Japan International Cooperation Agency (JICA)

Ministry of Natural Resources and Environment Protection
Almaty City Government
Republic of Kazakhstan

The Study on Solid Waste Management for Almaty City in the Republic of Kazakhstan

Final Report

SUMMARY REPORT

January 2000

Yachiyo Engineering Co., Ltd.
CTI Engineering International Co., Ltd.

Japan International Cooperation Agency (JICA)

Ministry of Natural Resources and Environment Protection
Almaty City Government
Republic of Kazakhstan

The Study on Solid Waste Management for Almaty City in the Republic of Kazakhstan

Final Report

SUMMARY REPORT

January 2000

Yachiyo Engineering Co., Ltd.
CTI Engineering International Co., Ltd.

Preface

In response to a request from the Government of the Republic of Kazakhstan, the Government of Japan decided to conduct a development study on Solid Waste Management for Almaty City in the Republic of Kazakhstan and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Hiroshi ABE of Yachiyo Engineering Co., Ltd. and consisting of members from Yachiyo Engineering Co., Ltd. and CTI Engineering International Co., Ltd. to Kazakhstan three times between February 1999 to January 2000. In addition JICA set up an advisory committee headed by Mr. Morikazu MIYANOHARA, Assistant Manager, Clean Center Administration Division, Environment Bureau, Kobe between February 1999 to January 2000.

The team held discussions with the officials concerned of the Government of the Republic of Kazakhstan and conducted field surveys in the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

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

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Kazakhstan for their close cooperation extended to the Team.

January 2000

Mr. Kimio FUJITA
President
Japan International Cooperation Agency

Mr. Kimio FUJITA
President
Japan International Cooperation Agency

January 2000

Letter of Transmittal

We are pleased to submit to you the report of The Study on Solid Waste Management for Almaty City in the Republic of Kazakhstan. The report includes the advise and suggestions of the authorities concerned of the Government of Japan and your Agency as well as the comments made by the Ministry of Natural Resources and Environment Protection, Almaty City Government and other related authorities in the Republic of Kazakhstan. This report consists of Summary Report, Main Report, Supporting Report, Data Book and Environmental Impact Assessment Report.

This report deals with the present conditions of solid waste management in Almaty City and presents the master plan for solid waste management with the target year of 2010, as well as the results of the feasibility study for the priority project proposed in the master plan.

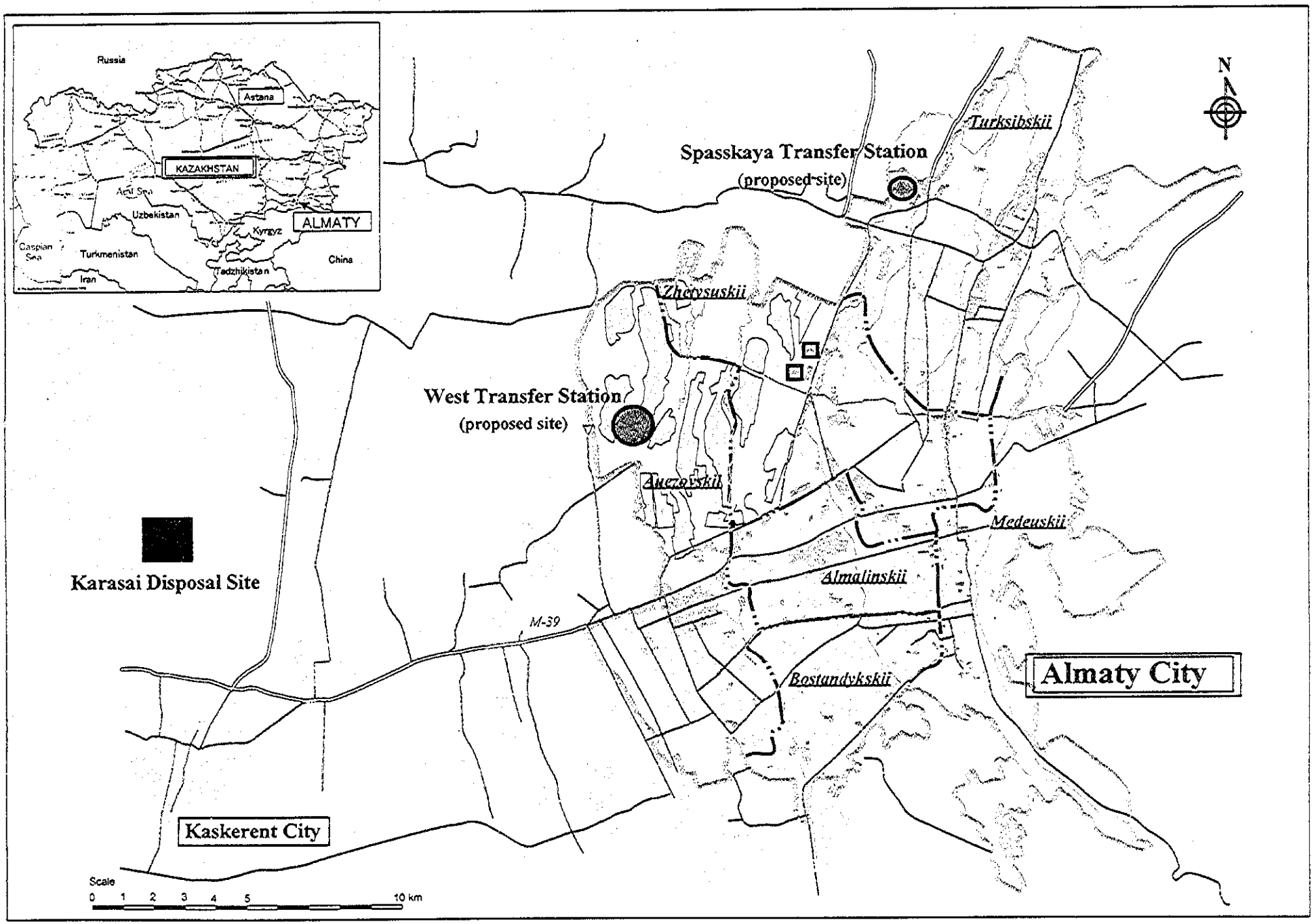
In accordance with the contract with your Agency, we Yachiyo Engineering Co., Ltd. in association with CTI Engineering International Co., Ltd. implemented this study during the period of February 1st, 1999 to February 7th, 2000. Based on a deep understanding of the existing conditions in the Republic of Kazakhstan we have prepared a plan that is feasible and can be implemented.

Finally we sincerely hope that this report will be effectively used for the realization of the master plan. We wish to express our gratitude to your Agency, the Ministry of Foreign Affairs and other concerned Governmental Agencies for the close cooperation and assistance extended to us during the Study.

Very truly yours,

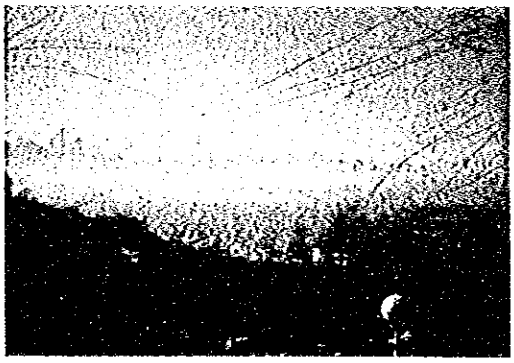
阿部 宏

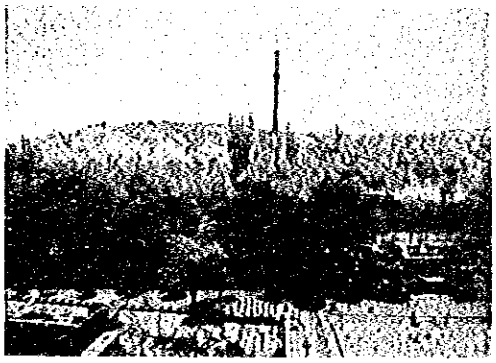
Mr. Hiroshi ABE
Team Leader
The Study on Solid Waste Management for
Almaty City in the Republic of Kazakhstan



Location Map of the Study Area

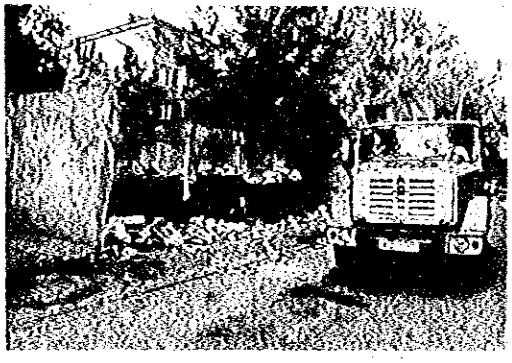
A - ALMATY CITY



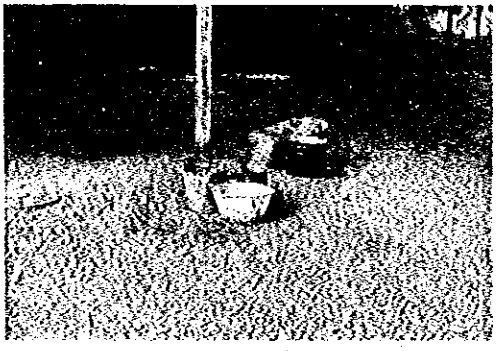


B - SWM CONDITIONS IN THE CITY

1) Collection from individual houses

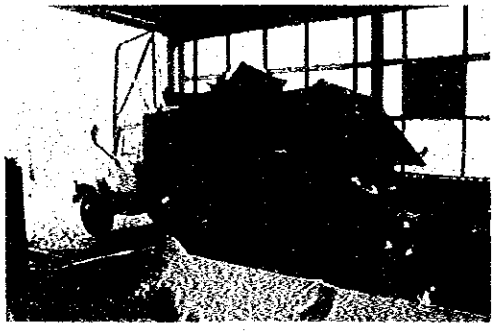


2) Collection from block houses



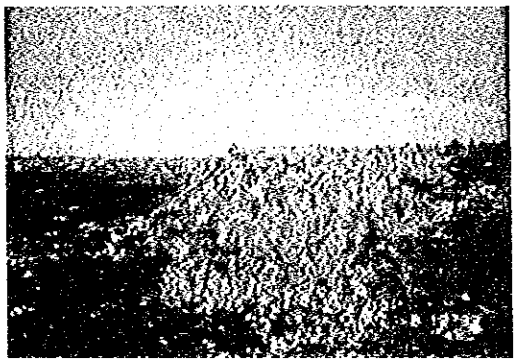
3) Discharge containers in IH

4) Container station for block houses



5) Existing Compost Plant operated as a transfer facility
(a) KO collection trucks emptying (b) KO415 trucks transport to Karasai

6) Transfer station temporary operation



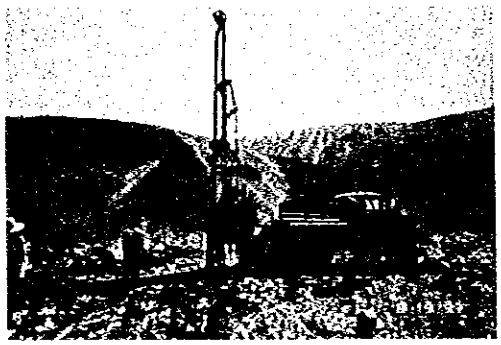
7) Karasai disposal site

8) Entrance gate of Karasai disposal site

9) Disposal operation at Karasai

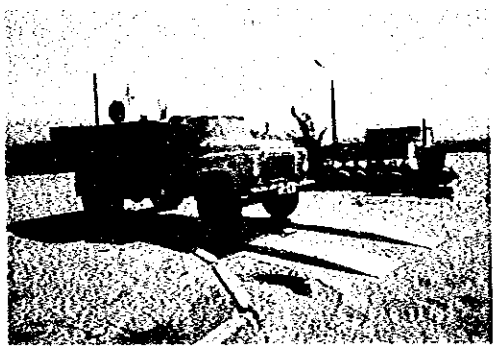
C - FIELD SURVEYS

10) Water sampling



11) Soil investigation

12) Waste sampling



13) Waste amount measurement

14) Topography survey at new West T/S site

15) Soil sampling survey

D – URGENT IMPROVEMENT AREAS FOR COLLECTION SERVICE

16) Self burning in individual housing areas because of infrequent collection (Auezovski district)

17) Uncollected waste in Turksibski district near individual and block housing areas

18) Uncollected waste burning at low to medium rise block housing (Medeuski)

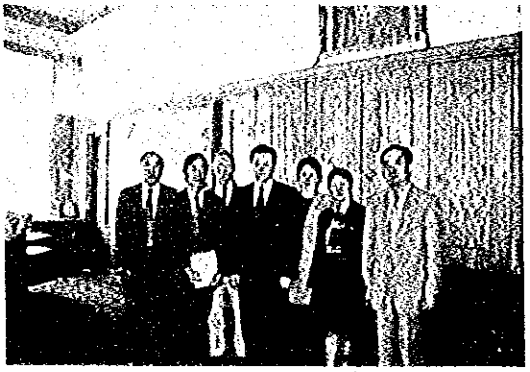
19) Uncollected waste at individual housing area (Zheteususki)

20) Waste scattered beside containers because of lack of container capacity and infrequent collection (Almalinski)

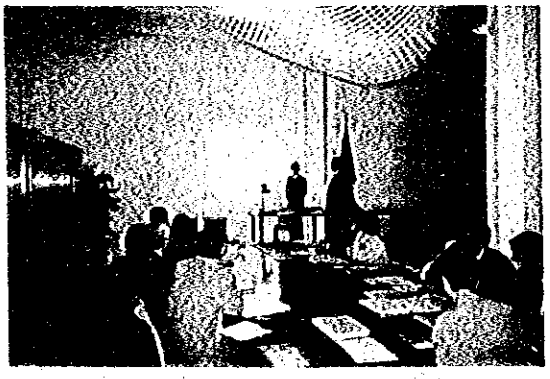
21) Open dumping at site outside the city illegally receiving Almaty city wastes (Barys site)

E – JOINT STUDY BETWEEN JICA TEAM AND KAZAKH SIDE

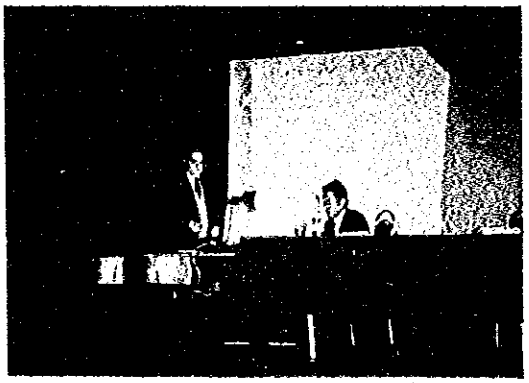
22) Discussion of the M/P with Minister of Environment at Karasai disposal site



23) Meeting with Almaty City Akim, deputy Akim and the Akim staff



24) Steering Committee meeting to present Study report



25) One of two seminars held during the Study course

FINAL REPORT COMPOSITION

The Final Report is composed of the following reports:

1. SUMMARY REPORT
2. MAIN REPORT
3. SUPPORTING REPORT
4. DATA BOOK
5. ENVIRONMENTAL IMPACT ASSESSMENT REPORT

This report is the SUMMARY REPORT

EXCHANGE RATE
US$ 1.00 = KZT 115 (May 3, 1999)
US$ 1.00 = Yen 121.10 (May 6, 1999)

Abbreviations

ACDEP	Almaty City Department of Environmental Protection
(Akim)	Head of Local Government, Mayor, Governor, or Head of District
(Akimate)	Local Government Office
(Maslikhat)	Parliament, Council of Local Government
(Oblast)	Province
AMC	Territorial Committee on Regulating Natural Monopoly and Protecting Competition – Anti Monopoly Committee
Alt.	Alternative
BH	Block housing
C/N	Carbon-Nitrogen factor
CIS	Commonwealth of Independent States
D/S, DS	Disposal site
EIA	Environmental Impact Assessment
EIU	Economic Intelligence Unit
EL	Elevation
FDI	Foreign Direct Investment
FSU	Former Soviet Union
GDP	Gross Domestic Product
GKI	Territorial Committee of State Property and Privatization
GRDP	Gross Regional Domestic Product
IC/P	Incineration Plant
IEE	Initial Environmental Examination
IH	Individual housing
JICA	Japan International Cooperation Agency
JSC	Joint Stock Company
KSD (PKSK)	Cooperatives for individual house community management
KSK (PKSK)	Cooperatives for block housing management
KZT, T	Kazakhstan Tenge (Exchange rate at May 3, 1999 US$ 1.00 = KZT 115.0)
Kcal/kg	Kilo calorie per kilogram
Kg, kg	Kilogram
Kg/cap/d	Kilogram per capita per day
Km, km	Kilometer
NEAP/SD	National Environment Action Plan for Sustainable Development
NEC	National Environment Center of the Ministry
RMB	Road Management Board
SWM	Solid Waste Management
T/S, TS	Transfer station
The (Study) Team	The JICA Study Team of the Study
The Ministry	Ministry of Natural Resource and Environmental Protection

The Study	The Study on Solid Waste Management in Almaty City
USD	United States Dollar
USSR	Union of Soviet Socialist Republics
bn	Billion
m^3	Volume in cubic meters
t/a	Ton per annum
t/d	Ton per day

SUMMARY REPORT
CONTENTS OF THE SUMMARY REPORT

LIST OF FIGURES AND TABLES

EXECUTIVE SUMMARY

1. BACKGROUND AND PURPOSE OF THE STUDY

Almaty city is the largest city in the Republic of Kazakhstan with a population of 1.1 million. It is the economic center of the Republic. Solid waste generated in the city is estimated to be 350,000 ton/year (960 ton/day) including industrial waste. Solid waste collection and management of the transfer station and disposal site have been privatized since 1996. Collection companies make contracts with waste generators such as KSK (Resident Cooperatives) then collect solid waste and service charge. However, the tariff for the service is set at a very low level by the Anti-Monopoly Committee (AMC). None of the collection companies have any capability to renew equipment and facilities.

A compost plant was constructed but is not currently producing any compost due to a lack of demand. At present it is operated as a transfer facility. Karasai disposal site is the only approved disposal site for solid waste from Almaty city. It is located about 34 km from Almaty city center. To cope with the long transportation distance, a transfer station was constructed but is not currently continuously operating due to a shortage of transportation vehicles and accumulation of solid waste inside the transfer station. As a result, half of the solid waste collected in Almaty city is transported to other disposal sites which were intended to service only small neighboring towns, not Almaty city. These sites are not operated as sanitary landfill sites.

The solid waste management system (SWM) of Almaty City is on the verge of collapse. Since solid waste collection and proper disposal is indispensable to maintain public health and cleanliness of the living environment, a sustainable system must be established.

In 1997, the Government of the Republic of Kazakhstan requested the Government of Japan to conduct a study on SWM for Almaty city to prepare a master plan and feasibility study to address these problems.

2. MASTER PLAN

2.1 Framework and Planning Conditions

The population of Almaty city in 2010 is estimated to be 1,150,000 persons, almost the same as the current number. GRDP of Almaty City is expected to be 311 billion KZT in 2010 based on projections of 2% annual economic growth after the year 2000. Further projections of solid waste generation and income in 2010 are:

- Population in 2010 — 1,150,000 person
- GRDP in 2010 — 311 billion KZT
- Average income — 6,900 KZT/month/capita
- Solid waste in 2010 — 366,588 ton/year (1,004 ton/day)

The economy of the Republic of Kazakhstan is still in transition from a centrally planned economy to a market oriented economy. Therefore, many laws and institutions are still undergoing changes. However, the master plan has been formulated on the assumption that Almaty city is responsible for SWM and that the cost of the service shall be covered

by residents and/or Almaty city itself, in accordance with the policies of decentralization and privatization.

2.2 Major Proposal

Firstly, the master plan proposes to create the Waste Authority as a state enterprise under the control of Almaty City Government. The Waste Authority will be responsible for SWM in Almaty City and will guarantee universal service. Actual operation of solid waste collection, and management of transfer stations and the disposal site will be contracted out to private companies.

Secondly, the master plan proposes that the Waste Authority shall collect the service charge from solid waste generators to cover all of the costs of providing the service.

Thirdly, the master plan proposes that the collection system shall be changed, new transfer stations shall be constructed, facilities and operation of Karasai disposal site shall be up-graded and a realistic recycling system shall be introduced.

2.3 Contents and Schedule of the Master Plan

	Contents of Master Plan	Cost KZT mill	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	Phase I												
(1)	Establishment of Waste Authority	4.6	▼		▼						▼		
(2)	Introduction of new collection system	808.7											
(3)	Construction of transfer stations	1,149.4											
(4)	Improvement of Karasai disposal site	1,123.3											
(5)	Rehabilitation of Illegal dump site	198.1											
	Engineering service	164.1											
	Sub total	3,448.2											
2	Phase II												
(1)	Expansion of new collection system	478.4											
(2)	Introduction of separate collection	208.9											
(3)	Capacity expansion of T/S & D/S	73.5											
(4)	Rehabilitation of illegal dump site	282.5											
(5)	Others (revise of tarift)	0.0											
	Engineering service	52.2											
	Sub total	1,095.5											
	Total	4,543.7											

Note: ▼ Introduction of new tariff rates

In Phase I, all equipment required will be procured by the Waste Authority because the private sector is too weak to finance such acquisitions. It is anticipated that the private sector will gradually increase its capacity to finance new equipment and will procure half of the required collection vehicles after the year 2005.

2.4 Financial Plan

Expenditures of the Waste Authority to provide the overall service will be KZT 1.2 and 1.4 billion (excluding VAT) in the years 2005 and 2010 respectively. The required tariffs are:

	Unit	2005	2010
Domestic waste	KZT /person/month	75	90
Commercial and medical waste	KZT per ton	3,900	4,680
Transfer station	KZT per ton	1,750	2100
Disposal site	KZT per ton	770	924

The above tariff for domestic waste is about 1% of the income of residents. Revenue and expenditure of Waste Authority are projected to be:

(Unit : KZT million)

	2005	2010
Revenue	1,206.8	1,542.1
Expenses	1,232.5	1,363.3
Balance	-25.7	178.8

Note: VAT is not included

Up to the year 2005, 70% of financing will be provided by foreign loans and the balance by local loans. For both foreign and local loans an interest of 8% in real terms and a term of 20 years with no grace period have been assumed. Investment after 2006 is financed from internal reserves. Cash flow projections for the Waste Authority show that it will survive under these conditions. Cash reserves and debt in year 2010 will be KZT 0.6 and 2.0 billion respectively.

2.5 Effectiveness of the Master Plan

- All technical systems recommended in the Master plan satisfy requirements such as economics, simplicity, acceptability by and adaptability for residents.
- The Master plan has greatly reduced environmental and public health risks by raising the collection rate to close to 100% and improving the cleanliness at collection points by using better containers and more effective collection trucks. The universal collection service will contribute to a clean and healthy living environment in Almaty City.
- The master plan has achieved improved performance at a minimum economic cost. The new charging mechanism for the service ensures that funds are available for carrying out this essential public service. The plan also creates financial stability for the Waste Authority and private companies involved in SWM.
- The creation of the Waste Authority will for the first time clearly define the public responsibility for the overall management of this public service, while creating a mechanism to privatize service delivery in sympathy with the privatization policies. It will create a model that may be used in other sectors. It will help clarify the role and responsibility of Government for such services. This role has become very confused in the changing economic environment.
- The plan has protected the poorest strata of society through introduction of a cross subsidy. The tariff burden imposed on households will be no more than 1% of their income.
- Improvement of the existing disposal site will mitigate the environmental impact on the surrounding area. Rehabilitation of illegal dump sites will rectify current environmental problems. Environmental impacts generated by the construction of new transfer stations will be minimized through mitigation measures for water pollution and odor.

- The incentive for illegal dumping will be greatly reduced by providing sufficient capacity for all collection contractors to use the transfer stations.

3. FEASIBILITY STUDY

3.1 Priority Project and Step-wise Implementation

It is proposed to implement the master plan in two phases according to the priority of the components. Phase One should be implemented by the year 2005 and consists of the following components:

a. Establishment of Waste authority
b. Introduction of new collection systems
c. Construction of transfer stations
d. Improvement of Karasai disposal site
e. Model rehabilitation of Spasskaya illegal disposal site

It is desirable to implement all of the priority project as soon as possible. However, it is necessary to implement the priority project step by step in view of the financial constraints. Therefore, the components of the Priority Project are divided into an Urgent Improvement Project and a Second Priority Project.

3.2 Contents and schedule of priority project

	Contents of Priority Project	Cost KZT mill	2000	2001	2002	2003	2004
1	Urgent Improvement Project						
(1)	Establishment of Waste Authority	4.6	▼ ▼		▼		
(2)	Procurement of collection equipment for urgent area	330.6					
(3)	Construction of West transfer station	705.8					
(4)	Procurement of disposal equipment	248.8					
	Engineering service	64.5					
	Sub total	1,354.3					
2	Second priority project						
(1)	Procurement of collection equipment	478.1					
(2)	Construction of Spasskaya transfer Station	443.6					
(3)	Improvement of Karasai disposal site	874.5					
(4)	Model rehabilitation of illegal dump site	198.1					
	Engineering service	99.7					
	Sub total	2,094.0					
	Total	3,448.3					

Note: ▼ Introduction of new tariff rates

3.3 Financial Plan

The tariff in 2005 should be KZT 75 /person/month to cover the cost of service provided by the Waste Authority. The tariff should be raised in two steps:

(i) An interim tariff (including the cross subsidy) to be introduced in July 2000 of KZT 56 /person/month, the same as the present tariff for individual houses; and

(ii) the new tariff of KZT 75 /person/month to be introduced in April 2002 once universal coverage of the service is achieved by using the West transfer station and equipment procured through the urgent improvement project.

Three alternative cases for financing the urgent improvement project and the second priority project have been considered:

Case a.	The whole priority project will be financed by foreign and local loans.
Case b.	The urgent improvement project portion of the priority project will be financed by a grant and the second priority project will be financed by foreign and local loans.
Case c.	The whole priority project will be financed by foreign and local loans with different loan conditions from that of Case a.

For cases a and b the loan terms have been assumed to be:- Interest rate 8%; repayment period 20 years with no grace period. For case c the terms have been assumed to be:- interest rate of 10%; repayment period 10 years with two years grace period.

For the Waste Authority to survive, it is preferable to obtain a grant for the urgent improvement project. However, the Waste Authority will survive even if all investments for priority projects are financed by loans (case a). In case c the Waste Authority will be forced to take additional long-term loans after the year 2006 and cannot accumulate any cash reserves. Accordingly the tariffs are higher in this case.

3.4 Project Evaluation

(1) Technical evaluation

Currently there is an imbalance in the system, with insufficient capacity for transfer of waste at transfer stations and transport to the final disposal site. Until this balance is restored illegal dumping is inevitable. The proposed priority projects will bring the overall waste management system back into balance.

(2) Environmental evaluation

The anticipated environmental impact of the priority project is largely beneficial, as the project is essentially an urban environmental improvement project. The new transfer stations will have some negative impacts, but mitigation measures will minimize these. Improvements at the disposal site will reduce the current impact of this site on the surrounding area.

(3) Economic and Financial evaluation

The priority projects are designed to maximize the productivity of the limited capital available through two key measures:

- Firstly a new transfer station is developed as quickly as possible. This maximizes the productivity of both the existing collection fleet and new collection vehicles. It also minimizes the future investments necessary in collection vehicles.
- The deemed leasing charge introduced in the contract out system will force the contractors to maximize the productivity of both existing and new equipment.

This is in stark contrast to the existing system which actually discourages efficient use of existing capital resources.

The priority project and the management procedures to be introduced by the Waste Authority represent a major step towards improving capital utilization in the sector.

The only source of revenue for the Waste Authority is the service charge. The tariff has been set to cover the cost of the service while bearing in mind the ability of residents to pay. Tariff structure will include a cross subsidy measure so that residents within the lowest 25% income group are exempt. Tariff in 2005 is set at KZT 75 /person/month for residents, which is less than 1% of the average income of the remaining 75% of the population. Total revenue of the Waste Authority is estimated to be KZT 1.2 billion in 2005 which will be only 0.43% of GRDP.

4. RECOMMENDATIONS

The Master Plan foresees that eventually most of the investment needed in this sector will come from the private sector, once stronger private companies emerge and the local banking system recovers some capability for long term financing. However the private sector is currently extremely weak and it is likely to be at least ten years before it can play a major role in financing of this sector. In the meantime, Government must play a significant role in financing this sector.

Unfortunately the city government still does not appear to appreciate the changed role of financial institutions in the new economic order. Thus the first step to implementing the priority project must be a change in attitude by the city government.

Secondly a reassessment needs to be made of realistic financing options. In the opinion of the study team the only realistic option is "a loan from one of the international development banks to the city government or the Waste Authority with a guarantee from the Republican government. This might be combined with a grant from one of the international aid organizations." The other options appear to be unrealistic.

The city government should therefore concentrate on trying to arrange finance from one or several of the international development banks. The city government should prepare for negotiations with potential lenders. Again it must be stressed that each potential lender will insist on making their own assessment of its financial viability. Therefore, the City must cooperate with that process.

Thirdly, the City government should proceed as quickly as possible with the formation of the Waste Authority. The city government is uncertain about the prospects for financing the priority project, given its limited powers to influence the priorities assigned by the Republican Government for the use of foreign loans and grants. The City government should not let this uncertainty slow the formation of the Waste Authority.

Formation of the Waste authority is important not only for the implementation of other new projects. It will play an immediate and critical role in management of the sector even if financing for other new projects is delayed. It does not require external financing. The only financing needed to establish the Authority is a contribution for working capital from the city budget for the year 2000.

Chapter 1

INTRODUCTION

1. INTRODUCTION

Almaty is the largest city in Kazakhstan with a population of 1.1 million and is the economic center of the Republic. Solid waste generated in the city is estimated to be 340,000 ton/year (960 ton/day) including industrial waste. Solid waste collection and management of the transfer station and disposal site have been privatized since 1996. The collection companies make contracts with waste generators such as KSK (Resident Cooperation Organization) under which they will collect solid waste and collect payment directly from the waste generators. However, tariff for the service is set at a very low level by the Anti-Monopoly Committee (hereinafter referred to as "AMC"). None of the collection companies have the capability to renew equipment and facilities.

A compost plant was constructed but is not producing compost at present due to lack of demand for compost. It is used as transfer operation. Karasai disposal site is the only approved disposal site for solid waste from Almaty city and is located about 34 km distance from Almaty city center. To cope with the long transportation distance, a transfer station was constructed but does not operate continuously at present because of a shortage of transportation vehicles and accumulation of solid waste inside the transfer station. As a result, half of the solid waste collected in Almaty city is disposed of at other disposal sites which are designated for use by neighboring small towns but not for Almaty city.

The City has failed to provide a proper service and to guarantee universal service throughout Almaty City. The solid waste management system of Almaty city is on the verge of collapse. Since solid waste collection and proper disposal is indispensable to maintain public health and cleanliness of the living environment, a sustainable system must be established.

Under these circumstances, the Government of the Republic of Kazakhstan (hereinafter referred as "the RK") requested the Government of Japan in 1997 to conduct a study on Solid Waste Management for Almaty City.

The Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, sent a Study Team to the RK on February 9th, 1999, to commence "The Study on Solid Waste Management for Almaty City in the RK" (hereinafter referred to as "the Study") in accordance with the Scope of Works for the Study signed on August 17th, 1998, in Almaty City between officials of the Ministry of Ecology and Natural Resources, Agency for Strategic Planning and Reforms and Almaty City Government for the Kazakh side and the JICA Preparatory Study Team for the Japanese side.

The Study is intended to produce a master plan and to carry out feasibility studies of the most urgent projects.

Chapter 2

EXISTING CONDITIONS

2. EXISTING CONDITIONS

Solid Waste Management (hereinafter referred to as "SWM") in Almaty City is on the verge of collapse. The reasons can be summarized as follows. These conditions are well known to the officials of the Akimate and the concerned ministries but so far there has been no realistic plan or means for improving them.

- The waste is collected by private companies under direct contracts with resident groups in the absence of overall coordination at the public level.
- The tariff levels for the service are fixed at low levels by the AMC. As a result the financial condition of the collection companies is desperate. They are in no position to expand the collection service or renew their old equipment.
- It is estimated that the private collection companies have about 210 trucks, all Russian made and half of which are dump trucks. Fifty-five (55%) percent of the trucks are over 6 years of age and one fifth are over 10 years old. Service is provided regularly in block housing areas but irregularly in individual housing areas. The collection service coverage is about 75%. However illegal dumping at disposal sites surrounding the city but not sanctioned for Almaty City waste is rampant, with only 50% of the collected waste going to the only sanctioned disposal site for Almaty City at Karasai.
- The distance to Karasai disposal site requires the operation of a transfer facility and trucks. However the existing transfer facilities (these facilities include the existing compost plant which is operated as a transfer facility and the transfer station which is operated from time to time) can only transfer at most 200 tons a day to the disposal site and this is the main reason for the wide spread illegal dumping of waste.
- The existing disposal site at Karasai is 24.5 kilometers from the western boundary of the city on an area of 29.2 hectares. The site is presently operated as an uncontrolled dumping site and lacks the facilities and heavy equipment to sustain sanitary a landfill operation. It receives on average 400 ton/day of waste from Almaty City. The site is operated by a private company and is monitored by both the Almaty City Department of Environmental Protection (hereinafter referred to as "ACDEP") and Oblast Department of Environmental Protection. However both organizations have failed to control dumping at this site.
- Illegal dumping is encouraged by the lack of sufficient collection and transfer capabilities. ACDEP is constantly monitoring and forcing closure of illegal dump sites, but newer sites appear almost instantly. The largest illegal dump site in the city, Spasskaya site located in Turksibski district receives about 100 tons of waste a day.
- Recycling is carried out mainly by waste pickers at the disposal sites and transfer station and the demand for recyclable materials has dropped significantly because of the poor economic conditions. It is estimated that less than half of one percent (<0.5%) of the generated plastic and paper wastes in the city are recycled at present.
- Much effort has recently been applied to regulate the classification and treatment of industrial waste in Kazakhstan. ACDEP has records of 394 industrial establishments and estimates of the waste amounts they produce. However no system is in place to record the amount and quality of the actual waste generated.

It is recommended to replace the present toxic waste classification system with a system compatible with international standards and to establish a monitoring system to record actual generation and recovery of wastes.

- It is necessary to improve the management of hospital waste in Almaty city. Infectious wastes should be separated at the hospitals. Introduction of intermediate treatment system for these wastes is required prior to their transport to the disposal site.
- Norms and standards for collection and disposal exist but many are not enforced because of the poor conditions of the facilities of SWM. However there is a need to introduce laws defining the role of the State organs in SWM, the ownership of the SWM facilities and equipment, the leasing and contracting out of SWM services to private companies and the setting of tariff levels for the service.
- At present the SWM service is supported financially only by the tariffs collected from the citizens and the tipping fees collected at the transfer station and disposal site. The tariff levels set by the AMC for household and industrial waste collection service have recently (August 1999) been increased by 17%, the first increase since 1997. However this increase is far smaller than inflation over the same period, and fails to bring the tariff up to a realistic level. Furthermore the system for collection of the tariff is not well established and it is reported that only 70% of the expected tariff is actually collected.

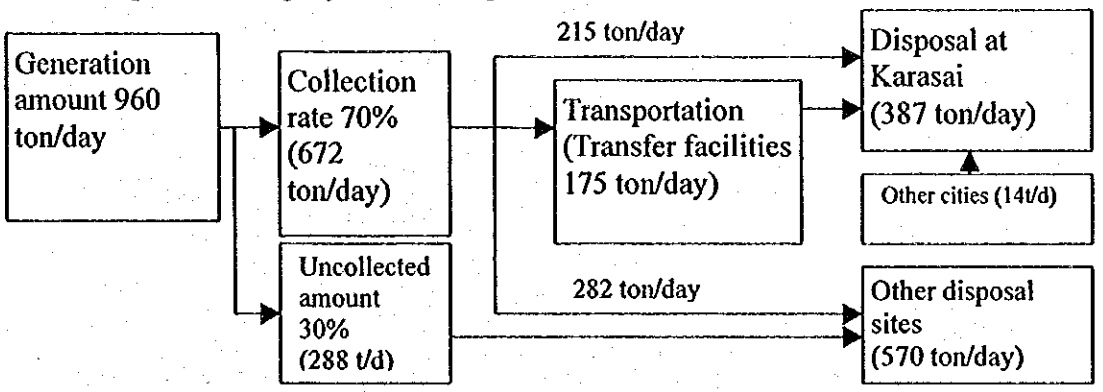
Chapter 3

ISSUES TO BE SOLVED

3. ISSUES TO BE SOLVED

It must be very clearly stated that SWM in Almaty City is on the verge of collapse as described in the previous section. The following issues which have led to this situation are considered in the preparation of the master plan (hereinafter referred to as "M/P").

(1) In outline, current solid waste flow is as follows. Although Karasai disposal site is the only approved disposal site for waste from Almaty city, it receives less than half the amount of solid waste collected in the city. The remaining waste is disposed of illegally at other disposal sites.



(2) Although all responsible authorities, including the municipality, understand this situation, no effective measures have been taken or are planned.

(3) None of the collection companies are able to replace their equipment. Therefore, it is doubtful that they can continue their service for much longer.

(4) Privatization of solid waste collection service started in 1996 but the financial condition of the companies is poor and the service provided is inadequate. The main causes are:

a. Tariff for the service is set by the Anti-monopoly committee but the tariff is too low to meet the costs of the services required.

b. Local government administration is basically responsible for the state of affairs within its territory, as outlined in the Constitution, Article 85. However Almaty City has passed the responsibility of public health, which is included the "state of affairs" to private companies.

c. Collection of SWM related tariffs is much more difficult than collection of electricity or water tariffs because there is no effective sanction against non payment. The present system does not allow for this problem.

Chapter 4

MASTER PLAN

4. MASTER PLAN

4.1. Basic Policy and Target

1) Basic Policy

The basic policy to formulate the M/P is set for each of technical, financial and institutional aspects as shown in Figure 4.1.1.

TECHNICAL ASPECTS

1. Set up minimum requirements for the Service
2. Formulate alternatives to achieve minimum requirements
3. Select the minimum cost alternative

FINANCIAL ASPECTS

1. Formulate financial base to cover operation and maintenance costs through collection of service charge
2. Introduce cross subsidy system
3. Tariff level between 1-2 % of income

INSTITUTIONAL ASPECTS

1. Review and reform SWM service system
2. Guarantee universal service to whole area by the city
3. Reform tariff system set by Anti-monopoly committee
4. Establish implementation organization for investment
5. Restructure the management system of facilities and equipment
6. Provide incentives for private sector development of service delivery

Figure 4.1.1 Basic Policy for the M/P

2) Target of the M/P

The targets of the SWM service are to provide speedy, efficient and economical service to collect solid waste from urban areas where it is generated and to dispose of it in a sanitary manner, in order to provide the citizens with a sound sanitary environment. The need for environmental conservation has pushed countries in the developed world to exert efforts to transform from heavy waste generation societies to ones where less waste is generated, through development of waste reduction and recycling schemes. In the case of Almaty these shall be considered among the targets for the long term plan.

On the other hand the important issues in Almaty City are at present to rebuild a sustainable system to provide collection service to the whole area of the city and to provide the much needed sanitary disposal of solid waste. The resolution of these issues shall be tackled in the medium term. Therefore the target of the M/P is to develop a sustainable SWM system.

a. Target year Medium term: 2005, Long term: 2010
b. Target

Establish a Sustainable SWM System

- Arrangement of appropriate equipment and facilities
- Reform of institutional set up
- Establishment of financial base
- Provision of appropriate service to whole city area
- Introduction of an appropriate system to reduce and recycle solid waste once the economic conditions have improved sufficiently to sustain such a system

4.2. Framework and Conditions of the M/P

4.2.1 Future Population

Almaty City Architectural and Town Planning Department is preparing a new M/P for the city with the target year of 2030. The population forecasts for the new plan have been adopted in this Study and are shown in the following Table 4.2.1.

Table 4.2.1 Population Forecast

(unit: person)

District	1999	2005	2010
Almalinski	188,500	184,900	183,200
Auezovski	246,600	288,000	319,800
Bostandyski	233,500	212,100	210,600
Zhetesuski	130,700	132,400	129,400
Medeuski	130,300	132,100	132,100
Turksibski	145,000	150,500	174,900
Total	1,076,600	1,100,000	1,150,000
Block housing with all services	70.2%	69.4%	68.1%
Block housing with partial services	8.6%	10.8%	13.3%
Individual housing with no services	21.2%	19.9%	19.6%

Source: Almaty City Architectural and Town Planning Department

4.2.2 Solid Waste Amount and Composition

1) Solid Waste Amount

Solid waste amount generation surveys were conducted twice during the Study, in Winter and in Summer, and the average unit generation rates were obtained as shown in Table 4.2.2. Average rates were applied in the M/P to determine the present waste amount generation rates.

Table 4.2.2 Waste Unit Generation Rates

Waste Type	Unit Generation Rate		
	Winter	Summer	Average
Domestic waste (kg/day/cap)			
Block housing (full conveniences)	0.30	0.45	0.38
Block housing (low rise, partial conveniences)	0.31	0.60	0.45
Individual housing	0.87	0.42	0.65
Commercial waste			
Restaurant (kg/day/entity)	11.1	8.8	10.0
Shops (kg/day/entity)	2.5	2.9	2.7
Office (kg/day/entity)	5.5	5.0	5.2
Market (kg/day/stall)	2.0	4.3	3.2
Street Sweeping Waste (kg/km)	57.1	93.2	75.2

Source: JICA Study survey results in Winter and Summer, 1999

Taking into consideration the forecasts for population growth prepared by Almaty City Department of Architecture and City Planning and applying an annual growth rate of 1% to the present unit generation rates the waste amounts forecast for the years 2005 and 2010 (as well as the present amounts) are shown in Table 4.2.3.

Table 4.2.3 Forecast Generated Waste Amounts

(unit = ton/year)

Waste Type	Waste Amount		
	1999	2005	2010
(1) Domestic waste			
Block housing (full conveniences)	103,852	111,790	119,426
Block housing (low rise, partial conveniences)	15,509	20,759	29,567
Individual housing	53,698	54,588	56,173
(2) Commercial waste	115,372	124,758	136,778
(3) Street Sweeping	28,062	29,789	31,308
(4) Medical Waste	7,835	8,808	9,586
(5) Non hazardous industrial waste	25,225	25,225	25,225
Total Waste Amount	349,553	375,717	408,064

Note: For background on the estimation of the present amounts of waste types (4) and (5) refer to the Main Report.

2) Solid Waste Composition

The survey results for solid waste composition for both Summer and Winter seasons are summarized in Table 4.2.4. It is expected that in the future there will be a decrease in food wastes and sand, and an increase in paper, plastic and metal contents. Both moisture content and bulk density are accordingly expected to decrease, and the calorific value will increase.

Table 4.2.4 Solid Waste Composition

Waste composition	Domestic waste			Commercial waste			Market waste		
	Win.	Sum.	Ave.	Win.	Sum.	Ave.	Win.	Sum.	Ave.
Combustible									
Paper	17.6	18.0	17.8	37.8	33.4	35.6	23.7	18.3	21.0
Textile	1.8	2.5	2.2	3.4	1.7	2.6	0.9	0.6	0.8
Plastic	12.0	9.9	10.9	5.7	11.1	8.4	7.8	7.9	7.8
Leather	0.3	1.4	0.9	1.5	0.3	0.9	0.2	0.0	0.1
Leaves	1.2	3.5	2.3	0.2	2.0	1.1	0.8	11.0	5.9
Food	50.8	57.2	54.0	38.7	42.9	40.8	56.5	49.3	52.9
Sub total	83.7	92.4	88.1	87.2	91.4	89.3	89.9	87.1	88.5
Non combustible									
Metal	3.0	2.2	2.6	3.6	1.9	2.7	3.0	1.8	2.4
Glass	6.6	4.5	5.6	7.9	2.9	5.4	5.5	2.7	4.1
Ceramic	1.1	0.3	0.7	0.4	1.1	0.7	0.3	0.0	0.2
Sand	5.6	0.5	3.1	0.9	2.8	1.8	1.3	8.4	4.9
Sub total	16.3	7.5	11.9	12.8	8.6	10.7	10.1	12.9	11.5
Total	100	100	100	100	100	100	100	100	100
Density	0.31	0.34	0.32	0.22	0.22	0.22	0.24	0.45	0.34
Moisture content	40.7	45.6	43.1	34.2	37.3	35.7	44.9	41.2	43.0
Lower calorific value	1,695	1,768	1,731	2,028	2,032	2,030	1,703	1,740	1,722

Source: JICA Study survey results in Winter and Summer, 1999

4.2.3 Minimum Requirements of SWM Service

The M/P has been prepared taking into consideration the minimum requirements set for the SWM service. These requirements (described in Table 4.2.5) are based on the field surveys, public awareness survey and discussions with the Kazakh side.

Table 4.2.5 Minimum Service Level Requirements for M/P Formulation

	Year 2005	Year 2010
a. Waste collection (domestic and commercial waste)		
(1) BH – Block housing (complete or partial conveniences)	• Waste (including kitchen waste) will be collected 3 times/week. • Collection from stations with containers. • Collection coverage: 95%.	• Waste (including kitchen waste) will be collected 3 times/week. • Collection from stations with containers. • Collection coverage: 100%.
(2) IH – Individual housing (no conveniences)	• Waste (including kitchen waste) will be collected 2 times/week. • Collection from stations and door-to-door. • For collection stations plastic bag discharge shall be required. • Collection coverage: 95%	• Waste (including kitchen waste) will be collected 2 times/week. • Collection from stations and door-to-door. • For collection stations plastic bag discharge shall be required. • Collection coverage: 100%.
(3) Commercial waste	• In principle minimum 2 times/week collection. • Central area and markets will have daily collection.	• In principle minimum 2 times/week collection. • Central area and markets will have daily collection.

(4) Materials resources		• Source separation for at least two of; glass, plastic, and paper. • Separated items collected separately. • Collection 2 - 4 times per month. • Amenity centers introduced for receiving the separated items.
(5) Harmful waste discharged from households		• Harmful wastes will be collected separately. • Manifest system for harmful wastes shall be introduced.
b. Waste treatment and disposal		
	• Sanitary landfill site operation. • Harmful waste will be disposed (buried) separately or stored.	• Sanitary landfill site operation. • Harmful waste will be disposed (buried) separately or stored.
c. Waste reduction, processing and resource utilization		
		• Introduction of system for waste volume reduction (collection of recyclable materials). • Separate collection of recyclable materials and their recycling. • Introduction of economically feasible treatment system.
d. Medical waste		
	• Separate collection and disposal of infectious wastes.	• Separate collection, treatment and disposal of infectious wastes.
e. Industrial waste		
	• Generators will be responsible for their waste disposal. Industrial waste cadastre will be established. • System for educating and registering companies responsible for collection and treatment.	• Generators will be responsible for their waste disposal. • System for educating and registering companies responsible for collection and treatment.
f. Street sweeping		
	• Minimum once/week, and daily in city center.	• Minimum once/week, and daily in city center.
g. Illegal dump sites		
	• System for abolishing and control of illegal dumping. • Phased rehabilitation of illegal dump sites.	• System for abolishing and control of illegal dumping. • Rehabilitation of all illegal dump sites.
h. Waste collection tariff		
	• Maximum 1-2% of household income.	• Maximum 1-2% of household income.

4.2.4 Financial Constraints

The M/P has been prepared taking into consideration the present and forecast gross regional domestic product for Almaty City and household incomes. GRDP of Almaty City is forecast to grow as shown in Table 4.2.6.

Table 4.2.6 GDP and GRDP of Almaty City (forecast)

	1999	2000	2005	2010
GDP (KZT bn; at 1999 price)	1,812.0	1,848.3	2,040.6	2,253.0
GDP Growth Rate	-4.0%	2.0%	2.0%	2.0
GRDP (KZT bn; at 1999 price)	250.2	255.2	281.7	311.1

Sources: (1) Economist Intelligence Unit: GDP and GDP growth rates in 1999 and 2000
(2) Ministry of Economic Planning: GRDP data from 1994 to 1999
(3) JICA Study Team: Remaining figures based on JICA Study Team estimates

At present waste management services are privatized and the City Government allocates no budget for such services, except for street sweeping. The Almaty Environmental Protection Fund collects fines from environmental polluters and 11% (or KZT 4.0 million) from that fund has been earmarked for SWM in 1999.

One important aspect of the M/P was to set the tariff levels that can both sustain the SWM and not put too heavy a burden on the residents. One to two percent of the household income was considered a reasonable level. Forecasts of household incomes are shown in Table 4.2.7.

Table 4.2.7 Household Income

(per person, monthly; KZT)

	1999	2000	2005	2010
Average	5,547.1	5,658.0	6,246.9	6,897.1
Physical Workers	5,927.0	6,045.5	6,674.7	7,369.5
Office Workers	5,725.6	5,840.1	6,448.0	7,119.1
Non-Governmental	4,886.9	4,984.6	5,503.4	6,076.3
Pensioners	4,492.2	4,582.0	5,058.9	5,585.5

Source: (1) Almaty City Statistical Department source of 1999 figures
(2) Projections prepared by JICA Study Team

4.3 Alternatives

4.3.1 Technical Alternatives

1) Formulation of the Technical Alternatives

Four technical alternatives were studied and the most suitable one was selected for the M/P. The alternatives were formulated to ensure all major technical options were considered. These alternatives are described in Table 4.3.1 and the waste flows for each are shown in Figure 4.3.1.

Table 4.3.1 Formulation of the Technical Alternatives

Alternative / Activity	Alternative 1	Alternative 2	Alternative 3	Alternative 4
1) Collection	The same technical system is applied in all four alternatives			
2) Transport	One transfer station west of the city.	Two transfer stations west and north of the city.	One transfer station west of the city.	One transfer station west of the city.
3) Intermediate Processing	None	None	None	An incineration plant
4) Final disposal	One disposal site; Karasai	One disposal site; Karasai	Two disposal sites; Karasai and Enbek	One disposal site; Karasai

The following points were considered when formulating these alternatives.

- Collection systems were studied independently and the most suitable collection system was adopted in all four alternatives
- The existing Karasai disposal site will serve as the city's main disposal site in all the alternatives because it has sufficient capacity to receive the waste throughout the planning period. Because of Karasai's long distance from the city it is necessary to consider transfer facilities. All four alternatives include transfer facilities.
- Transfer station locations considered were those specified by the Kazakh side. A large transfer facility can be constructed on the West site located in front of TETS-2 and the site is conveniently situated towards the center of the city's north-south axis. Accordingly three alternatives have been formulated with the West transfer station. Alternative 1 considers all the city's waste going to the West transfer station for transfer to Karasai. Alternative 2 proposes transporting the city's waste to two transfer stations, the major part to the West T/S and the waste generated north of the City to a smaller transfer station located there.
- Alternative 3 studies the use of a second disposal site, Embek, north of the city instead of construction of a second transfer station there. This site is actually used at present by towns and villages outside Almaty
- Alternative 4 includes an intermediate processing plant. Given the waste composition and the earlier unsuccessful experience with a compost plant, an incineration plant was considered

2) Selection of Optimum Technical Alternative

Estimated operating and maintenance costs for each alternative in the year 2010 are shown in Table 4.3.2.

Table 4.3.2 Operation and Maintenance Costs in 2010

(unit = 1,000 KZT)

SWM Activity	Alt. 1	Alt. 2	Alt. 3	Alt. 4
1) Collection	453,728	388,477	555,702	474,729
2) Transfer Stations	180,186	203,547	125,803	91,996
3) Processing Plant	—	—	—	1,072,200
4) Sanitary Landfill	202,138	202,138	228,236	104,367
5) Source Separation	68,851	68,851	68,851	68,851
Total	904,903	863,013	978,592	1,812,143
USD	786,880.0	750,450.0	850,950.0	15,757,760.0

Alternative 1 requires construction of only one facility, the West Transfer Station while all the other three require construction of more than one facility. Alternative 2 provides two transfer stations, stable operation and the lowest operation and maintenance costs. Alternative 3 evaluates the construction of a second disposal site north of the city but the collection costs are high because of the direct haul to that second distant site. Alternative 4 is too costly in spite of the revenues from the sale of heat and electricity and savings at the disposal site.

Therefore Alternative 2 was selected for the M/P.

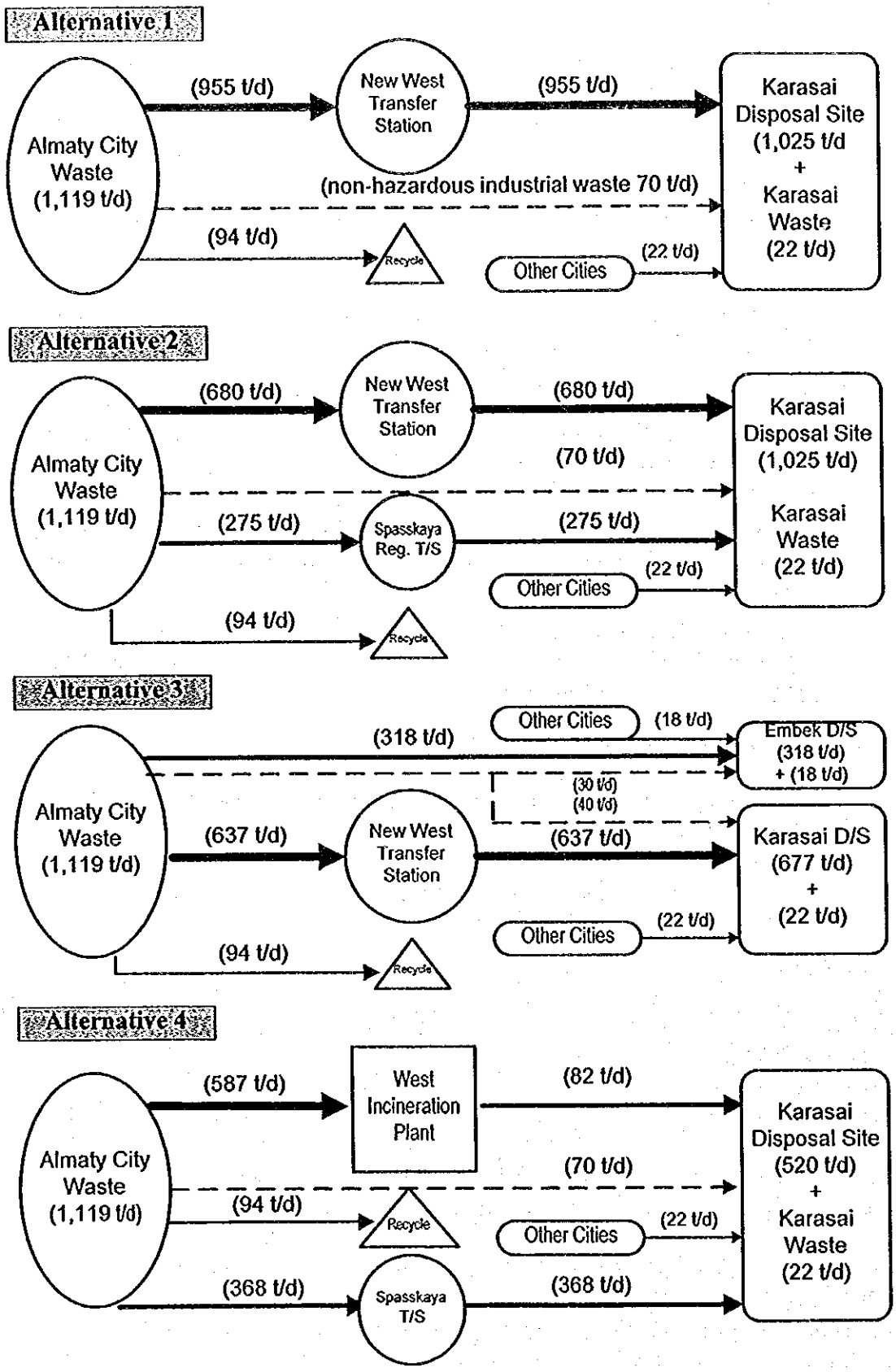


Figure 4.3.1 Solid Waste Flows by Alternative in 2010

4.3.2 Institutional Alternatives

The major institutional alternatives that were considered are:

(1) Fully Private Operation System

A "fully privatized" system, where all services are provided by private companies who are paid directly by the users of the service. The service covers only those areas where collection companies succeed in negotiating a collection contract with local residents (KSK's, KSD's or other residents' groups) or commercial enterprises. This is the system currently in operation in Almaty.

(2) Contract Out System

A "contract out" system where a state entity determines what services are required, collects fees from residents and commercial entities to provide these services, but uses private contractors to actually provide the services. This is the system most commonly adopted in developed countries where there has been a move towards privatization of utility services.

(3) Mixed Operations System

A "mixed operations" system, where the private sector is left to provide services directly to residents, but the Government sets up a state enterprise to provide services in areas where the private sector fails to provide adequate services.

A fourth alternative, a fully state owned system which operates all services under the direct control of the local Government – effectively the system that operated pre 1991 – was not seriously considered, as it is clearly against the stated Privatization Policies of the Republican Government.

These alternatives were reviewed, as summarized in Table 4.3.3, in the light of the following key objectives:

- **Universal coverage:** Under the existing system there is no systematic procedure to ensure that a contract is negotiated to cover every part of the city. Currently parts of the city are not covered.
- **Financial viability of service:** None of the existing companies in the sector are financially healthy; many are technically bankrupt, though formal actions have not been lodged to declare these companies bankrupt. The revised structure must create a financially sustainable service.
- **Protection of the poor:** The poorest residents are unable to pay for basic utilities. The system must recognize this reality and ensure that services are still provided to these residents in the interests of public health, but provide a mechanism to excuse them from paying charges for the service.
- **Enforcement of tariff collection:** Many residents who have the ability to pay for this service have been avoiding making payments. KSK's, KSD's and collection companies have not found any practicable solution to the collection of charges from these residents. The revised structure must provide effective collection of service fees.
- **Effective enforcement of environmental and public health standards:** While there are some weaknesses, existing laws set reasonable standards for public

health and environmental protection. These laws are not being enforced effectively despite a plethora of monitoring and enforcement bodies. The revised system must provide a more effective enforcement system.

Table 4.3.3 Institutional Alternatives Considered

	Private operation (existing system)	Contract out	Mixed operations
Overall management and co-ordination	Government sets standards. Other co-ordination informal	City manages overall operations and is responsible for ensuring that contracts are let to cover all areas	Government sets standards. City becomes a service provider of last resort
Operations and day to day management	Private companies under contracts with KSK's KSD's	Private companies under contracts with the City	Some municipally managed operations where private initiatives have failed.
Fee collection	By private company	By city or state enterprise	By city or private company depending on collection arrangements
Investment	By private investors or by city with equipment then leased to private companies	By city with equipment then leased to private companies	By private investors or by city with equipment then leased to private companies
Ownership of equipment	Private company or by city and leased to private company	Private company or by city and leased to private company	Private company or by city and leased to private company
Ownership of facilities	City	City	City
Management of facilities	Under management contract (preferred) or lease (current arrangement)	By city or under management contract	Under management contract (preferred) or lease
Other Government responsibilities	Setting of tariffs (current arrangement) or monitoring of competition	Effectively manages tariffs through negotiation of collection contracts	Monitoring of competition

The review concluded that the only system that could meet all of these objectives was the "contract-out" system where some state body was responsible for overall management of the system. In summary the Contract Out System alternative would provide the following advantages over the two other systems in order to meet the objectives as outlined above:

(1) Universal service

Unlike other services, in the case of waste services if such coverage is not provided there is a clear public health risk. In urban areas, at least if waste services are not provided to some individual households, the build up of waste poses a health threat to neighboring households. Under the Contract Out System service will be ensured even in areas where it may be difficult to collect the service charges to cover the costs, or where the nature of the area requires specific technical system which raise the costs. In case of the Private Operation System, service provision to such areas may be difficult the same as the present. Under the Contract Out system such areas will be covered through contract obligation.

(2) Financial viability

None of the present collection companies are financially healthy. Public support to provide the service is required for a while. Public support will be easier in the case of the Contract Out system, while it will be difficult in the other two systems because of the already weak financial base of the private companies. The Contract Out system will guarantee fair competition and have the final say in tenders and contract out, within a legal framework that should be clear and unambiguous.

(3) Protection of the poor

In the current economic conditions in Kazakhstan the ability of many households to pay for waste collection services is far from certain, even though the tariffs may be low. The Contract Out System will allow the local government to ensure that adequate services are provided to all households and poor households are exempt from payment of charges.

(4) Enforcement of the tariff collection

Being a state authority, the Waste Authority under the Contract Out System will be in a strong position to collect the waste collection fees and therefore ensure the continued sustainability of the SWM system. The private sector may not have such powers.

(5) Effective enforcement of environmental and public health standard

Enforcement of environmental and public health standards will be easier in the case of the Contract Out system because the responsibility to provide the service is clearly defined in one body. The other alternatives would scatter the responsibility amongst different parties. It should also be noted that collection companies can follow instructions only when they enjoy a healthy financial base.

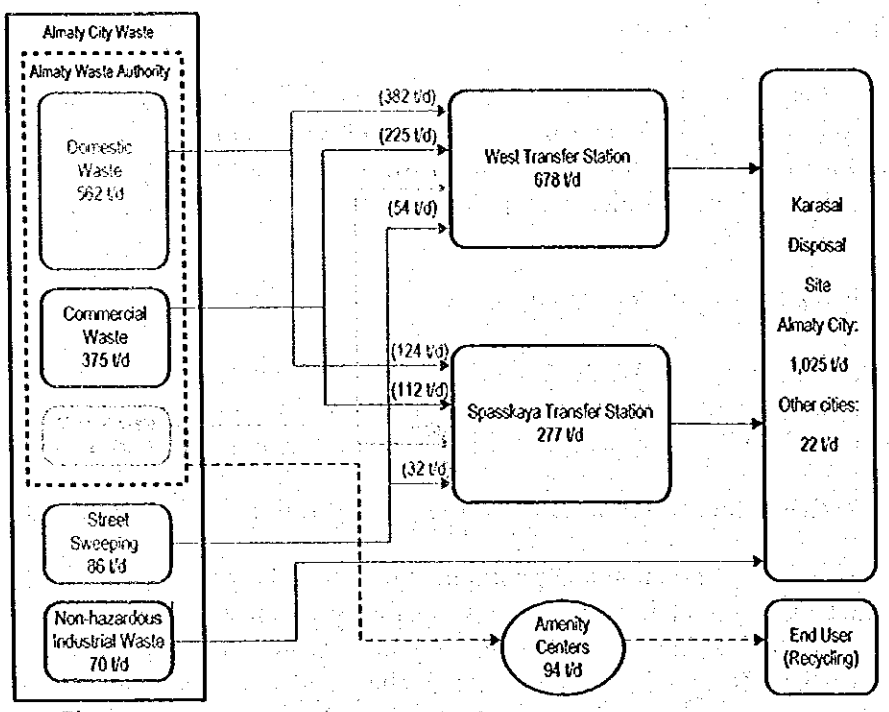
It is therefore concluded that only a state body should be given the powers necessary to ensure collection of tariffs from the residents, and that this state body should be responsible for tariff collection as well as overall management of the service.

It is also concluded that this state body should be responsible for setting tariff levels, and that these must be set bearing in mind the financing needs of the sector. In future tariffs should be set by this state body based on prices submitted by contractors competing for service contracts. The price controls currently imposed by the Anti-Monopoly Committee, based solely on historic costs, must be abandoned.

4.4. Master Plan

4.4.1 Solid Waste Flow

The M/P has been prepared with the target year of 2010. Accordingly the solid waste flow for that year is shown in Figure 4.4.1. The Waste Authority will be responsible for contracting out the collection of 869 t/d to be transported to both transfer stations for transfer to Karasai disposal site. Ten percent of the domestic and commercial waste will be recycled.



Notes to Figure:

- Medical waste to be collected separately
- Waste transported to proposed three (3) Amenity Centers will be separated at generation source

Figure 4.4.1 Solid Waste Flow in 2010

4.4.2 Collection and Transportation

1) Objectives of the Collection System

(1) Planning Conditions

a. The present market demand for recyclable materials is low and therefore mixed discharge of solid waste shall continue beyond the year 2005. Source separation is planned to be introduced in the year 2010 and recycling target for that year is set at 10% of domestic and commercial waste.

b. The collection plan targets domestic, commercial and medical waste types which will be the responsibility of the Waste Authority to be newly established. Medical wastes shall be collected separately. Infectious wastes in the medical waste shall be separated at the source and treated by the hospitals to render the waste harmless.

c. Street sweeping activity shall continue to be implemented by the Road Exploitation Department. Street sweeping wastes shall be received at the transfer stations and disposal site.

d. Collection and transport of industrial wastes shall be the responsibility of the generators themselves. Non hazardous wastes shall be received at the disposal site.

Table 4.4.1 Waste Amount targeted by the Collection Plan

(unit = ton/day)

Waste type	2005		2010	
	Generated	Collected	Generated	Collected
Domestic waste	513	487	562	506
Commercial waste	342	325	375	334
Medical waste	24	24	26	26
Total	879	836	963	866

(2) Objectives

The objectives of the collection system to be introduced under the M/P are summarized as follows:

a. Provision of 100% collection service coverage by the year 2010 and an interim target of 95% by 2005.
b. Introduction of collection system using cost-effective equipment suitable for Almaty city conditions.
c. Development of community cooperation in discharge practices in order to make the collection work more efficient

2) Equipment Plan

(1) Collection System

Based on the prevailing land use conditions in the residential and commercial areas of the city, three collection systems are proposed as follows:

a. Compactor truck ($8m^3$) with manual loading in individual housing areas
b. Compactor truck (both $8m^3$ and $12m^3$) with mechanical loading in block housing areas using containers of $1.1m^3$
c. Compactor truck ($12m^3$) with mechanical loading using containers of $1.1m^3$ for smaller commercial concerns and arm roll truck with medium size container ($6\ m^3$) for large commercial generators.

(2) Types of Equipment

Presently Russian made dump trucks with manual loading and side loaders with mechanical loading (of $0.7\ m^3$ containers) are used in individual housing and block housing areas respectively. Field surveys have shown that the productivity of these trucks is low both in terms of trip numbers per shift and waste haul per trip. With this type of truck the number of trucks required to achieve 100% service coverage in 2010 is estimated to be about 240 units. On the other hand using compactors and arm roll trucks as proposed in the M/P, the required number of trucks drops to 101 units. The operating costs of both truck types will be very similar in spite of the difference in purchase cost of the compactor and side loader, but the compactor trucks will provide a more stable and sanitary service. Accordingly compactors were chosen in the M/P.

Three compactor truck sizes were considered, large (16m³), medium (12m³) and small (8m³). Large compactor trucks were not proposed because most container points in block housing areas are located within the block housing areas away from the main streets and maneuvering these units within the narrow confines of the block housing areas would be difficult. Both medium and small size compactors were selected for the M/P. Arm roll trucks are very efficient for collection of waste from large generation areas, such as hotels, markets, department stores, large office buildings and educational complexes. Although larger sizes are available, 6 m³ size containers were adopted to avoid space problems.

3) Required Equipment Number and Distribution

The city has been divided into ten collection zones for the purpose of contract out of collection by the Waste Authority, and the equipment and manpower requirements for each zone have been determined. In low rise block housing areas and older parts of the city small size compactors will be used. Table 4.4.1 shows the distribution.

Table 4.4.2 Distribution of Equipment and Manpower in 2010

Item	Compactor (8m³)	Compactor (12m³)	Arm roll	Staff
1) Collection Zone				
(1) Almalinski	3	6	4	40
(2) Auezovski North	2	5	3	30
(3) Auezovski South	4	6	3	41
(4) Bostandyksi	4	5	1	37
(5) Zhetesuski West	2	3	4	28
(6) Zhetesuski East	3	3	4	31
(7) Medeuski North	4	2	2	29
(8) Medeuski South	3	2	1	22
(9) Turksibski North	4	3	2	32
(10) Turksibski South	4	4	4	39
Total Almaty	33	40	28	329
2) Waste amount collected (t/6d week)				
(1) Domestic	290	300	—	
(2) Commercial	—	157	236	
(3) Medical	—	31	—	
Total waste collected	290	488	236	

4) Operation and Maintenance Conditions

The operating conditions are described in Table 4.4.3.

Table 4.4.3 Collection System Operation Conditions

Item	Operation conditions
1) Working days	6 day/week and 1 shift/day
2) Collection crew	
- Supervision	One supervisor for 8-10 trucks
- Driver	One driver per truck
- Worker	- 3 for manual loading
	- 2 for mechanical loading
	- 1 for arm roll truck

3) Discharge system	2 day/week in individual housing areas, in plastic bags to designated collection stations.
	3 day/week in block housing areas and small commercial areas, to small containers placed at collection points
	Daily for large commercial generators such as markets
4) Maintenance	Daily and preventive maintenance at private company's garage
	Large repairs at specialized private workshops
	Maintenance of maintenance and repair sheets for each truck

5) Transfer Station

Karasai disposal site is located at a distance of 34 kilometers from the city center and it is therefore necessary to provide transfer facilities. The M/P proposes the construction of two facilities, the larger west of the city and the second in the north, along Spasskaya road.

The West Transfer Station is planned to serve Auezovski, Zhetysuski, Bostandyksi and Almalinski districts while Spasskaya transfer station is planned to serve Tursibski and the northern part of Medeuski district.

Both stations will be the direct load type and will have capacities of 800 and 480 tons/day respectively. Number of required semi-trailers (40 m^3 capacity) in the year 2010 will be 15 and 8 for each station. West transfer station is planned to start operation in 2002 and Spasskaya transfer station one year after in 2003. Details of the transfer station facilities and operation are briefly summarized in section 5.5 of this report.

4.4.3 Disposal and Illegal Dumpsites

1) Management Policy

Although open dumping, as currently practiced in Almaty and its environs, is the cheapest method of disposal, it causes environmental pollution and can potentially affect the health of residents near the disposal sites. Therefore, it is necessary for Almaty City to adopt the sanitary landfill method. A sanitary landfill of the highest environmental standards is still much more economical than other disposal methods such as incineration and other intermediate treatment.

There are a large number of illegal dump sites varying from trash on the streets and riverbanks to piles of waste in vacant lots, to major dump sites on the city outskirts. ACDEP presently recognizes 12 sites, almost all of which have stopped operation. Some of these sites, however, require proper closure and reclamation in order to minimize environmental, social and aesthetic impacts.

2) Facility Plan of Karasai Disposal Site

To introduce the sanitary landfill system at the existing final disposal site at Karasai, major facilities, such as administrative office and leachate control system, should be constructed or reconstructed. The present waste dumped in the site is estimated at approximately 820,000 m^3, The total capacity is estimated to be 3.96 million cubic meter (m^3), sufficient to meet the needs of the city until early 2011. This capacity has been calculated based on an elevation of 860 m for the final cover. This level has been chosen to take account of the surrounding topographical features.

• Access road;	• Waste retaining structure;
• Leachate collection & drainage system;	• Leachate retention & treatment ponds;
• Gas exhaust equipment;	• Rainwater collection gutter;
• Monitoring wells;	• Truck scale;
• Main control building and other auxiliary facilities.	

Layout plan and cross section of the Karasai disposal site are shown in Figures 4.4.2 and 4.4.3, respectively.

3) Equipment Plan of Karasai Disposal Site

Quantity estimates and major specifications are based on the projected waste disposal quantities in the target year of the M/P, i.e., 2010.

The list of heavy equipment required is given in Table 4.4.4 below, and the total number of staff required for operating the site is estimated at 30.

Table 4.4.4 List of Heavy Equipment for Landfill Operation and Maintenance at Karasai (Year 2010)

Items	Number	Remarks
1. Bulldozer	5	- Spread and Compaction
2. Excavator	2	- Soil Excavation
3. Wheel Loader	1	- Soil Excavation and Transportation
4. Dump Truck	5	- Soil Transportation
5. Water Tanker	1	- Water Sprinkling

4) Illegal Dumpsite Reclamation

Project components of the closure and reclamation work comprise land reclamation, final cover to landscape the site and post-closure care including leachate and gas management. Amongst the existing illegal dumpsites in Almaty, except sites already liquidated with cover soil and small-scale dumpsites, the following six (6) major illegal dumpsites were identified for closure and reclamation as soon as possible.

- Spasskaya;
- Raiymbek north;
- Zhetysu south-west;
- Ryskulov north;
- Near the sludge retention pond; and
- Kulagher north.

In addition, the existing transfer station along the Severnoe Koltso shall also be closed down to minimize its harmful influence on the surrounding residents.

The illegal dumpsite near Spasskaya Street is the only site within the city boundary that has been receiving wastes generated from the city. From the environmental point of view, the site should be closed and reclaimed because of its proximity to a river. Therefore, the closure and reclamation work for Spasskaya site should be carried out as a model project in the city.