

社会開発調査部報告書

JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)

No. 62

MUNICIPALITY OF POZNAN
MINISTRY OF PHYSICAL PLANNING AND CONSTRUCTION

THE REPUBLIC OF POLAND

**THE STUDY
ON
THE SOLID WASTE MANAGEMENT
FOR
POZNAN CITY**

**FINAL REPORT
VOLUME I: EXECUTIVE SUMMARY**

MAY 1993

**KOKUSAI KOGYO Co.Ltd.,
PACIFIC CONSULTANTS INTERNATIONAL**

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In this report, project cost is estimated at January 1993 price and at an exchange rate of 1 US\$ = ¥ 125 = 15,700 Zl.

PREFACE

In response to a request from the Government of the Republic of Poland, the Government of Japan decided to conduct a master plan and feasibility study on the Solid Waste Management for Poznan City and entrusted the study to the Japan International Cooperation Agency (JICA).

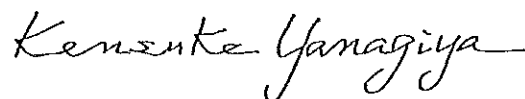
JICA sent to Poland a study team headed by Mr. Shinya Kawada, Kokusai Kogyo Co., Ltd. and composed of members from Kokusai Kogyo Co., Ltd. and Pacific Consultants International, four times between April 1992 and March 1993.

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

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

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Poland for their close cooperation extended to the team.

May 1993



Kensuke Yanagiya
President
Japan International Cooperation
Agency

May 1993

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

Dear Mr. Yanagiya,

Letter of Transmittal

We are pleased to submit to you the study report on the Solid Waste Management for Poznan City in the Republic of Poland. This study contains the master plan until 2010 and the feasibility study on the first priority projects.

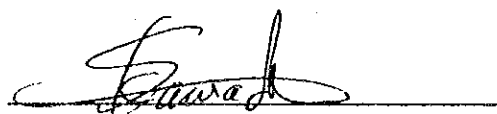
The master plan proposes the construction of an incineration plant, 8 public recycling centres and a sanitary landfill, and the feasibility study was conducted for the first priority projects which consist of the incineration plant (phase 1), 8 public recycling centres and the sanitary landfill (1st section).

Throughout the study, we have taken into full consideration the present situation in Poznan, and have concluded that the proposed first priority projects are feasible. We recommended to the Municipality of Poznan that the first priority project should be implemented provided economic and financial status would exceed the assumption made in this study.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs, and the Ministry of Welfare. We also wish to express our deep gratitude to the Ministry of Physical Planning and Construction, the Municipality of Poznan, the Municipality of Lublin, and the Embassy of Japan in the Republic of Poland.

At last, we hope that this report will be effectively used for the implementation of the project.

Respectfully,



Shinya KAWADA

Team Leader

The Study of the Solid Waste
Management of Poznan City

**THE STUDY
ON
THE SOLID WASTE MANAGEMENT
FOR
POZNAN CITY**

LIST OF VOLUMES

VOLUME I : EXECUTIVE SUMMARY

VOLUME II : MAIN REPORT

VOLUME III : ANNEXES

- A. Profile of the Study Area
- B. Waste Amount and Composition Survey
- C. Public Opinion Survey
- D. Investigation of Present and Candidate Disposal Sites
- E. Other Field Surveys
- F. Present Municipal Solid Waste Management
- G. Evaluation of Present MSWM
- H. Examination of Technical System Alternative Plan
- I. The Master Plan
- J. Feasibility Study of the First Priority Project
- K. General Recommendation for the Improvement of ISWM

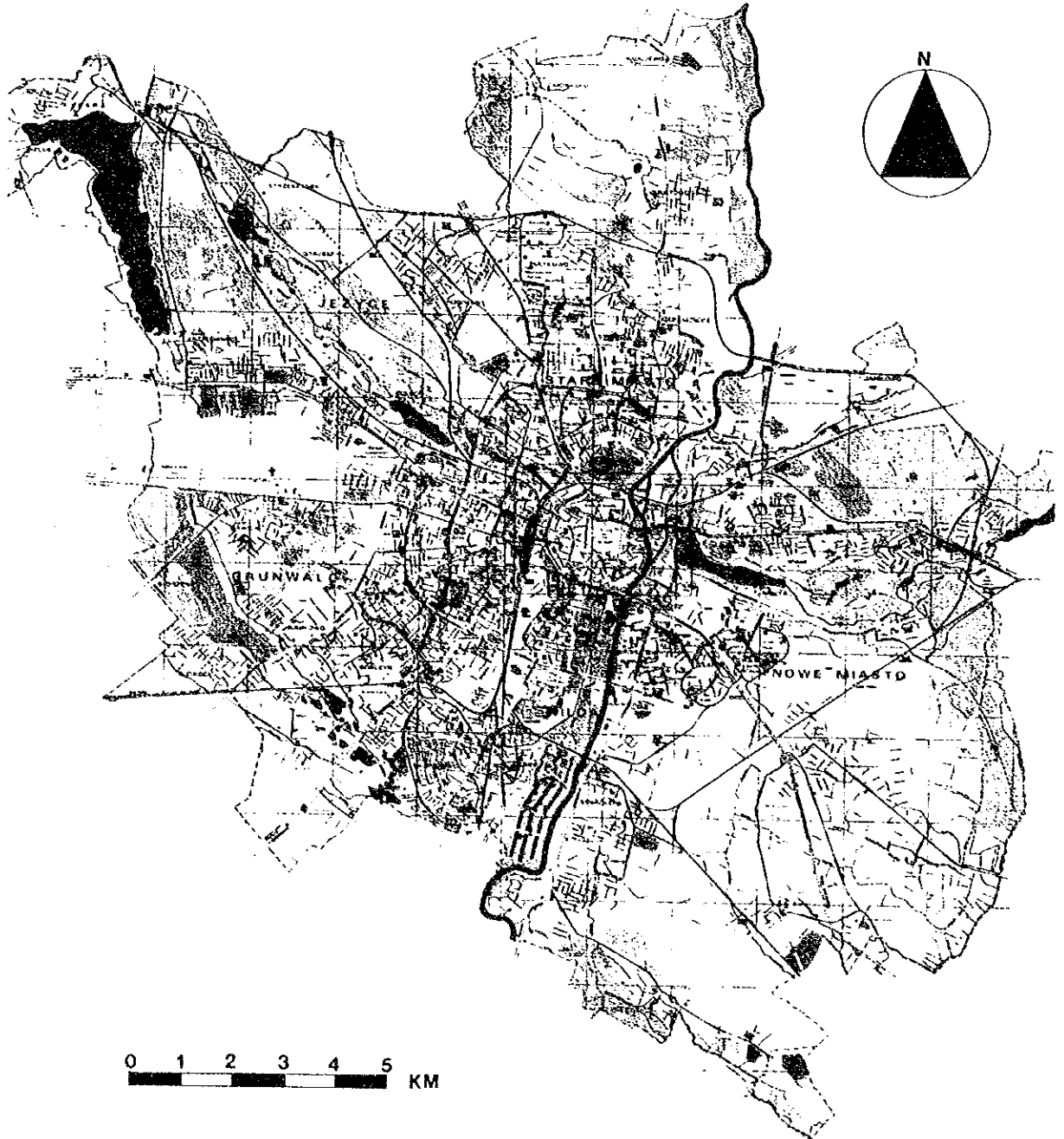
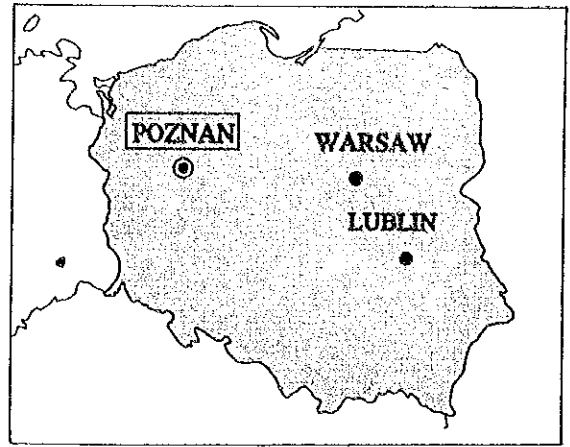
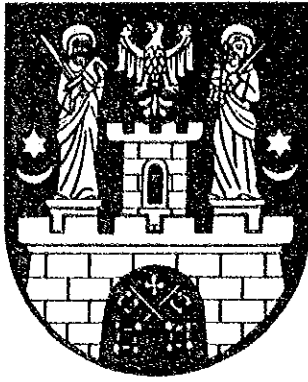
VOLUME IV : DATA BOOK

MANUAL FOR FORMULATION AND IMPLEMENTATION OF MSWM MASTER PLAN (English Version)

MANUAL FOR FORMULATION AND IMPLEMENTATION OF MSWM MASTER PLAN (Polish Version)

CASE STUDY OF MSWM MASTER PLAN MANUAL FOR LUBLIN

This is EXECUTIVE SUMMARY.



LOCATION MAP

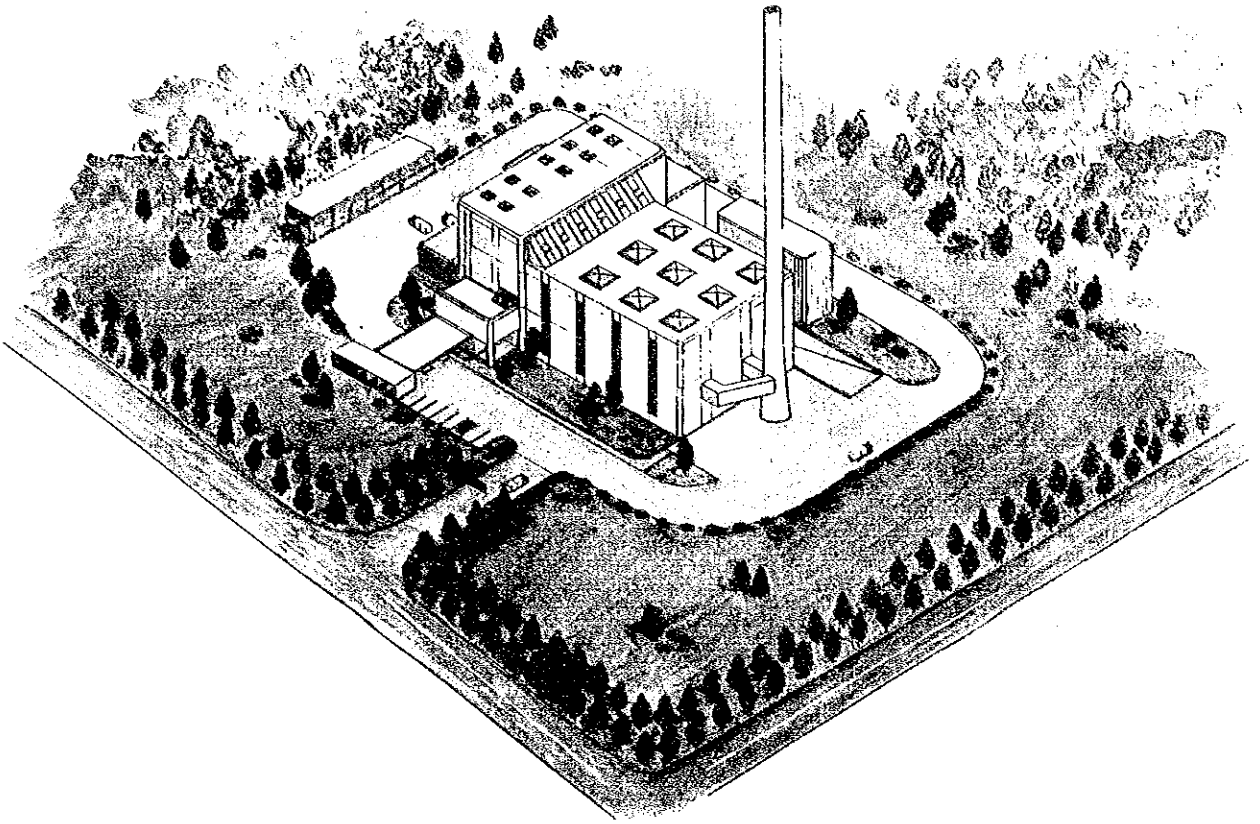


Plate 1 Image of Incineration Plant

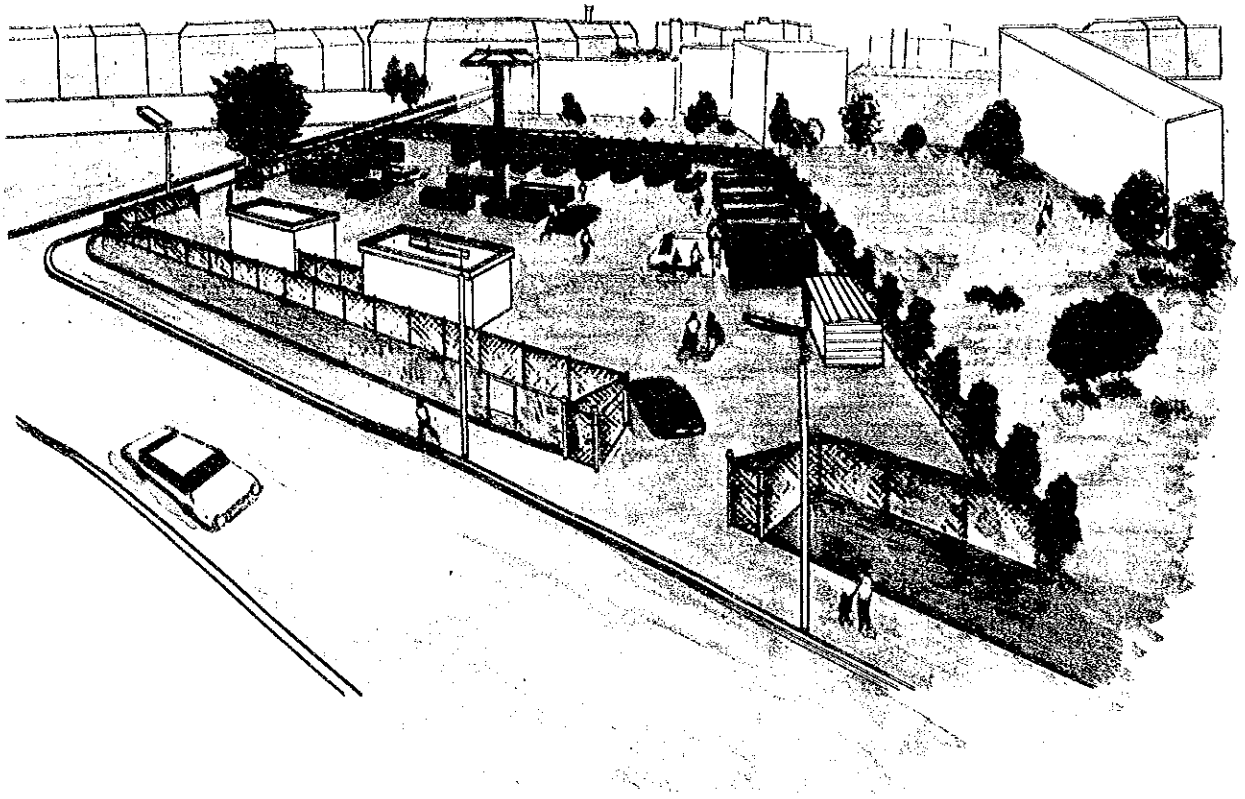
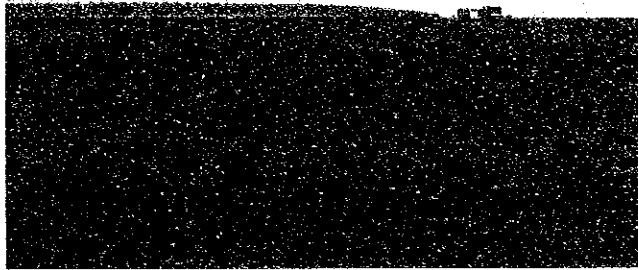
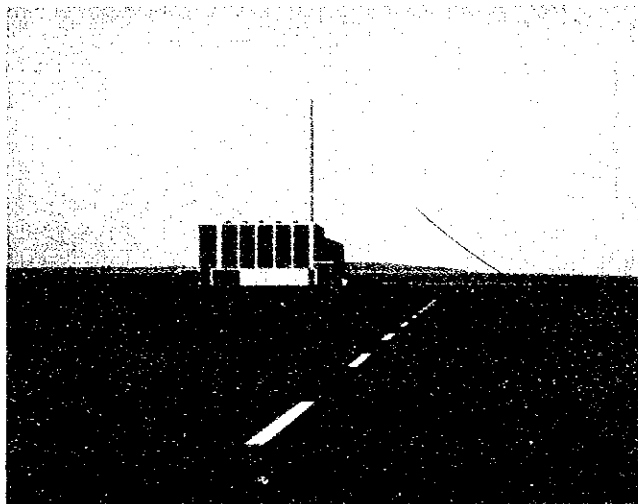


Plate 2 Image of Public Recycling Centre

from South



from East



Bird's Eye View
(from Northern East)

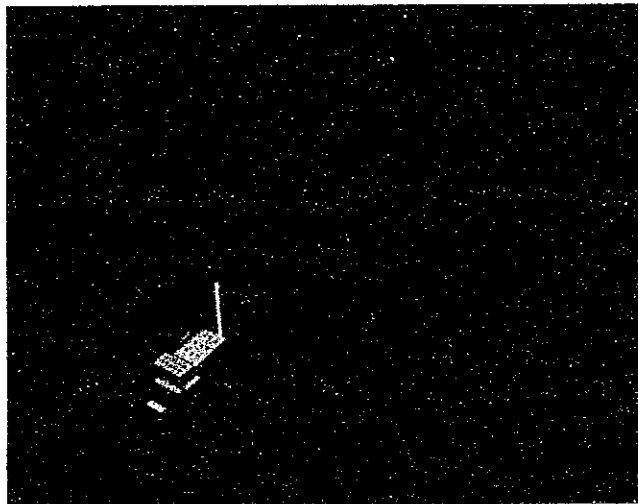
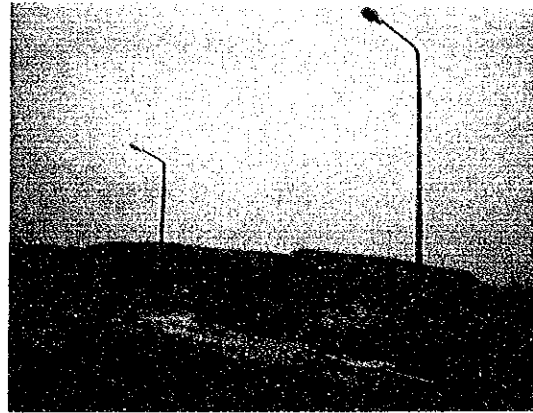


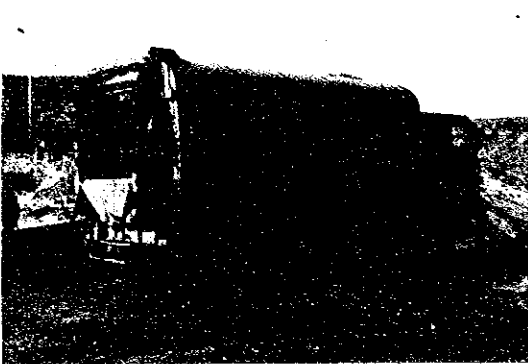
Plate 3 Computer Graphics for Franowo-Michalowo Site Development



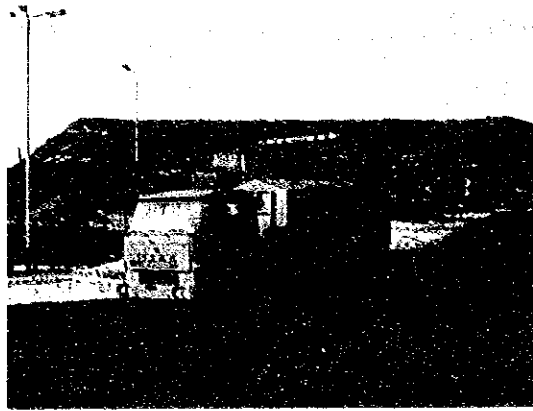
Existing landfill at Suchy Las



Control House and Truck Scale at Suchy Las



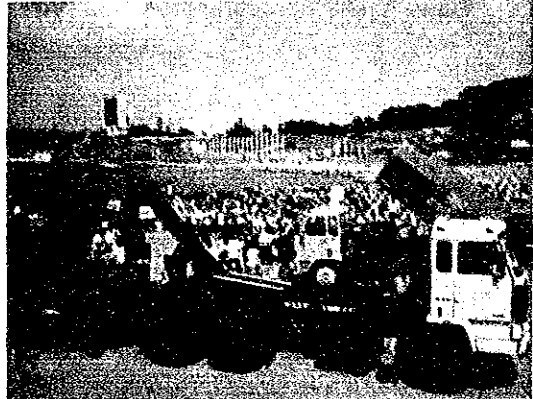
Compaction Truck



Hoist Truck



One of Illegal Dumping Sites



**Promotion Event of Public Cooperation
(Malta Ecological Marathon)**

Plate 4 Present MSWM in Poznan

***THE STUDY ON THE SOLID WASTE MANAGEMENT
FOR
POZNAN CITY***

PREFACE

LETTER OF TRANSMITTAL

LIST OF VOLUMES

LOCATION MAP

PLATES

- Plate 1 : Image of Incineration Plant
- Plate 2 : Image of Public Recycling Centre
- Plate 3 : Computer Graphics for Franowo-Michalowo Site Development
- Plate 4 : Present MSWM in Poznan

CONTENTS

		Page:
	LIST OF CONTENTS	i
	LIST OF TABLES	iii
	LIST OF FIGURES	iv
	ABBREVIATION	v
1	INTRODUCTION	1
1.1	Background	1
1.2	Scope of the Study	1
1.3	Policy of the Study	2
1.4	Key Assumptions	4
1.5	Work Processes of the Study	7
2	PRESENT MUNICIPAL SOLID WASTE MANAGEMENT	8
2.1	Profile of the Study Area	8
2.2	Field Survey	9
2.3	Present Municipal Solid Waste Management	15
2.4	Evaluation of Present MSWM	18

3	THE MASTER PLAN	21
3.1	Examination of Technical System Alternatives for Master Plan	21
3.2	The Master Plan	29
4	FEASIBILITY STUDY	48
4.1	Feasibility Study of the First Priority Project	48
4.2	Implementation Plan	60
5	OTHER STUDIES	65
5.1	General Recommendations for the Improvement of ISWM	65
5.2	Case Study of Master Plan Manual for Lublin	68
6	RECOMMENDATIONS	74
6.1	Conclusion	74
6.2	Recommendations	77

LIST OF TABLES

		Page:
Table 2.2-1	Method of Waste Amount Survey	10
Table 2.2-2	Waste Discharge Ratio and Waste Amount	11
Table 2.2-3	Physical Composition of MSW (Wet Base)	12
Table 2.2-4	Chemical Composition of MSW	12
Table 2.2-5	Lower Calorific Values	13
Table 3.1-1	Summary of Alternatives Systems	26
Table 3.1-2	Overall Evaluation	28
Table 3.2-1	Target Schedule	29
Table 3.2-2	Target Year	30
Table 3.2-3	Population Forecast	31
Table 3.2-4	Forecast for MSW and Other Wastes, Poznan Municipality	32
Table 3.2-5	Comparison of Waste Composition Data for MSW	32
Table 3.2-6	Forecast for Composition of MSW without Ash, Poznan	33
Table 3.2-7	Comparison of Three Contents and LCV, Poznan	34
Table 3.2-8	Forecast for Lower Calorific Value	34
Table 3.2-9	GDP Estimate in 1990 Constant Price (million USD)	36
Table 3.2-10	Outline of Technical System in 2010	38
Table 3.2-11	Institutional Plan	42
Table 3.2-12	Required Investment Cost and Its Financial Sources	43
Table 3.2-13	Annual Expenditure	43
Table 3.2-14	Solid Waste Fee	44
Table 3.2-15	Waste Fee List	45
Table 3.2-16	Amount shouldered by Citizens	45
Table 3.2-17	Amount shouldered by Poznan Municipality	46
Table 3.2-18	Balance Sheet	47
Table 4.1-1	Public Recycling Centres	49
Table 4.1-2	Outline of Incineration Plant	50
Table 4.1-3	Outline of Final Disposal Site	51
Table 4.1-4	Investment Cost	52
Table 4.1-5	Operation Cost in 2005	52
Table 4.1-6	Environmental Evaluation of Public Recycling Centres	53
Table 4.1-7	Environmental Evaluation of the Incineration Plant	53
Table 4.1-8	Environmental Evaluation of the Disposal Site	54
Table 4.1-9	Project Evaluation Methods	54
Table 4.1-10	Benefits, Costs and Criteria	55
Table 4.1-11	Income, Expenditure and Evaluation Criteria	56
Table 4.1-12	List of Economic and Market Prices	57
Table 4.2-1	Implementation Schedule	60
Table 4.2-2	Required Finance and Source for P.R.C	61

Table 4.2-3	Required Finance and Source for Incineration Plant	61
Table 4.2-2	Breakdown of Financial Sources for Operation	62
Table 4.2-5	Investment and Annual Expenses for Incineration Plant	62
Table 4.2-6	Required Finance and Source for Sanitary Landfill	63
Table 4.2-7	Investment and Annual Expenses for Sanitary Landfill	63
Table 4.2-8	Balance Sheet and Money Flow of PTDC	64
Table 5.2-1	Waste Amount in Lublin	69
Table 5.2-2	Physical Composition and Lower Calorific Value of MSW (Wet Base) in Lublin	70
Table 5.2-3	Population Forecast	72
Table 5.2-4	Forecast for MSW and Other Wastes, Lublin Agglomeration	72
Table 5.2-5	Forecast for Composition of MSW without Ash, Lublin Agglom- eration	73
Table 6.1-1	Estimated Project Costs	75

LIST OF FIGURES

	Page:	
Fig.2.2-1	Present Waste Stream of MSW	14
Fig.2.3-1	Present Condition of MSW Collection Service	16
Fig.3.2-1	Waste Stream in 2010	35
Fig.3.2-2	Phased Implementation Plan of MSWM Master Plan	39
Fig.3.2-3	Money Flow for MSWM	44
Fig.4.1-1	Cash Flow Diagram of Poznan Treatment and Disposal Com- pany	59
Fig.5.2-1	Present Waste Stream of MSW	71

ABBREVIATIONS

ORGANIZATIONS

DIA	Department for Investment Affairs, Poznan Municipality
DCRA	Department for Communal and Residential Affairs, Poznan Municipality
EBRD	European Bank for Reconstruction and Development
EC	European Communities
JICA	Japan International Cooperation Agency
LPEC	Lublin Heat Energy Company
MOPPC	Ministry of Physical Planning and Construction
MPO	Municipal Cleansing Company
PEC	Heat Supply Company
SANEPID	Sanitary Epidemiological Institute
SANITECH	Sanitary Technology Company

REPORT and STUDY

ASG	Apparent Specific Gravity
CV	Calorific Value
DF/R	Draft Final Report
F/R	Final Report
IC/R	Inception Report
ISW	Industrial Solid Waste
ISWM	Industrial Solid Waste Management
IT/R	Interim Report
LCV	Lower Calorific Value
M/M	Minutes of Meeting
MSWM	Municipal Solid Waste Management
O & M	Operation and Maintenance
PR/R	Progress Report
S/W	Scope of Work
SWM	Solid Waste Management
WACS	Waste Amount and Composition Survey
EC PHARE Report	Municipal Waste—Strategy for Waste Management and Applicable Methods for Collection and Treatment in 1992

SOCIO-ECONOMY

EIRR	Economic Internal Rate of Return
FIRR	Financial Rate of Return
GDP	Gross Domestic Product

GNP	Gross National Product
GRDP	Gross Regional Domestic Product
USD	U.S. dollar
zl	Zlotych
p.a.	per annually
mill.	million
bill.	billion

UNIT

mm	millimetre
cm	centimetre
m	meter
km	kilometre
m ²	square meter
km ²	square kilometre
ha	hectare
m ³	cubic meter
mg	milligram
lit.	litre
kg	kilogram
ton	ton
sec.	second
min.	minutes
hr	hour
d	day
%	percent
no.	number
nos.	numbers
kw	kilowatt
kj	kilojoule
kcal	kilocalorie

1 INTRODUCTION

1.1 Background

The Central Government of Poland has been planning a study project to formulate an MSWM master plan for the City of Poznan as a model for other major cities.

In Poznan City, the MSWM system has not been sufficiently established and many problems such as mixed waste collection, unsanitary waste disposal and illegal dumping can be observed. It is, therefore, essential to establish the comprehensive MSWM plan immediately to cope with the expected increase in the demand for MSWM services, both in quantity and quality.

In response to the request of the Government of Poland, the Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, undertook the Study in close cooperation with the concerned authorities of the Government of Poland. Kokusai Kogyo Co. Ltd., and Pacific Consultants International were the consultants selected by JICA to carry out the Study.

1.2 Scope of the Study

1) Objective of the Study

The objectives of the Study are:

- to formulate a master plan for the improvement of the Municipal Solid Waste Management of Poznan City in the target year 2010;
- to make recommendations on the future Industrial Solid Waste Management strategies of Poznan City;
- to conduct a feasibility study on the priority project to be identified in the said master plan;
- to prepare a manual for the formulation and implementation of the MSWM master plan; and
- to carry out a case study in Lublin in order to i. check the applicability of the draft manual to other Polish cities, ii. make necessary modifications on it, and iii. to prepare recommendations for the improvement in

the City of Lublin including a concept of her municipal SWM master plan.

2) Study Area

The study area was the whole area within the boundaries of Poznan City. The future landfill site and its environs, however, were included in the study area even if they are located outside Poznan City.

3) Study Waste

The wastes studied were household wastes, market wastes, commercial wastes, road sweeping wastes and institutional wastes. Medical wastes, however, were excluded. As for industrial solid waste, a quick diagnosis was carried out based on existing information and data, resulting in the proposal of general recommendations for the improvement of industrial solid waste management in Poznan City.

1.3 Policy of the Study

1) Utilization of Local Consultants

In addition to the eminent characteristics of an MSWM study due to the rapid change in the socio-economic as well as the political situation in Poland, it was very important to identify the present status of the institutional system on MSWM and to make an appropriate institutional development plan. This task, however, was not easy for foreign professionals without the appropriate support of the Polish professionals. Therefore, a team of Polish consultants was utilized to successfully conduct the Study within a limited period and to formulate a master plan compatible with local conditions.

2) Joint Study

In order to conduct the Study successfully, the Study Team proposed the joint implementation of the Study and asked the cooperation and active participation of the Polish side.

3) Environmental Standard

For sanitary and environmental protection, the EC standards as well as the Polish Standards were taken into account in the Study. Environmental evaluation of the first priority project for the Feasibility Study was carried out taking into account the existing EC (European Communities) environmental legislations and/or guidelines.

4) Model Project

In Poland, there are several cities with more than half a million population urgently requiring the improvement of Municipal Solid Waste Management. As such, the Government of Poland hoped to use Poznan City as a model for such cities. Therefore, as a result of the Study, a manual on the formulation and implementation of the municipal solid waste management master plans was prepared taking into account the local conditions which differed from city to city.

1.4 Key Assumptions

Key assumptions used in this study area are as follows:

1) Socio-economic Conditions

Items	Unit	Descriptions
1. Population		
- Projected Population		1992 2000 2010 590,100 604,000 620,000
- Annual Growth Rate	persons %	0.275%/year
2. Economy		
- GDP	bill.USD	73.7 in 2000 132.0 in 2010
- Annual Increase Rate of GDP in Real Term	%	1993 - 1994 0% 1995 - 2000 3% 2001 - 2010 6%
- Future Budget Scale of the Poznan Municipality	bill.Zl	The budget in 1992 will increase in accordance with GDP increase in real term. 1,062 in 2000 1,902 in 2010
- Income Level of the Citizens (per household)	Zl/month	The income will increase according to the GDP increase in real term+population growth. 4,335,000 in 2000 7,556,000 in 2010
- Currency Exchange Rate		1 USD = 15,700 Zloty = 125 Yen
- Inflation Rate	%	70% in 1991 40 - 45% in 1992 0% from 1993 to 2010 for the economic and financial analysis of the Study

2) Waste Amount and Composition

Items	Unit	Descriptions		
1. Waste Amount				
1-1 Waste Discharge Ratio		1992	2001	2010
- MSW	g/person/day	769(166)	683(151)	867(196)
- MSW excluding Road Sweeping and Bulky Wastes with Ashes	(1,000 ton/year)	735(158)	644(142)	819(185)
- MSW excluding Road Sweeping and Bulky Wastes without Ashes		561(121)	644(142)	819(185)
1-2 Collection Ratio of Household Waste	%	90	100	100
1-3 Annual Increase Rate of Waste Discharge		1992 - 2000	2001 - 2010	
- MSW with Ash	%	- 1.33	2.70	
- MSW without Ash	%	1.40	2.70	
Note: Ash discharge from households will be ended by 2001.				
2. Waste Composition				
2-1 Forecast for Waste Composition				
<p>The chart displays the percentage composition of waste components over time. Garbage (black) is the largest component, followed by Paper (white), Textile (dark grey), Plastics (medium grey), and others. The composition remains relatively stable from 1992 to 2010, with minor fluctuations in the proportions of different materials.</p>				
2-2 Lower Calorific Value		1992	2001	2010
- MSW for Incineration (MSW excluding Road Sweeping and Bulky Wastes with Ashes)	kcal/kg	1,437	1,865	1,924
- MSW without Ashes for Incineration	kcal/kg	1,805	1,865	1,924
- Separately Collected MSW for Incineration	kcal/kg	2,199	2,270	2,338
- Sewage Sludge and Separately Collected MSW for Incineration	kcal/kg	1,956	2,020	2,083

3) Life Span of Equipment and Facilities

	Life Span (years)	Salvage value (%)
Container	5	0
Vehicle and Heavy Equipment	7	10
Machinery	15	0
Building and Civil Works	30	0

Note: The life span of other facilities for the disposal site depends on the period of its operation.

4) Executing Bodies for Technical Systems of MSWM

Technical System	Executing Bodies
1. Collection	
- MSW except Road Sweeping and Bulky Wastes	Department for Municipal Solid Waste Management
- Road Sweeping Wastes	Provincial Road Authority in the City
- Bulky Wastes	Department for Municipal Solid Waste Management Department for Municipal Solid Waste Management
2. Recycling Centres	Department for Municipal Solid Waste Management
3. Incineration Plants	Poznan Waste Treatment and Disposal Company
4. Sanitary Landfill	Poznan Waste Treatment and Disposal Company

5) Loan Conditions

	Repayment Schedule and Interest Rate in Real Term
- Long Term Loans	Repayment over 10 years with a 3 years grace period, 7.5%
- Short Term Loans	Repayment in the Following Years, 13.5%

1.5 Work Processes of the Study

The study commenced in April of 1992 and will end in May of 1993. The study consisted of the following two phases:

Phase 1: Formulation of a Master Plan (April – October, 1992)

Phase 2: Feasibility Study on the First Priority Project

(November 1992 – May 1993)

2 PRESENT MUNICIPAL SOLID WASTE MANAGEMENT

2.1 Profile of the Study Area

1) Location and Population

Poznan City is located in the central-western part of the Republic of Poland. The City is the fifth largest city in Poland and by the end of 1991, its area of 261 sq. km is inhabited by 591,000 people. Poznan can be called a "green city" because more than 20 % of its area is occupied with forests and parks.

2) Climate

Poland lies in a temperate climatic zone. Its climate borders between marine and continental and is characterized by largely varying weather conditions. According to the meteorological data of the past 10 years, the maximum and minimum temperatures are 35.7°C and -28.5°C, respectively. There is not much annual rainfall and the values observed only ranged from 300mm to 600mm.

3) Land Use

The present land use of the study area (26,100 ha) is as follows:

Category	Area (ha)	Share (%)
Developed area		
Residential area	5,640	21.6
Commercial area	840	3.2
Industrial area	1,620	6.2
Transportation area	1,150	4.4
Public facilities	70	0.3
Public green area	2,380	9.1
Agricultural facility area	520	2.0
Others	380	1.5
Sub-total	12,600	48.3
Non-developed area		
Forest	3,300	12.7
Water area	600	2.3
Meadow	2,100	8.0
Cultivated land	7,500	28.7
Sub-total	13,500	51.7
Total	26,100	100 %

4) Regional Economy

Poznan city is one of the large industrial cities in Poland due to the introduction of large-scale industrial investments in the 1970s. The city has great potentials for economic development due to its location where transportation routes linking Paris and Berlin with the capital city of Warsaw and Moscow are established. In March 1992, the city has 17,476 enterprises including 170 foreign firms. Due to a hyper-inflated economy, the average wage of employees increased 50 times in 5 years, from 1985 to 1990, though the indices of consumer prices increased 60 times in these terms. This condition made life difficult for pensioners. Although the average wage of a government employee was about 2 million Zl in 1991, the income level of Poznan city is higher than the average income nationwide.

5) Administration

The Republic of Poland consists of 49 Provinces and the City of Poznan is located at the centre of Poznan Province. The Provincial Governments (Voivodeships) are executing bodies under the central government, having the right to suspend decisions taken by the municipalities. The Local Governments have their own councils and only the directly elected unit of local government and the councils can decide on all matters affecting their locality.

The City Council of Poznan has 65 seats. The executive body, the Board, consists of a Mayor, three Vice-Mayors and 2 Board Members.

2.2 Field Survey

1) Field Survey

Basic information such as the quantity and quality of solid waste generated in the study area, population covered by collection services, etc., is the principal and the key factor for a successful and feasible municipal solid waste management plan. In order to clearly understand the present MSWM, the following field survey were conducted:

- time and motion study for waste collection and cleansing works;
- survey on scavengers;
- survey on the recycling system and the market for reusable materials;
- POS (Public Opinion Survey)(totally 150 households were surveyed)

- investigation of present and future final disposal sites (four sites were investigated); and
- study on waste amount and composition both in summer and winter (75 samples were selected and analyzed in each season).

Upon consideration of the importance of the surveys, the WACS and POS are briefly described below.

2) Waste Amount and Composition Survey

a. Method of the Survey

A WACS (Waste Amount and Composition Survey) was carried out both in summer (June 1992) and winter (December, 1992) in order to obtain the basic information on waste generation ratio, discharge amount, amount of self-disposal and collection, and finally to clarify the waste stream in the Study area.

The method applied in the waste amount survey is tabulated in Table 2.2-1.

Table 2.2-1 Method of Waste Amount Survey

Category	Discharge Ratio Survey	Disposal Amount Survey	Interview Survey
MSW (Total)		x	
Household Waste	x		
Market Waste	x		
Commercial	x		
Institutional	x		
Road Sweeping	x		
Bulky Waste		x	
Other Wastes (Total)		x	
PEC Ash			x
Sewage Sludge			x
Others		x	

Note: The item given "x" was surveyed in the Study.

b. Findings

i. Waste amount

The waste discharge ratio and waste amount were concluded as shown in Table 2.2-2.

Table 2.2-2 Waste Discharge Ratio and Waste Amount

Category of Waste	Discharge Ratio (gram)	Quantity	Waste Amount per Day (ton/day)
1. MSW			
Household Waste	-	-	386.0
(Household Waste)	(480)	(590,100 persons)	(283.2)
(Domestic Ash)	(870)	(118,020 persons)	(102.8)
Commercial Waste	-	-	32.5
(Shops)	(24)	(202,966 m ²)	(4.9)
(Catering)	(160)	(172,725 m ²)	(27.6)
Market Waste	3,040	1,940 shops	6.0
Institutional Waste	58	161,085 employee	9.3
Road Sweeping Waste	-	-	4.0
Bulky Waste	-	-	*15.7
Sub-total			453.5
2. Other Wastes			
PEC Ash	-	-	14.9
Sewage Sludge	-	-	40.9
Others	-	-	26.6
Sub-total			*82.4
Total			535.9

Note: * The figure is for disposal amount.

Accordingly, the following major figures on waste discharge ratio are deduced:

- MSW discharge amount (estimated) : **453.5 tons/day**
- MSW discharge ratio per capita : **769 g/person/day**
- Annual MSW discharge : **165,500 tons/year**

The average daily disposal amount at Suchy Las landfill observed by truck scale is **508.6 tons/day**.

The actual disposal amount of MSW is calculated at **426.2 tons/day** (508.6 - 82.4 tons/day). The figure is equivalent to **93.9%** of the estimated discharge amount of MSW.

Considering a present collection coverage ratio of **90 %** and the permissible error of the WACS, these results are observed to be quite reasonable.

ii. Waste composition

The composition of MSW excluding domestic ash, road sweeping and bulky wastes is estimated and tabulated in Table 2.2-3 and 2.2-4.

Table 2.2-3 Physical Composition of MSW (Wet Base)

Category	Item	Ratio (%)
Combustible	Garbage	33.95
	Paper	19.33
	Textile	7.27
	Plastics	7.89
	Grass & Wood	5.90
	Leather & Rubber	2.26
	Sub-total	76.60
Noncombustible	Metal	3.76
	Glass	15.16
	Ceramic & Soil	1.53
	Others	2.93
	Sub-total	23.38
	Total	100

Note: MSW here excludes domestic ash and road sweeping and bulky wastes.

Table 2.2-4 Chemical Composition of MSW

Category	Item	Ratio (%)
Three contents	Moisture	35.74
	Combustible	38.04
	Ash	26.23
Chemical Contents of Combustible Wastes	Carbon	19.03
	Hydrogen	4.21
	Nitrogen	0.71
	Sulphur	0.05
	Chlorine	0.40
	Oxygen	13.63
C/N Ratio		26.8
Lower Calorific Value (All Waste)		1,854 kcal/kg
		7,762 kj/kg
Lower Calorific Value (Combustible Matter)		5,442 kcal/kg
		22,785 kj/kg

Note: 1. MSW here excludes domestic ash and road sweeping and bulky wastes.
2. The lower calorific values were measured using the calorimeter.

In order to clearly understand the lower calorific value (all waste) of MSW excluding road sweeping and bulky wastes, the following figures are calculated by the formula elaborated by the Study Team.

Table 2.2-5 Lower Calorific Values

Waste Category	Lower Calorific Value (kcal/kg)
MSW ^{*1} without Ash (Measured)	1,854
MSW without Ash (Estimated)	1,805
MSW with Ash (Estimated)	1,437
Household Waste without Ash (Estimated)	1,792
Household Waste with Ash (Estimated)	1,384
Wastes with ashes, of households with coal based heating system (Estimated)	806
Household Waste (1984/85 Waste Study) ^{*2}	855

Note: *1 MSW here excludes domestic ash and road sweeping and bulky wastes.
 *2 1984/85 Waste Study refers to "Research on Technological Properties of Poznan Municipal Waste" done by Engineering College of Warsaw.

iii. Waste stream

The waste stream of the Study area was prepared as a draft for the future study, as shown in Fig. 2.2-1.

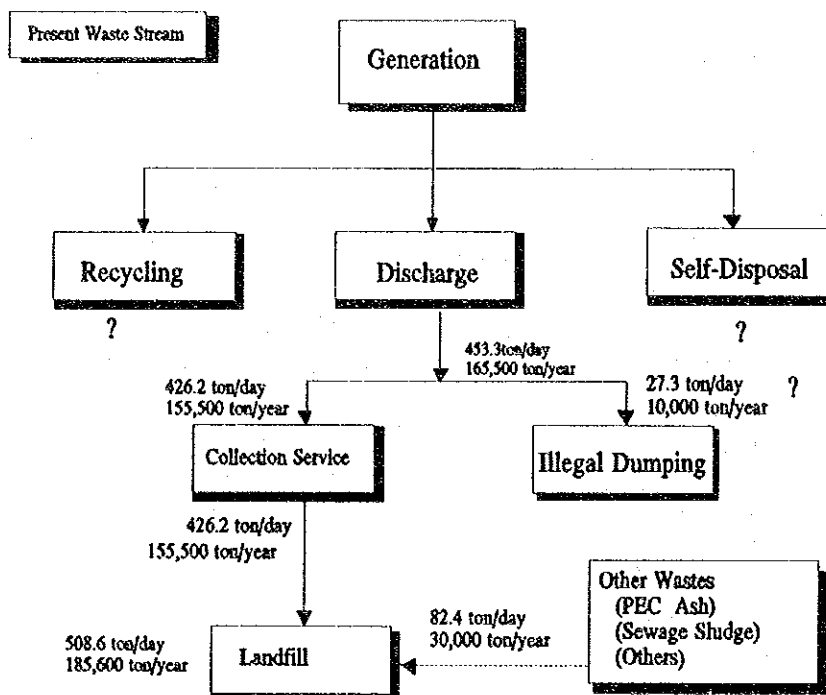


Fig.2.2-1 Present Waste Stream of MSW

3) Public Opinion Survey

A POS (Public Opinion Survey) was carried out in order to understand the reasoning of the public regarding MSWM, which would be taken into account in the formulation of the master plan.

The salient features of the results of the POS are as follows:

- The citizens are observed to be very aware of recycling (almost 100% answered that resource recovery and recycling were necessary and 93% are willing to cooperate in waste segregation).
- 37% of the citizens living in detached houses answered that they are not receiving any waste collection services.

- Half of the citizens think the Municipality should provide subsidies to supplement the cost of SWM.
- More than 90% of citizens consider public cooperation as necessary to maintain the city and its environment beautifully and state that they will cooperate in the works.
- Almost all citizens think that public educational campaigns for maintaining the city and its environment beautifully is necessary.
About 60% think that the Municipality should take such actions.

2.3 Present Municipal Solid Waste Management

1) Technical System

a. Sanitary condition

Poznan is generally a very beautiful and clean city, a fact that may be attributed to the efforts made by the Municipality on sanitation. However, an increasing number of insanitary places can still be found within parts of old apartment building areas, detached and semi-detached housing areas, and the present Suchy Las landfill site.

b. MSWM situation

MSWM is the responsibility of the Municipality, and two departments are designated for it, namely the Investment Department and the Communal and Residential Affairs Department.

The implementation of MSWM is left to the municipal enterprise, SANITECH, and the municipality is not directly involved with the management. Further, the Municipality is considered to have little influence on the SWM since all subsidies to SANITECH have been terminated.

c. Final disposal

Except for the old incinerators installed in hospitals, the city of Poznan has no waste processing facilities. The Suchy Las Disposal Site located outside of the city to the north of Poznan, is the only disposal site used by the city and virtually all kinds of wastes, i.e. municipal, industrial, construction, hospital, are disposed of at this area. The operation of the site started in 1984.

d. Waste collection

Waste collection services are carried out by the enterprises in accordance with the contract established between the customer and the enterprise. The enterprise independently collects waste collection fees from the customers according to the number of containers and the frequency of collection.

The present service coverage is 90% and the distribution is summarized in Fig. 2.3-1.

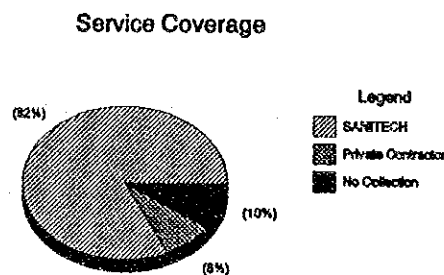


Fig.2.3-1 Present Condition of MSW Collection Service

In spite of the increase in waste generation, the administrative authorities have not taken any effective countermeasure. In fact, the number of waste collection vehicles decreased within the past 5 years, resulting in the decrease in waste collection frequency. This also reduces the efficiency ratio of the waste collection services and haulage operation as well.

e. Illegal dumping

Illegal dumping is a very serious problem in Poznan City and has been observed to have particularly increased since 1989. The budget allocated for the reinstatement of lands has been increasing lately and is becoming a heavy burden to the municipality.

2) Institutional System

a. Status for organizational and institutional development in Poland

The ongoing transition of Poland from a centralized, socialist community to a decentralized community with free market economy and strengthened local authority affects execution of all public services including MSWM.

At present the responsibility for MSWM is divided among several ministries and divisions of responsibility and authority between national, regional and local levels are not yet finally determined.

Ministry of Environmental Protection, Natural Resources and Forestry and Ministry of Physical Planning and Construction are the most involved ministries in MSWM as they define environmental policies, draft legislation and govern municipal enterprises. The local authority is strengthened and powers from the regional level are transferred to national or local levels.

Finally, the environmental legislation is under revision and new acts related to MSWM are drafted, but not yet passed by the Parliament. The present legislation lacks important tools for the local authorities executing MSWM, e.g. with regard to enforcing compulsory participation in municipal collection services.

A drafted Law on Waste will provide adequate tools for the municipalities for planning and execution of MSWM in the future.

b. Status for organizational and institutional development in Poznan Municipality

The organizational and institutional development in Poznan Municipality is also undergoing considerable changes at present.

MSWM is placed under the authority of the Vice-Mayor of Technical Affairs and this area is proposed to be strengthened with the introduction of a City Engineer.

In January 1993 SANITECH, a municipal company of Poznan Municipality, became the new company Rethman-Poznan Waste Management Co. Ltd., by entering a joint venture with a German contractor. Poznan Municipality holds 49% of the shares and the German 51%, thus, holding the majority.

2.4 Evaluation of Present MSWM

1) Technical System

a. Collection and haulage

- Irregular collection services mainly caused by different collection frequencies agreed upon and stipulated in individual waste collection contracts should be improved.
- The use of dust chutes should be terminated.
- The waste discharge system in old apartment areas and detached and semi-detached areas is not adequate.
- A collection for bulky waste has not been established.
- In terms of road sweeping and public area cleansing, there seems to be no urgent issues except for the limiting budget.

b. Final disposal

- The methods employed at the present Suchy Las landfill are considered not adequately hygienic and waste volume is not precisely monitored by weight.
- The most serious problem concerning the construction of a new disposal site is the difficulty in obtaining permits for land use.
- Compensation for the residents residing at the Suchy Las landfill area started in 1989 and the total cost for 3 years, from 1989 to 1991, amounted to approximately 6 million US\$. The enormity of the cost seems to weigh down the finances of the municipality, making the further use of Suchy Las as a disposal site or the use of a disposal site outside of the city very difficult.

c. Processing and recycling

- There are no MSW processing facilities in the city of Poznan.

- Although a recycling system has been established already, it does not work sufficiently yet.

2) Institutional System

Based on the study of the present MSWM, the following conclusions can be presented:

a. General conclusions

- Incomplete legislation and the absence of administrative and managerial tools at local level hinder proper MSWM with regard to enforcing compulsory household collection, enforcing competitive bidding of waste service, and financing of waste services including raising of loans for investments.
- Many Polish municipalities are ineffectual in providing an appropriate MSWM (and other public services as well) due to insufficient public backup.
- The tradition of public subsidization inherited from the former socialist system causes very low financial contributions from the users for public services.
- It is very difficult to overcome opposition and obtain land for new waste facilities.
- There is a general lack of experience in competitive bidding and the supervision carried out in the construction of facilities is poor leading to frequent deviation from design.

b. Conclusions related to Poznan Municipality

- MSW-services in Poznan are generally carried out in a satisfactory way.
- Since Rethman is the major stockholder of the Rethman-Poznan Waste Management Co. Ltd., Poznan Municipality is necessary to obtain appropriate administrative tools from the central government in order to secure municipal control over MSWM including the exercising of control over decisions related to compulsory municipal services.

- The municipal waste regulation allows the citizens to choose freely from among the contractors in the market. The same street, therefore, may be served by several contractors depending on the individual contracts, a situation that leads to unnecessary use of transportation, too expensive and diversified services.

- The drafted Law on Waste states the responsibility of the Municipality in Municipal Waste Management and the selection of a collector. Although Poznan Municipality is involved in the new collection company, it must consider competitive bidding as a tool to provide the citizens in future with the best services their money can buy.

- The waste collection service fee is collected by the collector (SANITECH or private contractor). The future fee collection system must be incorporated under municipal jurisdiction to provide unified services to the citizens.

3 THE MASTER PLAN

3.1 Examination of Technical System Alternatives for Master Plan

1) Work Flow of the Examination

The following work procedures for the examination of technical system alternatives for the MSWM master plan are applied in the Study:

- i. Setting up of a planning framework for the examination
- ii. Examination of technical system components
- iii. Presentation of the technical system alternatives for screening
- iv. Conceptual design and cost estimation of each alternative
- v. Examination of institutional requirements for each alternative
- vi. Evaluation of each alternative
- vii. Selection of the optimum alternative

The brief examinations on the above-mentioned items are made below.

2) Planning Framework for the Examination

The planning framework, i.e. target year, future population, forecast on waste amount and composition, future economic and financial condition, etc., was set up for the examination work. Based on additional data obtained during the progress of the Study, the planning framework was partly modified for the preparation of the Master Plan.

3) Examination of Technical System Components

The MSWM technical system consists of several sub-systems, i.e. collection, transfer, intermediate treatment, etc.. Each sub-system has various technical system components, e.g. incineration, composting, RDF (Refuse Derived Fuel), etc.,

for intermediate treatment. Various system components of the sub-systems were examined and primarily screened for the comparison of the technical system alternatives.

4) Presentation of Technical System Alternatives

After the examination of the possible intermediate treatment facilities, seven technical system alternatives are presented as shown below.

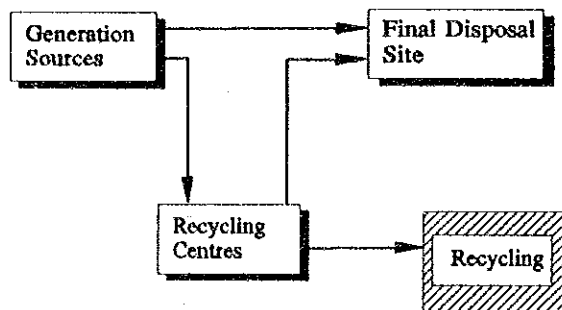
Alternative 1

Mix Collection (present system)
Sanitary Landfill



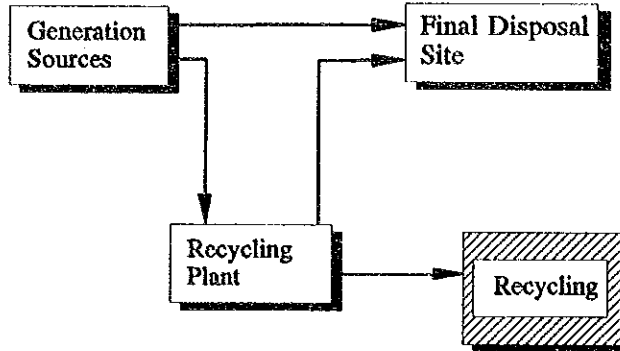
Alternative 2

Mix Collection
Recycling Centres (2-large and 6-small)
Sanitary Landfill



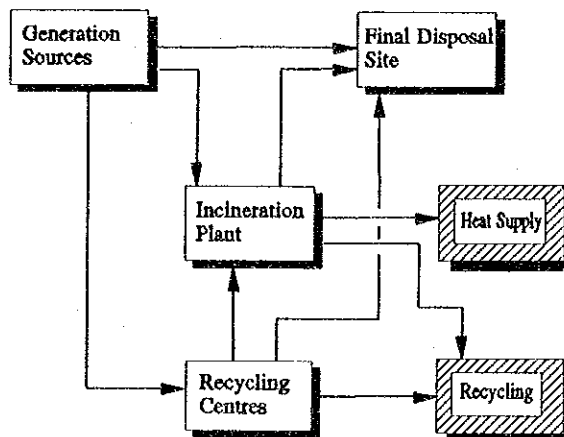
Alternative 3

**Separate Collection
Recycling Plant
Sanitary Landfill**



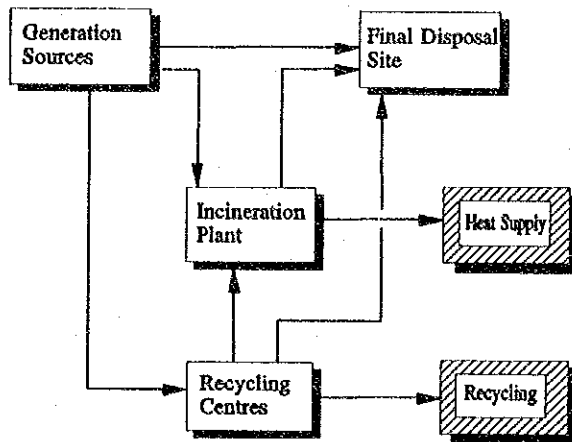
Alternative 4

**Mix Collection
Recycling Centres (2-large and 6-small)
Incineration Plant
Sanitary Landfill**



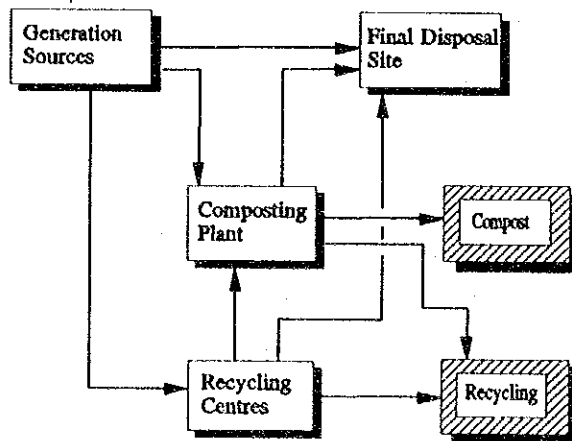
Alternative 5

Separate Collection
Recycling Centres (2-large and 6-small)
Incineration Plant
Sanitary Landfill



Alternative 6

Mix Collection
Recycling Centres (2-large and 6-small)
Composting Plant
Sanitary Landfill



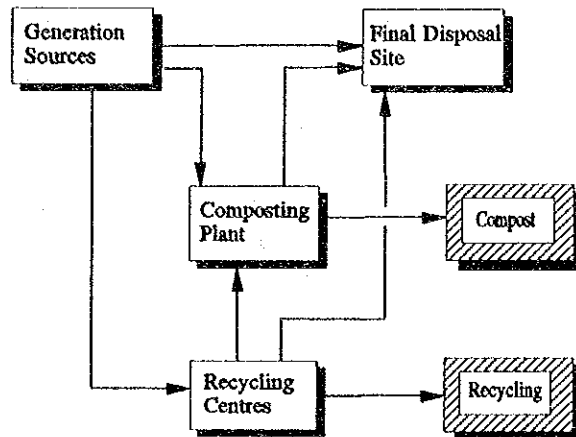
Alternative 7

Separate Collection

Recycling Centres (2-large and 6-small)

Composting Plant

Sanitary Landfill



5) Conceptual Design and Cost Estimation

Regarding the 7 alternatives presented, the conceptual design and cost estimation of the following systems and facilities for each alternative were carried out:

- Storage, collection and haulage system
- System for road sweeping and public area cleansing
- Incineration plant
- Composting plant
- Sorting plant
- Recycling centre
- Sanitary landfill

For the comparison of the 7 alternatives, annual expenses in the year 2010 of the alternatives were calculated in addition to the required investment cost, as shown in Table 3.1-1.

Table 3.1-1 Summary of Alternatives Systems

in the year 2010

	Unit	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Main system components								
Collection system								
Recycling								
Processing								
Final disposal								
		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
		-Combined nil nil -Sanitary landfill	-Combined -Recycling centres nil -Sanitary landfill	-Separated -Sorting plant nil -Sanitary landfill	-Combined -Recycling centres -Incineration plant -Sanitary landfill	-Separate -Recycling centres -Incineration plant -Sanitary landfill	-Combined -Recycling centres -Composting plant -Sanitary landfill	-Separated -Recycling centres -Composting plant -Sanitary landfill
Total generation	v/d	741.1	741.1	741.1	741.1	741.1	741.1	741.1
Collection to Processing Plant	v/d	-	-	132.6	485.5	393.9	393.5	393.5
to Final disposal sites	v/d	485.5	485.5	445.5	0	57.5	485.5	91.6
Direct Haulage	v/d	-	112.6	-	112.6	112.6	112.6	112.6
to Recycling Centres	v/d	-	-	0	69.2	69.2	69.2	69.2
to Processing plant	v/d	143.0	143.0	143.0	73.8	73.8	73.8	73.8
to Final disposal site	v/d	-	-	26.5	263.1	179.2	193.4	87.2
Residue	v/d	-	101.5	-	63.9	37.6	74.2	74.2
from Processing plant	v/d	0	11.1	136.1	18.3	11.1	51.9	11.1
from Recycling centres	v/d							
Final	v/d							
Recycling	v/d							
Recovery or product	v/d							
Landfill	v/d (m ³ /d)	741.1, (926.4)	730.0, (912.5)	615.0, (768.8)	Heat :2200 GJ/d 374.5, (314.8)	Heat :2200 GJ/d 382.2, (324.4)	Heat :2200 GJ/d 340.4, (425.5)	Heat :2200 GJ/d 382.2, (477.8)
Storage cap.	nos.	88,413	71,767	132,626	71,767	107,650	71,767	107,650
110 l dustbin	nos.	8,918	7,239	13,377	7,239	10,860	7,239	10,860
1.1 m ³ container	nos.	1,375	1,116	2,748	1,116	2,231	1,116	2,231
6-10 m ³ container	units	74	60	82	60	66	60	66
Compaction truck	units	35	29	39	29	31	29	31
Hoist truck	units	13	11	14	11	12	11	12
Dump truck	units	0	7	0	7	7	7	7
Roll-on roll-off truck	units							
Recycling Centres	sites	nil	2	nil	2	2	2	2
Large (A = 3000 m ²)	sites	nil	6	nil	6	6	6	6
Small (A = 2000 m ²)								
Intermediate treatment plant								
		nil	nil	Sorting plant 320 v/d	Incineration plant 744 v/d	Incineration plant 648 v/d	Composting plant 685 v/d	Composting plant 548 v/d
Final disposal amount from 1994 until 2010	m ³	4,573,000	4,531,000	4,096,000	2,697,000	2,762,582	3,038,122	3,199,234
Cost	mill. z	465,854	442,152	742,715	1,002,402	1,011,058	703,802	753,688
Total investment	mill. z	70,704.1	66,429.9	101,329.6	130,103.2	126,986.9	93,341.0	95,551.6
Annual O & M Cost	mill. z	0	8	29	39,513	39,502	28	2,395
Annual Sale	mill. z							

6) Examination of Institutional Requirements

The institutional requirements for the alternatives are presented as general requirements to be applied at national and regional levels and specific requirements addressed to Poznan Municipality and the recommended technical Master Plan alternatives.

The selection of the most appropriate Master Plan alternative should not be determined from the institutional aspect. Since institutional demands generally result from prevailing technological conditions, attention should be given instead, to the selection of the optimum technical system.

7) Evaluation of each Alternative

The four evaluation criteria used for highlighting the distinguished features of the alternatives are:

- technical desirability
- social acceptability and public cooperation
- environmental acceptability
- economic/financial viability

The alternatives identified are ranked quantitatively and qualitatively based on the above-mentioned evaluation criteria.

8) Selection of the Optimum Alternative

a. Overall evaluation

The evaluation results based on each of the four evaluation criteria are summarized in a matrix form in Table 3.1-2. A neighbourhood consensus is difficult to obtain for the construction of a final disposal site for alternatives 1 and 2 due to the absence of an intermediate treatment facility.

Table 3.1-2 Overall Evaluation

Criteria	Alternatives						
	1	2	3	4	5	6	7
1. Technical Evaluation	B	B	B	A	A	A	A
2. Social Evaluation	C	C	B	A	A	B	B
3. Environmental Evaluation	C	C	C	A	A	B	B
4. Economic/Financial							
a. Economic Evaluation	A	A	B	C	C	B	B
b. Financial Evaluation	A	A	B	B	B	B	B
Overall Evaluation	C	C	C	A	A	B	B

Note: A: Good, B: Fair, C: Poor

Although Alternative 4 and 5 were ranked "A", Alternative 5, including separate collection, is superior because of higher reliability regarding incineration of municipal solid waste.

b. Recommendation

At the Steering Committee meeting on the Interim Report, the Study Team based on the overall evaluation, recommended that:

- i. Upon consideration of the financial viability of the Municipality and its citizens, Alternative 5 should be selected as an optimum technical system of the MSWM Master Plan if the Poznan Municipality can afford its share of the burden and wishes to achieve the goal established.
- ii. If the Municipality as well as its citizens will not shoulder the finances for the introduction of an incineration system, Alternative 2 should be selected as an optimum technical system of the MSWM Master Plan because the economic and financial evaluation results show that Alternative 2 is superior.

c. Selection of the Optimum alternative

The Steering Committee selected Alternative 5 for the MSWM technical system Master Plan for Poznan City, provided that this decision would be confirmed and approved by the Poznan City Council by 30 November, 1992.

The Poznan City Council approved the decision on 15 December, 1992.

3.2 The Master Plan

1) Planning Framework

a. Goal, targets and strategy

i. Goal

Development of an environmentally sound solid waste management system

The goal of the Solid Waste Management Master Plan is achieved through:

- *Citizens' participation*
- *Establishment of self-sustainable solid waste management*
- *Resource recovery and recycling*

ii. Targets

- To attain 100% collection service rate by the year 2001.
- To incinerate 100% combustible waste by the year 2010.
- To start operation of the sanitary disposal site by the year 1995.
- To terminate illegal dumping by the year 2001.

Table 3.2-1 Target Schedule unit: %

Target	1992 (existing)	1995	2001	2006	2010
Collection Service	90	93	100	100	100
Incineration	0	0	33	66	100
Sanitary landfill	* 1	100	100	100	100
Illegal dumping	10	7	0	0	0

Note: *1 The present landfill operation is not considered as a 100% sanitary landfill due to the insufficient environment protection measures.

iii. Strategy for the attainment of goal

The proposed strategy for the attainment of the Goal is detailed in six paragraphs as follows:

- Provision of facilities to apply to the basic objective for the execution of the Solid Waste Management.
- Provision of solid waste services and facilities to minimize of solid waste production and the need for landfill, and to utilize solid waste as second raw material and for energy production, according to the nature of the solid waste.
- Provision of appropriate and scheduled services to the citizens for the proper storage, collection and reception of solid waste. Illegal dumping must be eliminated.
- Self-financed solid waste management through the increase of citizens' burden.
- Increase in public involvement in environmental protection and increase in public attention on environmental matters.
- Full control over activities related to Solid Waste Management and the cleanliness of the City.

b. Target year and population

i. Target year

The master plan covers the year 1994 to 2010. The targeted years for the master plan are as shown in Table 3.2-2.

Table 3.2-2 Target Year

Plan	Target Year
Master Plan	1994 to 2010
Long Term Improvement Plan	2004 to 2010
Medium Term Improvement Plan	1999 to 2003
Short Term Improvement Plan	1994 to 1998

ii. Population forecast

The Urban Development Master Plan of Poznan City estimated a population ranging from 610,000 to 620,000 in 2010. Consequently, the 620,000 population estimated in 2010 was adopted for the SWM Master Plan, as shown in Table 3.2-3.

Table 3.2-3 Population Forecast unit:person

Year	1992	1995	2001	2005	2010
Population	590,100	595,083	603,388	611,693	620,000

c. Forecast on waste amount and composition

i. Forecast on waste amount

Methodology

Waste generation will be projected based on the increase in population, however creating a margin for the increase in generation ratio attributed to increase in GDP.

Discharge ratio of domestic ash from households is assumed to reach zero (0) by the year 2001 due to increase in PEC consumers and change in heating source from coal to other modes.

The most direct influence on waste generation is the change in population, and the estimated annual population growth in Poznan Municipality for the planning period is 0.275 %.

Based on the Japanese statistics regarding the relation between GDP and waste generation, the increase in waste generation per capita per year is estimated as:

- 1993 - 2000 1.4 %/year
- 2001 - 2010 2.7 %/year

Forecast on waste amount

The forecast for MSW and other wastes is presented in Table 3.2-4 based on the WACS results and the above-mentioned assumptions.

Table 3.2-4 Forecast for MSW and Other Wastes, Poznan Municipality

unit:ton/day; 1 year=365 days

	1992	1994	1998	2001	2003	2007	2010
1. MSW							
Household	283.2	292.9	313.1	333.4	353.5	397.6	434.1
Domestic Ash	102.8	77.5	26.3	0	0	0	0
Shop	4.9	5.0	5.4	5.7	6.1	6.8	7.5
Catering	27.6	28.6	30.5	32.5	34.5	38.8	42.4
Market	6.0	6.2	6.6	7.1	7.5	8.4	9.2
Institutional	9.3	9.7	10.3	11.0	11.7	13.1	14.3
Road Sweeping	4.0	4.2	4.4	4.7	5.0	5.7	6.1
Bulky	15.7	16.3	17.3	18.5	19.6	22.0	24.1
2. Other Wastes	82.4	85.2	91.0	96.9	102.8	115.6	126.3
Total	535.9	525.6	504.9	509.8	540.7	608.0	664.0

ii. Forecast on waste composition

In Table 3.2-5, results of the MSW from the WACS are compared with the data in Poland provided in the EC-Study; Municipal Waste -Strategy for Waste Management and Applicable Methods for Collection and Treatment, 1992. Data from a developed country like Denmark were also take into account.

Table 3.2-5 Comparison of Waste Composition Data for MSW unit:%

	* WACS 1992 without Ash	WACS 1992 with Ash	EC- Study, 1992	EC- Study, forecast 2010	Denmark 1985
1. Combustibles	76.6	58.5	56	64	85
Garbage	33.9	25.9	38	27	35
Paper	19.3	14.7	14	28	41
(Dry Paper)	-	-	-	-	(17)
(Wet Paper)	-	-	-	-	(24)
Textile	7.3	5.6	2	2	-
Plastic	7.9	6.0	2	5	6
Grass and Wood	5.9	4.5	-	-	-
Leather and Rubber	2.3	1.8	-	-	-
Others	-	-	-	2	3
2. Non-Combustibles	23.4	41.5	44	36	15
Metal	3.8	2.9	2	14	4
Glass	15.2	11.6	7	-	7
Ceramic and Soil	1.5	1.2	-	-	-
Inorganic	-	23.7	35	22	-
Others	2.9	2.2	-	-	4
Total	100	100	100	100	100

Note: * Composition of MSW (without ash and measured) excluding road sweeping and bulky wastes.

WACS : Waste Amount and Composition Survey

Referred to Table 3.2-5, the frame of the waste composition in 2010 is set as follows:

- Paper ratio will increase up to 28% as forecasted by the EC study.
- Non-combustible ratio will decrease up to 20%, a ratio in between the WACS without ash and Denmark 1985 ratios.
- Other fractions would only be considered as minor changes.

Based on the above, forecast for composition of MSW is done and tabulated in Table 3.2-6.

Table 3.2-6 Forecast for Composition of MSW without Ash, Poznan

unit: %

Composition	1992	1994	1998	2001	2003	2007	2010
Garbage	33.9	33.9	33.9	34.0	34.0	34.0	34.0
Paper	19.3	20.3	22.2	23.6	24.6	26.5	28.0
Textile	7.3	7.0	6.5	6.1	5.9	5.4	5.0
Plastic	7.9	7.9	7.9	8.0	8.0	8.0	8.0
Grass and Wood	5.9	5.7	5.3	4.9	4.7	4.3	4.0
Leather and Rubber	2.3	2.2	1.9	1.7	1.5	1.2	1.0
Metal	3.8	3.9	4.2	4.4	4.5	4.8	5.0
Glass	15.2	14.6	13.5	12.6	12.0	10.9	10.0
Ceramic and Soil	1.5	1.8	2.3	2.8	3.0	3.6	4.0
Others (Non-combustible)	2.9	2.7	2.3	1.9	1.7	1.3	1.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: MSW here excludes road sweeping and bulky waste.

iii. Forecast for calorific value

Table 3.2-7 shows our survey data and the data of the 1984/85 waste study.

Table 3.2-7 Comparison of Three Contents and LCV, Poznan

	1992 JICA			1984/85 Waste Study
	MSW Without Ash	MSW With Ash	(Coal Heating) Household With Ash	
Moisture content (%)	35.7	37.9	41.9	41.8
Combustible (%)	38.0	31.4	20.0	24.1
Ash (%)	26.2	30.7	38.1	34.1
Lower calorific value				
Measured (kcal/kg)	1,854	-	-	856
Estimated (kcal/kg)	1,805	1,437	806	-

Note: MSW excludes road sweeping and bulky waste.

The data shown above in 1992 by JICA Study are weighing averages, taking the waste discharge amount by each generation category into account.

The LCV (Lower Calorific Value) of MSW in future is estimated by multiplying the LCV of combustible wastes in the wet base by the ratio of the future physical composition.

Based on the data in Japan, the LCV of separated waste is estimated in Table 3.2-8 assuming a 10% inclusion of non-combustibles into combustible waste.

Table 3.2-8 Forecast for Lower Calorific Value

Year	Lower Calorific Value (kcal/kg)	
	Mixed	Separate
1992	1,805	2,199
1994	1,820	2,214
1998	1,844	2,244
2001	1,865	2,270
2003	1,877	2,284
2007	1,904	2,315
2010	1,924	2,338

Note: MSW excludes domestic ash and road sweeping and bulky waste.

d. Future waste stream

The waste stream forecast for the year 2010 is as shown in Fig. 3.2-1.

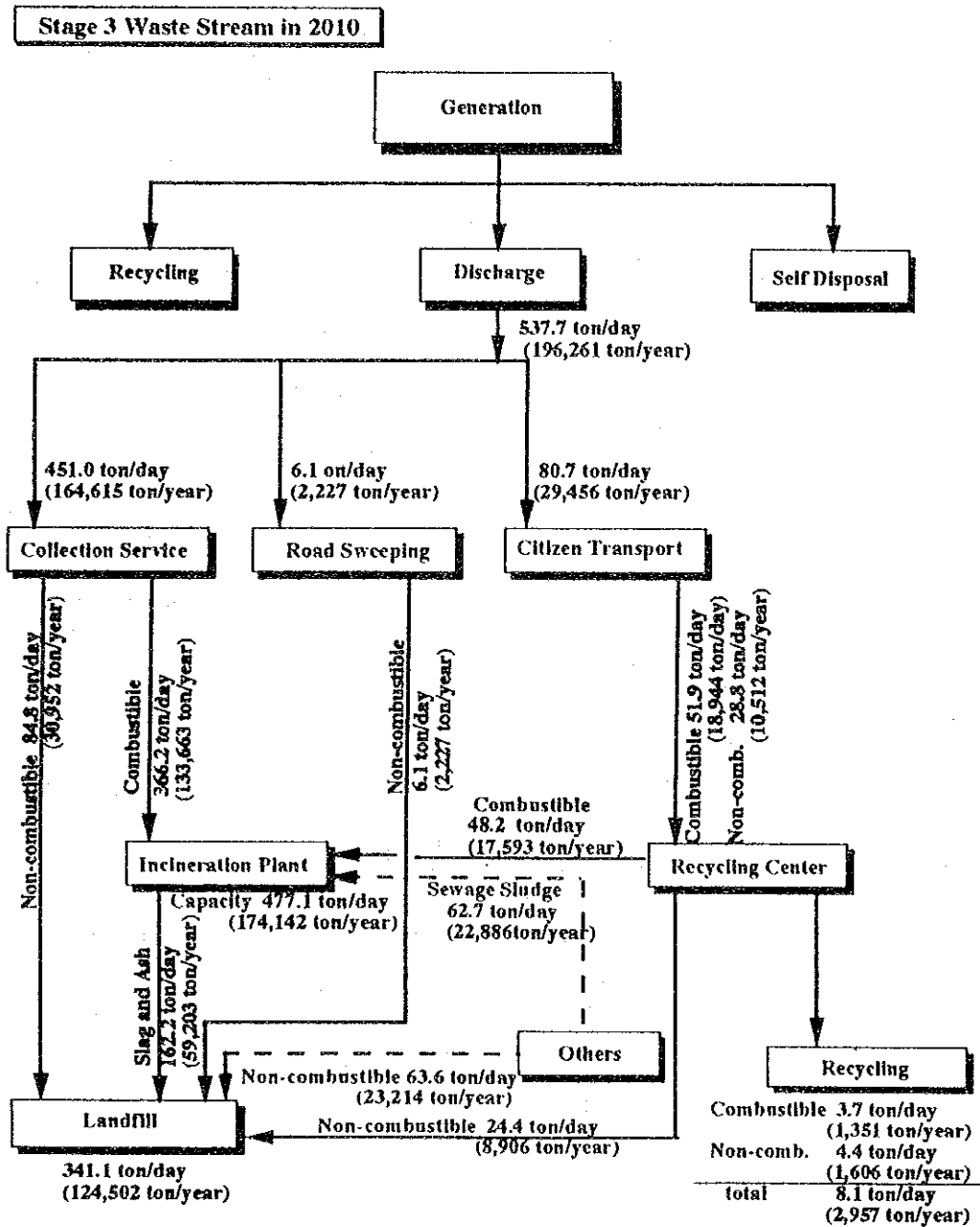


Fig.3.2-1 Waste Stream in 2010

e. Economic and financial condition

The economy of Poland is being restructured at present. The economic growth rate for the past several years showed a downward trend due to the collapse of the former economic system although steady growth can be expected if the social economic condition becomes stable after the socio-economic structure is successfully reconstructed.

The following two projected cases of economic growth rate (GDP) are assumed in the study:

- case A: 1995 same as 1990 level
- 1996 - 2000 3 % increase/year
- 2001 - 2010 6 % increase/year

- case B 1995 same as 1990 level
- 1996 - 2000 3 % increase/year
- 2001 - 2010 4.5 % increase/year

Table 3.2-9 GDP Estimate in 1990 Constant Price (million USD)

	1990	1992	1995	2000	2005	2010
GDP (bill.USD)						
Case A	63.6	63.6	63.6	73.7	98.7	132.0
Case B	63.6	63.6	63.6	73.7	91.9	114.5
Financial affordability of the municipality (bill.zl) *						
Case A		916	916	1,062	1,421	1,902
Case B		916	916	1,062	1,323	1,649

Note: This is assumed to increase in accordance with the increase rate of GDP.

f. Conditions for cost estimation

All design and cost estimates presented are based on the assumption that new facilities for Poznan will be designed and constructed to meet prevailing EC standards. However, one must bear in mind that the present economy of Poland cannot

realistically afford overnight steps to change the level and standard of the facilities. Improvements can only be obtained gradually.

2) Technical System

a. Outline of technical system

The proposed technical system for the MSWM Master Plan is summarized and tabulated in Table 3.2-10.

b. Phased implementation plan

The phased implementation plan of the MSWM Master Plan for the technical system is elaborated as shown in Fig. 3.2-2.

Table 3.2-10 Outline of Technical System in 2010

Technical Sub-Systems	Contents
<p>1. Discharge and Storage a. Amount of discharge b. Type of Refuse Bins</p>	<p>196,261 tons/year (537,7 tons/day) In addition to the present system, paper bags will be used for detached houses.</p>
<p>2. Collection and Haulage a. Coverage Ratio b. Collection System Provided c. Amount of Waste Collected (304 days of work a year)</p>	<p>100% - Regular separate collection of combustibles and non-combustibles - Bulky waste collection - Recycling centre collection - Regular collection of combustibles : 439.7 tons/day - Regular collection of Non-combustibles : 101.8 tons/day - Bulky waste collection : 29.0 tons/day - Recycling centre collection : 67.8 tons/day <hr/> Total : 638.4 tons/day</p>
<p>3. Public Recycling Centres a. Number of Centres b. Waste Amount (304 days/year)</p>	<p>8 places in total, 2 for large (3,000 m²) and 6 for small (2,000 m²) Input: from bulky waste collection : 29.0 tons/day from recycling centre collection : 67.8 tons/day Output: to incineration plant : 57.8 tons/day to recycling : 9.7 tons/day to final disposal : 29.3 tons/day</p>
<p>4. Road Sweeping and Public Area Cleansing</p>	<p>The same as the present system</p>
<p>5. Intermediate Treatment a. Proposed Site b. Received Waste c. Capacity d. Working Hours e. Heat Recovery</p>	<p>Franowo-Michalowo, Area 5.0 ha MSW excluding road sweeping and non-combustible wastes, and sewage sludge and hospital wastes 10 tons/hour/line x 3 lines and 720 tons/day 24 hours/day and 7,000 hours/year Hot water supply 1,215 TJ/year</p>
<p>6. Final Disposal a. Proposed Site b. Daily Disposal c. Cumulative Disposal Amount d. Landfill Method e. Landfill Area</p>	<p>Franowo-Michalowo and site area 47.4 ha 369 cu.m/day and 341.1 tons/day 3,100,000 cu.m from 1995 to 2010 Sanitary landfill and leachate is carried to sewage treatment facility 24.8 ha from 1995 to 2010</p>
<p>7. Recycling a. Recycling Facility b. Others</p>	<p>Non specific facility will be provided except for public recycling centres in the private sector. Administrative support to private recycling business and introduction of on-site composting.</p>

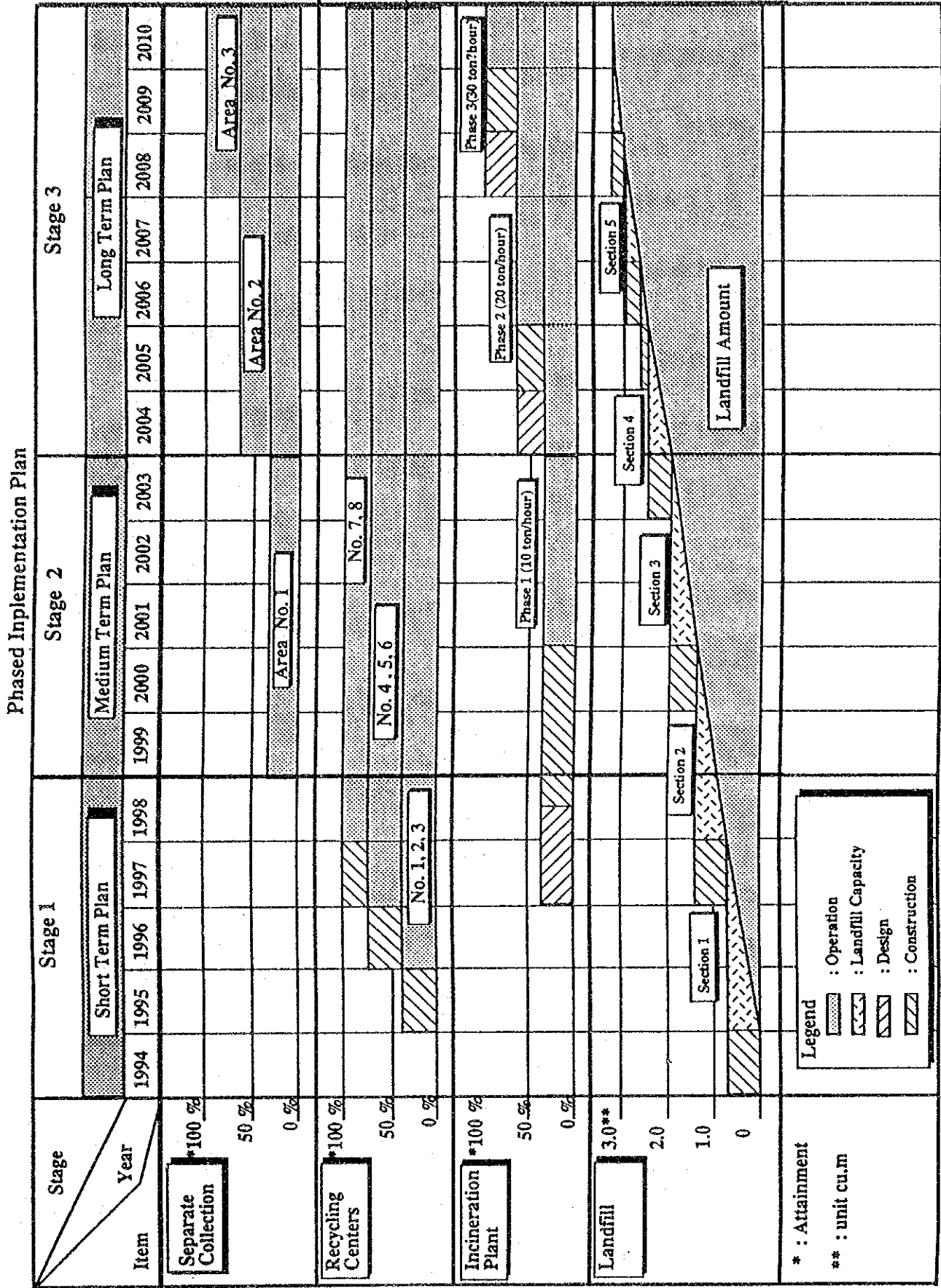


Fig.3.2-2 Phased Implementation Plan of MSWM Master Plan

3) Institutional system

a. Strategy for institutional and organizational development in Poznan Municipality

The general modernization of MSWM in Poznan Municipality and the increase in activities to be carried out make it appropriate to determine a strategy for the institutional and organizational development.

The basic philosophy in the strategy is that MSWM is a public task and, thus, should be operated under public control. It is, however, recommended that subordinate municipal companies, business-like in structure and orientation, should be formed to smoothen the daily operation. Aside from recommending the introduction of competitive bidding, the following guidelines were recommended, too:

- Service of MSWM will be executed by subordinate independent companies under municipal control in a business-like manner to facilitate decision-making and administration.
- Competitive bidding regarding cleansing services (i.e. collection, road sweeping, etc.) must be introduced to secure the best service for least costs.
- Facilities that will contribute to the pollution of the environment after their primary operation shall be owned 100% by the Municipality (e.g. a sanitary landfill).
- In case a private investor becomes a shareholder of the municipal company, the Municipality must secure ultimate public control for services related to compulsory waste services.
- If compulsory municipal waste services are performed parallel to commercial waste services, a division of these group of activities must be done in order to control costs.
- Fees and charges will be imposed and collected by the Municipality for public services determined by the Law or by municipal regulation.
- Activities related to overall planning and administration will remain in the municipal organization under strengthened power.
- The Municipality will exercise independent control over the activities (municipal control).

The study also includes important recommendations for solid waste management at national and regional levels. One of the recommendations is the vesting of the regional level, which is in a continually weakening state, with discretionary powers regarding SWM, to enforce improved operation of waste treatment and disposal facilities and improved training of staff.

b. Overall institutional system for Poznan Municipality

Table 3.2-11 shows the proposed institutional system for Poznan Municipality. A Department for Municipal Solid Waste Management will be formed from the present Department for Communal and Residential Affairs and will be responsible for tasks related to planning, administration, collection of fees and control and supervision.

For execution of waste services the following is proposed:

- Compulsory municipal collection systems and operation of recycling centres are tendered to private contractors. If parts of the districts are entrusted directly to Rethman-Poznan Waste Management Co. Ltd., the contract price for tendered districts should be the basis in determining the price for the services of the company.
- Incineration plant and sanitary landfill shall be operated by a municipally owned company.
- Road sweeping services will be tendered to private contractors by the Provincial Road Authority and the Department for Municipal Solid Waste Management.
- Public area cleansing services will be tendered to private contractors by the Forest Authority and the Green Area Authority.

Table 3.2-11 Institutional Plan

Category	Responsible Organization	Work Items
RESPONSIBLE BODY	Department for Municipal Solid Waste Management in Poznan Municipality	<ul style="list-style-type: none"> - Planning - Administration - Collection of fees - Control and supervision
IMPLEMENTING/BODIES	Department for Municipal Solid Waste Management in Poznan Municipality through direct tender	Operation of: <ul style="list-style-type: none"> - Collection system - Recycling centres - Bulky waste collection
	Poznan Waste Treatment and Disposal Company	Operation of: <ul style="list-style-type: none"> - Incineration plant - Sanitary landfill
	Provincial Road Authority and Department for Municipal Solid Waste Management through direct tender	Execution of road sweeping
	Forest Authority and Green Area Authority through direct tender	Execution of public area cleansing
INVESTMENT	Department for Municipal Solid Waste Management in Poznan Municipality	<ul style="list-style-type: none"> -Recycling centers -Bulky waste collection
	Rethman-Poznan Waste Management Co.,Ltd.	-Regular collection
	Poznan Waste Treatment and Disposal Company	<ul style="list-style-type: none"> -Incineration plant -Sanitary landfill
	Others	<ul style="list-style-type: none"> -Regular collection -Public area cleansing

4) Financial Plan

a. Required finances and their sources

The required investment cost and its proposed sources are presented in Table 3.2-12.

Table 3.2-12 Required Investment Cost and Its Financial Sources

unit: mill.zł

	1994 - 2000	2001 - 2005	2006 - 2010	Total
Investment Cost				
Public Recycling Centres	17,644	5,864	5,394	28,902
Incineration Plant	539,155	252,770	252,770	1,044,695
Sanitary landfill	103,926	45,736	46,566	196,228
Bulky Waste Collection	640	640	640	1,920
Total	661,365	305,010	305,370	1,271,745
Financial Sources				
Budget of Poznan Municipality	18,284	6,504	6,034	30,822
Poznan Treatment & Disposal Co.	643,081	298,506	299,336	1,240,923
(long-term loan)	(379,155)	(252,770)	(252,770)	(884,695)

Note:

- The cost of replacing old trucks for regular collection, road sweeping and public area cleansing is not included.
- Long-term loan is only for the incineration project. As for the sanitary landfill project, the investment for Section 1 will be covered by short-term loan and the investment for Section 2 will be made by the internal reserves.

The required annual expenditure is presented in Table 3.2-13.

Table 3.2-13 Annual Expenditure

unit: mill.zł

Category	1995	2000	2005	2010
Regular Collection	46,073	38,211	44,686	51,689
Public Recycling Centres	-	9,989	10,390	10,390
Incineration Plant	-	-	48,010	104,913
Sanitary landfill	15,034	14,884	15,393	14,291
Bulky Waste Collection, Road Sweeping and Public Area Cleansing	9,008	9,008	9,008	9,008
Total	70,115	72,092	127,487	190,291

Note: - O & M cost and depreciation are included in the figure above.

Based on the following conditions, the waste collection fee shown in Table 3.2-14 were estimated.

- International lending agencies shall be the financial sources of the incineration plant and the landfill project.
- Required internal rate of return is more than 15 %.
- Other projects should be self-financed.

Table 3.2-14 Solid Waste Fee

unit: zl/ton

	in 1992	1995 - 2000	2001 - 2010
Treatment and Disposal	117,000	139,000	537,000
Collection	278,000	314,000	314,000

b. Money Flow

Overall money flow is presented in Fig.3.2-3.

The Municipality collects fees from householders. The expenses of the activities of Poznan Treatment and Disposal Company are covered by the sale of heat and tipping fees.

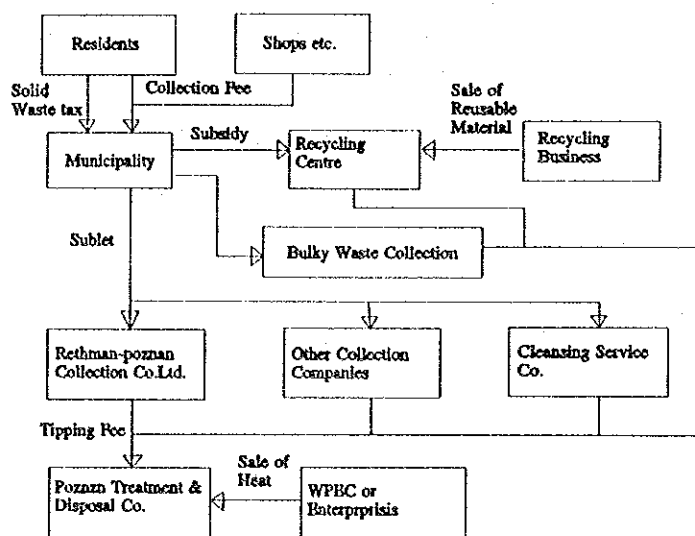


Fig.3.2-3 Money Flow for MSWM

c. Fee collection system

Every fee collection system has its advantages and disadvantages. A fee collection system according to weight of waste discharged should be introduced by 2010 in order to maintain equality. However, the waste fee system based on the number of persons and waste tax based on their income were proposed, because there are many difficulties involved in introducing the former. The waste fee list is shown in Table 3.2-15.

Table 3.2-15 Waste Fee List

unit: zł

Fee	unit	Present	1995 - 2000	2001 - 2005	2006 - 2010
Collection Fee					
- General Waste					
Household	zł/person/month	5,500	5,635	5,635	5,940
Shops	zł/m ² /month	NA	1,210	2,420	2,910
Market	zł/ton	NA	453,000	851,000	851,000
- Bulky Waste	zł/ton	-	625,000	1,023,000	1,023,000
Solid Waste Tax	zł/household/ month	-	8,290	27,920	33,580
Tipping Fee					
- Standard	zł/ton	117,000	139,000	537,000	537,000
- Special	zł/ton	-	-	1,790,000	1,790,000

Note:

- Collection fee for shops, market and bulky waste shall include collection, treatment and disposal costs.
- Collection fee for household waste shall include collection cost only.
- Solid waste tax shall include treatment and disposal costs.
- Collection fee shown at "present" excludes disposal cost from the collection fee of Corporative apartments.

d. Amount shouldered by citizens and Poznan Municipality

Amount shouldered by citizens is presented in Table 3.2-16.

Table 3.2-16 Amount shouldered by Citizens

	unit	1992	1995	2000	2005	2010
Citizens' Cost-Burden (per year)						
- Solid Waste Tax	mill.zł	-	17,914	18,164	62,019	75,604
- Collection Fee	mill.zł	41,486	40,240	40,801	41,363	44,194
- Bulky Waste Collection Fee	mill.zł	-	1,129	1,225	2,330	2,700
- Dustbin	mill.zł	-	3,248	4,748	5,882	5,882
Total	mill.zł	41,486	62,531	64,938	111,594	128,380
Number of Family	nos	178,573	180,081	182,594	185,108	187,621
Burden per Family (per month)	zł	19,360	28,937	29,637	50,238	57,021
Average Monthly Income	1000 zł	3,824	3,792	4,335	5,723	7,556
Rate of Citizens' Cost-Burden	%	0.51	0.76	0.68	0.88	0.75

Amount shouldered by the municipality of Poznan is presented in Table 3.2-17.

Table 3.2-17 Amount shouldered by Poznan Municipality

	unit	1992	1995	2000	2005	2010
Municipality's Cost-Burden						
- Capital Investment *1	mill.zl	10,500	6,508	1,380	1,380	2,320
- O & M cost of P.R.C.	mill.zl	-	0	11,034	20,832	22,890
- Public Area Cleansing	mill.zl	10,100	8,213	8,233	9,039	9,196
- Control and Supervision	mill.zl	0	6,083	6,083	6,083	6,083
- Subsidies for Containers *2	mill.zl	0	0	0	0	0
Total	mill.zl	20,600	20,804	26,730	37,334	40,489
Budget of Municipality	bill.zl	916	916	1,062	1,421	1,902
Municipality's Cost-Burden	%	2.25	2.27	2.52	2.63	2.13

- Note:
- *1 The capital investment includes the construction cost of P.R.C., replacement cost of containers for P.R.C, and the first purchase cost of bulky waste collection equipment.
 - *2 Subsidies for purchase of containers are required only in 1998, 2002 and 2006. They are, therefore, not shown in this table.

Table 3.2-18 Balance Sheet

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Revenue																	
Waste Tax*		17,914	17,964	18,014	18,064	18,114	18,164	61,345	61,513	61,682	61,850	62,019	74,794	74,996	75,199	75,401	75,604
Collection Fee																	
General collection	0																
Household*		40,240	40,352	40,464	40,577	40,689	40,801	40,913	41,026	41,138	41,250	41,363	43,720	43,838	43,957	44,075	44,194
Shops etc.		5,501	5,516	5,532	5,547	5,562	5,578	11,186	11,217	11,248	11,278	11,309	13,636	13,673	13,710	13,747	13,784
Market etc.		2,662	2,712	2,761	2,794	2,844	2,894	5,622	5,777	5,964	6,119	6,305	6,492	6,678	6,896	7,082	7,299
Bulky collection*	0	1,129	1,150	1,170	1,184	1,205	1,225	2,072	2,140	2,196	2,263	2,330	2,397	2,464	2,543	2,621	2,700
Sale																	
Container*	3,248	3,248	3,248	3,248	3,916	4,748	4,748	3,931	4,953	5,621	5,834	5,882	5,637	6,814	6,843	7,075	5,882
PM budget allocation	0	14,296	19,347	24,003	26,918	26,964	27,020	35,793	36,185	36,499	37,331	37,683	38,095	38,546	38,938	39,408	39,898
Subtotal(A)	3,248	84,991	90,289	95,193	99,001	100,126	100,430	160,863	162,812	164,347	165,925	166,891	184,771	187,009	188,084	189,410	189,261
Annual Expense																	
Contract out																	
General collection	0	66,469	62,848	59,111	56,283	55,738	55,126	107,783	110,983	114,306	117,630	121,109	124,743	128,377	132,198	136,111	140,087
Public cleansing **	0	8,213	8,218	8,223	8,223	8,228	8,233	8,921	8,960	8,980	9,019	9,039	9,078	9,117	9,137	9,176	9,196
P.R.C.**	0	0	4,370	8,405	10,943	10,984	11,034	19,120	19,473	19,767	20,499	20,832	21,204	21,616	21,988	22,420	22,890
Bulky collection	0	1,177	1,182	1,186	1,189	1,194	1,198	2,014	2,049	2,079	2,114	2,149	2,184	2,220	2,261	2,302	2,343
Control & Supervise**	0	6,083	6,083	6,083	6,083	6,083	6,083	6,083	6,083	6,083	6,083	6,083	6,083	6,083	6,083	6,083	6,083
Subsidy for container**	0	0	0	0	3,914	0	0	0	3,914	0	0	0	3,352	0	0	0	0
Purchase of container	3,248	3,248	3,248	3,248	3,916	4,748	4,748	3,931	4,953	5,621	5,834	5,882	5,637	6,814	6,843	7,075	5,882
Depreciation***	0	82	758	1,374	1,751	1,751	1,751	1,751	1,751	1,751	1,812	1,812	1,812	1,812	1,812	1,812	1,812
Interest	0	86	125	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal(B)	3,248	85,359	86,832	87,630	92,303	88,726	88,174	149,604	158,167	158,587	162,990	166,906	174,094	176,038	180,321	184,979	188,293
Balance	0	-368	3,458	7,563	6,697	11,400	12,255	11,260	4,645	5,760	2,935	-14	10,677	10,971	7,763	4,431	1,067

notes: Annual Expense is sum of O/M cost, Disposal cost of collection, depreciation cost and interest.

4 FEASIBILITY STUDY

4.1 Feasibility Study of the First Priority Project

1) Contents of the First Priority Project

Since the Poznan City Council approved the selection of Alternative 5 in December 1992, the contents of the first priority project for feasibility study are as follows:

- Construction of 8 public recycling centres;
- Construction of Franowo-Michalowo incineration plant Phase 1; and
- Construction of Franowo-Michalowo sanitary landfill Section 1(W1).

2) Preliminary Design

In contrast to a disposal site distanced remotely from the city, the recommendation of Franowo-Michalowo, located within 7km from the centre of the city, as a disposal site will reduce transportation costs. To obtain the consensus of the residents, however, the proposed facilities must meet the strict environmental standard, hence the preliminary designs of both incineration plant and landfill for Franowo were made in accordance with the EC environmental standard. The designs were carried out in accordance with the European Standards and are summarized in Tables 4.1-1, 4.1-2, 4.1-3. The illustrations are in Plates 2, 3 and 4.

Table 4.1-1 Public Recycling Centres

Item	Plan										
a. Number of Centres	8 places in total, 2 large and 6 small centres										
b. Location	<ol style="list-style-type: none"> 1. between Naramowicka St. and Lechicka St. 2. in Marysienki Residential Area 3. in Sytkowo near Dabrowskiego St. 4. at the crossing of Grunwaldzka St. and Malwowa St. 5. in Swierczewo near Opolska St. 6. at the river Cybina near Zamenhofa St. 7. in Polna st. near Dabrowskiego St. 8. beside the incineration plant in Franowo 										
c. Waste amount through recycling centres (304 days/year)	<p>Input:</p> <table style="width: 100%; border: none;"> <tr> <td style="padding-left: 20px;">from Bulky waste collection</td> <td style="text-align: right;">: 29.0 tons/day</td> </tr> <tr> <td style="padding-left: 20px;">from Recycling centre collection</td> <td style="text-align: right;">: 67.8 tons/day</td> </tr> </table> <p>Output:</p> <table style="width: 100%; border: none;"> <tr> <td style="padding-left: 20px;">to Incineration plant</td> <td style="text-align: right;">: 57.8 tons/day</td> </tr> <tr> <td style="padding-left: 20px;">to recycling</td> <td style="text-align: right;">: 9.7 tons/day</td> </tr> <tr> <td style="padding-left: 20px;">to final disposal</td> <td style="text-align: right;">: 29.3 tons/day</td> </tr> </table>	from Bulky waste collection	: 29.0 tons/day	from Recycling centre collection	: 67.8 tons/day	to Incineration plant	: 57.8 tons/day	to recycling	: 9.7 tons/day	to final disposal	: 29.3 tons/day
from Bulky waste collection	: 29.0 tons/day										
from Recycling centre collection	: 67.8 tons/day										
to Incineration plant	: 57.8 tons/day										
to recycling	: 9.7 tons/day										
to final disposal	: 29.3 tons/day										
d. Proposed Area	<table style="width: 100%; border: none;"> <tr> <td style="padding-left: 20px;">Large centres</td> <td style="padding-left: 20px;">: 3,000 m² x 2 sites = 6,000 m²</td> </tr> <tr> <td style="padding-left: 20px;">Small centres</td> <td style="padding-left: 20px;">: 2,000 m² x 6 sites = 12,000 m²</td> </tr> </table>	Large centres	: 3,000 m ² x 2 sites = 6,000 m ²	Small centres	: 2,000 m ² x 6 sites = 12,000 m ²						
Large centres	: 3,000 m ² x 2 sites = 6,000 m ²										
Small centres	: 2,000 m ² x 6 sites = 12,000 m ²										
e. Equipment	<table style="width: 100%; border: none;"> <tr> <td style="padding-left: 20px;">Large centres</td> <td style="padding-left: 20px;">: 5 small and 16 large containers</td> </tr> <tr> <td style="padding-left: 20px;">Small centres</td> <td style="padding-left: 20px;">: 3 small and 10 large containers</td> </tr> </table>	Large centres	: 5 small and 16 large containers	Small centres	: 3 small and 10 large containers						
Large centres	: 5 small and 16 large containers										
Small centres	: 3 small and 10 large containers										
f. Personnel	<table style="width: 100%; border: none;"> <tr> <td style="padding-left: 20px;">Large centres</td> <td style="padding-left: 20px;">: 3 workers</td> </tr> <tr> <td style="padding-left: 20px;">Small centres</td> <td style="padding-left: 20px;">: 2 workers</td> </tr> </table>	Large centres	: 3 workers	Small centres	: 2 workers						
Large centres	: 3 workers										
Small centres	: 2 workers										

Table 4.1-2 Outline of Incineration Plant

Items	Contents	Remarks
a. Target Year	2001	
b. Service Population	206,000	
c. Proposed Site	Franowo-Michalowo	Site area 5.0 ha
d. Received Waste	Combustible Waste - Household Waste - Commercial Waste - Market Waste - Institutional Waste - Bulky Waste - Sewage Sludge - Hospital Waste	Calorific value Low 1,400 kcal/kg STD 2,100 kcal/kg High 2,500 kcal/kg
e. Capacity	10 ton/hour/line x 1 line	240 tons/day
f. Working Hours	24 hour/day	7,000 hours/year
g. Facilities Outline	Reception Facilities - Access road - Weigh bridge - Building for waste reception Waste pit Waste cranes Incineration Lines Boiler Bottom and Fly Ash Handling System Flue Gas Cleaning System Auxiliary Equipment	Movable grate system Water tube boiler (Natural water circulation) Semi-dry system Emission Gas Quality Dust: 30 mg/Nm ³ HCl: 50 mg/Nm ³ SO ₂ : 300 mg/Nm ³
h. Heat Recovery	Hot water supply	332 TJ/year
i. Personnel	80 persons	
j. Construction Period	4 Years	1997 Planing and Basic Design 1998 Tender and Construction 1999 Construction 2000 Construction and Test Run 2001 Take over

Table 4.1-3 Outline of Final Disposal Site

Items	Contents	Remarks
a. Target Year	1995	
b. Service Population	595,000	
c. Proposed Site	Franowo-Michalowo	Site area 47.4 ha
d. Waste to be Disposed	<ul style="list-style-type: none"> - Household Waste - Commercial Waste - Market Waste - Institutional Waste - Bulky Waste - Road Sweeping Waste - Other Wastes 	
e. Capacity	700,000 cu.m	
f. Life of Site	3 years	From 1995 to 1997
g. Landfill Method	Sanitary landfill	Leachate is carried to sewage treatment facility
h. Landfill Area	4.0 ha	From 1995 to 1997
i. Facilities Outline		
- Main Facilities	Enclosing structure, drain system	
- Environmental Protection Facilities	Buffer zone, gas removal, leachate collection and monitoring facilities.	
- Building and Accessories	Office and weighbridge, garage and workshop	
j. Equipment	Compactors, traxcavator, dump truck and tractor	
k. Personnel	18 persons	
l. Construction Period	1 Year	1994 Design and Construction

3) Project Cost

a. Investment cost

The foreign currency portion of financial cost includes 10% of import tax and 5% of turn over tax. The local currency portion of it includes only 5% of turn over tax. The economic cost excludes the import tax and turn over tax.

The investment costs of the 3 projects are estimated and shown in Table 4.1-4.

Table 4.1-4 Investment Cost unit: mill.zl

	Financial Cost			Economic Cost
	Foreign	Local	Total	
Public Recycling Centres	0	16,264	16,264	14,941
Incineration	379,155	160,000	539,155	401,852
Final Disposal	5,417	41,100	46,517	42,071
Total	384,572	217,364	601,936	458,864

- Note:
1. Investment was estimated based on 1993 price.
 2. Investments for Public Recycling Centres is a total of 3 years from 1995 to 1997.
 3. Investment for an incineration plant is a total of 3 years from 1998 to 2000.
 4. Cost for final disposal is the investment in 1994.
 5. Total cost includes engineering fees and physical contingencies.

b. Operation cost

Operation cost consists of the depreciation cost and the operation/maintenance cost which covers costs for fuel, personnel and management, etc.

Based on the above assumption, the operation cost in 2005 is calculated and shown below in Table 4.1-5.

Table 4.1-5 Operation Cost in 2005 unit: mill.zl

	Operation & Maintenance			Depreciation Cost	Total
	Personnel Cost	Fuel & Others	Maintenance Cost		
Public Recycling Centres	2,457	5,606	597	1,730	10,390
Incineration	6,380	7,540	3,480	30,610	48,010
Final Disposal	1,465	2,895	690	10,343	15,393
Total	10,302	16,041	4,767	42,683	73,793

4) Environmental Evaluation

The environmental evaluation of the first priority projects is presented in Tables 4.1-6, -7 and -8. In terms of the atmospheric impact of the incineration plant, it is confirmed that the estimated air quality near the plant complies with the Polish environmental standard.

Table 4.1-6 Environmental Evaluation of Public Recycling Centres

Item	Effect	Mitigation of Adverse Impacts
Water pollution	Decrease in the possibility of surface and ground water pollution by termination of illegal dumping.	Noise of incoming vehicles is negligible.
Noise		
Landscape		

Table 4.1-7 Environmental Evaluation of the Incineration Plant

Item	Effect	Mitigation of Adverse Impacts
Air Pollution	Improved air condition because incineration plants replace old district heat plants.	Emission from the incineration plant complies with the EC standard.
Water Pollution	Improved water condition at landfill because some organic components are incinerated.	Effluent from the incineration plant is treated properly.
Noise		Low noise from the incineration plant.
Odour	Odour at landfill is minimized because some organic components are incinerated.	Odour from the waste pit is emitted into furnace.
Preservation of Nature	Heat recovery from waste saves consumption of fossil resources.	

Table 4.1-8 Environmental Evaluation of the Disposal Site

Item	Effect	Mitigation of Adverse Impacts
Water Pollution	No surface and ground water pollution	Surface and ground water pollution by leachate can be prevented with the application of a waterproof liner.
Odour	No odour.	Odour will be reduced because some organic components are incinerated and immediate soil coverage is applied.
Noise	Elimination of noise around the existing site and along the access road.	Detectable but low.
Landscape	The landscape would be improved if the existing site is covered with green trees.	The change in the landscape is mitigated by the construction of a green belt.
Scattering of Waste	Termination of waste scattering at the existing site.	A movable fence and immediate soil coverage reduces waste scattering.

Note. All effects described in this table are attained by the termination of the operation of the existing Suchy Las landfill.

5) Project Evaluation

a. Methods of project evaluation

The method of project evaluation applied in this study are shown in Table 4.1-9.

Table 4.1-9 Project Evaluation Methods

Project	Public Recycling Centre	Incineration Plant	Sanitary Landfill
Economic Evaluation	- Cost-benefit analysis - Qualitative analysis	- Cost-benefit analysis - Qualitative analysis	(- Least cost method) - Qualitative analysis
Financial Evaluation (1)	nil	- Income and expenditure analysis in 2005	- Income and expenditure analysis in 2005
Financial Evaluation (2)	nil	- Financial analysis on Poznan Treatment and disposal Company from 1998 until 2015	

The method presented in the table were adopted for the following reasons:

- Economic evaluations on environmental projects are usually carried out based on a least cost method because quantitative benefits are too difficult to estimate.

- A cost-benefit analysis is used for the project that proposes an incineration plant in order to analyze its economic value on a national scale.
- The cost-benefit analysis is adopted for public recycling centres in order to analyze the cost saving effect of collection work.
- Qualitative analysis is adopted for a sanitary landfill project which fulfil the EC standard. Because it is an indispensable facility for MSWM, although the quantitative benefits are not expected.
- Financial evaluation is carried out on the following:
 - . Income and expenditure of the incineration plant in 2005.
 - . Income and expenditure of the sanitary landfill.
 - . Cash flow analysis of the Poznan Treatment and Disposal Company from 1998 to 2015.
- Financial evaluation is not carried out for public recycling centres because the Municipality proposes to operate them directly.

b. Methods of economic evaluation

The economic evaluation methods applied in this study are shown in Table 4.1-10.

Table 4.1-10 Benefits, Costs and Criteria

	Public Recycling Centre	Incineration Plant	Sanitary Landfill
Benefit	<ul style="list-style-type: none"> - Recovery of reusable substances * - Cost saving on collection * - Cost saving on final disposal * - Termination of illegal dumping * 	<ul style="list-style-type: none"> - Recovery of heat * - Saving haulage cost - Reduction of final disposed volume * - Incineration of sewage sludge - Incineration of hospital waste - Others <ul style="list-style-type: none"> . Environmental improvement . Promotion of regional development 	<ul style="list-style-type: none"> - Environmental improvements <ul style="list-style-type: none"> . Improvement of sanitary conditions . Preservation of ground water . Protection from scattering waste
Cost	<ul style="list-style-type: none"> - Investment - O & M - Treatment and disposal 	<ul style="list-style-type: none"> - Investment - O & M - Treatment and Disposal 	<ul style="list-style-type: none"> - Investment - O & M
Criteria	$B - C > 0$	$EIRR > 15\%$	
Evaluated Period **	from 1995 until 2010	from 1998 until 2015	

Note: * These were analyzed quantitatively.
 ** Evaluation period was determined based on the construction year and their life years.

c. Methods of financial evaluation

The income, expenditure and evaluation criteria for financial evaluation are tabulated in Table 4.1-11.

As for public recycling centres, the financial evaluation is not carried out because the Municipality proposes to operate them directly due to much less income (sale of reusables) than expenditure (O&M cost, disposal cost, depreciation and interest).

Table 4.1-11 Income, Expenditure and Evaluation Criteria

	Incineration Plant	Sanitary Landfill
Income	- Sale of heat - Tipping fee . standard fee . special fee for * sewage sludge * hospital waste	- Tipping fee
Expenditure	- O & M - Disposal cost of residues - Depreciation - Interest (7.5%; 3 years grace period)	- O & M - Depreciation - Interest (13.5%)
Criteria 1	FIRR > 8 %	FIRR > 8 %
Evaluation Period	from 1998 until 2015	from 1994 until 2010 *
Criteria 2	FIRR > 15%	
Period for Evaluation	from 1998 until 2015 **	

Note: * The financial evaluation of the only sanitary landfill project was determined based on the target year of the Master Plan.

** Evaluation period was determined based on the construction year and life year of the incineration plant.

Main assumptions on income and expenditure analysis are as follows:

- Income and expenditure of the incineration plant from 2010 will remain the same.
- The amount of investment, operation, maintenance and income after 2010 will remain the same until 2015.
- Income and expenditure of the landfill after 2000 will remain the same.

d. Economic and market prices

The economic and market prices used in the economic and financial evaluation are as follows:

Table 4.1-12 List of Economic and Market Prices

	Unit	Economic Price	Market Price
- Sale of heat	zl/GJ	92,100	88,300
- Haulage of waste	zl/ton	314,000	314,000
- Incineration of sewage sludge	zl/ton	1,790,000	1,790,000
- Final disposal	zl/ton	139,000	139,000
- Compensation	zl/ton	52,200	-
- Land use	USD/ha	241.5	-
- Reusable components			
. Glass	zl/ton	60	60
. Textile	zl/ton	580	580
. Paper	zl/ton	400	400
. Metal	zl/ton	4,650	4,650
- Incineration plant			
. Foreign currency portion	mill. USD	21.00	24.15
. Local currency portion	mill. zl	75,200	160,000
. O & M	mill. zl/year	17,400	17,400

e. Proposed waste collection fee and tax

The waste collection fee and tax proposed are shown in Table 3.2-15.

f. Project evaluation

i. Evaluation of public recycling centres

The quantitative analysis shows that the construction of public recycling centre is feasible according to the following reasons.

- $B/C = 1.22$
- Present value = 13,426 mill.Zl (discount rate - 15%)
- EIRR = 29.4 %

The qualitative analysis also concluded its feasibility because of the termination of illegal dumping cases.

Since the income and expenditure analysis of public recycling centres proved that the expenditure exceeds the income, their operation will not be possible without financial support.

ii. Evaluation of the incineration plant

The economic evaluation concluded the construction of an incineration plant to be feasible because of a 15.8 % EIRR.

The results of the qualitative analysis on the following effects also concluded the construction to be feasible.

- Sanitary treatment of hospital wastes
- Decrease in amount of methane generated at landfills
- Improvement of landfill sanitary level
- Promotion of regional development by using heat energy

The financial evaluation between 1998 and 2015 only limited to the incineration plant Phase 1 also showed an 7.7 % FIRR.

In addition, the FIRR of the whole incineration project including Phase 2 and 3 was estimated to be 9.9 %.

iii. Sanitary landfill

The results of the qualitative analysis concluded the implementation of sanitary landfill as feasible based on the following reasons:

- To improve public sanitary condition and the surrounding environment by alternating from controlled tipping to sanitary landfill.
- To protect ground water from deterioration with the application of a liner.
- To prevent the surroundings from scattering wastes by fences.

This is also proven as financially feasible due to an 18.8 % FIRR between 1994 and 2000.

iv. Financial evaluation of Poznan Treatment and Disposal Company

Financially it is evaluated to be feasible due to a 17.5 % FIRR between 1998 and 2015 regarding incineration plant and sanitary landfill. The cash flow diagram shown in Fig.4.1-1 is based on the present value and excludes future inflation.

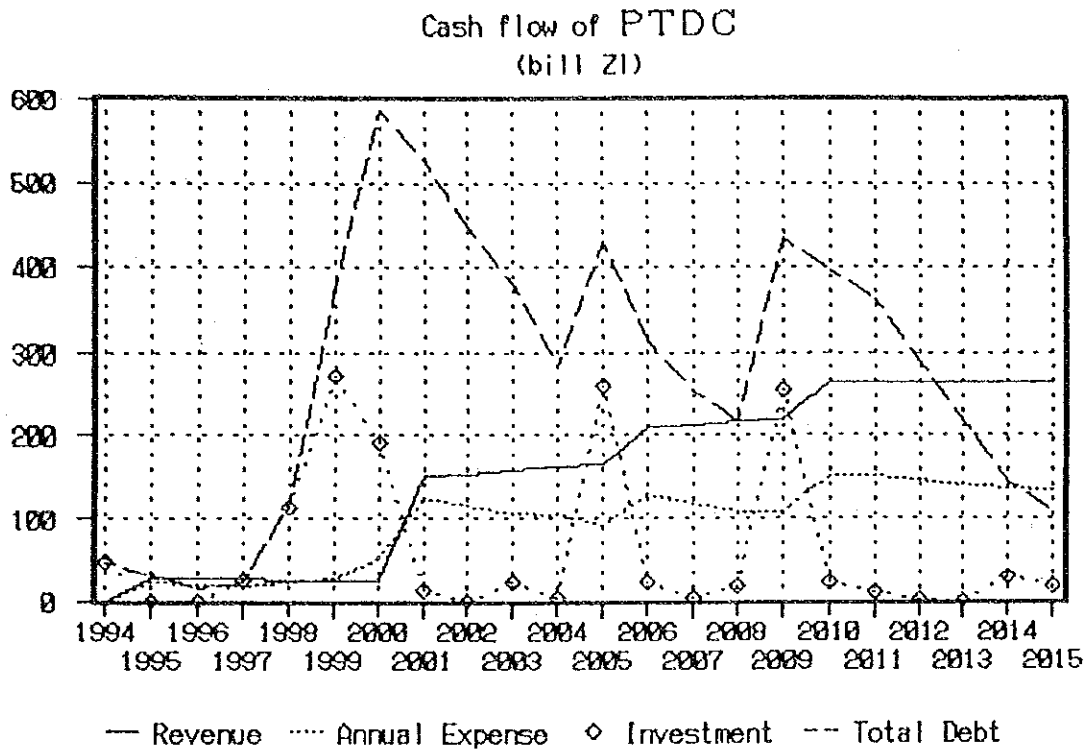


Fig.4.1-1 Cash Flow Diagram of Poznan Treatment and Disposal Company

4.2 Implementation Plan

1) Project Implementing Bodies

The implementing bodies of the 3 projects will be as follows:

- Public Recycling Centres : Department for MSWM
- Incineration Plant : Poznan Waste Treatment and Disposal Company
- Sanitary Landfill : Poznan Waste Treatment and Disposal Company

2) Implementation Schedule

The proposed implementation schedule for the 3 projects are tabulated in Table 4.2-1.

Table 4.2-1 Implementation Schedule

Project	Public Recycling Centres	Incineration Plant	Sanitary Landfill
Schedule			
1. Design Target Year	1997	2001	1995
2. Service Commencement Year	No. 1,2,3: 1996 No. 4,5,6: 1997 No. 7, 8 : 1998	January 2001	January 1995
3. Preparatory Period			
- Acquisition of Funds	1994	1996	1993
- Detailed Design	1994	Jan. 1997 - Apr. 1998	1993
- Tender	1994	Machinery: Sep. 1997 - Jan. 1998 Civil: May 1998 - July 1998	
4. Construction			
- Construction	No. 1,2,3: 1995 No. 4,5,6: 1996 No. 7, 8 : 1997	July 1998 - Aug. 2000	1994
- Test Run	-	Sep. 2000 - Dec 2000	-
- Take Over	-	January 2001	January 1995

3) Financial Plan

The financial plan was based on the results of the financial analysis described in the section 8.4.2. In the financial analysis of the Poznan Treatment and Disposal Company, corporation tax was excluded. However, 40 % corporation tax is included in the financial plan.

a. Public Recycling Centres

As shown in Table 4.2-2, required finance and its source will be secured from the budget of Poznan Municipality.

Table 4.2-2 Required Finance and Source for P.R.C unit: mill.zł

	1995	1996	1997	1998	1999	2000	Total
Required investment	6,508	6,038	3,718	0	0	* 1,380	17,644
Budget of Municipality	6,508	6,038	3,718	0	0	1,380	17,644
O & M Cost		4,370	8,405	10,943	10,984	11,034	34,793
Budget of Municipality		4,370	8,405	10,943	10,984	11,034	34,793

Note:

* The investment in 2000 will be based used for the replacement of old containers.

b. Incineration Plant

i. Financial Source

Financial sources are proposed as follows:

- Long-term loan from an international lending agency
- Short-term loan from a lending agency in Poland

Table 4.2-3 Required Finance and Source for Incineration Plant unit: mill.zł

	1998	1999	2000	Total
Required investment	107,831	269,578	161,747	539,156
Breakdown				
Long-term loan	75,831	189,578	113,747	379,156
Short-term loan	32,000	80,000	48,000	160,000

The operation and maintenance cost shall be covered by income of heat sale and treatment and disposal fee.

Table 4.2-4 Breakdown of Financial Sources for Operation

unit: mill.zl

	2001	2002	2003	2004	2005	Total
Required O & M cost	48,010	48,010	48,010	48,010	48,010	240,050
Sources						
Heat sale	29,297	29,007	28,878	28,620	28,330	144,132
Tipping fee						
Standard	21,737	21,443	21,169	20,855	20,541	105,745
Special	31,426	32,406	33,321	34,366	35,412	166,931
Total	82,460	82,856	83,368	83,841	84,283	416,808

ii. Expenditure

Investment and O & M cost are presented in Table 4.2-5.

Table 4.2-5 Investment and Annual Expenses for Incineration Plant

unit: mill.zl

Year	Investment	Annual Expense		Total
		O & M	Depreciation	
1998	107,831	0	0	107,831
1999	269,578	0	0	269,578
2000	161,747	0	0	161,747
2001	0	17,400	30,610	48,010
2002	0	17,400	30,610	48,010
2003	0	17,400	30,610	48,010
2004	0	17,400	30,610	48,010
2005	0	17,400	30,610	48,010

c. Sanitary Landfill

i. Financial sources

The short-term loan of local lending agencies are planned as investment source.

O & M cost is planned to be covered by tipping fee.

Table 4.2-6 Required Finance and Source for Sanitary Landfill unit: mill.zl

	1994	1995	1996	1997	1998	1999	Total
Required investment	46,517	0	0	24,103	4,700	0	75,320
Short-term loan	46,517	0	0	24,103	4,700	0	75,320
Required O & M		15,034	14,984	14,934	19,604	14,884	79,440
Tipping fee		26,397	26,037	25,667	25,332	25,083	128,516

ii. Expenditure

Investment and O & M cost are presented in Table 4.2-7.

Table 4.2-7 Investment and Annual Expenses for Sanitary Landfill unit: mill.zl

Year	Investment	Annual Expense	
		O & M	Depreciation
1994	46,517		
1995	0	5,700	9,334
1996	0	5,650	9,334
1997	24,103	5,600	9,334
1998	4,700	5,570	14,034
1999	0	5,550	9,334

Note: Investment for replacing old equipment is included.

d. Financial Plan of Poznan Treatment and Disposal Company

The balance sheet and the money flow sheet are shown in Table 4.2-8.

These tables prove that the income basically tends to exceed expenditure excepted for in 1999 and 2000. The total debt decreases after the peak in 2000. Consequently, the financial status of the Poznan Treatment and Disposal Company will be sound accordingly to the financial plan.

Table 4.2-8 Balance Sheet and Money Flow of PTDC

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Revenue																							
Sale	0	0	0	0	0	0	0	0	29,297	29,007	28,878	28,628	28,330	28,330	28,330	28,330	28,330	28,330	28,330	28,330	28,330	28,330	28,330
Heat supply	0	0	0	0	0	0	0	0	31,426	32,406	33,321	34,366	35,412	35,412	35,412	35,412	35,412	35,412	35,412	35,412	35,412	35,412	35,412
Special Fee	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipping Fee	0	0	0	0	0	0	0	0	21,737	21,443	21,169	20,855	20,541	20,541	20,541	20,541	20,541	20,541	20,541	20,541	20,541	20,541	20,541
Incineration plant	0	0	0	0	0	0	0	0	67,563	70,562	73,541	76,677	79,852	79,852	79,852	79,852	79,852	79,852	79,852	79,852	79,852	79,852	79,852
Final disposal	0	0	26,397	26,037	25,667	25,332	25,083	24,830	150,023	153,417	156,908	160,518	164,135	164,135	164,135	164,135	164,135	164,135	164,135	164,135	164,135	164,135	164,135
Subtotal(A)	0	0	26,397	26,037	25,667	25,332	25,083	24,830	150,023	153,417	156,908	160,518	164,135	164,135	164,135	164,135	164,135	164,135	164,135	164,135	164,135	164,135	164,135
Expense																							
O/M	0	0	5,760	5,650	5,600	5,570	5,550	5,550	21,750	21,930	22,100	22,280	22,450	22,450	22,450	22,450	22,450	22,450	22,450	22,450	22,450	22,450	22,450
Depreciation	0	0	9,334	9,334	9,334	14,034	9,334	9,334	45,251	40,954	40,954	44,454	40,954	43,047	43,522	40,022	41,625	40,425	43,925	41,625	40,425	40,425	45,125
Interest	0	0	6,280	4,608	2,826	4,179	12,801	36,910	58,163	55,131	49,964	47,109	41,049	34,841	30,231	22,575	13,299	814	0	0	0	0	0
Subtotal(B)	0	0	21,313	19,592	17,759	23,783	27,685	51,794	125,164	118,014	113,038	113,842	104,453	100,338	96,203	85,047	77,373	63,688	66,375	64,075	62,875	62,875	67,575
Profit or Loss (C=A-B)	0	0	5,084	6,446	7,907	1,549	-2,601	-24,964	24,858	35,403	43,870	46,676	59,682	63,797	67,932	79,088	86,762	100,447	97,760	100,660	101,260	101,260	96,560
Profit tax	0	0	2,834	2,578	3,163	620	0	0	9,943	14,161	17,548	18,870	23,873	25,519	27,173	31,635	34,705	40,179	39,194	40,024	40,504	40,504	38,624
Profit excluding tax	0	0	3,050	3,867	4,744	930	-2,601	-24,964	14,915	21,242	26,322	28,005	35,809	38,278	40,759	47,453	52,057	60,268	58,566	60,636	60,756	60,756	57,936

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Balance	0	0	3,050	3,867	4,744	930	-2,601	-24,964	14,915	21,242	26,322	28,005	35,809	38,278	40,759	47,453	52,057	60,268	58,566	60,636	60,756	60,756	57,936
Depreciation	0	0	9,334	9,334	9,334	14,034	9,334	9,334	45,251	40,954	40,954	44,454	40,954	43,047	43,522	40,022	41,625	40,425	43,925	41,625	40,425	40,425	45,125
Subtotal(C)	0	0	12,384	13,201	14,078	14,963	6,733	-17,631	60,166	62,196	67,276	72,459	76,763	81,326	84,282	87,475	93,682	100,693	102,581	101,661	101,181	101,181	103,061
Money Demand																							
Investment	0	46,517	0	0	24,103	112,531	269,578	190,352	13,630	0	21,903	3,500	4,703	23,103	3,500	18,763	1,200	21,903	10,203	1,200	0	28,606	16,760
Loan	0	0	0	0	0	0	0	0	54,165	54,165	54,165	54,165	54,165	54,165	54,165	0	0	0	0	0	0	0	0
Long Term	0	0	0	0	0	0	0	0	8,031	8,031	8,031	8,031	8,031	8,031	8,031	0	0	0	0	0	0	0	0
Short Term	0	0	12,384	13,201	14,078	14,963	6,733	-17,631	60,166	62,196	67,276	72,459	76,763	81,326	84,282	87,475	93,682	100,693	102,581	101,661	101,181	101,181	103,061
Subtotal	0	46,517	12,384	13,201	14,078	14,963	6,733	-17,631	60,166	62,196	67,276	72,459	76,763	81,326	84,282	87,475	93,682	100,693	102,581	101,661	101,181	101,181	103,061
Money Supply																							
Budget from PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
from lim.Fund	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long Term	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Short Loan	0	46,517	0	0	10,025	21,737	73,267	94,236	7,629	0	8,792	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	0	46,517	0	0	10,025	21,737	73,267	94,236	7,629	0	8,792	0	0	0	0	0	0	0	0	0	0	0	0
Surplus of Money	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reserved Fund	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total of Debt	0	46,517	34,132	20,931	30,956	128,524	391,349	599,351	552,815	490,619	445,246	376,287	306,227	248,904	187,222	93,510	6,028	0	0	0	0	0	0

5 OTHER STUDIES

5.1 General Recommendations for the Improvement of ISWM

1) Method of the Study

In this study, general recommendations for the improvement of the Industrial Solid Waste Management (ISWM) in Poznan City are proposed based on existing information and data.

Investigation of reports regarding the present status of ISWM, review of plan for the future waste management system, and interviews with relevant organs and some industries were carried out in this study.

2) General Recommendations

a. Laws and Regulations

Primarily, laws and regulations should be established in keeping with the EC legislations and guidelines.

Enterprises must also develop processes which would enable the treatment of industrial waste at generation source. It is necessary that enterprises examine the raw materials they use and take necessary steps that would mitigate environmental pollution caused by their waste.

In Japan, all enterprises are required to plan the utilization of these recyclable materials and to increase the means for their utilization. They are also required to fully equip themselves with the required machineries and to improve their techniques.

Similarly in Poland, it is also possible to promote the utilization of recyclable paper and residues from glass manufacturing companies, and to reuse concrete as raw material for construction work.

b. Administration and Organization

In Poland, the administrative organization for industrial wastes management is getting more structured, although other issues start surfacing in the actual operation.

Guidelines and plans should be made with regard to industrial waste management to serve as a standard the enterprises have to comply with.

It will be essential to review the personnel disposition within the administration and organization and increase the staff responsible for industrial waste management, and then conduct necessary training courses.

Furthermore, in keeping with the EC standards, the administration is required to have technical knowledge (in discharge, treatment, recycling, disposal methods, etc.), collect information and develop new techniques. The administration has to transfer technical information to enterprises and provide them with technical aid through subsidies and other schemes.

c. Generation of Waste

Every factory submits to the provincial government information on the characteristics and amount of industrial waste they generate. The amount of money charged for the use of the environment is registered. The information can be used for the management of industrial waste. Inventory system is effective for supervising ISWM. Therefore, precise registration and continuous updating of inventories shall be implemented.

Manufactures should adopt new production processes and change the raw materials they use to reduce the generation of industrial solid waste. They should also try to reuse and recycle their solid waste to reduce the amount to be disposed of.

Dischargers should try to separate hazardous wastes from non-hazardous ones in order to reduce the amount of hazardous industrial solid wastes to be disposed of and facilitate waste reuse and recycling.

d. Transportation

Hazardous waste to be transported should be packaged properly with appropriate labelling. Packaging and labelling standards should be set for each type of hazardous waste by the provincial government. Establishment of appropriate standards for collection vehicles to be used in the transportation of hazardous wastes is also important. Accidental mixing of non-compatible wastes should be avoided.

The companies which actually transport or plan to transport hazardous industrial solid wastes have to get a permit from the provincial government.

The manifest system is an effective method to precisely grasp the flow of the treatment of the industrial waste and to confirm that the wastes have been appropriately treated. In this system the manifests containing the routes from the forwarding location to the destination, matters to be noted when handling, etc., are attached to the cargoes so that the contents of the cargoes can be checked at each transit point to confirm whether a part or whole of the cargoes is missing or not and the necessary documents are signed and invoices received.

e. Treatment and Disposal

Basic treatment and final disposal methods needed for industrial wastes are chemical treatment such as neutralization, oxidation and reduction, thermal treatment such as incineration, and secured landfill. The characteristics of industrial solid waste are so variable that it is necessary to find out the best treatment and final disposal alternatives from a technical and economic point of view.

In many cases the most convenient treatment and final disposal method is secured landfill, because its cost is relatively low. The provincial government may be requested to construct such facility for the sake of environmental protection if it is very difficult for the private sector to acquire land and funds for such construction.

ODPAD an organization for the disposal of industrial waste in Poznan city, was jointly established by nine enterprises and is trying to acquire land for disposal sites. The provincial government is expected to support the organization to accomplish the purpose.

Environmental impact assessment is a necessity prior to the construction of an industrial waste disposal site.

f. Supervision and advice

Appropriate supervision and sound advices from the provincial government are most important to steadily implement industrial solid waste management.

It is, therefore, important to primarily analyze and improve administrative capacity, then conduct inspection and give advices on the operation of the storage, transportation and final disposal of industrial solid wastes.

5.2 Case Study of Master Plan Manual for Lublin

1) Background

The draft manual for the formulation and implementation of the MSWM master plan was prepared and included in the Interim Report submitted in mid-October 1992. Based on the draft manual, this case study was carried out in order to:

- check the applicability of the draft manual to other Polish cities;
- make necessary modifications; and
- to prepare recommendations for the improvement of municipal solid waste management in the City of Lublin including the concept of her MSWM master plan.

2) Field Survey

a. Field survey

Although the existing EC PHARE report elaborated the two scenarios for the MSWM in Lublin, it did not identify the waste amount and composition in Lublin. Due to the study time limitation and the degree of importance for the preparation of an MSWM master plan, only WACS (Waste Amount and Composition Survey) in winter and POS (Public Opinion Survey) were conducted. Basically, both the WACS and POS were conducted using the method applied in the study of Poznan.

b. Waste amount and composition survey

i. Waste amount

Based on the WACS, the following major figures on waste discharge ratio are deduced:

- MSW discharge amount : **178.9 ton/day**
- MSW discharge ratio per capita : **508 g/person/day**
(in Poznan **769 g/person/day**)
- Annual MSW discharge : **65,300 ton/year**

Regarding the disposal amount in the present Jawidz landfill, the estimation was made based on the discharge ratio in Lublin due to the lack of measurements at the landfill, and tabulated in Table 5.2-1.

Table 5.2-1 Waste Amount in Lublin Unit: ton/day

Category of Waste	Waste Discharge in Lublin	Estimated Disposal Amount at Jawidz Landfill	Waste Amount in Poznan
1. MSW			
Household Waste	140.9	196.9	386.0
(Household Waste)	(130.4)	-	(283.2)
(Domestic Ash)	(10.5)	-	(102.8)
Commercial Waste	4.2	5.9	32.5
(Shops)	(2.3)	-	(4.9)
(Catering)	(1.9)	-	(27.6)
Market Waste	3.0	4.2	6.0
Institutional Waste	11.8	16.5	9.3
Road Sweeping Waste	* 13.3	18.6	4.0
Bulky Waste	*5.75	8.0	*15.7
Sub-total	178.9	** 250.1	453.5
2. Other Wastes	-	* 41.1	* 82.4
Total	-	291.2	535.9

Note: * Disposal amount.
 ** The figure is deduced by multiplying 178.9 by 492,500 (the population including other local authorities)/352,500 (the population of the City of Lublin)