GOVERNORATE OF KHAN YUNIS
PALESTINIAN INTERIM SELE-GOVERNMENT AUTHORITY

BASIC DESIGN STUDY REPORT

ON

THE PROJECT FOR SANITATION IMPROVEMENT

IN THE AREA OF KHAN YUNIS

IN

PALESTINIAN INTERIM

SELE-GOVERNMENT AUTHORITY

SEPTEMBER 1998

JAPAN INTERNATIONAL COOPERATION AGENCY

PACIFIC CONSULTANTS INTERNATIONAL

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PREFACE

In response to a request from the Palestinian Interim Self-Government Authority, the Government of Japan decided to conduct a basic design study on the Project for Sanitation Improvement in the Area of Khan Yunis and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Palestine a study team from April 8 to April 28, 1998.

The team held discussions with the officials concerned of the Palestinian Interim Self-Government Authority and conducted a filed survey at the study area. After the team returned to Japan, further studies were carried out, and as this result, the present report was finalized.

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

I wish to express my sincere appreciation to the officials of the Palestinian Interim Self-Government Authority for their close cooperation extended to the study team.

September, 1998

Kinio Fujita
President
Japan International Cooperation Agency

September, 1998

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Sanitation Improvement in the Area of Khan Yunis in the Palestinian Interim Self-Government Authority.

This study was conducted by the Pacific Consultants International under a contract to JICA, during the period of April to September, 1998. In conducting the study, we have examined the feasibility and rationale for the project with due consideration to the present situation of the PA and formulated the most appropriated 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 your,

Toshiaki Tokumasu
Project Manager,
Basic Design Study Team on the Project for
Sanitation Improvement in the Area of Khan Yunis
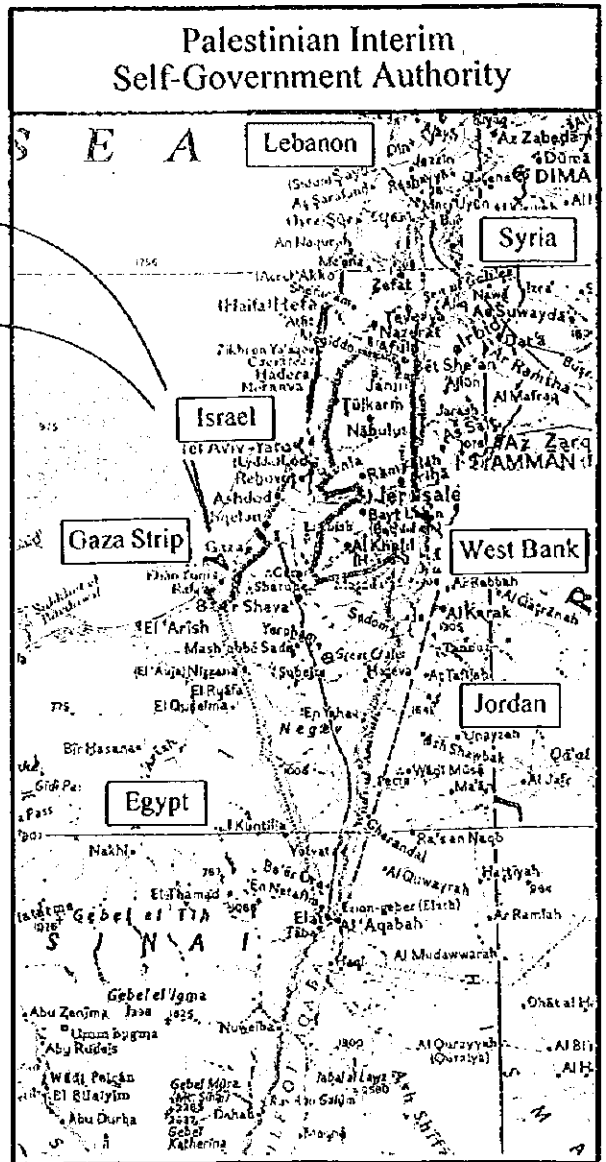Pacific Consultants International

Gaza Strip

Israel

Mediterranean Sea

Legend

Gaza Strip

Security Line

Crossing Road

Israeli Settlement

Yellow Area

Khan Yunis Governorate

Egypt

0 2 4 6 8 10   20 Km

Palestinian Interim Self-Government Authority

S E A

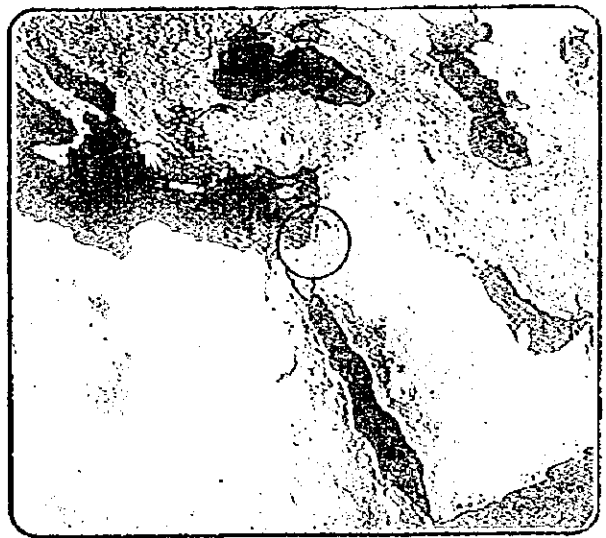Lebanon

Syria

Israel

Gaza Strip

West Bank

Jordan

Egypt
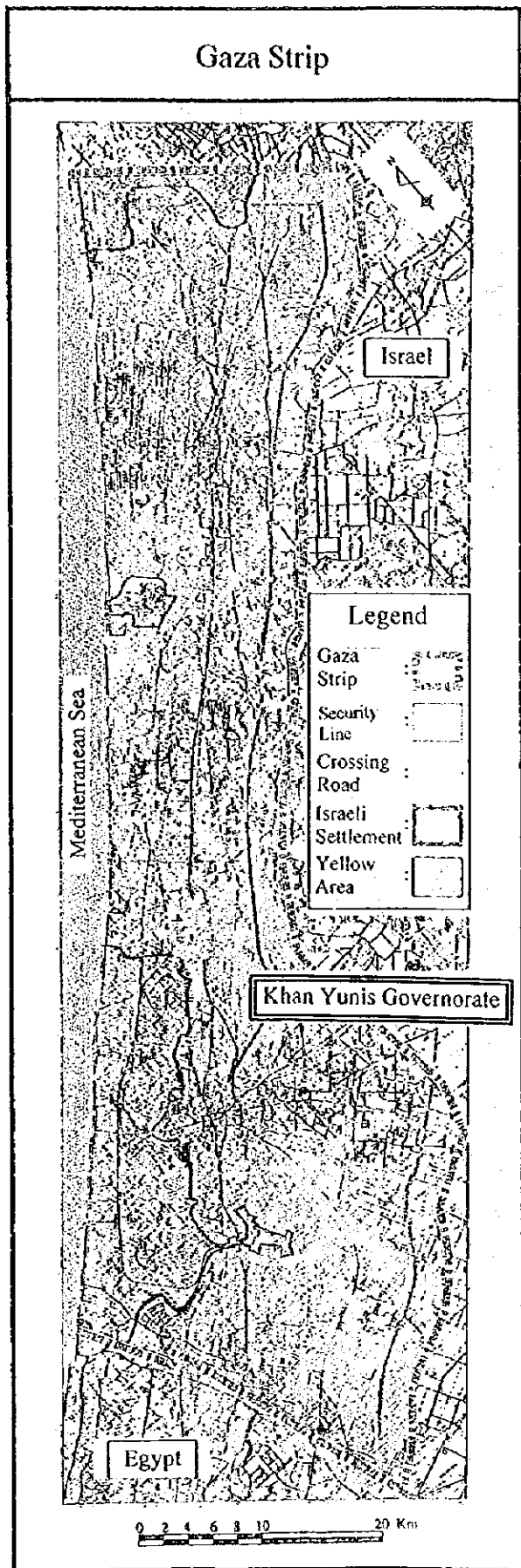
Figure 1 Location of Palestinian Interim Self-government Authority

90

89

88

87

86

85

84

83

82

81

80

79

78

77

76

Mediterranean Sea

N

QARRARA

Refugee Camp

New Workshop

KHAN YUNIS

Old Workshop

BANI SOHAILA

ABASSAN SAGHERA

ABASSAN KABERA

(KIZAN DISTRICT)

KHUZAA

Access Road
(L ≒ 6km)

Final Disposal Site

80   81   82   83   84   85   86   87   88   89   90   91

0   1.0   2.0   3.0   4.0(km)
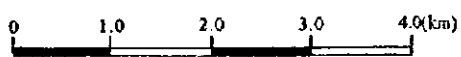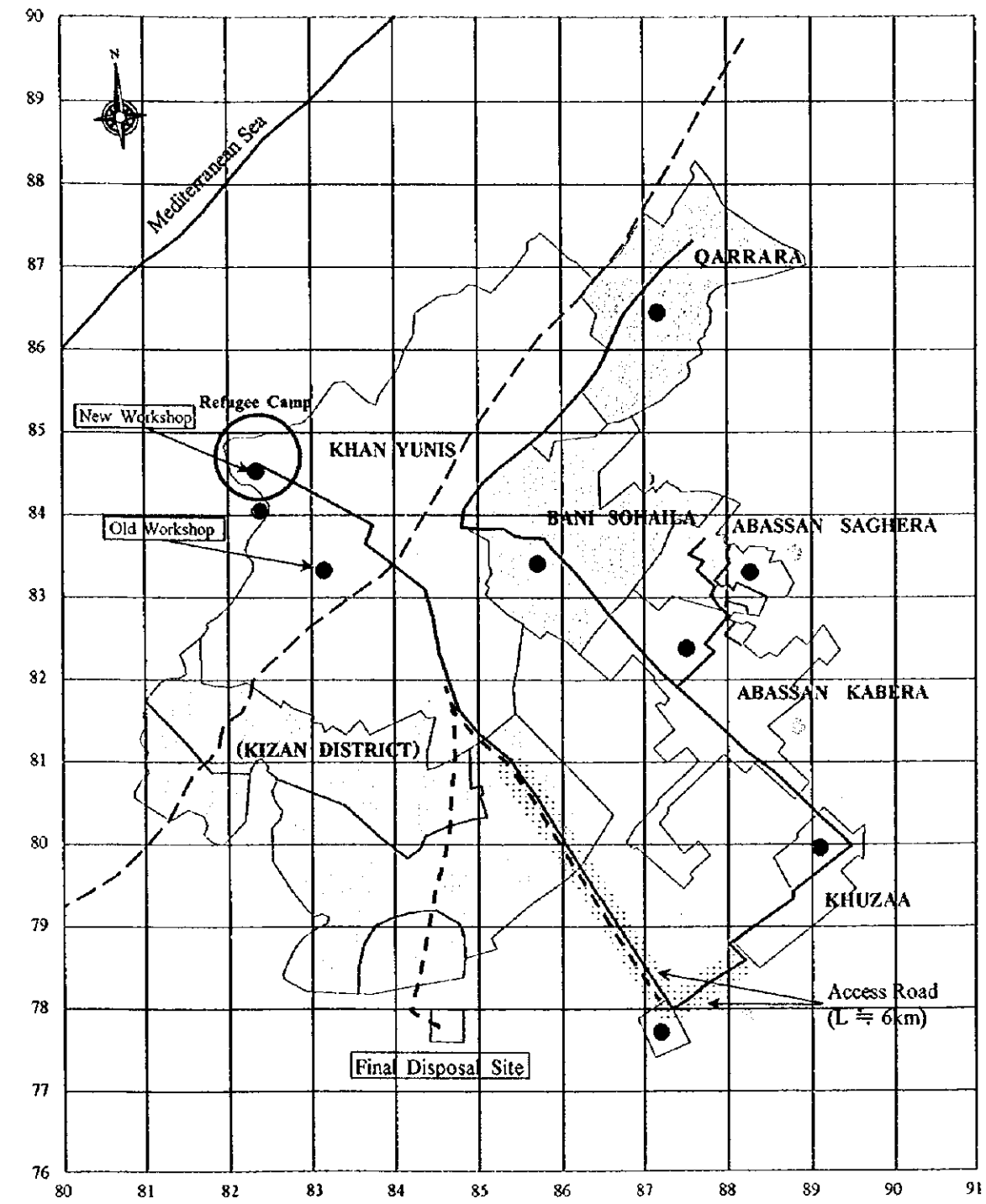
Disstance to Drying Bed	
Khan Yunie	9.0 km
Qarara	14.2 km
Bani Sohaila	8.6 km
Abassan Saghera	8.8 km
Abassan Kabera	7.3 km
Khuzaa	3.0 km

LEGEND

———— Route of CollectedSludge

- - - - Route of Dried Sludge

● Large Disposal Site

᛫ Smell Disposal Site

● Garage

● Drying Bed

Figure 2   Location of Project Site

THE PROJECT FOR SANITATION IMPROVEMENT
IN THE AREA OF KHAN YUNIS

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CHAPTER 1

BACKGROUND OF THE REQUEST

CHAPTER 1   BACKGROUND OF THE REQUEST

After the Oslo Agreement was reached from 1993 to 1995, Palestinian Interim Self-Government Authority (hereafter referred to as PA) was recognized in the international society.   In this context, the Government of Japan (hereafter referred to as GOJ) has been coordinating, with other donors, to promote the Middle-East peace process and to assist the self-support of PA.

During several decades, PA could not improve the basic urban infrastructure such as wastewater management systematically.   The Area of Khan Yunis has a present population of over 200,000, but no sewerage system is operational at all.   Khan Yunis City is the second largest one after Gaza City in the Gaza Strip.   Therefore JICA conducted a development study "The Study of Sewerage Development Plan in the Area of Khan Yunis" in response of PA's request.   It is estimated that several years will be required to provide service to the residents as a large scale construction is required.

In the Khan Yunis Area including 6 cities the residents are now using cess pits for toilet wastewater (called as blackwater) for storage.   Since a certain volume wastewater is penetrating into underground from cess pit, the groundwater is contaminated.   Other wastewater is discharged into streets and open space to penetrate into underground.

The soil in the Khan Yunis Area is very fine and the permeability is very low.   A new cess pit is almost clogged after two year usage.   Once a cess pit is filled with toilet wastewater, the user will request the city or private sector to empty the cess pit.   This is called as desludging.   The residents are paying the desludging charge for each time about 20 NIS.   The collected sludge is dumped into a disposal site near the residential area by about 200 m.   Since there is no treatment, the groundwater is heavily contaminated.   There are also problems of bad smells and noise around the area.

All the 6 cities of the Khan Yunis area have 8 vacuum vehicles (one is out of order).   25 vacuum tractor are owned by the private sector.   Except 4 vacuum trucks which were donated recently by the German and French Government, all other vacuum tractors are to or more years old.   In 3 cities of Bani Sohaila, Qarrara and Abassan Kabera only the private sector is serving the desludging.   The private sector is easily dumping the collected sludge into near-by site to reduce the transportation length.   This practice is, however, deteriorating the environment.

Based on the background, PA or Khan Yunis Governorate as the implementing agency plans to close the present dumping site and small sites, and to open a new site in the eastern part of the area. This will be operated as sludge drying bed.

The collected sludge is discharged into the drying bed, and dried up after several days. The dried sludge is collected by a shovel dozer and loaded on a dump truck. The dump truck will transport the dried sludge into the final disposal site of solid waste. To realize the plan, the PA requested a grant aid scheme from the Government of Japan to purchase the equipment required.

The content of the request is as follows:

Table 1-1   The Request Content of PA

Item	Number
Vacuum Truck	27
Bulldozer	4
Dump Truck	4

CHAPTER 2

CONTENTS OF THE PROJECT

CHAPTER 2   CONTENTS OF THE PROJECT

2.1   Objectives of the Project

The Khan Yunis area is less developed with basic urban infrastructure such as sewerage system than the other areas in Gaza Strip.   The present population of about 215,000 is projected to increase at a high level of about 6.5%.   The returnees of Palestinians residing abroad will contribute to the high increase of the population.

PA intends to improve the sanitation and health conditions in the area of Khan Yunis, since a large investment and long period will be required for improvement.

The purpose of this project is to improve the sanitation in the Khan Yunis area by providing the equipment to collect and transport sludge from the cess pits, to operate the sludge drying bed, and to transport the dried sludge to the final disposal site.

2.2   Basic Concept of the Project

In all the 6 cities of the Khan Yunis area, the study team surveyed the sludge generation volume, desludging volume and disposal method, as well as the operational conditions of the existing equipment of both the public and private sector.

The future desludging volume was projected.   The contents, specifications and numbers of the requested equipment were confirmed to aim at year 1999.

2.2.1   Confirmation of the Request Content

The equipment requested by PA is shown in Table 2-1.   The contents and the request reasoning are explained below.   At the time of the request, PA planned to construct two drying bed plants at east and west of the Khan Yunis area.   Later PA has changed its plan to the construction of only one drying bed plant at east of the area.

Table 2-1 Equipment Request by Palestinian Authority

Item	Number	Specification
Vacuum Trucks	27	Not specified
Bulldozer	4	Not specified
Dump Truck	4	Not specified

(1)   Request Content of PA

a.   Vacuum trucks (27 units)

To the questionnaire prepared by of the study team concerning the member and specification of vacuum trucks, the Palestinian side did not clearly explain it to the study team. All what PA explained was that they want to increase the public portion against the private one and to improve the environment in the area.

b.   Bulldozer (4 units)

As mentioned above, the Palestinian side planned originally to construct two drying bed plants. They explained that each plant would be operated and maintained with two vehicles. But later they changed their plan to the construction of only one drying bed plant. In the field study, it was found that a mini bulldozer would not be appropriate for loading the dried sludge to a dump truck. Therefore PA suggested the change from a mini bulldozer to a shovel dozer.

c.   Dump Truck (4 units)

PA explained to the study team that four dump truck would be used equally to two drying bed plants, but suggested that the reduction of the dump truck could be possible due to reduction of drying bed plant. The dump truck will transport the dried sludge from the drying bed to the final disposal site of the Rafah Governorate about 10 km distant from the plant. This disposal site has been operational since 1998.

(2)   Condition for the Project Implementation

The Palestinian side shall fulfill the following conditions so that the project can be implemented.

a. Establishment of the organization and budget of the Administrative Council of Sanitation of Khan Yunis Governorate.

b. Construction of a drying bed plant.

c. Pavement of the access road to the drying bed plant.

2.2.2 Discussion of the Equipment Procurement

The number and specification of the equipment required shall be decided to realize the target, taking also into account the role of the private sector.

(1) Khan Yunis City

The present population of the city is about 157,000 and the daily desludging volume is estimated at about 877 m^3. The drying bed plant is far by about 9 km from the city center. The city has four almost new vacuum trucks and one 10-year old one. The private sector is working with 15 vacuum vehicles, which are so old as 20 years or more.

(2) Bani Sohaila City

The present population of the city is about 19,000. The distance from the city center to the drying bed is about 8.6 km.

The city owns one old vacuum tractor while the private sector owns three ones. All of them are very old and their operational conditions are bad.

(3) Qarrara City

The present population of the city is about 12,000. There is no public vacuum vehicle, but just the private sector is working with three vacuum tractors. The distance to the drying bed plant is about 14.2 km, or the longest.

(4) Abassan Saghera City

The present population of the city is as small as about 6,000. Though the city has one vacuum tractors, this is too old for long operation. Another vacuum tractor owned by the private sector is very old. The distance to the drying bed plant is about 8.8 km.

(5)   Abassan Kabera City

The present population of the city is about 13,000.   There is no public vacuum tractors.
Only the private sector is working for desludging.   The distance to the drying bed plant is
about 7.3 km.

(6)   Khuzaa City

The present population of the city is so small as about 7,000.   The city has one old
vacuum tractor.   The private sector is also active for desludging.   The distance to the
drying bed plant is about 3 km.

(7)   Administrative Council of Sanitation of Khan Yunis Governorate

The council was just established by the related Bylaw in April 1998.   It is planning to
prepare staff and budget.

2.2.3   Basic Approach

The basic approach of the project can be summarized as follows:

(1)   Collection and Transportation of the Sludge

The equipment (vacuum truck) to collect sludge from cess pits and transport it will cover
the whole area of Khan Yunis with both public and private sectors..

(2)   Sludge Drying

The collected sludge will be discharged into the drying bed.   Once the sludge is dried up,
a tractor shovel will collect the dried sludge and load it to a dump truck.

The collected sludge will be transported to the drying bed plant and discharged into a dried,
as shown in Fig. 2-1.   The size of one drying bed is approximately 20m x 50m x 1m deep.
There will be 8 beds.   One cycle will be set up to 8 days; discharge-drying-removal.
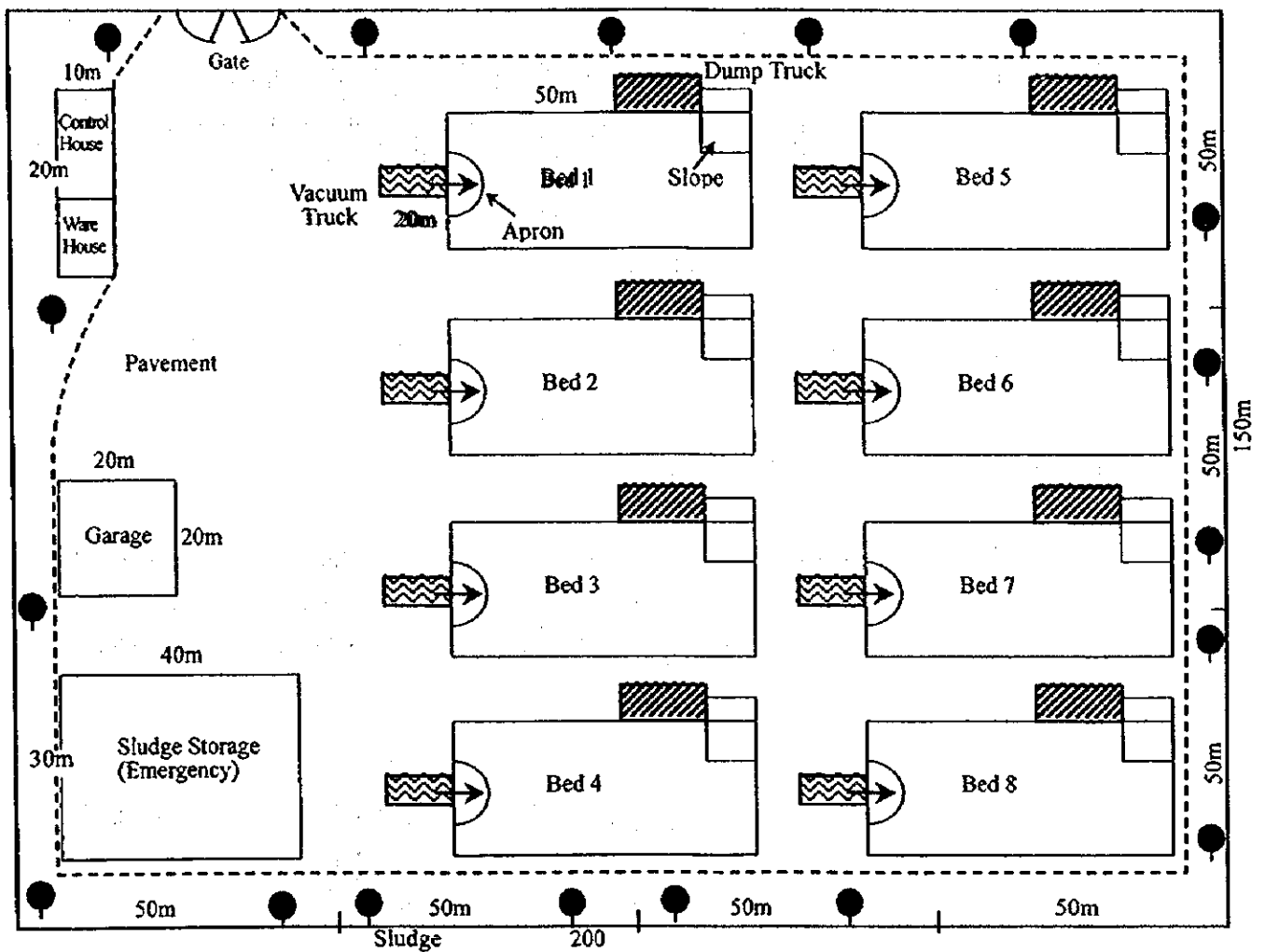
Fig. 2-1   Sketch of Drying Bed Plant

(3)   Sanitary Treatment of Drying Bed

The present disposal site of collected sludge is close to the residential area and causing environmental problems such as groundwater contamination and smell/noise. The proposed drying bed bill be constructed far from the residential area. Its elevation is about 80m/MSL, and the level of groundwater is 60m deep from the ground. It is expected that soil bacteria will treat water penetrating from the drying bed.

(4)   Transportation of Dried Sludge

The dried sludge will be transported by a dump truck to the final disposal site distant by
about 10 km from the drying bed plant. This site is located in Khan Yunis area, but
operated by the Rafah Governorate.

2.3   Basic Design

2.3.1   Design Concept

(1)   For the Natural Condition

The Khan Yunis area is located in the zone of Mediterranean climate and situated on a fine
sand zone. The access road to the drying bed plant is unpaved. Therefore the
equipment shall be endurable and be protected against rust and dust under such conditions.

(2)   For the Procurement

The equipment required for the project can not be procured in Palestine. The equipment
procurement shall be decided from the view point where the spare parts can be easily
procured from the representing agency at the site, Japan or nearest European countries.

All the items of the equipment and spare parts shall be imported through an Israeli port.
A due consideration will be required in terms of homologation of Israel.

(3)   For the Operation and Maintenance

The vacuum trucks shall be operated and maintained by the 6 cities of Khan Yunis area.
The cities shall generate the budget and staff required for the operation and maintenance.
The drying bed shall be operated and maintained by the Administrative Council of
Sanitation in Khan Yunis Governorate. At present the council has no experience to
operate and maintain the drying bed. Therefore the initial training for the operators will
be necessary.

All 6 cities will be responsible for daily maintenance of their vacuum trucks. For regular
inspection of once a month all the vacuum trucks and the dump truck shall be brought to
the workshop of Khan Yunis City. The tractor shovel shall be cheek, and repaired if

necessary, at the drying bed plant by the inspectors of Khan Yunis workshop. Those costs shall be charged to the cities and the Sanitation Council.

2.3.2 Basic Design

(1) Equipment Plan

For the desludging volumes of the 6 cities of Khan Yunis area, the capacities of the existing equipment and the equipment to be procured by the project are estimated in the period upto year 2005. The collection ratio shall be kept at 100% in 1999 by procuring the additional equipment required. The following figures are used for the estimation:

a. Population

The population of Khan Yunis area in the period between 1996 to 2005 was estimated based on the population projections of MOPIC and the Palestinian Central Bureau of Statistics.

b. Sludge Volume

It is estimated that each person generates toilet wastewater of about 8ℓ/capita/day for Arabic toilet, based on the JICA study. The penetration ratio from the cess pit into underground is estimated at 70% in average.

c. Daily Trips of Vacuum Vehicles

There are two kinds of vacuum vehicles: vacuum truck and vacuum tractor. The vacuum truck can run at 35 km/hr in average, while the vacuum tractor can run at 10 km/hr in average. Table 2-2 shows average trips of vacuum vehicles.

Table 2-2   Average Trips of Vacuum Vehicles

City Name	Present		Planning		Distance to Plant
Vacuum	Truck	Tractor	Truck	Tractor	(km)
Khan Yunis	9	5	9	3	9.0
Bani Sohaila	None	9	9	4	8.6
Qarrara	None	9	6	2	14.2
Abassan Saghera	None	9	9	3	8.8
Abassan Kabera	None	9	10	4	7.3
Khuzaa	None	9	13	8	3.0

Note: None means no vehicle.

d.   Operational Ratio of Vacuum Vehicles

Since a new vehicle shall be inspected regularly, the operational ratio is less than 100%.   The longer the vehicle is used, the lower the operational ratio becomes. Table 2-3 shows the operational ratio of a new vehicle.   The vacuum tractors operated by the private sector are assumed to keep their operational ratio at 67% based on the field survey.

Table 2-3   Operational Ratio of a New Vehicle

Year	1	2	3	4	5	6	7	8	9	10
Operational Ratio (%)	96	96	95	95	93	90	86	83	76	70

e.   Vacuum Truck Requirement

The requirement of vacuum trucks for 6 cities is estimated to satisfy the demand of year 1999 with the existing equipment as follows:

i)   Since Khan Yunis city has a refugee camp with about 20% of the total population, where narrow streets exist.   One small vacuum truck ($2m^3$) shall be provided, while other areas in the city will be served by large vacuum trucks ($6m^3$).

ii)   Bani Sohaila City has a small area for refugees, where narrow streets will prevent a large vacuum trucks.   There fore one small one ($2m^3$) shall be provide, while other areas served by a large one ($6m^3$) will be.

iii)   Other 4 cities shell be served by large vacuum trucks ($6m^3$), because the streets are basically large enough for large ones.

The following table shown the requirement of vacuum trucks for 6 cities.

Table 2-4   Requirement of Vacuum Trucks

City	Small vacuum Trucks (2m³)	large Vacuum Trucks (6m³)	Total
Khan Yunis	1	11	12
Bani Sohaila	1	1	2
Qarrara	0	2	2
Abassan Saghera	0	1	1
Abassan Kabera	0	1	1
Khuzaa	0	1	1
Total	2	17	19

f.   Volume of Dried Sludge

The collected sludge is estimated to be about 0.36% of solid matters based on the Japanese data.   The moisture content of dried sludge is estimated to be 60%.   The following table shows the volume of dried sludge.

Table 2-5   Volume of Dried Sludge

Item	Unit	Year						
		1999	2000	2001	2002	2003	2004	2005
Population		229,181	244,596	257,756	271,698	286,473	302,149	318,789
Collected Sludge	m³/d	1,283	1,370	1,443	1,552	1,604	1,692	1,785
Solid Matters	t/d	4.6	4.9	5.2	5.6	5.8	6.1	6.4
Dried Sludge Weight	t/d	12	12	13	14	15	15	16
Dried Sludge Volume	m³/d	22	22	24	25	27	27	29
Transportation of Dried Sludge	m³/d	25	25	28	29	31	31	33

g.   Dump Truck

The dried sludge shall be transported to the Rafoh final disposal site by a dump truck.   The distance is about 10 km.   The operational schedule of dump truck is shown in Table 2-6.

Table 2-6 Operational Schedule of Dump Truck

Loading Time (hr)	Transportat -ion Time (hr)	Unloading Time (hr)	Return Time to Drying Bed (hr)	Cycle Time (hr)	Transportat -ion Frequency (Times/day)	Preparation Time (hr)	Washing Time (hr)	Total Time (hr)
0.2	0.3	0.3	0.3	1.1	6	0.1	0.3	7

The total volume of dried sludge in 1999 is estimated to be 25m³/day. Based on six times of transportation, the size of the dump truck is estimate to be 4.2m³ for one dump truck. However to avoid the stop of the transportation, two dump truck shall be procured. The available size of the required dump truck is 2.4m³ for two dump truck, as shown is Table 2-7.

Table 2-7 Transportation capacity of Dump Truck

Item	Unit	Year						
		1999	2000	2001	2002	2003	2004	2005
Loading Capacity *1	m³	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Transportation Frequency	Times/day	6	6	6	6	6	6	6
Operational Ratio	%	96	96	94	94	92	88	85
Transportation Capacity	m³/d	29	29	27	27	26	25	24
Transportation Volume	m³/d	25	25	28	29	31	31	33
A/B x 100	%	116	116	96	93	84	81	73

Note) *1 Loading Capacity = 2.4m³/unit x 2 unit =4.8m³

h. Capacity of Tractor Shovel

The dried sludge shall be collected and loaded to a dump truck by a tractor shovel. If the size of the dump truck is 2.4m³, the appropriate basket volume of a tractor shovel is 0.5 to 0.8m³. The available volume is only 0.8m³ in international market. This is planned for procurement of one tractor shovel. The collection time of the tractor shovel is 1.25hr (25/20). The loading tine is estimated at 1.3 hr (25/19). The total working time by one tractor shovel is 2.25 hr.

The tractor shovel is equivalent to wheel loader.

(2) Based on the above assumptions, the required numbers of the equipment to be procured by the project are estimated as shown in Table 2-5 through Table 2-10. The additional equipment after year 2000 shall be procured and maintained by the 6 cities.

Table 2-8 Desludging Volume (Khan Yunis City)

Item	Year							
	1998	1999	2000	2001	2002	2003	2004	2005
Population	156682	167364	178813	188530	198841	209801	221461	233870
Desludging Volume (m³/day)	877	937	1001	1056	1114	1175	1240	1310
Unit Generation (l/capita /day)	8	8	8	8	8	8	8	8
Penetration Ratio	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Desludging Capacity								
(1) Present Total Capacity (m³/day)	491	389	385	383	378	369	359	351
1) Public Capacity (m³/day)	240	238	231	233	227	219	208	200
(a) Desludging Capacity (m³/day)	207	207	205	205	201	194	186	179
Number (German, French)	4	4	4	4	4	4	4	4
Tank Volume (m³)	6	6	6	6	6	6	6	6
Trips (time/day)	9	9	9	9	9	9	9	9
Operation Ratio	0.96	0.96	0.95	0.95	0.93	0.90	0.86	0.83
(b) Desludging Capacity (m³/day)	32	31	29	28	26	24	23	21
Number (American)	1	1	1	1	1	1	1	1
Tank Volume (m³)	6	6	6	6	6	6	6	6
Trips (time/day)	9	9	9	9	9	9	9	9
Operation Ratio	0.6	0.57	0.51	0.51	0.48	0.45	0.42	0.39
2) Private Capacity (m³/day)	251	151	151	151	151	151	151	151
Number (German, American)	15	15	15	15	15	15	15	15
Tank Volume (m³)	5	5	5	5	5	5	5	5
Trips (time/day)	5	3	3	3	3	3	3	3
Operation Ratio	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Existing Recovery Ratio	56%	42%	38%	36%	34%	31%	29%	27%
(2) Procurement Total Capacity (m³/day)		587	585	581	581	569	551	526
(a) 2m³ Truck Capacity (m³/day)		17	17	17	17	17	16	15
2m³ Truck Number		1	1	1	1	1	1	1
Tank Volume (m³)		2	2	2	2	2	2	2
Trips (time/day)		9	9	9	9	9	9	9
Operation Ratio		0.96	0.96	0.95	0.95	0.93	0.9	0.86
(b) 6m³ Truck Capacity (m³)		570	570	564	564	552	535	511
6m³ Truck Number		11	11	11	11	11	11	11
Tank Volume (m³)		6	6	6	6	6	6	6
Trips (time/day)		9	9	9	9	9	9	9
Operation Ratio		0.96	0.96	0.95	0.95	0.93	0.9	0.86
Project Recovery Ratio		63%	58%	55%	52%	48%	44%	40%
(3) Additional Truck Capacity (m³/day)			52	104	156	259	363	467
Additional Number			1	2	3	5	7	9
Tank Volume (m³)			6	6	6	6	6	6
Trips (time/day)			9	9	9	9	9	9
Operation Ratio			0.96	0.96	0.96	0.96	0.96	0.96
Additional Recovery Ratio			5%	10%	14%	22%	29%	36%
(4) Total Desludging Capacity (m³/day)	491	976	1022	1068	1115	1197	1273	1344
(5) Total Recovery Ratio	56%	104%	102%	101%	100%	102%	103%	103%

Desludging Volume (Khan Yunis)

Present Capacity Procurement Capacity Additional Capacity Present Volume
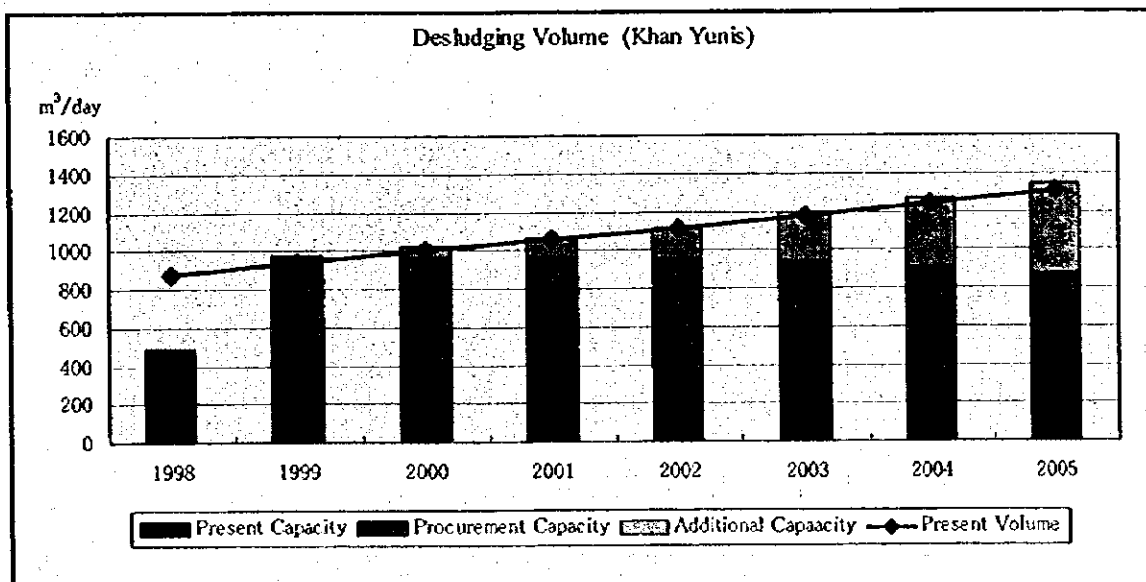
Table 2-9 Desludging Volume (Bani Sohaila City)

Item	Year							
	1998	1999	2000	2001	2002	2003	2004	2005
Population	19168	20414	21741	22828	23970	25168	26427	27748
Desludging Volume (m³/day)	107	114	122	128	134	141	148	155
Unit Generation (l/capita /day)	8	8	8	8	8	8	8	8
Penetration Ratio	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Desludging Capacity								
(1) Present Total Capacity (m³/day)								
(1) Private Capacity (m³)	50	40	40	40	40	40	40	40
Number	3	3	3	3	3	3	3	3
Tank Volume (m³)	5	5	5	5	5	5	5	5
Trips (time/day)	5	4	4	4	4	4	4	4
Operation Ratio	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Existing Recovery Ratio	47%	35%	33%	31%	30%	29%	27%	26%
(2) Procurement Total Capacity (m³/day)		69	69	68	68	67	65	62
(a) 2m³ Truck Capacity (m³/day)		17	17	17	17	17	16	15
2m³ Truck Number		1	1	1	1	1	1	1
Tank Volume (m³)		2	2	2	2	2	2	2
Trips (time/day)		9	9	9	9	9	9	9
Operation Ratio		0.96	0.96	0.95	0.95	0.93	0.9	0.86
(b) 6m³ Truck Capacity (m³/day)		52	52	51	51	50	49	46
6m³ Truck Number		1	1	1	1	1	1	1
Tank Volume (m³)		6	6	6	6	6	6	6
Trips (time/day)		9	9	9	9	9	9	9
Operation Ratio		0.96	0.96	0.95	0.95	0.93	0.9	0.86
Project Recovery Ratio		61%	57%	53%	51%	47%	44%	40%
(3) Additional Truck Capacity (m³/day)			52	51	103	100	97	93
Additional Number			1	1	2	2	2	2
Tank Volume (m³)			6	6	6	6	6	6
Trips (time/day)			9	9	9	9	9	9
Operation Ratio			0.96	0.95	0.95	0.93	0.9	0.86
Additional Recovery Ratio			33.10%	30.90%	58.80%	54.80%	49.90%	45.90%
(4) Total Desludging Capacity (m³/day)	50	109	161	160	211	208	202	195
(5) Total Recovery Ratio	47%	96%	132%	125%	158%	147%	137%	126%

Desludging Volume (Bani Sohaila)

Legend: Present Capacity Procurement Capacity Additional Capaacity Present Volume

2 - 12
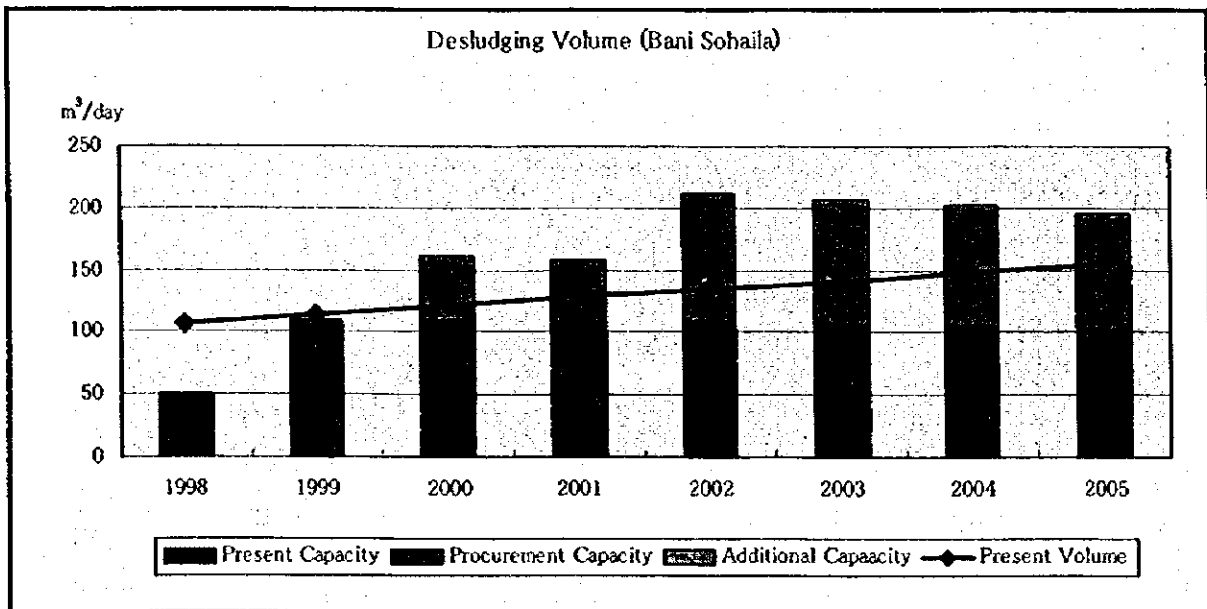
Table 2-10   Desludging Volume (Qarrara City)

Item	Year							
	1998	1999	2000	2001	2002	2003	2004	2005
Population	12496	13258	14067	14925	15836	16802	17827	18915
Desludging Volume (m³/day)	70	74	79	84	89	94	100	106
Unit Generation (l/capita /day)	8	8	8	8	8	8	8	8
Penetration Ratio	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Desludging Capacity								
(1) Present Total Capacity (m³/day)	54	13	13	13	13	13	13	13
1) Private Capacity (m³/day)	54	13	13	13	13	13	13	13
Number	2	2	2	2	2	2	2	2
Tank Volume (m³)	5	5	5	5	5	5	5	5
Trips (time/day)	8	2	2	2	2	2	2	2
Operation Ratio	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Existing Recovery Ratio	77%	18%	16%	15%	15%	14%	13%	12%
(2) Procurement Total Capacity (m³/day)		69	69	68	68	67	65	62
(a) 6m³ Truck Capacity (m³/day)		69	69	68	68	67	65	62
6m³ Truck Number		2	2	2	2	2	2	2
Tank Volume (m³)		6	6	6	6	6	6	6
Trips (time/day)		6	6	6	6	6	6	6
Operation Ratio		0.96	0.96	0.95	0.95	0.93	0.9	0.86
Project Recovery Ratio		93%	87%	81%	76%	71%	65%	58%
(3) Additional Truck Capacity (m³/day)				35	35	34	34	33
Additional Number				1	1	1	1	1
Tank Volume (m³)				6	6	6	6	6
Trips (time/day)				6	6	6	6	6
Operation Ratio				0.96	0.96	0.95	0.95	0.93
Additional Recovery Ratio				42%	39%	36%	34%	31%
(4) Total Desludging Capacity (m³/day)	54	82	82	116	116	114	112	108
(5) Total Recovery Ratio	76.57%	111.35%	104.30%	138.57%	130.79%	121.70%	112.40%	102.26%

Desludging Volume (Qarra)

Present Capacity   Procurement Capacity   Additional Capaacity   Present Volume
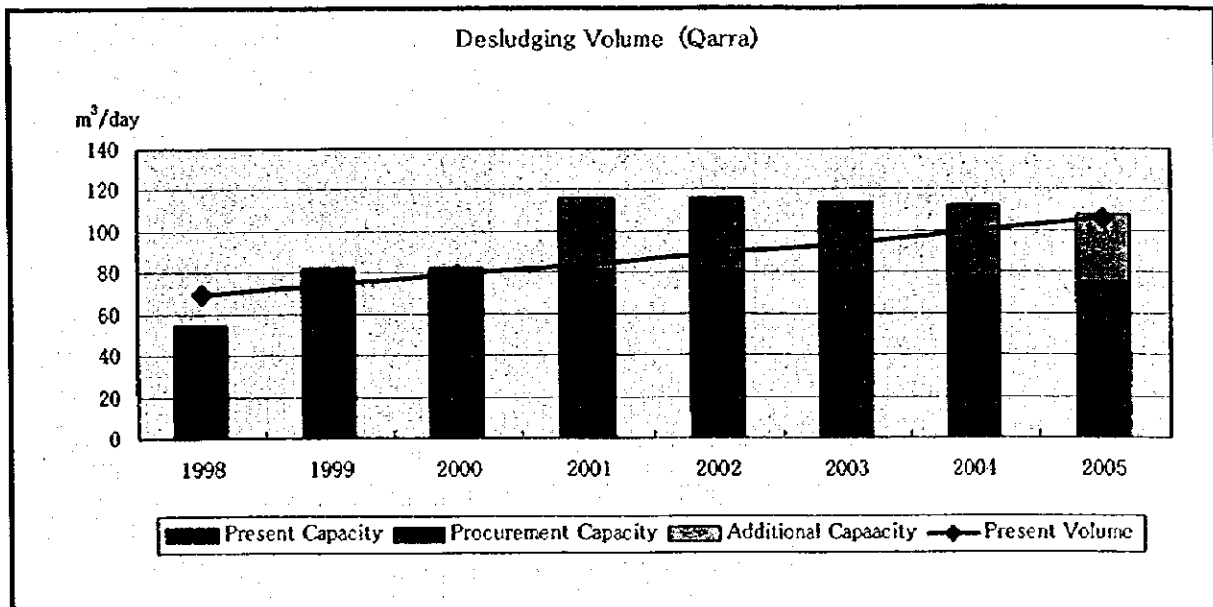
Table 2-11 Desludging Volume (Abassan Saghera City)

Item	Year							
	1998	1999	2000	2001	2002	2003	2004	2005
Population	6238	6644	7076	7429	7801	8191	8600	9030
Desludging Volume (m³/day)	35	37	40	42	44	46	48	51
Unit Generation (l/capita /day)	8	8	8	8	8	8	8	8
Penetration Ratio	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Desludging Capacity								
(1) Present Total Capacity (m³/day)	40	5	5	5	5	5	5	5
1) Public Capacity (m³/day)	27							
Number	1							
Tank Volume (m³)	5							
Trips (time/day)	8							
Operation Ratio	0.67							
2) Private Capacity (m³)	13	5	5	5	5	5	5	5
Number	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Tank Volume (m³)	5	5	5	5	5	5	5	5
Trips (time/day)	8	3	3	3	3	3	3	3
Operation Ratio	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Existing Recovery Ratio	115%	14%	13%	12%	11%	11%	10%	10%
(2) Procurement Total Capacity (m³/day)		35	40	40	40	45	43	46
6m³ Truck Capacity (m³)		40	40	39	39	39	37	36
6m³ Truck Number		1	1	1	1	1	1	1
Tank Volume (m³)		6	6	6	6	6	6	6
Trips (time/day)		6	7	7	7	8	8	9
Operation Ratio		0.96	0.96	0.95	0.95	0.93	0.9	0.85
Project Recovery Ratio		93%	101%	95%	91%	97%	90%	90%
(4) Total Desludging Capacity (m³/day)	40	40	45	45	45	50	48	51
(5) Total Recovery Ratio	115%	107%	113%	107%	102%	108%	100%	100%

Desludging Volume (Abassan Saghera City)

m³/day

Present Capacity   Procurement Capacity   Present Volume
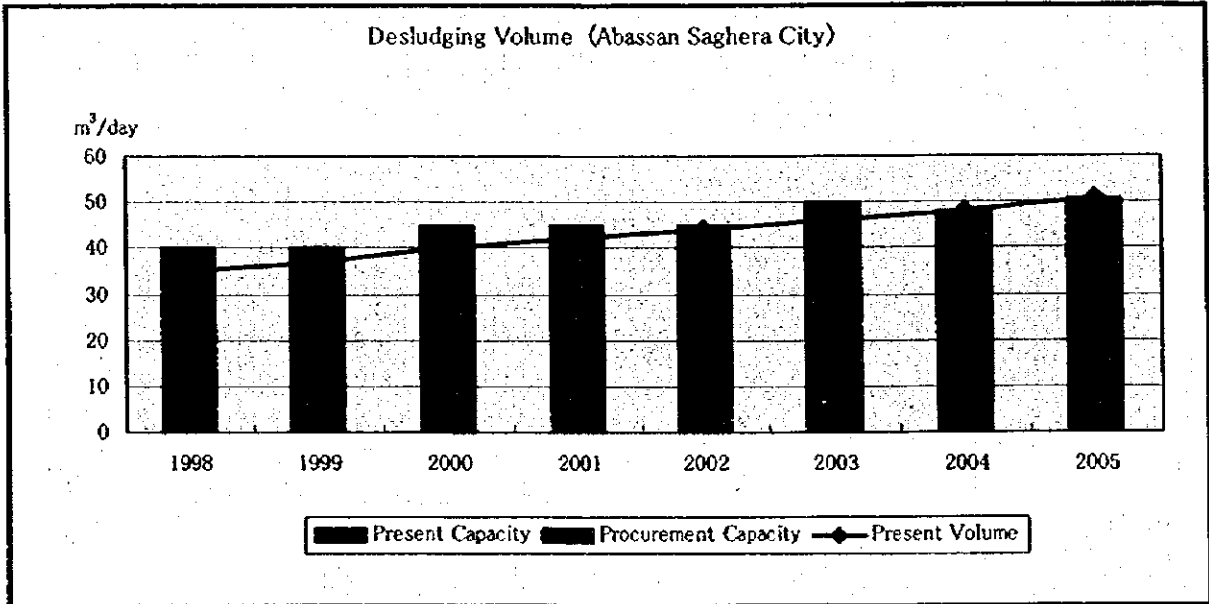
Table 2-12   Desludging Volume (Abassan Kabera City)

Item	Year							
	1998	1999	2000	2001	2002	2003	2004	2005
Population	13157	14012	14923	15669	16453	17275	18139	19046
Desludging Volume (m³/day)	74	78	84	88	92	97	102	107
Unit Generation (l/capita /day)	8	8	8	8	8	8	8	8
Penetration Ratio	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Desludging Capacity								
(1) Present Total Capacity (m³/day)								
1) Private Capacity (m³/day)	107	54	54	54	54	54	54	54
Number	4	4	4	4	4	4	4	4
Tank Volume (m³)	5	5	5	5	5	5	5	5
Trips (time/day)	8	4	4	4	4	4	4	4
Operation Ratio	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Existing Recovery Ratio	145%	69%	64%	61%	58%	55%	53%	50%
(2) Procurement Total Capacity (m³/day)		35	35	34	40	45	49	52
1) 6m³ Truck Capacity (m³/day)		35	35	34	40	45	49	52
6m³ Truck Number		1	1	1	1	1	1	1
Tank Volume (m³)		6	6	6	6	6	6	6
Trips (time/day)		6	6	6	7	8	9	10
Operation Ratio		0.96	0.96	0.95	0.95	0.93	0.9	0.86
Project Recovery Ratio		44%	41%	39%	43%	46%	48%	48%
(4) Total Desludging Capacity (m³/day)	107	88	88	88	94	98	102	105
(5) Total Recovery Ratio	145%	113%	105%	100%	102%	101%	100%	98%

Desludging Volume (Abassan Kabera City)

Legend: Present Capacity — Procurement Capacity — Present Volume
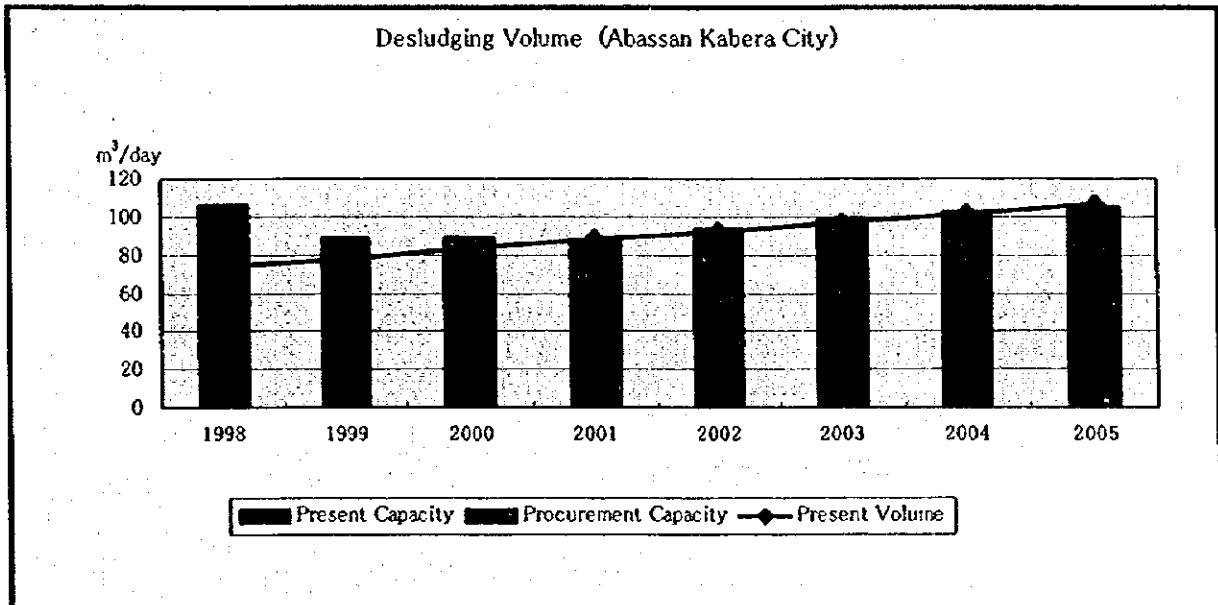
Table 2-13　Desludging Volume (Khuzaa City)

Item	Year							
	1998	1999	2000	2001	2002	2003	2004	2005
Population	7032	7489	7976	8375	8794	9233	9695	10180
Desludging Volume (m³/day)	39	42	45	47	49	52	54	57
Unit Generation (l/capita /day)	8	8	8	8	8	8	8	8
Penetration Ratio	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Desludging Capacity								
(1) Present Total Capacity (m³/day)	40	13	13	13	13	13	13	13
1) Private Capacity (m³)	27							
Number	1							
Tank Volume (m³)	5							
Trips (time/day)	8							
Operation Ratio	0.67							
Existing Recovery Ratio	69%							
2) Private Capacity (m³)	13	13	13	13	13	13	13	13
Number	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Tank Volume (m³)	5	5	5	5	5	5	5	5
Trips (time/day)	8	8	8	8	8	8	8	8
Operation Ratio	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Existing Recovery Ratio	34%	32%	30%	29%	27%	26%	25%	24%
(2) Procurement Total Capacity (m³/day)		29	35	34	40	39	43	46
1) 6m³ Truck Capacity (m³)		29	35	34	40	39	43	46
6m³ Truck Number		1	1	1	1	1	1	1
Tank Volume (m³)		6	6	6	6	6	6	6
Trips (time/day)		5	6	6	7	7	8	9
Operation Ratio		0.96	0.96	0.95	0.95	0.93	0.9	0.86
Project Recovery Ratio		69%	77%	73%	81%	75%	80%	81%
(4) Total Desludging Capacity (m³/day)	40	42	48	48	53	52	57	60
(5) Total Recovery Ratio	103%	100%	107%	101%	109%	101%	105%	105%

Desludging Volume　(Khuzaa City)

m³/day

Present Capacity　Procurement Capacity　Present Volume
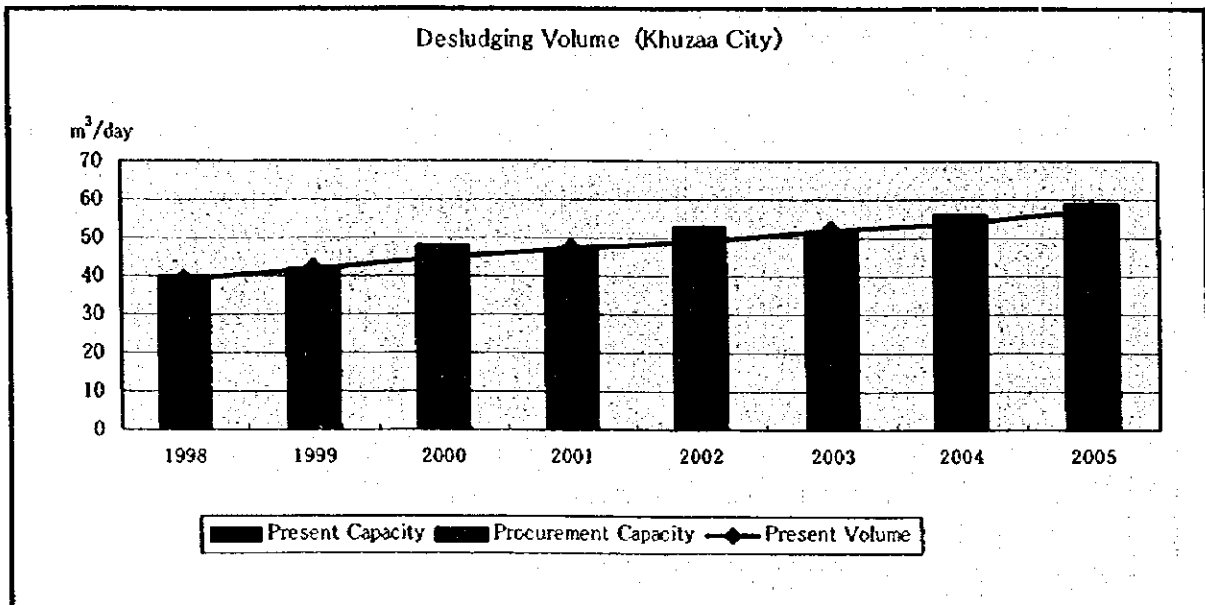
Basic Plan of Equipment Procurement is shown in Table 2-14 for each city and the Sanitation Council. The equipment to be procured by the project is sown in Fig. 2-2.

Table 2-14   Summary of Equipment Procurement

Item	Unit	Specification		
		Volume (m3)	Type	GVW (kg)
Small Vacuum Truck	2	2	Closed type	3,000
Large Vacuum Truck	17	6	Closed type	6,100
Wheel Loader	1	0.8	Wheel type	4,800
Dump Truck	2	2.4	Diesel Engine	3,000
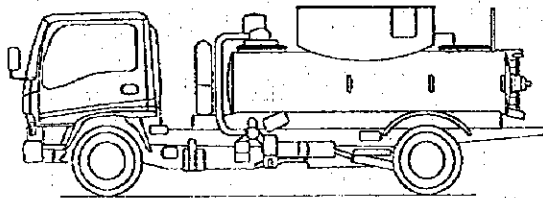
Small Vacuum Truck (2m^3)
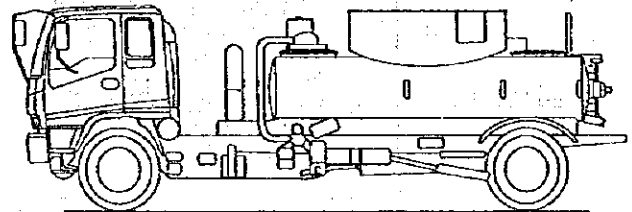
Large Vacuum Truck (6m^3)
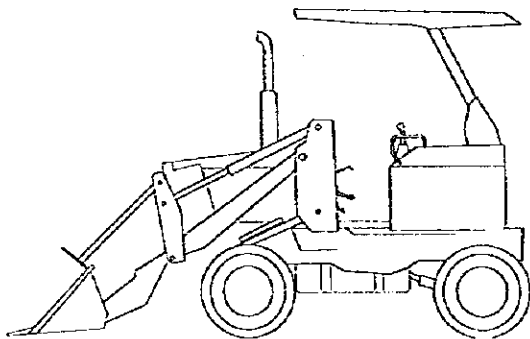
Wheel Loader (0.4m^3)
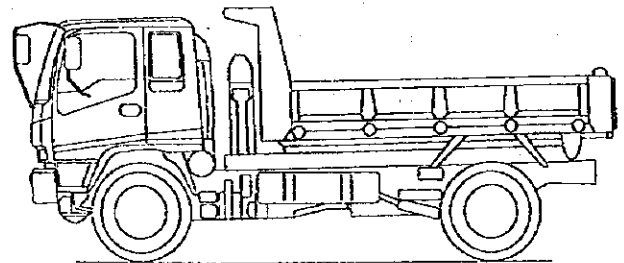
Dump Truck (2.4m^3)

Fig.2-2 Equipment Supply by the Project

2.4   Implementation System of the Project

2.4.1   Organization

a.   The Administrative Council of Sanitation in Khan Yunis Governorate

This council was established in April 1998 by a Bylaw, and will be materialized with staff and budget.   The proposed organization is shown in Fig. 2-3.

The chairman of the council is the Governor of Khan Yunis Governorate.   The board consists of six mayors of Khan Yunis area to be authorized for the decision.

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                    ┌──────────────────┐
                    │     Chairman     │
                    └──────────────────┘
                             │
                    ┌──────────────────┐
                    │    Executive     │
                    │     Director     │
                    └──────────────────┘
                             │
        ┌────────────────────┼────────────────────┐
┌───────────────┐    ┌───────────────┐    ┌───────────────┐
│Financial Affairs│   │Technical Affairs│   │ Administrative │
│   Division     │    │   Division     │    │Affairs Division│
└───────────────┘    └───────────────┘    └───────────────┘
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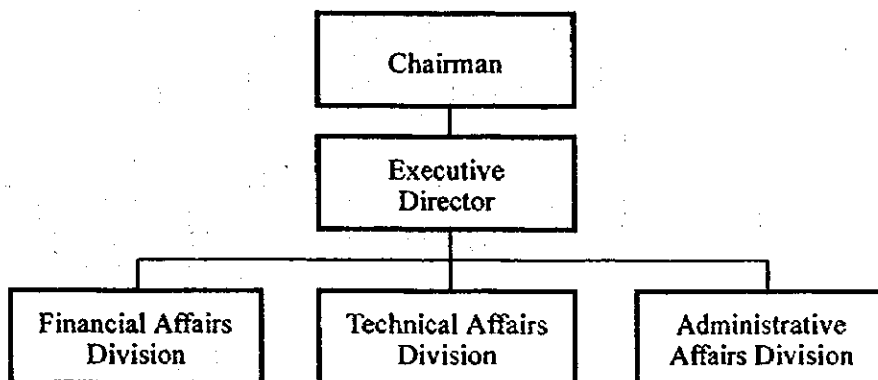
Fig. 2-3   Organization of the Administrative Council of Sanitation of
Khan Yunis Governorate (1998)

b.   Khan Yunis City

Khan Yunis City is the center of Khan Yunis area.   The organization is shown in
Fig. 2-4.   The total staff are 460.   At present the city owns 5 vacuum trucks under
the Health Section.   Since the city is conducting the desludging service, new
vacuum trucks can be maintained in the same section just by increasing the staff
number.

Fig. 2-4   Organization Chart of Khan Yunis Municipality in 1988

c. Bani Sohaila City

As show in Fig. 2-5, the city has six sections with a total staff of 41 in 1998. No staff is working for desludging, because a vacuum tractor of the city is out of order.
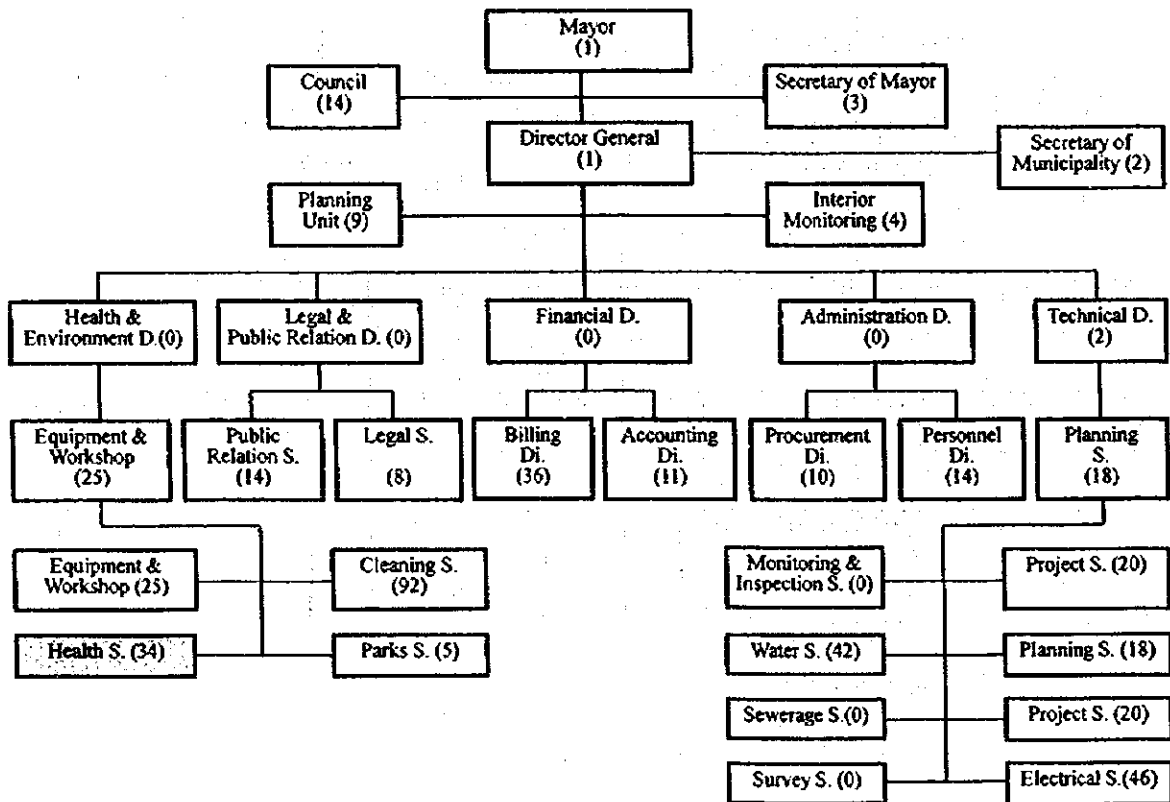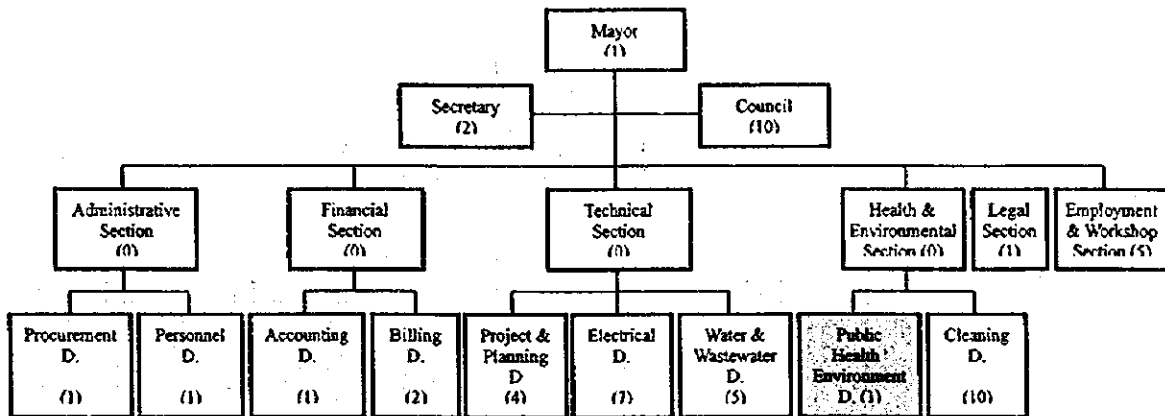
Note:
1. D: Department
2. A total number of officials are 41.
3. The figures in parenthesis show the number of official.

Fig. 2-5 Organization Chart of Bani Sohaila Municipality

d. Qarrara City

The organization of the city is shown in Fig. 2-6. The total number of staff is 31. There is no vacuum vehicle. All the desludging service is dependent upon the private sector.
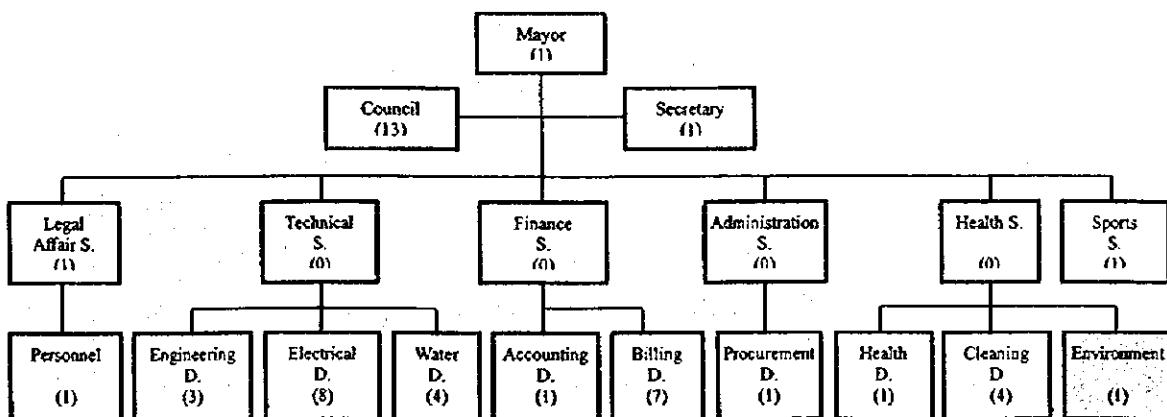
Note:
1. S. and D. show Section and Department respectively.
2. A total number of official is 31 including service staff.

Fig. 2-6 Organization Chart of Qarrara Municipality

e. Abassan Saghera City

The organization of the city is shown in Fig. 2-7. The staff number is 37 in total. The city owns one vacuum tractor. Four staff members of the Cleansing Div. are working for desludging.
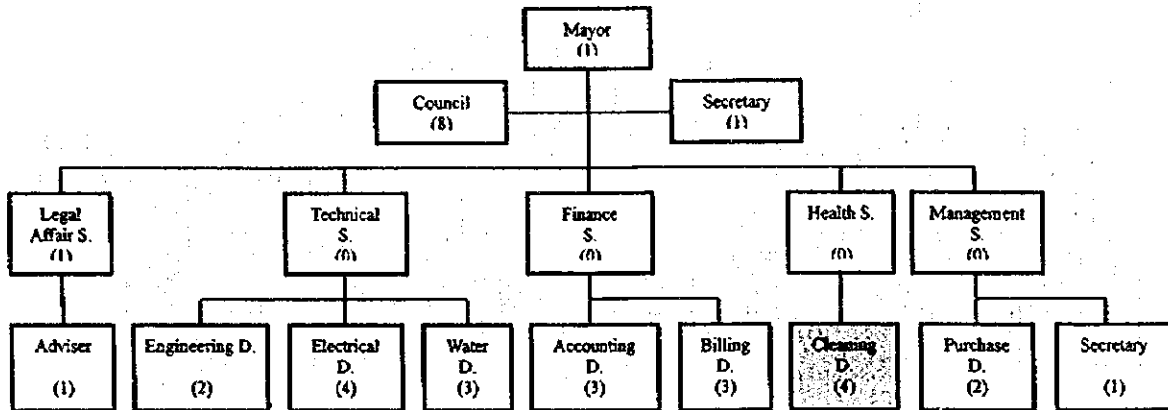
Note: 1   S. and D. show Section and Department respectively.
2.   A total number of official is 26 including service staff.

Fig. 2-7   Organization Chart of Abassan Saghera Municipality

f. Abassan Kabera City

The organization of the city is shown in Fig. 2-8 with a total staff number of 37. Since there is no vacuum vehicle of the city, the desludging is dependent upon the private sector.
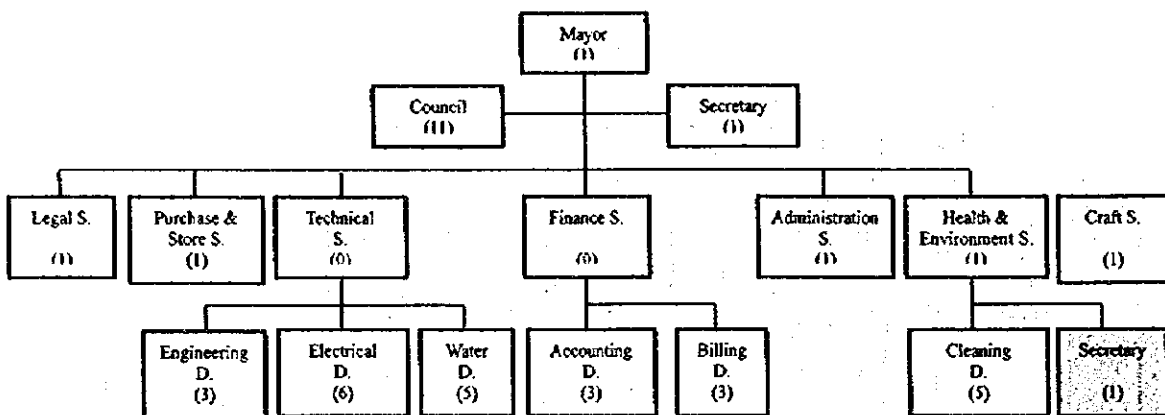
Note: 1.   S. and D. show Section and Department respectively.
2.   A total number of official is 37 including service staff.

Fig. 2-8   Organization Chart of Abassan Kabera Municipality

g Khuzaa City

The organization of the city is shown in Fig. 2-9. There are five sections with a total staff of 23. It has one vacuum tractor under Cleansing Section.
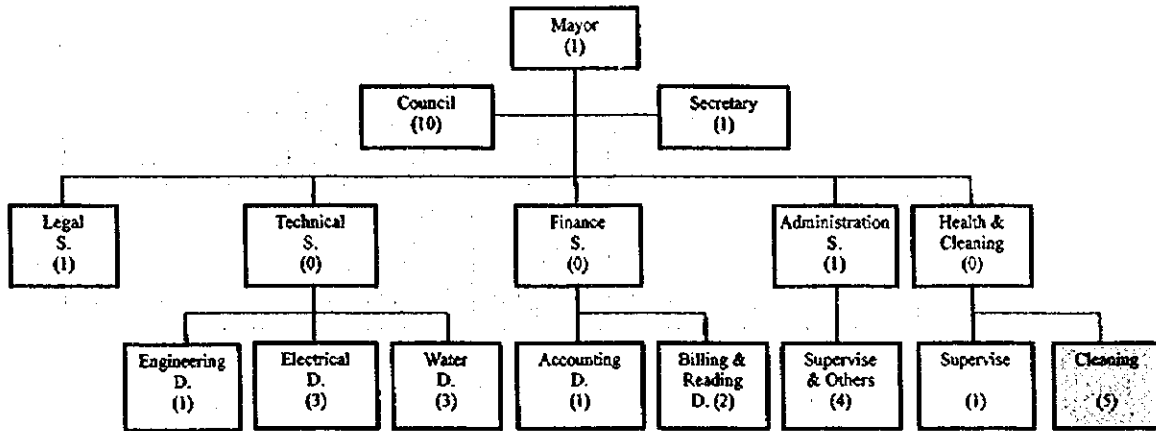
Note: 1. S. and D. show Section and Department respectively.
      2. A total number of official is 23 including service staff.

Fig. 2-9   Organization Chart of Khuzaa Municipality

2.4.2 Budget

a.   The Administrative Council of Sanitation of Khan Yunis Governorate

Table 2-15 shows the financial position.   No budget is allocated, because it was just established.   When a shovel dozer and a dump truck are procured for the council in 1999, about 115,000 NIS shall be generated.

Table 2-15   Financial Position of the Sanitation Council (1,000 NIS)

Year	1998	1999
Revenue	-	(N.A.)
Expenditure	-	(N.A.)
for Sanitation Improvement	-	+136

Note: Established in April 1998.

b. Khan Yunis City

Khan Yunis City owns 5 vacuum trucks for desludging. The financial position of the city is shown in Table 2-16. It is estimated that additional cost of 1,033,000 NIS for sanitation improvement will be required, when the requested equipment is supplied to the city.

Table 2-16 Financial Position of Khan Yunis City (1,000 NIS)

Year	1996	1997	1998	1999
Revenue	17,883	22,274	26,062	(N.A.)
Expenditure	17,883	22,274	26,062	(N.A.)
for Sanitation Improvement	213	237	263	+1,033

c. Bani Sohaila City

Bani Sohaila City owns one vacuum tractor, which is out of order. Therefore there is no cost for sanitation at present. But when the equipment is supplied to the city, additional cost of 146,000 NIS shall be born by the city.

Table 2-17 Financial Position of Bani Sohaila City (1,000 NIS)

Year	1996	1997	1998	1999
Revenue	2,878	3,572	4,089	(N.A.)
Expenditure	2,878	3,564	4,089	(N.A.)
for Sanitation Improvement	0	0	0	+146

d. Qarrara City

There is now no vacuum vehicle owned by Qarrara City. There is no cost for sanitation in the city's budget. When the requested equipment is supplied to the city, it shall generate additional cost of 154,000 NIS.

Table 2-18 Financial Position of Qarrara City (1,000 NIS)

Year	1996	1997	1998	1999
Revenue	127	354	602	(N.A.)
Expenditure	127	354	602	(N.A.)
for Sanitation Improvement	0	0	0	+154

e. Abassan Saghera City

Since Abassan Saghera City owns and is operating one vacuum vehicle, the budget for sanitation in 1998 is 74,000 NIS.   When the requested equipment is supplied to the city, additional cost of 72,000 NIS shall be born by the city.

Table 2-19   Financial Position of Abassan Saghera City (1,000 NIS)

Year	1996	1997	1998	1999
Revenue	831	970	1,068	(N.A.)
Expenditure	831	970	1,068	(N.A.)
for Sanitation Improvement	60	67	74	+72

f. Abassan Kabera City

There is no vacuum vehicle for Abassan Kabera at present.   But when the requested equipment is supplied for the city, it shall generate the cost for sanitation improvement by 70,000 NIS.

Table 2-20   Financial Position of Abassan Kabera City (1,000 NIS)

Year	1996	1997	1998	1999
Revenue	2,520	2,505	2,898	(N.A.)
Expenditure	2,520	2,505	2,898	(N.A.)
for Sanitation Improvement	0	0	0	+70

g. Khuzaa City

Khuzaa City owns and is operating one vacuum tractor by the cost of 62,000 NIS in 1998.   When the requested equipment is supplied to the city, additional cost of 34,000 NIS shall be born for sanitation improvement by the city.

Table 2-21   Financial Position of Khuzaa City (1,000 NIS)

Year	1996	1997	1998	1999
Revenue	1,554	1,623	1,786	(N.A.)
Expenditure	1,554	1,623	1,786	(N.A.)
for Sanitation Improvement	30	33	37	+62

2.4.3   Staffing and Technical Level

a.   The Administrative Council of Sanitation of Khan Yunis Governorate

The council was just established in April 1998 and will be equipped with staff and budget.   No equipment is existent.   New staff will be required for operation and maintenance of the drying bed by using a shovel dozer and a dump truck.

It is assumed that the staff for D/M of the drying bed can be recruited in Gaza Strip.

b.   Khan Yunis City

The city owns the same equipment for desludging.   The technical level will be no problem.   But the increased number of the vacuum trucks will require more drivers and laborers.   It is assumed that the staffing can be recruited in Gaza Strip.

In addition the workshop of the city will need to be strengthened to conduct the regular inspection for all the equipment required by the project.

c.   Bani Sohaila City

Though there is no vacuum vehicle owned by the city, two vacum trucks will be provided.   The staffing will be accordingly required.   But the staff required can be found in Gaza Strip.

d.   Qarrara City

In the city only the private sector is active for desludging.   When the required equipment is supplied for the city, the staff will need to be recruited.   It is assumed that there will be no problem for the city.

e.   Abassan Saghera City

Since the city owns one vacuum vehicle, there will be no technical problem.

f.   Abassan Kabera City

At present there is no vacuum vehicle owned by the city.   Only the private sector is active for desludging.   The city shall recruit the personnel required for the requested equipment.

g.   Khuzaa City

At present the city owns one vacuum tractor for desludging.   It is assumed that the city can recruit the staff required for the equipment within Gaza Strip.   The city will have no technical problem.

CHAPTER 3

IMPLEMENTATION PLAN

CHAPTER 3 IMPLEMENTATION PLAN

3.1 Implementation Plan

3.1.1 Implementation Concept

(1) Implementation Agency

In case this project is to be implemented by the grant aid scheme of GOJ, the E/N (Exchange of Note) between PA and GOJ will describe the conditions for implementation.

The implementation agency will be the Administrative Council of Sanitation of Khan Yunis Governorate (hereafter referred to as ACS), under supervision of the Governorate of Khan Yunis.

The Governorate of Khan Yunis will hire a Japanese consultant for assistance of detailed design, bidding documents, bidding and implementation of the equipment procurement.

The Governorate of Khan Yunis shall follow the guidelines of the Grant Aid Scheme of the Japanese Government for the project implementation of equipment procurement.

(2) Bidding and Contract

The equipment procurement of the project shall be conducted by a firm with Japanese nationality.

(3) Responsibility of PA

For smooth and effective implementation of the project, PA shall carry out its responsibility related with the project without delay. Since the project contributes the sanitation improvement of the Khan Yunis area, the project implementation will be significant. It is to be noted that the equipment to be procured shall be maintained properly for desludging and operation of the drying bed.

Therefore the following undertakings shall be carried out by PA with guarantee:

a. To maintain properly the equipment procured and the existing one. The Sanitation Council shall provide the staff and budget for the purpose.

b. To construct a drying bed plant, where the collected sludge will be dried for final disposal. The Sanitation Council shall find the fund required.

c. To pave the access road to the drying bed with a fund of PA.

d. To secure the final disposal of the dried sludge transported by a dump truck.

e. To strengthen the workshop of Khan Yunis City, where all the equipment procured will be maintained. To establish the system to require the private workshop for complicated repairs.

f. To prepare the garage for the vacuum truck(s) by each city of Khan Yunis Area.

3.1.2 Implementation Conditions

PA (or the Governorate of Khan Yunis) shall construct the drying bed, while each city shall prepare the garage for the equipment procured.

3.1.3 Scope of Works

In case of the project implementation, Japan and Palestine shall implement the following parts:

Table 3-1 Undertakings of GOJ and PA

Item	Japan	Palestine
Land Acquisition for Sludge Drying Bed		O
Constitution of Sludge Drying Bed		O
Completion of Garage		O
Pavement of Access Road		O
Equipment Supply	O	
Training Related to Equipment Supply	O	

3.1.4 Consultant and Supervision

In case of the project implementation, PA shall have contract with a Japanese consultant, while the consultant shall conduct the design and supervision for the project.

(1) Implementation Design

The implementation design shall include: detailed design, bidding documents and preparation for the project implementation.

(2) Bidding

The consultant shall assist the Khan Yunis Governorate for the pit, witnessed by JICA. The contract of PA with a contractor after the bidding shall be effective with the effective E/N.

(3) Supervision

The consultant shall assist the Khan Yunis Governorate in supervising the equipment production, the interim/final examination, equipment transportation, hand-over and the training with special stress to control the contractor in production and quality assurance, and in implementing the project within the period set by E/N.

3.1.5 Procurement Plan

The equipment will be procured based on the quality and price as follows, taking also into account the possibility of the third country.

Table 3-2 Supply origin of the Equipment

Equipment	Supply Origin
Vacuum Truck (2m^3)	Japan
Vacuum Truck (6m^3)	Japan
Wheel Loader	Japan
Dump Truck	Japan

The equipment and spare parts will be transported to Israel from Japan, and brought to custom clearance at Ashdod Port (Israel). After the custom clearance, the equipment and spare parts will be transported about 80 km to south to Erez Check Point on surface. The

equipment and spare parts will be handed over to Palestinian side at Erez, and transported about 40 km south to Khan Yunis Governorate. The vacuum trucks will be separated and transported to the garages of the 6 cities. A shovel dozer will be transported to the drying bed plant.

3.1.6 Implementation Schedule

The whole implementation schedule is shown in Table 4-1. The total period will be 14 months after the E/N agreement agreed: the contractor will be selected in 4 months after E/N and the equipment will be handed over to the Khan Yunis Governorate.

Table 3-3   Implementation Schedule

Item \ Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Detailed Design	Field Survey	Approval of Tender Documents / Work in Japan			Tendering & Evaluation										
Procurement		Certification of Manufacturing Drawings					Procurement Production of Equipment						Transportation / Inspection & Handover		

3.1.7 Obligation of Recipient Country

For implementation of the project, PA shall have the following obligation.

Table 3-4   Obligation of PA

(Unit: Million Yen)

Content	Palestine	Remarks
Construction of Drying Bed	500	about 3 ha
Pavement of Access Road	300	about 6 km
Preparation of Garage	200	6 cities
Total	1000	

Note: Rough estimation

Based on the basic concept of the project, the coverage ratio shall be kept at 100%. The Palestinian side shall procure the additional vacuum trucks and maintain them beyond year 2000 by its financial and organizational capacity. The additional vehicles for each city are shown below:

Table 3-5 Additional Requirement of Vacuum Trucks

City \ Year	1999	2000	2001	2002	2003	2004	2005
Khan Yunis	0	1	1	1	2	2	2
Bani Sohaila	0	1	0	0	0	0	1
Qarrara	0	0	1	0	0	0	0
Abassan Saghera	0	0	0	0	0	0	0
Abassan Kabera	0	0	0	0	0	0	0
Khuzaa	0	0	0	0	0	0	0

Note: Large vacuum truck (6m³)

3.2 Operation and Maintenance Plan

For implementing the project a plain to operate and maintain the equipment to be procured by the project shall be formulated to clarify the staff and cost required.

(1) Required Staff

The additional staff for the requested project are summarized below:

Table 3-6 Summary of Required Drivers and Labors

Council/City	Driver	Labor
Administrative Council of Sanitation	4	2
Khan Yunis	22	0
Bani Sohaila	4	0
Qarrara	4	0
Abassan Saghera	2	0
Abassan Kabera	2	0
Khuzaa	2	0
Total	40	2

(2)   Required Cost

The operation and maintenance cost is summarized in Table 3-7.

Table 3-7   O/M Cost

City/Council	Sludge volume (1000m³/yr)	O/M Cost (1000 NIS/yr)			
		Personnel Cost	Repair Cost	Fuel Cost	Total
Khan Yunis	214	345.600	122.475	564.837	1,032.912
Bani Sohaila	25	57.600	16.725	71.403	145.728
Qarrara	25	57.600	21.150	75.737	154.487
Abassan Saghera	13	28.800	10.575	32.394	71.769
Abassan kabera	13	28.800	10.575	31.025	70.400
Khuzaa	11	28.800	10.575	22.812	62.187
Sanitation Council	468 (8)*¹	81.600	26.700	27.300	135.600
Total		628.800	218.775	825.508	1,678.083

Note) *1 Collected Sludge Volume, the figure in parenthesis is dried sludge volume.

The budgets of the six cities including sanitation are shown in Table 3-7, improvement.

Table 3-8   Budgets of 6 Cities

Year City/Council	Present (1998)		Project Implementation (1999)	
	Total Budget	Sanitation Improvement	Additional	Total
Khan Yunis	26,062	263	1033	1,296
Bani Sohaila	4,089	0	146	146
Qarrara	602	0	154	154
Abassan Saghera	1,068	74	72	146
Abassan kabera	2,898	0	70	70
Khuzaa	1,786	37	62	99
Sanitation Council	0	0	136	136
Total	36,505	374	1,673	2,047

The sludge disposal cost is that of collection transportation of sludge, and operation an transportation of dried sludge.   The sludge disposal cost is summarized in Table 3-9.

Table 3-9   Sludge Disposal Cost

Year City council	Sludge Collection		Public Collection	O/M Cost	Cost Per m³	6m³ Truck Cost	2m³ Truck Cost
	m³/day	1000m³/yr	1000m³/yr	1000NIS/yr	NIS/m³	NIS/tine	NIS/tine
Khan Yunis	937	342	301	1296	4.31	25.8	8.6
Bani Sohaila	114	42	25	146	5.80	34.8	11.6
Qarrara	74	27	25	154	631	37.0	
Abassan Saghera	37	14	13	146	5.54	33.2	
Abassan kabera	78	28	13	70	5.38	32.3	
Khuzaa	42	15	11	99	5.64	33.8	
Sanitation Council	0	0	468	436	0.29	1.7	0.6
Total	1282	468		2047			

The present collection fee by vacuum tractor (5m³) is about 20 NIS. The present operation is causing environmental problems. Therefore the collection fee shall be increased for sanitation improvement, after the project is implemented.

The project is targeted at year 1999. Additional vacuum trucks will be required for three cities of Khan Yunis, Bani Sohaila and Qarrara, as shown in table 3-10.

Table 3-10   Annual Budget for Additional Equipment (1,000 NIS)

City	Vacuum Vehicle	1999	2000	2001	2002	2003	2004	2005
Khan Yunis	Project Procurement	1,032	1,032	1,032	1,032	1,032	1,032	1,032
	Additional Procurement		89	178	267	445	623	801
	Sub-total	1,032	1,121	1,210	1,299	1,477	1,655	1,833
Bani Sohaila	Project Procurement	145	145	1451	145	145	145	145
	Additional Procurement		88	88	88	88	88	88
	Sub-total	145	233	233	233	233	233	233
Qarrara	project Procurement	154	154	154	154	154	154	154
	Additional Procurement			77	77	77	77	77
	Sub-total	154	154	231	231	231	231	231
Abassan Saghera	Project Procurement	72	77	77	77	82	82	87
Abassan kabera	Project Procurement	70	70	70	76	82	88	87
Khuzaa	Project Procurement	62	67	67	71	71	76	80
Sanitation Council	Project Procurement	136	136	136	136	136	136	136

CHAPTER 4

PROJECT EVALUATION AND RECOMMENDATION
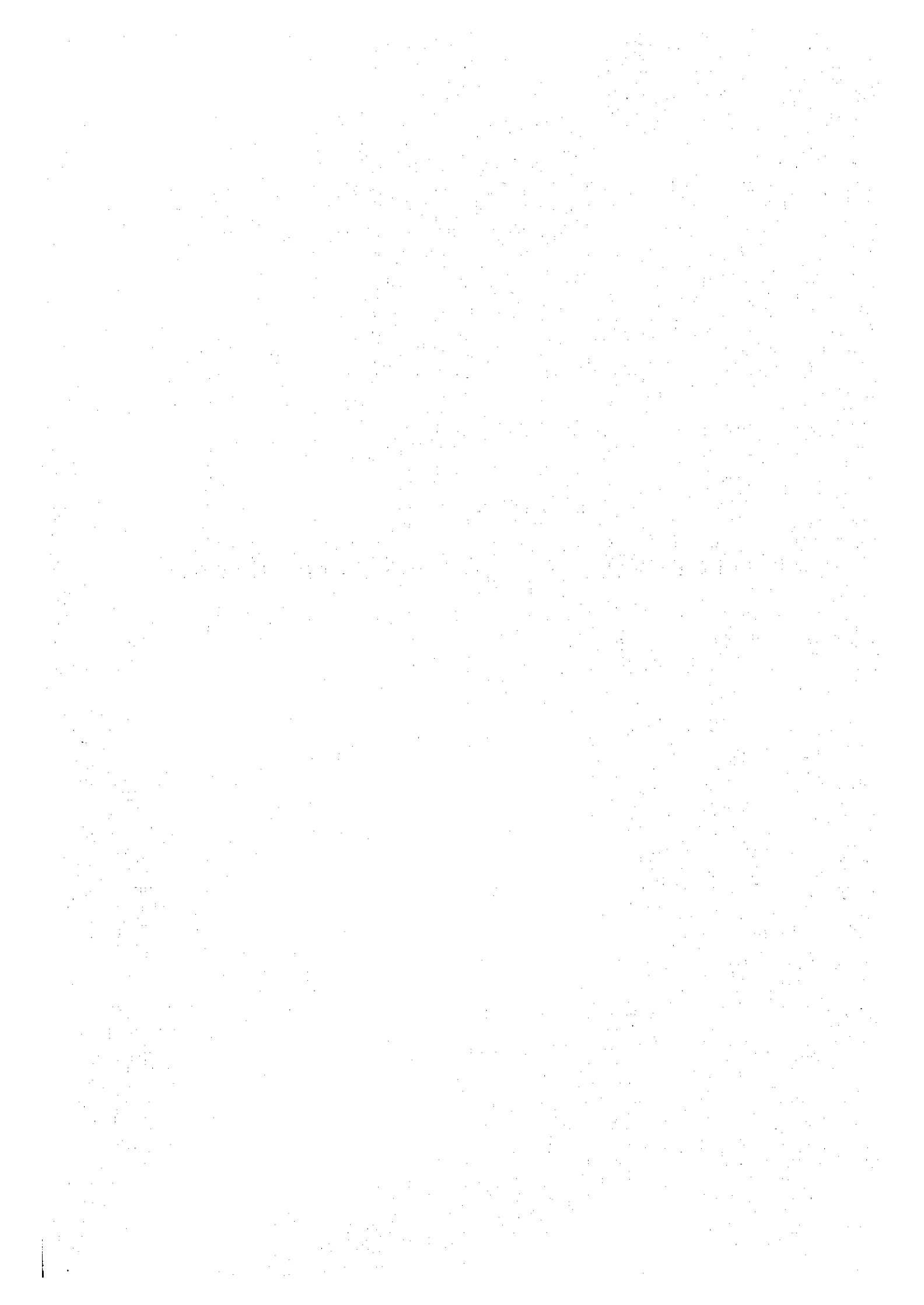
CHAPTER 4   PROJECT EVALUATION AND RECOMMENDATION

4.1   Project Effect

The project is expected to produce direct effects and indirect effects as follows.

(1)   Direct effects

    a.   100% of sludge will be collected and treated in the drying bed.   The dried sludge will be transported to the final disposal site.   This will eliminate the illegal dumping of the sludge and improve the sanitation conditions.

    b.   The present disposal site close to the residential area (about 200m) will be closed, when a new drying bed is constructed and operated.   This will improve the environmental conditions of the present site.

(2)   Indirect effects

    a.   The operation of sludge disposal will give good experience to the sanitation council and 6 cities for the operation and maintenance of the sewerage system.

    b.   The community identity will be generated by observation of the systematic sludge disposal.

Therefore this project is judged to be appropriate for implementation by the grant aid scheme as follows:

    i)   The population of Khan Yunis area at present is as large as 215,000 persons.

    ii)   The area has a high population increase at 6.5% per year, including returnees. The project is required urgently due to tack of the sewerage system.

    iii)   The staff and budget of 6 cities and the Sanitation Council will enable to operate and maintain the project.   The residents are affordable to support the project.

    iv)   The project will not decrease the function of the private sector, but the public and private sector can work together for sanitation improvement.

    v)   The dried sludge will be disposed of under control of the sanitation council, though the trips will be decreased to the long distance to the drying bed.

vi) If all the processes of sludge collection, transportation, drying and disposal will be conducted as planned, the environment will not be deteriorated.

vii) This project can be implemented within the scheme of Japanese grant aid.

4.2 Technical Assistance and Coordination with Other Donors

There is no technical assistance for this project.

Other donors (German and French) have recently donated two vacuum trucks each recently. There is no other plan of coordination from other donors.

The drying bed shall be constructed by the Palestinian side as promised.

4.3 Recommendation

The project will be significant in improving the sanitary conditions of the Khan Yunis area. However, the following issues shall be solved for successful project:

(1) The Administrative Council of Sanitation of Khan Yunis Governorate was just established in April 1998. Its organization and budget shall be established and materialized as soon as possible.

(2) PECDAR plans to construct the drying bed plant. The schedule shall be kept without delay before arrival of the equipment.

(3) The dried sludge shall be transported by a dump truck to the final disposal site at Rafah. The dumping permission shall be obtained for continuous operation.

(4) The access road (about 6km) to the drying bed plant shall be paved for transportation of collected sludge, because the present road is constructed on sand.

(5) The operational record for desludging is not kept properly. For the equipment to be procured a proper record shall be kept on desludging activity, regular maintenance, repair, etc.

(6) Since the spare parts for the equipment are difficult to be obtained in Gaza Strip, the inspection and repair plan shall be formulated to facilitate to obtain the spare parts on schedule.

(7) Complicated repairs for the equipment may be difficult in the workshop of Khan Yunis City. In such a case the equipment shall be repaired in a private garage. So a budget shall be born by PA.

ATTACHMENTS

Attachment 1

1. The List of Study Team Members

	Name	Assignment	Position	Remarks
1	Ms. Masami OISHI	Team Leader	Staff, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs	4/8~4/19
2	Mr. Toshiaki TOKUMASU	Chief Consultant / Operation & Management	Manager, Pacific Consultants International (PCI)	4/8~4/28
3	Dr. Norihiro NODA	Sewage Treatment Plan	Manager, Pacific Consultants International (PCI)	Same as above
4	Mr. Kazuhiko HARUYAMA	Equipment Plan / Cost Estimation / Procurement Plan	Vice President, Haruyama Motors, Ltd.	Same as above

Attachment 2

Field Survey Schedule

No.	Date		Major Activities			
			Team Leader	Team Members		
1	April 8	Wed	-	From Tokyo to Frankfurt		
2	9	Thu	From Tokyo to Tel Aviv	From Frankfurt to Tel Aviv		
3	10	Fri	Visit Embassy of Japan to Israel, More to Gaza			
4	11	Sat	Explanation and Discussion with PA			
5	12	Sun	Site Visit to Workshop, Discussion with 6 cities			
6	13	Mon	Site Visit to Project Sites, Discussion with SWMC			
7	14	Tue	Meeting with other Donors	Site Visit to Project Areas		
8	15	Wed	Initial Discussions for Minutes of Meeting (M/M)			
9	16	Thu	Agreement/Signature of M/M, Report Embassy of Japan to Israel			
10	17	Fri	Meeting with other Donors	Arrangement of Collected Data / Information		
11	18	Sat	Leave Tel Aviv	Additional Site Visit, Reporting		
12	19	Sun	Arrival at Tokyo	Additional Site Visit, Reporting		
13	20	Mon	-	Discussion with Governorate		Workshop
14	21	Tue	-	Discussion with Municipality		Workshop
15	22	Wed	-	Operation and Maintenance	Treatment Facility Plan	Equipment Procurement
16	23	Thu	-	Operation and Maintenance	Treatment Facility Plan	Equipment Procurement
17	24	Fri	-	Report to Embassy of Japan to Islael		
18	25	Sat	-	Further Study, Reporting		
19	26	Sun	-	Study and Move to Tel Aviv		
20	27	mon	-	Leave Tel Aviv for London		
21	28	Tue	-	London to Tokyo		

Attachment 3

The List of Persons Met by the Study Team

1. Japanese Embassy in Israel

Mr. Kunikata Tosio	:	Minister
Mr. Hayashi Katsuyoshi	:	Councilor
Mr. Sato Kohei	:	Third Secretary
Mr. Yoshida Susumu	:	Special Surveyor

2. JICA Expert

Mr. Hideomi Ohi	:	JICA Expert

3. Ministry of Planning & International Cooperation (MOPIC)

Dr. Nabee Shaath	:	Minister
Dr. Ali Shaat	:	Deputy Minister
Mr. Waleed A.Siam	:	Director General, International Cooperation
Mr. Saeed Abu Jalalah	:	Director, Sewerage & Water Department

4. Governorate of Khan Yunis

Mr. Sakher Bessissou	:	Governor
Mr. Jamal Abozaid	:	Director, Development & Project Management Department
Mr. Talat Harb	:	Mechanical Engineer
Mr. Jehad Eljebour	:	Chemical Engineer

5. Khan Yunis Municipality

Dr. Osama Alfarra	:	Mayor
Mr. Osama Barbakh	:	Council Member
Mr. Salim Elagha	:	Mechanical Engineer
Mr. Ahmed Zuarub	:	Civil Engineer, Urban Planning
Mr. Amen Mohamad Hassanain	:	Mechanical Engineer, Workshop

6. Bani Sohaila Municipality

Mr. Mossa Abu Saada	:	Mayor
Mr. Ahmed Baraka	:	Mechanical Engineer
Mr. Adli Abudaga	:	Legal Officer

7. Qarrara Municipality
   Mr. Aid Al Abadlla : Mayor
   Mr. Mohammed Abulehya : Vice Mayor
   Mr. Abdula Abu Enin : Civil Engineer

8. Abassan Saghera Municipality
   Mr. Jalal El Daghma : Mayor
   Mr. Hassan Abu Salah : Head, Personnel Office

9. Abassan Kabera Municipality
   Mr. Mostafa S. Shawaf : Mayor
   Mr. Ibrahim El Shawaf : Civil Engineer, Engineering Department

10. Khuzaa Municipality
    Mr. Shehadeh El Naggar : Mayor
    Mr. Rasmi Abu Jamea : Legal Officer

11. Solid Waste Management Council
    Mr. Salah M. Borno : Director
    Mr. Manfred Scheu : Project Advisor

12. World Bank
    Mr. Husam Abu-Dagga : Gaza Office Coordinator

13. Palestinian Economic Council for Development & Reconstruction (PECDAR)
    Dr. K. A. Nigim : Director

Attachment 4

Socio-economic Conditions of the Recipient Country

Country Name	Palestinian Interim Self—Government

General

Political System	Republic		Capital	Jericho
State Head	Yasser Arafat		Major Cities	Gaza, Khan Yunis (Gaza)
Independence Date	28 September 1995 (Interim Agreement)		Working Population	416,000 (1995)
Race (s)	Palestinians		Compulsory Education	6 Years
			Elementary Education Ratio	
Language	Arabic language		Elementary Education Completion Ratio	
Religion	Islam		Literacy Ratio	84.9%/83.4% (1994/95)
UN Joining			Population Density	
WB & IMF Joining	28 September 1995 (Interim Agreement)		Population Increase Ratio	
			Average Life Expectancy	68.3/67.5
			Infant Mortality Ratio	
Area	5,937 km²		Calorie Supply	
Population	2,640,000 (1992)			

Economic Indicators

Currency	NIS		Trade	
Exchange Rate (1US$)	1 US$ = 30 NIS		Export	229.0 Million Dollar(1995)
Fiscal Year	January - December		Import	1,247.4 Million Dollar (1995)
National Budget			Import Coverage Ratio	
Rename	684.2 Million Dollar (1996)	*1	Major Exports	
Expedition	779.3 Million Dollar (1996)	*1	Major Imports	
International Balance	-165.0 Million Dollar (1995)	*1	Export to Japan	—
ODA Amount	596.3 Million Dollar (1996)	*2	Import from Japan	—
GDP	3,685 Million NIS (1986)	*3		
Per Capita GNP	1,845 NIS real Value, 1986	*2	Foreign Reserve	
GNP Per Industry	Agriculture 22% Primate Service 36%		Foreign Debt Amount	
(1995)	Construction 21% Public Sector 16%	*1	Foreign Debt Ratio	
	Manufacture 9%		Inflation Ratio	10.6% (1995)
Employment	Agriculture 26.2% others 46.8%	*3		
(1992)	Industry 11.3%	*4		
	Construction 11.3%		National Development Plan	
Economy Growth Ratio	3.5% -1995	*3		

Climate (1980~1995 Average) Locations: Gaza													
month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average/Total
Average Temperature (°C)	13.6	14.0	15.8	18.0	21.3	23.8	25.7	26.2	25.2	22.9	19.8	15.4	21.0 °C
Precipitation(mm)	70.84	77.24	34.20	2.44	1.00	-	-	-	2.35	16.45	66.00	66.00	341.30 mm
Rainy/Dry Season	Rainy	Rainy	Rainy	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Rainy	Rainy	

*1 Palestinian Bureau of Statistics, MOPIC

*2 Geographical Distribution of Financial Flow 1997

*3 IMF Estimate, Israeli Central Bureau of Statistics

*4 Israeli central Bureau of Statistics

*5 Palestine Outlook (1997, Japanese Embassy in Israel)

Country Name	Palestinian Interim Self –Government

*5

Total Japanese ODA			(Pledge Base : Unit = 100 million Yen)	
Item FY	1993	1994	1995	1996
Grant Aid	2,892.93	3,087.67	2,796.65	2,395.50
Technical Assistance	2,244.22	2,456.48	3,256.28	3,180.92
Loan	3,939.97	4,352.21	3,878.22	2,799.84
Total	9,077.12	9,896.36	9,931.04	8,356.26

Japanese ODA to Palestine			(Real Amount : Million Dollar)	
Item FY	1993	1994	1995	1996
Grant Aid	49.62	50.82	61.35	53.06
Technical Assistance	0.52	0.87	1.06	-
Loan	-	-	-	-
Total	50.14	51.69	62.41	53.06

*6

Economic Cooperation of OECD Counties (1996)	Donation (1)		Loan	Development Aid (ODA)	Other Public & Private	Assistance	(Expenditure : Million Dollar)
		Technical Assistance	(2)	(1) + (2) = (3)	(4)	(3) + (4)	
Bilateral	251.5	-	5.4	256.9	9.6	266.5	
(Major Continues)							
1. Holland	58.8	-	0.0	58.8	0.0	58.8	
2. Norway	50.4	-	0.0	50.4	0.0	50.4	
3. Sweden	27.6	-	0.0	27.6	0.0	27.6	
4. Germany	24.6	-	0.0	24.6	0.0	24.6	
Multi-lateral	306.1	-	0.0	306.1	0.0	306.1	
(major organization)							
1. CEC	132.0	-	0.0	132.0	0.0	132.0	
2. UNRWA	118.2	-	0.0	118.2	0.0	118.2	
Others	27.9	-	0.0	27.9	0.0	27.9	
Total	585.5	-	5.4	590.9	9.6	600.5	

*7

Government organization of PA for ODA	
Technical	MOFCI
Grant Aid	
Volunteers	

*5 Japan's ODA Annual Report 1997

*6 Geographical Distribution of Financial Flow to Aid Recipients 1997

*7 JICA

Attachment –5

Ratio of Solid Matters in Collected Sludge

The ratio of solid matters in collected sludge is estimated on the basis of the Japanese solid matters in residential wastewater(see "Guidelines of Sewerage Facility Planning and Design(1994)). The pollution loads of the Japanese population are shown in Table –1 below.

Table –1 Pollution Loads in Japan (g/capita/day)

Item	Average	Standard Deviation	Data Number	Average Portion	
				Nightsoil	Others
BOD₅	57	13	43	18	39
COD	28	6	29	10	18
SS	43	15	31	20	23
T-N	12	2	7	9	3
T-P	1.2	0.3	8	0.9	0.3

Source: Guidelines of Sewerage Facility Planning and Design(1994)

The suspended solid (SS) originated from nightsoil amounts for 20g per capita and day. If it is assumed that this amount of SS is contained in 8 litter per capita and day, the concentration of the sludge is calculated at 2.5 g per litter. If the moisture content of the sludge remains unchanged, the concentration of the sludge to be collected by a vacuum truck will be 3.6 g per litter (=2.5 g/l x 100/(100-PR), where PR means penetration ratio (30%). Therefore the concentration ratio of 3.6 g/l is used for the collected sludge.

Attachment –6

Performance Efficiency of Tractor Shovel

(1) Capacity of Digging and Pushing
The capacity of digging and pushing by a tractor shovel is given by KENDO or the Guidelines of Construction Vehicles in Japan (1997), as shown below:

$$Soil \cdot Volume = \frac{60 \cdot q \cdot f \cdot E}{C_m}$$

Where q = Soil volume dug in one cycle (m³)

f = Conversion ratio of soil volume

E = Performance efficiency

C_m = Cycle time (min) = 0.027 l +0.78 (min)

(l = Average length of digging and pushing (m))

Thickness of dried sludge (m)≈Volume of dried sludge (m³) /Area of drying beds(m²)

The volume of dried sludge in 1999 is estimated at 12 t/day, or 22 m3/day to be transported to the final disposal site. Therefore the thickness of dried sludge can be calculated as follows:
The thickness of sludge = 22 m³/(20 m*50 m)=0.22 m

The volume of the bucket of the tractor shovel is 0.8 m3. The length L of pushing by the tractor shovel can be calculated as follows:
0.8 m³ = thickness of dried sludge * width of bucket * L

$$L = \frac{0.8m3}{0.022 * 1.98} = 18.4(m)$$

L can be expected to be 20 m, because the volume of the bucket (0.8 m3) is based on flat loading. The actual volume Q of digging and pushing by the tractor shovel can be estimated as follows:
Q = 0.022m * 1.98 m * 20m =0.87 m³

f (onversion ratio of soil volume) is estimated at 1, because the soil is no compacted.

E (performance efficiency) is normally estimated at 0.7, because the soil condition to be pushed is judged to be normal according to the criteria. However to scratch the dried sludge will reduce

the performance efficiency, so E is estimated at 0.5.

C_m (cycle time) ca be calculated as follows:,assuming the pushing length at 20m:

C_m=0.027 * 20 + 0.78 = 1.32 (min)

Therefore the soil volume is calculated as follows:

$$Soil \cdot Volume = \frac{60 \cdot 0.87 \cdot 1 \cdot 0.5}{1.32} = 20(m^3 / hr)$$

The time required for digging and pushing 25m/day in 1999 can be calculated as follows:

25(m^3/day)/20 (m^3/hr)=1.3 hr

The time required for loading one dump truck can be calculated as follows:

2.4 m^3/20m^3=0.12 hr

Therefore the time required for loading two dump trucks is estimated at 0.24hr. This means that if the tractor shovel starts the digging and pushing work by 15 min earlier, it can pile up the volume of dried sludge for two dump trucks.

(2) Loading of the dump truck

The volume of the dump truck is 2.4 m3. The loading capacity can be calculated as follows:

$$LoadingCapacity = \frac{60 \cdot V_B \cdot K \cdot E}{C_m}$$

Where

V_B=Volume of the shovel bucket (=0.8 m^3)

K=Bucket coefficient(= 0.7 to 0.9, 0.8 is applied)

E=Performance efficiency(0.8 in average)

C_m=Cycle time(min)=Moving time + Fixed time (0.6)

Moving length = 50 m * 2 =100 m

Speed=6 km/hr (Komatsu (1998))

Therefore

C_m=100(m)/6(km/hr) + 0.6=1.6 (min)

$$LoadingCapacity = \frac{60 \cdot 0.8 \cdot 0.8 \cdot 0.8}{1.6} = 19.2(m^3 / hr)$$

T_L(time for loading one dump truck with dried sludge) is calculated as follows:

$$TL = \frac{Volume \cdot of \cdot Dump \cdot Truck}{Loading \cdot Performance}$$

$$= \frac{2.4m^3}{19.2m^3 / hr} = 0.13(hr)$$

Attachment 7

Calculation of Operation and Maintenance Cost

1. Sludge Collection Cost of 2 m³ Vacuum Truck

    1) Specification

        Loading Capacity: 2m³

        Power: 80PS

        Base Cost: ¥ 5,904,000

        Use duration: 6 year

        Repair ratio: 25%

    2) Personnel cost

        Driver/Labor: 1,200 NIS/month * 12 months * 2=28,800 NIS (¥ 1,152,000)

        (Two persons will work for 7 days by shifting)

    3) Repair cost

        ¥ 5,904,000 * 25% /6 years=¥ 246,000/unit

    4) Fuel cost

        a) During driving

        The fuel consumption ratio (=0.037litter/PS/hr) is used.

            0.037 litter/PS/hr * 80PS =3 litter/hr

        b) During suction and discharging of the sludge

        The fuel consumption ratio (=0.242litter/PS/hr) is used.

Activity	Pump Power(PS)	Time(min)	Fuel Consumption (l/time)
Suction	93	8	0.242 * 93 * 8/60 = 3.0
Discharging	59	4	0.242 * 59 * 4/60 =1.0
Total			4.0

2. Sludge Collection Cost of 6 m³ Vacuum Truck

    1) Specification

        Loading Capacity: 6 m³

        Power: 150PS

        Base Cost: ¥ 10,160,000

        Use duration: 6 year

        Repair ratio: 25%

    2) Personnel cost

        Driver/Labor: 1,200 NIS/month * 12 months * 2=28,800 NIS (¥ 1,152,000)

(Two persons will work for 7 days by shifting)

3) Repair cost

¥ 10,160,000 * 25% /6 years =¥ 423,000/unit

4) Fuel cost

a) During driving

The fuel consumption ratio (=0.040litter/PS/hr) is used.

0.040 litter/PS/hr * 150 PS =6 litter/hr

b) During suction and discharging of the sludge

The fuel consumption ratio (=0.242litter/PS/hr) is used.

Activity	Pump Power(PS)	Time(min)	Fuel Consumption (l/time)
Suction	93	18	0.242 * 93 * 18/60 = 6.8
Discharging	59	9	0.242 * 59 * 9/60 =2.1
Total			8.9

3. Pushing and loading cost of the wheel loader

1) Specification

Number: one unit

Bucket: 0.8 m³

Power: 55 PS

Base Cost: ¥ 6,256,000

Use duration: 6 year

Repair ratio: 35%

2) Personnel cost

Driver/Labor: 1,200 NIS/month * 12 months =14,800 NIS (¥ 576,000)

(Work for 7 days)

3) Repair cost

¥ 6,256,000 * 35% /6 years =¥ 364,000/unit

4) Fuel cost

Fuel consumption: ratio   0.115 litter/PS/hr

Fuel consumption: 0.115 litter/PS/hr * 55 PS=6.3 litter/hr

Operation time per day: 1.3 hr (pushing) + 1.3 hr (loading) = 2.6 hr

Fuel consumption per day: 6.3 litter/hr * 2.6 hr =16 litter

Working days per year: 26 days * 12 months = 312 days

Fuel consumption per year: 16 litter /day * 312 days = 4,992 litter

4. Operation cost of the dump truck

1) Specification

Number:	two units
Capacity:	5.7 t, 3.8 m³
Power:	184 PS
Base Cost:	¥ 3,520,000
Use duration:	5 year
Repair ratio:	50%

2) Personnel cost

Driver/Labor: 1,200 NIS/month * 12 months * 3=43,200 NIS (¥ 1,728,000)

(Three persons will work for 7 days by shifting)

3) Repair cost

¥ 3,520,000 * 50% /5years * 2 units =¥ 704,000/unit

4) Fuel cost

Fuel consumption: ratio	0.040 litter/PS/hr
Fuel consumption:	0.040 litter/PS/hr * 184 PS=7.4 litter/hr
Operation time per day:	0.6 hr * 6trips = 3.6 hr
Fuel consumption per day:	7.4 litter/hr * 3.6 hr =27 litter
Working days per year:	26 days * 12 months = 312 days
Fuel consumption per year:	27 litter /day * 312 days = 16,848 litter

5. Calculations of personnel and repair costs

Khan Yunis

	Unit	Vacuum Truck		Total
		2 m3	6 m3	
Per one unit				
Personnel cost	NIS/yr	28,800	28,800	
Repair cost	NIS/yr	6,150	10,575	
Unit number	number	1	11	
Annual personnel cost	NIS/yr	28,800	316,800	345,600
Annual repair cost	NIS/yr	6,150	116,325	122,475

Bani Sohaila

	Unit	Vacuum Truck		Total
		2 m3	6 m3	
Per one unit				
Personnel cost	NIS/yr	28,800	28,800	
Repair cost	NIS/yr	6,150	10,575	
Unit number	number	1	1	
Annual personnel cost	NIS/yr	28,800	28,800	57,600

Annual repair cost	NIS/yr	6,150	10,575	16,725

Garrara

	Unit	Vacuum Truck		Total
		2 m3	6 m3	
Per one unit				
Personnel cost	NIS/yr	28,800	28,800	
Repair cost	NIS/yr	6,150	10,575	
Unit number	number	0	2	
Annual personnel cost	NIS/yr	0	57,600	57,600
Annual repair cost	NIS/yr	0	21,150	21,150

Abassan Saghera

	Unit	Vacuum Truck		Total
		2 m3	6 m3	
Per one unit				
Personnel cost	NIS/yr	28,800	28,800	
Repair cost	NIS/yr	6,150	10,575	
Unit number	number	0	1	
Annual personnel cost	NIS/yr	0	28,800	28,800
Annual repair cost	NIS/yr	0	10,575	10,575

Abassan Kabera

	Unit	Vacuum Truck		Total
		2 m3	6 m3	
Per one unit				
Personnel cost	NIS/yr	28,800	28,800	
Repair cost	NIS/yr	6,150	10,575	
Unit number	number	0	1	
Annual personnel cost	NIS/yr	0	28,800	28,800
Annual repair cost	NIS/yr	0	10,575	10,575

Khuzaa

	Unit	Vacuum Truck		Total
		2 m3	6 m3	
Per one unit				
Personnel cost	NIS/yr	28,800	28,800	
Repair cost	NIS/yr	6,150	10,575	
Unit number	number	0	1	
Annual personnel cost	NIS/yr	0	28,800	28,800
Annual repair cost	NIS/yr	0	10,575	10,575

6. Calculation of Fuel Consumption

Khan Yunis

		Unit	Vacuum Truck		Total
			2 m³	6 m³	
Per	Trip time to drying bed	Hr/time	0.52		
	Trip number	Times/day	9		
one	Driving fuel consumption*¹	Litter/day	14	28	
	Site fuel consumption*²	Litter/day	36	80	
unit	Daily consumption	Litter/day	50	108	
	Annual consumption*³	Litter/yr	18,250	39,420	
Working vehicle		Number	1	11	
Annual fuel consumption		Litter/yr	18,250	433,620	
Annual fuel cost*⁴		NIS/yr	22,812	542,025	564,837

Note: *¹ Fuel consumption (2 m³: 3l/hr, 6 m³: 6l/hr) * trip hours * trips

*² Fuel consumption (2 m³: 4l/time, 6 m³: 8.9l/time) * trips

*³ Annual fuel consumption = daily fuel consumption * 365 days

*⁴ Annual fuel cost = annual fuel consumption * 1.25 NIS/l

Bani Sohaila

		Unit	Vacuum Truck		Total
			2 m³	6 m³	
Per	Trip time to drying bed	Hr/time	0.50		
	Trip number	Times/day	9		
one	Driving fuel consumption*¹	Litter/day	13.5	27	
	Site fuel consumption*²	Litter/day	36	80	
unit	Daily consumption	Litter/day	49.5	107	
	Annual consumption*³	Litter/yr	18,068	39,055	
Working vehicle		Number	1	1	
Annual fuel consumption		Litter/yr	18,068	39,055	
Annual fuel cost*⁴		NIS/yr	22,585	48,818	71,403

Note: *¹ Fuel consumption (2 m³: 3l/hr, 6 m³: 6l/hr) * trip hours * trips

*² Fuel consumption (2 m³: 4l/time, 6 m³: 8.9l/time) * trips

*³ Annual fuel consumption = daily fuel consumption * 365 days

*⁴ Annual fuel cost = annual fuel consumption * 1.25 NIS/l

Bani Sohaila

		Unit	Vacuum Truck		Total
			2 m³	6 m³	
Per	Trip time to drying bed	Hr/time	0.82		
	Trip number	Times/day	6		
one	Driving fuel consumption*¹	Litter/day	15	30	
	Site fuel consumption*²	Litter/day	24	80	
unit	Daily consumption	Litter/day	39	107	
	Annual consumption*³	Litter/yr	14,235	39,055	
Working vehicle		Number	0	2	
Annual fuel consumption		Litter/yr	0	60,590	

Annual fuel cost*⁴	NIS/yr	0	75,737	75,737

Note: *¹ Fuel consumption (2 m³: 3l/hr, 6 m³: 6l/hr) * trip hours * trips

*² Fuel consumption (2 m³: 4l/time, 6 m³: 8.9l/time) * trips

*³ Annual fuel consumption = daily fuel consumption * 365 days

*⁴ Annual fuel cost = annual fuel consumption * 1.25 NIS/l

Abassan Saghera

		Unit	Vacuum Truck		Total
			2 m³	6 m³	
Per	Trip time to drying bed	Hr/time	0.50		
	Trip number	Times/day	6		
one	Driving fuel consumption*¹	Litter/day	9	18	
	Site fuel consumption*²	Litter/day	24	53	
unit	Daily consumption	Litter/day	33	71	
	Annual consumption*³	Litter/yr	12,045	25,915	
Working vehicle		Number	0	1	
Annual fuel consumption		Litter/yr	0	25,915	
Annual fuel cost*⁴		NIS/yr	0	32,394	32,394

Note: *¹ Fuel consumption (2 m³: 3l/hr, 6 m³: 6l/hr) * trip hours * trips

*² Fuel consumption (2 m³: 4l/time, 6 m³: 8.9l/time) * trips

*³ Annual fuel consumption = daily fuel consumption * 365 days

*⁴ Annual fuel cost = annual fuel consumption * 1.25 NIS/l

Abassan Kabera

		Unit	Vacuum Truck		Total
			2 m³	6 m³	
Per	Trip time to drying bed	Hr/time	0.42		
	Trip number	Times/day	6		
one	Driving fuel consumption*¹	Litter/day	7.5	15	
	Site fuel consumption*²	Litter/day	24	53	
unit	Daily consumption	Litter/day	31.5	68	
	Annual consumption*³	Litter/yr	11,498	24,820	
Working vehicle		Number	0	1	
Annual fuel consumption		Litter/yr	0	24,820	
Annual fuel cost*⁴		NIS/yr	0	31,025	31,025

Note: *¹ Fuel consumption (2 m³: 3l/hr, 6 m³: 6l/hr) * trip hours * trips

*² Fuel consumption (2 m³: 4l/time, 6 m³: 8.9l/time) * trips

*³ Annual fuel consumption = daily fuel consumption * 365 days

*⁴ Annual fuel cost = annual fuel consumption * 1.25 NIS/l

Abassan Saghera

	Unit	Vacuum Truck		Total
		2 m³	6 m³	

Per	Trip time to drying bed	Hr/time	018		
	Trip number	Times/day	5		
one	Driving fuel consumption*[1]	Litter/day	2.7	5.4	
	Site fuel consumption*[2]	Litter/day	20	45	
unit	Daily consumption	Litter/day	23	50	
	Annual consumption*[3]	Litter/yr	8,395	18,250	
Working vehicle		Number	0	1	
Annual fuel consumption		Litter/yr	0	18,250	
Annual fuel cost*[4]		NIS/yr	0	22,812	22,812

Note: *[1] Fuel consumption (2 m^3: 3l/hr, 6 m^3: 6l/hr) * trip hours * trips

*[2] Fuel consumption (2 m^3: 4l/time, 6 m^3: 8.9l/time) * trips

*[3] Annual fuel consumption = daily fuel consumption * 365 days

*[4] Annual fuel cost = annual fuel consumption * 1.25 NIS/l

7. Personnel, repair and fuel costs of the Sanitation Council

	Unit	Drying bed	Wheel loader	Dump Truck	Total
Personnel cost	NIS/yr	24,000*[1]	14,400	43,200	81,600
Repair cost	NIS/yr	0	9,100	17,600	26,700
Vehicle	Unit	0	1	2	3
Fuel cost	NIS/yr	0	6,240	21,060	27,300

Note *[1]2 labors:1,000 NIS/month * 12 months * 2 persons = 24,000 NIS/yr

Attachment 8

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