARAB REPUBLIC			
Mobile Workshop			
DATE	SCALE	DWG.NO.	REVISION
'96.3	Non	361-0956-MW-170	0
yec	YACHIYO ENGINEERING CO., LTD. CONSULTING ENGINEERS AND ARCHITECTS		



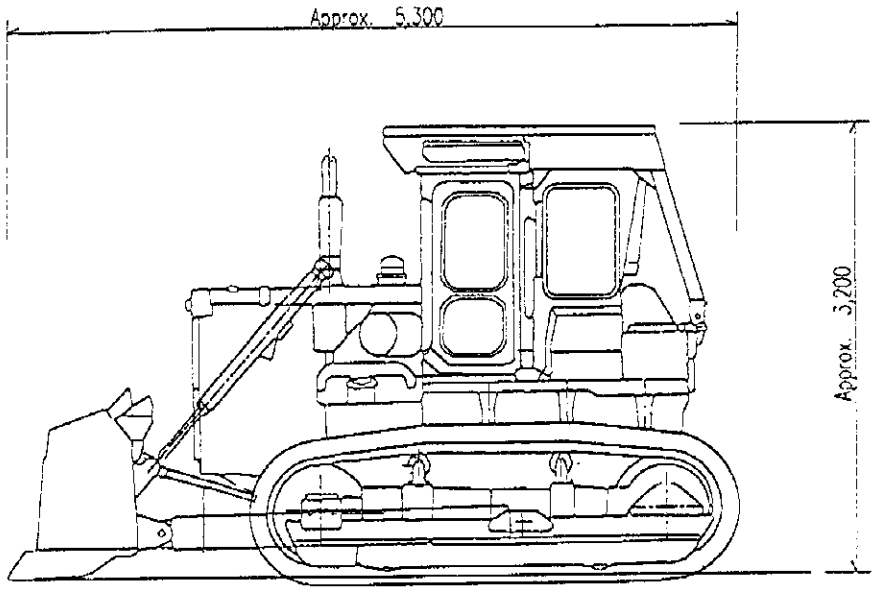


Figure 2-3-9 Bulldozer (200 HP)

THE PROJECT FOR IMPROVEMENT OF WASTE DISPOSAL EQUIPMENT IN ALEPPO CITY IN THE SYRIAN ARAB REPUBLIC			
Bulldozer(200HP)			
DATE	SCALE	DRG.NO.	REVISION
'98.3	Non	351-0956-BD-200	0
yec	YACHIYO ENGINEERING CO., LTD. CONSULTING ENGINEERS AND ARCHITECTS		

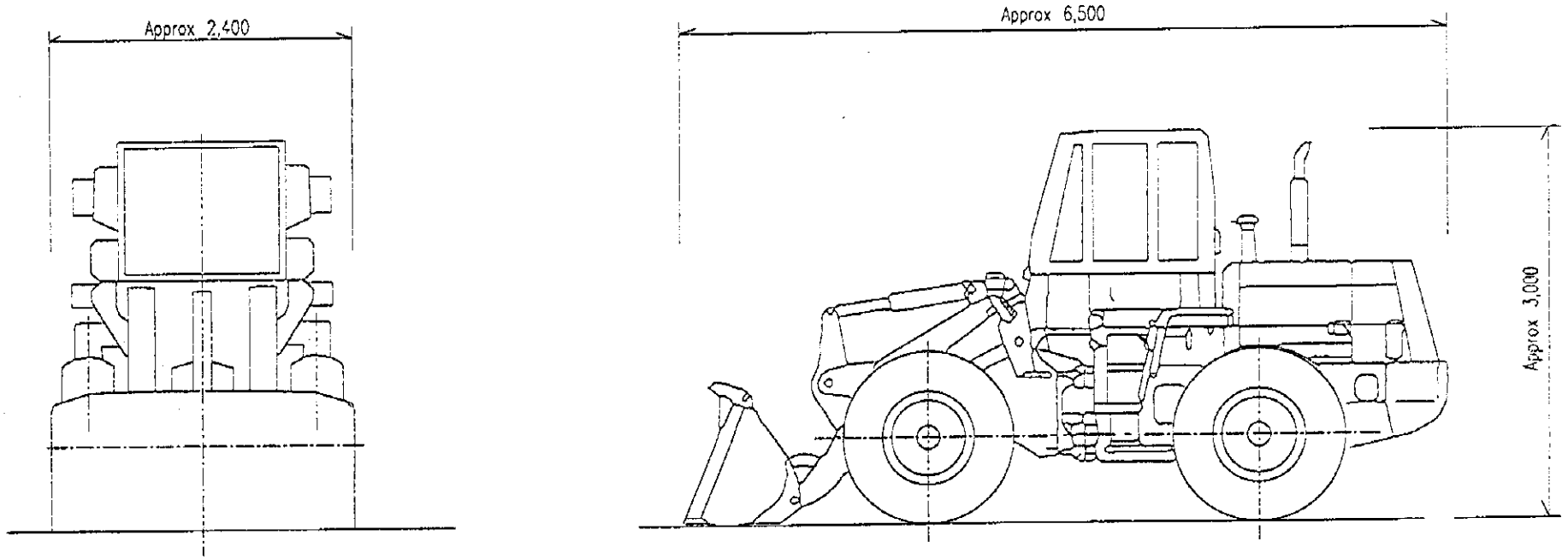


Figure 2-3-10 Wheel Loader

THE PROJECT FOR IMPROVEMENT OF WASTE DISPOSAL EQUIPMENT IN ALEPPO CITY IN THE SYRIAN ARAB REPUBLIC			
Wheel Loader(1.5m³)			
DATE	SCALE	DWG.NO.	REVISION
'98.3	None	351-0956-WL-1.5	0
yec	YACHIYO ENGINEERING CO., LTD. CONSULTING ENGINEERS AND ARCHITECTS		

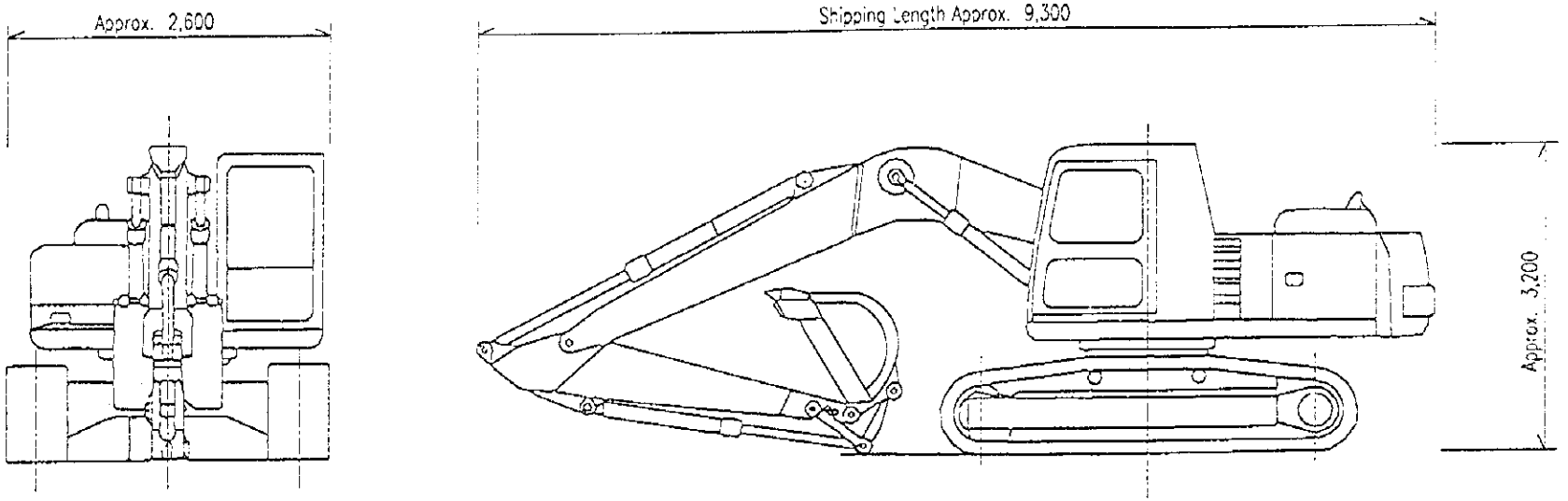
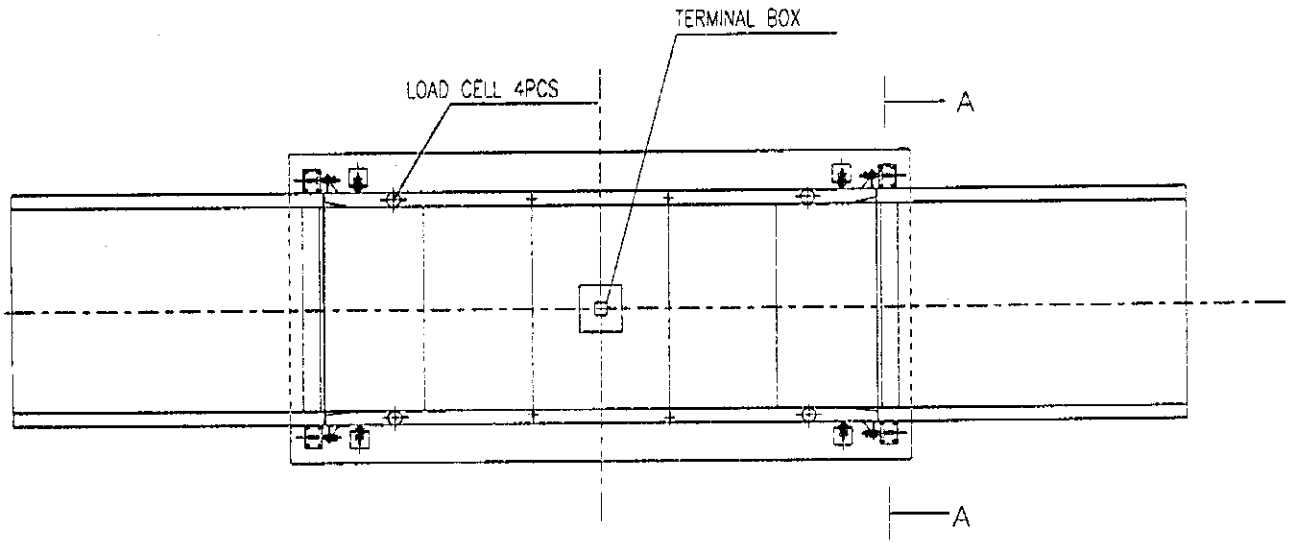
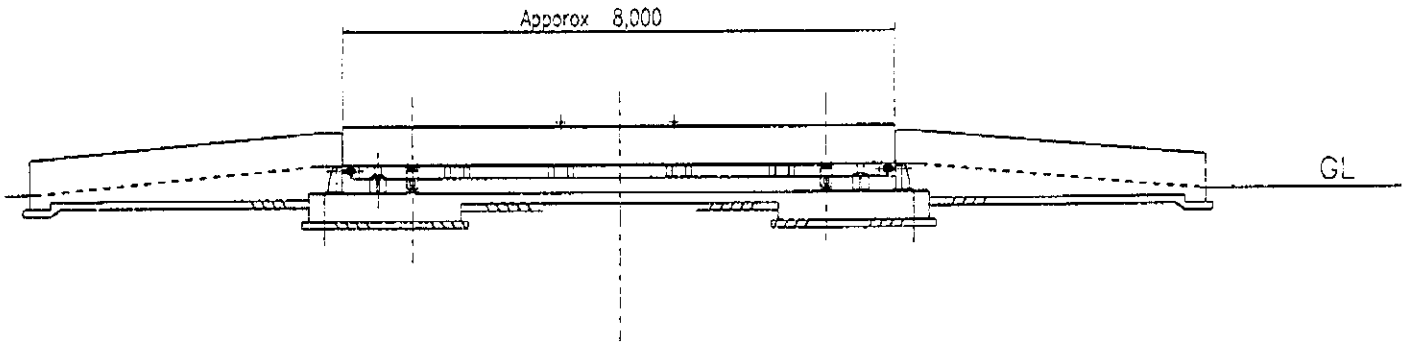


Figure 2-3-11 Back Hoe

THE PROJECT FOR IMPROVEMENT OF WASTE DISPOSAL EQUIPMENT IN ALEPPO CITY IN THE SYRIAN ARAB REPUBLIC			
Back Hoe(0.7m³)			
DATE	SCALE	DWG.NO.	REVISION
'98.3	Non	351-0956-BH-0.7	0
yec	YACHIYO ENGINEERING CO., LTD. CONSULTING ENGINEERS AND ARCHITECTS		





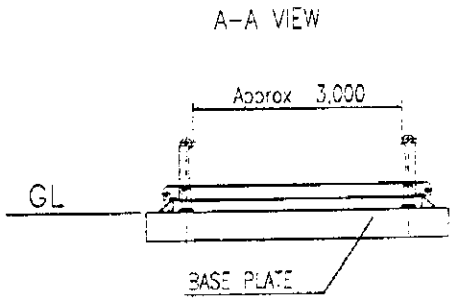


Figure 2-3-12 Weigh Bridge

THE PROJECT FOR IMPROVEMENT OF WASTE DISPOSAL EQUIPMENT IN ALEPPO CITY IN THE SYRIAN ARAB REPUBLIC			
Weigh Bridge			
DATE	SCALE	DWG.NO.	REVISION
'96.3	Non	351-0956-WB-40	0
yec	YACHIYO ENGINEERING CO., LTD. CONSULTING ENGINEERS AND ARCHITECTS		

(7) Location

1) Positional Relationship of Sites

Since the whole of the Aleppo urban area is targeted for solid waste collection and the new final disposal site is located some 60 km south of the city center, a new transfer station is to be constructed approximately 5 km from the city center in order to ensure that solid waste is efficiently transported to the final disposal site.

With respect to selection of the site for the final disposal site, a report presented by the Syria side states that, "the present site was selected upon establishing a site selection committee consisting of the Agriculture and Forestry Department and other related departments and carrying out aerial and ground investigations of the whole area."

Concerning the site of the transfer station, it was originally planned to construct this on a piece of land scheduled for an industrial estate, however, following a decision to close down the existing compost plant in December 1997, some voices were raised within the municipal government calling for this site to be used for the transfer station. In this way there was a temporary conflict of opinion, however, apparently it has finally been decided to adopt the originally planned site as a result of intervention by the Mayor in February 1998.

2) Conditions of Sites

The collection area is divided into five cleansing districts. In topographical terms, the whole area slopes gently from north to south, however, as an exception, the urban district of Serian is characterized by relatively steep undulations.

The planned site of the new transfer station covers approximately 10 ha of gently sloping vacant land, located within an area that has been designated for industrial use.

Concerning the site of the new final disposal site currently under construction, this is located in a small valley surrounded by hills. Since this site can be developed up to a width of approximately 600 m and a depth of approximately 20 m, it is estimated that a total disposal volume of roughly 10 million cubic-meters and a useful service life of more than 15 years can be secured on the site.

3) Situation Regarding Infrastructure Development

Almost all the roads in the treatment area are paved. The ring road which is currently being constructed around the perimeter of the city is a high standard road possessing a median strip and four lanes in both directions, and 80% of this road has already been opened to traffic. Aleppo City Council is currently compiling a master plan for city development, which aims to carry out infrastructure development (roads, water supply, sewerage system, etc.) up until the target year of 2015.

4) Geological Conditions

Concerning geological conditions in the area around the new final disposal site, there is a surface layer of clay ranging between 3-5 m (at a point approximately 3.5 km from the disposal site). Beneath that can be found a rock layer of 5-30 m and then another clay layer of approximately 100 m.

CHAPTER 3 IMPLEMENTATION PLAN

CHAPTER 3 IMPLEMENTATION PLAN

3-1 Implementation Plan

3-1-1 Implementation Concept

Since the Project shall be implemented in accordance with the framework of the grant aid system of the Government of Japan, the Project shall move into the implementation stage following approval by the Government of Japan and signing of the E/N between Japan and Syria. Following that, a Japanese consultant shall be selected by the Government of Syria and shall enter into the implementation design work. Following completion of tender documents based on the results of the implementation design, the Japanese contractor determined by the tender shall carry out equipment supply. The basic items and points requiring particular attention in the case of Project implementation are described below.

(1) Main Project Implementing Body

The agencies responsible for implementation of the Project on the Syria side are the Sanitation Affairs Directorate and Technical Directorate of Aleppo City Council. The Government of Syria needs to appoint a responsible person for the Project to hold close communications and consultations with the Japanese consultant and contractor and generally ensure the smooth advancement of Project implementation, and it is expected that the Manager of the Sanitation Department will fill this post.

The said responsible person needs to fully explain the Project contents to related officials to obtain their full understanding and provide guidance to ensure that cooperation is received in advancing the Project.

(2) Consultant

Since the Project is a grant aid undertaking for equipment supply, the Japanese consultant shall conclude a consultant supervision contract with the Government of Syria and carry out the implementation design and supply supervision of the Project equipment. The consultant shall also prepare tender documents and act on behalf of the Project implementing agencies in advancing the tender.

(3) Supply Contractor

In accordance with the grant aid system of the Government of Japan, a Japanese corporate contractor selected through open tender shall carry out the supply of equipment.

Moreover, since it is considered that continued spare parts supply, breakdown handling and other services will be required following the equipment supply, it is necessary for the contractor to be able to respond swiftly concerning communications and coordination following handing-over of the equipment.

(4) Necessity of Engineer Dispatch

Since Aleppo City Council has had no prior experience of sanitary landfilling, it will be necessary to provide guidance in this area at the time when the equipment is introduced. Since this guidance will concern the basic method of landfilling, it is judged that roughly one week of such guidance will be sufficient. In the Project, this guidance for installation, operation and maintenance of the weigh-bridge as well as landfilling method shall be provided at the time of equipment handing-over and inspection by the consultant.

3-1-2 Implementation Conditions

(1) Supply Plan

1) Apart from the containers, the equipment to be supplied in the Project is not manufactured in Syria, so it will need to be procured from Japan or a third country.

2) In view of their experience in carrying out the inland transportation of equipment on the occasion of the Project for Improvement of Waste Disposal Equipment in City of Damascus, transportation operators in Syria can be said to possess ample experience and capacity to carry out the inland transportation of the supplied equipment within Syria.

3) When supplying equipment, care shall be taken to standardize vehicles under the same type as much as possible, in order to make operation and maintenance following Project implementation easier.

(2) Laws and Regulations

1) Vehicles that are produced according to the criteria of Japan or European and American countries are judged to be compliant with the road traffic laws of Syria.

2) Because Syria prohibits the import of equipment made in Israel, procurement of equipment from this country is not possible.

3-1-3 Scope of Works

The scope of works under the Project to be borne by the Japanese and Syrian sides is as indicated in Table 3-1-1.

The Project plans for solid waste to be collected in containers by compactor truck (2 ton, 3 ton and 7 ton). Since container production is carried out in Syria and Aleppo City Council, too, has ample experience in this, it has been decided to make the manufacture of containers an item to be borne by the Syrian side.

Table 3-1-1 Items to be Borne by the Japan and Syrian Sides

Item	Japan Side	Syrian Side
1. Supply of collection and haulage equipment		
(1) Supply of vehicles	Supply	—
(2) Supply of containers	—	Supply
2. Relay transportation		
(1) Transfer station construction	—	Supply
(2) Relay transportation equipment	—	Supply
(3) Weigh Bridge	Supply	See Note
3. Supply of landfill equipment		
(1) Heavy machinery	Supply	—
(2) Dump trucks	—	Supply
4. Supply of maintenance equipment	Supply	—
5. Transportation	Marine transportation	Inland transportation in Syria

(Note) Machinery installation and operation, etc. is the responsibility of the Syrian side.

3-1-4 Consultant Supervision

Based on the grant aid system of the Government of Japan, the consultant shall form an integrated Project Team for the implementation of design work and consultant supervision work in accordance with the purport of the basic design, and shall carry out the smooth implementation of work. In the consultant supervision stage, the consultant shall dispatch an engineer at necessary times in line with progress of the work, provide guidance on the weigh bridge installation work, be present during inspections and provide follow-up for the items to be borne by the recipient country.

(1) Basic Concept of Consultant Supervision

The consultant needs to manage and provide guidance for contractors throughout all areas of the supply work to ensure that the Project is surely and safely implemented within the set period. The contents of the work involved are indicated in Table 3-1-2.

Table 3-1-2 Contents of Consultant Work in the Project

	Work Contents
1. Pre-supply stage	Implementation design study Preparation of tender documents Tender Evaluation of tender results Contract work assistance
2. Supply stage	Consultant supervision Inspections Report preparation, etc.

1) Progress Control

a) Concerning the manufacture and transportation of equipment, the Consultant shall manage progress by making contractors periodically report on the state of progress.

b) The Consultant shall check schedules for each supply item every month and provide guidance to ensure that contractors adhere with the contract period.

c) Regarding the Syria side obligations of transfer station and final disposal site construction and container manufacture, these items are scheduled to be completed by the start of 1999 before the handing-over of equipment. Therefore, the Consultant shall advise the Syrian side to ensure that it follows this schedule.

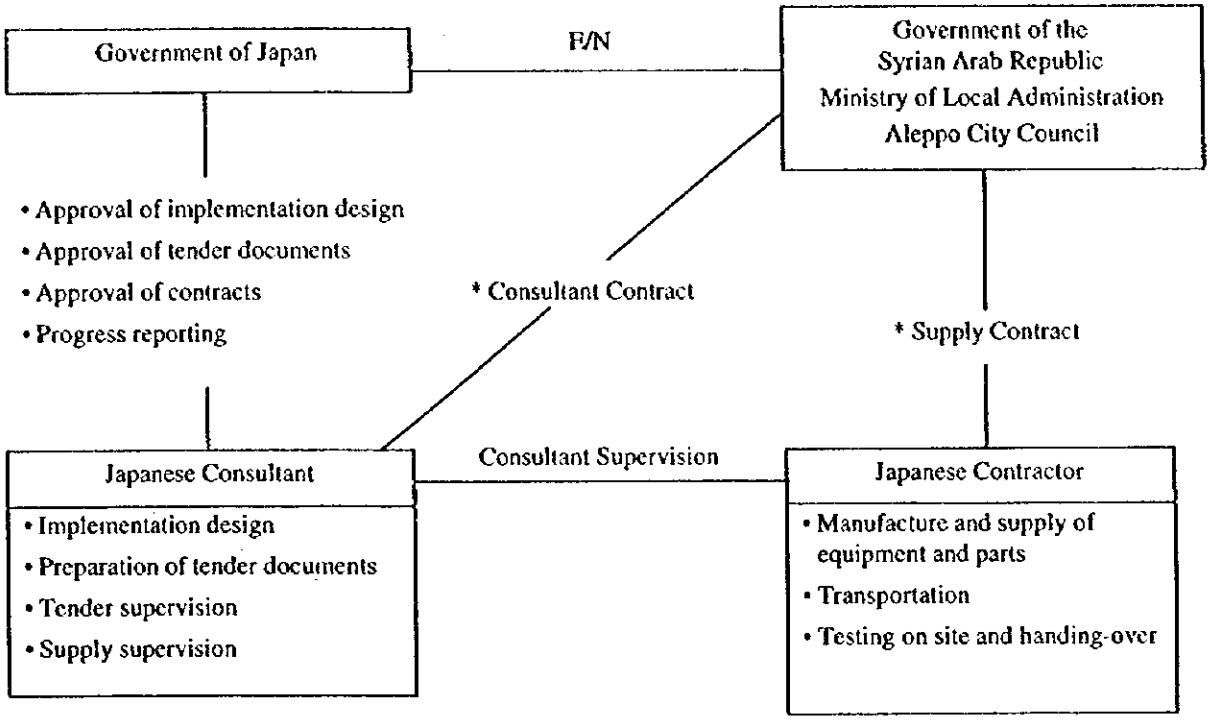
2) Quality Control

a) The Consultant shall confirm the specifications and quality of equipment based on the implementation design documents.

b) Attend quality inspections, performance tests and other plant inspections carried out when the plant manufacture of equipment is completed.

(2) Overall Relationship During Consultant Supervision

The following diagram illustrates the consultant supervision setup and overall relationship between concerned agencies, etc. during consultant supervision.



* Note: The consultant contract and supply contract require the official approval of the Government of Japan

Figure 3-1-1 Project Implementation Relationship Chart

3-1-5 Procurement Plan

In view of the fact that, apart from the containers, the Project equipment is not manufactured in Syria, the equipment shall be procured either in Japan or a third country.

Consequently, based on comparative examination of standards, specifications, quality, production and supply stability, supply time and price, the equipment shall be procured in the manner shown in Table 3-1-3. Moreover, concerning spare parts for the supplied equipment, these shall be procured from the countries of original equipment supply.

Table 3-1-3 Countries of Equipment Supply

Equipment	Country of Origin		
	Syria	Japan	Third Country
Compactor trucks (2 t)		○	○
Compactor trucks (3 t)		○	○
Compactor trucks (7 t)		○	○
Mobile workshop		○	○
Bulldozers (200 HP)		○	○
Wheel loader (1.5 m^3)		○	○
Back hoe (0.7 m^3)		○	○
Weigh Bridge (40 t)		○	○

3-1-6 Implementation Schedule

In the event where the Project is implemented under the grant aid system of the Government of Japan, Project implementation following conclusion of the E/N between the two party countries shall consist of the following three stages: ① preparation of detailed design documents, ② tender and supply contract, and ③ equipment supply.

(1) Detailed Design Work

Following conclusion of the E/N, the Japanese consultant shall immediately sign a consultant contract with the Government of Syria and enter into the detailed design.

Based on the results of the basic design study and detailed design study, the consultant shall prepare tender documents (specifications and detailed design drawings). At the beginning and end of the detailed design, the consultant shall hold close consultations with related agencies on the Syrian side and obtain approval for the final products before entering into the tender work. The time required for detailed design is expected to be 2.5 months.

(2) Tender and Contract Work

The consultant, acting on behalf of the Government of Syria, shall announce the tender, register participants to the tender, explain the tender process, distribute the tender documents, etc. and set a certain period for tender preparation. Following receipt of the presented tender prices and documents, the consultant shall quickly examine these and

work to advance conclusion of a supply contract with a contractor that must be a Japanese corporate person.

The tender shall take place in the presence of all those concerned. The bidder that presents the lowest price shall, in the case where its tender contents are judged to be appropriate, become the successful bidder and sign a supply contract with the Government of Syria.

It is forecast that a period of 1.2 months will be required from the distribution of tender documents through to conclusion of the supply contract.

(3) Equipment Supply

Following conclusion of the supply contract and its verification by the Government of Japan, the contractor shall enter into the supply work. Judging from the scale of the Project, if equipment supply goes smoothly and the work items of the Syrian side are carried out without delay, it is expected that the period required for supply will be 7.8 months.

The consultant shall meet with the contractor before the start of work to guide and supervise the contractor and it shall carry out schedule control and quality control and ensure that the work is completed within the period set out in the E/N.

Figure 3-1-2 shows the expected work implementation schedule for each phase.

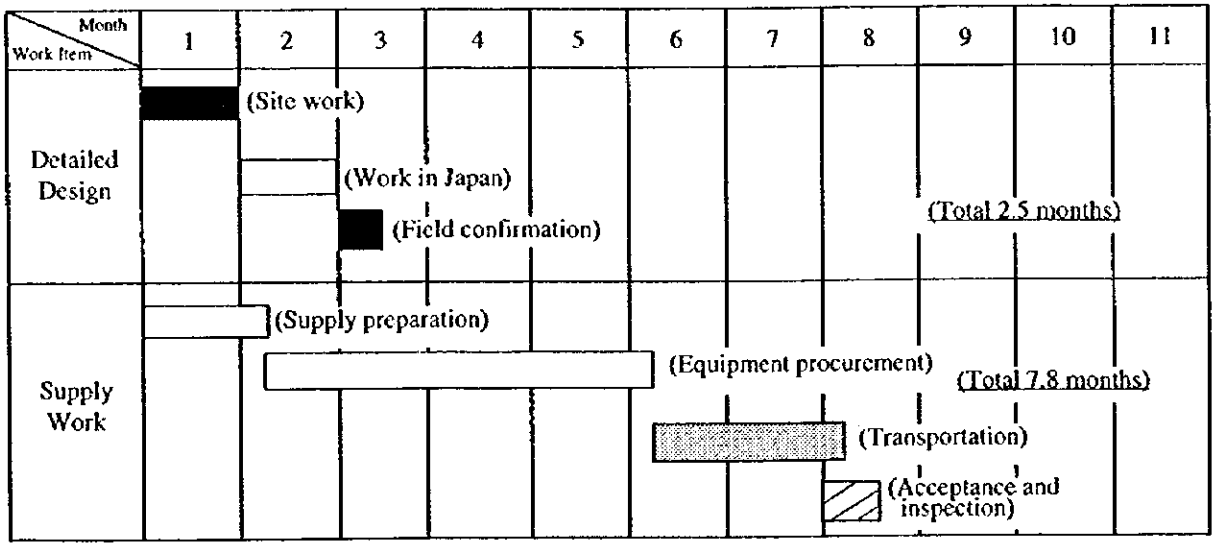


Figure 3-1-2 Work Implementation Schedule

3-1-7 Work to be Undertaken by Recipient Country

The items to be undertaken by the Syrian side are as follows:

1) to provide necessary data and information for the Project;
2) to take measures for the prompt unloading and customs clearance in Syria of the equipment supplied under the Project;
3) to ensure tax exemptions and provide necessary conveniences for the equipment supplied and Japanese nationals dispatched under the Project;
4) to ensure customs duty and business tax exemptions for the equipment supplied under the Project;
5) to bear payment commissions and expenses for opening an account with a Japanese foreign exchange bank;
6) to bear all expenses other than those covered by the Grant, necessary for the execution of the Project;
7) to appoint expert technicians for the acceptance of operation and maintenance technology transfer;
8) to maintain properly and effectively the equipment supplied under the Project;
9) to supply containers that are suitable for handling by the compactor trucks (2 ton, 3 ton, 7 ton) to be supplied under the Project;
10) to carry out the installation of the weigh bridge to be supplied under the Project and construct an administration building; and
11) to carry out the inland transportation in Syria of the equipment to be supplied under the Project.

3-2 Operation and Maintenance Plan

3-2-1 Basic Concept

Maintenance activity consists solely of regular oil changes (after every 2,500 km of running for compactor trucks) and, apart from that, vehicles are only admitted into the garage for repair whenever a driver reports a problem or after a breakdown occurs.

Consequently, there is no preventive maintenance equivalent to the periodic inspection and maintenance and annual automobile inspections that are legally required in Japan.

The aims of inspection and maintenance are to continually preserve vehicles in good working order and, by discovering the signs of breakdown at an advanced stage, prevent breakdowns before they happen and restrict damage to a minimum. Based on this viewpoint, following introduction of the Project equipment, vehicle maintenance shall be carried out through adopting this method of preventive inspection and maintenance. When the equipment is introduced, manuals relating to inspections and repair shall be supplied and guidance shall be provided on the maintenance system.

3-2-2 Contents of Repair and Maintenance Work

Vehicle maintenance in Japan is carried out based on legal inspection and maintenance guidelines established by the Ministry of Transport. These guidelines lay down contents relating to inspection and maintenance that should be carried out every month, every three months and every year. In the Project, too, since the supplied equipment will be put to use in an important public service utility, the contents of maintenance work shall be planned based on these guidelines. However, due to differences in the operating conditions of each vehicle, inspection and maintenance shall be carried out according to set traveling distances and to set time intervals.

Apart from everyday inspections, the contents of work that should be carried out at regular intervals are indicated in the following table.

(1) Vehicle Maintenance Work

Contents of Necessary Repair and Maintenance Work

No.	Item	Traveling Distance	Maintenance Contents
1	Minor maintenance	Approx. every 3,000 km	Lubricate and inspect and confirm the functions of power line systems, hydraulic systems, automotive electrical parts and suspension systems. Preventive inspection and maintenance is a particularly important aspect of maintenance work.
2	Medium-scale maintenance	Approx. every 12,000 km	The abrasion, deformation, cracking and breakage, etc. of parts differs according to working conditions, but medium-scale maintenance is required approximately every 12,000 km. Adjust, touch up and replace parts for engines, power transmission systems, all suspension and hydraulic systems. In view of the equipment required for this work, it all needs to be carried out in a repair workshop. It is also necessary to maintain hydraulic system for loading and unloading, and plate coating work, etc. according to necessity at this time.
3	Major maintenance	Approx. every 36,000 km	Contents are the same as for medium-scale maintenance, but priority is given to brakes, clutch lining and suspension (especially spring-related points).

3-2-3 Spare Parts Preparation Plan

(1) Spare parts for the Project equipment shall be replaced according to traveling distance or time of operation. Spare parts shall be prepared separately as parts for maintenance and parts necessary over the service life of equipment and in the event of unexpected breakdowns, etc. Concerning the types and quantities of parts, a permanent supply that satisfies the cycles of the aforementioned periodic maintenance plan needs to be kept.

(2) In the Project, spare parts shall be supplied for use over a traveling distance of 50,000 km for collection vehicles and an operation time of 5,000 hours for construction machinery. As for additional spare parts after this initial supply, the Syrian side will need raise to funds for purchase through its own efforts. It is thought that the cost of this will amount to roughly 5% of the original equipment cost per year.

(3) Of the equipment to be supplied, the compactor trucks (2 ton and 3 ton) will largely operate in areas of steep gradient and on narrow roads. Therefore, concerning parts for engines, clutches and brakes which will be subject to extreme wear and tear in these operating conditions, it is necessary to prepare spare parts with special attention given to quantities.

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATION

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATION

4-1 Project Effect

4-1-1 Validation of Appropriateness

The appropriateness of the Project is validated in the manner described below.

1) Increase in Solid Waste Collection Efficiency

In narrow road districts including the Old City, because collection vehicles are unable to gain access and transportation distances for primary collection hand carts and tricycles are long, collection efficiency is low and working conditions for collection staff are extremely hard. The mechanization of collection work through combining the use of small compactor trucks with containers will improve the efficiency of primary collection and greatly improve the working conditions in these districts.

In collection districts that are to be served by large compactor trucks, a similar situation to that described above is occurring because of insufficient numbers and inappropriate positioning of containers. Consequently, through the bolstering and appropriate positioning of containers by the self efforts of the city authorities, the same effects as those described above can be anticipated in the said districts.

As a result, it will be possible to deal with the increasing amount of solid waste while maintaining existing primary collection staff levels, and the solid waste collection rate will increase from the present 85% to 100% by the target year of 2002, providing that the Syrian side carries out all the items that it has committed itself to.

2) Reduction in Equipment Maintenance Costs as a Result of Deteriorated Equipment Renewal

High repair costs made necessary by the fact that much of the existing solid waste collection equipment is deteriorated are placing a burden on operation of the solid waste management utility. By reducing maintenance and repair costs through the renewal of deteriorated vehicles, the Project will contribute to the stable operation of the utility.

Whereas the present maintenance and repair cost (for 84 vehicles) based on actual figures from 1996 and 1997 is S£ 43,900,000, working out as S£ 520,000 per vehicle on

average, by the target year of 2002, the same cost for 94 vehicles will be reduced to S£36,300,000, or S£390,000 per vehicle.

3) Countermeasures against Deterioration of Major Collection Equipment

Following the target year of 2002, it is planned that 30 operating vehicles will have been in use for 10 years. Because these deteriorated vehicles may frequently break down on the road during collection work and hinder operations, the Project intends to supply a mobile workshop to promptly repair road breakdowns and thus minimize the impact on collection work.

Compared to the present average operating rate of 65% of vehicles that have been in use for 12 years or less, the corresponding figure in the target year of 2002 will be increased to 76%.

4) Response to Future Increases in the Amount of Solid Waste Generation

Whereas the average amount of solid waste collected by existing vehicles is 800 tons per day (1997), this will increase to 1,160 tons per day by 2002 as a result of collection equipment supply. Therefore, the daily solid waste collection capacity will increase by approximately 360 tons.

5) Implementation of Sanitary Landfilling at the Final Disposal Site

Since final disposal work is currently limited to open dumping due to the shortage of equipment, the scattering of waste, generation of odor, disease and pest damage and smoke damage caused by spontaneous combustion are having a large detrimental impact on the surrounding environment. In the Project, the supply of landfill equipment will allow the introduction of daily sanitary landfilling by earth covering and thus reduce the environmental load on surrounding areas.

6) Utilization of Data in Compilation of Solid Waste Management Improvement Plans

In the current situation, management of the entry of solid waste collection vehicles into the final disposal site is performed manually and collection amounts are recorded in terms of vehicle haul capacities. As a result, necessary data are insufficient and inaccurate, and this situation is hindering the efficient management of work. Moreover, the data that are recorded are not put to effective use. In the Project, a computer-equipped weigh bridge will be installed at the transfer station, which is currently being constructed under the municipal budget, and since this will record various technical data relating to collection and transportation and automatically output the results of data analysis, a contribution

will be made to the compilation of improvement plans for the solid waste management utility.

4-1-2 Project Effect

Implementation of the Project will generate the following effects, resulting in improvement of the urban sanitary environment of Aleppo City.

1) Response to Future Increases in the Amount of Solid Waste Generation

In response to future increases in the amount of generated solid waste that will occur in line with the high rate of population increase in Aleppo of 3.6%, the bolstering of collection equipment will secure a collection rate of 100% by the target year of 2002.

2) Improvement of the Collection Rate in the Primary Collection System

The appropriate bolstering and distribution of containers for use with each type of compactor truck by the Syria side will mitigate the work load of primary collection personnel and raise work efficiency. Moreover, because carrying distances from households to collection stations will be reduced, it will be easier to obtain the cooperation of residents.

3) Improvement of the Collection Rate in Narrow Road Districts

By assigning small compactor trucks and appropriately distributing the above-mentioned containers in districts centering around the Old City where roads are narrow, the current waiting station method whereby collection vehicles have to stay parked on roads for long periods will no longer be necessary and the collection rate will increase.

4) Reduction in Equipment Maintenance Costs as a Result of Equipment Renewal

The existing 2-ton and 4-ton compactor trucks will be scrapped by the target year of 2002, thus making it possible to cut expenses that have so far been incurred in maintaining these deteriorated vehicles.

5) Countermeasures against Deterioration of Core Collection Equipment

The 24 7-ton MAN compactor trucks, which currently form the core of collection equipment, were introduced in 1993 will have been in use for nine years by the Project target year of 2002, by which time they will have reached a deteriorated state. Supply of the mobile workshop will make it possible to promptly carry out repairs on the road and

get broken down vehicles quickly back in operation, thus preventing a fall in the operating rate.

6) Implementation of Sanitary Landfilling at the Final Disposal Site

The supply of landfill equipment to the new final disposal site will enable the daily implementation of sanitary landfilling by earth covering, so mitigating the environmental impacts placed on the surrounding environment.

7) Utilization of Data in Compilation of Solid Waste Management Improvement Plans

Installation of a weigh bridge at the transfer station will make it possible to record and analyze various precise technical data relating to solid waste collection, and thus make use of these data in compiling improvement plans for the solid waste management utility viewed not only in the short term but also the medium and long terms.

Moreover, the benefiting population of the Project, in view of the fact that solid waste which is generated in all districts of Aleppo will be promptly collected and disposed of, can be said to be the whole urban population of 1.7 million. In particular, a total of 450,000 citizens, that is to say 200,000 people who live around open stations, 200,000 people who live in later-developed districts and 5,000 people who live in areas around the old and new final disposal sites where there are frequent complaints from citizens concerning present solid waste management, will directly benefit from improvement in the living environment and the level of public sanitation.