MONITORING OF SOLID WASTE IN HONG KONG 1999

Waste Management Facilities in Hong Kong

Environmental Protection Department

Monitoring of Solid Waste in Hong Kong

1999

Facilities Planning Group

Environmental Protection Department

2000

Printed on recycled paper

Monitoring of Solid Waste in Hong Kong 1999

Report Number	EPD/TR6/00
Date	December 1999
Author	Tony C. H. YAM
Work Done By	S. K. CHEUNG K. F. WONG W. LI
Work Supervised By	Tom K.L. LAI
Approved By	Ellen Y.L. CHAN
Security Classification	Unrestricted

Monitoring of Solid Waste in Hong Kong 1999

Contents

List of Figures

Figure

List of Table

Table

List of Appendices

Appendix

Abbreviations

C&D	Construction and Demolition
C&I	Commercial and Industrial
CED	Civil Engineering Department
CWTC	Chemical Waste Treatment Centre
EPD	Environmental Protection Department
EPS	Expanded Polystyrene
FEHD	Food and Environmental Hygiene Department
GDP	Gross Domestic Product
IETS	Island East Refuse Transfer Station
IWTS	Island West Refuse Transfer Station
KBTS	Kowloon Bay Refuse Transfer Station
KCIP	Kwai Chung Incineration Plant
MSW	Municipal Solid Waste
NENT	North East New Territories Landfill
NLTS	North Lantau Refuse Transfer Station
NT	New Territories
OITF	Outlying Islands Refuse Transfer Facilities
RSD	Regional Services Department
RTS	Refuse Transfer Stations
SENT	South East New Territories Landfill
STTS	Sha Tin Refuse Transfer Station
tpd	tonnes per day
USD	Urban Services Department
WENT	West New Territories Landfill
WKTS	West Kowloon Refuse Transfer Station
WRFP	Waste Reduction Framework Plan

Executive Summary

(1) The monitoring of solid waste in 1999 was a continuation of previous work. The latest findings were recorded under similar headings and formats of previous reports in the same series.

(2) The solid waste quantities disposed of in 1999 were the actual quantities recorded at all the waste facilities throughout the year. The characteristics of various types of waste in the municipal solid waste stream, including domestic waste, commercial waste and industrial waste, were determined through an annual waste survey at refuse transfer stations and landfills using sampling techniques. The forecasted waste quantities were generated by new linear regression models.

(3) In the 1999 waste survey, a total of 140 waste samples, each with volume of one cubic metre, were taken from three refuse transfer stations and two landfills for analysis. For each sample, sorting was carried out on site for its composition and a small portion of which was taken out randomly before sorting for moisture content determination.

(4) In 1999, Hong Kong generated 51,470 tonnes of solid waste and reusable materials daily. The net intake quantity of solid waste in 1999 at all waste facilities was 18,040 tonnes per day; an increase by 9% from 1998. The major types of solid waste disposed of at waste facilities were municipal solid waste (9,270 tonnes per day) and construction & demolition waste (7,890 tonnes per day). Landfilled municipal solid waste was made up of 7,430 tonnes of domestic waste, 1,250 tonnes of commercial waste and 590 tonnes of industrial waste. As regards waste recovery, 4,208 tonnes of recyclable materials in the municipal solid waste were recovered daily for recycling and 29,220 tonnes of inert construction & demolition material were reused for land formation.

(5) There were 1.54 million tonnes of materials recovered from the municipal solid waste stream in 1999 (i.e. 31% of the total municipal solid waste generated in Hong Kong), of which 0.23 million tonnes were recycled locally and 1.31 million tonnes were exported for recycling. The remaining municipal solid waste was disposed of at the three strategic landfills, namely West New Territories Landfill (WENT), North East New Territories Landfill (NENT) and South East New Territories Landfill (SENT); WENT had the daily intake of 4,340 tonnes, NENT 2,600 tonnes and SENT 2,330 tonnes.

(6) All refuse transfer stations transferred daily 5,120 tonnes of municipal solid waste in bulk by containers to WENT and NENT by means of marine and land transport respectively. This quantity represented 55% of the total municipal solid waste disposed of at landfills.

(7) For construction & demolition waste disposed of at landfills, SENT had the highest daily

intake of 5,780 tonnes, WENT 1,320 tonnes and NENT 790 tonnes. The overall intake of construction & demolition waste at all landfills was 44% of the total waste landfilled in 1999, as a result of continuous diversion of inert construction & demolition material to public filling areas. The total quantity of construction & demolition material delivered to landfills and public filling areas in 1999 was 13% higher than that of 1998.

(8) Putrescibles, paper and plastics were the major components constituting about 80% of the landfilled municipal solid waste, representing about 34%, 26% and 19% respectively. Waste paper was the most popular item for recycling in 1999 and non-ferrous metals had the greatest financial value for recovery despite their relatively smaller percentage by weight.

(9) Domestic waste refers to household waste (1) , waste generated from institutional premises (e.g. government offices and schools) and refuse collected from public cleansing services such as litter collected by the then Regional Services Department and Urban Services Department (the predecessors of the Food and Environmental Hygiene Department), marine refuse and waste from country parks. The generation rate of domestic waste in 1999 was 1.06 kg per person per day, about 4% higher than that of 1998. The generation rate of commercial & industrial (C&I) waste was 0.59 kg per employee per day in 1999, taking account of the total employment size in the territory, i.e. the employment size of all sectors in the Hong Kong Standard Industrial Classification.

(10) A study was commissioned in early 2000 to review the collection of waste data and forecast of waste arisings, in which linear regression models for the forecast of quantities of individual waste types in the municipal solid waste stream were also developed. The quantities of domestic waste and C&I waste forecasted by these models for year 2016 are 13,190 and 2,540 tonnes per day respectively. Accordingly, the per capita generation rates of domestic waste and C&I waste in 2016 are 1.48 and 0.58 kg per day respectively.

(1) It was found from a household waste survey at public and private housing estates in 1998 that the average waste generation rate of a household member was 0.79 kg per person per day.

1. Introduction

1.1 Background

1.1.1 Following the growth in population and economy in Hong Kong since the 1980s when the monitoring of solid waste started, the total quantity of waste discarded from households, commercial and industrial activities has generally increased over the years. Figure 1 portrays the wasteloads disposed of at waste facilities since 1986 by type.

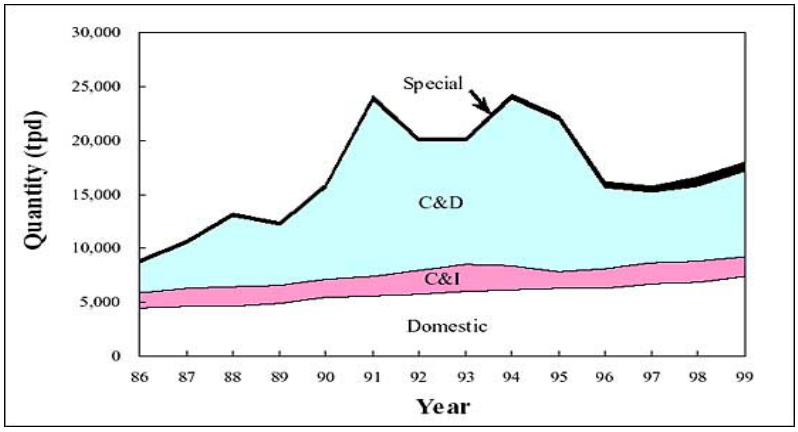


Figure 1: Quantities of the major types of solid waste disposed of at waste facilities 1986 - 1999

(Note : Please refer to section 2.1 for waste classification and terminology)

1.1.2 In 1981, the Environmental Protection Agency, the predecessor of the Environmental Protection Department (EPD), launched a waste monitoring programme to gather information related to the design needs of the waste management system. The objectives of this programme include establishing geographical distribution of solid waste and their major constituents as well as identifying socio-economic parameters that can be used for forecasting future waste management needs and planning for appropriate waste facilities. Since then, subsequent waste monitoring has been conducted annually.

1.1.3 The information collected from the monitoring work has been used in various aspects of waste management planning which include the development of the Waste Disposal Plan (1989) and the Waste Reduction Framework Plan (1998).

1.1.4 The Waste Disposal Plan published in 1989 sets out the disposal strategy for solid waste and includes the development of cost-effective new waste facilities of high environmental standards. In 1999, these facilities include the

Chemical Waste Treatment Centre, three strategic landfills and a network of six refuse transfer stations and four outlying islands refuse transfer facilities under the management of the EPD.

1.2 Importance of the Waste Monitoring Programme

1.2.1 Waste monitoring is important for keeping track of waste statistics and relevant development. The existing database of waste information has been compiled since 1981. The latest waste disposal records and data collected each year from the waste monitoring programme enable the EPD to fine-tune waste forecast and take account of the best estimates for strategic waste management and planning such as:

(a) forecasting waste arisings and their geographical distribution;
(b) forecasting future utilization of waste disposal facilities;
(c) planning for new waste disposal facilities;
(d) planning for waste reduction measures;
(e) establishing waste management models for development of cost-effective waste management plans;
(f) identifying new waste management initiatives; and
(g) monitoring of waste reduction and materials recovery.

1.3 Scope of this Report

1.3.1 his annual report for calendar year 1999 is the sixteenth in a series of reports on the solid waste monitoring work carried out by the EPD.

1.3.2 Chapter 2 covers the classification and terminology of different types of solid waste used in this report and describes the approaches in monitoring waste information in 1999 together with relevant sources of reference.

1.3.3 The latest findings of waste monitoring survey and records of waste handled at all waste facilities are compiled under various tables and figures in Chapters 3 to 5 and appendices in similar structure and headings as in recent reports.

1.3.4 Chapter 3 summarizes the records of waste intake at the waste facilities: landfills, refuse transfer stations and the Chemical Waste Treatment Centre.

1.3.5 Chapter 4 presents the updated information on the materials recovered from the municipal solid waste stream and financial values of various recovered materials.

1.3.6 Chapter 5 provides the per capita generation rates of domestic waste and commercial & industrial waste in 1999 and their forecasted quantities up to 2016. The forecasted quantities of municipal solid waste and construction & demolition waste up to 2016 are also presented.

2. Classification of Solid Waste and Waste Monitoring Methodology

2.1 Waste Classification and Terminology

2.1.1 In this report, solid waste is classified into five main types by making reference to the sources of waste and the institutional arrangements for waste collection and disposal. These five types of solid waste are municipal solid waste, construction & demolition (C&D) waste, chemical waste, special waste and other solid waste. The current classification system of solid waste is depicted in Figure 2. The detailed interpretations of some commonly used terms are described below.

2.1.2 **Municipal solid waste** includes domestic waste, commercial waste and industrial waste.

- **Domestic waste** refers to household waste, waste generated from daily activities in institutional premises and refuse collected from public cleansing services. Public cleansing waste includes dirt and litter collected by the then Regional Services Department (RSD) [(1)] and Urban Services Department (USD) [(1)] , marine refuse collected by the Marine Department and waste from country parks collected by the former Agriculture and Fisheries Department [(2)] .

- **Commercial waste** is waste arising from commercial activities taking place in markets, shops, restaurants, hotels, offices, etc. It is collected mainly by private waste collectors. However, some commercial waste is mixed with domestic waste and collected by the RSD/USD. Some not mixed is also collected by the RSD/USD for historical reasons.

- **Industrial waste** is waste arising from industrial activities and does not include C&D waste and chemical waste. It is usually collected by private waste collectors. However, some industries may deliver their industrial waste directly to landfills for disposal.

It should be noted that there are bulky items like furniture and domestic appliances which cannot be handled by conventional compactor type refuse collection vehicles. These items are regarded as bulky waste and are usually

collected separately. They may come from residential premises, commercial and industrial activities.

2.1.3 Construction & Demolition (C&D) waste includes waste arising from any land excavation or formation, civil/building construction, site clearance, demolition activities, roadworks and building renovation. It includes various types of building debris, rubble, earth, concrete, timber and mixed site clearance material. Type I C&D waste, as stated in the landfill contracts, is defined as C&D waste containing not more than 20% by volume (or 30% by weight) of inert material. Inert material comprises dirt/soil/mud, concrete, reinforced concrete, asphalt, brick/sand, cement plaster/mortar, aggregate, inert building debris, and rock/rubble. Type II C&D waste, which is not normally accepted by landfills, consists of more than 20% by volume (or 30% by weight) of inert material content.

2.1.4 Chemical waste is defined in the Waste Disposal (Chemical Waste) (General) Regulation under the Waste Disposal Ordinance (Cap. 354). Chemical waste can be any substance arising from any process or trade activity which contains chemical in such form, quantity or concentration that can cause pollution to the environment or become a risk to health.

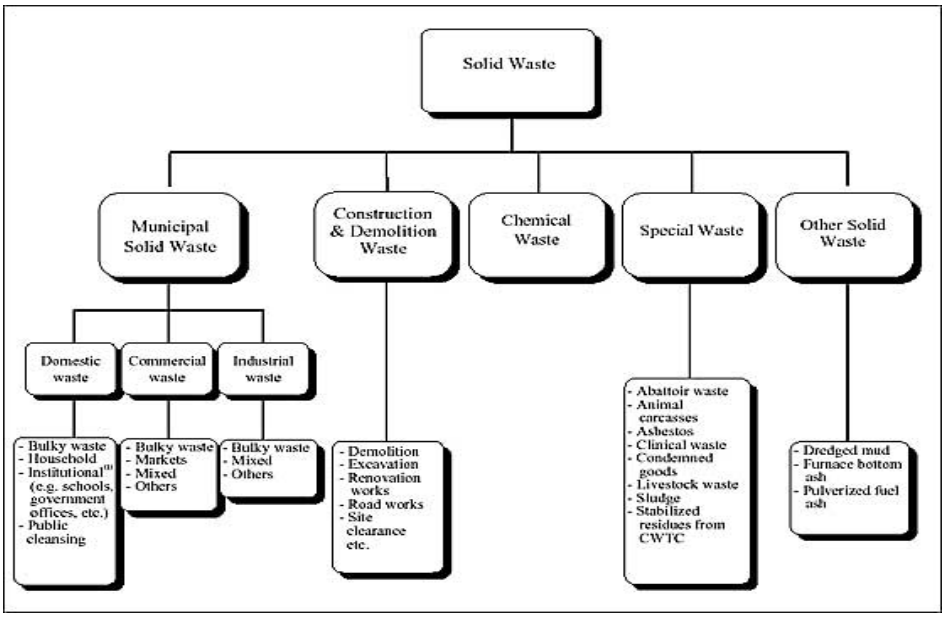
2.1.5 Special waste includes abattoir waste, animal carcasses, asbestos, clinical waste, condemned goods, livestock waste, sewage treatment and waterworks treatment sludge, sewage works screenings and stabilized residues from Chemical Waste Treatment Centre.

2.1.6 Other solid waste refers to solid waste types not covered by the above descriptions. These include coal ash, dredged mud and excavated material disposed of at marine dumping sites.

Notes :

(1) The RSD and USD were re-organised to form the Food and Environmental Hygiene Department and Leisure & Cultural Services Department on 1.1.2000.

(2) The Agriculture and Fisheries Department was re-named as Agriculture, Fisheries and Conservation Department since 1.1.2000.



Notes :

(1) Waste generated from schools, government offices, etc. was usually mixed with household waste and/or public cleansing refuse during the process of collection carried out by the RSD/USD.

Figure 2 : Current classification of solid waste

2.2 Methodology

2.2.1 Solid waste data are mainly collected by two approaches: weighing exercise at all waste facilities throughout the year and waste characterization using sampling techniques. All solid waste facilities in Hong Kong are managed by the Environmental Protection Department (EPD) whereas public filling areas and barging points accepting inert C&D material are managed by the Civil Engineering Department (CED). Whilst the wasteload intake is recorded immediately at each waste facility, waste composition is characterized through sampling exercises in a separate survey. Other departments, such as the CED, the RSD and USD, Census and Statistics Department and Planning Department, provide the EPD with relevant statistics regularly.

2.2.2 The following data were collected from various sources throughout the year and compiled into various tables, figures and appendices in this report :

- waste intake records taken at weighbridges of landfills and refuse transfer stations (RTS);
- results of survey on waste composition conducted in November/December 1999 at landfills and RTS;

- results of quarterly exercises of weighing waste from various districts conducted by the RSD, USD and EPD;
- annual figures of total gross domestic product (GDP), population and employment provided by the Census and Statistics Department;
- figures of population and employment in 2006 , 2011 and 2016 predicted by the Planning Department under Scenario B of the Territorial Development Strategic Review; and
- quantities of special waste and other solid waste from relevant specialist groups of the EPD and concerned government departments.

3. Waste Quantities and Characteristics

3.1 Waste Disposal Statistics

3.1.1 In 1999, a daily average of 18,040 tonnes of solid waste were disposed of at the landfills. Compared with the 16,560 in 1998, there was an overall increase of about 9%.

3.1.2 All solid wastes requiring disposal were disposed of at the three strategic landfills at the west, south east and north New Territories, abbreviated as WENT, SENT and NENT. Table 1 summarizes by waste type the quantities of solid waste disposed of in 1999 and their percentage changes from 1998. Domestic waste and construction & demolition (C&D) waste were the major components summing up to 85% of all solid waste. Compared with 1998, the C&D waste had the highest increase in terms of quantity by 862 tonnes per day (tpd) whilst the commercial waste had the highest reduction by 36 tpd. There was a net overall increase in the quantity of solid waste requiring disposal. The increased intake of C&D waste at landfills was a result of the increase of total C&D material arising in 1999 by 13%.

3.1.3 The domestic waste intake at the landfills increased by 9% to 7,426 tpd. Commercial waste intake decreased by 3% to 1,250 tpd and industrial waste intake decreased by 5% to 593 tpd. Hence, there is a slight net increase of municipal solid waste (MSW) intake by 6% to 9,269 tpd. Special waste intake increased by 11% to 880 tpd, mainly due to the increase of grease trap waste.

3.1.4 Table 1 also presents the breakdown of solid waste collected by the public and private sectors. In general, C&D waste and commercial & industrial (C&I) waste were collected by private waste collectors whereas domestic waste was collected by the RSD and USD and transferred to landfills through a network of refuse transfer stations managed by the EPD. However, publicly collected domestic waste included some C&I waste owing to (i) mixing of C&I waste with domestic waste prior to delivery to refuse collection points in some old urban areas, (ii) historical reason that RSD and USD had been collecting C&I waste from some commercial establishments and commercial districts, and (iii) the practice that RSD and USD collected some market waste, i.e. waste from the markets managed by these two departments.

Waste type	Quantity (tpd)			Change from 1998	
	Public(1)	Private(2)	Total	Quantity (tpd)	Percentage
a. Domestic waste					
- household mixed/public cleansing	5.926	1.298	7.224		
- bulky waste	163	39	303		
Sub-total	60.89[3]	1.337	7.426	+ 604	+ 9%
b. Commercial waste					
- commercial mixed	-	1.113	1.113		
- bulky waste	-	73	73		
- markets	-	62	62		
- others		2	2		
Sub-total		1.25	1.25	- 36	- 3%
c. Industrial waste					
- manufacturing mixed	-	302	302		
- bulky waste	-	20	20		
- others	-	271	271		
Sub-total		593	593	- 31	- 5%
d. Municipal solid waste received at disposal facilities (a+b+c)	6,089	3.180	9,269	+ 537	+ 6%
e. Construction & demolition waste (landfilled)	-	7,895	7,895	+ 862	+ 12%
f. Special waste (landfilled)	443	437	880	+ 86	+ 11%
g. All waste received at waste facilities (d+e+f)	**6,530[4]**	**11,510[4]**	**18,040[4]**	+ 1,480[4]	+ 9%

Notes:
(1) Waste collected by the RSD and USD, RSD/USD contractors and other government vehicles.
(2) Waste collected by private waste collectors.
(3) Publicly collected domestic waste included some commercial and industrial waste.
(4) Figures are rounded off to the nearest 10 tpd.

Table 1: Quantities of solid waste disposed of at refuse transfer stations and landfills in 1999

3.1.5 The average daily waste intake at each waste facility by waste type in 1999 is given in Appendix 1.

3.1.6 The past disposal records of solid waste from 1986 to 1999 at all waste facilities are compiled by waste type in Table 2 and by facility in Appendix 2. Only domestic waste showed a continuous increasing disposal trend over the last decade. Its quantity was primarily dependent on population which also increased steadily during that period. For the other waste types, their quantities were affected by the territory's economic and construction activities. The substantial reduction of C&D waste intake at landfills after 1995 was a result of (i) joint effort amongst government departments in providing new barging points and public filling outlets for inert C&D material and promoting the reuse of the material, and (ii) support from the construction trade.

Year	Quantity of waste by type (tpd)						
	Municipal solid waste				C&D (landfilled) (e)	Special (landfilled) (f)	TOTAL (g)=(d)+(e)+(f)
	Domestic (a)	Commercial (b)	Industrial (c)	Sub-total (d)=(a)+(b)+(c)			
1986	4,420	370	1,080	5,870	2,850	240	8,960
1987	4,630	430	1,240	6,300	4,220	250	10,770
1988	4,580	420	1,410	6,410	6,520	260	13,190
1989	4,870	450	1,270	6,580	5,580	310	12,480
1990	5,460	380	1,270	7,10	8,450	360	15,920
1991	5,560	400	1,430	7,390	16,380	340	24,110
1992	5,760	460	1,710	7,930	11,960	320	20,210
1993	6,000	570	1,880	8,450	11,520	250	20,220
1994	6,070	700	1,660	8,430	15,480	390	24,300
1995	6,210	520	1,060	7,790	14,120	350	22,260
1996	6,260	1,090	800	8,140	7,520	490	16,150
1997	6,760	1,220	700	8,680	6,480	620	15,780
1998	6,820	1,290	620	8,730	7,890	790	16,560
1999	7,430	1,250	590	9,270	7,890	880	18,040

Remark: Figures are rounded off to the nearest 10 tpd and may not add up to total due to rounding-off.

Table 2: Summary of the major types of solid waste disposed of at waste facilities 1986 - 1999

3.1.7 There was seasonal fluctuation of municipal solid waste in 1999, with a maximum of 7% surge in the summer months from the annual average. The surge might be explained by the increased production of domestic waste during the summer time, for instance, soft drink containers and fruit waste.

3.1.8 The quantities and disposal methods of special waste and other solid waste are summarized in Table 3

Waste type	Disposal method	Quantity disposed of (tpd)
Abattoir waste	Landfilling	22
Animal carcasses	Landfilling	21
	Crematories, Kennedy Town By-Product	3
Asbestos waste	Co-disposal at landfills	7
Chemical waste other than asbestos waste	CWTC	170
	Co-disposal at landfills	6
Clinical waste	Co-disposal at landfills	4
Condemned goods	Landfilling	21
CWTC stabilised residue	Landfilling	42
Dewatered dreged materials(2)	Landfilling	6
Dewatered waterworks and	Landfilling	335
Dredged mud and excavated	Marine dumping	21.896
Furnace bottom ash	Concrete manufacturing, stored in lagoon	191
Grease trap waste	Co-disposal at landfills	185
Livestock waste	Composting and other environmentally	643
	Landfilling	139
Pulverised fuel ash	Concrete manufacturing, stored in lagoon	1,451
Sewage works screenings	Landfilling	45
Waste tyre	Landfilling	27

Note :

(1) Kennedy Town By-Product Plant was closed in August 1999. The average daily intake during operation period of the

(2) Assuming the density of the dredged mud and excavated materials to be one tonne per cubic metre.

(3) Examples of environmentally acceptable means include on-site composting, aerobic treatment, dry muck-out, etc.

Table 3 : Quantities of different kinds of special and other solid wastes disposed of in 1999

3.2 Geographical Distribution of Major Solid Waste

3.2.1 The quantity of each type of solid waste disposed of at waste facilities is attributed to 18 waste arising districts identical to that of the District Board districts. In order to facilitate waste data capturing and recording, these 18 waste arising districts are sub-divided into 54 waste arising areas. The list of waste arising districts and waste arising areas is provided in Appendix 3. The geographical distribution of the major types of solid waste disposed of at waste facilities in 1999 by waste arising districts is shown in Table 4. The geographical breakdown should be regarded as indicative reference only as the information was provided by drivers who generally stated the last pick up location at the weighbridges of waste facilities although each waste collection vehicle might have collected waste from a number of locations.

3.2.2 Figure 3 depicts the bulk containerized transfer routings of solid waste by road and sea from refuse transfer stations to landfills. Figure 3 also portrays in bar-charts the quantities of domestic waste and C&I waste collected and disposed of at waste facilities within four geographical regions, namely Islands & West NT, North East NT, Kowloon & HK Island and South East NT. Kowloon & Hong Kong Island had the highest collected quantity of MSW in the territory in 1999. Since there was no final disposal outlet in this region, the domestic waste collected was delivered to the refuse transfer stations for containerized bulk transfer to landfills in other regions for final disposal. Waste collected from a particular geographical region may not end up in the waste facilities in its vicinity. The flexibility of the waste transfer system is that its destiny can be changed to where the new disposal facility will be, without disrupting the waste collection services in any region.

3.3 Utilization of Waste Facilities

3.3.1 Appendix 1 summarizes the waste intake by type at each waste facility in 1999. All refuse transfer stations accepted publicly collected MSW. Since 1998, IETS, WKTS, NLTS and OITF also accepted privately collected MSW. Among the three strategic landfills, SENT received the majority of C&D waste and privately collected MSW in 1999. It also received the greatest amount of waste in 1999. At both WENT and NENT, more than 70% of solid waste intake was MSW. WENT and NENT each accepted about 60% and 40% of RTS processed MSW

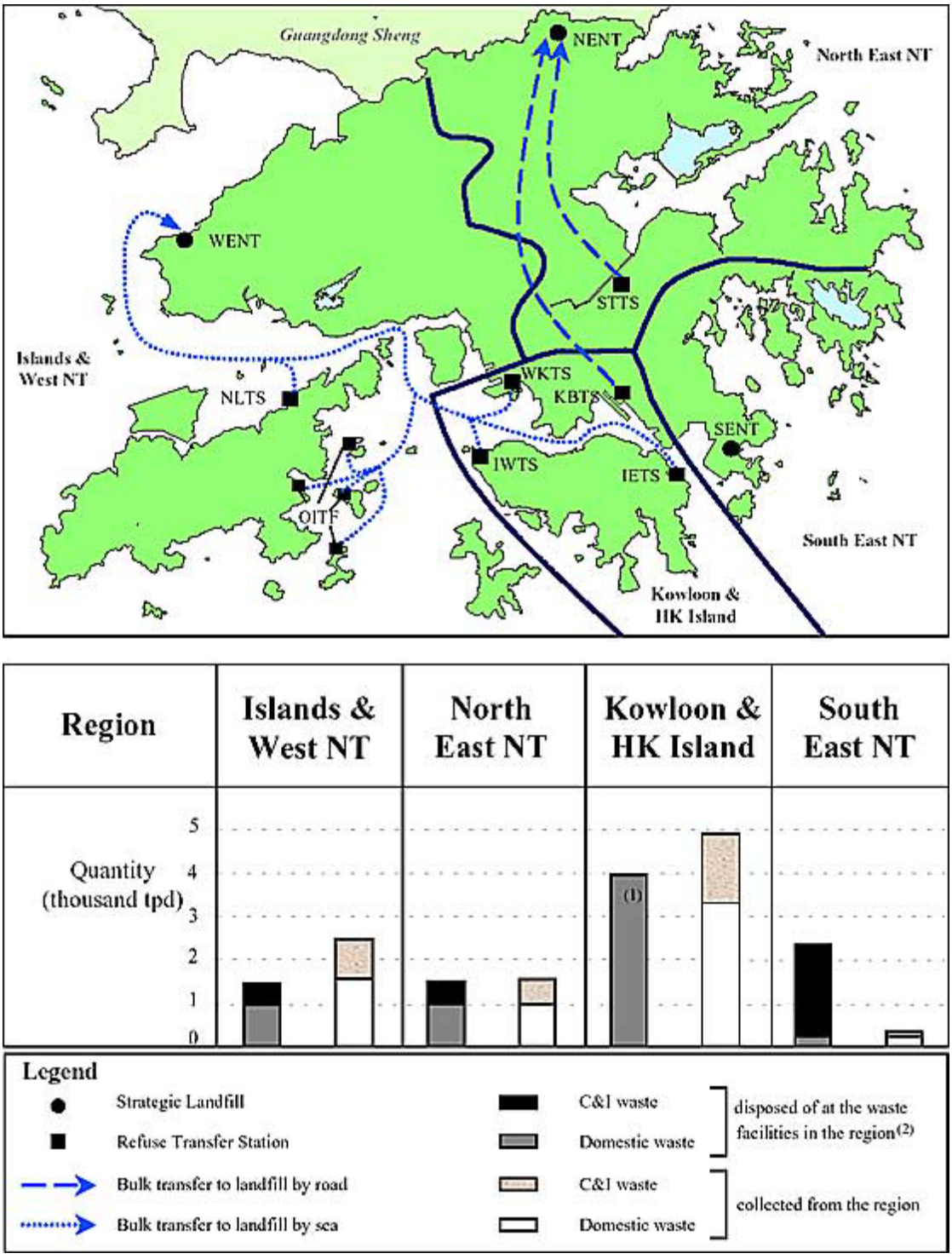
respectively for final disposal.

3.3.2 Figure 4 presents the provision of waste facilities in 1999, the average daily waste intake at each waste facility in 1999 and its percentage change over the previous year 1998.

Waste Arising District (WAD)	Quantity[1] (tpd)					
	Domestic waste		C&I Waste	Municipal solid waste	C&D waste (Landfilled)	All solid waste[3]
	Publicly collected[2] (a)	Privately collected (b)	(c)	(d) =(a)+(b)+(c)	(e)	(f) =(d)+(e)
Central & Western	346	80	91	517	615	1,129
Wanchai	267	88	75	430	260	690
Eastern	444	125	101	670	384	1,054
Southern	275	19	25	319	129	448
Hong Kong Island Sub-total	1,332	312	292	1,936	1,385	3,321
Yau Tsim Mong	517	1108	121	746	604	1,350
Sham Shui Po	332	108	108	548	352	900
Kowloon City	306	109	80	495	427	922
Wong Tai Sin	482	98	199	778	1,036	1,814
Kwun Tong	1,986	444	543	2,973	2,725	5,698
Kowloon Sub-total	1,986	444	543	2,973	2,725	5,698
Kwai Tsing	343	31	136	510	405	915
Tsuen Wan	247	119	161	527	370	897
Tuen Mun	423	80	143	646	531	1,177
Yuen Long	428	44	118	590	710	1,300
North	283	140	70	493	462	955
Tai Po	311	61	56	428	159	587
Sha Tin	380	74	169	623	356	979
Sai Kung	255	32	76	333	671	1,004
NT - Mainland Sub-total	2,640	581	929	4,150	3,664	7,814
Cheung Chau[4]	37	-	-	37	-	-
Mui Wo[4]	25	-	-	25	-	-
Peng Chau[4]	9	-	-	9	-	-
Discovery Bay[4]	23	-	-	23	-	-
Lamma Island[4]	16	-	-	16	-	-
Hei Ling Chau[4]	4	-	-	4	-	-
North Lantau[4]	17	-	79	96	-	-
NT - Outlying Islands Sub-total	131	-	79	210	121[5]	331
Territorial Total	6,089	1,337	1,843	9,269	7,895	17,164

Note :
(1) The geographical distribution of solid waste is based on weighbridge records and should be regarded as indicative only
(2) Publicly collected domestic waste included public cleansing waste as well as some commercial and industrial waste
(3) Special waste not included in this table
(4) These islands are aggregated to form one WAD-Outlying Islands
(5) Breakdown into individual islands/areas is not available.

Table 4: Geographical distribution of major solid wastes disposed of at landfills in 1999

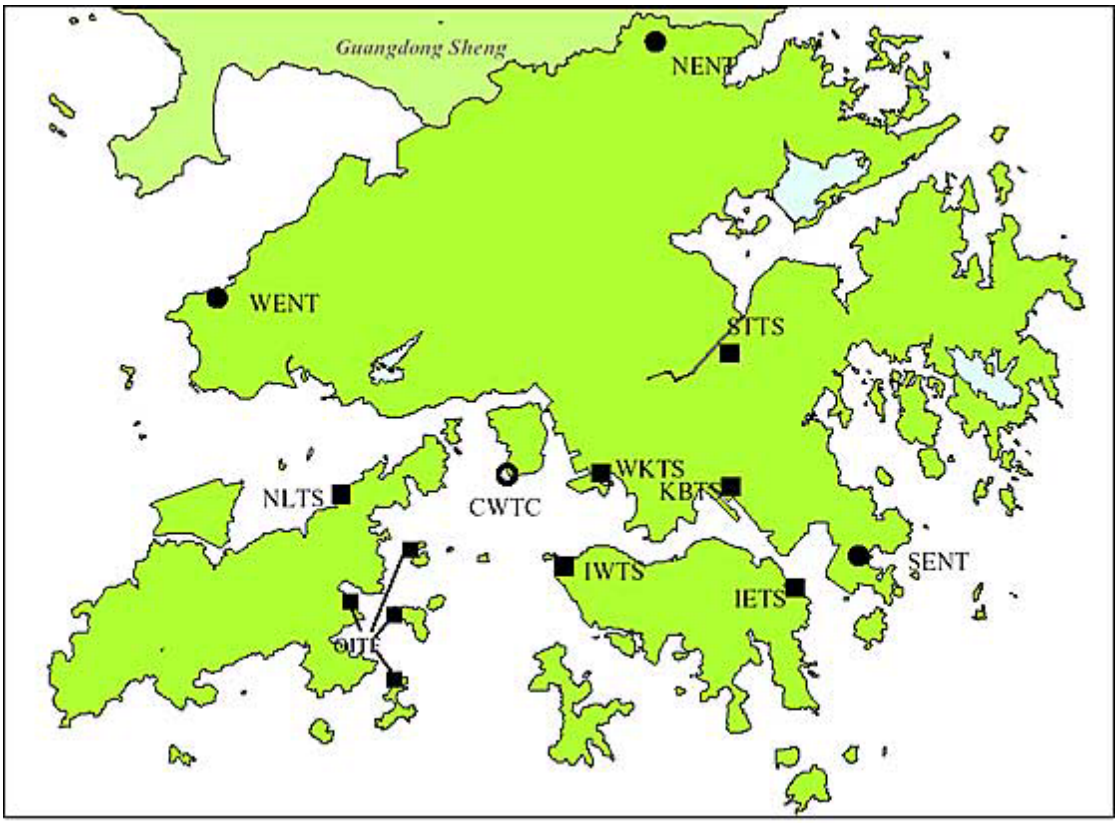


Notes:

(1) Domestic waste disposed of at RTS in the region of Kowloon & HK Island was transferred to WENT and NENT by sea and road respectively.

(2) To avoid double-counting of waste quantities, the waste intake quantities at landfills exclude the quantity of MSW processed at the RTS.

Figure 3 : Quantities of municipal solid waste collected and disposed of at waste facilities in 1999 by geographical region



Landfill	●	WENT 6,195 tpd (+14.4%)	SENT 8,359 tpd (+6.6%)	NENT 3,490 tpd (+5.7%)		
RTS	■	IETS[1] 862 tpd (+3.2%)	IWTS[1] 477 tpd (+3.0%)	WKTS[1] 1,545 tpd (+6.7%)	OITF[1] 120 tpd (+1.7%)	NLTS[1] 92 tpd (+22.7%)
		KBTS[2] 1,098 tpd (+1.8%)	STTS[2] 973 tpd (+7.9%)			
CWTC	○	170 tpd (-17.1%)				

Remark :
Percentage increase/decrease of waste quantity over previous year is shown in brackets.

Notes:
(1) Waste from IETS, IWTS, WKTS, OITF and NLTS was transferred to WENT by sea.
(2) Waste from KBTS and STTS was transferred to NENT by road.

Figure 4 : Waste intake at waste facilities in 1999

3.4 Disposal of C&D Waste at Public Filling Areas and Landfills

3.4.1 Public filling areas are proper disposal outlets for inert C&D material (commonly known as public fill) which can be reused beneficially for land formation. Public filling areas and public fill barging points are managed by the Civil Engineering Department (CED).

3.4.2 The quantities of inert C&D material delivered to public filling areas and C&D waste disposed of at landfills in 1998 and 1999 are shown in Figure 5. The total C&D material arisings, i.e. inert C&D material delivered to public filling areas and C&D waste disposed of at landfills, increased by 13% from 32,710 tpd in 1998 to 37,110 tpd in 1999. The quantity of inert C&D material delivered to public filling areas increased by 14% from 25,680 tpd in 1998 to 29,220 tpd in 1999. During the same period, the quantity of C&D waste disposed of at landfills increased by 12% from 7,030 tpd to 7,890 tpd. The C&D waste disposed of at landfills in 1999 represents 21% of total C&D material arisings as a result of continuous diversion of inert material to public filling areas.

3.4.3 Figure 6 presents the proportion of C&D waste out of the total waste intake at landfills in 1998 and 1999. Percentage of C&D waste intake at landfills was 44% in 1999, about 2% higher than that of 1998.

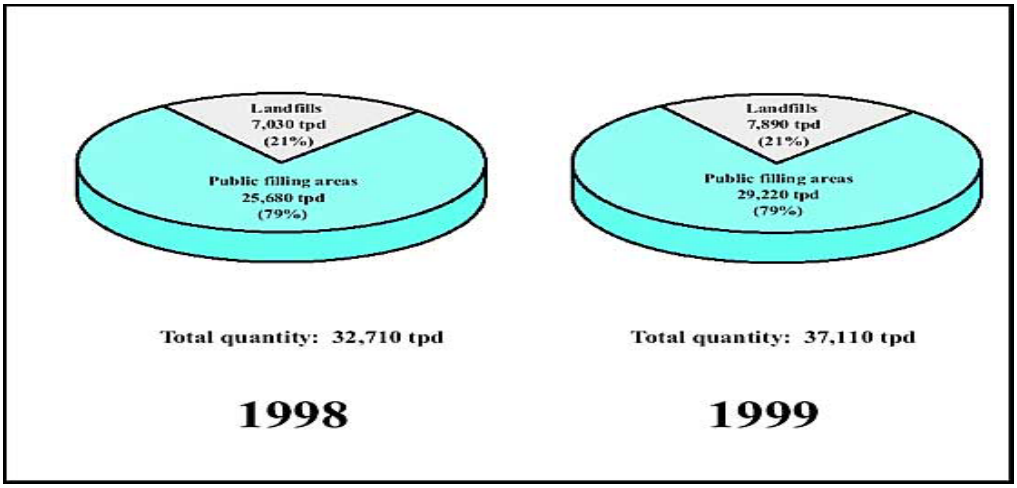
3.5 Waste Characteristics

3.5.1 The characteristics of MSW were identified through annual waste survey conducted at refuse transfer stations and landfills. The determined compositions of domestic waste, C&I waste and MSW in the years 1986 to 1999 are summarized in Appendices 4, 5 and 6 respectively. The proportions of major waste components have remained fairly constant.

3.5.2 In the annual waste survey for 1999, about 70 samples of domestic waste were taken from STTS, IWTS and WKTS and another 70 samples of C&I waste were taken from WENT and SENT for composition and moisture content analyses during the survey period in November and December. The samples, each with volume of one cubic metre, were sorted manually on site. A small portion of about one kilogram was taken out randomly from each sample before sorting and sent to laboratory for moisture content determination.

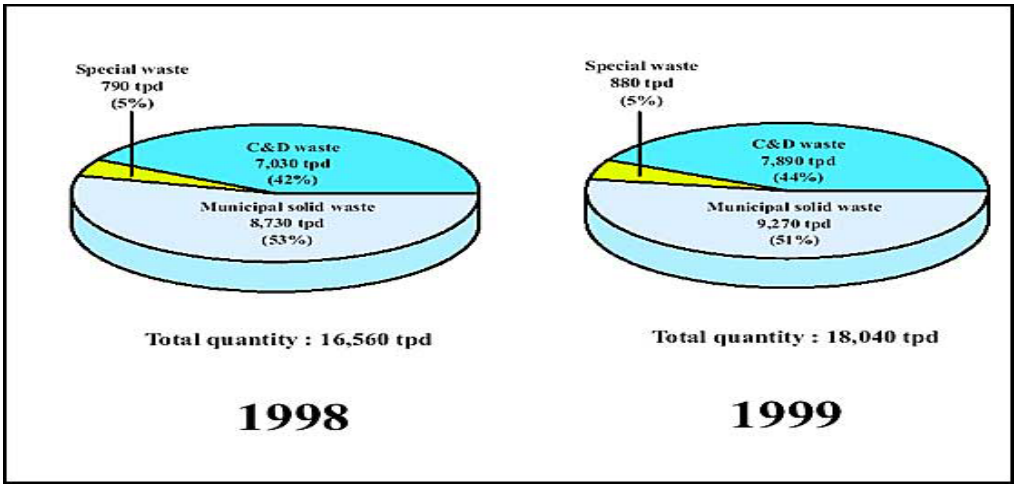
3.5.3 The average moisture contents for domestic waste and C&I waste were estimated to be 29% and 27% respectively based on the representative samples taken during the survey in 1999.

3.5.4 The three major components of domestic waste were again putrescibles (38.4%), paper (25.0%) and plastics (18.9%). Other minor components included textiles (3.2%), metals (2.9%), glass (2.8%), bulky waste (2.7%) and wood/rattan (1.3%).



Remark : Figures are rounded off to the nearest 10 tpd.

Figure 5: Quantities of inert C& D material delivered to public filling areas and C & D waste disposed of at landfills in 1998 and 1999



Remark :Figures are rounded off to the nearest 10 tpd and may not add up to total due to rounding-off.

Figure 6: Porportion of C & D waste out of the total waste intake at landfills in 1998 and 1999

3.5.5 Likewise, the major components of C&I waste were paper (30.3%), plastics (21.4%), putrescibles (15.3%) and wood/rattan (12.9%). Other minor components included bulky waste (5.0%), textiles (2.8%), metals (2.3%) and glass (2.0%). In line with the diminishing textile and garment manufacturing industry in Hong Kong, the quantity as well as the relative proportion of textile waste has dropped in recent years.

3.5.6 The composition of MSW in 1999, i.e. a summation of its components in domestic waste and C&I waste, is summarized in Table 5. The major components of MSW were putrescibles (33.8%), paper (26.1%) and plastics (19.4%). Other components included wood/rattan (3.6%), bulky waste (3.2%), textiles (3.1%), metals (2.8%) and glass (2.6%).

3.5.7 In addition to identifying the quantities of the above waste components, the quantities of sub-components of recyclable materials were also estimated through sample weighing during the annual waste survey. Recyclable content determination is useful for the investigation of further opportunities to increase the level of materials recovery. Breakdown of the major recyclable materials in domestic waste and C&I waste disposed of at waste facilities in 1999 is compiled in Table 6. It should be noted that the actual amount of waste which could be recovered for recycling depends mainly on the extent of contamination, practicality in separating recyclable materials, financial incentive and availability of market outlets.

3.5.8 In 1999, the major recyclable materials in either domestic waste or C&I waste were still paper and plastics, constituting together more than 40% by weight of the MSW disposed of at waste facilities. In domestic waste, newsprint and colour bags were the main recyclable sub-components of paper and plastics respectively. This standout phenomenon was not obvious in C&I waste where recyclable sub-components were more evenly spread. For instance, newsprint, cardboard and writing paper constituted 6.3%, 4.8% and 2.9% by weight of C&I waste respectively in 1999.

Component	Quantity (tpd) and its percentage by weight		
	Domestic Waste (a)	Commercial & Industrial Waste (b)	Municipal Solid Waste (c)=(a)+(b)
Bulky waste	203 (2.7%)	93 (5.0%)	296 (3.2%)
Glass	205 (2.8%)	37 (2.0%)	242 (2.6%)
Metals	218 (2.9%)	43 (2.3%)	261 (2.8%)
Paper	1,859 (25.0%)	559 (30.3%)	2,418 (26.1%)
Plastics	1,400 (18.9%)	394 (21.4%)	1,794 (19.4%)
Putrescibles	2,854 (38.4%)	282 (15.3%)	3,136 (33.8%)
Textiles	234 (3.2%)	52 (2.8%)	286 (3.1%)
Wood/rattan	95 (1.3%)	237 (12.9%)	332 (3.6%)
Others	358 (4.8%)	146 (7.9%)	504 (5.4%)
Total	**7,426 (100%)**	**1,843 (100%)**	**9,269 (100%)**

Remark:
Figures indicate the quantities and percentages by wet weight, and may not add up to total due to rounding-off.

Table 5 : Estimated composition of municipal solid waste in 1999

Component		Domestic Waste		C&I Waste	
		Quantity (tpd)	% by weight	Quantity (tpd)	% by weight
Glass bottles	- Brown	30	(0.4%)	3	(0.2%)
	- Clear	128	(1.7%)	15	(0.8%)
	- Green	46	(0.6%)	13	(0.7%)
	(Glass bottles) Sub-total	204	(2.7%)	31	(1.7%)
Metals	- Ferrous metals	175	(2.3%)	33	(1.8%)
	- Non-ferrous metals	43	(0.6%)	10	(0.5%)
	(Metals) Sub-total	218	(2.9%)	43	(2.3%)
Paper	- Cardboard	297	(4.0%)	89	(4.8%)
	- Newsprint	903	(12.1%)	116	(6.3%)
	- Writing	14	(0.2%)	54	(2.9%)
	- Others[1]	645	(8.7%)	300	(16.3%)
	(Paper) Sub-total	1,859	(25.0%)	559	(30.3%)
Plastics	- Clear bags	128	(1.7%)	80	(4.3%)
	- Colour bags	732	(9.9%)	119	(6.5%)
	- EPS food/drink	59	(0.8%)	27	(1.5%)
	- Other Polyfoams	15	(0.2%)	6	(0.3%)
	- PET bottles	59	(0.8%)	22	(1.2%)
	- Other beverage bottles	63	(0.9%)	8	(0.4%)
	- Trim-off & scraps	0	(0.0%)	9	(0.5%)
	- Others[2]	344	(4.6%)	123	(6.7%)
	(Plastics) Sub-total	1,400	(18.9%)	394	(21.4%)
	Total	3,681	(49.5%)	1027	(55.7%)

Remark:
Figures indicate the quantities and percentages by wet weight, and may not add up to total due to rounding-off.

Notes :
(1) Other paper sub-components are drink pack (tetrapak), tissue paper, etc.
(2) Other plastics subcomponents include household utensils, packaging materials and toys

Table 6 : Major recyclable materials in domestic waste and commercial & industrial waste disposed of at waste facilities in 1999

4.1 Recovery and Recycling of Municipal Solid Waste

4.1.1 In 1999, about 1.54 million tonnes of recyclable materials were recovered from the municipal solid waste (MSW) for recycling. This represents about 31% of the total MSW arisings, amongst which 0.23 million tonnes (15%) were recycled locally and 1.31 million tonnes (85%) were exported for recycling overseas (see Figure 7). The quantities of recovered materials for recycling locally and overseas are tabulated in Appendix 7 and the relative proportion of major recyclable materials recovered is presented in Figure 8. The major recyclable materials were paper (44%), ferrous metals (35%), plastics (10%) and non-ferrous metals (5%). The remaining 6% included glass bottles, wood and textiles.

4.1.2 Paper was the most popular item for recycling in 1999. Its actual volume handled in 1999 was larger than that of metals which have much higher density than paper but lower recovered amount by weight. The recycling of plastics was considerable in view of their low density. Plastics recovered in Hong Kong mainly consisted of relatively clean scraps, rejects from manufacturing sources and plastic wrapping sheet from cargo handling sources and there was little but increasing reprocessing of post-consumer plastic packaging waste such as polyethylene terephthalate bottles. The reasons and practical constraints might be as follows:

- Recycling of paper was relatively more popular, convenient and well publicized. Recycling bins or boxes for paper waste were available in most housing estates, railway stations and offices. In contrast, similar facilities for plastics were less common in 1999.
- There was extensive paper recycling due to the presence of relatively greater market demand, both locally and overseas, for recycled paper.
- Most plastics found in waste was packaging materials (like plastic bags and beverage bottles) which were usually contaminated. In addition, the cost of transporting plastics per unit weight was high and hence profit margin of recycling plastics was usually low.

4.1.3 Opportunities of making profit through recycling depend on the prices of competing raw materials, the market demand for recycled products, and to a lesser extent the prevailing prices for the disposal alternative. The government therefore has been gradually implementing appropriate initiatives under the Waste Reduction Framework Plan to promote waste recovery and recycling and to render assistance to the recycling industries. As recycling activities in Hong Kong are dominantly market driven, the extent of recycling may be reflected by the market values of

different types of recyclable material. Table 7 provides in details the quantities and values of various exported recyclable materials and their values per unit weight in 1999.

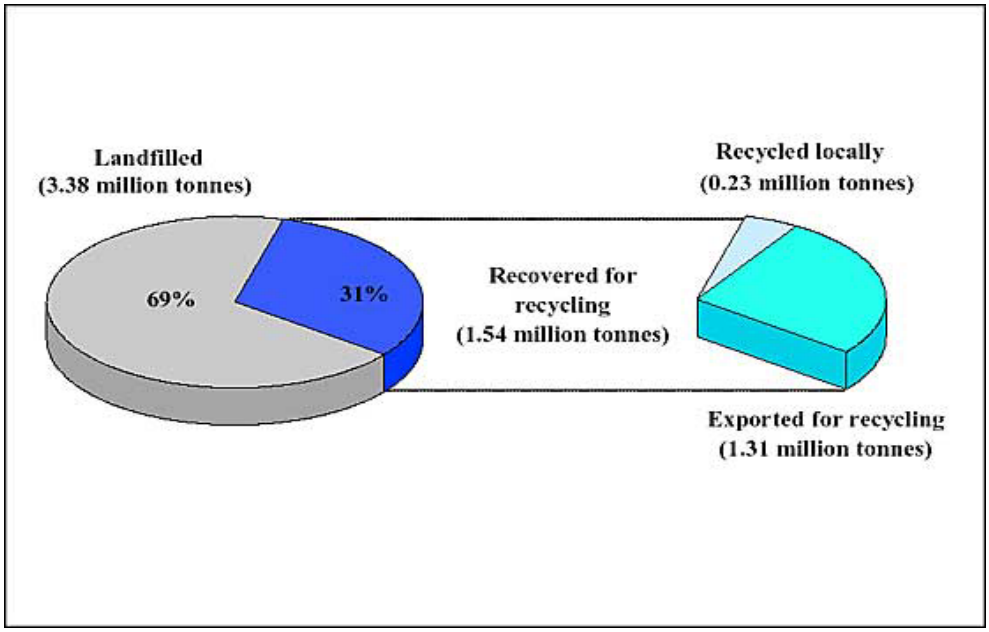


Figure 7 : Recovery of municipal solid waste in 1999

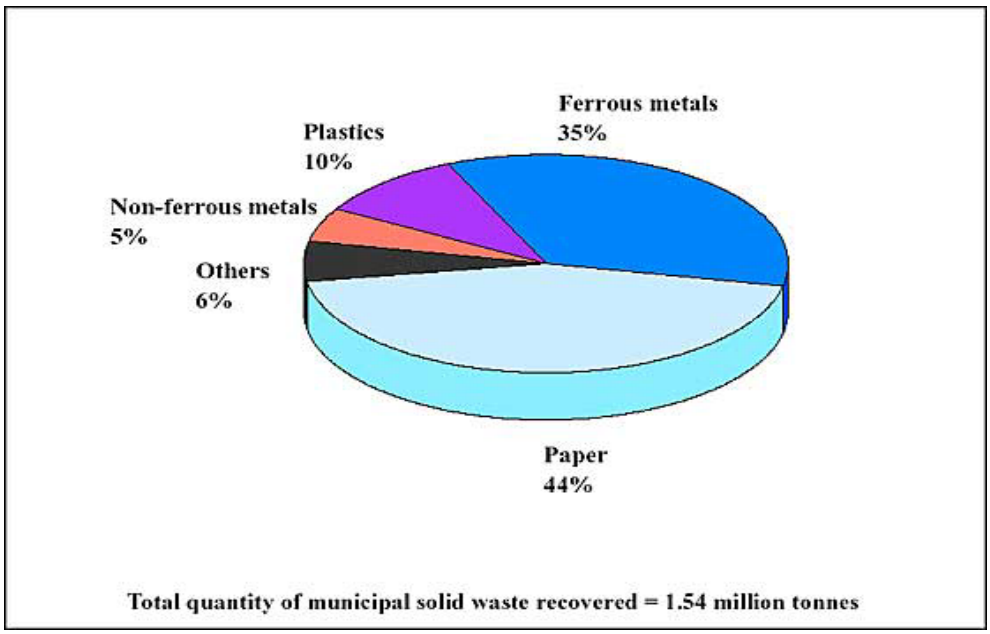


Figure 8: Proportion of major recyclable materials recovered from municipal solid waste in 1999

4.1.4 The relative exported values of the four major recyclable materials, i.e. paper, ferrous metals, plastics and non-ferrous metals, are shown in Figure 9. The export value of non-ferrous metals, including aluminium and copper & alloys, was the greatest in 1999.

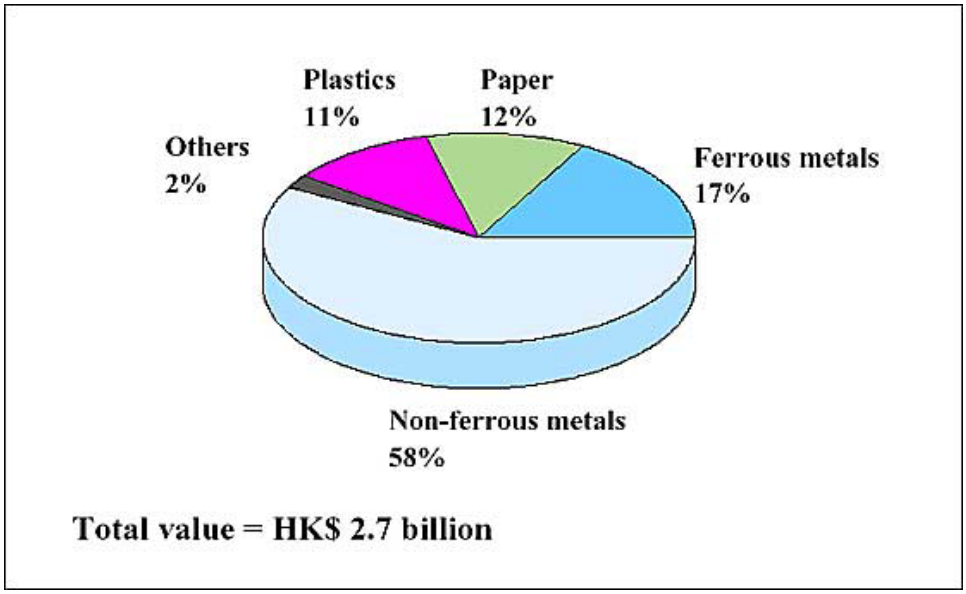


Figure 9: Values of exported recyclable materials in 1999

4.2 Recovery and Recycling of Construction & Demolition Waste

4.2.1 In 1999, totally about 13.5 million tonnes of construction & demolition (C&D) material was delivered to public filling areas and landfills, of which, about 79% (or 29,220 tpd) was inert C&D material reused as fill material for land formation projects whilst the rest was C&D waste disposed of at landfills (see Figure 5). C&D waste, usually containing a mixture of inert and non-inert substances, arises from site clearance, excavation, construction, refurbishment, renovation, demolition and roadworks. The non-inert portion of C&D waste disposed of at landfills, comprising bamboo, plastics, timber, vegetation and other organic materials, was often mixed with inert substances, e.g. concrete, asphalt, brick/sand, rock/rubble etc. As shown in Figure 6, an average of 7,890 tonnes of C&D waste were disposed of at landfills everyday in 1999, representing about 44% of total waste intake at landfills.

4.2.2 Government is implementing a C&D waste management strategy which is essentially to avoid, minimize, recycle and dispose of waste (in order of desirability). The target is to reduce the generation of C&D waste and hence its intake at landfills, and to reuse and recycle as much C&D material as possible.

	Categories of waste materials	Quantity[1] (tonnes)	Value[1] ($ thousand)	Value per unit weight ($ / tonne)
a.	Ferrous metals & steel			
	- alloy steel scrap	26,892	102,976	3,829
	- pig or cast iron	14,742	18,434	1,250
	- tinplate	482	690	1,432
	- other scraps	497,169	334,555	673
	Sub-total	539,285	456,655	847
b.	Glass[2]			
	Sub-total	2	51	24,425
c.	Non-ferrous metals			
	- aluminium	20,474	93,848	4,584
	- copper & alloys	54,726	339,177	6,198
	- lead	1,099	3,058	2,783
	- magnesium	0	0	-
	- metal ash & residues	188	6,516	34,660
	- nickel	103	2,318	22,505
	- precious metal	119	1,097,945	9,226,429
	- tin	15	273	18,200
	- zinc	636	4,976	7,824
	- other base metals	0	0	-
	Sub-total	77,360	1,548,111	20,012
d.	Plastics			
	- polyethylene	15,108	30,985	2,051
	- polystyrene & copolymers	30,100	78,272	2,600
	- polyvinyl chloride	13,9887	21,169	1,513
	- others	71,956	158,937	2,209
	Sub-total	131,151	289,363	2,206
e.	Textile fibre			
	- cotton	12,766	21,613	1,693
	- man-made fibres	177	970	5,480
	- silk	0	6	20,000
	- wool/other animal hair (not pulled)	67	791	11,806
	- wool/other animal hair (pulled)	0	0	-
	- old clothing & other old textile articles, rags, etc.	6,858	25,630	3,737
	Sub-total	19,868	49,010	2,467
f.	Wood & pape			
	- paper	533,741	333,282	624
	- wood (include sawdust)	8,118	5,348	659
	Sub-total	541,859	338,630	625
	Total	1,309,525	2,681,820	2,048

Note :
(1) Figures provided by the Census & Statistics Department and rounded off to the nearest 1.
(2) This category includes cullet, scrap of glass and glass in the mass.

Table 7: Quantities and value of exported recyclable materials by type in 1999

5. Waste Generation Rates and Forecasts

5.1 Generation Rates of Municipal Solid Waste

5.1.1 Waste generation per capita requiring disposal, expressed in kilograms per head per day, is the basis for comparison of the historical trend of municipal solid waste (MSW) disposal. Per capita generation rates of domestic waste and commercial & industrial (C&I) waste that have been considered separately since previous monitoring work on waste disposal revealed close relationships between population and domestic waste quantity, and between economic activities and C&I waste quantity. The employment size of all the sectors in the Hong Kong Standard Industrial Classification has been taken into account in the calculation of C&I waste generation rate [(1)].

5.1.2 In working out the waste generation rates in 1999 by district, the population and employment data and their geographical distribution into 18 waste arising districts adopted in the calculation are based on the Census & Statistics Department's consolidated information. Per capita generation rates of domestic waste and C&I waste of various districts in 1999 are shown in Table 8.

5.1.3 From the generation rates of domestic waste in 1999, the following major points are noted :

- The territorial average per capita generation rate is 1.06 kg per person per day, about 4% higher than that of 1998.
- The largest deviations from the territorial average are observed on the outlying islands (1.55 kg per person per day) and some commercial and industrial districts, such as Yau Tsim Mong (1.97 kg per person per day), Wan Chai (1.81 kg per person per day), North (1.56 kg per person per day) and Central & Western (1.47 kg per person per day) [(2)].

5.1.4 It has been noted that the sources of commercial waste and industrial waste are always very close and the wastes are often mixed together, e.g. fast food restaurants, offices and factories may be located in the same building. In addition, it is observed over the past few years that industrial activities in the traditional industrial areas have been gradually replaced by commercial ones and the wastes generated from there are very mixed. For the purpose of waste projection, it is considered more practical to combine these wastes into a single

waste type, i.e. C&I waste. From the generation rates of C&I waste in 1999, the following major points are noted :

- The territorial average generation rate is 0.59 kg per employee per day in 1999 as indicated in Table 8.
- The districts with greatest deviations of per capita generation rate from the territorial average are found in the New Territories such as Sai Kung (1.79 kg per employee per day), Yuen Long (1.67 kg per employee per day), and Tuen Mun (1.65 kg per employee per day) where the subtotal employment figure of these districts (200,000) constituted only 6% of the total employment size in the territory.
- The lowest per capita generation rates are found in Central & Western (0.22 kg per employee per day), Wanchai (0.26 kg per employee per day) and Yau Tsim Mong (0.29 kg per employee per day). As discussed in Section 5.1.3, the mixing of a considerable amount of C&I waste with domestic waste in these districts had caused an apparent reduced quantity of C&I waste for collection by private waste collectors.
- For the outlying islands, virtually all C&I waste was delivered to refuse collection points and then mixed with domestic waste before collection by the RSD; hence per capita generation rate of C&I waste for the outlying islands could not be determined. 5.2 Correlation of Quantity of Municipal Solid Waste with Gross Domestic Product

Note :

(1) In the previous reports, the employment size of only the sectors grouped under Divisions 3, 6 and 8 of the Hong Kong Standard Industrial Classification was taken into account in the calculation of C&I waste generation rate. In this report, however, the employment size of all the sectors has been taken into account in computation of the per capita C&I waste generation rate. For comparison, the C&I waste generation rates calculated for 1998 and 1999 by adopting this definition of employment size are 0.61 and 0.59 kg per employee per day respectively.

(2) Owing to the existing practice of collecting unsegregated MSW, the domestic waste colleted often contained certain amount of C&I waste, particularly in the above districts which have a significant employment size.

District	Domestic waste (kg/person/day)	C&I waste[1] (kg/employee/day)
Central & Western	1.47	0.22
Wanchai	1.81	0.26
Eastern	0.87	0.38
Southern	1.00	0.41
Hong Kong Island Average[2]	**1.14**	**0.28**
Yau Tsim Mong	1.97	0..29
Sham Shui Po	1.17	0.51
Kowloon City	1.01	0.38
Wong Tai Sin	0.84	0.36
Kwun Tong	0.93	0.36
Kowloon Average[2]	**1.12**	**0.44**
Kwai Tsing	0.77	0.62
Tsuen Wan	1.26	1.12
Tuen Mun	0.98	1.65
Yuen Long	1.10	1.67
North	1.56	1.60
Tai Po	1.16	0.86
Sha Tin	0.69	1.14
Sai Kung	0.82	1.79
NT (excluding Outlying Islands) Average[2]	**0.98**	**1.13**
NT - Outlying Islands Average[2]	**1.55**	**- [3]**
Territorial Average	**1.06**	**0.59**

Notes:

(1) Please see footnote (1) on page 25 of this report.

(2) Per capita generation rates are weighted average values.

(3) On Outlying Islands, C&I waste is usually mixed with domestic waste.

Table 8 : Per capita generation rates of domestic waste and commercial & industrial waste in 1999

5.2 Correlation of Quantity of Municipal Solid Waste with Gross Domestic Product

5.2.1 It has been established in previous reports that the quantity of MSW disposed of correlates well with the economic activities as measured by the total gross domestic product (GDP). Figure 10 shows three best-plotted straight lines of total GDP against quantity of MSW and its individual constituents disposed of at waste facilities from 1979 to 1999.

5.2.2 Domestic waste has an almost straight-line relationship with the total GDP in Hong Kong whereas C&I waste has a weaker linear correlation. Due to the large contribution of domestic waste to MSW, the linear relationship of MSW to total GDP is strong.

5.3 Municipal Solid Waste Projection

5.3.1 In early 2000, the EPD commissioned a study to review the collection of waste data and forecast of waste quantities. The objectives of the study included, amongst other things, the determination of a suitable forecast methodology for projection of waste quantities for domestic waste and C&I waste.

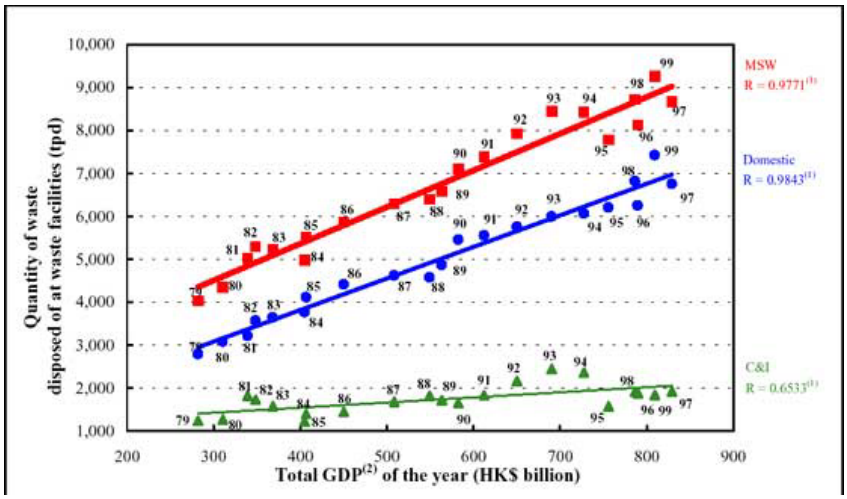
5.3.2 The forecast of domestic waste is related primarily to the growth of population in Hong Kong. A linear regression model of historical waste quantities against historical population has been developed. Population forecast provided by the Planning Department has been applied to the domestic waste projection using the regression relationship between population and waste quantity in the model.

5.3.3 Similar linear regression models have been developed for C&I waste through the following :

- Commercial waste generation is considered against GDP contribution of the commercial sector; and
- Industrial waste generation is considered against the Index of Industrial Production. The forecast of this index is derived from the projection of population and GDP growth provided by the Planning Department and the Financial Services Bureau respectively.

5.3.4 Based on the above linear regression models, the projected generation rates of domestic waste and C&I waste are obtained and presented in Figure 11.

5.3.5 The projected quantities of domestic waste and C&I waste requiring disposal for each of the 18 waste arising districts in the years 2006, 2011 and 2016 are presented in Table 9. The waste quantity for each waste arising district is derived by multiplying the projected waste generation rate for each type of waste by the respective population/employment size provided by the Planning Department.



Year	Domestic waste ●	C&I waste ▲	Municipal solid waste ■	Total GDP(2)
	Quantity (tpd)			(HK $ billion)
1979	2,790	1,240	4,030	282
1980	3,080	1,270	4,350	310
1981	3,220	1,820	5,030	339
1982	3,570	1,730	5,300	348
1983	3,650	1,580	5,230	368
1984	3,770	1,220	4,990	405
1985	4,120	1,400	5,510	407
1986	4,420	1,440	5,870	450
1987	4,630	1,680	6,300	509
1988	4,580	1,820	6,410	549
1989	4,870	1,720	6,580	563
1990	5,460	1,650	7,100	583
1991	5,560	1,830	7,390	612
1992	5,760	2,170	7,930	650
1993	6,000	2,450	8,450	690
1994	6,070	2,360	8,430	727
1995	6,210	1,580	7,790	726
1996	6,260	1,880	8,140	794
1997	6,760	1,920	8,680	829
1998	6,820	1,910	8,730	786(3)
1999	7,430	1,840	9,270	809(3)

Remark :
Figures on waste quantities are rounded off to the nearest 10 tpd and may not add up to total due to rounding-off.

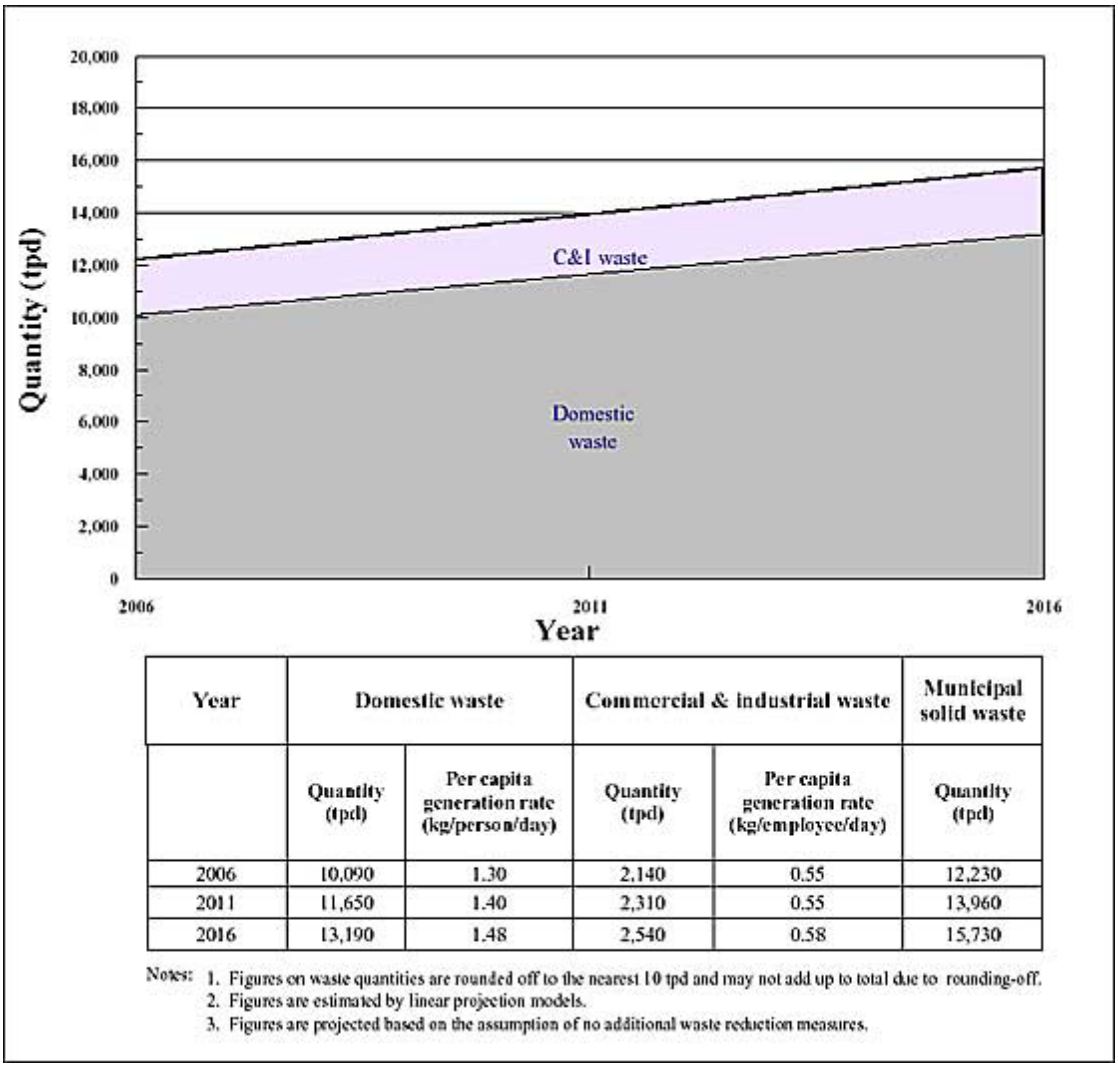
Notes:
(1) R = 1 shows best fitted regression line.
(2) GDP at constant (1990) market prices.
(3) Preliminary estimate provided by Census & Statistics Department.

Figure 10 : Correlation of municipal solid waste with total GDP 1979 - 1999

	Domestic waste (tpd)[1]						Commercial & Industrial waste (tpd)			Total MSW (tpd)		
	Public			Private								
Year	**2006**	**2011**	**2016**	**2006**	**2011**	**2016**	**2006**	**2011**	**2016**	**2006**	**2011**	**2016**
Central &	400	420	540	90	90	120	90	100	110	580	610	770
Wanchai	330	350	380	70	80	80	60	60	70	460	490	530
Eastern	510	540	560	110	120	120	90	90	90	710	750	770
Southern	270	320	350	60	70	80	30	30	40	640	420	470
Hong Kong Island	**1,510**	**1,630**	**1,830**	**330**	**360**	**400**	**270**	**280**	**310**	**2,110**	**2,270**	**2,540**
Yau Tsim Mong	620	660	710	140	140	160	110	100	110	870	900	980
Sham Shui Po	510	570	600	110	120	130	100	100	110	720	790	840
Kowloon City	510	530	540	110	120	120	60	60	60	680	710	720
Wong Tai Sin	410	430	450	90	90	100	30	40	40	530	560	590
Kwun Tong	570	630	800	130	140	180	180	180	220	880	950	1,200
Kowloon	**2,620**	**2,820**	**3,100**	**580**	**610**	**690**	**480**	**480**	**540**	**3,680**	**3,910**	**4,330**
Kwai Tsing	420	430	440	90	90	100	140	150	160	650	670	700
Tsuen Wan	330	390	430	70	90	100	140	140	150	540	620	670
Tuen Mun	540	650	660	120	140	150	190	190	220	850	960	1,030
Yuen Long	690	900	1,210	150	200	260	230	280	330	1,070	1,380	1,800
North	460	760	910	100	170	200	120	140	160	680	1.070	1,270
Tai Po	520	550	590	120	120	130	80	70	70	720	740	790
Sha Tin	330	350	370	70	80	80	150	105	160	550	580	610
Sai Kung	390	460	500	90	100	110	180	190	200	660	750	810
NT (excluding Outlying	**3,680**	**4,470**	**5,110**	**810**	**990**	**1,120**	**1,230**	**1,310**	**1,450**	**5,720**	**6,770**	**7,680**
NT - Outlying Islands	**560**	**770**	**940**				**160**	**240**	**240**	**720**	**1,010**	**1,180**
Territorial Total	**8,370**	**9,690**	**10,980**	**1,720**	**1,960**	**2,210**	**2,140**	**2,310**	**2,540**	**12,230**	**13,960**	**15,730**

Notes:
(1) The difference when compared with the forecast made in the 1998 and previous reports is due to the change of waste generation rates as explained in section 5.1.1 and adoption of new forecast models as explained in sections 5.3.1 to 5.3.3.

Table 9 :Projected quantities of municipal solid waste by waste arising district in 2006, 2011 and 2016



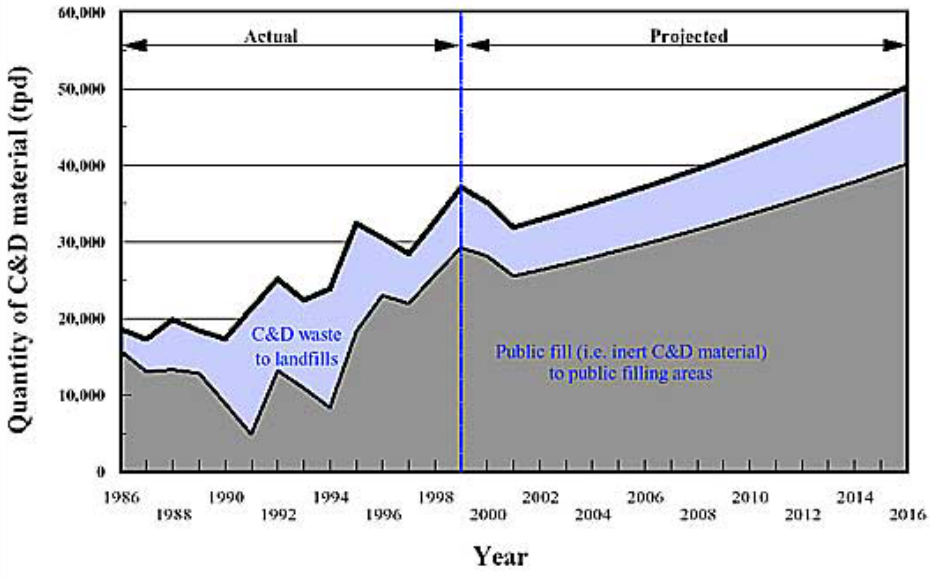
Year	Domestic waste		Commercial & industrial waste		Municipal solid waste
	Quantity (tpd)	Per capita generation rate (kg/person/day)	Quantity (tpd)	Per capita generation rate (kg/employee/day)	Quantity (tpd)
2006	10,090	1.30	2,140	0.55	12,230
2011	11,650	1.40	2,310	0.55	13,960
2016	13,190	1.48	2,540	0.58	15,730

Notes:
1. Figures on waste quantities are rounded off to the nearest 10 tpd and may not add up to total due to rounding-off.
2. Figures are estimated by linear projection models.
3. Figures are projected based on the assumption of no additional waste reduction measures.

Figure 11 : Projection of per capita generation rates and quantities of municipal solid waste disposed of at waste facilities 2006-2016

5.4 Forecasting Construction & Demolition Waste

5.4.1 Since 1998, the forecast of construction & demolition (C&D) material has been carried out by the Civil Engineering Department (CED) which oversees the management of public fill (i.e. inert C&D material) through its Fill Management Committee. The public fill planning model, one of the key elements of the public filling strategy set out by the Committee and developed by CED, amongst other things, forecasts the quantity of C&D material arisings. Based on the information generated from the planning model, the forecast quantities of C&D material arising in 2006, 2011 and 2016 are provided in Figure 12. The forecast quantities of C&D waste to be disposed of at landfills are based on the current situation that about 80% of the total C&D material arising being diverted to public filling areas. The actual quantities of public fill and C&D waste disposed of at public filling areas and landfills respectively since 1986 are also shown in Figure 12.



Year	C&D waste to landfills		Public fill to Public Filling Areas		Total C&D material
	Quantity (tpd)	% of total C&D material	Quantity (tpd)	% of total C&D material	Quantity (tpd)
1986	2,850	15.3	15,780	84.7	18,630
1987	4,220	24.2	13,070	75.6	17,290
1988	6,520	32.9	13,320	67.1	19,840
1989	5,580	30.3	12,820	69.7	18,410
1990	8,450	48.7	8,900	51.3	17,350
1991	16,380	77.0	4,880	23.0	21,260
1992	11,960	47.6	13,170	52.4	25,130
1993	11,520	51.4	10,880	48.6	22,400
1994	15,480	64.9	8,370	35.1	23,850
1995	14,120	43.6	18,280	56.4	32,400
1996	7,520	24.6	22,990	75.4	30,510
1997	6,480	22.8	21,950	77.2	28,430
1998	7,030	21.5	25,680	78.5	32,710
1999	7,890	21.3	29,220	78.7	37,110
2006	7,430	20.0	29,720	80.0	37,150
2011	8,650	20.0	34,610	80.0	43,260
2016	10,040	20.0	40,150	80.0	50,190

Remark :
Figures on waste quantities are ronded off to the nearest 10 tpd and may not add up to total due to rounding-off.

Notes:
(1) Forecast figures on total C&D material are provided by the Civil Engineering Department, based on the assumption of no additional waste reduction measures.

Figure 12: Quantities of construction and demolition material

Appendix 1: Breakdown of solid waste delivered to refuse transfer stations and landfills in 1999

Disposal facilities	Average daily waste intake by waste type in 1999 (tpd)				
	MSW		Construction & demolition	Special	Total
	Public	Private			
KBTS - Kowloon Bay Refuse Transfer Station[1]	1,098	-	-	-	1,098
IETS - Island East Refuse Transfer Station[2]	855	7	-	-	862
STTS - Sha Tin Refuse Transfer Station[1]	973	-	-	-	973
IWTS - Island West Refuse Transfer Station[2]	477	-	-	-	477
WKTS - West Kowloon Refuse Transfer Station[2]	1,519	26	-	-	1,545
OITF - Outlying Islands Refuse Transfer Facilities[2]	74	1	-	2	77[3]
NLTS - North Lantau Refuse Transfer Station[2]	18	73	-	1	92
WENT - West New Territories Landfill	850[4]	441[4]	1,323	529[4]	3,143[4]
SENT - South East New Territories Landfill	225	2,103	5,784	247	8,359
NENT - North East New Territories Landfill	0[4]	529	788	101	1,418[4]
Sub-total	**6,089**	**3,180**			
Total	**9,269**		**7,895**	**880**	**18,044**

Notes :

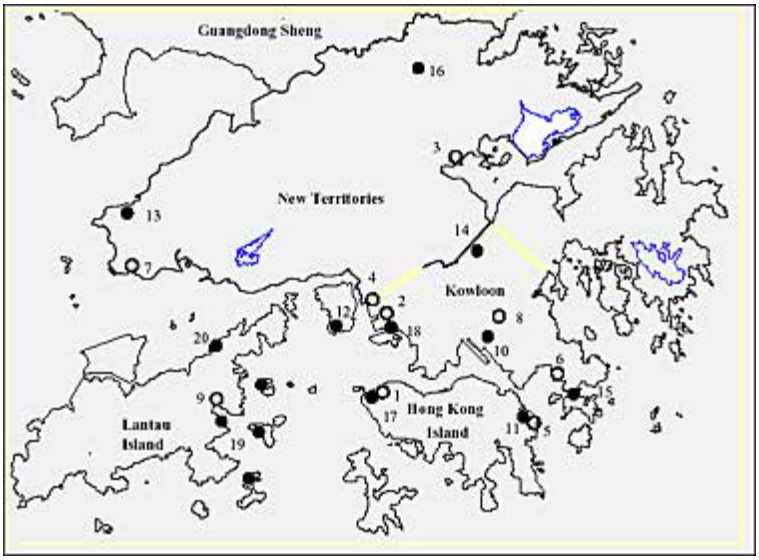
(1) Waste from KBTS and STTS was delivered to NENT by road.

(2) Waste from IETS, IWTS, WKTS, OITF and NLTS was delivered to WENT by sea.

(3) The quantity shown here does not include inert C&D material received by OITF (43tpd).

(4) The quantity shown here does not include waste transferred from the RTS and OITF.

Appendix 2: Review of solid waste intake at waste facilities



- Decommissioned
- In operation

Appendix 2: Review of solid waste intake at waste facilities

Waste facilities		Year commissioned	Average daily intake (tpd) [2]													Year decommissioned
			1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	
1 ○	Kennedy Town Incineration Plant	1967	630	550	580	780	820	780	680	420	-	-	-	-	-	-	1993
3 ○	Shuen Wan Landfill	1974	1,240	1,360	1,950	2,450	3,750	7,000	5,670	6,410	7,570	6,230	-	-	-	-	1995
5 ○	Chai Wan Composting/ Pulverisation Plant	1979	350	420	490	390	390	430	-	-	-	-	-	-	-	-	1991
7 ○	Pillar Point Valley Landfill	1983	1,330	1,560	1,790	1,920	2,070	2,640	3,410	2,130	2,430	4,690	2,800	-	-	-	1996
9 ○	Mui Wo Incineration Plant	1987	-	10	10	10	10	10	10	10	10	-	-	-	-	-	1994
11 ●	Island East Transfer Station Chemical Waste	1992	-	-	-	-	-	-	40	1,140	1,250	1,200	1,220	940	840	860	
13 ●	WENT Landfill	1993	-	-	-	-	-	-	-	1,170	2,700	2,810	1,970	4,180	5,420	6,200	
15 ●	SENT Landfill	1994	-	-	-	-	-	-	-	-	1,160	7,070	7,230	7,830	7,840	8,360	
17 ●	Island West Transfer Station	1997	-	-	-	-	-	-	-	-	-	-	-	460	460	480	
19 ●	Outlying Islands Transfer Facilities[1]	1998													120	77	
20 ●	North Lantau Transfer Station	1998													80	92	

Remark: Figures are rounded off to the nearest 10 tpd.

Note :

(1) The Outlying Islands Transfer Facilities include the facilities at Cheung Chau, Mui Wo, Peng Chau and Hei Ling Chau.

(2) Italic figures are average of actual operation days rather than 365 days during the year of commissioning and decommissioning.

Appendix 3: Waste arising districts and waste arising areas

District name	Source area name
Central & Western	Central
	Sheung Wan
	Mid Levels
	Peak
	Kennedy Town
Wanchai	Wanchai
	Tai Hang / Happy Valley
Eastern	North Point
	Quarry Bay
	Shau Kei Wan
	Chai Wan
Southern	Pok Fu Lam
	Aberdeen
	Stanley
Yau Tsim Mong	Tsim Sha Tsui East
	Tsim Sha Tsui West
	Yau Ma Tei
	Mongkok North
	Mongkok South
Sham Shui Po	Sham Shui Po
	Shek Kip Mei
	Cheung Sha Wan
	Lai Chi Kok
Kowloon City	Hung Hom
	Ho Man Tin
	Kowloon Tong
Wong Tai Sin	Wong Tai Sin
	Ngau Chi Wan
Kwun Tong	Kwun Tong East
	Kwun Tong West
	Sau Mau Ping
	Lam Tin
Kwai Tsing	Kwai Chung
	Tsing Yi
Tsuen Wan	Tsuen Wan
Tuen Mun	Tuen Mun
	Lam Tei
Yuen Long	Yuen Long
	Tin Shui Wai
	Kam Tin / Shek Kong
	San Tin
North	Sheung Shui / Fanling
	Shau Tau Kok
Tai Po	Tai Po
	Shuen Wan
	Tai Po Rural
	Sai Kung North
Sha Tin	Sha Tin West
	Sha Tin East
	Sha Tin South
	Ma On Shan
Sai Kung	Sai Kung South
	Clear Water Bay
	Junk Bay
Outlying Islands	

Appendix 4 : Review of composition of domestic waste

Year	Quantity (tpd) and its percentage by weight [1]									
	Bulky waste	Glass	Metals	Paper	Plastics	Putrescibles	Textiles	Rattan/wood	Others	Total
1986	320 (7.2%)	110 (2.5%)	150 (3.4%)	970 (22.0%)	630 (14.3%)	1,340 (30.4%)	190 (4.2%)	190 (4.2%)	520 (11.8%)	4,420
1987	250 (5.5%)	130 (2.7%)	160 (3.4%)	1,000 (21.7%)	680 (14.8%)	1,450 (31.4%)	210 (4.5%)	190 (4.1%)	550 (11.9%)	4,630
1988	280 (6.1%)	180 (3.9%)	190 (4.1%)	870 (19.1%)	720 (15.6%)	1,190 (26.1%)	240 (5.2%)	130 (2.8%)	780 (17.1%)	4,580
1989	220 (4.6%)	170 (3.4%)	210 (4.3%)	1,040 (21.4%)	740 (15.3%)	1,390 (28.6%)	290 (5.9%)	70 (1.4%)	730 (15.1%)	4,870
1990	240 (4.4%)	130 (2.4%)	130 (2.5%)	1,040 (19.1%)	810 (14.9%)	2,070 (38.0%)	220 (4.0%)	70 (1.4%)	730 (13.3%)	5,460
1991	320 (5.8%)	140 (2.5%)	170 (3.0%)	1,010 (18.2%)	870 (15.7%)	1,740 (31.4%)	270 (4.8%)	130 (2.4%)	900 (16.2%)	5,560
1992	490 (8.5%)	110 (2.0%)	170 (3.0%)	1,080 (18.7%)	790 (13.8%)	1,910 (33.1%)	230 (3.9%)	130 (2.2%)	860 (14.8%)	5,760
1993	770 (12.8%)	150 (2.5%)	150 (2.5%)	1,210 (20.2%)	890 (14.8%)	1,600 (26.7%)	240 (4.0%)	130 (2.2%)	860 (14.3%)	6,000
1994	640 (10.5%)	140 (2.3%)	150 (2.5%)	1,150 (18.9%)	750 (12.4%)	1,920 (31.7%)	290 (4.8%)	20 (0.3%)	1,010 (16.6%)	6,070
1995	480 (7.8%)	180 (2.8%)	210 (3.4%)	1,250 (20.1%)	950 (15.3%)	1,930 (31.0%)	200 (3.2%)	200 (3.3%)	820 (13.1%)	6,210
1996 [2]	250 (4.0%)	160 (2.5%)	190 (3.0%)	1,270 (20.3%)	950 (15.2%)	2,030 (32.5%)	270 (4.4%)	140 (2.2%)	990 (15.9%)	6,260
1997	290 (4.3%)	240 (3.5%)	240 (3.5%)	1,740 (25.8%)	1,160 (17.2%)	2,050 (30.4%)	230 (3.4%)	100 (1.4%)	710 (10.5%)	6,760
1998	180 (2.6%)	210 (3.1%)	240 (3.6%)	1,790 (26.2%)	1,260 (18.5%)	2,390 (35.1%)	210 (3.1%)	50 (0.8%)	480 (7.0%)	6,820
1999	200 (2.7%)	210 (2.8%)	220 (2.9%)	1,860 (25.0%)	1,400 (18.9%)	2,850 (38.4%)	230 (3.2%)	100 (1.3%)	160 (4.8%)	7,430

Remark:
Figures indicate the quantities and percentages by wet weight.
Figures on waste quantities are rounded off to the nearest 10 tpd and may not add up to total due to rounding-off.

Notes :

(1) The estimated quantity of each waste component shown here is based on results of sampling exercise for domestic waste.

(2) 1996 data were estimates based on the trends in previous years as sampling exercise was not conducted.

Appendix 5 : Review of composition of commercial & industrial waste

Year	Quantity (tpd) and its percentage by weight [1]									
	Bulky waste	Glass	Metals	Paper	Plastics	Putrescibles	Textiles	Wood/rattan	Others	Total
1986	N.A.	50 (3.2%)	60 (4.0%)	280 (19.3%)	240 (16.9%)	240 (16.9%)	290 (20.2%)	150 (10.7%)	130 (8.8%)	1,440
1987	N.A.	70 (3.9%)	60 (3.8%)	340 (20.2%)	300 (17.8%)	260 (15.7%)	280 (16.4%)	210 (12.5%)	160 (9.7%)	1,680
1988	N.A.	60 (3.5%)	80 (4.2%)	290 (16.1%)	290 (16.0%)	270 (15.1%)	290 (16.0%)	250 (13.6%)	280 (15.5%)	1,820
1989	20 (1.3%)	40 (2.6%)	90 (5.0%)	330 (19.4%)	310 (17.9%)	180 (10.2%)	290 (17.0%)	170 (10.0%)	290 (16.6%)	1,720
1990	20 (0.9%)	30 (1.9%)	90 (5.7%)	330 (20.3%)	300 (18.0%)	150 (9.0%)	420 (25.5%)	160 (9.7%)	150 (9.0%)	1,650
1991	30 (1.8%)	50 (2.6%)	70 (4.0%)	340 (18.4%)	320 (17.7%)	240 (12.9%)	350 (19.0%)	180 (9.9%)	250 (13.7%)	1,830
1992	50 (2.5%)	50 (2.2%)	60 (2.9%)	430 (19.8%)	460 (21.4%)	160 (7.5%)	400 (18.5%)	190 (9.0%)	350 (16.2%)	2,170
1993	40 (1.6%)	20 (0.9%)	80 (3.2%)	780 (31.7%)	430 (17.3%)	130 (5.3%)	280 (11.6%)	260 (10.4%)	440 (18.0%)	2,450
1994	180 (7.7%)	40 (1.8%)	60 (2.5%)	690 (29.3%)	400 (16.9%)	140 (5.8%)	200 (8.4%)	280 (11.8%)	370 (15.8%)	2,360
1995	50 (3.0%)	40 (2.4%)	80 (5.0%)	500 (31.3%)	280 (17.4%)	50 (2.9%)	120 (7.3%)	250 (16.1%)	230 (14.6%)	1,580
1996 [2]	80 (4.1%)	30 (1.8%)	70 (3.5%)	570 (30.1%)	310 (16.2%)	90 (4.7%)	130 (6.8%)	320 (16.9%)	300 (15.9%)	1,880
1997	90 (4.8%)	40 (2.1%)	80 (4.0%)	490 (25.5%)	320 (16.4%)	160 (8.3%)	140 (7.0%)	340 (17.6%)	280 (14.3%)	1,920
1998	80 (4.1%)	60 (3.3%)	50 (2.7%)	580 (30.3%)	270 (14.0%)	310 (16.0%)	60 (3.0%)	270 (14.1%)	240 (12.5%)	1,910
1999	90 (5.0%)	40 (2.0%)	40 (2.3%)	560 (30.4%)	390 (21.4%)	280 (15.3%)	50 (2.8%)	240 (12.9%)	150 (7.9%)	1,840

Remark:
Figures indicate the quantities and percentages by wet weight.
Figures on waste quantities are rounded off to the nearest 10 tpd and may not add up to total due to rounding-off.
N.A. = Not available.

Notes :

(1) The estimated quantity of each waste component shown here is based on results of sampling exercise for commercial and industrial waste.

(2) 1996 data were estimates based on the trends in previous years as sampling exercise was not conducted.

Appendix 6 : Review of composition of municipal solid waste

Year	Quantity (tpd) and its percentage by weight [1]									
	Bulky waste	Glass	Metals	Paper	Plastics	Putrescibles	Textiles	Wood/rattan	Others	Total
1986	320 (5.4%)	160 (2.7%)	210 (3.5%)	1,250 (21.3%)	880 (15.0%)	1,590 (27.1%)	480 (8.1%)	340 (5.8%)	650 (11.1%)	5,870
1987	250 (4.0%)	190 (3.0%)	220 (3.5%)	1,340 (21.3%)	980 (15.6%)	1,720 (27.2%)	490 (7.7%)	400 (6.3%)	710 (11.4%)	6,300
1988	280 (4.4%)	240 (3.8%)	270 (4.1%)	1,170 (18.2%)	1,010 (15.7%)	1,470 (22.9%)	530 (8.3%)	380 (5.9%)	1,070 (16.7%)	6,410
1989	250 (3.7%)	210 (3.2%)	300 (4.5%)	1,370 (20.9%)	1,050 (16.0%)	1,570 (23.8%)	580 (8.7%)	240 (3.7%)	1,020 (15.5%)	6,580
1990	260 (3.6%)	160 (2.3%)	230 (3.2%)	1,380 (19.4%)	1,110 (15.6%)	2,220 (31.3%)	640 (9.0%)	230 (3.3%)	880 (12.3%)	7,100
1991	350 (4.8%)	180 (2.5%)	240 (3.2%)	1,350 (18.3%)	1,200 (16.2%)	1,980 (26.8%)	610 (8.3%)	320 (4.3%)	1,150 (15.6%)	7,390
1992	540 (6.8%)	160 (2.1%)	230 (3.0%)	1,510 (19.0%)	1,260 (15.9%)	2,070 (26.1%)	630 (7.9%)	320 (4.0%)	1,210 (15.2%)	7,930
1993	810 (9.5%)	170 (2.0%)	230 (2.7%)	1,990 (23.6%)	1,320 (15.6%)	1,730 (20.5%)	520 (6.2%)	380 (4.5%)	1,300 (15.4%)	8,450
1994	820 (9.7%)	180 (2.2%)	210 (2.5%)	1,840 (21.8%)	1,150 (13.6%)	2,060 (24.5%)	490 (5.9%)	300 (3.5%)	1,380 (16.3%)	8,430
1995	530 (6.8%)	210 (2.8%)	290 (3.7%)	1,740 (22.3%)	1,230 (15.8%)	1,970 (25.3%)	310 (4.0%)	460 (5.9%)	1,050 (13.4%)	7,790
1996 [2]	330 (4.0%)	190 (2.4%)	260 (3.1%)	1,840 (22.6%)	1,260 (15.4%)	2,120 (26.1%)	400 (4.9%)	450 (5.6%)	1,290 (15.9%)	8,140
1997	380 (4.4%)	280 (3.2%)	310 (3.6%)	2,230 (25.7%)	1,480 (17.1%)	2,210 (25.5%)	370 (4.2%)	440 (5.0%)	980 (11.3%)	8,680
1998	260 (3.0%)	280 (3.1%)	300 (3.4%)	2,370 (27.1%)	1,530 (17.5%)	2,700 (30.9%)	270 (3.1%)	320 (3.7%)	710 (8.2%)	8,730
1999	300 (3.2%)	240 (2.6%)	260 (2.8%)	2,420 (26.1%)	1,790 (19.4%)	3,140 (33.8%)	290 (3.1%)	330 (3.6%)	500 (5.4%)	9,270

Remark:
Figures indicate the quantities and percentages by wet weight.
Figures on waste quantities are rounded off to the nearest 10 tpd and may not add up to total due to rounding-off.

Notes :

(1) The estimated quantity of each waste component shown here is based on results of sampling exercises for domestic waste and commercial & industrial waste.

(2) 1996 data were estimates based on the trends in previous years as sampling exercise was not conducted.

Appendix 7 : Recovery of major recyclable wastes in 1999

Waste type	Quantity of waste recovered in 1999 (thousand tonnes)		
	Exported for recycling [1] (a)	Recycled locally (b)	Total recovery (c) = (a) + (b)
Ferrous metals	540[4]	0	540
Glass[2]	less than 0.1	1.3	1.3
Non-ferrous metals	77	2.1	79
Paper	534	145	679
Plastics	131	23	154
Rubber tyre	0.3	14.5[5]	14.8
Textiles	20	0	20
Wood	8	40	48
Total[3]	**1,310**	**230**	**1,540**

Note :

(1) Figures are based on records of the Census and Statistics Department.

(2) Excluding glass beverage bottles recovered through deposit-and-refund system operated by local beverage manufacturers.

(3) Figures are rounded off to the nearest 10 thousand tonnes.

(4) As advised by the Hong Kong Metal Merchants Association, this figure (based on information provided by export traders) may be over quoted as the exported scrap metals may be mixed with virgin materials and metal products. The Association estimated that the quantity was about 450,000 tonnes in 1999.

(5) Quantity includes retreating, reuse and recycling of waste tyres.