

JAPAN INTERNATIONAL COOPERATION AGENCY  
THE SOFIA GREATER MUNICIPALITY, THE REPUBLIC OF BULGARIA

THE STUDY ON  
THE SOLID WASTE MANAGEMENT FOR  
THE TERRITORY OF  
THE SOFIA GREATER MUNICIPALITY

SUMMARY

July 1994

Yachiyo Engineering Co., Ltd.  
Tokyo, Japan

SSS

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JAPAN INTERNATIONAL COOPERATION AGENCY

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*SUMMARY*

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## PREFACE

In response to a request from the Government of the Republic of Bulgaria, the Government of Japan decided to conduct a master plan and feasibility study on solid waste management for the Territory of the Sofia Greater Municipality and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to Bulgaria a study team headed by Mr. Kango Mito, Yachiyo Engineering Co., Ltd., 3 times between March 1993 and January 1994.

The team held discussions with the officials concerned of the Government of Bulgaria, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

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 Republic of Bulgaria for their close cooperation extended to the team.

13 July 1994



---

Kensuke Yanagiya  
President,  
Japan International Cooperation Agency

July 1994

Mr. Kensuke Yanagiya  
President of Japan International Cooperation Agency  
Tokyo, Japan

Dear Sir,

Letter of Transmittal

We are pleased to submit to you the reports of the Master Plan, the Feasibility Study, their Executive Summary and the other related documents for "The Study on Solid Waste Management for the Territory of the Sofia Greater Municipality (SGM)". The reports include the advice and suggestions of the authorities concerned, the Government of Japan and your Agency.

The reports deal with future plan of the solid waste management (SWM) in the SGM. There were two main objectives, one was to formulate a Master Plan on SWM in the SGM and the other to carry out a Feasibility Study on selected priority project.

The Master Plan covers until year 2010, and formulated and examined 4 alternatives. As a result, Alternative 2; disposal of all waste by sanitary landfill method up to 2004 and introduction of incineration plant with capacity 600 ton/day by 2005, conditional upon economic recovery, is recommended. The Master Plan also proposes establishing a new Public Limited Company (PLC) to replace the present organization for more efficient SWM.

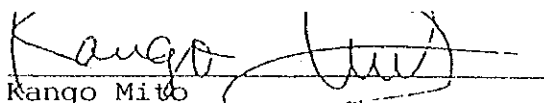
Based on this Master Plan, the following priority project that shall be implemented by year 2000 was selected as follows.

- (1) Improvement of collection system
- (2) Construction of new final disposal site
- (3) Pilot project for recycling
- (4) Establishment of New Public Limited Company for SWM
- (5) Establishment of new waste tax and service fee system

The Feasibility Study confirmed that the above priority project should be implemented to achieve the targets set in the master plan. Although, there are problems to be solved to construct new final disposal site, the team expects the above priority project be implemented as soon as possible.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs, and the Ministry of Health and Welfare. We also wish to express our deep gratitude to the Sofia Greater Municipality and the Governmental Agencies concerned in the Republic of Bulgaria for the close cooperation and assistance to us during our study. We hope this report will contribute to the development of the Republic of Bulgaria.

Very truly yours,

  
Rango Mitov

Team Leader of the Study Team on Solid Waste Management  
for the Territory of the Sofia Greater Municipality.

## EXECUTIVE SUMMARY





## Executive Summary

### A. Master Plan

#### 1. Planning Preconditions

* Plan Year	2010
* Study Area	Sofia Greater Municipality (1,310 km <sup>2</sup> )
* Population	1,380,000 in 2010
* Waste Types	Domestic/commercial waste, non-hazardous industrial waste, street waste
* Waste Amount	Collection amount 1,293 t/d Incineration amount 510 t/d Recycling amount 201 t/d Sanitary disposal amount 985 t/d

#### 2. Master Plan Targets

The goal of the master plan is development of municipal solid waste management (SWM) in SGM by the year 2010 to a level no less than that of the European Union (EU) cities. The planning targets identified to reach that goal are shown in Figure 1.

#### TARGETS OF SWM MASTER PLAN

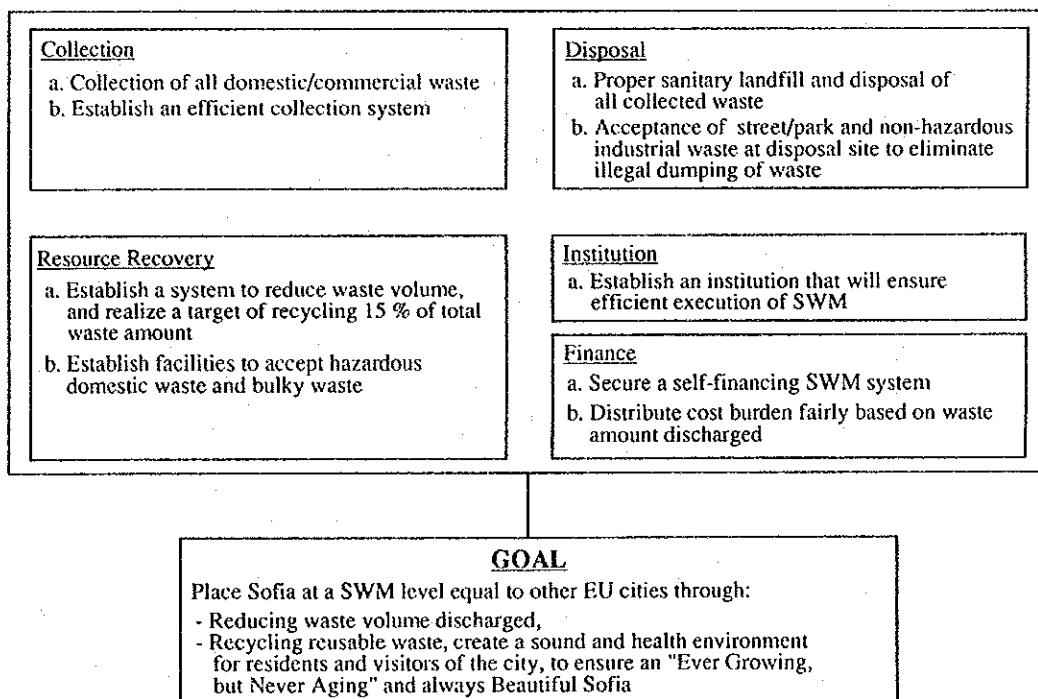


Figure 1 Master Plan Goals and Targets

### 3. Master Plan

#### 3.1 Collection and Haulage

SGM shall be rearranged into 8 collection zones based on land use characteristics. The suitable collection system adopted for each zone is shown in Table 1.

Table 1 Waste Collection System

Zone	Frequency	Container	Vehicle
I	6 days/week	Meva (110 ltr)	7m <sup>3</sup> Compactor
II - V	3 days/week	Ra (1.1m <sup>3</sup> )	16m <sup>3</sup> Compactor
VI - VIII	2 days/week	Meva (110 ltr)	16m <sup>3</sup> Compactor
		Kison (4m <sup>3</sup> )	Arm roll
Large Waste Generators	Contract base	Kison (4m <sup>3</sup> )	Arm roll

The equipment required for the above collection system in 2010 are as follows:

- Vehicles

16m <sup>3</sup> Compactors	115 vehicles
7m <sup>3</sup> Compactors	23 vehicles
Arm roll	99 vehicles

- Containers

110 Liter	43,957 containers
1.1 m <sup>3</sup>	10,739 containers
4.0 m <sup>3</sup>	357 containers

#### 3.2 Intermediate Treatment

An incineration plant with capacity 600 ton/day shall be constructed by 2005 on a site located south west of the city, to treat waste collected from Zones I, II and III in principle.

#### 3.3 Disposal Site

The disposal site is essential for efficient SWM. Considering the three criteria of location, landfill capacity and feasibility of land acquisition among others, Katina quarry site has been selected as a future disposal site. The estimated site capacity is 8.2 million m<sup>3</sup> and the site shall be planned and designed for full-scale sanitary landfill operations, inclusive of groundwater and leachate treatment, gas removal, cover material, and other necessary facilities.

### 3.4 Waste Recycling and Amenity Center Operation

An appropriate recycling system shall be established in order to fulfill the objectives of waste volume reduction and resource reutilization. The main two items addressed in this recycling system are used paper and cullet, representing 15% of the total waste amount.

In order to receive hazardous household waste six amenity centers shall be constructed; one each at the five vehicle depots and at Katina disposal site. Waste will be accepted free of charge at these centers.

### 3.5 Organization

The existing organization responsible for SWM shall be reestablished as a public limited company (PLC). In 2010, the PLC shall have 1,100 employees. In addition it is recommended that positive steps be taken to contract out portions of the SWM activities to the private sector.

### 3.6 SWM Cost

In 2010, the depreciation cost will be US\$ 15.5 million and operation and management cost US\$ 8.5 million, with a total of US\$ 24 million.

Investment costs by activity during the period of 1995 to 2010 are shown in Table 2.

Table 2 SWM Investment Costs  
(unit: US\$ million)

Item	Investment Cost
Collection and Haulage	41.0
Intermediate Treatment	139.1
Final Disposal	29.1
Recycling	14.0
Work shops, etc	4.8
Total	228.0

### 3.7 Fees

The fee levels estimated in the master plan (see Table 3) are based on the beneficiary-pays principle, and ensure stable

SWM and financial self sufficiency of the PLC.

Table 3 Waste Tax and Service Fee System

	1997	2000	2005	2010
-----				
Waste Tax				
Household (US\$/Cap)	3.3	6.6	18.8	18.8
Shops, etc (US\$/Ton)	47.8	42.9	41.4	40.3
Service Fees				
Collection (US\$/Ton)	22.0	22.0	63.1	63.1
Tipping (US\$/Ton)	7.4	7.4	39.1	39.1

In addition to the fees collected, revenues are expected from sales of generated electricity and recyclable materials. In total a revenue of US\$ 40.2 million is estimated in 2010.

Operation and maintenance and depreciation costs in 2010 are estimated to reach US\$ 24.0 million, 4 times the respective costs in 1995. However the remainder of the total debt will decrease to US\$ 10 million in 2015, from US\$ 64.7 million in 2010, indicating the master plan is financially sound.

### 3.8 Implementation Plan

In order to realize the master plan by the year 2010, a staged plan comprising three phases has been developed; Phase I (1995-2000), Phase II (2001-2005), and Phase III (2006-2010), as shown in Table 7-2 (refer to section 7, Master Plan, of this report volume). In this staged plan the construction of a new disposal site at Katina is urgent and therefore called for in the first phase.

### 3.9 Identification of Priority Project

The priority project consists of the projects to be implemented in the First Phase. The feasibility of these projects was studied as a case study. The projects are:

- Improvement of collection system
- Construction of Katina disposal site
- Implementation of Recycling Pilot Project
- Reorganization of SWM administration and improvement of related facilities
- Revision of waste tax and service fee system

## B. Priority Project

### 1. Priority Project Preconditions

The population and waste amount to be dealt with under the priority project are shown in Table 4.

Table 4 Population and Waste Amount under Priority Project

	1995	2000
Population (1,000)	1,205	1,208
Waste amount (t/d)	1,139	1,391

### 2. Priority Project Summary

#### 2.1 Collection Equipment Required

- Vehicles
  - 16m<sup>3</sup> Compactors            125 vehicles
  - 7m<sup>3</sup> Compactors             24 vehicles
  - Arm roll                     107 vehicles
  
- Containers
  - 110 Liter                    57,709 containers
  - 1.1 m<sup>3</sup>                        14,305 containers
  - 4.0 m<sup>3</sup>                        387 containers

#### 2.2 Katina Disposal Site Construction and Equipment

Katina Disposal Site: Area developed = 72 ha.  
Disposal capacity = 8,200,000 m<sup>3</sup>

Heavy Equipment : Waste compactor = 3 units  
Bulldozer = 4 units  
Loader = 4 units  
Backhoe = 1 unit  
Dump Truck = 6 units  
Tanker = 1 unit

#### 2.3 Recycling Pilot Project

Equipment required for the recycling pilot project at Mladost and Lyulin districts are as follows:

Vehicle = 6 units  
Container = 710 sets

## 2.4 Amenity Center

Six amenity center facilities shall be provided; one each at the five vehicle depots and one at the Katina disposal site.

## 2.5 Organization

The PLC will be established in 1995. Existing facilities will be used for the new company's headquarters, vehicle depots and workshops.

## 2.6 Fee Tariff

The new fee tariff system is shown in Table 5.

Table 5 Waste Fee Tariffs

	1997	2000
Waste Tax		
Household (US\$/Cap)	3.3	6.6
Shops, etc (US\$/Ton)	47.8	42.9
Service Fees		
Collection (US\$/Ton)	22.0	22.0
Tipping (US\$/Ton)	7.4	7.4

## 3. Investment Cost

Annual investment costs up to the year 2000 are shown in Table 6.

Table 6 Annual Investment Costs

(US\$ million)

	1995	1996	1997	1998	1999	2000	Total
Collection	1.3	3.0	4.5	4.3	3.1	3.6	19.8
Disposal	2.7	23.5	0.0	0.0	0.0	0.0	26.2
Recycling	0.0	0.0	0.2	0.0	0.4	0.8	1.4
PLC Facilities	0.5	3.1	0.0	0.0	0.0	0.0	3.6
Total	4.5	29.6	4.7	4.3	3.5	4.4	51.0

#### 4. Financial Plan

Tables 7 and 8 show the required loan amount and conditions for executing the priority project by year up to 2000.

Table 7 Necessary Loan Amount

(unit: US\$ 1,000)

	1995	1996	1997	1998	1999	2000	Total
Inner Fund	1,324	2,608	3,279	3,037	3,298	4,451	18,032
Foreign Loan	2,725	11,547	0	0	0	0	14,272
Local Loan: Long Term	522	15,056	0	0	0	0	15,578
Short Term	0	341	1,393	1,214	239	0	3,187
<b>Total</b>	<b>4,570</b>	<b>29,552</b>	<b>4,673</b>	<b>4,286</b>	<b>3,536</b>	<b>4,451</b>	<b>51,069</b>

Table 8 Loan Conditions

Loan Type and Conditions	Repayment	Grace Period	Interest
Foreign Loan	15 Years	5 Years	7.5%
Local Loan: Long term	10 Years	3 Years	8.5%
Short term	1 Year	--	12.5%

#### 5. Feasibility of Implementation

The results of the study have determined that the priority project implementation is feasible from the technical, environmental, economic, and financial aspects.

Unfortunately it was not possible during this study to form a consensus of all the related authorities in connection with using Katina quarry site as a disposal site. Therefore this feasibility study has been compiled as a case study in the final report. It is hoped that, as Bulgaria continues to make progress in its social and economic conditions, a consensus may be reached on utilization of Katina disposal site and the project may once more be revived.





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## ABBREVIATIONS

Alt.	alternative
B/C	Benefit over Cost ratio
BKC	Abbreviation of Bulgarian word meaning "Urbanization and Public Utilities Services"
cap.	capita
CAW	Citizens' Awareness Survey
CHIPP	Collection and Haulage Improvement Priority Project
cu m	cubic meters
EC/EU	European Community/European Union
ETCS	European Technical Committee, document 8 on "Geotechnics of Landfill and Contaminated Land"
EIA	Environment Impact Assessment
EPL	Environmental Protection Law
F/S	Feasibility Study
FIRR	Financial Internal Rate of Return
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
Ha., ha	Hectare
HCS	Hauled Container System
HEI	Hygiene Epidemiologic Inspectorate
km	kilometer
l	liter
Lv	Leva (Bulgarian currency)
M/P	Master Plan
MIA	Ministry of Internal Affairs
MOA	Ministry of Agriculture
MOH	Ministry of Health
MOE	Ministry of Environment
MOL	Ministry of Labor and Social Welfare
MRD	Ministry of Regional Development and Construction
MUN	Municipalities
NPV	Net Present Value
O & M	Operation and Maintenance
PCW	Precompressed waste blocks
pcu	passenger car unit
PDS	Pound Sterling
PLC	Public Limited Company: New public company proposed for operation of SWM
RC	Reinforced Concrete
RDF	Refuse Derived Fuel
REI	Regional Environment Inspectorate
SCS	Stationary Container System
SG	State Gazette
SGM	Sofia Greater Municipality
SHW	Solid Household Waste
sq m	square meters
SWM	Solid Waste Management
t/d	ton per day
UPUD	Urbanization and Public Utilities Department, SGM
Veh	vehicle
VOC	Vehicle Operating Cost

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## CHAPTER 1

# STUDY SUMMARY AND CONDITIONS IN SOFIA GREATER MUNICIPALITY



## Chapter 1 Study Summary and Conditions in Sofia Greater Municipality (SGM)

### 1. Study Summary

#### 1.1 Background of the Study

Bulgaria is taking bold social and economic initiatives in order to create a free and democratic society and shift from a centrally planned economy to a market oriented one. These initiatives also cover environmental aspects, and the government has introduced various environmental protection laws and environmental impact assessment regulations modeled after those of the EU. Presently a new waste act has been prepared and is awaiting final parliamentary approval.

Included in this act is a recommendation that the concerned governmental agencies improve operation of sanitary landfill sites in line with practices in West European countries.

Under the changing socioeconomic conditions in Sofia Greater Municipality (SGM), Bulgaria's capital city and center of commercial and service business with a population of 1.2 million, a corresponding change in Solid Waste Management (SWM) is urgently called for. It is therefore required that the related authorities, led by the central government develop effective SWM facilities and measures that can cope with the expected future increase in solid waste amount and changes in its characteristics, and are in conformity with the stipulations of the waste act under parliamentary review. These efforts must also be channeled to constructing a new final disposal site and setting SWM on a sound financial basis. The authorities concerned should then carry out the necessary feasibility studies needed as an initial step to implement the agreed upon priority projects.

The Bulgarian government accordingly made a request to the Japanese government for the assistance of the Japan International Cooperation Agency (JICA) to formulate an SWM master plan and prepare a feasibility study for a priority project(s) from the master plan. JICA responded to the request by dispatching a preliminary study mission in October 1992, which discussed the study scope of works with the Bulgarian side. This Study was implemented based on the contents of that scope of works by Yachiyo Engineering Co., Ltd.

Following the development of the master plan a number of priority projects were determined and a feasibility study was conducted. Katina disposal site construction was selected as one of these projects, but just before submission of the study final report it became clear that it was difficult to attain a consensus among the related authorities as to its use.

## 1.2 Objectives of the Study

This Study was implemented under the following objectives:

- a. Formulation of a SWM master plan with the target year 2010
- b. Selection of a priority project(s) and preparation of a feasibility study needed to implement the master plan
- c. Transfer of technology related to the study

## 1.3 Scope of the Study

### (1) Study Area

Under this study a SWM master plan has been prepared for all the territory of SGM (area 1,310 km<sup>2</sup>). Candidate sites for disposal sites were also studied from within the boundaries of SGM.

### (2) Types of Waste

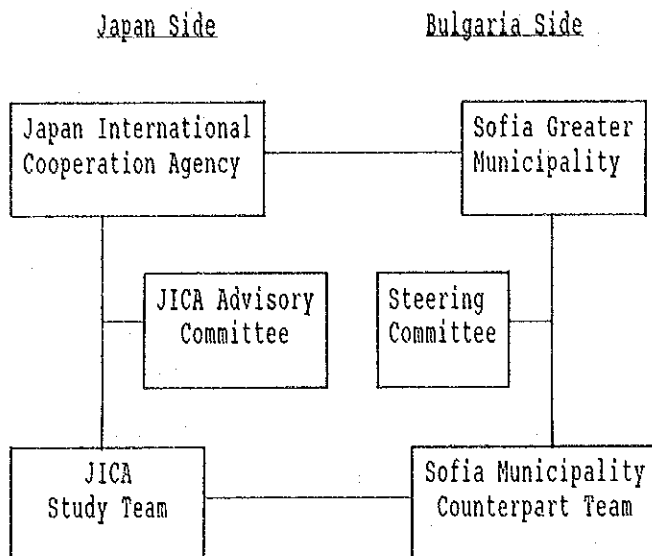
The types of waste studied were those presently being accepted at the municipal disposal sites, namely; domestic, commercial, street sweeping, and part of non-hazardous industrial waste.

In the case of hazardous industrial waste, the study prepared recommendations to improve industrial waste disposal.



## 1.4 Organization of Execution of the Study

### (1) Organization Chart



### (2) Structure of the Japanese Side

#### a. JICA Advisory Committee

Dr. Sachiho Naito	Advisory Committee Chairman Chairman, Board of Trustees Kanto Gakuin (School Corporation)
Dr. Tohru Furuichi	Head of Waste Management Planning Div. Waste Management Engineering Dept., Institute of Public Health
Dr. Kunitoshi Sakurai	Guest Professor of International Environmental Planning University of Tokyo
Dr. Isamu Yokota	Assistant Professor, Graduate School of Nutritional & Environmental Sciences University of Shizuoka
Mr. Tadayoshi Kawano	Chief, Plant Engineering Dept., Public Cleansing Department City of Sapporo

b. Study Team

Mr. Kango Mito	Study Team Leader
Mr. Akira Osawa	Deputy Team Leader - (Phase I) Collection System and Manuals
Mr. Hiroshi Abe	Deputy Team Leader - (Phase II) Collection System and Manuals
Mr. Hirochika Manabe	Collection and Transport I
Mr. Mahmoud-S. Riad	Collection and Transport II
Mr. David S. Wallace	Treatment and Disposal
Dr. Abdelaziz Belherazem	Industrial Waste Study
Mr. Komei Kawauchi	Facilities Plan and Costing
Mr. Naoyuki Minami	Solid Waste Surveys and Analysis
Mr. Peter E. Krista	Organization and Institutional Plan
Mr. Kozo Baba	Economic and Financial Evaluation
Dr. Lothar Schilak	Environmental Study

(3) Structure of the Bulgarian Side

a. Steering Committee:

Mr. T. Kuzmanov	Steering Committee Chairman Deputy Mayor, SGM
Mr. P. Dobrev	Expert, Public Utilities Dept. Ministry of Reg. Development
Mr. D. Iliev	Expert, Min. of Reg. Development
Ms. Dr. Garsilova	Expert, Ministry of Health
Ms. St. Tzekova	Expert, Ministry of Environment
Ms. S. Lyubenova	Expert, Ministry of Industry
Ms. V. Chakarova	Public Utilities Dept., SGM
Mr. A. Doichev	SGM Mayor's Adviser
Mr. Y. Yanev	SGM Mayor's Adviser

b. Counterpart Team:

Ms. M. Gugova	Head of Environmental Dept., SGM (up to March, 1994)
Mr. O. Bogoev	Chief Expert, Environmental Dept.
Mr. N. Danchev	Consultant to SGM

## 2. Socioeconomic Conditions in Bulgaria and SGM

### 2.1 Socioeconomic Conditions in Bulgaria

The Republic of Bulgaria has a population of approximately 9 million. Geographically it shares borders with Rumania in the north, Greece to the south and Serbia to the west. To the east of the country is the Black Sea.

Like the other East European countries, Bulgaria's shift from a centrally planned economy to a free market one is ushering in many changes in various economic sectors. At the start of the reforms the country was faced by many economic problems; a falling gross domestic product, rapid inflation and rising unemployment. These circumstances, combined with the continued decline of the Bulgarian currency (Leva) against the US dollar, resulted in the 1992 gross domestic product dropping to US\$ 9.5 billion, about 48% of the US\$ 19.9 billion figure in 1990 (refer Table 2-1). As a result the 1992 income per capita in US dollars dropped to US\$ 1,050 from US\$ 2,250 in 1990.

Table 2-1 Major Economic Indices in Bulgaria

	1990	1991	1992	1993
GDP (US\$ billion)	19.9	11.9	9.5	8.0
Difference from previous year(%)	-9.1	-40.2	-20.2	-15.8
Unemployment (1,000 persons)	72	419	680	748
Inflation rate (%)	123.8	473.7	79.5	63.9
Current balance (US\$ million)	-1,152	-887	429	-980
Lv/US\$ Exchange rate	2.19	17.5	23.34	27.5
Debt (US\$ billion)	10.0	11.4	12.9	14.0

Sources: JETRO office in Sofia  
Bulgarian Economic Outlook  
World Development Report 1992, 1993  
1991, 1993 JICA study team estimates

### 2.2 Socioeconomic Conditions in SGM

#### 1) Population and Area

SGM has a population of 1,182,540 and an area of 1,310 Km<sup>2</sup>. The population of SGM reached its peak in 1989 with 1.22 million people, after which it fell considerably in 1992. This tendency is continuing.

## 2) Regional Economy of Sofia

The regional economy of SGM accounts for about 14% of the total income and employment in the country and it is Bulgaria's center for commerce and industry. Industrial activity occupies 22% of the regions overall activities, but industrial output represents only 6% of the total national output.

## 3) SGM Budget

The final budget of 1993 was 7,861 million leva. This was 42.4% more than the originally planned budget of 5,520 million Leva (Table 2-2). The proposed 1994 budget of SGM is 10,535 million leva.

Table 2-2 1993 Proposed Budget  
(unit: Mill. Leva)

Major Revenues		Major Expenditures	
Income Taxes	1,420	Communal Activities	2,009
Turnover Taxes	1,263	Public Health	1,354
Profit of Municipal Companies	987	Education	1,316
Others	1,850	Others	841
Total	5,520	Total	5,520

## 2.3 Natural Conditions

SGM lies in the country's western region in the center of the Sofia Basin which, together with some other basins, represents one of the main intramontane plains of the western parts of the country.

The city's geographical position is 42°41'N and 23°19'E at an approximate height of 550m above the mean sea level.

The main rivers are the river Iskar and the river Lesnovska flowing from south to north, crossing the Balkan mountain range and discharging into the Danube river.

In late tertiary times the entire Sofia Basin was covered by a broad lake. The lignites excavated in the north-western territory of SGM represent a tertiary stratum which is found in the underground of the entire Sofia Basin and originates from this lake.

The Quaternary sediments cover almost completely the central and eastern parts of the Sofia Basin. They comprise deluvial and proluvial sediments. They occupy the peripheral part of the basin and comprise sand-like oolites, gravel and coarse cobbles with a sand and clay binding material, having a thickness of 30 to 300 m. Alluvial sediments are deposited in the central part of the plain quite often based on graded gravels below gravels and sands permeated by clays and topped by clayish sands and sandy clays. The thickness of this alluvial layer varies from 4 to 50 meters.

Annual mean temperature is 11.7°C with a mean maximum of 21.7°C and a mean minimum of -2.0°C (1931-1986). Average annual precipitation is 638.5 mm, rainfall being heaviest in Spring and least in Winter. Average annual wind speed in the city area is reported to be approximately 2.0 m/sec.

Within SGM areas the average unit discharge ranges from 5-10 liters per second per km<sup>2</sup>. The eastern fluvial terraces of the Sofia Basin covered by Iskar River sediments have a high ground water level.

Bulgaria is in an area of known and studied seismic activity. Sofia in particular suffers from this activity and lies in a force IX zone.

#### 2.4 Natural Environmental Conditions

Bulgaria is well known for the richness of its natural environment and many valuable species of flora and fauna are protected. The slope of Mt. Vitoshi located in the southern part of Sofia basin is designated as a natural conservation area.

### 3. Solid Waste Management in SGM

#### 3.1 Administration

Each of the 24 districts of SGM has a municipality owned BKC company (a public company providing urban and public utilities services) responsible for solid waste collection, cleaning of streets and gardens, and maintenance of related buildings within its borders. In addition there is another municipality owned company, the Chistota General Co., which has sole responsibility for operating the municipal disposal sites and cleaning of the main streets of the city.

Each BKC company is already run as a public company, however the financial basis of these companies is insecure and they rely heavily on SGM for financial resources. In addition, the large number of these companies and their diverse responsibilities has led to varying service levels throughout the city and inefficient utilization of available resources. It is feared that under this organization it may be difficult to meet the stipulations set out in the new waste act. Furthermore, equipment is generally not being renewed.

At the municipality level, the Public Utilities Department prepares SWM budget and oversees expenditures, while the Environmental Department monitors implementation.

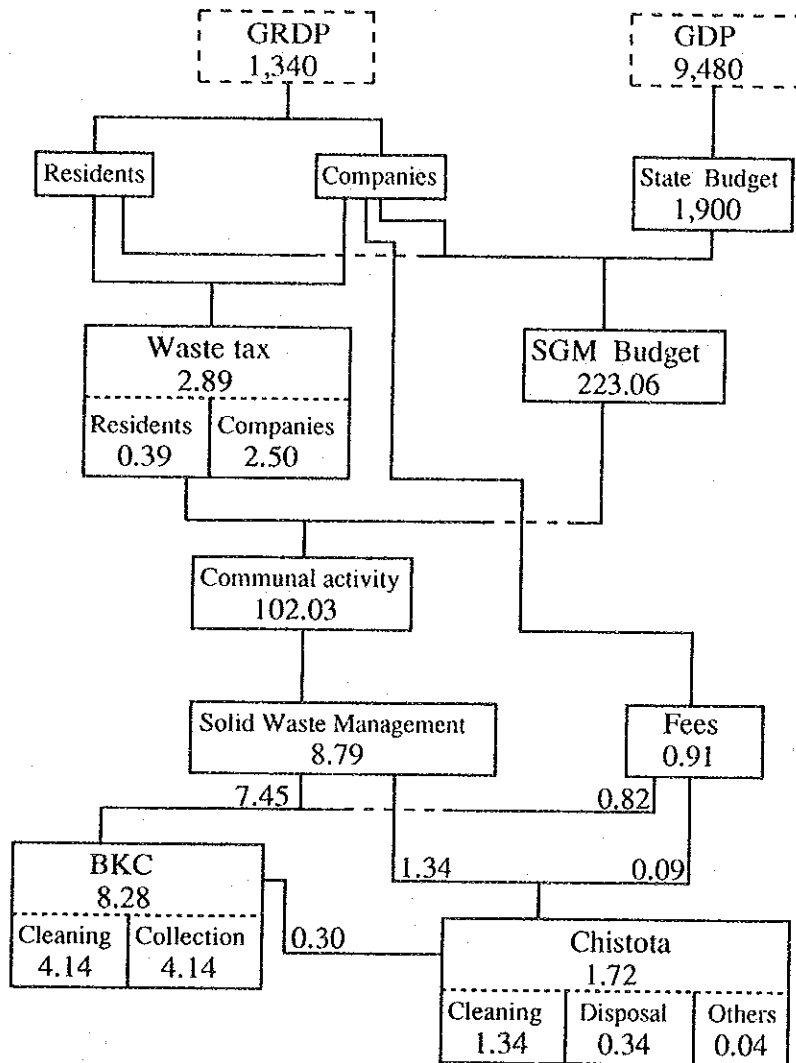
#### 3.2 Laws and Regulations

The new waste act is now awaiting parliament ratification to become law. This law stipulates responsibility of SGM for SWM, the need for waste amount reduction through resource recycling and proper operation of sanitary landfill sites for non-hazardous domestic waste. Furthermore, with an eye to entering the European Community, the environmental protection law and environmental impact assessment requirements have been introduced. Also more stringent measures for disposal of solid waste and hazardous industrial waste have been enacted.

#### 3.3 SWM Financing

In order to secure financing for SWM in SGM a waste tax is collected. The waste tax value is determined based on property value and is fixed, and does not reflect the actual volume discharged. In addition for waste collection from large shops and dischargers of non-hazardous industrial waste a collection fee is collected based on a contract between the relevant BKC and the discharger.

The 1992 budget for cleansing activity comprising both solid waste collection and disposal and street sweeping was US\$ 8.8 million. Of this total, the BKC received US\$ 7.5 million, and the remaining US\$ 1.3 million was used by Chistota General Co. The budget flow is depicted in Figure 3-1. Removing street sweeping expenses, the budget for solid waste collection and transport was US\$ 4.1 million and that allocated to Chistota Co. for disposal was US\$ 0.4 million. Thus the total budget was US\$ 4.5 million. The cost per ton of solid waste can be estimated as US\$ 12.8.



Notes: 1. Figures are in US\$ millions  
 2. Exchange rate (June 1992)  
 US\$ 1.00 = Lv 23.2

Figure 3-1 Solid Waste Management Money Flow in 1992

### 3.4 Waste Amount and Composition

At present the solid waste generated in SGM is disposed of at the two disposal sites of Suhudol and Dolny Bogrov. Daily average collected disposed amount in these two sites is about 1,000 tons, 91% of which comprises domestic and commercial waste. Waste amount disposed as classified by type is as follows;

Domestic/commercial waste	959 ton/day
Street and park waste	24 ton/day
Non-hazardous industrial waste	74 ton/day
Total	1,057 ton/day

The significant features of the composition of solid waste are large variation by season, and large share of non-combustible waste (35% by wet base). The large amount of glass in the non-combustible waste (16%) is also significant. The lower calorific value averages 1,200 kcal/kg which indicates that the waste is suitable for incineration.

### 3.5 Collection and Haulage

This activity is implemented by 24 municipality-owned companies (BKC), attached to each district of SGM. Each BKC is responsible for collection of domestic and mixed domestic/commercial waste from its own district under contract with the respective district authorities. The BKC companies also provide collection services from large-amount dischargers and dischargers of non-hazardous industrial waste on a contract basis regardless of district. Private sector activity in this field is negligible at present.

Three communal container types are used in SGM; Meva ( $0.1\text{m}^3$ ), Ra ( $1.1\text{m}^3$ ) and Kison ( $4\text{m}^3$ ) are placed at stations throughout the city and discharge is permitted at any time. Collection frequencies vary by area, and are usually daily in central and residential areas, and once weekly in suburban places.

A vehicle fleet of 375 vehicles belongs to SGM, of which 227 units are compactor vehicles, 78 vehicles are hauled container type, and the remainder are dump trucks. There are four compactor vehicle types, and 90% of them have a loading capacity of more than  $10\text{m}^3$ . Average age of the vehicles is 6 years. In the past 6 years no new large compactor vehicles have been added to the fleet.



The study survey results showed that average trip haul and vehicle usage efficiencies were 72% and 54% respectively. Vehicles presently operate one shift per day and on average 1.6 trips per shift. Collection and transport cost for one ton of solid waste was 420 Leva.

Costs fluctuated by district. In general central districts incur large costs due to poor vehicle utilization. Large costs in suburban districts, on the other hand are due to lengthier trip distances.

### 3.6 Street Cleaning

Street sweeping and washing is handled by both BKC companies in their respective districts and Chistota General Co. along main streets. SGM has at its disposal a total of 326 vehicles, 61 of which are mechanical sweepers, and the remainder water tankers and dump trucks. Vehicle maintenance is poor.

Due to shortage of funds this activity is being implemented on an irregular basis for all areas outside the city's Inner Ring Road. During Winter this activity is replaced by snow removal.

### 3.7 Treatment and Disposal

At present there are two disposal sites in SGM, at Dolny Bogrov and Suhudol, while four other sites are currently receiving inert waste.

Other wastes are treated and/or disposed of as follows:

- a. Slaughterhouse, Veterinary and Pathological Wastes are incinerated at special purpose-built installations.
- b. Hazardous and other special industrial wastes are 'stock-piled' at generation locations.

Dolny Bogrov, the older of the two operational sites, comprises an older-style general 'dump' within a sand and gravel quarry excavated down into highly permeable sand beds of the original Sofia flood plain.

The quarry is unlined and uncapped. Rainwater flows, groundwater and natural waste decomposition discharge a strong 'leachate' into the river basin flows. Continued use of this site will increase the risks to health and the environment.

Suhudol disposal site is located within a small natural valley, some 6 km west of the city's edge. The environmental situation at this site is markedly improved on that at Dolny Bogrov. With an extension planned, the remaining capacity is some 2.2 million cu m. Leachate is collected to a pit where it is pumped out into lorry tankers.

Chistota General Co. operates both sites. However due to the tight budget proper maintenance of the equipment at the sites is not done. Compaction of waste, covering with soil and monitoring of behavior are not adequately practiced.

### 3.8 Recycling

Presently recycling is mainly handled by the state owned company, Mehaplast through its seventy-odd recycling shops scattered over the territory and scavengers.

BKC companies are not directly involved in this activity.

The recycled amount by Mehaplast, the most active participant has been constantly decreasing annually, under the poor present economic environment and there is a need to set up a new recycling system to strengthen this activity.

### 3.9 Maintenance

Each BKC has a workshop which specializes in maintenance works and small repairs. Major repairs are done by Chistota Co. at its central workshop.

There are about 70 employees at the central workshop. While many BKC workshops suffer from lack of spare parts, Chistota workshop is tolerably equipped with spare parts and tools at the moment.

However, most of the equipment used in SGM is East European made and already there are shortages in some parts originally manufactured in now closed down plants. This situation is expected to become so severe with time that some countermeasures will be necessary in the near future.

### 3.10 Industrial Waste

The National Statistics Institute data indicated that amounts of industrial waste not containing harmful pollutants generated in SGM were 1.7 million tons in 1992.

If mining and construction wastes are excluded, the amount was about 320,894 tons for 1992.

Recommendations for treatment and disposal of hazardous and non-hazardous industrial wastes in the future are as follows:

- a. Survey of actual generation amount and disposal conditions
- b. Separation and recycling at source to reduce volume
- c. Acceptance and monitoring of non-hazardous waste at the disposal sites to comprehend generation and treatment conditions of existing industrial waste
- d. Maintaining records of industrial waste produced at the source. This will enable the producer to estimate the generated waste amount and exert effort to reduce waste and help SGM to determine its responsible domain for waste disposal and facilitate monitoring.
- e. It is desirable to effectively use the incineration facility at the military medical hospital for medical waste. Total medical waste generated in the city is estimated at 3.6 t/d, an amount which can be treated at the incinerator. Needless to say, disposal of such contagious waste should be prohibited at the municipal disposal sites.
- f. Hazardous industrial waste in 1990 was estimated at 53,000 t/d. This waste cannot be disposed of at the municipal disposal sites and so it is urgent to prepare a treatment and disposal plan.

### 3.11 Identification of Issues

The issues relating to the existing SWM practice are summarized in Figure 3-2.

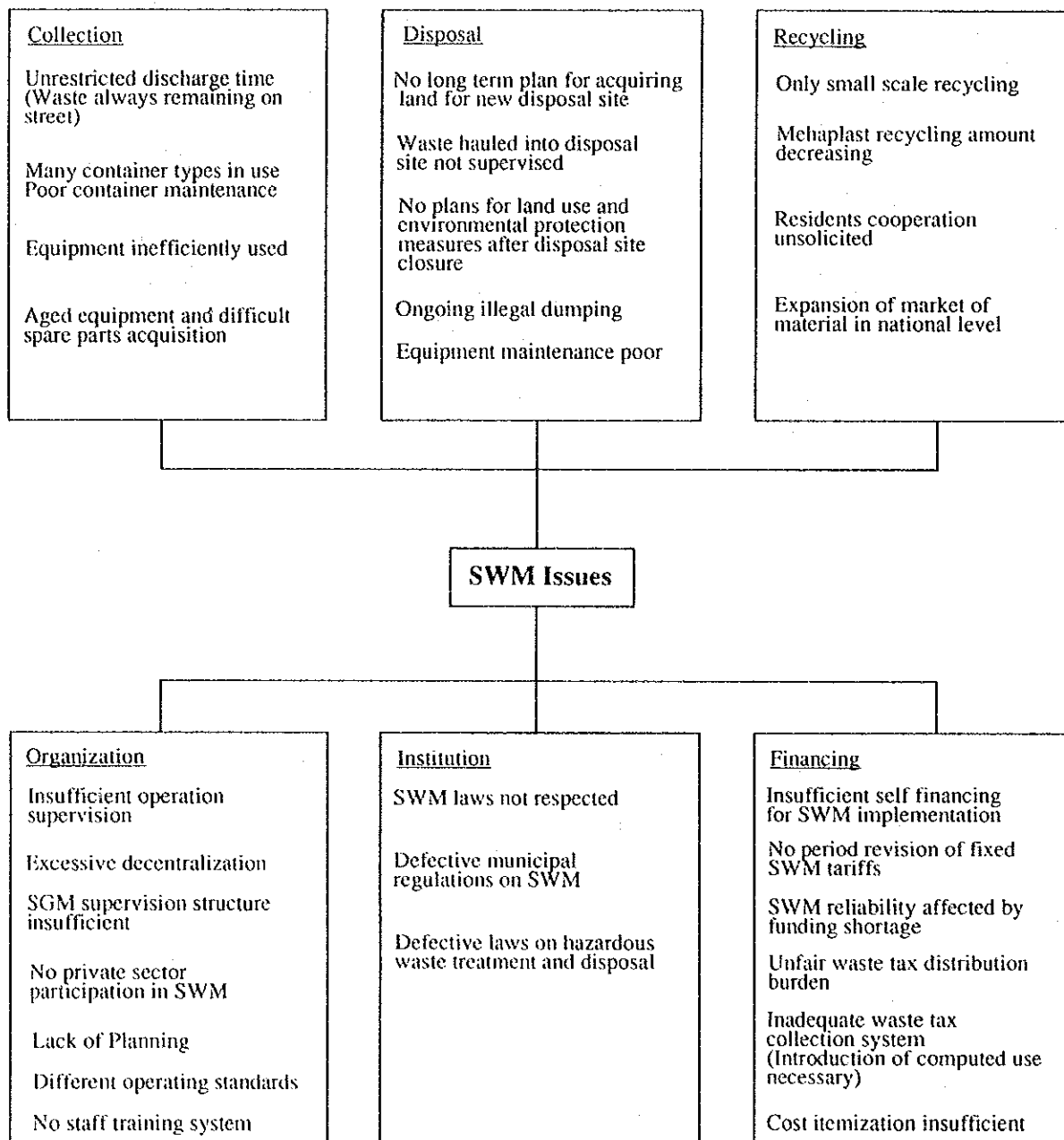


Figure 3-2 Present SWM Issues

## CHAPTER 2

## MASTER PLAN



## Chapter 2 Master Plan

### 4. Master Plan Preconditions

#### 4.1 Target Year

The Master Plan target year will be 2010.

#### 4.2 Study Area

All SGM territory will be the subject of the master plan.

#### 4.3 Types of Waste

The types of waste covered in the master plan are municipal wastes, excluding industrial waste. These types are:

- Domestic and commercial waste
- Street sweeping waste
- Part of non-hazardous industrial waste

The above street sweeping waste and non-hazardous industrial waste shall be received and disposed of at the municipal disposal sites.

#### 4.4 Socioeconomic Conditions

The amount of waste generated is determined by the city's economic activity and the income scales of the residents. As Bulgaria shifts from a centrally planned economy to a market oriented one the economy may continue to suffer but it is assumed that in the year 1998 it will be possible for the economy to recover to the 1990 level. Under that assumption the forecast economic indices shall be as shown in Table 4-1.

Table 4-1 Forecast SGM Budget and Residents Income

Year	1995	1998	2000	2005	2010
GDP (Mill. US\$)	8,000	19,900	22,400	28,800	35,100
GRDP (Mill.US\$)	1,120	2,786	3,136	4,032	4,914
SGM Budget (Mill.US\$)	208	517	581	750	913
Income/capita (US\$)	901	2,249	2,524	3,253	3,958
Population (1000 cap.)	1,205	1,250	1,280	1,330	1,380

The figures in Table 4-1 are based on the following assumptions:

- Beginning from 1995, the GDP will recover to the 1990 level by 1998, grow at an annual rate of 6% during 1998-2002, and then grow at 4% during 2003 to 2010
- GRDP of SGM is equivalent to 14% of the total GDP throughout the planning period
- SGM budget is estimated at 18.6% of its GRDP
- Income/capita was estimated in the same manner as GDP, based on estimated income in 1993 (US\$ 901/capita)
- US\$ 1.00 = 26.5 Lv. (July 1993)

#### 4.4 Waste Amount and Composition

As the economy recovers, living standards will improve and unit waste generation rates are likely to increase. Taking these factors into account, the waste amount generated is forecast to increase, as estimated in Table 4-2.

Table 4-2 Future Waste Amount Forecast

Year				(t/d)
	Domestic/ commercial	Street/ park	Non-hazardous Industrial waste	Total
1993	1,005.2	24.4	74.2	1,133.7
1995	1,009.7	24.6	74.1	1,138.3
2000	1,249.7	25.1	116.2	1,391.0
2005	1,369.7	25.6	120.9	1,516.2
2010	1,487.0	26.1	125.2	1,638.3

Waste composition is also predicted to change in the future as shown in Figure 4-1. The predicted waste bulk density at discharge is 0.23 ton/m<sup>3</sup>.

#### 4.5 Master Plan Targets and Goals

The goal of the master plan is to realize an efficient SWM system for SGM that will maintain the city's beauty and public health at a level no less than that of other EU cities. To achieve this by 2010, targets for improving collection, treatment, disposal, resources recovery, and administration have been set for the master plan, as outlined in Figure 1 of the Executive Summary.



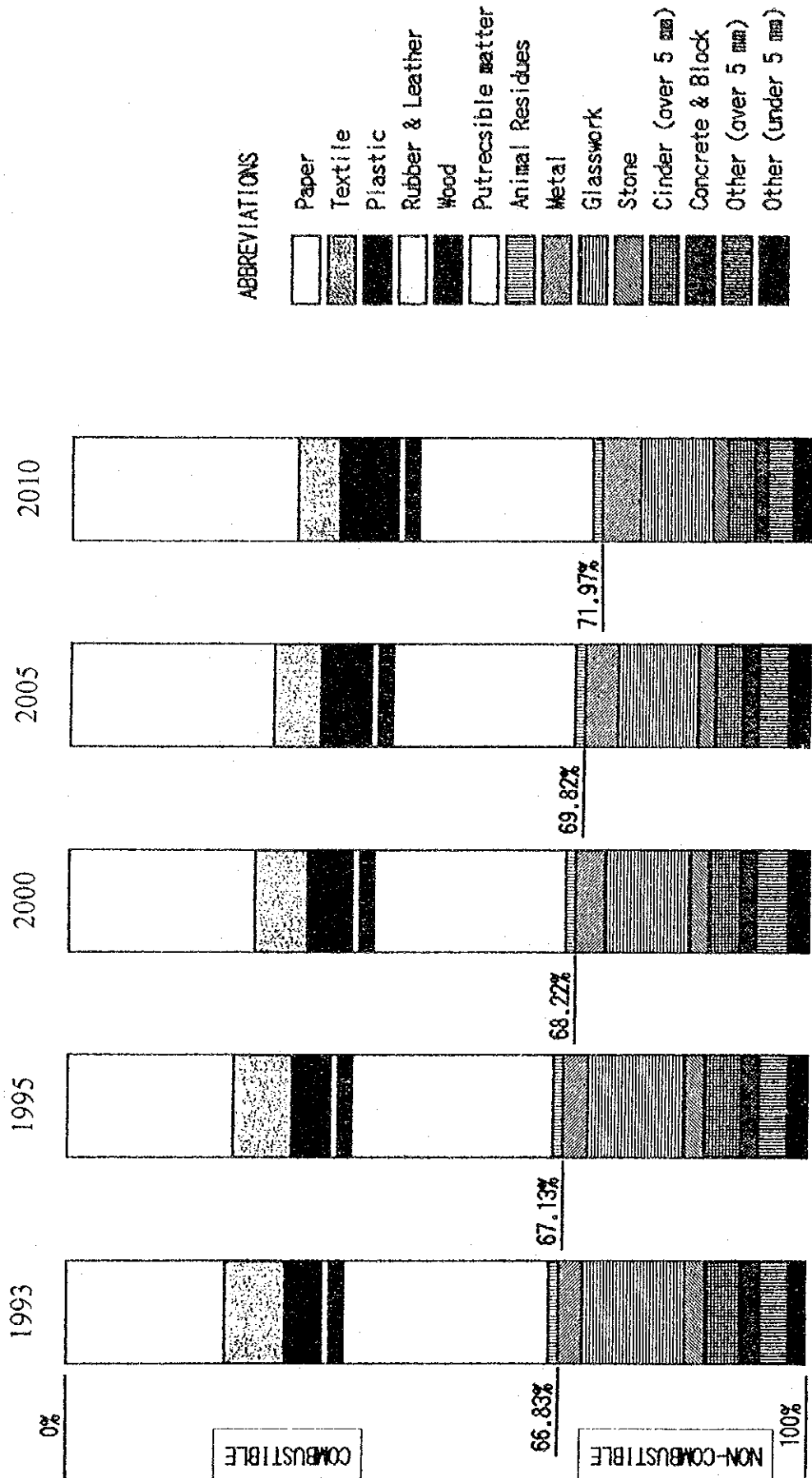


Figure 4-1 Forecast Waste Composition

## 5. Candidate Disposal Site Selection

### 5.1 Identification of Candidate Sites

Of the two disposal sites presently employed, environmental pollution has occurred at Dolny Bogrov, and at Suhudol the capacity is rapidly declining, even if the extension project proposed there is implemented. Introduction of waste incineration will not eliminate the need for a disposal site (disposal of incinerated ash) and securing of a new site in SGM is a very important issue.

The work of identifying possible candidate disposal sites was carried out through close coordination and discussions with the Bulgarian side after determining selection criteria. The following candidate sites were selected for further review:

Balsha	Buhovo	Dolny Bogrov (Extension)
Graditz	Gnilayne	Katina
Korriata	Novi Iskar	Rudinata
Suhudol(West)	Suhudol II	Kremikovtsi Mine

### 5.2 Selection of Candidate Site

The 12 candidate sites were comparatively evaluated as to land acquisition, landfill capacity, and environmental conditions, and the results are shown in Table 5-1.

Table 5-1 Comparative Evaluation of Candidate Disposal Sites

CANDIDATE DISPOSAL SITES	Municipal Property	Capacity	Geology and Topography	Ecology and Environment	Flood liability	Location suitability	Located in SGM	Total Evaluation
Balsha	X	X	X	X	0	X	0	X
Buhovo	X	0	0	X	0	X	0	X
Dolny Bogrov (ext)	0	0	X	X	X	X	0	X
Graditz	X	0	0	X	0	X	X	X
Gnilayne	X	0	0	X	X	0	0	X
Katina	0	0	0	0	0	X	0	0
Koriata	0	0	X	X	X	X	0	X
Novi Iskar	X	X	0	0	0	X	0	X
Rudinata	X	0	0	0	0	0	0	0
Suhodol(west)	0	X	X	0	X	0	0	X
Suhodol II	0	X	0	0	0	0	0	0
Kremikovtsi	X	0	0	0	0	0	0	0

Since the most important SWM facility is the final disposal site, land for the site should be secured with sufficient capacity for at least 10 years operation. Concerning this comparison criteria, Rudinata, Kremikovtsi and Katina have an advantage of the other candidate disposal sites. However from the viewpoint of ease of land acquisition, Katina and Rudinata have an edge over Kremikovtsi, where it seems difficult to resolve land acquisition there in the near future.

Of the remaining two sites, at present quarrying of aggregates at Rudinata is continuing and use of that site as a disposal site would entail closing down the quarry. Katina, on the other hand, is located close to a military airfield and the use of that site is subject to the approval of the Ministry of Defense. It is therefore not possible at this time to specify either of the two sites as a disposal site.

Fortunately both sites are located at almost the same distance from the city center, and therefore the waste collection and transport plan will not vary much for either site. Concerning disposal site construction cost, in the case of Katina the lake in the planned site must be drained and therefore construction cost of this site is comparatively higher than for Rudinata. Therefore, to be on the safe side and ensure a sufficient financial base, this master plan has been developed using Katina as the candidate disposal site.

The location of Katina is shown in Figure 5-1.

### 5.3 Candidate Sites for Other Facilities

The Master Plan has not only considered disposal site location, but also the feasibility for introducing transfer stations to decrease collection and transport costs, and incineration plant(s) for volume reduction as well was studied.

Locations selected for these facilities are in the southern half of SGM taking into consideration transport efficiency as the most suitable candidate disposal site was located in the north. Based on discussions with the Bulgarian side, two locations were selected as described below:

- a. South-east of the city: Koriata
- b. South-west of the city: Boyana

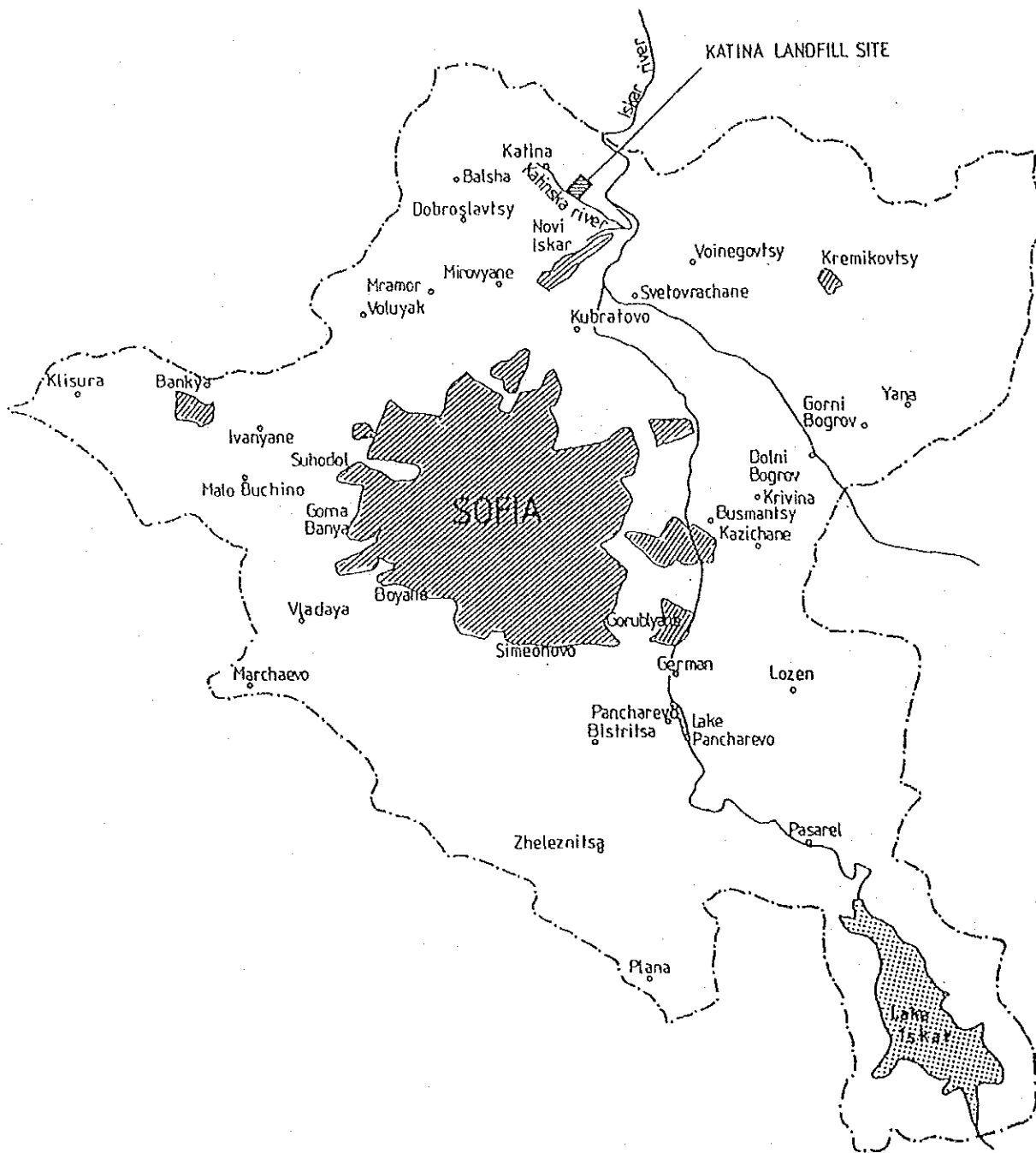
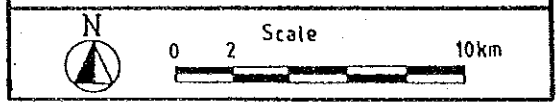


Figure 5-1 Locations of Candidate Disposal Sites



## 6. Evaluation of Alternatives

### 6.1 Technical Alternatives

Four SWM alternatives were developed for costing and evaluation to prepare the optimum master plan for the year 2010. They are described below and shown in Figures 6-1 to 6-4.

- Alt. 1:- Half of domestic and commercial waste shall be incinerated, and the remaining half plus produced incinerated ash shall be disposed of by sanitary landfill at Katina.
- Alt. 2:- All generated waste shall be disposed of by sanitary landfill at Katina.
- Alt. 3:- Waste generated in the southern part of SGM shall be hauled to transfer stations, transferred to container vehicles, and then transported to Katina landfill site for disposal by sanitary landfill.
- Alt. 4:- All waste shall be compressed into blocks at transfer stations and Katina and then disposed of at Katina disposal site.

Waste collection system will be the same for all alternatives; central area will be served daily (excluding Sundays), urban areas thrice/week, and suburban areas twice/week. To develop resource recovery a recycling pilot project shall be implemented.

Each SWM activity is briefly described hereafter.

#### 1) Collection

- a. All domestic/commercial waste (excluding the recycled amount) shall be collected.
- b. The present 24 zone configuration shall be reduced to 6-8 zones.
- c. Collection frequency shall be daily in city center, 3 times/week in urban zones and 2 times/week in suburban areas.

The collection system will be the same for all alternatives and is shown in Table 6-1.

Alt. 1 2010

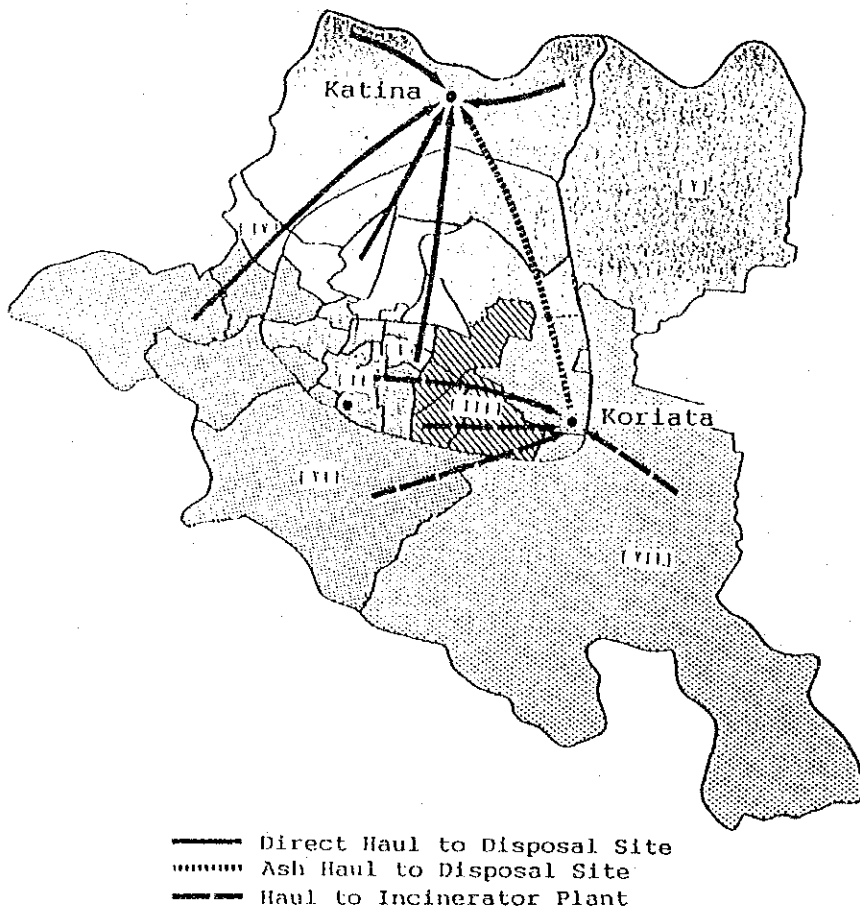
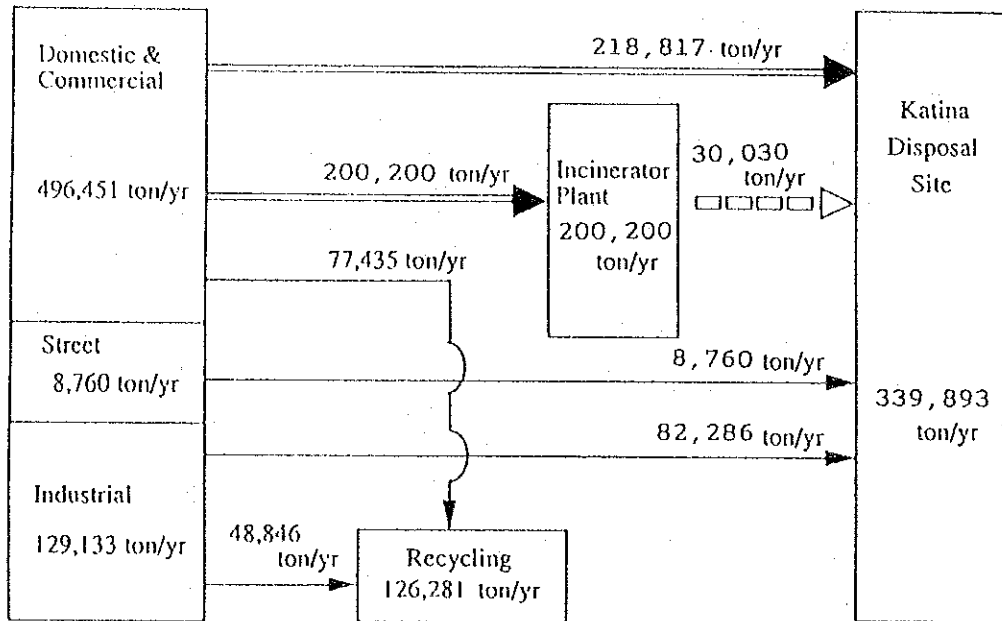
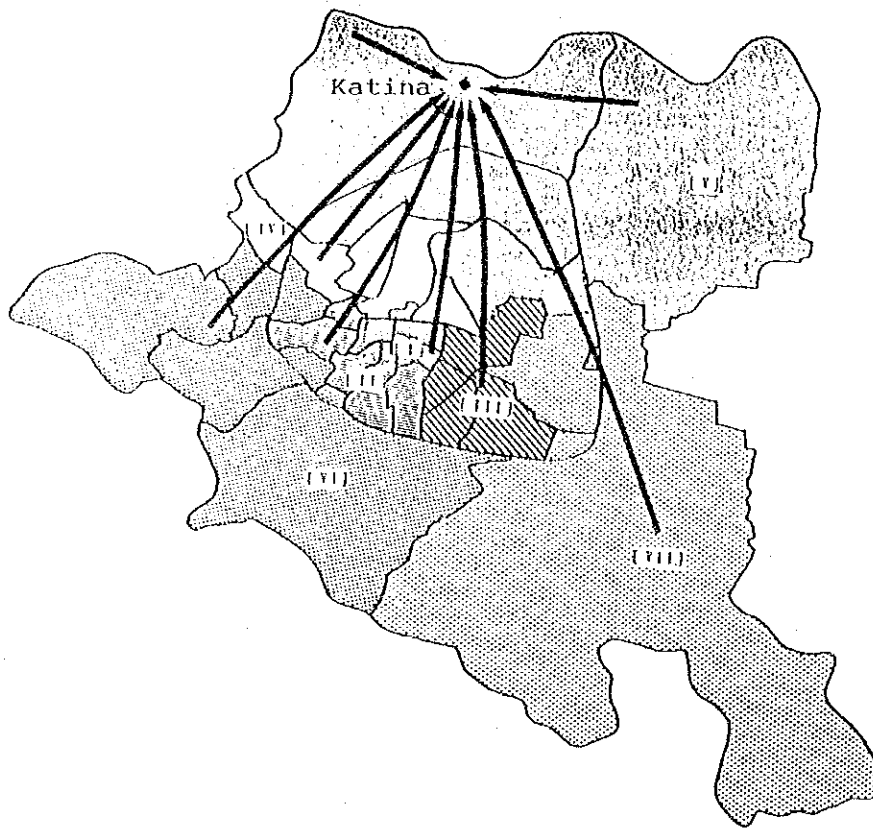
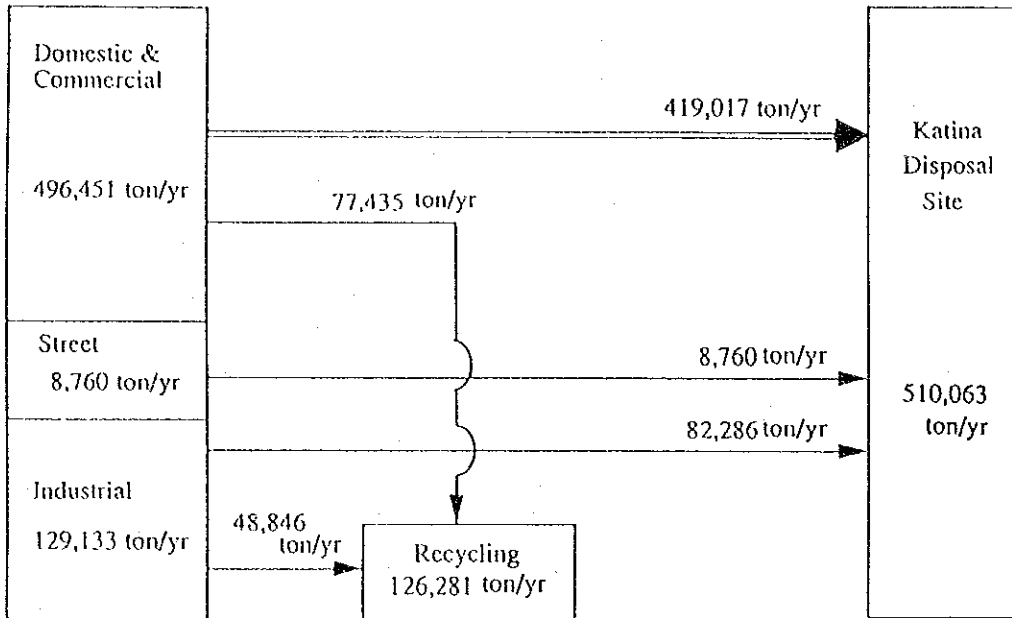


Figure 6-1 Master Plan Alt.1

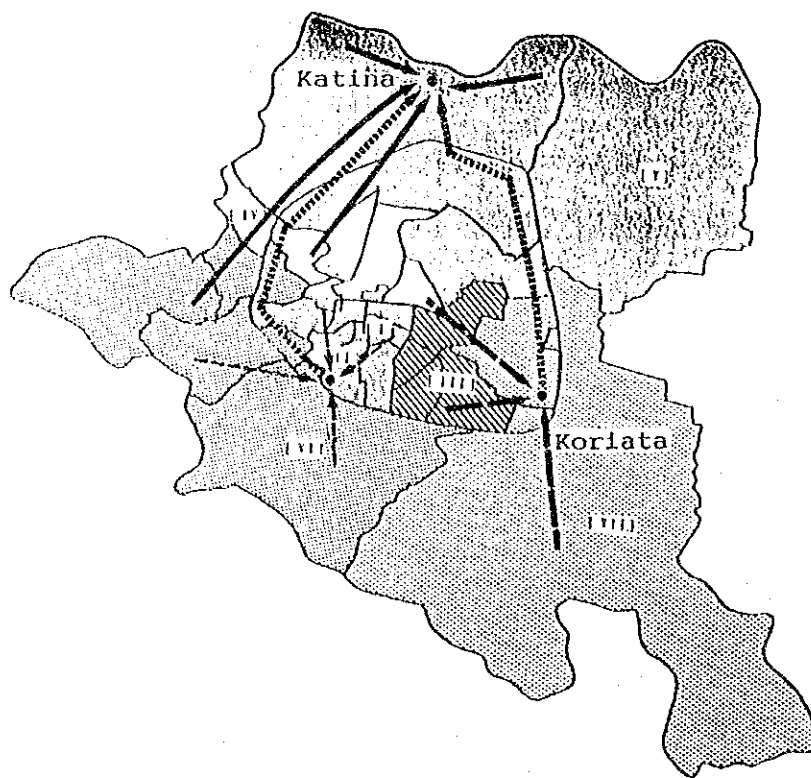
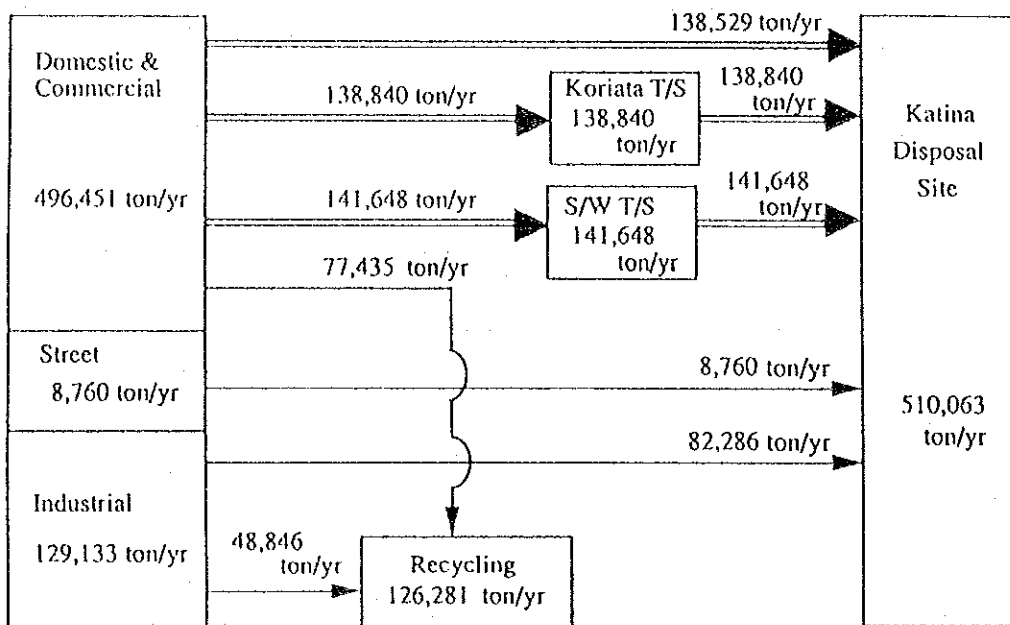
Alt. 2 2010



— Direct Haul to Disposal Site

Figure 6-2 Master Plan Alt.2

Alt. 3 2010



- Direct Haul to Disposal Site
- ..... Haul from Intermediate Facilities to Disposal Site
- - - - Haul to Koriata T/S Facility
- . - . Haul to S/W T/S Facility

Figure 6-3 Master Plan Alt.3



Alt. 4 2010

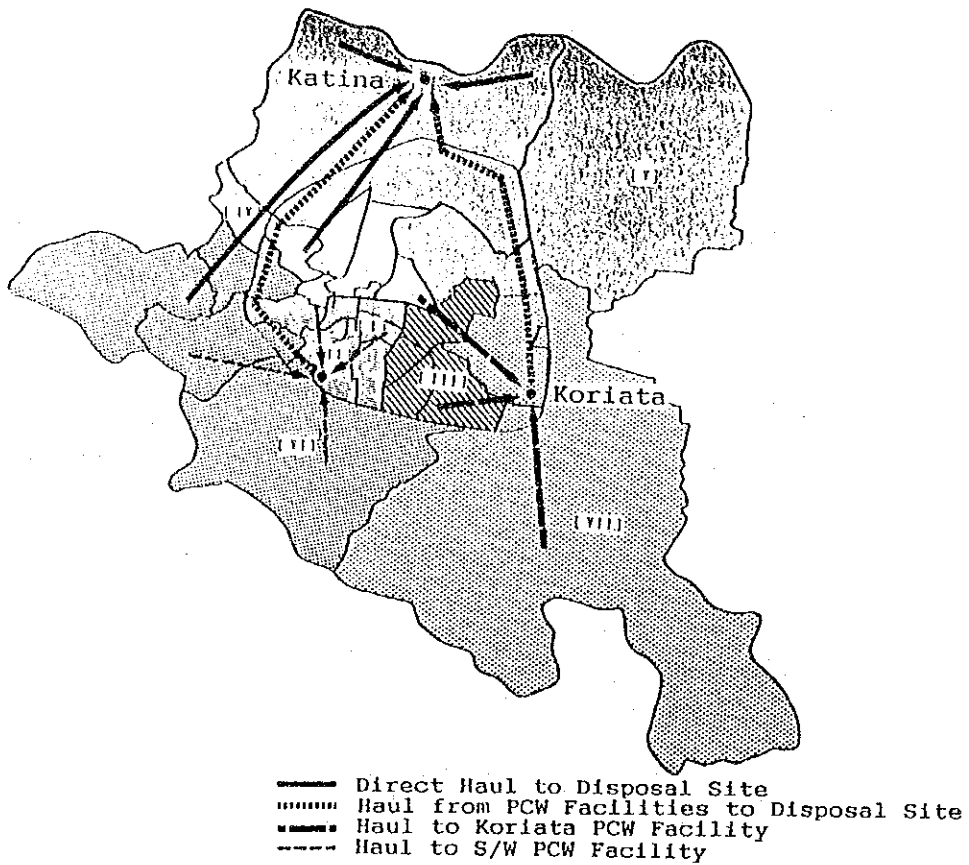
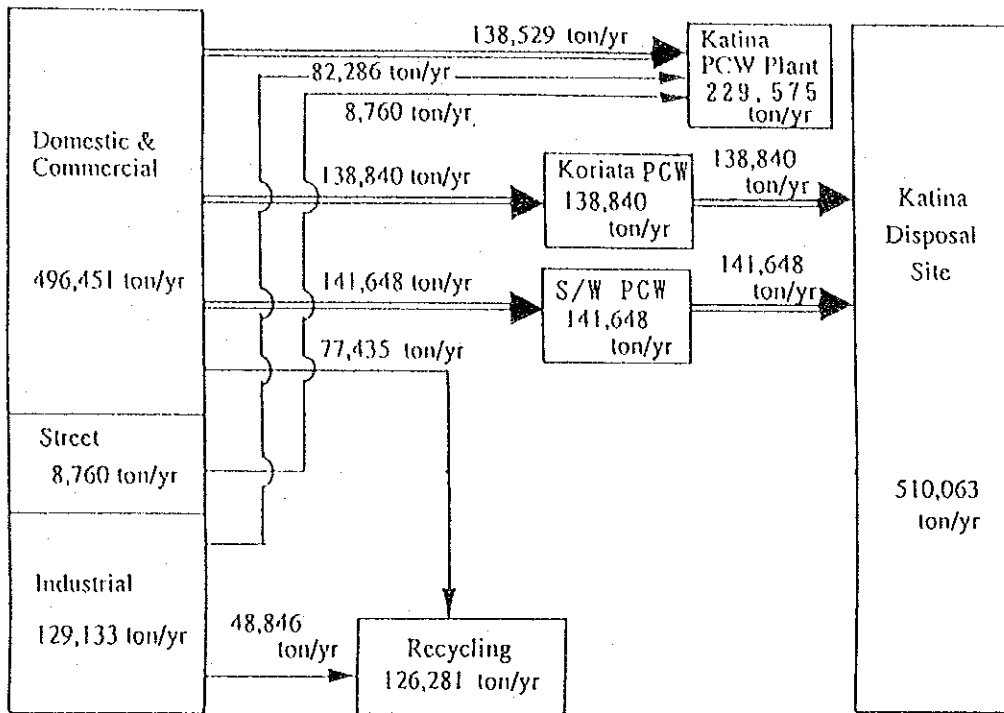


Figure 6-4 Master Plan Alt.4

Table 6-1 Proposed Collection System

	Container	Vehicle
Center	Plastic bag or Meva	Medium size Compactor vehicle
Urban	Ra container	Large size Compactor vehicle
Suburban	Meva and Kison	Large size Compactor vehicle and Roll-on vehicle

## 2) Transport

Considering the comparatively long distance to the disposal site, transfer stations were studied. There are three transfer station types: loose, compaction and pre-compressed (belted) types. For environmental reasons the loose type is not recommended at transfer stations located within urban areas. The compaction type is the general type, while the pre-compressed type decreases the risk of waste being scattered by wind at the disposal site, so both these types were considered.

## 3) Intermediate Treatment

Waste intermediate treatment options include incineration, composting, shredding, conversion to fuel pellets, etc.

Incineration is used in many countries of the world because of its effectiveness in reducing waste volume and stabilizing waste harmfulness. Therefore incineration shall be considered as a treatment facility in the master plan.

Composting calls for separation of the organic substances in the waste and subjecting them to bacterial decomposition to produce soil conditioner and/or fertilizers. As there is presently no market for compost in Bulgaria and no demand is foreseen in the future, composting was not considered in the master plan as an option.

Shredding is considered a pretreatment process for incineration and other treatment options. The benefit of this option in terms of extending the disposal site life is marginal compared to the additional cost, and therefore this option is not considered in the master plan. Other intermediate treatment processes, such as converting waste into fuel are not yet technically developed in a sufficient manner. Without

confirmation of sound operation, introduction of such processes into the master plan has not been proposed.

#### 4) Disposal

Even with incineration plant introduction, a disposal site is required for resulting ash and non-combustible waste. Therefore it is very important to secure disposal site. As outlined in Chapter 5, the most suitable location for a sanitary disposal site is in the northern part of SGM, at Katina or at Rudinata. Bulgarian technical specifications for sanitary landfill and also, in line with Bulgaria's stated policy to join the EU, the EC standards were followed and accordingly a plan for Katina sanitary landfill was developed.

#### 5) Resource Recovery and Hazardous Domestic Waste Treatment

Resource recovery is one of the important items addressed in the new waste act. However this activity is heavily effected by market demand and its costs may exceed its benefits, as has happened in many countries. Therefore the master plan shall study a recycling pilot project in order to seek an implementable and appropriate system for SGM. When preparing the future SWM system, it is necessary to establish a system that will meet the diverse waste composition. Therefore the German experience in setting up amenity centers to receive such waste was studied in this plan.

### 6.2 Cost of Alternatives

The costs for each alternative are shown in Table 6-2.

### 6.3 Evaluation of Alternatives

Financial evaluation shows that for Alt. 1, the highest cost alternative, the financial burden to be borne by SGM will be less than 3% of its budget, and burden upon residents will not exceed 0.5% of their annual revenue. The alternative can therefore be evaluated as financially feasible.

Amongst the four alternatives, Alternative 2, total waste disposed of at sanitary landfill, is the least costly one and therefore has the advantage of placing the least burden on both the SGM budget and the residents. Provided that sanitary landfill is executed according to sound technical standards and there is no negative impact on the environment and the site is within the standards, this is the most promising alternative.

Table 6-2 Costs of Alternatives

(US\$ 1,000)

	Alt.1	Alt.2	Alt.3	Alt.4
<b>A. INVESTMENT COST</b>				
<b>(1) Construction Cost</b>				
- Transfer Station	--	--	14,400	22,200
- Incineration Plant	139,000	--	--	--
- Landfill Site	17,709	17,709	17,709	17,709
- Other Facilities	2,000	2,000	2,000	2,000
<b>(2) Equipment Cost</b>				
- Collection	14,679	16,119	14,409	14,409
- Transport	90	90	1,383	1,220
- Landfill	1,752	1,968	1,968	1,968
- Other Facilities	600	600	600	600
<b>Total</b>	<b>175,830</b>	<b>38,396</b>	<b>52,468</b>	<b>60,106</b>
<b>B. ANNUAL COSTS</b>				
Depreciation	12,765	4,448	5,371	5,522
Operation	7,486	4,822	6,174	7,394
<b>Total</b>	<b>20,251</b>	<b>9,270</b>	<b>11,545</b>	<b>12,915</b>

Therefore an evaluation of all the other alternatives compared to Alt.2 has been made. Five items have been compared as shown in Table 6-3 and described below.

a. Technical Aspect

Collection vehicles operated under Alt.3 and Alt.4 are less in number than for the other alternatives, and therefore create an advantage in terms of maintenance and work supervision. In terms of waste amount reduction Alt.1 reduces the amount by 33% when compared to Alt.2. Alt.3 provides no reduction. Alt.4 reduces the waste amount by 18% compared to Alt.2. Alt.1 is therefore superior in this respect.

b. Economical Aspect

Benefit of Alt.1 will be US\$ 2.95 million, 1.5 times the other alternatives. In terms of the benefit-cost (B/C) ratio, Alt.2 has the largest ratio of 1.41 while that of Alt.1 is least at 1.02. However Alt.1 provides advantages such as early stabilization of landfilled waste by introduction of incineration and a reduction in collection vehicles and traffic around the disposal site. These advantages are difficult to quantify but will tend to lessen the difference between Alt.1 and Alt.2.

c. Financial Aspect

In Alt.1 the cost for SWM of one ton of waste is US\$ 47.6, the highest of all alternatives, and at less than half that cost, Alt.2 has the least unit cost. Alt.2 is followed by Alt.3 then Alt.4. Although Alt.1 has the highest cost, nevertheless it is evaluated as feasible since the burden imposed on citizens from implementing this alternative is less than 0.5% of their annual income.

d. Social and Institutional Aspects

Although all alternatives meet the minimum requirements of the new Waste Act, Alt.1 and Alt.4 are more responsive to the provisions of that act which underline the need to reduce waste volume, and increase the possibility of attaining approval of residents residing nearby disposal sites.

e. Environmental Aspect

All alternatives satisfy the environmental regulations in force. However concerning disposal site and the surrounding environment, Alt.2 is the least advantageous, because of the large amount of waste directly transported to the disposal site by the greatest number of vehicles. Alt.1 is the most advantageous as it decreases the waste amount arriving at the site, and reduces the number of vehicles needed to transport the waste. Handling of pre-compressed waste blocks as in Alt.4 may result in a more acceptable disposal site from the viewpoint of sanitation, neat appearance and minimal scattering of waste.

Table 6-3 Alternatives Compared with Alt. 2

	Alt.2	Alt.1	Alt.3	Alt.4
Technical	E	S	E	E
Economical	E	S	I	E
Financial	E	I	I	I
Institutional/Social	E	S	E	S
Environmental	E	S	E	S
Overall Evaluation	E	S	I	E

Notes: E : equivalent to alternative 2

S : Superior to alternative 2

I : inferior to alternative 2

As the table shows, the transfer station option (Alt.3) does not have much benefit. Alt.4 is expected to have a positive effect on the environment surrounding the disposal site, however when compared to Alt.1 the effect from volume reduction is unexpectedly small. Therefore Katina disposal site will be almost full by the year 2010 under this alternative and it is noted that it will then be necessary to introduce another volume reduction facility.

Alternative 1 requires the highest investment costs but it is financially feasible and superior in all the evaluation items except financial to Alt.2, the least cost alternative. Therefore Alternative 1 is evaluated as the optimum alternative for future SWM in Sofia Greater Municipality.

#### 6.4 Institutional and Administrative Options

The present SWM administration is weakened by excessive decentralization, and by the fact that concerned administrations also have to deal with other activities in addition to SWM. In order to upgrade SWM efficiency the following items are considered necessary.

- a. Working systems and equipment for both SWM and street cleaning are different, and therefore street cleaning activity will be separated and the new administration shall be only responsible for solid waste collection, treatment and disposal.
- b. The existing large number of collection zones shall be reorganized into a lesser number to improve equipment efficiency.

A number of options for the new SWM administration were developed considering the following three basic forms; direct administration by the municipality, public company, and private company. Combinations of these forms, including having several companies, were also considered. The maximum number of companies, either public or private, was limited to four based on the area and population of SGM and considering similar European cities such as Munich, in Germany.

The following six options have been considered in detail for the new SWM administration:

- a. Direct central management by SGM
- b. SGM and other public companies
- c. One public enterprise
- d. Four different public enterprises
- e. One private company
- f. Four private companies

After a comparative evaluation of the above management options considering operation efficiency, service level, management cost, tariff adjustments, subsidies and social impacts (Table 6-4), management by one public enterprise (partial participation of SGM in its equity) was found to be the best option, and has therefore been adopted.

Table 6-4 Comparative Evaluation of Management Options

Criteria	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
	Direct Central Management SGM	Direct Central Management SGM & Mixed	Management by one Public Enterprise	Management by four Public Enterprises	Management by one Private Company	Management by four Private Companies
Management Effic.	B	B	B	B	A	A
Service Level	B	B	B	B	X	B
Admin & Oper Cost	A	B	B	X	B	X
Tariff Adjustment	X	X	B	B	A	A
Subsidy Level	X	X	B	B	A	A
Social Impact	A	B	B	B	X	X

## 7. Master Plan

### 7.1 Summary

In the year 2010 SWM will be implemented under the following preconditions.

#### (1) Waste Collection and Transport

The master plan collection system is shown in Table 6-1. All domestic and commercial waste shall be collected. In the case of large dischargers, collection service shall be provided on a contract basis. In the year 2010, 144 compactor vehicles, 38 arm-roll vehicles and 5 depots will be required.

#### (2) Intermediate Treatment

By the year 2010, half of the generated domestic and commercial waste shall be treated in an incineration plant of capacity 600 t/d. The plant shall be located at a site southwest of the city, along the Outer Ring Road.

#### (3) Disposal Site

The collected waste and ash from the incineration plant shall be disposed of at Katina disposal site (capacity 8.2 million m<sup>3</sup>) by sanitary land filling method. To avoid illegal dumping, non-hazardous industrial waste brought to the site shall be disposed of there against payment of a tipping charge to be borne by the generator.

Leachate shall be collected by circulation pipes and drained into the sewage system where it will be treated together with the sewerage water.

#### (4) Recycling

An efficient system for the total area of SGM shall be set up to realize the target of recycling 15% of the domestic/commercial waste in 2010. Materials to be recycled are paper and glass, and depending on market demand other items may be added when feasible.

Amenity centers will be provided at the depots to receive the domestic hazardous waste.



#### (5) Institution

In 2010 SWM will be operated by a public limited company (PLC) with a staff of 1,100 employees under the command of its general manager. The PLC facilities will include headquarters, 5 vehicle depots, incineration plant, and disposal site. The company will include sections dealing with surveys, planning and public relations which are lacking at present. These sections will encourage citizen participation in SWM.

Preparation for establishing the PLC should commence in 1994, and based on that progress the PLC is planned to start operation at the beginning of 1995.

SGM will monitor the activities of the PLC, waste tax and service fee, and will provide support as a government authority for land acquisition necessary for SWM facilities.

#### (6) SWM Cost

In 2010 the cost incurred for SWM will total US\$ 24.0 million, of which US\$ 15.5 million will be allocated to depreciation and US\$ 8.5 million to cover operating costs.

On the other hand, during the period of 1995 to 2010 the investment costs for SWM shall be as shown in Table 7-1.

Table 7-1 SWM Investment Costs (1995-2010)  
(unit: Mill US\$)

Item	Investment Cost
Collection and Transport	41.0
Intermediate Treatment	139.1
Disposal Site	29.1
Recycling	14.0
Workshop	4.8
Total	228.0

#### (7) Financing

Fee levels have been set up with the aim of making the SWM public limited company self-financing and at the same time ensuring continued and stable service. Fees are levied on the principle of beneficiary-to-pay, and are shown in Table 3 of the Executive Summary.

These fees will impose a burden on residents of less than 0.5% of their annual income; 1997 - 0.20%, 2000 - 0.26%, and 2010 - 0.47%. However as the incineration plant will be introduced in 2005, the charge will peak in 2005 at 0.58% of the annual income, after which it will gradually decline once the large investments incurred in the plant construction have been completed, reaching 0.47% by 2010.

As the waste tax charge amounted to US\$ 0.9 per capita in 1994, stepwise increase is planned.

Under these tariff levels, the total revenue from SWM including the revenue from sale of generated electricity and recyclable materials is shown in Table 7-2. Total revenue is projected to increase from US\$ 15.8 million in 2000 to US\$ 38.1 million in 2005 and to US\$ 40.2 million in the year 2010.

Table 7-2 SWM Revenue

(unit: US\$ 1,000)

Item	1994	1997	2000	2005	2010
-----					
Waste Tax					
Household	1,056	4,106	8,409	24,971	25,910
Shops, etc.	5,583	5,583	5,583	5,583	5,583
Collection Fee					
Shops, etc.	717	1,036	1,355	4,033	4,158
Tipping Fee	38	129	141	780	816
Electricity	0	0	0	1,650	1,914
Reusable Materials		20	264	1,082	1,860
PM Budget Allocation	325	325	0	0	0
-----					
Total	7,719	11,199	15,752	38,099	40,241
(Self-financing rate %)	96	97	100	100	100

## 7.2 Staged Development Plan

The Master Plan period, from 1995 to 2010 has been divided into three phases; I, II and III, and the attached Table 7-3 shows the works that should be completed in each phase. The staged plan has been prepared according to the following considerations:

- a. Phase I of the master plan will coincide with the economic revival period in Bulgaria, and so investments during that period shall be kept to the minimum requirements possible.
- b. Introduction of the incineration plant will require large investments which must be covered by increasing waste tax tariffs and collection fees. It is therefore better to delay introduction of the incineration plant to Phase II of the master plan to allow time for the economic recovery to take root. The incineration plant is scheduled to start operation in the year 2005.
- c. Equipment renewal, contracting-out of collection to the private sector, etc., shall continue in Phase III, and recycling shall be expanded to cover all the territory of SGM and achieve the recycling target of 15% of total waste. In particular, it is estimated that Katina sanitary landfill site will be full around 2010 under the master plan and therefore preparation for a new site must be completed during this phase.

During 1994 it is necessary to prepare for securing the required investments for executing Phase I of the master plan.

## 7.3 Financial Plan

The financial plan corresponding to the staged development plan is shown in Figure 7-1 and Table 7-4.

As indicated in the table, the new PLC will continue to receive subsidies from SGM (US\$ 325,000/year) and will not pay any taxes for the first five years. As the revenue from SWM increases with the sale of recycled items and the sale of generated electricity after introduction of the incinerator plant in 2005, the PLC will be financially sound even with payment of company tax.

Table 7-3 Master Plan - Revised Phased Plan

Preparatory Phase 1994	First Phase 1995-2000	Second Phase 2001-2005	Third Phase 2006-2010
<p>Organisation</p> <ul style="list-style-type: none"> <li>-Apply for loan for First Phase project as necessary</li> <li>-Prepare local budget for First Phase project</li> <li>-Prepare for establishment of a new organisation</li> </ul>	<ul style="list-style-type: none"> <li>a. Form new public Limited company</li> <li>b. Transfer operation from existing structure to new organisation</li> <li>c. Alignment of offices Depots &amp; workshop</li> <li>d. Preparation for contract out</li> </ul>	<ul style="list-style-type: none"> <li>a. Introduction of contract out</li> </ul>	<ul style="list-style-type: none"> <li>a. Select new disposal site</li> <li>b. Expansion of contract out</li> </ul>
<p>Collection Improvement</p>	<ul style="list-style-type: none"> <li>a. Improvement of solid waste collection                             <ul style="list-style-type: none"> <li>-purchasing of vehicle and container</li> <li>-Rearrangement of collection zones</li> <li>-Change collection system</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>a. Renewal of equipment</li> </ul>	<ul style="list-style-type: none"> <li>a. Renewal of equipment</li> </ul>
<p>Disposal</p> <ul style="list-style-type: none"> <li>-EIA &amp; detailed design incl. tender documents for Katina disposal site</li> <li>-Expansion of Suhudol</li> </ul>	<ul style="list-style-type: none"> <li>b. Construction of Katina disposal site- Stage I with amenity center (1997)</li> <li>-Construction of Katina disposal site- Stage I</li> <li>-Purchase of heavy equipment</li> </ul>	<ul style="list-style-type: none"> <li>a. Construction of Katina disposal site- Stage II</li> <li>-Construction of Stage II</li> <li>-Renewal of equipment</li> </ul>	<ul style="list-style-type: none"> <li>b. Construction of Katina disposal site- Stage III</li> <li>-Renewal of equipment</li> </ul>
<p>Intermediate treatment</p>		<ul style="list-style-type: none"> <li>b. Introduction of a 600ton/day incineration plant</li> </ul>	
<p>Resource Recovery</p>	<ul style="list-style-type: none"> <li>c. Setting a 5% recycling target</li> <li>-Pilot project for recycling-Paper, Glass</li> <li>-Construction of Amenity centers</li> </ul>	<ul style="list-style-type: none"> <li>c. Setting a 10% recycling target</li> <li>-Expansion of Pilot project for recycling area and items-e.g. metal, plastic</li> </ul>	<ul style="list-style-type: none"> <li>c. Setting a 15% recycling target</li> <li>-Expansion of recycling to all SGM area</li> <li>-Grade-up of separation</li> </ul>
<p>Revised Fee</p> <ul style="list-style-type: none"> <li>-Gradual waste tariff increase</li> </ul>	<ul style="list-style-type: none"> <li>d. Establishment of a new tariff value (3.3-6.6\$/capita)</li> </ul>	<ul style="list-style-type: none"> <li>d. Increase of tariff value (6.6-18.8\$/capita)</li> </ul>	<ul style="list-style-type: none"> <li>d. Further upgrading of tariff value (18.8\$/capita)</li> </ul>
	<ul style="list-style-type: none"> <li>e. Related project</li> <li>-Construction of Novi Iskar by-pass road</li> </ul>		

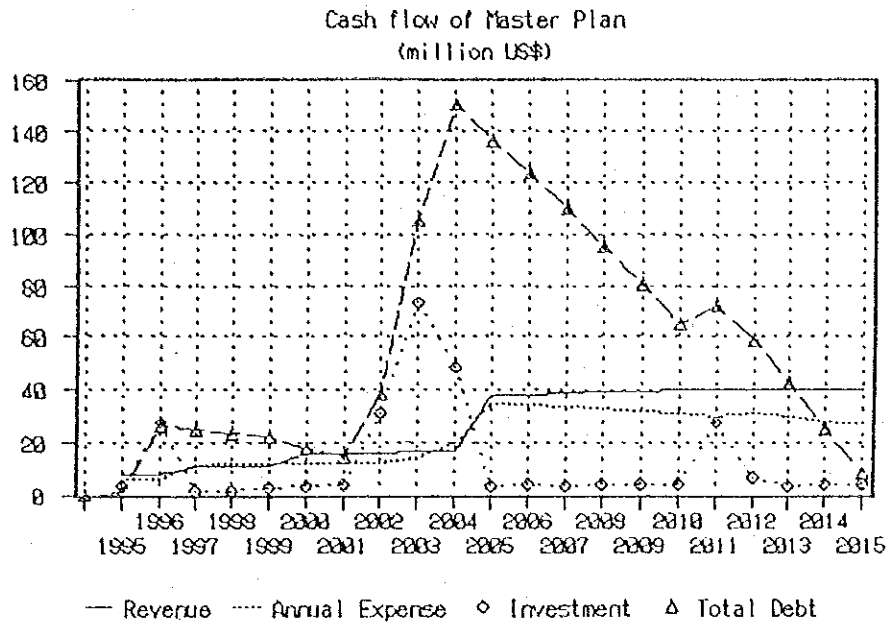


Figure 7-1 Master Plan Cash Flow

Although the annual operation and maintenance costs including depreciation but excluding interest charges will increase substantially to US\$ 24 million by 2010, as shown in Figure 7-1, the PLC will still be able to repay 62% of the initial loan (US\$ 168.9 million) by the year 2010. The outstanding loan amount is US\$ 64.7 million in 2010 and only US\$ 10.0 million in 2015. Therefore it can be said that the PLC can be established on a financially sound basis.

#### 7.4 Components of the Priority Project

Concerning the new disposal site the problem of selecting a candidate site still remains as the required consensus among the related authorities has yet to be reached. However it is desirable to construct the site early, and the following projects should be implemented during Phase I.

- (1) Improvement of waste collection
- (2) Development of Katina sanitary landfill site
- (3) Implementation of resource recovery pilot project
- (4) Establishment of SWM public limited company
- (5) Revision of waste fee system





Table 7-4 Sofia Solid Waste Management System - Master Plan  
Profit and Loss Statement

Profit & Loss Statement (M/P)																
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>Revenue</b>																
Waste Tax																
Household*	1,056	1,056	4,106	4,106	4,106	8,409	8,409	8,409	8,409	8,409	24,971	25,159	25,347	25,534	25,722	25,910
Shops etc.	5,583	5,583	5,583	5,583	5,583	5,583	5,583	5,583	5,583	5,583	5,583	5,583	5,583	5,583	5,583	5,583
Collection Fee																
Shops etc.	717	717	1,036	1,142	1,249	1,355	1,366	1,377	1,388	1,399	4,033	4,058	4,083	4,108	4,133	4,158
Tipping Fee	38	38	129	133	137	141	142	144	145	147	780	787	794	802	809	816
Electricity		0	0	0	0	0	0	0	0	0	1,650	1,703	1,756	1,809	1,861	1,914
Reusable materials			20	21	109	264	428	591	755	919	1,082	1,246	1,408	1,571	1,718	1,860
SGM budget allocation**	325	325	325	325	325	0	0	0	0	0	0	0	0	0	0	0
Subtotal(A)	7,719	7,719	11,199	11,310	11,508	15,752	15,928	16,104	16,280	16,456	38,099	38,535	38,971	39,406	39,826	40,241
<b>Annual Expense</b>																
O & M cost																
Personnel	2,380	2,146	2,169	2,217	2,257	2,319	2,354	2,390	2,441	2,477	2,335	2,372	2,397	2,429	2,449	2,474
Maintenance	1,389	1,249	1,341	1,432	1,343	955	986	1,018	1,056	1,087	2,230	2,260	2,283	2,310	2,330	2,353
Others	1,647	1,467	2,015	2,100	1,881	1,919	1,949	1,977	2,018	2,045	3,634	3,660	3,687	3,702	3,712	3,717
Depreciation	532	908	3,858	4,236	4,713	5,160	5,315	5,470	5,642	5,797	14,868	15,003	15,120	15,247	15,356	15,476
Interest(long)	0	249	2,394	2,394	2,205	2,016	1,720	1,424	3,287	8,389	11,338	10,015	8,693	7,371	6,048	4,726
Interest(short)	0	0	0	0	0	0	0	0	0	0	563	906	1,408	1,781	2,081	2,322
Subtotal(B)	5,947	6,019	11,778	12,378	12,400	12,368	12,324	12,279	14,443	19,795	34,968	34,217	33,588	32,840	31,976	31,069
Balance	1,772	1,699	-579	-1,069	-892	3,384	3,603	3,825	1,837	-3,339	3,131	4,319	5,383	6,566	7,849	9,172
Tax	0	0	0	0	0	439	1,874	1,989	955	0	0	2,138	2,799	3,414	4,082	4,770
Profit or loss	1,772	1,699	-579	-1,069	-892	2,945	1,730	1,836	882	-3,339	3,131	2,181	2,584	3,152	3,768	4,403

Cash Flow (F/S)																
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Balance	1,772	1,699	-579	-1,069	-892	2,945	1,730	1,836	882	-3,339	3,131	2,181	2,584	3,152	3,768	4,403
Depreciation	532	908	3,858	4,236	4,713	5,160	5,315	5,470	5,642	5,797	14,868	15,003	15,120	15,247	15,356	15,476
Subtotal(C)	2,303	2,608	3,279	3,167	3,822	8,104	7,045	7,306	6,523	2,458	18,000	17,184	17,704	18,399	19,124	19,879
<b>Money Demand</b>																
Investment	3,776	27,509	1,638	1,866	2,689	3,406	3,925	31,234	72,930	48,373	3,820	4,271	3,766	3,869	4,124	4,383
Loan repayment																
Long Term	0	0	0	2,225	2,225	3,653	3,653	3,653	3,653	3,653	16,926	16,926	16,926	16,926	16,926	15,499
Short Term	0	0	0	0	0	0	0	0	0	0	4,503	7,249	11,262	14,251	16,647	18,574
Subtotal	3,776	27,509	1,638	4,091	4,914	7,059	7,577	34,886	76,583	52,025	25,249	28,446	31,955	35,046	37,698	38,455
<b>Money Supply</b>																
SGM Budget**	0	0	0	0	0	0	0	-0	0	-0	0	0	0	0	0	0
Long Term																
Foreign loan	2,725	11,547	0	0	0	0	0	20,380	50,950	30,660	0	0	0	0	0	0
Local loan	522	15,056	0	0	0	0	0	7,420	18,550	11,130	0	0	0	0	0	0
User*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Short Loan	0	0	0	0	0	0	0	0	0	4,503	7,249	11,262	14,251	16,647	18,574	18,577
Subtotal	3,247	26,603	0	0	0	0	0	27,800	69,500	46,293	7,249	11,262	14,251	16,647	18,574	18,577
Surplus of Money	1,774	1,702	1,641	-924	-1,092	1,046	-533	220	-560	-3,274	-0	0	0	0	0	0
Reserved Fund	1,774	3,475	5,116	4,193	3,100	4,146	3,614	3,834	3,274	0	0	0	0	0	0	0
Total of Debt	3,247	29,850	29,850	27,624	25,399	21,746	18,094	42,241	108,089	150,729	136,549	123,636	109,698	95,169	80,169	64,673





## CHAPTER 3

### CASE STUDY ON FEASIBILITY OF THE PRIORITY PROJECT

### Chapter 3 Case Study on Feasibility of the Priority Project

The feasibility study on the priority projects selected from the master plan was based on the precondition that Katina may be used as a disposal site. However an agreement could not be reached regarding the use of Katina, thus the results of the feasibility study implemented for the priority projects, inclusive of Katina sanitary landfill have been compiled in this report as a case study. The sequence of events leading to the present situation are described hereafter.

During the final discussions held with the Bulgarian side concerning the Master Plan, in October 1993, various viewpoints and considerations concerning Katina disposal site, an essential element of the priority project, were raised.

During these discussions, the Bulgarian side proposed the early introduction of an incineration plant in parallel with the construction of the disposal site, to effectively reduce waste volume and stabilize its content and thereby lighten the burden imposed on the environment at the disposal site. The feasibility of this proposal was studied further. The study concluded that early introduction of the incineration plant would impose an excessive financial burden on the SGM and the residents during this period of transition from a planned economy to a market economy. Once the economy revives and the financial basis is more stable then investing in such a large scale project may be appropriate. The result of this study is reported on in Annex 1 of the Main Report.

With regard to final disposal sites, and with the aim of closing down Dolny Bogrov disposal site by mid 1993 due to environmental problems generated there, SGM developed a plan to extend the Suhudol disposal site. Unfortunately, the rampant inflation made it impossible to secure financing to construct the Suhudol site extension and accordingly closure of Dolny Bogrov was not possible and SGM is continuing to use that site.

Bearing this in mind, the need to construct a sanitary landfill site at an early stage made it imperative to search for candidate sites where land acquisition poses no serious problem. Katina was a candidate site which met this requirement and accordingly Katina was selected with the approval of the Deputy Mayor.

After reaching this joint decision with the Bulgarian side, the Study Team commenced the feasibility study from November 1993. Since then, over a considerable period of time, opinions were exchanged with the authorities concerned over the construction of Katina disposal site, notably the Ministry of Defense and at the Novi Iskar District. As a result of this exchange, flight safety at the nearby military airfield and environmental protection in the vicinity of the proposed Katina disposal site were repeatedly studied from various aspects, and countermeasures were proposed.

However, during the final phase of the preparation of the final report in March 1994, it became evident that in addition to the opposition to construction of a disposal site at Katina by the surrounding residents, attaining the agreement of the Ministry of Defense on construction was necessary. Discussions with the Ministry of Defense in relation to this matter had been continuing since 1970, when the nearby military airfield authorities expressed fear that a disposal site in Katina may hamper its flight operations, and it is now clear that a long period of time may be required to resolve this issue. Therefore, starting operation at Katina disposal site by the beginning of 1997, as set out in the priority project implementation schedule seems exceedingly difficult at present.

Under this condition where clarification of the final disposal site location has not been resolved, it is naturally not possible to prepare a feasibility study (F/S) for the priority projects. However, since the F/S had already been developed to its final stage, it is strongly desirable that the Bulgarian side, in one form or another, benefit from the results. Therefore the study has been compiled in this report as a case study for a F/S of a series of SWM priority projects based on the precondition that Katina site shall be the final disposal site.

Given that it is not possible to open Katina disposal site in the near future as aforementioned, no other land can be allocated as an alternative site, and in addition the agreement of local residents surrounding other candidate disposal sites has yet to be sought, it is necessary to resort to temporary measures to resolve this difficulty. There is no alternative but to continue using Dolny Bogrov site in addition to the extension of Suhudol disposal site. However, due to the many environmental problems generated by Dolny Bogrov site such as pollution of groundwater and scattering of waste, resulting in the petition by surrounding residents,

the municipality agreed to close down this site. Therefore continued use of this site must be conditional on enforcement of stringent environmental improvement and protection measures. A countermeasure plan for using this site has been included in Annex 2 of the Main Report for reference.

## 8. Preconditions of the Case Study

### 8.1 Priority Projects

The priority projects that will be covered under this case study are those five listed in Phase I (1995-2000) of the Master Plan.

- a. Collection and Transport
  - Collection zones rearrangement
  - New collection system introduction
  - Equipment renewal
- b. New final disposal site
  - Katina disposal site construction
  - Equipment provision
- c. Recycling
  - Recycling pilot project
  - Amenity Centers establishment
- d. Institutional Development
  - SWM Public Limited Company setup
  - Related facilities renovation
- e. Waste Tariff Revision
  - Waste tax and fees revision

### 8.2 Target Year

The priority projects shall be executed during the period of 1995 to 2000.

### 8.3 Waste Amount and Composition

Waste amount and composition forecast for the master plan shall be used. Waste flow forecast for the year 2000 is shown in Figure 8-1.

### 8.4 Schedule

The priority project schedule was prepared taking into consideration remaining disposal capacity at existing disposal sites, revival of the Bulgarian economy, period required for preparation within relevant agencies, and time for establishment of the new SWM public limited company.

The schedule shall be as follows:

- a. Katina disposal site will start operation in 1997. Up to 1997, the waste will continue to be disposed at the existing two disposal sites.
- b. The new company will be established as soon as possible, aiming at the beginning of 1995. Existing facilities will be used for the new company depots, etc with any necessary renovations completed by 1997.
- c. The new collection zones shall be set up with the establishment of the new company.
- d. Collection equipment will be completely renewed by 2000.
- e. The recycling pilot project shall start in 1997, to allow time for economic recovery.
- f. Waste tariff levels will be gradually adjusted to meet the target of covering costs by 2000.

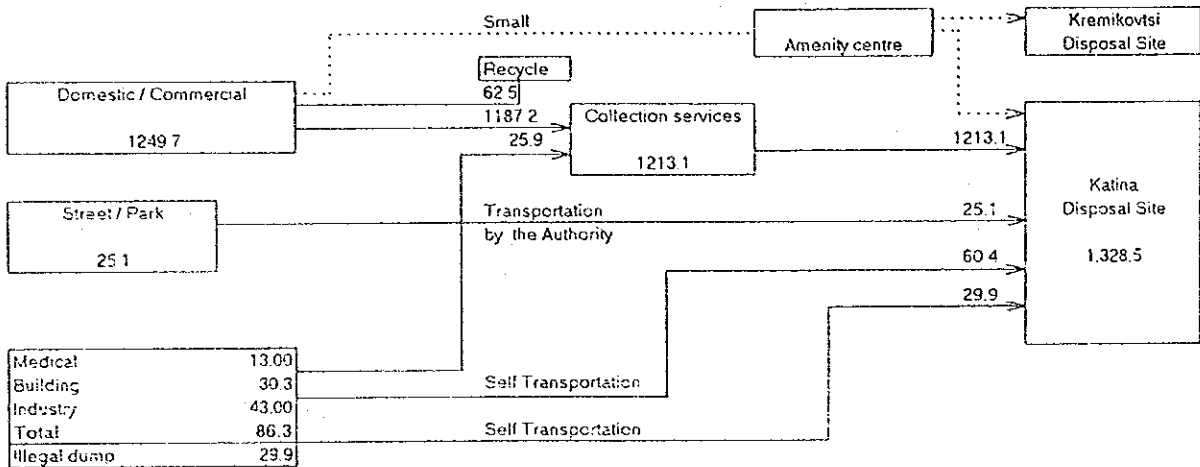


Figure 8-1 Waste Flow in Year 2000  
(t/d)

## 9. Priority Project Plan

### 9.1 Collection and Transport Improvement Plan

Under this improvement plan, the collection zones shall be rearranged, an efficient collection system introduced, and a transport system to haul the collected waste to Katina disposal site prepared.

#### (1) Collected Waste Amount

The waste amount to be collected in 2000 by the SWM public company is as shown in Table 9-1.

Table 9-1 Waste Amount to be Collected  
(unit: t/yr)

Waste type (ton/year)	1995	2000
Domestic/commercial	360,512	381,306
Large commercial generators, etc		51,996
Industrial	8,112	9,453
Total	368,624	442,755

All the collected waste shall be transported to Katina for sanitary landfill disposal. A different collection system shall be employed for recycled waste.

#### (2) Collection Zones

SGM shall be reorganized into 8 collection zones as shown in Figure 9-1.

#### (3) Collection System

The proposed collection system is described in Table 9-2.



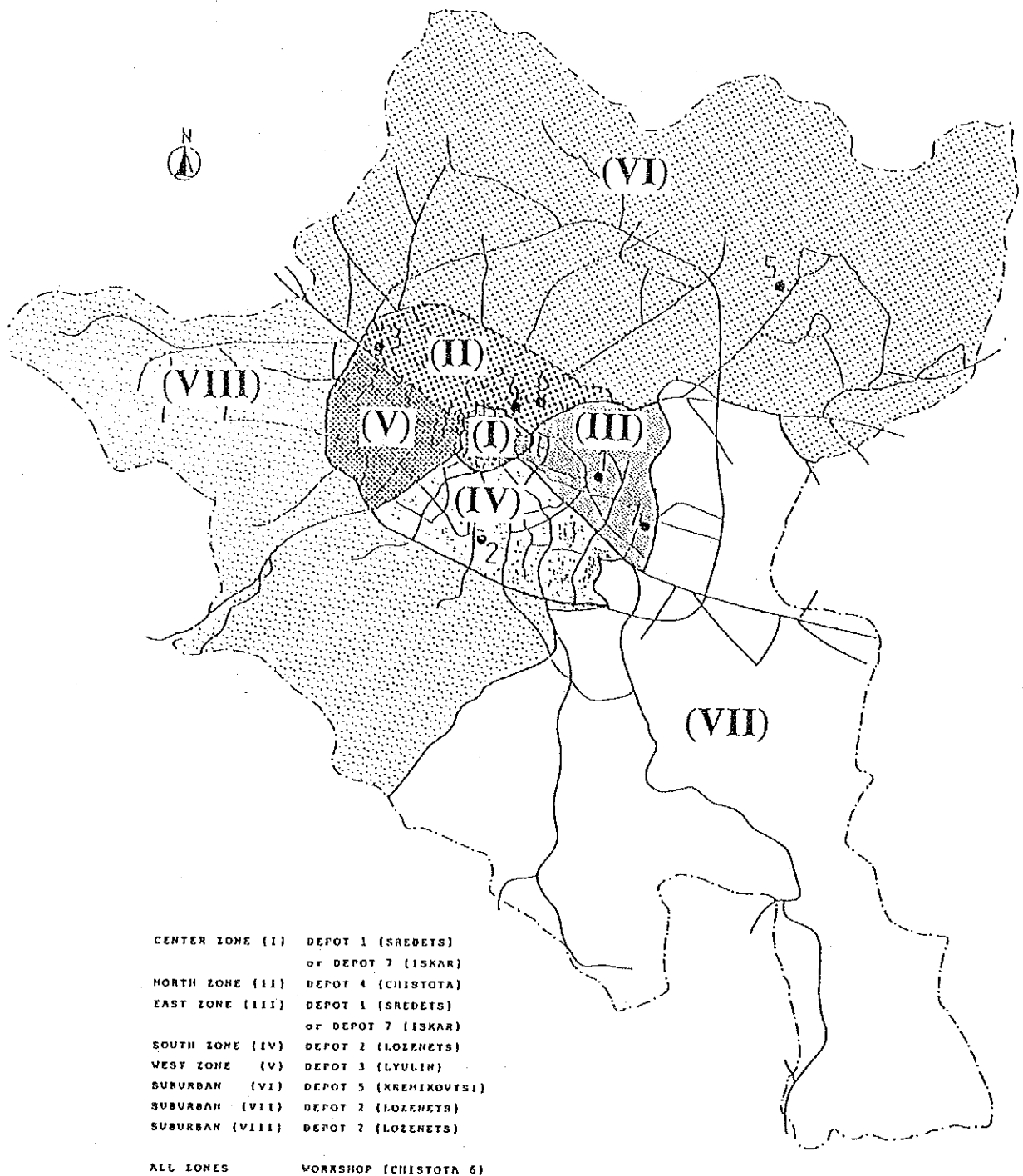


Figure 9-1 New Collection Zones

Table 9-2 Collection System in 2000

Item	Central Zone I	Urban Zones II-V	Suburban Zones VI-VIII
1) Communal Container Type (pl. bag)	Meva	Ra	Meva
2) Collection Point	Door-to -Door	Communal Station	Door-to -Door
3) Collection Frequency	Daily (exc. Sunday)	3 times/ week	1-2 times/ week
4) Discharge Time	Fixed Time	---	---

(4) Depots

Of the existing BKC and Chistota workshops 5 facilities were selected to serve as depots for the new collection zones and one as a central workshop. Locations are shown in Figure 9-1. In principle existing facilities will be used, and any necessary facility rehabilitation shall be completed by 1997 as possible.

(5) Schedule

- 1995:- Collection zones shall be reorganized into 8, and zones shall be allocated to the five depots to park their vehicle fleets. Collection equipment utilization efficiency will be upgraded.
- 1997:- Vehicle renewal plan shall commence in earnest. Vehicles purchased during 1995 and 1996 are those set out in existing plans.

(6) Equipment and Manpower Requirements

Collection vehicles, containers and manpower requirements and procurement schedules during the priority project period are shown in Table 9-3.

Table 9-3 Collection Vehicles and Manpower Requirements

	1995	1996	1997	1998	1999	2000
<hr/>						
I. REQUIRED VEHICLES	225	216	243	244	250	256
(1) Existing Fleet Vehicles						
- RTK	17	0	0	0	0	0
- Bobur	106	95	70	50	20	0
- Norba	18	5	0	0	0	0
- GAZ 53M	16	16	6	0	0	0
- GAZ Truck	16	8	0	0	0	0
- Zil Truck	20	16	0	0	0	0
- GAZ 53KM (Old)	32	20	10	0	0	0
(2) New Vehicles						
- Compactor L	0	25	53	75	103	125
- Compactor S	0	0	10	20	24	24
- GAZ 53KM (New)	0	31	94	99	103	107
<hr/>						
II. VEHICLE PROCUREMENT SCHEDULE						
- Compactor L	0	25	28	22	28	22
- Compactor S	0	0	10	10	4	0
- GAZ 53KM (New)	0	31	63	5	4	4
<hr/>						
III. CONTAINER PROCUREMENT SCHEDULE						
(1) Required Containers						
- Meva	33,760	35,068	36,427	37,839	39,306	40,829
- Ra	8,412	8,725	9,050	9,387	9,736	10,099
- Kison	102	120	310	311	311	336
(2) Procurement Schedule						
- Meva	16,880	1,308	1,359	18,292	1,467	18,403
- Ra	4,206	313	325	4,543	349	4,569
- Kison	51	18	207	35	0	76
<hr/>						
IV. MANPOWER REQUIREMENTS						
Drivers	225	216	243	244	250	256
Crew	772	660	556	580	588	596
Total	997	876	799	824	838	852

(7) Operation

a. Working Hours

Working hours shall be 8 hours/day, 6 days a week and 310 days a year.

b. Trip Number per Shift

In 2000 average trips per shift shall be as follows:

- Small Compactor vehicle 2.0 trips/shift
- Large Compactor vehicle 1.7 trips/shift

- Haul container vehicle 3.4 trips/shift

## 9.2 Katina Landfill Site Construction

It is urgently required to commence construction of the new disposal site, and consequently the feasibility study was conducted for Katina quarry site where land acquisition has been settled in favor of SGM. However it is necessary to reach an agreement among all the concerned authorities before construction can commence there.

### 1) The Site

Katina is an unused closed down coal quarry located north of SGM. The site lies adjacent to Katinska River, which flows into Iskar River, and there is a lake at its center. Just adjacent to the site's eastern edge are a number of holiday homes, and 300 m away there is a Novi Iskar residential area. 4.5 km south of the site there is a military airfield.

Collection vehicles will access the site from Sofia using the new Novi Iskar by-pass which is scheduled to be completed by 1996.

The geological features of the site are mainly intermingled coal and clay layers, with heavy mining of coal having occurred at within the site. In parts of the site self igniting coal can be observed and slope collapse. The present ground-water level is in agreement with the lake water level.

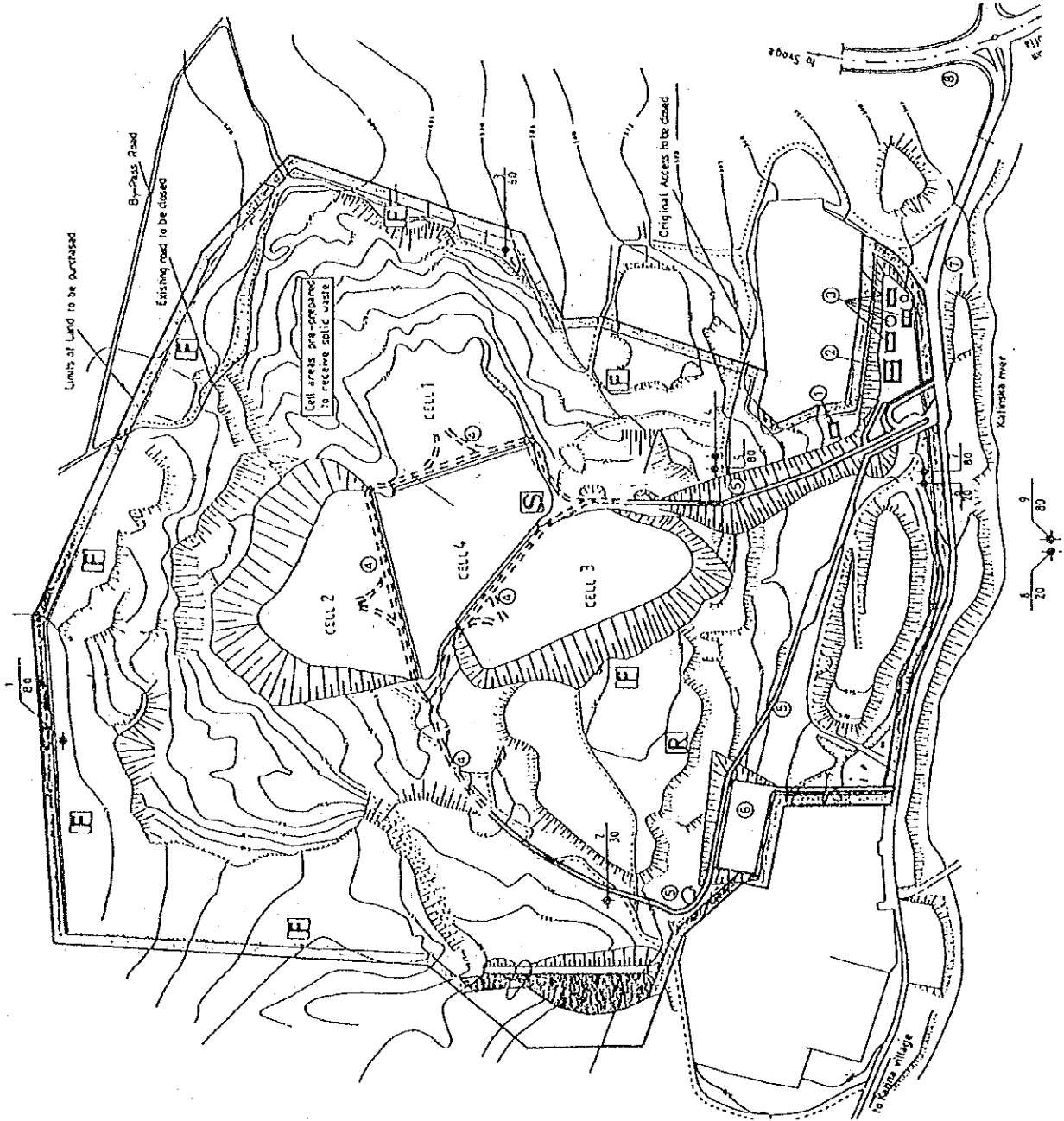
### (2) Katina Site Capacity

Katina site capacity:	8,200,000 m <sup>3</sup>
Area:	72 ha
Disposal period:	1997-2010
Disposal amount in 2000:	1,328 ton/day
Domestic/Commercial	1,187
Street	25
Non-hazardous industrial	116
Disposal amount up to 2000:	1,850,000 ton

### (3) Major Facilities and Construction Works

a. The following facilities shall be constructed at Katina disposal site (refer to Figure 9-2):

- Administrative facilities: Administrative office, Fence and gate, Site road network



**KEY SYMBOLS**

- F Area Floodlighting tower
- Ground water monitoring wells (HG and depth to the screen)
- S Vertical Shaft at the top end of the main underground culvert.
- R Rain gauge
- Trees and bushes
- Permanent Roadways
- Temporary roads - reusable PC Slabs

**Legend**

- 1 Leachate collection tank and recirculation pumps
- 2 Sedimentation tanks
- 3 Future leachate pretreatment
- 4 Temporary roadway (moveable)
- 5 Permanent roads
- 6 Administrative area
- 7 Public Highway to be enlarged
- 8 Projected by-pass road

0 50m 100m Scale

Figure 9-2 Katina Disposal Site Layout Plan

- Reception facility: Weigh bridge, etc.
- Rainwater Drainage: Drainage culvert, discharge facility
- Reclamation of 1st stage disposal zone development
- Leachate and groundwater circulation and discharge facility
- Site Management: Illumination, fire fighting hydrant
- Utilities: Electricity, water supply
- Environmental protection: Site net, monitoring wells, green belt, vehicle disinfection facility
- Amenity Center

b. First Stage Disposal Zone

- Site development
- Groundwater drainage
- Impermeable lining
- Leachate collection facility
- Temporary site road
- Temporary rain water drainage
- Gas removal facilities

c. Disposal site equipment

- |                       |          |
|-----------------------|----------|
| - Landfill compactors | 3 number |
| - Bulldozers          | 4        |
| - Excavators          | 4        |
| - Dump Trucks         | 6        |
| - Tanker              | 1        |

(4) Katina Site Environmental Protection Measures

Always keeping in mind stringent environmental protection measures, operation activities for waste disposal and soil covering will be conducted. Further facilities for environmental protection, such as green belt, leachate collection system and sewage discharge, groundwater quality monitoring and Iskar River drainage channel, vehicle washing and disinfection, and others will be constructed. As countermeasures to bird attraction problem monitoring equipment, net construction, and birds of prey will be introduced. Adjacent holiday homes shall be removed and owners compensated, and any development planned within 1 km of the disposal site shall be subject to municipal approval.

### 9.3 Recycling Pilot Project

Specialized containers shall be placed in front of each block building in the pilot project area and emptied twice a month by crane-mounted trucks. The system to be adopted is illustrated in Figure 9-3.

The pilot project progress and results shall be evaluated and the system modified and expanded to cover all Mladost area and Lyulin district by the year 2000.

Pilot project specifics are as follows:

- (1) Location (1997); Mladost 4 sub-districts (all Mladost and Lyulin districts in year 2000)
- (2) Population; 240,000 in the year 2000
- (3) Targeted recyclable materials:
  - Paper (cardboard, mixed paper)
  - Glass cullet (white, green)
- (4) Recycled amount in 2000;

Pilot project: Paper	6,400 ton/year
Glass	5,100 ton/year
Through existing route	12,300 ton/year
- (5) Equipment

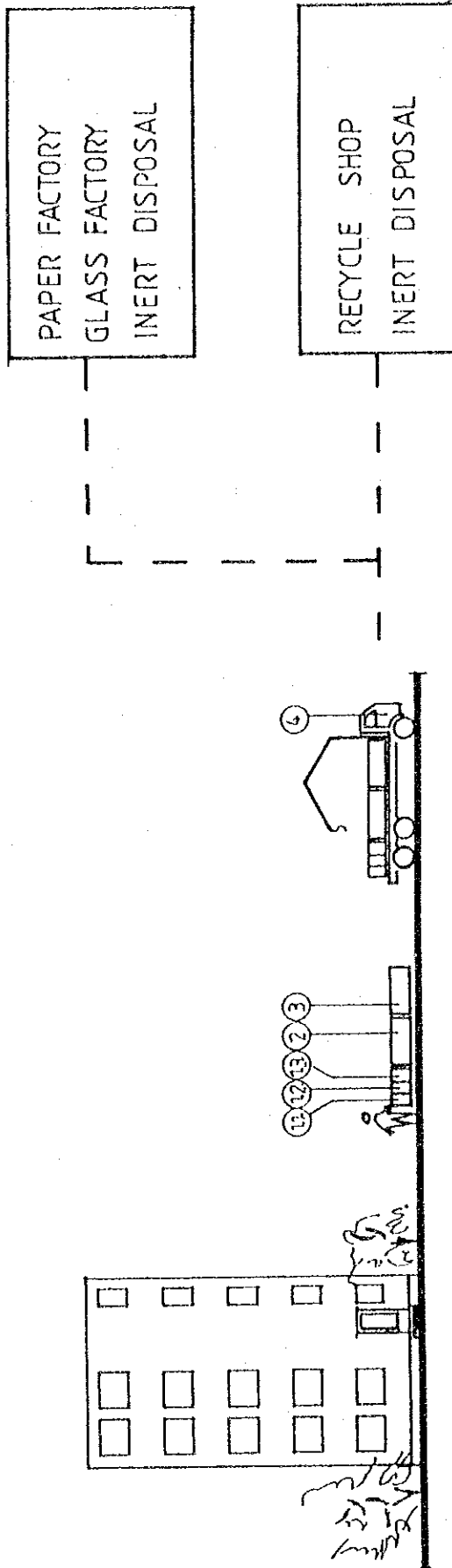
Container	710 sets
Crane truck	6 vehicles

### 9.4 SWM Public Limited Company (PLC)

PLC shall be timely established to start operation in early 1995. For the first five years of its life, PLC will continue to receive a subsidy from SGM, but after that the PLC will become financially independent. General structure of the company is shown in Figure 9-4. A general manager will oversee two main departments, one dealing with administration/finance and a second with planning/operation. Under the general manager there will also be two lesser departments for common services and secretariat to assist and support the two main departments.

The Central Department for Planning/Operation shall oversee the central workshop, five vehicle depots, and final disposal site.

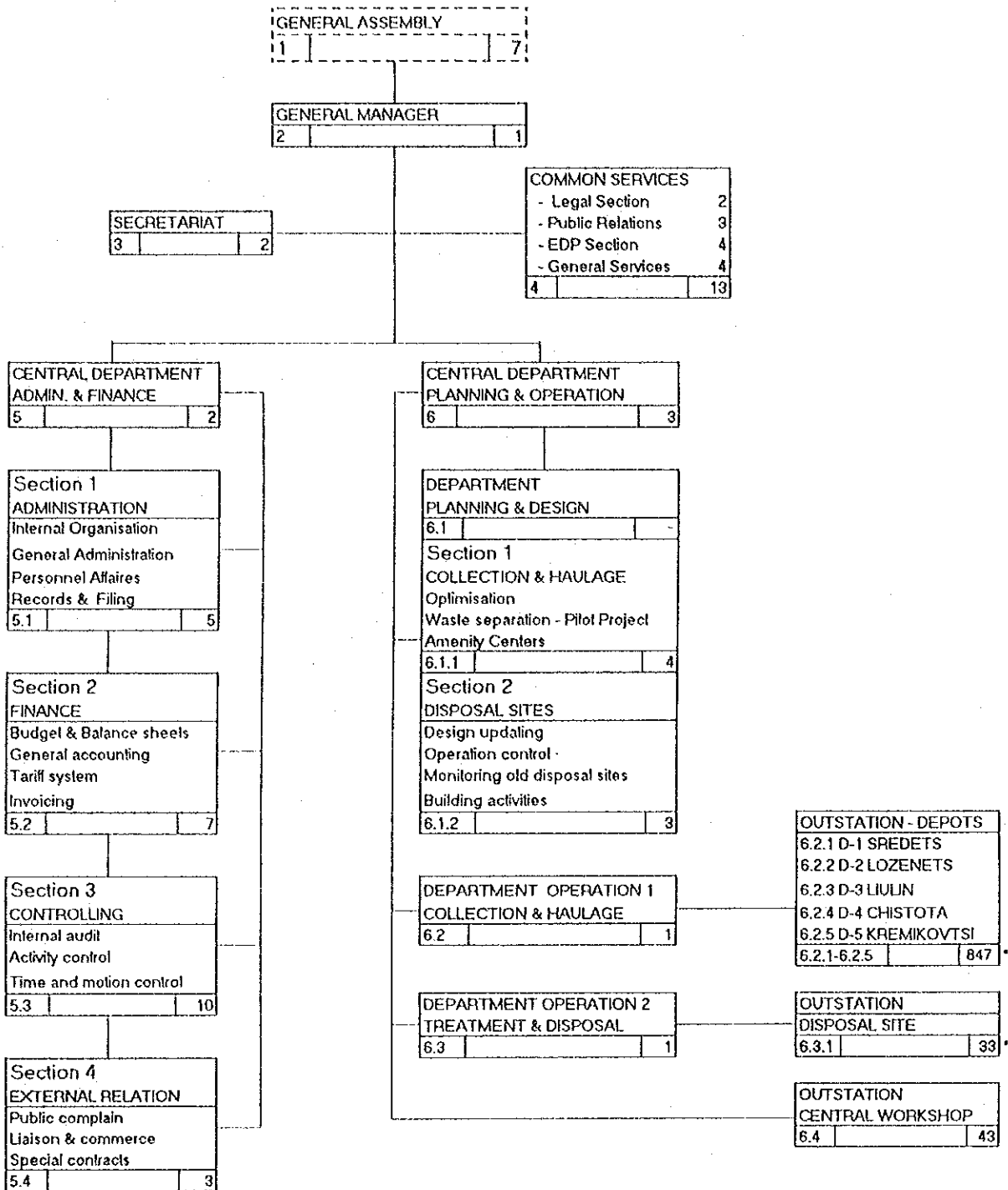
The present SWM operators, BKC and Chistota are also involved in a number of other activities. They are expected to continue the other activities, but with a streamlined staff.



- ① stationary container with 3 sections for;
- ① white glass
- ② green glass
- ③ other glass
- ② stationary container for mixed paper
- ③ stationary container for cardboard
- ④ special car-crane truck

Figure 9-3 Recycling Pilot Project System





• Required manpower in 1997

Figure 9-4 General Structure of the PLC

In 1997, the total number of employees shall be 978, of which 847 shall be engaged in collection and transport, 43 in the workshop, and 33 at the disposal site.

#### 9.5 Revision of Fee System

Fee tariff shall be linked to amount of waste discharged and accordingly burden will be fairly distributed on the principle of 'beneficiaries-to-pay'. The tariff standard shall be determined with the goal of covering SWM costs in the year 2000. Taking into consideration the opening of Katina disposal site in 1997, and construction and operation costs associated with the site, its relative remoteness from the city and the increased collection and transport costs and increased tipping cost, present rate of US\$ 12.8/ton shall be increased to US\$ 22/ton.

The present tariff level per capita, which has been fixed at US\$ 0.9, will be gradually increased. On the other hand, shops are unfairly paying an expensive tariff at present and this will be reduced gradually by 2000. The waste tax tariffs, etc. up to year 2000 are shown in Table 9-4.

Table 9-4 Waste Disposal Fees

		1994	1997	2000
-----				
Waste Tax				
Household	\$/cap.	0.9	3.3	6.6
Shops etc	\$/ton	54.4	47.8	42.9
Service Fees				
Collection	\$/ton	5.1	22.0	22.0
Tipping	\$/ton	1.5	7.4	7.4

## 10. Priority Project Cost and Financial Plan

### 10.1 Project Cost

#### (1) Conditions for Cost Estimation

Priority project cost estimation is made based on the following assumptions.

- a. Price level is of January 1994
- b. Local and foreign portions distribution
 

Local Portion:	Construction cost	Materials cost
		Labor cost
	Equipment cost	General equip. cost
	Local consultants' fees	
Foreign Portion:	Construction Cost	Equip. oper. cost
	Equipment cost	Special equip. cost
	Foreign consultants' fees	
- c. Both local and foreign portions of the costs have been calculated in US dollar. Exchange rate of US\$ 1.00 = 36.4 Leva was applied (January 1994).

#### (2) Investment and Operation Cost

Investment costs are calculated as shown in Table 10-1 and operation and depreciation costs in Table 10-2.

Table 10-1 Priority Project Investment Cost

(unit: US\$ 1,000)

	1995	1996	1997	1998	1999	2000	Total
Collection							
Vehicle	0	2,840	4,305	2,865	3,000	2,150	15,160
Container	1,324	109	218	1,421	110	1,452	4,634
Landfill							
Civil work	2,500	19,102	0	0	0	0	21,602
Equipment	0	2,580	0	0	0	0	2,580
Recycling							
Vehicle	0	0	60	0	60	240	360
Container	0	0	90	0	366	609	1,065
Workshop, etc.							
Civil Work	522	2,484	0	0	0	0	3,005
Container	0	600	0	0	0	0	600
Sub-total	2,345	27,715	4,673	4,286	3,536	4,451	49,008
Contingency	225	1,838	0	0	0	0	2,061
<b>Total</b>	<b>4,570</b>	<b>29,552</b>	<b>4,673</b>	<b>4,286</b>	<b>3,536</b>	<b>4,451</b>	<b>51,069</b>

Table 10-2 Priority Project Operation Costs

(unit: US\$ 1,000)

	1995	1996	1997	1998	1999	2000	Total
Collection							
Personnel	2,194	1,957	1,859	1,907	1,942	1,977	11,836
Maintenance	1,384	1,244	1,323	1,330	1,210	757	7,248
Others	1,183	989	1,001	1,058	1,084	1,100	6,416
Landfill							
Personnel	89	93	107	107	107	107	611
Maintenance	5	5	0	83	101	136	330
Others	346	360	725	753	503	512	3,200
Recycling							
Personnel	0	0	11	11	16	43	81
Maintenance	0	0	6	6	20	50	81
Others	0	0	3	3	8	22	36
Workshop, etc.							
Personnel	96	96	192	192	192	192	960
Maintenance	0	0	12	12	12	12	50
Others	117	117	285	285	285	285	1,376
<b>Total</b>	<b>5,415</b>	<b>4,862</b>	<b>5,525</b>	<b>5,748</b>	<b>5,481</b>	<b>5,192</b>	<b>32,224</b>

## 10.2 Financial Plan

A financial plan has been developed to implement the priority project. The plan has been prepared in US dollars and does not take into consideration inflation.

### (1) Required Fund

The investment cost during the priority project period, inclusive of vehicle fleet renewal cost is estimated at US\$ 51.1 million. Total cost when excluding interest payment on loans and PLC taxes amounts to US\$ 32.2 million.

### (2) Revenue

PLC revenue sources are the waste tax collected by SGM, service fees, sale of recyclable materials, and subsidy from the SGM during the first five years. Total revenue estimated during 1995 to 2000 is US\$ 65.2 million. In principle it is necessary to work within the remaining sum of that figure after subtracting the investment sum amount.

### (3) Loan

As the SGM budget is limited and cannot cover the necessary investment cost, a loan will be required. Based on loan conditions of various international financing agencies, such as EBRD, conditions were assumed as shown in Table 10-3. The foreign portion of the final disposal site construction shall be financed by foreign agencies, while other investment costs shall be covered by domestic loan or self financing.

Table 10-3 Loan Conditions

	Repayment Condition	Interest Rate
Foreign Loan	Repayment over 15 years with a five year grace period	7.5%
Local Loan		
Long term	Repayment over 10 years with a three year grace period	8.5%
Short term	Repayment in the following year	12.5%

### (4) Financial Plan

The financial and loss statement of PLC, calculated based on the aforementioned conditions is shown in Table 10-4.

Up to the year 2000, PLC will be operating in black ink. After 2000 it will be necessary to start paying taxes. Deficit will start appearing in that year, increasing gradually to reach US\$ 12.6 million in 2005. Assuming PLC will pay only US\$ 9.9 million in taxes up to 2005, it is considered that the company can efficiently carry out its obligations. Attention must be paid to the following points;

- a. It is desirable to decrease as much as possible the tax burden on PLC, in light of charging minimum rates for its services, introduction of incineration technology, provision of disposal sites after care service, etc.
- b. Loan interest payment amount will be a heavy burden on the PLC. SGM must exert efforts to secure a loan under reasonable conditions.
- c. As SWM moves forward towards introducing new sanitary landfilling technology and effective recycling systems governmental subsidy is indispensable.
- d. To strengthen PLC financial basis, waste tax and service fee values should be revised in line with inflation.

Table 10-4 PLC Financial Plan  
Profit & Loss Statement of PLC

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Revenue											
Basic Tax	1,056	1,056	4,106	4,106	4,106	8,409	8,409	8,409	9,409	8,409	8,738
Household Shops etc.	5,583	5,583	5,583	5,583	5,583	5,583	5,583	5,583	5,583	5,583	5,583
Collection Fee	717	717	1,036	1,142	1,249	1,355	1,366	1,377	1,388	1,399	1,410
Shops etc.	38	38	129	133	137	141	142	144	145	147	148
Tipping fee	0	0	0	0	0	0	0	0	0	0	0
Electricity	0	0	20	21	109	264	428	591	755	919	1,082
Reusable materials	325	325	325	325	325	0	0	0	0	0	0
SGM budget allocation	7,719	7,719	11,199	11,310	11,508	15,752	15,928	16,104	16,280	16,456	16,961
Subtotal(A)											
Annual Expense											
0 = W cost											
Personnel	2,380	2,146	2,169	2,217	2,257	2,319	2,354	2,390	2,441	2,477	2,512
Maintenance	1,389	1,249	1,341	1,432	1,343	955	986	1,018	1,056	1,087	1,119
Others	1,647	1,467	2,015	2,100	1,881	1,919	1,949	1,977	2,018	2,045	2,063
Depreciation	532	908	3,858	4,238	4,713	5,160	5,315	5,470	5,642	5,797	5,949
Interest(long)	0	249	2,394	2,394	2,388	2,199	1,989	1,693	1,397	1,101	805
Interest(short)	0	0	94	94	255	553	531	354	84	0	295
Subtotal(B)	5,947	6,019	11,778	12,473	12,838	13,104	13,125	12,903	12,638	12,507	12,743
Balance	1,772	1,699	-579	-1,163	-1,330	2,648	2,803	3,201	3,642	3,949	4,217
Tax	0	0	0	0	0	686	1,458	1,665	1,894	2,054	2,193
Profit or loss	1,772	1,699	-579	-1,163	-1,330	1,963	1,345	1,537	1,748	1,895	2,024

Cash Flow of PLC

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Balance	1,772	1,699	-579	-1,163	-1,330	1,963	1,345	1,537	1,748	1,895	2,024
Depreciation	532	908	3,858	4,238	4,713	5,160	5,315	5,470	5,642	5,797	5,949
Subtotal(C)	2,303	2,608	3,279	3,073	3,384	7,122	6,661	7,007	7,390	7,693	7,974
Money Demand	4,570	29,552	4,673	4,286	3,536	4,451	1,594	1,193	2,436	7,027	7,287
Investment	0	0	0	75	2,225	2,498	3,653	3,653	3,653	3,653	3,578
Loan repayment	0	0	0	755	2,043	4,421	4,248	2,835	573	0	2,358
Long Term	0	0	0	5,116	7,805	11,371	9,495	7,680	6,761	10,680	13,724
Short Term	0	0	0	0	0	0	0	0	0	0	0
Subtotal	4,570	29,552	4,673	5,116	7,805	11,371	9,495	7,680	6,761	10,680	13,724
Honey Supply	0	0	0	0	0	0	0	0	0	0	0
SGM Budget	0	0	0	0	0	0	0	0	0	0	0
Long Term	2,725	11,547	0	0	0	0	0	0	0	0	0
Foreign loan	522	15,056	0	0	0	0	0	0	0	0	0
Local loan	0	0	0	0	0	0	0	0	0	0	0
User	0	0	0	0	0	0	0	0	0	0	0
Short Loan	0	0	755	2,043	4,421	4,248	2,835	673	0	2,358	5,250
Subtotal	3,247	26,603	755	2,043	4,421	4,248	2,835	673	0	2,358	5,250
Surplus of Honey	979	-341	-639	0	0	0	0	0	529	-629	0
Reserved Fund	979	639	0	0	0	0	0	0	529	0	0
Total of Debt	3,247	29,850	30,604	31,818	31,971	29,300	24,234	18,419	14,094	12,800	12,113

## 11. Priority Project Evaluation

### 11.1 Technical Evaluation

The collection and haulage improvement priority project basically calls for more efficient utilization of equipment and lack of technical expertise is not considered a problem.

Katina site is considered the earliest candidate site where a new disposal site can be constructed and no technical problems are foreseen during construction. Leachate amount will be reduced through circulation and drained into the sewage system, exceedingly simplifying the disposal site operation.

The close proximity of a military airfield to the site has made it necessary to consider countermeasures against bird attraction. Successfully applied measures in other European sites, such as keeping birds of prey at the site and constructing a net over the site are proposed.

The success of recycling pilot project hinges on residents cooperation and availability of market for recyclable items. Therefore a small area, in the city's heavily populated residential district of Mladost has been selected for the priority project and a system used in many developed countries are proposed.

The purpose behind amenity centers introduction is to provide residents a place to bring their hazardous domestic wastes and bulky waste. Hazardous domestic waste shall be disposed of at the present hazardous waste disposal site.

Based on the above, and on condition that consensus on using Katina as the new disposal site is achieved, implementation of the priority projects is judged technically feasible.

### 11.2 Economic Evaluation

#### (1) Benefits of Priority Project

The following benefits are expected to result from the priority project implementation.

- a. More cost efficient collection and haulage
- b. Unifying a high standard of collection service level throughout SGM, thereby upgrading public health and aesthetics.

- c. Ensure efficient proper landfill operation will continue in the future for a long time by securing new disposal site.
- d. Proper sanitary landfill operation at a new disposal site will enable closure of existing poorly operated disposal sites and put a stop to the environmental damages they are creating.
- e. The new disposal site will make it possible to accept non-hazardous industrial waste portion that is illegally disposed of and reduce amount of waste illegally disposed.
- f. Waste recycling will provide an income from sale of reusable materials and decrease volume of waste necessary for disposal, thereby decreasing disposal costs.
- g. Reutilization of resources will lead to savings in raw materials and energy costs.
- h. The establishment of the PLC will allow savings in personnel and more efficient utilization of facilities such as depots.
- i. Revised fee system will ensure a more sound financial base for SWM.
- j. Amenity center introduction will ensure that hazardous domestic waste and bulky waste are properly disposed of, thereby positively effecting the environment.

Of the above effects, only those described in a. and f. can be quantitatively evaluated. However feasibility of implementing the following priority project components are described hereafter.

- a. Collection and Haulage Improvement
- b. Katina Disposal Site
- c. Recycling Pilot Project
- d. Public Limited Company

#### (2) Collection and Haulage Improvement

The cost benefit analysis of the collection and haulage improvement project was done by assuming that collection and transport cost without improvement is the benefit, and that cost in case of implementing the improvement is the cost.

Therefore, during the 1995 to 2010 period the benefit was US\$ 136.0 million, while the cost is estimated to be US\$ 123 million, ie a ratio of 1.11. With an additional benefit of an EIRR of 24% and under preconditions of institutional development and revised waste tariffs, the project may be evaluated as economically feasible.



### (3) Katina Disposal Site Construction Project

The benefits incurred from construction of Katina disposal site are described in items c., d. and e. above. These benefits can be used as a basis for quantitatively comparing Katina site to another site of sufficient disposal capacity.

As explained in the Main Report's Annex 2, the investment cost for construction of Katina disposal site is about 1/3rd the respective cost for continuing disposal operation at the existing disposal sites.

### (4) Recycling Pilot Project

Benefits of the pilot project are described in items f. and g. Assuming the pilot project will be successfully implemented and expanded to other areas as planned, in 2010 the benefits incurred from this activity will be US\$ 22 million, while the cost will be US\$ 18 million. Therefore a B/C ratio of 1.24 is estimated. With an estimated EIRR of 26.6%, this project is considered to be economically feasible.

However to establish an optimum recycling system, expand the pilot project area, and realize a benefit, the economic foundations of recycling; a constantly improving and sensitive system and a market for reusable goods, are indispensable.

As the technical system proposed in the pilot project has also been tried in EU countries, and recycling is an important environmental protection measure, implementation of this project is strongly urged.

### (5) Public Limited Company

The quantifiable economic benefits that will be incurred from setting up one PLC in the place of 24 BKC and Chistota companies are as follows;

- Reduction in management and supervisory staff at the company headquarters will lead to savings in salaries.
- Reduction in required office space and utilities consumption will lead to savings from office rental.

Accordingly savings in employees salaries shall be US\$ 221 thousand, and those in headquarters office shall be US\$ 88 thousand. Therefore a total saving of US\$ 309.2 thousand annually for the company headquarters is estimated.

### 11.3 Financial Evaluation

Financial evaluation of each priority project component is implemented based on distribution of all the financial resources available to the system in proportion to the revenue of the respective component. In order to comfortably afford to repay the investments, the Financial Internal Rate of Return (FIRR) on the priority project should be in the range of minimum 8.5%. Table 11-1 shows that the FIRR of the individual projects calculated under various assumptions all exceed the minimum rate. Therefore the priority project can be evaluated as sufficiently feasible as a whole from the financial viewpoint.

Table 11-1 Priority Project FIRR

	Revenue	Expenditure	FIRR
Collection improvement project	Waste tax (96%) Collection service fee	Collection cost (Disposal cost) Depots cost	R>E 31.9%
Katina disposal site construction	Tipping fee (Disposal cost)	Disposal cost	R>E 2.9%
Recycling pilot project	Reusable materials sales Waste tax (4%)	Recycling cost Non-reusable material disp.	R>E NPV>0 (8.5% discount)
Priority Project Overall	Waste tax Collection Service Fee Tipping Fee Reusable materials sales	Collection cost Disposal cost Depots cost Recycling cost	R>E 14.4%

As described above financial feasibility for each priority project component is confirmed. In the case of PLC establishment, where tax and additional costs will be necessary the company's financial standing has been examined as shown in Table 10-4.

#### 11.4 Social Evaluation

As the change in collection frequency does not aim to reduce the service extent, but to rationalize resources efficiency, residents are expected to be supporting. The recycling pilot project will be implemented in a residential area far from the present day recycling activity of scavengers at the disposal site and so the project is not expected to create frictions with them.

Use of Katina site as a disposal site is conditional upon the consent of the residents of Katina and the Ministry of Defense. On the other hand, the proposed proper sanitary operation of the new Katina site will discourage scavenging activity which is common at the poorly operated Dolny Bogrov.

Establishment of a more efficient SWM public limited company will lead to dismissal of surplus staff. It will be necessary to expand other services to absorb such people.

The revised waste tax and service fees tariff will be confined to within 0.5% of household incomes, assuming an economic revival, which is considered quite reasonable and socially acceptable.

#### 11.5 Environmental Evaluation

Only at the start of Katina disposal site construction, the lake water will be discharged into the adjacent Katinska River. Discharge will be done at the period when the river water level is high so as to dilute the lake water. Leachate water and water used at site will be discharged to a drain to prevent water quality pollution. Groundwater quality will be monitored and discharged in Katinska River if no environmental problems are feared. If water quality is poor, then measures to discharge groundwater directly into Iskar River will be necessary.

Compensation must be made to owners of holiday homes within 100 m of the site.

The site topography will help in decreasing the problem of wind scattering the waste. Waste at Katina will be disposed of to the height of the surrounding level and a green belt will be constructed around the site to decrease the effect of wind scattering.

At Katina birds of prey will be bred and a net built, both as countermeasures to the bird attraction problem.

Vehicle washing and disinfectant facilities will be provided at the site for waste collection vehicles.

It is therefore considered that the environmental problems that may occur as a result of constructing a disposal site at Katina may be resolved.

#### 11.6 Overall Evaluation

While the priority project will have some limited environmental effects on its surroundings, overall evaluation based on technical, economic, financial, institutional and social aspects shows the project to be feasible.

Although Katina site is located close to Novi Iskar village and a military airfield, the site surroundings will be protected by effective countermeasures and monitoring thereby ensuring that environmental effects are kept to a minimum. In addition this site is an abandoned clay quarry hole, and from environmental and safety points of view the early restoration of the site is desirable.

As explained earlier, use of Katina site as a disposal site is only possible after attaining the consent of surrounding residents and Ministry of Defense. It is necessary for SGM to make maximum efforts to implement the priority project in order that the implementation may not only contribute to creating a desirable SWM system for SGM but also help SGM show its ability to appropriately cope with SWM in the transition period to a market economy.

Therefore not only should this priority project be evaluated as feasible to implement, but should also be considered as an initial phase in achieving the master plan targets and goal, and accordingly be highly evaluated.

- a. Katina disposal site will continue operation to the year 2010, thereby playing a guiding role for future SWM amelioration.
- b. The new PLC will be established in line with the policy to shift to a market economy, acting as an efficient executing entity for SWM.

- c. The recycling pilot project will make it possible to study and identify the optimum recycling system to be employed throughout the city.
- d. Not only will the amenity center offer a system to properly dispose of hazardous domestic waste, but it will also serve as a place for residents and officials to exchange ideas and discuss about solid waste issues.

## 12. Implementation Plan

### (1) Implementation Organization

The PLC shall be responsible for implementing the priority project. However to prepare for establishing the PLC and other components of the priority project, a project implementation unit (PIU) is proposed to be established within the municipality. Upon establishment of the new company, and to ensure continuity, the PIU staff will transfer to it. The PIU should be formed of municipality experts coming from environmental, public utilities, technical and financial departments, BKC companies and Chistota.

### (2) Implementation Schedule

The implementation schedule is shown in Figure 12-1. The 1994 preparatory period for PLC establishment should also be used for securing financial resources to realize all components of the priority project. In addition, during 1994 execution of Environmental Impact Assessment for Katina disposal site is necessary.

### (3) Financial Plan

The sources of investment funds needed for implementing the priority project are shown in Table 12-1. Foreign loan is indispensable. To set the minimum possible cleansing service cost, efforts should be made to make loans at reasonable conditions and also find domestic funding sources.

Table 12-1 Sources of Investment Funds

(unit: US\$ 1,000)

	1995	1996	1997	1998	1999	2000	Total
Inner Fund	1,324	2,608	3,279	3,073	3,298	4,451	18,032
Foreign Loan	2,725	11,547	0	0	0	0	14,272
Local Loan							
Long term	522	15,056	0	0	0	0	15,578
Short term	0	341	1,393	1,214	239	0	3,187
Total	4,570	29,552	4,673	4,286	3,536	4,451	51,069

	1994	1995	1996	1997
a.Loan application				
b.Loan agreement		x		
c.Establishment of new organization		x		
- Preparation				
- Head Office	--	x		
- Depot	--	x	=====	x
- Workshop	--	x	=====	x
- Amenity center			=====	x
c.Collection				
- Preparation				
- Veh. Procurement, etc.			=====	x
- Zone rearrangement	-----	x		
- Container Procurement	-----	x		
- Change frequency & collection system	-----	x		
d.Katina disposal site				x
- Detail design & tender document				
- EIA	-----			
- Construction			=====	
- Heavy equipment purchase			=====	x
e.Establish new tariff value		x	x	x
- Preparation	-----			
g.Prepare groundwork for privatization				-----
h.Recycle Pilot Proj				x
- Preparation				-----
- Vehicle & Container				x
i.Related work				
- Novi Iskar bypass	=====			
- Suhudol II ext.	-----	x		

Note: ===== Tender process  
----- Construction and other work  
Existing facility of workshop and depot will be used temporary until 1997.

Figure 12-1 Priority Project Implementation Schedule





## RECOMMENDATIONS



## Recommendations

### (1) Establishment of Project Implementation Unit (PIU)

Much preparatory work is required before the priority project implementation can proceed. It is therefore recommended that a project implementation unit (PIU) be established of experienced staff from related SGM Environmental Department, BKC, and Chistota Co. with a view to a future Planning Department of PLC in order to set up a system by deployment of full time staff. In particular PIU will have the urgent tasks of setting up the new PLC and implementing the environmental impact assessment required in connection with the construction of Katina disposal site, so it is necessary to select highly qualified staff for this unit.

### (2) Institutional Development

It is very important to develop institutions overseeing SWM in order to upgrade efficiency. The main features of the institutional development shall be establishing the PLC during the priority project period, strengthening related departments within SGM and defining their responsibilities, tariff system and distribution of tax and subsidies to the PLC, and remedying the problems associated with the present municipal disposal sites.

### (3) Existing Disposal Sites

Of the two present disposal sites, there are strong calls from residents surrounding Dolny Bogrov site to close that site because of waste disposal proceeding there in the absence of sufficient environmental protection measures. The continued use of the site, as present will greatly increase clean-up costs expected in the future. Therefore a decision on closing the site immediately should be taken.

On the other hand, such a decision would leave Suhudol site, the second disposal site as the only open site, until the construction of a new disposal site. Therefore citizens cooperation in reducing waste volume and implementation of the Suhudol extension plan are recommended so as to prolong the life of disposal site as much as possible.

#### (4) New Disposal Site

The new disposal site at Katina will serve as a model for future disposal sites to be constructed and operated in Bulgaria. This site will therefore have a large influence on future disposal sites to be constructed in the country.

All data on aspects of the disposal site construction from environmental assessment and implementation program to site operation and closing down should be open to the public in order to attain the understanding of surrounding residents as much as possible while improving upon the project aspects where required and based on the discussions. This open flow of information should continue with the public during site operation and at site closing down.

#### (5) Recycling and Waste Volume Reduction

Preconditions for reutilization of waste materials are existence of market demand and delivery system. However market demand is very sensitive to economic activities and price fluctuations which are sensitive to available supply. This risk cannot be met at the municipality level only, but the central government should also be involved in this activity to shoulder some of the risk involved. In particular recycling should not be evaluated from the narrow viewpoint of cost only, but a more broader evaluation in terms of the effects this activity will have on reducing environmental damage, energy savings, creation of employment opportunity, promotion of citizens participation and strengthening community activity is desirable.

#### (6) Private Contracts

Lack of private concerns expertise in SWM is the reason why it is recommended to establish a public company for SWM.

However in the long run letting out contracts to private companies for parts of SWM activities will help to avoid unnecessary expansion of the public company, inefficient operation and costs escalation.

It is therefore recommended to establish the necessary regulations, institutions and technology exchange to promote private companies participation in the future.

#### (7) Proper Use of Surplus Personnel

Proper utilization of surplus personnel is one of the key factors in improving the collection system and development of new SWM administration. Therefore it is recommended to consider reallocation of staffing in the various public service activities, including street cleaning with the aim of upgrading service levels and unifying service standards.

#### (8) Systematic Data Collection and Analysis

Solid waste characteristics are sensitive to seasonal and socioeconomic changes. Fluctuations in amount and composition on daily, monthly and annual bases are expected. It is therefore strongly recommended to periodically execute the following surveys and studies.

- Populations and land use by collection zones
- Waste amount by collection zone and generator
- Waste composition by season and generator
- Recycling amount by waste material
- Environmental monitoring at disposal site
- Cost analysis by SWM activity

#### (9) Proper Waste Tariff Level and Collection

The master plan adopts the principle of 'beneficiary to pay', where dischargers should be charged based on waste volume. Tariff level should be set at levels which will ensure that a balance between revenue and expenditure is achieved with periodical review and adjustment to inflationary trends.

It is further recommended to adjust levels and revise them when necessary based on social and economic conditions so as to ensure fairness and ability to pay.

#### (10) Revision of Master Plan

The SWM master plan was prepared with the target year of 2010 and based on forecasts for solid waste amount and composition up to then. Bulgaria is in the process of transferring from a command economy to a market economy and in this transitional phase it is difficult to accurately forecast all social and economic conditions.

Therefore it is strongly recommended that the preconditions of the master plan be reviewed on a periodic basis and revised as required.

#### (11) Public Education

Positive citizens' cooperation is indispensable to ensure smooth operation of SWM activities. To achieve this, implementation of definite plans for SWM practices as discharge manner, recycling, source separation, and minimizing discharged waste amount through the mass media, at schools and in religious and other community groupings is recommended.

#### (12) Education of SWM Personnel

It is recommended that the central government, through workshops and seminars, provide forums for exchange of opinions and expertise between the personnel involved in SWM to develop this vital public service on a national basis. Furthermore qualifications and levels of staff engaged should be screened through an examination process by the government.

#### (13) European Community SWM Standards

As Bulgaria has the aim to enter the European Union and continue its integration efforts in the European developed countries, SWM in Bulgaria should meet EC standards. In particular following aspects should be considered and developed where necessary.

- SWM related laws and institutions.
- Environmental protection measures and reduction of environmental damage
- Management of hazardous industrial waste (in line with the Basel Convention)
- Suitable institutional system in which public and private concerns may cooperate in SWM
- Human resources development and promotion of citizens participation

#### (14) Industrial Waste Treatment

Industrial waste should be properly treated in accordance with waste quality. At present there is a problem in insufficient intermediate treatment facilities and unprepared disposal sites. It is very important to formulate an understanding of actual amounts of industrial waste produced and plan for recycling of usable materials and reduction of waste amount. It is also recommended to monitor non-hazardous industrial waste presently accepted at municipal disposal sites for composition and amount to provide proper guidance for treatment.



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