

financial soundness of solid waste management performed by the Seoul Municipal Government. Based upon the beneficiary-pays-principle, it is considered that the higher the self-sustaining degree, higher the point. Financial feasibility of the project depends, in large, upon the ability of the collection fee payers or the Government to absorb increased costs which will be incurred by the implementation of the project. The ability of the fee payers, therefore, is estimated first taking into account the possible future changes in population, per capita generation rate and types of buildings. Financial internal rates of return are calculated for the several levels of collection fees.

Then, financial statements are prepared for the purpose of considering the required revenues to cover operation/maintenance costs and debt service and to finance further investments. Calculations are made in current price basis so as to evaluate effects of inflation to debt service. Sensibility analysis is made by varying terms of loan. The work flow of financial analysis for the project is presented in Fig. 10-1-1.

10-1-2 Financial Feasibility

(2) Collection Fees in Future

The future revenues from collecting fee are estimated for Gangdong Gu, in such a manner as described in Subsection 5-5-6. The average fee for solid waste disposal by each category of buildings is assumed to be the same as that in Seoul City. The estimated collection fee and social structure information for the base of calculations are summarized in Tables 10-1-1 and 10-1-2.

The revenues from collection fee in Gangdong Gu will increase from W2,722,300 thousand in 1988 to W4,161,200 thousand in 2005 with an annual growth rate of 2.5 percent. The unit collection fee slightly decreases from W4,280 in 1988 to W4,140 in 2005 due to the future low growth in percentage of apartment houses which pay higher fee than independent houses do.

Fig. 10-1-1 Work Flow for Financial Analysis

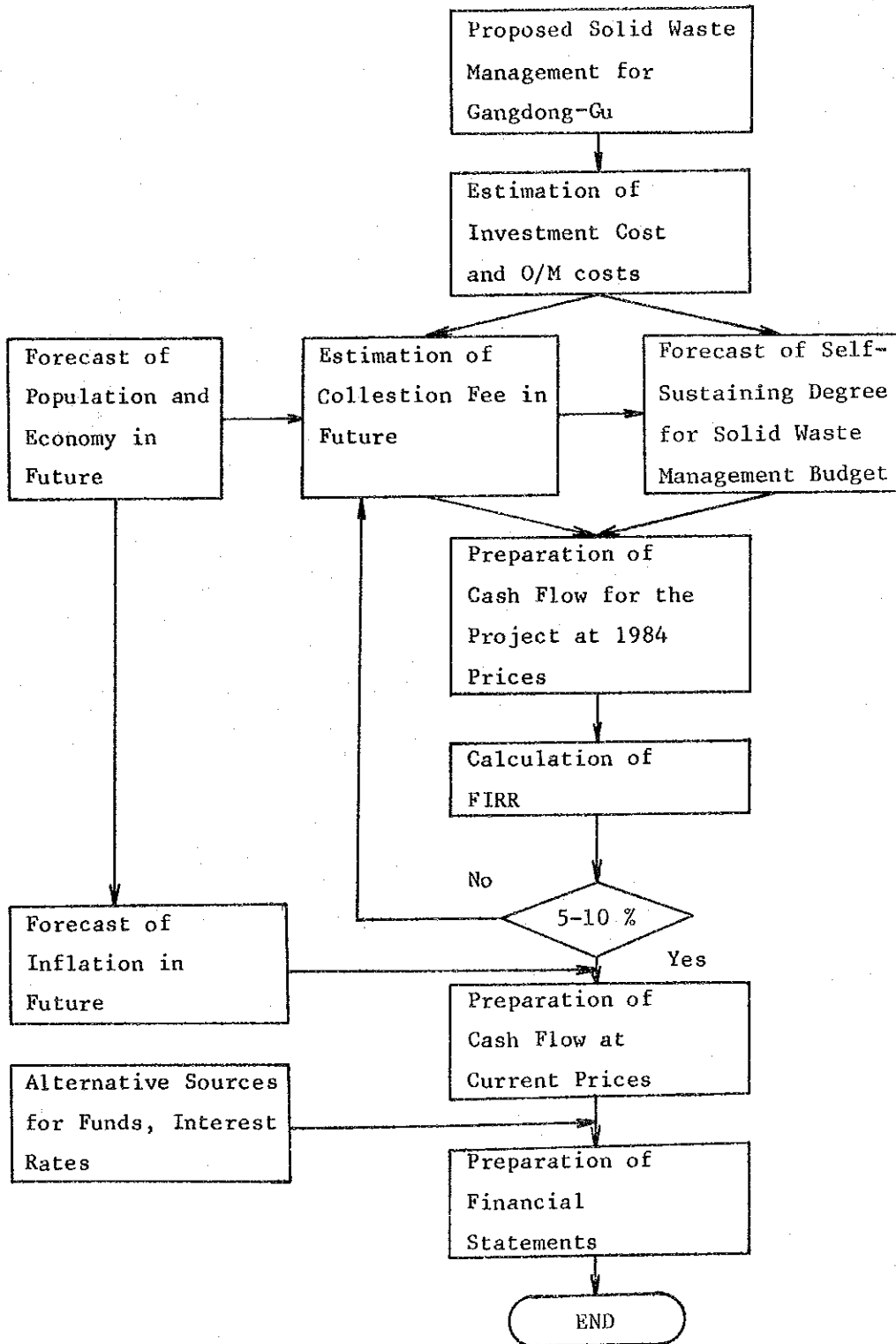


Table 10-1-1 Estimated Collection Fee of Gangdong-Gu

(Unit: million Won)

Category	Unit Fee (W/yr)	1988	1991	1996	2001	2005
Independent House	5,500	635.8	672.1	708.4	744.7	761.8
Apartment	11,100	1,404.2	1,698.3	1,990.2	2,286.6	2,422.0
Commercial	20,400	199.9	228.5	255.0	283.6	295.8
Large Amount Source	4,000	482.4	506.0	576.8	635.6	681.6
Total	-	2,722.3	3,104.9	3,530.4	3,950.5	4,161.2
Unit Collection						
Fee (W/t)	-	4,280	4,280	4,230	4,180	4,140

Table 10-1-2 Social Structure Information of Gangdong-Gu

	1984	1988	1991	1996	2001	2005
Population	727,500	950,000	1,080,000	1,210,000	1,340,000	1,400,000
No. of Independent Houses	104,225	115,600	122,200	128,800	135,400	138,500
No. of Housing Complexes	81,143	126,500	153,000	179,500	206,000	218,200
No. of Commercial Establishments	7,529	9,800	11,200	12,500	13,900	14,500
Generation Rate from Large Amount Sources (t/yr)	108,655	120,600	126,500	144,200	158,900	170,400

In the future, family incomes will increase in accordance with the growth of per capita GNP. KDI forecasts that per capita GNP in Korea will grow by 2.6 times from US\$1,962 in 1983 to US\$5,103 in 2000 in the 1984 constant prices. In this situation, family finance can afford to pay higher collection fee for solid waste disposal suitable to the high standard of living.

(2) Financial Internal Rate of Return (FIRR)

Following standard practice utilized by international lending institutions, financial internal rates of return are calculated for the purpose of evaluating the financial feasibility of the proposed project. The FIRR is computed for several cases by varying the self-sustaining degree of solid waste management as well as the level of collection fee.

In compliance with the proposed implementation schedule of the project in Chapter 9, an annual disbursement schedule is established for the project in Gangdong Gu. The operation and maintenance costs are estimated as presented in Table 10-1-3. Project life is set at 20 years from the start in operation of the incineration plant, taking into account its economic life. The solid waste management is financed by the Seoul Metropolitan Government which collects the fee from the beneficiaries. The cash flows for the alternatives are expressed in the 1984 constant prices. The results of FIRR calculation are summarized in Table 10-1-4.

The rationale of FIRR calculation is outlined as follows. This solid waste management project is not implemented for the purpose of profit-making but for the indispensable needs of the society. This kind of project produces high socio-economic benefits to the society even if its financial return is low compared with that in commercial terms. It is, therefore, financially feasible if the FIRR of each alternative case is higher than the interest rate of financial sources available to the project. In Korea the interest rate on loans for the Government is now 5.0 percent per annum. In addition, bilateral loans are available with interest in the 4.5 to 4.75 percent range.

Table 10-1-3 Operation/Maintenance Cost of Project in Gangdong-Gu

(Unit:Thousand Won)

	Collection			Transportation			Transfer Station		
	Without De- preciation	Depre- ciation	Subtotal	Without De- preciation	Depre- ciation	Subtotal	Without De- preciation	Depre- ciation	Subtotal
1988	1,275,014	241,125	1,516,139	526,842	207,875	734,717	92,657	27,505	120,162
1989	2,550,028	482,250	3,032,278	1,053,683	415,750	1,469,430	185,314	55,010	240,324
1990	2,550,028	482,250	3,032,278	1,053,683	415,750	1,469,433	185,314	55,010	240,324
1991	2,550,028	482,250	3,032,278	1,053,683	415,750	1,469,433	185,314	55,010	240,324
1992	2,550,028	482,250	3,032,278	1,053,683	415,750	1,469,433	185,314	55,010	240,324
1993	2,550,028	482,250	3,032,278	1,053,683	415,750	1,469,433	185,314	55,010	240,324
1994	2,550,028	482,250	3,032,278	1,053,683	415,750	1,469,433	185,314	55,010	240,324
1995	2,550,028	482,250	3,032,278	1,845,196	607,000	2,452,196	185,314	55,010	240,324
1996	2,550,028	482,250	3,032,278	1,845,196	607,000	2,452,196	185,314	55,010	240,324
1997	2,550,028	482,250	3,032,278	1,845,196	607,000	2,452,196	185,314	55,010	240,324
1998	2,550,028	482,250	3,032,278	1,845,196	607,000	2,452,196	185,314	55,010	240,324
1999	2,550,028	482,250	3,032,278	1,845,196	607,000	2,452,196	185,314	55,010	240,324
2000	2,550,028	482,250	3,032,278	1,845,196	607,000	2,452,196	185,314	55,010	240,324
2001	2,550,028	482,250	3,032,278	1,845,196	607,000	2,452,196	185,314	55,010	240,324
2002	2,550,028	482,250	3,032,278	1,845,196	607,000	2,452,196	185,314	55,010	240,324
2003	2,550,028	482,250	3,032,278	1,845,196	607,000	2,452,196	185,314	55,010	240,324
2004	2,550,028	482,250	3,032,278	1,845,196	607,000	2,452,196	185,314	55,010	240,324
2005	2,550,028	482,250	3,032,278	1,845,196	607,000	2,452,196	185,314	55,010	240,324
2006	2,550,028	482,250	3,032,278	1,845,196	607,000	2,452,196	185,314	55,010	240,324
2007	2,550,028	482,250	3,032,278	1,845,196	607,000	2,452,196	185,314	55,010	240,324
2008	1,275,014	241,125	1,516,139	922,598	303,500	1,226,098	92,657	27,505	120,162
	(-1,929,000)			(-2,523,625)			(-248,300)		

	Incineration			Landfill			Total		
	Without De- preciation	Depre- ciation	Subtotal	Without De- preciation	Depre- ciation	Subtotal	Without De- preciation	Depre- ciation	Subtotal
1988	280,179	349,242	629,421	40,493	4,381	44,874	2,215,185	830,128	3,045,313
1989	924,590	1,152,500	2,077,090	86,965	10,774	97,739	4,800,580	2,116,284	6,916,864
1990	924,590	1,152,500	2,077,090	90,990	12,077	103,067	4,804,605	2,117,587	6,922,192
1991	924,590	1,152,500	2,077,090	95,016	13,379	108,395	4,808,631	2,118,889	6,927,520
1992	924,590	1,152,500	2,077,090	95,726	13,734	109,460	4,809,341	2,119,244	6,928,585
1993	924,590	1,152,500	2,077,090	95,726	14,090	109,816	4,809,341	2,119,600	6,928,941
1994	924,590	1,152,500	2,077,090	95,726	14,386	110,112	4,809,341	2,119,896	6,929,237
1995	924,590	1,152,500	2,077,090	272,019	387,796	659,815	5,777,147	2,684,556	8,461,703
1996	924,590	1,152,500	2,077,090	265,927	376,737	642,664	5,771,055	2,673,496	8,444,552
1997	924,590	1,152,500	2,077,090	269,150	382,561	651,711	5,774,278	2,679,321	8,453,599
1998	924,590	1,152,500	2,077,090	273,090	389,737	662,827	5,778,218	2,686,497	8,464,715
1999	924,590	1,152,500	2,077,090	265,927	376,737	642,664	5,771,055	2,673,497	8,444,552
2000	924,590	1,152,500	2,077,090	270,032	383,377	653,409	5,775,160	2,680,137	8,455,297
2001	924,590	1,152,500	2,077,090	274,522	390,135	664,657	5,779,650	2,686,895	8,466,545
2002	924,590	1,152,500	2,077,090	260,554	363,716	624,270	5,765,682	2,660,476	8,426,158
2003	924,590	1,152,500	2,077,090	263,419	367,768	631,187	5,768,547	2,664,528	8,433,075
2004	924,590	1,152,500	2,077,090	268,076	375,114	643,190	5,773,204	2,671,874	8,445,078
2005	924,590	1,152,500	2,077,090	229,942	346,698	576,640	5,735,070	2,643,458	8,378,528
2006	924,590	1,152,500	2,077,090	229,942	346,106	576,048	5,735,070	2,642,866	8,377,936
2007	924,590	1,152,500	2,077,090	229,942	346,106	576,048	5,735,070	2,642,866	8,377,936
2008	462,295	576,250	1,038,545	129,422	342,258	471,680	2,881,986	1,490,638	4,372,624
				(-3,399,905)			(-64,820,720)		

In consideration of this situation, it will be reasonable to adopt 5-percent of FIRR as selection criteria for the project. It means that the project is financially feasible if its FIRR is higher than 5 percent. For reference purpose, calculation is made to consider how much the self-sustaining degree is reduced when FIRR becomes more than 10 percent which corresponds to the interest rates of international lending institutions. The self-sustaining degree is a ratio of the collection fee to the budget of the Seoul Metropolitan Government for the municipal solid waste management as expressed:

$$\text{Self-sustaining Degree} = \frac{\text{Collection Fee}}{\text{Budget for Solid Waste Management}}$$

As the interest rate which corresponds to FIRR is included in the budget, the self-sustaining degree increases when FIRR decreases.

The FIRR was calculated for 6 alternative cases (Table 10-1-4). Case 1 to Case 3 are for that collection fee is fixed at the present level by varying the self-sustaining degree from 27 to 34 percent. At the Present level of collection fee, the project will be financially feasible when the self-sustaining degree is 34 percent. Case 4 to 7 are for raising the present level of collection fee. If the collection fee is raised by 30 percent, the self-sustaining degree rises to more than 40 percent. In order to get more than 10-percent FIRR, the self-sustaining degree drops to 35 percent.

Table 10-1-4 FIRR for Short Term Project in Gangdong Gu

Case	Collection Fee	Self-Sustaining Degree (%)	FIRR (%)
1	At present level	30	8.0
2	do.	34	5.1
3	do.	27	10.8
4	30% up	35	10.9
5	do.	45	4.7
6	1988-1995 30% up	45	6.2
7	1996-2008 50% up	45	6.2

10-1-3 Financial Condition

(1) Price Escalation

Financial statements from 1986 to 1995 are constructed for the purpose of evaluating the actual flows of money and burden of debt service. In order to make calculations in terms of the current prices, inflation in the future was estimated on the basis of the past trend.

The co-existence of high economic growth rates and high inflation rates was one of the characteristics of the Korean economy. The wholesale price index was boosted at 16.0 percent per annum from 1962 till 1981. In the 1970's, the wholesale price skyrocketed by around 40 percent twice in 1974 and 1980 over the previous year which coincided with the first and second oil crises as shown in Table 10-1-5. The outlooking economic policy raised the ratio of foreign trade to national income in the Korean economy, therefore, the price level has tendency to be influenced strongly by import prices.

Table 10-1-5 High Inflation and Wage Rates

(Unit: %)

Year	Wholesale Price	Consumer Price	Wage	Nominal GNP
1971	8.6	13.5	16.0	23.4
1972	13.8	11.5	13.5	23.1
1973	6.9	3.2	17.6	29.5
1974	42.1	24.5	35.6	39.5
1975	26.5	25.2	26.8	34.5
1976	12.2	15.3	33.2	37.5
1977	9.0	10.2	33.2	30.5
1978	11.6	14.5	34.0	33.7
1979	18.8	18.3	28.5	29.0
1980	38.9	28.7	22.9	19.1
1981	20.4	21.3	20.2	23.0
1982	4.7	7.3	14.6	13.1
1983	0.2	3.4	11.9	12.5

Source : Economic Statistics Yearbook, The Bank of Korea

In 1982, however, wholesale and consumer prices were surprisingly stabilized to 4.7 percent increase against 20.4 percent up in a year before and to 7.3 percent increase against 21.3 percent up, respectively. This was partly due to the stabilization of import prices such as petroleum and industrial products. In 1983, wholesale and consumer prices presented a stabler increase of 0.2 percent and 3.4 percent, respectively, compared with those in 1982. This was again attributed to stable prices for oil and other commodities.

Taking into account the tendency in these years, the rate of inflation both for local and foreign currency portions is projected to be 4.0 percent in the near future. The annual disbursement for the project in Gangdong Gu was escalated with this rate of inflation as presented in Table 10-1-6.

Table 10-1-6 Annual Disbursement of Current Prices
(Unit: million Won)

Year	Gangdong-Gu	
	Investment Cost	Direct Operation Cost
1986	3,105	-
1987	10,690	-
1988	27,567	2,592
1989	100	5,841
1990	70	6,080
1991	72	6,328
1992	36	6,581
1993	454	6,845
1994	10,505	7,118
1995	5,939	8,893

(2) Financial Plan

a. Revenue Projections

Revenues for the project comprise collection fees from beneficiaries and the budget of the Seoul Metropolitan Government for solid waste management. The unit collection fee was assumed as 30 percent higher than the present level estimated in Subsection 10-1-2.

Other revenues from the government budget, special taxes or selling of scrapped equipment are expected to cover the deficit of net operating income due to the insufficient level of collection fee.

b. Expenses

Direct operating expenses are based on the estimates presented in Subsection 10-1-2 and escalated for inflation. Depreciation is based on the economic life of major equipment and facilities.

c. Capital Investments

Capital investments of the project will be financed by the subsidies from the Seoul Metropolitan Government and the Central Government as well as loans from foreign aid programs. The foreign aid loans are assumed to be available for the foreign currency portion of the total capital requirements for the construction period from 1986 to 1988.

Two cases were considered for the foreign aid loans taking into account the terms of loan agreement in the case of bilateral aid programs and international lending institutions. The terms of these two cases are outlined below:

	<u>Case A</u>	<u>Case B</u>
Interest	5.0 %	9.3 %
Grace Period	7 years	3 years
Principal Repayment Period	25 years	15 years

d. Assets

In order to estimate assets for the project, the level of inventories was projected to be 10 percent of the direct operating expenses. Account receivable was also projected to be 12 percent of the revenues.

e. Liabilities

Account payable in the current category are assumed to be 20 percent of the direct operating expenses. Long term debt is based on the terms of repayment for foreign aid loans outlined in Item c. of this section.

(3) Financial Statements

Based on the conditions and assumptions described in Item (2) of this section, income statements, fund statements and balance sheets were prepared for Gangdong Gu. The results are as shown in Tables 10-1-7 and 10-1-8.

The projected income statements show that in the case of Loan "Case B" other revenues mainly from the Government budget shall be 14.5 percent higher than those in the case of Loan "Case A" in 1990 in order to cover the deficit of net income. Debt service ratios were calculated for both cases as shown below:

<u>Loan "Case A"</u>	
<u>Year</u>	<u>Debt Service Ratio (%)</u>
1990	9.0
1993	8.1
1995	6.5

<u>Loan "Case B"</u>	
<u>Year</u>	<u>Debt Service Ratio (%)</u>
1990	15.6
1993	25.7
1995	18.6

The debt service ratio for Loan "Case A" decreases from 9.0 percent in 1990 to 6.5 percent in 1995, while that for Loan "Case B" reaches 25.7 percent in 1993 which is rather high. There may be no significant burden of debt service for Loan "Case A". For Loan "Case B", however, the burden of debt service will be heavy around 1993. On the other hand, in both cases, current assets exceed current liabilities by wide margins, which shows the financial soundness.

In conclusion, Loan "Case A" is to be preferred due to the lower burden of debt service. However, even with Loan "Case B" the project is still financially feasible.

Table 10-1-7 Financial Statements for Loan "Case A"

(Unit: million W)

INCOME STATEMENT										
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1. Operating Statistics										
1.1 Quantity of Waste Collected (1000t)	-	-	265	634	634	634	634	634	634	634
1.2 Unit Fee (W/t)	-	-	6510	6770	7040	7320	7600	7880	8180	8490
2. Revenues										
2.1 Collecting Fee	-	-	1725	4292	4463	4641	4818	4996	5186	5383
2.2 Other Revenues	-	-	2030	5000	5175	5350	5565	5740	5950	6155
2.3 Total Revenues	-	-	3755	9292	9638	9991	10383	10736	11136	11808
3. Expenses										
3.1 Direct Operating Expenses	-	-	2592	5841	6080	6328	6581	6845	7118	8893
4. Income before Depreciation & Interest	-	-	1163	3451	3558	3663	3802	3891	4018	5005
4.1 Depreciation	-	-	971	2574	2680	2788	2900	3017	3138	4133
5. Income before Interest	-	-	192	877	878	875	902	874	880	872
5.1 Interest	-	27	182	872	872	872	872	872	872	871
6. Net Operating Income	-	-27	10	5	6	3	30	2	8	1
7. Net Income Cumulative	-	-27	-17	-12	-6	-3	27	29	37	38
FUNDS STATEMENT										
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
8. Sources										
8.1 Income before Depreciation and Interest	-	-	1163	3451	3558	3663	3802	3891	4018	5005
8.2 Long Term Debt	532	3101	13816	-	-	-	-	-	-	-
8.3 Government Subsidy	2573	7589	13751	100	70	72	36	454	10505	5939
8.4 Increase in A/C Payable	-	-	518	658	48	50	50	53	55	355
8.5 Total Sources	3105	10690	29248	4201	3676	3785	3888	4398	14578	11290
9. Applications										
9.1 Capital Investment	3105	10690	27567	100	70	72	36	454	10505	5939
9.2 Loan Repayment	-	-	-	-	-	-	-	-	-	30
9.3 Interest	-	27	182	872	872	872	872	872	872	871
9.4 Increase in A/C Receivable	-	-	207	308	21	21	21	22	22	24
9.5 Increase in Inventory	-	-	259	325	24	25	25	27	27	177
9.6 Total Applications	3105	10717	28215	1605	987	990	954	1375	11426	7041
10. Increase in Cash	-	-27	1033	2596	2689	2795	2934	3023	3152	4258
11. Cash Cumulative	-	-27	1006	3602	6291	9086	12020	15043	18195	22453
BALANCE SHEET										
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
12. Assets										
12.1 Current										
12.1.1 Cash	-	-27	1006	3602	6291	9086	12020	15043	18195	22453
12.1.2 A/C Receivable	-	-	207	515	536	557	578	600	632	646
12.1.3 Inventory	-	-	259	584	608	633	658	685	712	869
12.1.4 Total Current Assets	-	-27	1472	4701	7435	10276	13256	16328	19529	23988
12.2 Fixed										
12.2.1 Fixed Assets in Service	-	-	41362	41462	41532	41604	41640	42094	52599	58538
12.2.2 Less Accua. Depr.	-	-	971	3545	6225	9013	11913	14930	18068	22201
12.2.3 Net Value of Fixed Assets in Service	-	-	40391	37917	35307	32591	29727	27164	34531	36337
12.2.4 Work-in-Progress	3105	13795	-	-	-	-	-	-	-	-
12.2.5 Total Fixed Assets	3105	13795	40391	37917	35307	32591	29727	27164	34531	36337
12.3 Total Assets	3105	13768	41863	42618	42742	42867	42983	43492	54060	60325
13. Liabilities & Equity										
13.1 Liabilities										
13.1.1 Current										
13.1.1.1 A/C Payable	-	-	518	1168	1216	1266	1316	1369	1424	1779
13.1.1.2 Long Term Debt Due in One Year	-	-	-	-	-	-	-	-	30	202
13.1.1.3 Total Current Liabilities	-	-	518	1168	1216	1266	1318	1369	1454	1981
13.1.2 Long Term Debt (other than amt. due in one year)	532	3833	17449	17449	17449	17449	17449	17449	17419	17217
13.1.3 Total Liabilities	532	3833	17967	18617	18665	18715	18765	18818	18873	19198
13.2 Equity										
13.2.1 Government Equity	2573	10162	23913	24013	24083	24155	24191	24645	35150	41089
13.2.2 Retained Earnings	-	-27	-17	-12	-6	-3	27	29	37	38
13.2.3 Total Equity	2573	10135	23896	24001	24077	24152	24218	24674	35187	41127
13.3 Total Liabilities & Equity	3105	13768	41863	42618	42742	42867	42983	43492	54060	60325

Table 10-1-8 Financial Statements for Loan "Case B"

(Unit: million W)

INCOME STATEMENT										
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1. Operating Statistics										
1.1 Quantity of Waste Collected (1000t)	-	-	265	634	634	634	634	634	634	634
1.2 Unit Fee (W/t)	-	-	6510	6770	7040	7320	7600	7880	8180	8490
2. Revenues										
2.1 Collecting Fee	-	-	1725	4292	4463	4641	4818	4996	5186	5383
2.2 Other Revenues	-	-	2180	5750	5925	6100	6255	6330	6395	6835
2.3 Total Revenues	-	-	3905	10042	10388	10741	11073	11326	11581	14216
3. Expenses										
3.1 Direct Operating Expenses	-	-	2592	5841	6080	6328	6581	6845	7118	8093
4. Income before Depreciation & Interest										
4.1 Depreciation	-	-	971	2574	2680	2768	2900	3017	3138	4133
5. Income before Interest										
5.1 Interest	-	49	338	1623	1623	1619	1590	1455	1320	1185
6. Net Operating Income										
6. Net Operating Income	-	-49	4	4	5	6	2	9	5	7
7. Net Income Cumulative										
7. Net Income Cumulative	-	-49	-45	-41	-36	-30	-28	-19	-14	-7
FUNDS STATEMENT										
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
8. Sources										
8.1 Income before Depreciation and Interest	-	-	1313	4201	4308	4413	4492	4481	4463	5325
8.2 Long Term Debt	532	3101	13816	-	-	-	-	-	-	-
8.3 Government Subsidy	2573	7589	13751	100	70	72	36	454	10505	5939
8.4 Increase in A/C Payable	-	-	518	650	48	50	50	53	55	355
8.5 Total Sources	3105	10690	29388	4951	4426	4535	4578	4988	15023	11619
9. Applications										
9.1 Capital Investment	3105	10690	27567	100	70	72	36	454	10505	5939
9.2 Loan Repayment	-	-	-	-	-	44	303	1454	1454	1454
9.3 Interest	-	49	338	1623	1623	1619	1590	1455	1320	1185
9.4 Increase in A/C Receivable	-	-	207	308	21	21	21	22	22	24
9.5 Increase in Inventory	-	-	259	325	24	25	25	27	27	177
9.6 Total Applications	3105	10739	28371	2356	1738	1781	1975	3412	13328	8779
10. Increase in Cash										
10. Increase in Cash	-	-49	1027	2595	2688	2754	2603	1576	1695	2840
11. Cash Cumulative										
11. Cash Cumulative	-	-49	978	3573	6261	9015	11618	13194	14889	17729
BALANCE SHEET										
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
12. Assets										
12.1 Current										
12.1.1 Cash	-	-49	978	3573	6261	9015	11618	13194	14889	17729
12.1.2 A/C Receivable	-	-	207	515	536	557	578	600	622	646
12.1.3 Inventory	-	-	259	584	608	633	658	685	712	889
12.1.4 Total Current Assets	-	-49	1444	4672	7405	10205	12854	14479	16223	19264
12.2 Fixed										
12.2.1 Fixed Assets in Service	-	-	41362	41362	41532	41604	41640	42094	52599	56538
12.2.2 Less Accum. Depr.	-	-	871	3545	6225	9013	11913	14930	18068	22201
12.2.3 Net Value of Fixed Assets in Service	-	-	40391	37817	35307	32591	29727	27164	34531	36337
12.2.4 Work-In-Progress	3105	13795	-	-	-	-	-	-	-	-
12.2.5 Total Fixed Assets	3105	13795	40391	37817	35307	32591	29727	27164	34531	36337
12.3 Total Assets										
12.3 Total Assets	3105	13746	41835	42489	42712	42796	42581	41643	50754	55601
13. Liabilities & Equity										
13.1 Liabilities										
13.1.1 Current										
13.1.1.1 A/C Payable	-	-	518	1168	1216	1266	1316	1369	1424	1779
13.1.1.2 Long Term Debt Due in One Year	-	-	-	-	44	303	1454	1454	1454	1454
13.1.1.3 Total Current Liabilities	-	-	518	1168	1260	1569	2770	2823	2878	3233
13.1.2 Long Term Debt (other than amt. due in one year)	532	3633	17449	17449	17405	17102	15648	14194	12740	11286
13.1.3 Total Liabilities	532	3633	17967	18617	18665	18671	18418	17017	15618	14519
13.2 Equity										
13.2.1 Government Equity	2573	10162	23913	24013	24083	24155	24191	24645	35150	41089
13.2.2 Retained Earnings	-	-49	-45	-41	-36	-30	-28	-19	-14	-7
13.2.3 Total Equity	2573	10113	23868	23972	24047	24125	24163	24626	35136	41082
13.3 Total Liabilities & Equity										
13.3 Total Liabilities & Equity	3105	13746	41835	42589	42712	42796	42581	41643	50754	55601

10-2 Social and Other Impact Evaluation

10-2-1 General

Solid waste management is inevitable for a sound development of an effective society. But it has been given low priority after the development of industry and commerce in city planning. This is partially due to the fact that the solid waste management existed when society appeared and functioned as was necessary.

Establishment of a waste management system which is sound and effective from social, economic, sanitary and environmental viewpoints is very important for city management as long as it exists and produces waste.

The social impact on Seoul and Gandong Gu due to the Project is evaluated to identify necessity and propriety of the proposed solid waste management system.

10-2-2 Concept of Project

Project evaluation should be made from two aspects.

- If the objective of the Project is reasonable, and
- If the implementation plan fits the objective, and is the most effective.

The basic concepts of the Project are the same as those of the Master Plan, which aim to ensure the effective and sanitary management of waste from generation to final disposal. It should meet the following needs:

- Need to reduce the disposal volume of waste due to lack of landfill sites in Seoul,
- Need to establish a new collection/transportation system for cost saving, and improved working conditions and environmental sanitation,

- Need for effective use of waste, and
- Need for environmental conservation regarding solid waste management.

The Project comprises:

- Introduction of an intermediate processing system which attains high rate of volume reduction: Incineration plant
- Introduction of an effective and sanitary collection/ transportation system: Vehicle collection and transfer station
- Introduction of a recycling system: Material recovery facilities
- Introduction of environmental conservation measures through the waste management system

The Project is evaluated by considering these concepts.

10-2-3 Social and Other Impact Evaluation

The result of financial evaluation made in Section 10-1 shows that the Project is feasible from viewpoints of financial scale and self-sustaining degree in Seoul City. In addition, the need of the Project, its contribution to society, and environmental impact should be checked. The project should meet the citizens' financial burden because it is not a profit oriented project like a water supply and sewerage scheme.

(1) Incineration Plant

The effect of volume reduction by the proposed incineration plant is not large when compared to the total waste volume of Seoul. However, it is highly needed for training of workers, obtaining data and technology improvement as the first step of the Master Plan.

The main impacts due to the plant are:

- Contribution to the local community by district heating
- Improvement of roads around the plant
- Lower values of adjacent land
- Air pollution by emission gas if the proper measures are not provided

Although the cost needed for construction and operation of the plant is not small, the Project should be implemented as soon as possible, because land acquisition is becoming more difficult in Seoul.

Incineration of all the combustible waste should be set as a target as it is the most effective method of volume reduction. The devices to prevent air pollution by emission gas and the wastewater treatment facilities should be provided.

(2) Collection and Transportation

Effectiveness of solid waste management depends on establishment of effective collection and transportation system. The Project consists of;

- Introduction of separate collection for incineration and recycling, and
- Adoption of vehicle collection for improvement of effectiveness and sanitary environment.

Advantage and disadvantage of the Project are shown in Table 10-2-1.

Table 10-2-1 Advantage and Disadvantage of Project

	Advantage	Disadvantage
Separate Collection	<ul style="list-style-type: none"> . Fitness for incineration and material recovery 	<ul style="list-style-type: none"> . High cooperation of citizens is required
Vehicle Collection	<ul style="list-style-type: none"> . High collection efficiency . Decrease in traffic accidents to workers . Sanitary collection . Improvement of working conditions . Saving the operation cost . Improving the status of workers 	<ul style="list-style-type: none"> . Concentration of vehicles . High truck purchase cost

As shown in Table 4-2-18, cost of the proposed system does not differ a lot from the existing system. As the share of personnel expenses in the existing system is high, the proposed system is expected to be more economic in the future as the personnel expenses would rise rapidly.

In order to assure the safe and smooth movement of the waste collection vehicles, a supplementary turning lane should be provided at the plant entrance.

(3) Material Recovery

Material recovery is an excellent method of intermediate processing, because it has the following advantages:

- It enables effective use of resources
- It reduces the disposal volume of waste

Besides these advantages, the material recovery system would promote enhancement of recognition about limited amount of natural resources. Thus, it works to spread consideration of resource saving, and consequently reduces the generation of waste.

10-3 Comprehensive Evaluation

A Project should be evaluated not only from local viewpoint, but from regional or national viewpoint. Evaluation of the proposed project should be made regarding its effect and impact in the project area, Gandong Gu, and also around the landfill site.

Considering the results of financial, social and other impact evaluations, comprehensive valuation of the Project is made here compared with the existing system as shown in Table 10-3-1.

Table 10-3-1 Comprehensive Evaluation of the Project

Criteria	Existing System	Proposed System
Volume Reduction	x	o
Collection Efficiency	x	o
Working Conditions	x	o
Recycle	Δ	o
Environmental Conservation	x	o

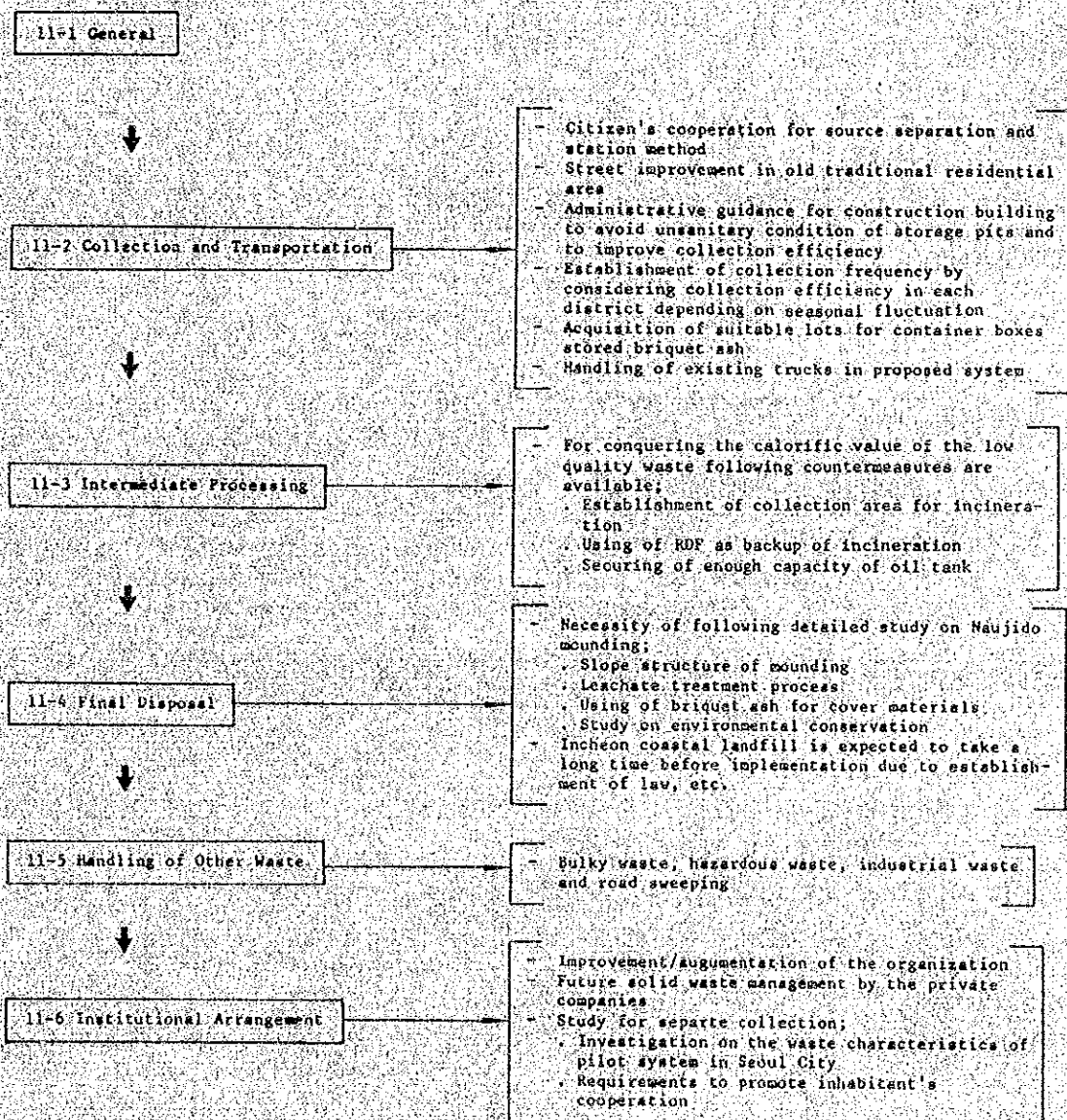
Legend: o = Superior, Δ = Acceptable, x = Inferior

The proposed project conforms to the objective of this study and is evaluated as reasonable. The Project is recommended to be implemented as soon as possible since the Study revealed that this system is most effective and meets the financial and environmental requirements.

PART IV CONCLUSION AND RECOMMENDATIONS

PART IV CONCLUSION AND RECOMMENDATIONS:

: (1) Chap. 11 CONCLUSION AND RECOMMENDATIONS



CHAPTER 11

CONCLUSION AND RECOMMENDATIONS

CHAPTER 11 CONCLUSION AND RECOMMENDATIONS

11-1 General

Through this study, various problems were identified on the existing solid waste management system in Seoul. Several alternatives for the master plan were established considering the measures for these problems. Each alternative was evaluated and the optimum master plan was selected. The feasibility study was made for Gangdong Gu as the first step of the master plan. The results of this study are as follows.

11-2 Collection and Transportation

11-2-1 Master Plan

Three component separation of combustibles, non-combustibles, briquet ash is required for incineration, material recovery and preparing covering material for landfill.

Hand cart collection system should be changed to vehicle collection system in whole Seoul by 1995 to improve collection efficiency, sanitary conservation, working hours and worker's status.

Transfer stations are recommended for the effective transportation of waste to the disposal site.

To establish the proposed collection and transportation system, several subjects should be considered as follows.

(1) Citizens' Cooperation

Citizens' cooperation is strongly required for the establishment of source separation and improved onsite storage methods, especially the station method of storage for apartment houses. In order to obtain citizens' cooperation, long and continuous guidance is needed.

For this purpose, public relations activities such as distribution of pamphlets should be fully utilized.

(2) Street Improvement in Old Traditional Residential Areas

Many narrow paths and alleys of about 2.0m width are found in old traditional residential areas, which is probably the reason why the hand cart collection system is effectively adapted and the car collection system has fallen behind.

The width of an alley is often too narrow to let waste collection hand carts in and sometimes an alley is nothing but a foot path, although there are many residences along it requiring waste collection services. Under such circumstances, effective waste collection is out of the question.

According to the new building code (1972), all houses should face roads of more than 4.0m width. Hence, the new towns which have been built in the last 10 years are considered to be good residential areas. It is therefore, recommended that the renovation of some old traditional residential areas be undertaken as soon as possible.

(3) Administrative Guidance for Construction of Buildings

Many large buildings, apartments and offices are equipped with dust chutes, which are used as solid waste storage pits. The waste storage rooms are generally located below the ground level without consideration of collection. Therefore, the storage area becomes more unsanitary due to leachate formation propelled by rain water and odor generation and furthermore storage rooms become nesting places for rats and insects. The collection workers have to transfer these wastes from its small outlet into baskets and convey them to hand carts and collection trucks; hence the operation efficiency is very low.

Whenever construction of new apartments or housing estates is planned, establishment of a new legal system needs to be implemented so it will be required to submit a storage structure plan to the concerned authority who must examine the documents for approval. The approval should be regarded as one of the indispensable conditions prior to engaging in construction. Seoul City Authorities prepared their solid waste collection program according to the plan submitted. Modernized solid waste storage systems for multi-story apartment house or office buildings, such as the container room system and rotary drum system are shown in Fig. 11-2-1.

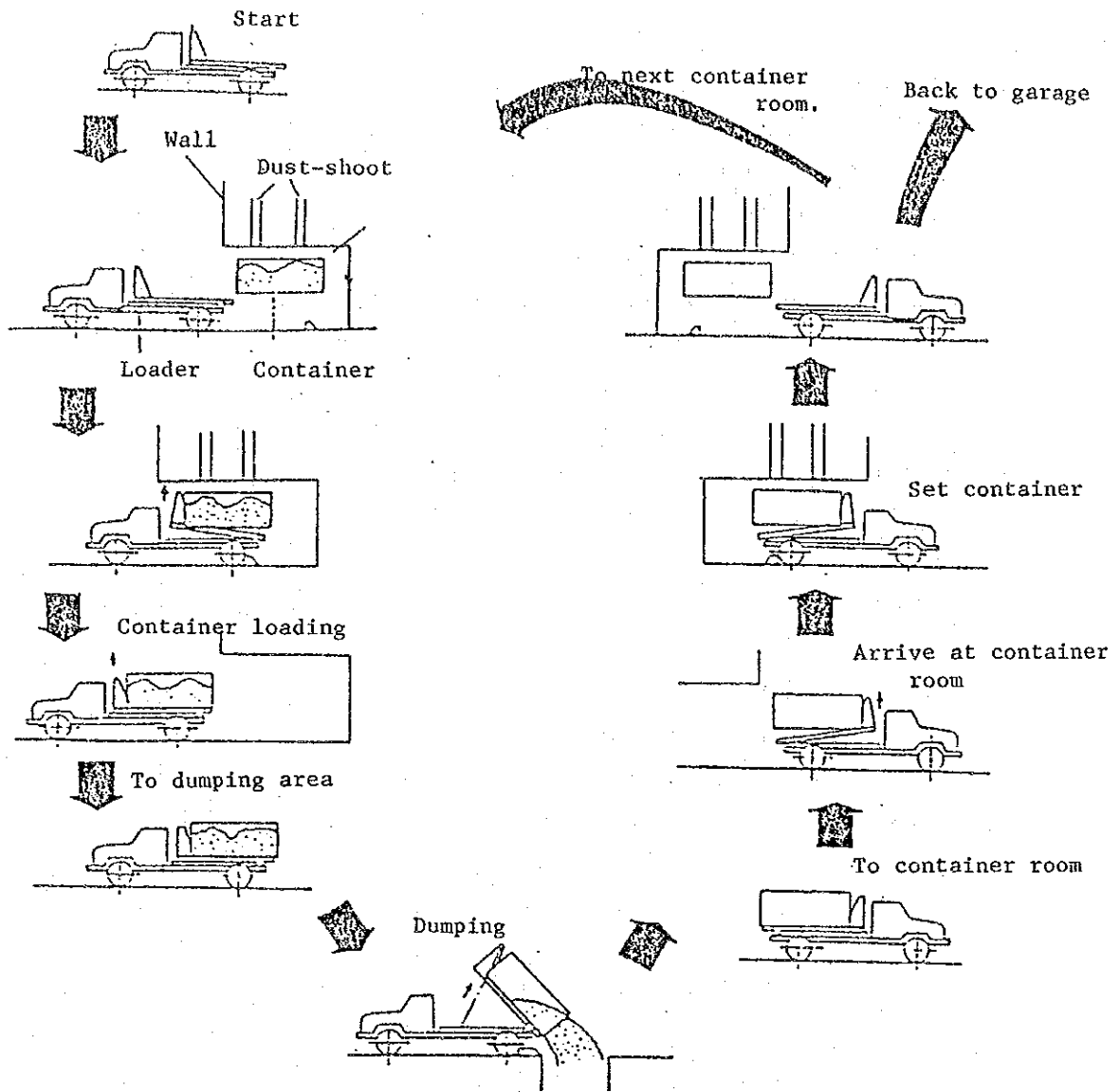
11-2-2 Feasibility Study

Improved collection and transportation system will be established in whole Gangdong-Gu in 1988. Transfer station with its capacity of 1,150 t/day, is proposed to be constructed at the east end of Gangnam-Gu where an incinerator is also provided.

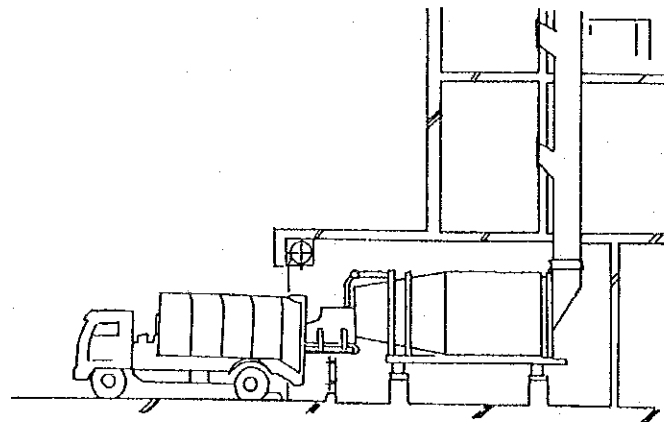
Compactor trucks collect combustible waste and dump trucks collect briquet ash and non-combustible waste.

Container trucks are used for transportation from transfer station and incinerator to disposal site. Two tons and four tons of trucks are used for collection in accordance to road width in collection site. Gangdong-Gu is proposed to be divided into 7 zones for the purpose of the uniformity of daily collection amount of waste and daily working hours in relation to collection frequency in each zone.

To establish the proposed collection and transportation system, following subjects should be considered.



Container Room System



Rotary Drum System

Fig. 11-2-1 Modernized Solid Waste Storage Systems for Apartment or Building.

(1) Collection Frequency

Seasonal fluctuation of waste is very large, especially that of briquet ash. Fluctuation ratio of briquet ash is 0.5 in August compared to annual average and 1.5 in December. Actual collection frequency should be determined by considering balance of the waste amount to be sorted in houses and collection efficiency in each district depending on seasons.

(2) Lots for Container Boxes

Briquet ash is recommended to be stored in container boxes. Container boxes are set along the street. Thus, it is necessary to acquire suitable lots for setting container boxes.

(3) Handling of Existing Trucks

There are 25 vehicles with capacities of 4 to 8.5 tons used in Gandong-Gu in 1984. These vehicles should be utilized in new system. The dump trucks are used for collection and the container trucks are used for transportation.

11-3 Intermediate Processing

11-3-1 Master Plan

Construction of 13 units of incineration plants are proposed in master plan where one unit is 600 t/d. The amount of incinerated waste would amount to 2,574 thousand tons in 2005, which is 48% of estimated combustible waste. Material recovery plants are also proposed in the plan. Daily processing rate will be 300 ton in 2005, which means 99 thousand tons are treated annually by the plants. With the operation of the intermediate processing plants, 2,060,000 m³/year of landfill volume will be reduced in 2005.

11-3-2 Feasibility Study

Construction of 600 ton/day incineration plant was proposed. The plant is expected to be in operation in autumn 1988. In 1988, 100 days of operation is planned and 330 days after 1989. The reduction of landfill volume by this plant will amount to 157,000 m³/year.

Project area for feasibility study is Gangdong Gu. Lower heating value of low quality waste was estimated as 840 kcal/kg in 1988 on the condition of three component separation. However, some of the data in basic field surveys show low heating value. In order to conquer this problem, following countermeasures are available.

- Establish collection area for incineration (Subsection 7-3-1).
- Use RDF as backup of incineration when heating value is lowest.
- Secure enough capacity of oil tank preparing for warming-up and backup of incineration.

The location of the intermediate processing plant is at the east end of Gangnam Gu. On the west of the plant, there is Tanchon sewage treatment plant. In combination with this plant, following advantages would be available.

- Waste water treatment will be simplified if effluent of incineration plant can be treated in sewage treatment plant.
- Power or heat recovered in the incineration plant can be used in the sewage treatment plant.

Cooperations shown above would be a good approach to closed system.

In the master plan, material recovery is planned to be implemented from 1995. In feasibility study, only the site for material recovery plant is secured between incineration plant and transfer station. However, the construction period is not decided. As separate collection will be carried out prior to the operation of incinerator, it would be easy to implement material recovery in Gangdong Gu. If the financial conditions are favorable, the material recovery plant can be constructed before the schedule of the master plan.

11-4 Final Disposal

Final disposal for this project is proposed as Nanjido mounding, Incheon coastal landfilling and use of subsidiary landfills. Subsidiary landfills are significant if sufficient area can be secured within reasonable distances, and if administrative settlements can be made in the case of sites out of the administrative boundaries.

(1) Nanjido Mounding

As is already discussed in previous Subsection 4-4-3, the existing plan studied by Seoul City University seems to need detail study regarding the following items.

1) Slope Structure of Mounding

Briquet ash should be used for slope structure and the other disposal refuse should be filled inside landfill to prevent the mounding from rotational slip.

2) Leachate Treatment Process

The treatment process proposed by Seoul City University consists of aerated lagoon and high rate chemical sedimentation tank. Considering environmental preservation and investment effect, it is recommended to install rapid sand filter and activated carbon adsorption column in addition to the proposed process.

(2) Incheon Coastal Landfill

The expected landfill site next to Nanjido is Incheon coastal area which was studied by O.O.E. However, it is expected to take a long time before implementation of the plan due to such tasks as establishment of law, comprehensive organization, standard of receiving refuse and etc. from Japanese experience. Therefore, efforts of rapid preparation against tasks mentioned above are required.

(3) Other Aspects

1) Recovery of Methane Gas

One consideration of value for landfills is the recovery of methane generated inside the fill. Simple gasifiers constructed by installing pipes into the fill can give a supply of methane gas to be used as energy. In fact, presently at Nanjido, a crude form of this recovery is already being carried out by the residents of the Nanjido landfill site. However, a well planned system is advised in order to avoid dangerous explosions and fires.

2) Land Reuse

Another aspect to consider is the after-use of completed landfill sites. When a fill is completed and sufficient subsidence is accounted for, the site can be reclaimed as land for such uses as golf courses, tennis courts, baseball diamonds and other recreational facilities as well as parking lots, school grounds, parks and botanical gardens. However, residential, factory and similar structural uses should be avoided due to unexpected subsidences and possible gas explosions and other factors.

3) Environmental Conservation

As a measure to prevent environmental deterioration, a system to monitor conditions at the landfill is highly advisable. Possible disruptions are, among others, contamination of water resources, generation of odor, emission of harmful gases which can cause fire and explosions, and concentration of hazardous materials. The monitoring system should be operated continuously on a 24-hour basis to detect any abnormally high levels of pollutants and harmful substances at any time so that quick response can be made.

11-5 Handling of Other Wastes

11-5-1 Waste Covered in Study

The present JICA Study covers municipal solid waste of Seoul City which consists of domestic and commercial waste. The components of this waste are combustibles such as paper, plastics, textile and wood, and non-combustibles such as metals, glass, ceramics and briquet ash. However, other wastes are also observed and these will require consideration in the near future when a comprehensive solid waste management system is required for planning. Suggestions only on wastes relevant to Seoul City administration are given here.

11-5-2 Bulky Waste

Bulky waste is in the same category as domestic and commercial waste, but consists of large sized materials which cannot be stored inside the usual on-site storage methods, and which cause difficulties for collection. An example of bulky waste classification is listed below.

Furniture	:	Closet, table, desk, sofa, bed, chair, etc.
Appliance	:	Refrigerator, television, washing machine, sewing machine, stereo components, etc.
Playstuff	:	Bicycle, tricycle, over-sized toys, athletic apparatus, etc.
House Remodeling Debris	:	Door, roofing material, lumber, toilet bowl, sink, pipe, etc.

Little data is shown about bulky waste generation. Data accumulation is necessary to forecast the bulky waste generation rate. However, relatively small percentage of bulky waste is already mixed in the municipal waste of Seoul and this percentage is foreseen to rise very soon and will probably create collection problems. A recommended procedure to counter this situatio is as follows.

1. Generator are requested to limit their ordinary waste to a certain size, whereby large materials must be broken down into the required size.
2. Bulky waste which cannot be broken down by the generators will be collected at intervals of, for example, six months, by appropriate collection methods. If a generator requires emergency service, he can call the cleansing office in his jurisdiction and have the waste picked up at extra cost.
3. The collected waste is brought to a into manageable size and are appropriately processed in the same manner as ordinary waste.

11-5-3 Hazardous Waste

Hazardous materials in the waste are dry cell batteries, fluorescent lamps and thermometers. Presently, these materials are generated in small quantities that problems do not arise. However, when the amount increases and these are filled to landfill sites, the hazardous substances can concentrate to high levels to pollute the soil with resultant contamination of water resources and other environmental disruption. This can cause problems on public health. One method to avoid this situation is to request generators to separate the hazardous materials and these should be collected separately for special processing.

11-5-4 Industrial Waste

Industrial waste is generated as the consequence of industrial activities. Waste from these activities include the following.

Ash	Animal and plant residues
Sludge	Waste rubber
Waste oil	Scrap metals
Waste acid	Waste glass and ceramics
Waste alkali	Slag

Waste plastics	Construction debris
Waste paper	Animal excreta
Waste wood	Animal carcass
Waste textile	Dust

Presently in Seoul, industrialists dispose of their waste for themselves through contracts with private collection companies. These are sometimes illegally dumped at the Nanjido landfill site through back entrances. Therefore, stricter regulations pertaining to illegal dumping or provisions for handling of industrial waste are definitely necessary. An advantage of processing industrial waste is that recycling of certain materials is easier than that of household waste or commercial waste due to the fact that a large quantity of related material is generated. Therefore, planning on recovery may prove to be feasible.

11-5-5 Road Sweeping

At the present, 12 road-sweeping cars and 2,477 road-sweeping personnels clean the streets covering a length of 1,110 km (width is over 12 m). Only the main streets are cleansed mechanically. However, other streets are cleaned by road sweeping men whose duty length is approximately 450 m per day per person in densely populated areas. The road sweepers clean streets, drainage inlets, and sidewalks, and also collect waste from shopping malls. Manual cleansing of streets had better to be substituted by a mechanical type from the standpoint of the dangers involved in the work such as traffic accidents. However, hiring for manual cleansing is often a countermeasure of unemployment in other countries. It has significant meaning in economic policy. Implementation of mechanical cleansing must be carried out very carefully. Furthermore, cleansing of sidewalks, shopping centers and other situations where pedestrians are involved should be carried out by manual means, due to the fact that mechanical equipments can be dangerous to passerby.

Generally speaking, waste from road sweeping is little compared with domestic waste. In Japan, no more than 0.5% was waste from road sweeping (in Tokyo, 27,028 tons of road sweeping waste generation and 5,239,895 tons of domestic waste were disposed in 1983). Therefore, waste amount from road sweeping is considered not to be significant on solid waste management system.

11-6 Institutional Arrangement

11-6-1 Improvement/Augmentation of the Organization

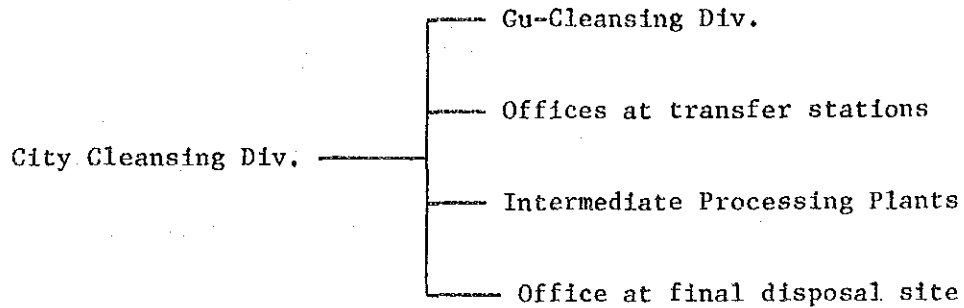
In view of the scope of study, organizational recommendations will be made only for refuse management aspect.

The range of jurisdiction for the municipality and Gu's is recommended as described in Table 11-6-1.

Table 11-6-1 Recommendations on the Improvement of Jurisdiction

Duty	Jurisdiction	Comment
Collection	Gu	- Presently under jurisdiction of Gu - Requires close communication with residents
Haul to Transfer Station	Gu	- Presently under jurisdiction of Gu - Requires close communication with residents
Transfer Station and Transportation from Transfer Station to Landfill Site	City	- Requires a unified management of trucks serving all transfer stations - One station may serve more than one Gu
Intermediate Processing Facility	City	- Requires a standardized system of operation and maintenance - Effectiveness of construction planning when administered by city - Accumulation of technological know-how
Nanjido Disposal site	City	- Though Nanjido is presently managed by Mapo Gu, the city has responsibility for implementation of the mounding plan

The following is the recommended city management system.



It's noticed that there is no division to be required for construction of facilities in the above figure.

Estimated number of staff members in 2005 reveals that the change of related organization of the city will be remarkable not only in quantitative but in qualitative especially. Therefore, the countermeasures for its change should be prepared sufficiently. Since all transfer stations which will be a core of the collection and transportation system will be constructed from 1988 to 1995, hand carts for the collection will be replaced by collection vehicles accordingly.

Therefore, it is recommended that the number of drivers and mechanical workers should be increased and training must be conducted for them.

Though reduction of the number of collection workers will be necessary, there is a limit to convert them to other occupation in the city. Therefore, reduction of collection workers of private companies will be considerable as one of countermeasures for that.

11-6-2 The Future Solid Waste Management by the Private Companies

Present problems associated with the management by the private companies are discussed and enumerated as follows:

- a. Management without adequate profit at present
- b. Difficulty in fund management
- c. Unsettlement of employees

- d. Collection of wastes including those with a considerable seasonal fluctuation in generation amount as well as covering areas with a lower revenue level to extend business activities
- e. Considerable difference of unit revenue by zone.

To solve the aforementioned problems, the following measures are recommended.

- a. The number of private companies should be reduced and services should be provided by large-sized companies. To avoid a monopoly by a limited number of companies it is suggested to assign one company to each Gu.
- b. Funding with lower interest rates should be arranged for these private companies.
- c. Collection of charges should be conducted by the City covering all the City service area, and the contract with private companies should be made in consideration of the characteristics of each Gu.
- d. Feasibility study should be made to employ private companies for the exclusive collection of briquette ash during the winter season.
- e. The average revenue should be at least 5,000 won per ton.

11-6-3 Study for Separate Collection

- (1) Investigation on the Waste Characteristics of Pilot System in Seoul City.

Cleansing Division of Seoul City is planning to introduce the pilot system of the three components separate collection in August 1985.

The investigation of the waste characteristics of solid wastes is necessary during the implementation of the pilot system. The results of the investigation will be useful to study the possibility of the

reduction of lower calorific value caused by the separation of recyclable materials from solid wastes.

(2) Requirements to Promote Cooperation by Inhabitant

Around 60 to 70 % of inhabitants showed their willingness in cooperation for the separate collection of wastes. It seems to be difficult to expect full assistance by inhabitants on this separate collection practices. With regard to this circumstances, the followings are recommended.

- a. To obtain the agreement of women's and consumer's associations.
- b. To have detailed explanation by Gu cleansing division, representatives at meetings with dongs and tongs.
- c. To give detailed explanations to major waste generation sources.
- d. Implementation of source separation in the public facilities governed by the city and Gu.
- e. To offer cooperation through various communication medias (e.g. television, radio, newspaper, paper for public relations)
- f. To assign personnel in charge in the cleansing division of the problems and request from the inhabitants and business establishments.
- g. Follow up investigation through polling after implementation of separate collection.
- h. Promotion by the city to;
 - Arrangement of observations trip to solid waste disposal facilities for the inhabitants
 - Augmentation of surveillance system
 - Advertising panel fixed on the collection vehicles
 - Preparation of movies, leaflets and pamphlets
- i. To organize an advisory committee consisting of those with experience in this field, related associations and representatives of inhabitants

