

Fig.4.1.3-1 Location of Previous and Existing Disposal Sites in Poznan and its Vicinity

No.	Location	Area(ha)
1.	Umultowo I and II were used for 10 years, 1974-84	16.0
2.	Lechicka St. / Former Fortification No. V	7.5
3.	Naramowicka St. - Serbska St.	1.0
4.	Lechicka St. - Naramowicka St.	5.5
5.	Winogrody St. - Naramowicka St. Sports Field	5.0
6.	Obornicka St. - Słowianska St.	7.2
7.	Pułaskiego St. - Sports Ground AZS	5.2
8.	Al. Wielkopolska, Both banks of river Bogdanka	1.5
9.	Niestachowska St. near Park Solacki	6.5
10.	Bałtycka St. - Syrenia St.	2.0
11.	Smolna St.	6.5
12.	Boarder of Poznan and Swarzedz near road No. 2 (used for over 40 years) Near lake Swarzedzkie and Cybina River	6.0
13.	Piotrowo St. / Embankment of Warta River	2.7
14.	Left Bank of Warta River - Queen Jadvigi Bridge (former Marchlewskiego Bridge)	21.5
15.	Bukowska St. (former Swierczewskiego street) near the airport	3.0
16.	Wyszomirska St. - Marcelinski Forest	8.0
17.	Taczanowskiego St. - Smardzewska St.	1.2
18.	Zatorze	1.0
19.	Drużynowa St. and its surroundings	9.0
20.	Siarolecka St.	1.0
21.	Opolska St. boarder of Lubon and on both sides of Garaszewo Street	5.2
22.	Garaszewo	4.5
23.	Sytkowo (Smochowice)	3.0
24.	Mechowo (near Bogucin) - landfill site for industrial waste of POMET, now Worker's gardens	15.0
25.	Suchy Las	12.94
		in 1991
	Total	157.94

#### 4.1.4 Waste Collection

##### 1) Present Waste Collection System

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 market for waste collection business is considered to be very competitive as its operation requires neither a license nor permit.

Contracting waste collection services became compulsory on the 1st of June 1992. Many of the householders, however, did not comply by declaring that they dispose of the wastes themselves.

The present service coverage and distribution are summarized in Fig. 4.1.4-1.

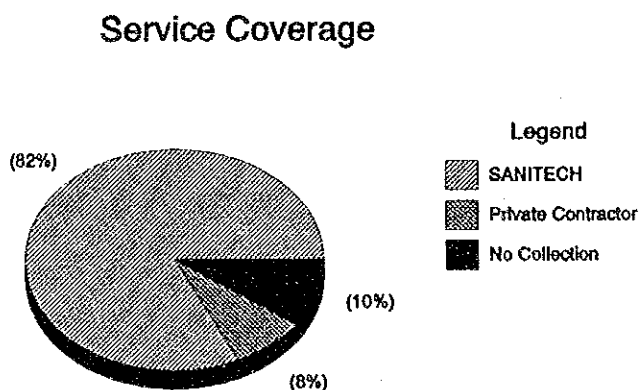


Fig.4.1.4-1 Present Condition of MSW Collection Service

SANITECH, which provides the biggest number of householders with municipal waste collection services, is not capable of catching up with the increasing amount of waste presently generated. Further, it is not capable of meeting the frequency for waste collection services stipulated in the contract, too. The majority of the customers, therefore, are dissatisfied and many of those from the detached and semi-detached housing areas are reconstructing their contracts to less frequent collection services to accommodate the incapacities of SANITECH. Due to dissatisfaction with the collection services and the exorbitant collection fees, more

and more people cancel their waste collection services contract. Accordingly, these intensified illegal dumping in Poznan.

## 2) Waste Amount

Since the shift to a market-oriented economy in 1989, it is believed that the amount of waste in Poznan has increased and still does, albeit the absence of reliable data. Formerly, people can only buy commodities with the coupons given to them by the government; in 1989, however, they became free to purchase any product in unlimited quantities. This change is considered to have led to drastic waste generation increase.

In spite of these, the administrative authorities have not taken any effective countermeasure. In fact, the number of waste collection trucks decreased within the past 5 years, as shown in Fig.4.1.4-2, resulting in the decrease in waste collection frequency. This also reduces the efficiency ratio of the waste collection services and haulage operation as well.

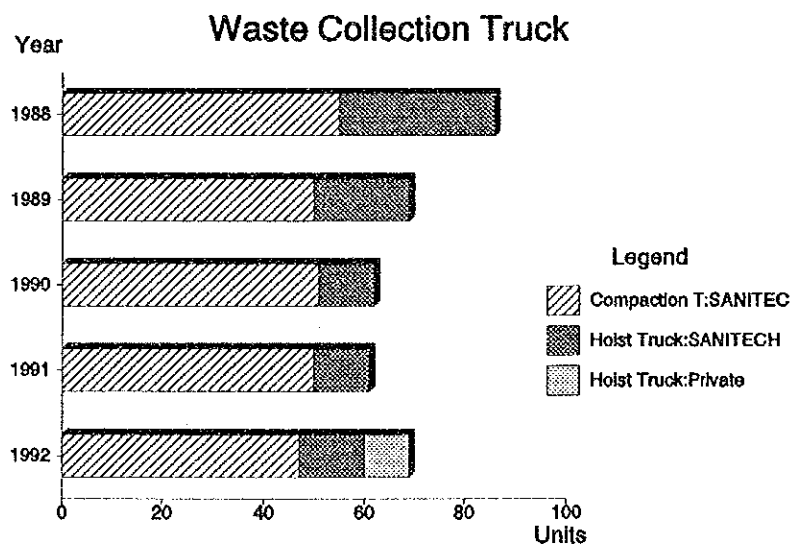


Fig.4.1.4-2 Number of Waste Collection Truck

#### 4.1.5 Illegal Dumping

Illegal dumping is a very serious problem in Poznan City and is observed to have particularly increased since 1989. Few of the authorities such as the Provincial Environment Inspector, the Communal and Residential Affairs Department of the Municipality, the municipal police established in 1990, started to give it special attention. It is difficult to point out the violators due to the absence of a supervising system.

With the cooperation of the municipal police, the Communal and Residential Affairs Department within the Municipality endeavors to reinstate the municipal lands affected by illegal dumping. If a violator is identified, however, he shall be obliged to reinstate the area, otherwise the contractor shall be ordered by the municipality to undertake it. The budget allocated for the reinstatement of lands has been increasing lately and is becoming a heavy burden to the municipality's finances.

It is very difficult to locate the sites within the city of Poznan where illegal dumping takes place as their number has been observed to increase by the day. Fig. 4.1.5-1 and Table 4.1.5-1, which show the conditions of the illegal dumping sites, were prepared by combining the survey results of the JICA Study Team and the illegal dumping data given by the district branches of the Communal and Residential Affairs Department.

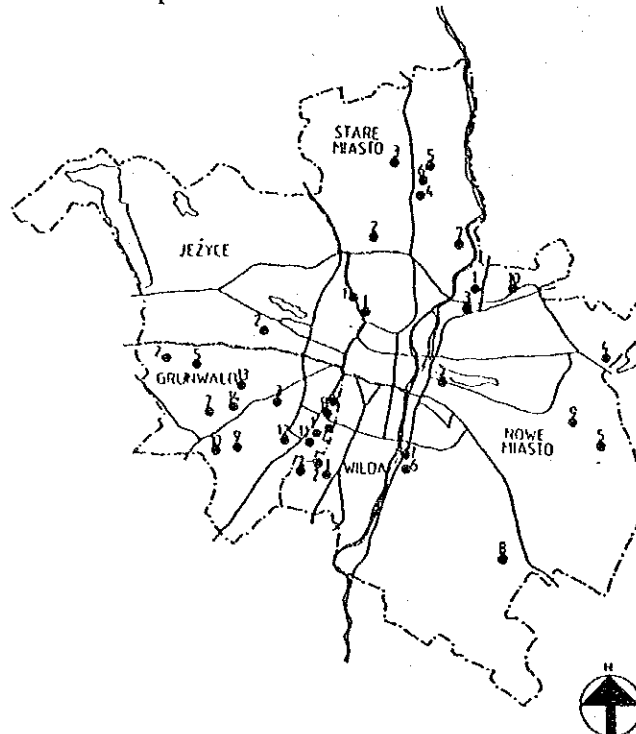


Fig.4.1.5-1 Location of Existing Illegal Dumping Sites

Table 4.1.5-1 Present Illegal Dumping Site

No.	Location district-street	Surface sq.m	Removal pre- dicted cost zlotych	Remark
<b>I.</b>	<b>GRUNWALD</b>			
1.	Gorki St.	55	4,950,000	50% organic, 50% construction materials, contract ready contract ready construction materials constr. m. + earth 90% constr. m. + organic constr. m. constr. m. + organic constr. m. constr. m. 50% + organic 50% constr. m. + earth 80% constr. m. 80% + organic constr. m. 80% + org. + earth
2.	Slawinska St.	1,150	9,430,000	
3.	Konfederacka St.	2,450	20,090,000	
4.	Dwatory St.	12,000	350,000,000	
5.	Bajkowe Quarter	4,500		
6.	Chlodna St.			
7.	Cmentarna St.			
8.	Dniowski St.			
9.	Junikowska St.			
10.	Misnienska St.	4,336	5,000,000	
11.	Krzywa St.	176	130,000,000	
12.	Weglowa St.	4,600	700,000,000	
13.	Pasia St.	25,000	130,000,000	
14.	Miczurina St.	4,600		
<b>II.</b>	<b>NOWE MIASTO</b>			
1.	Chemiczna St.	8,000		30% communal + constr. m. + earth concrete plates + earth + constr. m. 90% 30% communal 50% communal + 50% constr. m., earth 100% communal communal + machinery + motorcar body constr. m. constr. m. + industrial m. constr. m. + communal constr. m. + industrial + communal
2.	Majakowski and Kurlandzka St.	20,000		
3.	Smolna St.	10,000		
4.	Sarnia St.	20,000		
5.	Darzynska St.	5,000		
6.	Ksiazeca St.	5,000	90,000,000	
7.	Starolecka St.	30,000	560,000,000	
8.	Graszewo	4,000	70,000,000	
9.	Kobylepole	500	140,000,000	
10.	Baltycka St.	80,000		
<b>III</b>	<b>JEZYCE</b>			
1.	Obornicka St.	3,000	80,000,000	constr. m.
2.	5 Stycznia St.	10,000	150,000,000	constr. m.
<b>IV.</b>	<b>WILDA</b>			
1.	Opolska St.	4,000		now being removed
2.	Bohaterow Westerplatte, Przelecz and Krajewski St.	15,000		
<b>V.</b>	<b>STARE MIASTO</b>			
1.	Obornicka and Slowianska St.	12,000	333,000,000	contracted
2.	Umultowska, Sarmacka and Madziarska St.	8,000	224,000,000	poor houses area
3.	Umultowska and Zagajnikowa St.	10,000	280,000,000	constr. m.
4.	Bozydara St.	200		constr. m.
5.	Jarowa St.	200	5,600,000	constr. m.
6.	Kopcowa and Blonie St.	200	5,600,000	constr. m.
7.	Karpia St.	30,000	5,600,000	communal + industrial m.
	<b>Total</b>	<b>333,967</b>		

## 4.2 Waste Stream

### 4.2.1 Concept of Waste Stream

The waste stream in the Study area is drawn up based on the following surveys:

- WACS (Waste Amount and Composition Survey) in summer and winter;
- POS (Public Opinion Survey);
- disposal amount obtained at the Suchy Las landfill; and
- information on discharge amount obtained from PEC and sewage plants.

A concept of the waste stream is illustrated and shown in Fig.4.2.1-1. Solid waste generated in each generation source is classified into the three categories; i.e. recycled, discharged and self-disposed waste. The discharged waste is divided into waste collected by each collection service and waste illegally dumped.

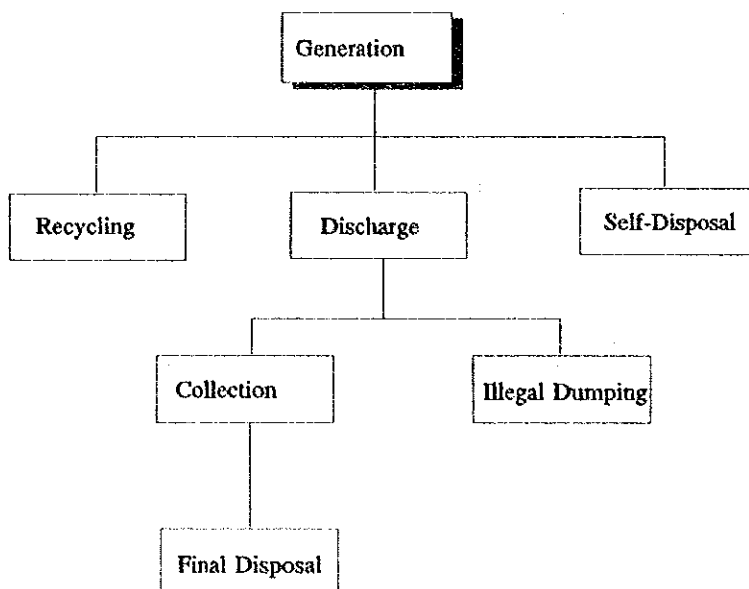


Fig.4.2.1-1 Concept of Waste Stream

## 4.2.2 Waste Stream

### 1) Classification of Waste

The following sorts of wastes are presently hauled to the disposal site.

#### a. MSW

- i. Household Waste
  - Household Waste (excluding ash)
  - Domestic Ash
- ii. Commercial waste
  - Market waste
  - Institutional waste (Office waste)
  - Road sweeping waste
  - Bulky waste

#### b. Other wastes

- i. PEC ash
- ii. Sewage sludge
- iii. Others (construction waste, etc.)

### 2) Waste Stream

The discharge ratio of MSW without bulky wastes was calculated in the WACS and the total disposal amount was measured at SLL (Suchy Las landfill). The discharge ratio of bulky wastes was not surveyed but their total disposal amount was measured at SLL.

The amount of recyclable and self-disposed wastes is hard to determine and requires a lot of work. Although the waste stream could not be completed because of this, a draft was prepared as a reference for future studies and is shown in Fig.4.2.2-1.

Illegal dumping amount may be deduced as follows

$$\begin{aligned}\text{Illegal Dumping Amount} &= \text{Discharge Amount} - \text{Collected Amount} \\ &= 27.3 \text{ tons/day (10,000 tons/year)}\end{aligned}$$

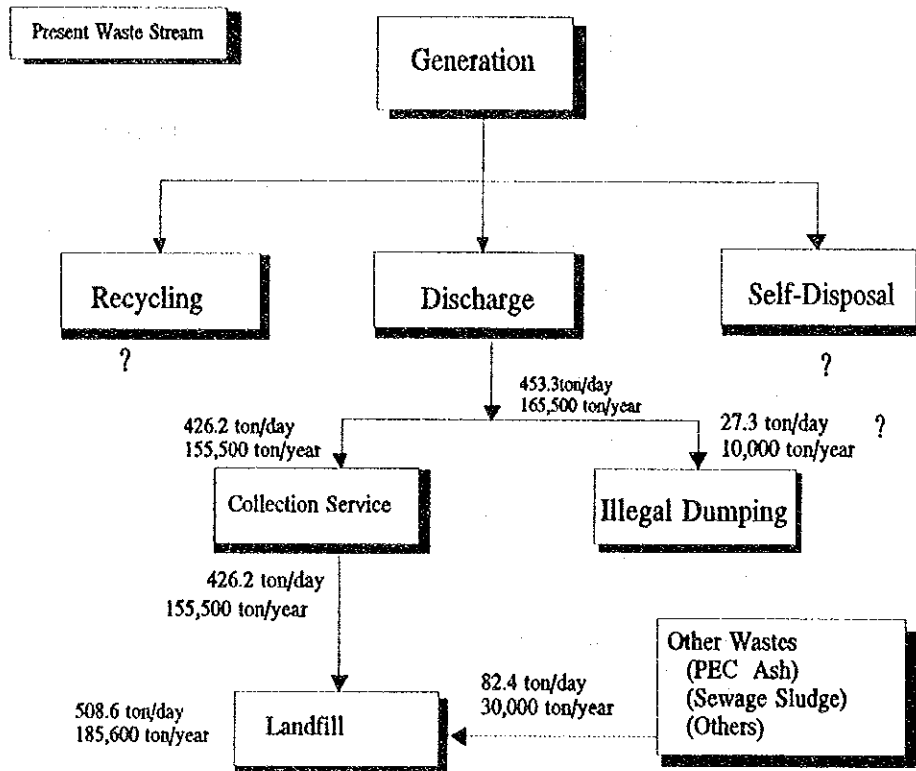


Fig.4.2.2-1 Present Waste Stream of MSW



## **4.3 Discharge, Storage, Collection and Haulage**

### **4.3.1 Discharge**

There are two discharge methods employed:

- carrying of waste to where the dustbin or communal containers are, or
- dropping of waste into a dust chute opening.

#### **1) Dustbins and Communal Containers**

This is the most common discharge method and the most problem free.

#### **2) Dust chute**

In buildings with more than 12 floors, the installation of dust chutes is required by the law. There are chutes made of asbestos -cement.

Chutes are often troublesome as the rough surface gets contaminated with waste and is difficult to clean or disinfect. They are frequently misused and become stuffed. Accordingly, the residents in apartment buildings stopped using dust chutes due to insanitary and clogging problems.

The population still employing dust chutes is estimated between 30 – 80,000.

### **4.3.2 Storage**

There are three types of containers utilized in the study area: 110 liter dustbins, 1.1 m<sup>3</sup> communal containers, and 6 to 10 m<sup>3</sup> communal containers.

- Dustbins of 110 liter capacity (SM-110) are mechanically emptied into the compactor collection truck.
- Wheeled containers of 1.1 m<sup>3</sup> capacity, called in "Bobr" (type PA-11), mechanically emptied into the compactor type collection trucks.

- Communal containers of 6 – 10 m<sup>3</sup> capacity; full containers are exchanged by empty ones at the container locations with a hoist truck.

Those containers used are shown in Table 4.3.2-1.

Table 4.3.2-1 Situation of Container Use

	New building apartment area	Old building apartment area	Detached & Semi-detached area
110 l dustbin	not used	used	used
1.1 m <sup>3</sup> communal container	not used	mainly used	not used
6 – 10 m <sup>3</sup> communal container	used	not used	not used

The SM-110 type of dustbin generally used has a hinged lid and is made of steel. Plastic bins have been introduced, but are only suitable in areas where district heating is installed. At premises with solid fuel heating, hot ashes are likely to be put in the dustbin with resultant damage. The use of plastic bins, however, was considered to have the following advantages:

- less weight and easier handling
- more attractive appearance
- easier to clean
- quieter in the emptying operation

The PA-11 wheeled containers used are made of steel. These containers are placed in residential areas constructed with high rise apartment buildings and also in some commercial areas. These containers are difficult to maintain; the wheels in some cases do not stand up to rough usage, and lids of most containers are found to be missing.

Large communal containers are used extensively in suburban areas where large quantities of waste are generated. They are used in shopping areas and markets, too. The following are some of the difficulties experienced in the use of these containers:

- waste freezing on to the side wall of the container in winter
- closed containers with loading apertures too high for convenient use

### 4.3.3 Collection and Haulage

#### 1) Collection Frequency

In areas where large communal containers are used, the frequency of collection depends on the quantity of waste to be collected and its location. Most apartment blocks receive once or twice a week collection, a frequency considered to be most common in the area.

In areas where compactor trucks are used, collection frequency depends on the capacity of the collection trucks, as there are no spares. Collection of waste from individual houses is commonly conducted once or more than once a week. In spite of the fact that the contract stipulated a particular frequency, collection is not conducted periodically due to poor collection and haulage capacity. In fact the number of collection trucks owned by SANITECH has decreased since 1988, as shown in Table 4.3.3-1. Although private contractors have been supplementing hoist trucks, no institution or agency seem to be doing so with regard to compactor trucks. With this problem, waste collection and haulage is becoming more ineffective.

Table 4.3.3-1 Number of Collection Trucks owned by SANITECH

Year	Compactor truck (unit)	Hoist Truck (unit)
1988	55	31
1989	50	19
1990	51	11
1991	50	11
1992	47	13

#### 2) Collection Truck

Compactor trucks and communal containers are generally used. The two standard types of collection trucks used are:

- rear-loading plate compactor
- rear-loading rotating type (KUKA design)

Collection trucks with compaction bodies are produced by two manufacturers; by Wroclaw in Poland and Presko and by Wuko in Lodz. Trucks for moving bulky containers are also manufactured by them. The rear loading rotating KUKA trucks are made in Czechoslovakia.

The capacity of these trucks ranges from 12 m<sup>3</sup> to 16 m<sup>3</sup> and their loading capacity is 6 to 8 tonnes. For the transportation of large containers, on the other hand, hook-lift type of trucks are extensively used.

### **3) Operation Method**

Trucks for loading dustbins and containers, carrying a team of 3 or 4 people (including the driver) are expected to make 2 trips a day. The sub-contractor of SANITECH often makes 3 trips a day but for 10 – 12 hours. The average time to complete a collection route is 3 – 4 hours, and it also depends on the type of property served, the kinds of dustbin and containers, and general traffic conditions. The collection services are expected to cover a distance between 30 and 50 km per round trip, occasionally exceeding 70 km.

In some of the old building areas, guardians are assigned to carry the containers beside the road before the arrival of the collection truck. The collectors then empty the containers and return them to the yard, and this part of the work is difficult and eats a lot of time, because the access to the yard is quite narrow.

## **4.4 Road Sweeping and Public Area Cleansing**

The roads are generally observed to be kept clean and tidy. Since April of 1992, the administration has introduced a tender system for the selection of road cleaning contractors to curtail expenditures. This system is now observed to be working considerably well and hence should be continued in future.

### **4.4.1 Road Sweeping**

#### **1) Responsible Organization**

Roads are classified into 3 categories, namely state road, provincial road, and municipal road, according to budget source. The responsible governmental bodies are shown in Table 4.4.1-1.

The majority of the municipal roads is maintained by SANITECH except for a few which is maintained by a small enterprise.

Table 4.4.1-1 Implementation Organization

Category of Road	Quantity	Source of Budget	Executing Agency	Contractor
State Road	683,734 m <sup>2</sup> (49 km)	Central Government	Provincial Authority for Road in the City	-SANITECH
Provincial Road	2,124,616 m <sup>2</sup> (221.9 km)			-Lekan -HUBERTUS -DROMO -Square and Road Cleaning Enterprise
Municipal Road	(707.1 km)	Municipality	Communal & Residential Affairs Dept. Municipality	-SANITECH
				-Private Company

## 2) State Road and Provincial Road

The Provincial Authority on City Roads, a government-owned provincial, is entrusted with the road sweeping works for state and provincial roads, except for state road No.2 which connects Berlin and Warsaw, within the city of Poznan.

The actual road sweeping work was monopolized by SANITECH until 1991 under the Authority on Roads in the City. The Authority on Roads in the City introduced the tender system in April 1992 to maintain the present road sweeping services within a very limited budget.

The implementation of the tender system reduced the hold of SANITECH to 80%. Aside from SANITECH, there are 4 private companies presently under contract with the Authority on Roads in the City for road sweeping work.

The present road sweeping work condition by contractor is shown in Fig.4.4.1-1.

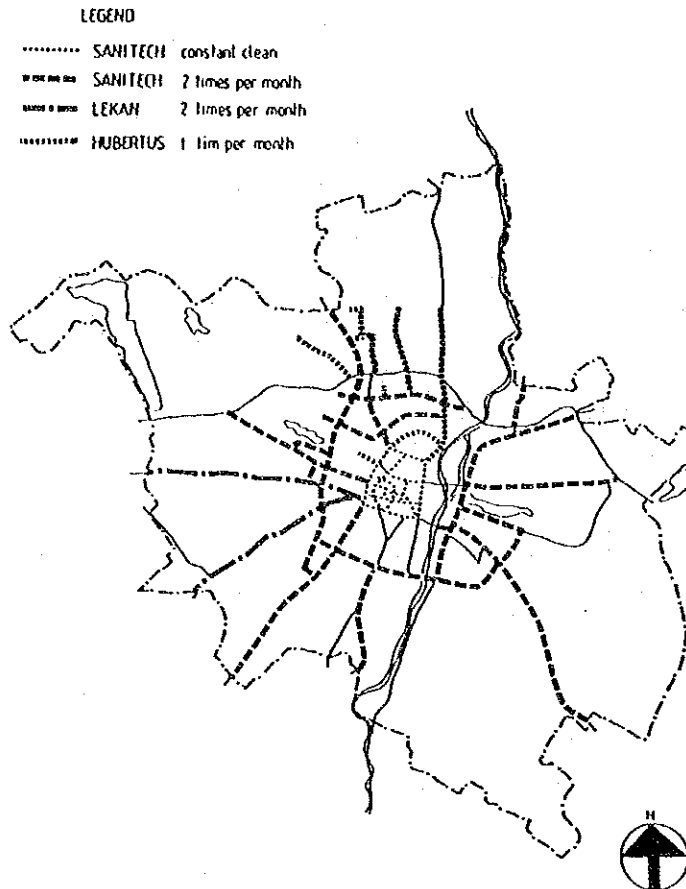


Fig.4.4.1-1 Present Assignment of Road Sweeping Work

### 3) Municipal Road

The sweeping work for municipal roads is executed under the Communal and Residential Affairs Department. The implementation of the tender system only gave SANITECH an 80% hold on road sweeping services, leaving roads such as Nowe Miasto and Stare Miasto to other small private companies. These companies conduct cleaning services manually.

### 4) The Provincial Authority on Roads in the City

The scope of the services of the Provincial Authority on Roads in the City includes construction, maintenance, and road sweeping services for state and provincial roads.

Length of roads:	
total	: 978.0 km
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municipal	: 707.1 km
provincial	: 221.9 km
state	: 49.0 km

#### 4.4.2 Public Area Cleansing

The cleaning services for public areas are divided into 3: forest area cleaning services, park and green area cleaning services, and the collection of trash boxes in town. These works are respectively carried out by the agencies shown in Table 4.4.2-1.

Table 4.4.2-1 Assignment of Work

Category of Work	Executing Body
Forest Area Cleansing	Forest Authority
Park and Green Area Cleansing	Green Areas Authority
Waste Collection of Trash Boxes	HUBERUTUS (Private company)

The Municipal Green Area Authority covered the forest areas until February 1990. The Municipal Forest Authority established in 1990 took over thereafter. There is no concrete specification as to the distinction of forest and green areas.

##### 1) Park and Green Area

The Municipal Green Area Authority, which is under the Communal and Residential Affairs Department, is in charge of cleaning the parks and green areas.

There are 4 work stations in Poznan City which are also utilized as transfer stations. They are in Cytadela, Niestachow, Komandoria Street, and Ogr. dzialk.

The cut grasses and wastes collected from the parks and green areas are first stored in these transfer stations. These wastes are occasionally transported to the Suchy Las Disposal Site. It is only in autumn when grasses and leaves are gathered in the natural composting yard of 2.5 ha at Albanska St. in Grunwald. The compost is not put up for sale.

The general information concerning the business of the Green Authority is as follows:

Total area serviced	: 908 ha
- Intensive care	: 482.1 ha
- Non-intensive care	: 436.1 ha

. Total number of parks	: 34 parks
. Total area of parks	: 320 ha
. Total number of fountains	: 9 places
. Military Cemetery	: 11 places
. Municipal open ditches	: 14 places
	26,575 m
. Total number of employees	: 182 persons
- workers	: 137 persons
- non-workers	: 55 persons
- management	: 33 persons
. Equipment owned :	
- Tractor	: 8 nos.
- Truck	: 2 nos.
- Delivery truck	: 6 nos.
- Large grass mower	: 5 nos.
- Small grass mower	: 20 nos.
- Mini tractor	: 6 nos.
- Forklift	: 1 nos.
. Number of sub-contractor	: 14 companies

## 2) Trash Boxes Collection

The collection of trash boxes is divided into two. The collection of trash boxes in tramcar stations or bus stations, and collection of trash boxes along the roads.

### a. Trash Boxes in Tramcar or Bus Stations

Collection is carried out by the Municipal Transportation company. A private company called "HUBERUTUS" is actually under contract for this work, and 1,200 trash boxes are placed in the stations.

### b. Trash Boxes along Roads

Collection was conducted by SANITECH until the end of 1991. HUBERUTUS took over and is monopolizing the work at present. The Communal and Residential Affairs Department finances the work.

2,107 trash boxes are placed along roads and squares. Ordinarily, the work would involve a small truck with a driver and two workers, and two workers following the truck on foot to empty the trash boxes.

### c. Problems



- . Waste is easily scattered by wind because the trash box is wide open and very shallow.
- . Since the trash boxes are moveable, they are often stolen.

## **4.5 Processing and Final Disposal**

The municipality of Poznan has only one disposal site, the Suchy Las Disposal Site located outside of the city. Furthermore, the municipality has no processing facilities except for the few incinerators installed in hospitals. In addition to this, Suchy Las will be closed down at the end of 1993 because it is located outside the city boundary and because the areal residents are opposed to the ongoing operation.

### **4.5.1 Processing**

#### **1) Incineration plant**

The incineration plant in Poznan City was operated for 26 years, from 1928 to 1954, using coal as auxiliary fuel. At present, however, the municipality is without an incineration plant, except for those installed in hospitals.

#### **2) Others**

- There are no modern composting plants in Poznan.
- A private company called LEWAR presses wastes in the containers with a back hoe to save dumping fees
- A private recycling company called SURMET owns paper compaction machines

#### **3) Technical Level**

Boiler and heat delivery technology has accumulated in Poznan since heat distribution has been historically developed. Although there are no incineration plants, highly advanced technology from neighbouring countries like Germany, Switzerland, and Italy, can be introduced.

## 4.5.2 Final Disposal

The existing final disposal site is located in Suchy Las at the area belonging to the military and has been rented by the municipality since 1984. The outline of the disposal site is as follows:

### 1) Outline of Suchy Las Disposal Site

- Whole area : 12.7 ha
- Operation hour : 24 hours (Except Sundays)
- Landfill Method : controlled tipping
- Height of landfill : more than 15 m
- Seepage control work : none (except for natural clays under the ground)
- Cover material : excavated soil and others
- Waste being disposed
  - . municipal solid waste (households, office, etc.)
  - . bulky waste (refrigerator, washing machine, furniture, etc.)
  - . sludge
  - . coal ash from heat-supply company
  - . construction waste
  - . some hospital wastes
  - . industrial solid waste (moulding-core sand, etc.)
- Leachate scarcely seeping due to little precipitation, 400 to 500 mm/year.

### 2) Others

The amount of bulky wastes is comparatively large. After they are stored at the disposal site for some time, recyclable ones are utilized by SURMET or the scavengers.

## 4.5.3 Illegal Dumping

Illegal dumping is a very serious problem in Poznan City and is observed to have particularly increased since 1989. Few of the authorities such as the Provincial Environment Inspector, the Communal and Residential Affairs Department of the Municipality, the municipal police established in 1990, started to give it special

attention. It is difficult to point out the violators due to the absence of a supervising system.

With the cooperation of the municipal police, the Communal and Residential Affairs Department within the Municipality endeavors to reinstate the municipal lands affected by illegal dumping. If a violator is identified, however, he shall be obliged to reinstate the area, otherwise the contractor shall be ordered by the municipality to undertake it. The budget allocated for the reinstatement of lands has been increasing lately and is becoming a heavy burden to the municipality's finances.

## **4.6 Recycling**

### **4.6.1 Recycling Companies**

Poznan used to have two recycling companies, namely the Surmet Cooperative and the S & W. Due to difficult financial situations, however, S & W was liquidated in January 1992, leaving only Surmet Cooperative as the sole recycling company in the city.

#### **1) Surmet**

Surmet was established as a labour cooperative in 1956, it is, therefore, exempt from asset tax. Surmet has 70 employees and occupies the biggest market share. It recycles bottles, paper, steel, metal, fabric and glass.

#### **2) S & W**

S & W was the state recycling company which operated in 6 provinces including Poznan. Since it was a state company, it was not exempt from asset tax, and the termination of flow of subsidies led to its liquidation.

## 4.6.2 Market for Reusable Materials

### 1) Recycled Quantity

The quantity of materials recycled in 1991 is shown in Table 4.6.2-1

Table 4.6.2-1 Quantity of Waste Recycled in Poznan

Items	unit	Surmet	S & W	Total
Bottle	ton	1,431	---	1,431
Paper	ton	7,829	1,914	9,743
Steel	ton	23,315	---	23,315
Metal	ton	1,683	---	1,683
Fabric	ton	66	160	226
Glass	ton	277	192	469
Plastic	ton	---	53	53
Rubber	ton	---	4	4

### 2) Price of Reusable Material

The price of reusable materials has fluctuated and the present average price recycling companies use when purchasing from the people are shown in Table 4.6.2-2.

Table 4.6.2-2 Price of Reusable Materials

Item	unit	Price
Papers of various kind	zl/kg	350
Cardboard	zl/kg	450
Newspaper	zl/kg	500
Bottle	zl/pc	600
Non-ferrous metal	zl/ton	207,000
Ferrous metal	zl/ton	4,435,000
Fabric	zl/ton	100,000
Glass	zl/ton	50,000

### 4.6.3 Scavenging

According to the scavenger survey, only an average number of around 20 scavengers work in Suchy Las disposal site. It is also concluded that there are only few scavengers in the city and that only a small amount of recyclable wastes are recovered through scavenging.

## 4.7 Equipment

### 4.7.1 Equipment

#### 1) Equipment owned by SANITECH

SANITECH has two work stations: the headquarters and the main motorpool in Gorecka Street and the old motorpool with workshop in Niepoleglosci Street. Approximately 90 % of equipment are installed in the motorpool in Gorecka Street. Some of these equipment are shown in Tables 4.7.1-1 to 4 (refer to Annex F for details).

Table 4.7.1-1 Number of Containr

Type	Capacity	Numbers
Large Communal Container	7 m <sup>3</sup>	216
	8 m <sup>3</sup>	250
	10 m <sup>3</sup>	239
Communal Container "Bohr"	1.1 m <sup>3</sup>	5,515
Dustbin	110 l	34,678

Table 4.7.1-2 Compactor Type Truck

No.	Type	Production year	Numbers	Capacity (m <sup>3</sup> )
1	SKODA BOBR	1980	1	11.5
2		1983	4	11.5
3		1984	2	11.5
4	JELCZ 325 JPH	1984	1	14.0
5	JELCZ 325 SM93	1982	3	13.5
6	JELCZ 325 SM 94	1984	2	13.5
7		1985	2	13.5
8		1986	3	13.5
9	LIAZ BOBR 16.2	1986	2	16.0
10		1987	6	16.0
11		1988	6	16.0
12	LIAZ BOBR 12.1	1987	2	12.0
13	LIAZ SM 100	1987	2	13.5
14		1988	3	13.5
15		1989	8	13.5
Total			47	-

Table 4.7.1-3 Hoist Truck

No.	Type	Production year	Numbers
1	STAR 28 SMW 1	1976	1
2	STAR 28 SMW 10	1986	2
3	STAR 28 SMW 10	1987	5
4	STAR 28 SMW 10	1989	2
5	STAR 200 SMW 226	1982	1
6	STAR 28 SMW 28	1983	1
7	STAR 28 SMW 28	1988	1
Total			13

Table 4.7.1-4 Road Sweeper

No.	Type	Production year	Numbers	Capacity (m <sup>3</sup> )
1	STAR 28 ZM-7	1982	1	3.6
2		1985	2	3.6
3		1986	2	3.6
4		1987	2	3.6
5		1988	2	3.6
6		1989	2	3.6
Total			11	-

## 2) LEWAR

LEWAR has its main office in Umultowo along with its workshop and motorpool. The company also leases construction machinery, while the equipment used in waste collection are as stated hereunder:

- . Hoist truck : 6 units.
- . Large container 10 m<sup>3</sup> : 2 units.
- . Large container 8 m<sup>3</sup> : 250 units.

## 3) TECH-KOM

TECH-KOM has its office in Suchy Las village and the equipment it owns are:

- . Hoist truck : 3 units.
- . Large container 8 m<sup>3</sup> : 100 units.

## 4) Surmet

Surmet has its main office in Druzynowa street and has several work stations in town. Equipment used to collect bottles are:

- . Tipper with telescopic crane : 1 units.
- . Container 1, 1.5, 2 m<sup>3</sup> : 250 units.

#### 4.7.2 Operation and Maintenance

This section only describes the operation and maintenance conditions of SANITECH.

The life span of compactor trucks is usually 7 years. Although the compactor truck of SANITECH is quite old at 6 years old (1992), its operation ratio is quite high at approximately 80%.

Maintenance is considered to be satisfactory excluded as most of the equipment are kept clean and all trucks are washed daily after use.

Conclusively, SANITECH seems to put a lot of effort in waste collection and haulage activities.

SANITECH has 20 mechanics, a number that quite exceeds the total number of trucks available. The high operation ratio observed can only be attributed to the satisfactory execution of maintenance work.

On the other hand, purchasing new equipment would be cheaper than using old ones due to exorbitant repair costs.



## **4.8 Administration**

### **4.8.1 National Level**

A number of ministries are directly and indirectly involved in MSWM in Poland. The laws they enact mainly revolve on environmental views, although financial, managerial and the privatization aspects impact MSWM, too.

The ministries most involved in MSWM are:

- Ministry of Environmental Protection, Natural Resources and Forestry
- Ministry of Physical Planning and Construction
- Ministry of Health and Social Assistance

The Ministry of Environmental Protection, Natural Resources and Forestry is responsible for formulation of environmental policies and strategies, preparation of legislation and guidelines, and monitoring and control works for to the protection of the natural environment.

The Ministry of Physical Planning and Construction is responsible for enacting laws related to municipal management, and the Ministry of Health and Social Assistance is responsible for the effects of MSWM on human health.

#### **The State Inspectorate of Environmental Protection**

The State Inspectorate of Environmental Protection was once under the Provincial Government (Voivodeship) but was recently moved under the auspices of the Ministry of Environmental Protection, Natural Resources and Forestry.

The Inspectorate operates at national and provincial levels and its objectives include:

- Control of pollution permissions issued by the Department for Environmental Protection in the Provincial Government.
- Participation in localization of waste disposal sites and waste utilities including provision of requirements for the design and operation.
- Act on violators of pollution permits.

## **State Sanitary and Epidemiological Inspectorate – SANEPID**

SANEPID is an authority under Ministry of Health and Social Assistance operating at national, provincial and local levels.

SANEPID's area of responsibility is impact on health including also occupational health. The authority covers the following concerning MSW:

- Inspection of storage, collection and transportation, and treatment and disposal of solid wastes.
- Participation in localization of waste disposal sites and waste utilities including provision of requirements for the design and operation.

### **4.8.2 Provincial Level**

The Provincial Government (Voivodeship) is the central figure in the Polish administrative system as executive body of the central Government.

#### **The Department for Environmental Protection**

The Department for Environmental Protection in the Provincial Government checks the observance of environmental protection regulations and prepares plans and programmes for environmental protection, including investment plans and environmental programmes enforcing the national policy at the provincial level.

Furthermore, the department is involved in the localization of waste facilities, the issuance of permits to industries for the pollution of the environment, and the decision and collection of pollution charges from industries.

#### **The Fund for Environmental Protection and Water Management**

The above mentioned pollution charges and penalties for violation of regulations are directed to the Fund for Environmental Protection and Water Management. The Funds are divided into national and regional (provincial) categories and administered by the Department for Environmental Protection in the Provincial Government.

Generally, 60% of the Provincial Fund for Environmental Protection is appropriated to municipalities for local projects (the appropriated amount may cover 50% of the project investment).

The remaining 40% is transferred to the National Fund and although it may be used to support local projects, it is mainly used to support special investments, the realization of ecological education programmes and implementation of complex research.

### 4.8.3 Poznan City

Fig.4.8.3-1 illustrates the main bodies in Poznan Municipality under the Vice-Mayor of Technical Affairs involved in the execution of MSWM.

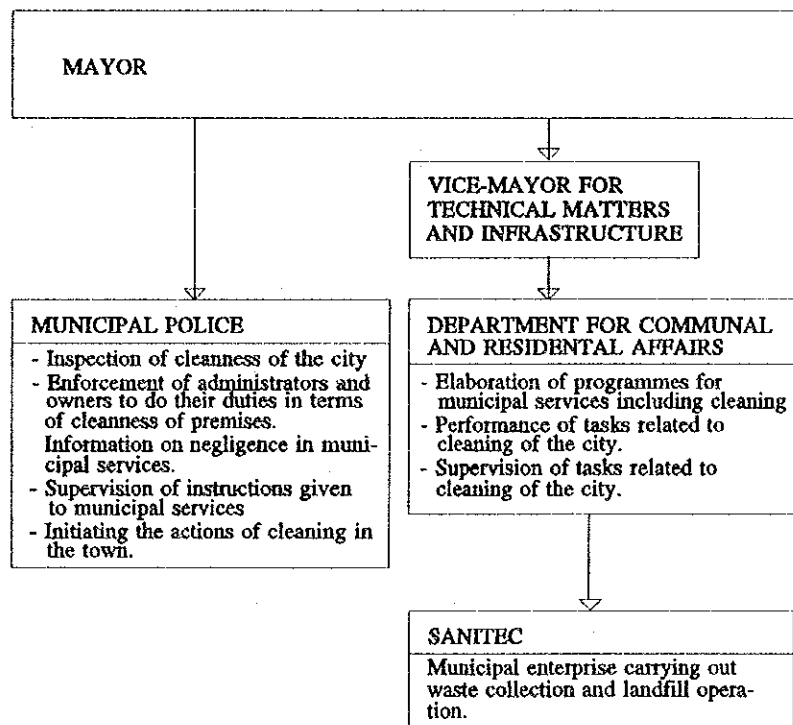


Fig.4.8.3-1 Organization of MSWM in Poznan Municipality

At present, Poznan Municipality considers to change the general structure under the Vice-Mayor for Technical Affairs with the introduction of a City Chief

Engineer, to strengthen management and relieve the working load of the Vice-Mayor.

### **The Department for Communal and Residential Affairs**

The responsibility for execution of waste services is placed in the Department for Communal and Residential Affairs to which SANITECH is subordinated as an executive and accountable unit.

The department is responsible for carrying out in detail the municipal cleansing programs and their supervision through its 5 district offices in the city.

### **SANITECH**

SANITECH was a municipally controlled enterprise executing various waste collection services, street sweeping, operation of landfill site, etc..

SANITECH's MSW collection services were based on individual contracts. MSW collection services, however were not only limited to SANITECH as private contractors are allowed to offer the same service, too.

SANITECH became a part of a new company in 1993, and the details are stated hereafter.

### **Rethman-Poznan Waste Management Co. Ltd.**

In 1992, the municipality of Poznan negotiated the establishment of a limited liability company from SANITECH, by closing down the latter, with the German company, Rethman Recycling GmbH, as private investor. The new company's operation commenced in January 1993.

The Municipality's contribution to the company were the assets of the defunct SANITECH while the German contributed money and other assets (equipment etc.).

In accordance with the assets and other contributions made by both parties, the shares of the newly established company were distributed as follows:

- 51% to Rethman Recycling GmbH.
- 49% to Poznan Municipality.

According to the draft articles, 75% of the net profit for the first 10 financial years shall be re-invested in the company. The organization for the new company is shown below.

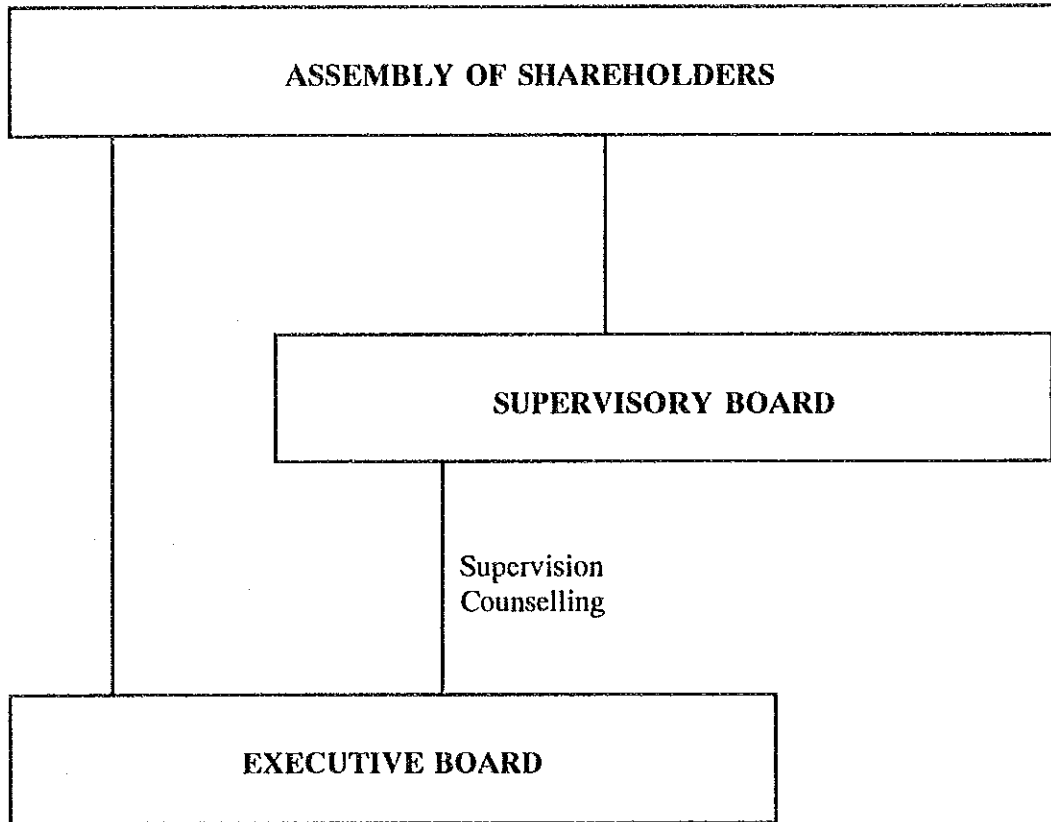


Fig.4.8.3-2 Organization of Rethman-Poznan Waste Management Co. Ltd. according to Draft Articles

According to the draft articles, the Assembly of Shareholders will be responsible for the following tasks:

- Investigate and approve reports prepared by the Executive Board (the Management) and the Supervisory Board, the balance sheets, and financial statements of the previous year.
- Decide on the division of profit and compensation of losses.
- Approve activities of the Executive Board and the Supervisory Board.
- Approve the annual operation plan of the company.

Except for extraordinary decisions, the Assembly of Shareholders can make decisions provided 2/3 of the share is represented and the decisions can be made with absolute majority.

The Supervisory Board is composed of five members appointed by the Assembly of Shareholders for a 4 year period:

- Two representatives from Poznan Municipality.
- Two representatives from Rethman Recycling GmbH.
- One representative from the company's personnel.

The tasks of the Supervisory Board are:

- Permanent supervision of the operations of the Executive Board including auditing the balance sheets and financial statements. The Supervisory Board will prepare an annual report with analysis and recommendations and submit it to the Assembly of Shareholders.
- Counselling for the Executive Board.

The Executive Board is composed by one or two members and it is appointed unanimously by the Assembly of Shareholders for an unlimited period of time.

The Executive Board represents the company in court and outside court and it makes decisions independently (taking full responsibility) in accordance with the scope of the annual operation plan for the company.

### **The Municipal Police**

The Municipal Police has a controlling function over the cleanness of the city and, thus, supervises the performance of landowners, SANITECH and private contractors.

To complete the description of the municipal organization, two departments should be additionally mentioned.

### **The Department for Environmental Protection**

The Department for Environmental Protection plays an important role in the localization of waste treatment and disposal facilities. The department suggests or recommends possible sites for location of waste treatment and disposal facilities. Thus, the department is involved in the initial screening of possible locations, which are further investigated and evaluated later, with the involvement of other authorities, too.

### **The Department for Urban Development, Architecture and Construction Supervision**

This department is among the others responsible for issuing construction permits and approvals for projects to be carried out in Poznan Municipality. The department also makes sure that requirements issued by authorities are fulfilled in the final project (eg. to check the observance of requirements given by national, regional and local authorities for a new landfill ).

### **Road Sweeping and Public Area Cleansing**

Duties related to road sweeping are carried out by a Provincial Authority in Poznan City for state and provincial roads and by the Department for Communal and Residential Affairs for municipal roads. Both authorities use tender for the road sweeping services, however, SANITECH holds the main parts of the contracts.

Duties related to public area cleansing are carried out by the Municipal Forest Authority and the Municipal Green Area Authority.

## **4.9 Organization**

This section presents the organization of the MSWM. Organizational aspects for the national and the provincial level are covered in previous sections, therefore, this section will focus on the local level.

#### 4.9.1 Poznan City

In 1992, the City Council of Poznan passed a new regulation on waste removal. Landowners are obliged to arrange the document that a waste service is carried out by SANITECH, a private contractor or themselves (direct delivery to the landfill site).

The regulation includes a compulsory disposal of household waste by the landowners but does not define in detail the service norms (type or size of dust bins, collection frequency, etc.).

Poznan Municipality has introduced a regulation on repair works in order to control the generation and disposal of construction waste. When construction companies apply for permission to use municipal road for access to a construction site, the permission is followed by a request to sign a contract with SANITECH on the collection of the waste generated during the works.

#### 4.10 Financial Situation

##### 4.10.1 National Level

The state budget has been increasing rapidly because of hyper-inflation. The ratio of revenue to GDP was less than 40% in 1990. The balance was improved by cutting the subsidies for the expenditure.

Table 4.10.1-1 The Changes in the Financial Situation

	1985	1986	1987	1988	1989	1990
Revenue	4,043	4,899	5,851	10,089	31,109	196,241
% of GDP at current price	46.7	45.8	41.8	40.4	29.6	38.8
Expenditure	4,079	4,953	5,973	10,010	33,687	193,801
within subsidies (% of expenditure)	1,245 (30.5)	1,475 (20.8)	1,843 (30.9)	3,326 (33.2)	9,677 (28.7)	32,949 (17.0)
Balance	-36	-54	-122	+79	-3,578	+2,439

Source: Rocznik Statystyczny, 1991



The budget of 1992 was approved in the midst of June 1992, though the fiscal year started in January. The approved budget is as follows:

Table 4.10.1-2 State Budget 1992 unit: Bill.zl

Item	Amount
<b>Revenue</b>	<b>337,650</b>
tax revenue	267,580
sales (turnover) tax	114,900
income tax	133,680
wage growth tax	16,900
other taxes	2,100
current non-tax revenue	59,870
interest & dividends	12,500
NBP contributions	8,635
customs duty	24,200
contributions from Treasury-sector units	9,435
other revenue	5,100
privatization revenue	10,000
interest on foreign credit granted	200
<b>Expenditure</b>	<b>403,149</b>
subsidies to finance economic projects	24,062
product-specific subsidies	5,520
producer-specific subsidies	4,310
various subsidies	12,070
subsidies to enterprises' invest projects	2,162
social-insurance	81,700
Treasury sector's expenditure	232,551
spending of economic units	22,828
science	7,894
education	41,823
culture & the arts	3,042
health care, physical culture, sports, tourism, recreation	50,821
social welfare	25,652
civil service	8,804
courts and public prosecution	5,185
public security	11,963
national defence	24,148
costs of state-assets privatization & other expenditure	2,791
special purpose reserves	27,600
foreign debt servicing	13,095
settlements with banks, domestic debt services & guarantees	43,770
Council of Minister's general reserve	400
general reserve for communes (guminas)	7,571
<b>Balance</b>	<b>-65,499</b>

The changes in the political and economic situation in Poland, especially in the reconstruction of the local government, causes temporary confusion and difficulties in the methods of financing and in managing solid waste management services. Until the previous year, all kinds of investment for municipal management were appropriated from the state government budget through the Voivodeship. But

recently, self-financing was imposed, though tax allocation has not been decentralized yet.

There are three ministries responsible for the solid waste management, but the expenditures they allocate for solid waste management are very small. Only a limited share was spent on the maintenance of state roads. The financial forecast for the year 1992 (obtained from the Ministry of Environmental Protection, Natural Resources and Forestry) is as follows:

- 3.4 bill. Zl - protection of water
- 0.4 bill. Zl - nature and forests
- 0.6 bill. Zl - geology
- 0.7 bill. Zl - others

The national fund for Environmental Protection and Water Management, which originates from the provincial (Voivodeship) funds for environmental protection and water management is 5.1 bill. Zl and covers the following:

- 2.10 bill. Zl - protection of water
- 1.40 bill. Zl - air protection
- 0.35 bill. Zl - waste management and land surface protection
- 0.50 bill. Zl - nature and forests
- 0.60 bill. Zl - geology
- 0.15 bill. Zl - others

#### 4.10.2 Provincial Level

After the reconstruction of the local government in 1991, state government grants are given to communes (guminas) directly. The budget of the Provincial Government (voivodeship) is only for their work and inter-regional (guminas) projects. Therefore, the budget of provincial governments (voivodeship) is very limited (see below).

- 1991 about 1,700 bill. zl
- 1992 about 2,000 bill. zl

Increments are only appropriated to the budget for social welfare and health services.

The budget for communal investments is only 51 million zl in 1992. The budget for roads is 56 bill. zl. The changes in the budget for roads are as follows:

- 1990 77 bill. zl
- 1991 87 bill. zl
- 1992 56 bill. zl

Because of inflation and budgetary limitations, it is difficult to construct new roads at present.

The budget of Poznan Provincial (voivodeship) Funds for Environmental Protection and Water Management in 1992 allocated only 100 bill. Zl for 70 environmental protection and water management projects, and only 10 bill. Zl will be allocated for solid waste management. In 1991, only 2.1 bill. Zl was allocated for solid waste management.

There was another budget for road maintenance including the sweeping services for state and provincial roads within Poznan city. The budget was 63 bill. Zl in 1991, and 8 bill. zl was appropriated for road sweeping services.

#### **4.10.3 Poznan Municipality**

##### **1) Money Flow for solid waste management in Poznan**

Money flow for the solid waste management in Poznan in 1992 is summarized in Fig.1.4.3-1.

The characteristics of money flow for solid waste management are as follows:

- Solid waste management is executed mainly by "SANITECH", which is one of the budgetary units. The funds are mainly from collection and disposal services fees.
- The budget sources of Poznan Municipality are mainly local taxes and state tax such as income tax and sales tax. On the other hand, the subsidy offered by the State is very limited.
- Only 2.3% of the municipal budget is allocated for solid waste management and the compensation for Suchy Las disposal site.

These characteristics were made known after the local government was reformed.

##### **2) Budget of Poznan Municipality**

The budget of Poznan Municipality is shown in Table 4.10.3-1.

Some municipal enterprises are subsidized with more than 500 billion zl and about half of this goes to the "Municipal Public Transportation Company". On the other hand, SANITECH is obliged to appropriate more than 9.7 billion zl for payments for gumina Suchy Las.

### 3) Budget of SANITECH

The changes in the financial situation of SANITECH are shown in Table 4.10.3-2.

Table 4.10.3-1 Financial Changes in "SANITECH" unit:mill.zl

	1989	1990	1991		
			Jan. to July	Aug. to Dec.	Total
<b>Revenue</b>					
- Collection	965	14,109	10,725	13,512	24,237
- Cleansing	1,074	9,500	6,708	4,744	11,452
- Landfill,etc.	88	1,031	1,175	1,317	2,492
- Subsidies	1,952	679	814	256	1,070
- Others		133	19,422	603	603
Total	4,079	25,452		20,432	39,854
<b>Expenditure</b>					
- Collection	2,280	12,420	12,985	10,022	23,007
- Cleansing	1,102	7,352	6,423	4,085	10,508
- Landfill,etc.	33	603	345	532	877
- Others	3,415	542	19,753	886	886
Total		20,917		15,525	35,278
<b>Balance</b>	+664	+4,535	-331	+4,907	+4,576

Notes: - Cleansing work includes night-soil collection.  
 - Landfill,etc., includes technical and maintenance work and transport services.

The prices for waste collection and disposal services were raised after SANITECH became a budgetary unit of the municipality, as shown in Table 4.10.3-2.

Table 4.10.3-2 Old and New Collection Fee

Item	Old price	New price
Solid waste collection service	19,500	33,200
Tipping fee	5,000	20,000

The balance of SANITECH improved due to increase in prices.

Only the subsidies of the following two cases were approved in 1991:

- land reclamation of disposal site 256 mill.zł
- purchase cost for containers 814 mill.zł

The comparison of revenue and expenditure showed the landfill division to be most beneficial, indicating a revenue 2.843 times its cost. The revenue estimated for the collection division, on the other hand, was 1.053 times its cost.

The cost according to services are summarised in Table 4.10.3-3.

Table 4.10.3-3 Cost according to SWM Services

	Collection	Disposal	Cleansing	Transport	Management	Table
Personnel cost (Wage)	1,508.5 (1059.5)	270.7 (151.4)	160.2 (109.2)	1,471.0 (612.7)	2,410	5,820.4 (1,932.8)
Materials (Fuel)	2,836.9	1,145.7	674.6	1,334.8 (756.2)	265.8	6,257.8 (756.2)
Maintenance		19.3		878.3		897.6
Division activities	310.6		551.5	460.0		1,322.1
Sub-total	4,656.0	1,435.7	1,386.3	4,144.1	2,675.8	14,297.9
Share of						
- Disposal	1,089.0	-1,095.7	6.7			0
- Transportation	2,452.4	13.9	1,595.9	-4,062.2		0
- Management	1,923.8	77.7	656.3	18.0	-2,675.8	0
Total (Rate %)	10,121.2 (70.8)	431.6 (3.0)	3,645.2 25.5	99.9 0.7	0.0	14,297.9 100.0
Waste treated (m <sup>3</sup> )	537,071	69,457	3,310			
Unit cost (zł/m <sup>3</sup> )	18,845	6,214	1,101,269			

The above-mentioned cost covers the period from August to December 1991 and does not include depreciation costs. The comparison of prices and costs showed high disposal fees, while the fee for waste collection was considered not sufficient enough to cover the replacement cost of old trucks.

The share of every resident in solid waste management expenses is estimated to amount to 0.5 - 0.6% of their average income per annum.

- The collection money of SANITECH in 1990 = 12,420 mill.zł/year
- The population who received collection services from SANITECH and paid the fee

$$(A-b \times A-C) = 375,000$$

where

A: The population of the city in 1990 = about 500,000

b: un-paid ratio = 10%;

non paying population = 50,000

C: The population receiving collection services from private enterprises = 75,000

- share of residents = 33,120 zl/capita/year  
= 2,760 zl/capita/month
  
- income in 1990
  - . employees = 632,206 zl/capita/month
  - . retirees and pensioners = 570,698 zl/capita/month

The above estimates show that the implementation of SWM is dependant on service fees, with the exception of the cleaning work for public areas and investments for collection work which should be shouldered by the municipality.

#### 4.10.4 Private Enterprises

The biggest enterprise conducting collection work is LEWAR which was established in November, 1991. The financial situation is summarized in Table 4.10.4-1.

Table 4.10.4-1 Financial Situation of LEWAR

mill.zl/month

Item	Amount
Revenue	500
- Collection Service	500
Expenditure	350
- Personnel cost (30 persons)	160
- Disposal cost (250 trucks x 450,000 zl/truck)	100 - 110
- Fuel cost	60
- Depreciation, etc. (20 % of evaluated assets)	28.3 - 29.3
- Special insurance	0.7
Profit	approx. 150

There are also other companies, but they are rather very new and small and their financial foundations are not well established yet. Nevertheless, these companies are expected to profit only if they reduce their fees to SANITECH's level.

## **4.11 Privatization**

The Government encourages the rapid development of private businesses, particularly with the introduction of foreign investments and new technology. More than 8,000 state-owned enterprises are undergoing privatization since 1990 according to the Law on Privatization of State-owned Enterprises. The government aims to establish an ownership structure similar to that of the countries in the European Community (EC).

The privatization law opens for two methods of privatization: Transformation into a joint stock 100%-Treasury-owned company later sold to investors or liquidation followed by a transfer or sale of the assets.

The Ministry of Ownership Change is responsible for the national policy on privatization and responsible for legalities. The privatization/commercialization of municipal enterprises holding monopoly on waste service is included in the ongoing privatization.

## **4.12 Public Cooperation, Legislation and Enforcement**

### **4.12.1 Public Cooperation**

Although it can be generally confirmed that environmental concern is growing and that environmental matters are expected to gain more importance in the eyes of the Polish citizens, it has not led to the acknowledgement of the necessity of increased financial contributions from the society and citizens to implement environmental protection measures.

As for recycling, the present market for recyclable materials provides the collector with a yield. With the present general living condition in Poland, the yield is very important regardless of the amount. It is also fundamentally used to operate a network of private centres where citizens can deliver recyclable materials.

## 4.12.2 Legislation

### **Law on Environmental Protection and Modelling**

The basic law for the handling of waste is the Law on Environmental Protection and Modelling which stipulates that the local administration must provide organizational and technical conditions necessary for the protection of the environment and for keeping the terrain tidy. This is also the general law on environmental protection.

### **Law on Protection of Environment against Waste**

This is the executive law of the Law on Environmental Protection and Modelling concerning waste management. It defines the duties of the municipalities and covers the following:

- Consider environmental protection tasks in preparation of development plans (town plans).
- Provide facilities for treatment and disposal and guarantee their proper operation.
- Define tasks to be provided by the municipal cleaning enterprises and guarantee the fulfilment of their duties.

Finally, the law defines the duties of owners and administrators of real estates in relation to the disposal of waste in non-developed parts and areas destined for public use and the equipping of the estate with facilities for waste storing and provision of a sanitary storage area.

### **Law on Charges for Use of the Environment**

The law settles charges for 152 types of waste categorized under 4 levels according to degree of harmfulness (group I is considered most harmful; group IV the least harmful). The charges for disposal of waste (not to be mixed with the fee claimed at the disposal site) categorized were for 1992:

- 250,000 zl./tonne for group I.
- 100,000 zl./tonne for group II.



- 40,000 zł./tonne for group III.
- 20,000 zł./tonne for group IV.

### **Law on Investments specially harmful to the Environment and Human Health**

The law states the necessity of preparing an environmental impact assessment for investments considered highly hazardous to the environment and human health. Among others, an environmental impact assessment is necessary for projects effecting:

- Annual emission of more than 20,000 tons of dust particles and gasses. However, only 5,000 tons is allowed in country borders and areas ecologically endangered.
- Pollution, intrusion of the ground surface or changes in the assignation of agricultural land or forests on areas more than 100 ha. However, only 50 ha. is the limit in areas ecologically endangered or in areas under special protection.

### **4.12.3 Proposed Laws and Regulations**

#### **Draft Law on Environmental Protection**

A new Law on Environmental Protection is under preparation. The new law will bring the Polish legislation in accord with EC legislations. According to information on the drafted law, the principles underpinning the details of the legislation are:

- Harmonious development – which seeks to ensure that waste management activity is advanced to achieve accord with other economic development.
- Protective measures – to ensure protection of the environment where conflicts in development arise.
- Rational balance – to ensure that resources are directed in ways which offer the best improvements for expenditure.
- Liability of producers – producers of waste must bear the responsibility for the proper disposal of the waste.

- Polluter pays principle – polluters must be responsible for the consequences of his activity and pay accordingly.

The municipalities are required to provide organizational, technical and financial conditions necessary for the protection of the environment against waste and they are obliged to arrange services for the collection and recycling of waste. This does not, however, oblige the municipality to cover the entire area but it may issue binding regulations to fulfil its obligations.

#### **Draft Law on Waste**

A proposal for Law on Waste is under discussion. It shall be an independent legal law concerned with the rational handling of waste, and when in force, it will replace articles like the Law on Environmental Protection and Modelling.

The law states that the producer legally responsible for his waste. As for MSW, the law declares the Municipal head responsible for the producer.

The transfer of the responsibility of households to the municipality will enable the latter to decide fully on the collection of waste (contractor, storage capacity, container type, frequency, etc.).

This will grant the municipalities appropriate tools for the enforcement of a high level of cleansing service and for the introduction of competitive bidding. Thus, the goal to provide best service qualify at a minimum cost can be obtained.

#### **4.12.4 Enforcement**

The Polish Authorities engaged in supervision and control generally carry out their duties with care until now. Violators are only persecuted or fined for severe crimes and importation of hazardous waste.

The controlling authorities are also involved in the localization and designing of new waste facilities based on design criteria determined in cooperation with the investor. Although this procedure is generally appropriate, it is weakened by the difficulties in obtaining land for the facilities.

#### **4.13 Existing Policy and Standards in the EC**

The waste policy and directives passed by the European Communities (EC) are of interest to Poland as it wants to be a member of EC. Prior to its membership it may be beneficial to adopt the policies and standards of EC to smoothen its entry.

Waste management plays an important role in the entire economy of EC. In 1988 the waste industry employed over 3 million persons throughout the Community with a turnover of more than 200 billion ECU.

The EC-Commission passed in 1989 a policy on waste management aiming to clarify principles for future efforts in EC and the Member States including identification of general priorities until 2000.

##### **4.13.1 The EC-Waste Policy**

The Rome Treaty, where the EC is founded from, put forward three basic objectives related to environmental policy:

- 1: To preserve, protect and improve the quality of the environment.
- 2: To protect human health.
- 3: To secure utilization of natural resources in a thoughtful and rational way.

The EC environmental policy is based on the polluter-pays-principle and the declared policy on waste is:

##### **1: Prevention**

- Technology based prevention. Development of clean technologies to perfect non-polluting manufacturing processes.
- Product based prevention. Market of products making the smallest possible contribution by their manufacture, use or final disposal, to increasing the amount or harmfulness of waste and pollution hazards.

##### **2: Recycling**

Recycling is considered the best method to minimize or eliminate negative environmental impact of waste.

**3: Optimization of the final disposal**

Landfill disposal and incineration are the most common disposal methods in EC, although both methods pollute of the environment. Thus, the strengthening of the standards for landfills and incineration plants is considered essential in the EC policy.

**4: Control of transport of waste**

This strategy concerns transport of hazardous waste and dangerous goods.

**5: Rehabilitation of contaminated sites**

Contaminated sites are considered a threat to mankind and environment and it is foreseen that tremendous funding must be spent on cleaning of sites.

**4.13.2 The EC-Directives**

EC has passed several directives related to waste management and at present other directives are proposed. The key directives are presented below:

- **Council Directive of 15 July 1975 on waste (75/442/EEC) amended 18 May 1991 (91/156/EEC)**

The Directive requires the Member States to establish an integrated and sufficient network of treatment and disposal facilities, so the EC as a whole can provide treatment and disposal of all waste generated in the EC. The network shall be established by considering of the best available technology and reasonable costs involved.

- **Council Directive of 8 June 1989 on the prevention of air pollution from new municipal waste incineration plants (89/369/EEC).**

The Directive introduces strict standards concerning design and operation of MSW incineration plants. Application of the emission limits in the Directive necessitates special attention on flue gas purification equipment for acid gasses.

- **Amended Proposal for a Council Directive on civil liability for damage caused by waste (COM(91) 219 final – SYN 217).**

A prime objective of the Directive is to adopt the "polluter pays" principle and to introduce a uniformed system of liability within the Community to ensure, firstly, that victims of damage caused by waste receive fair compensation and, secondly, that industry's waste-related costs resulting from environmental damage are reflected in the price of the product or service giving rise to the waste.

The Directive, which covers almost all kinds of waste, defines that the producer of waste shall be liable under civil law for the damage and injury to the environment caused by the waste irrespective of fault on his part. The liability is in force until disposal is ensured under prescribed conditions and when the waste is disposed of properly, the disposal agent is liable.

- **Proposal for a Council Directive on Disposal of Waste (Com (91) – SYN 335)**

The proposal aims at a high level of protection of ground water and soil. It is mentioned that landfills should have a good reputation with the general public and the neighbourhood and, thus, respect all regulations necessary to establish that image.

The proposal classifies waste according to its origin (household waste and industrial waste) and character (hazardous waste, non-hazardous waste and inert waste). Landfill sites are categorized according to the characters of waste.

The proposal includes several regulations of which the following are of significant importance:

- After closing of a landfill, the operator (owner) is responsible for its maintenance, supervision and control for 10 years unless otherwise stated by the authorities.
- Disposal fees. The disposal fee must cover all expenses related to the disposal services.
- Performance security. The operator must submit a performance security covering estimated costs for closing of the landfill and the cost for control and supervision.

#### 4.14 Review of Existing Plans and Studies

In 1991, the Ministry of Environmental Protection, Natural Resources and Forestry initiated the project "Municipal Waste – Strategy for Waste Management and Applicable Methods for Collection and Treatment".

The project draws the attention to several key issues, among others:

- There is a need to ensure the implementation of standards required for preparation and operation of waste management facilities. Activities should be monitored and people who fail to comply with conditions should be subject to enforcement procedures.
- Procedures relating to obtaining land use permits for waste management purposes appear to be insufficiently strong to overcome objection.
- There is a necessity to provide clear guidance for municipalities with respect to their duties and powers and what level of service is expected.
- There are major problems related to the funding of capital projects. Money is not readily available from the central government and municipalities are insufficiently developed to raise loans.
- Privatization of municipal enterprises is being carried out, but there is a need for further commercialisation to ensure that they are sufficiently well prepared for a future business environment.

Accordingly, the project proposes recommendations for a national policy for municipal solid waste management on areas where the greatest return can be achieved, eg.:

- In towns, collection services will be available to 100% of the population by the year 2000. In rural areas, a regular service to allow the safe and proper disposal of household wastes will be available to 80% of the population by the year 2000.
- Uncontrolled landfilling (dumps) will be phased out by the year 2000.
- All current and future waste treatment and disposal operations will be licensed enforced by a new regulation authority.

- Strengthened procedures for land use/development permits will be introduced to ensure that decisions are made in the best interest of the population as a whole.
- Strengthened acquisition procedures will be introduced to allow municipalities compulsory purchase of sites for certain types of development, including those for waste management, which are for the benefit of the community as a whole.
- Realistic charges for household, commercial and industrial waste services given by municipalities. These charges include the full costs of the operation, its administration and services, and the loans and bank charges arising from the investments made to carry out the service.
- The concept of "the fit and proper person" will be introduced in site licensing as a legal requirement to ensure that the operation of sites and facilities is carried out by competent personnel.

# **CHAPTER 5**

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## **EVALUATION OF PRESENT MSWM**



## **CHAPTER 5 EVALUATION OF PRESENT MSWM**

*This chapter describes the current issues and problems identified throughout the study and makes preliminary recommendations for preparation of the further studies.*

### **5.1 Technical System**

#### **5.1.1 Collection and Haulage**

- 1) According to the public opinion survey results, the main complaint on the present SMW is the irregular collection service.

The present waste collection system, in which waste is collected in accordance with the individual waste collection frequency contract by household, is only possible if the waste collection and haulage capacity exceed greatly the amount of waste generated, because the collection schedule in this system is not determined on the basis of the efficiency of the operation of waste collection. In this system, collection trucks may service the same street every day to collect waste from different frequency customers. The efficiency of this system is very low.

In fact, SANITECH is collecting waste from customers at the same frequency, not corresponding to the contract collection frequency, because their collection and haulage capacity does not have enough room. This policy of non-fulfilment of the contractual obligations leads customers to cancel the contract or decrease collection frequency.

- 2) Dust chutes have been observed to always have insanitary problems in new apartment building areas.

The dust chute system should be prohibited. The convenience obtained from dust chutes is estimated to be quite small. On the other hand problems created by dust chutes such as insanitary problems are quite serious. With the people's cooperation, elevators will be utilized to discharge waste and dust chute system will be prohibited. Moreover, since the latter is one of the main obstructions in the introduction of a source separation of waste, it shall be terminated.

- 3) The waste discharge system of old apartment building areas is worse than in other areas.

Many old apartment buildings are located in the town centre, and in contrast to the former days, offices, shops etc., are located in these buildings now. Cleaning and garbage disposal works are left to the guardians. It seems to be difficult to obtain people's cooperation for waste control.

In addition, people tend to be unconcerned about waste discharge manners as the container yard is ordinarily at the back yard which is not visible from the outside.

- 4) It is observed that soil, home renovation waste, ash, etc. are disposed into dustbins in detached and semi-detached areas. This attitude lowers the efficiency of waste collection. This discharging manner should be improved with the introduction of an incineration plant or a composting plant.
- 5) A collection system for bulky waste has not been established yet. Generally, with a little tip, people give their bulky wastes to the SANITECH collectors for disposal. But since the compactor truck is not capable for carrying this kind of waste, accidents occur and work efficiency is lessened.

### **5.1.2 Road Sweeping and Public Area Cleansing**

#### **1) Road Sweeping**

The roads of Poznan city are very clean and tidy and no urgent problems have been found except for the limited budget appropriated for this service. However, the Road City Authority endeavour to minimize costs by introducing various methods such tendering. Efforts to introduce such new systems should be continued and completed while the existing road sweeping machineries are still fully capable. At present only half of SANITECH's road sweepers are working, due to decrease in contracted work.

#### **2) Public Area Cleansing**

There are many parks and public squares in Poznan City and they are always maintained in tidy and clean condition, therefore is no need to introduce new measures.

### 5.1.3 Final Disposal

- 1) The permission to use the Suchy Las disposal site is unstable and it greatly influence the SWM plan of Poznan City by the following reasons.
  - The residents who live near the Suchy Las disposal site are not obliged to cooperate in the waste disposal of Poznan City, because they are not Poznan citizens.
  - To persuade the Suchy Las residents, the Municipality is left with no other alternative but to offer financial support. The compensation for Suchy Las started in 1989 and the total cost for 3 years, from 1989 until 1991, was approximately USD 6 million.
  - The contract can be easily cancelled because of Poland's present situation.
- 2) The existing Suchy Las disposal site is operated 24 hours a day. Night operation is not only dangerous but also has the following problems:
  - difficulty to carry out proper landfill operations
  - difficulty to judge the sort of waste
  - poor working conditions
- 3) Suchy Las disposal site receives all kinds of waste because it is the only disposal site for Poznan City. This situation makes it more difficult to obtain land use consensus from residents.
- 4) The access road to the existing Suchy Las disposal site was constructed as a temporary road, as the site was primarily intended for temporary use. However, it has been utilized for more than 7 years, and the 1 km temporary road, which now has a rough surface, is damaging to all collection trucks.
- 5) The amount of waste carried in the Suchy Las disposal site is not monitored by weight. This makes it too difficult to understand the actual situation of SWM and to take timely countermeasures.
- 6) Plenty of waste is blown and scattered around the surrounding areas of the disposal site creating insanitary conditions, because earth covering operations are not properly timed. Fire occasionally results from this as well.

## 7) Business proposals on Municipal Solid Waste Management.

The Poznan Municipality has received business proposals concerning collection, recycling and disposal of waste. The proposal includes participation of private companies in the planning and operation of the activities.

With the present economic situation of municipalities in Poland, business proposals, which may relieve the municipality of heavier investments and operations, are attractive offers.

"Profit", however, is the precept of the proposal and would, therefore, oblige the population served to pay.

It is important that the municipality carefully considers the proposal; not only in the light of the short term benefit, but the long term aspects as well must be evaluated.

### 5.1.4 Recycling

- 1) The recycling system has already been established but does not function sufficiently yet.

According to the public opinion survey result, nearly all interviewees answered that they are willing to cooperate in recycling. However, materials such as glasses are not reused as they are not directly profitable to the people. In order to promote the recycling activity of reusable materials which are not directly profitable to people, it is essential to educate people on the importance of environmental protection.

- 2) Reusable materials such as steel cans, aluminium cans and cartons, especially the latter, are increasing but not recycled due to the absence of a plant in Poznan.

### 5.1.5 Equipment owned by SANITECH

- 1) Many containers are stolen, missing or hidden, SANITECH is responsible for the maintenance of the containers and, therefore provides the customers with these. The cost of this provision is a burden to SANITECH.

- 2) Most trucks are very old and repair costs are very high.  
In order to minimize the actual operation cost and maintenance of machineries, the repair cost and depreciation must be also taken into account. It is necessary to establish a calculation system in order to judge the optimum time to sell or dismantle the machine. It can be considered that buying new machines is more economical than using the existing old machines.
- 3) The 1.1 m<sup>3</sup> communal containers are not well structured, difficult to handle and not durable, especially the wheels and lid. The majority of this type of container not only makes collection work difficult but also creates unsanitary conditions.
- 4) 1101 dustbins are also observed to be non durable and inconvenient.

## 5.2 Institutional System

The following conclusions are made based on the evaluation of the present institutional system of MSWM in Poznan:

### 1) General Conclusions

- a. Incomplete legislation and absence of administrative and managerial tools at local level hinder proper MSWM with regard to:
  - Enforcing compulsory household collection
  - Enforcing competitive bidding of waste services
  - Financing of waste services, raising of loans for investments.
- b. Many Polish municipalities are ineffectual in providing an appropriate MSWM (and other public services as well) due to insufficient public backup. Only limited experience can be observed in inter-municipal cooperation as a tool to form appropriate financially capable units.

Further, the municipalities generally have difficulties in obtaining loans, thereby eliminating the possibility to carry out feasible, but fully invested heavy projects.

- c. The tradition of public subsidization inherited from the former socialist system causes very low financial contributions from the users for public services. This results in inefficient and expensive services and lack in public interest in the services (a service is assessed by the fees charged).
- d. It is very difficult to overcome opposition and obtain land for new waste facilities. Further, it is anticipated that the area where localization takes place will receive a compensation for the resulting nuisances. These obstacles may lead to inappropriate localization of waste facilities based on deals between bigger and smaller municipalities.
- e. 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.

## **2) Conclusions related to Poznan Municipality**

- a. MSW-services in Poznan are generally carried out in a satisfactory way.

SANITECH is incorporated in the municipal organization as an unit accountable to the Department for Communal and Residential Affairs, which supervises its activities.

In January 1993, SANITECH will be closed down and a new company will be formed from it. This company will be a joint venture between the municipality and foreign investor. Poznan Municipality will possess 49% of the shares and the foreign investor 51% and majority in decisions.

Despite the municipality's involvement in the new company, it is forced to reorganize the organization to secure municipal control over MSWM including decisions related to compulsory municipal services, as majority of the shares is owned by the private company.

- b. The newly introduced municipal waste regulation allows the citizens to choose freely from among the contractors in the market.

Therefore, several contractors may end up serving the same street depending on the individual contracts, leading to unnecessary use of transportation, too expensive and diversified services.

- c. 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 formed from the defunct SANITECH, it must consider competitive bidding as a tool to provide the citizens in future with the best services their money can buy.

- d. The fee for the provided waste service is collected by the collector (SANITECH or private contractor).

The future fee collection system must be reorganized under municipal ordinance in order to provide an unified services to the citizen. Also, a municipal control over the prices must be exercised to prevent racketeering or fluctuations in prices ending in poor services.

- e. Fees are collected based on individual contracts between the contractor and the landowners. In future, more simplified charging must be evaluated, eg. by implementation of a reasonable number of standardized services (eg. one standard service for a family living in a detached housing area defining the type of dust bin (eg. 100 litre) and collection frequency (eg. once a week)).
- f. Containers and dust bins are provided to the users by SANITECH, however, the users do not sufficiently maintain them in sanitary condition.

In order to enforce maintenance and manifest an improved cleaning service, as well as adopt a self financed MSWM, users should provide their own containers.

- g. Generally, construction wastes constitute the majority of illegally dumped waste mainly dumped by small construction companies without waste storage and transportation facilities other than trailer and vans.

Poznan Municipality has taken several important steps to enforce waste services at construction sites to prevent illegal dumping. These should be required in the application and granting of all construction permits, thus expanding the services to new building construction areas.

# **PART II**

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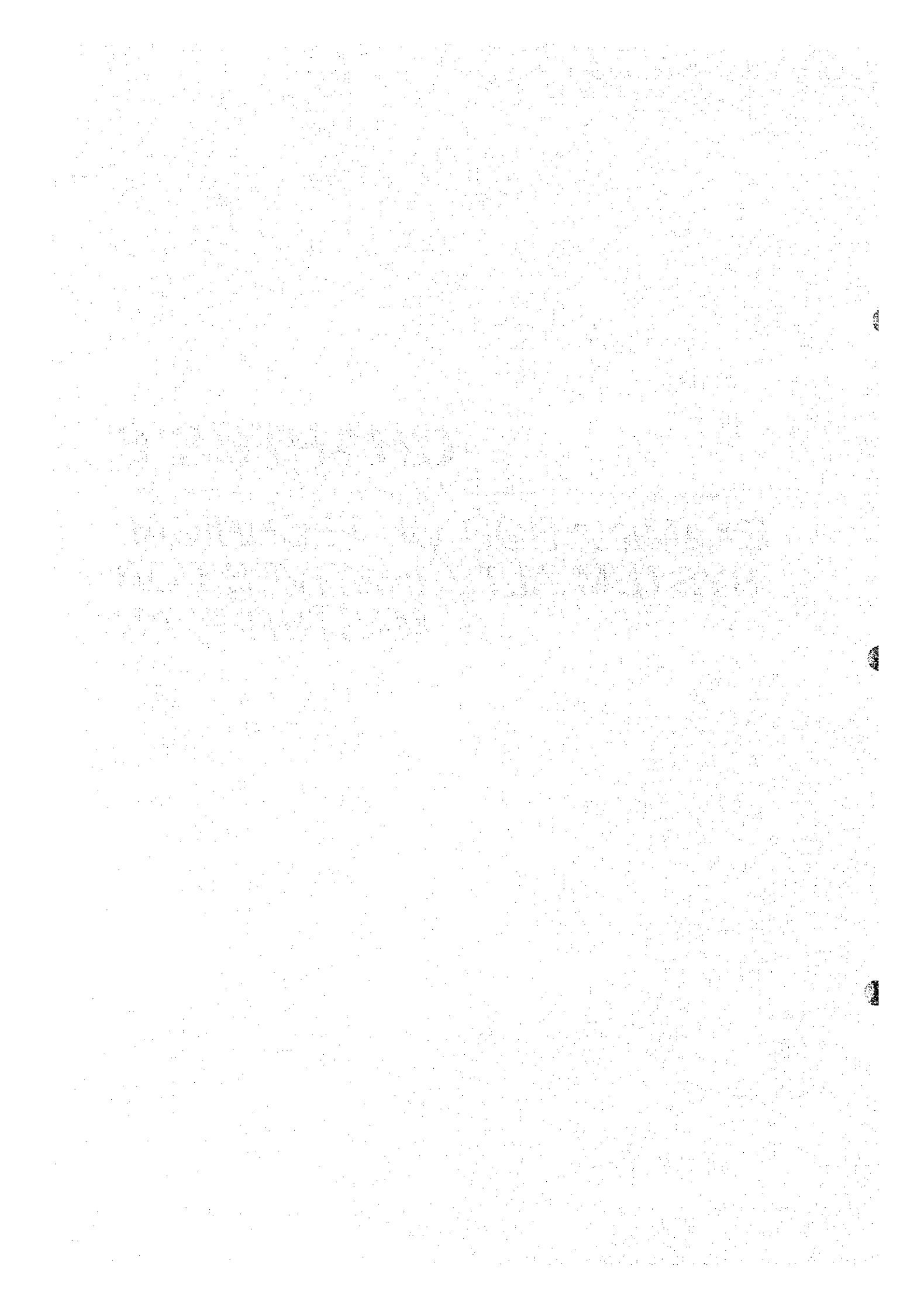
## ***MASTER PLAN***



# **CHAPTER 6**

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## **EXAMINATION OF TECHNICAL SYSTEM ALTERNATIVES FOR MASTER PLAN**



## **CHAPTER 6 EXAMINATION OF TECHNICAL SYSTEM ALTERNATIVES FOR MASTER PLAN**

*This chapter describes the selection process of the optimum MSWM technical alternative for the Master Plan.*

### **6.1 Planning Framework for the Examination**

#### **6.1.1 Target Year and Population**

##### **1) Target Year**

The master plan covers a period from the year 1993 to 2010. The targeted years for the master plan are as shown in Table 6.1.1-1.

Table 6.1.1-1 Target Year

Plan	Target Year
Master Plan	1993 to 2010
Long Term Improvement Plan	2006 to 2010
Medium Term Improvement Plan	2001 to 2005
Short Term Improvement Plan	1996 to 2000
Immediate Improvement Plan	1993 to 1995

##### **2) Service Coverage**

The present service coverage level of Poznan city is approximately 90 %. The city aims to attain and maintain 100% service coverage by and after 2001.

### 3) Present Population

The basic indices concerning population in Poznan are as follows:

- Population : 590,100
- Total Number of households : 178,573
- Average dwellers per flat : 3.18 person/flat
- Population density : 22.5 person/ha

### 4) Population Forecast

The Basic Master Plan of Poznan City estimated a population ranging from 610,000 to 620,000 by 2010. Consequently, the 620,000 population estimate was adopted for the SWM Master Plan. The annual population growth rate is, therefore, estimated at 0.275 %.

## 6.1.2 Forecast on Waste Amount and Composition

### 1) Forecast Model

The Waste Amount and Composition Survey (WACS) carried out by the JICA Study Team was used as a reference in the elaboration of the MSWM estimate of Poznan Municipality.

The forecast model will include interim estimates for the years 1995, 2001 and 2005 of the planning period. The types of waste to be forecast are:

- Domestic waste
- Commercial waste
- Market waste
- Institutional waste
- Road sweeping waste
- Sewage waste
- Other waste

## **2) Methodology for the Forecast-Model**

The forecast-model covers two (2) items. The first item is the forecast of the total amount of waste and its composition. The forecast of the total waste amount will require a study on the relation between GDP and the generation of waste.

The second item is the forecast of the calorific value for the evaluation of the quality of waste to incinerate and consideration of the development of non-compostable waste to forecast those suitable for composting in the future.

For the type of wastes to be forecast, the following assumptions were made:

### **a. Domestic Waste**

The weighed result for the PEC and non-PEC residential areas will be used. Waste generation will be projected based on the number of inhabitants, with a margin for the effects of a GDP increase.

### **b. Commercial Waste**

Waste generation will be forecast based on the floor area of shops, with a margin for the effects of a GDP increase.

### **c. Market Waste**

Waste generation will be forecast based on the number of shops in the market, with a margin for the effects of a GDP increase.

### **d. Institutional Waste**

Waste generation will be forecast based on the number of employees, with a margin for the effects of a GDP increase.

### **e. Other Waste**

Waste generation will be forecast based on the population.

## **3) Relation between GDP and Waste Generation**

An increase in the GDP is expected to have a big impact on the generation of waste per capita of developing countries than of developed countries. Also, at a

certain welfare level, increase in GDP will remarkably change the composition of waste.

Japan has fine statistics allowing for the analysis of the relation of GDP and waste generation in a developing economy (1963 – 1970) and a developed economy (1975 – 1988). The years 1970 – 1975 are excluded due to fluctuations in data resulting from a new treatment law and economic recession and instability caused by the oil crisis.

**a. Developing Economy**

Based on the data of Japan for the period 1963–1970, a developing economy can be characterized as follows:

- Average increase in waste generation per capita: 5.789 %/year
- Average increase in GNP \*: 10.438 %/year

\* GNP was used due to the unavailability of a GDP.

**b. Developed Economy**

Based on the data of Japan for the period 1975–1988, developed economies are characterized as follows:

- Increase in waste generation per capita: 1.276 %/year
- Increase in GDP: 4.415 %/year

Based on these figures, we assume that the change in GDP will affect waste generation as follows:

- Flexibility for a developing economy: 0.55 of GDP–change in %
- Flexibility for a developed economy: 0.29 of GDP–change in %

A 4% annual increase in GDP would result to increase in waste generation due to increased welfare,  $4 \times 0.55 = 2.2\%$  and  $4 \times 0.29 = 1.2\%$  for developing economies and developed ones, respectively.

The ratio to be selected will depend on the estimated actual capacity of the economy. Although the increase in the GDP ratio may be high, the actual value could be low, thus effecting a lower impact ratio than the figures shown in data of Japan.

The GDP of Poland (taken from the 1990 constant) is supposed to develop as follows:

- 1993 - 2000                   + 3.5 %
- 2001 - 2010                   + 7.0 %

However, it is assumed that a background that may trigger a Japanese "boom" is unlikely in Poland. Therefore, approximately 70% of flexibility 0.55 for a developing economy in Japan is assumed to be constantly observed in the planning period 1993 - 2010 due to increased welfare on waste generation, i.e.  $0.55 \times 0.7 \approx 0.4$ . The increase in waste generation per capita per year is, therefore, estimated as:

- 1993 - 2000     $3.5 \times 0.4 = 1.4$  %/year
- 2001 - 2010     $7.0 \times 0.4 = 2.8$  %/year

#### 4) Forecast on Waste Amount

The forecast on MSW is presented in Table 6.1.2-1 based on the WACS results, the assumptions in section 6.1.2 on each type of waste and the impact of GDP growth, and the coefficients from Table 6.1.2-1 and -2.

Table 6.1.2-1 Forecast on Waste Generation Ratio

	Unit	1992	1995	2001	2005	2010
Domestic 1	g/pers/d	430.0	448.7	492.3	565.8	691.7
Domestic 2	g/pers/d	670.0	699.2	767.1	881.6	1,077.8
Shop	g/m <sup>2</sup> /d	31.0	32.3	35.5	40.8	49.9
Catering	g/m <sup>2</sup> /d	210.0	219.1	240.4	276.3	337.8
Market	g/nos./d	3,060.0	3,193.2	3,503.6	4,026.6	4,922.6
Institutional	g/cmpl/d	65.0	67.8	74.4	85.5	104.6
Bulky	g/pers/d	52.5	54.8	60.1	69.1	84.5
Others	g/pers/d	143.3	149.6	164.1	188.6	230.6

Note: Domestic 1 -- Heat Supply; Domestic 2 -- Non-heat Supply

Table 6.1.2-2 Forecast for Population and Others

	Unit	1992	1995	2001	2005	2010
Domestic 1	person	354,060	396,718	484,027	543,709	620,000
Domestic 2	person	236,040	198,365	121,022	67,984	0
Total	person	590,100	595,038	605,049	611,693	620,000
Shops	m <sup>2</sup>	202,966	204,679	208,107	210,392	213,249
Catering	m <sup>2</sup>	172,725	174,181	177,098	179,043	181,474
Market	nos.	1,970	1,988	2,021	2,043	2,071
Institutional	employee	161,085	162,446	165,166	166,980	169,248

Domestic 1 -- Heat Supply    Domestic 2 -- Non-heat Supply

Table 6.1.2-3 Forecast for MSW, Poznan Municipality

unit:ton/day; 1 year=365 days

	1992	1995	2001	2005	2010
Domestic 1	152.2	178.0	238.3	307.6	428.9
Domestic 2	158.1	138.7	92.8	59.9	0
Shop	6.3	6.6	7.4	8.6	10.6
Catering	36.3	38.2	42.6	49.5	61.3
Market	6.0	6.3	7.1	8.2	10.2
Institutional	10.5	11.0	12.3	14.3	17.7
Bulky	31.0	32.6	36.4	42.3	52.4
Others	95.0	99.8	111.2	129.0	159.7
Total	495.4	511.2	548.1	619.4	740.8

Note:Domestic 1 -- Heat Supply; Domestic 2 -- Non-heat Supply

### 5) Forecast on Waste Composition

A change in the composition of waste is expected due to new products and a different consumption pattern.

In Table 6.1.2-4, WACS results for domestic waste 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 included. The data from WACS are



modified with the moisture content to make them comparable with the data of the EC-Study and Denmark.

Table 6.1.2-4 Comparison of Waste Composition Data for Domestic Waste

	WACS 1992 (JICA)	EC-Study, 1992	EC-Study, forecast 2010	Denmark 1985
Garbage	30.2	38	27	35
Paper	19.1	14	28	-
Dry Paper	-	-	-	17
Wet Paper	-	-	-	24
Textile	5.3	2	2	-
Plastic	4.1	2	5	6
Grass and Wood	9.9	-	-	-
Leather and Rubber	1.7	-	-	-
Other Combustibles	-	-	2	3
Metal	5.2	2	14	4
Glass	11.3	7	-	7
Ceramic and Soil	5.7	-	-	-
In-organic	-	35	22	-
Other(Non-Comb.)	7.5	-	-	4
Total	100	100	100	100

Provided that the figure for grass and wood is added to garbage, equilibrium can be achieved among the WACS figures.

The JICA Study Team found that the existing data on Poland to be insufficiently updated and has observed rapid changes in waste composition.

Although the estimates of polish experts indicate very low MSW calorific value per tradition, WACS obtained the opposite which is more consistent with the impression gained after several visits to the disposal site.

The analysis was, therefore, focused on the comparison of the data of WACS and Denmark, assuming that changes in waste composition would result to wastes characteristic of a developed economy.

Denmark was chosen for its reliable waste data and its geographical and demographic features which is similar to Poland.

The fraction papers necessitate considerations on the carrying out of estimations. Development on the other hand will only be considered as a minor change.

## Paper

The difference in the amount of papers is probably smaller than the figures indicate as recycling activities were not yet fully implemented in Denmark in 1985 contrary to Poznan where it is well implemented due to economic incitement.

A level lower than Denmark but higher than the present is expected in the planning period.

Table 6.1.2-5 shows the forecast on waste composition.

Table 6.1.2-5 Forecast on Composition of Domestic Waste, Poznan

	1992	1995	2001	2005	2010
Garbage	30.2	30.8	32.1	32.8	34.0
Paper	19.1	20.9	24.6	27.0	30.0
Textile	5.3	5.2	5.1	5.1	5.0
Plastic	4.1	4.5	5.1	5.5	6.0
Grass and Wood	9.9	8.9	7.0	5.6	4.0
Leather and Rubber	1.7	1.6	1.3	1.2	1.0
Others (Combustibles)	-	-	-	-	-
Metal	5.2	5.2	5.1	5.1	5.0
Glass	11.3	11.1	10.6	10.4	10.0
Ceramic and Soil	5.7	5.4	4.9	4.5	4.0
Others (Non-combustible)	7.5	6.4	4.2	2.8	1.0
Total	100.0	100.0	100.0	100.0	100.0

### 6) Forecast on Calorific Value and Suitability of Waste for Composting

With the changes in composition, treatment methods may have to be changed too. For incineration, the calorific value is the key-parameter. Composting, on the other hand, shall depend on waste composition.

#### a. Calorific Value

The lower calorific values obtained in the WACS are presented in Table 6.1.2-6.

Table 6.1.2-6 Result of Lower Calorific Values

Category	Lower Calorific Value (Kcal/kg)
Domestic waste	1,544
Market waste	536
Commercial waste	1,126
Institutional waste	2,848

In Denmark, the average calorific values shown in Table 6.1.2-6 are registered for wastes at incineration plants:

Table 6.1.2-7 Average Calorific Values for the Incinerator in Denmark

Category	Average Calorific Value (kCal/kg)
Domestic waste	2,000
Bulky waste (selected)	2,500
Commercial waste (selected)	2,500
Industrial waste (non-hazardous)	3,000
Waste from construction activity (selected)	3,000

For non-household wastes the average calorific values vary from plant to plant according to the local structure of trade and industry.

Based on the waste composition forecast, the following calorific values are assumed:

Table 6.1.2-8 Forecast for Calorific Value

	unit	1992	1995	2001	2005	2010
Domestic	kCal/kg	1,544	1,650	1,800	1,900	2,000
Market	kCal/kg	536	560	600	600	600
Commercial	kCal/kg	1,126	1,400	1,800	2,150	2,500
Institutional	kCal/kg	2,848	2,700	2,500	2,750	3,000
Sewage Sludge	kCal/kg	389	390	390	390	390
Weight Average	kCal/kg	1,408	1,515	1,677	1,768	1,884
		↓ 1,400	↓ 1,500	↓ 1,700	↓ 1,800	↓ 1,900

The treatment of market wastes by incineration, that is if incineration plants are introduced, will not seriously affect the equipment due to the minimum amount of calorific value it contains. However, wastes with poor calorific value should be rejected at the entrance gate. Acceptance of non-hazardous industrial wastes on the other hand will increase the total average calorific value.

**b. Suitability for Composting**

The amount of non-compostable matters is used to indicate the possible amount of compost to be produced. Although non-compostable items end as rejects, they still are included in the calculation of operational and capital costs.

The experiences of Western European countries indicate that non-compostable and harmful matters increase as a result of social development (GDP increase), the quality of compost decreases. Source segregation of waste is, therefore, recognized as beneficial for the successful introduction of composting, as it serves two purposes: minimize the amount of rejects (and thus minimize average cost per ton of produced compost) and separate harmful items to ensure the production of compost of very good quality.

**C/N-Ratio**

C/N-Ratio is used as a guideline in the selection of waste suitable for composting. Generally, the ratio used is approximately 35. The result of the chemical analysis on Poznan waste shows the following Carbon (C) and Nitrogen (N) contents:

Table 6.1.2-9 C/N-Ratio

C/N-Ratio	Residential (PEC)	Residential (non-PEC)	Market	Commercial	Institutional	Weighed Average
Carbon (%)	18.35	17.64	10.90	13.37	27.69	-
Nitrogen (%)	0.88	0.75	0.34	0.37	0.30	-
C/N-Ratio	20.85	23.52	32.06	36.14	92.3	25.72

### 6.1.3 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 socioeconomic structure is successfully reconstructed.

#### 1) Forecast of Economic Growth

The following two cases of economic growth rate were projected:

- case 1: 1992	same as 1990 level
1993 - 2000	4 % increase/year
2001 - 2010	8 % increase/year
- case 2 1995	same as 1990 level
1996 - 2000	3 % increase/year
2001 - 2010	6 % increase/year

The income level of Poznan is higher than the national average, and its GRDP is expected to increase more than the GDP due to the higher development potentials regional economies have which may be attributed to a border-less and free market system. Nevertheless, the ratio of the GRDP and the financial capability of the municipality is in proportion to the GDP, although population growth rate is lower than the overall population growth rate of the country.

The changes in income level estimated from GDP per capita are shown in Table 6.1.3-1.

Table 6.1.3-1 Changes in Income level

	1985	1986	1987	1988	1989	1990
GDP (trillion zł)	8.7	10.7	14.0	25.0	105.0	506.3
Exchange rate (zł/USD)	147.2	175.2	265.2	430.6	1446	9500
Population (million)	37.3	37.6	37.8	37.9	38.0	38.2
GDP per capita (USD)	1,577	1,624	1,398	1,531	1,910	1,395
Reference: GNP per capita WEIS*	(6,470)		(6,883)	1,860 (7,270)	1,790 (1,560)	1,690

Sources : Rocznik Statystyczny 1991, World Development Report

\* mark WEIS ARC report (CIA,Economic Statistics 1990)

The calculation results are shown in Table 6.1.3-2.

Table 6.1.3-2 GDP estimate based on the 1990 constant price (million USD)

	1990	1992	1995	2000	2005	2010
GDP (bill.USD)						
Case 1	53.3	53.3	59.9	72.9	107.2	157.5
Case 2	53.3	53.3	53.3	61.8	82.7	110.7
Financial affordab- ility of the munici- pality (bill.zł)						
Case 1		1,362	1,531	1,863	2,739	4,025
Case 2		1,362	1,362	1,579	2,113	2,829

The income level (GRDP per capita) will be between 2,770 USD(case 2) and 3,940 USD(case 1) in 2010.

#### 6.1.4 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.

All cost estimates were conducted based on the following:

- The prices were based on the June 1992 prices.
- Labour costs and investments for constructions and equipment available in Poland reflect Polish prices. These prices are presented in Zloty (Zl). Table 6.1.4-1 presents information on the June 1992 unit prices in Poznan.
- Prices for equipment not available in Poland reflect price level in Western Europe. These are presented in CIF prices of USD (1 USD = 13,500 Zl, June 1992).
- Costs for the acquisition of land as well as for connection fees (electricity, water and sewerage) are not included.
- Costs for preliminary studies and design works to be conducted to gain the approval of the authorities for the installation of facilities are not included.
- All salaries are net salaries, including 20 % tax and 45 % social security services.
- The inflation rate is not taken into account.

In order to obtain information on price levels available in Poznan, information on typical unit prices for earthworks, concrete works, buildings, etc. were obtained from AKO-consulting company specializing in the provision of construction services. Table 6.1.4-1 presents information on unit prices available in Poznan in June 1992.

Table 6.1.4-1 Information on Unit Prices Available in Poznan

DESCRIPTION	UNIT PRICE INCL. ALL MATERIALS AND WORKS POZNAN, JUNE 1992
<p><i>Salary for construction works including 20 % tax and 45 % social security services:</i></p> <ul style="list-style-type: none"> <li>- director</li> <li>- manager</li> <li>- engineer and mechanic</li> <li>- supervisor</li> <li>- driver and operator</li> <li>- worker</li> <li>- clerk</li> </ul>	<p>12.3 mill. zl/month 6.3 mill. zl/month 5.2 mill. zl/month 4.8 mill. zl/month 4.8 mill. zl/month 3.2 mill. Zl/month 3.6 mill. Zl/month</p>
<p><i>Earthworks</i></p> <ul style="list-style-type: none"> <li>- Excavation of soil and 50 m transport to storage heap</li> <li>- Excavation of soil and 500 m transport to storage heap</li> <li>- Excavation of soil, 50 m transport and compaction in an embankment</li> <li>- Supply of gravel for drainage including laying in a 0.3 m thick layer</li> <li>- D 110 PVC laid in a 1 to 1.5 m deep trench, including all materials and earthworks</li> <li>- Supply and laying of 1 m<sup>3</sup> stones for a stone drain</li> </ul>	<p>61,000 Zl/m<sup>3</sup> 68,000 Zl/m<sup>3</sup> 85,000 Zl/m<sup>3</sup> 62,000 Zl/m<sup>2</sup> 550,000 Zl/m. 520,000 Zl/m.</p>
<p><i>Pavements</i></p> <p>Consisting of:</p> <ul style="list-style-type: none"> <li>- 3 cm asphalt top layer</li> <li>- 7 cm asphalt bottom layer</li> <li>- 15 cm mechanical stable gravel</li> <li>- 30 cm course gravel</li> </ul> <p>Consisting of 30 cm layer of mechanical stable gravel</p>	<p>710,000 Zl/m<sup>2</sup> 160,000 Zl/m<sup>2</sup></p>
<p><i>Concrete works:</i></p> <p>Formwork, reinforcement, concrete and all works for the following:</p> <ul style="list-style-type: none"> <li>- wall</li> <li>- slab</li> <li>- column</li> <li>- continuous footing foundation</li> </ul>	<p>1,850,000 Zl/m<sup>3</sup> 2,100,000 Zl/m<sup>3</sup> 2,450,000 Zl/m<sup>3</sup> 1,300,000 Zl/m<sup>3</sup></p>
<p><i>Buildings</i></p> <ul style="list-style-type: none"> <li>- Garage of a steel structure with steel cladding, including foundation and concrete floor</li> <li>- Office building of brickwork, including all works</li> </ul>	<p>2,950,000 Zl/m<sup>2</sup> 4,250,000 Zl/m<sup>2</sup></p>
<p><i>Fences</i></p> <ul style="list-style-type: none"> <li>- 2 m high galvanized wire mesh erected on galvanized steel posts each 2.5 m</li> <li>- Gate (8 m wide)</li> </ul>	<p>350,000 Zl/m 8,100,000 Zl</p>
<p><i>Electrical works</i></p> <ul style="list-style-type: none"> <li>- 4 x 95 m<sup>2</sup> (aluminium) including earthwork for trench</li> </ul>	<p>220,000 Zl/m</p>
<p><i>Purchase of Polish equipment</i></p> <ul style="list-style-type: none"> <li>- Dump truck, 3 axle</li> <li>- Dump truck, 2 axle</li> <li>- Tractor (type)</li> </ul>	<p>370,000,000 Zl 300,000,000 Zl 100,000,000 Zl</p>
<p><i>Materials</i></p> <ul style="list-style-type: none"> <li>- Diesel oil</li> <li>- Cement</li> <li>- Steel beams</li> <li>- Energy</li> </ul>	<p>4,900 Zl/l 30,000 Zl/50kg 15,000 Zl/kg 744 Zl/kWh</p>



## **6.2 Selection Method of an Optimum Alternative**

In view of the present SWM in the study area, a goal to develop an environmentally sound and cost effective SWM in Poznan was made. The following were conducted to ensure the achievement of the goal:

### **1) Selection of the Optimum Technical System**

#### **a. Possible intermediate treatment facilities**

In order to develop and realize an environmentally sound SWM in Poznan, the introduction of intermediate treatment facilities shall be examined. Possible treatment facilities will be examined and selected.

#### **b. Examination of technical sub-systems**

After the selection of possible intermediate treatment facilities, possible sub-system alternatives will be selected for each possible treatment facility. For example, the introduction of composting plant would require the selection of a segregated collection system (i.e., waste will be separated into compostable and non-compostable).

#### **c. Examination of combinations of technical sub-systems**

A comparative study on technical systems will be carried out by combining each technical sub-system.

#### **d. Selection of an Optimum Technical System**

Upon consideration of the results of the above study, an optimum technical system will be selected.

### **2) Selection of the Optimum Institutional System**

After the selection of the optimum technical system, a study will also be made to generate alternatives for the organizational, institutional and financial aspects suitable to the selected technical system. After the comparative study on the above-mentioned alternatives, an optimum SWM system will be finally selected.

### 6.3 Examination of Technical System Component

The MSWM system consists of technical and institutional systems, and the technical system consists of the following sub-systems:

- discharge and storage
- collection and haulage
- roads sweeping and public area cleansing
- transfer
- intermediate treatment and recycling
- final disposal

Some sub-systems are always necessary, while others such as intermediate treatment depend on several factors: financial capacity and waste characteristics are major factors. In addition, each sub-systems has various technical system components.

In this section various system components of the above-mentioned sub-systems were examined.

As for the intermediate treatment technology, there are various processing and resource recovery (including recycling) facilities and the following intermediate technologies are examined and primarily screened for the comparison of the technical system alternative:

- incineration
- composting
- RDF(Refuse Derived Fuel)
- pyrolysis
- ash solidification
- biogas
- size reduction (crushing and shredding)
- sorting

Upon consideration of the examination of intermediate treatment systems and the present SWM in the city of Poznan, the following systems are redundant and omitted:

- RDF
- pyrolysis
- ash solidification

- biogas
- size reduction

While the following are retained for further study:

- incineration
- composting
- sorting

#### 6.4 Technical System Alternatives

Upon consideration of the proposed goal and the present SWM in Poznan, the introduction of the following intermediate treatment facilities will be examined:

- recycling centres
- a sorting plant
- an incineration plant
- a composting plant

Seven studied alternatives consisting of the above-said system components are shown in Table 6.4.1-1.

Table 6.4.1-1 List of Alternatives

Alternative Plan		1	2	3	4	5	6	7
Collection	Mix Collection	x	x		x		x	
	Separate Collection			x		x		x
Recycling	Recycling Centre		x		x	x	x	x
	Sorting Plant			x				
Treatment and Disposal	Incineration Plant				x	x		
	Composting Plant						x	x
	Sanitary Landfill	x	x	x	x	x	x	x

Note: Alternative Plan 1 is a reference plan to be used for comparison.

## **1) Public Recycling Centres**

### **a. Objectives**

- to offer private householders and small traders the opportunity to hand in all sorts of waste except kitchen refuse.
- to let users sort the waste into appropriate containers at the centres
- to increase the utilization of recyclable materials
- to ensure that the intermediate treatment plant only receive waste suitable for production, whereas other categories of waste are separated to be recycled, composted, or dumped.
- to reduce illegal dumping

### **b. Method**

Recycling centres are supervised container sites, which are in principle open for a certain number of hours every day throughout the year. Admission is free for all householders. However, the registered total weight of vehicles must not exceed a certain amount, for example 3,500 kg, in order to avoid industrial waste disposal. The householders sort their own waste into appropriate containers, which are distinctly labelled.

### **c. Waste Disposal**

Materials for recycling such as paper, cardboard, glass and bottles, metal and clothes and plastic are sent to recycling enterprises. The rest is sent to the incineration plant, the composting plant or the disposal site in accordance with the sorts of waste and the existing treatment facilities.

## **2) Sorting Plant**

### **a. Objective**

The objective of the sorting plant is to make it possible to sort out recyclable materials and non-combustible objects.

### **b. Method**

The waste is unloaded into a pit and carried to the picking band by means of an apron conveyor. A crane is installed at the band to remove large and heavy

items. Through side hoppers the separated materials are thrown into containers or conveyor bands leading to containers. Cardboard is placed in compressors.

**c. Waste Disposal**

Recyclable materials are sold to recycling industries, whereas the rest goes to landfills.

**3) Incineration Plant**

**a. Objectives**

The main objective of incineration method is to treat solid combustible waste with proper consideration of the environment. It also purposed to neutralize and reduce the volume of waste to minimize the amount to be disposed of. Another main purpose is to utilize waste as a source of heat of district heating systems and/or for electricity.

**b. Method**

Incineration reduces waste to about 5 % of the original volume, the residue consisting of raw clinkers and fly ash. Most of the clinker is to be disposed of at a landfill.

**c. Waste Disposal**

Recyclable materials such as metal are sorted after burning and sold to recycling industries. The rest is sent to the disposal site.

**4) Compost Plant**

**a. Objectives**

- to utilize organic waste for compost production
- to reduce disposal volume

**b. Method**

If organic materials are separated from municipal solid wastes and subjected to bacterial decomposition, the end product remaining after dissimilatory and bacterial activity is called humus. The entire process involving both the

separation and microbial conversion of the organic solid waste is composting.

**c. Waste Disposal**

Recyclable materials such as metal are sorted and sold to recycling industries. The rest is sent to the disposal site.

**6.5 Conceptual Design and Evaluation**

**1) Summary of Alternative Systems**

7 alternatives are described below, and their comparison table is presented in Table 6.5.1-1

**Alternative 1**

**Mix Collection (present system)  
Sanitary Landfill**

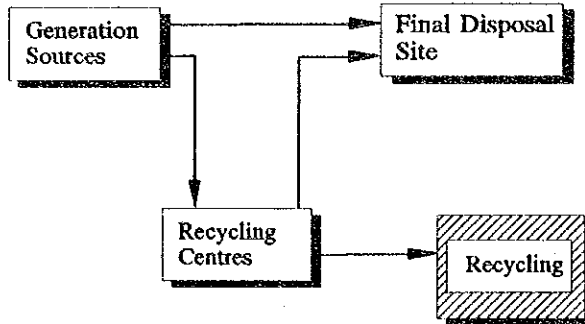


**Alternative 2**

**Mix Collection**

**Recycling Centres (2-large and 6-small)**

**Sanitary Landfill**

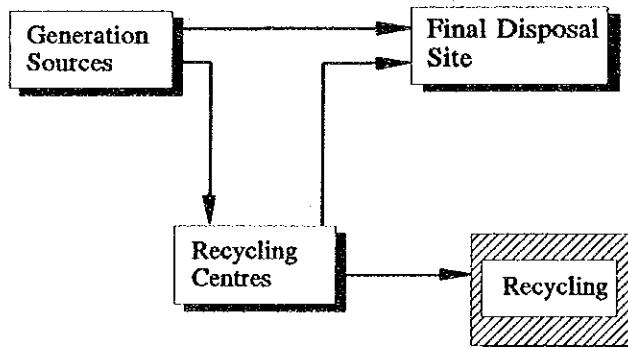


**Alternative 3**

**Separate Collection**

**Recycling Plant**

**Sanitary Landfill**



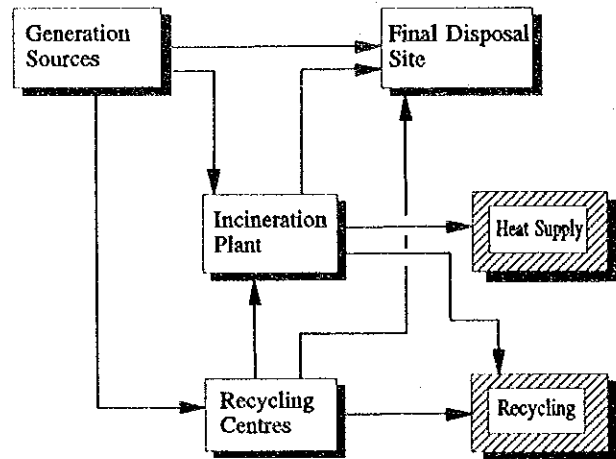
**Alternative 4**

**Mix Collection**

**Recycling Centres (2-large and 6-small)**

**Incineration Plant**

**Sanitary Landfill**



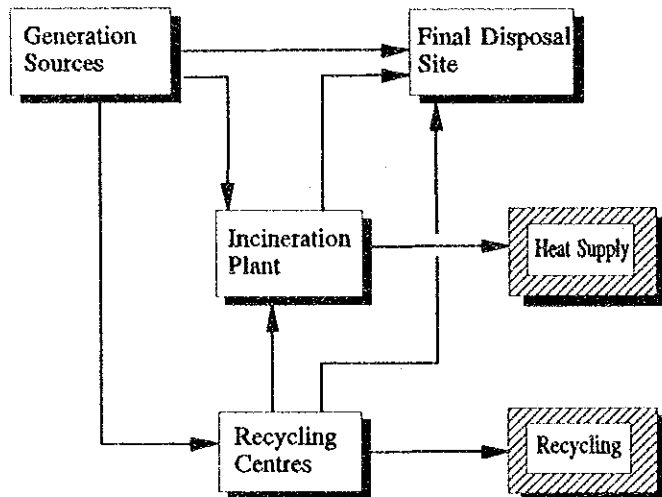
**Alternative 5**

**Separate Collection**

**Recycling Centres (2-large and 6-small)**

**Incineration Plant**

**Sanitary Landfill**





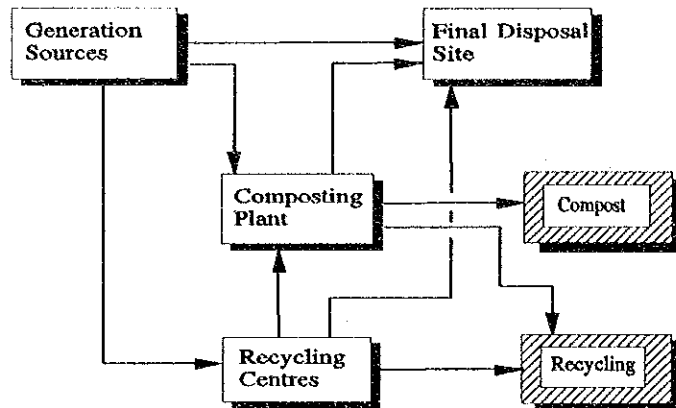
**Alternative 6**

**Mix Collection**

**Recycling Centres (2-large and 6-small)**

**Composting Plant**

**Sanitary Landfill**



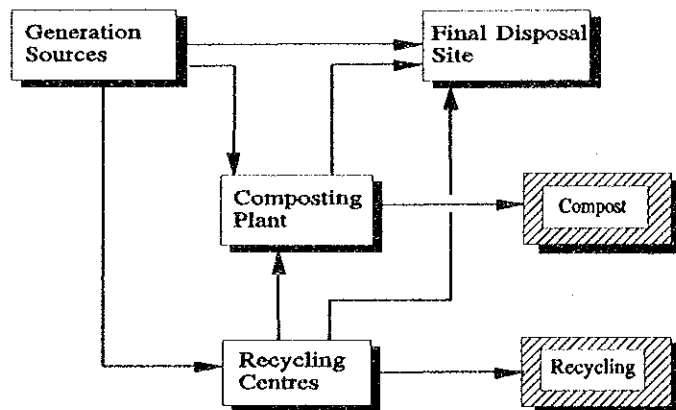
**Alternative 7**

**Separate Collection**

**Recycling Centres (2-large and 6-small)**

**Composting Plant**

**Sanitary Landfill**



## **2) Waste Flow Forecast in the Year 2010 of Each Alternative**

The present waste flow and the waste flow forecast in 2010 of each alternative are presented in Fig.6.5-1.

## **3) Investment and Annual Expenses**

The investment and the annual expenses of the 7 alternatives in 2010 are presented in Table 6.5.1-2 and -3.

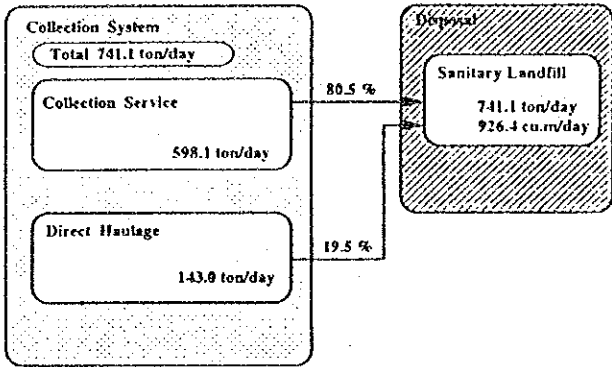
Table 6.5.1-1 Summary of Alternative Systems

in the year 2010

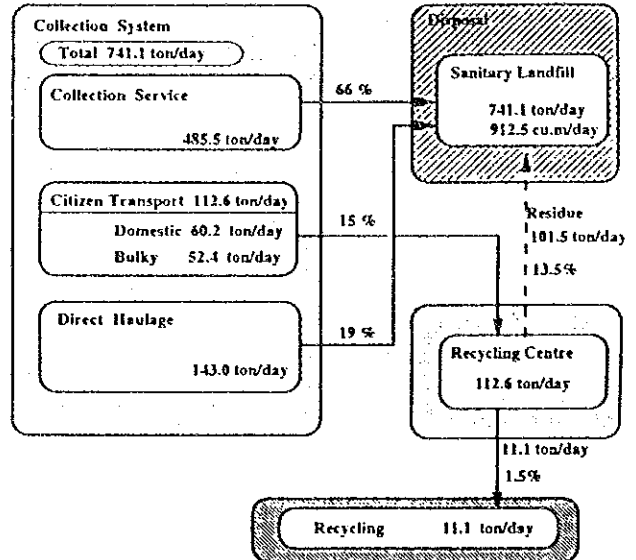
	Unit	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
Main system components								
Collection system								
Recycling		-Combined	-Combined	-Separated	-Combined	-Separate	-Combined	-Separated
Processing		nil	-Recycling centres	-Sorting plant	-Recycling centres	-Recycling centres	-Recycling centres	-Recycling centres
Final disposal		nil	nil	nil	-Incineration plant	-Incineration plant	-Composting plant	-Composting plant
		-Sanitary landfill	-Sanitary landfill	-Sanitary landfill	-Sanitary landfill	-Sanitary landfill	-Sanitary landfill	-Sanitary landfill
Total generation	t/d	741.1	741.1	741.1	741.1	741.1	741.1	741.1
Collection to Processing Plant	t/d	-	-	152.6	485.5	393.9	339.5	339.5
to Final disposal sites	t/d	485.5	485.5	445.5	0	57.5	485.5	91.6
Direct Haulage	t/d	-	112.6	-	112.6	112.6	112.6	112.6
to Recycling Centres	t/d	-	-	0	69.2	69.2	69.2	69.2
to Processing plant	t/d	143.0	143.0	143.0	73.8	73.8	73.8	73.8
to Final disposal site	t/d	-	-	26.5	263.1	179.2	193.4	87.2
Residue from Processing plant	t/d	-	-	-	63.9	37.6	74.2	74.2
from Recycling centres	t/d	0	11.1	126.1	18.8	11.1	51.9	11.1
Recycling	t/d							
Recovery or product	t/d							
Landfill	t/d, (m <sup>3</sup> /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 eqp.	nos.	88,413	71,767	132,626	71,767	107,650	71,767	107,650
1.1 m <sup>3</sup> container	nos.	8,918	7,239	13,377	7,239	10,860	7,239	10,860
6-10 m <sup>3</sup> container	nos.	1,375	1,116	2,748	1,116	2,231	1,116	2,231
Haulage truck	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 <sup>2</sup> )	sites	nil	6	nil	6	6	6	6
Small (A = 2000 m <sup>2</sup> )								
Intermediate treatment plant								
		nil	nil	Sorting plant	Incineration plant	Incineration plant	Composting plant	Composting plant
				320 t/d	744 t/d	648 t/d	685 t/d	548 t/d
Final disposal amount from 1994 until 2010	m <sup>3</sup>	4,573,000	4,531,000	4,096,000	2,697,000	2,762,582	3,038,122	3,199,284
Cost	mill. z	465,854	442,152	742,715	1,002,402	1,011,058	703,802	735,688
Total investment	mill. z	70,704.1	66,429.9	101,329.6	130,103.2	126,396.9	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							

Fig.6.5.1-1 Waste Flow Forecast

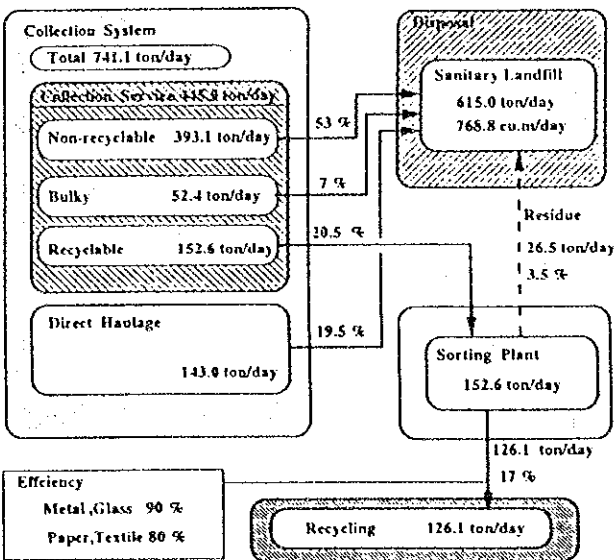
Alternative 1 in 2010



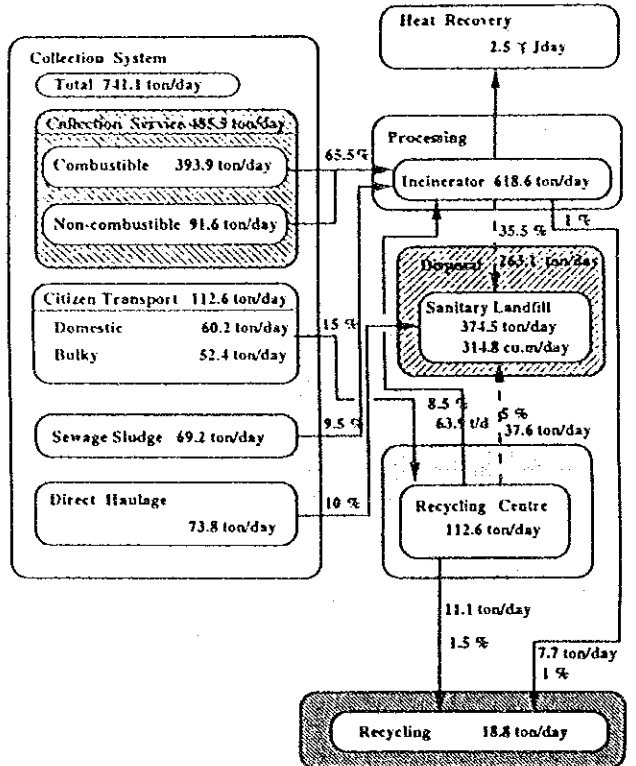
Alternative 2 in 2010



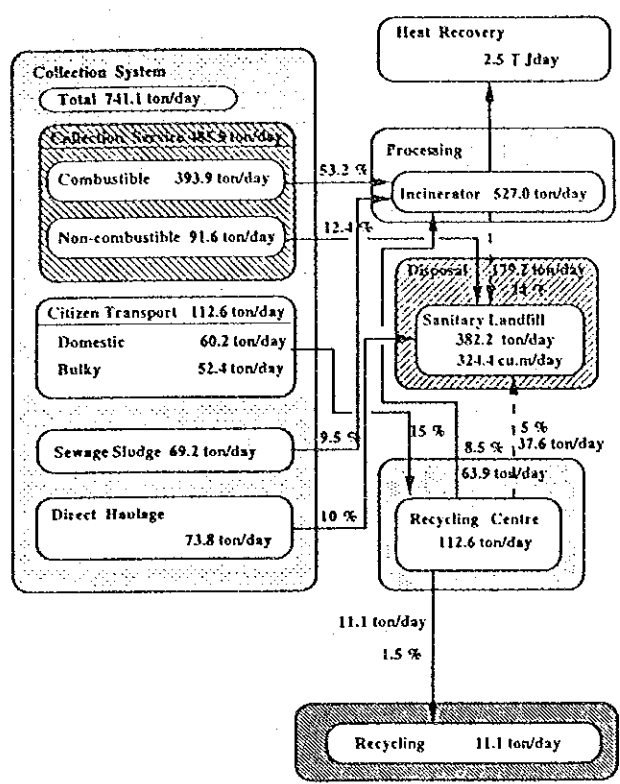
Alternative 3 in 2010



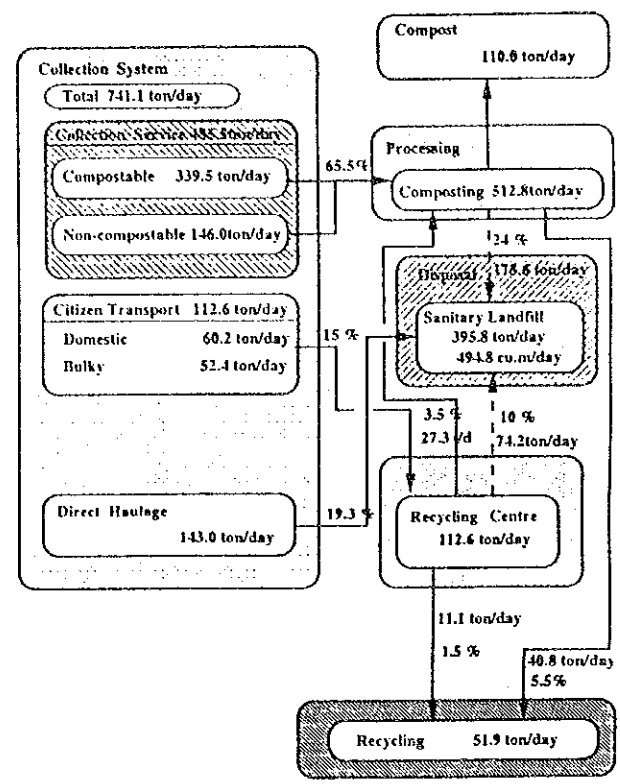
Alternative 4 in 2010



**Alternative 5 in 2010**



**Alternative 6 in 2010**



**Alternative 7 in 2010**

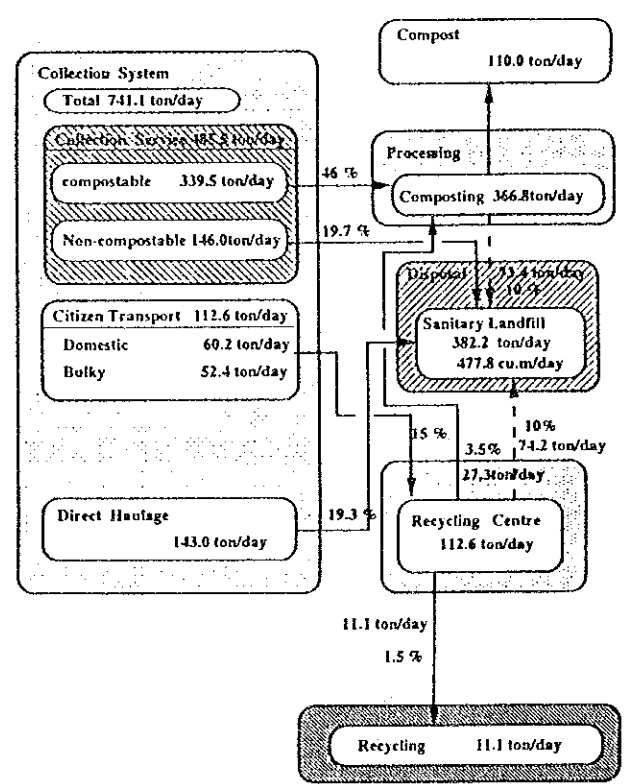


Table 6.5.1-2 Investment Cost

unit: mill. zł

	Alt.1	Alt.2	Alt.3	Alt.4	Alt.5	Alt.6	Alt.7
A. Construction							
1) Sorting P. - Civil Work - Machinery			163,000 43,735 119,265				
2) Recycling C. - Civil Work		8,958		8,958	8,958	8,958	8,958
3) Incinerator - Civil Work - Machinery				643,500 90,000 553,500	560,950 79,000 481,950		
4) Composting - Civil Work - Machinery						284,850 125,000 159,850	232,170 100,000 132,170
5) Landfill - Civil Work 1* - Civil Work 2*	182,125 15,375 166,750	182,125 15,375 166,750	182,125 15,375 166,750	98,875 15,375 83,500	98,875 15,375 83,500	126,625 15,375 111,250	126,625 15,375 111,250
Sub Total	182,125	191,083	345,125	751,333	668,783	420,433	367,753
B. Purchase of Trucks etc.							
1) Collection - Truck	51,585	45,405	57,155	45,405	49,305	45,405	49,305
2) Composting - Heavy Eq.						16,150	12,830
3) Landfill - Heavy Eq.	15,000	15,000	15,000	5,600	5,600	8,000	8,000
4) Cleansing - Road Sweeper	12,240	12,240	12,240	12,240	12,240	12,240	12,240
Sub Total	63,825	57,645	69,395	57,645	61,545	73,795	74,375
C. Purchase of Containers							
1) Collection - Container	52,026	42,230	86,267	42,230	70,032	42,230	70,032
2) Recycling C. - Container		3,030		3,030	3,030	3,030	3,030
Sub Total	52,026	45,260	86,267	45,260	73,062	45,260	73,062
Total A + Bx2 + Cx3	465,854	442,152	742,715	1,002,402	1,011,058	703,802	735,688

Note:

\*1 The life span of the civil work 1 (building, etc.) is assumed to be 30 years.

\*2 The life span of the civil work 2 (liner, earthwork, etc.) is assumed to be 10 years.

Table 6.5.1-3 Annual Expenses in 2010

unit:mill. zł

	Alt.1	Alt.2	Alt.3	Alt.4	Alt.5	Alt.6	Alt.7
Collection							
Depreciation	17,038	14,283	24,602	14,284	20,346	14,284	20,346
Personnel Cost	10,568	8,955	11,689	8,955	9,769	8,955	9,769
Maintenance	2,065	1,817	2,288	1,817	1,973	1,817	1,973
Fuel & etc	13,690	11,452	15,151	11,452	12,507	11,452	12,507
Sub Total	43,360	36,508	53,730	36,508	44,595	36,508	44,595
Recycling C.							
Depreciation		905		905	905	905	905
Personnel Cost		1,613		1,613	1,613	1,613	1,613
Maintenance							
Fuel & etc.							
Sub Total		2,517		2,517	2,517	2,517	2,517
Sorting Plant							
Depreciation			9,409				
Personnel Cost			1,362				
Maintenance			3,742				
Fuel & etc.			4,988				
Sub Total			19,501				
Incinerator							
Depreciation				39,900	34,763		
Personnel Cost				2,340	2,110		
Maintenance				10,632	7,800		
Fuel & etc.				19,113	15,400		
Sub Total				71,985	60,073		
Composting							
Depreciation						16,900	13,794
Personnel Cost						2,610	2,240
Maintenance						4,600	3,738
Fuel & etc						8,700	7,070
Sub Total						32,810	26,843
Landfill							
Depreciation	12,250	12,250	12,250	6,144	6,144	8,085	8,085
Personnel Cost	868	868	868	503	503	503	503
Maintenance	950	950	950	443	443	528	528
Fuel & etc.	3,693	3,693	3,693	1,721	1,721	2,052	2,052
Sub Total	17,761	17,761	17,761	8,811	8,811	11,168	11,168
Cleansing							
Depreciation	1,574	1,574	1,574	1,574	1,574	1,574	1,574
Personnel Cost	864	864	864	864	864	864	864
Maintenance	612	612	612	612	612	612	612
Fuel & Cost	2,682	2,682	2,682	2,682	2,682	2,682	2,682
Sub Total	5,732	5,732	5,732	5,732	5,732	5,732	5,732
Administration							
Depreciation							
Personnel Cost	3,852	3,908	4,607	4,551	4,669	4,607	4,697
Maintenance							
Fuel & etc.							
Sub Total	3,852	3,908	4,607	4,551	4,669	4,607	4,697
Total	70,704	66,425	101,330	130,103	126,397	93,341	95,552

## **6.6 Institutional Requirements**

The institutional requirements to be implemented independently from the recommended Master Plan Alternative will be presented in this Section. Section 6.6.2, on the other hand, presents the specific requirements of the Master Plan Alternatives.

In the selection of an optimum alternative, the institutional requirements must be analyzed. The basic constraint is if the optimum alternative is technically not in conformity with the legislation in force. It is also crucial to appropriately secure financing for the alternative, including sufficient contributions from the citizens.

In forming the future institutional system it is important to strengthen the planning part and to divide responsibilities, so the best possible self control can be exercised. Also, it is necessary to distinguish between compulsory municipal services and services performed in a free market with full competition.

### **6.6.1 General Institutional Requirements**

The efforts at national and regional level are put into provision of a proper operational frame for the municipalities (local governments) as the executing administrative level in MSWM.

At present, the framework is incomplete lacking basic tools for implementation of appropriate local MSWM. Thus, efforts should be put into determination of national policies, completion of legislation, and national financial actions (taxes and subsidizes) in order to provide the necessary foundation for the local planning. The determination and completion of these prerequisites should be followed by a period of at least 4-6 years for local implementation. A continuously flow of changes in legislations, policies and standards may disturb the local planning and delay implementation of improvements.

The following recommendations should be observed for national and regional levels:

#### **1. Determination of National Policy on MSWM including an Implementation Schedule.**

Purpose : To clarify initiatives which necessitate action at the national level.



The aim is to define the prerequisites for planning of a local MSWM services at an early stage. The national policy should include a plan for the implementation of legal initiatives and standards.

**2. Completion of legislation and standards related to MSWM including improved possibilities for acquisition of land under compulsory powers.**

Purpose: To implement the national policy and complete the background for local MSW-plans and projects (legislation and standards). Necessary tools for proper municipal management shall be implemented (possibility for enforcement of compulsory participation in MSW-services, enforced public control of private operation in MSWM etc.).

**3. Provision of proper means for financing including municipalities possibilities to raise loans.**

Purpose: To furnish local authorities with the possibilities to finance feasible project through loans, taxation etc.

**4. Implementation of a Licensing Institution responsible for licensing of waste utilities.**

Purpose: To strengthen operation of waste utilities and to ensure sufficient education and training of operation personnel

A regular licensing of waste utilities will strengthen the public control with operation of waste utilities.

The licensing shall also ensure that data to complete the waste flow is made available for the planning authorities to improve the planning and implementation of new initiatives.

**5. Strengthen of supervision during implementation of projects.**

Purpose: To ensure that implementation (construction) is in accordance with the required design.

Increased public supervision is necessary to cover up the inefficient supervision conducted by investors and contractors

## **6. Clarification of aspects concerning private operation in MSWM.**

**Purpose:** To clarify items where private operation is appropriate or acceptable from the public's point of view. Clarification should be followed by guidelines for private operation including the elaboration of guidelines and legislation concerning competitive bidding.

## **7. Initiation of Public Education Programmes**

**Purpose:** To prepare the public for increased cooperation in the field of environmental protection.

Initiation can take place through general campaigns making use of the mass media and through introduction of environmental education in schools.

### **6.6.2 Specific Institutional Requirements for Poznan Municipality**

In addition to the general institutional requirements the following specific institutional requirements to the Master Plan Alternatives are deemed appropriate:

## **8. Public Control with MSWM**

**Purpose:** The proposed joint venture shall be published and advertised in articles and to organizations. In the upcoming negotiations, Poznan Municipality must be able to maintain full control of activities related to MSWM.

Compulsory municipal services must be made independent of commercial activities in order to control the costs.

## **9. Strengthening of organization within Department for Communal and Residential Affairs**

**Purpose:** To ensure that all matters related to the determination of the extension of services and the establishment of contact with the citizens (determination and collection of payment) are performed by the municipal administration (the company involved in the joint venture should only be an executing body).

These duties may appropriately be placed in the Department of Communal and Residential Affairs by strengthening the Department, which would also include the introduction of a general in service training.

The operation of a new disposal site should remain a municipal responsibility, and must be incorporated, therefore, in the Department of Communal and Residential Affairs.

#### **10. Specification of minimum waste services**

**Purpose:** To determine an appropriate level of compulsory waste service to be implemented when legal possibility is clarified.

The aim is to introduce unified service and further a unified system of payment.

#### **11. Development of a fee collection system**

**Purpose:** To collect fees for waste services under municipal responsibility.

#### **12. Introduction of competitive bidding**

**Purpose:** To secure highest value for the money and to introduce private operation in a public service.

The competitive bidding should include daily operation of collection systems and construction of services and facilities in the selected Master Plan alternative.

#### **13. Stimulation of public cooperation at local level**

**Purpose:** To increase the public cooperation at local level.

An annual ecological marathon similar to the one organized by the JICA Study Team could be an opportunity to meet the citizens with messages and allow for a better communication.

#### **14. Determination of a fee system supporting the waste flow**

**Purpose:** Formulation of economic incentives to ensure an appropriate waste flow.

Subsidies should be directed to areas where a full charge in collection services is expected to prevent uncontrolled flow of waste. The need for subsidies will be reduced and phased out over a period of time. Future fees and charges should be announced to reduce later opposition.

#### **15. Nurse of general public consensus**

**Purpose:** Poznan Municipality must nurse the general public consensus through fair and informative measures to gain acceptance for the localization and implementation of specific projects (eg., localization of new disposal site in Franowo). Ignorance on facts about pollution hazards may cause misunderstanding among the public. Proper information will minimize opposition.

Summarized, it can be concluded that implementation of modern waste management sets comprehensive demands to the institutional development and Poznan Municipality is not an exception. It is of vital importance that the municipal organization is strengthened to fulfil the expectations from the citizens and to comply to the duty to administer the tax revenues and public services in proper way.

An overall appropriate framework defined at national and regional is, however, also vital for the success at local level. Especially, completion of legislation and provision of proper financial tools are key areas to be solved immediately.

## **6.7 Evaluation of the Alternatives**

### **6.7.1 Methodology**

#### **1) Planning Objectives**

The procedure adopted for the evaluation of the proposed alternatives is shown in Fig.6.7.1-1 and consists of the three following steps:

- formulation of alternative plans in accordance with the prescribed objectives;
- evaluation of individual alternatives based on four evaluation criteria; and
- integration of individual evaluation results.

The goal of the Master Plan is "the development of environmentally sound solid waste management system in Poznan". This can be achieved through the following:

- citizens' participation
- establishment of self-sustainable solid waste management
- resource recovery and recycling

#### **2) Evaluation Criteria**

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.

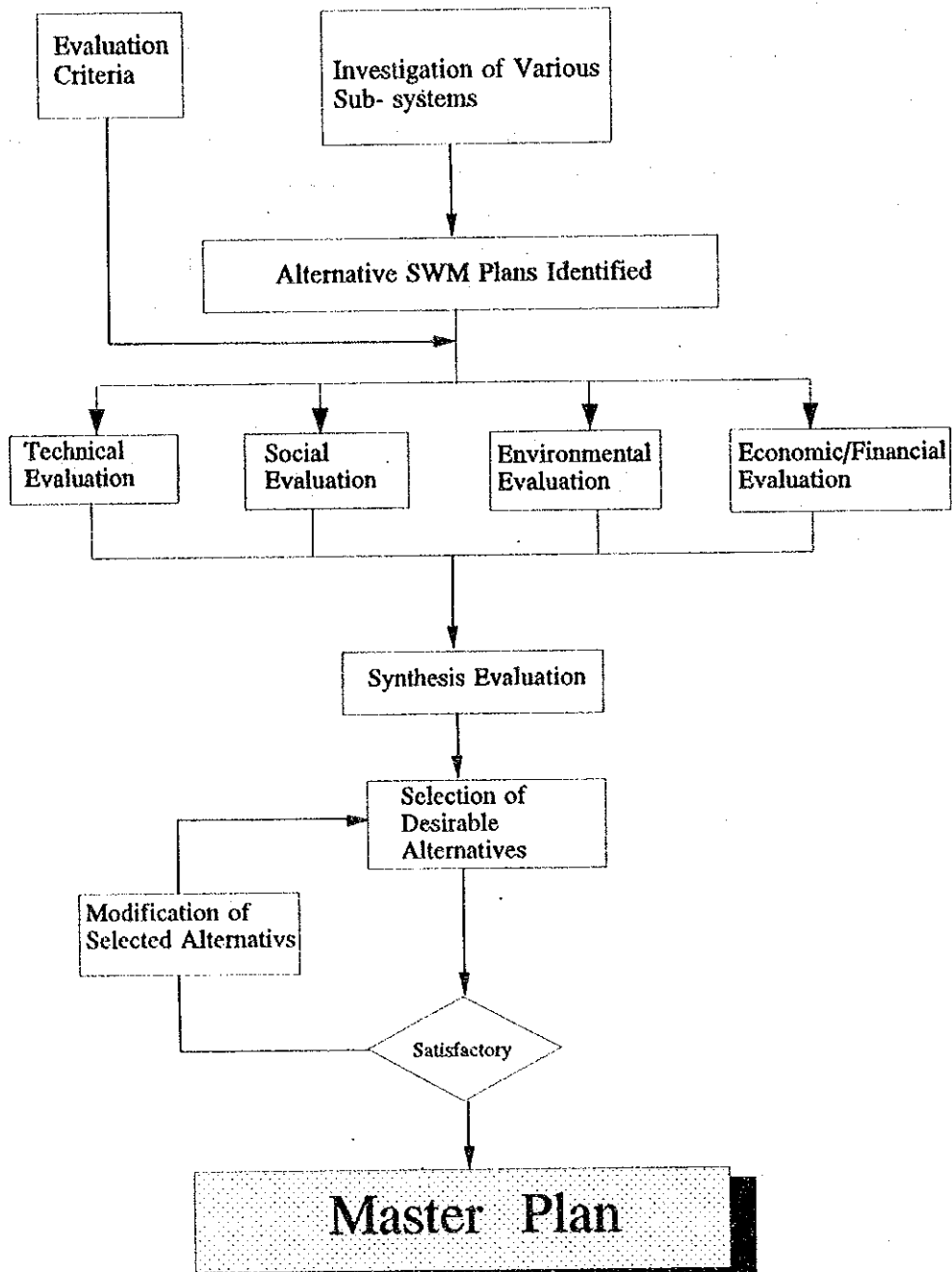


Fig.6.7.1-1 Procedure for the Evaluation of Alternatives

## **6.7.2 Technical Evaluation**

### **1) Evaluation Factors**

The technical evaluation of each alternative plan was conducted on the basis of the following four factors, and the alternatives were ranked accordingly as shown in Table 6.7.2-1.

#### **a. Working conditions**

- safety and hygiene
- equal work load and work suitability

#### **b. Operation and maintenance**

- reliability and maintainability of facilities
- difficulty of operation and maintenance

#### **c. Construction**

- local availability for construction

#### **d. Indirect advantages**

- prospect of future technical development
- contribution to fostering or upgrading engineering skills

### **2) Evaluation**

#### **a. Working Conditions**

Workers involved in solid waste management are engaged in different types of work determined by such processes as collection, transportation, control of recycling centres, operation of sorting plant, incineration plant and composting plant and final disposal. The following three types of works in particular require improved working conditions to ensure both safety and hygiene.

- work in each intermediate treatment facilities
- loading of solid waste into collection trucks
- landfill work at disposal sites

Although the same technical systems will be applied to the discharge/storage, collection/haulage and final disposal, the final disposal amount will vary depending on the alternative. The final disposal amount of Alternatives 4, 5, 6 and 7 are one half to one third of Alternatives 1, 2 and 3, respectively. Moreover, the working environment at the final disposal site of Alternatives 4, 5, 6 and 7 is much better than in Alternatives 1, 2 and 3, because humus organic materials can be intercepted before arrival in the final disposal site by subjecting them to intermediate treatment.

Additionally, the improvement of the work conditions for the following operations should be given full consideration.

- segregation work at the sorting plant
- removal work of bottom ashes at the incineration plant
- secondary fermentation work at the composting plant

Segregation work at the sorting plant is particularly very labour intensive.

#### **b. Operation and maintenance**

- i. Operation and maintenance difficulties in the disposal site are estimated to be almost the same at every alternative plan. Operation and maintenance work in Alternatives 4 and 5, however, is estimated to be the easiest, because the amount of waste disposed is the least in these areas and because humus organic wastes are incinerated.
- ii. Only few problems can be observed in the operation and maintenance work at the recycling centres as they only involve the transportation of large containers with a roll on-roll-off truck.
- iii. Difficulties observed in the operation of the sorting plant lies on the sorting work itself. It is necessary to educate and train the workers to create an effectively functioning sorting plant.
- iv. Incineration control is very important and difficult to operate and maintain. Therefore, its operation shall be made automatic. Nevertheless, the workers must be trained and educated to acquire the skills required for a smooth O & M implementation.
- v. The quality control of compost products is most important in the operation and maintenance of the composting plant.



Waste segregation should be strictly conducted at generation sources for Alternative 7, because composts of low quality will lead to loss of customers. In addition, organic materials like manure and night soil must be mixed with municipal organic solid waste to produce composts of fine quality.

**c. Construction**

The proposed SWM site for the 7 Alternatives is the same, namely Franowo-Michalowo. The construction of the incineration plant, composting plant, and sorting plant, in this order, will require highly advanced technology. The technology used in Poland presently will be good enough for the construction of all facilities except the incineration plant.

**d. Indirect Advantage**

Future technological development and the upgrading of engineering skills can be expected from the introduction of the incineration, composting and sorting plants. The introduction of an incineration plant will especially contribute to the establishment of a foundation for incineration technology. (The first incineration plant is under construction in Swietochtowice).

**3) Summary of Technical Evaluation**

Table 6.7.2-1 Summary of Technical Evaluation

Criteria	Alternatives						
	1	2	3	4	5	6	7
a. Working Condition	B	B	C	A	A	A	A
b. Operation and Maintenance	B	B	B	B	B	B	B
c. Construction	A	A	A	B	B	A/B	A/B
d. Indirect Advantage	B	B	A	A	A	A	A
Overall Assessment	B	B	B	A	A	A	A

Note. A:good, B:fair, C:poor

### **6.7.3 Social Evaluation**

#### **1) Evaluation Factors**

The social evaluation of each alternative was conducted based on the following factors, and the alternatives were ranked accordingly as shown in Table 6.7.3-3.

- a. Possibility for land acquisition**
  - land use restriction
  - land ownership
- b. Compatibility with regional development plans**
- c. Possibility of acquiring neighbourhood consensus**
- d. Introduction of public cooperation**
  - haulage to the recycling centre by citizens
  - separate discharge
- e. Introduction of resource recovery and recycling system**
  - recycling centre
  - sorting plant
  - incineration plant
  - composting plant

#### **2) Evaluation**

##### **a. Possibility of Land Acquisition**

The acquisition of the land for the intermediate treatment facilities is expected to be easy as it is a state agricultural land at present.

The acquisition of land intended for the recycling centres is also expected to be easy as one recycling centre only requires an area of 1,500 to 3,000 m<sup>2</sup>.

##### **b. Compatibility with Regional Development Plans**

At present, the formulation of the Urban Development Master Plan is being carried out by the Poznan Municipality. According to the Master Plan, only Franowo-Michalowo area is supposed to be proposed as a solid waste facilities site.

**c. Possibility of acquiring neighbourhood consensus**

The nearest residence is located 200 m away from the border of the proposed site. The approval of the inhabitants is required prior to the construction of the facilities.

The approval of the majority of the Poznan citizens even only for the sanitary landfill project is said to be very difficult to obtain. In order to obtain the support of the majority of the citizens, the addition of a modern intermediate treatment facility would be very effective.

The facility most attractive to Poznan citizens seems to be the incineration plant which can supply energy and provide amenities such as a thermal swimming pool.

**d. Introduction of Public Cooperation**

Citizens' participation is essential to attain the goal of the Master Plan, and all Alternatives except Alternative 1 shall require the cooperation of the public. The recycling centre system shall require public cooperation in carrying wastes from houses to the recycling centres and separate collection shall require it in source segregation. It is difficult, however, to acquire public cooperation.

The level of public cooperation required is estimated and shown in Table 6.7.3-1.

Table 6.7.3-1 Required Public Cooperation Level

Public cooperation item	Alternative						
	1	2	3	4	5	6	7
Self haulage to recycling centres		+		+	+	+	+
Source separation discharge			+		+		+
Required public cooperation level	C	B	B	B	A	B	A

Note: + : necessary  
 A : more necessary and more difficult  
 B : necessary and difficult  
 C : same as present