QUETTA MUNICIPAL CORPORATION
ISLAMIC REPUBLIC OF PAKISTAN

BASIC DESIGN STUDY REPORT
ON
THE GARBAGE COLLECTION AND DISPOSAL PROJECT
FOR
THE IMPROVEMENT OF ENVIRONMENTAL CONDITIONS IN QUETTA, THE ISLAMIC REPUBLIC OF PAKISTAN

DECEMBER 1996

JAPAN INTERNATIONAL COOPERATION AGENCY
CTI ENGINEERING CO., LTD.

BASIC DESIGN STUDY REPORT ON THE GARBAGE COLLECTION AND DISPOSAL PROJECT FOR THE IMPROVEMENT OF ENVIRONMENTAL CONDITIONS IN QUETTA, THE ISLAMIC REPUBLIC OF PAKISTAN
DECEMBER 1996

BASIC DESIGN STUDY REPORT
ON
THE GARBAGE COLLECTION AND DISPOSAL PROJECT
FOR
THE IMPROVEMENT OF ENVIRONMENTAL CONDITIONS IN QUETTA, THE ISLAMIC REPUBLIC OF PAKISTAN

DECEMBER 1996

JAPAN INTERNATIONAL COOPERATION AGENCY
CTI ENGINEERING CO., LTD.

PREFACE

In response to a request from the Government of the Islamic Republic of Pakistan, the Government of Japan decided to conduct a basic design study on the Garbage Collection and Disposal Project for the Improvement of Environmental Conditions in Quetta and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Pakistan a study team from August 17 to September 15, 1996.

The team held discussions with the official concerned of the Government of Pakistan, 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 Pakistan 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 Islamic Republic of Pakistan for their close cooperation extended to the teams.

December, 1996

Kimio Fujita
President
Japan International Cooperation Agency

December, 1996

LETTER OF TRANSMITTAL

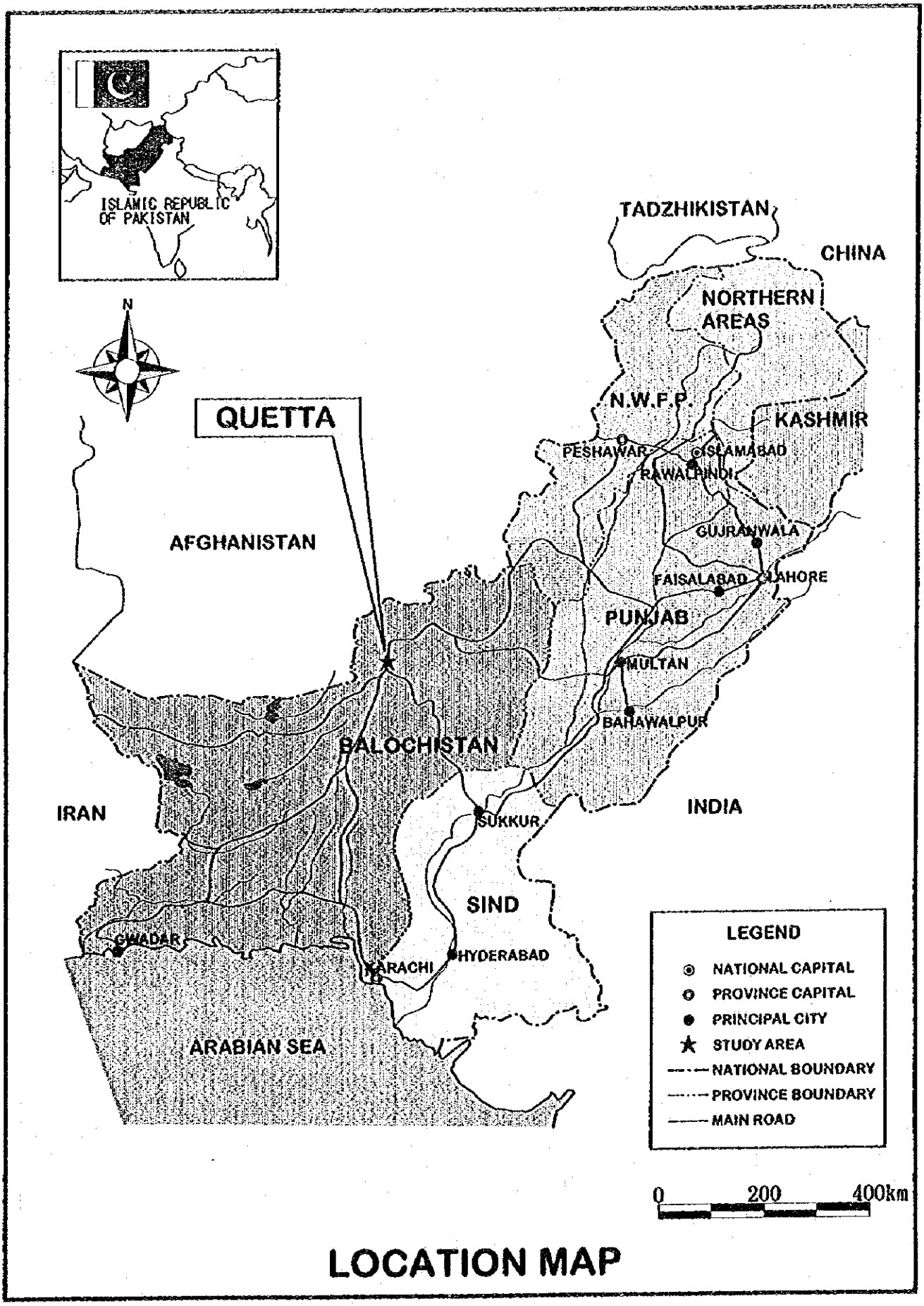
We are pleased to submit to you the basic design study report on the Garbage Collection and Disposal Project for the Improvement of Environmental Conditions in Quetta, Pakistan.

This study was conducted by CTI Engineering Co., Ltd., under a contract to JICA, during the period from August 7, 1996 to December 20, 1996. In conducting the study, we have examined the feasibility and rational of the project with due consideration to the present situation of Pakistan and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

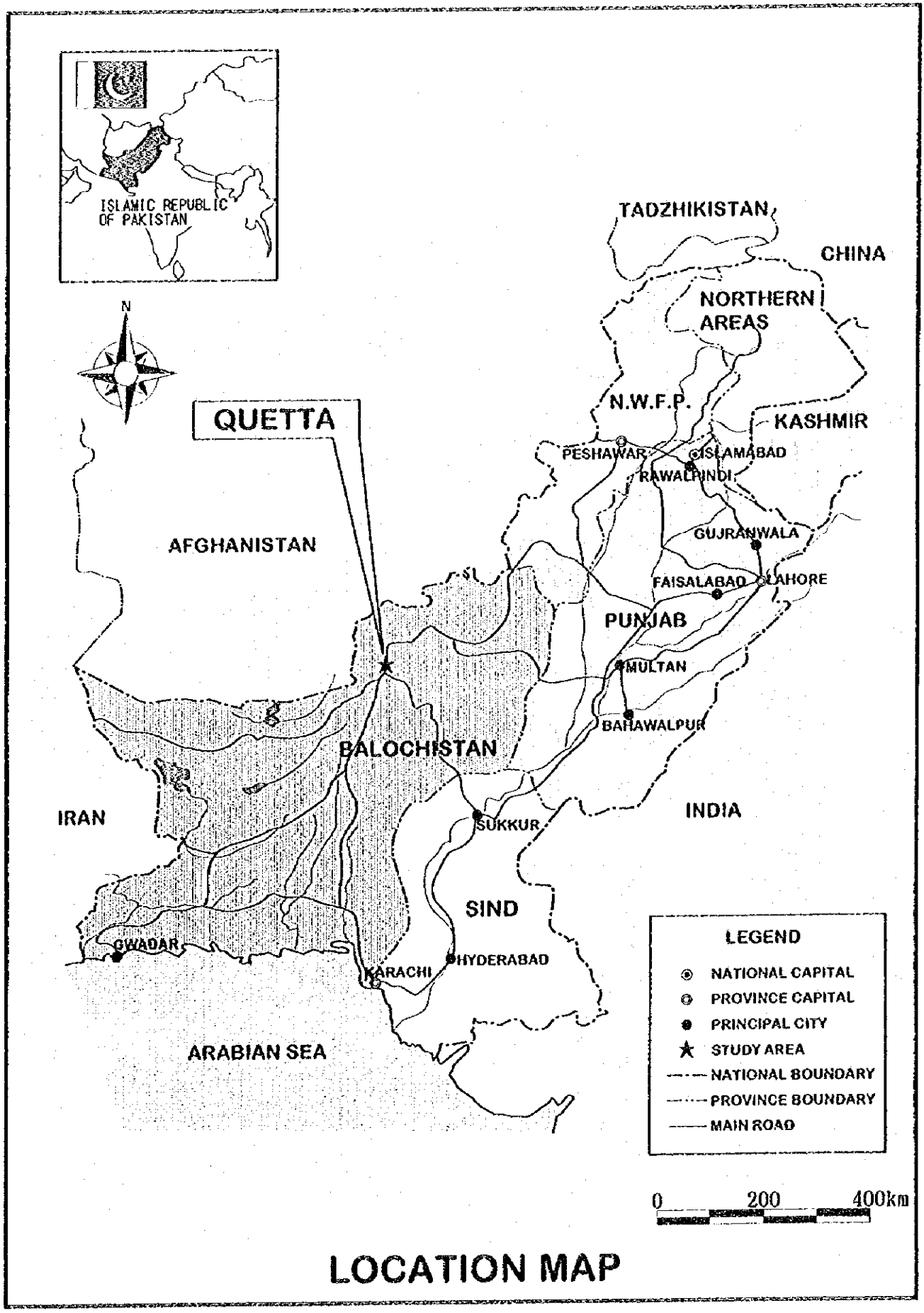
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

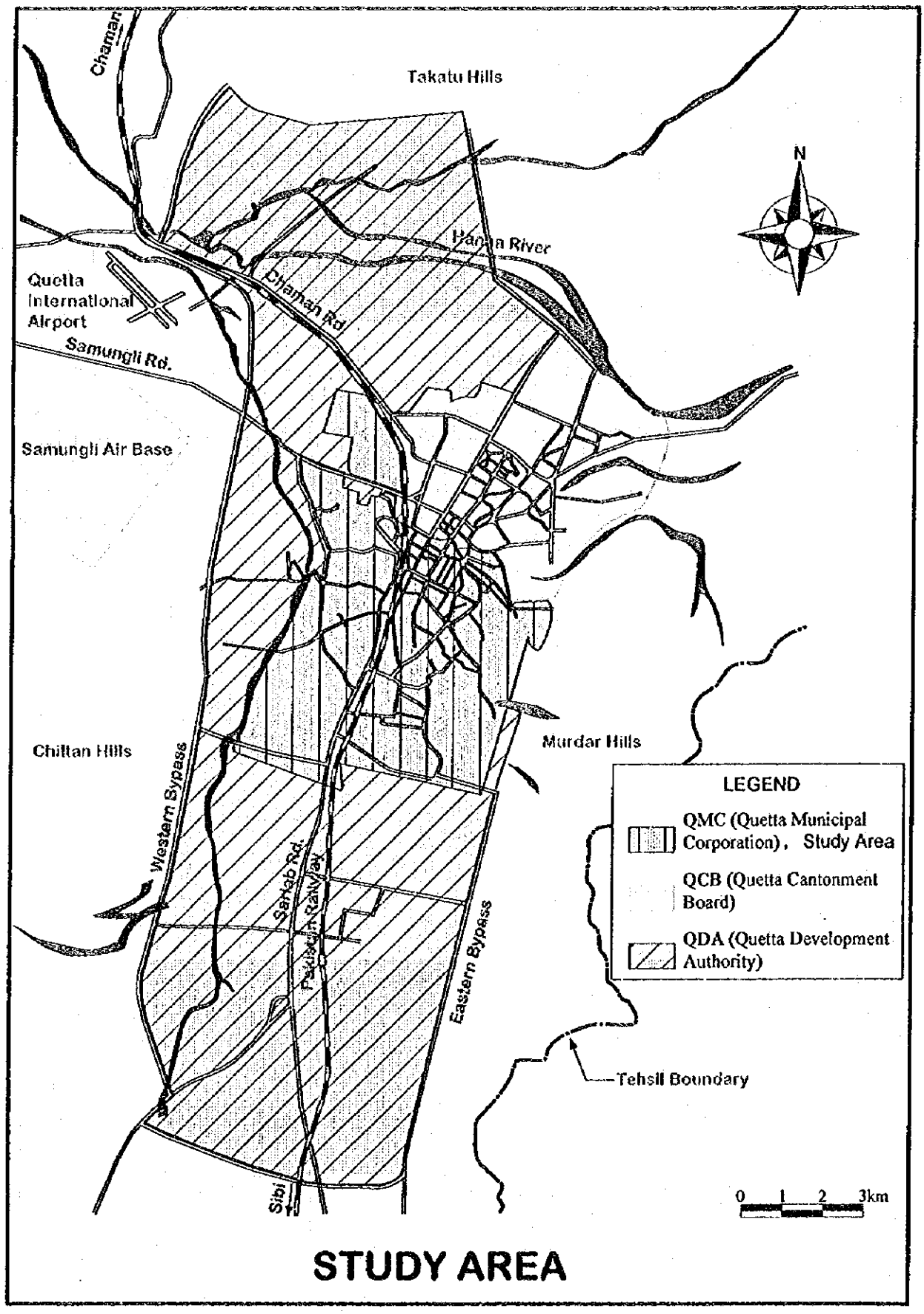
Takao Yoshida
Project Manager
Basic Design Study Team
on the Garbage Collection and
Disposal Project for the Improvement
of Environmental Conditions in
Quetta, Pakistan
CTI Engineering Co., Ltd.



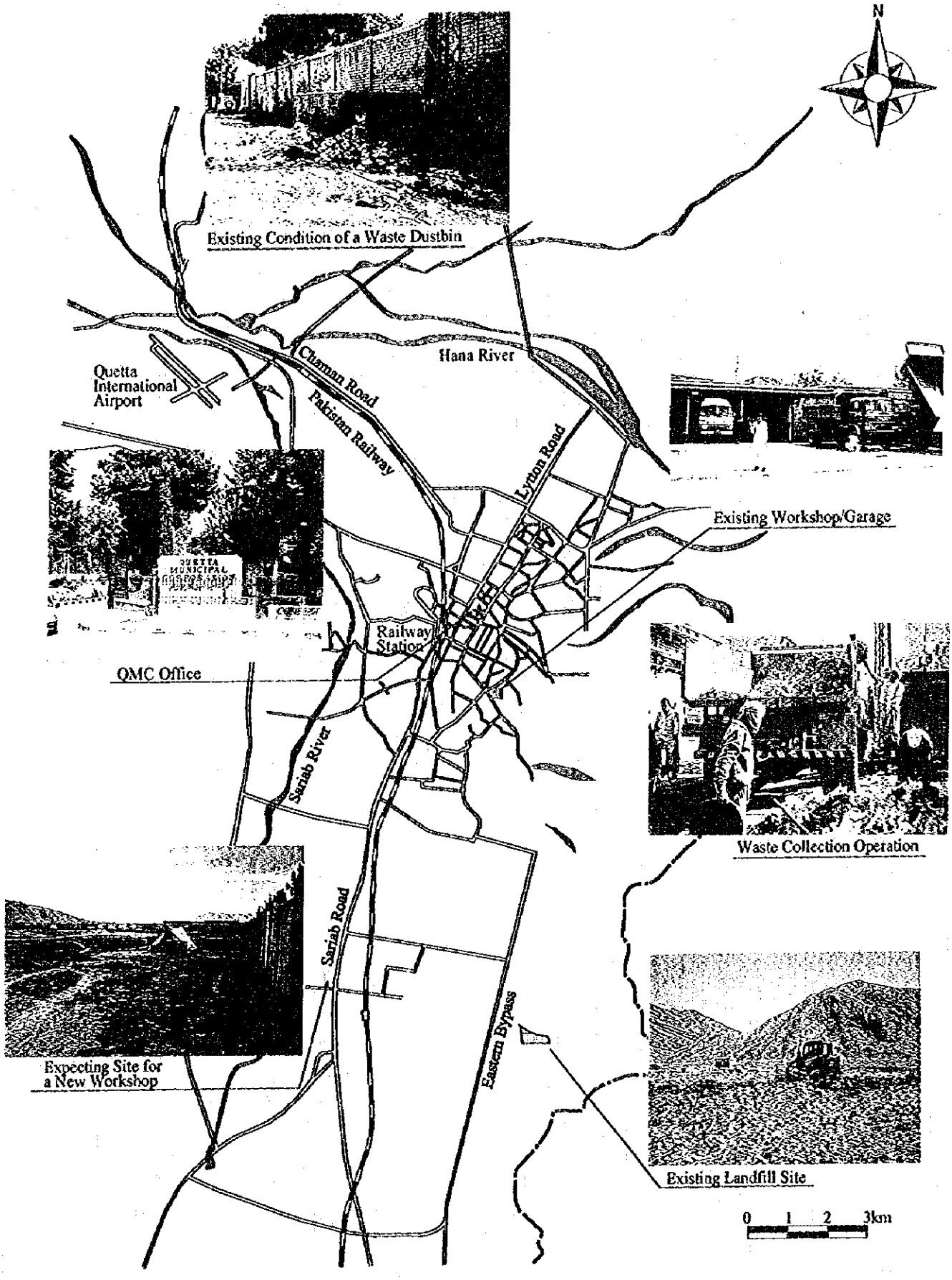
LOCATION MAP



LOCATION MAP


Chaman
Takatu Hills
N
Hanna River
Quetta International Airport
Dhanah Rd
Samungli Rd.
Samungli Air Base
Chiltan Hills
Murdar Hills
Western Bypass
Sariab Rd.
Pakistan Railway
Eastern Bypass
Sibi
LEGEND
QMC (Quetta Municipal Corporation), Study Area
QCB (Quetta Cantonment Board)
QDA (Quetta Development Authority)
Tehsil Boundary
0 1 2 3km

STUDY AREA



Existing Conditions of Solid Waste Management in QMC

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

CIDA	Canadian Intenational Development Agency
E/N	Exchange of Notes
GDP	Gross Domestic Product
JICA	Japan International Cooperation Agency
NCS	National Conservation Strategy
NEQS	National Environmental Quality Standards
SWM	Solid Waste Management
UNICEF	United Nations Children's Fund
PEP	Pakistan Environment Program
PEPA	Pakistan Environmental Protection Act
PEPC	Pakistan Environmental Protection Council
PEPO	Pakistan Environmental Protection Ordinance
QMC	Quetta Municipal Corporation
QCB	Quetta Cantonment Board
QDA	Quetta Development Authority
QWSP	Quetta Water Suppy Project
WASA	Water and Sanitation Agency

CHAPTER 1 BACKGROUND OF THE PROJECT

CHAPTER 1

BACKGROUND OF THE PROJECT

The Islamic Republic of Pakistan is located in Southwest Asia, bordered by Iran and Afghanistan to the West, India to the East and the Arabian Sea to the South. Its total land area is about 796,000 km^2 and its population is 131,630,000 as estimated by the Government of the Islamic Republic of Pakistan in January 1996.

The economic condition of Pakistan had improved steadily from 1989 to 1992. In particular, the annual GDP (Gross Domestic Product) growth rate was recorded at 6.4% in fiscal year 1991-92; however, it decreased to 2.3% in 1992-93 due to the big floods, deterioration of international cotton markets and depression of export business.

The consumer price increase rate was also continuously going up from 9.3% in 1992 and 11.2% to 13.0% in 1993. The Government of the Islamic Republic of Pakistan has adopted several policies such as liberalization of the economy and deregulation to find a way out of such economic difficulties, and has carried out economic structural adjustments to regain the economy. A huge amount of external assets and defense budgets hinders the Government from rebuilding the economy.

In the Eighth Five-Year Plan (the national development plan of Pakistan) and the National Conservation Strategy (NCS, Pakistan's environmental action program), one of the priority issues is the protection of the environment. As mentioned in the national development plan and the environmental action program, however, Pakistan has recently been faced with a variety of environmental problems such as deforestration, soil erosion, desertification, water and air pollution, and deterioration of urban environment.

The nation's progressive pace of urbanization including the rising number of population has lead to major problems in solid waste management in major cities. Only around a half of the 48,000 tons/day of solid waste generated throughout the country is collected and disposed and the rest is dumped on roads and open spaces. This improper collection and disposal of solid wastes create a nuisance or hazards to public health and safety such as the breeding of rats and insects and the contamination of groundwater.

To find a solution to these environmental problems, the Government of the Islamic Republic of Pakistan enacted the Pakistan Environmental Protection Ordinance (PEPO) in 1983, the

above-mentioned NCS in 1992, and the National Environmental Quality Standards (NSQS) in 1993. The Government also drafted the Pakistan Environmental Protection Act (PEPA) in 1995. Simultaneously, the Environmental Protection Agency (EPA) and the Ministry of Environment, Urban Affairs, Forestry and Wildlife were established in 1987 and 1990, respectively, to function as implementing and supervisory organizations for enviromental issues.

The City of Quetta is the capital of Balochistan Province. The present population of the city is about 730,000 persons and is growing at a rate of 7% per annum. As a result of this increase in population including the Afghan refugee immigrants, the generation rate of solid waste which is now about 480 tons/day, is concurrently increasing. The present capacity of refuse collection and disposal cannot cope with this situation, which results in a large volume of waste being left uncollected or dumped along streets, side ditches and other areas inside the city.

The Master Plan formulated in 1990 for the Quetta Region, which partially influences the scope of this present Project, is in the process of establishing specific measures for the improvement of the urban environment and sanitary conditions in the city. The concerned authority of the City of Quetta, the Quetta Municipal Corporation (QMC), has drafted the basic Solid Waste Management (SWM) policy of the city based on the above Master Plan. Due to fiscal constraints, however, the municipal authority has serious difficulties in allocating the city's scarce budgetary resources for the procurement of new equipment and materials to replace or replenish the aging and insufficient equipment and materials currently owned by the city. This has led the Government of the Islamic Republic of Pakistan to approach the Government of Japan with a request to provide the necessary equipment and materials to permit the implementation of the basic municipal plan.

CHAPTER 2 CONTENTS OF THE PROJECT

CHAPTER 2

CONTENTS OF THE PROJECT

2-1 Objective of the Project

The objective of this Project is to assist in the improvement of the urban environment and sanitary conditions through the procurement of necessary equipment and materials for the implementation of the City's solid waste management program based on the official request made by the Government of the Islamic Republic of Pakistan to the Government of Japan.

2-2 Basic Concept of the Project

2-2-1 Confirmation of the Nature of the Request

The details of the request has been modified, as shown in Table 2-1, based on the Solid Waste Management (SWM) program established by the QMC.

The SWM program of the QMC is based on the assumption that wastes are to be collected in containers and transported by dump trucks. This mode of operation has been selected in accordance with an independent study conducted by the municipal authorities on the quantity of wastes. In parts of the city with narrow roads where the installallation of containers is not possible, the program has proposed a collection and transportation system involving the use of small compactor vehicles. For the landfill site that are currently in service as open dumping grounds, however, the program has envisioned a change to a system of sanitary land reclamation with proper servicing measures such as covering with topsoil.

The QMC has made a request for the necessary equipment based on these basic plans. For the maintenance and management of the equipment, the QMC has made provisions for the construction of a new vehicle parking area that should also function as a maintenance workshop. The land for the construction of parking area has already been acquired and the plans, including the layout drawings, have already been completed. For the efficient upkeep and maintenance of the equipment, however, the QMC will require the necessary tools and spare parts, and an additional request for these has been submitted by the QMC.

Table 2-1 Modified Request

Utilization	Initial Request (Dec. 28, 1994)		Modified Request Confirmed by Basic Design Study Team	
	Name of Equipment	Quantity	Name of Equipment	Quantity
Collection/ Transportation	Container trucks with detachable containers	60	Container trucks ($7m^3$)	36
	Dump trucks	20	Detachable containers ($7m^3$) (for above vehicles)	180
			Compaction-type collection vehicles ($6m^3$)	27
Disposal	Wheel loaders	4	Wheel loaders	3
	Water tank vehicles	6	Wheel dozers	2
			Excavators	2
			Water sprinkler vehicles	5
Others			Workshop tools	1 Set
			Spare parts	5%

2-2-2 Basic Considerations for the Project

The government and implementation authorities of both countries concerned have engaged in mutual consultations, and a field survey has been conducted. As a result, the following basic considerations have emerged:

(1) The present Project shall include household, office, business and shop wastes, excluding hospital and industrial wastes.

(2) The QMC has already established a detailed SWM plan and is determined on promoting its sanitation and cleansing activities. In essence, therefore, the aim of this Project is to confirm and examine the program through a field survey and analysis to make the program more suitable to the local conditions.

(3) The whole SWM program of the QMC covers a population of 814,000 estimated to be residents in the jurisdictional area of QMC as of 1996. The total amount of waste generated by this population in a day is 540 tons, including 10 tons of solid waste discharged through the drainage system. This waste volume will therefore need collecting, transporting and disposal, so that the appropriate equipment for the collection, transportation and disposal will need to be procured. The SWM program

envisions the concurrent use of collection and transportation vehicles to be procured under this Project and the dump trucks which have already been in waste collection service by the QMC for a duration still within their service life.

As a result of the field survey and analysis it has been established that in view of the above the Project would essentially increase the rate of waste collection from its present level of only 35% to 76% through the equipment procured under this Project. The remaining 24% would be met with the equipment that is currently in service. The following basic factors have been identified as the Project scope in the field survey and analysis. The population covered by the Project, in particular, is estimated at 729,000 instead of 814,000.

Table 2-2 Basic Factors of the Project

(1) Solid wastes covered by the Project	Household, office, business and shop solid wastes
(2) Target population	729,000 inhabitants
(3) Amount of waste generated	480 t/day
(a) Household solid wastes	365 t/day
(b) Commercial solid wastes	71 t/day
(c) Solid wastes from government offices	11 t/day
(d) Solid wastes from road cleansing	30 t/day
(e) Solid wastes from drainage ditch cleaning	3 t/day
(4) Bulk density of solid waste	0.615 t/m^3
(5) Amount of solid waste collection and disposal	480 t/day
(6) Planned solid waste collection rate	100%
(7) Solid waste collection rate achieved with the Project equipment	76%
(8) Solid waste collection rate covered with the existing equipment	24%
(9) Landfill site	Use of existing landfill site is to continue after improvement.

2-2-3 Relevance of Request Contents

(1) Waste Collection and Transportation Plan

The collection and transportation plan under the SWM program of QMC aims to eliminate the unauthorized, illegal dumping of wastes as well as the problem of waste residues left after waste collection, to improve the efficiency of waste loading work,

and to improve the sanitary conditions for municipal waste collection and transportation workers. For this reason, the QMC has made a request for detachable containers and container trucks, as well as waste compaction-type vehicles, to permit the transition from the present concrete waste dumping sites or pits (locally called as dust bins) and open roadside dumping areas to a system including the concurrent use of containers and compactors.

Under the Project, the existing concrete waste dumping pits are to be replaced by containers to the maximum possible extent. To overcome the problem of unauthorized, illegal dumping of wastes as a result of the inadequacy of dumping pits, consideration is to be given to the required number of containers to be installed in an organized manner. The use of compactor vehicles is intended for areas with narrow roads which make the access of container trucks difficult.

The field survey and analysis has produced the following results.

The concrete waste dumping pits that are currently in use give rise to waste dispersion in the neighborhood of the pit sites because of the uneven use of the dumping area as mountains of wastes accumulate at the pit entrance but no waste is thrown to the back of the pit. They also lead to the problem of waste leachate formation. Since the pits are provided only in a few locations the current situation is that wastes are thrown away on empty land and on roads, especially narrow city roads. This is not only an eyesore detracting from the appearance of the city but also causes a serious deterioration of the sanitary environment for inhabitants of the city. It is therefore reasonable and relevant to employ a container system to eliminate the present waste dumping pits to the greatest possible extent. Detailed examination of the container installation plan under the QMC's SWM has led to the conclusion that with reference to the installation positions for containers it would be appropriate to install the containers in the present waste pit location and, in addition, to install containers in new sites which are currently blackspots for the unauthorized, illegal dumping of wastes.

Since the city also has a large number of narrow streets that are inaccessible to container trucks, consideration has also been given to the introduction of compactor vehicles. A quantitative study of the components of the wastes collected by the present waste collection vehicles was conducted in the field survey and the results have shown that a considerable amount of sand is present in the household wastes on the present waste pit. This is believed to be due to the fact that the broom brushes of road

sweepers will collect waste as they sweep the roads. Due to the presence of sand, however, it will not be possible to achieve a high compaction effect with the use of compaction-type vehicles. Additionally, as the roads become narrower their surfaces become increasingly more uneven. Due to these bumps and dents in the road the compactor vehicles will jolt so badly that their rear portion with the waste inlet opening will make contact with the road. This, it is feared, might cause the vehicles to break down. For this reason it is felt that an open dump truck would be more relevant than a compactor vehicle.

The SWM program, however, does provide for the need of cleaning the concrete waste collection pits after the waste has been collected from them (that is, the existing collecting pits where it will be difficult to install containers). The program also provides for the need to introduce sprinkler cars in the collection and transportation of wastes because the plan does not allow for the cleaning of containers at the landfill.

The concurrent use of the container system and the collection system using the existing waste collecting pits requires from the general public as the generator of waste an awareness that waste should be put out only at the specified places and at specified times. To inculcate this awareness, it will be necessary to educate the public and to conduct PR campaigns on when and where to put out wastes. Education will also be required for the sweeper personnel who are employed by the Sanitation Section of QMC.

(2) Waste Disposal Plan

Under the SWM waste disposal plan established by the QMC, the 64-acre open dumping type landfill site presently owned by the QMC at approximately 10 km south of the center of the city is to continue in use after improvements to upgrade the sanitation facilities. The equipment that has been requested for use at this site comprises wheel dozers, wheel loaders, excavators and sprinkler vehicles.

The field survey and analysis has demonstrated that the waste quantity capable of being accommodated on the landfill site is limited because of the current disposal system. It has also been shown that the landfill site already has a negative effect on the environment due to the airborne dissemination of wastes to the surrounding locations. The improvement of the site to achieve a sanitary landfill system with a clearly demarcated zone for waste disposal is therefore considered a minimum requirement

also in view of the plans that already exist for the construction of a school in the vicinity of the landfill site.

The equipment considered appropriate for the landfill site by allowing for the most important factors for the waste compaction, topsoil excavation and covering work as the main operational factors at the landfill site are therefore large bulldozers rather than wheeldozers.

(3) Operation and Maintenance/Management Plan

The workshop site currently owned by the QMC is too small, and tools and repair equipment are totally inadequate to repair and service the vehicle fleet. For this reason, the operation and maintenance/management plans of the QMC's SWM envisions the construction of the main facilities in a new workshop site (approximately 12 ha) in the close vicinity of the landfill site that has already been secured. In the interest of greater efficiency in vehicle maintenance and management, the request also includes for procurement of the tools and equipment (including spare parts) to be used in the new workshop.

The results of the field survey and analysis have demonstrated that the new workshop site is an ideal location as it is close to the landfill site (roughly 8 km), has a sufficiently large area, and is adjacent to a main trunk road. The tools and equipment requested for the workshop are considered appropriate for assuring smooth operation, maintenance and management of the waste collection and transportation vehicles after they have been procured.

In addition to the above, the operation, maintenance and management cost schedule should be arranged if the SWM prepared by the QMC envisages the levy of a new sanitation tax to be imposed on each household. This tax burden will come in addition to the 1.0 million rupees waste treatment costs a year charged to commercial premises such as shops under the existing system.

There are precedents in many other cities of Pakistan which have also levied a sanitation tax in connection with their moves to introduce a new waste collection and disposal system. It may therefore be assumed that the introduction of the new tax in Quetta will not meet with any serious problems, and it is also considered a fair assessment to estimate that the tax will be collected at a rate of 40% (similar to the water tax). If the new tax is fixed at an amount of Rs.15 per month per household, the

revenue from this tax will cover only 0.5 to 0.75% of the average monthly pay of sweepers and drivers in the employ of the Sanitation Section of QMC which is 2,000 to 3,000 rupees (including overtime work). The amount can thus be considered appropriate because it would permit the allocation of operating and maintenance/management costs of the equipment to be introduced.

2-3 Basic Design

2-3-1 Comparison of Project Details with Alternative Plans

The basic concept of the Project outlined above has in essence been established on the basis of the Solid Waste Management (SWM) program drawn up by the city authorities of Quetta (the QMC). Apart from this, a number of other plans that are not based on the SWM have been proposed. The following five alternatives will be scrutinized for comparative evaluation to assess the relevance of the previously outlined basic concept and to establish the general policy in pursuing the basic design.

(1) Alternative A: Plan envisaging the renewal of existing vehicle fleet alone

The 22 waste collecting vehicles currently owned by the QMC includes 12 dump trucks (9t capacity) that are still within their normal service life, and the plan is to let them continue in service while the remaining 10 vehicles should be replaced by new dump trucks (9t) of the same specifications as the existing ones. Waste collection should take place in the present form from the existing waste dumping pits. No particular provision is made for the disposal of waste.

(2) Alternative B-1: Container System and Dump Trucks, with 100% waste collection rate

This plan essentially conforms to the QMC's SWM in that it envisions the abolition of the existing waste dumping pits to the greatest possible extent and their replacement by a container system. The waste collection and transportation needs that cannot be met by the container system should be covered by the use of the 12 (9t) dump trucks that are owned by the QMC and still within their normal service life and by the introduction of new medium (4t) dump trucks to be used mainly for city areas with narrow roads. The plan also provides for the use of sprinkler vehicles for road sprinkling and for cleaning the remaining waste after collection in waste dumping pits. For the disposal, the plan

intends to change the present open-dumping system to a sanitary landfill system. The scheduled waste collection rate will be 100%. The scheduled waste collection rate means the ratio of the amount of waste collected through waste collection works to the calculated amount of waste generated.

(3) Alternative B-2: Container System and Dump Trucks, with 80% waste collection rate

This plan is similar in content to Alternative B-1, except that the scheduled waste collection rate is only 80%. For the disposal, the plan intends to change the present open-dumping system to a sanitary landfill system.

(4) Alternative C: Container System and Compactor Vehicles

This alternative is similar in content to Alternative B-1, except that compactor vehicles (6 m^3 capacity) should be used instead of the medium dump trucks for the City's narrow roads. For the disposal, the plan intends to change the present open-dumping system to a sanitary landfill system.

(5) Alternative D: Dump Trucks

The plan calls for an increase in the number of concrete waste dumping pits similar to the existing ones and proposes to collect and transport the City's wastes by using the 12 (9t capacity) trucks that are owned by the QMC and still within their service life and by introducing dump trucks of the same standards and medium (4t capacity) dump trucks mainly for city areas with narrow roads. The plan also provides for the use of sprinkler vehicles for road sprinkling and for cleaning the remaining waste after collection in waste dumping pits. For the disposal, the plan intends to change the present open-dumping system to a sanitary landfill system.

Close examination of these five alternatives makes it clear that each has certain advantages and disadvantages. Table 2-3 has been prepared by making rough calculation of the operational costs associated with each project component and gives the results of comparisons of these alternatives by considering the annual balance of costs and revenues, taking into account the operating and maintenance/management costs.

These comparisons demonstrate that the optimum plan is Alternative B-1. This alternative is based on the QMC's SWM and is capable of assuring an improvement in the environment of the city as a whole.

Table 2-3 COMPARISONS OF THE PROJECT DETAILS WITH ALTERNATIVE PLANS

Alternative Plan / Item	Alternative-A: Renewal of the existing vehicles alone	Alternative-B: Container system + Dump trucks		Alternative-C: Container system + compaction-type collection vehicles	Alternative-D: Dump trucks only
		B-1 (Scheduled collection rate; 100%)	B-2 (Scheduled collection rate; 80%)		
Design Concept	**Collection/transportation:** In 22 collection/transportation vehicles owned by QMC, 12 operational dump trucks (payload: 9t) will still be used for the work. Remaining 10 dump trucks will be replaced by new dump trucks (payload: 9t) of the same specifications as the existing ones. These trucks will collect waste from the existing dust bins. **Final Disposal:** No particular provision is made for the disposal of waste.	**Collection/transportation:** The existing dust bins will be demolished to the greatest possible extent and replaced by a container system. Additionally, the existing 12 operational dump trucks (9t) owned by QMC and new medium (4t) dump trucks which are mainly used for the city areas with narrow roads will cover waste collection and transportation needs. Water sprinklers will also be used for road sprinkling and for cleaning remaining wastes after collection in the dust bins. The scheduled collection rate will be 100%. **Final Disposal:** The present open-dumping system will be changed to a sanitary landfill system.	**Collection/transportation:** This plan is similar in content to Alternative B-1 except that the scheduled waste collection rate is only 80%. **Final Disposal:** Same as Alternative B-1.	**Collection/transportation:** This plan is also similar in content to Alternative B-1 except that compaction-type collection vehicles (6 m^3 capacity) will be used instead of the medium dump trucks for the city's narrow roads. The scheduled waste collection rate will be 100% **Final Disposal:** Same as Alternative B-1.	**Collection/transportation:** The number of dust bins similar to the existing ones will be increased, and new dump trucks of the same specifications as the existing 12 operational dump trucks (payload:9t) owned by QMC and new medium (4t) dump trucks which are mainly used for the city's narrow roads will be additionally introduced. Water sprinklers will also be used for road sprinkling and for cleaning the remaining wastes after collection in dust bins. The scheduled collection rate will be 100%. **Final Disposal:** Same as Alternative B-1.
Project Components (Number of vehicles/Equipment)	**Collection/transportation:** 1. Existing dump truck (9t): 12 2. New dump trucks (9t): 10 **Final Disposal:** Not applicable (N/A). **Others:** 1. Workshop tools 2. Spare parts (8%)	**Collection/transportation:** 1. Detachable container truck (7m^3): 37 2. Container (7m^3): 208 3. Existing dump truck (9t): 10 4. New dump truck (4t): 10 5. Water sprinkler: 2 **Final Disposal:** 1. Wheel loader: 1 2. Bulldozer: 3 3. Excavator: 1 4. Existing dump truck (9t): 2 5. Water sprinkler: 2 **Others:** 1. Workshop tools 2. Spare parts (8%)	**Collection/transportation:** 1. Detachable container truck (7m^3): 34 2. Container (7m^3): 191 3. Existing dump truck (9t): 10 4. Water sprinkler: 2 **Final Disposal:** 1. Wheel loader: 1 2. Bulldozer: 3 3. Excavator: 1 4. Existing dump truck (9t): 2 5. Water sprinkler: 2 **Others:** 1. Workshop tools 2. Spare parts (8%)	**Collection/transportation:** 1. Detachable container truck (7m^3): 37 2. Container (7m^3): 208 3. Existing dump truck (9t): 10 4. Compaction-type collection vehicle (6m^3): 15 5. Water sprinkler: 2 **Final Disposal:** 1. Wheel loader: 1 2. Bulldozer: 3 3. Excavator: 1 4. Existing dump truck (9t): 2 5. Water sprinkler: 2 **Others:** 1. Workshop tools 2. Spare parts (8%)	**Collection/transportation:** 1. Existing dump truck (9t): 10 2. New dump truck (9t): 36 3. New dump truck (4t): 10 4. Water sprinkler: 5 **Final Disposal:** 1. Wheel loader: 1 2. Bulldozer: 3 3. Excavator: 1 4. Existing dump truck (9t): 2 5. Water sprinkler: 2 **Others:** 1. Workshop tools 2. Spare parts (8%)
Advantages of the Plan	-No additional operation, maintenance, and management costs are made.	-The introduction of container system can eliminate illegal dumping and problems of residues left after waste collection and improve the efficiency of collection/transportation work. -Medium dump trucks can collect waste from the city's narrow roads. -The sanitary landfill system can increase as the amount of waste disposed of on the landfill site grows and alleviate negative environmental impacts to the surrounding areas.	-The introduction of container system can eliminate illegal dumping and problems of residues left after waste collection and improve the efficiency of collection/transportation work. -The sanitary landfill system can increase as the amount of waste disposed of on the landfill site grows and alleviate negative environmental impacts to the surrounding areas.	-The introduction of container system can eliminate illegal dumping and problems of residues left after waste collection and improve the efficiency of collection/transportation work. -Medium dump trucks can collect waste from the city's narrow roads. -The sanitary landfill system can increase as the amount of waste disposed of on the landfill site grows and alleviate negative environmental impacts to the surrounding areas.	-The introduction of new dump trucks similar to the existing ones does not cause technical problems from the vehicle's repair and maintenance points of view. -The sanitary landfill system can increase as the amount of waste disposed of on the landfill site grows and alleviate negative environmental impacts to the surrounding areas.
Disadvantages of the Plan	-Although the introduction of new dump trucks instead of the existing dump trucks makes the waste collection rate increase from 35% to 40 to 50%, this plan does not contribute to improve environmental conditions of the city.	-Operation, maintenance and management costs for the planned vehicles/equipment require introduction of a new sanitation tax.	-It is impossible for planned collection vehicles to collect waste from the city's narrow roads. -Operation, maintenance and management costs for the planned vehicles/equipment require introduction of a new sanitation tax.	-Due to the presence of sand, it will not be possible to achieve a high compaction effect with the use of compaction-type vehicles. -Bumps and dents on the roads might cause the compaction-type vehicles to break down. -Operation, maintenance and management costs for the planned vehicles/equipment require introduction of a new sanitation tax.	-Remaining dust bins result in an obstacle to make waste collection/transportation work more effective and to improve working conditions of sweepers and loaders. -Operation, maintenance and management costs for the planned vehicles/equipment require introduction of a new sanitation tax.
Balance of Costs and Revenues for O&M (in Rs. million)	-Costs (O&M costs only) : 3 -Revenue (QMC budget) : 3	-Costs (Labor costs) : 2.32 (O&M costs) : 8 Total: 10.32 -Revenue (QMC budget) : 3 (Sanitation tax) : 7.56 Total: 10.56 Tax collection rate:40%, Tax:Rs.15/house/month	-Costs (Labor costs) : 1.92 (O&M costs) : 7.03 Total: 8.95 -Revenues (QMC budget) : 3 (Sanitation tax) : 6.05 Total: 9.05 Tax collection rate:40%, Tax:Rs.12/house/month	-Costs (Labor costs) : 2.63 (O&M costs) : 8.46 Total: 11.09 -Revenues (QMC budget) : 3 (Sanitation tax) : 8.57 Total: 11.57 Tax collection rate:40%, Tax:Rs.17/house/month	-Costs (Labor costs) : 2.32 (O&M costs) : 7.09 Total: 9.41 -Revenues (QMC budget) : 3 (Sanitation tax) : 6.55 Total: 9.55 Tax collection rate:40%, Tax:Rs.13/house/month
Rough Project Costs (in Japanese yen) (without consultant fee)	-Collection/Transportation : 60 million -Final disposal : N/A -Others : 10 million **Total : 70 million**	-Collection/Transportation : 460 million -Final disposal : 120 million -Others : 60 million **Total : 640 million**	-Collection/Transportation : 370 million -Final disposal : 120 million -Others : 50 million **Total : 540 million**	-Collection/Transportation : 540 million -Final disposal : 120 million -Others : 70 million **Total : 730 million**	-Collection/Transportation : 540 million -Final disposal : 120 million -Others : 70 million **Total : 730 million**
Evaluation	No improvement for environmental conditions of the city can be made although there is no difficulty of budget allocation in terms of operation, maintenance and management costs for collection vehicles ✕	This plan is based on the QMC's SWM and is capable of assuring an improvement in the environment of the city as a whole. ○	It is impossible for planned collection vehicles to collect waste from the city's narrow roads. Improvement of the city's environment thus cannot be achieved. △	The introduction of compaction-type collection vehicles is not necessarily effective for collecting and transporting waste in the Project area. △	This plan has the highest project costs among the alternatives. Remaining dust bins are still constraints for enhancing labor efficiency and working conditions. △

2-3-2 Design Policy

In view of the comparative evaluation results above, the following basic design policy should be adopted.

(1) Waste Collection and Transportation Plan

(a) The present concrete waste dumping pits should be replaced by a container system.

(b) Container trucks with detachable containers should be used.

(c) For areas that are inaccessible to container trucks, open dump trucks should be used.

(d) Sprinkler vehicles should be used for road sprinkling and for cleaning the remaining waste after collection in dumping pits.

(2) Waste Disposal Plan

(a) The present open-dumping system should be changed to a sanitary landfill system.

(b) Bulldozers should be used for waste compaction and topsoil leveling and wheeldozers for topsoil piling.

(c) Excavators should be used for a variety of tasks, including the leveling of piles of waste, the movement of waste on a large scale, for finishing topsoil banks, and for trenching of drainage on the landfill site.

(3) Operation, Maintenance and Management Plan

(a) New equipment and materials (including tools and spare parts) should be introduced to meet new waste collection, transportation and disposal programs and to improve the maintenance and management capabilities.

(b) The fullest consideration should be given to the sharing of maintenance and management cost burden incurred by the QMC in connection with the procurement of the equipment and materials.

2-3-3 Basic Plan

(1) Waste Collection and Transportation Plan

(a) Container Arrangement

The results of the field survey and analysis have revealed that there are 109 concrete waste dumping pits (locally called as dust bins) in the city and some of these dumping sites cannot be containerized because they either lack the space for installing containers or are inaccessible to container vehicles. There are also many locations in the city without waste collecting sites so that waste is thrown away on the roads or in open derelict spaces.

Since the installation of containers is a key principle of the SWM program established by the QMC, site investigation have been conducted to check in each of the scheduled container installation sites whether there is space for accommodating the container, whether the road is sufficiently wide for container vehicle access and what the present situation is in terms of waste dumping and collection. The results are presented in Table 2-4, and it can be seen that 95 out of the total of 109 dust bin sites is amenable to containerization. In addition, plans have been made to install containers in another 103 new sites. The containers to be installed have also been classified into three groups as to how often, that is, at what intervals, waste needs to be collected to meet the volume of waste dumping. The high-use containers are collected everyday, the medium-use containers every other day, and the low-use containers once in every four days. Fig. 2-1 shows the container siting plan based on the results of the present study.

Table 2-4 Container Installation Plan based on the SWM Program by QMC and the Results of Field Survey/Analysis

Item	QMC's SWM	Result of Field Survey/Analysis
Remaining number of existing dust bins	27	14
Number of existing dust bins for containerization	86	95
Number of sites for new container installation	94	103
Total number of containers to be installed	180	198
High-use container (collected everyday)	-	(40)
Medium-use container (collected every other day)	-	(80)
Low-use container (collected once every 4 days)	-	(78)

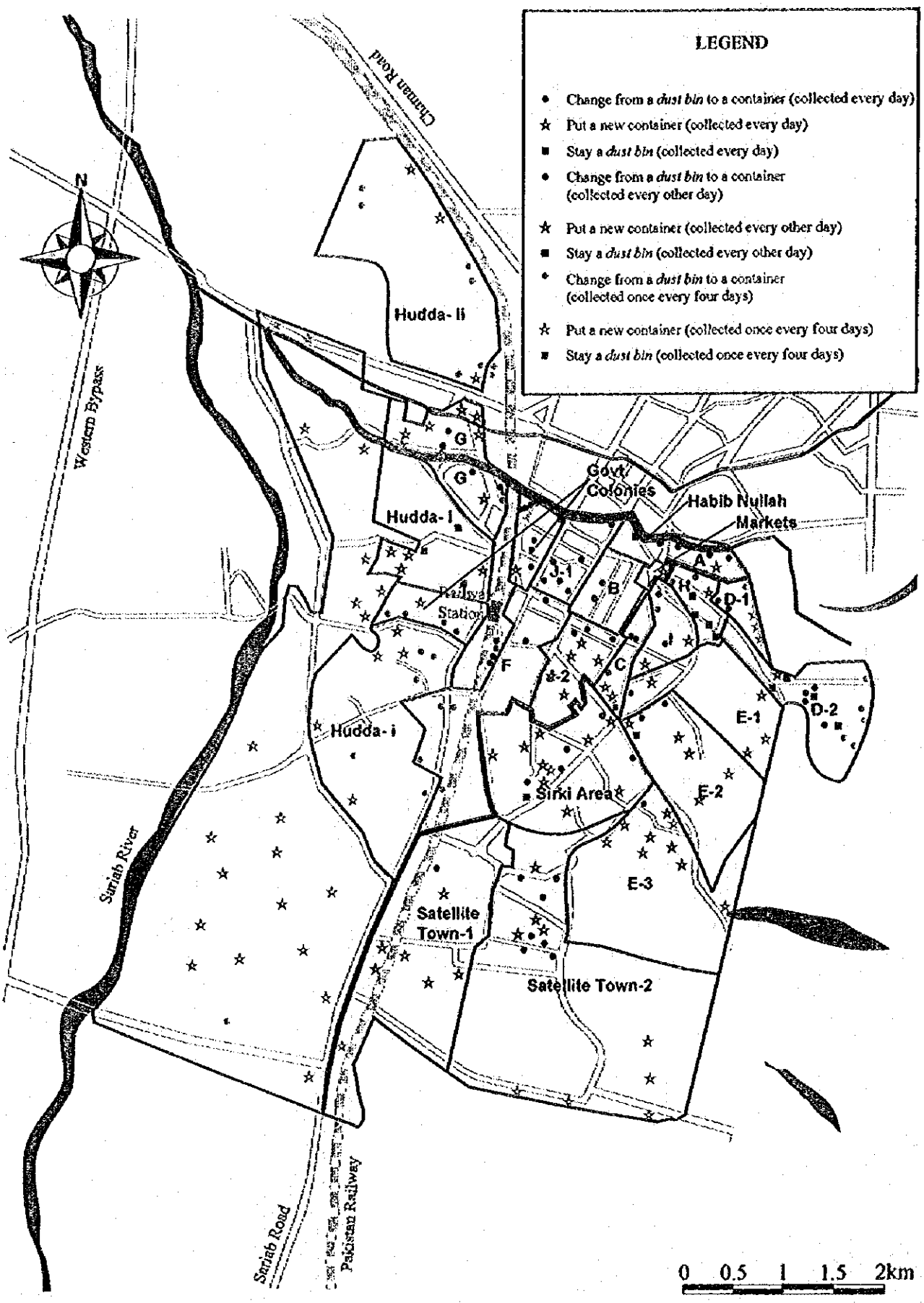


Fig.2-1 Container Installation Plan Based upon the Site Survey

(b) Vehicle Fleet Composition

Based on the design policy, the vehicle fleet for waste collection and transportation should have the composition described below. Essentially, waste collection and transportation will take place using containers and, for those parts of the waste collection and transportation service which cannot be met by containerization, the existing dump trucks should be used or new dump trucks introduced.

(i) Detachable-Container Trucks (4t)

These trucks collect the containers installed in waste dumping locations, including the existing dust bins, on roads or on vacant derelict plots. Detachable-container trucks with can be classified into two categories based on the release mechanism. These two types are the arm (or arm roll) type and the horizontally moving detachment type. The advantages and disadvandages of each type are as compared in Table 2-5.

From the comparison, it can be seen that although the arm type has a lower unit price than the horizontally moving detachment type, the field survey and analysis has shown that it would be difficult to load the container onto the truck with the arm type of release mechanism because the roads in the city are very bumpy. It has also been found that when the existing dust bins are replaced by containers it would be difficult to position the containers for easy loading onto the truck. For these reasons a horizontally moving detachment type should be selected. The trucks for detachable containers should be of 4-ton capacity (medium) type in view of the local road width and the spaces available for container installation.

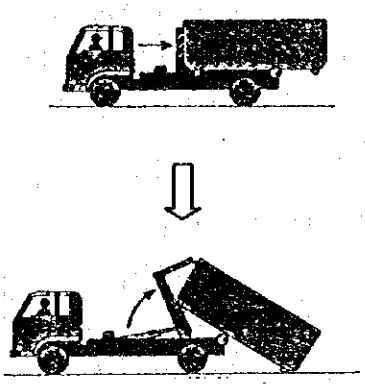
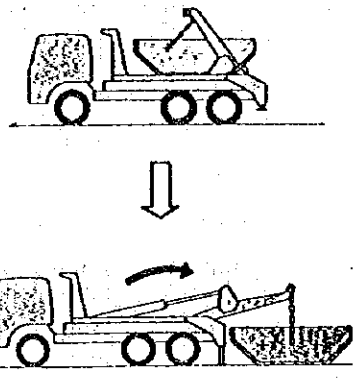
(ii) Existing Dump Trucks (9t)

The trucks remaining after deducting the number of trucks required for the collection and transportation of road and drainage ditch cleaning wastes and the transportation of topsoil from the landfill site should be used as at present.

(iii) New Dump Trucks (4t)

New dump trucks should be introduced for the collection and transportation of wastes that cannot be collected by Items (i) and (ii) (1) above. For these wastes, medium-type (4-ton) dump trucks should be used. These have a smaller vehicle length and width than the existing dump trucks (large type), so that they can negotiate the many narrow roads that are inaccessible to the existing dump trucks or unsuitable for the installation of containers.

Table 2-5 Comparison of Detachable-Container Trucks

Item	Arm (Arm Roll) Type	Horizontally Moving Type
General view		
Release mechanism	An hydraulically operated arm is placed on a hook provided in one location at the front of the container, and the arm pulls the container up onto the truck. The container is tilted at an angle when loaded on the vehicle.	A chain is applied to two (or four) points on the sides of the container which is loaded onto the truck by an hydraulically operated arm. The container is maintained in the horizontal position when loaded onto the vehicle.
Advantages	- Given the same truck chassis specification, the arm roll truck can take a container of larger capacity than the horizontal release type. - The shape of the container can be selected with a relatively greater degree of freedom.	- The container can be loaded onto the truck regardless of the surface condition of the road on which the container is positioned. - It is not necessary to align the truck position accurately with the container hook position. - The container is maintained in the horizontal position while being loaded onto the truck. This means that the container can be loaded without water spilling out from the container.
Disadvantages	- Since the edge of the container moves on the road surface while being loaded onto the truck, the truck cannot be used on bumpy road surfaces. - During the loading operation, it is necessary to position the truck accurately with the container position.	- Given the same truck chassis specifications, the container has a smaller capacity than the one for the arm roll type. - There are certain limitations on the shape of the container.
Rough Cost Estimate	0.7 each	1.0 each

Note: Rough cost estimate is based on standard specifications and shows the price of the arm roll type system as the proportion of the price of the horizontally moving container system which is taken as 1.

(iv) Water Sprinkler

Water sprinkler vehicles should be used for cleaning the remaining dust bins after waste collection and for sprinkling the road in extremely dry conditions when the roads are covered with a large amount of sand and soil.

(c) Determination of the Basic Conditions

To roughly estimate the required number of the above vehicles, the basic conditions have been fixed as follows:

(i) Operating Time

Inquiries were made to establish the standard working hours for the QMC. The findings are that the personnel working in the collection and transportation of wastes work an average of approximately 4.2 hours a day (excluding the midday break). This corresponds to the local work practices and it has been realized that it would be extremely difficult to change this, seeing that the QMC Labor Unions are very powerful.

(ii) Number of Collection/Transportation Trips

With the introduction of containerization, the working time required for collection would be significantly reduced from the present 1.5 ~ 2 hours to about 10 ~ 20 minutes per trip. Since the transportation time is largely dependent on road congestion conditions, it may be assumed that the time will not change from the present 1 ~ 1.5 hours. As a result, the tip time in case of containerization would be 1.2 ~ 1.8 hours. Since there are 4.2 working hours in a day, it would be possible to make 4.2 ÷ 1.2 ~ 1.8 = 3.5 ~ 2.3, or 3 trips a day on average. For the existing and new dump trucks, however, it would not be possible to achieve greater efficiency (time saving) for the collection work so that the number of trips possible in a day would be the same as the present 1.0 ~ 1.7, that is, 2 trips a day.

(iii) Container Capacity and Performance

In view of the width of local roads and the space available for container installation, the capacity per container should be 7 m^3. Assuming that 70%

of the total container capacity corresponds to the "full" condition during transportation, and given that the bulk density (unit volume-weight) of the waste as determined by site measurements is 0.615 t/m^3, it is possible to calculate the transportation performance per container as follows:

$$7 \times 0.70 \times 0.615 = 3t$$

(iv) Dump Truck Capacity and Performance

Site measurements have shown that the existing dump trucks have a load-carrying performance of 7t/each and the new dump trucks, a performance of 4t/each.

(v) Availability

In view of the need for repair in case of breakdowns and maintenance/management and in view of the breaktime for drivers, vehicles and containers could not be operated at 100% of their capacity all the time. Based on the study results of similar projects, the availability factor for vehicles and containers have been set as follows:

Vehicles	90%
Container	95%

(d) Calculation of the Required Quantities

(i) Detachable-Containers Trucks (4t)

Under the container installation program shown in Fig. 1-3, it will be necessary to provide the following container quantities if container collection and transportation is required on a daily basis.

40 (collected every day) × 80 × 1/2 (collected every other day) × 78 × 1/4 (collected once every four days) = 99.5; say 99

To transport these on a rota of three trips a day, it will be necessary to have:

99 ÷ 3 = 33 trucks

Assuming an availability factor of 90%, the quantity will be:

33 ÷ 0.90 = 37 trucks

The volume requiring collection and transportation per day by detachable-container trucks amounts to 99 × 3 = 297 t/day and corresponds to approximately 62% of the total waste volume generated.

(ii) Containers

Under the container installation program, a total of 198 containers are to be installed. If an availability factor of 95% is assumed, the number of containers required will be 198 × 0.95 = 208.

(iii) Existing Dump Trucks (9t)

Under the disposal program to be explained later, two of the existing dump trucks will be required to service the landfill site. In addition, 3 tons of wastes are recovered from the drainage ditches during the once--a-day cleaning session and need to be collected and transported. For this, 3 ÷ 7 = 0.4; in other words, 1 truck will be required. For the handling of the 30 tons of road cleaning waste generated in a day, it will be necessary, furthermore, to have 30 ÷ (7 × 2) = 2.1; thus, 2 trucks will be required. The combined total required for handling the drainage ditch and road cleaning waste will therefore be 3 trucks. The number of existing dump trucks which can be used for handling general wastes will therefore be (12 - 2 - 3) × 0.90 = 6 units (availability 90%). The amount of waste collected and transported with the existing dump trucks in a day thus totals 117 t/day, a quantity roughly equivalent to 24% of the entire waste volume generated. This total is broken down as follows: 6× 7 × 2 = 84 t/day of general wastes and 30 + 3 = 33 t/day of road and drainage ditch cleaning wastes.

(iv) New Dump Trucks

The plan is to use the new dump trucks to collect and transport wastes that cannot be handled by the above vehicles. This waste portion amounts to: 480 - 297 - 177 = 66t /day. Consequently, the number of trucks required to handle this amount is: 66 ÷ (4×2) = 8.3 trucks, in other words, 9 trucks.

Assuming that these trucks are operated at 90% availability, the number required will be 9 ÷ 0.90 = 10 trucks. The amount of waste collected and transported by these new trucks in a day will therefore be 66 t/day. This amount is equal to approximately 14% of the total amount of waste generated.

(v) Water Sprinkler

A total of two sprinkler vehicles will be required on the assumption that at least 6,000-liter capacity sprinkler vehicles are used to sprinkle water on both sides of the road covering a total road length of 100 km.

(1)	The duty stretch to be covered in a road	:	100 km × 2 sides ÷ 5 days = 40 km/day
(2)	Speed	:	10 km/hr
(3)	Sprinkling time per day	:	40/10 + 7 (travel and water-filling time) = 11 hours
(4)	*Dust-bin* cleaning locations per day	:	14 locations ÷ 5 days = 2.8; say, 3 locations
(5)	Cleaning time per day	:	3 × 0.25 + 2 (travel and water-filling time) = 2.75 hours
(6)	Total working hours	:	11 + 2.75 = 13.75 hours/day
(7)	Working time per day if 2 sprinkler vehicles are used	:	13.75 ÷ 2 sprinklers = 6.9 hours/day/sprinkler vehicle

(2) Waste Disposal Plan

(a) Landfill Disposal

(i) Sanitary Landfill

With the present open dumping method, the waste-dumping height is limited and cannot exceed the height to which new wastes can be dumped on the existing waste from the truck unless a bulldozer is employed to compact the waste. A further problem is that since the waste is not spread and leveled, the range in which waste can be dumped is limited to the area which is

accessible to the truck. As a result, the landfill site as a whole is not used effectively and the required disposal volume cannot be secured. In addition, the height of the landfill will increase as the amount of waste disposed of on the landfill site grows. Due to this increase in the height of the landfill, it will take longer for the waste to dry (as compared with the present). This has a detrimental effect on the surrounding environment due not only to the generation of offensive odors and gases but also to the associated problem of insects and animal pests.

For this reason, consideration should be given to the procurement of such equipment as will be capable of performing the following tasks to assure sanitary conditions for landfill operation.

Topsoil spreading	Same-day topsoil (0.2 m) Final topsoil (0.5 m minimum)
Landfill zoning	The landfill site should be divided into one-year zones and dumping operation should move on successively from one zone to the next on a yearly rotation basis. This would facilitate management of the landfill site and assist in leachate volume control.
Leachate collection/ discharge and intermediate leachate detention pond	The leachate generated during rainfall should be collected and stored in a reservoir pond. In dry weather, the leachate liquid should be sprinkled on the landfill site to let it evaporate.

(ii) Landfill Disposal Method

With the cell method, topsoil is spread on the same day (to a height = 0.2m) on each waste layer (H = 1.7m). After the waste layers have been completed, a final topsoil layer (H = 0.5m) is applied.

(iii) Landfill Site Road (Access Road)

In addition to the site road built around the landfill for transporting the wastes, it will be necessary to provide a transport track by filling a 1.0m thick layer of sand and soil on the landfill waste itself.

(iv) Topsoil Removal, Transportation, Disposal and Leveling

Topsoil is taken from the unused landfill zones of the landfill site and transported to the landfill zone to be used where it is discharged and leveled out.

(b) Facilities and Facility Layout

Fig. 2-2 is a top view and Fig. 1-3 a standard section view of the facility layout for the landfill site (future plan). In view of the fact that the present condition of the landfill site does not have a significant adverse effect on the environment, it will be possible to provide the facilities on a gradual basis. The facilities required in the first year would be the retaining structures on the scale shown in Fig. 1-4, site roads, leachate detention pond, leachate collecting and distributing facilities, an office building, a vehicle depot and rainwater (surface water) drainage ditch.

The following descriptions give an outline of the various facilities.

(i) Retaining Structure (Earth Dams)

Retaining structures (earth dams) should be erected around the landfill site, with an earth fill height of 1.5m and a total extended length of approximately 2,350m.

(ii) Leachate Collecting and Drainage Facilities

At the bottom of each landfill zone, a water permeable layer should be provided with the use of cobblestones and gravel, to retain and drain the percolated leachate.

(iii) Leachate Detention Pond

The leachate collected from the leachate drainage facilities during rainfall periods should be totally retained in the leachate detention pond. The required detention volume is $38{,}700m^2 \times 0.200m \approx 8{,}000m^3$ for the leachate (equivalent to 200mm rainfall) generated from one landfill zone ($A = 38{,}700m^2$).

(iv) Rainwater (Surface Water) Drainage Ditch

The surface water from the unused landfill zones and the used landfill zones with the final topsoil layer should be discharged through ditches.

(v) Rainwater (Surface Water) Detention Pond

In dry weather periods, large amounts of water are required for road sprinkling and for adjusting the water content of the earthfill dams and topsoil. The rainwater (surface water) stored during rainy periods should then be used to provide part of the water required in the dry season. The volume capacity of the rainwater (surface water) detention pond should be approximately 10,000 m^3.

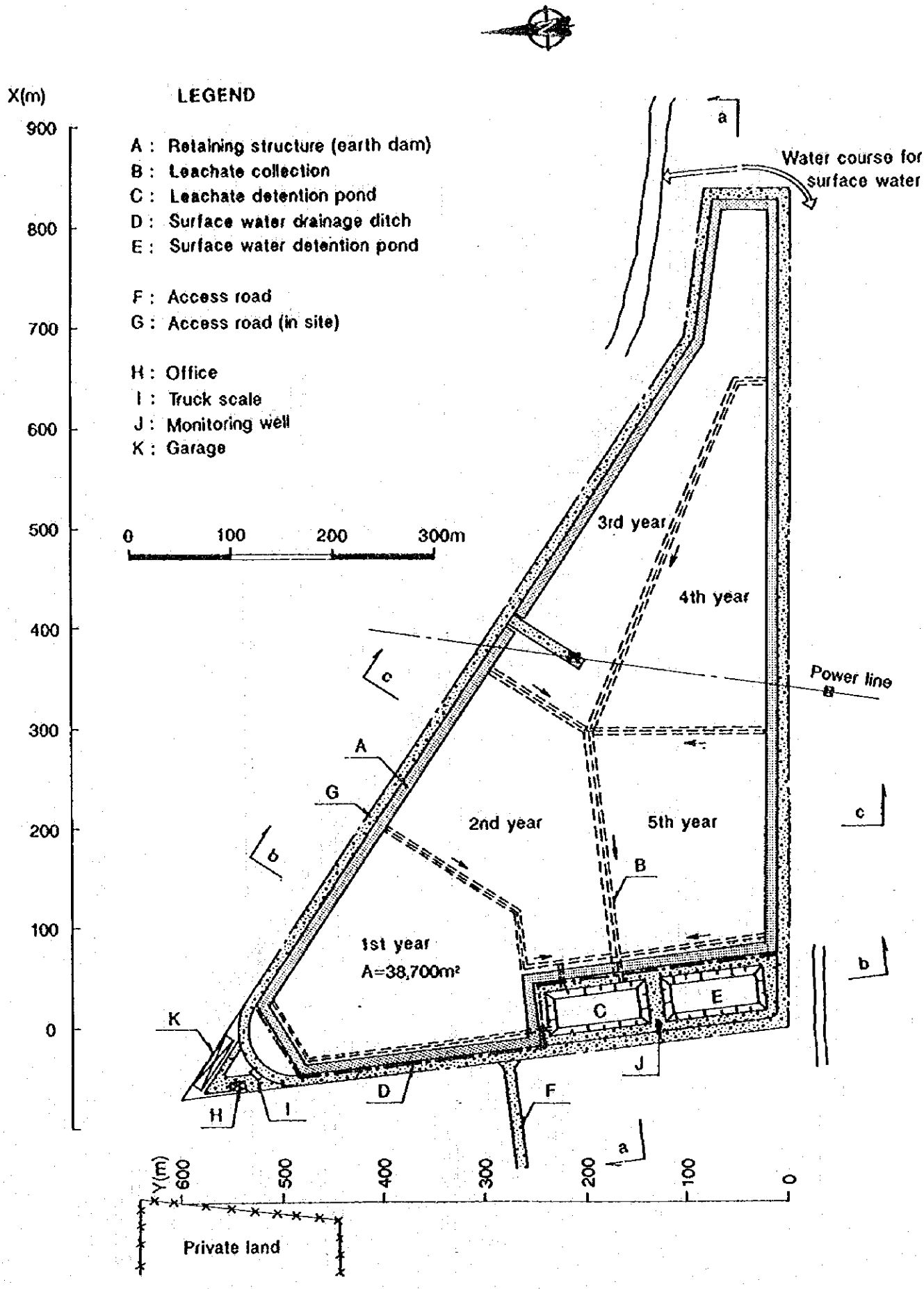


Fig. 2-2 Top View of the Facility Layout of the Landfill Site
(Scale = 1:5,000)

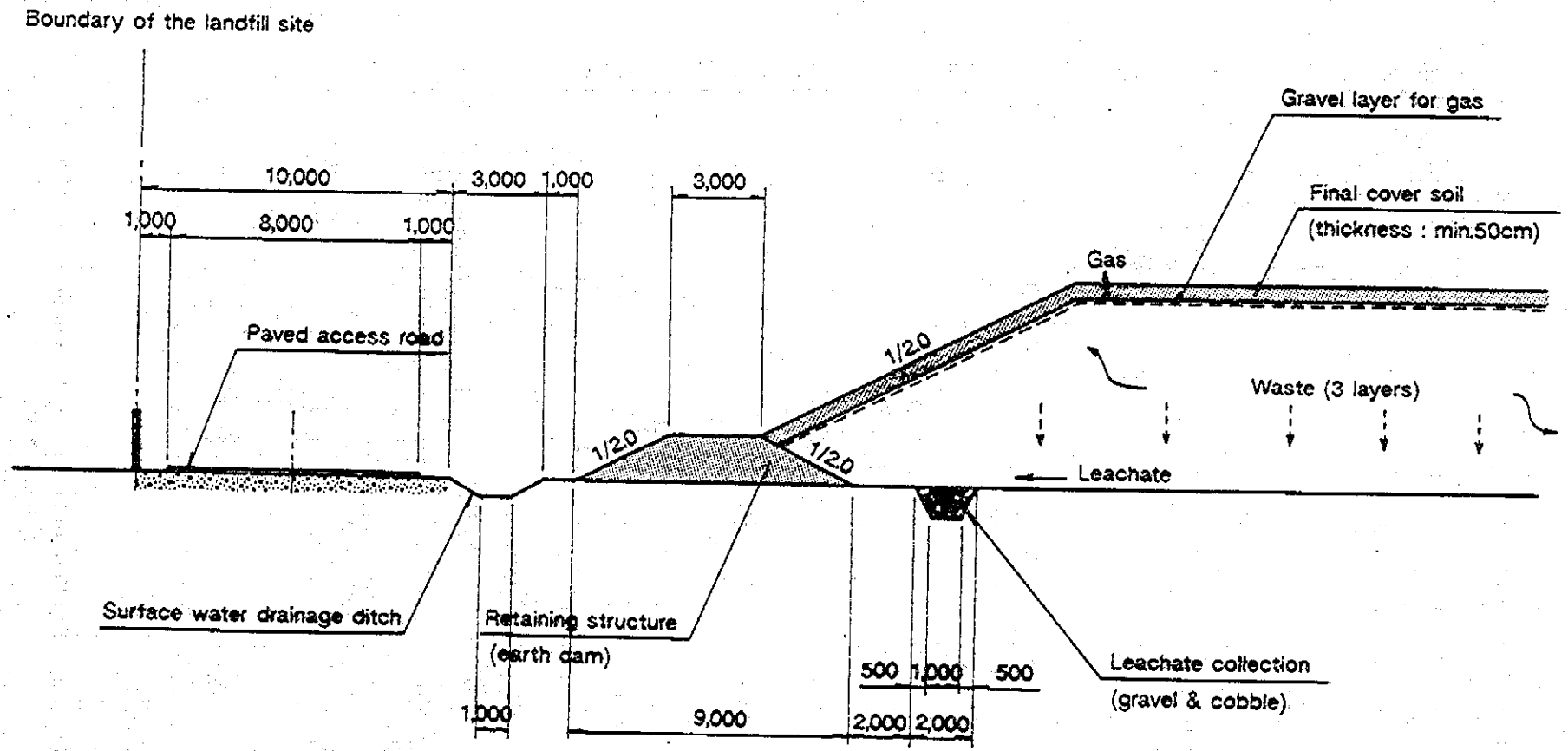


Fig. 2-3 Standard Section View of the Facility Layout of theLandfill Site
(Scale = 1:200)

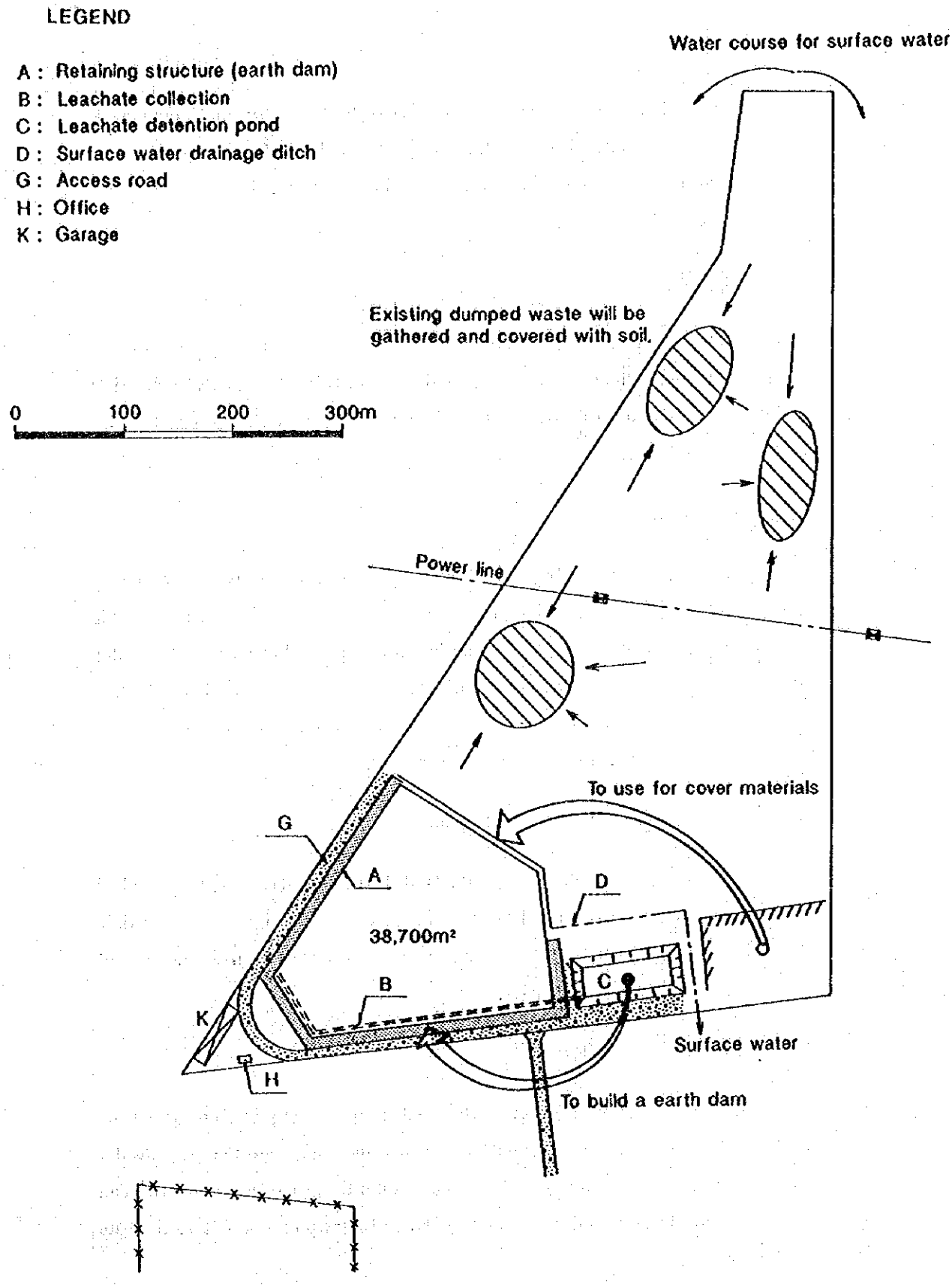


Fig. 2-4 Facility Improvement and Landfill Plans Required in the First Year

(vi) Access Road

The 1.35 km stretch from the Eastern Bypass to the landfill site is not paved. To reduce wear and tear on the transport vehicles and improve the travel speed of the vehicles, it would be desirable to surface this distance with a simple asphalt pavement.

(vii) Site Road

A gravel-paved road should be constructed within the landfill site compound. This road would be used for access by the vehicles delivering wastes and topsoil to the landfill and also the vehicles used for site management.

(viii) Office Building

To assure sanitary landfill conditions, management tasks will be required. These include the weighing of the wastes, the demarcation of the landfill zones (cells), the checking of the landfill height, adjustment of the water content, and monitoring of the leachate volume and water quality. For this purpose, a building will need to be constructed to house the landfill supervisors permanently stationed at the site.

(ix) Truck Scale (Truck Weighing System)

The waste amounts delivered to the landfill site each day should be weighed on a truck scale (20t) and the weights need to be recorded. For the time being, however, the waste amount may be estimated from the number of waste transportation vehicles.

(x) Groundwater Monitoring

Since the leachate is stored in the leachate detention pond throughout the year, there is a high risk that the leachate may seep into the groundwater with time. It is therefore necessary to monitor the groundwater quality on an ongoing basis in order to check for groundwater pollution due to leachate seepage.

(xi) Equipment/Truck Depot (Garage)

To prevent theft of the equipment and vehicles used on the landfill site, a depot (garage) should be built on the site compound.

(c) Working Hours

Waste collection starts at 7:00 a.m. and the trucks arrive at the landfill site at 9:00 a.m. Landfill disposal work including the topsoil work is finished at 4:00 p.m..

Topsoil excavation and transportation begins when the waste disposal work on the landfill site is half-finished. The topsoil is dumped on the landfill waste. When the waste disposal on the landfill has been completed, the dumped topsoil is spread out and the ground is leveled.

Table 2-6 Working Time Schedule

Time		9	10	11	12	13	14	15	16	17	18	Working Time
Waste disposal on landfill					Break							6 hours
Same-day topsoil coverage												3 hours
Soil excavation/ transportation												(2 hours)
Spreading out/ leveling												(1 hour)
Servicing (soil/civil works)												5 hours

(d) Equipment Plan

Waste disposal on a landfill site involves work on soft ground overlying the waste. It is therefore essential to select crawler type bulldozers with outstanding maneuverability as the main equipment. The auxiliary equipment should include an excavator. The waste carried by the waste transportation vehicles is dumped in the disposal yard and the damped waste is shoved and leveled by a bulldozer. Since the bulldozer travels on the waste, it will also have a compaction effect. The excavator is used for building the transportation route on the landfill waste and for ancillary jobs that are difficult to carry out with a bulldozer. In practice, the excavator is used for duties such as the leveling of waste piles, the transfer of

waste on a large scale, the building up of the soil bank, the building of a transportation route on the landfill waste, and for digging water drainage trenches on the landfill site.

To strip the topsoil it would be appropriate to use a bulldozer with ripper attachment for the excavation and collection of the topsoil. For the loading work wheel loaders should be used since they offer outstanding maneuverability in favorable ground conditions. It is planned to use dump trucks for loading and transportation.

Except for the short rainy season, the ground at the site is extremely dry. It will therefore be necessary to adjust the moisture of the ground, that is, the topsoil and earth fill, during compaction and to sprinkle water on the access road on the site.

Most of the facilities and services on the site are provided by earthwork and civil engineering work. This work can therefore be conducted gradually in accordance with the landfill zones that are being worked at any particular time. For this reason, it would also be possible to make use of the equipment normally employed for the topsoil work to perform the construction tasks.

(e) Calculation of the Required Quantities of Equipment

Landfill Equipment

(i) Bulldozers (21t)

- Scheduled work volume per day = Waste volume + Topsoil volume
  = 480×(1+0.12) = 538 m^3/day
- Work volume per hour = 70 m^3/hr

The work volume per hour can be calculated as follows in accordance with the Calculation Standards for Civil Engineering Work by the Ministry of Construction of Japan. (These Standards also apply to the calculation below.)

1. Leveling of Ground

Q_1 = 10E(18D+13) D: Finished thickness 0.30m (0.50m spreading thickness)
= 10×0.6×(18×0.30+13)
= 110 m^3/hr

2. Compaction

Q_2 = (V×W×D×E)/N V: 3,500m/hr, W: 0.9m, D: 0.30m, E: 0.8, N: 4 times
= (3,500×0.9×0.30×0.8)/4
= 189 m^3/hr

3. Composite Work (1 and 2 above)

$Q = (Q_1 \times Q_2)/(Q_1+Q_2)$

$= (110 \times 189)/(110+189)$

$= 69.5\ m^3/hr$; say, $70\ m^3/hr$

- Actual working time = 6 hr/day
- Work volume per day = 420 m^3/day
- Required number of bulldozers = 538÷420 = 1.3; say,: 2 bulldozers

(ii) Excavators (0.6m^3)

Excavators are used to support the work of the bulldozers and are assigned to the following tasks.

a. Leveling out the waste piles that are difficult to spread with a bulldozer and transporting of waste on a large scale.

b. Finishing of banks (dam slopes) and compaction duties (Compacting banks with the bucket attachment)

c. Excavation of drainage trenches on the landfill site.

- Work volume per day = 50% of waste volume = 480×0.5 = 240 m^3/day
- Work volume per hour = 60 m^3/hr.

Essentially used for excavation and loading work

$Q_E = (3{,}600 \times q \times f \times E)/Cm$ q: 0.59 m^3, f: 1.0, E: 0.8, Cm: 30 sec

$= (3{,}600 \times 0.59 \times 1.0 \times 0.8)/30$

$= 56.6\ m^3/hr$; say, $60\ m^3/hr$

- Actual working time = 6 hr/day
- Work volume per day = 420 m^3/day
- Required number of excavators = 240÷360 = 0.7; say, 1 excavator

<u>Topsoil Stripping Equipment</u>

(i) Bulldozers (21t)

- Scheduled work volume per day = 480×0.12 = 538 m^3/day
- Work volume per hour = 80 m^3/hr

1. Ripping Work

$Q_R = (60 \times a \times L \times E)/Cm$ a: 0.40, L: 20m, E: 0.60

$= (60 \times 0.40 \times 20 \times 0.60)/1.08$ Cm: 1/24×L+0.25 = 1/24×20+0.25 = 1.08min

= 266.7 m^3/hr

2. Excavation and counterweight filling work

Q_B = (60×q×f×E)/Cm q: 2.81m^3 (ground soil volume), f: 1.0, E: 0.9

= (60×2.81×1.0×0.9)/1.33 Cm: 0.027×L+0.79 = 0.027×20+0.79 = 1.33min

= 114.1 m^3/hr

3. Composite Work (1 and 2 above)

Q = {Q_R×(Q_B+N×Q_B)}/(Q_R+Q_B)

= (266.7×114.1)/(266.7+114.1)

= 79.9 m^3/hr; say, 80 m^3/hr

-Actual working time = 2 hr/day

-Work volume per day = 420 m^3/day

-Required number of bulldozers = 58÷160 = 0.4; say, 1 bulldozer

(ii) Wheel Loaders (2.0m^3: Loading work)

- Work volume per day = 480×0.12 = 58 m^3/day

- Work volume per hour = 100 m^3/hr

Q = (3,600×q×f×E)/Cm q: 1.66m^3 (ground soil volume), f: 1.0, E: 0.65 (Cobble soil)

= (3,600×1.66×1.0×0.65)/40 Cm: 40 sec

= 97.1 m^3/hr; say, 100 m^3/hr

- Actual working time = 2 hr/day

- Work volume per day = 200 m^3/day

- Required number of wheel loaders = 58÷200 = 0.3; say, 1 excavator

(iii) Dump trucks (9t Class: for Transportation)

- Work volume per day = 480×0.12 = 58 m^3/day

- Work volume per hour = 15 m^3/hr

Q_B = (60×qf×E)/Cm q: 5.0m^3 (ground soil volume)

= (60×5.0×1.0×0.9)/18.4 γ = 1.8t/m^3 (ground soil volume ≈ Compacted soil volume)

= 14.7 m^3/hr; say, 15 m^3/hr f: 1.0, E: 0.9, Cm: 4.8×L+α = 4.8×0.5+16 = 18.4min

- Actual working time = 2 hr/day

- Work volume per day = 30 m^3/day

- Required number of wheel loaders = 58÷30 = 1.9; say, 2 dump trucks

(iv) Water Sprinkler (6,000 liters minimum; sprinkling width 4m; water supply, 12 minutes)

- Scheduled work area per day	=	On site: 38,700m^3. On roads: 2 km
- Speed	=	10 km/hr
- Single-cycle sprinkling time	=	38,700/4.0 + 2km = 11,675 m = 11.7 km
		11.675/10×60+12 = 82; say, 80 min.

In summer, it will be necessary to sprinkle water once every 30 minutes to 1 hour. Two sprinkler vehicles can operate at intervals of 40 minutes.

(3) Operating and Maintenance/Management Plan

The equipment required for the operation and maintenance/management of the procured equipment should consist of the following units in order to meet the new waste collection, transportation and disposal plans described above and in order to improve the maintenance and management capabilities of the QMC which will be responsible for the execution of this Project.

(a) Spare Parts

These shall include all replacement parts required for the repair of the above waste collection, transportation and disposal equipment.

(b) Workshop Tools

These shall include all tools required for repairing and inspecting/checking the scheduled equipment and shall consist of the following:

(i) Garage equipment
(ii) Material handling tools
(iii) Brake and steering repair tools
(iv) Tire repair tools
(v) Sheet metal tools
(vi) Parts cleaning tools
(vii) Painting tools
(viii) Oiling and lubricating tools
(ix) Air compressor
(x) Manual tools
(xi) Electric tools

(4) List of Equipment and Materials

Table 1-6 is a list of the designed equipment due for new procurement in connection with the waste collection, transportation and disposal as well as operation and maintenance/management.

Table 2-7 List of Designed Equipment (Newly Procured Part)

Name of Equipment	Main Specifications	Qty.	Application
Waste Collection and Transportation			
1. Detachable container truck	Total vehicle weight: 7,500 - 9,000kg Engine:Diesel, water-cooled, 110-150 PS Support Bed: Horizontal mobile detachable body. The following containers can be attached/detached.	37	The containers below are recovered in the city and transported to the landfill for waste disposal.
2. Container	Container capacity: 7.0m^3 Container type: Closed type	208	To be installed for waste collection and retention instead of the existing concrete waste dumping pits.
3. Dump truck	Total vehicle weight: 7,500 - 9,000kg Engine: Diesel, water-cooled, 110 - 150 PS Support Bed: With Top Cover Load Carrying Capacity: Approx. 4t	10	To be used for waste collection and transportation in city areas that are inaccessible to container trucks or lack the space for installing containers.
4. Water Sprinkler	Total vehicle weight: 10,500 - 12,000kg Engine: Diesel, water-cooled, 160 - 175 PS Support Bed: With Sprinkler Tank capacity: 6,000 liters minimum	2	To be used for road sprinkling and for cleaning duties after waste collection in remaining waste dumping pits.
Waste Disposal			
5. Wheel Loader	Overall weight: 9,000 - 14,000kg Rated output: 110 - 150 HP Engine: Diesel, water cooled Bucket capacity: Approx. 2.0m^3	1	To be used for loading onto dump trucks the sand/soil for topsoil coverage.
6. Bulldozers	Overall weight: 17,000 - 21,000kg Rated output: 165 - 200 HP Engine: Diesel, water cooled Attachment: Ripper (for topsoil stripping only)	3	Two bulldozers to be used for counterweight filling, leveling and compacting of waste material brought to the landfill site. One bulldozer equipped with a ripper attachment for topsoil stripping is to be used for excavation and piling of topsoil.
7. Excavators	Overall weight: 16,000 - 21,000kg Rated output: 90 - 140 HP Engine: Diesel, water cooled Bucket capacity: Approx. 0.6m^3 Attachment: Breaker and skeleton bucket	1	To be used for various duties, including leveling of waste piles difficult to handle with bulldozers, moving wastes on a large scale, finishing topsoil banks, building a transportation route on the landfill deposited waste, and excavation of drainage trenches on the landfill site.
8. Water Sprinkler	Specifications identical to 4. above.	2	To be used for moisture adjustment during topsoil, earthfill compaction and for sprinkling access roads on the site.
Operation and Maintenance/Management			
9. Spare Parts		Lot	All replacement parts required for repair of the above equipment
10. Workshop tools		Set	To be used for repair and inspection/ checking of the above equipment

CHAPTER 3 IMPLEMENTATION PLAN

CHAPTER 3

IMPLEMENTATION PLAN

3-1 Implementation Plan

If the Project is executed under the Japanese Grant Aid scheme, the implementation plan will be as follows.

3-1-1 Implementation Policy

The Principal for this Project is the Quetta Municipal Corporation (QMC) which will bear the responsibility for the whole Project from the detailed design through the completion and transfer to the maintenance and management thereafter. After the signing of an Exchange of Notes (E/N) between the Government of Pakistan and the Government of Japan, the QMC will execute a contract with a Japanese Consultant for the detailed design and procurement supervision to assist in the call for tenders and evaluation for the supply of project equipment. A contract with the equipment supplier (manufacturer) will then be executed, based on the evaluation of tenders submitted. The main contractor shall be a Japanese company because the Project will take place on the basis of a grant for development assistance by the Japanese government. In connection with the procurement of project equipment it is essential that the contractor should have extensive experience in the project area and a thorough understanding of the project content.

In the execution of this Project, the Japanese company acting as the main contractor shall procure the equipment under the supervision of the Consultant based on the verified contract and ship the equipment to the specified place within the specified period. In order to check and verify the performance of the procured equipment, the Supplier/Contractor shall assign members of his technical staff within the contract period and to the place or places specified in the contract to perform trial operations, provide operating instructions, and check the performance of the equipment.

Fig. 3-1 illustrates the implementation system for the execution of this Project. For the equipment procured, it will be necessary to provide operational instructions covering the operation, maintenance and management of the equipment in the event that the QMC does not have any prior experience with the vehicles and construction equipment concerned. It is also

desirable that the Consultant should carry out a field survey to check the progress made in the improvement of the landfill site and the construction program for the building of new workshop planned by the QMC.

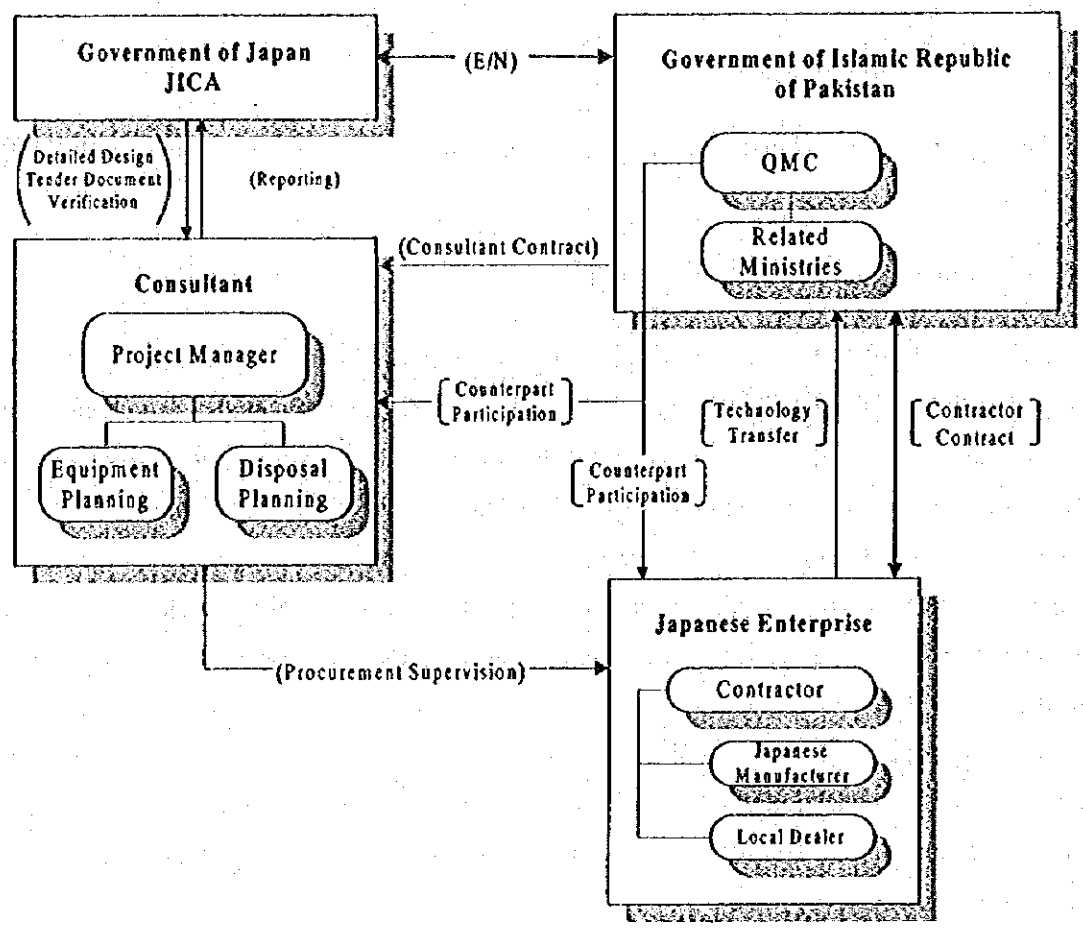


Fig. 3-1 Execution System for Detailed Design and Procurement Supervision/Management

3-1-2 Cautions in Connection with Project Execution

The problems of inland transportation call for particular caution in connection with the equipment procurement in accordance with this Project.

The equipment procured from Japan will be shipped by sea to Karachi Port and transported from Karachi over land to Quetta as the Project area. Over-land transport can take place either by road or by rail. Of these two alternatives, road transport would be more advantageous in view of the transportation time and safety considerations associated with rail transport.

The route for road transport would be from Karachi via Bela - Khuzdar and Kalat to Quetta. The distance from Karachi to Quetta by road is approximately 620 km and road conditions are satisfactory.

3-1-3 Demarcation of Responsibilities for Project Execution

For the execution of the Project, the following role-sharing model may be considered between Japan and Pakistan. Japan should assume responsibility for land transportation partly because Pakistan has made a request to this effect and partly because of existing precedents that should be taken into account.

(1) Share of Responsibility Assumed by the Government of Japan

(a) Consulting tasks in connection with the execution of this project.

(b) Procurement of equipment for the collection and transportation of solid wastes and for waste disposal on landfills as well as equipment and materials for maintenance and management.

(c) Maritime transportation and insurance from Japan to Karachi Port.

(d) Land transportation from Karachi to Quetta and insurance.

(e) Dispatch of engineers for acceptance testing of the procured equipment and for operational instruction and guidance.

(2) Share of Responsibility Assumed by Government of the Islamic Republic of Pakistan

(a) Securing of storage sites required for all equipment in connection with the execution of the Project (Construction of the new workshop).

(b) Improvement of existing landfill site (Introduction of sanitary landfill operations).

(c) Speedy implementation of all administrative measures required for the execution of this Project, including exemption from all taxes and customs tariffs, and the provision of all materials.

(d) Accepting responsibility for all costs beyond the scope of the Japan's Grant Aid Scheme such as the bearing of all bank charges.

(e) Assuring the smooth completion of the immigration/entrance formalities for the Japanese engineers assigned to Pakistan in connection with the execution of this Project, granting exemption from taxation and assuring their safe stay in Pakistan.

(f) Provision of a system for operation, maintenance and management, including personnel and budget allocations, required for achieving effective operational performance for the equipment procured under this Project.

3-1-4 Design and Supervision Plan

All activities from the project detailed design through the tendering procedures, contract signing duties and equipment procurement supervision to the inspection of the procured equipment shall be carried out on the following schedule.

(1) Carrying out of the detailed design for the procurement of the project equipment and preparation of the tender documentation.

(2) Support in tendering procedures and evaluation of tender results.

(3) Witnessing, and giving advice on, all procedures from the launch of the tender to the signing of the contract.

(4) Schedule management regarding the dispatch of Japanese engineers to Pakistan for the procurement and transportation of the equipment, checking of equipment performance, and providing instruction and guidance on equipment operation.

(5) Confirming the level of progress made with the improvement plans for the QMC landfill site and the construction plans for the building of the new workshop.

(6) Implementation of inspection.

(7) Preparation of report.

This Project shall commence with the Exchange of Notes (E/N) conferring the grant for economic development cooperation between the governments of Japan and Pakistan. The Project shall be completed within the same Japanese fiscal year.

When the E/N is signed, the QMC as the Executing Authority for this Project shall sign a consultancy contract with the Japanese consultant with respect to this Project. The consultant shall then carry out the implementation design. After the approval of the consultancy contract

by the Japanese Government, the consultant shall proceed with the preparation of the tender documentation. After both the Government of Japan and the Government of the Islamic Republic of Pakistan have given their approval to the tender documentation, the tender shall take place and the tender submission evaluated. Contract negotiations shall then take place between the QMC and the successful bidder for the award of the contract and the contract shall be signed. The Contract with the successful Tenderer/Contractor shall take effect subject to the approval by the Government of Japan. The process from the signing of the E/N to the Contractor's Contract is expected to take approximately 4.8 months.

After approval of the contract, the Contractor shall procure the equipment. The delivery period for the equipment will take approximately 5.5 months, the maritime transportation, customs clearance and land transportation in Pakistan approximately 2 months, and the acceptance inspection of the equipment and the provision if operational instruction approximately 0.7 months. Fig. 2-2 below shows the entire schedule.

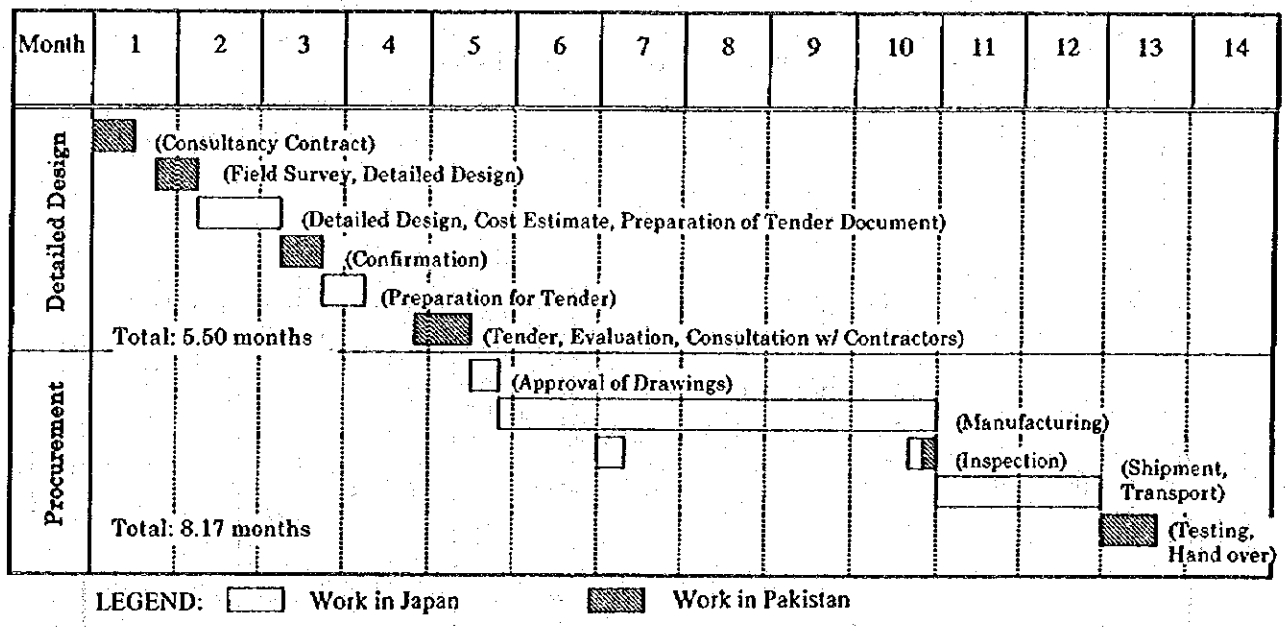


Fig. 3-2 Project Implementation Schedule

3-1-5 Equipment Procurement Plan

For the procurement of the equipment under this Project, consideration may also be given to the possibility of procurement in the beneficiary country's own market, provided that this would not be injurious to the procurement of the equipment of the required quality and in specified quantity. From the viewpoint of assuring ease of equipment maintenance and management

quantity. From the viewpoint of assuring ease of equipment maintenance and management after procurement and of securing an effective after-sales service it will also be necessary to give consideration to the use of non-Japanese products.

In the event that non-Japanese products should be used, the reason should not merely be that these products have a lower price. Rather, it will be important to take also into consideration such aspects as the future maintenance and management of the equipment and the technical skills and capabilities available in the beneficiary country itself.

(1) Existing Conditions of Procured Equipment in QMC and Dealers in Pakistan

(a) Equipment Already Procured in QMC

The following explanations of the existing procurements refer to the waste collection and transportation vehicles in the possession of the QMC and to the spare and wearing parts procured by the QMC.

(i) Waste Collection and Transportation Vehicles

The current situation is that the QMC has already in its position 22 vehicles from previous procurements.

Table 3-1 Currently Owned Waste Collection and Transportation Vehicles in QMC

Type	Qty.	Year Acquired	Supplier	Fund Provided by	Remarks
Bedford	1	1984	National Motors	QMC	
Nissan, 10-wheels	2	1986	Ghandara Nissan Diesel	Province of Balochistan	
Hino small	1	1986	HinoPak Motors	QMC	
Nissan	4	1987	International Motors	QMC	
Belaruis	2	1993	Daavi Autos	QMC	Russian-made import
Hino FF174L	12	1994	HinoPak Motors	Prime Minister's Special Budget	
Total	22				

feed pumps, fuel pumps, sub-starters, filters, and piston parts. Practically all stocks are genuine products procured locally in Quetta.

In Quetta, there are over 100 spare parts dealers handling spares of practically all makes and types of vehicles. Most of these dealers have small stores offering a practically complete range of spares and capable of ordering spares from Karachi or Japan if not in stock.

(iii) Wearing Parts

The wearing parts kept in the workshop include items such as battery fluid, lubricant and engine oil. These are purchased from gas filling stations in Quetta with which the city has a supply contract.

(b) Dealers/Assembly Manufacturers

The following local dealers and assembly manufacturers are existing at present.

(i) Vehicles

Import agents and knock-down (KD) assembly manufacturers for Japanese, German and Swedish trucks. The share position of truck manufacturers in Pakistan shows that Japanese trucks occupy the number one position.

For Japanese trucks, there is a complete spare parts procurement and after-care service system in place covering both import and KD production vehicles. The trucks handled by the various companies differ in class and body type.

(ii) Body Manufacturers in Pakistan

There are roughly two or three body manufacturers each for detachable container trucks (horizontally moving type), sprinkler vehicles and containers.

(iii) Construction Equipment

There are import agents for equipment manufactured in Japan, Korea, the U.S.A, Italy, and Germany. The share position of the various manufacturers of construction equipment in Pakistan shows that Japanese products occupy

the number one position. For Japanese products, there is a complete spare parts procurement and after-care service in place.

(2) Local Procurement and Procurement from Third-Party Countries

The following considerations apply for the local procurement of Project equipment and for procurement from third-party countries.

(a) Local Procurement

(i) Vehicles, etc.

There are Japanese vehicles manufactured on a knock-down assembly basis in Pakistan. The type of vehicles produced is limited and each company has a different class of chassis. Some dealers only import vehicles and do not produce them locally.

Containers have been procured locally at some time in the past under a similar grant aid project. There is also a high probability that local procurement may be possible in view of the transport costs.

(ii) Construction Equipment

Construction equipment is not manufactured locally.

(b) Procurement from Third-Party Countries

(i) Types of Vehicles and Construction Equipment

It is not possible to argue that products from third-party countries are more advantageous in terms of maintenance and management. Nor has the QMC expressed any particular desire to procure equipment from third-party countries. There is therefore a low possibility of procurement from third-party countries.

(ii) Products from Neighboring Countries

The neighboring countries of India, Iran and China do also produce vehicles and construction equipment. Though their prices are low it can be expected

that the procurement of spare parts and the availability of after-care service would be a problem.

3-2 Project Cost Estimation

3-2-1 Rough Estimate of Project Costs Borne by Pakistan

Based on the previously described demarcation of the cost parts borne by Pakistan, the overall amount required for the implementation of the Project borne by Pakistan has been estimated as follows.

The part of the costs borne by Pakistan will be in the region of 40,030,000 rupees (Rs.). These costs are broken down below.

(1) Costs for construction of workshop/vehicle park	Rs. 13,151,500
(2) Costs for improvement of existing landfill site	Rs. 26,876,700
Total	Rs. 40,028,200

3-2-2 Operation, Maintenance and Management Costs

(1) Types of Skills and Number of Employees Required for the Project

The QMC will need to reinforce its organization and secure suitable manpower to strengthen its manpower in order to assure the smooth operation of the cleaning services. Manpower increases will be required for the drivers of the vehicle and construction equipment fleet, for the servicing staff stationed in the new workshop, and for the supervisor and cleaner personnel on the landfill site.

Table 3-2 gives an overview of the number of personnel required to be newly recruited in accordance with the Design Bill of Quantities of this Project.

Table 3-2 Number of Personnel Requiring to be Newly Recruited

Item No.	Skill	Number
New Workshop		
1.	Driver*1	26
2.	Foreman	2
3.	Diesel Mechanic	7
4.	Helper	14
5.	Hydraulic Engineer	2
6.	Auto Electrician	2
7.	Turner	2
8.	Welder	2
9.	Blacksmith	2
10.	Washerman	3
11.	Fabricator	2
Landfill Site		
12.	Supervisor	2
13.	Sweeper	10
Total		76

Note *1: The required number of drivers has been calculated as follows by allowing for the number of vehicles operated under this Project.

Container trucks	33
New dump trucks (4t)	9
Existing dump trucks (9t)	11
Water Sprinklers	4
Wheel loader	1
Bulldozers	3
Excavator	1
Total	62; say, 66 (Availability, 95%)

Apart from the 22 drivers currently employed, budget allocations have already been made available for an additional 18 drivers to be employed, making a total of 40 drivers. In addition to this total of 40, it will therefore be necessary to allocate a new budget for an additional 26 drivers.

(2) Rough Calculation of Costs Required for the Project

(a) Increase in Personnel Costs Associated with New Recruitment

The execution of this Project will require the new recruitment of additional personnel as calculated in the previous section, and the QMC will need to find the fund resources to pay for the additional personnel costs. The wages paid to QMC

personnel is decided on a uniform basis in accordance with the job grade which is determined by the type of job and the years of continued service. On this basis, the increased personnel costs for recruiting the necessary personnel will therefore be as shown in Table 3-3.

These calculations show that the increase in personnel costs due to the recruitment of new personnel will be roughly Rs. 2,320,000.

Table 3-3 Increase in Personnel Cost Associated with New Recruitment

Job Type	Number	Job Grade	Monthly Pay (Rs.)	Annual Personnel Costs (Rs.)
New Workshop				
Driver	26	6	2,535	790,920
Foreman	2	11	3,207	76,968
Diesel Mechanic	7	9	3,060	257,040
Helper	14	3	2,070	347,760
Hydraulic Engineer	2	17	7,360	176,640
Auto Electrician	2	8	2,860	68,640
Turner	2	7	2,695	64,680
Welder	2	7	2,695	64,680
Blacksmith	2	7	2,695	64,680
Washerman	3	1	1,770	63,720
Fabricator	2	8	2,860	68,640
Landfill Site				
Supervisor	2	5	2,390	57,360
Sweeper	10	1	1,770	212,400
Total	76			2,314,128

(b) Costs for Maintenance and Management Service Vehicles and Construction Equipment

For assessing the possibility of project execution from the financial aspect, it would be helpful to calculate the annual maintenance and management costs

required for the service vehicles and construction equipment associated with this Project.

The maintenance and management costs for the service vehicles and construction equipment should be considered as follows:

(i) Costs for Fuel and Oil/Lubricant

Table 3-4 below lists the fuel and oil/lubricant costs calculated for the equipment. The results indicate that a total of Rs. 5,326,193 would be required for fuel and oil/lubricant.

Table 3-4 Annual Fuel and Oil/Lubricant Costs

No.	Description of Vehicle	Number	Fuel Consumption (liter/day)	Working Days (Day)	Diesel iRs. j	Oil/ Lubricant iRs. j	Total (Rs.)
1	Detachable Containet Trucks	33	825	360	2,242,350	448,470	2,690,820
2	Dump Truck (4t)	9	90	360	244,620	48,924	293,544
3	Dump Truck (9t) *1	11	220	360	597,960	119,592	717,552
4	Wheel Loader	1	40	360	108,720	21,744	130,464
5	Bulldozer	3	234	360	636,012	127,202	763,214
6	Excavator	1	84	360	228,312	45,662	273,974
7	Water Sprinkler	4	140	360	380,520	76,104	456,624
Total							5,326,193

Note *1: Existing trucks

(ii) Repair and Overhaul Costs

In view of the vehicles' service life, the equipment should be renewed after a period of 5 to 6 years. If the Project equipment is properly serviced, repaired and overhauled as is also the practice in Japan, it will be possible in most cases to operate the equipment for about 10 years. The costs required for servicing and repairing/overhauling the equipment are determined in terms of their proportion to the basic equipment costs. Starting from the premise that servicing facilities will be provided under this Project and

allowing for the fact that some of the servicing tools and spare parts are included in the standard accessories, it is fair to assume that the annual repair and overhaul costs would be about 1% of the basic equipment costs.

Since the basic equipment costs will be approximately 600 million yen it is possible to estimate that the repair and overhaul costs will be around 6 million yen (approximately 1.78 million rupee).

(iii) Maintenance and Management Costs

From the above, it follows that the maintenance and management costs for the service vehicles and construction equipment will be as follows:

Approx. Rs. 5,330,000 + Approx. Rs. 1,780,000 = Approx. Rs. 7,110,000

(3) Balance of Budget Allocations/Revenue and Expenditure for the Services

The balance of budget appropriations/revenue and expenditure for the services should be examined on the following basis:

Revenue	The budget appropriations/revenues should be assessed on the basis of the budget appropriations received by the Sanitation Section from the QMC by considering two cases: one in which the Sanitation Tax is inroduced, and one in which the Sanitation Tax is not introduced. For the personnel costs as part of the budget, however, only the part of the personnel costs associated with the new recruitment needs should be considered and the personnel costs for the manpower already employed should not be considered as an extra budget appropriation item.
Expenditure	The personnel costs required for new recruitment and the maintenance and management costs for the vehicles and construction equipment used for the cleansing service after equipment procurement under this Project should be considered.

(a) Revenue

(i) Annual Maintenance/Management Costs for the Vehicles Owned by the Sanitation Section

The following overview gives the maintenance and management costs of the Sanitation Section of the Health Department which are funded by budget

appropriation from the QMC. These costs have been incurred in connection with the service operation of the Sanitation Section for the last three years. From this, it follows that the maintenance and management costs can be expected to be in the same region of about 3 million rupees a year as until the present.

Table 3-5 Annual Maintenance/Management Costs for Vehicles Owned by the Sanitation Section

Fiscal Year	1993-94	1994-95	1995-96
Fuel Costs (Rs.)	1,523,074	1,452,208	1,591,909
Repair and Overhaul Costs (Rs.)	1,484,400	974,712	1,402,272
Total (Rs.)	3,007,474	2,426,920	2,994,181

(ii) Increase in Tax Revenue due to the Introduction of the Sanitation Tax

The procurement of the new equipment under this Project will increase the maintenance and management costs associated with the increase in the number of vehicles and in the number of personnel. QMC plans that these cost increases should be met by imposing the sanitation tax that is currently only charged to enterprises on each household in the city and by increasing the tax revenue through measures to activate the region's economy.

The revenue estimated to accrue from the levy of the sanitation tax can be calculated as follows:

Percentage of population subject to tax levy:

40% (This proportion should be the same as that for the water tax.)

Number of households liable to the Sanitation Tax:

42,000 households* (This number should be the same as that for the households liable to pay water tax.)

Note*: The city's total number of households that can be estimated from this and the percentage of the population subject to Sanitation Tax is 105,000. Assuming that the size per household is around 7 persons, it follows that the total population is 735,000, roughly identical to the 729,000 figure on which the Project plan is based.

Tax amount:

15 rupees per household per month (At present, the basic water tax is 75 rupees and can be paid by middle-class households and above. It may be assumed that the extra levy of 15 rupees will not be a serious problem for these households. Assuming an average monthly income of 3,000 rupees, the levy of 15 rupees per month would be no more than 0.5% of this monthly income.)

Increase in tax revenue:

42,000 households × Rs. 15 × 12 months = Rs. 7,560,000-

From the above, it can be estimated that tax revenue will increase by Rs. 7.56 million as a result of the introduction of the Sanitation Tax.

(iii) Increase in the Sanitation Section's Budget due to the Economy Growth

The following Fig.2-3 compares the budget records of the QMC, the Health Department and the Sanitation Section for the last six years, including the current fiscal year.

The QMC's budget has seen a steady growth pattern during the last three years. The budgets of the Health Department and the Sanitation Section have registered definite increases for the latest four-year period, with the Sanitation Section, in particular, having maintained a high rate of budget expansion in the region of 20 to 30% each year for the last three years. The fiscal sources for the budget come, to a good 70%, from a tax revenue described as the *Octroi*. This tax is levied on products entering the QMC territory at a rate depending on the product item, quantity and price. The revenue accruing from this tax will therefore grow further as the city's economy expands. Apart from the *Octroi* which holds the overwhelming share in the city treasury, the city also has other tax revenues, including the automobile tax accounting for approximately 8% and the real estate transfer (property sales) tax accounting for approximately 5% of the city's total tax revenue.

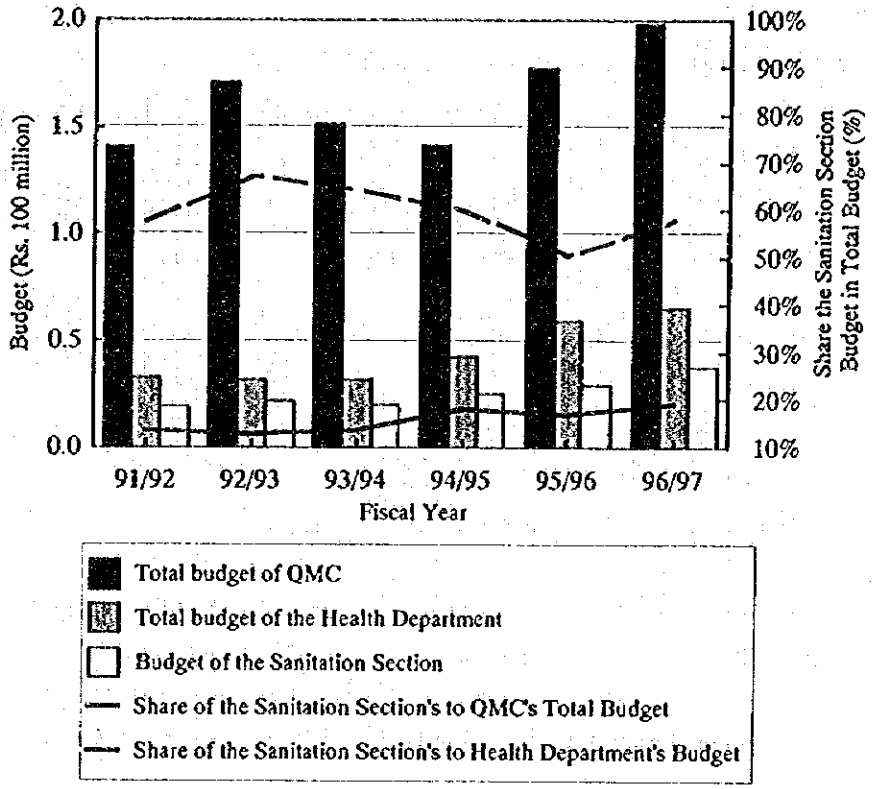


Fig. 3-3 Variation in the Total QMC's, Health Department's and Sanitation Section's Budget for the Last Six Years

The budget of the QMC does not depend on central or state government subsidies. Rather, the municipal (local) taxation in which the *Octroi* plays a particularly prominent role accounts for an overwhelmingly large share of the budget sources, so that it is fair to conclude that the QMC budget is practically totally linked to the economic profile of the Quetta region. Unless some external factors should arise causing the city economy to stagnate, it is reasonable to expect a similar growth rate for the budget in the foreseeable future.

If the procurement of the equipment under this Project is to go ahead in March 1998 it will be essential to take the necessary budgetary measures for the procurement in and with effect from fiscal 1997-98. On the assumption that the Sanitation Section's budget (for fiscal 1997-98) will grow at virtually the same rate as that maintained for the last three years, it is

possible to estimate the Sanitation Section's budget for fiscal 1997-98 as follows:

(1) Fiscal 1996-97 Budget	Rs. 37,928,000
(2) Rate of budget growth recorded for the last three years	23% (average)
(3) Estimated budget for fiscal 1997-98	Rs. 37,928,000×1.23 = Rs. 46,651,000

From Items (1) and (3) above, it follows that the Sanitation Section is likely to achieve a budget increase of around Rs. 8.7 million in the next fiscal year as compared with the previous fiscal year.

(iv) Service Revenue

Assuming that the Sanitation Tax will be Introduced

On the premise that the Sanitation Tax will be introduced, it can be expected that an annual revenue of around Rs. 10,560,000 (Rs. 3,000,000 + 7,560,000) will be generated for the increased maintenance and management costs.

Assuming that the Sanitation Tax will not be Introduced

As stated before, it is possible to anticipate that the increase in the budget for the next fiscal year (1997-98) will be approximately Rs. 8,700,000. The service revenue will therefore be as follows after the budget increase has been taken into account:

Increase in the budget of the Sanitation Section for the next fiscal year (1997-98)	Rs. 8,700,000 (estimated)
Appropriation funds for the service operation after allowing for the increased budget allocation made to the Sanitation Section	Rs. 3,000,000+Rs. 8,700,000 = Rs. 11,700,000

It can thus be concluded that even in the event that the introduction of the new Sanitation Tax is delayed, the increase in tax revenue associated with

the increase in the regional population and the activation of the local economy can be expected to yield a level of service funds from budget appropriations at a level of approximately RS. 11,700,000, that is, roughly the same level as that which would be realized if the Sanitation Tax were introduced.

(b) Expenditure

From the previous considerations, the following expenditures can be calculated:

Personnel costs associated with new manpower recruitment	Rs. 2,330,000
Maintenance and management costs for service vehicles and construction equipment	Rs. 7,700,000
Total	Rs 10,030,000

(c) Balance of Revenue (incl. Budget Appropriation Funds) and Expenditure (Service Costs)

The above results can be interpreted as evidence to suggest that revenues (including budget appropriation funds) will exceed expenditure whether or not the Sanitation Tax is introduced and that, consequently, the economic feasibility and viability of the Project will be assured.

Fig. 2-3 shows how the proportion of the maintenance and management costs in the total budget of the Sanitation Section has changed for the last three years. If the equipment procured under this Project is taken into consideration, it can be seen that this cost share will increase from the roughly 10% level it has been for the last two years to a level of around 14 to 16%, in other words, the same level as that of previous three years. This can be described as a perfectly natural result of the move toward greater mechanization from a system that until now has depended mainly on manpower.

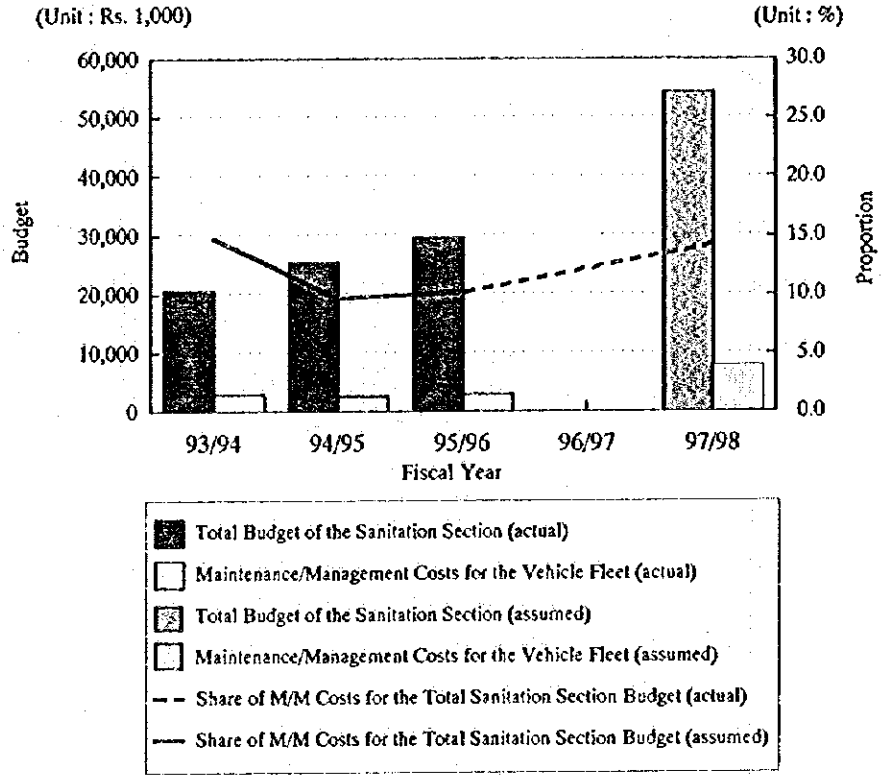


Fig. 3-4 Proportional Share of Annual Maintenance and Management Costs for the Vehicle Fleet in Relation to the Total Budget of the Sanitation Section

CHAPTER 4 PROJECT EVALUATION AND RECOMENDATIONS

CHAPTER 4

PROJECT EVALUATION AND RECOMMENDATIONS

4.1 Project Effects

The collection rate of solid waste will be increased through the following improvements: (1) the substitution of the present manual labor throwing garbage into dump trucks with the proposed mechanization by the detachable-container trucks and containers, (2) the increase of the number of collection trips from the present 1~1.7 times per day to 3 times per day, and (3) the increase of the number of collection/transportation vehicles from 22 to 51. It will also be possible to eliminate derelict garbage and to reduce waste and offensive odor from scattering through the installation of 198 containers which are about twice the number of the present concrete waste dumping pits. This container installation will be realized through the replacement of existing concrete waste dumping pits with containers and placing containers at the existing waste collecting sites on roads or open spaces. The decrease of solid waste left in the city shall consequently improve the appearance of city streets and residential areas and the environmental conditions in the city. The solid waste transported to the landfill site, on the other hand, will give minimal influence to the surrounding environment with the proposed topsoil covering and leachate collecting/drainage facilities which will prevent flies and mosquitoes generating and prevent ground/surface water contamination.

The implementation of this project should thus contribute to the improvement of the environmental conditions of the entire QMC. The number of direct beneficiaries of this project will be correspondingly about 729,000 which is the population of the QMC. In addition, the number of indirect beneficiaries will be about 1,000,000 which is the population of the district that consists of the QMC, the QCB and the QDA.

4.2 Recommendations

The recommendations for smooth implementation of the Project are as follows:

(1) Independence of Sanitation Section

The Sanitation Section of the Health Department is the executing authority of sanitation and cleansing services of the QMC and substantially functions as an independent

organization under direct control of the Administrator. The Sanitation Section is however managed under the Health Department from the organizational and financial points of view. In actual position, the personnel of the Sanitation Section occupies more than a half of that of the QMC in terms of number, and the budget appropriation of the Sanitation Section also occupies more than 50% of the Health Department's budget. Since a more efficient management, operation and maintenance under the increased number of collection/transportation vehicles is required in the future, the Sanitation Section should be strengthened as soon as possible through organizational and financial independence as the sole authority responsible for sanitation and cleansing services.

(2) Execution of Sanitation Education

The success of public sanitation and cleansing services will depend on the consciousness of citizens who are the final generators of solid waste. Sanitation education has not been on the stage of dissemination to gain the citizens' consciousness since the present system has a small amount of and rather deteriorated collection/transportation vehicles.

The execution of public education is recommendable in parallel with the implementation of the Project, by which the required number of collection/transportation vehicles will come into operation. The education will be carried out through campaigns and dissemination activities which will be prepared based on a planned dissemination program. By emphasizing the important role of public sanitation and cleansing services at the turnover ceremonies for new vehicles and the system, the people should recognize that proper solid waste treatment will improve the surrounding environmental conditions.

Apart from the above, it will also be necessary to incorporate in the curriculum for upper grade levels in elementary schools, with appropriate materials prepared, the said sanitation education which will teach why the proper way of solid waste treatment is necessary. This educational approach to children will be effective for the dissemination to elder persons.

(3) Regulations on Construction Waste

Almost all buildings (houses, walls, etc.) in Quetta City are made of brick covered with clay. The Study Team found that many houses are being constructed or reconstructed

and discovered that brick stuff and soils are discharged from these construction sites. It was also observed that construction wastes placed on narrow streets tend to disturb the local traffic. On the other hand, the said construction wastes have caused the volume and the bulk density of solid waste to increase and have been the source of dust under the arid climatic conditions. The said waste has worsened the environmental conditions of the city.

The generators of solid waste, in principle, shall be the responsible entities of sanitation and cleansing activities. The collection and disposal of domestic waste have been a matter of public service from the viewpoint of sanitation. As to construction waste, however, the construction entities should be the ones responsibile. It is therefore recommended that the city should enact municipal regulations on construction waste at the time of introducing the new collection/transportation system of the project. In accordance with the regulations, each construction enterprise will be obliged to bring its construction waste to the final landfill site.

Regarding the final landfill site of the city, it will be indispensable under the conditions of individual bringing of construction waste by enterprises or citizens to introduce sanitary landfill methods and to control the enterprises appropriately. This Project comprises the improvement plan of the final disposal system of the city and will be able to cope with these subjects correspondingly.

(4) Classified Collection and Disposal of Hospital Waste

The Study Team recognized considerable hospital waste consisting of tablets, capsules, used dropper bags, hypodermic syringes, etc., in the existing landfill site. This indicates that hospital waste has been transported into the landfill site without separation from domestic waste of houses.

Considering the topsoil spreading works at the landfill site and the activities of scavengers who make their living by recovering valuables from garbage, the existence of infectious waste may result in secondary infection. It should therefore be considered that hospital waste be collected and transported separately in special containers and not to mix it with domestic waste from the stage of collection. At the final landfill site, on the other hand, it will is essential that the disposal areas for hospital waste be demarcated and the hospital waste covered with topsoil without delay. On the contrary, some hospitals have been incinerating their own waste in open lots where incineration

seems to be of dangerous chances. It is recommended that progressive ways of hospital waste disposal will be developed.

APPENDICES

1. Member List of the Basic Design Study Team

Name	Position	Affiliation
Mr. Takashi Sasaki	Team Leader	Development Specialist, Institute for International Cooperation, Japan International Cooperation Agency (JICA)
Mr. Tomio Kawabata	Technical Adviser	Vehicle Division, Public Cleaning Project Bureau, Yokohama City
Mr. Tatsuhide Hamasaki	Coordinator	First Project Study Division, Grant Aid Project Study Department, JICA
Mr. Takao Yoshida	Chief Consultant, Management, Operation and Maintenance Planner	CTI Engineering Co., Ltd.
Mr. Tsugiya Fukumoto	Collection and Transportation Planner	CTI Engineering Co., Ltd.
Mr. Masakazu Maeda	Disposal planner/ Environmental Analyst	CTI Engineering Co., Ltd.
Mr. Kenichiro Kondo	Cost Estimate/ Procurement Planner	CTI Engineering Co., Ltd.

2. Itinerary of the Basic Design Study Team

No.	Date	Day	Activity
1	17 Aug.	Sat.	Depart Tokyo
2	18 Aug.	Sun.	Arrive Islamabad, Courtesy call to EOJ, JICA, EAD
3	19 Aug.	Mon.	Depart Islamabad
4	20 Aug.	Tue.	Courtesy call to QMC and site survey.
5	21 Aug.	Wed.	Submission and explanation of Inception Report
6	22 Aug.	Thu.	Meeting and Discussion with QMC
7	23 Aug.	Fri.	Data analysis and site survey
8	24 Aug.	Sat.	Meeting and Discussion on the Draft of the Minutes of Meeting
9	25 Aug.	Sun.	Signing of Minutes of Meeting
10	26 Aug.	Mon.	Team Leader, Technical Adviser and Coordinator depart Quetta
11	27 Aug.	Tue.	Team Leader, Technical Adviser and Coordinator report to EOJ, JICA
12	28 Aug.	Wed.	Site survey
13	29 Aug.	Thu.	Site survey
14	30 Aug.	Fri.	Data organization and analysis
15	31 Aug.	Sat.	Data Analysis
16	1 Sep.	Sun.	Site survey and data collection
17	2 Sep.	Mon.	Site survey
18	3 Sep.	Tue.	Site survey
19	4 Sep.	Wed.	Site survey
20	5 Sep.	Thu.	Site survey
21	6 Sep.	Fri.	Data organization
22	7 Sep.	Sat.	Data organization
23	8 Sep.	Sun.	Data analysis
24	9 Sep.	Mon.	Data analysis
25	10 Sep.	Tue.	Data analysis
26	11 Sep.	Wed.	Meeting with QMC and related organizations
27	12 Sep.	Thu.	Depart Quetta, Report to EOJ,JICA
28	13 Sep.	Fri.	Data analysis
29	14 Sep.	Sat.	Depart Islamabad
30	15 Sep.	Sun.	Arrive Tokyo(Consultant Team)

3. List of Party Concerned in the Recipient Country

Local Government, Rural Development & Agrovilles Department

Mr. Ghulam Mohammad Taj, Secretary

Environment Protection Department (EPD)

Mr. Usman Durrani, Secretary, Former Director General of QDA

Planning and Development Department (P&DD)

Mr. Ata Muhammad Jaffar, Additional Chief Secretary

Mr.Abdul Aziz Lasi, Secretary Planning

Mr. Faj Mohammad Faiz, Chief of Section (Environment)

Mr. Chaudhry Muhammad Amin, Secretary, Managing Director of WASA

Quetta Municipal Corporation (QMC)

Mr. Mohammad Abid Javed, Administrator

Mr. Mahmood Ul Hassan, Municipal Commissioner

Mr. Inayat Ullah, Chief Corporation Officer

Mr. Haji Ali Mohammad Baloch, Public Relation Officer

Mr. Mohammad Younus, Officer of Special Duty

Mr. Mohammad Afzal, Sanitation Officer

Mr. Mohammad Riaz, Law Officer

Mr. Qazi Mohammad Anwar, Executive Engineer

Mr. Irshad Uddin, Assistant Engineer

Mr. Abdul Rahim, Budget Superintendent

Mr. Haji Mohammad Younis, Accounts Superintendent

Mr. Malick Younas, Chief Sanitary Inspector

UNICEF (United Nations Children's Fund)

Mr. Abdul Ahad Khan, Resident Project Officer, Quetta

Embassy of Japan, Pakistan

Mr. Mitsuyoshi NAKADA , First Secretary

JICA Pakistan Office

Mr. Akira MURATA, Resident Representative

Mr. Noriaki NISHIMIYA, Deputy Resident Representative

Mr. Masatoshi MURAO, Deputy Resident Representative

Mr. Mahmood A. Jilani, Deputy Resident Representative, Chief Programme Officer