nities of developing countries (eg South Africa). It is considered, however that hand sorting would be difficult to implement satisfactorily in Bulgaria and would be incompatible with the health and environmental targets of a major European Capital.

It is recognized that the Bulgarian Economy is currently undergoing fundamental and dynamic changes and that it may well be some time before stable and lasting market values for recycled domestic waste materials are apparent and before the public can be expected to be able to afford major subsidies for the sake of 'Recycling'. It is considered that until that time it will not be possible to guarantee long term viability (or not) of municipal waste recycling.

To launch upon a major recycling project at this time may well only be sensible if the Government or SGM were willing to commit funding on temporary or permanent basis.

2) Pilot Project for Recycling

Targets proposed are to meet the SWM criteria and:

- To actively promote Public Consciousness in Waste reduction, waste economy, and waste recovery (support preseparation etc);
- to commence an initial pre-separation programme in respect of household waste paper and glass;
- to provide all citizens with a proper and controlled place where they can freely dispose of any household waste within normal daylight hours;
- to provide all citizens with a place where they can voluntarily bring preseparated hazardous household waste for disposal (oils, surplus paints, batteries, drugs, etc);
- to minimize, whenever possible and economic, the burden on the use of Municipal Household Waste Facilities (save landfill volumes - unless profitable, save transport & other disposal costs, etc);
- in parallel with the 'recycling/waste disposal' proposals, provide convenient waste disposal points suitably dispersed through the region whereby small organizations, business and commercial can readily dispose of waste on-the-spot for a fee (profitable): rather than be tempted to illegally dump.

In the long term, the effect of recycling efforts will have to be periodically re-evaluated as the Economy adjusts.

An indication of the potential worth of waste disposal minimization can be illustrated by considering the effect of achieving the M/P targets for wastepaper and glass alone: The proposed savings will reduce landfiling requirement by some 70,000 tons per annum. Over the possible landfill life of Katina the ultimate saving could well equal the capacity of the current Suhudol Extensions. If the recovered waste can be sold a double benefit occurs.

In view of the above discussion and due to current economic constraints, no major capital intensive or resource committing projects are proposed for SGM at this time. However in the meantime a lot can be done to promote 'resource management' concepts and to effect improvements in regional recycling waste minimization.

Long term targets would be set and actively pursued. Initial proposals for these targets are set out with projections of the constituent proportions of the collectible household waste as as shown in Table 6-1-2:-

Table 6-1-2 Recycling Amounts Targets

Year	M/P Recycled Amount		Mehaplast Recycle Amount	Total Recycling	Share of Tot. Waste
	Paper (t/yr)	Glass (t/yr)	(t/yr)	(t/yr)	(%)
1995	--	--	12,282	12,282	3.3
1997	474	423	12,282	13,178	3.1
2000	6,422	5,118	12,282	23,822	5.2
2005	27,422	17,898	12,282	57,602	11.5
2010	49,681	23,565	12,282	85,528	15.8

In the following text proposals are made as to how it is considered a start at 'Resource Management' can be made and possible advantages & potential economic savings properly explored. The creation of a special post for 'recycling' is envisaged together with proposals for a pilot 'pre-separation/recycling' programme in an area to be selected.

6.1.6 Domestic hazardous waste

In order to respond to articles 23 & 67 of the Bulgarian Waste act it is proposed that:

- The Amenity Centers be equipped with facilities for controlled receipt of 'Pre-separated Domestic Hazardous Waste' and that the first of these be included in the Priority Project proposals (for oils, surplus paints, batteries, drugs, etc);
- further plans be made to set up special containers for such waste as part of a pilot project in selected areas with a view to promoting the separate collection of pre-separated hazardous items from district containers. The plans to be linked with a local publicity and public awareness campaign;
- upon receipt, the waste type be recorded, that the waste type be properly considered, and unless it falls into the category of 'special wastes' it is disposed of in accordance with the EC guidelines to the municipal landfill in the prescribed proportions. Domestic refuse 'Special Wastes' if they occur, should be disposed of on a case-by-case basis. 'Special wastes' (ie unacceptable) can be disposed of at Kremikovtsi until such time as more permanent facilities are established.

It should be noted that term "Hazardous Waste" is somewhat subjective. Unfortunately no exacting and clear Bulgarian definition is given and accordingly the interpretation of the nature of "Hazardous Waste" is controversial. For present purposes it is assumed that Domestic Hazardous Waste is includes waste which, by its nature, needs careful handling and/or that which is generally harmful to man and has an environmental risk associated with its uncontrolled disposal. The EC directive defines 'Special Waste' and sets out sensible eluate tests for waste classification into appropriate groups.

It is proposed that SGM aim to establish at appropriate Municipal centers throughout the region several strictly controlled 'Amenity Centers' where private citizens and proprietors of small businesses can bring domestic hazardous waste and any surplus rubbish, and the like for disposal by the Municipal authorities.

It is proposed that the service be free to private citizens for 'Household Refuse' and that a charge be made to small businesses for the receipt of limited quantities of their commercial waste: (a higher charge rate than for direct collection or from that levied for bulk deliveries to the Disposal Sites).

6.2 Development and Examination of Alternatives

6.2.1 Development of Alternatives

1) Formulation of Alternatives

Alternatives are developed through combinations of SWM technical, Institutional and financial systems. The technical system itself also has many combinations. The technical system will serve as a basis to provide the required service and cost it, and alternatives will be proposed based on following considerations:

a. As mentioned in Section 6.4 of this chapter, establishment of one public limited company to ensure efficient organization of SWM.
b. Financial system shall be prepared to cover SWM cost that will be determined based on cost of technical system.

Technical system consists of collection, haulage, intermediate treatment, recycling and disposal. Alternatives are presented based on combinations of those sub-systems. Collection system and recycling system will be the same for all alternatives although effect of distance is taken into account for each alternative.

Table 6-2-1 Description of Alternatives

	Collection	Haulage	Intermediate treatment	Disposal	Recycling
Alternative 1	Described in 6.1.1	Direct	600 t/day	Disposal at Katina	Paper & Glass
Alternative 2	Described in 6.1.1	Direct	--	"	"
Alternative 3	Described in 6.1.1	Transfer haulage with compaction	--	"	"
Alternative 4	Described in 6.1.1	Transfer haulage (with press.)	--	"	"

These alternatives are described as follows:

Alternative 1:
Alternative 1 introduces a 600 t/day incinerator plant as an intermediate treatment facility at Koriata.

In the year 2010 the alternative proposes that about 44% of the city's collected domestic and commercial waste will be incinerated and the remainder will be directly hauled to the sanitary landfill site at Katina. Ash resulting from the incineration plant will be transported to Katina also.

Alternative 1b.:
Alternative 1b. offers the same facility as that of Alternative 1, but at a different location, south-west of the city (S/W). This alternative has been studied to identify the effect on collection and haulage costs for locating the facility closer to the city center.

Under this alternative in the year 2010, 43% of the waste shall be incinerated and the remainder directly hauled to Katina sanitary landfill site. Ash resulting from the incineration plant will also be transported to Katina.

Alternative 2:
This alternative proposes that all collected waste be directly hauled from the collection zones to the Katina site.

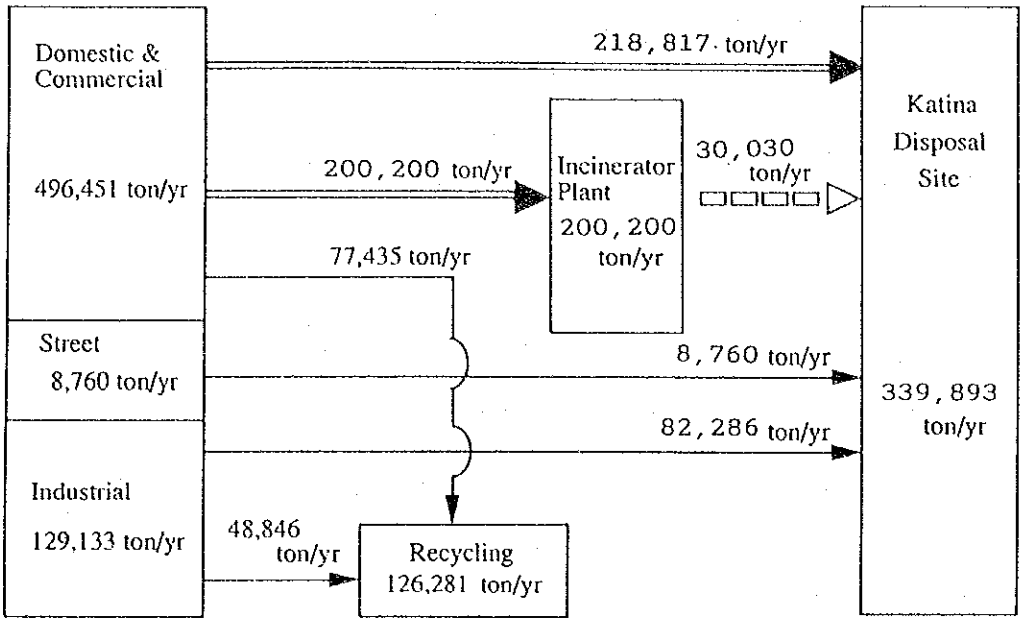
Alternative 3:
In Alternative 3, two transfer stations are introduced at Koriata and S/W. Each transfer station shall have a capacity of 500 ton/day.

In the year 2010, 66% of waste amount shall be hauled into the two stations from surrounding areas. The waste shall then be compacted into 40 m^3 containers mounted on trailers and transported to Katina landfill disposal site. The remaining amount shall be directly hauled to Katina.

Alternative 4:
Under Alternative 4, three pre-compressed waste block plants are proposed at Katina, Koriata and S/W with a total capacity 1,500 ton/day. All waste shall be compressed and tied in blocks before being disposed of in Katina landfill site.

The waste flows for each of the four alternatives in the year 2010 are shown in Figures 6-2-1 a) to d).

Alt. 1 2010



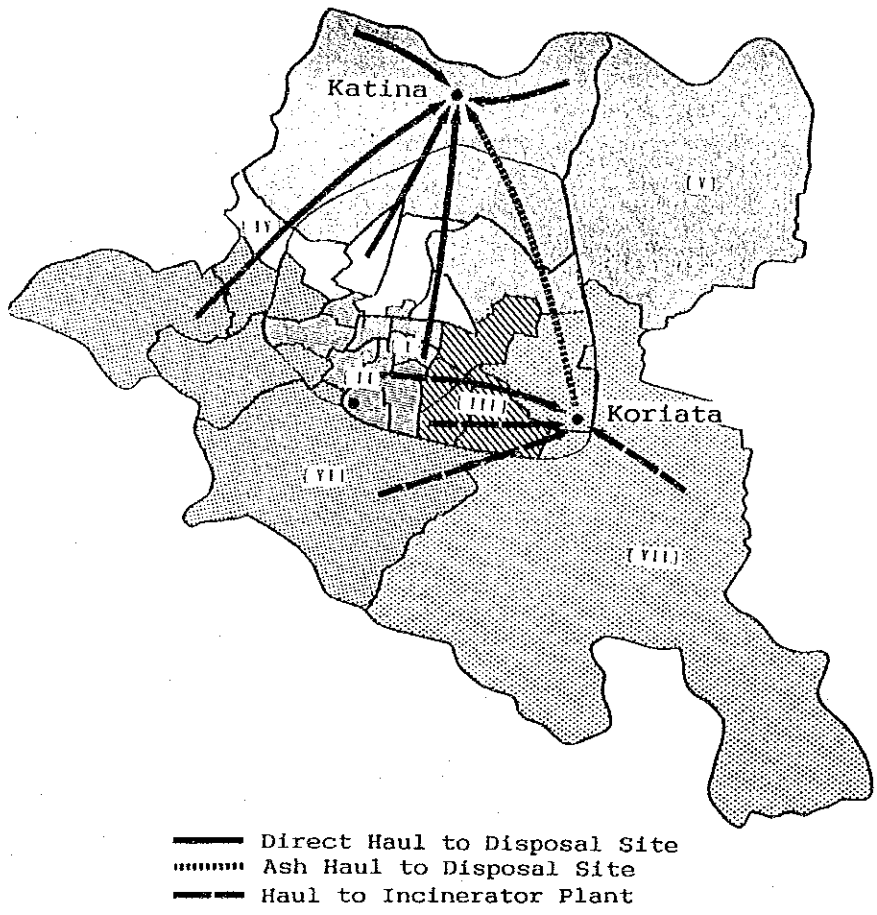
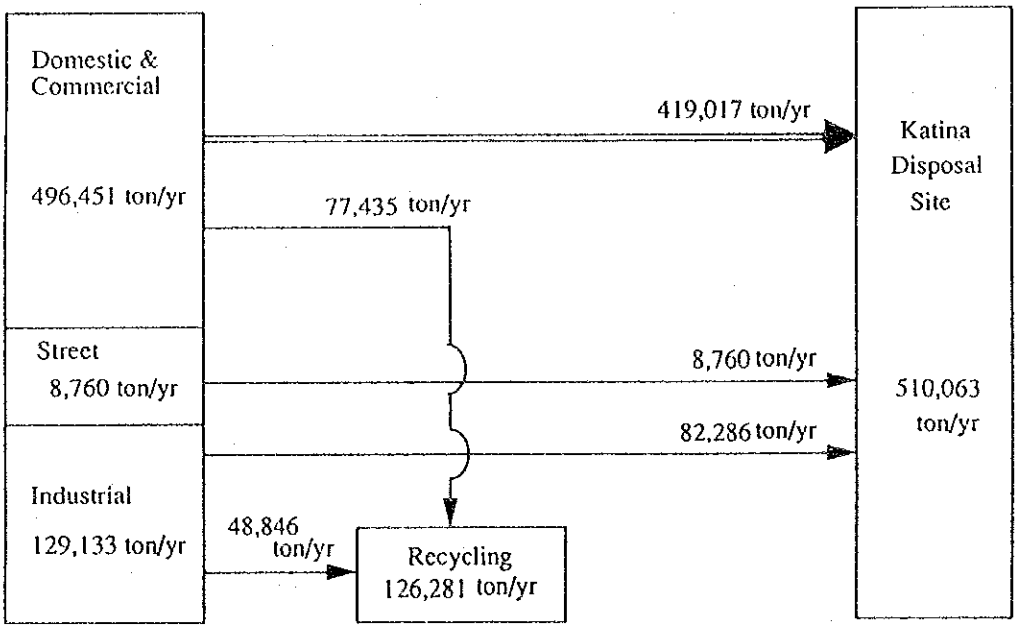
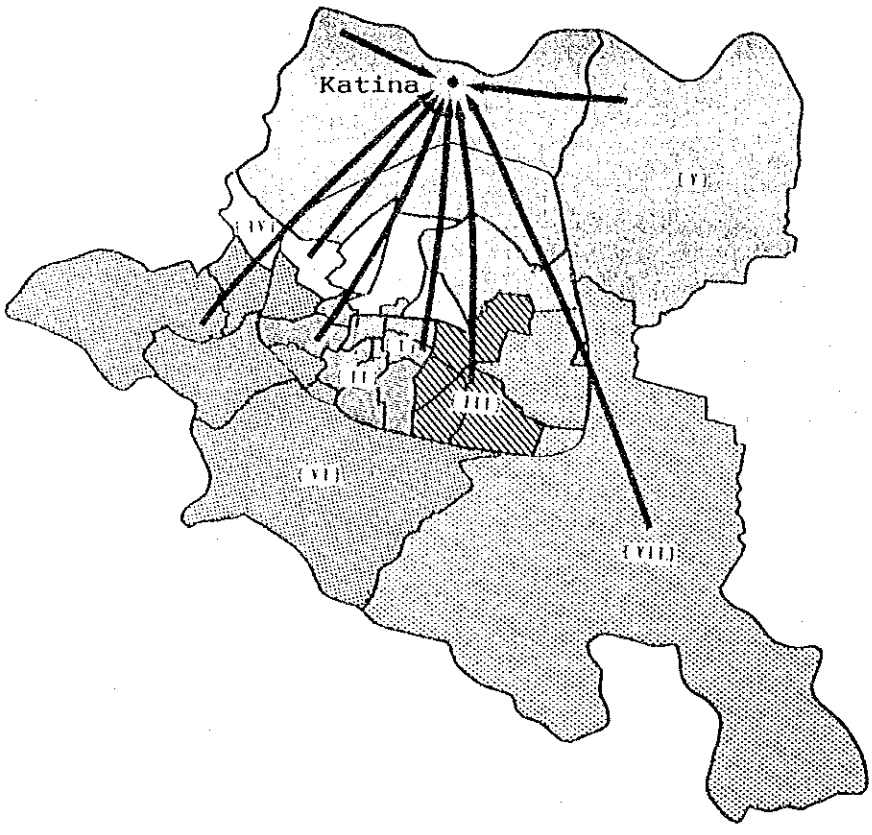


Figure 6-2-1 a) Alternative 1

Alt. 2 2010

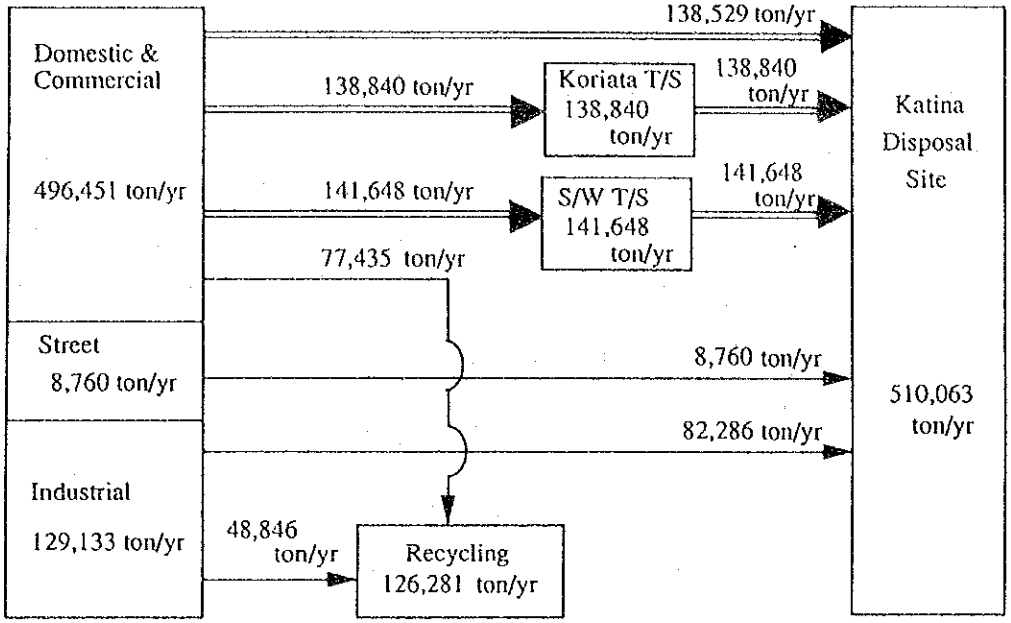




Direct Haul to Disposal Site

Figure 6-2-1 b) Alternative 2

Alt. 3 2010



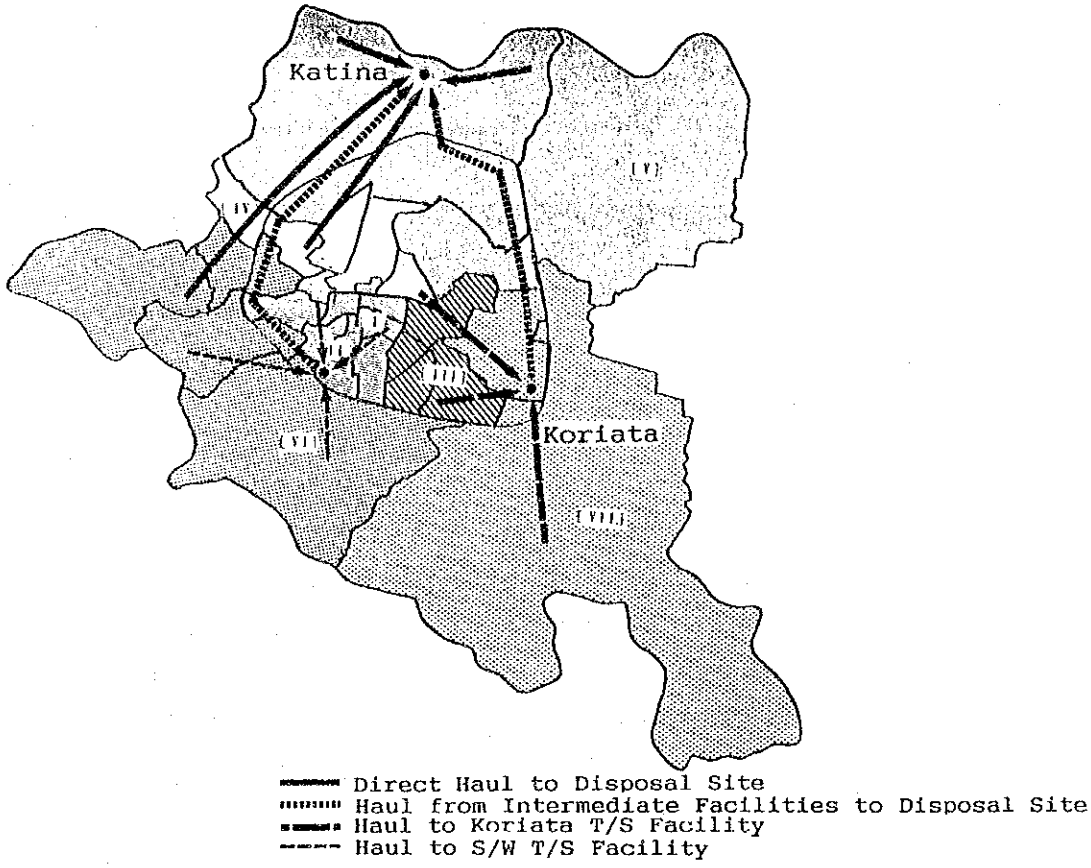
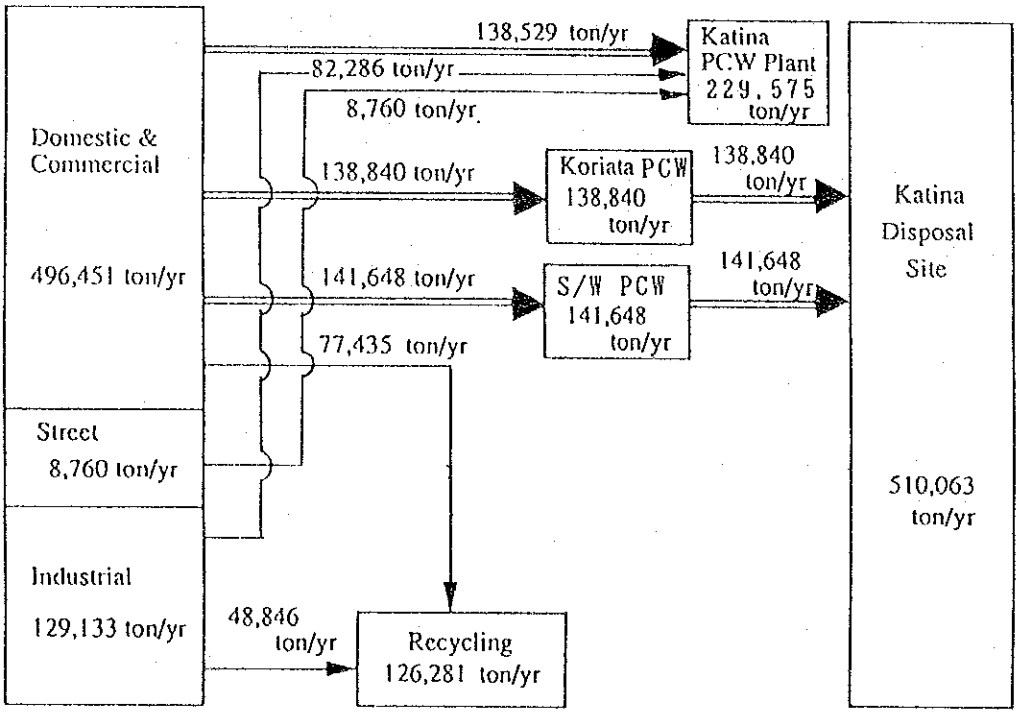


Figure 6-2-1 c) Alternative 3

Alt. 4 2010



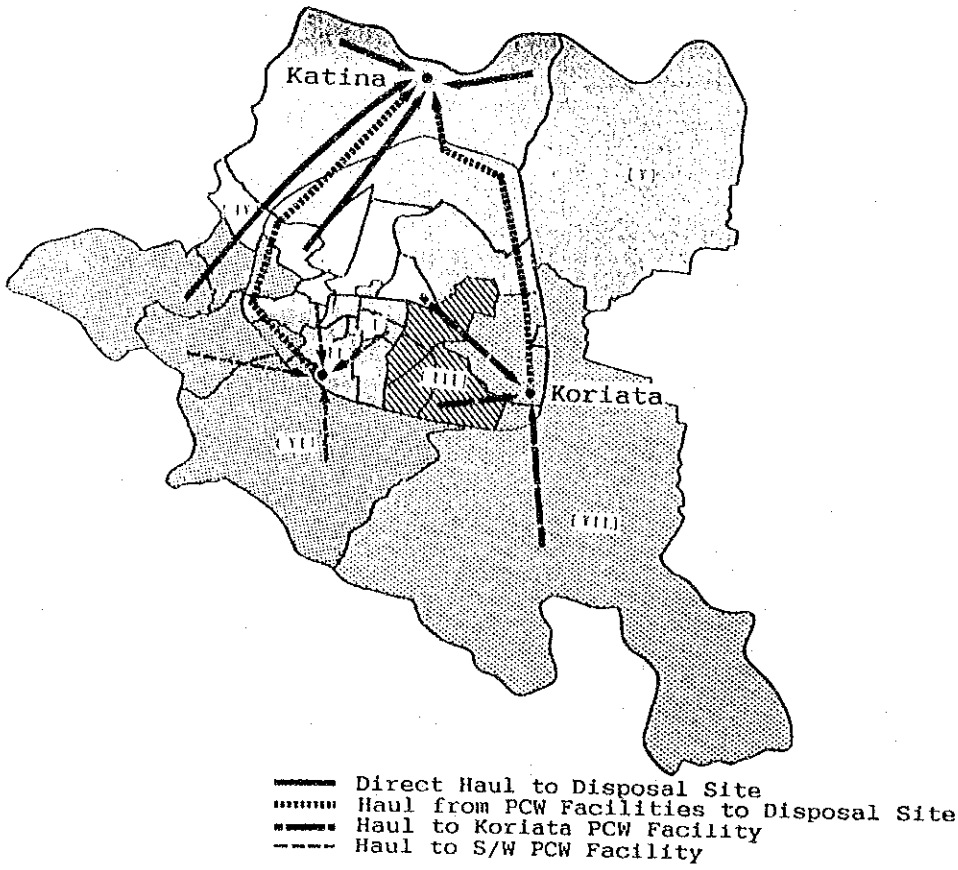


Figure 6-2-1 d) Alternative 4

6.2.2 Cost Estimation

1) Details of alternatives

Cost estimation is made for each alternative described hereinbefore. W/O (Without Project) assumes the case where the existing collection system will continue without improvement, but with the development of Katina landfill site. This case is costed to compare it with the four alternatives.

Major assumptions of the W/O project case are:
- Collection: Vehicle use efficiency = 60%
  Collection Zones = 24
- Intermediate Treatment: None
- Disposal : Katina landfill site (same as Alternative 2)
- Amenity Centers: None

Each alternative is composed of the combination of Collection System, Landfill Site, Amenity Centers etc. and Treatment Plants. Three treatment plant types; incineration Plant, transfer station and PCW plant are taken into consideration.

Amenity Centers etc. include Head Office, Central Workshop, Amenity Centers, Vehicle Depots etc.

The quantitative details of major items of each alternative are summarized in Table 6-2-2. The values given in that table show the ones generated or required in the year 2010. The cost estimation is made based on this table.

2) Composition of costs

The cost of each alternative consists of the combination of the following four main components;
- Collection cost
- Treatment plant cost
- Landfill site cost
- Amenity center cost

For each component, Investment Cost and Operation and Maintenance Cost (O & M cost) are estimated.

3) Conditions for cost estimation

Cost estimation is made under the following assumptions;
- Price level is as of July 1993 (exchange rate at that date was US$ 1 = 26.5 Lv).

Table 6-2-2 Details of Alternatives in Year 2010

Item	Unit	Alt. 1-a	Alt. 1-b	Alt. 2	Alt. 3	Alt. 4	W/O
1. Collection							
1.1 Amount of waste							
1) Collected waste	t/d	1,343	1,343	1,343	1,343	1,343	1,343
2) Haul to Katina							
a) Direct haul	t/d	752	762	1,343	444	444	1,343
b) Secondary haul	t/d	90	90	—	899	899	—
3) Haul to Koriata	t/d	591	581	—	445	445	—
4) Haul to S/W	t/d	—	—	—	454	454	—
1.2 Number of collection vehicles							
1) Compactor vehicle	No.	144	133	148	130	130	482
2) Haul container vehicle	No.	38	30	40	30	30	156
1.3 Number of containers (Ra and Kison)	No.	15,150	15,150	15,150	15,150	15,150	17,270
1.4 Number of plastic bags	No.	6,900,000	6,900,000	6,900,000	6,900,000	6,900,000	—
1.5 Number of Personnel							
1) Drivers	No.	185	165	190	165	165	640
2) Workers	No.	580	535	595	525	525	1,928
2. Landfill site							
2.1 Amount of waste	t/y	337,925	339,893	510,063	510,063	510,063	510,063
2.2 Number of mobils							
1) Light vehicle	No.	2	2	2	2	2	2
2) Heavy equipment	No.	6	6	7	7	7	7
2.3 Number of Personnel							
1) Administration etc.	No.	7	7	8	8	8	8
2) Drivers	No.	6	6	8	8	6	8
3) Workers	No.	5	5	6	6	5	6
3. Incineration plant							
3.1 Treatment capacity							
1) Koriata	t/d	600	—	—	—	—	—
2) South-West	t/d	—	600	—	—	—	—
3.2 Number of vehicle (Ash transport)	No.	3	3	—	—	—	—
3.3 Number of Personnel							
1) O & M personnel	No.	48	48	—	—	—	—
2) Drivers	No.	3	3	—	—	—	—
3.4 Ash genaration	t/d	90	90	—	—	—	—
3.5 Power generation	Mw	3.3	3.3	—	—	—	—

Table 6-2-2 (cont...)

Item	Unit	Alt. 1-a	Alt. 1-b	Alt. 2	Alt. 3	Alt. 4	W/O
4. Transfer station							
4.1 Treatment capacity							
1) Koriata	t/d	—	—	—	500	—	—
2) South-West	t/d	—	—	—	500	—	—
4.2 Number of vehicle							
1) Tractors	No.	—	—	—	9	—	—
2) Trailer-containers	No.	—	—	—	16	—	—
4.3 Number of Personnel							
1) O & M personnel	No.	—	—	—	16	—	—
2) Drivers	No.	—	—	—	9	—	—
5. P.C.W. plant							
5.1 Treatment capacity							
1) Koriata	t/d	—	—	—	—	500	—
2) South-West	t/d	—	—	—	—	500	—
3) Katina	t/d	—	—	—	—	500	—
5.2 Number of vehicle							
1) Tractors	No.	—	—	—	—	8	—
2) Trailer-containers	No.	—	—	—	—	14	—
5.3 Number of personnel							
1) O & M personnel	No.	—	—	—	—	24	—
2) Drivers	No.	—	—	—	—	8	—
6. Amenity Centers etc.							
6.1 Number of facilities							
1) Head office (Admi. office)	No.	1	1	1	1	1	—
2) Central workshop	No.	1	1	1	1	1	—
3) Vehicle depot	No.	3	3	3	3	3	—
4) Amenity center	No.	4	4	4	4	4	—
6.2 Number of personnel							
1) Head office admi. & operation personnel	No.	60	60	58	58	58	—
2) Operation personnel for Vehicle Depot	No.	39	39	39	35	35	—
3) Operation personnel for Central Workshop	No.	30	30	30	28	28	—
4) Operation personnel for Amenity Center	No.	8	8	8	8	8	—
5) Conventional Bekase and Chistota administration personnel (excl. Collection and Landfill Site personnel)	No.	—	—	—	—	—	300

- All costs are estimated in US dollar in consideration of the severe inflation in Bulgaria.
- Land acquisition costs and the costs of connection fees of public utilities (water, electricity, sewerage) are not included.

4) Investment cost and O & M cost

Investment costs for collection, landfill site, treatment plant and amenity centers are summarized in Table 6-2-3, while Table 6-2-4 shows the operation and maintenance cost for each. Costs are shown for each alternative separately.

Investment Costs and O & M Costs shown in the tables indicate the ones, under the price level at July 1993, necessary to afford the items given on Table 6-2-2 "Details of Alternatives".

For the calculation of Depreciation Cost, the following life span is assumed;

	Life Span (years)	Salvaged Value (%)
Plant and machinery	15	0
Vehicles and mobiles	8	10
Containers	5	0

Table 6-2-3 Investment Costs of Alternatives

(Unit: US$ 1,000)

Item	Alt.1-a	Alt.1-b	Alt.2	Alt.3	Alt.4	W/O
1. Construction						
1.1 Disposal site						
1) Civil work	14,109	14,109	14,109	14,109	14,109	14,109
2) Leachet treatment	3,600	3,600	3,600	3,600	3,600	3,600
1.2 Incineration Plant						
1) Civil work	26,300	26,300	—	—	—	—
2) Equipment	112,700	112,700	—	—	—	—
1.3 Transfer station						
1) Civil work	—	—	—	3,000	—	—
2) Equipment	—	—	—	11,400	—	—
1.4 P.C.W. Plant						
1) Civil work	—	—	—	—	4,700	—
2) Equipment	—	—	—	—	17,500	—
1.5 Amenity center etc.						
1) Civil work	2,000	2,000	2,000	2,000	2,000	0
SUB-TOTAL (1)	158,709	158,709	19,709	34,109	41,909	17,709
2. Purchase of Vehicles etc.						
1) Collection Vehicle	13,302	12,240	13,680	11,970	11,970	44,784
2) Landfill Mobil	1,752	1,752	1,968	1,968	1,968	1,968
3) Transportation Vehicle	90	90	0	1,383	1,220	0
4) Container	2,439	2,439	2,439	2,439	2,439	5,287
5) Container for Amenity Center	600	600	600	600	600	0
SUB-TOTAL (2)	18,183	17,121	18,687	18,359	18,197	52,038
Total of Initial Investment	176,892	175,830	38,396	52,468	60,106	69,747
Additional Investment						
1) Vehicle & Mobil	15,144	14,082	15,648	15,320	15,158	46,752
2) Container	6,078	6,078	6,078	6,078	6,078	10,574
Total Investment Cost	198,115	195,991	60,122	73,867	81,342	127,073

Table 6-2-4 Operation Costs of Alternatives in 2010

(Unit: US$ 1,000)

Item	Alt.1-a	Alt.1-b	Alt.2	Alt.3	Alt.4	W/O
1. Depreciation cost						
1.1 Collection						
1) Vehicle	1,496	1,377	1,539	1,347	1,347	5,038
2) Container	488	488	488	488	488	1,057
1.2 Treatment Plant						
1) Plant	9,267	9,267	0	960	1,480	0
2) Vehicle	10	10	0	156	137	0
1.3 Landfill site						
1) Civil work	1,173	1,173	1,946	1,946	1,595	1,946
2) Mobil	197	197	221	221	221	221
1.4 Amenity Center etc.						
1) Civil work	133	133	133	133	133	0
2) Mobil	120	120	120	120	120	0
SUB-TOTAL (1)	12,884	12,765	4,448	5,371	5,522	8,263
2. O & M cost (per 1 year)						
2.1 Collection						
1) Personnel	1,677	1,528	1,721	1,474	1,474	3,393
2) Maintenance	597	548	613	536	536	1,211
3) Others	1,135	1,110	1,308	1,008	1,008	1,544
2.2 Treatment Plant						
1) Personnel	103	103	0	55	64	0
2) Maintenance	1,264	1,264	0	1,303	1,933	0
3) Others	1,899	1,893	0	616	1,179	0
2.3 Landfill site						
1) Personnel	71	71	80	80	80	80
2) Maintenance	47	48	64	64	64	64
3) Others	504	506	688	688	678	688
2.4 Amenity Center etc.						
1) Personnel	162	150	158	143	144	278
2) Maintenance	60	60	60	60	60	53
3) Others	207	205	130	146	173	112
SUB-TOTAL (2)	7,726	7,486	4,822	6,174	7,394	7,422
TOTAL (1+2)	20,610	20,251	9,270	11,545	12,915	15,685
SUB-TOTAL 1) Collection	5,393	5,050	5,669	4,854	4,854	12,243
SUB-TOTAL 2) Treatment Plant	12,543	12,537	0	3,089	4,793	0
SUB-TOTAL 3) Landfill site	1,992	1,995	3,000	3,000	2,638	3,000
SUB-TOTAL 4) Amenity Center etc.	683	669	602	602	630	442

6.3 Evaluation of Alternatives

6.3.1 Technical Evaluation

1) Collection and Haulage

Alternatives 3 and 4 require a lesser number of collection vehicles and workers when compared with the other alternatives, and thereby offer some advantage in controlling the collection work. Correspondingly, Alt.2 which requires the highest numbers of collection vehicles and workers is disadvantageous.

Compared with the present collection and haulage cost, calculated to be 420 Lv/ton based on the 1993 survey for one week (Chapter 3), all the master plan alternatives contribute to reduction in cost.

2) Treatment and disposal

As mentioned in Section 6.2, Alt.2 does not offer any reduction in volume of solid waste to be disposed of, while Alt.1 provides the highest volume reduction of all the 4 alternatives. Therefore Alt.1 will contribute to prolonging the life of the disposal site.

Alt.1 has an added benefit of realizing heat recovery.

Other aspects are as follows;

(1) Working conditions of laborers

An important issue of the master plan is to improve working conditions of laborers. Since all alternatives employ the same collection system, differences in working conditions appear in haulage, intermediate treatment and disposal. Working conditions at the disposal site will improve under alternatives 1 and 4 because disposal volumes are smaller. Disposal of pre-compressed solid waste blocks under Alt.4 will contribute to reducing waste scattering, which will also improve working conditions at the disposal site.

(2) Operation and maintenance

Alt.4 which proposes pre-compressing all waste, will require special equipment at Katina for handling. Since solid waste characteristics vary widely, Alt.4 has some disadvantage be-

cause of unstable operation.

Furthermore highly mechanized systems are less advantageous largely due to difficulty in obtaining spare parts. In that sense, Alt.2, with no intermediate treatment or need for specialized equipment at Katina, has some advantage over the others.

In terms of dealing with emergency situations such as snow in winter, an alternative offering shorter haulage distances would be better. Alternatives 3 and 4 have the advantage of offering shorter haulage distances, while Alt.2 offers the longest haulage distances.

(3) Construction of facilities

In terms of construction scale, while Alt.2 has the advantage of requiring the minimum amount of construction works, on the other hand its application will lead to shortening the life of Katina disposal site, and perhaps requiring large construction projects for other SWM facilities in the not too distant future. Alternatives 3 and 4 both require construction of related facilities, while contribution to elongation in life of Katina disposal site and consequent delay in requirement of future facilities is not very large.

Alt.1, while calling for the construction of an incineration plant, and thereby proposing the largest construction project of all the alternatives, offers a significant means to extend the life of the disposal site.

(4) Indirect technical merits

Alternatives 1, 3 and 4, which introduce new technologies in Bulgaria such as incineration and transfer station may bring about informative values as well as local human resources development potential.

3) Conclusion

From the technical viewpoint Alternative 1 is the most highly evaluated as it offers significant reduction in waste volume to be disposed of at Katina and resource recovery, even though it poses some difficulties in terms of large scale construction, and operation and maintenance. On the other hand alternatives 2 and 3 are considered to have the least advantages from technical viewpoint.

6.3.2 Economic and Financial Evaluation

1) Economic Evaluation

SWM is an indispensable public service in the society. Benefit derived from SWM project consists mainly of improvement in sanitation and living environment in urban areas. Benefit and economic costs of alternatives for the period of 1996 to 2010 are estimated and compared for economic evaluation.

(1) Benefit of Alternative 1

Since cost of Alt.1 includes all cost necessary for SWM until 2010, all cost that will be required for continuing SWM under the present system will be considered as the principle benefit. In addition to this benefit, Alt.1 offers an extra benefit of energy recovery at the incineration plant. Remaining capacity of disposal site in the year 2010 will be a benefit resulting from volume reduction of disposed waste. The following are also qualitative benefits of Alt.1.

a. Less environment impact at disposal site
b. Reducing waste harmfulness
c. Stabilization of waste at disposal site

For comparison of alternatives, remaining value of equipment and facilities are listed as a benefit for all alternatives. It is noted that reduction of collection cost through incineration plant reflects costs of Alt.1.

(2) Benefit of Alternative 2

In Alt.2, benefit is the cost that will be required for continuing present system only.

(3) Benefit of Alternative 3

In Alt.3 benefit is the cost that will be required for continuing present system. Also, less environmental impact of traffic to disposal site will be a benefit.

(4) Benefit of Alternative 4

In Alt.4, benefit is the cost that will be required for continuing present system and remaining capacity of disposal site. Also, less environmental impact is a benefit of this alternative.

(5) Economic cost of alternatives

As the Bulgarian economy continues to develop into a free market one, price stability is not expected. Therefore, for some materials the economic prices considering international prices, shall be used for economic evaluation, as shown in Table 6-3-1.

Table 6-3-1 Economic Prices and Market Prices

		Economic price	and Market price
Electricity	cents/kWH	10.0	2.3
Fuel	cents/l	34.1	28.7
Land	$/m^2	4.0	-
Disposal	$/m^3	2.8	2.1
Salary of worker	$/month	105	150

Using these economic prices, the economic costs of alternatives are estimated and shown in Table 6-3-2. Total economic costs for 1996 to 2010 are estimated based on the following schedule.

- The sanitary landfill shall be constructed within 2 years (1996 and 1997).
- Amenity centers, a head office and central work shop and depots shall be constructed by 2000.
- Transfer stations and pre-compressing facilities shall be constructed within 3 years
  in 1997: 20%
  in 1998: 50%
  in 1999: 30%
- Concerning incineration plant in alternative 1
  in 2002: 20%
  in 2003: 50%
  in 2004: 30%

(6) Comparison of alternatives

As shown in Table 6-3-3, total benefit and economic cost of alternatives from 1995 to 2010 are summarized.

Table 6-3-2 Economic Costs of Alternatives

(1993 constant prices)(US$ 1,000)

	Alt.1a	Alt.1b	Alt.2	Alt.3	Alt.4	W/O
Initial Investment						
Collection						
Vehicle	11,972	11,016	12,312	10,773	10,773	40,306
Container	2,439	2,439	2,439	2,439	2,439	5,287
Treatment Plant						
Plant	137,145	137,145	0	14,170	21,860	0
Vehicle	81	81	0	1,244	1,098	0
Land	90	90	0	160	160	0
Landfill						
Civil work	17,069	17,069	17,069	17,069	17,069	17,069
Mobil	1,577	1,577	1,771	1,771	1,771	1,771
Amenity Center etc.						
Civil work	1,900	1,900	1,900	1,900	1,900	0
Container	600	600	600	600	600	0
Total	172,873	171,917	36,091	50,126	57,670	64,432
O & M cost in 2010						
Collection						
Personnel	1,411	1,282	1,448	1,257	1,233	2,507
Maintenance	597	548	613	536	536	1,211
Others	1,250	1,220	1,456	1,100	1,100	1,834
Treatment Plant						
Personnel	103	103	0	55	64	0
Maintenance	1,264	1,264	0	1,302	1,933	0
Others	1,907	1,900	0	640	1,199	0
Landfill						
Personnel	71	71	80	80	80	80
Maintenance	48	49	79	79	70	79
Others	504	510	831	831	729	831
Amenity Center etc.						
Personnel	137	127	133	122	121	207
Maintenance	57	57	57	57	57	50
Others	213	212	144	159	181	133
Total	7,563	7,343	4,841	6,217	7,304	6,933
Benefit						
Energy recovery	2,578	2,534				

Table 6-3-3 Total Benefit and Economic Cost

(1993 constant prices)(US$ million)

	Alt-1	Alt-2	Alt-3	Alt-4
Benefit				
Cost without project	165.1	165.1	165.1	165.1
Energy recovery	13.9	0	0	0
Remaining of disposal site	15.9	9.6	9.6	15.5
Remaining value of facilities	100.1	18.8	22.3	24.3
Total (B)	295.0	193.5	197.0	204.9
Economic cost (C)	288.5	137.0	166.6	187.0
Cost benefit ratio B/C	1.02	1.41	1.18	1.10
Other benefits				
Environment of disposal site	Better	Fair	Good	Better
Reducing waste harmfulness	Good	Fair	Fair	Fair
Stabilization of disposal site	Good	Fair	Fair	Fair
Total evaluation	A	B	C	A

As shown in Table 6-3-3, results of comparison are:

a. Although Alt.2 has the smallest benefit, it's cost benefit ratio is largest of all alternatives.
b. Alt.1 has the largest benefit but smallest cost benefit ratio.
c. Benefit is larger than cost in all alternatives.
d. Alt.1 can offer additional benefits that are difficult to convert into cost.
e. Alt.2 is the least cost alternative.

It is also noted that benefit of alternatives 1 and 4 will have more value considering difficulty of acquisition of new disposal sites. Therefore, alternatives 1 and 4 are evaluated as superior to Alt.2, and Alt.3 is considered inferior to Alt.2.

2) Financial Evaluation

The financial evaluation was carried out based on the year 2010. The annual cost includes depreciation and no interest. The costs are summarized in Table 6-3-4. Alt.2 is the least cost alternative.

If SGM bears all required cost for SWM, the burden for all alternatives will be within 3% of the total budget of SGM in 2010. Assuming the citizens bear all costs related to the alternative plan, the burden for all alternatives will be less than 0.5% of their average income.

These figures indicate the possibility for SGM to bear all alternatives in 2010 from a financial aspect.

Table 6-3-4 Financial Evaluation

(US$ 1,000)

Alternative	1	1b	2	3	4	W/O
Initial investment cost	176,892	175,730	38,396	52,468	60,106	69,747
Rank	5	4	1	2	3	
Total investment cost	198,115	195,991	60,122	73,867	81,342	127,073
Rank	5	4	1	2	3	
Operation & Maintenance cost	7,726	7,486	4,822	6,174	7,394	7,422
Rank	5	4	1	2	3	
Annual cost(C)	20,610	20,251	9,270	11,545	12,915	15,685
Rank	5	4	1	2	3	
Revenue(R)	583	573				
Net cost(C-R)	20,027	19,678	9,270	11,545	12,915	15,685
Rank	5	4	1	2	3	
Unit cost($/ton)	47.6	46.8	22.1	27.5	30.7	37.3
Share of SGM budget(%)	2.2	2.2	1.0	1.3	1.4	1.7
Net cost per capita($)	14.5	14.3	6.7	8.4	9.4	11.4
Share of income(%)	0.41	0.40	0.19	0.23	0.26	0.32
Assessment	B	B	A	B	B	

6.3.3 Social and Institutional Aspects

1) Compatibility with New Waste Act Stipulations

Alternatives shall be evaluated taking into consideration the policy and stipulations of the new Waste Act.

It can be said that all alternatives satisfy the policy of the new waste act. However, achievement of solid waste volume reduction as stipulated in the act, will differ by alternative, although reduction through recycling will be the same for all. Alt.1 offers the largest waste reduction through incineration, 85% in weight and 90 - 95% in volume.

Alt.4 will provide a reduction in waste volume to be disposed, of around 20%. Therefore alternatives 1 and 4 are superior to alternatives 2 and 3.

Resource recovery is another issue of the new act. Alt.1 can recover heat energy at the incineration plant. Therefore alternative 1 has an advantage in this point.

2) Organization

Although facilities are different in each alternative, total numbers of manpower required are almost the same. However, control of collection may be easier in alternatives 3 and 4 because haulage distance of collection vehicle is lesser than that of Alt.2 and more stable collection may be possible.

3) Other Points

At Katina disposal site, compensation shall be considered for removal of adjacent holiday homes, some of which are used as temporary housing. However this situation is common in all the alternatives, as all use Katina disposal site.

Scavengers working in Dolny Bogrov disposal site may lose their livelihood after closure of the site. As Katina shall be operated as sanitary landfill, it is not desirable to permit their activity in the new disposal site from environmental view point. This will be the case in all alternatives.

6.3.4 Environmental Aspect

Sound and efficient SWM will improve environmental and sanitary conditions within SGM territory through providing stable collection service and proper intermediate treatment and disposal. However, environmental impacts on the surrounding areas of disposal site and other facilities should be considered.

Since all alternatives employ the same collection system, contribution to improving cleanliness and sanitation of service area is the same for all alternatives. Negative impact of facilities will differ by type of facility.

As all alternatives use the same sanitary disposal site, Katina, items of possible negative impact are almost similar.

Concerning Katina disposal site, Alt.2 is at a disadvantage compared to the other alternatives. Alt.1 decreases amount of waste to be disposed of at Katina. Traffic volumes are least under alternatives 3 and 4. Alt.4 may realize a more acceptable disposal site through handling of pre-compressed waste.

Incineration plant, transfer station and pre-compress facility will also have an environment impact on their surrounding areas. Most of the negative impact can be avoided by protective measures, and impact on traffic can be minimized through traffic control plans in the vicinities of the facilities and operating night shifts.

Since environmental protection measures employed in incineration plant, transfer station and pre-compress facility are more reliable than those of disposal site, from the environment viewpoint alternatives 1 and 4 have an advantage, while alternatives 2 and 3 will have some disadvantage.

6.3.5 Overall Evaluation

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.

Therefore an evaluation of all the other alternatives compared to Alt.2 has been made. Five items have been compared as shown in Table 6-3-5 and described below.

Table 6-3-5 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

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.

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/Administrative Alternatives

6.4.1 Municipality

SGM has a number of municipal companies, such as Chistota, BKC, VIK for water and wastewater, Sofiainvest etc.

Most of them are registered as Municipal Enterprises on the register held by the Sofia City Court in accordance with Decree No.56 on Economic Activity.

The administration of SGM itself is organized in different levels as explained in Chapter 3.

1) Existing situation concerning SWM

The household waste of Sofia citizens is collected by 24 municipality owned companies according to administrative districts and directly transported to two disposal sites which are operated by the Municipality owned Chistota company. All companies are also involved in other activities such as;

BKC:-
- cleaning of streets
- maintenance and repair of public buildings
- construction work on special contracts
- collection of rent for state owned flats and buildings
- street maintenance, pavement, repairs, construction of sidewalks etc.
- landscaping

Besides their official activities to the District Administration, BKC have the right to offer and execute other work with the available equipment and personnel on competitive bases.

Chistota:-
- collection of street waste from the central part of the city including street cleaning
- cleaning of selected main streets during all seasons
- general maintenance and repair of their own equipment and repair work for BKC equipment

In addition to these activities waste collection and transport is executed on special contract bases.

These different activities within one enterprise, particular-

ly the BKC, the different responsibilities, different nature of work and related equipment including distribution of work into 24 plus 1 companies spread over Sofia is neither from the technical nor from economical point of view a solution which should be kept for the future.

2) New formation of activities

For better efficiency of work executed and many other reasons it is suggested to concentrate all activities related to SWM; collection, transport and disposal in one or more organizations dealing exclusively with this target.

The same strategy should apply as well for street cleansing activities and for construction, repair and maintenance of public buildings and installations.

Other activities like trading, private contracts etc. should be linked out respectively prohibited for the time being.

3) Basic assumptions for new organizations

Based on above recommendations the activities of Chistota and 24 BKC companies should be reorganized into:

- One enterprise with a minimum of branch offices if necessary, with the only responsibility to maintain and repair public buildings. Merging with other existing companies being responsible for construction work of buildings would be an advantage.
- One central enterprise with outstations, organizing and executing street cleaning for the entire municipality area during summer and winter, merging with the existing companies responsible for road construction and maintenance
- One or more enterprises with the sole responsibility to collect, transport and dispose of household waste and waste similar to household waste

6.4.2 Basic Management Alternatives for SWM

Out of several management alternatives and overlapping solutions only the most important basic ones are mentioned hereafter.

1) Self Management by SGM

A special department or an integrated enterprise within SGM operates under the direct day-to-day management control of

the Municipality. With regard to Degree No.56 on Economic Activity of January 1989 this alternative does not take into consideration the changes introduced, separation of the management and the trading relationship of the enterprise. Ownership, operation and control would be in one hand.

2) Public enterprise

Since Chistota and 21 out of 24 BKC are registered under Degree No.56 mentioned above this alternative represents the existing status as the decentralized solution. Reorganization respectively establishment of new enterprises and/or transformation into a registered corporate company according to Articles 61 and 62 of the Law of Commerce, subject to the decision of the Municipal Council, would be required.

If this alternative will be selected it will be automatically limited to a five years period starting from the registration date. The ownership of this organization will change afterwards according to the relevant Articles of the Law on Privatization. During the first five years assets will remain with SGM as owner, management and operation will be executed by the public enterprise and control through SGM and other Authorities.

Further ownership will depend on the initial decision of the Municipal Council.

3) Joint operation of enterprises

After reorganization and establishment of the enterprise for SWM according to the Law of Commerce, SGM as sole proprietor of the company can contract out any part of the required activity to a qualified private company for operation, management control or assistance based on a contract specifying scope of work, service standards, remuneration, employment law etc.

SGM shall own the assets, while management and operation shall be by public and private companies according to contract. SGM shall control activities with other Authorities.

4) Private company

This alternative would mean partial or full privatization. The later would take all responsibilities for ownership, management and operation from the Municipality. Managed as a full commercial organization one or more private companies

for SWM have to put emphasis on general cost reduction, and generation of adequate revenues for necessary investments.

The most important decision will be necessary in early 1994 concerning the reorganization of activities actually executed by 24 BKC and Chistota and reconstruction and/or transformation of existing enterprises to comply with the Law of Commerce(LoC) or to establish new enterprises either as a

- Sole Proprietor Private Limited Company, or
- Sole Proprietor Public Limited Company

taking into consideration the further steps specified in the Law for Transformation and Privatization of State owned and Municipal Enterprises from May 1992.

6.4.3 Future Options for New SWM Organization

The future organization for SWM entirely depends on a few main decisions as described earlier. Each reconstruction, new establishment and/or transformation decision for enterprises being involved in solid waste develops its own further dynamics according to the Law on Commerce and the Transformation and Privatization Law.

Consequently the following options have to be seen from a theoretical point of view.

Option 1
Direct central management and operation of all activities by SGM by a special section, department or integrated enterprise with three to four outstations for regional operation

Option 2
Direct central management and operation of some activities by SGM as under Option 1 and specific activities awarded to public or private companies on contract basis

Option 3
Management and operation by one Public Enterprise being responsible for all activities like collection, transport and disposal with three to four outstations for regional operation - the central solution

Option 4
Management and operation by four public enterprises, three of them for collection and transport of waste in three determined districts covering municipality area and one for the

operation of disposal sites - the decentralized solution

Option 5
Management and operation by one private company with full responsibilities for all activities with a few outstations for regional operation similar to option 3

Option 6
Management and operation by four private companies for the municipality area divided into three districts and the disposal sites similar to option 4

Further options would be any possible combination between two or more options mentioned above.

Based on the evaluation criteria like management efficiency, service level, overall costs for administration and operation, tariff adjustment and the actual local situation, option 3 - management and operation executed by one Public Enterprise is selected as the most acceptable solution for the future development of solid waste activities in SGM with further options to Privatization in the future based on performance of this company and the decisions made by the Municipal Council.

6.4.4 Assessment of Basic Management Alternatives

Before entering into any evaluation of different organizational options positive and negative consequences of the different basic management alternatives shall be discussed in general:

A. Direct Self Management by the Municipality

Positive
- management and operation is executed directly by a special section of the Municipality only dealing with waste
- opportunity to build up an effective new organization to meet the future requirements
- employment of selected personnel from BKC and other in-house resources
- cheapest alternative since part of the administration will be handled by other municipality departments
- assets will remain with the Municipality

Negative
- direct responsibility of the Municipality towards any

mistake, failure, claim or unsatisfactory service
- efficiency of management and operation may be doubtfully due to lack of creativity and/or innovation expected from the free market economy
- adjustments of the existing tax system to realistic tax or tariff charges will be difficult due to direct Municipality accountability
- continued burden on the Municipality for subsidizing the budget for waste treatment
- difficulties for lending agencies for long term credits
- control functions have to be executed by other authority

B. Public Enterprise Management

Positive
- management and operation are executed by one or several enterprises owned by the Municipality on contract basis
- reconstruction of a new organization with employment of existing personnel of BKC responsible for SWM up to now
- social conflicts can be minimized

Negative
- responsibility lies with the enterprise but interference into management trough political channels is most likely
- efficiency of management and operation, adjustment of existing tax system, subsidizing of budget, racing long term funds remain very similar to the consequences stated under direct management above

C. Joint Management of Public and Private Enterprises

The Municipality can award contracts on competitive basis to private companies for one or more operation activities like waste collection, transport to site, operation of waste disposal sites and any installation or for management improvement.

Positive
- the responsibility will be divided between the companies, public and private according to their contractual obligations
- management skills and expertise from outside will be introduced
- optimization of operation for the particular activities contracted out
- training of staff members by outside employees
- new ideas will bring fertilization effects to public enterprises

- assets will remain with the Municipality and controlling functions are with the Municipality

Negative
- dividing of responsibilities might have as well unfavorable effects
- adjustment of existing tax system will still be difficult
- subsidies for budget will be further required
- difficulties for lending agencies for funding remain the same
- social problems due to reduction of employee numbers

D. Private Management

Positive
- most effective management and operation based on commercial principles and high service level
- assessment of real costs for SWM and introduction of quantity orientated tariff system to motivate customers for reduction of waste generation
- no further burden on Municipality concerning budget allocation
- foreign capital from private sources might be introduced

Negative
- a very rigid control of all activities by Municipality and REI is required to guaranty level of services to citizen and standards for environment
- assets would be sold by the Municipality as part of the privatization process
- interference into private company even if necessary will be difficult
- most expensive alternative due to increase of tariffs based on real costs including capital financing charges
- social conflicts will be difficult to avoid due to considerable reduction of employees

6.4.6 Evaluation of decentralized, semi-centralized and centralized organization models

The existing decentralized organization with 24 BKC and Chistota Company, are demonstrating mainly negative aspects such as;

- 25 administrative bodies with a huge number of employees each of them following their own way of work according instructions from 25 different directors

- 25 operational bodies under the leadership of 25 department heads resulting in different level of services, in many cases different equipment and different way of data processing with all the resulting negative consequences

This form of organization should be regarded as an ancient and most unfortunate solution which represents the most expensive and ineffective way to organize the SWM for a capital city like Sofia.

A semi-centralized solution would mean the separation of SGM area into three or four districts and each of them will be treated by one independent company and the disposal sites by another company or by the Municipality itself.

This solution bears certain advantages and as well disadvantages such as;

- competition between more then one operating companies could lead to favorable financial conditions and a good level of services

but

- any individual company obviously needs its own manager and key-personnel, administrative department, work shop etc. which automatically creates higher costs for personnel and operation in comparison to any central solution

Further more the general strategy of SWM within the city will be more difficult to implement with more then one company considering waste reduction, separation and treatment.

The main arguments from above lead without doubts to the central solution which guarantees;

- the most economic solution due to minimization of employees and savings on expenses regarding repair and maintenance
- the most effective solution due to a central management, following one identified and approved strategy

A central organization should consist of one head-office with a central work shop including spare parts depot for repair and maintenance of the vehicle fleet, garages and two to three outstations only as vehicle depots for area operation.

4) Evaluation on future options for SWM organization

The following evaluation of different options considers legislative, management and operational aspects under strict attention of economic principals.

Option 1 - Direct central management by the Municipality

Whereas this option represents the cheapest solution in terms of expenses for salaries it has several disadvantages specified as described above. Furthermore considerable legislative difficulties would arise since such a step backwards from the existing structure is not foreseen in the Law on Commerce. This option is not considered further.

Option 2 - Direct Central Management partially by the Municipality partially by other companies

This option is not considered further based on legal aspects explained for option 1.

Option 3 - Management by one Public Enterprise

One enterprise with central administration and outstations for operation and disposal sites would be the organizational setup for this option.

Under prevailing conditions in Bulgaria, lack of know-how concerning SWM and limited funds of local private companies this option will be the best solution weighting the advantages and disadvantages explained in sections above.

Option 4 - Management by four Public Enterprises

This option represents an interesting alternative to option 3 since it can provoke effective competition between them. Nevertheless this alternative will create higher administrative and operation costs which is at the moment very difficult to defend knowing the existing budgetary constraints. This option is not considered further.

Option 5 - Management by one Private Company

One private company with a central administration and outstations would create an efficient management and operation based on commercial principals and high service level. This option would be certainly a solution for the long term future. At present its seems rather an unrealistic alternative

since under the existing circumstances neither the required know-how nor the financial capabilities are available in the local private sector. In addition to that it is very doubtful if the citizen can be charged with tariffs based on real costs. For this reason this option is not considered further.

Option 6 - Management by four Private Companies

This option would have similar advantages as option 5 but with the disadvantage of being more expensive then option 5. Consequently it will not be taken into consideration.

Table 6-4-1 shows the results of the evaluation.

Table 6-4-1 Evaluation of Options

Criteria	Option 1 Direct Central Management Municip.	Option 2 Direct Central Management Municip. & Mixed	Option 3 Management by one Public Enter-prise	Option 4 Management by Four Public Enter-prises	Option 5 Management by one Private Company	Option 6 Management by Four Public Companies
Management Efficiency	○	○	○	○	◎	◎
Service Level	○	○	○	○	×	○
Admin. & Oper. Cost	◎	○	○	×	○	×
Tariff Adjustment	×	×	○	○	◎	◎
Subsidy Level	×	×	○	○	◎	◎
Social Impact	◎	○	○	○	×	×

◎ Good respectively optimal
○ Satisfactorily respectively acceptable
× Difficult to accept respectively, unacceptable or unfortunate development

Based on the evaluation criteria like management efficiency, service level, overall costs for administration and operation, tariff adjustment and the actual local situation, option 3 - management and operation executed by one Public Enterprise is selected as the most acceptable solution for the future development of solid waste activities in the SGM with further options to privatization in the future based on performance of this company and the decisions made by the Municipal Council.

CHAPTER 7

MASTER PLAN

CHAPTER 7 MASTER PLAN

7.1 Framework of Solid Waste Management

(1) Target year

The target year shall be 2010. The Master Plan (M/P) period shall be divided in to three phases up to 2010 to prepare the M/P program.

a. First Phase Year 1995 to 2000
b. Second Phase Year 2001 to 2005
c. Third Phase Year 2006 to 2010

(2) Service Area

Sofia Greater Municipality (SGM) shall be the served area.

(3) Served Population

The population residing in SGM, as shown in Table 7-1-1 shall be served.

Table 7-1-1 SGM Population

SGM	1993	2000	2005	2010
Population	1,180,000	1,280,000	1,330,000	1,380,000

(4) Type of Solid waste

The types of waste covered under the plan are:

a. Commercial/domestic waste
b. Street waste
c. Part of non-hazardous industry waste

Street waste shall be accepted at the disposal site.

(5) Solid waste amount and composition

Future solid waste amount has been estimated considering population growth and increase in unit generation rate of domestic/commercial waste. Estimated amounts are shown in Table 7-1-2.

Table 7-1-2 Solid Waste Amount

(unit: t/d)

Waste Type	1993	2000	2005	2010
Commercial/domestic	1,005	1,250	1,340	1,487
Street waste	24	25	26	26
Non-hazardous industry waste	74	116	121	125
Total	1,103	1,391	1,517	1,638

(6) Waste flow at 2010

Solid waste management flow is shown in figures 7-1-1, 2 and 3 for the years 2000, 2005 and 2010 respectively.

(7) SWM Organization

Although street sweeping and waste collection is done by 24 BKC and Chistota companies at present, it is proposed to establish a sole public limited company (PLC) specialized in SWM and separate street sweeping and other functions. Therefore, the responsible organizations will be as follows:

a. Domestic/commercial waste
Domestic/commercial waste will be collected, intermediately treated and disposed of by PLC. Solid waste discharged by large shops and factories will be collected by the PLC on a contract base.

b. Street sweeping
Street sweeping shall be done by another organization that will be separately established for this function. However, street waste will be accepted and disposed of at the municipality disposal site operated by PLC.

c. Non-hazardous industry waste
Although self-treatment and disposal of waste is the principal responsibility of the generating industries, PLC will collect part of this waste on a contract basis and accept it at the disposal site to prevent illegal dumping.

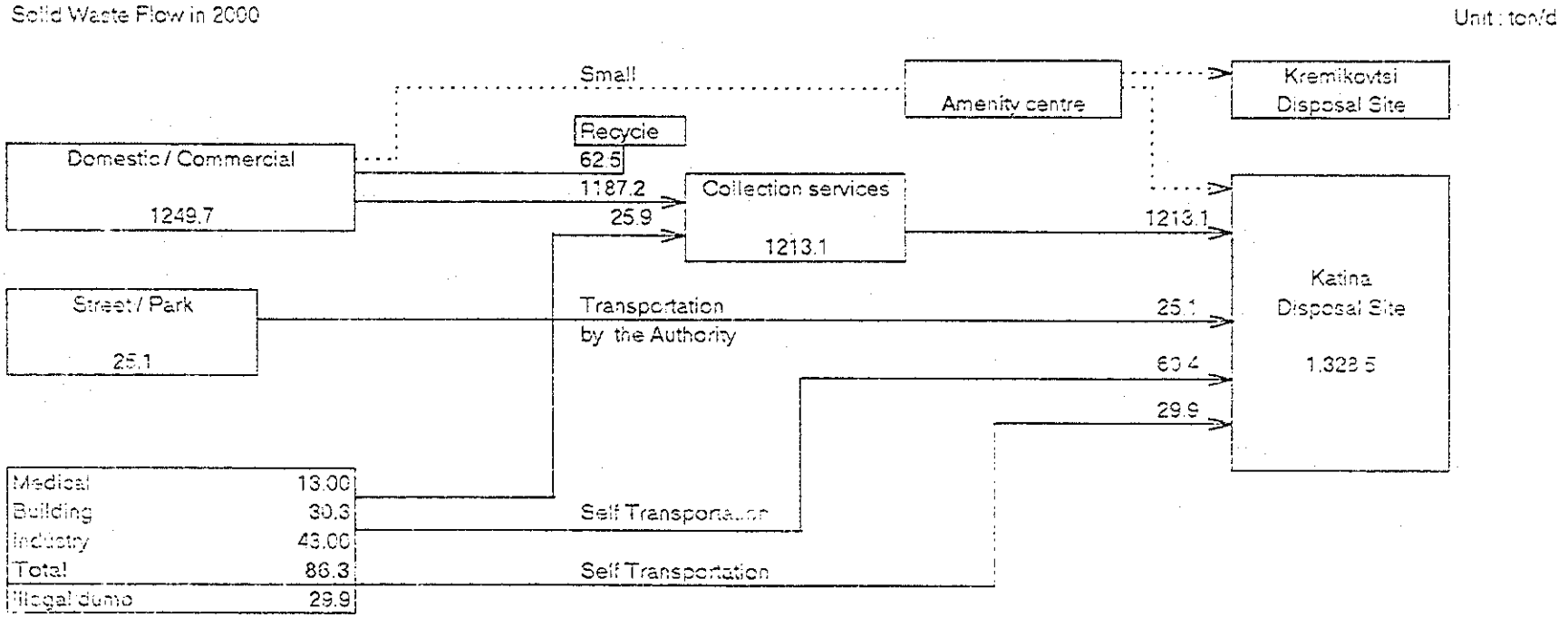


Figure 7-1-1 Solid Waste Flow in 2000

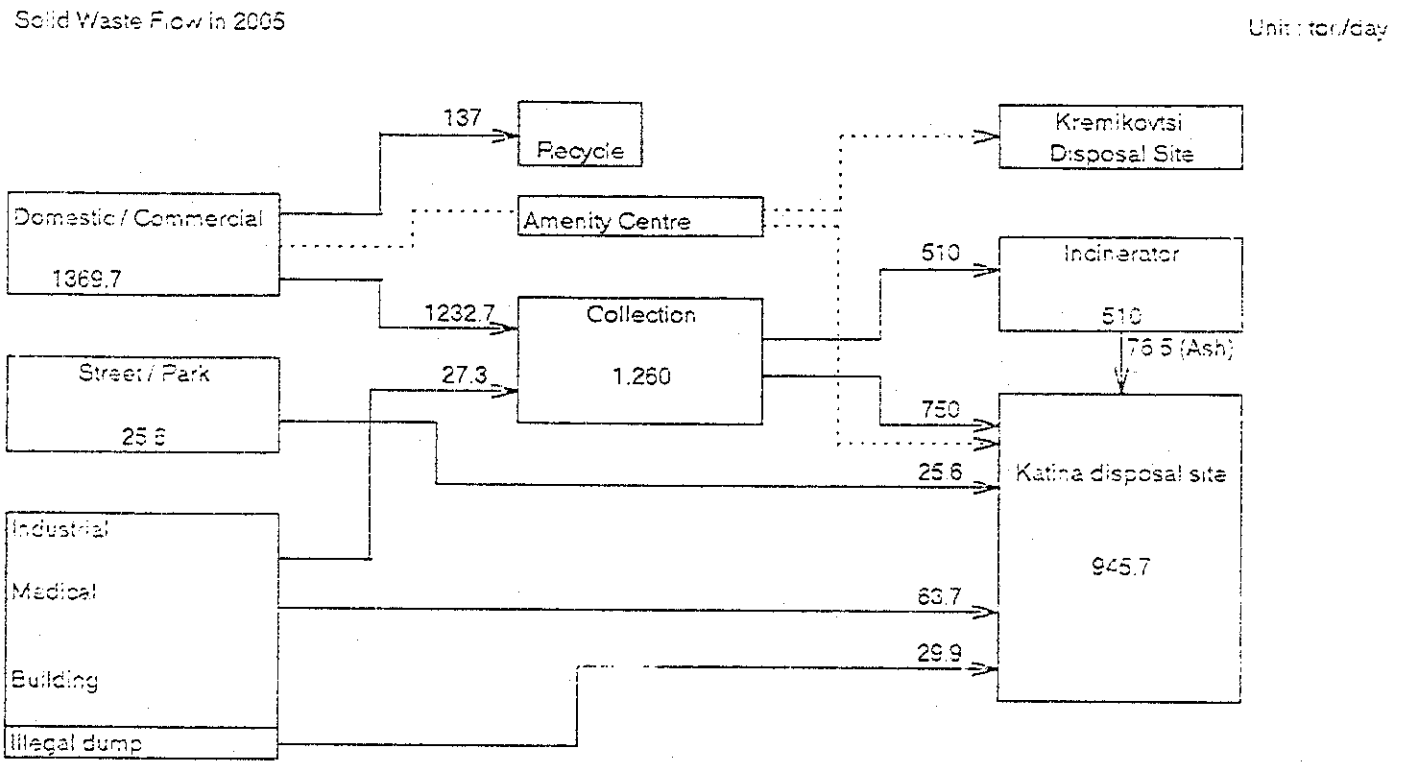


Figure 7-1-2 Solid Waste Flow in 2005

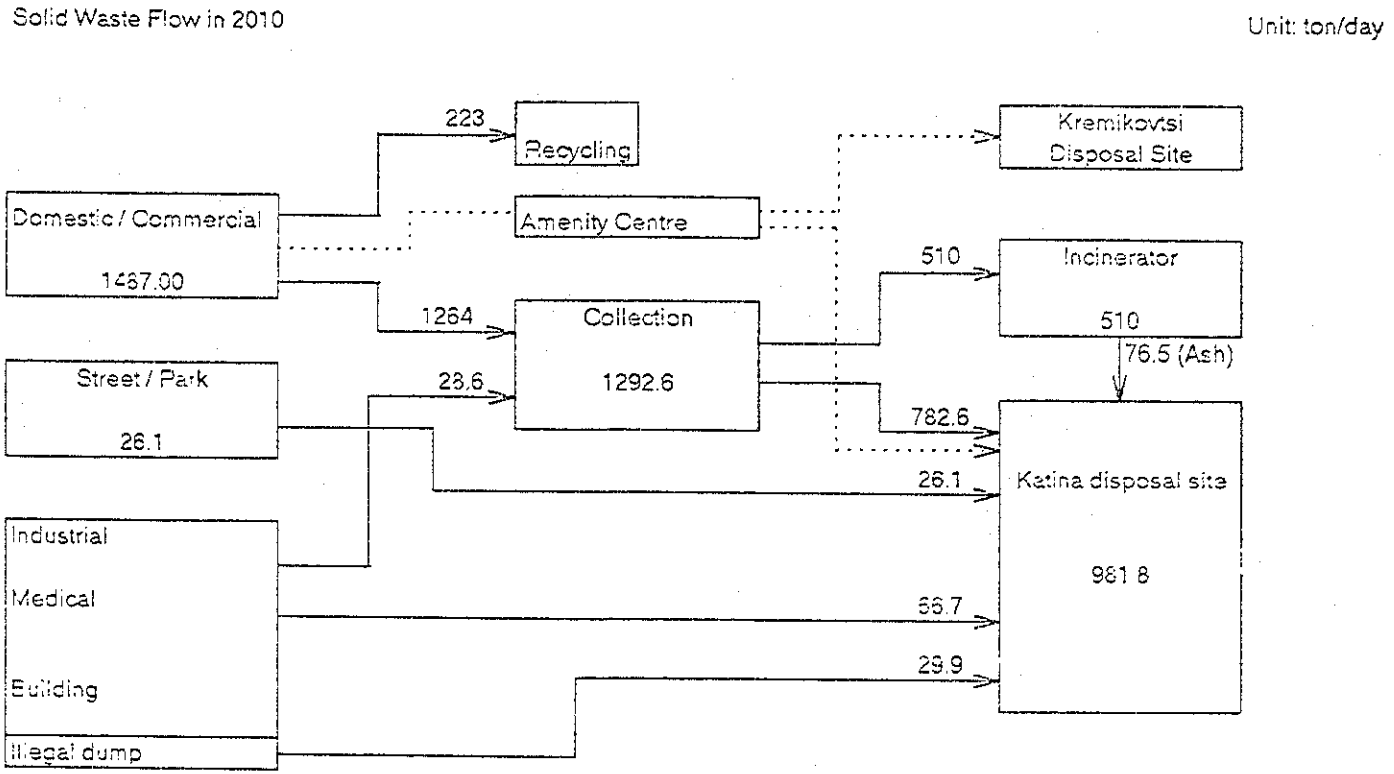


Figure 7-1-3 Solid Waste Flow in 2010

7.2 Collection and haulage

(1) Collection service to be provided

The collection service to be provided by type of waste shall be:

Domestic/commercial waste	100%
Non-hazardous industry waste	30%

(2) Solid waste amount to be collected

Table 7-2-1 shows the waste amount to be collected.

Table 7-2-1 Solid Waste Amount to be Collected

(unit: t/d)

Waste Type	1993	2000	2005	2010
Domestic/commercial	959	1,187	1,233	1,264
Non-hazardous industry waste	22	26	27	29
Total	981	1,213	1,260	1,293

(3) Collection zone

The present collection zones shall be reviewed and modified as necessary to ensure more efficient vehicle utilization. Collection zones shall be rearranged in to 8 zones as shown in Figure 7-2-1.

(4) Collection system

A unified collection system in each zone shall be planned taking into consideration the zone characteristics.

a. Central area

The present system of using Meva containers for loading onto collection vehicles is time consuming, and therefore a more efficient system is required in the future. One idea would be plastic bag system. Table 7-2-2 compares both systems. Although Meva container system requires time for collection, it shall be proposed for the central area because the plastic bag system will create hard work for the laborers.

Also it is proposed to use 7 m^3 compactor vehicles for the central area considering narrow streets and on-street

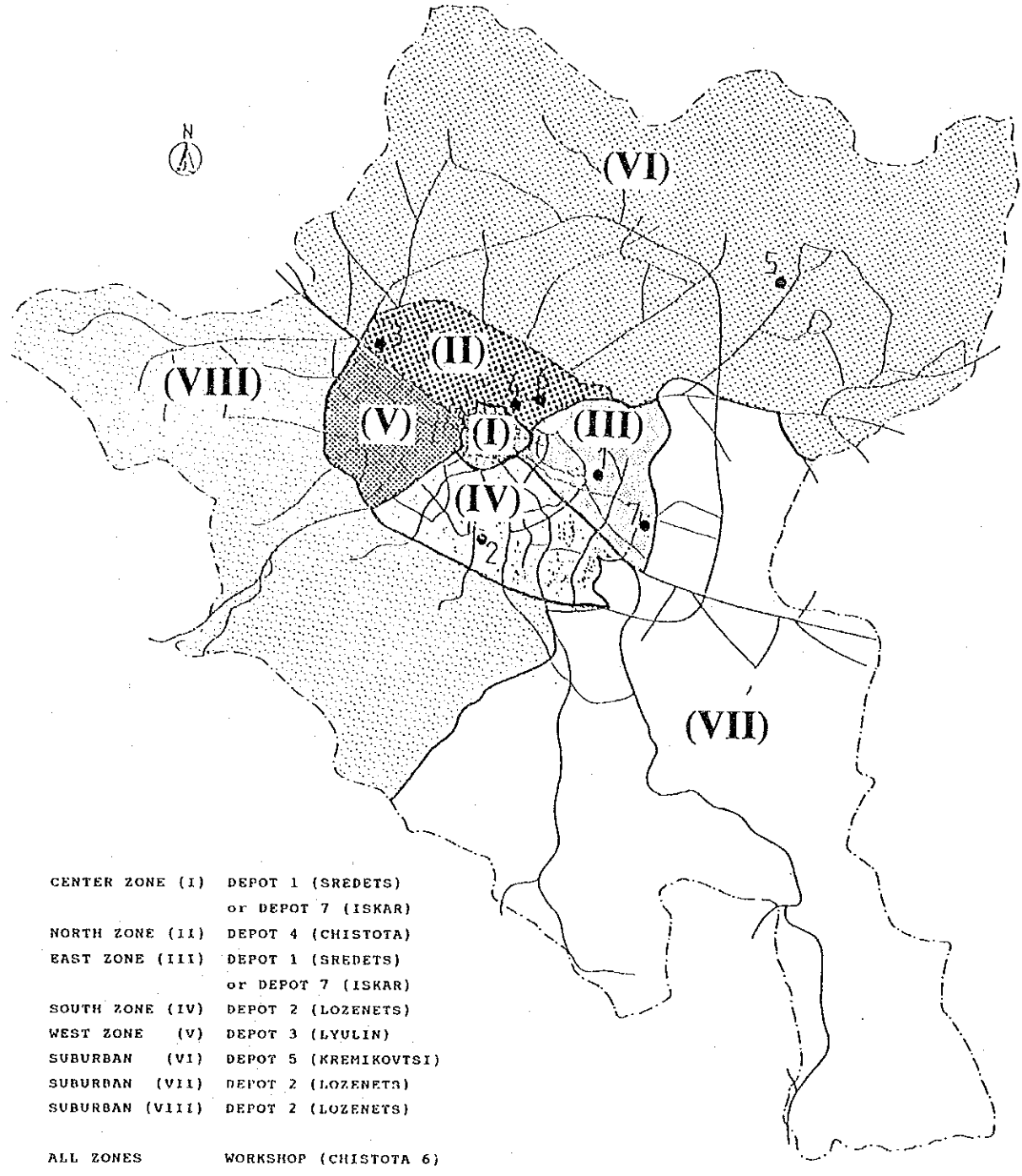


Figure 7-2-1 New Collection Zones and Selected Depot Facilities

Table 7-2-2 Meva Containers and Plastic Bag Use

Item	Plastic Container	Meva Container
1) Dischargers	- Plastic bag purchase may be costly	- No cost burden
	- Not suitable for heavy waste, such as coal	- No problem
	- One trip to pick-up point	- Empty household container at pick-up point and return it
	- Strict fixed discharge time must be observed	- Fixed discharge time unnecessary
2) Collection Operation	- Faster to load into collection vehicle	- More time required for emptying container into vehicle
	- Necessary to clean up scattered waste often caused by torn bags	- Scattered waste around containers may not be so serious if container number sufficient
	- Collection time must be strictly maintained	- Collection time need not be so strict
	- More freedom in changing vehicle type	- Specialized collection vehicle necessary
	- Increase of plastic element in waste may cause treatment and disposal problems	- No effect upon plastic content in waste
3) Public Street Atmosphere	- Street atmosphere may be improved	- Stationary containers occupy space, and emit bad odor. Create pedestrian and car parking problems
	- Stray animals may tear bags and scatter waste causing dirty streets, attracting insects and rodents	- No stray animal problem if containers are properly covered
	- Rain and snow may aggrevate scattered waste condition	- No weather problem
	- Waste does not linger on the street	- Containers encourage waste discharge with disregard to collection time and frequency

car parking. Smaller vehicles will also contribute to decreasing time spent on route, when using Meva containers.

b. Urban area
It is desirable to unify the container type used in the urban area to the Ra type, from the present system of using mixed Ra and Meva containers. Ra is suitable for the area's predominate block housing. Large compactor vehicle (16 m^3) will be used in this area.

c. Suburban area
The suburban area mainly consists of detached houses and scattered villages. Therefore, in principle the only way shall be to use Meva containers because of difficulty in allocating sites for large containers and to maintain reasonable walking distances to the containers. But in remote village and tourist areas Kison containers shall also be adopted. Large compactor vehicles and hauled container vehicles will be used.

d. Large shops and factories
Waste discharged by large dischargers, such as large shops and factories shall be collected on contract base using Kison containers that will be transported on hauled container trucks.

(5) Equipment and manpower requirement

It is proposed to use compactor vehicle to collect waste from Meva and Ra container. Hauled container truck is used for Kison container. Old vehicles shall be replaced as soon as possible. Necessary equipment is estimated based on standard work volume of each collection vehicle type.

a. Standard work volume of collection vehicle

	Number of trip/day	Loading weight	Work volume
Large compactor	1.7 trip	5.4 ton	9.2 ton/day
Small compactor	2.0 trip	2.2 ton	4.4 ton/day
Haul container veh.	4.0 trip	1.0 ton	4.0 ton/day

Note: Working day 6 day/week x 52 week = 312 day/year

b. Life time of equipment

Collection vehicle		8 year
Container:	Meva	3 year
	Ra	5 year
	Kison	5 year

c. Required manpower
Required manpower is also estimated based on the following working conditions.

Working hour	8 hr/d
Working day	6 d/week

d. Equipment List
Required equipment has been calculated as shown in Table 7-2-3.

Table 7-2-3 Equipment Required

Year	2000	2005	2010
A. Vehicles			
Compactor Vehicle 7m^3	24	23	23
Compactor Vehicle 16m^3	125	112	115
Haul Container Vehicle	107	97	99
B. Containers			
Meva (110l)	40,829	42,599	43,957
Ra (1.1 m^3)	10,009	10,480	10,739
Kison (4 m^3)	336	349	357

7.3 Intermediate Treatment

1) Facilities to be introduced

It is proposed to introduce one incineration plant with capacity 600 t/d by the year 2005. Plant location is not yet fixed but it is proposed at a site south-west of the city. Due to traffic volume, optimum economy and convenience will possibly be achievable, were the place located on a main traffic artery within or adjacent to the outer ring-road.

2) Incineration plant to be constructed

The plant will incorporate full flue gas clean up measures necessary to meet current EC discharge criteria and the process will be of the type which enables ash and residues to be deposited at Katina without further treatment. A devoted autogenous combustion traveling grate incineration plant with 3 parallel burners and power generation is envisaged.

Modern incinerators can be very pleasing, and a technically advanced installation will have minimal environmental impact if well-maintained. An incinerator of the size proposed (3 x 200 t/hr) is however a large and dominating installation with a particularly prominently tall flue stack (chimney).

3) Major features of the incineration plant

a. Capacity shall be 600 ton/day (200 ton/day x 3 units)
b. Domestic/commercial wastes shall be accepted
d. Characteristics of solid waste to be treated
   Lower calorific value in 2005 1,500 kg/kcal
   2010 1,700 kg/kcal
c. Solid waste amount to be treated
   Incineration plant will be operated continuously in principal. It will be operated 85% of the year (310 day/year) considering necessary period of maintenance of facilities.
   Average amount to be treated =
   600 ton/day x 0.85 = 510 ton/day
   600 ton/day x 365 day x 0.85 = 186,000 ton/year
d. Ash amount is estimated to be 15% of total waste.
   510 ton/day x 0.15 = 76.6 ton/day
   186,000 ton/year x 0.15 = 27,900 ton/year
e. System of facilities is shown in the figure attached in Chapter 6.
f. Heat recovery
   Turbine type: Back pressure type
   Electric generation: 3.3 MW

7.4 Final Disposal

1) Location of the disposal site

Because of the limited capacity of existing disposal site, a new disposal site shall be constructed as soon as possible. It is proposed to construct Katina disposal site to start operation in 1997 considering the necessary period for construction and preparation of fund.

Katina site is located north of the city at a 16 km distance from the city center. It is an abandoned mining site with an area of 72 ha.

Although no insurmountable geotechnical or environmental engineering problems are seen, it is apparent that particular and special professional care to maintain site safety must be taken during construction and operation of this site. This is due to the presence, of long-term self igniting and sustained burning lignite coal seams. Therefore it is noted that:

(i) no un-investigated potential unsaturated coal seams (or sections of seams) lie below the quarry floor,
(ii) all identifiable seams in the gentler side slopes of the quarry are investigated, cut back to solid deposits and sealed off behind at least 3 m of selected clay,
(iv) all undisturbed seams found in the quarry faces be cut into and isolated against the ingress of air or gas;
(v) site landfilling operations are permanently and directly supervised by an experienced professionally qualified geotechnic engineer or an engineering geologist.

2) Solid waste amount to be disposed of

Waste amount to be disposed of is shown in Table 7-4-1.

Table 7-4-1 Waste Disposal Amount

(unit: t/d)

	2000	2005	2010
Commercial/domestic	1,187	723	754
Street waste	25	26	26
Non-hazardous industry	116	121	125
Ash		77	77
Total	1,328	947	982

2) Plan of Katina disposal site

The site can be confidently developed for waste landfilling. Outline of the plans drawn up after consideration of the geotechnical and hydrogeological conditions is shown in Figure 7-4-1 and briefly described hereafter:

a. Total capacity 8,200,000 m^3
b. Disposal method Sanitary landfill
c. Main facilities

- The site is secured and isolated by a 10 m green belt with tree and bush 'forestry screen'. Entire area is fenced off. Fill area is not externally visible;
- To drain lake surface waters and to hold the aquifer head to a level approx. 553.5 m at the quarry center, an RC culvert (2m x 2m) laid at a gradient of 1:500 (from 553 m) from below the inner large lake level to Katinska Stream shall be constructed.
- The large lake shall be filled with culvert excavations and under the quarry floor to displace lower waters and to form a foundation for groundwater drainage and sealing clay layer. Small ponds shall be eliminated.
- Coal seams found above the 553.5 m level shall investigated, cut into and sealed.
- Groundwater drainage comprising a 500 mm gravel layer sloping down to 553.5 m with piped herring bone collectors shall be installed
- Inner large lake area shall be covered with minimum 2 m of clay layer to a level of approx. 555.0 m.
- Leachate collection pipe shall be installed on the above-mentioned clay layer.
- The initial landfilling area is shown in Figure 7-4-1.
- The culvert excavations shall be trimmed off to enable a quarry exit route to the main road.
- Separate 'in' and 'out' permanent roadways and internal operational temporary roads.
- Weigh bridging and all admin. offices.
- Leachate recirculation system
- Leachate treatment process with peak hydraulic capacity 4 l/sec.
- Surface water drainage to the culvert.
- Amenity Center
- Other facilities

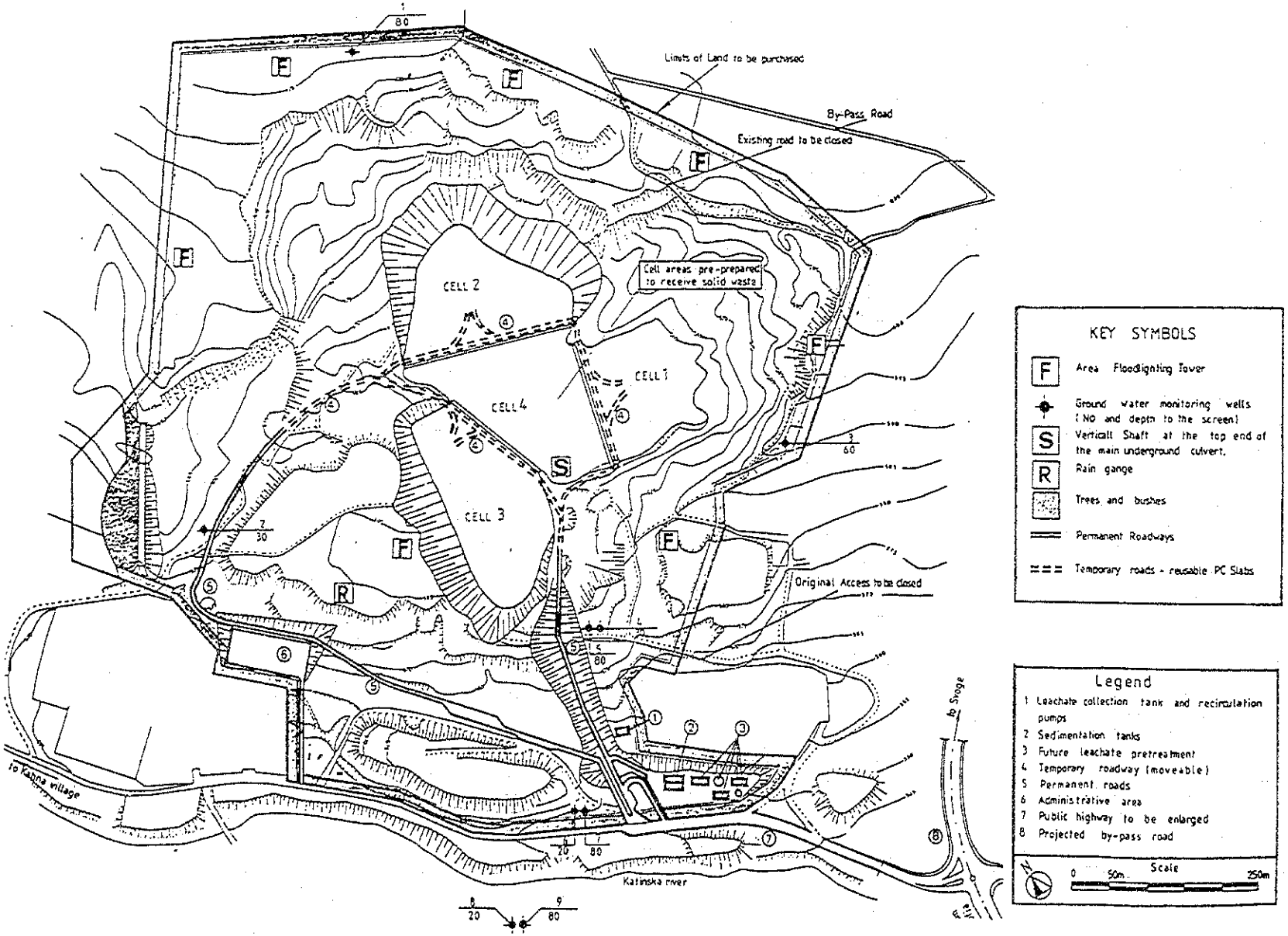


Figure 7-4-1 Katina Landfill Site

4) Operation Plan of Katina Disposal Site

The requirement for subsequent work such as the preparation of the 2nd stage and subsequent cellular stages will be constant over the life of the site and should be undertaken by the site staff as part of the day-to-day geotechnical engineering of the landfill. In Phases II and III Katina disposal site will be used continuously while implementing necessary expansion and additional construction.

Main equipment to be used during operation is as follows;

- Waste compactors : 3 units
- Dozers/Graders : 4 units
- Excavators-Tracked : 4 units
- Dump Trucks : 6 units
- Backacting Excavator : 1 unit
- Tanker : 1 unit

7.5 Recycling and Amenity center

It is proposed to start a pilot project for recycling in a small area and to expand the area in the future. SGM is expected to reap the following advantages from recycling:

a. to reduce solid waste generation,
b. to reduce landfilling requirement,
c. to reduce transport haulage cost,
d. to obtain an income and reduce its collection burden, and
d. to encourage solid waste reduction.

Also it is recommended to construct amenity centers to receive domestic hazardous waste.

7.5.1 Recycling Pilot Project

1) Used material to be recycled by the pilot project

At present waste paper commercially purchased by Mehaplast is compressed into blocks and is sold to a paper mill for recycling. In view of the existing 'market' it is proposed that waste paper can be 'pre-separated' by the inhabitants and SGM can collect and sell it in the market.

The study found that glass represents some 14% of the total waste on a wet basis and some 24% on a dry basis composition. It appears that the proportions are sufficiently high as to justify an attempt at pre-separation.

Although it is necessary to study the extent of market demand for used paper and glass, it is proposed to recycle these two items in the pilot project.

2) Pilot Project for recycling

It is proposed that:

- A pilot area shall be selected
- Dischargers shall be encouraged to separate used paper
- Collection of separated used paper and glass
- Once the pilot collection is established the project shall be evaluated for economic viability
- If economically feasible, the collection shall be continued and expanded, possibly inviting private contractors to tender a payment for the collection rights
- Economic evaluation includes accounting for the real costs of collection, haulage and disposal and for effects of the savings on further landfill acquisition.

It is proposed that a container based recycling system will be established and that the appropriate public promotion and follow up shall be undertaken.

3) Expansion of the area

The target of recycling is set to 5% in 2000, 10% in 2005 and 15% in 2010 of domestic/commercial waste. To achieve these figures it is recommended to start with the pilot project then expand to other areas.

4) Other material

Following commencement of the public awareness campaigns and the foregoing pilot work, it is suggested that the program be extended to other materials.

Separate collection of aluminum cans is a possibility if there is an encouraging response to the pilot bottle collection project. Especially if it appears that the quantity of aluminum cans being consumed in Sofia is increasing. Present initial impressions are that the turnover of canned beer and soft drinks in disposable containers has been restricted by their affordability.

5) Manager for Recycling

In order to promote affordable and possibly economic 'resource separation/recovery' in SGM, it is proposed that a resource management officer be appointed with the responsibilities and a budget to work towards:

- Increasing public awareness of the requirement to reduce waste;
- promoting waste reduction concepts and ideals with the respective institutions and manufacturers and with commercial and business concerns within the region;
- promoting introduction and establishment of economically achievable measures to recycle municipal waste.

It is recommended that international technical assistance will be useful to obtain external experience on recycling in establishing the initial policies and detailed economic approach.

- monitoring and promoting the use of waste amenity centers;
- monitoring, evaluating and promoting initial pilot programs for waste separation and recycling;
- encouraging the public to use new central waste depositaries (Amenity Center) rather than resort to 'abandoning' bulky items or dumping waste on abandoned lands etc.

7.5.2 Amenity Center

Amenity centers shall be constructed to receive domestic/hazardous waste.

In the initial stage, amenity centers shall be constructed at the 5 vehicle depots and Katina disposal site considering control of the facilities. Since it is convenient for the residents to provide many amenity centers, it may be necessary to increase the number in the future. Therefore, monitoring and promotion of use of amenity center is required. The standard amenity center is shown in Figure 7-5-1.

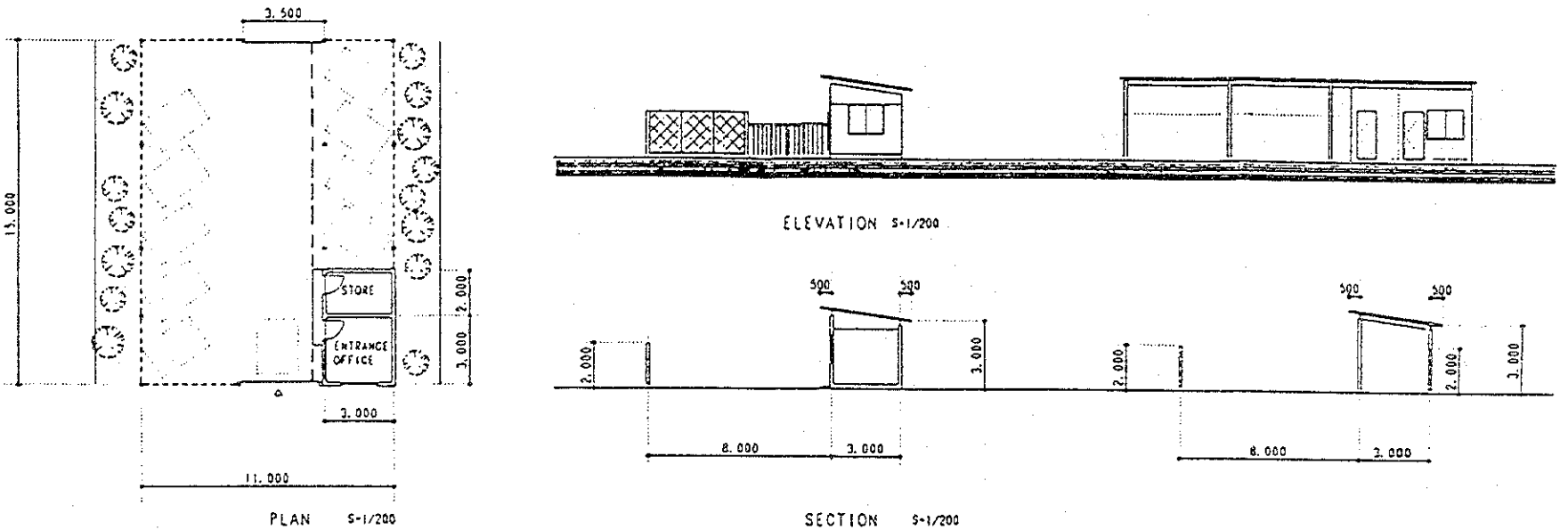


Figure 7-5-1 Amenity Center (Plan, Elevation, Section)

7.6 Organizational Structure

Based on the explanation in Chapter 6, the central management for the new public company will be the best solution which is suggested for all technical alternatives with the same outlines like;

- central administration and general coordination of operation in the headquarters
- central operation for collection and transport to landfill site from three vehicles depots
- central work shop for repair and maintenance of vehicles
- operation of each waste disposal site with own facilities

Prior the first technical stage of the project starting in 1997, the new company should be set up already having in mind that important basic decisions and preparatory work should start as early as possible under consideration of the existing situation.

7.6.1 General Structure of the Company

The general structure is shown in Figure 7-6-1.

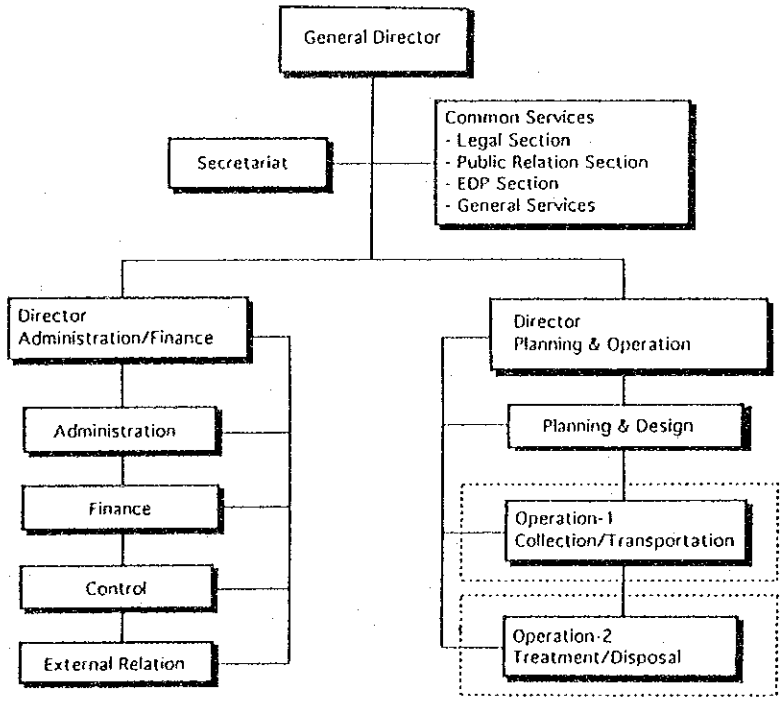


Figure 7-6-1 PLC Headquarters

The headquarter consists of the following departments:

- Administration & Finance dealing with general administration, personnel affairs and general organization, accounting, tariff system and invoicing, the internal control and external relations in different sub-sections and

- Planning & Operation being responsible for planning and design activities and the overall coordination of operational activities of outstations such as three vehicle depots, the work shop and disposal sites separated into operation department 1 and 2

Both main departments are assisted by common services for legal and public relation activities and an electronic data processing section should be built up as management information system. Figure 7-6-2 shows the structure of Operation Department 1.

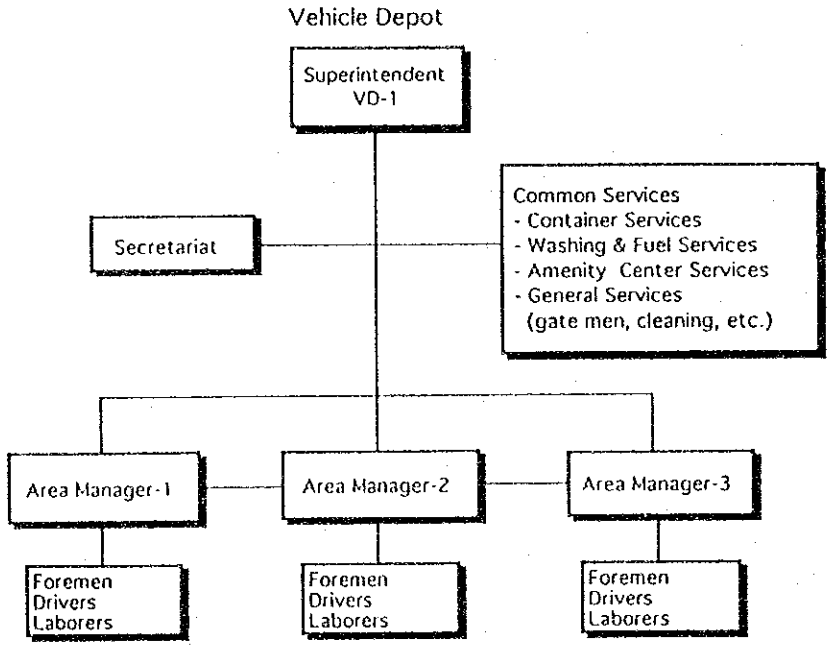


Figure 7-6-2 Operation Department - 1

The organizational structure as outlined above is identical for the three vehicle depots considered necessary for an efficient and economic collection and transport. These operational centers are operating to a great extent independent from the headquarters but in close coordination with the central work shop to guarantee optimal maintenance of vehicles.

Each depot needs enough space to accommodate garages to lock up the waste collection vehicles, washing and fulling facilities and an area for container storage. The operation office requires additional space for the staff members such as locker rooms, sanitary facilities and an inspection bridge.

Amenity centers will be located as well at each depot in the future.

The central work shop consists of the main repair hall with at least six repair and maintenance places, facilities for body repair and painting, steam cleaning and fueling including a machine shop. In addition to the workshop office facilities for staff members such as locker and sanitary rooms will have to be provided and a spare part depot of reasonable size. Central work shop organization chart is outlined in Figure 7-6-3.

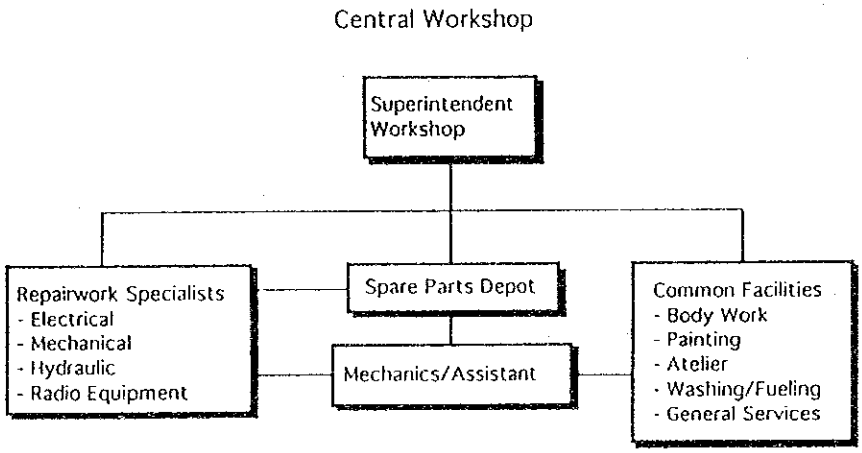


Figure 7-6-3 Central Work Shop Organization

Operation department - 2 deals for the time being only with disposal sites like Katina. All future treatment activities like incineration will be integrated into this department.

The organizational requirements for the disposal site are the offices and general facilities for the operation team, roof covered parking space for heavy equipment, weigh bridges and a washing facility for transport vehicles. Figure 7-6-4 shows the treatment and disposal organization.

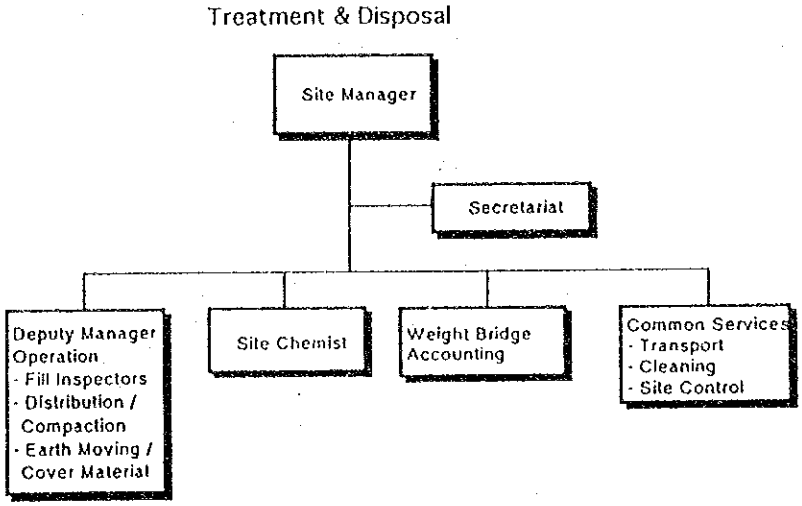


Figure 7-6-4 Operation Department - 2

The general structure of the company can remain the same as long as all activities will be executed by themselves. Adjustments concerning responsibilities, staff strength and infrastructure may be required according practical experiences.

For the first operational period starting in 1996 the following staff strength will be required;

Headquarters	
- Administration, finance and coordination of operation	56
Vehicle depots(3)	
- Operational management	39
- Drivers & laborers	702
Central work shop	
- Management and operation	30
Landfill site(1)	
- Management and operation	22

The total staff strength in 1996 would be in the order of 850 people considering only one disposal site.

The required infrastructure to be ready in the same year can be summarized as follows;

Headquarters	
- office space	app. 700 m^2
- parking space-minimum	app. 300 m^2
Vehicle depot (1)	
- garages, parking space, offices etc.	app.7,650 m^2
Central workshop	
- repair hall, offices & common facilities	app.2,000 m^2
Landfill site (1)	
- office space	app. 100 m^2

Concerning the above mentioned infrastructure it is needless to say that the best configuration would be a headquarters in N/W of the city center together with one vehicle depot and the central work shop for easy communication and coordination of activities and one vehicle depot each in the S/E and the S/W of the city in the vicinity of the existing ring road.

7.6.2 Phase I - Establishment and Optimization of Public Company

This most important phase for the future organization of the solid waste activities in SGM area should be sub-divided into an initial phase for the;

- decision making process, the
- preparatory works and the
- implementation phase which should start almost immediately and the,
- operation and optimization phase.

a. Sub-Phase Decision Process

Any activity to establish the proposed company requires the following basic main decisions from the Municipal Council

- decision to concentrate all activities concerning SWM into one enterprise under consideration of all facts summarized in Chapter 6
- decision on the establishment and status of the company whether reorganized and reconstructed out of existing companies with transformation according LoC or creation of a new company as private or public limited company
- decision on the basic structure of the proposed company including set up headquarters, departments and main infrastructure

Based on above mentioned decisions the next step can be started.

b. Sub-Phase Preparatory Work

This phase includes inter alia

- formation of company, articles of association, company capital, registration etc,
- request for permit from the Regional Environmental Inspectorate (REI) according Art.18 of the Waste Act
- assessment of the existing manpower in 24 BKC and Chistota working in the field of SWM and selection for positions in new company regarding management, key-personnel and other employees
- assessment of existing equipment in BKC and Chistota related to SWM including selection of equipment required to run the company efficiently
- preparation of necessary infrastructure like headquarters, vehicle depots and central workshop, emphasis should be given to take over existing facilities owned by SGM and to convert them accordingly
- preparation of an implementation schedule for the smooth transfer of management and operation from the existing companies to the new one

The key-personnel like General Manager and Department Chiefs should be already appointed to be integrated into all activities during the preparatory phase.

Following the main points specified above a contract between SGM and the company can be drafted which indicates scope of work, level of services, responsibilities and remuneration, rights to utilize assets and conditions concerning operation and maintenance, obligation of SGM to make available the necessary disposal facilities and the internal and external control and monitoring requirements.

However it should be investigated and considered, if it would not be of advantage to transfer all existing assets from SGM to the new company thus increasing the initial capital worth of the company, resulting in the advantage that they have as well couplet control and responsibility over all assets.

The final step of the preparatory work is the approved implementation schedule which leads to the following

c. Sub-Phase Implementation

The detailed schedule will give the guideline in which way the different activities of all together 25 companies will be transferred to the new company to guarantee a minimum of disturbance to citizens and to shorten the transfer period.

All activities necessary to start off the new company with its new organization and new infrastructure, but in well known surrounding, should be finalized not later than during the fourth quarter of 1995 to start implementation by January 1, 1996.

The Municipality should be assisted during this period by an experienced management consultant team.

d. Sub- Phase Operation and Optimization

As soon as all activities have been taken over an extensive training program on theoretical and practical aspects as training on the job should be started which will gradually lead to efficient management and operation of all activities.

This operation and optimization phase might be limited if the Municipal Council decides to transform an existing company under Decree 56 into a company as a Sole Proprietor Public Limited Company according to LoC. After a maximum period of 5 years from the date of registration the ownership of the company would change by application of Art. 22 to 25 of the Transformation and Privatization Law. If the decision will be taken to create an entirely new company, the suggested solution, SGM has a wide range of future options to privatize the company partially or totally or to subcontract parts of the activities to other more experienced companies.

The basic strategy and the necessary groundwork for future introduction of privatization should be decided and prepared for the following phases.

7.6.3 Phase II - Private Participation

During this phase of the master plan an incineration plant with a capacity of 600 t/d should go into operation. The organizational structure will have to take this into consideration by creation of an additional section in the department of operation 2, treatment and disposal and the complete operation team for the plant on a four shift basis.

Simultaneously the amenity centers will be established and operated mainly to separate hazardous household waste according to the provisions foreseen in the Waste Act and to give the citizens the possibility to deliver household waste free of charge and to further promote separation of waste. Each center will be operated by two persons.

A continuous careful assessment of the efficiency and effectiveness of the company will give SGM the essential decision background whether a separate contract for some collection zones to a private company will be more economic and efficient in comparison to retain all activities with the public company.

The high investment costs for the second phase might lead as well to other options like integration of a potential foreign company which might finance a certain percentage of the project costs through increasing the capital of the company.

7.6.4 Phase III - Further Development

The further development of the company during the third stage between 2005 and 2010 can neither be proposed nor predicted. Any decision for additional privatization and/or sub-contracting depends entirely on the performance of activities executed so far, the general political trends and development with regards to total privatization of municipal public utilities, the financial situation of the company and the investment requirements.

Since many organizations responsible for solid waste management in west-European countries are still owned and operated by municipalities it is not a condition that privatization is the solution to every thing as long as a good level of services, professional operation and appropriate tariffs are prevailing.

7.7 Implementation Plan

1) Staging

The master plan period will be divided into three phases as follows:

- Preparatory work	:	1994
- Phase I	:	1995 - 2000
- Phase II	:	2001 - 2005
- Phase III	:	2006 - 2010

2) Procurement and Construction Schedule

As there are many old collection vehicles at present, collection vehicle shall be replaced in Phase I considering availability of fund.

Katina disposal site shall be opened in 1997 considering remaining capacity of existing disposal sites. Construction period will require 2 years including tender process.

Considering shortage of funds to construct incineration plant, it is recommended to start construction during Phase II instead of Phase I. Therefore, it is planned to start construction from 2002 with operation to commence in 2005.

Pilot project for recycling will start in 1997 in anticipation of demand recovery of used paper and cullet. Area will be expanded based on experience gained from the Pilot Project.

It is recommended to start reorganization as soon as possible.

(3) Stage Plan

Table 7-7-1 shows the staged development of the master plan during these three stages.

Table 7-7-1 Master Plan Phased Plan

Preparatory Phase 1994	First Phase 1995-2000	Second Phase 2001-2005	Third Phase 2006-2010
- Apply for loan for First Phase project as necessary - Prepare local budget for First Phase project - Prepare for establishment of a new organisation	a. Form new Public Limited company b. Transfer operation from existing structure to new organisation		a. Select new disposal site b. Further development treatment facilities
	a. Improvement of solid waste collection - purchasing of vehicle and container - Rearrangement of collection zones - Change collection system	a. Renewal of equipment	a. Renewal of equipment
- EIA & detailed design incl. tender documents for Katina disposal site - Expansion of Suhodol - Construct Novi Iskar by-pass road (local) fund	b. Construction of Katina disposal site - Stage I with amenity center (1997) - Construction of Katina disposal site - Stage I - Purchase of heavy equipment	a. Detailed design, construction of Katina disposal site - Stage II and III -Construction of Stage II - Renewal of equipment	-Construction of Stage III -Renewal of equipment
		b. Introduction of a 600 ton/day incineration plant	
	c. Setting a 5 % recycling target - Pilot project for recycling-Paper, Glass - Construction of Amenity centers	c. Setting a 10 % recycling target - Expansion of Pilot project for recycling-area and item-e.g. metal, plastic	c. Setting a 15 % recycling target - Grade-up of separation
- Gradual waste tariff increase	d. Establishment of a new tariff value (1.5-4.2 $/capita)	d. Increase of tariff value (4.2 - 8.8 $/capita)	d. Further upgrading of tariff value (8.8 - 12.2 $/capita)
	e. Preparation of ground work for privatisation (1995) - To give opportunity experience - Preparation of standard for tendering		
- Preparatory work	f. Establishment of a public limited company - Head office - 3 branch offices with depot and Amenity center - Central workshop		
	g. Related project - Construction of Novi Iskar by-pass road		

7.8 Financing Plan

7.8.1 Allocation of Financial Burden

1) General

The main revenue source for SWM shall come from fees for waste collection and disposal under the principal of 'beneficiary-to-pay', although there will be some subsidy from SGM, and income from sales of reusable material and electricity produced through energy recovery at the incineration plant. Also one of the M/P targets is to achieve a sufficient self-financing base without subsidy from SGM in year 2010.

It is noted that cost of SWM in 2010, excluding interests on loan will reach US$ 24 million/year, ie more than 5 times the present cost. This cost shall be covered by the waste tax and fees to be collected from residents and companies to maintain an adequate SWM system.

2) Fee collection system

The financial burden placed on residents and companies shall correspond to the respective amounts of waste they discharge, to ensure that the burden is fairly distributed, and encourage their efforts for waste amount reduction. Based on this principal, the residents share of the burden shall increase in the future compared to their present share which is not proportional to the amount of waste they discharge. The present situation where companies are carrying an unfair burden shall be rectified, but gradually so as to avoid drastic changes.

Waste collection and disposal fee is presently collected by means of a waste tax. Table 7-8-1 identifies several fee collection methods and their advantages/disadvantages.

At present waste tax is related to citizens' property tax. A measure to reevaluate citizens' properties has been decided in December 1993. Values will become ten times the former values, and rate of waste tax in SGM will be reduced from 15 per mill. to 4 per mill. in 1994. The idea that property tax should reflect not only property price but also the affordability of payers is under study in Bulgaria.

Considering the above conditions, the proposed fee system is a combined system of waste tax and service fee as shown in Table 7-8-2.

Table 7-8-1 Comparison of Fee Systems

Alternatives	Criteria	Advantages	Disadvantages
a- Fee Charge	Weight	Fair burden will be expected. It is easy to establish a self-financial base. Incentives for discharged waste reduction are expected.	Measurement system has not been established. Own fee collection system should be established.
b- Fee Charge	Volume	Burden is proportional to volume discharged. It is easy to establish self-financial base. Incentives for discharged waste reduction are expected.	It is possible to measure by plastic bags or containers. Own fee collection system should be established.
c- Waste Tax	Property value	It is easy to collect tax with property tax.	The burden is not in proportion to the waste discharged. Cost recovery depends on tax system, and is difficult when inflation is severe. It is difficult to motivate discharged waste amount reduction.
d- Waste tax	Income	It is easy to collect tax with income tax. It is easy to cope with the influence of inflation.	The burden is not in proportion to the waste discharged. Cost recovery depends on tax system. It is difficult to motivate discharged waste reduction.
e- Waste tax	Volume of Waste	It is easy to reflect the volume of waste discharged. Offers incentive to reduce the waste discharged.	The cost recovery depends on the tax system. It is necessary to adopt multi container systems. Data base of payers should be established.

Table 7-8-2 Proposed Fee System

	System	Criteria	Collection methods
Waste tax	indirect	Property	Payment with property tax value (tax offices)
Service fees			
- Collection/ tipping	direct	Volume	Remittance through banks (contract)
- Tipping	direct	Weight (measure-ment)	Remittance through banks

It is proposed that fees on commercial waste shall be collected based on direct contracts as much as possible. However it may be difficult to enter into contracts with small shops. It is assumed that commercial waste will be 30% of domestic/commercial waste and that 40% of commercial waste can be covered by direct contracts for fee collection and the remaining 60% of commercial waste (ie, 18% of total domestic/commercial waste) shall be covered by waste tax paid by companies.

It is noted that waste tax shall be pegged to property value and will reflect to some degree the amount of solid waste discharged. However this system shall not be sensitive to efforts on the part of citizens to reduce waste amount generated. Therefore, further study to improve the system is recommended in the future.

3) Burden on Households

The expenses incurred in collection, treatment and disposal of waste discharged from households should be covered by means of waste tax collected from the citizens. According to the SWM cost, residents may be required to pay US$ 6.6/cap./year upon commencement of Katina disposal site operation in 1997 and US$ 18.8 in 2005 at start of incineration plant operation. But it seems difficult to charge that fee in 1997, in light of the present light burden, and a more reasonable figure of half that fee shall be considered. The resulting shortfall shall be covered by subsidy from SGM or fees collected from companies.

Accordingly SWM fees on residents, by year, will be:

1994	US$	0.9/capita
1997	US$	3.3/capita
2000	US$	6.6/capita
2005	US$	18.8/capita
2010	US$	18.8/capita

4) Burden on companies

The expenses incurred in the collection, treatment and disposal of waste discharged from shops, offices and factories should be covered by the fees or taxes collected from companies. It is assumed that waste tax amount collected from companies shall cover 60% of cost for SWM of commercial waste and the remaining 40% shall be covered by service fee.

It should be noted that the expenses incurred in collection, treatment and disposal of waste discharged from public authorities should be covered by the respective responsible administrative bodies.

At present the waste tax amount collected from residents is more than the cost incurred in SWM of their generated waste, ie their burden is unfair. Therefore under the M/P this present burden will be maintained at the same level with no increase up to the year 2010, to more fairly distribute the burden between residents and companies. Service fee tariffs will be increased in 1997 and 2005 when Katina disposal site and incineration plant operation respectively start. Accordingly companies' burden will be as described in Table 7-8-3. The same table shows the values of service fees which are set to cover costs of incineration and disposal after 2005.

Table 7-8-3 Waste Tax and Service Fees

(unit: US$/Ton)

	Waste tax	Service Fees	
		Collection/tipping	Tipping
1994	54.4	5.1	1.5
1997	47.8	22.0	7.4
2000	42.9	22.0	7.4
2005	41.4	63.1	39.1
2010	40.3	63.1	39.1

5) Burden of SGM

Although the plan calls for no subsidy from SGM for SWM in the year 2010, it will be necessary to cover the shortage in income up to the year 2000 that will result from adopting gradual increase in residents burden, instead of drastic increases that may increase revenue but would be socially unacceptable. Also it must be noted that costs of street cleaning and snow removal shall be covered by SGM and/or the residents. Under the plan SWM shall receive the same subsidy amount from SGM up to 1999.

7.8.2 SWM Revenue

The estimated SWM fees and waste tax tariffs by year are shown in Table 7-8-4. Based on these figures, the SWM revenue in estimated as shown in Table 7-8-5, and graphically in Figure 7-8-1.

Table 7-8-4 M/P SWM Tariffs

		1994	1997	2000	2005	2010
Waste Tax						
Household	$/capita	0.9	3.3	6.6	18.8	18.8
Shops etc.	$/ton	54.4	47.8	42.9	41.4	40.3
Collection Fee						
Shops etc.	$/ton	5.1	22.0	22.0	63.1	63.1
Tipping Fee	$/ton	1.5	7.4	7.4	39.1	39.1
Electricity	cents/kWH	2.3	10.0	10.0	10.0	10.0
Reusable materials						
Paper	$/ton	32.0	32.0	32.0	32.0	32.0
Glass	$/ton	17.0	17.0	17.0	17.0	17.0
Cost	$/ton	13.7	22.0	22.1	46.7	45.9

Table 7-8-5 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	0	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 %)	95.8	97.1	100.0	100.0	100.0

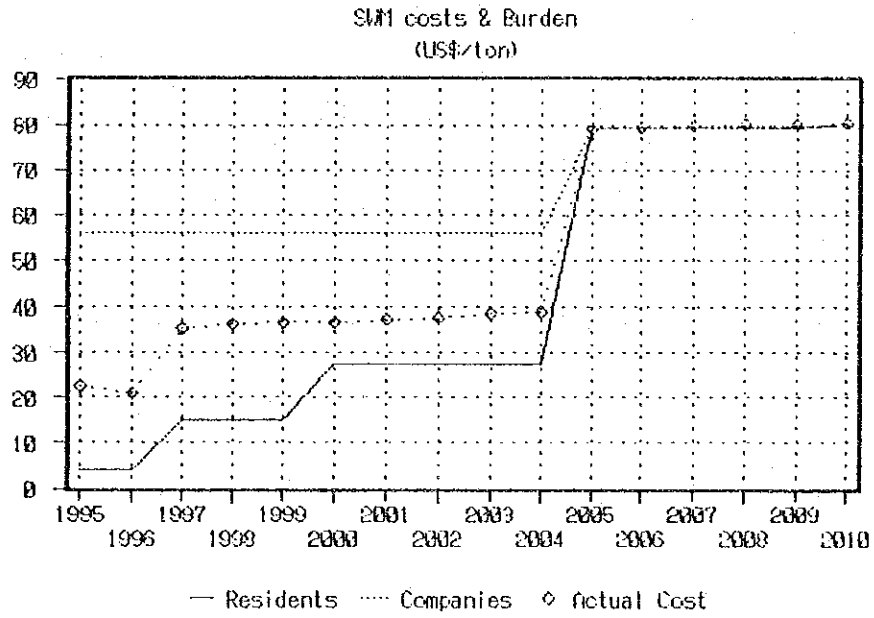


Figure 7-8-1 SWM Costs and Burden

7.8.3 Financial Plan

Inflation is not considered in the formulation of the financial schedule of the Master Plan. The financial plan is prepared for the PLC, scheduled to be established in 1995.

1) Financial requirement

a. Investment cost

Based on the implementation schedule set in the following section 7.7, total investment cost by each phase is shown in Table 7-8-6. The schedule for construction of an incineration plant was set during 2002 and 2004. Additional investment for renewal of equipment is assumed based on the life span of vehicles and containers as shown in Table 7-8-7.

Table 7-8-6 Investment Plan

(unit: US$ 1,000)

Period years	I 1995 - 2000	II 2001 - 2005	III 2006 - 2010	Total
Collection	19,794	9,136	12,094	41,024
Treatment Plant	0	139,090	0	139,090
Landfill	26,244	2,826	0	29,070
Recycling	1,425	4,926	7,625	13,976
Workshop etc.	3,605	600	600	4,805
Total	51,069	156,578	20,319	227,965

Table 7-8-7 Life Span of Equipment and Facilities

	Life Span(years)	Salvaged Value(%)
- plant and machinery	15	0
- vehicles and mobiles	8	10
small ones	5	25
- containers	5	0
Meva	3	0
- Katina disposal site	15	0

b. Annual cost

Operation and maintenance cost is estimated for alternative 1 and as shown in Table 7-8-8.

Beside operation cost, interest on loan and tax levied on PLC shall be taken into account. PLC shall pay a profit tax equal to 52% of its profit.

Table 7-8-8 Annual Cost for SWM

(unit: US$ 1,000)

	1995	1997	2000	2005	2010
Depreciation					
Collection					
Vehicle	0	893	1,895	1,713	1,753
Container	530	595	662	689	709
Treatment Plant					
Plant	0	0	0	9,267	9,267
Transp.Vehicle	0	0	0	10	10
Landfill					
Civil work	2	1,551	1,551	1,551	1,551
Mobil & plant	0	473	473	372	372
Recycling					
Vehicle	0	8	45	165	270
Container	0	18	213	781	1,225
Workshop etc.					
Civil work	0	200	200	200	200
Container	0	120	120	120	120
Sub-total	532	3,858	5,160	14,868	15,476
O & M cost					
Collection					
Personnel	2,194	1,859	1,977	1,792	1,831
Maintenance	1,384	1,323	757	685	701
Others	1,183	1,001	1,100	865	887
Treatment Plant					
Personnel	0	0	0	103	102
Maintenance	0	0	0	1,264	1,264
Others	0	0	0	1,901	1,895
Landfill					
Personnel	89	107	107	94	94
Maintenance	5	0	136	84	84
Others	346	725	512	505	531
Recycling					
Personnel	0	11	43	154	256
Maintenance	0	6	50	183	292
Others	0	3	22	79	119
Workshop etc.					
Personnel	96	192	192	192	192
Maintenance	0	12	12	12	12
Others	117	285	285	285	285
Sub-total	5,415	5,525	5,192	8,199	8,545
Total	5,947	9,383	10,352	23,067	24,021

2) Financial Sources

a. Source to cover investment cost

The foreign portion of disposal site and incineration plant are assumed to be financed by overseas bank(s) under loan conditions as shown in Table 7-8-9. The local portion of these facilities are assumed to be financed by domestic banks under the conditions shown in the same table. Remaining investment cost including purchase cost of collection vehicle, containers and equipment required for recycling and their renewal costs, and construction cost for adaptation of depots and workshop, and for amenity center shall be covered by own fund.

Table 7-8-9 Loan Conditions of Long Term Loan

Loan	Repayment schedule	Grace period	Interest rate (real base)
Long term			
Foreign loan	15 years	5 years	7.5%
Local loan	10 years	3 years	8.5%
Short term	1 year	0	12.5%

Accordingly the financial source for investment is shown in Table 7-8-10.

Table 7-8-10 Financial Source for Investment

(unit: US$ 1,000)

Period years	I 1995 - 2000	II 2001 - 2005	III 2006 - 2010	Total
Budget from SGM	0	0	0	0
Own Fund	21,219	17,488	20,319	59,025
Long Term Loan				
Foreign Loan	14,272	101,990	0	116,262
Local Loan	15,578	37,100	0	52,678
Total	51,069	156,578	20,319	227,965

b. Source to cover annual cost

Annual cost includes operation and maintenance costs, and interest payments on loans. This cost shall be covered by own-fund. Revenue for SWM is estimated based on the tariff of waste tax and service charge set in section 7.8.1 and shown in Table 7-8-4.

3) Financial Plan

Based on the above mentioned financial requirements and sources, the financial plan has been prepared and summarized in Table 7-8-11 and Figure 7-8-2. However, it is noted that profit tax of PLC shall be exempted until year 1999 because during this period renewal of old vehicles and obtaining subsidies from SGM for SWM are planned.

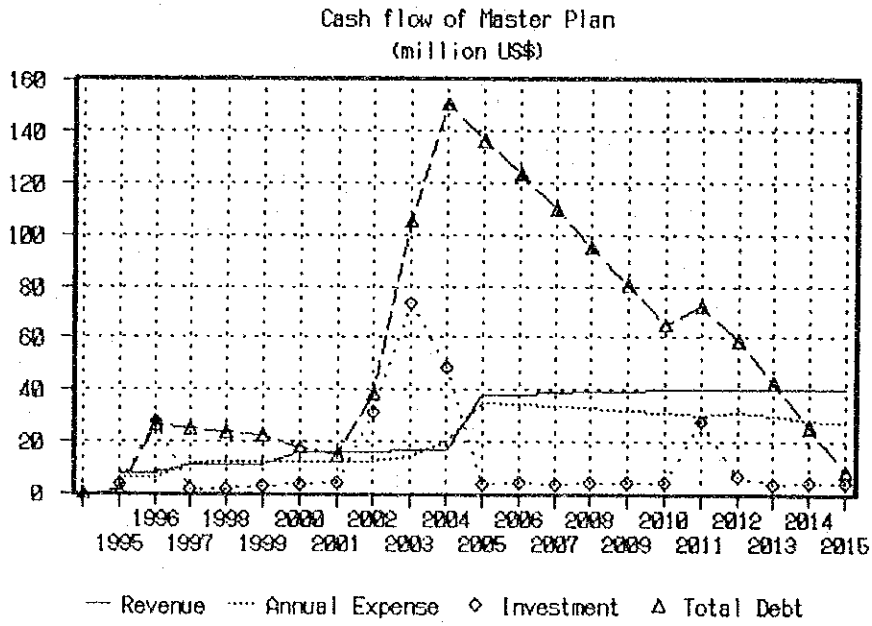


Figure 7-8-2 M/P Cash Flow

The balance sheet provided in Table 7-8-11 shows black figures in 2000 and after 2005. The total debt will decrease after 2004, and will be less than US$ 10 million in 2015.

The burden to be borne by both residents and SGM are summarized in Table 7-8-12. The table shows that the burden to be borne by residents in 2005 will represent 0.58% of their income that year, and the respective figure for 2010 shall be 0.48%. The burden borne by SGM will remain the same level as at present, reaching zero by 2000. In addition, SGM can be expected to receive part of the profit tax after 2000.

Table 7-8-11 SGM Solid Waste Management Financial System

Profit & Loss Statement (M/P)

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Revenue																
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
Annual Expense																
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
Money Demand																
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
Money Supply																
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

Table 7-8-12 Burden by Residents and SGM

		1996	1997	2000	2005	2010
Residents	(US$1,000)	1,056	4,111	8,420	24,925	25,925
per capita	(US$)	0.9	3.3	6.6	18.8	18.8
share of income	(%)	0.07	0.20	0.26	0.58	0.48
SGM	(US$1,000)	325	325	0	0	0
share of Budget	(%)	0.12	0.09	0.00	0.00	0.00

These figures indicate the possibility of executing the Master Plan under the condition of rapid economic recovery until 1998 and at a growth expected to be 4 to 6% per annum after 1998.

7.9 Priority Project

The Priority Project shall cover the components of Phase I of the Master Plan as defined in the preceding sections of this chapter.

These are summarized hereafter as follows:

1) Collection and Haulage Improvement

- Redefinition of Collection Zones
- Upgrading of Vehicle Utilization Efficiency
- Vehicle Renewal Plan and Costing
- Resource Recycling
- Suitable collection system for Central area

2) Disposal

- Development of technical preliminary designs and final cost estimates for the construction of the new landfill site at Katina
- Katina disposal site construction cost estimates and implementation Schedule

3) Recycling

- Recycling pilot project in specified area
- Setting up of Amenity Centers for receiving of hazardous domestic waste and bulky waste

4) Organizational Structure of Public Limited Company

- General Structure and Organization of PLC
- Staff Structure and related matters
- Determining infrastructural requirements

5) Revision of Fee Collection System

- allocation of fee amount
- fee collection and distribution
- income and expense structure
- Feasibility study cost estimates
- Financial analysis and formulation of financial plan for the first phase.

RECOMMENDATIONS OF THE STUDY

RECOMMENDATIONS OF THE STUDY

(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. 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.

(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.

(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, 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 the i improvement of 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.

1) Populations and land use by collection zones
2) Waste amount by collection zone and generator
3) Waste composition by season and generator
4) Recycling amount by waste material
5) Environmental monitoring at disposal site
6) 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, definite plans for spreading proper SWM practices such 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

The central government is recommended, through workshops and seminars, to 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 the qualifications and levels of the staff engaged in this activity should be improved 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 that county should meet EC standards. In particular the following aspects should be considered and developed where necessary.

1) SWM related laws and institutions.
2) Environmental protection measures and reduction of environmental damage
3) Management of hazardous industrial waste (in line with the Basel Convention)
4) Suitable institutional system in which public and private concerns may cooperate in SWM
5) 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 at present accepted at municipal disposal sites for composition and amount.

ANNEX

ANNEX 1

INTRODUCTION OF INCINERATION PLANT

Annex 1 Financial Evaluation of Incineration Plant Introduction

1. Option for Incineration of Half the Waste Amount

For the M/P five alternatives were studied.

Alternative 1: Incineration of 600 ton/day at incineration plant to be introduced at Koriata
Alternative 1b: Incineration of 600 ton/day at plant to be introduced at a different location, south-west of the city
Alternative 2: Sanitary landfill of the total waste amount with direct haulage
Alternative 3: Sanitary landfill with introduction of transfer station for partial secondary transport
Alternative 4: Sanitary landfill of precompressed waste blocks

Concerning alternative 1, two cases with variation in introduction time were studied.

a- Operation will be started in 2005
b- Operation will be started in 2000

The results of analysis are summarized as shown in Table A-1-1. Case b has been analyzed under two conditions, as shown in the table (b-1 and b-2). Case b-1 increases the fee tariffs to more realistic levels to cope with the debt while b-2 maintains the fee tariffs set for case a.

Table A-1-1 Results of Analysis by Introduction Time

Case	Introduction period	Fee Tariff	FIRR (%)	Burden of residents in 2000 ($/capita,%)	Total Debt (million US$) 2010	2015
a	2005	Table A1-2	9.6	4.2 (0.17)	34	- 53
b-1	2000	Table A1-3	5.2	10.3 (0.41)	1	97
b-2	2000	Table A1-2	4.2	4.2 (0.17)	102	235

Fee Tariffs were formulated to cope with the SWM cost in 2000 and in 2005 as shown in Tables A-1-2 and A-1-3.

Table A1-2 Fee Tariff (Case a)

		1994	1997	2000	2005	2010
Waste Tax						
Household	$/capita	0.9	2.1	4.2	10.3	10.3
Shops etc.	$/ton	54.4	48.1	45.6	44.6	44.6
Collection Fee						
Shops etc.	$/ton	5.1	17.3	17.3	47.0	47.0
Tipping Fee	$/ton	1.5	5.6	5.6	22.9	22.9
Electricity	cents/kWH	2.3	10.0	10.0	10.0	10.0

Table A-1-3 Fee Tariff (Case b-1)

		1994	1997	2000	2005	2010
Waste Tax						
Household	$/capita	0.9	5.2	10.3	10.3	10.3
Shops etc.	$/ton	54.4	48.1	45.4	44.6	44.1
Collection Fee						
Shops etc.	$/ton	5.1	17.3	47.0	47.0	47.0
Tipping Fee	$/ton	1.5	5.6	22.9	22.9	22.9
Electricity	cents/kWH	2.3	10.0	10.0	10.0	10.0

Table A-1-1 shows that Case a has the highest FIRR and the burden borne by residents in 2000 was lower.

The cash flows of each case are shown in Figures A-1-1, A-1-2 and A-1-3. The cash flow in Case a shows the possibility to reserve some inner fund and thereby strengthen the SWM budgetary condition before preparation of introducing an incineration plant.

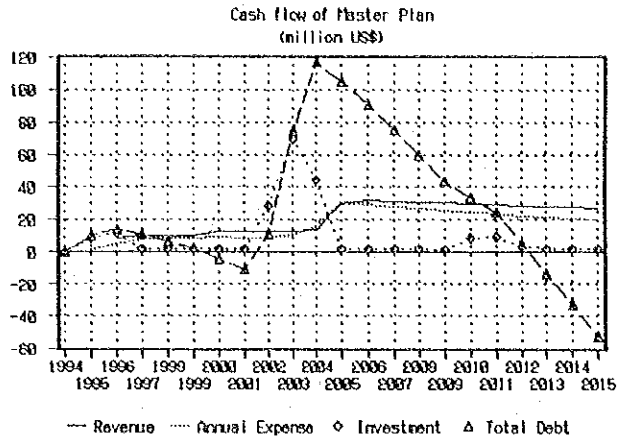


Figure A-1-1 Cash Flow of Case a

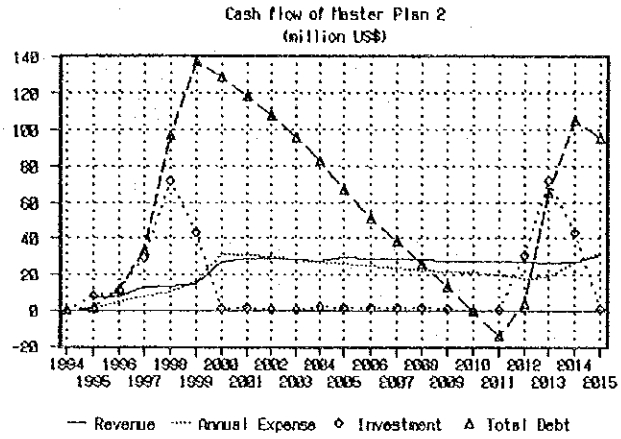


Figure A1-2 Cash Flow of Case b-1

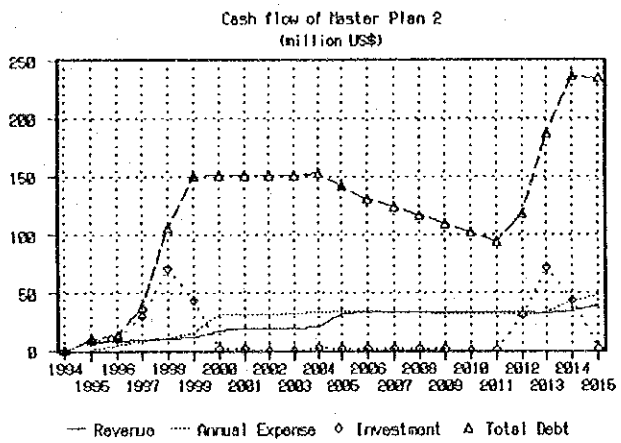


Figure A1-3 Cash Flow of Case b-2

Based on the study results Case a was judged to be the most suitable from financial viewpoint and its implementation. Therefore Case a was recommended for the Master Plan.

2. Option for Incineration of Full Waste Amount

As the Bulgarian side is interested in introducing immediate environmental improvements, therefore a full incineration option at an early stage has been analyzed by the Study Team as an additional study.

The full incineration option will require having a treatment facility of capacity 1,500 ton/day. Taking into consideration transportation efficiency, construction of two incineration plants of 750 ton/day each, at Koriata and the south west area of the city were studied.

Under this option, and changing operation commencement years, four cases were formulated as follows:

a. Case 1: Full incineration to start operation in the year 1997
b. Case 2: Full incineration to start operation in the year 2000
c. Case 3: One plant(750 ton/day) to start operation in the year 1997, and the second in the year 2000
d. Case 4: One plant(600 ton/day) to start operation in the year 1997, and the second(900 ton/day) in the year 2005

The costs for introduction of incinerator plants are:-

- Construction costs:	750 ton/day	US$ 348 million
	600 ton/day	US$ 278 million
	900 ton/day	US$ 418 million
- Operation and maintenance costs		US$ 8 million/year

The cost that shall result from construction and operation of the incineration plant shall be borne by SGM and its residents. The municipality shall subsidize:-

- Half the interest amount to be paid back on debts incurred in construction of incineration and disposal site etc.,
- Procurement costs of collection vehicles, and
- Shortage of operation and maintenance costs shown in Tables A-1-5, A-1-6, A-1-7 and A-1-8.

The results of analysis were summarized in Table A-1-4.

Table A-1-4 Results of Analysis by Introduction Time

Case	Introduction period	FIRR (%)	Burden of residents in 1997 ($/capita,%)	Burden of residents in 2000 ($/capita,%)	Burden of SGM in 2000 (million US$)	Total Debt 2010	Total Debt 2015
1	1997	5.3	9.8 (0.59)	19.7 (0.78)	15,701 (2.71)	418	531
2	2000	0.6	9.8 (0.59)	19.5 (0.78)	11,179 (1.93)	102	336
3	1997 & 2000	0.1	9.8 (0.59)	19.6 (0.78)	7,662 (1.32)	206	410
4	1997 & 2005	5.0	5.3 (0.32)	10.5 (0.42)	7.186 (1.24)	286	240

Case 1 has the highest FIRR because subsidies for operation & maintenance in 1997 and 2000 are most expensive (Table A-1-5). It is necessary to subsidize about US$18 million to cover shortage in O&M costs. Adding subsidy necessary to pay for interest on loan and procurement cost of vehicles, amount of subsidy will exceed US$27 million in 1997.

The financial sources and tariffs calculated from the SWM costs are shown as follows.

Table A-1-5 Revenue and Fee Tariff (Case 1)
a. Financial Source for Annual Cost (US$ 1,000)

	1994	1997	2000	2005	2010
Waste Tax					
Household	1,056	12,310	25,212	26,197	27,182
Shops etc.	5,583	5,583	5,583	5,583	5,583
Collection Fee					
Shops etc.	717	717	3,294	6,736	7,160
Tipping Fee	38	1,072	2,254	2,301	2,333
Electricity		3,282	4,022	4,732	5,545
PM budget allocation	325	17,551	300	0	0
Total	7,719	40,516	40,665	45,549	47,802
Self-financing rate(%)	95.8	56.7	99.3	100.0	100.0

Table A-1-5 (cont..)
b. Fee Tariff

		1994	1997	2000	2005	2010
Waste Tax						
Household	$/capita	0.9	9.8	19.7	19.7	19.7
Shops etc.	$/ton	54.4	48.1	45.4	44.6	44.1
Collection Fee						
Shops etc.	$/ton	5.1	89.7	89.7	89.7	89.7
Tipping Fee	$/ton	1.5	50.4	50.4	50.4	50.4
Electricity	cents/kWH	2.3	10.0	10.0	10.0	10.0
Cost	$/ton	9.6	95.3	91.7	89.7	88.7

Table A-1-6 Revenue and Fee Tariff (Case 2)
a. Financial Source for Annual Cost (US$ 1,000)

	1994	1997	2000	2005	2010
Waste Tax					
Household	1,056	12,211	25,007	25,984	26,961
Shops etc.	5,583	5,583	5,583	5,583	5,583
Collection Fee					
Shops etc.	717	717	3,268	6,682	7,102
Tipping Fee	38	119	2,234	2,281	2,312
Electricity		0	4,022	4,732	5,545
PM budget allocation	325	0	0	0	0
Total	7,719	18,630	40,114	45,261	47,502
Self-financing rate(%)	95.8	100.0	100.0	100.0	100.0

b. Fee Tariff

		1994	1997	2000	2005	2010
Waste Tax						
Household	$/capita	0.9	9.8	19.5	19.5	19.5
Shops etc.	$/ton	54.4	48.1	45.4	44.6	44.1
Collection Fee						
Shops etc.	$/ton	5.1	17.3	89.0	89.0	89.0
Tipping Fee	$/ton	1.5	5.6	49.9	49.9	49.9
Electricity	cents/kWH	2.3	10.0	10.0	10.0	10.0
Cost	$/ton	10.5	17.3	91.0	89.0	88.0

Table A-1-7 Revenue and Fee tariff (case 3)
a. Financial Source for Annual Cost (US$ 1,000)

	1994	1997	2000	2005	2010
Waste Tax					
Household	1,056	12,235	25,057	26,036	27,015
Shops etc.	5,583	5,583	5,583	5,583	5,583
Collection Fee					
Shops etc.	717	717	3,274	6,695	7,116
Tipping Fee	38	1,065	2,239	2,286	2,317
Electricity	2.3	1,641	4,022	4,732	5,545
PM budget allocation	325	2,646	0	0	0
Total	7,719	23,886	40,175	45,331	47,575
Self-financing rate(%)	95.8	88.9	100.0	100.0	100.0

b. Fee Tariff

		1994	1997	2000	2005	2010
Waste Tax						
Household	$/capita	0.9	9.8	19.6	19.6	19.6
Shops etc.	$/ton	54.4	48.1	45.4	44.6	44.1
Collection Fee						
Shops etc.	$/ton	5.1	89.2	89.2	89.2	89.2
Tipping Fee	$/ton	1.5	50.0	50.0	50.0	50.0
Electricity	cents/kWH	2.3	10.0	10.0	10.0	10.0
Cost	$/ton	10.5	56.2	91.2	89.2	88.2

Table A-1-8 Revenue and Fee Tariff (Case 4)
a. Financial Source for Annual Cost (US$ 1,000)

	1994	1997	2000	2005	2010
Waste Tax					
Household	1,056	6,588	13,492	26,776	27,783
Shops etc.	5,583	5,583	5,583	5,583	5,583
Collection Fee					
Shops etc.	717	717	1,735	6,885	7,318
Tipping Fee	38	612	1,120	2,373	2,406
Electricity		1,313	1,609	4,730	5,544
PM budget allocation	325	5,654	0	0	0
Total	7,719	20,467	23,539	46,348	48,634
Self-financing rate(%)	95.8	72.4	100.0	100.0	100.0

b. Fee Tariff

		1994	1997	2000	2005	2010
Waste Tax						
Household	$/capita	0.9	5.3	10.5	20.1	20.1
Shops etc.	$/ton	54.4	48.1	45.6	44.6	44.6
Collection Fee						
Shops etc.	$/ton	5.1	48.1	47.2	91.7	91.7
Tipping Fee	$/ton	1.5	28.7	25.0	51.9	51.9
Electricity	cents/kWH	2.3	10.0	10.0	10.0	10.0
Cost	$/ton	10.1	48.1	47.2	91.7	90.7

The tariffs for residents in 1997 were set at half the cost in 2000 because it seems very difficult for them to bear the full cost in 1997 when compared to the present burden. The cash flow of each case is shown as follows.

Figure A-1-4 Cash Flow (Case 1)

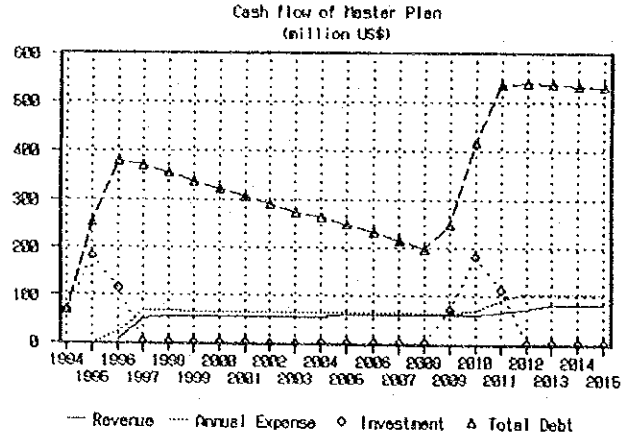


Figure A-1-5 Cash Flow (Case 2)

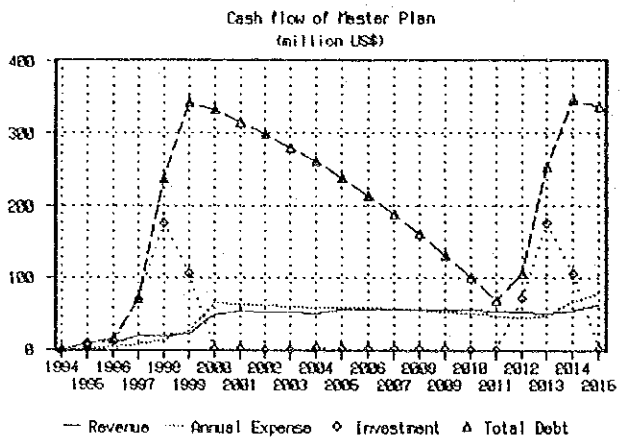


Figure A-1-6 Cash Flow (Case 3)

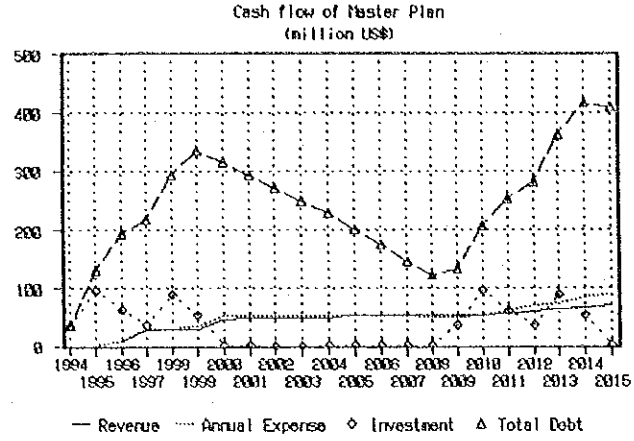
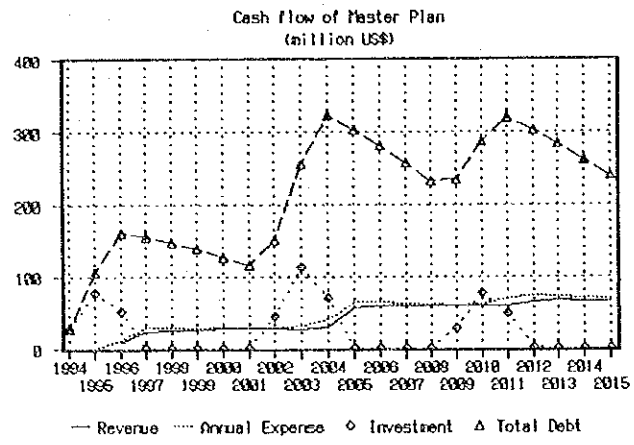


Figure A-1-7 Cash Flow (Case 4)



All figures show that it will be necessary to replace the incineration plants before finishing repayment of original loans. Concerning case 4, result of sensitivity analysis shows that construction cost of incinerator effects FIRR more than revenue from residents if quality is guaranteed (see Figure A-1-8).

Therefore it is very difficult to say that the full incineration option is feasible taking into consideration the Bulgarian economy and financial situation of SGM even though immediate improvement of environment is desirable.

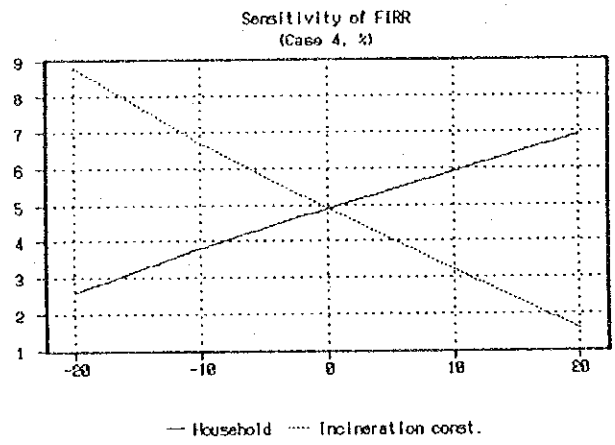


Figure A-1-8 Sensitivity Analysis

ANNEX 2

EXTENDED USE OF DOLNY BOGROV DISPOSAL SITE AS AN ALTERNATIVE FOR THE MASTER PLAN

Annex 2: Extended use of Dolny Bogrov Disposal Site as an Alternative for the Master Plan

1. General

Katina is recommended as the final disposal site for SGM in the Master Plan because it is the only suitable site considering the urgency of securing the next final disposal site. However, there are several difficulties with adopting the Katina site, including opposition from the residents as well as from the Air-force. It should be noted that the Council of Ministers in 1974 once planned that Katina should serve as a final disposal site instead of site restoration by the Ministry of Energy. The Air-force was represented in the Council of Ministers and its deliberations.

Considering the above situation concerning the Katina site, an alternative plan for final disposal sites has been proposed.

It is most likely that the only option available to SGM is to use the existing disposal sites until construction of the next disposal site which may be either at Katina or Rudinata. It may take time to formulate a positive consensus allowing use of the Katina site for final disposal of solid waste in SGM. In the case of the Rudinata site, time for land acquisition and for obtaining the approval of related authorities and surrounding residents is also necessary.

The extension plan for the existing Suhudol site is incorporated in the master plan which considers early utilization of Katina site. As an alternative plan in case early utilization is not possible, extended use of the Dolny Bogrov site ha s been examined. The Dolny Bogrov site does have some remaining capacity, although it is recommended that further use of the Dolny Bogrov site should be avoided from an environmental view point.

This Annex presents the plan for further use of Dolny Bogrov site with necessary environmental protection measures.

2. Preconditions

(1) Schedule to open next final disposal site.

As more time is necessary for obtaining agreement to use Katina as a final disposal site or for land acquisition of

Rudinata site, it is assumed that utilization of either site will be possible around year 2002. The reasons for this assumption are as follows:

a. The Suhudol extension plan will provide 3 years' capacity for disposal of all solid waste from SGM. This means that the Suhudol extension can be used for a maximum of 7 years if only 40 % of the SGM solid waste is disposed of there.
b. Dolny Bogrov should be closed as soon as possible. Therefore it is difficult to increase its share of the disposal amount in addition to extended use of this site.
c. Considering both a. and b. above, the next disposal site shall be opened when Suhudol site is full, expected in about 2002.

(2) Capacity required

Considering the schedule for opening of the next disposal site (assumed to be around 2002) and the estimated capacity of the Suhudol extension of 2.2 million m3, an additional 3.3 million m3 shall be disposed of at Dolny Bogrov site as shown in Table 1.

To be disposed	Suhudol site (40 %)	Dolny Bogrov site (60 %)
(Accumulation in ton)		
1994 to 2000	1,229,000	1,844,000
to 2001	1,425,000	2,137,000
to 2002	1,622,000	2,533,000
(Accumulation in m3)		
1994 to 2000	1,722,000	2,582,000
to 2001	1,995,000	2,992,000
to 2002	2,270,000	3,406,000

(3) Environmental protection

Costly environmental protection measures are essential if the Dolny Bogrov site is to be used, specially for protection from further pollution of groundwater. However it is noted that these measures will contribute to a reduced future risk of groundwater pollution caused by past and present disposal activity as well. Necessary important measures are as follows:

a. Enclosure of site groundwater
b. Leachate collection and treatment in sewerage system
c. Surrounding green belt and fence
d. Control of solid waste amount and quality
e. Control of landfill work and soil covering

(4) Other conditions

a. Covering soil shall be supplied from outside of the site
b. This site shall be closed when the next site starts operation.

2. Preliminary design

2.1 Enclosure of groundwater

Sealing of groundwater is the key point for avoiding further pollution of groundwater. It is essential to provide a vertical sealing wall to isolate polluted groundwater within the site from groundwater in the Sofia plain, because of the high level of groundwater and difficulty of horizontal sealing. The subsurface at the site comprises alluvia layers of sand, gravel and clay.

Considering the past extent of solid waste disposal, vertical sealing is planned as shown in Figure A-2-1. It is recommended that a special structure for vertical sealing be adopted as shown in Figure A-2-2. The depth of sealing must be designed based on a detailed soil investigation of the site. Data obtained through this study shows the possibility of two clay layers that may be reliable for containment of leachates. One is located at a depth of around 15 meters and another is located at around 30 meters. It has been assumed that the clay layer located at around 15 meters and having a thickness of about 3 meters will be reliable for sealing although this must be checked in the detailed design stage.

2.2 Leachate collection and treatment

Once the site groundwater has been isolated from outside groundwater, the leachate collection system will be the same as for the collection of groundwater. For efficient collection of leachate, it is proposed to install a leachate collection pipe along the vertical sealing wall. Leachate shall be pumped-up and fed into the sewer pipe that will be constructed under the green belt.