2. Field Investigations

2 Field Investigations

2.1 Waste Amount and Composition Survey

This part of the Waste Amount and Composition Survey (WACS) intends to provide an overview of the solid waste situation in the target area, based on data from sample representative sectors. The subject sectors of the study are household, which is divided further into inhabited area (apartment area, Ger area and summer house area), commercial (restaurant and other shop), office, market (meat, vegetable, fruit, dairy product and other), hotel, school and roads and parks, which compose the cross-section of waste generators in the municipality. They are also considered the major contributors to the city's day to day waste generation.

The survey seeks to find out the types, amount and composition of wastes generated by the representative sectors. The results of the survey will be used to clarify the waste stream in the study area and to formulate an appropriate system of solid waste management, specifically in formulating effective collection and disposal systems, developing waste utilisation plans and strategies, planning multi-sectoral involvement and designing a workable mechanism for managing the system. A WACS was carried out 2 times, first in December 2004 in order to obtain waste data for the winter season. The second survey was conducted in June 2005 in order to obtain waste data for the summer season.

The WACS actually consists of the following two surveys.

- The Waste Amount Survey
- The Waste Composition Survey.

Objectives, methodologies and results are independently described for each survey in the first two corresponding sections and findings of the surveys are discussed together in the third section.

2.1.1 Waste Amount Survey

a. Objective and Definitions

a.1 Objectives of the Survey

The objective of the Waste Amount Survey is to know the current waste generation rates of households, restaurants, shops, markets, schools, road and parks, hotels and offices in the Study Area. Knowledge of the waste generation rate is essential for the development and design of integrated solid waste management systems.

The data on waste generation rates obtained in this survey is then applied to elaborate the waste stream, which is used to comprehend the current flow of waste and to make future projections in the Study Area.

a.2 Definition of Waste

For purposes of the WACS, the words used in the Study are defined as follows.

a.2.1. Household Waste

Also referred to as household waste, this category comprises wastes that are the consequence of household activities such as food preparation, sweeping, cleaning, gardening, etc.

a.2.2. Commercial Waste

The category of waste in this type is divided into 2 sub-sectors. The first sub-sector is waste discharged from catering business like restaurant and food shop. The second is waste from other commercial shops such as stationery, book store, electric appliance shop, etc. The wastes from the latter are mainly discharged through commercial activities.

a.2.3. Office Waste

Government offices, state enterprises, banks, private offices are included in this category. Generally, this category involves a large portion of paper from daily office work.

a.2.4. Market Waste

Waste generated in or discharged from markets both from fixed place market, mobile market and wholesale market.

a.2.5. Hotel Waste

This category of waste includes all waste generated by the hotel activities.

a.2.6. School Waste

This category of waste includes all waste generated by the school activities.

a.2.7. Public Area Cleaning (Roads and Parks) Waste

This category of waste includes all waste generated by the street and park sweeping cleansing service. This category of waste always includes grass and wood.

b. Methodology

b.1 Target wastes

Sample wastes are collected from: households, restaurants, shops, offices, markets, hotels, schools, and road and parks. ECOS Co., Ltd., a local consultant in Ulaanbaatar, gave suggestion to select the targets for collecting sample wastes so that they reflect the present situation of the Study Area properly. The targets are listed in the Table 2-1 below.

Households are categorized into five by their location and environment. Firstly, households are categorized whether they are located in planned area (Apartment area) or in unplanned area (Ger area). Those located in planned area are further categorized into “Apartment with dust chute” and “Apartment without dust chute.” Those located in unplanned area are further categorized into “Ger with collection service”, “Ger without collection service” and “Summer house.”

Targets in Markets are categorized into five types of stalls by what they sell, that are Meat stalls, Vegetable stalls, Fruit stalls, Dairy product stalls and other stalls.

Table 2-1: Targets for sample wastes collection

Category		No. of targets	Days for sample collection	No. of samples
Households	Ger with collection service	15 (3 areas x 5 targets each)	7	105
	Ger without collection service	15 (3 areas x 5 targets each)	7	105
	Summer house	Winter season : 5 (from 1 area only)	7	35
		Summer season : 15 (3 areas x 5 target each)	7	105
	Apartment with dust chute	20 (4 areas x 5 targets each)	7	140
	Apartment without dust chute	20 (4 areas x 5 targets each)	7	140
Commercial	Restaurants	5	7	35
	Shops	5	7	35

Offices		5	7	35
Markets[1]	Meat stalls	4 (2 markets x 2 stalls each)	7	28
	Vegetable stalls	4 (2 markets x 2 stalls each)	7	28
	Fruit stalls	4 (2 markets x 2 stalls each)	7	28
	Dairy product stalls	4 (2 markets x 2 stalls each)	7	28
	Other stalls	4 (2 markets x 2 stalls each)	7	28
Hotels		5	7	35
Schools		5	7	35
Roads and parks		2	7	14
Total		Winter season : 122	-	854
		Summer season : 132	-	924

The listing of the areas of the target households is as Table 2-2 below. The listing of other targets is as shown in

Table 2-3 below.

Table 2-2: Areas of Target Households

Category	Area		
Ger with collection service	ChD		VIII khoroo
	BZD		II khoroo
	ChD		XIV khoroo
Ger without collection service	ChD		XVIII khoroo Yagaitiim
	SKhD		VII khoroo
	ChD		XVIII khoroo Dood salhit zadgai
Summer house	Winter season	ChD	XVIII khoroo
	Summer season	ChD	XVIII khoroo
		BGD	VI, XVIII khoroo
		BZD	V, XIII khoroo
Apartment with dust chute	SBD		III khoroo
	BGD		VIII, IX, X, XIX khoroo
	BGD		V, VI khoroo
	BZD		V khoroo
Apartment without dust chute	ChD		I, II khoroo
	SBD		I, II khoroo
	BZD		IV khoroo
	SKhD		XVIII khoroo

Table 2-3: Targets other than Households

	Restaurants		Shops		Offices		Hotels	
No	Name	No. of Chairs	Name	No. of Employees	Name	No. of Employees	Name	No. of rooms
1	Sunway	40	Good shop	3	Ministry of foreign affair	34	Mika	25
2	Winner's	45	Drugstore	5	Chingeltei district judge	23	Amarbaya sgalant	13
3	Sakura	18	Hairdresser, cosmetic saloon	44	Capital democratic party	30	Edelweiss	10
4	Mika	40	Electric goods shop	18	9th branch of Golomt bank	3	Anuujin	25
5	Shine zuum	65	Photo center	4	Hydro Construction Co., Ltd.	7	White house	50

	Schools		Markets		Roads and Parks	
No	Name and Category	No. of Students	Name	Address	Name	Address
1	university (Computer science and Management Institution)	1,300	Mercury	SBD	Road form 4th Grocery's to National University of Education	SBD
2	university (Soyol Erdem)	450	Tavan - Erdene	BGD	Road of 3rd and 4th khoroolo	BGD
3	Private school (Orchlon)	600	---	---	---	---
4	Secondary school (Setgemj Complex)	1,600	---	---	---	---
5	Secondary school (School #47)	1,500	---	---	---	---

[1] Collection of sample wastes from 3 Markets had been tried but one of them did not give enough samples for the survey in winter season.

b.2 Survey method

- Weight measurement

All the wastes generated from the targets above was collected daily as sample and they were weighed individually. Targets of Ger with collection service, Ger without collection service and summer house are asked to dispose of ash and other wastes separately to measure them individually. Targets in Markets were provided with containers and others were provided with plastic bags. They were asked to put their wastes in the containers and the plastic bags so that the Study team could collect them.

- Interview

All the targets has been interviewed to obtain such data as number of family members in household, number of chairs in restaurant, number of employees in shop, number of employees in office, number of stalls in market, number of rooms in hotel and number of students in school.

b.3 Schedule

The survey in the winter was conducted from December 22nd to 30th in 2004 and the survey in the summer was conducted from July 2nd to 9th in 2005. The survey was conducted for the first two days in the winter and first day in the summer on trial so that the participants would get accustomed to it. The samples were actually collected from the third day.

c. Results

c.1 Generation Rate of Household Wastes

We obtained generation rate of household wastes from the results of the survey as summarized in Table 2-4 below.

Table 2-4: Generation Rate of Household Wastes

Category		Unit	winter season			Summer season		
			Average	Maximum	Minimum	Average	Maximum	Minimum
Ger with collection service	Ash	g/person/day	830	1,370	320	0	0	0
	Other wastes	g/person/day	160	410	70	260	830	40
	Total	g/person/day	990	---	---	260	---	---
Ger without collection service	Ash	g/person/day	700	1,330	300	0	0	0
	Other wastes	g/person/day	170	490	50	160	390	20
	Total	g/person/day	870	---	---	160	390	20
Summer house	Ash	g/person/day	920	1,480	540	0	0	0
	Other wastes	g/person/day	140	200	100	190	330	80
	Total	g/person/day	1,060	---	---	190	---	---
All the samples of households located in unplanned area	Ash	g/person/day	788	---	---	0	---	---
	Other wastes	g/person/day	163	---	---	202	---	---
	Total	g/person/day	951	---	---	202	---	---
Apartment with dust chute		g/person/day	240	490	70	200	630	40
Apartment without dust chute		g/person/day	270	680	90	260	500	50
All the samples of households located in planned area		g/person/day	256	---	---	228	---	---
All the samples of households excluding ash (Total amount of wastes other than ash/Total population)		g/person/day	210	---	---	216	---	---
All the samples of households including ash (Total amount of waste/Total population)		g/person/day	590	---	---	216	---	---

c.2 Waste Generation Rate of Other Targets than Households

We obtained waste generation rate of other targets than households from the results of the survey as summarized in Table 2-5 below.

Table 2-5: Waste Generation Rate of other targets than Households

Category		Unit	Winter season			Summer season		
			Average	Maximum	Minimum	Average	Maximum	Minimum
Commercial	Restaurants	g/chair/day	250	390	180	270	560	60
	Shops	g/employee/day	140	260	50	180	360	50
		g/shop/day	1,200	2,360	370	1,640	3,620	180
Offices		g/employee/day	130	280	70	180	280	70
Markets	Meat stalls	g/stall/day	3,300	6,200	600	2,400	5,800	500
	Vegetable stalls	g/stall/day	2,500	5,600	200	9,900	20,900	4,300
	Fruit stalls	g/stall/day	1,400	7,100	100	2,300	4,200	400
	Dairy product stalls	g/stall/day	500	900	200	700	2,000	300
	Other stalls	g/stall/day	500	1,800	100	1,200	6,600	400
	Weight Average	g/stall/day	850	---	---	1,720	---	---
Hotels		g/room/day	130	190	70	110	190	70
Schools		g/student/day	3.0	5.3	1.5	1.5	3.0	0.8
Public Area Cleaning (Roads and parks)		g/m2/day	3.0	3.4	2.6	11.3	12.9	9.7

c.3 Estimated waste generation amount in Study area

The following table shows the estimated daily waste generation amount of Households, Restaurants, Shops, Offices, Markets, Hotels, Schools, and Roads and parks.

Table 2-6: Estimation of Waste Generation Amount in Study Area (2005)

Generation Source		Number of Generation Source	Unit	Generation Ratio (g/day)		Daily Generation Amount (ton/day)	
				Winter season	Summer season	Winter season	Summer season
Household Waste	Apart	450,627*1	g/person/day	256	228	115.4	102.7
	Ger*1	415,964*1	g/person/day	951	202	395.6	84.0
	Total	**866,591*1**	**g/person/day**	**590**	**216**	**511.0**	**186.7**
Commercial Waste (Restaurant)		41,812*1	g/chair/day	250	270	10.5	11.3
Commercial Waste (Other Shop)		3,009*1	g/shop/day	1,200	1,640	3.6	4.9
Office Waste		105,376*1	g/employee/day	130	180	13.7	19.0
Market Waste		4,354*2	g/stall/day	850	1,720	3.7	7.5
School Waste		271,378*1	g/student/day	3	1.5	0.8	0.4
Hotel Waste		11,506*1	g/room/day	130	110	1.5	1.3
Business Total		-	-	-	-	**33.8**	**44.4**
Public Area Cleaning Waste		3,266,375*2	g/m2/day	**3.0**	**5.1**	**10.0**	**17.0**
Total						**554.8**	**248.1**

(Note)

*1: Source : Department of Statistics, Information and Research of Ulaanbaatar

*2: Based on the information obtained in the interviews to managers and responsible persons during the Study

*3: The generation rates of summer house in winter and in summer are 1,060 and 190 g/person/day respectively. The generation rate of summer house is included in it of Ger area.

c.4 Comparison of Waste Generation Rates

SWM studies of JICA, including this, give the data summarized in Table 2-7 below.

Waste generation rate in Ulaanbaatar excluding the amount of ash is one of the lowest in other cities of similar situation economically in terms of GNP per Capita.

Table 2-7: Comparison of Waste Generation Rate

Country/City		Population (Person)	Study Year	GNP per Capita in 1998 (IDA)	Generation Rate of Household Waste	Generation Rate of MSW*1
			Year	US$/Year	g/person/day	g/person/day
Mongol Ulaanbaatar	In winter	866,591	2005	552 in 2004	590	640
	In summer	866,591	2005	552 in 2004	216	286
Laos*3	Vientiane	142,700	1991	330	753	970
Cambodia*4	Phnom Penh	1,199,414	2003	268	498	556
Poland*5	Poznan	590,500	1992	3,900	654 (470, 913)*2	NA
	Lublin	352,500	1992	3,900	399 (336, 542)*2	NA
Paraguay*6	Asuncion	510,500	1994	1,760	961	1,312
	F.Mora	99,201	1994	1,760	961	1,098
Nicaragua*7	Managua	834,400	1994	390	664	802
Tanzania*8	Dar es Salaam	2,030,000	1996	210	698	873
Nicaragua*9	Leon	134,000	1996	390	736	762
	Chinandega	100,700	1996	390	630	756
	Granada	76,300	1996	390	661	749
Philippines*10	Quezon	1,989,400	1997	1,050	423	524
	Makati	484,200	1997	1,050	416	670
	Paranaque	391,300	1997	1,050	418	556
Honduras*11	Tegucigalpa	848,859	1998	730	375	566
Azerbaijan*12	Baku	2,025,300	1999	849 in 2000	233	244
Turkey*13	Adana	1,196,620	1999	3,160	498	696
	Mersin	634,850	1998	3,160	473	703

Note *1: MSW : Municipal Solid Waste
*2: Figures in parentheses are generation rates of households with and without central heat supply, respectively.

Sources:
*3: The Study on the Solid Waste Management System Improvement Project in Vientiane, Lao People's Democratic Republic, Final Report, August 1992
*4: The Study on Solid Waste Management in the Municipality of Phnom Penh in the Kingdom of Cambodia, Final Report, March 2005
*5: The Study on the Solid Waste Management for Poznan City, the Republic of Poland, Final Report, May 1993
*6: The Study on the Solid Waste Management for the Metropolitan Area of Asuncion in the Republic of Paraguay, Final Report, August 1994
*7: The Study on the Improvement of The Solid Waste Management System for the City of Managua, May 1995
*8: The Study on the Solid Waste Management for Dar es Salaam City, Final Report, September 1997
*9: The Study on the Improvement of Urban Sanitation Environment of Principal Cities in the Republic of Nicaragua, January 1998
*10: The Study on Solid Waste Management for Metro Manila in the Republic of the Philippines, March 1998
*11: The Study on Solid Waste Management of the urban area of Tegucigalpa's Central District in the Republic of Honduras, Final Report, March 1999
*12: The Master Plan Study on Integrated Environmental Management in Baku City in Azerbaijan Republic, March 2001
*13: The Study on Regional Solid Waste Management for Adana-Mersin in the Republic of Turkey, Final Report, January 2000

d. Findings

The followings are main findings from data obtained in winter and summer:

1. The waste generation rate (amount) in winter and in summer differs significantly, especially household waste in Ger area, i.e. it in winter is 4.71 times more than it in summer. This is mainly due to the coal ash from Ger area in winter.
2. To the contrary, waste generation rate (amount) of Business waste in summer is 1.31 times more than it in winter. The reason of this fact is assumed that business in summer is more active than it in winter.
3. As a conclusion, generation rate (amount) of municipal solid waste (MSW) in winter is 2.24 times more than it in summer.

4. The table above shows MSW generation rate and amount in 2005, i.e. WACS results. However, it does not include those of construction waste, non-hazardous wastes from factories and non-infectious waste from hospitals although those wastes are disposed of at the current municipal landfills. Those are presented in the other sections.

2.1.2 Waste Composition Survey

a. Objective

The objective of the Waste Composition Survey is to obtain basic data that is necessary to determine the composition of the waste generated in the Study area at present and predict that in the future. The determination and prediction of waste composition is one of the most essential tasks to develop and design integrated solid waste management systems.

b. Methodology

Followings properties of the target wastes are measured and/or analysed in the waste composition survey.

- Apparent specific gravity
- Physical composition
- Proportion of three components (Water content, Combustible matter and Ash)
- Chemical property (Carbon and Nitrogen content of dry solid)

b.1 Target wastes

Sample wastes collected for the waste amount survey are further utilized for measurement and analysis in the waste composition survey. As described in the earlier section of the waste amount survey, they were originally collected from the targets of the 16 categories, that are Ger with collection service, Ger without collection service, Summer house, Apartment with dust chute, Apartment without dust chute, Restaurants, Shops, Offices, Meat stalls, Vegetable stalls, Fruit stalls, Dairy product stalls and Other stalls, Hotels, Schools, and Roads and parks. Sample wastes of the same category collected on the same day are aggregated and used as a sample for the waste composition survey.

Analyses of physical composition and apparent specific gravity are conducted for all the samples. Each sample is separated into 10 components for physical composition analysis, that are Kitchen wastes, Paper, Textile, Plastics, Grass and wood, Rubber and leather, Metal, Bottles and glass, Ceramics and stone, and Others.

Three component analysis is conducted for some of those satisfying following both conditions.

- Separated as Kitchen wastes, Paper, Textile, Plastics, or Grass and wood in the physical composition analysis
- Categorized as Apartment without dust chute, Restaurants, Vegetable stalls or Fruit stalls

Chemical analysis is conducted for some of those satisfying following conditions.

- Separated as Kitchen wastes in the physical composition analysis
- Categorized as Apartment without dust chute, Ger with collection service, Restaurants, Vegetable stalls or Fruit stalls

The number of sample wastes originally collected for the WACS and that of samples prepared for each analysis of the waste composition survey are summarized in Table 2-8.

Table 2-8: Number of samples for Waste Composition Survey

Category			No of original sample wastes	No. of samples / targets prepared for analysis			
				Apparent specific gravity analysis	Physical composition analysis	Three component analysis	Chemical analysis
Households	Ger with collection service		105	7	7	-	1
	Ger without collection service		105	7	7	-	-
	Summer house	winter season	35	7	7	-	-
		summer season	105	7	7	-	-
	Apartment with dust chute		140	7	7	-	-
	Apartment without dust chute		140	7	7	12	3
Restaurants			35	7	7	12	3
Shops			35	7	7	-	-
Offices			35	7	7	-	-
Markets	Meat stalls		28	7	7		
	Vegetable stalls		28	7	7	4	3
	Fruit stalls		28	7	7	9	2
	Dairy product stalls		28	7	7		
	Other stalls		28	7	7		
Hotels			35	7	7	-	-
Schools			35	7	7	-	-
Roads and parks			14	7	7	-	-
Total		winter season	854	112	112	37	12
		summer seaon	924	112	112	37	12

(Note) Three component analysis: Analysis of Water content, Combustible matter and Ash
Chemical analysis: Analysis of Carbon and Nitrogen

b.2 Survey method

b.2.1. Preparation of samples

Sample wastes collected for the waste amount survey are further utilized in the waste composition survey. They are prepared as follows.

Step 1: Sample wastes of the same category collected on the same day are put together and regarded as a source of a sample. Large particles like cardboard and textiles are cut smaller.

Step 2: It is stirred thoroughly and divided into four. Its volume is halved by keeping two of them. This step is repeated until it becomes about 40 liters.

Step 3: It is dropped 3 times from a height of 30 centimeters in a plastic bucket to make its volume proper.

b.2.2. Apparent Specific gravity analysis

Weight and volume of all the waste samples are measured, and apparent specific gravity is calculated as follows.

Apparent specific gravity = Weight / Volume

b.2.3. Physical Composition analysis

Each sample is separated into 10 components shown below. Weight of the components was measured individually before the wastes become dry and lighter.

Combustible waste
- Kitchen wastes
- Paper
- Textile
- Plastics
- Grass and wood
- Rubber and leather

Incombustible waste
- Metal
- Bottles and glass
- Ceramics and stone
- Others

b.2.4. Three component analysis

Targets of the analysis are selected from the components separated as Kitchen wastes, Paper, Grass and wood, Textile or Plastics of the samples categorized as Apartment without dust chute, Restaurants, Vegetable stalls or Fruit stalls. Weight of the targets is measured before any treatment (Original weight). It is measured again after keeping the targets for two hours in a dryer at 104 degrees Celsius (Dry weight). Ash is left by burning those dried targets for five hours in a furnace at 500 degrees Celsius. Proportions of Water content, Combustible matter and Ash are calculated as follows.

Water content (%) = ((Original weight − Dry weight) / Original weight) × 100
Ash (%) = (Weight of Ash / Original weight) × 100
Combustible matter (%) = 100 − Water content (%) − Ash (%)

b.2.5. Chemical analysis

Targets of the analysis are selected from the components separated as Kitchen wastes of the samples categorized as Apartment without dust chute, Ger area with collection, Restaurants, Vegetable stalls, or Fruit stalls. The Kjeldahl Method (1965) is adopted for chemical analysis of nitrogen content and the Pregeli F., Gelman N. E., and black method is adopted for chemical analysis of carbon content.

c. Results

c.1 Apparent specific gravity analysis

Table 2-9 shows the results of the apparent specific gravity.

Table 2-9: Apparent Specific Gravity

Unit: kg/liter

Category		winter season	summer season	Average
Households	Ger with collection service	0.11	0.13	0.12
	Ger without collection service	0.09	0.10	0.10
	Summer house	0.11	0.12	0.12
	Apartment with dust chute	0.10	0.11	0.11
	Apartment without dust chute	0.11	0.13	0.12
Commercial	Restaurants	0.21	0.28	0.25
	Shops	0.05	0.04	0.05
Offices		0.07	0.06	0.07
Markets	Meat stalls	0.21	0.19	0.20
	Vegetable stalls	0.18	0.25	0.22
	Fruit stalls	0.07	0.17	0.12
	Dairy product stalls	0.04	0.06	0.05
	Other stalls	0.02	0.05	0.04
Hotels		0.06	0.06	0.06
Schools		0.05	0.06	0.06
Roads and parks		0.07	0.37	0.22

c.2 Physical Composition analysis

Proportion of each component is calculated in Table 2-10 and Table 2-12 below. For the samples of Ger with collection service, Ger without collection service and Summer house, proportions are calculated as shown as “excluding ash” regarding the samples as whole wastes. If ash had not been excluded from those sample, proportions would have been calculated as shown as “including ash.” Proportions of ash in the wastes of those categories are referred to what were calculated in the waste amount survey.

Table 2-10: Physical composition analysis (1/3)

Category			Households											
Component			Ger with collection service			Ger without collection service			Summer house			All the samples of households located in unplanned area		
			Winter season		Summer season	Winter season		Summer season	Winter season		Summer season	Winter season		Summer season
			excluding ash	including ash	----	excluding ash	including ash	----	excluding ash	including ash	----	excluding ash	including ash	----
Combustible Wastes	Kitchen wastes	(%)	25.0	4.0	33.6	25.3	4.9	38.4	36.4	4.8	30.3	28.8	4.6	34.2
	Paper	(%)	22.5	3.6	10.4	10.2	2.0	10.0	8.4	1.1	13.9	13.7	2.2	11.4
	Textile	(%)	2.1	0.3	15.7	6.4	1.3	6.0	9.4	1.2	6.2	6.0	0.9	9.3
	Plastics	(%)	10.8	1.7	18.8	15.3	3.0	18.1	13.3	1.8	16.3	13.1	2.2	17.8
	Grass and wood	(%)	0.0	0.0	2.7	4.0	0.8	5.5	0.1	0.0	3.9	1.4	0.3	4.0
	Rubber and leather	(%)	0.7	0.1	3.6	0.0	0.0	3.1	0.1	0.0	0.8	0.3	0.0	2.5
	Sub-total	(%)	61.1	9.7	84.8	61.2	12.0	81.1	67.7	8.9	71.4	63.3	10.2	79.2
Incombustible Wastes	Metal	(%)	5.1	0.8	1.5	3.3	0.6	3.3	1.4	0.2	6.4	3.3	0.5	3.7
	Bottles and glass	(%)	15.0	2.4	5.8	28.4	5.5	13.8	9.0	1.2	12.9	17.4	3.0	10.8
	Ceramics and stone	(%)	6.8	1.1	5.8	3.6	0.7	0.8	5.7	0.8	7.2	5.4	0.9	4.6
	Others	(%)	12.0	1.9	2.1	3.5	0.7	1.0	16.2	2.1	2.1	10.6	1.6	1.7
	Ash	(%)	---	84.1	---	---	80.5	---	---	86.8	---	---	83.8	---
	Sub-total	(%)	38.9	90.3	15.2	38.8	88.0	18.9	32.3	91.1	28.6	36.7	89.8	20.8
Total		(%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note : Proportion of Ash is referred to those calculated in the waste amount survey.

Table 2-11: Physical composition analysis (2/3)

Category			household						Those other than Households					
Component			Apartment with dust chute		Apartment without dust chute		All the samples of households located in planned area		Restaurants		Shops		Offices	
			Winter season	Summer season	Winter season	Summer season	Winter season	Summer season	Winter season	Summer season	Winter season	Summer season	Winter season	Summer season
Combustible Wastes	Kitchen wastes	(%)	27.3	40.6	43.9	37.6	35.5	39.0	42.5	55.2	3.8	5.4	10.6	6.3.
	Paper	(%)	6.9	21.6	15.4	21.6	11.1	21.6	8.7	9.4	31.3	41.7	23.6	25.8
	Textile	(%)	3.4	6.1	6.3	3.9	4.9	5.0	0.5	1.4	10.4	1.8	4.7	2.5
	Plastics	(%)	36.1	15.1	11.7	16.1	23.8	15.6	9.5	10.7	18.9	22.7	20.1	10.5
	Grass and wood	(%)	1.1	1.0	1.6	0.6	1.4	0.8	0.2	0.5	0.6	2.8	0.1	35.4
	Rubber and leather	(%)	1.5	0.0	0.3	0.9	0.9	0.5	0.0	0.0	0.0	1.2	0.0	0.0
	Sub-total	(%)	76.3	84.4	79.2	80.7	77.6	82.5	61.4	77.2	65.0	75.6	59.1	80.5
Incombustible Wastes	Metal	(%)	4.1	1.5	3.6	2.0	3.9	1.8	5.7	6.0	7.9	2.6	4.7	0.2
	Bottles and glass	(%)	13.0	6.2	5.1	13.2	9.1	9.7	30.0	16.1	14.0	11.1	28.0	4.6
	Ceramics and stone	(%)	1.2	7.9	9.1	3.7	5.2	5.8	0.1	0.7	0.0	2.5	0.0	14.2
	Others	(%)	5.4	0.0	3.0	0.4	4.2	0.2	2.8	0.0	13.1	8.2	8.2	0.5
	Ash	(%)	---	---	---	---	---	---	---	---	---	---	---	---
	Sub-total	(%)	23.7	15.6	20.8	19.3	22.4	17.5	38.6	22.8	35.0	24.2	40.9	19.5
Total		(%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 2-12: Physical composition analysis (3/3)

Category			Those other than Households															
Component			Markets										Hotels		Schools		Roads and parks	
			Meat stalls		Vegetable stalls		Fruit stalls		Dairy product stalls		Other stalls							
			Winter season	Summer season	Winter season	Summer season	Winter season	Summer season	Winter season	Summer season	Winter season	Summer season	Winter season	Summer season	Winter season	Summer season	Winter season	Summer season
Combustible Wastes	Kitchen wastes	(%)	35.7	17.4	77.2	85.3	73.1	41.2	37.1	23.4	23.2	20.3	4.7	9.3	6.1	2.7	14.2	16.6
	Paper	(%)	0.7	15.1	7.0	8.5	12.4	45.6	16.0	21.9	19.9	34.6	29.4	24.2	25.1	28.1	36.8	17.9
	Textile	(%)	1.5	1.7	0.0	0.1	0.0	1.6	0.0	4.1	0.5	0.6	1.2	2.7	1.6	8.1	4.1	0.0
	Plastics	(%)	3.1	12.1	0.6	4.2	13.3	10.8	38.6	38.4	46.5	28.1	30.6	26.4	13.6	18.4	21.3	21.2
	Grass and wood	(%)	0.4	0.2	0.0	0.0	0.0	0.1	0.0	0.7	0.4	6.1	0.1	1.4	4.0	15.5	1.3	1.6
	Rubber and leather	(%)	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.1	0.0	3.6	0.0	0.8	0.1	0.7
	Sub-total	(%)	41.4	46.5	84.8	98.1	98.8	99.5	91.7	88.5	90.5	89.8	66.0	67.6	50.4	73.6	77.8	58.0
Incombustible Wastes	Metal	(%)	0.0	0.1	0.0	0.1	0.1	0.0	0.0	3.3	0.4	0.1	2.5	6.1	1.8	11.8	1.8	11.5
	Bottles and glass	(%)	0.0	0.0	0.0	0.0	0.0	0.5	0.0	6.3	1.1	1.2	15.0	25.0	30.4	11.6	13.1	2.0
	Ceramics and stone	(%)	42.0	53.4	0.0	1.8	0.0	0.0	6.6	1.9	1.4	8.9	0.5	0.2	0.0	0.4	0.7	28.5
	Others	(%)	16.6	0.0	15.2	0.0	1.1	0.0	1.7	0.0	6.6	0.0	16.0	1.1	17.4	2.6	6.6	0.0
	Sub-total	(%)	58.6	33.5	15.2	1.9	1.2	0.5	8.3	11.5	9.5	10.2	34.0	32.4	49.6	26.4	22.2	42.0
Total		(%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

c.3 Three component analysis

Proportions of Water content, Combustible matter and Ash for selected targets are shown in Table 2-13 below.

Table 2-13: Three Component Analysis

Unit :wet %

Component	Category	Winter season				Summer season			
		Water content	Combustible matter	Ash	Total	Water content	Combustible matter	Ash	Total
Kitchen wastes	Apartment without dust chute	58.4	21.3	20.3	100.0	74.6	22.1	3.3	100.0
	Fruit stalls	54.5	33.3	12.2	100.0	86.1	11.0	2.9	100.0
	Vegetable stalls	52.1	19.7	28.2	100.0	72.6	13.0	14.4	100.0
	Restaurants	43.8	40.8	15.4	100.0	---	---	---	---
Paper	Apartment without dust chute	26.8	60.0	13.2	100.0	19.6	66.3	14.1	100.0
	Fruit stalls	33.4	58.1	8.5	100.0	56.9	36.5	6.6	100.0
	Restaurants	37.1	52.3	10.6	100.0	---	---	---	---
	Vegetable stalls	---	---	---	---	24.5	49.6	25.9	100.0
Grass and wood	Apartment without dust chute	24.2	56.4	19.4	100.0	---	---	---	---
	Fruit stalls	---	---	---	---	50.9	42.7	6.4	100.0
Textile	Apartment without dust chute	14.0	47.4	38.6	100.0	---	---	---	---
	Vegetable stalls	---	---	---	---	12.1	78.8	9.1	100.0
Plastics	Apartment without dust chute	11.9	75.9	12.2	100.0	41.4	49.4	9.2	100.0
	Vegetable stalls	2.5	69.1	28.4	100.0	10.0	63.8	26.2	100.0
Rubber and leather	Fruit stalls	---	---	---	---	3.8	52.4	43.8	100.0

c.4 Chemical analysis

Carbon and Nitrogen content of dry solid for selected targets are shown in Table 2-14 below.

Table 2-14: Chemical Analysis of Kitchen Waste and Grass and Wood

Classification		Winter season			Summer season		
		Carbon dry %	Nitrogen dry %	C/N (-)	Carbon dry %	Nitrogen dry %	C/N (-)
Kitchen Wastes	Apartment without dust chute	42.6	3.0	14	67.5	4.8	14
	Ger area with collection service	67.6	0.5	135	43.0	0.24	179
	Fruit stalls	54.9	0.2	366	---	---	---
	Vegetable stalls	31.9	3.2	10	40.4	0.42	96
					32.5	0.1	325
	Restaurants	39.5	3.0	13	---	---	---
Grass and Wood	Apartment without dust chute	---	---	---	39.0	0.57	68
	Ger area with collection service	---	---	---	40.8	0.13	313

c.5 Comparison of results with survey in other cities

SWM studies of JICA, including this, give the data summarized in Table 2-15 below and Table 2-16. As observed in other cities, Kitchen wastes are the most dominant component of the household wastes. However, the proportion of that in Ulaanbaatar is lower than that in other cities.

Table 2-15: Comparison of Physical Composition of Household Waste

Country / Physical Composition	Unit	Mongol Ulaanbaatar*1		Turkey	Cambodia	Poland		Paraguay	Philippines	Tanzania	Honduras
		Winter	Summer	Adana	Phnom Penh	Lublin		Asuncion	Manila	Dar es Salaam	Tegucigalpa
						With ash	Without ash				
Kitchen waste	%	32.7(4.9)	35.7(30.4)	75.53	63.6	45.25	65.26	36.60	45.82	42.00	47.20
Paper	%	12.7(2.4)	21.7(13.9)	9.88	4.6	13.67	11.11	6.40	15.39	3.10	11.50
Textile	%	4.6(1.0)	4.1(6.2)	1.77	2.5	2.10	3.77	1.30	4.33	1.20	2.80
Plastic	%	22.4(2.2)	14.5(16.3)	5.87	18.0	4.40	3.80	3.90	15.60	2.20	7.10
Grass & Wood	%	1.1(0.2)	5.3(3.9)	1.62	6.0	1.61	2.30	22.20	7.45	25.30	11.60
Leather & Rubber	%	0.7(0.1)	0.4(0.8)	0.29	0.1	2.67	1.83	0.70	0.80	0.90	2.20
Combustible Total		**74.2(10.8)**	**81.7(71.5)**	**94.96**	**94.8**	**69.7**	**88.07**	**71.1**	**89.39**	**74.7**	**82.4**
Metal	%	4.0(0.6)	1.8(6.4)	0.53	0.7	3.31	3.05	1.30	5.47	2.00	1.90
Bottle & Glass	%	12.4(3.0)	9.5(12.9)	3.33	0.6	5.23	6.51	3.10	2.69	3.50	3.50
Ceramic & Stone	%	4.4(0.9)	6.5(7.1)	1.14	1.6	21.74	2.38	2.50	1.26	0.40	12.10
Miscellaneous	%	5.0(1.8)	0.5(2.1)	0.04	2.3	-	-	22.00	1.19	19.40	0.10
Ash		0(82.9)	0(0)	-	-	-	-	-	-	-	-
Incombustible Total		**25.8(89.2)**	**18.3(28.5)**	**5.04**	**5.2**	**30.3**	**11.93**	**28.9**	**10.61**	**25.3**	**17.6**
Total	%	100.00	100.0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ASG	kg/l	0.11(0.27)	0.12(0.12)	0.19	0.25	0.18	0.215	0.22	0.19	0.39	0.20

Note *1: Figure is the Planned area (Unplanned area). Planned area includes business waste.
Sources: The same as Table 2-7: Comparison of Waste Generation Rate

Table 2-16: Comparison of MSW Composition

Country / Physical Composition	Unit	Mongol Ulaanbaatar*1		Turkey	Cambodia	Poland		Paraguay	Philippines	Tanzania	Japan
		Winter	Summer	Adana	Phnom Penh	Poznan	Lublin	Asuncion	Manila	Dar es Salaam	Tokyo 1994
Kitchen waste	%	12.6	33.8	64.41	63.3	33.96	61.11	37.40	45.35	45.03	25.11
Paper	%	5.2	18.9	14.80	6.4	19.34	14.18	10.20	16.80	4.07	35.64
Textile	%	2.0	4.8	1.62	2.5	7.27	3.10	1.20	3.88	1.10	3.44
Plastic	%	7.8	15.2	5.92	15.5	7.89	4.41	4.20	15.62	2.01	15.16
Grass & Wood	%	0.5	4.8	2.66	6.8	5.90	2.33	19.20	6.71	25.11	4.42
Leather & Rubber	%	0.2	0.6	0.30	0.1	2.26	2.09	0.60	0.74	0.71	1.38
Combustible Total		**28.3**	**78.1**	**89.71**	**94.6**	**76.62**	**88.06**	**72.80**	**89.10**	**78.03**	**85.15**
Metal	%	1.5	3.5	1.40	0.6	3.76	3.29	1.30	5.21	1.65	6.43
Bottle & Glass	%	5.4	10.5	3.08	1.2	15.16	6.69	3.50	3.37	2.90	5.46
Ceramic & Stone	%	1.9	6.8	2.17	1.5	1.53	2.81	2.50	1.12	0.33	0.40
Miscellaneous	%	2.7	1.1	3.64	2.1	2.93	-	19.90	1.20	17.09	2.56
Ash		60.2	-	-	-	-	-	-	-	-	-
Incombustible Total		**71.7**	**21.9**	**10.29**	**5.4**	**23.38**	**11.94**	**27.20**	**10.90**	**21.97**	**14.85**
Total	%	100.00	100.0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sources: The same as Table 2-7: Comparison of Waste Generation Rate.

d. Findings

The present compositions of household and MSW (municipal solid waste) in the study area and those obtained from other JICA SWM studies are as shown in the following tables. A prominent feature of the waste composition in the study area is:

- Regarding household waste, the same as waste generation there are quite big difference in waste composition of apartment area and Ger area, and winter and summer.
- The Study, therefore, examines the waste amount and composition dividing into those of planned (apartment + business) area and unplanned (Ger) area, and winter and summer. Since most of business generation sources locate in the planned area, wastes generated from business activities are categorized into planned area.
- Regarding household waste in planned area, there is not so big difference in waste composition of winter and summer. Contrary to the planned area, there is very big difference in it in unplanned area of winter and summer due to the large amount of ash from heating facilities.
- Household waste in planned area contains a large portion of recyclable waste, i.e. papers, textiles, plastics, metals and bottles/glass. Especially portion of papers and plastics (high calorific wastes) is quite high of 35.1 % in winter and 36.2 % in summer that exceeds it of kitchen waste, 32.7 % and 35.7 % respectively. This characteristic of waste composition also applies to the waste in unplanned area in summer although it is quite different in winter.
- Regarding MSW there are quite big difference in waste composition of winter and summer. Because portion of ash overwhelms in winter; 60.2 % of MSW while it in summer is nil.

2.2 Time and Motion Survey

2.2.1 Objectives of the Survey

Since the cost of collection and haulage work generally occupies the largest portion of the total SWM costs in developing countries, improvements in collection and haulage system efficiency is the most effective means to reduce the total SWM cost and to improve the whole SWM system.

Solid waste collection is extremely labor intensive. At the same time, the cost of collection vehicles is high compared to labor cost. Therefore, the time and motion survey aims at the following three items.

- Maximum use of the vehicle capacity
- Maximum use of legal working hours
- Improvement of working conditions for collection workers

The survey included the following items.

- Bearing of time, distance and weight on collection and haulage.
- Type of dustbin and container used
- Work efficiency of waste collectors
- Collection routes
- Level of user cooperation in waste collection activities
- Service level
- Maintenance and condition of equipment

2.2.2 Method of the Survey

The Time and Motion Survey was conducted twice; January 17 to 28, 2005 in winter and August 24 to September 3, 2005 in summer.

a. Survey in Winter

Majority of the waste collection services in the study area are being provided by renovation companies. The collection trucks operated by two renovation companies, Bayanzurkh TUK and Chingeltei TUK were selected for the time and motion survey for winter season.

The survey was conducted for ten days as shown in Table 2-17:.

Table 2-17: Actual Schedule of Time and Motion Survey for Winter

Date	Day	District	Type of Collection Truck	Type of Area	Khoroo
Jan. 17	Mon	Bayanzurkh	M 53, Russian made compacter truck	Planned area	7
18	Tue	Bayanzurkh	KO-440, Russian made container truck	Planned area	15
19	Wed	Bayanzurkh	Compactor truck, Isuzu, Japan	Planned area	1 & 4
20	Thu	Bayanzurkh	MN-4506, Russian made truck	Gel	6
21	Fri	Bayanzurkh	ZIL-555, Russian made truck	Gel	10
22	Sat				
23	Sun				
24	Mon	Chingeltei	SA-3206, China made compactor truck		1, 2, 3
25	Tue	Chingeltei	Isuzu, Compactor	Planned area	1, 2, 3
26	Wed	Chingeltei	ZIL-43362, Russian made truck	Gel	14
27	Thu	Chingeltei	ZIL-554, Russian made truck	Gel	18
28	Fri	Chingeltei	ZIL-130, Russian made truck	Gel	12


17 Jan, M53


18 Jan, KO-440


19 Jan, Isuzu Compactor


20 Jan, ZIL-43362


21 Jan, ZIL-4503


24 Jan, SA-3206


25 Jan, Isuzu Compactor


26 Jan, ZIL-43362


27 Jan, ZIL-554


28 Jan, ZIL-130

e. Survey in Summer

Time and motion survey for summer season was carried out for twelve days as shown below.

Table 2-18: Actual Schedule of Time and Motion Survey for summer (August and September in 2005)

Date	Day	District	Type of Collection Truck	Type of Collection Area
24	Wed	Chingeltei	Zil 555, Russia	Ger
25	Thu	Chingeltei	Zil 130, Russia	Ger
26	Fri	Chingeltei	Zil 130, Russia	Ger
27	Sat	Chingeltei	Zil 130, Russia	Summer houses
28	Sun			
29	Mon	Chingeltei	Zil 130, Russia	Ger
30	Tue	Chingeltei	Zil 130, Russia	Ger
31	Wed	Sukhbaatar	Zil 130, Russia	Apartment
1	Thu	Sukhbaatar	Oct-77	Apartment
2	Fri	Sukhbaatar	GAZ, Russia	Summer houses
3	Sat	Sukhbaatar	Zil 130, Russia	Apartment
4	Sun	Sukhbaatar	Zil 130, Russia	Apartment
5	Mon	Sukhbaatar	Isuzu ELF250	Apartment

The following times were recorded and the time consumed in each cycle was calculated.

- Departure time from the vehicle garage
- Arrival and departure times from each point on the collection route
- Arrival and departure times from disposal site
- Arrival time at the vehicle garage

The following distances in kilometers were recorded using the odometer of a collection truck.

- Initial indicator in kilometers at the time of departure from the vehicle depot
- Distance in kilometers at the time of arrival at each station
- Distance in kilometers at the time of arrival at the disposal site
- Distance in kilometers at the time of arrival at the vehicle depot

The following information was marked on the map.

- Collection route
- Collection points

2.2.3 Findings of the Survey in Winter

a. Efficiencies of Activities

Table 2-19 summarizes the time of the each activity measured in T&M survey.

Table 2-19: Summary of Time and Motion Records

Items		unit	17-Jan	18-Jan	19-Jan	20-Jan	21-Jan	24-Jan	25-Jan	26-Jan	27-Jan	28-Jan
Number of Trips	Tr	trips	2.0	2.0	2.5	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Travel Distance	D	km	81.8	56.8	81.6	75.7	40.8	58.6	71.5	68.8	74.3	59.3
Preparation	t1	m	0	15	0	22	47	59	5	19	51	56
Collection	t2	m	199	402	222	384	246	309	220	312	369	336
Travel	t3	m	269	144	219	203	114	232	216	203	266	151
Service/Repair	t4	m	112	5	0	0	0	0	0	0	0	0
Discharge	t5	m	21	11	9	16	12	16	11	35	17	10
Record	t6	m	8	0	4	5	0	6	16	3	5	4
Fuel	t7	m	15	6	5	4	2	5	0	10	13	1
Recycle	t8	m	0	0	6	0	0	0	0	11	2	5
Lunch	t9	m	0	0	22	21	26	22	21	0	24	0
Idling/Others	t10	m	0	0	17	9	9	17	56	27	91	6
Total working hours	t11	m	624	583	504	664	456	666	545	620	838	569
Actual working hours	t12	m	624	583	482	643	430	644	524	620	814	569
Efficiency			0.821	0.966	0.952	0.952	0.870	0.882	0.884	0.908	0.823	0.882
Vehicle Velocity	V	km/h	18.2	23.7	22.4	22.4	21.5	15.2	19.9	20.3	16.8	23.6

Actual working hours excludes lunch time.
Efficiency=(t1+t2+t3+t5+t6)/t12

Table 2-20 shows the activities' times of unplanned area and planned area.

Table 2-20: Analysis of Time and Motion Records

items	Code	Unplanned (minutes)	Planned (minutes)	Unplanned	Planned
Preparation	t1	39.0	15.8	6.2%	2.7%
Collection	t2	329.4	270.4	52.3%	46.3%
Travel	t3	187.4	216.0	29.8%	37.0%
Service/Repair	t4	0.0	23.4	0.0%	4.0%
Discharge	t5	18.0	13.6	2.9%	2.3%
Record	t6	3.4	6.8	0.5%	1.2%
Fuel	t7	6.0	6.2	1.0%	1.1%
Recycle	t8	3.6	1.2	0.6%	0.2%
Lunch	t9	14.2	13.0	2.3%	2.2%
Idling/Others	t10	28.4	18.0	4.5%	3.1%
Total working hours	t11	629.4	584.4		

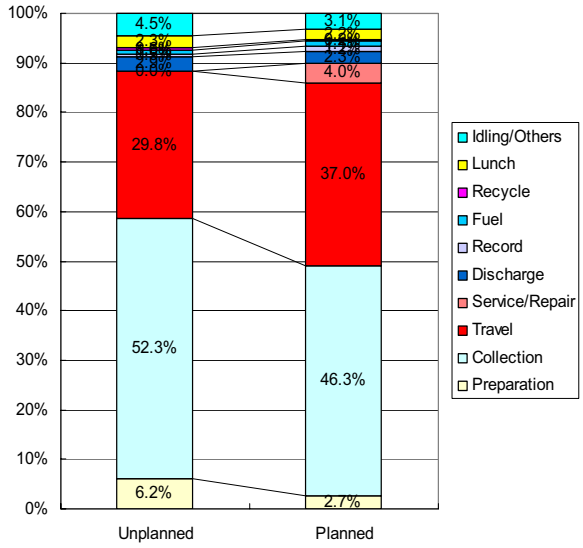


Figure 2-1: Comparison of Ratios of Times, Planned vs. Unplanned Areas

b. Institutional System related to the Waste Collection System

The main objectives of the T&M survey is to well observe the current waste discharge, collection and haulage operations and to analyze the technical and public participation factors which currently affect the present activities so that the findings will be taken into account for the improvement plan. However, we have found that the current institutional system affect the current waste collection efficiency greater than the technical system and public participation. Therefore, the institutional system which seriously affects the waste collection operation at present is briefly described.

1) Six TUK in Ulaanbaatar which deal with most of waste collection services in the study area are private companies which were privatized in April 2004. Because TUK obtain the all revenue from waste collection fee through neither MUB nor district offices, TUK are concessionaire but not contractors for the waste collection work. Therefore, TUK has extensive freedom in their management.

2) TUK well utilize their right of freedom in the management. One of management measures which seriously affect the waste collection operation is the rental contract for drivers and waste collectors. At present, in any TUK the salary system for drivers and collection workers is not based on the basic working hours and overtime hours. Their incomes are the remainder after deducting the petrol expense, spare parts expense, etc. from the certain percentage of the total revenue from customers' payment for fee. This is actually same as the contracting out. Therefore, both of them are not interested in the improvement of the waste collection work efficiency because the cost for TUK has been fixed and the working hours are not related to their income at all. The way to increase the income under this system is only to minimize the petrol consumption amount and number of workers involved. Therefore, what are actually done are 1) minimization of collection and haulage distance even though taking a long time, and 2) reduction of collection workers. This employment system greatly hinders the improvement of the collection work efficiency.

3) In unplanned area, the waste collection work is greatly influenced by the fee collection efficiency because waste is collected in return for fee payment. The present fee collection system has limited the options of waste collection system.

c. General

1) There are no fixed waste collection days and the actual waste collection is irregular. Waste dischargers such as residents and business entities don't know the waste collection days.

2) There are no fixed collection routes and it depends on the drivers.

3) Each waste collection crew decides their working hours by themselves.

4) There are no uniform for both drivers and collection workers.

5) Gasoline is cheaper than diesel. As of January 2005, gasoline is 580Tg/l while diesel is 760Tg/l.

6) Most of all waste collection trucks are made in Russia and use gasoline.

7) Both Chingeltei and Bayanzurkh TUK control the supply amount of petrol to the waste collection trucks very strictly. The petrol amount supplied by Chingeltei TUK seems too little for trucks to haul waste along the official haulage route, and it caused them to take short cut routes.

8) Each TUK verifies all their trucks' entrance records to the Ulaan Chuluut disposal site with the entrance certificates issued at each entry to the disposal site by Nuuts in order to ensure all trucks to carry waste to the disposal site. However, it was found that some of trucks got the all entrance certificates at one time instead of every entry. Therefore, the present control system somehow has been deteriorated.

9) Some of trucks have to be pushed by many people to start their engines in the morning due to having no properly functioning batteries. These trucks have to keep the engines operational until their arrival to the garage and it is very costly. This battery problem is caused by very cold climate.

10) Ordinary departure times of trucks are between 8:30 am and 10 am and the arrival times are between 6 pm and 11 pm. In addition, there are some trucks do the night collection.

11) According to the staff at the control house in the Ulaan Chuluut disposal site, generally the last truck come to the disposal site around 4 am and the first truck comes around 6 am.

12) During the ten days T&M survey for different crews, there were four crews did not take lunch. In most cases they didn't have enough money to take lunch and some crew bought biscuits instead of lunch by the income from sale of recyclables during the operation.

d. Maintenance condition

1) Each TUK have a wide and nice garage with heating system. Heating system is essential for the smooth operation of trucks during hard winter although its heating cost is very costly.

2) There are few repairing tools and equipment in the garages.

3) Drivers generally repair their trucks and it is the conventional system in Mongolia. They are familiar with repairing Russian made trucks but they are not familiar with others.

4) The existing maintenance system is insufficient to maintain compactor trucks and trucks using diesel.

5) Most of all trucks are decrepit. Trucks often leak oil and then they generally refill it with used oil which drivers get from petrol stations in free of charge.

6) In the morning most drivers and waste collection workers wipe truck bodies.

e. Planned area

The present discharge, storage, collection systems are summarized as follows.

e.1 Apartment with dust chute

System
People open the dust chute lid installed at every floor and drop their waste in it. Waste drops through the dust chute to a waste chamber at the ground floor. A waste collection crew opens a door of the waste chamber and scrapes waste from the chamber for loading waste to a truck.

Advantages
1) This system is very convenient for both dischargers and collectors due to the following reasons.

- People can easily discharge their waste anytime.
- Collectors can do the waste collection work any time they like, even midnight, due to no required public cooperation. In addition, they can ignore the collection frequency for a quite many days. The collection cost at the low collection frequency is cheap because a large amount of waste can be loaded at one collection point.

2) There is no scattered waste because they are kept within a waste chamber until being collected.

Disadvantages
1) Waste often clogs dust chutes.

2) Waste in waste chamber often burn and smoke come out to all floor through a dust chute and opening.

3) Offensive odor and many flies generated from waste in waste chamber and come into the inside of the apartment. Very unsanitary impact.

4) Loading work is very labor intensive because public cooperation for this activity is not applicable.

5) It decreases people's consciousness on the waste issue because the system is too convenient for them.

Evaluation
The dust chute system should be prohibited although it is very convenient for everybody because of the many associated problems and their serious negative impacts.

e.2 Apartment with waste storage room

System
People discharge their waste in a waste storage room which often installed under the stair at the ground floor inside the entrance. Waste collectors scrape waste from storage and load them onto a truck. This system is often used for old apartments.

Advantages
1) Although people have to bring their waste to the ground floor, it is still very convenient for them because they can discharge their waste in a storage room any time.

2) There is no scattered waste because they are kept within a waste chamber until being collected.

Disadvantages

1) It is very unsanitary because large amount of waste is kept in a storage room.

2) Loading waste onto a truck is very labor intensive and inefficient because:

- Most waste is discharged in a storage room without packing.
- No pubic cooperation for loading work.
- It decreases people's consciousness on the waste issue because the system is too convenient for them.

Evaluation

The waste storage room system should be improved by the application of the proper waste discharge rule such as compulsory use of plastic bags for waste.

e.3 Apartment with a waste storage house outside of the building

System

People discharge their waste at a storage facility installed at the part of land of apartments. Waste collectors collect and load waste from a storage facility onto a truck.

Advantages

- Although people have to bring their waste to the yard, it is still very convenient for them because they can discharge their waste there anytime without packing.
- The condition is sanitary because the waste storage keeps a certain distance from apartments.
- There is no scattered waste because it is kept within a waste chamber until being collected.

Disadvantages

1) In most cases, the structure of storage houses is not convenient for loading waste to a truck, because the design ignores the loading work.

Evaluation

This system can be one of appropriate options.

e.4 Apartment using a part of land for waste storage

System

People discharge their waste at the part of land of apartments which is specified as waste storage yard. Waste collectors collect and load waste onto a truck.

Advantages

a) Although people have to bring their waste to the yard, it is still very convenient for them because they can discharge their waste there anytime without packing.

Disadvantages

1) Very ugly and unsanitary due to terrible scattered waste.

2) Dogs and birds scavenge food and scattered waste.

3) Waste pickers scatter waste through collecting recyclable materials from waste.

Evaluation

This system should be prohibited due to very unsanitary and ugly condition.

e.5 Apartment using a bell collection system

People discharge their waste in corridors and guards or cleaners employed by owners' union carry them to certain points within the apartment. A waste truck makes horn to inform of their arrival when it comes to the apartment for waste collection. Then guards, cleaners and also residents carry waste from the apartment to the truck for loading waste.

Advantages

1) There is no scattered waste because waste is taken care by cleaners or guards within apartment until being collected.

2) Easy for loading waste onto a truck because cleaners, guards and residents carry waste to a truck.

Disadvantages

1) Public cooperation is necessary.

Evaluation

This system is the most appropriate system among the current systems.

e.6 Communal container system

There are 150 communal containers with $1m^3$ volume capacity used for apartments and business waste in Chingeltei duureg. Chingeltei TUK uses two compactor trucks with 20 m^3 volume capacity with lifting device to collect waste from these communal containers. This equipment was donated in 2003.

Advantages

1) Anybody can discharge waste into communal containers anytime.

2) Easy for loading waste from communal containers because the compactor truck have lifting device.

3) This system is suitable for business which can be taken care by the business entity.

Disadvantages

1) There are lots of scattered wastes around communal containers. There are two causes for scattered waste.

- Nobody take care communal containers because no ownership feeling to anybody.
- Waste pickers scatter waste when they scavenge recyclables from waste in containers.

2) During winter waste are often frozen in containers and stick to container. Waste collectors have to remove frozen waste adhered to containers by iron bars to load waste onto a compactor truck. It is very hard work and time consuming.

3) Homeless people often burn waste in containers to warm themselves. There are many containers which have been burned.

4) After only two years use of 150 containers, most of all have been defected especially cover plates and wheels.

5) The compactor truck is too large for UB City in terms of accessibility and however to lift a 1m3 container requires such heavy equipment.

Evaluation

This system is inappropriate system for residential waste; however it is appropriate for some of non-residential waste.

Unplanned Area

1) Waste collection frequency is generally once a month. This is because they collect money once a month and they collect waste in return for waste collection fee payment.

2) Most of waste contents in unplanned areas are ash. People discharge waste in a drum or poly sacks which packed coals when they buy coal. It is very hard to load ash waste in a drum onto a truck because it is too heavy.

3) Dischargers are responsible for carrying their waste to a truck and load it onto a truck. A waste collection worker is generally responsible for receiving waste on a truck carrier. Public cooperation level is very high.

4) The side open truck is easier to load waste on a carrier than the rear open truck.

5) All trucks cover waste on the carrier with sheet to prevent waste from scattering during haulage of waste from the collection area to the disposal site.

f. Collection work data

1) The average number of trips per day during the ten days T&M survey was 2. Considering the trucks generally made two trips in Bayanzurkh duureg which is the farthest from the Ulaan Chuluut disposal site, it is presumed that the average number of trips per day in the whole study area is more than two.

2) The total working hours per day in the unplanned area is longer than that in planned area by 35 minutes. T&M survey suggested that it is caused by complex factors and it is too difficult to identify a main cause.

3) The total collection time in planned area is shorter than that in unplanned area by about 60 minutes. It is considered mainly due to the effect to the loading waste by the use of compactor trucks for planned area while dump trucks are used for unplanned area. As the other possible factor, it can be pointed out that the waste collection fee being done together with the waste collection work.

4) The time spend for informal recycling activity by workers is negligible, only less than 1% of the total working hours. It implies that the recycling by workers is not active and little influence to the waste collection work.

5) During ten days survey, only six crews took lunch and the lunch time they spent for was very short, only 20 to 25 minutes.

g. Fee Collection in Unplanned Areas

1) In unplanned area, the waste collection work is carried out with the fee collection work. There are little differences in the fee collection system between Bayanzurkh TUK and Chingeltei TUK.

2) In Bayanzurkh, a staff belonging to the khoroo office collects fee when the waste collection is carried out. Therefore, money collectors are different by khoroo. In addition, the staffs in the khoroo office sometimes randomly visit houses to check if they have paid fee.

3) Chingeltei TUK directly employs fee collectors and they work like a chief of a collection crew.

4) Fee collectors in Bayanzurkh sometimes complain of the difficulty of fee collection because it isn't their main work, while fee collectors employed by Chingeltei TUK

which are professional for fee collection always think about how to collect fee and never complained of difficulties.

5) In Chingeltei, the district office employs an assistant for the waste management in each kheseg from residents in the kheseg. The assistant is responsible for informing the arrival of a collection truck in advance, promoting residences for preparation of waste discharge and collection fee. The assistance and the fee collector of TUK visit house by house on the waste collection day to collect fee. If some residents don't have money on the collection day, extending the fee collection and waste is collected. When residents get money for fee, residents inform of it to the assistant in kheseg and the assistant inform of it to the fee collector for coming to collect fee. According to the director of Chingeltei TUK, although the assistant system is applied to most khesegs, it well function only for khoroo 12 and 14, and this system highly depends on both fee collector's and assistant's capabilities.

6) The reason why the system doesn't function well in the other khoroo is that most khoroo governors have lack of interest for waste fee collection, especially after TUK was privatized.

7) There are many cases of bargaining for the waste collection fee at site.

8) The fee which has not been paid is accumulated. It is therefore very difficult for residents to clear non-payment.

h. Evaluation of Equipment

M 53, Russian made compacter truck

Although this equipment looks like a compactor, the compaction doesn't function at all. The compaction device works only as a loading device. This is very old equipment and should be replaced.

KO-440, Russian made container truck

Although this equipment has a loading device for waste with a 0.7 m^3 container, it isn't work well because hard to manually put waste in a high container and a lot of waste scattered during the waste transfer from a container to the truck.

SA-3206, China made compactor truck

This equipment which has 20 ton capacity is too large for working in Ulaanbaatar city, although the collection and haulage work efficiency is quite good. The reason why such large compactor trucks are used is for lifting 1 m^3 public containers which are placed in Chingeltei district. However, the public container system itself is unsuitable for the apartment area.

Trucks made in Russia

These trucks are uneconomic due to the high gasoline consumption. However, drivers are familiar with the maintenance of the equipment since they are very simple.

2.2.4 Findings of the Survey in Summer

a. Efficiencies of Activities

Table 2-19 summarizes the time of the each activity measured in T&M survey.

Table 2-21: Summary of Time and Motion Records

Items		unit	24-Aug	25-Aug	26-Aug	27-Aug	29-Aug	30-Aug	31-Aug	1-Sep	2-Sep	3-Sep	4-Sep	5-Sep	Average
Number of Trips	Tr	trips	1	2	2	1	1	2	1	1	1	1	1	2	1.3
Travel Distance	D	km	28.3	66	69.2	51	35.3	78.5	36.4	27.3	69.3	28.4	34.3	90.1	51.2
Preparation	t1	m	84	51	40	16	127	179	55	0	0	11	3	15	
Collection	t2	m	229	304	401	241	164	289	261	245	144	126	404	207	
Travel	t3	m	68	207	203	129	87	252	98	144	120	76	73	213	
Service/Repair	t4	m		7	6	2	102	12	41	0	0	3	0	121	
Discharge	t5	m	11	14	13	16	8	40	16	34	9	17	10	16	
Record	t6	m			0	0	2	0	0	0	0	0	0	0	
Fuel	t7	m	5	5	5	0	0	3	6	0	0	2	3	1	
Recycle	t8	m	0	13	10	0	0	7	0	4	0	0	0	0	
Lunch	t9	m	0	39	0	0	0	0	0	0	0	0	0	0	
Idling/Others	t10	m	35	15	43	3	6	73	0	0	31	0	42	14	
Total working hours	t11	m	432	655	721	407	496	855	477	427	304	235	535	587	
Actual working hours	t12	m	432	616	721	407	496	855	477	427	304	235	535	587	
Efficiency			0.907	0.935	0.911	0.988	0.782	0.889	0.901	0.991	0.898	0.979	0.916	0.768	0.905
Vehicle Velocity	V	km/h	25.0	19.1	20.5	23.7	24.3	18.7	22.3	11.4	34.7	22.4	28.2	25.4	23.0
Tire punctured time			1	0	0	0	1	1	1	0	0	0	0	1	0.4

Note:
Actual working hours excludes lunch time.
Efficiency=(t1+t2+t3+t5+t6)/t12

b. Ger Area

1) The physical composition of waste discharged in summer is very different from that in winter.

- The waste in summer doesn't contain ash of coal.
- The waste in summer and contain light waste such as paper and plastic which are supposed to be burnt in winter.
- The waste in summer contains construction waste because many gers repair their houses in summer.
- They discharge even wooden furniture.

2) The waste in summer is generally still heavy and too difficult for loading because it contains soil and stones. (WACS in summer season, however, did not receive such waste so much.)

3) The waste collection fee in summer is cheaper than that in winter in Chingeltei duureg.

c. Apartment Area

1) The collection method in Sukhbaatar is unsystematic and its work is very low efficiency. There are many on site communal waste bins and communal containers and waste is manually loaded onto the dump truck. The waste loading from those storages is very difficult. There is no skipper truck instead of there are many skip containers placed.


Collection workers load waste from a container onto the truck due to no skip container truck.

2) Most collection trucks in Sukhbaatar TUK are bad condition. Tires often went flat and the tube had many patching.

3) Sukhbaatar TUK use only one compactor truck which has 4 m^3 capacity.

d. Summer House Area

1) There are several communal collection points. People carry their waste to these points by their cars. TUK's dump truck come to such collection points and load waste onto the

truck. The collection system is, therefore, the station collection but not the door-to-door system.


There are lots of waste scattered at most communal collection points in summer house areas.

2) The waste physical composition in summer house areas looks similar to the waste in the planned area because it contains many packaging waste.

3) Therefore, there are waste pickers collecting recyclables at collection points.

4) There are waste fee collectors for summer houses. The waste collection fee for a summer house is 5,000 Tg. per season, for collecting waste for four months.

5) There are some permanent residents in summer houses throughout a year and such houses are increasing. It is expected that the summer house area will be an outskirts residential area because the distance from the summer house area to the city center is only less than 15km..

6) The regular waste collection service throughout a year will be necessary in near future due to the increase of permanent residents.

e. TUK

1) TUK doesn't properly control the employees. It caused the disorder of works.

2) TUK ignoring customers, especially residents. TUK's drivers collect waste when they want to collect. Their own convenience first.

3) Collection workers work is very labor intensive.

4) Drivers often ignore the road and drive on grassland. They often take short cut routes and even cross streams.

5) Most TUK's trucks are in bad condition. During the time and motion for summer, five trucks out of 12 trucks, 42% of working days, had tire puncture.

6) TUK doesn't have any future plan nor marketing plan. They have very poor business mind.

7) To change TUK's minds and attitudes is essential to improve SWM.

f. General Findings

1) The dust chute system causes many problems such as irregular waste collection, fire, flies, lack of consciousness on waste by public, unsanitary condition.

2) The system of discharging waste outside causes following problems in many places.

- Waste scattered by waste pickers.
- Waste pickers burn waste in winter.
- Waste frozen in winter. It probably occurs from Nov. to March.

3) Public cooperation is very good in some points.

- People who discharged waste in ger area help load their heavy waste.
- In some apartment areas, people carry waste to the truck when it arrives.

4) The waste collection from gers and organizations is inefficient. This is because the waste is collected together with the inefficient fee collection. To improve the waste collection efficiency for ger and organizations, the fee collection system should be separated.

Date	2005/1/17
District	Bayanzurkh
Collection Khoroo	7
Type pf collection area	Apartment
Registration No.	60-76 YBB
Type of Truck	Compactor
Model	M 53, Russia, gasoline
Year of Fabrication	1980
Volume capacity	7 m3
Ton	5 ton
Crew	1 driver, 1 collection worker
Working hour	10h 30m, from 7:00 to 17:24

Trip No	Time	Duration	Mileage	Distance	Activities	No	Container	Waste source
			km	km				
	7:00	1:45	0.0		Service			
1st	8:45	0:05		0.7	Traveling			
	8:50	0:15	0.7		Fuelling, 31 liter, Petrol card limit 20000Tg/day			
	9:05	0:03		0.6	Traveling			
	9:08	0:10	1.3		Collection	1	garbage storage	Apartment
	9:18	0:04		0.2	Traveling			
	9:22	0:03	1.5		Collection	2	garbage storage	Apartment
	9:25	0:03		0.8	Traveling			
	9:28	0:17	2.3		Collection (Bell collection)	3	bags	Apartment
	9:45	0:02		0.2	Traveling			
	9:47	0:22	2.5		Collection (Bell collection)	4	nothing	Apartment
	10:09	0:02		0.4	Traveling			
	10:11	0:09	2.9		Collection (Bell collection)	5	bags	Apartment
	10:20	0:02		0.4	Traveling			
	10:22	0:04	3.3		Collection (Bell collection)	6	bags	Apartment
	10:26	0:08		3.0	Traveling			
	10:34	0:09	6.3		Collection	7	metal container	Apartment
	10:43	0:01		0.1	Traveling			
	10:44	0:32	6.4		Collection, checking oil of the truck	8	brick container	Apartment
	11:16	0:02		0.3	Traveling			
	11:18	0:04	6.7		Collection (Bell collection)	9	bags	Institution
	11:22	0:01		0.1	Traveling			
	11:23	0:14	6.8		Collection	10	bags	Apartment
	11:37	0:01		0.1	Traveling			
	11:38	0:03	6.9		Collection	11	bags, basket	Apartment
	11:41	0:01		0.1	Traveling			
	11:42	0:06	7.0		Collection	12	bags	Institution
	11:48	0:01		0.1	Traveling			
	11:49	0:21	7.1		Collection	13	bags	Apartment
	12:10	0:35		18.5	Traveling			
	12:45	0:06	25.6		Unloading waste			
	12:51	0:01		0.4	Traveling to the landfill office			
	12:52	0:04	26.0		Recording at the landfill office			
2nd	12:56	0:29		13.0	Traveling			
	13:25	0:07	39.0		Service, adding oil			
	13:32	0:08		3.0	Traveling			
	13:40	0:15	42.0		Collection	14	bags	Apartment
	13:55	0:01		0.1	Traveling			
	13:56	0:22	42.1		Collection	15	bags	Apartment
	14:18	0:07		1.9	Traveling			
	14:25	0:17	44.0		Collection	16	brick storage	Dormitory
	14:42	0:02		0.2	Traveling			
	14:44	0:17	44.2		Collection	17	small fence	Dormitory
	15:01	0:02		0.1	Traveling			
	15:03	0:22	44.3		Collection	18	metal container	Dormitory
	15:25	0:02		0.2	Traveling			
	15:27	0:22	44.5		Collection	19	metal container	Dormitory
	15:49	0:36		18.5	Traveling			
	16:25	0:15	63.0		Unloading waste			
	16:40	0:04	63.4	0.4	Recording at the landfill office			
	16:44	0:40		18.4	Traveling			
	17:24		81.8		Arriving at the garage			

Date	2005/1/18
District	Bayanzurkh
Collection Khoroo	15 & 18
Type pf collection area	Apartment
Registration No.	87-22
Type of Truck	Compactor truck with lifting device for a 0.7m3 container
Model	KO440, Russia, gasoline
Year of Fabrication	Came in 2001
Volume capacity	7 m3
Ton	5 ton
Crew	1 driver 1 collection worker
Working hour	9h 55m, from 10:35 to 20:30

Trip No	Time	Duration	Mileage	Distance	Activities	No	Container	Waste source
			km	km				
	10:35	0:15	0.0		Meeting			
1st	10:50	0:01		0.1	Traveling			
	10:51	0:03	0.1		Stopped			
	10:54	0:01		0.1	Traveling. Back to the garage			
	10:55	0:02	0.2		Getting some tools at the garage			
	10:57	0:04		1.5	Traveling			
	11:01	0:06	1.7		Fuelling			
	11:07	0:08		3.6	Traveling			
	11:15	0:24	5.3		Collection	1	Container	Apartment
	11:39	0:03		0.2	Traveling			
	11:42	0:06	5.5		Collection	2	Bags	Institution
	11:48	0:06		2.3	Traveling			
	11:54	1:28	7.8		Collection. A driver helps to collect waste. Dust chute was clogged at 7th floor.	3	Metal container, dust chute	Apartment
	13:22	0:01		0.1	Traveling			
	13:23	0:55	7.9		Collection. A driver helps to collect waste. The first collection this year since 24 Dec.	4	Metal container, dust chute	Apartment
	14:18	0:41		19.3	Traveling			
	14:59	0:11	27.2		Unloading waste			
2nd	15:10	0:35		13.3	Traveling			
	15:45	0:51	40.5		Collection. A driver helps to collect waste.	5	Metal container, dust chute	Apartment
	16:36	0:01		0.0	Traveling			
	16:37	0:47	40.5		Collection. A driver helps to collect waste. They came back to No.4 because they didn't finish the collection.	4	Metal container, dust chute	Apartment
	17:24	0:01		0.1	Traveling			
	17:25	0:41	40.5		Collection. A driver helps to collect waste.	6	Metal container, dust chute	Apartment
	18:06	0:01		0.1	Traveling			
	18:07	1:30	40.6		Collection. A driver helps to collect waste.	7	Metal container, dust chute	Apartment
	19:37	0:21		16.2	Traveling			
	19:58	0:01			Stopped for checking the truck			
	19:59	0:12			Traveling			
	20:11	0:02			Stopped for checking the truck			
	20:13	0:08			Traveling			
	20:21		56.8		Unloading waste, no return to the garage due to the further night collection			

Date 2005/1/19
District Bayanzurkh
Collection Khoroo 1& 4
Type pf collection area Apartment
Registration No. 04-81
Type of Truck Compactor truck
Model Isuzu, Japan, gasoline
Year of Fabrication 1991 came in 2004
Volume capacity 6 m3
Ton 2.75 ton
Crew 1 driver, 1 collection worker
Working hour 8h 29m, from 8:30 to 16:59

Trip No	Time	Duration	Mileage	Distance	Activities	No	Container	Waste source
			km	km				
	8:30	0:05	0.0		Preparation			
1st	8:35	0:05		1.6	Traveling to the petrol station			
	8:40	0:05	1.6		Fuelling			
	8:45	0:05		1.5	Traveling to the TUK office			
	8:50	0:13	3.1		Got the salary at the office			
	9:03	0:06		0.1	Traveling			
	9:09	0:24	3.2		Collection	1	Nothing	Apartment
	9:33	0:01		0.2	Traveling			
	9:34	0:03			Collection	2	Bags	Apartment
	9:37	0:03			Traveling			
	9:40	0:10			Collection (Bell collection)	3	Bags	Apartment
	9:50	0:01			Traveling			
	9:51	0:01			Collection	4	Bags	Shops
	9:52	0:01			Traveling			
	9:53	0:10	3.4		Collection	5	Bags Nothing	Apartment
	10:03	0:02		0.6	Traveling			
	10:05	0:03	4.0		Collection	6	Bags	Apartment
	10:08	0:01		0.1	Traveling			
	10:09	0:05	4.1		Collection	7	Bags	Apartment+shops+hospitals
	10:14	0:01		0.1	Traveling			
	10:15	0:04	4.2		Collection	8	Bags	Apartment
	10:19	0:02		0.3	Traveling			
	10:21	0:11	4.5		Collection	9	Bags	Apartment
	10:32	0:02		0.1	Traveling			
	10:34	0:09	4.6		Collection	10	Bags+Nothing	Apartment
	10:43	0:05		0.7	Traveling			
	10:48	0:10	5.3		Collection	11	Bags	Apartment
	10:58	0:01		0.1	Traveling			
	10:59	0:11	5.4		Collection	12	Bags	Hotel+shops
	11:10	0:38		17.2	Traveling			
	11:48	0:04	22.6		Unloading waste			
	11:52	0:02	22.9		Registration at the control office			
2nd	11:54	0:07		3.3	Traveling			
	12:01	0:22	26.2		Lunch			
	12:23	0:27		13.3	Traveling			
	12:50	0:17	39.5		Collection	13	Bags+Nothing	Apartment
	13:07	0:05		1.0	Traveling			
	13:12	0:08	40.5		Collection	14	Bags	Apartment
	13:20	0:01		0.2	Traveling			
	13:21	0:02	40.7		Collection	15	Bags	Apartment
	13:23	0:01		0.2	Traveling			
	13:24	0:02	40.9		Collection	16	Bags	Apartment
	13:26	0:01		0.2	Traveling			
	13:27	0:20	41.1		Collection	17	Metal container	Hotel (flower)
	13:47	0:02		0.4	Traveling			
	13:49	0:10	42.1		Collection	18	Bags	Apartment
	13:59	0:02		0.4	Traveling			
	14:01	0:05	42.5		Collection	19	Bags	Apartment
	14:06	0:01		0.2	Traveling			
	14:07	0:07	42.7		Collection	20	Bags	Apartment
	14:14	0:01		0.1	Traveling			
	14:15	0:07	42.8		Collection	21	Bags	Apartment
	14:22	0:01		0.2	Traveling			
	14:23	0:05	43.0		Collection	22	Bags	Apartment
	14:28	0:01		0.1	Traveling			
	14:29	0:03	43.1		Collection	23	Bags	Hotel, Restaurant
	14:32	0:01		0.1	Traveling			
	14:33	0:06	43.2		Collection	24	Bags	Apartment
	14:39	0:02		0.2	Traveling			
	14:41	0:05	43.4		Collection	25	Bags	Apartment
	14:46	0:01		0.1	Traveling			
	14:47	0:01	43.5		Collection	26	Bags	Apartment
	14:48	0:01		0.1	Traveling			
	14:49	0:03	43.6		Collection	27	Bags	Apartment
	14:52	0:01		0.1	Traveling			
	14:53	0:03	43.7		Collection	28	Bags	Apartment
	14:56	0:13		17.0	Traveling			
	15:09	0:06			Selling plastic pet bottles			
	15:15	0:24			Traveling			
	15:39	0:05	60.7		Unloading waste			
3rd	15:44	0:02	60.7		Registration at the office			
	15:46	0:39		16.8	Traveling			
	16:25	0:17	77.5		Collection	29	Fenced	Grocery market
	16:42	0:02		4.1	Traveling			
	16:44	0:02			Stopped to give information to the manager of grocery market			
	16:46	0:09			Traveling			
	16:55	0:02			Stopped for meeting			
	16:57	0:02			Traveling			
	16:59		81.6		Arrived at the garage			

Date	2005/1/20
District	Bayanzurkh
Collection Khoroo	6 & 16
Type pf collection area	Gel
Registration No.	58-30
Type of Truck	Dump truck
Model	MN4506, Russia, gasoline
Year of Fabrication	Came in 1999
Capacity	6 m^3, 5 tons
Crew	1 driver, 1 collection worker, 1 clerk
Working hour	11h 5m, from 8:50 to 19:55

Trip No	Time	Duration	Mileage	Distance	Activities	No	Container	Waste source
			km	km				
	8:52	0:22	0.0		Preparation			
1st	9:14	0:01		0.2	Traveling			
	9:15	0:03	0.2		Stopped to go to the office			
	9:18	0:02		1.1	Traveling			
	9:20	0:02	1.3		Fuelling, 20,000Tg in cash			
	9:22	0:01		0.1	Traveling			
	9:23	0:28	1.4		Collection	1	Drum	Shop
	9:51	0:01		0.3	Traveling			
	9:52	0:13	1.7		Collection	2	Drum	Gel
	10:05	0:01		0.1	Traveling			
	10:06	0:18	1.8		Collection	3, 4	Drum	Gel
	10:24	0:01		0.1	Traveling			
	10:25	0:18	1.9		Collection	5	Noting	Gel
	10:43	0:02		0.1	Traveling			
	10:45	0:21	2.0		Collection	6	Bags	Gel
	11:06	0:02		0.1	Traveling			
	11:08	0:23	2.1		Collection	7	Bags & drums	Gel
	11:31	0:03		6.6	Traveling			
	11:34	0:01			Stopped to drop the money collector at the office			
	11:35	0:13			Traveling			
	11:48	0:02	8.7		Collection			
	11:50	0:02		0.1	Traveling			
	11:52	0:36	8.8		Collection	8	Bags & drums	Gel
	12:28	0:01		0.1	Traveling			
	12:29	0:08	8.9		Collection	9	Bags & drums	Gel
	12:37	0:01		0.1	Traveling			
	12:38	0:43	9.0		Collection	10	Bags & drums	Gel
	13:21	0:01		0.1	Traveling			
	13:22	0:11	9.1		Collection	11	Bags & drums	Gel
	13:33	0:26		8.7	Traveling			
	13:59	0:04	17.8		Stopped for checking the truck and selling recyclables			
	14:03	0:13		6.1	Traveling			
	14:16	0:08	23.9		Unloading waste			
	14:24	0:03			Registration at the landfill office			
2nd	14:27	0:10		3.7	Traveling			
	14:37	0:21	27.6		Lunch			
	14:58	0:23		10.8	Traveling			
	15:21	0:01	38.4		Stopped on the way			
	15:22	0:02		0.1	Traveling			
	15:24	0:11	38.5		Collection	11	Bags & drums	Gel
	15:35	0:01		0.1	Traveling			
	15:36	0:12	38.6		Collection	12	Bags & drums	Gel
	15:48	0:04		0.2	Traveling			
	15:52	0:11	38.8		Collection	13	Bags & drums	Gel
	16:03	0:03		0.3	Traveling			
	16:06	0:27	39.1		Collection	14	Bags & drums	Gel
	16:33	0:03		0.1	Traveling			
	16:36	1:06	39.2		Collection	15	Bags & drums	Gel
	17:42	0:01		0.2	Traveling			
	17:43	0:36	39.4		Collection	16	Bags & drums	Gel
	18:19	0:18		7.1	Traveling			
	18:37	0:02	46.5		Fuelling for 15,000Tg			
	18:39	0:27		10.0	Traveling			
	19:06	0:08	56.5		Unloading waste			
	19:14	0:02		19.2	Registration at the landfill office			
	19:16	0:39			Traveling			
	19:55		75.7		Arrived at the garage			

Date	2005/1/21
District	Bayanzurkh
Collection Khoroo	14
Type pf collection area	Gel
Registration No.	60-88
Type of Truck	Dump truck
Model	ZIL 555, Russia, gasoline
Year of Fabrication	1984
Volume capacity	6
Ton	6
Crew	1 driver, 2 collection worker, 1 clerk
Working hour	7h 36m, from 9:41 to 17:17

Trip No	Time	Duration	Mileage	Distance	Activities	No	Container	Waste source
			km	km				
	9:41	0:47	0.0		Preparation			
1st	10:28	0:14		4.1	Traveling			
	10:42	0:45	4.1		Collection	1	Bags & drums	Gel
	11:27	0:01		0.1	Traveling			
	11:28	0:13	4.2		Collection	2	Bags & drums	Gel
	11:41	0:01		0.1	Traveling			
	11:42	0:38	4.3		Collection	3	Bags & drums	Gel
	12:20	0:01		0.0	Traveling			
	12:21	0:47	4.4		Collection	4	Bags & drums	Gel
	13:08	0:01		0.0	Traveling			
	13:09	0:39	4.4		Collection	5	Bags & drums	Gel
	13:48	0:01		0.0	Traveling			
	13:49	0:25	4.4		Collection	6	Bags & drums	Gel
	14:14	0:01		0.1	Traveling			
	14:15	0:39	4.5		Collection	7	Bags & drums	Gel
	14:54	0:08		1.2	Traveling			
	15:02	0:02	5.7		Fuelling for 15,000 Tg			
	15:04	0:09			Waiting for the clerk			
	15:13	0:45		16.5	Traveling			
	15:58	0:12	22.2		Unloading waste and registration			
	16:10	0:09		3.1	Traveling			
	16:19	0:26	25.3		Lunch			
	16:45	0:32		15.5	Traveling			
	17:17		40.8		Arrived at the garage			

Date 2005/1/24
District Chingeltei
Collection Khoroo 1, 2, 3
Type pf collection area Apartment
Registration No. None
Type of Truck Compactor truck with lifting device for 1 m3 container
Model SA3206, China, diesel
Year of Fabrication 2002, donated by Australia
Volume capacity 21
Ton Pay load: 12.2t, Max weight: 26t
Crew 1 driver, 1 collection worker (ordinary 2 collection workers. Today one was leave in sick)
Working hour 11h 06m, from 9:00 to 20:06

Trip No	Time	Duration	Mileage	Distance	Activities	No	Container	Waste source
			km	km				
					Some waste collected on the previous day was left in the truck. Probably about half of the capacity.			
	9:00	0:59	0.00		Preparation			
1st	9:59	0:01			Went out of the garage			
	10:00	0:07			Checking tires			
	10:07	0:02		0.30	Traveling			
	10:09	0:05	0.30		Fuelling for 43,000 Tg of diesel at the petrol station.			
	10:14	0:10		2.50	Traveling			
	10:24	0:03	2.80		Collection	1	1m3 container: 2	Apartment
	10:27	0:02		0.30	Traveling			
	10:29	0:27	3.10		Collection	2	1m3 container: 6	Apartment
	10:56	0:06		0.40	Traveling			
	11:02	0:14	3.50		Collection	3	1m3 container: 3	Apartment
	11:16	0:01		0.10	Traveling			
	11:17	0:06	3.60		Collection	4	1m3 container: 2	Apartment
	11:23	0:01		0.05	Traveling			
	11:24	0:11	3.65		Collection	5	1m3 container: 4	Apartment
	11:35	0:02		0.35	Traveling			
	11:37	0:30	4.00		Collection	6	1m3 container: 3	Apartment
	12:07	0:03		0.20	Traveling			
	12:10	0:20	4.20		Collection	7	1m3 container: 2	Apartment
	12:30	0:37		13.50	Traveling			
	13:07	0:08	17.70		Unloading waste			
	13:15	0:02		10.70	Registration at the landfill office			
2nd	13:17	0:24			Traveling			
	13:41	0:04	28.40		Stopped on the way			
	13:45	0:12		3.40	Traveling			
	13:57	0:05	31.80		Collection	7	1m3 container: 2	Apartment
	14:02	0:02		0.40	Traveling			
	14:04	0:01	32.20		Stopped on the way			
	14:05	0:02		0.05	Traveling			
	14:07	0:05	32.25		Collection	8	1m3 container: 1	Institution
	14:12	0:01		0.05	Traveling			
	14:13	0:37	32.30		Collection	9	1m3 container: 5	Apartment
	14:50	0:01		0.05	Traveling			
	14:51	0:12	32.35		Collection	10	0.7m3 container: 2	hotel
	15:03	0:01		0.35	Traveling			
	15:04	0:05			Stopped on the way for talking with a friend			
	15:09	0:01			Traveling			
	15:10	0:22	32.70		Lunch			
	15:32	0:02		0.20	Traveling			
	15:34	0:30	32.90		Collection	11	1m3 container: 4	Apartment
	16:04	0:09		0.50	Traveling			
	16:13	0:14	33.40		Collection	12	1m3 container: 2	Apartment
	16:27	0:10		1.00	Traveling			
	16:37	0:23	34.40		Collection	13	1m3 container: 7	Apartment
	17:00	0:12		0.50	Traveling			
	17:12	0:10	34.90		Collection	14	1m3 container: 3	Apartment
	17:22	0:01		0.10	Traveling			
	17:23	0:10	35.00		Collection	15	1m3 container: 2	Apartment
	17:33	0:01		0.10	Traveling			
	17:34	0:13	35.10		Collection	16	1m3 container: 4	Apartment
	17:47	0:05		0.20	Traveling			
	17:52	0:39	35.30		Collection	17	1m3 container: 4 + 4 m3 in nothing	State department
	18:31	0:43		12.20	Traveling			
	19:14	0:08	47.50	0.40	Unloading waste			
	19:22	0:04	47.90		Registration at the landfill office			
	19:26	0:40		10.70	Traveling			
	20:06		58.60		Arrived at the garage			

Date	2005/1/25
District	Chingeltei
Collection Khoroo	Road 1, 2, 3
Type pf collection area	Apartment
Registration No.	72-45
Type of Truck	Compactor truck
Model	Isuzu, Japan, gasoline
Year of Fabrication	1991
Volume capacity	4.9
Ton	2
Crew	1 driver
	1 collection worker
Working hour	9h 05m, from 8:38 to 17:43

Trip No	Time	Duration	Mileage	Distance	Activities	No	Container	Waste source
			km	km				
	8:38	0:05	0.0		Preparation			
1st	8:43	0:07		2.1	Traveling			
	8:50	0:02	2.1		Collection	1	Nothing	Along the road
	8:52	0:01		0.1	Traveling			
	8:53	0:01	2.2		Collection	2	Nothing	Along the road
	8:54	0:09		1.5	Traveling			
	9:03	0:02	3.7		Collection	3	Plastic container	Institution
	9:05	0:03		0.6	Traveling			
	9:08	0:09	4.3		Checked the collection site but no waste			
	9:17	0:01		1.5	Traveling			
	9:18	0:01	5.8		Collection	4	Nothing	Along the road
	9:19	0:05		1.4	Traveling			
	9:24	0:05	7.2		Collection	5	Nothing	Along the road
	9:29	0:01		0.3	Traveling			
	9:30	0:02	7.5		Collection	6	Plastic container	Along the road
	9:32	0:01		0.6	Traveling			
	9:33	0:01	8.1		Collection	7	Nothing	Along the road
	9:34	0:01		0.1	Traveling			
	9:35	0:01	8.2		Collection	8		Institution
	9:36	0:01		0.0	Traveling			
	9:37	0:01	8.2		Collection	9	Nothing	On the street
	9:38	0:02		0.8	Traveling			
	9:40	0:08	9.0		Collection	10	Nothing	On the street
	9:48	0:02		0.7	Traveling			
	9:50	0:14	9.7		Collection	11	Fenced	Institution
	10:04	0:02		0.3	Traveling			
	10:06	0:07	10.0		Collection	12	Bags & drums	Institution
	10:13	0:02		0.3	Traveling			
	10:15	0:13	10.3		Collection	13	Nothing	Institution
	10:28	0:01		0.0	Traveling			
	10:29	0:02	10.4		Collection	14	Drums	Street cleaing waste
	10:31	0:05		0.8	Traveling			
	10:36	0:03	11.1		Collection	15	Dust chute	Apartment
	10:39	0:02		0.7	Traveling			
	10:41	0:33	11.8		Collection	16	Dust chute	Apartment
	11:14	0:05		0.9	Traveling			
	11:19	0:07	12.7		Stopped for selling plastic bottles			
	11:26	0:04		13.7	Traveling			
	11:30	0:03			Stopped for checking smoke from the truck			
	11:33	0:31			Traveling			
	12:04	0:17			Stopped for checking smoke from the truck			
	12:21	0:05			Traveling			
	12:26	0:20			Stopped for checking smoke from the truck			
	12:46	0:01			Traveling			
	12:47	0:05	26.4		Unloading waste			
	12:52	0:12			Repair work and registration at the landfill office			
2nd	13:04	0:36		16.8	Traveling			
	13:40	0:21	43.2		Lunch			
	14:01	0:03		0.8	Traveling			
	14:04	0:27	44.0		Collection	17	Dust chute	Apartment
	14:31	0:02		0.0	Traveling			
	14:33	0:20	44.0		Collection	18	Dust chute	Apartment
	14:53	0:02		0.0	Traveling			
	14:55	0:41	44.0		Collection	19	Dust chute	Apartment
	15:36	0:01		0.0	Traveling			
	15:37	0:17	44.1		Collection	20	Dust chute	Apartment
	15:54	0:04		1.2	Traveling			
	15:58	0:16	45.3		Collection	21	Bags & drums	Apartment
	16:14	0:02		0.5	Traveling			
	16:16	0:03	45.8		Collection	22	Bags & drums	Institution
	16:19	0:40		15.2	Traveling			
	16:59	0:06	61.0		Unloading waste			
	17:05	0:04			Registration at the landfill office			
	17:09	0:34		10.5	Traveling			
	17:43		71.5		Arrived at the garage			

Date 2005/1/26
District Chingeltei
Collection Khoroo 14
Type pf collection area Gel
Registration No. 61-35
Type of Truck Dump truck
Model ZIL-43362, Russia, gasoline
Year of Fabrication 1998
Capacity 6 m3, 6 ton
Crew 1 driver, 2 collection worker, 1 Clerk
Working hour 10h 20m, from 8:30 to 18:50

Trip No	Time	Duration	Mileage	Distance	Activities	No	Container	Waste source
			km	km				
	8:30	0:19	0.00		Preparation			
1st	8:49	0:07		2.60	Traveling			
	8:56	0:07	2.60		Fuelling. 29,000 Tg. 50l of gasoline at gas station			
	9:03	0:07		1.20	Traveling			
	9:10	0:25	3.80		Waited for waste collectors			
	9:35	0:27		0.02	Collection	1	Gags & drums	Gel
	10:02	0:03			Traveling			
	10:05	0:12	3.82		Collection	2	Gags & drums	Gel
	10:17	0:01		0.02	Traveling			
	10:18	0:07	3.84		Collection	3	Gags & drums	Gel
	10:25	0:01		0.02	Traveling			
	10:26	0:29	3.86		Collection	4	Gags & drums	Gel
	10:55	0:01		0.02	Traveling			
	10:56	0:08	3.88		Collection	5	Gags & drums	Gel
	11:04	0:01		0.02	Traveling			
	11:05	0:13	3.90		Collection	6	Gags & drums	Gel
	11:18	0:01		0.02	Traveling			
	11:19	0:12	3.92		Collection	7	Gags & drums	Gel
	11:31	0:04		0.98	Traveling			
	11:35	0:03			Stopped on the way for selling recyclables			
	11:38	0:02			Traveling			
	11:40	0:03	4.90		Stopped at the gas station for paying the remainder			
	11:43	0:39		18.80	Traveling			
	12:22	0:17	23.70		Unloading waste & registration			
2nd	12:39	0:36		14.00	Traveling			
	13:15	0:18	37.70		Collection	8	Gags & drums	Gel
	13:33	0:01		0.02	Traveling			
	13:34	0:03	37.72		Collection	9	Gags & drums	Gel
	13:37	0:01		0.08	Traveling			
	13:38	0:10	37.80		Collection	10	Gags & drums	Gel
	13:48	0:01		0.02	Traveling			
	13:49	0:07	37.82		Collection	11	Gags & drums	Gel
	13:56	0:01		0.03	Traveling			
	13:57	0:23	37.85		Collection	12	Gags & drums	Gel
	14:20	0:01		0.15	Traveling			
	14:21	0:13	38.00		Collection	13	Gags & drums	Gel
	14:34	0:04		0.40	Traveling			
	14:38	0:32	38.40		Collection	14	Gags & drums	Gel
	15:10	0:01		0.01	Traveling			
	15:11	0:10	38.41		Collection	15	Gags & drums	Gel
	15:21	0:01		0.01	Traveling			
	15:22	0:06	38.42		Collection	16	Gags & drums	Gel
	15:28	0:01		0.02	Traveling			
	15:29	0:13	38.44		Collection	17	Gags & drums	Gel
	15:42	0:03		0.10	Traveling			
	15:45	0:09	38.54		Collection	18	Gags & drums	Gel
	15:54	0:09		0.16	Traveling			
	16:03	1:00	38.70		Collection	19	Gags & drums	3 Shops
	17:03	0:05		19.30	Traveling			
	17:08	0:08			Stopped for selling bottles on the way			
	17:16	0:38			Traveling			
	17:54	0:02			Stopped for removing the cover sheet			
	17:56	0:05			Traveling			
	18:01	0:18	58.00		Unloading waste			
	18:19	0:03			Registration at the landfill office			
	18:22	0:28		10.80	Traveling			
	18:50		68.80		Unloading waste			

Date	2005/1/27
District	Chingeltei
Collection Khoroo	18
Type pf collection area	Gel
Registration No.	75-07
Type of Truck	Dump truck
Model	ZIL-554, Russia, gasoline
Year of Fabrication	1991
Volume capacity	6
Ton	6
Crew	1 driver, 2 collection worker, 1 Clerk
Working hour	13h 58m, from 8:10 to 22:08

Trip No	Time	Duration	Mileage	Distance	Activities	No	Container	Waste source
			km	km				
	8:10	0:51	0.00		Preparation & waited for money for gasoline			
1st	9:01	0:09		2.60	Traveling			
	9:10	0:03	2.60		Fuelling. 25L			
	9:13	0:06		2.90	Traveling			
	9:19	1:11	5.50		Collection	1	Nothing	Gel
	10:30	0:01		0.02	Traveling			
	10:31	0:28	5.52		Collection. Some waste doesn't belong to anyone	2	Bags & outside	Gel
	10:59	0:01		0.15	Traveling			
	11:00	0:13	5.67		Collection	3	Bags	Gel
	11:13	0:04		0.13	Traveling			
	11:17	0:24	5.80		Collection	4	Bags & drums	Gel
	11:41	0:01		0.02	Traveling			
	11:42	0:21	5.82		Collection	5	Bags & drums	Gel
	12:03	0:01		0.02	Traveling			
	12:04	0:39	5.84		Collection	6	Bags & drums	Gel
	12:43	0:48		20.26	Traveling			
	13:31	0:07	26.10		Unloading waste			
2nd	13:38	0:08		6.80	Traveling			
	13:46	0:02			Sold plastic bottles			
	13:48	0:06			Traveling			
	13:54	0:06	32.90		Stopped for buying biscuit			
	14:00	0:11		3.90	Traveling			
	14:11	0:16	36.80		Stopped for get the clerk and money			
	14:27	0:16		2.50	Traveling			
	14:43	0:07	39.30		Fuelling. 20L			
	14:50	0:04		2.10	Traveling			
	14:54	0:21	41.40		Collection	7	Bags & drums	Gel
	15:15	0:01		0.02	Traveling			
	15:16	0:35	41.42		Collection	8	Bags & drums	Gel
	15:51	0:24		0.18	Lunch			
	16:15	0:03			Traveling			
	16:18	0:23	41.60		Collection	9	Bags & drums	Gel
	16:41	0:01		0.02	Traveling			
	16:42	0:51	41.62		Collection	10	Bags & drums	Gel
	17:33	0:01		0.18	Traveling			
	17:34	0:15	41.80		Collection	11	Bags & drums	Gel
	17:49	0:01		0.01	Traveling			
	17:50	0:28	41.81		Collection	12	Bags & drums	Gel
	18:18	0:11		0.19	Traveling			
	18:29	0:01	42.00		Stopped and one collector got off.			
	18:30	1:06		12.10	Traveling			
	19:36	0:38	54.10		Stopped on the way due to lack of gasoline			
	20:14	0:02		0.40	Traveling			
	20:16	0:03	54.50		Fuelling. 10L			
	20:19	0:20		8.80	Traveling			
	20:39	0:15	63.30		Registration at the landfill office and unloading waste			
	20:54	0:26		11.00	Traveling			
	21:20	0:30			Stopped on the way due to lack of gasoline. Fueling 5L			
	21:50	0:18			Traveling			
	22:08		74.30		Arrived at the garage			

Date	2005/1/28
District	Chingeltei
Collection Khoroo	12
Type pf collection area	Gel
Registration No.	28-21
Type of Truck	Dump truck, gasoline
Model	ZIL-130
Year of Fabrication	1993
Volume capacity	6
Ton	5
Crew	1 driver, 2 collection worker, 1 clerk
Working hour	9h 29m, from 8:00 to 17:29

Trip No	Time	Duration	Mileage	Distance	Activities	No	Container	Waste source
			km	km				
	8:00	0:56	0.00		Preparation			
1st	8:56	0:03		0.90	Traveling			
	8:59	0:21	0.90		Collection from 3 households	1	Bags & drums	Gel
	9:20	0:01		0.02	Traveling			
	9:21	0:14	0.92		Collection from 3 households	2	Bags & drums	Gel
	9:35	0:01		0.03	Traveling			
	9:36	0:10	0.95		Collection from 4 households	3	Bags & drums	Gel
	9:46	0:01		0.05	Traveling			
	9:47	0:15	1.00		Collection from 2 households	4	Bags & drums	Gel
	10:02	0:01		0.10	Traveling			
	10:03	0:12	1.10		Collection from 2 households	5	Bags & drums	Gel
	10:15	0:01		0.10	Traveling			
	10:16	0:09	1.20		Collection from 3 households	6	Bags & drums	Gel
	10:25	0:01		0.05	Traveling			
	10:26	0:26	1.25		Collection from 3 households	7	Bags & drums	Gel
	10:52	0:01		0.03	Traveling			
	10:53	0:27	1.28		Collection from 3 households	8	Bags & drums	Gel
	11:20	0:07		3.02	Traveling			
	11:27	0:01	4.30		Fuelling. 11,600 Tg, 20 L			
	11:28	0:16		15.70	Traveling			
	11:44	0:03			Stopped for selling plastic bottles			
	11:47	0:13			Traveling			
	12:00	0:03			Removed the cover sheet			
	12:03	0:02			Traveling			
	12:05	0:05	20.00		Unloading waste			
2nd	12:10	0:30		12.30	Traveling			
	12:40	0:29	32.30		Collection from 3 households	9	Bags & drums	Gel
	13:09	0:01		0.05	Traveling			
	13:10	0:35	32.35		Collection from 3 households	10	Bags & drums	Gel
	13:45	0:01		0.15	Traveling			
	13:46	0:17	32.50		Collection from 2 households	11	Bags & drums	Gel
	14:03	0:03		0.30	Traveling			
	14:06	0:38	32.80		Collection from 3 households	12	Bags & drums	Gel
	14:44	0:01		0.10	Traveling			
	14:45	0:05	32.90		Collection car parks	13	Bags & drums	Gel
	14:50	0:02		0.20	Traveling			
	14:52	0:26	33.10		Collection from 2 households	14	Bags & drums	Gel
	15:18	0:01		0.05	Traveling			
	15:19	0:26	33.15		Collection from 2 households	15	Bags & drums	Gel
	15:45	0:01		0.01	Traveling			
	15:46	0:26	33.16		Collection	16	Bags & drums	Gel
	16:12	0:24		7.94	Traveling			
	16:36	0:02	41.10		Stopped for selling recyclables			
	16:38	0:13		7.70	Traveling			
	16:51	0:03			Stopped for removing the sheet			
	16:54	0:03			Traveling			
	16:57	0:09	48.80		Unloading waste and registration			
	17:06	0:23		10.50	Traveling			
	17:29		59.30		Arrived at the garage			

2.3 Public Opinion Survey

2.3.1 Objective of the Survey

There are no easy solutions to the problems related to Solid Waste Management (SWM). The SWM system should be formulated based on a precise grasp of natural and socioeconomic conditions, the state of the present SWM system and the lifestyle of local residents along with the opinions of all the people in the target area. In addition, the MSWM system should include a mechanism that increases people's awareness and promotes public participation, because active public involvement is indispensable for a sustainable MSWM system.

An effective method for obtaining a precise grasp of the opinions of local residents is a Public Opinion Survey (POS). In particular, a POS can give us essential information for formulating the M/P, such as the way people discharge wastes in their daily lives and the level of waste tariff people are willing to pay. In addition, a POS can show us the level of people's environmental awareness and give us a hint about acceptable approaches for local people to improve the SWM system.

Therefore, the team decided to conduct a POS, targeting all the households and business establishments in UB, in order to obtain the basic information, which is summarized below.

At present in UB, the social and economic conditions as well as the waste collection method in the Apartment area and the Ger area are very different. In the POS, the team aimed at gathering opinions on the current collection service, as well as information on awareness level of social and environmental issues, while paying an attention to their difference in types of residence..

(1) Household Survey
  1) In the Apartment area
    • Generation and recycling of waste at the source
    • Way of storing and discharging waste.
    • Awareness of environmental issues, in particular SWM

  2) In the Ger area
    • Generation and recycling of waste at the source
    • Way of storing and discharging waste.
    • Awareness of environmental issues, in particular SWM
    • Need of waste collection service and willingness to pay
      (only for those who do not receive a collection service at present)

(2) Business Establishments Survey
    • Generation and recycling of waste at the source
    • Way of storing and discharging waste.
    • Awareness of environmental issues in particular SWM

The result of the survey was reflected in the draft of M/P, aiming at increasing people's environmental awareness, improving waste collection services, examining the introduction of separate waste collection and reducing waste amount.

2.3.2 Method of the Survey

a. Design of Survey

The survey is divided into two parts: the household (residential) survey and the business establishment (non-residential) survey. The household survey has two different targets: those who live in the Apartment area and the others who live in the Ger area.

In total, there were 500 samples, and 400 of the samples were allocated to the household survey and 100 to the business establishment survey. The 400 samples for the household survey were further divided into two groups mentioned above (approximately 200 samples in each group)

The method and outline of survey is shown as follows.

1. Method of Survey: interview
2. Target of Survey: (1) household - all the people of 18 years old and over living in 6 Duuregs in UB
   (2) business establishment - all the business establishments located in UB with a collection service
3. Number of samples: (1) household - 400 valid samples
   (approximately 200 samples were allocated to the apartment area and Ger area respectively)
   (2) business establishment – 100 valid samples
4. Target area: 6 duuregs in Ulaanbaatar City (SKhD, SBD, BGD, KhUD, and BZD)
5. Number of questions: about 50 questions related to the objectives of the survey.
6. Subjects of questions: (1) generation and recycling of waste at the source
   (2) the way of storing and discharging waste
   (3) awareness of SWM

b. Preparation of Questionnaire and Show Card

b.1 Questionnaire

The questionnaire consists of 12 sections and they are divided into six categories: (1) general environmental issues, (2) problems caused by solid waste, (3) generation of waste and its management, (4) reuse/recycling of waste, (5) public cooperation, and (6) about the interviewee. The purpose and content of each category are summarized below. The contents and expressions were modified based on the result of the pilot test.

b.1.1. About interviewee

The first category tried to gather personal information such as age, sex, and income to examine explanatory factors for the in-depth analysis.

In addition, the results were used to examine how selected samples represent the population, by comparing the distribution of samples in terms of sex, age, and household income to other data such as the national census data.

b.1.2. General Questions

The main purpose of this group of questions is to know people’s priorities in their daily lives and the degree of environmental awareness in general.

b.1.3. Problems caused by solid waste

The third category of questions tries to reveal how much people are aware of current problems caused by improper management of solid waste.

b.1.4. Generation of waste and its management

In this category, the target is divided into two groups: (1) households and business establishments in the Apartment area (2) households and business establishments in the Ger

area. Interviewees were asked different questions depending on the types of the residence and collection system.

It tried to reveal people's methods of managing their waste and opinion about the current collection service. A small number of samples in the Ger area did not receive a collection service at present. They were asked how much they needed the collection service and how much they were willing to pay for it.

b.1.5. Reuse/recycling of waste

The reduction of waste is a key element for sound waste management. One effective measure for reducing the volume of waste is the reuse and recycling of waste. It is important to know how much people reuse or recycle their waste in their daily lives at present and how aware people are of the importance of the reuse/recycling of waste.

b.1.6. Public Cooperation

It is almost impossible for the government to implement sound SWM without the understanding and cooperation of local residents. The purpose of these questions is to know how much people are willing to cooperate with UB and a collection service provider in order to improve the quality of the collection service and to find an appropriate approach for the government to develop cooperation with local residents.

b.2 Show Card

Some of questions had a long list of answers. In order to make it easy for interviewees to select the most appropriate answer, Show Card, bound cards with the list of answers, were prepared. At the time of interview, each interviewee could read the list of answers carefully, while the interviewer ask a question, so that the interviewee could ponder each question before choosing the most appropriate answer.

c. Sampling

c.1 Sample Frame

Sampling was one of the most crucial parts of the survey procedure. The team aimed to achieve an interval estimation of 5% with a confidence level of 90%. However, in general it is difficult to achieve this target in developing countries, since there are not enough data. In addition, in UB there are many unregistered household in the Ger area. Moreover, the number of samples in this survey is limited, 400 in total, and this made it even more difficult to keep the precision of the survey.

In consultation with the local subcontractor, Sant Maral Foundation (SMF), the team decided to adopt the following sampling method.

c.1.1. Household survey

Multi-stage random sampling was implemented for the residential survey. That includes the random selection of Khoroos in each of six Duuregs and planning of amount of households to be interviewed according to the population proportion. On the khoroo level the individual households were selected with the random route methodology.

At the time of interview, interviewers chose the most suitable person from the selected households, mainly female adult who were supposed to know the solid waste management issues most.

The planned sample frame in the Apartment and Ger area by Duureg, based on the statistical

census data from 2000[2], is shown in the table below.

Table 2-22: Planned Sample Frame by Duureg and Area for the Residential Survey

Duureg	Apartment area	Ger area	Total
Khan-Uul	12	28	40
Bayanzurkh	40	41	81
Sukhbaatar	26	27	53
Chingeltei	15	44	59
Bayangol	80	-	80
Songinokhairkhan	27	60	87
Total	200	200	400

c.1.2. Business Establishment Survey

The planned sectoral coverage for the non-residential survey included 5 categories - shops, restaurants, government/business offices, hotels and markets (including super markets and shopping centers) – each to be represented by 20 entities.

Samples in each category were randomly selected from the list of business establishments provided by the Duureg tax offices. The designed sectoral and district distribution, except markets[3], is shown in the table below.

Table 2-23: Planned Sample Frame by Duureg and Sector for the Non-residential Survey

Duureg/Sector	Shops	Restaurants	Offices	Hotels	Total
Khan-Uul	3	3	3	3	12
Bayanzurkh	4	3	3	3	13
Sukhbaatar	3	3	4	3	13
Chingeltei	3	3	3	3	12
Bayangol	4	4	4	4	16
Songinokhairkhan	3	4	3	4	14
Total	20	20	20	20	80

d. Execution of Survey

d.1 Pretest and Survey Preparation

The pretest was done by three interviewers on January 5-6, who interviewed 10 households (6 in ger area and 4 in Apartment area) and 4 business establishments. Based on the pretest some corrections were added to the questionnaire. The basic guidance of 10 enumerators was organized on January12.

d.2 Field Work

The fieldwork started at January 13 and was completed on February 2.

2.3.3 Result of the Survey

At first, the samples of the household survey were checked to see how much they represented the whole population. Since actual interviewees were selected by interviewers at the time of the interview survey based on their familiarity with waste management issues, interviewees tended to be older and the share of female respondents was higher than that of the population.

Then, the results of the household survey were analyzed based on the type of residence (apartment or Ger). The results were further analyzed based on age, sex, educational background, and household income. In this section, only remarkable results are shown. All the responses are tabulated by the type of residence and shown in the Data Book.

[2] The general proportion within horoo remains more or less the same since 2000.
[3] Since their number is limited, the selection of markets was not done by the duureg.

a. About Interviewees

a.1 Residential source (Households)

The numbers of valid respondents of the households survey in the apartment and Ger area were 186and 214 respectively. The sample shift to the Ger area happened because two Khoroos, 13 from Bayanzurkh Duureg and 12 from the Bayangol Duureg, were not Apartment areas as it was given in the official statistical data.

The sample distribution by Duureg and khoroo is shown in Table 2-24.

Table 2-24: Sample distribution of the residential survey by Duureg and khoroo

		DUUREG						Total
		Khan-Uul	Bayanzurkh	Sukhbaatar	Chingeltei	Bayangol	Songino-khairkhan	
KHOROO	1		6		5	8	10	29
	2	10	5	4	5			24
	3			4	1	8	10	23
	4	10	4	6		8		28
	5	4	5	4		9	8	30
	6	4	2	6		9	10	31
	7					1		1
	8		5		5			10
	9	4		9		7	11	31
	10	3	12		8			23
	11	5			6		11	22
	12		12	8	8	9	7	44
	13		5	10	8		7	30
	14				1	6	9	16
	15		2					2
	16		5		7			12
	17		12			7		19
	18		6		7			13
	19					7	5	12
Total		40	81	51	61	79	88	400

The number of samples by type of residence is shown the table below.

Table 2-25: Distribution of samples by type of residence

Type of Residence					Total
Apartment with garbage chute	Apartment without garbage chute	Summer house	Gel area with a collection service	Gel area without a collection service	
94	92	0	206	8	400

Distribution of samples by household size is summarized below. The average size of the household was 4.4.

Table 2-26: Household Size by Type of Residence

	Apartment with garbage chute	Apartment without garbage chute	Gel area with a collection service	Gel area without a collection service	total
1		1.1%	2.4%	12.5%	1.8%
2	8.5%	12.0%	6.3%		8.0%
3	14.9%	23.9%	13.6%	25.0%	16.5%
4	40.4%	31.5%	23.3%		28.8%
5	24.5%	18.5%	25.2%	37.5%	23.8%
6	9.6%	7.6%	17.0%	25.0%	13.3%
7		4.3%	5.8%		4.0%
8	1.1%		2.4%		1.5%
9		1.1%	2.4%		1.5%
10	1.1%		0.5%		0.5%
11			0.5%		0.3%
12			0.5%		0.3%
total	100%	100%	100%	100%	100%
average	4.2	4.0	4.8	4.3	4.4
Base:	94	92	296	8	400

a.2 Non residential source (Business establishments)

As designed 100 business establishments from 5 categories were interviewed for the non-residential sources from January 21 to February 2. During the survey it was revealed that 23 establishments had more than one type of business activities. Some shops, hotels and markets had restaurants or cafeterias in the same building/ place belonging to them. 6 of these establishments had 3 types of activities. As these activities were located in the same place and had common financial statements the provided data/responses were joint too. All these created some disorder in definition of the business type later.

Table 2-27: Sample distribution of the non-residential survey by type of business

Type of business	Sample
1 Shops	21
2 Restaurants	20
3 Government/Business Office	20
4 Hotels	19
5 Market & Others	20
Total	100

From the list of the randomly selected business entities, except the category 5 –markets, 36 establishments (45%) could be found, others, mostly small organizations, were replaced in accordance with the selected Duureg and khoroo. Such replacement was necessary, because tax offices do not timely upgrade their data: the addresses were not exact, some establishments moved or were closed (no activity at all).

Table 2-28: Sample distribution of the non-residential survey by Duureg and khoroo

		DUUREG						Total
		Khan-Uul	Bayanzurkh	Sukhbaatar	Chingeltei	Bayangol	Songinokhair khan	
KHOROO	1	3		2	5			10
	2	2		2	1			5
	3	2	1			1	1	5
	4	2	2		2	1		7
	5		3	1	2	3	2	11
	6	1	5		1	3	1	11
	7	2		2		2	1	7
	8		2	3		3		8
	9			1			1	2
	10	1		4				5
	11			1			1	2
	12						3	3
	13				2	2		4
	14		2		2	1		5
	15			1	2			3
	16		1				1	2
	17		2				1	3
	18					2	2	4
	19					2	1	3
Total		13	18	17	17	20	15	100

Table 2-29: Sample distribution by type of building

	shop	Restaurant	office	hotel	Market	total
Building with a garbage chute	3	5				8
Building without a garbage chute	2	4	4	3	1	14
Independent structure in the apartment area	8	10	12	13	14	57
Independent structure in the Ger area with a collection service	8	1	4	3	5	21
total	21	20	20	19	20	100

The number of employees by type of business is shown below. 40% of targeted business establishments employed less than 10 people.

Table 2-30: Number of employees

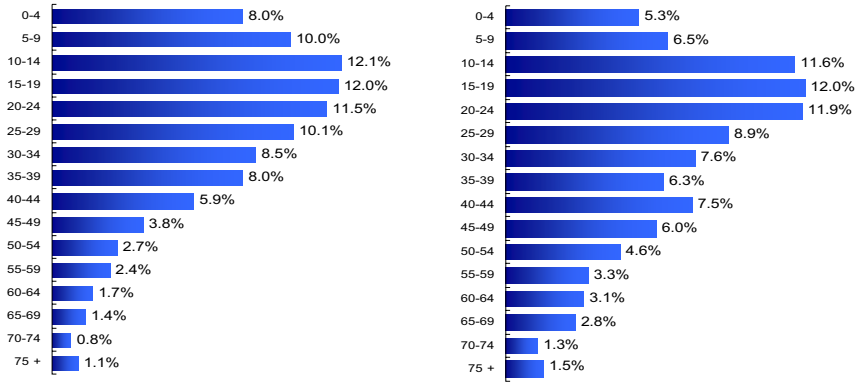
	shop		restaurant		office		hotel		market		total	
	count	col%	count	col%	count	col%	count	col%	count	col%	count	col%
1-5	14	66.7%	12	60.0%	0	0.0%	3	15.8%	2	10.0%	31	31.0%
6-10	5	23.8%	2	10.0%	2	10.0%	1	5.3%	2	10.0%	12	12.0%
11-15	2	9.5%	2	10.0%	2	10.0%	5	26.3%	2	10.0%	13	13.0%
16-20	0	0.0%	2	10.0%	1	5.0%	4	21.1%	5	25.0%	12	12.0%
21-50			1	5.0%	7	35.0%	6	31.6%	5	25.0%	19	19.0%
51-100			1	5.0%	1	5.0%			2	10.0%	4	4.0%
101-150					7	35.0%				0.0%	7	7.0%
151-200									1	5.0%	1	1.0%
300									1	5.0%	1	1.0%
total	21	100%	20	100%	20	100%	19	100%	20	100%	100	100%

Evaluation of samples

In order to evaluate how much the samples of the household survey represented the population, the distribution of all those who share houses with respondents by age and sex was compared to the National Census data in 2000, as shown in the table below[4]. If taking in account the drop of birthrate during the last 4-5 years, the population distribution of the sample in Table 2-31 looks similar to the population distribution of the census data.

Table 2-31: Population distribution in Ulaanbaatar by age and gender (Census data of 2000), in compare with population distribution in the sample of the residential survey.

Age	Population distribution in UB Census data 2000			Population distribution of the samples and all their family members of the residential survey		
	Total %	Male %	Female %	Total %	Male %	Female %
Total	100.0%	48.5%	51.5%	100.0%	47.0%	53.0%
0-4	8.0%	4.1%	4.0%	5.3%	2.3%	3.0%
5-9	10.0%	5.0%	5.0%	6.5%	3.4%	3.2%
10-14	12.1%	6.1%	6.1%	11.6%	5.9%	5.7%
15-19	12.0%	5.8%	6.2%	12.0%	5.3%	6.6%
20-24	11.5%	5.4%	6.1%	11.9%	5.5%	6.4%
25-29	10.1%	4.9%	5.2%	8.9%	4.6%	4.3%
30-34	8.5%	4.1%	4.4%	7.6%	3.7%	3.9%
35-39	8.0%	3.8%	4.1%	6.3%	2.6%	3.7%
40-44	5.9%	2.8%	3.1%	7.5%	3.5%	4.0%
45-49	3.8%	1.8%	2.0%	6.0%	2.9%	3.1%
50-54	2.7%	1.3%	1.4%	4.6%	2.3%	2.3%
55-59	2.4%	1.2%	1.2%	3.3%	1.5%	1.8%
60-64	1.7%	0.8%	0.9%	3.1%	1.1%	2.0%
65-69	1.4%	0.6%	0.8%	2.8%	1.4%	1.4%
70-74	0.8%	0.4%	0.5%	1.3%	0.5%	0.8%
75 +	1.1%	0.4%	0.7%	1.5%	0.6%	1.0%



Census Data in 2000 Respondents and their family

Figure 2-2: Age Distribution of Respondents and National Census

[4] In the interview survey, the number of people who shared the house with a respondent and their age and sex were asked. The distribution of respondents by age and sex was off to the older and more female strata, since people who were more familiar with SWM issues were arbitrarily selected.

The distribution of the monthly household income is shown below. According to the Statistical Yearbook 2003, the average monthly income per household in urban area was 184 639 MNT, the average monthly expenditure per household was 173 494 MNT. No information on income distribution was provided. However, if compare these average amounts with income and expenditure distribution in the sample, it gives rough estimation that income in the sample is approximately lower by 15 000 MNT and the expenditure by 5 000 – 6 000 MNT.

Table 2-32: Monthly Household Income

	Apartment with garbage chute		Apartment without garbage chute		Ger area with a collection service		Ger area without a collection service		Total	
	Count	Col	Count	Col	Count	Col	Count	Col	Count	Col
Less than Tg44,000/month	6	6.4%	6	6.5%	47	22.8%	3	37.5%	62	15.5%
Tg44,000 - 110,000	31	33.0%	28	30.4%	89	43.2%	4	50.0%	152	38.0%
Tg110,000 - 250,000	37	39.4%	42	45.7%	52	25.2%	1	12.5%	132	33.0%
Tg250,000 - 500,000	14	14.9%	10	10.9%	10	4.9%			34	8.5%
More than Tg500,000	3	3.2%	5	5.4%					8	2.0%
Do not know	3	3.2%	1	1.1%	5	2.4%			9	2.3%
No response					3	1.5%			3	0.8%
total	94	100%	92	100%	206	100%	8	100%	400	100%

According to the question about possession of durable goods, almost all respondents (98.8%) possessed at least one color or white & black TV set, and three quarters of them have at least one mobile phone set.

The most popular media in the whole AUB to access to daily news was TV, while respondents in the Apartment area also used newspaper and radio to obtain information, as shown in the table below.

Table 2-33: Frequency of access to news by type of media

Newspaper

	Apartment Area	Ger Area
Never	3.2%	7.5%
Rarely	36.0%	53.7%
One or two times per week	15.6%	15.9%
Everyday	**45.2%**	22.9%

Magazine

Apartment Area	Ger Area
40.9%	44.4%
46.8%	51.4%
7.5%	2.8%
4.8%	0.5%

Base: all

Radio

	Apartment Area	Ger Area
Never	22.6%	24.8%
Rarely	28.5%	39.3%
One or two times per week	3.8%	8.4%
Everyday	**45.2%**	27.1%

TV

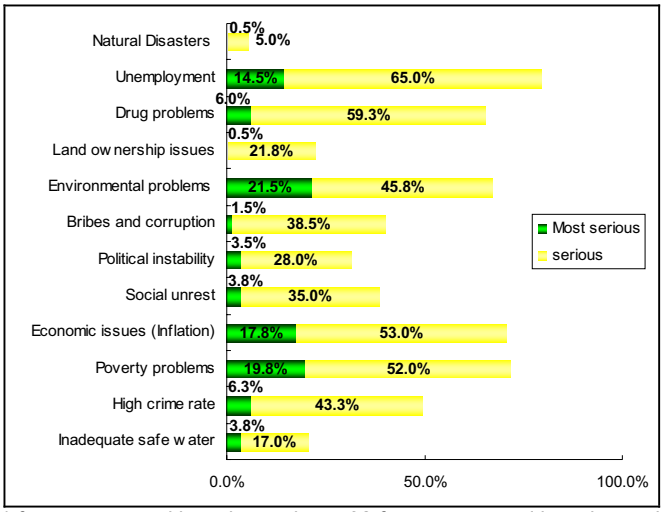
Apartment Area	Ger Area
0.5%	2.8%
5.4%	1.4%
2.2%	8.4%
91.9%	**87.4%**

Base: all

b. General Question

First of all, all the interviewees were asked to choose one answer from the list as the most serious problem at present in Ulaanbaatar. Then, respondents were asked to choose all the problems that they agreed as the second most serious problems.

Since the economic and social conditions of the Apartment area and Ger area were different, respondents in each group had different recognition of problems. The largest number of respondents (26.3%) in the apartment area chose Environmental problem as the most serious problem, while economic issues such as inflation and poverty were selected as the most serious problem in the Ger area.



Base: 400 (94 for apartment with garbage chute, 92 for apartment with garbage chute, 206 for Ger area with a collection service, and 8 for Ger area without a collection service)

Figure 2-3: Most and second most serious problem in UB (household survey)

As pollution problems such as air pollution became more serious in UB, it seems that more people are interested in environmental issues. In particular, the higher the academic background is, the higher the interest in environmental issues. As expected, 70% of respondents mentioned air pollution as the most serious environmental problem in UB.

Table 2-34: Interested in Environmental Issues (by academic background)

	no formal some primary	Complete primary and higher	complete secondary technical	University and higher	total
Yes	36.4%	51.0%	68.4%	75.6%	68.3%
Yes, but a little bit	45.5%	31.4%	21.3%	18.9%	22.3%
No	18.2%	17.6%	10.3%	5.5%	9.5%
toal	100%	100%	100%	100%	100%
Base	11	51	174	164	

The business establishment survey about the priority to be solved or improved in their daily business showed that solid waste management was given the highest priority, shown in Table 2-35. In the case of the households, the economic and social conditions due to the types of residence were so different that their priorities were different.

Table 2-35: Priority to be solved or improved in daily life

Business Establishments

	Water Supply	Sewer pipe network	Septic tank collection	SWM	Access road	Electricity supply	Drainage facilities	Telephone
Very important	39.0%	34.0%	36.0%	47.0%	33.0%	43.0%	29.0%	23.0%
Important	47.0%	50.0%	46.0%	46.0%	48.0%	35.0%	44.0%	46.0%
Little important	10.0%	10.0%	10.0%	3.0%	14.0%	16.0%	21.0%	18.0%
not important at all	4.0%	6.0%	5.0%	2.0%	4.0%	5.0%	3.0%	11.0%
no response	[5]		3.0%	2.0%	1.0%	1.0%	3.0%	2.0%
total	100%	100%	100%	100%	100%	100%	100%	100%
Score	1.63	1.64	1.84	***1.59***	1.89	1.83	1.98	2.17

Apartment with garbage chute

	Water Supply	Sewer pipe network	Septic tank collection	SWM	Access road	Electricity supply	Drainage facilities	Telephone
Very Important	40.4%	27.7%	18.1%	28.7%	13.8%	56.4%	19.1%	24.5%
Important	27.7%	40.4%	48.9%	54.3%	46.8%	22.3%	63.8%	33.0%
Little Important	12.8%	9.6%	6.4%	7.4%	31.9%	11.7%	13.8%	10.6%
Not Important	19.1%	22.3%	22.3%	9.6%	7.4%	9.6%	3.2%	31.9%
no response			4.3%					
score	2.11	2.27	2.34	1.98	2.33	***1.74***	2.01	2.50

[5] Score was calculated by giving 1 point to the answer "very important", 2 points to "Important", 3 points to "Little important", and 4 points to "Not important at all" respectively. The lower the score is, the more respondents give a priority.

Apartment without garbage chute

	Water Supply	Sewer pipe network	Septic tank collection	SWM	Access road	Electricity supply	Drainage facilities	Telephone
Very Important	50.0%	41.3%	37.0%	45.7%	28.3%	44.6%	30.4%	31.5%
Important	39.1%	48.9%	32.6%	45.7%	50.0%	33.7%	48.9%	30.4%
Little Important	7.6%	6.5%	23.9%	4.3%	17.4%	15.2%	17.4%	13.0%
Not Important	3.3%	3.3%	6.5%	4.3%	4.3%	6.5%	3.3%	25.0%
no response								
score	***1.64***	1.72	2.00	***1.67***	1.98	1.84	1.93	2.32

Ger area with a collection service

	Water Supply	Sewer pipe network	Septic tank collection	SWM	Access road	Electricity supply	Drainage facilities	Telephone
Very Important	49.5%	49.0%	73.8%	42.2%	51.0%	42.2%	48.5%	34.0%
Important	32.0%	35.0%	18.9%	47.1%	38.3%	40.3%	33.0%	34.5%
Little Important	14.1%	11.2%	5.3%	7.3%	8.3%	13.6%	16.5%	13.6%
Not Important	4.4%	4.4%	1.9%	2.4%	1.9%	3.4%	1.5%	16.0%
no response		0.5%		1.0%	0.5%	0.5%	0.5%	1.9%
score	1.73	1.78	***1.35***	1.70	***1.61***	1.78	1.70	2.08

Ger area without a collection service

	Water Supply	Sewer pipe network	Septic tank collection	SWM	Access road	Electricity supply	Drainage facilities	Telephone
Very Important	75.0%	62.5%	75.0%	75.0%	62.5%	37.5%	25.0%	25.0%
Important	12.5%	12.5%	12.5%	25.0%	37.5%	62.5%	37.5%	50.0%
Little Important	12.5%	12.5%					25.0%	12.5%
Not Important		12.5%	12.5%				12.5%	12.5%
no response								
score	***1.38***	1.75	1.50	***1.25***	***1.38***	1.63	2.25	2.13

c. Problems Caused by Solid Waste

Most of the respondents (94% in the household survey and 97% in the business establishment survey) recognized that there were problems caused by improper waste management in Ulaanbaatar. Since respondents in the Ger area faces more serious problems such as odor caused by illegal dumped waste, they had higher awareness of problems caused by improper solid waste management. On the other hand, judging from the result of other questions such as knowledge on the current collection system, it can be said that respondents in the Apartment area actually did not pay much attention to solid waste management issues.

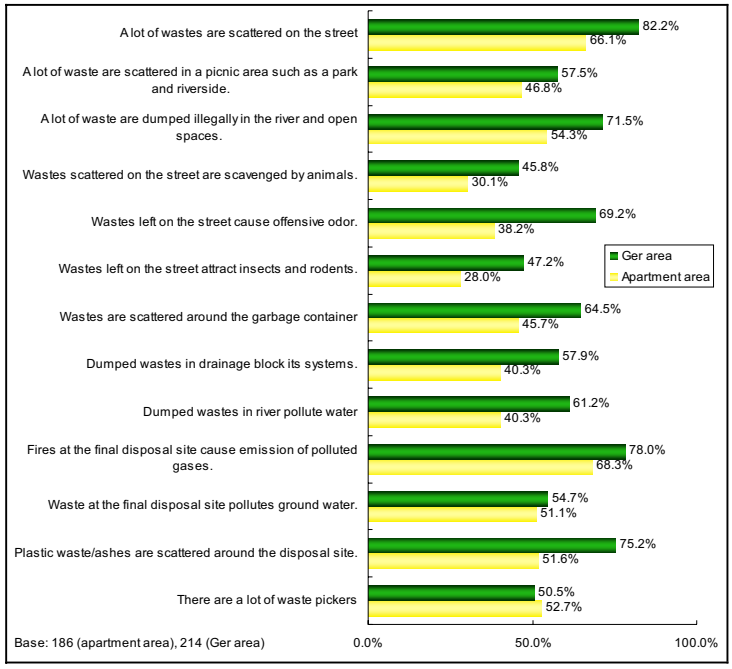


Figure 2-4: What kinds of problems are caused by bad SWM in UB? (Household survey)

d. About Your Waste and Its Management

d.1 Waste Generation and Handling

d.1.1. Waste Generation

All the interviewees were asked about the daily amount of waste generated at their houses or business. Since the answers were not accurate quantitatively, the results are shown only as a reference. Please refer to the results of WACS to obtain more precise quantitative data.

Table 2-36: Daily Average of Waste Amount Generated at Household

Item	Unit	Apartment with garbage chute	Apartment without garbage chute	Gel area with collection service	Gel area without service	total
Organic Waste	Kg/day	0.872	1.14	1.26	1.375	1.14
Aluminum Can	Can/month	10.26	10.56	7.325	9.5	8.31
Glass Bottle	Bottle/month	7.76	6.40	6.47	3.43	6.69
Plastic Bottle	Bottle/month	15.2	13.5	8.38	7.2	11.12
Paper/cardboard	Kg/month	3.25	2.76	5.34	5	3.581
Plastic Bag	Piece/month	35.59	44.83	47.01	10.71	43.15
Ash	l/month		0.75	5.24	3.38	5.13

d.1.2. Waste Handling

Almost all the respondents used some kinds of bag or container for storing waste. In the Ger area, about 70% of respondents separated coal/wood ash from other waste.

Half of the respondents in the Ger area burned waste along with coal or ash at a stove in their house. Paper was the most common waste for burning at the stove (100%), while 15.9% of them (17 respondents) burned plastics.

Female adults were mainly responsible for handling and discharging household waste, as shown in Table 2-37.

Table 2-37: Who Handles and Discharges Waste in Your Household?

	Apartment with dust chute	Apartment without dust chute	Gel area with collection service	Gel area without collection service
female adult	47.9%	52.2%	51.5%	37.5%
male adult	6.4%	5.4%	14.6%	12.5%
female children	27.7%	16.3%	8.7%	0.0%
male children	6.4%	4.3%	6.3%	0.0%
anyone who is available	10.6%	20.7%	18.9%	50.0%
pay someone to discharge	1.1%	1.1%	0.0%	0.0%
total	100%	100%	100%	100%
Base	92	94	206	8

In the case of business establishments, 55% of the respondents replied that they had a post which is in charge of waste management on the decision making level. The person in charge of waste management is summarized in Table 2-38.

Table 2-38: Who is in charge of SWM on the decision making level in your office/shop?

	Col %
Owner/general manager	12.7%
The person who is in charge of environment issues	0%
The person who is in charge of hygiene/cleansing issues	80.0%
Others	7.3%

Base: 55

d.2 Discharge/Treatment of Waste

The interviewees are divided into three groups: (1) Apartment area, (2) Ger area with a collection service and (3) Ger area without a collection service. The results are reported separately.

d.2.1. In Apartment Area

In general, apartments in UB have keepers, and they play an important role to discharge waste from households in the apartment properly and keep the discharge point clean. On the other hand, residents in apartments, in particular apartments with garbage chute, do not have to pay much attention to discharge of their waste and a collection service. It seems that they did not know the current collection systems well. Therefore, the team decided to conduct a follow-up survey, an interview survey with keepers of apartments, in order to grasp the current waste discharge conditions in the Apartment area. The result of the follow-up survey will be shown in the next report.

At first, the frequency of the collection service was asked. 34.4% of household respondents and 74.7% of business establishment respondents knew the frequency. The frequency of the collection service in summer, which was obtained from the survey, is shown below. The result is based on the answers from respondents and does not show the real frequency.

Table 2-39: Frequency of Collection Service (Apartment Area)

Frequency in summer	Household	Business
Everyday	12.5%	5.1%
6 times per week	6.3%	1.7%
5 times per week	0.0%	11.9%
4 times per week	3.1%	10.2%
3 times per week	4.7%	11.9%
2 times per week	10.9%	10.2%
Once a week	14.1%	16.9%
Once in 2 weeks (twice a month)	23.4%	15.3%
Once a month	9.4%	5.1%
Irregular	15.6%	5.1%
total	100%	100%
Base	64	59

The frequency of discharging waste, shown in the table below, indicated that many of respondents discharged their waste regardless of the frequency of the collection service.

Table 2-40: Frequency of Discharge

In summer	Household	Business
More than once every day	1.1%	25.3%
Once everyday	24.7%	44.3%
6 times per week	0.5%	1.3%
5 times per week	2.2%	
4 times per week	4.3%	3.8%
3 times per week	24.2%	8.9%
2 times per week	25.8%	1.3%
Once a week	7.0%	1.3%
Irregular	7.5%	11.4%
I do not know	2.7%	2.5%
total	100%	100%
Base	186	79

The way of discharging waste was also questioned. More than 90% of household respondents discharge waste in a bag. Few respondents living in apartments with dust chute have difficulty of discharging waste, while 14% of respondent living in apartments without it faces difficulties: there were no container near and the quality of collection service is poor.

d.2.2. In Ger Area with Collection Service

First of all, interviewees were asked if they received the regular collection service. 51.5% of the household respondents did not receive the regular collection service. It is likely that some of them could not receive the collection service since they did not pay the fee. According to another survey (a social survey in Ulaan Chuluut shown in Ch2.4), only 10% of respondents received a collection service, while 36% and 56% of respondents dumped waste in a open space and transported it to collection points in other areas respectively. It can be assumed that many parts of waste which were transported to collection points in other areas were actually

dumped illegally. Therefore, it can be said that a large part of waste generated in the Ger area were not collected properly and dumped illegally in an open space.

As same in the Apartment area, the frequency of their collection service was asked to those who received the service regularly. The frequency of the collection service that respondents in the Ger area indicated is summarized in the table below.

Table 2-41: Frequency of Collection Service (Ger Area)

	Household	Business
Once in 2 weeks		8.3%
Once a month	77.3%	58.3%
irregular	22.7%	
Others		33.3%
Base	44	12

Thirty percent of household respondents replied that they had problems of discharging waste. The biggest problem is the handling of accumulated waste for one month.

d.2.3. In Ger Area without Collection Service

Some areas were still left without a collection service. Interviewees in these areas were asked how they dispose of their waste, how much they needed the collection service, and how much they were willing to pay for the collection service. Since the number of samples was limited, 8, the result can be only as a reference. Out of 7 people who burned waste at the stove or outside, 6 replied that they burned plastics along with other waste.

Table 2-42: How is your waste disposed of? (Multiple answer)

It is dumped on the street, in the canal or open land.	37.5%
It is burned at the stove	25.0%
It is burned outside.	62.5%
It is buried in the garden	12.5%

Base: 8

Most of respondents recognized various problems caused by the lack of the collections service.

Table 2-43: What kinds of problems do you face now because there is no collection service? (Multiple answer)

Wastes are scattered around my house	100%
There are a lot of insects and rodents.	100%
There is a problem of offensive odor	100%
River/underground water is contaminated by waste.	37.5%
People suffer from skin diseases.	100%
People suffer from diarrhea	12.5%
Drainage canals are blocked with waste.	62.5%

Base: 8

d.2.4. Summer house

Fifty four respondents (13.5%) had summer houses. On average, they spent 87 days per year, mainly in summer. About half of respondents discharge their waste at a common discharge point regardless of the collection day. This might cause problems such as scattered waste.

d.3 Collection Service

To those who received a collection service, their opinions about the current collection service were asked, while samples who did not receive a collection service were asked how much they needed a collection service and how much they were willing to pay for it.

d.3.1. Payment of Waste Collection and Other Utility Services

Before asking about their opinions about the current collection service, questions about the collection fee and its payment were asked. 97% of the household respondents and 96% of the business respondents reply that they paid the collection fee directly to fee collectors or through the apartment maintenance fee. The result of other surveys such as an interview survey with renovation companies, however, shows that the actual payment rate is much lower than the result of this survey. The result described in d.2.2 also indicates that the actual payment rate is much lower.

The monthly amount of payment for the collection fee was asked along with other utility services. The average payments are summarized below. According to another interview survey with an electricity distribution company shows that 20% of households actually paid the fee. Therefore, it can be said that this result is the amount of rate which respondents were charged, rather than which they paid. In either case, households in the Ger area have to pay more than people in the Apartment area for basic utility services, even though their income level is lower.

Table 2-44: Average Payment for Utility Service

Households

Mean (Tg)	Apartment with garbage chute		Apartment without garbage chute		Gel area with collection service		Total	
	Average	# of samples	Average	# of samples	Average	# of samples	average	# of samples
1. waste collection service (monthly)	1,177.8	94	1,035.9	92	1,745.2	198	1,468.7	384
2. electricity (monthly)	13,268.8	94	11,135.8	91	6,903.7	205	9,426.9	390
3. drinking water (monthly)	5,803.0	91	4,434.4	86	1,264.5	187	3,148.1	364
4. telephone (monthly)	13,778.5	79	13,381.8	55	18,087.5*	20	14,196.4	154
5. coal/wood (annually)		0	12,533.3	3	55,971.4	203	53,882.5	206

* the number of sample who own fixed telephone or mobile phone sets was only 20. It seems that only those who really needed telephone owned the phone sets, and this probably made the average of payment very high.

Business Establishments

shop		Restaurant		Office		Hotel		Market		Total	
Average	# of samples	Average	# of samples	Average	# of samples	Average	# of samples	Average	# of samples	average	# of samples
8,700	21	16,794	17	38,629	16	39,781	18	90,295	19	38,658	91
80,475	20	144,222	18	652,111	18	346,294	17	782,750	20	403,070	93
28,883	12	71,200	15	347,793	17	282,438	16	134,882	17	183,624	77
75,000	13	31,438	8	212,350	20	245,357	14	129,063	16	154,556	71
299,375	8	600,000	1	8,741,667	3	400,000	1	2,408,333	6	2,319,474	19

In total, only 44.4 % of household respondents know who provided a waste collection service in their area, while more than 80% of business respondents know it. It is because most of business establishments pay the fee directly to collection service providers.

Since respondents in the Ger area are charged more than those who live in the Apartment area for the current collection service, 37.4% of the respondents thought the fee was too expensive. On the other hand, about half of business respondents replied that it was appropriate.

d.3.2. Evaluation of the Current Collection Service

To the question about the current collection service, household respondents living in apartments with garbage chute and business respondents were satisfied with the current collection service to some extent, while 80% of the respondents in the Ger area were not satisfied much or at all.

The main reasons for the dissatisfaction by household respondents are summarized below.

Table 2-45: Main reason for Dissatisfaction

	Apartment with garbage chute	Apartment without garbage chute	Gel area with collection service	Total
Frequency of collection is too few	**40.6%**	**26.9%**	**36.7%**	**35.2%**
Frequency of collection is irregular	15.6%	21.2%	24.7%	22.8%
Collection time is not appropriate	3.1%	0.0%	6.6%	4.8%
The garbage container at the collection points is always full of waste.	15.6%	7.7%	2.4%	5.2%
A lot of wastes are left on the streets.	15.6%	15.4%	12.0%	13.2%
A lot of waste are left around the container at the collection point	6.3%	21.2%	7.8%	10.4%
Collection point is far away from my house.	0.0%	5.8%	6.0%	5.2%
Others	3.1%	1.9%	3.6%	3.2%
total	100%	100%	100%	100%
Base:	32	52	166	250

Those who received a collection service at present were also asked if they recognized any changes in the quality of the service after the privatization of collection service. The majority of recipients did not recognize a major change.

The result of the question about the collection fee is summarized below. Since respondents in the Ger area pay more than those in the Apartment area, more respondents thought that the fee was too expensive.

Table 2-46: How do you think about the current collection fee?

	Household				Business
	Apartment with garbage chute	Apartment without dust chute	Gel area with collection service	Total	
Too expensive	5.3%	3.3%	37.4%	21.3%	12.0%
Expensive	63.8%	71.7%	54.4%	59.5%	30.0%
Appropriate	7.4%	2.2%	0.0%	2.3%	48.0%
Cheap	1.1%	1.1%	0.0%	0.5%	
Too cheap	22.3%	21.7%	8.3%	14.5%	2.0%
total	100%	100%	100%	100%	8.0%

Base: all

The survey asked interviewees if they were willingness to pay more for the better collection services. 27. 3% of the household and 17.0% of the business respondents agreed with the rise in the fee, while 46.5% of the household and 72.0% of business respondents thought that collection companies should take an effort to improve the quality of their services first.

The result of the question about the willingness and ability to pay for the improved collection service is shown below.

Table 2-47: Willingness and Ability to Pay for the Improved Collection Service

Household

Average (Tg)	Apartment with garbage chute	Apartment without garbage chute	Gel area with collection service	Average in total
willing to pay	1,100	1,000	1,300	1,200
afford to pay	1,500	1,300	1,600	1,500

Business

Average (Tg)	Shop	Restaurant	Office	Hotel	Market	Total
willing to pay	6,300	9,300	31,300	34,200	51,700	25,800
afford to pay	8,000	14,000	40,000	42,000	69,000	34,000

d.3.3. Need for Collection Service in the Non-Collection Area (Ger Area)

Since the number of samples is limited, the results of the survey are shown as references. 5 respondents out of 8 burned waste outside, while 3 respondents replied that they dumped it on the street or in a canal. As shown in the table below, all but 1 respondents needed the collection service very much.

Table 2-48: Do you need the collection service? Are you willing to pay?

Necessity of collection service	
Yes, very much	87.5%
Yes to some extent	0%
I do not need very much	12.5%
I do not need at all	0%

Willingness to pay	
Very willing	75.0%
Willing to some extent	12.5%
Not willing very much	0.0%
Not at all	12.5%

Base: 8

The result of question about the amount of the willingness to pay is shown below.

Table 2-49: Willingness to pay

Amount of willingness to pay (Tg)	Col
700	12.5%
750	12.5%
1000	25.0%
1500	25.0%
no response	25.0%
total	100%
Mean	1,075

e. Reuse/Recycling of Waste

Only 25.8% of household respondents in the Apartment area separate and sell recyclables, even though it is expected that apartment keepers are involved in recycling activities. On the other hand, about a half of respondents in the Ger area are involved in recycling activity.

According to the result of the business survey, 80% of the business respondents did not separate and sell recyclables.

To those who replied that they separated recyclables, types of waste which they recycled were asked. Table 2-50 shows the result. Glass and plastic bottles are the two main recyclables in Ulaanbaatar. In the Apartment area, recyclables were mainly sold to those who visit houses to buy theses goods, while in the Ger area more people went to shops or houses of buyers to sell recyclables.

Table 2-50: Share of Respondents who Recycle Waste by Item

Item	Household		Business				
	Urban	Rural	Shop	Restaurant	Office	Hotel	Market
Paper			16.7%	0%	0%	0%	0%
Cardboard	2.1%		33.3%	5.0%	0%	0%	0%
Glass bottles	91.7%	94.1%	66.7%	20.0%	0%	5.0%	0%
Aluminum can	25.0%	29.4%	50.0%	35.0%	0%	30.0%	0%
Metal can	4.2%	3.9%	16.7%	5.0%	0%	0%	0%
Plastic bottles	47.9%	66.7%	33.3%	15.0%	0%	15.0%	0%
Hard plastic				0%	0%	0%	0%
Soft plastic				0%	0%	0%	0%
Cloth/textile				0%	0%	0%	0%
Metal				0%	0%	0%	0%
Organic waste		1.0%		0%	0%	0%	0%
Base	48	102	6	8	0	6	0

To those who did not separate recyclable goods, the main reason for not recycling was asked. The results are summarized below. “Nonexistence of recycling system” was cited most as the main reason.

Table 2-51: Reasons for not recycling

	Household		Business
	Apartment	Ger	
It is inconvenient or difficult.	13.0%	11.6%	28.8%
It would take too much time.	4.3%	3.6%	7.5%
The need/benefit of recycling is not clear.	9.4%	6.3%	8.8%
There is no recycling system	69.6%	76.8%	52.5%
Others	3.6%	1.8%	2.5%

Base: 138, 112, and 80

f. Public Cooperation

5% of the household respondents and 24% of the business respondents has received an instruction how to deal with solid waste management. Khoroo governments are main provider of such instructions.

About 70% of the business respondents replied that someone in their organizations clean the adjacent public area near their shops/offices every day, while 70% of household respondents told that someone in their families sometimes clean the adjacent public area near their houses.

The respondents' most popular solution for problems such as scattered waste on the street was the enactment of an anti-littering law, particularly in the Ger area.

Table 2-52: Most Effective Measure to Solve Problems such as Waste Scattering

	Household		Business
	Apartment	Ger	
To enact an anti-littering law and regulation and control it strictly	32.8%	50.0%	33.0%
The number of collection vehicles and workers should be increased	12.4%	27.6%	17.0%
To instruct people how to discharge waste in order to improve the manner	25.3%	10.7%	18.0%
More street side waste containers have to be installed	23.1%	5.1%	24.0%
I do not know	4.8%	6.1%	7.0%
Others	1.6%	0.5%	1.0%

Base: All

During the socialist era, people were forced to participate in various activities in their offices, schools and communities. Among household respondents, 26.9% in the Apartment area and 11.2% in the Ger area replied that there were community based activities to improve liming conditions. In the Apartment area, the associations of apartment owners often organize this kind of activities, while in the Ger area Khoroo governments took an initiative. The number of respondents who actually participated in these activities was very small (10 respondents in the Apartment area and 19 respondents in the Ger area).

2.3.4 Findings of the Survey

(1) Awareness of environmental and waste issues

As a whole, the results of the POS indicate a high environmental awareness. Since pollution problems such as air pollution will be worsen for a while, people in UB would be more interested in environmental issues.

In the Ger area, due to the insufficient waste collection service, various problems such as scattered waste and illegal dumping along the main streets and in open spaces occurred. The result of the POS shows that people in the Ger area were more aware of problems caused by improper solid waste management than people in the Apartment area.

(2) Discharge and collection of waste in the Apartment area

In the Apartment area, most of waste was collected regularly, even though the quality of collection service was not high. In UB, apartments have keepers, who are in charge of keeping common space clean as well as securing safety of their apartment. As for the solid waste management, these keepers play an important role, and residents do not have to pay much attention to collection work. Consequently, the result of the POS could not show the actual situations of discharge and collection of waste, because respondents do not know well. Comparison with the result of the follow up interview survey with apartment keepers would be able to show actual conditions and problems to be solved.

(3) Discharge and collection of waste in the Ger area

In the Ger area, the majority of the respondents were not satisfied with the collection service, since the collection fee was high and its frequency was low. The need for a waste collection service in the Ger area is very high, but many people actually did not receive the collection service regularly because they could not pay the fee. As a result, many of them dumped their waste in an open space illegally, and this worsens the environmental conditions further in the Ger area.

(4) Recycling

The recycling rate in UB is not high. Since the number of final users of recyclables in UB is very limited, there are not many intermediate buyers, and ordinary people did not know where they could sell recyclables. Glass and plastic bottles are two main items of recyclables in UB.

2.4 Environmental Survey on the Conditions around Final Disposal Sites

2.4.1 Social Environment Survey

At present, there are three final disposal sites in UB. Due to the inappropriate operation and management, these three disposal sites cause environmental problems around the sites. In particular, it is urgent for MUB to take necessary measures to improve the operation of the disposal site in Ulaan Chuluut, which is the main final disposal site in UB.

In Ulaan Chuluut, a large number of people are living near the disposal site and along the main street, where many collection vehicles pass every day, while more than 200 waste pickers are working at the disposal site. In order to mitigate negative impacts of the improvement plan on these people, it is important for MUB to grasp the current environmental and living conditions of these areas and opinions of both local residents and waste pickers on the disposal site. Therefore, the team decided to conduct a social environmental survey around three final disposal sites.

a. Objective of the Survey

The social environmental survey has two different targets: (1) local resident living near disposal sites and along a main street where collection vehicles pass and (2) waste pickers. The local resident survey was conducted in three Khoroos, located in Duureg Songinokhairkhan, Khan Uul and Nalaikh respectively, while the waste picker survey was conducted only in Ulaan Chuluut, because the number of waste pickers at the two other disposal sites was not large. The location of three sites are shown in Figure 2-5.

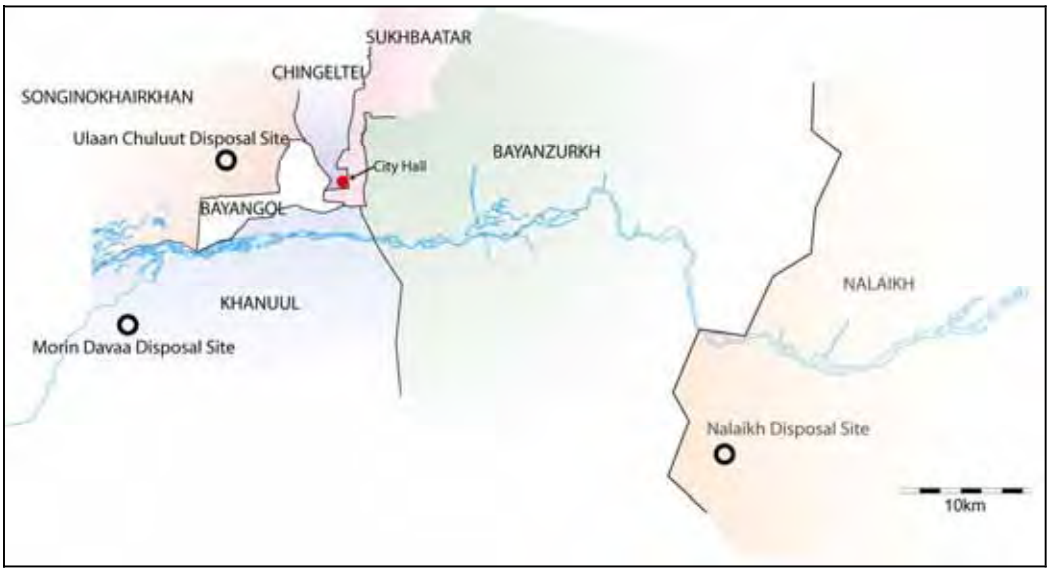


Figure 2-5: Location of Survey Sites

a.1 Local Resident Survey

The main purpose of the local resident survey is to obtain the opinion of people who are living around the disposal site about the current situation of the disposal site and its impact on their living conditions and surrounding environment. The results of the survey were reflected in the draft of the Master Plan on municipal solid waste management.

Because one of pilot projects aims at improving the operation of the Ulaan Chuluut disposal site, the result of the survey in Ulaan Chuluut will be reflected in the pilot project plan there.

a.2 Waste Picker Survey

The goal of the waste picker survey is to avoid or mitigate the negative impact of the operation/management improvement plan for the disposal site on them.

In addition, most of waste pickers had a deep distrust of people who visited the disposal site, since many of them took pictures without their approval and some of pictures appeared in the newspapers. The distrust made it extremely difficult for us to conduct a survey such as an observation survey to count the number of waste pickers at the disposal site. Therefore, the survey also aimed at establishing a relation of a mutual trust, by opening information on the project and listening to their opinions on current conditions of the disposal site.

b. Method of the Survey

b.1 Design of the Survey

The local resident survey was conducted in three Khoroos, which are summarized in the table below. Ulaan Chuluut is located relatively near from the center of the city, while two other sites are far away from it, as described in Figure 2-5.

Table 2-53: Information on Three Target Khoroos

	Ulaan Chuluut	Morin Davaa	Nalaikh
Location Duureg Khoroo	Songinokhairkhan, Khoroo 4	Khan Uul, Khoroo 3	Nalaikh Khoroo 12
Total Household Number in Khoroo	1,911	1,062	938
Total Population in Khoroo	Male: 4,826, Female: 5,034	Male: 2,225, Female: 2,607	Male: 2,004, Female: 2,119
Waste Pickers	Male: 83, Female: 98, Children: 72	Male: 7 Female: 8	12 persons officially informed but the locals said 40
Household number (waste pickers)	80	15	

Data were obtained from three Khoroo governments

Both the local resident and waste picker surveys consist of two parts: (1) an interview survey and (2) a focus group meeting. As already mentioned, the local resident survey paid more attention to Ulaan Chuluut, so the focus group meeting was organized only in Ulaan Chuluut.

In both survey, an interview survey was conducted first to obtain a general view. Based on the result of the interview survey, several topics for the focus group meeting were selected and discussed deeper at the meeting. The result of the interview survey was introduced at the meeting.

The basic design of both surveys is summarized as follows.

b.1.1. Local Resident Survey

(1) Interview Survey

1. Target area: the following areas in three Khoroos
   - within a radius of 1km from the disposal
   - along a main street where collection vehicles pass
2. Number of samples: 50 in Ulaan Chuluut and 15 in Morin Davaa and Nalaikh
3. Number of questions: around 40
4. Subject of survey:
   - Problems caused by the disposal site and opinion about possible solutions

- Awareness of environmental and solid waste management issues

(2) Focus Group Meeting

1. Target group: all the households located in the following areas in Khoroo 4 (Ulaan Chuluut)

- within a radius of 1km from the disposal (30 households)
- along a main street where collection vehicles pass (135 households)

2. Participants: one person from all the households in the target area

3. Number of participants: 50-100

4. Location: Cultural center

5. Subject of discussion:

- Introduction of the basic policy of solid waste management of MUB and a plan of pilot project at the Ulaan Chuluut disposal site
- Result of interview survey
- Current problems related to solid waste management including disposal site issuers
- Causes of problems and possible solutions.

b.1.2. Waste Picker Survey

(1) Interview Survey

1. Target group: waste pickers working at the disposal site

2. Number of samples: 20

3. Number of questions: around 40

4. Subject of survey:

- Problems they face while working at the disposal site
- Opinion about possible solutions
- Living conditions and environmental awareness
- Future plans

(2) Focus Group Meeting

1. Target group: all the waste pickers working at the disposal site in Ulaan Chuluut

2. Location: beside the office of Nuuts Company at the disposal site

3. Subject of discussion:

- Introduction of the basic policy of solid waste management of MUB and a plan of pilot project at the Ulaan Chuluut disposal site
- Result of interview survey
- Problems they face while working at the disposal site
- Causes of problems and possible solutions.
- Opinion about the plan of the pilot project

b.2 Selection of Samples and Meeting Participants

b.2.1. Local Resident Survey

(1) Interview Survey

At the time of interview survey, interviewees selected samples randomly from the target households, which are located within a radius of 1km from the disposal site and long the main street where collection vehicles pass, with support from the Khoroo and Kheseg.

(2) Focus Group Meeting

All the households in the target areas were invited. At the time of interview survey, interviewees were given previous notice of the meeting. The Khoroo 4 government distributed invitation letters to target households.

b.2.2. Waste Picker Survey

(1) Interview Survey

Because the team had not gained the trust of waste pickers yet at the time of the survey, it seemed impossible for the team to select samples directly. For that reason, the team asked Nuuts Company staff to select 20 people, considering the distribution in terms of age and sex. The interview survey was conducted at Nuuts Company's office at the disposal site.

Since interviewees were selected only from those who agreed with the survey, it is likely that interviewees tended to be more cooperative than average waste pickers.

(2) Focus Group Meeting

All the waste pickers who were working at the disposal site were invited. At the time of interview survey, a leaflet of the meeting was handed to all the interviewees. Nuuts company staff also informed waste pickers of the meeting.

b.3 Preparation of Questionnaire and Show Card

b.3.1. Questionnaire

(1) Local Resident Survey

The questionnaire is divided into nine sections: (1) general questions, (2) problems caused by solid waste, (3) your waste and its management, (4) reuse/recycling issues, (5) situation at the disposal site, (6) solutions of problems caused by waste, (7) relations with MUB, (8) health conditions, and (9) about the interviewee. The questions of the sections 1, 2, 3, and 4 were almost the same as those of the POS, so that the team could compare the opinions and behaviors of people in three Khoroos to those of other areas of MUB.

(2) Waste Picker Survey

The questionnaire is divided into seven sections: (1) family status, (2) family history, (3) general questions, (4) working conditions, (5) current living conditions and your health, (6) reason for starting waste picking and future plan, and (7) about you and your family.

b.3.2. Show Card

The Show Card, lists of answers, was prepared for both the local resident and waste picker surveys, in order to make it easier for interviewees to select most appropriate answers.

b.4 Execution of the Survey

b.4.1. Interview Survey

As already mentioned, the interview survey was conducted first. The survey for both local residents and waste pickers was conducted by three research assistants from the 4th of April to the 9th of April. The result was analyzed soon after the completion of the survey. Based on

the result of the interview surveys, key problems were selected as possible topics of the focus group meetings.

b.4.2. Focus Group Meeting

The focus group meeting for local residents and waste pickers were organized on the 19th and 20th of April respectively. Before the discussion started, the result of the interview survey was introduced so that all the participants could share common awareness of the issues.

(1) Local Resident Meeting

1. Participants: 80 local residents (approximately)
   Representative of MUB
   Representative of Duureg Songinokhairkhan
   Khoroo 4 Governor
   Director of Nuuts Company
   JICA study team members
2. Program:
   Opening remark by Khoroo Governor
   Introduction of Pilot Project by MUB representative
   Summary of the interview survey by JICA study team assistant
   Discussion

(2) Waste Picker Meeting

1. Participants: 70 waste pickers (approximately)
   Representative of MUB
   Representative of Duureg Songinokhairkhan
   Khoroo 4 Governor
   Director of Nuuts Company
   JICA study team members
2. Program:
   Opening remark by Khoroo Governor
   Introduction of Pilot Project by MUB representative
   Summary of the interview survey by JICA study team assistant
   Discussion

c. Result of the Survey

c.1 Local Resident Survey

c.1.1. Interview Survey

(1) About Interviewees

The number of samples by place of residence is shown in Table 2-54 and the distribution by age and sex is shown in Table 2-55. Since female members know about solid waste management issues more than male ones, the share of female respondents were dominant in number.

Table 2-54: Samples by Place of Residence

Location		Total
Ulaan Chuluut		50
near the disposal site	20	
right side of the main street where collection vehicles pass	14	
left side of the main street where collection vehicles pass	16	
Nalaikh		16
Morin Davaa		15
Total		81

Table 2-55: Distribution by age and sex

Age group	Female	Male	Total
18-24 years	20.0%	11.5%	17.3%
25-29 years	12.7%	11.5%	12.3%
30-34 years	14.5%	11.5%	13.6%
35-39 years	18.2%	7.7%	14.8%
40-44 years	18.2%	19.2%	18.5%
45-49 years	5.5%	23.1%	11.1%
50-54 years	7.3%	11.5%	8.6%
55-59 years	1.8%	3.8%	2.5%
60+	1.8%	0.0%	1.2%
Total number	55	26	81

The monthly household income by location of residence is shown below. Compared to the result of the POS, the household income level in Nalaikh is lower than the average of the Ger area in UB.

	Ulaan Chuluut	Nalaikh	Morin Davaa	Total
Less than Tg 44,000/month	22.0%	50.0%	6.7%	24.7%
Tg 44,000-Tg 110,000	58.0%	37.5%	80.0%	58.0%
Tg 110,000-Tg 250,000	18.0%	12.5%	13.3%	16.0%
I do not know	2.0%			1.2%

Base: all

(2) General Environment issues

About a half of the respondents in Ulaan Chuluut cited Environmental problems as the most serious problem in UB, while respondents in Nalaikh and Morin Davaa were mainly concerned about economic issues. The share of respondents in Ulaan Chuluut who cited environmental issues as the most serious problem was much higher, compared to the result of the POS. This could reflected from the serious situations in Ulaan Chuluut.

In all three Khoroos, respondents had the highest priority to solid waste management among basic social infrastructure in their community.

(3) Problems caused by solid waste

About 94% of respondents recognized problems caused by improper solid waste management in their areas. Most respondents complained about scattered waste in their areas, as shown in . In particular, scattered plastic bags were the symbol of troubles for them.

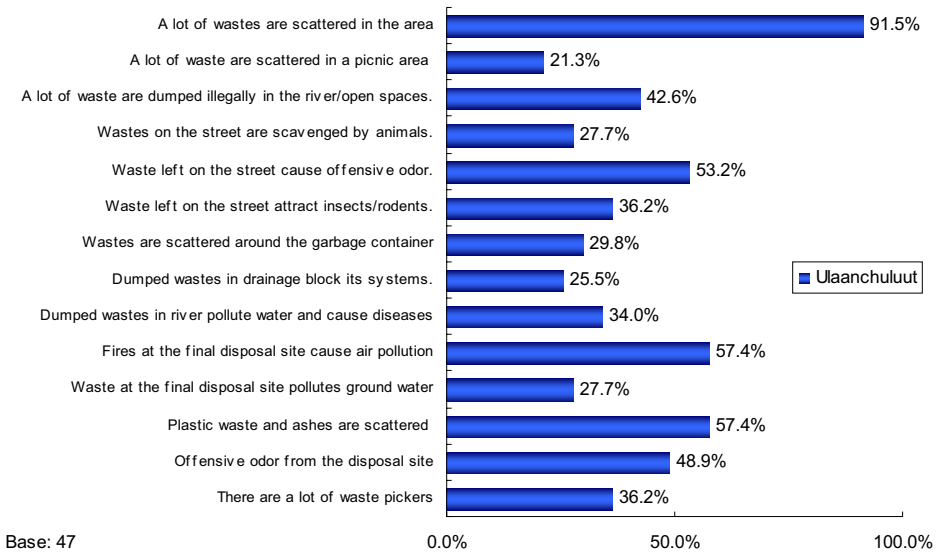


Figure 2-6: Recognized Problems Caused by Improper SWM

(4) Your Waste and Its Management

Even though large-scale waste generators were one of main sources of illegal dumping, the result of question about how waste was disposed of at each household indicated that many of local residents also dumped waste illegally. It is assumed that those who replied that they transported waste to a collection point in other area actually dumped waste there.

Table 2-56: How to Dispose of Waste

	Ulaan Chuluut		Nalaikh		Morin Davaa		total	
	count	col%	count	col%	count	col%	count	col%
It is collected by waste collection workers.	5	10.0%	2	12.5%	1	6.7%	8	9.9%
It is dumped on the street, in the canal or open land.	18	36.0%	5	31.3%	6	40.0%	29	35.8%
It is burned at the stove	1	2.0%	1	6.3%			2	2.5%
It is burned outside.	5	10.0%	3	18.8%			8	9.9%
It is buried in the garden.	2	4.0%	1	6.3%			3	3.7%
It is composted.	1	2.0%		0.0%			1	1.2%
It is transported to a collection point in other areas.	28	56.0%	10	62.5%	9	60.0%	47	58.0%
I do not know.								
total	50	100%	16	100%	15	100%	81	100%

(5) Reuse/Recycling of Waste

Compared to the result of the POS, more respondents were involved in reuse/recycling activities. Some waste buyers who did business with waste pickers were living in these Khoroos, and this could attribute to the higher percentage.

Table 2-57: Share of Respondents Who Separate and Sell Recyclables

	Ulaan Chuluut	Nalaikh	Morin Davaa
Yes	56.0%	75.0%	73.3%
No	44.0%	25.0%	26.7%
total	100%	100%	100%

Base: all

(6) Current Situations of Disposal Sites

A large majority of respondents were concerned about the adverse effect of the disposal site. In particular, they were worried about the environmental degradation. 61.7% of the Ulaan Chuluut respondents, 81.3% of the Nalaikh respondents, and 78.6% of the Morin Davaa respondents thought that the conditions of the disposal sites were worsened compared to 5 years ago.

The figure below shows the most and second most serious concerns respondents in Ulaan Chuluut had.

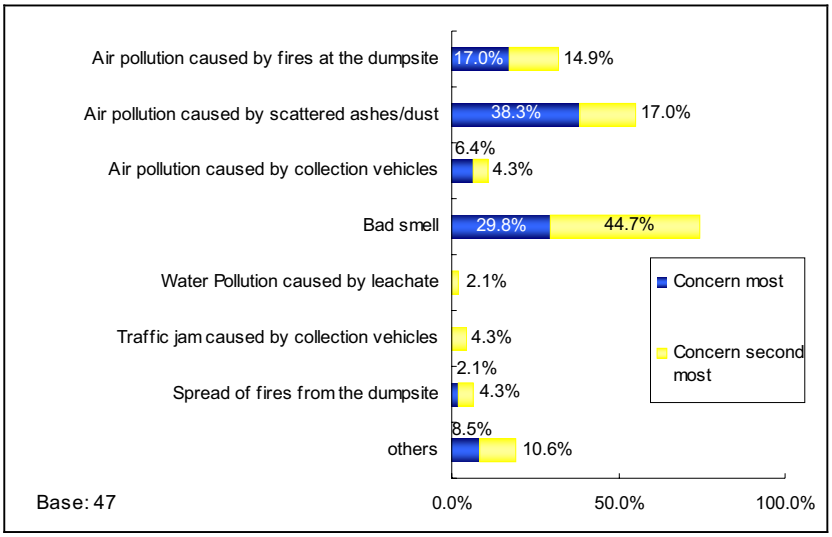


Figure 2-7: Issue Concern Most and Second Most in Ulaan Chuluut

(7) Solutions of problems caused by waste

As a solution to prevent illegal dumping and scattered waste, control by law and regulation and increase in number of collection vehicles and workers were the most popular measures among the respondents, as shown in the table below.

Table 2-58: Most effective measure to prevent scattered waste and illegal dumping

	Ulaan Chuluut	Nalaikh	Morin Davaa	Total
To enact an anti-littering law and regulation and control it strictly.	34.0%	50.0%	33.3%	37.0%
The number of collection vehicles and workers should be increased.	40.0%	25.0%	26.7%	34.6%
To instruct people how to discharge waste in order to improve the manner.	16.0%	6.3%	6.7%	12.3%
More street side waste containers have to be installed.	10.0%	18.8%	33.3%	16.0%
Total	100%	100%	100%	100%
Base: all	50	16	15	81

As the most effective solution to improve the conditions of the disposal site, 44% of the Ulaan Chuluut respondents cited the effort by ordinary people and business to reduce the volume of waste.

Table 2-59: Most Effective Measure to Improve Disposal Site

	Ulaan Chuluut	Nalaikh	Morin Davaa	total
The central government establishes strict regulations to control operation/management of the dumpsite	20.0%	25.0%	6.7%	18.5%
Ulaanbaatar City increases waste collection fee to finance the operation/management cost of the dumpsite	6.0%	25.0%	20.0%	12.3%
Ordinal people and business take an effort to reduce the volume of waste by further reuse/recycling of waste.	44.0%	12.5%	53.3%	39.5%
I do not know		6.3%	6.7%	2.5%
others (disposal site should be moved to somewhere else)	30.0%	31.3%	13.3%	27.2%
Total	100%	100%	100%	100%
Base: all	50	16	15	81

(8) Community Activities

About a half of the respondents replied that they participated in some activities in their community. Activities they participated are summarized. The main organizer of the government activities was the Khoroo government.

At present, 84% of respondents received information on UB through TV or radio. As a favorite media to get information on UB, about 30% of them cited Khoroo or district officer, while 60% liked to get information on UB through TV or radio.

Interviewees were asked if they faced environment related problems, with whom they consulted. About half of them chose Khoroo chief. In these three areas, Khoroo government and Khoroo chief are playing an important role.

c.1.2. Focus Group Meeting

At the meeting, key problems were identified and measures taken by each stakeholder in order to key problems were discussed. The result is summarized below.

(1) Problems caused by the disposal site

- A lot of wastes are scattered on the street from collection vehicles
- Plastic bags are scattered everywhere
- Traffic jam and accidents caused by collection vehicles
- Negative impact on health
- Bad smell
- Air pollution caused by ashes
- Flies
- Lot of dusts especially near by the houses close to the main road
- Disorder, alcoholism and robbery caused by waste pickers
- Waste pickers illegal dumping in the street
- Dogs

In addition, local residents were mentioning about illegal dumping and fires caused by public unconsciousness.

(2) Measures taken by each stakeholders

Individual level

- to bring wastes to the disposal site instead of dumping it illegally on the street
- to clean the streets
- to discharge waste to the collection vehicles and should know the schedule of the collection day
- to pay the waste collection fee

Government /khoroo

- to organize public cleaning at least 2 times a month
- to promote public participation and establish a mechanism in which people bare responsibility. (If the participation is weak then call an account.)
- to punish those residents who are not paying collection fees
- to inform collection schedule to the public
- to increase cooperation between khoroo and residents
- to place one big waste container in between 3 streets
- to establish 1 more police station

UB city

- to provide more waste collection vehicles
- to consider renewing of collection vehicles
- to improve road
- to dip up night soil

- to move disposal site to somewhere else

Nuuts company

- to control collection vehicles not to dump waste in the open site
- to have one more registration officer of collection vehicles in the last bus station
- to renew collection vehicles
- to get tax from private waste vehicles
- to stop dumping dog's meat

NGOs/International organization

- to organize health education training
- to promote public participation
- to promote homeless people who are in the care centers to participate in cleaning activities
- to take care of children who are working in the disposal site and provide for them training

Conclusions

Meeting concluded that local residents, UB city, khoroo, NGOs/International Organization should work closely for the improvement of disposal site in Ulaanchuluut.

c.2 Waste Picker Survey

c.2.1. Interview Survey

The results of the interview survey are briefly summarized.

(1) About Interviewees

The distribution of samples by age and sex is shown below.

	Female	Male	Total
18 – 24 years	21.4%		15.0%
25 – 29 years		16.7%	5.0%
30 – 34 years		16.7%	5.0%
35 – 39 years	7.1%		5.0%
40 – 44 years	42.9%	33.3%	40.0%
45 – 49 years	21.4%		15.0%
50 – 54 years		16.7%	5.0%
55 – 59 years	7.1%		5.0%
60 – 64 years		16.7%	5.0%
Base:	14	6	20

Interviewees were selected by a Nuuts Company staff at the time of interview survey. At this point of time, waste pickers in Ulaan Chuluut had a deep distrust of outsiders, since many people visited the disposal site and took their pictures without asking for their approval, and this hurt their pride. Therefore, it seems that those who agree with the interview survey tended to be more cooperative than average waste pickers. As a result, the share of women is larger than men.

On the other hand, the aggressive reaction of waste pickers against outsiders made it impossible for the team to conduct an observation survey, and the team does not have accurate data on the total number of waste pickers and their distribution by age and sex. Therefore, it is difficult to evaluate how much these samples represent the whole waste pickers. The team will continue to take an effort to establish a relationship of mutual trust

with them through the Pilot Project, and the necessary data could be obtained through this process.

The following table shows their educational background.

Table 2-60: Educational Background

	Female	Male	total
Some primary	7.1%	16.7%	10.0%
Completed primary school	35.7%	16.7%	30.0%
Some secondary	7.1%	33.3%	15.0%
Completed secondary school	50.0%	16.7%	40.0%
Technical/Vocational		16.7%	5.0%
total	100%	100%	100%
Base:	14	6	20

90% of the respondents lived in Khoroo 4, and 2 others live in Khoroo 3. 7. 35% of the respondents live near the disposal site. The table below shows the length of say at the current premises.

Table 2-61: Duration of Stay at the Current Premises

Duration of stay	count	col%
less than 1 year	3	15.0%
1 year - less than 3 years	7	35.0%
3 years - less than 5 years	6	30.0%
5 years - less than 10 years	2	10.0%
10 years and more	2	10.0%
total	20	100%

Among those who stayed at the current premises for less than 5 years (16 samples), the share of registered residents was 43.8%.

85% of the respondents had working experiences before starting to work at the disposal site, as shown in the table below. The types of previous job are also shown in the same table.

Table 2-62: Previous working Experience and Type of Job

	Female	Male	total
Yes	92.9%	66.7%	85.0%
No	7.1%	33.3%	15.0%
total	100%	100%	100%

Type of job	
tailor/dressmaker	35.3%
construction worker	17.6%
herder	17.6%
sales	17.6%
private	11.8%
total	100%
Base:	17

(2) General Questions

As shown in the figure below, the unemployment was selected by half as the most serious problem now in UB.

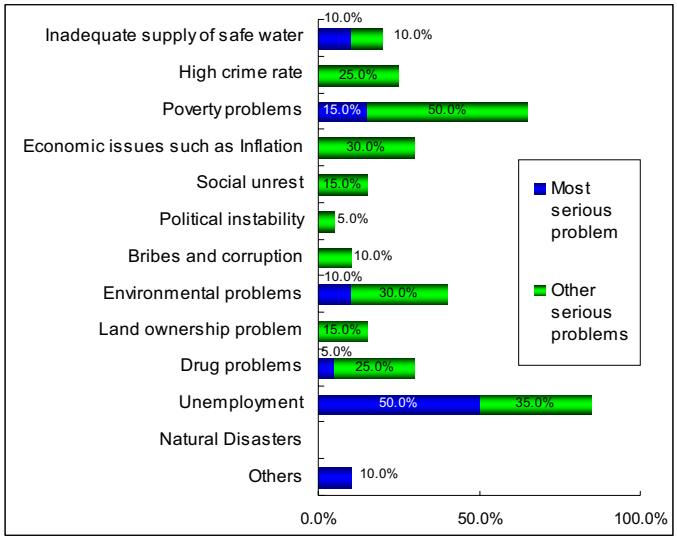


Figure 2-8: Most and Second Most Serious Problem in UB

(3) Working Conditions

85% of the respondents started to work at the disposal site in the last 5 years, while the others (3 respondents) had worked for more than 10 years.

Regarding the length of working hours, more than 80% of respondents worked for longer than 10 hours. The number of respondents who worked early in the morning or late at night was small, as shown in the figure below.

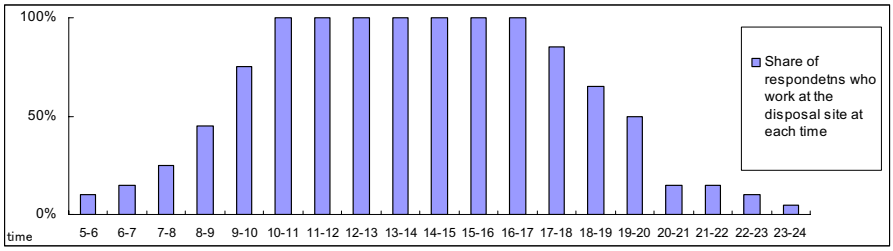


Figure 2-9: Share of respondents who work at the disposal site at each time

The items which they collected, the volume of collected item per day and daily earnings by selling these items were asked. The result is summarized below. The average daily amount by selling collected items is calculated based on the result.

Table 2-63: Collected Items, Earnings, and Waste Buyers

Items	Number of those who collect the item	Average volume collected	Average earning by selling the item (Tg)	To whom you sell?	
				1*	2**
paper	3	3.4 kg	61	1	2
cardboad	7	33 kg	490	0	7
glass bottles	19	97 bottles	610	2	17
aluminum cans	15	1.3 kg	580	2	13
metal cans	1	0.05 kg	30	0	1
plastic bottles	12	1.5 kg	510	2	10
soft plastics	17	3.3 kg	320	2	15
hard plastics	16	6.3 kg	320	2	14
cloth/textile					
metal	13	24 kg	450	2	6
organic waste					
Plastic bag	2	1.0 kg	140		2
Daily average earning					Tg 3,500

1*: Depo/shop
2**: to those who come to the disposal site

30% of the respondents had received a hygiene training program. Regarding protective goods, 90% of them used some kinds of protective equipments or tools. The percent of the respondents who used protective goods by items is shown below.

	Female	Male	total
Shoes	7.7%	40.0%	16.7%
boots	15.4%	40.0%	22.2%
gloves	92.3%	100%	94.4%
thick clothes	30.8%	40.0%	33.3%
mask	61.5%	40.0%	55.6%
others	61.5%	60.0%	61.1%
glass	7.7%	20.0%	11.1%
scarf	15.4%		11.1%
hook	38.5%	40.0%	38.9%
cap	15.4%		11.1%
total	100%	100%	100%
Base	13	5	18

As the most serious problem at the disposal site, 30% of the respondent selected “possibility of accidents”. In total, accident was the most serious concern at the disposal site along with fire and air pollution, as shown in the figure below.

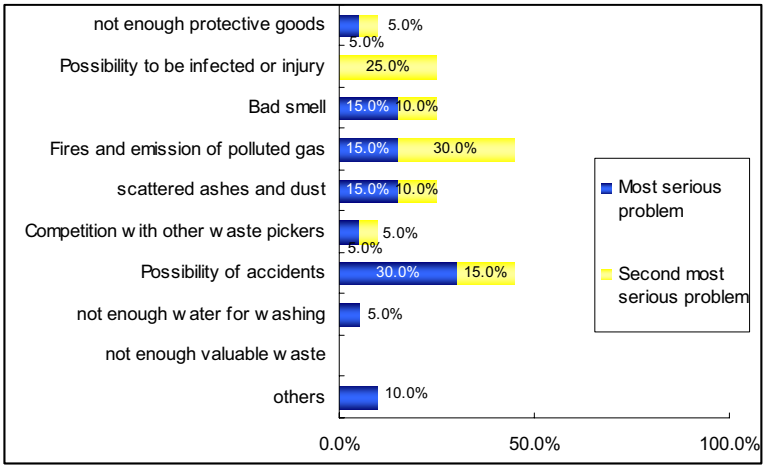


Figure 2-10: Most and Second Most Serious Problems at the Disposal Site?

(both are single-answer questions)

The survey tried to grasp how much percentage of the respondents had an experience of accident or infected.

Table 2-64: Accidents and injury at the disposal site

Have you ever had any experiences of being injured at the dumpsite?

Yes	30%
No	70%

Have you ever had a narrow escape from a collision with a collection vehicle or bulldozer at the dumpsite?

Yes	30%
No	70%

Have you ever had an experience of being infected at the disposal site?

Yes	0%
No	100%

Base: 20

A quarter of the respondents had children of 15 years old or under who were also working at the disposal site. In total, there are 6 children who are working at the disposal site with respondents. Their ages are between 10 and 16. Only one of them goes to school.

(4) Introduction of Rules at the Disposal Site

After explaining the outline of the pilot project briefly, interviewees were asked their opinions about the improvement of environmental conditions such as mitigation of odor. 95% of them valued it high to some extent. All the respondents thought that it was necessary to tale a measure to protect them and their children from accidents at the disposal site.

To the question about the introduction of rules such as the working area separation at the disposal site, 90% of the respondents agreed with rules.

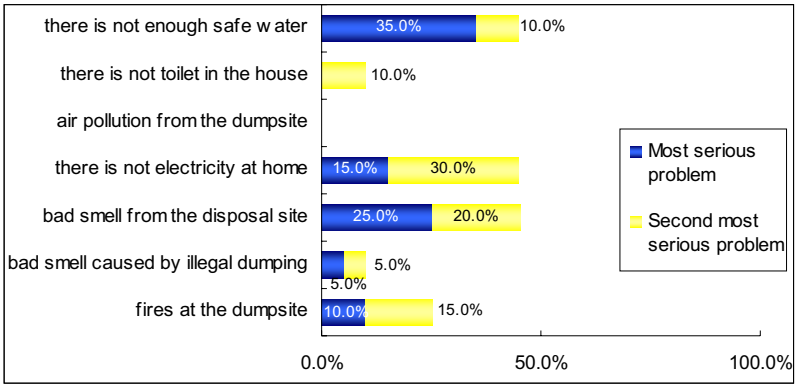
Table 2-65: Opinion about the introduction of rules at the disposal site

	Female	Male	total
If safety is enhanced and the environment is improved, I agree with rules.	92.9%	83.3%	90.0%
It is good to enhance the safety, but if this reduce the working time and revenue, I am against rules.	7.1%	16.7%	10.0%
I do not care the accidents and I am against the introduction of any rules.			
Total	100%	100%	100%
Base:	14	6	20

(5) Living Conditions

Regarding the daily life, bad smell and inadequate supply of basic need such as safe water and electricity were selected as the most and second most problems.

Figure 2-11: Most and second most serious problems regarding daily life
(both are single-answer questions)



(6) Future Plan

65% of the respondents started to work at the disposal site because they had any other choices. All of the interviewees wanted to do other jobs if possible. 65% of them thought that any types of works were acceptable if they could find. Age limit and prejudice against their appearances were thought to be the biggest obstacles to find other jobs.

They were asked how would they do if the disposal site would be moved to another area, 60% of them replied that they wanted to continue to work at the new disposal site, as shown below.

Table 2-66: If the dumpsite is moved to another place, what are you going to do?

	col%	count	count
want to continue to pick up waste at the new site	57.1%	66.7%	60.0%
to pick up waste on the street	7.1%	16.7%	10.0%
want to start new job such as collection work	21.4%		15.0%
will find some other job	14.3%	16.7%	15.0%
Total	100%	100%	100%
Base:	14	6	20

c.2.2. Focus Group Meeting

At the meeting, key problems were identified and measures taken by each stakeholder in order to key problems were discussed, in the same way as the local resident meeting. The result is summarized below.

(1) Problems caused by disposal site

- Smoke
- Pollution
- Fire
- Bad smell
- Homeless people

Problems regarding working condition

- working condition is poor
- Inadequate water supply
- not enough protective tools (mask, gloves etc)
- inadequate and poor sanitation and hygiene (no toilets)

(2) Possible ways to solve problems caused by disposal site

Individual level

- not to make fire
- to consider occupational safety
- to register in the khoroo
- not to allow their children to work in the disposal site
- not to allow to sell food/meal in the disposal site and set up kiosk

Government /khoroo/

- to register waste pickers and issue ID
- to provide access to health insurance
- to provide social allowances (3000Tgs) to the waste pickers
- to consider homeless people

UB city

- to improve current situation
- to create recycling company
- to create kiosk near the disposal to buy waste
- not to send journalist and TV to the disposal site

Nuuts company

- no to allow collection vehicles to load burning wastes
- to make collection vehicle drivers drive carefully
- to dump wastes in the proper place
- to control drivers of collection vehicles

NGOs/International organization

- to organize health screening at least once a month
- to provide training to the children working at the disposal site
- to stop taking photos/recoding
- to stop report false information on newspaper about waste pickers
- to stop misleading advertisement to waste pickers (by religious organization)

d. Findings

d.1 Local Residents Survey

(1) Awareness of problems caused by improper solid waste management

Local residents was aware of problems caused by improper solid waste management in Ulaan Chuluut. In particular, they were concerned environmental degradation in Ulaan Chuluut by the disposal site and illegal dumping, and its negative impact on their health.

The result of focus group meeting shows that some of them already considered possible solutions seriously.

However, their knowledge on solid waste management is limited. It is necessary for the team to support them to deepen the knowledge on SWM.

(2) Disposal Site

Most of the local residents want the disposal site to be moved to somewhere else. But they welcome the pilot project at the UCDS.

(3) Illegal Dumping

Whole the area in Khoroo 4, waste is scattered. In particular, plastic bags were flying everywhere. Most of meeting participants wanted to clean their areas.

Even though large-scale waste generators were main source of illegal dumping, local residents also dump their waste in an open space. According to the result of the focus group meeting, many of meeting participants recognized this. However, it seems difficult to stop local resident from dumping waste in an open space soon, because poor quality of collection service and its high collection fee are main factors for them not receiving the collection service.

(4) Khoroo Government

The government of Khoroo 4 was also concerned about problems caused by waste, and was willing to took a leading role to solve these problems. It is important for the team to support Khoroo 4 to increase people's awareness on SWM and to promote public participation to SWM.

(5) Others

This environmental social survey provided an opportunity for local residents to express their concerns about solid waste management in Ulaan Chuluut and to discuss with MUB. Te result of the interview survey was fed back to them at the focus group meeting. This could show them how their opinions were reflected in the plan of the pilot project at UCDS. As a result, MUB and the team could gain the confidence of local residents.

It is important to strengthen the relation by opening information further and exchanging opinions with them.

d.2 Waste Pickers Survey

(1) Establishment of Mutual Trust

Since most of waste pickers had a deep distrust of outside people, it is critical for MUB and the team to establish mutual trust with them in order to implement the pilot project at the UCDS.

This survey provided the first opportunity for both sides to know each other. Waste pickers could express their concerns and requests to MUB for the first time. It was a good opportunity for MUB to explain the plan of the pilot project directly to them, since there were inaccurate rumors about the future of the UCDS.

It is important for MUB and the team to continue to open information on the future plan of the UVDS to them and to arrange a place where the both side exchange opinions in order to establish mutual trust.

Even though the purpose of the visit is for the public interest, those who visit the disposal site to study the conditions of waste pickers should pay respect to them. Their right of to refuse to be photographed should also be considered seriously.

(2) Working Conditions

Waste pickers faced various problems. What they were concerned most was the possibility of accidents. The pilot project could decrease the risk of accidents considerably.

They also wanted to improve sanitary and hygienic conditions of the disposal site. At the focus group meetings, they requested to install toilets and water supply facilities.

(3) Living Conditions

Since many of them lived near the disposal site, their living conditions were also affected by the disposal site.

(4) Future Plan

Even though all the respondents wanted to deal with other jobs, they thought it was difficult to find other jobs. Therefore, if the disposal site moves to somewhere else, the majority of them wanted to continue to work at the disposal site.

(5) Child Waste Pickers

There are a lot of waste pickers, and many of them dropped out of school.

2.4.2 Water Quality Survey

The water quality survey was conducted twice in winter season and summer season.

a. Objectives

The purpose of this work is to obtain data on the water quality of leachate and underground water around disposal sites (UCDS, MDDS, NDS) and Narangiin Enger PDS. Based on the field investigation carried out at and around disposal sites and Narangiin Enger PDS, there is no leachate observed due to climate conditions and/or characteristics of waste composition. Therefore, the Study Team decided to take samples from following points.

- Underground water at wells around UCDS, MDDS and NDS
- Surface water around UCDS and Narangiin Enger PDS
- Surface water at Tuul River near MDDS

b. Samples and Sampling Points

The sample number and sampling points are shown below.

Table 2-67: Sampling Points and Location

No of Sample	Location			Water Sources	Sampling Season	
	Name	North latitude	East longitude		Winter	Summer
1	Ikh naran	N 47055'53.4	E 106047'41.4	Well	Done	Done
2	Baga naran-1	N 47055'43.8	E 106047'03.8	Well	Done	Done
3	Baga naran-2	N 47055'47.4	E 106047'33.5	Well	Done	Done
4	School of #65. south	N 47055'15.1	E 106047'39.3	Well	Done	Done
5	Morindavaa	N 47050'15.3	E 106041'07.5	Well	Done	Done
6	Nalaikh	N 47047'41.8	E 107025'13.5	Well	Done	Done
7	Tuul River	N 47051' 20.0	E 106042'35.0	Surface water	Done	Done
8	Spring of Naran (1)	-	-	Surface water	-	Done
9	Spring of Naran (2)	-	-	Surface water	-	Done
10	North spring of Naran	-	-	Surface water	-	Done
11	Entrance of UBDS	-	-	Surface water	-	Done
12 Reference well	Centre water source (Tuv San)	N 47046'23.0	E 107016'20.7	Tap water	-	Done
13	Bore-hole at Naran	-	-	Ground water	-	Done

The above sampling points and reference well are shown in the following figures.

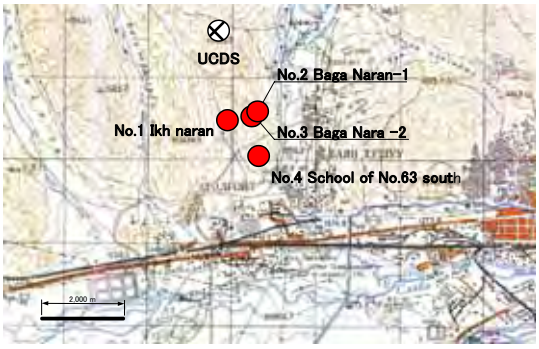


Figure 2-12: Sampling Point around UCDS

Figure 2-13: Sampling Point around MDDS

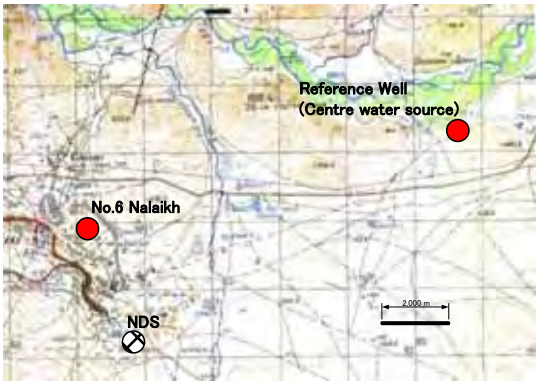


Figure 2-14: Sampling Point around NDS

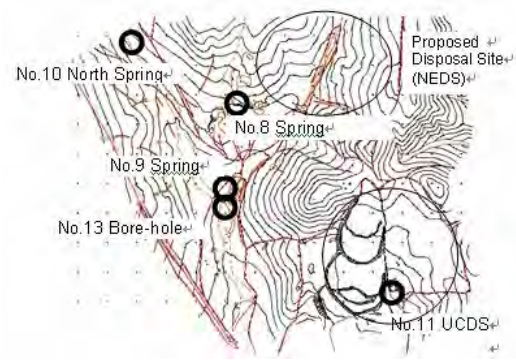


Figure 2-15: Sampling point around Narangiin Enger

c. Methodology

c.1 Water Sampling

Sampling was carried out in the winter season (Jan, 2005) and summer season (Aug, 2005) at designated points by the Study team and local consultant.

- Water samples were taken in the daytime.

- The location of sampling points was decided by the Study team and the local consultant.
- Water sample were stored in a car and protected from the sun after sampling.

c.2 Water Quality Measurement and Analysis

Three laboratories, Laboratory of Institute of Chemistry and Technology, Laboratory of Institute Physic and Laboratory of State Specialized Inspection Agency were selected for conducting water quality measurement and analysis. Two parameters, i.e. temperature and pH, were measured in the field.

Table 2-68: Examination Method for Each Parameter

No	Parameters	Method		Laboratory
		MNS No	Description	
1	Temperature	1097-70	AD-5624 Thermometer	Field test
2	pH	1097-70	pH meter D-51	
3	Electric conductivity	1097-70	Conductivity meter Â-173	Laboratory of Institute of Chemistry and Technology
4	Turbidity	3900-86	-	
5	Color	1097-70	Visual comparison method DR/850 Color meter (HACH)	
6	BOD	1097-70	Binkler method	
7	COD	1097-70	Binkler method	
8	SS	3899-86	Binkler method	
9	Hardness	1097-70	EDTA Titrimetric method	
10	Ammonium nitrogen(NH_4^+)	1097-70	Colorimetric method	
11	Nitrogen nitrate	1097-70	Colorimetric method	
12	Sodium (Na_2^+)	1097-70	Flame photometric method	
13	Potassium (K^+)	1097-70	Flame photometric method	
14	Calcium(Ca_2^+)	2572-78	EDTA Titrimetric method	
15	Magnesium ($Mg2^+$)	1097-70	EDTA Titrimetric method	
16	Sulfate (SO_4^{2-})	3898-86	Gravimetric method	
17	Chloride (CL^-)	3976-87	Argenometer method (titration)	
18	Hydrocarbonate(HCO_3^-)	1097-70	Titrimetric method	
19	Total Phosphorus	17,1.5.05-78	Stannous chloride method	
20	Hexavalent chromium	1097-70	Colorimetric method	
21	Total chromium	1097-70	Colorimetric method	
22	Cadmium (Cd)	1097-70	Spectrometer PERKIN-ELMER 5000	Laboratory of Institute Physic
23	Lead (Pb)	1097-70	Spectrometer PERKIN-ELMER 5000	
24	Zinc (Zn)	1097-70	Spectrometer PERKIN-ELMER 5000	
25	Total mercury (Hg)	1097-70	Spectrometer PERKIN-ELMER 5000	
26	Alkalescency	ISO 4698:98 1066	-	Laboratory of State Specialized Inspection Agency
27	Oil content		-	
28	Number of Colon bacteria		-	
29	As	-	AAS 84T	SGS Mongolia
30	CN	-	SOL85W	

d. Results of Water Quality Survey

The results of the water quality analysis are shown in the tables below.

Table 2-69: Results of Water Quality Analysis (winter season)

No	Analysis item	Unit	Number of Samples								Detection Limit (DL)	Mongolia Standard		WHO
			1	2	3	4	5	6	7	Reference		Surface water quality standards	Drinking water quality standards	Drinking Water Guideline *2
			Ikh naran	Baga naran -1	Baga naran -2	School of #65. south	Morindava a	Nalaikh	Tuul River	Tuv San				
			Well	Well	Well	Well	Well	Well	Surface water	Central source*1				
1	Groundwater level	m	4.2	12	30	54	42.0	80	-	-	-	-	-	-
2	Temperature	^{0}C	4.1	4.0	3.6	3.9	4.1	4.2	4.6	9.3	DL= 0.1	-	-	Acceptable
3	pH	-	7.7	7.8	7.7	7.7	7.7	7.8	7.0	6.8	DL= 0.1	6.5 - 8.5	6.5-8.5	-
4	Electric conductivity	µs/cm	787	477	508	810	311	502	131	113	DL= 1	-	-	-
5	Turbidity	FAU	1.0	< 0.1	< 0.1	< 0.1	1.0	< 0.1	< 0.1	0	DL= 0.1	-	5.0 mg/l	Average (1 NTU) Single sample (5 NTU)
6	Color	grade	colorless	colorless	colorless	colorless	colorless	colorless	colorless	60	-	-	20 grade	15 grade
7	BOD_5	mg/l	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	1.2	-	DL= 0.5	3 mg/l	3 mg/l	-
8	COD	mg/l	8.2	8.5	9.0	8.4	9.2	9.0	8.3	-	DL= 0.5	10 mg/l	10 mg/l	-
9	SS	g/l	0.7	0.5	0.5	0.7	0.3	0.1	0.9	-	DL= 0.1	-	1000 mg/l	-
10	Hardness *3	mg-eq/ml	9.7	5.3	5.2	9.5	3.5	0.8	40.6	-	DL=0.1	-	7 mg eq/l	-
		mg-$CaCO_3$/l	470.4	265.2	260.2	475.4	175.2	40.0	5.6	-	DL= 0.1	-	300 mg/l	-
11	Ammonium (NH_4^+)	mgNH_4/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.007	DL= 0.1	0.5 -	1.0 mg/l	-
12	Nitrogen nitrate (NO^{2-}) *3	mgNO_2/l	92.0	28.2	32.9	85.8	17.4	0.7	21.6	0.0	DL= 0.1	9.0 mg/l	10 mg/l	-
13	Sodium (Na^{2+})	mgNa/l	24	26	28	26	17	3	29	-	DL= 1	-	-	200 mg/l (c)
14	Potassium (K^+)	mgK/l	0.6	0.6	1.2	1.2	0.6	0.6	0.7	-	DL= 0.1	-	-	-
15	Calcium(Ca^{2+}) *3	mgCa/l	132.1	72.1	80.1	132.1	40.0	14.0	35.5	1.04	DL= 0.1	-	100 mg/l	-
16	Magnesium (Mg^{2+}) *3	mgMg/l	34.1	20.7	14.6	35.3	18.2	1.2	19.4	6.41	DL= 0.1	-	30 mg/l	-
17	Sulfate (SO_4^{2-})	mgSO_4/l	72.0	33.6	24.0	67.2	28.8	19.2	40.0	5.3	DL= 0.1	-	300 mg/l	250 mg/l (c)
18	Chloride (Cl-)	mgCL/l	106.3	34.5	48.8	103.4	14.4	5.7	42.6	6.6	DL= 0.1	300 mg/l	300 mg/l	250 mg/l (c)
19	Hydrocarbonate(HCO_3^-)	mgHCO_3/l	229	256	244	223	195	40	256	-	DL= 1	-	-	-
20	Total phosphorus	mgP/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.017	DL= 0.1	-	3.5 mg/l	-
21	Hexavalent chromium	mgCr^{6+}/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	-	DL= 0.1	0.01 mg/l	-	-
22	Cadmium (Cd)	mg/l	0.04	0.03	0.03	0.03	0.04	0.04	0.05	-	DL= 0.01	0.005 mg/l	0.01 mg/l	0.003 mg/l
23	Lead (Pb)	mg/l	0.05	0.02	0.06	0.04	0.03	0.04	0.06	0.0129	DL= 0.01	0.01 mg/l	0.03 mg/l	0.01 mg/l
24	Zinc (Zn) *3	mg/l	0.12	0.12	0.05	0.07	0.06	0.14	0.16	0.124	DL= 0.01	0.01 mg/l	3.0 mg/l	3 mg/l (c)
25	Total mercury (Hg)	mg/l	0.0002	0.0003	0.0003	0.0002	0.0002	0.0002	0.0003	-	DL=0.0001	0.0001 mg/l	0.001 mg/l	0.001 mg/l
26	Total chromium	mgCr/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	-	DL= 0.1	0.05 mg/l	0.05 mg/l	0.05 mg/l (p)
27	Alkalescency	mg-eq/l	4.1	4.6	4.1	5.0	3.4	1.2	5.6	43	DL= 0.1	-	-	-
28	Oil content	mg/l	3.2	1.72	<0.01	<0.01	<0.01	<0.01	<0.01	-	DL= 0.01	0.05 mg/l	0.05 mg/l	-
29	Number of colon bacteria	ml	1ml=100	1ml=6	1ml=4	1ml=2	1 ml=5	1ml=4	1ml=260	0.2	DL= 1	-	100 number/1cm^3	-

Note: *1: Source: The study on water supply system in Ulaanbaatar and surroundings, JICA, 1995

*2: WHO drinking water guideline: P = provisional guideline value, as there is evidence of a hazard, but the available information on health effects is limited; T = provisional guideline value because the calculated guideline value is below the level that can be achieved through practical treatment methods, source protection, etc.; C = concentrations of the substance at or below the health-based guideline value may affect the appearance, taste or odour of the water, resulting in consumer complaints.

*3: Measurement in winter season

Table 2-70: Results of Water Quality Analysis (summer season)

No	Analysis item	Unit	Number of Samples													Detection Limit (DL)
			1	2	3	4	5	6	7	8	9	10	11	12	13	
			Ikh naran	Baga naran -1	Baga naran -2	School of #65. south	Morindava a	Nalaikh	Tuul River	Spring of Naran (1)	Spring of Naran (2)	North spring of Naran	Entrance of UCDS	Central water source	Bore-hole at Naran	
			Well	Well	Well	Well	Well	Well	Surface water	Well	Surface water	Surface water	Surface water	tap water	Ground water	
1	Groundwater level	m	4.2	12	30	54	42.0	80	-	-	-	-	-	Tap	---	-
2	Temperature	^{0}C	9	5	6	7	5	9	16	20	18	16	-	16	17.1	DL=1
3	pH	-	7.0	7.0	7.0	7.2	7.4	7.3	6.8	7.9	7.1	6.8	6.9	6.1	7.6	DL=0.1
4	Electric conductivity	µs/cm	1103	937	650	1046	420	738	68	233	540	420	Impossible to Measure	61	450	DL=1
5	Turbidity	FAU	6	< 1	< 1	< 1	<1	< 1	9	4	180	376	Impossible to Measure	<1	**	DL=1
6	Color	degree	0	0	0	0	0	14	11	31	375	456	4844	0	4.0	-
7	BOD_5	mg/l	3.0	5.0	4.1	2.2	3.7	3.8	3.8	3.7	2.8	2.6	1176.4	4.1	43.6	DL=0.1
8	COD	mg/l	10.0	2.5	21.3	12.5	10.0	15.0	18.8	8.8	8.8	5.0	875.0	3.8	1500.0	DL=0.1
9	SS	g/l	1088	79	48	94	36	486	46	195	417	381	4604	113	484.5	DL=!
10	Ammonium (NH_4^+)	mgNH_4/l	0.12	0.09	0.14	0.12	0.07	0.13	0.15	0.09	0.14	0.14	0.35	0.15	1.50	DL=0.01
11	Total Nitrogen (T-N)	mgN/l	0.28	0.19	0.27	0.23	0.18	0.31	0.39	0.15	0.32	0.39	0.71	0.28	1.95	DL=0.01
12	Sodium (Na^{2+})	mgNa/l	26	31	25	25	14	5	5	15	20	12	1805	3	10.05	DL-1
13	Potassium (K^+)	mgK/l	3.1	2.1	1.8	2.2	1.6	1.6	1.5	2.1	5.5	2.4	813.3	1.0	9.65	DL=0.1
14	Sulfate (SO_4^{2-})	mgSO_4/l	40.3	40.5	50.6	81.6	45.2	56.3	56.2	49.9	72.0	45.2	105.5	62.4	52.83	DL=0.1
15	Chloride (Cl-)	mgCl/l	136.3	108.0	69.8	131.3	58.1	58.1	53.2	66.5	76.4	76.4	412.3	66.5	13.91	DL=0.1
16	Hydrocarbonate(HCO_3^-)	mgHCO_3	262	238	244	276	192	290	46	99	281	220	3721	38	244.0	DL=1
17	Total phosphorus	mgP/l	0.42	0.03	0.02	0.14	0.20	0.14	0.21	0.20	0.12	0.18	0.86	0.24	0.05	DL=0.1
18	Hexavalent chromium	mgCr^{6+}/l	< 0.001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	0.015	< 0.001	---	DL=0.001
19	Cadmium (Cd)	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.014	DL=0.001
20	Lead (Pb)	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.12	<0.005	0.005	DL=0.005
21	Total mercury (Hg)	mg/l	0.0074	0.0003	0.0004	<0.0001	0.0004	0.0002	0.0008	0.0008	0.0013	0.0005	0.0004	0.0007	0.0038	DL=0.0001
22	Total chromium	mgCr/l	< 0.01	0.12	< 0.01	0.06	0.21	0.14	0.24	0.04	0.11	0.120	8.83	0.40	0.138	DL=0.01
23	Alkalescency	mg-eq/l	4.3	3.9	4.0	4.5	3.2	4.8	0.8	1.6	4.6	3.6	61.0	0.6	4.0	DL=0.1
24	Oil content	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.19	<0.01	---	DL=0.01
25	Number of colon bacteria	ml	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	---	DL=1
26	CN^- *1	mg/l	0.04	0.02	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.02	DL=0.01
27	As *2	mg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	DL=1.0

*1 Measurement in summer season, Drinking water standard = 0.03 mg/l

*2 Measurement in summer season, Drinking water standard = 0.01 mg/l

e. Findings

e.1 Conditions of Sampling Points

The survey was conducted in the Study area during the winter season and summer season. The results obtained through this survey are limited for concluding all the characteristics of water quality in this region.

<Winter season>
The temperature in the Study area in winter is well below minus degrees, so all the surface water is frozen and there is no leachate observed at the disposal sites. Therefore, sampling points are limited to underground water in the wells or deep water in the Tuul River which is used for taking drinking water.

<Summer season>
Measurement for the summer season was carried out in August. The average temperature in the summer season is 15℃ with average monthly rainfall of 70mm. However, despite it being the rainy season, leachate was not detected at any of the disposal sites. The reasons for this are thought to be (1) the absolute amount of rainfall in the study area is low and moisture evaporation is high, (2) the moisture content of waste disposed is low and the water discharge from waste consolidation is also low.

The distances from UCDS, MDDS and NDS to the surrounding selected sampling points are from around 0.5 km to 3 km, and there is no sampling point found nearer these points. In addition, the 3 Narangiin Enger sampling points are a spring near the proposed NEDS and near the upper and lower part of a stream which has water only when rains.

e.2 Findings of Sampling Points

The survey was conducted in the winter season and the summer season. The results obtained through this survey are limited for concluding all the characteristics of water quality in this region. However, some environmental pollution was recognized in the groundwater from wells and water of the Tuul River.

e.2.1. Sampling Point No.1 (Well)

- This well is located at the Ger area inside the fence and is used for personal living. The well is very shallow. There is a pit latrine nearby and the water level of the well is lower than that of the latrine.
- This well is located further than sample No.2 from UCDS.
- The possibilities of the impact to the water quality by UCDS operations is considered to be low because 1) the distance from UCDS is far at around 2 km, 2) the water does not show high concentrations of BOD, COD and NH_3-N which are properties of leachate.
- Exceeded the Drinking Water Quality Standard in Mongolia

  <Winter season>
  8 analysis items (hardness, nitrogen nitrate, calcium, magnesium, cadmium, lead, oil content, Number of coliform bacteria)

  <Summer season>
  4 analysis items (Turbidity, SS, Total mercury and CN)

- The reason why the oil content and colon bacteria is above the Mongolian Standard in the winter season is that the water might be polluted by the nearby pit latrine

and/or drained water from neighboring houses. Meanwhile, in the summer season both contents were below the detection limit. In addition, total mercury and CN were only detected in the summer season. In this way, the seasonal varying analysis results have denoted differences in underground water behaviour according to season, namely in winter underground water accumulates; underground water is fluid in summer because the rainfall amount is high, and it is thought to be related to the living activities of neighbouring residents varying greatly according to season.

- The results for turbidity and SS were high in the summer season measurement however; this is considered to be due to a sampling problem.
- The level of total mercury and CN detected in the water in the summer season exceeded the Drinking Water Quality Standard in Mongolia. It is essential for UBC to conduct an investigation to identify the contamination cause.

- It is necessary to suggest that this water should not be used for drinking purposes because there are high contents of nitrogen nitrate, cadmium, lead, oil content, coliform bacteria, total mercury and CN.

e.2.2. Sampling Point No.2 (well)

- This water is sold to the nearby residents as drinking water.
- This is the well located nearest to the UCDS.
- The possibilities of the impact on the water quality by UCDS operations is considered to be low because 1) the distance from UCDS is far at around 1 km, 2) this water does not show high concentrations of BOD, COD and NH_3-N which are the properties of leachate.
- Exceeded the Drinking Water Quality Standard in Mongolia

  <Winter season>
  3 analysis items (Nitrogen nitrate, cadmium, oil content)

  <Summer season>
  2 analysis items (BOD_5 and Total Chromium)

- In order to clarify the causes of pollution, necessary data such as the location of nearby pit latrines, and discharge points of living drainage should be obtained. It is suggested that measures be taken for pollution sources and periodical water quality inspection is recommended.

- It is necessary to suggest that this water should not be used for drinking purposes because there are high contents of nitrogen nitrate, cadmium, oil content, BOD_5 and total chromium.

e.2.3. Sampling point No.3 (Well)

- This water is sold to the nearby residents as drinking water.

- This well is located further than sample No2 from UCDS so the impact from UCDS should be less.
- Exceeded the Drinking Water Quality Standard in Mongolia

<Winter season>
3 analysis items (Nitrogen nitrate, cadmium and lead)

<Summer season>
2 analysis items (BOD_5 and COD)

- In order to clarify the causes of pollution, necessary data such as the location of nearby pit latrines, and discharge point of living drainage should be obtained. It is suggested that measures be taken for pollution sources and periodical water quality inspection is recommended.

- It is necessary to suggest that this water should not be used for drinking purposes because there are high contents of nitrogen nitrate, cadmium, lead, BOD_5 and COD.

e.2.4. Sampling Point No.4 (well)

- This water is sold to the nearby residents as drinking water.
- This well is located further than sample No2 from UCDS so the impact from UCDS should be less.
- Exceeded the Drinking Water Quality Standard in Mongolia

<Winter season>
6 analysis items (Hardness, Nitrogen nitrate, calcium, Magnesium, cadmium, lead)

<Summer season>
2 analysis items (COD and Total chromium)

- In order to clarify the causes of pollution, necessary data such as the location of nearby pit latrines, and discharge point of living drainage should be obtained. It is suggested that measures be taken for pollution sources and periodical water quality inspection is recommended.

- It is necessary to suggest that this water should not be used for drinking purposes because there are high contents of nitrogen nitrate, cadmium, lead, COD and total chromium.

e.2.5. Sampling point No.5 (Well)

- This water is sold to the nearby residents as drinking water.
- The possibilities of the impact on the water quality by MDDS operations is considered to be low because 1) the distance from MDDS is far at around 1.5 km, 2)

this water does not show high concentrations of BOD, COD and NH_3-N which are the properties of leachate.

- Exceeded the Drinking Water Quality Standard in Mongolia

  <Winter season>
  2 analysis items (Nitrogen nitrate and cadmium)

  <Summer season>
  2 analysis items (BOD_5 and Total chromium)

- In order to clarify the causes of pollution, necessary data such as the location of nearby pit latrines, and discharge point of living drainage should be obtained. It is suggested that measures be taken for pollution sources and periodical water quality inspection is recommended

- It is necessary to suggest that this water should not be used for drinking purposes because there are high contents of nitrogen nitrate, cadmium, BOD_5 and total chromium.

e.2.6. Sampling point No.6 (Well)

- This water is sold to the nearby residents as drinking water.
- The possibilities of the impact on the water quality by the Nalaikh Disposal Site (NDS) operations is considered to be low because 1) the distance from NDS is quite far at around 3 km, 2) this water does not show high concentrations of BOD, COD and NH_3-N which are the properties of leachate.
- Exceeded the Drinking Water Quality Standard in Mongolia

  <Winter season>
  3 analysis items (Nitrogen nitrate and cadmium)

  <Summer season>
  3 analysis items (BOD_5, COD and Total chromium)

- In order to clarify the causes of pollution, necessary data such as the location of nearby pit latrines, and discharge point of living drainage should be obtained. It is suggested that measures be taken for pollution sources and periodical water quality inspection is recommended.

- It is necessary to suggest that this water should not be used for drinking purposes because there are high contents of nitrogen nitrate, cadmium, BOD_5, COD and total chromium.

e.2.7. Sampling point No.7 (Tuul river)

- This sampling point is located downstream from the UBC center and near MDDS in the Tuul River. In the winter season, sampling was carried out and surface water was

frozen. Therefore, the sampling was taken from under the frozen surface where the nearby residents opened up the hole to take water.

- Exceeded the Drinking Water Quality Standard in Mongolia

  <Winter season>
  4 analysis items (Nitrogen nitrate, cadmium, lead and Coliform bacteria)

  <Summer season>
  4 analysis items (Turbidity, BOD_5, COD and Total chromium)

- The distance from MDDS is more than 1 km and there is less possibility of having an impact from landfill operation.

- Since the sampling point is located downstream from the city center, there is a possibility that the discharged water from factories or untreated sewerage water might affect the quality of water.

- It is necessary to suggest that this water should not be used for drinking purposes because there are high contents of nitrogen nitrate, cadmium, lead, coliform bacteria, BOD_5, COD and total chromium.

e.2.8. Sampling Point No.8 (Surface water)

- This sampling point is at a spring located adjacent to the proposed disposal site (NEDS) and is used as drinking water by the nearby residents and grazing sheep.
- Nearby the spring there is a place of illegally recycling waste asphalt.
- This sampling point was only tested in the summer season.
- Exceeded the Drinking Water Quality Standard in Mongolia

  <Summer season>
  3 analysis items (Turbidity, Color and BOD_5)

- The possibilities of the impact on the water quality from UCDS operations is considered to be low because 1) the point located at around 0.5 km upstream area of the UCDS, 2) this water does not show high concentrations of BOD, COD and NH_3-N which are the properties of leachate.

- It is necessary to suggest that this water should not be used for drinking purposes because there are high contents of BOD_5.

e.2.9. Sampling Point No.9 (Surface water)

- This sampling point is at a spring located adjacent to the proposed disposal site (NEDS). The spring is not in an inhabited area but it is used as a source of drinking water by the downstream Ger residents.

- At the time of the study, water did not flow from the spring, only a small puddle of water could be observed.
- In the upstream area of the spring a place of illegally recycling waste asphalt..
- This sampling point was only tested in the summer season.
- Exceeded the Drinking Water Quality Standard in Mongolia

  <Summer season>
  3 analysis items (Turbidity, Color and Total Chromium)
- As the spring is a small pool, a significant amount of SS and other items were mixed in with the sample water at the time of sampling.
- The possibilities of the impact on the water quality from UCDS operations is considered to be low because 1) the point located at around 0.5 km upstream area of the UCDS, 2) this water does not show high concentrations of BOD, COD and NH_3-N which are the properties of leachate.
- It is necessary to suggest that this water should not be used for drinking purposes because there are high contents of total chromium.

e.2.10. Sampling Point No.10 (Surface water)

- This sampling point is at a spring located nearby the proposed disposal site (NEDS) and is located upstream from sampling point No.9. Similar to sampling point No.9, there was only a small puddle of water at this sampling point and there was no flowing water.
- Sampling was only carried out in the summer season.
- Exceeded the Drinking Water Quality Standard in Mongolia

  <Summer season>
  3 analysis items (Turbidity, Color and Total Chromium)
- As the spring is a small pool, a significant amount of SS and other items were mixed in with the sample water at the time of sampling.
- The possibilities of the impact on the water quality from UCDS operations is considered to be low because 1) the point located at around 0.5 km upstream area of the UCDS, 2) this water does not show high concentrations of BOD_5, COD and NH_3-N which are the properties of leachate.
- It is necessary to suggest that this water should not be used for drinking purposes because there are high contents of total chromium.

e.2.11. Sampling Point No.11 (Surface water)

- This sampling point is a pool of surface water from rainfall on the waste surface near the entrance of UCDS. As the waste layer was dry 30cm below the surface, it is thought that the sample water is water which has accumulated from the waste layer surface.
- In comparison with the results of well water and other surface water, the results of this sample show high levels in many contents and is affected by landfill Waste, i.e leachate.

- Sampling was only carried out in the summer season.
- Exceeded the Drinking Water Quality Standard in Mongolia

  <Summer season>
  9 analysis items (EC, Turbidity, Color, BOD_5, COD, Cl^-, Pb, Total Chromium, Oil content and CN^-)

e.2.12. Sampling point No.12 (Tap water)

- Sampling was conducted for one well which was selected from over 40 wells constructed as water sources for MUB and sampling was carried out.
- Sampling was only carried out in the summer season.
- Exceeded the Drinking Water Quality Standard in Mongolia

  <Summer season>
  2 analysis items (BOD_5 and Total chromium)
- The levels of BOD_5 and Total chromium detected in the water source well exceeded the Drinking Water Quality Standard in Mongolia. It is essential for MUB to conduct an investigation to identify the contamination cause.

e.2.13. Sampling point No.13 (Ground water)

- This sampling point was for ground water from bore-holes.
- Sampling was only carried out in the summer season.
- The quality of the ground water differs from that of the Naran spring as there are unusually high levels of COD. The reason for this is thought to be due to contamination by some kind of COD source at the time of bore-hole drilling.

e.3 Summary of Findings

- The measurement results of other points were evaluated based on the results of the central water source of drinking water sampling point No.12 and the surface water of sampling point No.11 at the entrance to UCDS which can be considered as leachate. It has been identified from the evaluation results that the impacts by leachate from the disposal sites seem to be less to the wells and surface water located near the disposal sites.
- The reason why leachate from the disposal site is not detected even in the rainy summer season is thought to be a combination of there being a low absolute amount

of rainfall in the study area, high moisture evaporation, low moisture content of collected waste and few water discharge from waste consolidation.

- Periodic measurement shall be carried out for the comparative figure sampling points No.8, 9 and 10 from the commencement of service of the proposed disposal site (NEDS) and the data will be accumulated.
- The climatic conditions of the Study area vary greatly in the winter and summer seasons. Thus, the following trends were identified from the measurement results in both seasons.
  - Many water quality items exceed the Drinking Water Quality Standard in Mongolia in the winter season compared with the summer season. This is thought to be due to the fact that in the winter season groundwater stagnates but in summer groundwater flows due to rainfall. Also, as the seasonal trend for water quality items varies, the living activities of residents also vary depending on the season.
  - There are the following differences in water quality items according to the winter and summer seasons.
    - BOD_5 component, Total chromium: virtually undetected in the winter season but detected at many sampling points in the summer season.
    - colon bacteria, Cadmium and Lead: tends to be detected in the winter season but not in the summer season.
  - It is possible that the above mentioned results are due to the flow of groundwater and differences in living activities however, it is undeniable that there could have possibly been issues with the treatment of sampling water at the time of measurement and analysis.
- In comparison with the average groundwater in Japan, the ion concentration of these measurement results show a high concentration in many water quality items. These results were discussed with a local analyst however, even when the analyst compared the values with those of another project, the values were not remarkably different and there was the view that it was extremely common. Considering this, it is thought that in terms of the water quality of wells and surface water in the vicinity of Ulaanbaatar, high concentrations can be seen depending on the item and there is considerable geological impact.
- As toxic contents were detected in all the wells and surface water used for drinking water, the Study Team suggests that these waters should not be used for drinking purposes. It is also essential to conduct a detailed study of the sampling point and the neighboring conditions and identify the contamination cause.

2.4.3 Topographic Survey

a. General

The purpose of this survey is to make topographical survey maps of the Final Disposal Sites and utilize them for future improvement plan. Ulaan Chuluut and Morin Daava are the target area for this topographical survey.

b. Scope of Work

The Work shall include all works such as mobilization, setting up of TBM (Temporary Bench Mark), leveling and traversing, reporting and so forth.

c. Contents of the Survey

The contents of the survey works were as follows;

Survey Area:	Topographical survey and mapping works covered the whole area of the site specified by the Study Team. The area to be surveyed covers the Morin Daava and Ulaan Chuluut final disposal sites and total area was approximately 80 ha.
Scale:	1/1,000
Contour Interval:	1.0 m

d. Work Method

d.1 Datum Level and Coordinates

All measurements were reduced in metric units. One TBM was set up at the site and the National Temporary Bench Mark was tied to it. Temporary Bench Marks was set up at the stable and safe place.

d.2 Leveling and Traversing

The elevation of the ground level was determined by leveling, starting from the Temporary Bench Mark. The coordinates was determined by traversing, starting from the existing control points. The accuracy of leveling shall be 2 cm $\sqrt{S}$, where $\sqrt{S}$ is leveling length in kilometers.

e. Reports

One original and three copies of the map(s) in English and in Mongolia with CD-ROM were submitted to the study team. The report includes the following.

1) Topographic Map
   - Drawing the topography with 1.0 m contour interval at scale 1/1,000
   - Indicating the location of the Temporary Bench Mark
   - Indicating the existing houses, roads, Fences and others, if any
   - Indicating the water level and the depth of the lakes and other water bodies if any

2) Others
   - Survey control point network
   - Coordinates and elevations (top of hills and ground level) of the Temporary Bench Mark
   - Description of the Temporary Bench Mark
   - Photographs of field works including the Temporary Bench Mark
   - Digital data of the topographical map

2.5 Survey on Medical Waste Management

2.5.1 Objectives and Definitions

a. Objectives of the Study

Medical waste requires appropriate treatment and disposal based on its physical, chemical and pathological properties. For example, as this waste is handled carelessly, medical staff sometimes injure themselves with sharps. Moreover, when medical waste is disposed of together with general waste, the toxic chemicals and pathogens that it contains may have a grave impact, whether directly on the staff in charge of collection and landfill work, or indirectly on the surrounding environment and the residents living near the disposal sites. Adequate care needs to be taken in its treatment and disposal.

This survey for medical institutions aims to elucidate how infectious, hazardous and general waste generated by medical institutions in Study area is handled, treated and disposed of. The results of this study should also be useful for the establishment of the future medical waste management system necessary in Study area.

b. Definition of Waste Generated in Medical Institutions

The WHO (World Health Organization) defines the waste generated in a medical institution as “health-care waste”. In this questionnaire, it is divided into two; i.e. medical waste (hazardous healthcare waste or healthcare risk waste) and general waste (non-risk healthcare waste).

Medical waste in this questionnaire is **hazardous healthcare waste** of WHO classification. A detailed classification of medical waste is summarized in the table below.

Table 2-71: Classification of Medical Waste

Waste Category	Description and examples
1. Infectious waste	Waste suspected to contain pathogens e.g. laboratory culture; waste from isolation wards; tissues, materials, or equipment that have been in contact with infected patients; excreta
2. Pathological waste	Human tissues or fluids e.g. body parts; blood and other body fluids; fetuses
3. Sharps	Sharp waste e.g. needles; infusion sets; scalpels; knives; blades; broken glass
4. Pharmaceutical waste	Waste containing pharmaceuticals e.g. pharmaceuticals that are expired or no longer needed; items contaminated by or containing pharmaceuticals (bottles, boxes)
5. Genotoxic waste	Waste containing substances with genotoxic properties e.g. waste containing cytostatic drugs (often used in cancer therapy); genotoxic chemicals
6. Chemical waste	Waste containing chemical substances e.g. laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents
7. Wastes with high content of heavy metals	Batteries; broken thermometers; blood-pressure gauges; etc.
8. Pressurized containers	Gas cylinders; gas cartridges; aerosol cans
9. Radioactive waste	Waste containing radioactive substances e.g. unused liquids from radiotherapy or laboratory research; contaminated glassware, packages, or absorbent paper; urine and excreta from patient treated or tested with unsealed radionuclide; sealed sources

（Source） Safe management of wastes from health-care activities, WHO Geneva, 1999

General waste in this questionnaire is **non-risk healthcare waste** of WHO classification. It comes mostly from the administrative and housekeeping functions of medical institutions and may also include waste generated during the maintenance of medical institutions.

2.5.2 Method of the Survey

There are a total of 550 medical institutions in the target areas generating medical waste as shown in the table below.

Table 2-72: Number of Present Medical Institutions and the Survey Coverage

Category of Institution	Whole Area*1	Medical Institution Survey
	No of Response.	No of Response.
1. Hospital	-	2
2. Poly-clinic	-	6
3. Clinic	-	5
4. Others	-	2
Total	550	15

(Source) Ministry of Health (WACS study, 2005)

Fifteen (15) medical institutions in the study area were selected for the survey (see the Table below). The survey is based largely on the information collected directly from doctor, manager, and those responsible for medical waste management of the selected 15 medical institutions. Not all information was provided from the institution and analysis was conducted only with available data.

- Interviews with doctor, manager or persons responsible for medical waste management in/of the medical institutions
- Observation of the temporary storage bins/site and final disposal of general waste and medical waste.

The interview focused on the generation, segregation, storage, discharge, collection, treatment, and disposal of medical waste.

Table 2-73: Medical Institutions Surveyed

Category of The Institution	No of Response	Number of Beds				
		Total		Average	Maximum	Minimum
		No	%			
1. Hospital	2	688	24.3	344	498	190
2. Poly-clinic	6	1,277	45.1	213	400	90
3. Clinic	5	465	16.4	116	240	0
4. Others	2	402	14.2	201	402	0
Total	15	2,832	100.0	-	-	-

2.5.3 Findings

Study area, that is the capital city of Mongolia, is with the highest population growth rate in the country. Consequently, the number of the medical institutions in Study area has remarkably grown and has been generating a larger amount of medical waste than the other cities. The findings of the survey conducted in January, 2005 are described below.

a. Waste Generation

a.1 Waste Unit Generation Rate

a.1.1. Generation Rate of Medical Waste

Unit amount of the medical waste generation at the target institutions is summarized in the table below. The unit amount is obtained by dividing the total waste amount by (i) the number of beds, (ii) net number of patients and (iii) the number of employees.

As for either the generation rate per bed, the generation rate per patients or the generation rate per employee, the hospital have higher figures than the other categories.

As indicated in the table, the proportion of the medical waste generation rate in Study area is still lower if compared with other countries in the world.

Table 2-74: Generation Rate of Medical Waste (per number of Beds)

Generation Source	No of Response	Generation rate (kg/bed/day)		
		Average	Maximum	Minimum
1. Hospital	2	0.436	0.584	0.287
2. Poly-clinic	3	0.122	0.356	0.002
3. Clinic		-	-	-
4. Others	1	0.003	0.003	0.003
Weighted Average	6	0.207	-	-

Table 2-75: Generation Rate of Medical Waste (per number of Patients)

Generation Source	No of Response	Generation rate (kg/patient/day)		
		Average	Maximum	Minimum
1. Hospital	2	0.519	0.715	0.323
2. Poly-clinic	3	0.051	0.145	0.000
3. Clinic	3	0.107	0.179	0.000
4. Others	2	0.011	0.016	0.006
Weighted Average	10	0.153	-	-

Table 2-76: Generation Rate of Medical Waste (per number of Employee)

Generation Source	No of Response	Unit generation rate (kg/employee/day)		
		Average	Maximum	Minimum
1. Hospital	2	0.289	0.338	0.239
2. Poly-clinic	3	0.108	0.320	0.001
3. Clinic	3	0.213	0.591	0.005
4. Others	2	0.036	0.070	0.001
Weighted Average	10	0.161	-	-

a.1.2. Generation Rate of General Waste

Generation rate of the general waste at the target institutions is summarized in the table below. As in the case of medical waste, the generation rate of general waste was calculated in three ways.

The generation rate of general waste in the hospitals and others are close but seven to twelve times higher than those of the poly-clinics or clinics.

Table 2-77: Generation Rate of General Waste (per no of Beds)

Generation Source	No of Response	Unit amount (kg/bed/day)		
		Average	Maximum	Minimum
1. Hospital	2	3.671	6.767	0.574
2. Poly-clinic	3	0.395	0.476	0.253
3. Clinic	1	0.417	0.417	0.417
4. Others	1	4.478	4.478	4.478
Weighted Average	7	1.917	-	-

Table 2-78: Generation Rate of General Waste (per no of Patients)

Generation Source	No of Response	Unit amount (kg/patient/day)		
		Average	Maximum	Minimum
1. Hospital	2	4.470	8.295	0.645
2. Poly-clinic	3	1.412	3.808	0.022
3. Clinic	4	1.145	4.348	0.016
4. Others	2	4.086	7.826	0.345
Weighted Average	11	2.357	-	-

Table 2-79: Generation Rate of General Waste (per no of Employees)

Generation Source	No of Response	Unit amount (kg/employee/day)		
		Average	Maximum	Minimum
1. Hospital	2	2.1995	3.92	0.479
2. Poly-clinic	3	0.338	0.698	0.136
3. Clinic	5	0.171	0.403	0.061
4. Others	1	1.818	1.818	1.818
Weighted Average	11	0.735	-	-

a.1.3. Comparison with Generation Rates of Medical and General Waste in Other Countries

The calculated generation ratios per bed of general and medical waste according to the type of medical institution and those obtained from other JICA SWM studies are shown in the table below. The generation ratios per bed of the Hospital appear to be similar to those obtained from other JICA SWM studies.

Table 2-80: Comparison with Generation Rates of Medical and General Waste in Other Countries

Country (City)	Type of Institution	Generation of General Waste	Generation of Medical Waste
Ulaanbaatar	Hospital	3.671 kg/bed/day	0.436 kg/bed/day
	Poly-clinic	0.395 kg/bed/day	0.122 kg/bed/day
	Clinic	0.417 kg/bed/day	-
	Others	4.478 kg/bed/day	0.003 kg/bed/day
Latin America[1)]		3 kg/bed/day	0.60 kg/bed/day (=20%)
Chile (Santiago)[2)]	Hospitals	2.72 kg/bed/day	1.27 kg/bed/day
	Clinics	2.81 kg/bed/day	1.57 kg/bed/day
	Rural health clinics	6.47 kg/clinic/day	3.57 kg/cinic/day
Turkey (Adana)[3)]	Hospitalizing institution	1.67 kg/bed/day	0.82 kg/bed/day
	Non-hospitalizing institution	42.2 kg/institution/day	10.6 kg/institution/day
Turkey (Mersin)[3)]	Hospitalizing institution	2.62 kg/bed/day	0.59 kg/bed/day
	Non-hospitalizing institution	25.5 kg/institution/day	9.25 kg/institution/day
El Salvador (San Salvador)[4)]	More than 200 beds	2.83 kg/bed/day	0.55 kg/bed/day
	50 to 200 beds	3.87 kg/bed/day	0.68 kg/bed/day
	Less than 50 beds	2.96 kg/bed/day	0.33 kg/bed/day
Azerbaijan (Baku)[5)]	General Hospital	0.58 kg/bed/day	0.42 kg/bed/day
	Hospital	1.14 kg/bed/day	0.34 kg/bed/day
	Clinic	27.50 kg/institution/day	14.0 kg/institution/day
	Others	0.73 kg/bed/day	0.69 kg/bed/day
Cambodia (Phnom Penh)[6)]	Hospital	5.17 kg/bed/day	0.26 kg/bed/day
	Poly-clinic	1.06 kg/bed/day	0.31 kg/bed/day
	Clinic	1.31 kg/bed/day	0.26 kg/bed/day
	Health Centre	5.07 kg/bed/day	0.95 kg/bed/day
Sri Lanka (Seven Model Towns)[7)]	Weighted average	1.57 kg/bed/day	0.07 kg/bed/day
	Average of highest two	1.82 kg/bed/day	0.19 kg/bed/day
	Average of lowest two	1.27 kg/bed/day	0.01 kg/bed/day

Source:

1. Average assumed generation for Latin America according to *Pan American Health Organization* and *World Health Organization* (/NK3/).
2. Final Report of The Master Plan Study on Industrial Solid Waste Management in the Metropolitan Region of the Republic of Chile, March 1996, JICA
3. Final Report of The Study on Regional Solid Waste Management for Adana-Mersin in the Republic of Turkey, January 2000, JICA
4. Final Report of The Study on Regional Solid Waste Management for San Salvador Metropolitan Area in the Republic of El Salvador, September 2000, JICA
5. Final Report of The Master Plan Study on Integrated Environmental Management in Baku City in Azerbaijan Republic, March 2001, JICA
6. Final Report of The Study on Solid Waste Management in the Municipality of Phnom Penh, March 2005, JICA
7. Final Report of The Study on Solid Waste Management for Secondary Cities in Sri Lanka, December 2003, JICA

a.2 Estimation of Waste Generation Amount in Study area

a.2.1. Estimation method

The figure below shows the process of estimating the medical waste generation amount from all the medical institutions in the city, taking the example of hospitals. The solid lines were the procedure originally intended by the team. The total waste amount could have been estimated in two ways: one using the unit generation rate per employee (and/or patient) per day and the other using the unit generation rate per occupied bed per day, both of which were calculated in the previous section.

These two ways, however, necessitate data of the number of employees (indicated in Box D in the figure) or the number of beds and bed occupancy rates (in Box E in the figure) of all the medical institutions in the city.

The number of beds and that of employees at every medical institution in Study area are obtained from "Statistical Handbook of Ulaanbaatar, XX Century." Using these figures and the unit amount of the target institutions, we estimated the total amount of medical waste and general waste generated at the medical institutions in Study area. Information on total number of beds and employees in Study area for each category of medical institutions (Hospital, Polyclinic, Clinic and Others) is not available so the estimation was conducted without such categorization. Consequently, the weighted average generation rates were used for estimation.

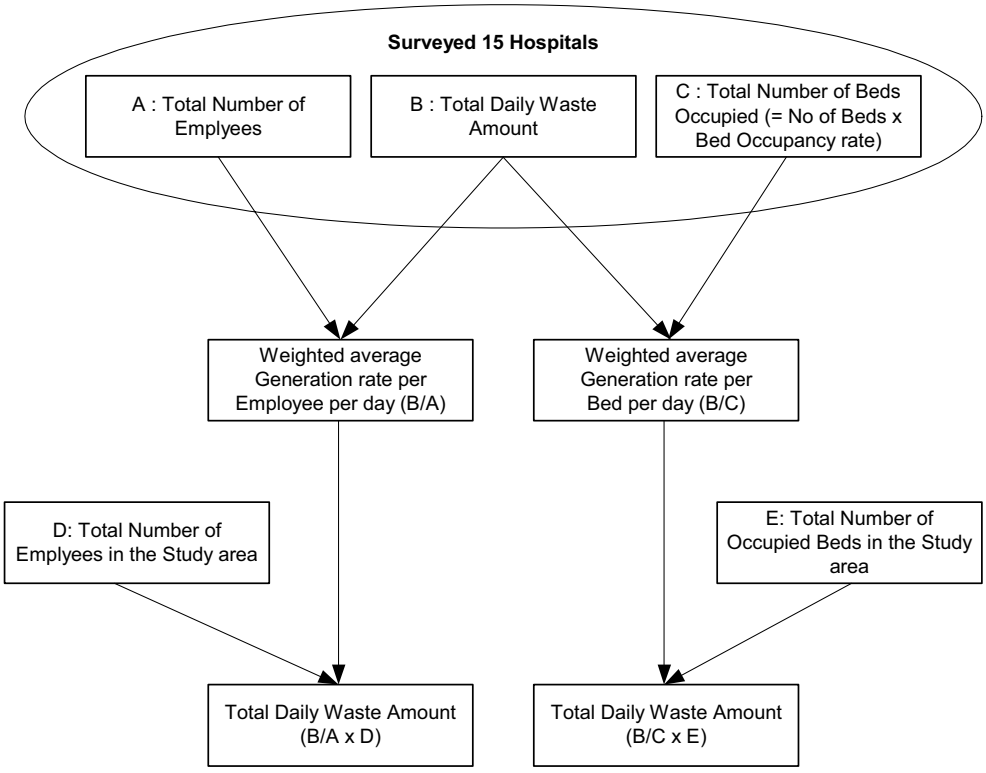


Figure 2-16: Waste Amount Estimation Process

a.2.2. Medical Waste

The number of beds and that of patients at every medical institution in the Study area were obtained from the MOH WACS study, 2005, and the number of employees was obtained from the "Statistical Handbook of Ulaanbaatar, XX Century". Using these figures and the

weighted generation rates obtained from the target institutions, we estimated the total amount of medical waste and general waste generated at the medical institutions in Study area. Information on total number of beds and employees in Study area for each category of medical institutions (Hospital, Polyclinic, Clinic and Others) is not available so the estimation was conducted without such categorization.

The generation amount of medical waste was estimated and shown in the table below. The medical waste amount from all the medical institutions in the city is estimated as 1.6 ton per day in the case of using a generation rate per bed, 2.6 ton per day in case of using generation rate per patient, and 2.4 ton per day in the case of using generation rate per employee.

The WACS survey on medical waste carried out by MOH in February 2005, surveyed the actual volume of medical waste generated by medical institutions in order to establish the generation rate per patient. According to the report, a medical waste generation rate of 0.2-1.0 ton/day was estimated from the number of patients using a waste output of 0.01-0.05 kg/patient/day. The figures estimated by the Team are rather high in comparison with the results estimated by the WACS survey.

However, in the investigation of future waste flow the generation amount estimated by generation rate per bed, which the Team has a lot of data on and is similar to the MOH results, will be used.

Table 2-81: Generation Amount of Medical Waste in Study area

Base : per Bed	Generation rate kg/bed/day	Number of Bed*1	Generation Amount (ton/day)
Medical waste (Hazardous/Infectious)	0.207	7,721	1.6
Base : per Patient	**Generation rate*1 kg/patient/day**	**Number of Patient*1**	**Generation Amount (ton/day)**
Medical waste (Hazardous/Infectious)	0.153	6,389,793 (patient/year)	2.6
Base : per Employee	**Generation rate*1 kg/employee/day**	**Number of Employee*2**	**Generation Amount (ton/day)**
Medical waste (Hazardous/Infectious)	0.161	15,109	2.4

Remark: *1 Source: MOH (WACS study, 2005)
*2 Statistical Handbook of Ulaanbaatar, XX Century, pp 134-135 (9 districts)

a.2.3. General Waste

The generation amount of general waste was estimated and shown in the table below. The amount of general waste from all the medical institutions in the city is estimated as 12.4 ton per day in the case of using unit generation rate per bed, 41.3 ton per day in the case of using generation rate per patient, and 11.1 ton per day in the case of using generation rate per employee.

The amount obtained from per patient is much more than the other two figures same as the result of medical waste.

In the aforementioned WACS survey on medical waste carried out by MOH, an interview survey was carried out similar to the Team's to discern the generation rate per patient. A generation amount for general waste of 0.4-9.0 ton/day was calculated from a generation rate per patient of 0.02-0.54 kg/patient/day and the number of patients. The figures estimated by the Team are slightly high in comparison with those from the WACS survey.

In the same way as with medical waste, the generation amount estimated from the generation rate per bed will be used to examine the future waste flow.

Table 2-82: Generation Amount of General Waste in Study area

Base : per Bed	Generation rate kg/bed/day	Number of Bed*1	Generation Amount (ton/day)
General waste	1.917	7,721	14.8
Base : per Patient	**Generation rate*1 kg/patient/day**	**Number of Patient*1**	**Generation Amount (ton/day)**
General waste	2.357	6,389,793 (patient/year)	41.3
Base : per Employee	**Generation rate*1 kg/employee/day**	**Number of Employee*2**	**Generation Amount (ton/day)**
General waste	0.735	15,109	11.1

Remark: *1 Source: MOH (WACS study, 2005)
*2 Statistical Handbook of Ulaanbaatar, XX Century, pp 134-135 (9 districts)

a.3 Generation Rates and Amount applied to the Study

Based on the above estimation, the Study Team applies the following general and medical waste generation rates and amount to the Study.

Table 2-83: Generation Rates and Amount of General and Medical Waste

Category of Waste	Generation Rate (kg/bed/day)	Number of Bed	Generation Amount (ton/day)
Medical waste (Hazardous/Infectious)	0.207	7,721	1.6
General waste	1.917	7,721	14.8

The tables below show generation amount and rate per capita of general and medical waste.

Table 2-84: Medical Waste Generation Rate in Other Cities

Country/City	Study Year	Population	Generation Amount (kg/day)	Unit Generation (g/person/day)
Chile / Santiago	1995	5,642,000	20,000	3.54
Turkey / Adana	1998	1,196,620	4,401	3.68
Turkey / Mersin	1998	643,850	1,539	2.39
Azerbaijan / Baku	2000	2,051,200	12,892	6.28
Cambodia / Phnom Penh	2003	1,199,414	961	0.80
Sri Lanka / Kandy	2002	110,049	530	4.81
Mongol / Ulaanbaatar	2005	866,591	1,600	1.85

Source: The same as Table 2-80: Comparison with Generation Rates of Medical and General Waste in Other Countries.

Table 2-85: General Waste Generation Rate in Other Cities

Country/City	Study Year	Population	Generation Amount (kg/day)	Unit Generation (g/person/day)
Chile / Santiago	1995	5,642,000	44,658	7.92
Turkey / Adana	1998	1,196,620	11,805	9.87
Turkey / Mersin	1998	643,850	4,663	7.24
Azerbaijan / Baku	2000	2,051,200	20,588	10.04
Cambodia / Phnom Penh	2003	1,199,414	9,719	8.10
Sri Lanka / Kandy	2002	110,049	4,734	43.02
Mongol / Ulaanbaatar	2005	866,591	14,800	17.08

Source: The same as Table 2-80: Comparison with Generation Rates of Medical and General Waste in Other Countries

b. Findings on Medical Waste Management

b.1 Medical Waste

b.1.1. Category of Generated Waste

Medical wastes generated at the target sites are mainly categorized as infectious waste, sharps and pharmaceutical waste.

b.1.2. Storage

Every target institution separates medical wastes from general waste. Plastic bags, paper bags and cardboard boxes are mainly used for collection and storage of medical wastes.

b.1.3. Disinfection treatment of Medical Waste

- Thirteen out of 15 target institutions gave answer regarding disposal of medical wastes. They all bury, burn and/or incinerate medical wastes at their properties, and five institutions dispose of them using incinerator. Some part of medical wastes is carried to UCDS and incinerated (2 medical institutions). There are institutions disposing of medical wastes together with general wastes (3 medical institutions).
- 5 institutions are using incinerator regularly to burn mixture of medical waste and general waste. However, those incinerators are not used for some problem.
- 4 institutions are using autoclaves to treat some of the medical waste. However, many autoclaves are for disinfection of medical implements.
- Some institutions pointed out problems of maintenance and air pollution from chimney regarding incinerations but none has pointed out the problems relating to autoclaves.

b.1.4. Waste Discharge

Most medical institutions in Study area store waste separately. Their waste, however, ends up mixed with general waste in 3 institutions, either by waste collectors or by the staff of the medical institutions when discharged. It is finally disposed of at UCDS, where a number of vulnerable waste pickers are working.

b.1.5. Collection

Waste collection is normally done by the TUK in most of the institutions. Some institutions have their own vehicles to transport their medical wastes to UCDS. Frequency of collection of wastes is varied from everyday to every 4 to 5 days collections depend on the institutions. As medical waste contains materials which putrefy rapidly, such frequent collection service is important.

b.1.6. In-house Collection System

In-house collection is carried out daily, normally by workers of the facilities themselves. Wastes at the point of origin are mostly contained in small plastic bags, paper bags and cardboard box.

The workers collect the primary bags or boxes of medical waste, which is mixed with solid wastes from other rooms and buildings, to store in secondary containers or in places within the premises of the facilities. Some of the primary bags or boxes used for general and medical wastes have not been labeled and are not covered or locked.

b.2 General Waste

b.2.1. Category of Generated Waste

General wastes generated at the target sites are mainly categorized as kitchen waste, paper and glass bottle.

b.2.2. Other Information

The system for collecting general waste within the hospitals, polyclinics, clinics, and others is similar to medical waste collection. As reported earlier, general waste is usually stored

separately from medical waste, but in many medical institutions they are mixed together when they are discharged.

Medical institutions in the whole city generate about 14.8 ton/day of general waste daily, almost all of which is collected and transported by TUK.

c. Financial Observation

One hundred percent of the surveyed medical institutions in study area pay a collection fee for medical waste as well as general waste. Their payment ranges from 23 - 231 US$/month for hospitals, 20 - 150 US$/month for polyclinics, 42 - 62 US$/month for clinics, and 60 - 325 US$/month for others.

Eight institutions stated their satisfaction with the waste collection and disposal services. The reasons for dissatisfaction of the remaining six medical institutions are that discharge system is poor (e.g. No bins, bins are broken or too small), and threw is problems with handling medical waste etc.

d. Overall Evaluation

The team concludes that the management system of medical waste in Study area requires much improvement. The important issues revealed by the present survey are as follows:

- Even though in house collection and storage are separated from medical wastes to general wastes, many cases are observed that those wastes are mixed during discharge to the collection and transportation to disposal site.
- One of the reasons why they are mixed is that neither the staff of the medical institutions nor the waste collection workers are fully aware of the possible risks posed by medical waste.
- The second reason is that there are few facilities that can appropriately treat medical waste in the study area. This makes the medical staff and the collection workers reluctant to strictly separate medical waste.

The leadership of the responsible authorities including the Ministry of Health and UBC in the development of a medical waste management system, particularly in raising public awareness of health risks, should be urgently strengthened.

2.5.4 Results of Survey

a. General Information

Q.1. What is your position within this medical institution?

Base: Population = 15		
Position	***Answer***	***%***
1. Vice-chief office	1	7
2. Manager	1	7
3. Head of Department	1	7
4. Head of Economic	1	7
5. Cancer research	1	7
6. Communicable research	3	20
7.Hygeine doctor	3	20
8. Nurse	2	13
7. no answer	2	13
Grand Total	**15**	**101**

Q.2. What is the number of employee (all staffs including doctors, nurses, etc. who work in the institution)? full-time [ ] persons
Part-time [ ] persons

Base: Population = 15(full time), 5(part time)

Category of the institution	*Full time*		*Part time*	
	Total	*Average*	*Total*	*Average*
1. Hospital	925	463	6	6
2. Poly-clinic	2,285	381	4	4
3. Clinic	728	146	9	5
4. Others	1,051	526	2	2
Grand Total	4,989	333	21	4

Q.3. Category of the institution.

Q.4. Type of institution:

Base: Population = 15

Category of the Institution	*Type of Institution*			*Grand Total*	*%*
	Public	*Private*	*Others*		
1. Hospital	2			2	13
2. Poly-clinic	3	3		6	41
3. Clinic	5			5	33
4. Others	1		1	2	13
Grand Total	**11**	**3**	**1**	**15**	**100%**

note : others : Joint stock hospital

Q.5. Outline of institution:

1. Number of beds : [ ] beds

Base: Population = 14 (No answer = 1)

Category of The Institution	*No of response*	*Number of Beds*			
		Total	*Average*	*Maximum*	*Minimum*
1. Hospital	2	688	344	498	190
2. Poly-clinic	6	1,277	213	400	90
3. Clinic	4	465	116	240	0
4. Others	2	402	201	402	0
Grand Total	14	2,832	202	498	0

2. Average bed occupation rate : [ ] %
: [ ] beds/day

Base: Population = 10 (No answer = 5)

Category of The Institution	*No of response*	*Average bed occupation rate %*		
		Average	*Maximum*	*Minimum*
1. Hospital	2	100	100	100
2. Poly-clinic	6	100	100	100
3. Clinic	1	100	100	100
4. Others	1	100	100	100
Grand Total	10	100	100	100

3. Average number of in-patients : [ ] patients /day

Base: Population = 14 (No answer =1)

Category of The Institution	*No of response*	*Number of in-patients/day*			
		Total	*Average*	*Maximum*	*Minimum*
1. Hospital	2	62	31	48	14
2. Poly-clinic	6	154	26	70	6
3. Clinic	4	44	11	23	0
4. Others	2	39	20	39	0
Grand Total	14	299	21	70	0

4. Average number of out-patients : [ ] patients /day

Base: Population = 14 (No answer = 1)

Category of The Institution	*No of response.*	*Number of out-patients/day*			
		Total	*Average*	*Maximum*	*Minimum*
1. Hospital	2	536	268	395	141
2. Poly-clinic	6	2,828	471	1,896	0
3. Clinic	4	2,336	584	2,099	0
4. Others	2	456	228	265	191
Grand Total	14	6,156	440	2,099	0

5. Season of high occupancy

Base: Population = 11 (No answer =4)

Category of The Institution	*No of respon se.*	*Season of high occupancy*				
		3 season (without summer)	**Feb. and Mar.**	**spring and autumn**	**summer**	**Winter**
1. Hospital	2	1	1			
2. Poly-clinic	5	1		2	1	1
3. Clinic	3	1		1	1	
4. Others	1					1
Grand Total	11	3	1	3	2	2

6. Season of low occupancy

Base: Population = 12 (No answer = 3)					
Category of The Institution	***No of respon se.***	***Season of high occupancy***			
		Jan. and Apr.	**summer**	**summer and winter**	**Winter**
1. Hospital	2	1	1		
2. Poly-clinic	5		4		1
3. Clinic	4		2	1	1
4. Others	1		1		
Grand Total	12	1	8	1	2

7. Total floor area

Base: Population = 8 (No answer = 7)				
Category of The Institution	***No of respon se.***	***Total floor area (m^2)***		
		Average	***Maximum***	***Minimum***
1. Hospital	1	6,000	6,000	6,000
2. Poly-clinic	2	6,150	11,400	900
3. Clinic	3	5,042	11,850	1,400
4. Others	2	375	720	30
Grand Total	8	4,272	11,850	30

b. Waste Management

b.1 Generation

The interviewer should get enough information to estimate generation amount of each waste!! For this purpose in case the answer is bags/week, please specify the volume of a bag.
[_____litters and bag] litters/bag
If you are not sure of the weight or volume, please estimate the number of garbage loads (e.g. handcarts, containers) collected from your institution per week:[_____]

Q.6. How many kilograms of each waste generated **per week**?

Base: Population = General waste : 12/10 , Medical waste : Solid					
Category of The Institution		***No of response.***	***Waste Generation Amount (kg/week)***		
			Average	***Maximum***	***Minimum***
1. General waste	1. Hospital	2	5,500	9,000	2,000
	2. Poly-clinic	3	645	1,000	296
	3. Clinic	5	203	700	16
	4. Others	2	6,620	12,600	640
	Total	12	2,266	-	-
2. Medical waste	1. Hospital	2	355.2	700	6.0
	2. Poly-clinic	3	24.4	100	0.1
	3. Clinic	3	29.8	250	1.0
	4. Others	2	10.0	15	5.0
	Total	10	81.3	-	-
Base: Population = General waste : 4 , Medical waste : Liquid					
Category of The Institution		***No of response.***	***Waste Generation Amount (litter/week)***		
			Average	***Maximum***	***Minimum***
2. Medical waste	1. Hospital	1	90	90	90
	2. Poly-clinic	0	-	-	-
	3. Clinic	2	8.5	12	5
	4. Others	1	225	225	225
	Total	**4**	83	-	-

Q.7. Which of the following types of general waste do you produce? (Tick all that apply and estimate the approximate percentages of the five main types. If you do not know this, just rank the five main types, 1 = highest, 2 = 2nd highest, etc.)

Base: Population = 14 (No answer = 1)						
General Waste	***No of respons e.***	***Rank***				
		1	***2***	***3***	***4***	***5***
1. Food/kitchen waste	11	4	2	4		1
2. Paper	13	6	4	2	1	
3. Textile	6			3		3
4. Grass and wood (garden waste)	6			1	3	2
5. Plastics	9			4	3	2
6. Leather and rubber	3			2		1
7. Metals	3				3	
8. Glass and bottle	10		4		3	3
9. Ceramics and stone	2					2
10. Coal ash and wood ash	2					2
11. Other (soil, etc.)	1					1

Q.8. Please describe what types of medical waste you produce and the approximate quantities of such wastes.

1. Tick

Base: Population = 13 (No.5 and No.10 : No answer)

	Waste of Types	No. of Medical institution														
		no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Infectious waste	11		x	x	x		x	x	x	x		x	x		x	x
2	Pathological waste	6		x		x		x	x	x	x						
3	Sharps	13	x	x	x	x		x	x	x	x		x	x	x	x	x
4	Pharmaceutical waste	10	x	x				x	x	x	x		x	x		x	x
5	Genotoxic waste	3		x						x					x		
6	Chemical waste	6		x		x			x								
7	Wastes with high content of heavy metals	1		x													
8	Pressurized containers	1		x													
9	Radioactive waste	1		x													

2. Quantities

Base: Population = 13 (No.5 and No.10 : No answer) Unit :Upper kg/week, lower litter/week

	Waste of Types		No. of Medical institution													
		Total	1	2	3	4	6	7	8	9	11	12	13	14	15
1	Infectious waste	845		-	-	5	100	-	700	5	2	-		18	15
														12	
2	Pathological waste	20.1		-		10	10	-	-	0.1					
3	Sharps	687.6	500	-	-	2	90	-	70	10	3.5	-	1	1.1	10
4	Pharmaceutical waste	783	500	-			24	-	-	3	1	-		250	5
5	Genotoxic waste	7		-					6				1		
6	Chemical waste	5		-		5		-							
									90					5	225
7	Wastes with high content of heavy metals	-		-											
8	Pressurized containers	-		-											
9	Radioactive waste	10		10											
Total	Solid	2,357.7	1,000	10	-	22	224	0	776	18.1	1	-	2	268	20
	Liquid	332							90					17	225

b.2 Storage, Discharge, Collection

b.2.1. In house collection system

Q.9. Specify the present waste collection system in your institution.

a. We use a standard system with containers or colored bags with labels
b. We use different types of labeled containers
c. Others

Base: Population = 15

		Waste collection system Main method No of response.		
Waste Category / Types		***a.***	***b.***	***c.***
a. General waste		6	1	1
b. Medical waste	1. Infectious waste	10	1	2
	2. Pathological waste	4	1	-
	3. Sharps	10	1	3
	4. Pharmaceutical waste	5	2	1
	5. Genotoxic waste	1	-	-
	6. Chemical waste	1	1	2
	7. Wastes with high content of heavy metals	-	-	-
	8. Pressurized containers	1	1	-
	9. Radioactive waste	-	-	-

Q.10. Describe the present container for collection of general/medical waste in your institution.(fill in the following table)

a. Plastic bag
b. Paper bag
c. Open container
d. Container with lid
e. Cardboard box

f. Direct disposal (i.e. no storage)
g. Own large concrete bin
h. Others

Base: Population = 15

Waste Category / Types		Waste collection system – Main method – No of response. a.	b.	c.	d.	e.	f.	g.	h.
a. General waste		7	3	1	1	4		3	2
b. Medical waste	1. Infectious waste	10	1		2	2		1	2
	2. Pathological waste	1				1		2	1
	3. Sharps	7	1		3	4		1	1
	4. Pharmaceutical waste	5	1		2	1			
	5. Genotoxic waste	1							
	6. Chemical waste	3				2			1
	7. Wastes with high content of heavy metals								
	8. Pressurized containers	1							1
	9. Radioactive waste				1				

Q.11. Specify the collection frequency of the general/medical waste (of the department) in your institution. (tick in the following table)

Base: Population = 15

Collection frequency	a. General – No of response.	a. General – %	b. Medical – No of response.	b. Medical – %
1. More than once daily	2	13	4	27
2. Once daily	3	20	7	46
3. Every 2-3 days	2	13	0	0
4. Every 4-5 days	0	0	1	7
5. Weekly	7	47	2	13
6. Other	1	7	1	7

Q.12. Are there cool storage points for pathological wastes in your institution?
[ ] 1. Yes
[ ] 2. No

Base: Population = 9

Category of The Institution	No of response.	Cool Storage – Yes	Cool Storage – No
1. Hospital	1	1	0
2. Poly-clinic	4	1	3
3. Clinic	3	3	0
4. Others	1	1	0
Grand Total	9	6	3

b.2.2. Storage

Q.13. How do you store general waste and medical waste?
[ ] 1. We mix them all together. (Go to Q.14)
[ ] 2. We store them separately. (Go to Q.15)

Base: Population = 15

Category of The Institution	No of response.	Storage general waste and medical waste – 1. We mix them all together.	2. We store them separately.
1. Hospital	2	0	2
2. Poly-clinic	6	0	6
3. Clinic	5	0	5
4. Others	2	0	2
Grand Total	**15**	**0**	**15**

Q.14. Why don't you separate medical waste?
All of them don't reply "1" in Q.13.
[ ] 1. There is no reason to separate them.
[ ] 2. It is troublesome to separate them.
[ ] 3. The waste collectors separate them.
[ ] 4. Others(specify :)

Base: Population =

Category of The Institution	No of response.	Storage general waste and medical waste – 1. There is no reason to separate them.	2. It is troublesome to separate them.	3. The waste collectors separate them.	4. Others
1. Hospital	-	-	-	-	-
2. Poly-clinic	-	-	-	-	-
3. Clinic	-	-	-	-	-
4. Others	-	-	-	-	-
Grand Total	**-**	**-**	**-**	**-**	**-**

Q.15. How do you store your waste within your institution? (fill in the following table)
a. Plastic bag
b. Paper bag
c. Open container
d. Container with lid
e. Cardboard box
f. Direct disposal (i.e. no storage)
g. Own large concrete bin
h. Others

Base: Population = 15

		Storage method							
		Main method							
		No of response.							
	Waste Category / Types	***a.***	***b.***	***c.***	***d.***	***e.***	***f.***	***g.***	***h.***
a. General waste		5	6			1		1	
b. Medical waste	1. Infectious waste	10	2		3	2		3	1
	2. Pathological waste	1				1		2	1
	3. Sharps	6	1		4	2			
	4. Pharmaceutical waste	5	1			1			
	5. Genotoxic waste	1							
	6. Chemical waste	3				2			1
	7. Wastes with high content of heavy metals								
	8. Pressurized containers								
	9. Radioactive waste								

b.2.3. Disposal (Intermediate treatment and final disposal)

Q.16. What do you do with your waste? (fill in first two columns of following table)
a. Place outside for collection by Renovation company or other collectors
b. Directly carry garbage to a waste collection vehicle
c. Take the waste to waste collection point of Renovation company or other collectors
d. Renovation company or other collectors collects from institution (including own bin)
e. Bury on site
f. Burn on site
g. Recycle
h. Compost on site
i. Incinerate on site
j. Autoclave disinfection on site
k. Open dumping outside property
l. Other (specify :)

Base: Population = 9 (No answer = 6)

		Main method for General waste											
		No of response.											
Waste Category / Types		***a.***	***b.***	***c.***	***d.***	***e.***	***f.***	***g.***	***h.***	***i.***	***j.***	***k.***	***l.***
	All	3			2		1						
a. General waste	1. Food/kitchen waste	1			1		1						
	2. Paper	1					1						
	3. Textile												
	4. Grass and wood (Garden waste)												
	5. Plastics				1	1							
	6. Leather and rubber												
	7. Metals												
	8. Glass and bottle				1								
	9. Ceramics and stone												
	10. Other (soil, etc.)												

Base: Population = 13 (No answer 2)

		Main method for Medical waste											
		No of response.											
	Waste Category / Types	***a.***	***b.***	***c.***	***d.***	***e.***	***f.***	***g.***	***h.***	***i.***	***j.***	***k.***	***l.***
b. Medical waste	1. Infectious waste					3	3			1			
	2. Pathological waste					2	1			1			
	3. Sharps					3	4			1			
	4. Pharmaceutical waste									1			
	5. Genotoxic waste									1			
	6. Chemical waste									1			1
	7. Wastes with high content of heavy metals									1			
	8. Pressurized containers									1			
	9. Radioactive waste									1			

Q.17. For the medical waste collection by Renovation company or other collectors, how are they disposed of? (fill in final column of above table)
a. Disposed of to the landfill together with other waste
b. Buried in a special pit at the landfill
c. Burned at the landfill
d. Incinerated at an incinerator
e. Buried at the town/city crematorium
f. Other (specify :).

Base: Population = 6 (No answer = 11)

		Main method for General waste					
		No of response.					
Waste Category / Types		***a.***	***b.***	***c.***	***d.***	***e.***	***f.***
	All				1	3	1
a. General waste	1. Food/kitchen waste					1	
	2. Paper					2	
	3. Textile						
	4. Grass and wood (Garden waste)						
	5. Plastics					1	
	6. Leather and rubber						
	7. Metals						
	8. Glass and bottle						
	9. Ceramics and stone						
	10. Other (soil, etc.)						

Base: Population = 5 (No answer = 10)

		Main method for Medical waste					
		No of response.					
Waste Category / Types		***a.***	***b.***	***c.***	***d.***	***e.***	***f.***
b. Medical waste	1. Infectious waste	1			1	1	1
	2. Pathological waste	1				1	
	3. Sharps	1			1	2	1
	4. Pharmaceutical waste	1			1	1	
	5. Genotoxic waste	1			1	1	
	6. Chemical waste	1					
	7. Wastes with high content of heavy metals	1			1		
	8. Pressurized containers	1			1		
	9. Radioactive waste						

Q.18. If you chose **g.** in Q.16, go to "Additional Sheet A".
All of them don't reply "g" in Q.16.

Q.19. If you chose **f. and i.** in Q.16, please provide the following information for the incinerator.

Information		Description				
		Hospital No.2	Hospital No.3	Hospital No.5	Hospital No.9	Hospital No.10
1	Location:	No answer	Inside of hospital	No answer	Inside of hospital	No answer
2	Capacity (furnace volume (m3) and waste burning capacity (kg/h):	5 kg/hour	No answer	$10m^3$. (Unit:Unclear)	No answer	2 - $3m^2$ (Unit:Unclear)
3	Description (e.g. no of chambers, operating principle):	Chamber - 1	Chamber - 1	Chamber - 2	Chamber - 1	No answer
4	Combustion fuel:	Wood	Patrol	Wood and paper	Coal	No answer
5	Height of chimney	No answer	20 m	1.2 m	20 m	No answer
6	Proximity of living/working spaces to incinerator:	Normal	Normal	No answer	Normal	No answer
7	Scrubbing/filtering of exhaust gases: Yes/No	No answer	No answer	No answer	Scrubbing	No answer
8	Normal operating hours:	4 - 6 hour	6 hour	No answer	No answer	4 hour
9	Ash disposal (amount and frequency):	No answer	1kg/hour	No answer	No answer	No answer
10	Age:	17	25	5	20	19
11	Reliability (no of days out of service per year; average outage time):	No answer	No answer	Sometimes	Yearly	No answer
12	Problems:	Need Maintenance	Shraps bad burned	Air pollution	No problem	No answer

Q.20. If you chose **j.** in Q.16, please provide the following information for the autoclave.

Information	Description			
	Hospital No.3	Hospital No.4	Hospital No.8	Hospital No.9
1. Location:	No answer	extenr room	watse chambered	Treatment center
2. Type	BK-75	TC-80	BK-75	BK-76
3. Capacity (Treatment volume (m3) and waste capacity (kg/h):	8-10 kg/hour	20 kg/hour	20 kg/hour	75m^3 (Unit:Unclear)
4. Description (e.g. no of autoclave, operating principle):	boiler apparatus	1, 132^{0}C, 30 minute	working 2 /day, 45 minute	3
5. Normal operating hours:	6 hour	1.5 hour	1.3 hour	7 hour
6. Average daily treatment amount :	8-10 kg/day	40 kg/day	7 kg/ day	12 kg/day
7. Disposal method of treated waste	foul system	burned	burned	uninfectious
8. Reliability (no of days out of service per year average outage time):	Reliability	always cheked	no answer	no answer
10. Problems:	no answer	no answer	no answer	no answer

Q.21. If you ticked **k.** in Q.16, where do you dump your waste outside your institution?

All of them don't reply "k" in Q.16.

[ ] 1. On banks of stream/river, or in stream/river
[ ] 2. On vacant land
[ ] 3. In a gully
[ ] 4. Other (specify :).

Base: Population =

Category of The Institution	*No of response.*	*Where do you dump your waste outside your institution?*			
		1. On banks of stream/river, or in stream/river	*2. On vacant land*	*3. In a gully*	*4. Other*
1. Hospital	-	-	-	-	-
2. Poly-clinic	-	-	-	-	-
3. Clinic	-	-	-	-	-
4. Others	-	-	-	-	-
Grand Total	-	-	-	-	-

b.2.4. Discharge

Q.22. How do you discharge medical wastes?

[ ] 1. We separate store but mix discharge.
[ ] 2. We separate store and separate discharge.
[ ] 3. We mix store and mix discharge.

Base: Population = 11 (No answer = 4)

Category of The Institution	*No of response.*	*How do you discharge medical wastes?*		
		1. We separate store but mix discharge.	*2. We separate store and separate discharge.*	*3. We mix store and mix discharge.*
1. Hospital	2	0	2	
2. Poly-clinic	3	0	3	
3. Clinic	5	3	2	
4. Others	1	0	1	
Grand Total	**11**	**3**	**8**	

Q.23. In case of "**separate store but mix discharge**", who mixes them?

[ ] 1. Collector
[ ] 2. Our employee
[ ] 3. Others (specify:)

Base: Population = 6

Category of The Institution	*No of response.*	*In case of "separate store but mix discharge", who mixes them?*	
		1. Collector	*2. Our employee*
1. Hospital	1	0	1
2. Poly-clinic	1	0	1
3. Clinic	4	2	2
4. Others	0	0	0
Grand Total	**6**	**2**	**4**

Q.24. Referring to an example given below, please tick appropriate boxes on the answer table to indicate your discharge manner of medical wastes.

Base: Population = 13 (No answer = 2)

		Your discharge manner of medical waste		
		No of response.		
	Waste Category / Types	*1. separated discharge*	*2. mixed discharge*	*3. not generated*
Medical waste	1. Infectious waste	5		
	2. Pathological waste	2	1	1
	3. Sharps	4	1	1
	4. Pharmaceutical waste	1		
	5. Genotoxic waste			1
	6. Chemical waste	2		
	7. Wastes with high content of heavy metals			1
	8. Pressurized containers			1
	9. Radioactive waste	1		

b.2.5. Collection

Q.25. Are you provided with a garbage collection service? (either direct collection or nearby waste collection points or direct pickup from institution – items **a, b, c or d** in Q.16)

[ ] 1. Yes
[ ] 2. No
[ ] 3. No answer – Do you want to receive a waste collection service?
– Answer: [ ] 1. Yes / [ ] 2. No

Base: Population = 15

Category of The Institution	*No of response.*	*Are you provided with a garbage collection service?*	
		Yes	*No*
1. Hospital	2	2	0
2. Poly-clinic	6	6	0
3. Clinic	5	5	0
4. Others	2	2	0
Grand Total	**15**	**15**	**0**

Base: Population = 0

Category of The Institution	*No of response.*	*Do you want to receive a waste collection service?*	
		Yes	*No*
1. Hospital	-	-	-
2. Poly-clinic	-	-	-
3. Clinic	-	-	-
4. Others	-	-	-
Grand Total	-	-	-

Q.26. Who collects your waste?

[ ] 1. Government
[ ] 2. TUK
[ ] 3. Private company other than Renovation company
[ ] 4. Don't know

Base: Population = 15

Category of The Institution	*No of response.*	*Who collects your waste?*			
		1. Government	*2. Renovation company*	*3. Private company other than Renovation company*	*4. Don't know*
1. Hospital	2		2		
2. Poly-clinic	6		6		
3. Clinic	5		5		
4. Others	2		2		
Grand Total	**15**		**15**		

Q.27. Do you use this waste collection service?

[ ] 1. Yes
[ ] 2. No

Base: Population = 14 (No answer = 1)

Category of The Institution	*No of response.*	*Do you use this waste collection service?*	
		Yes	*No answer*
1. Hospital	2	2	
2. Poly-clinic	6	5	1
3. Clinic	5	5	
4. Others	2	2	
Grand Total	**15**	**14**	**1**

If you answered no, please explain why below
(_____)

Q.28. How often do you discharge your garbage and how often is it collected? (Tick one)

Base: Population = 14

		a. General waste		*b. Medical waste*	
	Frequency	***Discharge***	***Collection***	***Discharge***	***Collection***
1.	More than once daily	2		2	1
2.	Once daily	4	3	5	5
3.	Every 2-3 days	5	4	5	4
4.	Every 4-5 days	2	1	2	1
5.	Weekly				
6.	Less than weekly				
7.	Irregularly				
8.	Other				

Q.29. Do you pay the TUK or a private collector an official waste collection fee?
[ ] 1. Yes
[ ] 2. No

Base: Population = 13 (No answer = 2)

Category of The Institution	***No of response.***	***Do you pay the TUK or a private collector an official waste collection fee?***	
		Yes	***No***
1. Hospital	2	2	
2. Poly-clinic	4	4	
3. Clinic	5	5	
4. Others	2	2	
Grand Total	**13**	**13**	

If yes, how much is this fee? And what type of wastes does it cover?

Category of The Institution	**Waste Type**	**Payment (US$/month)**			
		No of response	Average	Max	Min
Hospital	General	1	23	23	23
Poly-clinic	General	2	28	32	23
	Medical wastes	1	33	33	33
Clinic	General	3	87	150	40
	Medical	1	65	65	65
	General/Medical	1	65	65	65
	Sharps	1	15	15	15
Others	General	1	320	320	320

Q.30. Have you ever given a direct unofficial payment to waste collection workers for collection your waste?
[ ] 1. Yes
[ ] 2. No

Base: Population = 12 (No answer = 3)

Category of The Institution	***No of response.***	***Have you ever given a direct unofficial payment to waste collection workers for collection your waste?***	
		Yes	***No***
1. Hospital	1	1	
2. Poly-clinic	4		4
3. Clinic	5	2	3
4. Others	2	1	1
Grand Total	**12**	**4**	**8**

Q.31. What is the total amount of the unofficial payment you have given to waste collection worker over the last 12 months?
Answer: [_____]

Category of the Institution	Unofficial payment (US$/year)
1. Hospital	275
2. Poly-clinic	476
	400
3. Clinic	1,800
	500
	1,620
	1,000

Q.32. Are you satisfied with the existing waste collection and disposal service?
[ ] 1. Yes
[ ] 2. No

Base: Population = 14 (No answer = 1)

Category of The Institution	*No of response.*	*Are you satisfied with the existing waste collection and disposal service?*	
		Yes	*No*
1. Hospital	2		2
2. Poly-clinic	5	3	2
3. Clinic	5	3	2
4. Others	2	2	
Grand Total	**14**	**8**	**6**

If No, Why? (tick one or more)

	Base: Population = 6	*Why?*
1.	Discharge system is poor (e.g. no bins, bins are broken or too small)	4
2.	Waste collection point is too far away	
3.	Waste collection/sweeping is not properly done	2
4.	Waste collection service/sweeping is irregular	1
5.	Waste collection/sweeping frequency is too low	1
6.	Collection time is too early or too late	
7.	Waste collection workers behave badly	
8.	Waste collection workers demand payment for waste collection	
9.	Waste collection fee of the Renovation company or a private collector is too high	1
10	Lack of recycling	2
11	Problems with handling medical waste	4
12	Other	

Q.33. How many times have you complained about the waste collection service in the last year?
[ ] 1. None
[ ] 2. Once only
[ ] 3. Several times
[ ] 4. More than five times

Base: Population = 13 (No answer = 2)

Category of The Institution	*No of respons e.*	*How many times have you complained about the waste collection service in the last year?*			
		1. None	*2. Once only*	*3. Several times*	*4. More than five times*
1. Hospital	1	1			
2. Poly-clinic	5	3		2	
3. Clinic	5	3		2	
4. Others	2	1	1		
Grand Total	**13**	**8**	**1**	**4**	**0**

Q.34. Is any staff member of your institution responsible for ensuring that medical waste is collected and disposed of properly?
[ ] 1. Yes
[ ] 2. No

Base: Population = 13 (No answer = 2)

Category of The Institution	*No of response.*	*Is any staff member of your institution responsible for ensuring that medical waste is collected and disposed of properly?*	
		Yes	*No*
1. Hospital	1	1	
2. Poly-clinic	5	4	1
3. Clinic	5	5	
4. Others	2	2	
Grand Total	**13**	**12**	**1**

If you answered Yes, please explain position of persons and their duties below
Name and position of person: [ ]
Please describe their duties: [_____]

Category of The Institution	*Position of Person*	*Their duties*
Hospital	Disinfecting committee	No answer
Poly-clinic	Assistant (Operator of Autoclave)	No answer
	Hygiene auditor doctor	No answer
Clinic	Disinfecting committee	No answer
	Hodman	No answer
	Hygiene	No answer
Others	Vise president	No answer

b.3 Improvements to waste collection and disposal

b.3.1. General

Q.35. What improvements would you like to see to waste collection and disposal? (Please tick one or more and priorities the top three improvements you would like to see (1 = first priority, 2 = second priority, 3 = third priority)

Base: Population = 12 (No answer = 3)

		No of response.	*Priority*		
			first	*second*	*third*
1.	Improved waste discharge system	6	2	3	1
2.	Shorter distance to waste collection point	0			
3.	More reliable waste collection service	3	2		1
4.	Improved collection frequency	0			
5.	Greater recycling of waste	5	2	2	1
6.	Improved collection and disposal of medical waste	7	2	3	2
7.	Improvement of landfill operation	2		1	1
8.	Education to change people's bad habits	5	3	1	1
9.	Other	28	11	10	7

Q.36. Improved waste collection and disposal will cost additional money. Who do you think should pal these costs? (tick one or more)

[ ] 1. Central Government (e.g. Ministry of Health)
[ ] 2. Ulaanbaatar city (UBC)
[ ] 3. Individual medical institutions
[ ] 4. Other (specify : _____)

Base: Population = 13

Category of The Institution	*No of response.*	*Improved waste collection and disposal will cost additional money. Who do you think should pal these costs?*			
		1. Central Government	*2. Ulaanbaatar city (UBC)*	*3. Individual medical institutions*	*4. Other*
1. Hospital	1		1		
2. Poly-clinic	6	3	1	2	
3. Clinic	7	3	3	1	
4. Others	2	1	1		
Grand Total	**16**	**7**	**6**	**3**	

Q.37. Suppose that you are satisfied with the municipal solid waste management service, either as is or as a result of improvement. Think for a moment about the largest amount of money that your medical institution would be willing to pay each month as a garbage collection fee.

Amount of money: [_____] US$/month

Base: Population = 8 (No answer = 7)

Category of The Institution	*Garbage collection fee (US$/month)*			
	No of response	Aver age	Max	Min
Hospital	0	-	-	-
Poly-clinic	2	40	40	40
Clinic	5	55	83	23
Others	1	3	3	3

Q.38. If the current waste collection fee is more than this amount, your medical institution will not be able to afford to pay and will not be able to use the waste collection service. If you are still not willing to pay the current waste collection fee, explain why below:

Reasons:……..

Base: Population = 2 (No answer = 13)

Nos. of The Institution	*Reasons*
Clinic	expensive

b.3.2. Training and Instructions

Q.39. Is there some written instruction to separate and manage medical solid wastes in the institution?

[ ] 1.Yes
[ ] 2.No (Go to Q41)

Base: Population = 14 (No answer = 1)

Category of The Institution	*No of response.*	*Is there some written instruction to separate and manage medical solid wastes in the institution?*	
		Yes	*No*
1. Hospital	2	2	
2. Poly-clinic	5	4	1
3. Clinic	5	5	
4. Others	2	2	
Grand Total	**14**	**13**	**1**

Q.40. How often the staff of waste management is trained as a caution against contaminated or hazardous waste?
[ ] 1.Only at the start of the job
[ ] 2.Once a year
[ ] 3.Very often, please explain how often _____
[ ] 4.Never

Base: Population = 14 (No answer = 1)

Category of The Institution	*No of respons e.*	*How often the staff of waste management is trained as a caution against contaminated or hazardous waste?*			
		1.Only at the start of the job	*2.Once a year*	*3.Very often, please explain how often*	*4.Never*
1. Hospital	2	1		1	
2. Poly-clinic	5	2		3	
3. Clinic	5	2	2	1	
4. Others	2	1		1	
Grand Total	**14**	**6**	**2**	**6**	

b.3.3. Environmental education and general cleanliness

Q.41. Has anyone of this institution received any health and environmental education or information relating to solid waste? Yes/No,

Base: Population = 13 (No answer = 2)

Category of The Institution	*No of response.*	*Has anyone of this institution received any health and environmental education or information relating to solid waste?*	
		Yes	*No*
1. Hospital	2	1	1
2. Poly-clinic	5	4	1
3. Clinic	5	2	3
4. Others	1	1	
Grand Total	**13**	**8**	**5**

Q.42. Do you think that a campaign to raise the awareness of people for maintaining a cleaner city and environment is necessary? (tick one)
[ ] 1. Very necessary
[ ] 2. Somewhat necessary
[ ] 3. Not very necessary
[ ] 4. Not necessary at all

Base: Population = 13 (No answer = 2)

Category of The Institution	*No of response.*	*Do you think that a campaign to raise the awareness of people for maintaining a cleaner city and environment is necessary?*			
		1.Very necessary	*2. Somewhat necessary*	*3. Not very necessary*	*4. Not necessary at all*
1. Hospital	1	1			
2. Poly-clinic	5	5			
3. Clinic	5	5			
4. Others	2	2			
Grand Total	**13**	**13**			

b.3.4. Sewerage

Q.43. Where does the toilet waste from your institution go? (Tick one)
[ ] 1. Into septic tank
[ ] 2. Into pit
[ ] 3. Into pond, river, canal directly
[ ] 4. Into storm water drain or sewerage pipe directly
[ ] 5. Into wastewater treatment plant of the institution
[ ] 6. Don't know

Base: Population = 14 (No answer = 1)

Category of The Institution	*No of response.*	*Where does the toilet waste from your institution go?*					
		1. Into septic tank	*2. Into pit*	*3. Into pond, river, canal directly*	*4. Into storm water drain or sewerage pipe directly*	*5. Into wastewater treatment plant of the institution*	*6. Don't know*
1. Hospital	2				2		
2. Poly-clinic	5				5		

3. Clinic	5		5
4. Others	2		2
Grand Total	**14**	**14**	**14**

Q.44. If you chose 1. or 2. in Q.43, is wastewater and/or sludge removed from your institution by vacuum truck?
[ ] 1. Yes
[ ] 2. No
[ ] 3. Don't know

All of them don't need this question.

Base: Population =

Category of The Institution	*No of response.*	*Is wastewater and/or sludge removed from your institution by vacuum truck?*		
		1.Yes	*2.No*	*3. Don't know*
1. Hospital	-	-	-	-
2. Poly-clinic	-	-	-	-
3. Clinic	-	-	-	-
4. Others	-	-	-	-
Grand Total	**-**	**-**	**-**	**-**

Q.45. How many cubic meters of your septic tank or pit?
Capacity of septic tank or pit: [_____] m^3

All of them don't need this question.

Q.46. How often is septic tank or pit clean-up?
[ ] 1. Once a half year
[ ] 2. Once a year
[ ] 3. Less than once a year
[ ] 4. Don't know

All of them don't need this question.

Base: Population = 4

Category of The Institution	*No of response.*	*Do you think that a campaign to raise the awareness of people for maintaining a cleaner city and environment is necessary?*			
		1.Very necessary	*2. Somewhat necessary*	*3. Not very necessary*	*4. Not necessary at all*
1. Hospital	-	-	-	-	-
2. Poly-clinic	-	-	-	-	-
3. Clinic	-	-	-	-	-
4. Others	-	-	-	-	-
Grand Total	**-**	**-**	**-**	**-**	**-**

Q.47. Who clean-up septic tank or pit?
[ ] 1. Government
[ ] 2. Private company
[ ] 3. Don't know

All of them don't need this question.

Base: Population = 4

Category of The Institution	*No of respons e.*	*Who clean-up septic tank or pit?*		
		1. Government	*2. Private company*	*3. Don't know*
1. Hospital	-	-	-	-
2. Poly-clinic	-	-	-	-
3. Clinic	-	-	-	-
4. Others	-	-	-	-
Grand Total	**-**	**-**	**-**	**-**

c. Financial Matter

Q.48. How much do you pay for medical waste collection services per month?

Base: Population = 6 (No answer =9)

Type of waste	*No of response.*	*Collection fee (US$/month)*		
		Ave.	*Max.*	*Min.*
1. Infectious waste	2	75	116	33
2. Pathological waste	1	40	40	40
3. Sharps	3	51	120	15
4. Pharmaceutical waste	1	21	21	21
5. Genotoxic waste	1	13	13	13
6. Chemical waste	1	50	50	50
7. Wastes with high content of heavy metals				
8. Pressurized containers				
9. Radioactive waste				
10.Ash (if the waste burned or incinerated)				
11. Mixed waste	2	73	120	26

Q.49. How much do you pay for general waste collection services per month?
Amount of money: [_____] US$/month

Base: Population = 11 (No answer = 4)				
Nos. of The Institution	***No of response***	***US$/month***		
		Ave	***Max***	***Min***
Hospital	2	127	231	23
Poly-clinic	5	73	150	20
Clinic	2	52	62	42
Other	2	193	325	60

Q.50. If the market price of waste collection rose, how much, at maximum, could you afford to pay per month?

Base: Population = 7 (No answer = 8)				
Type of waste	***No of response.***	***US$/month***		
		Ave.	***Max.***	***Min.***
General Waste	2	188	333	42
1. Infectious waste	5	36	63	26
2. Pathological waste				
3. Sharps	3	41	63	26
4. Pharmaceutical waste	1	33	33	33
5. Genotoxic waste				
6. Chemical waste	1	26	26	26
7. Wastes with high content of heavy metals				
8. Pressurized containers				
9. Radioactive waste				
10.Ash (if the waste burned or incinerated)				
11. Mixed waste				

Q.51. Is there someone who comes around to collect or buy your reusable or recyclable materials?
[ ] 1. Yes.
[ ] 2. No. (Go to Q53)

Base: Population =10 (No answer = 5)			
Category of The Institution	***No of response.***	***Is there someone who comes around to collect or buy your reusable or recyclable materials?***	
		Yes	***No***
1. Hospital	1		1
2. Poly-clinic	4	1	3
3. Clinic	4	1	3
4. Others	1		1
Grand Total	**10**	**2**	**8**

Q.52. Which materials do they collect or buy from you?

Base: Population = 2	
	Answer
Type of Material	***No of response.***
1.Bottle	2
2.Glass	2
3.Cardboard	
4.Paper	
5.Aluminum can	2
6.Steel can	
7.Metal	1
8.Kitchen waste	1
9.Graden waste	
10.Plastic	2
11.Textile	
12.Leathers	
13.Wood/timber	
14.Tire	
15.Others	

d. Cooperation for Waste Management

Q.53. Coping with wastes requires efforts of not only the municipality but also the general public. Do you think there is something which your institution can do for good waste management?
[ ] 1. Yes.
[ ] 2. No.
[ ] 3. I don't know.
[ ] 4. Others (specify: _____)

Base: Population = 10 (No answer = 5)

Category of The Institution	No of response.	Do you think that a campaign to raise the awareness of people for maintaining a cleaner city and environment is necessary?			
		1.Very necessary	2. Somewhat necessary	3. Not very necessary	4. Not necessary at all
1. Hospital	0				
2. Poly-clinic	3	3			
3. Clinic	5	5			
4. Others	2	1		1	
Grand Total	**10**	**9**		**1**	

Q.54. What do you think your institution can do? (plural answer question)
[ ] 1. Discharging wastes neatly.
[ ] 2. Minimizing waste generation.
[ ] 3. Reusing wastes.
[ ] 4. Recycling wastes.
[ ] 5. Treating toxic/infectious wastes appropriately.
[ ] 6. Raising the environmental awareness of the public.
[ ] 7. Providing information to the public.
[ ] 8. Researching activities.
[ ] 9. Others (specify: _____)

Base: Population = 14

Type of Material	Answer No of response.
1. Discharging wastes neatly.	12
2. Minimizing waste generation.	3
3. Reusing wastes.	2
4. Recycling wastes.	2
5. Treating toxic/infectious wastes appropriately.	4
6. Raising the environmental awareness of the public.	7
7. Providing information to the public.	5
8. Researching activities.	4
9.Others	0

Q.55. Do you think the medical institutions should cooperate with the country and/or municipality in managing wastes?
[ ] 1. Yes.
[ ] 2. No.
[ ] 3. I don't know.
[ ] 4. Others (specify: _____)

Base: Population = 15

Category of The Institution	No of response.	Do you think the medical institutions should cooperate with the country and/or municipality in managing wastes?			
		1.Yes	2. No	3. I don't know	4. Others
1. Hospital	2	2			
2. Poly-clinic	6	6			
3. Clinic	5	5			
4. Others	2	2			
Grand Total	**15**	**15**			

Q.56. How is the trend of your cost for waste management?
[ ] 1. It is getting significantly higher.
[ ] 2. It is getting higher.
[ ] 3. It is relatively stable.
[ ] 4. It is getting lower.

Base: Population = 14 (No answer = 1)

Category of The Institution	No of response.	How is the trend of your cost for waste management?				
		1. It is getting significantly higher.	2. It is getting higher.	3. It is relatively stable.	It is getting lower.	5. Others
1. Hospital	2	1	1			
2. Poly-clinic	5		3	2		
3. Clinic	5		4	1		
4. Others	2			2		
Grand Total	**14**	**1**	**8**	**5**		

Q.57. How do you give the priority on the management of your wastes?
[ ] 1. We give very high priority.
[ ] 2. We give moderate priority.
[ ] 3. We give little priority.

Base: Population = 14 (No answer = 1)

Category of The Institution	*No of respon se.*	*How do you give the priority on the management of your wastes?*			
		1. We give very high priority.	*2. We give moderate priority.*	*3. We give little priority.*	*4. Others*
1. Hospital	2	2			
2. Poly-clinic	5	3	2		
3. Clinic	5	3	2		
4. Others	2	2			
Grand Total	**14**	**10**	**4**		

Q.58. Do you feel you need a support from the government or municipality or any other relevant organizations for the management of your waste? (plural answer question)

[ ] 1. Yes, we need financial support.
[ ] 2. Yes, we need technical support.
[ ] 3. Yes, we need support of other kinds (specify: _____)
[ ] 4. No, we don't.
[ ] 5. Others (specify: _____)

Base: Population = 14 (No answer =1)

Information source	*No of response.*
1. Yes, we need financial support.	10
2. Yes, we need technical support.	6
3. Yes, we need support of other kinds	2
4. No, we don't.	0
5. Other	0

e. Other

Q.59. If there any additional comments you would like to make about solid waste management provision and your needs, please comment below:

[_____]

Nos. of The Institution	*Additional comments*
Hospital	- Burned is very important - Need of waste management training
Poly-clinic	- Need of training - Need a burn and standart box - Good management - Need of waste management training
Clinic	- Need of training - Need of training and a burn - Need of training, a burn and car - Need of waste management training
Other	- Need of waste system and burn,

"Additional Sheet A"

Recycling: ONLY answer this section if you ticked Q.16 (g).

All of them don't replay this additional sheet A.

Write your answers to the following questions in the table below:

- What items do you recycle? (specify any other materials in the blank cells)
- How much do you recycle per month?
- What price do you sell these items for?
- Who do you sell/give these materials to? (e.g. individual collector, shop, middleman, industry)
- How does this recycling system work? (put 1, 2, etc. in method column)
  1. Take directly to shop for refund
  2. Give to collector who comes to premises
  3. Take directly to middlemen for sale
  4. Take directly to community group/NGO for sale
  5. Take directly to industry for sale
  6. Other – specify in table
- How often are these materials collected/taken for recycling? (daily, 2-3 times per week, weekly, monthly, other, irregularly)

Item	Quantity (kg/mnoth)	Price (MNT/kg)	Buyer	Method	Collection frequency
Paper					
Cardboard					
Glass bottles					
Polythene bags					
Saline bottles					
Other plastic					
Metal					
Organic waste for animal feed					

Additional space for answers:

[_____].

Nos. of The Institution	*Additional Answer*	*Memo*

- Are there any problems with this recycling system? Answer: Yes/No

If YES, please explain why below: [ ].

Nos. of The Institution	*Answer*	*Memo*

Contact details (address/telephone numbers for buyers):

[_____].

Nos. of The Institution	*Contact details*	*Memo*

- **Annexure : Hospital of Target Hospital**

No.	Name of Hospitals	Number of Beds
1	Clinic Hospital I	498*1
2	Center of Maternity and Children (children)	402*1
3	Obstetrics Clinic I	240*1
4	Forensic research centre	0*2
5	Clinic Hospital III	400*1
6	Puma hospital (private)	90*2
7	Traumatology and Rehabilitation Clinic	120*1
8	National Cancer Center	190*1
9	Clinic Hospital on Infectious Diseases	300*1
10	Bayanzurkh district hospital	200*2
11	Bayanzurkh Clinical Hospital	225*1
12	Sukhbaatar district health centre	NA*2
13	Chingeltei Clinical Hospital	167*1
14	Tooth, Chin and Facial Research Center	0*1
15	Yonsei friendship hospital	0*2

Note : *1 Data of MOH

*2 Data from this study

2.6 Survey on Industrial Waste Management

2.6.1 Objectives and Waste Flow

a. Objectives

The objective of the survey is to obtain basic data that is necessary for estimating the total amount of industrial waste (IW) generated in the Study area at present and to forecast that in the future. The estimation and forecast support the part of IW management system of the master plan (M/P).

b. Schedule of the Survey

The survey on industrial waste management was carried out twice according to the following schedule.

- First Survey: The Study Team conducted interview surveys of 18 factories in February 2005.
- Second Survey: The Study Team conducted interview surveys of 17 factories in September 2005. The second survey was carried out to identify the status of hazardous industrial waste (HIW) discharge. The factories interviewed in the second survey included 6 factories from the first survey on HIW discharge, as the volume and variety of HIW from these factories was not clear.

c. Waste flow

Through this factory survey, the generation amount, on-site reuse/recycling and treatment/disposal amount, collection/transportation amount, and off-site reuse/recycling and treatment/disposal amount should be understood. An IW flow should be developed as shown in the following figure.

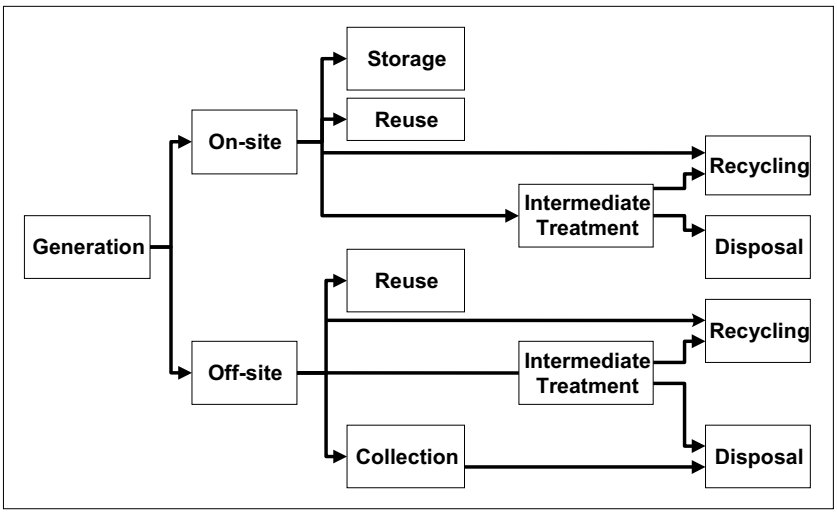


Figure 2-17: IW Flow

d. Work Flow

The factory survey followed the procedure illustrated below.

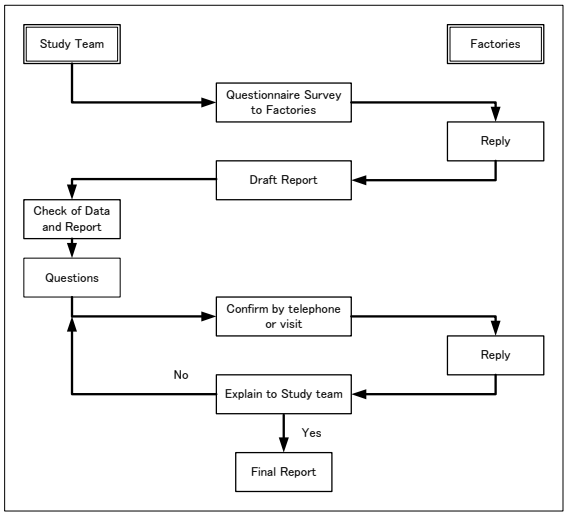


Figure 2-18: Work Flow of Factory Survey

2.6.2 Method of the Survey

a. Preparation of the Survey

a.1 Classification of IW

In this factory survey, IW was divided into two types: non-hazardous and hazardous. Non-hazardous industrial waste (non-HIW) and hazardous industrial waste (HIW) are further divided into groups as shown in the two tables below.

There is no official classification of industrial waste (IW) in Mongolia. The Team set up the following classification of non-HIW and HIW for the Study based on the past experience.

Table 2-86: Classification of Non-Hazardous Industrial Waste (Non-HIW)

Type of Non-Hazardous Industrial Waste	Non-HIW Code
Waste generated from non-production sources (general industrial waste)	GIW
Waste from animal such as bone, skin, hair	NH01
Wood	NH02
Paper	NH03
Plastic or polymers and resins	NH04
Textile and fiber	NH05
Grease, animal oil, vegetable oil	NH06
Natural rubbers	NH07
Metals and metal alloys such as aluminum, copper, bronze	NH08
Ceramics& Glass	NH09
Stone, ash/dust from coal-fired power plants, sand or material that have composition of soil such as tile, brick, gypsum, cement	NH10
Mixed waste	NH11
Others	NH12

Table 2-87: Classification of Hazardous Industrial Waste (HIW)

Type of Hazardous Industrial Waste	HIW Code	Example of Hazardous Industrial Waste
Inorganic acid	HW01	Sulfuric acid (H_2SO_4), Hydrochloric acid (HCl), Nitric acid (HNO_3), Phosphoric acid (H_3PO_4), Other inorganic acids
Organic acid	HW02	Acetic acid (CH_3COOH), Formic acid (HCOOH), Other organic acids
Alkalis	HW03	Caustic soda (NaOH), Ammonia (NH_3), Sodium carbonate (Na_2CO_3), Other alkaline materials
Toxic-Metal Compounds	HW04	Salts (Hg, As, Cd, Pb, Cr, etc)
Inorganic Compounds	HW05	Plating wastes, Cyanides, Picking waste, Sulfide, etc.
Other Inorganic	HW06	Asbestos, Slug, etc.
Organic Compounds	HW07	Reactive chemical wastes (Oxidizing agents, Reducing agents, etc), Solvents etc.

Polymeric Materials	HW08	Epoxy resin, Chelate resin, Polyurethan resin, Latex rubber etc.
Fuel, Oil and Grease	HW09	Fats, Waxes, Kerosene, Lubricating oil, Engine oil, Grease etc
Fine Chemicals and Biocides	HW10	Pesticides, Medicine, Cosmetic, Drugs, etc.
Treatment Sludge and contaminated rubbish	HW11	Inorganic sludge, Organic sludge etc.
Ash including from incinerator	HW12	---
Dust and APC products	HW13	Soot and dust waste from incineration facilities, treating exhaust gas
Other Hazardous substance (besides HW01-HW13)	HW14	HIWs other than the above

a.2 Preparation of Survey Sheet

The 1st survey should clarify the current generation, reuse/recycling and treatment/disposal. The contents of the questionnaire of the survey are divided into two parts: (1) general information and (2) IW management.

a.3 List of Factories

There are three kinds of factory lists. One is submitted by MOE and the second is submitted by MUB by the request of the JICA preparatory study. The third one is in the statistic handbook of Ulaanbaatar[6]. The number of factories listed in three reports is different.

The study team has estimated the number of factories basically based on the list submitted by MOE, and some categories like furniture and paper processing are based on the list submitted by MUB. The table below shows the number of factories in UBC, together with the factory category code that was used in the study.[7]

Table 2-88: Number of Factories in UBC

Code	Description	Range of Number of Employees					Source
		10>	11-100	101-500	>501	Total	
G01	Agriculture, Food, Dairy product	2,346	487	42	3	2,878	MOE
G02	Leather	107	23	0	0	130	MOE
G03	Textile	55	53	10	4	122	MOE
G04	Chemical	51	21	2	0	74	MOE
G05	Cement & Brick	42	25	9	1	77	MOE
G06	Metal processing	12	4	0	0	16	MOE
G07	Furniture	120	35	2	0	157	UBC
G08	Paper Processing	124	28	1	0	153	UBC
G09	Mining industry, Metallurgy	132	91	21	7	251	MOE
G10	Others	399	233	30	1	663	MOE
	Number of Factories	3,388	1,000	117	16	4,521	-

b. Method of the Survey

The survey was conducted as follows:

- Select target
  - First Survey : Target factories were selected taking into account their type and number of employees
  - Second Survey: (1) 6 factories which responded that HIW is being discharging as a factory process in 1st survey and (2) 11 factories which were selected as possible of discharging HIW

[6] Statistical Handbook of Ulaanbaatar, XX century, VIII Living conditions table2., 1) Agriculture, hunting and forestry; fishing 2) Mining and quarrying 3) Electricity, gas and water supply 4) Construction 5) Sum amount of Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods

[7] In case there are categories but no factory is categorized in MOE list, data in UBC is used to fill in the list.

- Questionnaires were distributed to the target factories to be interviewed and appointments were made for interviews
- The owners or representatives of the target factories were interviewed
- The results were analyzed

The number of factories surveyed in each industrial sector is shown in the table below. The team tried to cover factories with a large number of employees and overall categories of factory, but not all the factories that the team planned to visit accepted the survey due to the nature of the survey.

In 2nd Survey, as it was important to identify the status of HIW discharge, factories with one location (railway company, electric power plant, waste water treatment plant and cement factory) in the study area were also selected.

Table 2-89: Target Factories of the Survey

Factory Code	Factory Type	Number of Factories			
		1st Survey	2nd Survey		
			New Factory	Duplicated factory in 1st Survey	Total
G01	Food, Dairy product	**5**	1	1	**2**
G02	Leather	**2**	1	1	**2**
G03	Textile	**4**	-	1	**1**
G04	Chemical	**1**	1	1	**2**
G05	Cement & Brick	**2**	1	-	**1**
G06	Metal processing	**3**	1	2	**3**
G07	Furniture	**-**	-	-	**-**
G08	Paper Processing	**-**	-	-	**-**
G09	Mining industry, Metallurgy	**-**	-	-	**-**
G10	Others	**1**	6	-	**6**
Total		**18**	11	6	**17**

Remark: Factory code has been set up by the study team in ten categories.

2.6.3 Results of the Survey

a. The 1st Factory Survey

a.1 Current Systems of Industrial Waste Management (IWM)

a.1.1. Waste Separation

Seven out of 18 target factories replied that they generate HIW and they all separate HIW from non-HIW. Five factories replied that they did not separate HIW in spite of generating HIW. Six factories replied that they are not generating HIW.

In reality, however, when asked the generation amount of each type of waste, all factories answered only the generation amount of non-HIW.

a.1.2. Storage

Many of the 9 factories that store IW do not separate it from non-Industrial Waste. The rest store reusable / recyclable IW, non-reusable / non-recyclable IW and non-IW separately.

a.1.3. On-site Treatment and Reuse/Recycling

Four factories replied that they reuse/recycle IW on site. One factory is composting bird droppings, two factories utilize IW as raw materials after washing treatment and one factory is recycling iron and wood generated through operation processes.

a.1.4. Collection, Off-site Treatment and Reuse/Recycling, Disposal

Eight factories out of 17 are receiving TUK collection services and 3 factories out of 17 are using other private collection companies. Three factories out of remaining 6 are doing collection and transportation by themselves, other 3 factories are unknown how they are doing.

Three factories out of 17 replied that they know how their IW is treated at off-site but they did not describe concretely.

a.2 Future Management of IW

To the question about future IW generation, 5 factories answered that it will increase more or less, and 9 factories replied they will not change their IWM.

a.3 Financial Matters

Replies about off-site disposal costs were obtained from 8 factories out of 18. The cost per unit waste weight is shown in the table below. Off-site disposal cost has a large range depending on the category of factories and size of factories. The results obtained through the surveys are summarized as follows.

Table 2-90: Off-site Disposal Cost

Code	Off-site Disposal Cost	
	% (Disposal Cost/ Production Cost)	US$/year
G01	1	8,000 – 9,500
G01	no answer	5,040
G03	0.17	2,000
G03	no answer	600
G03	no answer	650
G03	0.1	no answer
G03	no answer	500
G06	0.03	29

a.4 Evaluation of the Present IW system

Eight factories observed the present IWM system to be problematic and 7 said that there is no problem. Seven out of the 8 factories that regard the present IWM system problematic pointed out the actual problems they are facing. These problems are summarized in the table below.

Table 2-91: Problems of Present IW system

Base: Population= 8	Frequency	%
1. We do not know the difference between HIW and non-HIW.	2	29
2. We do not segregate HIW from non-HIW.	2	29
3. There is no or only limited services available for IW treatment.	5	71
4. High cost of IW treatment	3	43
5. Reuse and recycling of IW is non-existent or limited.	4	57

a.5 IWM system in the future

- **IW Amount**: Nine factories estimated that there will not be any change in the amount of IW generated in the future. Five factories estimated an increase and three estimated a decrease.
- **IW Disposal Cost**: As many as 10 factories said that they would accept an increase in the IW disposal cost in the future or that the increase would not affect their business much.

On the other hand, 3 factories said that an increase in the IW disposal cost would result in the increase of their products and would affect their business.

b. 2nd Factory Survey

b.1 Separation of IW

Firstly in the second survey the concept of separating IW (non-HIW, HIW etc.) was questioned. From the responses it is understood that most factories separate recyclable waste but do not separate other waste types.

The following are considered to be the reasons for this.

- IW can be disposed of as mixed waste therefore waste separation is not necessary.
- There is a lack of knowledge regarding the separation method of waste.
- There is a lack of knowledge regarding the risk of HIW.

There is a possibility that discharged HIW could have a negative affect on the environment and lead to health hazards for the collection workers and employers due to factories` lack of knowledge regarding waste separation, particularly of HIW. Thus, together with UBC and MOE specifically defining HIW, factories must also be instructed on methods to appropriately dispose of HIW.

b.2 Discharge of HIW

It is understood from the answers of 10 of the 18 factories that oil and its attached waste, liquid waste, sludge and chemicals, are the main components of the HIW discharged in the study area. However, only 4 (C, D, H and J factory in the table below) of the 10 factories could confirm the amount. Remaining 6 factories did not answer the discharge amount.

As for the 4 factories replied the amount, factories (H and J) in the study area were a railway company and waste water treatment plant which are not listed in the target factories.[8] Consequently, HIW generation data from only 2 factories (C and D) were used for calculating the HIW generation rate.

The results of the responses for the status of HIW discharge are shown in the table below.

Table 2-92: HIW Discharge (Second Survey)

Code	Factory	HIW
G02	A	Liquid waste
G03	B	Wool with Oil
G04	C	Waste Oil
	D	Plastic Package for medicine
G06	E	Plastic container for dye
G10	F	Liquid waste with Chemicals
	G	Oil filter
		Waste Oil
		Plastic container for Oil
	H	Sludge
		Wood powder with Oil
		Towel with Oil
		Waste fuel
		Waste Oil
		Battery
	I	Gaseous waste
		Liquid waste
	J	Sludge

b.3 Intermediate Treatment and Recycling

[8] These two enterprises are surveyed for the reference.

- None of the factories from the second survey are conducting IW intermediate treatment.
- Five of the 18 factories reused or recycled factory based non-HIW (paper, iron, gravel, etc.). However, even at rest of the factories, the workers and waste pickers collected cans (aluminium and steel), PET bottles, wood, etc.

b.4 Collection and Disposal

IW was disposed of by the factories themselves or by the TUK collection service discharging it at the disposal sites. Regarding HIW, one factory has consigned disposal, 2 factories have on-site disposal and the remaining 8 factories unload it to UCDS/MDDS without treatment.

2.6.4 Findings

a. Waste Generation

a.1 Generation Rate of Industrial Waste Generation

The generation rate of the industrial waste generated at the target factories is summarized in the table below. The generation rate was obtained by dividing the waste amount by the number of employees.

Table 2-93: Generation rate of Industrial Waste Generation (per employee)

Factory Code	Unit amount (kg/employee/day)		
	1st survey	2nd survey	Average
G01	0.47	0.32	0.40
G02	2.29	-	2.29
G03	0.36	-	0.36
G04	-	1.88	1.88
G06	0.23	1.08	0.65
Average (All Waste amount / All number of employees)	0.86	-	0.86

a.2 Estimation of Waste Generation Amount in Study area

a.2.1. The Total Number of Employees in Study Area

The number of employees in the whole study area, necessary for estimating the IW generation rate, was calculated as follows.

- For factories with less than 10 employees it was assumed that discharge is the same as that of households and business enterprises and the number of employees for estimated generation rate was not included.
- The average number of employees was determined as shown below.
  - Range of Employees 11-100 : 50 employees
  - Range of Employees 101-500 : 300 employees
  - Range of Employees >501 : 750 employees

Table 2-94: Number of Employees in the Study Area

Code	Description	Range of Employees			
		11-100	101-500	>501	Total
G01	Agriculture, Food, Dairy product	24,350	12,600	2,250	39,200
G02	Leather	1,150	-	-	1,150
G03	Textile	2,650	3,000	3,000	8,650
G04	Chemical	1,050	600	-	1,650

G05	Cement & Brick	1,250	2,700	750	4,700
G06	Metal processing	200	-	-	200
G07	Furniture	1,750	600	-	2,350
G08	Paper Processing	1,400	300	-	1,700
G09	Mining industry, Metallurgy	4,550	6,300	5,250	16,100
G10	Others	11,650	9,000	750	21,400
	Number of Factory	50,000	35,100	12,000	**97,100**

a.2.2. Estimation of Waste Generation Amount in Study Area

The team estimated the IW generation amount from all the factories in the study area as shown in the table below. For the waste generation unit of the industrial sectors which were not covered by the present factory survey, the average of the unit generation rates of the industrial sectors covered by the present survey was substituted.

As a result, the total IW amount from factories in the study area was calculated at about 64 tons. The major sources were agriculture/food/dairy product factories (15.7 tons/day) and mining industry/metallurgy factories (13.8 tons/day), accounting for 46% together.

It was estimated that the amount of HIW generated in the whole study area was only 0.1 ton/day. This amount was calculated based on the answers provided by two factories, thus the calculated amount may be much lower than the actual figure. For example, waste oil and grease are surely generated if they use machinery at factories, but in this survey only four factories answered that they generated these.

Generally in Mongolia knowledge of factories on HIW management is very limited. This is because of unclear definition of HIW, lack of HIW management facilities, etc. This fact is proved by the fact only 4 factories could reply the amount of HIW while 6 among 10 factories, that generate HIW, could not. It is urgent issue that the MOE in cooperation with the other responsible organizations conduct a comprehensive HIW management study which forces the factories to reply actual management and formulate a HIW management plan including immediate, medium and long term measures.

Table 2-95: Generation Amount of IW

Type of Factory	Code	No of Factory*1 (no)	No of Employees (persons)	Non-HIW		HIW	
				Generation Rate*1 (kg/employee/day)	Generation Amount (ton/day)	Generation Rate (kg/employee/day)	Generation Amount (ton/day)
Food, Dairy product	G01	2,878	39,200	0.40	15.7	-	-
Leather	G02	130	1,150	2.29	2.6	-	-
Textile	G03	122	8,650	0.36	3.1	-	-
Chemical	G04	74	1,650	1.88	3.1	0.03	0.1
Cement & Brick	G05	77	4,700	0.86*1	4.0	-	-
Metal processing	G06	16	200	0.65	0.1	-	-
Furniture	G07	157	2,350	0.86*1	2.0	-	-
Paper Processing	G08	153	1,700	0.86*1	1.5	-	-
Mining industry	G09	251	16,100	0.86*1	13.8	-	-
Others	G10	663	21,400	0.86*1	18.4	-	-
Total		4,521	97,100	---	64.3	---	0.1

(Note) *1: The average value (0.86 kg/ employee/ day) was used for all data.

a.3 Generation Forecast

The generation amount of industrial waste for the year 2010, 2015 and 2020 was estimated according to the economic growth in the study area from 2005 to 2020. As shown in the following table, industrial waste (Non-HIW + HIW) generation is estimated as 84.0 ton/day

in 2010, 109.7 ton/day in 2015 and 143.4 ton/day in 2020 respectively.

The amount of industrial waste also increases by more than 2.2 times from 64.4 ton/day in 2005 to 143.4 ton/day in the year 2020.

Table 2-96: Generation Amount Forecast

Year	Non-HIW (ton/day)	HIW (ton/day)	Total (ton/day)
2005	64.3	0.1	64.4
2010	83.9	0.1	84.0
2015	109.6	0.1	109.7
2020	143.3	0.1	143.4

* See population forecast.

b. Tannery factory HIW

A tannery factory in Khan-Uul and leather waste water treatment plant was surveyed.

As the tannery factory uses various chemicals for tanning leather, extracting hide and fur, they generate a lot of residue waste water and pieces of fur/hide contaminated by those chemicals.

- Waste water: waste water is directly delivered from the factory to the leather waste water treatment plant and treated. After dehydrating the sludge generated at the leather waste water treatment plant, the dehydrated sludge is stored in an outdoor pile in the plant. Also, overflow from the sedimentation basin is discharged sewage and is disposed at the sewage treatment facility.
- Residue fur and hide: Disposed at UBDS and MDDS after draining.

It is necessary to formulate appropriate HIW counter measures to improve the current situation in which leather sludge storage piles and residue are being disposed as is, without being treated.

c. Liquid HIW

Cases of untreated liquid waste being discharged into the sewage system could be seen at textile factories. As there are two separate systems for discharging domestic waste water and industrial waste water in the sewage facilities in UBC, it is only natural that this kind of behaviour would be common for factories.

However the sewage amount is increasing and it is not possible to maintain the two sewage systems. The capacity of sewage facility in UBC is already limited and it is expected to have serious effects on the environment, thus it is necessary for UBC and MOE to investigate setting up a waste water treatment plant specifically for HIW or installing waste water treatment equipment in the individual factories.

d. Recycling at Cement Factories

Limestone and other raw material are burned at rotary kiln in cement factory and the cement is produced. If the kiln conforms to the conditions, it may be possible to treat HIW such as waste oil and sludge, etc..

As there is no cement factory in UBC, the cement factory in Darkhan city was visited and studied.

The details of the cement factory are as follows.

- Operation start-up : 1968

- Cement production : 185,000 ton/year
- Line of kiln : 2 lines
- Fuel : Coal

The facility is well maintained but it is old and small-scale (cement production amount). Thus, the following matters have to be investigated on the premise of using this facility for treating HIW without affecting the cement products.

- Survey the facility fully and examine possible HIW mixing and feeding process.
- Estimate the amount and type of treatable HIW.

e. Future IW management

In order to carry out appropriate IW management, it is necessary for administrative bodies such as MUB and MOE to clearly define HIW and introduce to factories methods for adequately disposing HIW. Moreover, they must promptly establish an intermediate treatment plant and final disposal site specific for HIW in order to support factories.

2.6.5 Questionnaire and Results of the 1st Interview Survey

a. Industrial Waste (IW) Management

a.1 Waste Generation

Q1. Are Non-Hazardous Industrial Waste (Non-HIW) and Hazardous Industrial Waste (HIW) discharged separately from your factory?

Table 2-97: Separation of Non-HIW and HIW

Base: Population = 18			
Q1		Answer	%
1.Yes, 100%	(Go to Q3)	3	17
2.Yes, partly	(Go to Q3)	4	22
3.No	(Go to Q2)	11	61
Total		18	100

Q2. What is the reason why these waste are not separated? You can select all that correspond to your factory.

Table 2-98: Reason of No Separation (Non-HIW and HIW)

Base: Population = 11		
Q2	Answer	%
1.We don't know the difference between Non-HIW and HIW.	0	0
2.The volume of waste is too small to separate.	0	0
3.The production process makes it difficult to separate Non-HIW and HIW.	1	9
4.The collection service does not require to separate Non-HIW and HIW.	1	9
5.It is troublesome and waste of time to separate Non-HIW and HIW.	0	0
6.It seems unnecessary to separate Non-HIW and HIW	2	18
7.It is difficult to separate Non-HIW and HIW.	1	9
8.Even though Non-HIW and HIW are separated, there are no ways to utilize them	1	9
9.HIW is not generated in our factory.	6	55
10.Others	0	0
Total	11	-

Q3. Is Non-HIW generated at the production process separated from general industrial waste (GIW) generated at other sections such as office in your factory?

Table 2-99: Separation of Non-HIW

Base: Population = 16 (No answer = 2)			
Q3		Answer	%
1.Yes, 100%	(Go to Q5)	5	31
2.Yes, partly	(Go to Q5)	2	13
3.No	(Go to Q4)	9	56
Total		16	100

Q4. What is the reason why your factory does not separate them?

Table 2-100: Reason of No Separation (Non-HIW and GIW)

Base: Population = 6 (No answer = 3)		
Q4	Answer	%
1. The volume of wastes is too small to separate.	1	17
2. The production process makes it difficult to separate them.	1	17
3. The collection service does not require to separate them.	2	33
4. It is troublesome and waste of time to separate them.	2	33
5. It seems unnecessary to separate them.	1	17
6. It is difficult to separate them.	0	0
7.Even though Non-HIW and HIW are separated, there are no ways to utilize them.	0	0
8.Others	0	0
Total	7	-

Q5. How many tons of IW (Non-HIW/HIW) is generated in your factory per year?

Table 2-101: IW generation Amount

Q5 Base: Population = 18				
Category Code	IW code	Name of IW/ Generation Source	Fr.	Waste amount (ton/year)
G01	NH01	Droppings of chicken	1	6,000
	NH03	General waste	1	30
	NH06	Grease, animal oil, vegetable oil	1	2
	NH13	Broken glass and paper package	1	1,970
		Vegetables	1	Don't know
G02	NH01	Leather, skin, hide	1	50
		Leather, skin, hide	1	406
	NH11	Mixed waste	1	406
G03	NH05	Wool and thread	1	310
		Textile and fiber	1	120
	NH10	Cashmere	1	Don't know
	NH11	Wool thread	1	Don't know
		General waste	1	120
G06	GIW	General waste	1	10
	NH08	Iron waste	1	50
G10	NH01	Waste from skin	1	Don't know
Grand Total			16	9,474

a.2 Storage

Q6. Is IW stored inside your factory?

Table 2-102: Storage of IW inside Factories

Base: Population = 18			
Q6		Answer	%
1. Yes, 100%	(Go to Q7)	9	50
2. No	(Go to Q10)	9	50
Total		18	100

Q7. How do you store IW?

Table 2-103: Storage manner

Base: Population = 9			
Q7		Answer	%
1. We mix them all together.	(Go to Q9)	5	56
2. We store them separately.		1	11
3. We store only waste that can be reused/recycled.		3	33
Total		8	100

Q8. Into how many categories is IW classified in your factory?

Table 2-104: Category of IW stored

Base: Population = 4			
Q8	Answer	%	Description
1. One category	0	0	-
2. Two categories	2	50	Non recyclable and Recyclable
3. More than two	2	50	cashmere, wood, Iron, thread
Total	4	100	-

Q9. What is the purpose of on-site storage of IW?

Table 2-105: Purpose of On-site Storage

Base: Population = 9		
Q9	Answer	%
1. Temporary storage before its collection by haulers.	8	89
2. Temporary storage for on-site reuse and recycling.	1	11
3. Temporary storage for on-site treatment and disposal.	0	0
4. Temporary storage due to no existence of proper treaters.	0	0
5. Others	0	
Total	9	-

a.3 Intermediate Treatment and Recycling

Q10. Is IW treated on-site in your factory?

Table 2-106: IW treated On-site

Base: Population = 13 (No answer = 5)		
Q10	Answer	%
1.Yes	5	38
2.No, all the IW are treated off site.	8	62
Total	13	100

Q11. If you chose 1.Yes in Q.10, please put information for the treatment method.

Category code	Waste type	Treatment method
G01	Droppings of birds	Compost
G03	Cashmere and Thread	Cashmere : Reuse after clean Thread : Reuse
	Spinning	Reuse
	Iron and wood	Recycling

Q12. Is IW reused or recycled inside your factory?

Table 2-107: IW Reuse or Recycling

Base: Population = 17 (No answer = 1)		
Q12	Answer	%
1.Yes	2	12
2.No, all the IW are treated off site.	15	88
Total	17	100

Q13. If you chose 1.Yes in Q.12, please put information for the reuse/recycle method.

Category code	Reuse/recycle method
G01	compost to plantation

Q14. Is there any plan to reuse/recycle IW generated in your factory?

Table 2-108: Plan to Reuse/Recycle IW

Base: Population = 17 (No Answer = 1)			
Q14		Answer	%
1.Yes, 100%	(Go to Q15)	4	24
2.No	(Go to Q16)	12	71
3.I don't know	(Go to Q16)	1	5
Total		17	100

Q15. What types of IW do you plan to reuse/recycle in your factory?

Table 2-109: Specify Plan to Reuse/Recycle IW

Base: Population = 4		
Code	Specify	Fr.
G01	Poultry waste	1
	Waste from animal such as bone, skin, hair	1
G02	protein from leather processing	1
G10	Sludge	1
	Grand Total	4

a.4 Collection and Disposal

Q16. Who collects wastes generated in your factory?
- TUK
- Others Private company contracted by us
- No collection service

Table 2-110: Collection service

Base: Population = 17 (No answer = 1)		
Q16	Answer	%
1.TUK	8	47
2.Others Private company	3	18
3. No collection service	6	35
Total	17	-

a.5 Off-site Treatment and Reuse/Recycling and Disposal

Q17. Do you know how IW discharged from your factory are treated/disposed of outside the factory?

Table 2-111: IW Treated/Disposal of Outside

Base: Population = 17 (No answer = 1)			
Q17		Answer	%
1.I know		3	18
2. I don't know	(Go to Q.19)	14	82
Total		17	100

Q18. If you know the method (treatment, reuse/recycling, disposal) by classification of IW, please enter those quantity in **the Answer Sheet**. (See the detail of type and code of IW in the attached Table 1-1 and 1-2)

b. Future Management of IW

Q19. How will the generation of IW develop in your factory?

Table 2-112: Future Trend of IW Amount

Base: Population = 17 (No answer =1)		
Q19	Answer	%
1. The volume of IW will not increase so much.	9	53
2. The volume will increase due to the expansion of production, change of raw materials, etc.	5	29
3.The volume will decrease due to improvement of manufacturing process, change of raw materials, etc..	3	18
4.Others	0	0
Total	17	100

Q20. Are there any future plans to reduce and recycle IW in your factory?

Table 2-113: Future Plan to Reduce and Recycle IW

Base: Population = 15 (No answer = 3)		
Q20	Answer	%
1. No, basically we will apply the present management.	10	67
2. Yes, we intend to improve the present waste reduction and recycling system.	4	27
3. Yes, we have a specific plan to improve waste reduction and recycling system in our factory.	1	6
Total	15	100

Q21. Are there any future plans to improve treatment and final disposal system of IW in your factory?

Table 2-114: Future Plan to Improve Treatment and Final Disposal System

Base: Population = 14 (No answer = 4)		
Q21	Answer	%
1. No, basically we will apply the present management.	9	62
2. Yes, we intend to improve present treatment and disposal system of our company.	5	38
3. Yes, we have a specific plan to improve treatment and disposal system in our factory.	0	0
Total	14	100

Q22. How will a possible future rise in disposal cost of IW affect your factory?

Table 2-115: Disposal Cost of IW

Base: Population = 14 (No answer = 4)		
Q22	Answer	%
1. The present costs of waste disposal are not significant and an increase in disposal costs will have little impact on our business.	6	43
2. The present costs of waste disposal are significant and a substantial rise in disposal costs will affect the price of our products.	2	14
3. The present costs of waste disposal are very significant and a substantial rise in disposal costs will threaten our business.	1	7
4. No matter how expensive the disposal cost is, an improved waste management is necessary to obtain environmental image of products.	4	29
5. Others	1	7
Total	14	100

c. Financial Matter

Q23. How much is the rate of waste management cost (total cost of on-site and off-site disposal) in the production cost?

[ ] 1. ……..% (……. US$ / year)
[ ] 2. I don't know.

Table 2-116: Waste Management Cost

Base: Population = 14		
Q23	Answer	%
1.I know	8	57
2.I don't know	6	43
Total	14	100

Category code	%	US$/year
G01	1	8,000 – 9,500
G01	no answer	5,040
G03	0.17	2,000
G03	no answer	600
G03	no answer	650
G03	0.1	no answer
G03	no answer	500
G06	0.03	29

Q24. How much do you spend for off-site disposal (collection, treatment and final disposal) of IW to the collection company per year?

[ ] 1. ……US$ / year , ……. US$ / ton or m^3 for transport company
and . …US$ / year , …. US$ / ton or m^3 for the disposing company
[ ] 2. I don't know.

Table 2-117: Off-Site Disposal Cost

Base: Population = 18		
Q24	Answer	%
1.I know	9	50
2.I don't know	9	50
Total	18	100

Category code	US$/year
G01	5,040
G03	3,067
G09	1,644
G03	650
G03	950
G04	500
G04	300
G06	500
G06	60

Q25. Do you know the cost of off-site disposal of each IW?

[ ] 1. Yes. (Please fill in the unit cost of collecting IW according to type in the following table)
[ ] 2. I don't know.

Table 2-118: The Cost of Off-Site Disposal Of Each IW

Base: Population = 11 (No answer = 7)		
Q25	Answer	%
1.Yes	3	27
2.No	8	73
Total	11	100

No	Type of IW		Unit Cost for Collection	Unit cost for Disposal
	Name	Code		
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-

Q26. Are you willing to pay more for the off-site disposal (collection, treatment and final disposal) of IW, if the quality of collection service is improved?

Table 2-119: Willing to Pay for Off-Site Disposal

Base: Population = 14 (No answer = 4)		
Q26	Answer	%
1. Yes	9	64
2. No.	5	36
Total	14	100

Q27. How much does your factory spend annually for the on-site disposal (treatment and final disposal) of IW?

Table 2-120: On-site Disposal Cost

Base: Population = 13 (No answer = 5)		
Q27	Answer	%
1.I know	5	38
2.I don't know	8	62
Total	13	100

Q28. Do you know the cost of on-site disposal (treatment and final disposal) of each IW?
[ ] 1. Yes. (Please fill in the unit cost of internal treatment for each type of IW in the following table)
[ ] 2. I don't know.

Base: Population = 5		
Q28	Answer	%
1.I know	2	40
2.I don't know	3	60
Total	15	100

Category code	US$/year
G03	931
G03	166

d. Evaluation of the Present IW System

Q29. Which of the following phrases best describes the present status of IWM in your factory?

Table 2-121: Present Status

Base: Population = 15 (No answer = 3)		
Q.25	Answer	%
1.There are no problems with the present IWM. (Go to the end)	7	47
2.There are some problems with present IWM.	8	53
Total	15	100

Q30. Do you think what are the present problems of IWM in your factory? (You may choose more than one answer given below)

Table 2-122: Problems of Present IWM

Base: Population= 7 (No answer = 1)		
Q30	Answer	%
1. We do not know the difference between hazardous and non-hazardous waste.	2	29
2. We do not segregate hazardous from non-hazardous waste.	2	29
3. There is no or only limited services available for industrial waste treatment.	5	71
4. High cost of industrial waste treatment	3	43
5. Reuse and recycling of industrial waste is non-existent or limited.	4	57
6. Others (-Collection waste service not irregularity, and -We don't generated the Hazardous industrial waste)	0	0
Total	16	---

Q31. Do you think what measures and actions need to be taken to solve the above problems? (You may choose more than one answer given below)

Table 2-123: Measures and Actions

Base: Population = 7 (No answer = 1)		
Q31	Answer	%
1. Formulation and enforcement of relevant laws and regulations.	2	29
2. Guidance on proper IWM to the factories (generators).	5	71
3. Introduction of financial and economic incentives to promote proper IWM.	4	57
4. Preparation of the guidelines for proper IWM	2	29
5. Development of the waste reuse and recycle market	5	71
6. Development of the intermediate treatment facilities for industrial waste.	3	43
7. Development of the final disposal facilities for industrial waste.	3	43
8. Others	0	0
Total	24	---

Annexure : List of Factory Surveyed in Ulaanbaatar city

No	Type of factory	Factory Code	Nos. of Employees		
			Employees of Factory	Person of Administration	Total Employees
First Factory Survey					
1	Vegetables	G01	No answer	No answer	No answer
2	Poultry	G01	48	8	56
3	Food, beverage	G01	170	32	510
4	Mealy products, candy	G01	300	40	340
5	Meat	G01	420	5	425
6	Leather	G02	98	11	109
7	Fur products	G02	30	4	34
8	Textile	G03	No answer	No answer	1,670
9	Knitted- goods factory	G03	410	80	490
10	Carpet	G03	260	25	285
11	Spring	G03	600	60	660
12	Cleaning factory	G10	21	5	26
13	Pharmaceutical factory	G04	70	16	86
14	Pharmaceutical factory	G04	28	10	38
15	Brick	G05	47	8	55
16	Metallic	G06	37	7	44
17	Metallic	G06	6	1	7
18	Beton armatur	G06	45	15	60
Second Factory Survey					
1	Food, beverage*	G01	---	---	---
2	Chemical	G04	255	28	283
3	Car washing	G10	25	1	26
4	Food, beverage	G01	23	12	35
5	Leather*	G02	---	---	---
6	Metallic*	G06	---	---	---
7	Chemical*	G04	---	---	---
8	Textile*	G03	---	---	---
9	Car repair	G10	16	4	20
10	Leather	G02	20	20	40
11	Railway	G10	No answer	No answer	No answer
12	Power generation	G10	803	164	967
13	Metallic*	G06	---	---	---
14	Water treatment	G10	10	5	15
15	Dry cleaning	G10	5	1	6
16	Metallic	G06	110	5	115
17	Cement	G05	250	60	310

note *: denotes factories which were re-surveyed.

2.7 Survey on Recycling Market

2.7.1 Introduction

Two surveys were carried out for the recycling market. The first survey was conducted in February 2005 and individual interview surveys were carried to the following parties:

- Five recyclable waste markets;
- Three end users; i.e. two plastic bag production companies and one toilet paper production company.
- One exporter; and
- Two waste pickers

Since the first survey could not provide sufficient figure of current recycling market, the second survey was carried out in August 2005 in order to obtain information such as regulations of recycling and associations or organizations for recycling activities. In addition, interview surveys were extended to waste buyers, recycling companies and end users to identify flow of recycling items in UBC. For this purpose the following individual interview surveys were carried to parties:

- Twelve end users; i.e. four metal processing factories, one toilet paper production company, four plastic products companies and three plastic (PET) exporters; and
- 92 recycling depots

2.7.2 The First Recycling Market Survey

a. Objectives

The objectives of the 1st survey are:

- To understand the trends and scale of the present recycling market and analyze future market demands for recycling materials in Study area.
- To use the results of this survey for the formulation of a SWM master plan for Study area.

b. Method

b.1 Method of the 1st Survey

The recycling market survey was implemented in the three steps below.

- A questionnaire was distributed to companies to be interviewed and appointments for interviewing were made.
- The owners or representatives of the waste recycling companies were interviewed.
- The survey results were analyzed.

b.2 Surveyed companies

The list of recycling market surveyed in this survey is shown in the table below.

Table 2-124: Recycling Markets included in this survey

No	Name of Company	Type of Company	Address	Telephone
1	"Sudalt" Co.,ltd	Supplier	Chingeltei District,14 Khoroo	357019/ 99149051
2	Chimgee/ Bumbugur/	Supplier	Bumbugur marke, Chingeltei Districtt	99889437
3	Uranchimeg/ Narantuul	Supplier	Bayanzurkh District, Narantuul International market	357019
4	Shinetsetseg/ Tsaiz	Supplier	Bayanzurkh District,16 Khoroo	99171949
5	Nadmid /Bars/	Supplier	Bayangol District, Railway Station	91819781

6	"Noosimpex" Co.,ltd	Toilet paper	Railway Station , Bayangol District	341577
7	"Trade & printing Company Mongol Khevlel " Co,.,ltd	Polythene bag	Sukhbaatar District, 8 Khoroo	329118
8	Onon Nomin Co,.ltd	Polythene bag	Songinokhairkhan District, 2 Khoroo	99190966/ 450892
9	Puma Service Co.,ltd	Exporter	Bayangol District, 4 Khoroo	341257
Waste pickers that involved in our survey				
1	A	Waste picker	Tsaiz	
2	B	Waste picker	Bars	

c. Results of the 1st Survey

Results of 1st recycling market survey in each market are shown in the following section below.

c.1 "Sudalt" Co., ltd.

"Sudalt" Waste Supplying Company was established in April, 1994. The "Sudalt" Company buys the wastes in their 700 m^2 of waste collecting fence.

The metal wastes and overused (lifetime finished) metal objects will be collected by small waste suppliers and organizations but however, daily wastes such as plastic bottles, and glasses will be collected by waste pickers or service enterprises of that location.

Upon purchasing the wastes they make a separation treatment as it's type and quality then they purchase it to the manufacturers or export it to foreign companies. The wastes that can be purchased by Sudalt Company is shown on Table 2-125.

Table 2-125: Waste that can be purchased by Sudalt Co., ltd.

No	Waste code	Waste type	Unit	Pay /MNT	Sell /MNT	Daily dealing amount (kg/day)
1	RW02-1	Plastic pet bottle	1 kg	300	350	500-700
2	RW02-2	Plastic container	1 kg	20	50	200-250
3	RW06-1	Aluminium	1 kg	900	1000	500-600
4	RW06-1	Aluminium can	1 kg	700	850-1000	300-350
5	RW06-2	Iron	1 kg	40	50	5000-8000
6	RW06-3	Copper	1 kg	2300	2400	500-800
7	RW06-4	Brass	1 kg	900	1000	400-450
8	RW06-5	Fusible alloy	1 kg	900	1000	600-700
9	RW06-6	lead	1 kg	200-300	400	100-150
10	RW07-1	Bottle	1 bottle	10-150	15-200	1000-1500
11	RW12	Accumulator	1 kg	1000-2000	1200-2500	100-150

Aluminium

Iron


Plastic pet bottle, aluminium can


Bottle

c.2 The waste purchasing market is located close to "Bumbugur" trade market

Owner of this waste purchasing market has been engaging her business since 1996 in accordance with related approval. They rented 600 m^2 fence for the purpose of buying wastes in their fence. This waste purchasing market has 0.5-1 million MNT fund and their daily income is between 5000 -10000 MNT.

Plastic pet bottles, bottles and aluminium cans will be collected by waste pickers and service enterprises which is located close to this mini market.

Upon purchasing the wastes they make a separation treatment as it's type and quality then they purchase it to the manufacturers or export it to foreign companies. The wastes that can be purchased by "waste purchasing market" are shown on Table 2-126.

Table 2-126: Waste that can be purchased Bumbugur trade market

No	Waste code	Waste type	Unit	Pay /MNT	Sell /MNT	Daily dealing amount (kg/day)
1	RW01-2	Cardboard	1 apple box	50-100	100-150	40-50
2	RW02-1	Plastic pet bottle	1 kg	200	300	50-70
3	RW02-2	Plastic container	1 kg	50	70	30-50
4	RW06-1	Aluminium can	1 kg	500-600	700	40-50
5	RW07-1	bottle	1 bottle	10-100	15-150	200-350


Cardboard


Bottle


Plastic pet bottle


Aluminium can

c.3 Waste purchasing market that located close to "Narantuul" International Trade Centre

Owner of this waste purchasing market has been engaging her business since 2002 in accordance with related approval. They rent 40 m^2 container for the purpose of buying wastes. They have 0.5-0.7 million MNT fund and their monthly income is 200.000 MNT.

The wastes can be supplied by waste pickers and service enterprises which are located close to this waste purchasing market and upon the wastes will be purchased it should be separated as type and quality then finally these wastes will be sold to manufacturers and the companies that exports to China. The wastes that can be purchased by waste purchasing market is shown on Table 2-127.

Table 2-127: Waste that can be purchased by Narantuul international trade centre

No	Waste code	Waste type	Unit	Pay /MNT	Sell /MNT	Daily dealing amount (kg/day)
1	RW07-1	Bottle	1 bottle	50-100	60-150	50-60
2	RW06-1	Aluminium can	1 kg	550-600	650	40-60
3	RW02-1	Plastic pet bottle	1 kg	550-600	650-750	30-50
4	RW02-2	Plastic container	1 kg	50	70	300-400

c.4 Waste purchasing market that located close to "Tsaiz" Trade Centre

Owner of the waste purchasing market has been engaging her business since April, 2004 in accordance with approval. The Company buys the wastes in their 700 m^2 fence.

The wastes will be supplied by waste pickers and the service enterprises that located close to this waste purchasing market. Upon purchasing the wastes it will be separated as its type and

quality then it will be sold to manufacturers and the companies that exports to foreign country. The wastes that can be purchased are shown on Table 2-128.

Table 2-128: Waste that can be purchased by Tsaiz trade centre

No	Waste code	Waste type	Unit	Pay /MNT	Sell /MNT	Daily dealing amount (kg/day)
1	RW02-1	Plastic pet bottle	1 kg	200-300	350-400	40-50
2	RW02-2	Plastic container	1 kg	50	70	30-50
3	RW06-1	Aluminium can	1 kg	700	800	200-350
4	RW06-1	Aluminium	1 kg	600-900	650-950	-
5	RW07-1	Bottle	1 bottle	5-100	20-150	300-350

c.5 Waste purchasing market that located close to "Bars" Trade Centre

Owner of waste purchasing market has been engaging her business since November, 2003 in accordance with related approval. This waste purchasing place is being located in the 40 m^2 basement of apartment area and they rented this place. The wastes will be supplied by the waste pickers and service enterprises. They have a fund of 0.2-0.3 million MNT and their monthly income is 0.35 million MNT in average.

Wastes secondary materials will be supplied by waste pickers and service enterprises of that location. The purchased wastes will be sorted out by its type and quality after that it will be sold to Manufacturers or Company that exports to foreign country. Waste /Secondary materials that can be purchased by waste purchasing place is shown on Table 2-129.

Table 2-129: Waste that can be purchased by Bars trade centre

No	Waste code	Waste type	Unit	Pay /MNT	Sell /MNT	Daily dealing amount (kg/day)
1	RW02-1	Plastic pet bottle	1 kg	300	400	45-50
2	RW02-2	Plastic container	1 kg	40	70	25-30
3	RW06-1	Aluminium can	1 kg	700	800	150-250
4	RW07-1	Bottle	1 bottle	10-100	20-150	300-350

c.6 "Noosimpex" Co., ltd.

Noosimpex Co. ltd., has been engaging its' business since August 10, 1992 to produce a toilet paper upon recycling waste papers in accordance with appropriate permission. "Noosimpex" Company has 24 employees and 40.8 million MNT invests have been sold, annual income is 58.8 million MNT. The floor area of waste materials/ secondary material receiving fence is 800 m^2 .The suppliers of Noosimpex Company are press and media factories and enterprises. Noosimpex

Raw material (waste paper)

Company recycles 2000 kg of waste paper daily. It was shown on Table 2-130.

Table 2-130: Waste that can be Recycled per day by Noosimpex Co., ltd.

No	Waste code	Waste type	Pay kg/MNT	Daily dealing amount (kg/day)
1	RW01-1	Office paper	20-25	500
2	RW01-2	Cardboard	15-20	300
3	RW01-3	Copy paper	20-25	1200

The following equipment is being used to crush, disinfect and filter the waste papers.

- Mixing bin
- Filter
- Washing machine
- Mill
- Refining machine
- Toilet paper producing machine

The equipment and toilet paper producing progress is shown on following pictures.

Mixing bin

Paper processing machine

Paper Processing machine

Paper product

Paper product

Toilet paper


Toilet paper


Reduce

The equipment which is shown above is the one that imported from "San Ai Regulator" Co., ltd. Japan. The capacity of this equipment is 6.4 tones of wastes will be recycled a day. Out of the waste papers non waterproof materials (such as, polythene bags and staples) etc are being generated 12 tones (year) and it will be disposed to waste disposal site.

c.7 "Mongol Press" Co., ltd.

"Mongol Press" Company produces a polythene bag. The Mongol Press Company has been engaging it's business since August, 2001 and it also engages a business of publishing activities. The floor area of collecting secondary materials is 500 m^2. The main suppliers of this Company is the vodka and juice producing factories and the supermarkets as well.
The Mongol Press Company buys 1 kg of waste polythene bags as 100 MNT. The Company recycles **50 kg of polythene bag a day** in average.


Raw material


Raw material


First product


Melter machine

c.8 "Onon Nomin" Co., ltd.

"Onon Nomin" Company has commenced engaging its business since September, 2004 and this Company recycles the plastic bag. Onon Nomin Company has a Hotel, Bar and Food Store. This Company also engages a business to exchange the students to study in Beijing, China. The floor area of recycling plastic bag factory is 240 m^2 and 50 million MNT bond are sold. The monthly income is 5 million MNT. The suppliers of this plastic bag recycling factory are waste pickers, waste supplying markets, service enterprises, individuals of households and factories. The waste materials 1 kg of (plastic bags) can be

bought as 100-150 MNT. This plastic bag recycling factory recycles **400 kg of waste plastic materials daily**.

Raw material

First product

Processing machine

Final product

Sample of Plastics bags

Plastic Bag Recycling Company sorts out the plastic bags, cleans and melts it after that they recycle the plastic bags. The equipment of this plastic bag recycling factory are imported from China and it was shown on Table 2-131.

Table 2-131: Equipment and Facilities of Onon Nomin Co., Ltd.

No	Treatment equipment	Capacity	Type
1	Washer	200 kg/ hour	China
2	Melter	60 kg/hour	China
3	Blowpipe	50 kg/hour	China
4	Laminator	50 kg/hour	China
5	Cutter	2000 piece/hour	China

The sewage discharged from factory will be connected to sewage treatment facility.

c.9 "Puma Service" Co., ltd.

"Puma Service" Company is the joint venture of Mongolian and Chinese Companies that are "San Meri" Co ltd., has invested 51% of investment from Mongolian side and "Kai Tai" Co ltd., has invested 49 % of investment from Chinese side. The "Puma Service" Company has been engaging its' business since spring, 2002 and the Company makes a treatment after they have received the waste plastic pet bottles. The floor area of waste materials receiving fence is 483.3 m^2. Currently, the Puma Service Company is located in a building of storage and

manufacture. The total floor area is 2016 m^2.The Puma Service Company made an agreement with "Bay Fang" International Commercial Company located in Ereen, China. The Puma Service Company has been supplying (exporting) the waste plastic bottles to "Bay Fang" Company since 2002 uninterestingly.

Table 2-132: Exported plastic PET bottles of Puma Service Co., Ltd.

No	Year	Exported plastic (ton/year)
1	2002	700
2	2003	810
3	2004	1335

The "Puma Service" Company has exported 2845 tones (3 years) of plastic bottles so that Company has 633 million MNT of income. The Company paid 4160.0 (thousand MNT) tax to the Tax Authority, Ulaanbaatar and the Company has 24 million MNT income. The cutter of waste plastic bottles cuts 640-1300 kg of plastic bottles a day in average and works in two shifts. In order to export 1 tone of waste plastic bottles 150,000-180,000 MNT will be expenditure and it's income is 40,000-60,000 MNT in average from one tone of waste plastic bottles. The waste materials that Puma Service Company buys from waste pickers and some small suppliers are shown on Table 2-133.

Table 2-133: Waste that can be purchased by Puma service company

No	Waste code	Waste type	Unit	Pay /MNT	Sell /MNT	Daily dealing amount (kg/day)
1	RW02-1	Plastic PET bottle	1 kg	400-480	-	1000
2	RW02-2	Plastic container	1 kg	-	-	-
3	RW06-1	Aluminium can	1 kg	700-800	-	700


Stock yard for Raw material


PET bottles


Cutting machine


Packages for Export

c.10 Waste pickers

The waste pickers pick up the wastes during the year and 2 of the waste pickers have included in this survey. As the waste pickers have been informed, 50-150 numbers of waste pickers have been living in that area and their daily income is 200-3000 MNT per day. The waste pickers collects aluminium can, plastic pet bottles, bottles and glasses, papers and

polythene bags then they sell those above mentioned wastes to the waste purchasing markets. The waste pickers sell their wastes that they have collected as 5-80 MNT to the waste purchasing markets.

d. Daily dealing Amount of Recyclable Materials in Study area (All Target recycling Market)

Prices and amounts of the wastes traded by the survey targets are summarized by each category in Table 2-134 below. Amount of traded wastes was calculated by summing up the amount of wastes the survey targets buy and is shown as "Including factory wastes." The figure obtained by subtracting factory wastes from that amount is shown as "Excluding factory wastes," that corresponds to traded MSW.

Table 2-134: Price and amount of traded wastes

Category of traded wastes	Sub No	Category of traded wastes	Unit	Price (MNT)		Amount of traded wastes (kg/day)	
				Buy	Sell	Including factory wastes	Excluding factory wastes
Paper wastes	1	Office paper	kg	20-25	-	1,700	510
	2	Cardboard	box	50-100	100-150	345	135
Plastics	1	PET bottles	kg	200-300	350-400	1,807	1,807
	2	Plastic container	kg	20-50	70	382	382
	3	Polythene bag	kg	100-150	-	450	328
Metal	1	Aluminium can	kg	550-900	700-1200	2,135	2,135
	2	Iron	kg	40	60	6,500	6,500
	3	Copper	kg	2300	2400	650	650
	4	Brass	kg	900	1000	425	425
	5	Fusible alloy	kg	900	1000	650	650
	6	Lead	kg	200-300	300-400	125	125
Glass Bottles	1	Bottles	bottle	5-150	20-100	2,525	2,525
					Total	17,694	16,172

e. Findings of 1st Survey

- Some wastes are recycled in Study area but the recycling system still needs to be improved.
- Mainly iron, glass bottles, aluminium cans and PET bottles are traded in the recycling market. Copper and aluminium cans are very highly priced, and PET bottles are fairly highly priced. This is consistent with what the Study team has observed in other cities of developing countries.
- Most of the reusable and recyclable wastes brought to the targets categorized as waste buyer is collected by waste pickers. The rest is directly brought to them from households and shops. In one of the cases of this survey, 85 to 90 percent of the traded wastes the waste buyer buy is brought by waste pickers.
- The target recycling company that produces toilet paper collects paper wastes by themselves. However, the amount of the paper wastes collected is so small that the company utilize only 30% of the capacity of its plant. The company is only processing paper wastes of high quality that is categorized as office paper. It has a plan to process paper wastes categorized as cardboard also.
- The target recycling companies that process plastics collect available wastes generated only in certain specific plants including their own and shops. This is because plastics of such material and purity that those recycling companies can utilize are very limited. The companies have the same difficulty in collecting enough amount of recyclable waste as the paper recycling company does.

- The target exporter trades PET bottles and aluminium, mainly with China. The target waste buyers export recyclable wastes that are not marketed domestically to China.
- Bottles are reused in Study area. Recycled wastes are almost limited to paper wastes and plastics of certain specific material. Very little amount of iron is also recycled in a works producing ornaments on gates. The recycling market in Study area is very little.
- The target waste pickers earn around 200 to 3000 MNT individually per day. The amount of the wastes they collect was not provided with in the survey.
- No information is available that can precisely tells the total number of waste pickers in Study area. According to the target waste pickers, there might be 50 to 150 waste pickers.

2.7.3 The Second Recycling Market Survey

a. Objectives

The existing condition of the recycling market was surveyed in detail including regulations for recycling and associations or organizations for recycling activity. At the same time a survey was conducted of end users who use valuables recycled as raw material for production and export of recycling materials.

b. Method

- Review of document from MUB and central government (Ministry of Commerce, Ministry of Industry, etc.)
- Interview of waste buyers, recycling companies and end users

c. Results of the 2nd Survey

c.1 Laws and Regulation for Recycling

The Study team surveyed each TUK, Ministry of Commerce and the Ministry of Commerce in regard to laws and factory licenses related to recycling. As a result of the 2nd survey, it is understood that there are no laws of licenses required for recycling companies.

Some recycling companies said that there are peer associations or organizations for recycling traders thus it is important to establish those kinds of organizations for recycling operations to receive preferential treatment and financial support.

c.2 Number of Recycling Company and Depot in UBC

The lists of factories and depots owned by district governments were examined before the commencement of the survey on the recycling company and depot in UBC.

c.2.1. Recycling Company

All kinds of factories operating or licensed in the waste raw materials recycling and exporting sector in Mongolia including small, medium, and national level large-scale factories were included in this survey.

The survey results determined that there are 37 secondary raw material (SRM) processing factories in Mongolia: 9 plastic processing factories, 21 licensed metal processing factories of which 13 are operational and the remaining 8 are ready to produce, and one paper processing factory in Ulaanbaatar; one small scale plastic processing and 1 bigger scale metal processing

factories in Darkhan city; 3 large scale metal factories and one paper producing factory with waste wood in Erdenet city.

If we look at all the recycling factories in Ulaanbaatar city, there are 4 operating in Bayangol, 6 in Bayanzurkh, 3 in Songinokhairkhan, 2 in Sukhbaatar, and 8 in Khan Uul districts. On the contrary, Chingeltei district does not yet have any recycling factory.

c.2.2. Recycling Depot

An interview study was held for TUK and the results of the survey of a number of recycling depots are shown in the table below. Through the survey it has become apparent that there are 228 recycling depots in the study area.

Table 2-135: Recycling depot in Study Area

№	District name	Number of suppliers
1.	Bayangol	25
2.	Bayanzurkh	44
3.	Sukhbaatar	67
4.	Songinokhairkhan	31
5.	Chingeltei	39
6.	Khan-Uul	22
	Total	228

The breakdown of capital for these recycling depots is shown below. From these figures it is apparent that the recycling depots are mostly small-scale. In addition, 9 of these depots are corporate organizations and 219 are private operations.

Table 2-136: Turn-over Asset Size of Recycling Depots

№	Classification	Turn-over asset /MNT.thousand/	Quantity /no./
1.	Very small	-80.0 ≤	116
2.	Small	< 80.0-200.0≤	76
3.	Medium	< 200.0-3.000.0≤	34
4.	Bigger	< 3.000.0-	2
	Total		228

c.3 Amount of Recycling Waste Dealt

c.3.1. Recycling Company

The results of the survey of the recycling companies are as shown below.

According to the results, the total recycling amount per day from recycling companies is as follows.

- Waste plastic bags 500 kg/day
- PET bottles 2,000 – 3,000 kg/day
- Waste metal 4,000 – 9,000 kg/day
- Waste Cast-iron 2,000 kg/day
- Waste Paper 1,750 kg/day

Table 2-137: Results of the Interview Survey of Recycling company

No	Operation type	Factory Capacity	Currently used factory capacity	Factory raw material reserve
		kg/day	kg/day	kg
1	Produce plastic bags	NA	NA	NA
2	Produce plastic bags	4,320	300	0 kg
3	Produce plastic bags	1,200	200	NA

4	Produce plastic products	8,640 (p/day)	0	0
5	Half-process and export plastic (PET)	NA	NA	NA
6	Half-process and export plastic (PET)	1,000-2,000	1,000	0
7	Half-process and export plastic (PET)	2,000-3,000	1,000-2,000	0
8	Process waste metal	5,000	2,000-3,000	5,000
9	Process waste metal	5,000	2,000-3,000	5,000
10	Process waste cast-iron	2,000	1,000	20,000
11	Process waste cast-iron	2,000	1,000	20,000
12	Produce toilet paper by processing waste paper	3,500	1,750	40,000

c.3.2. Recycling Depot

Interview surveys were carried out for 108 out of the 228 recycling depots in UBC. Surveys could not be carried out for the remaining 120 depots due to lack of cooperation or closure.

The recycling depots were generally purchasing glass bottles, PET bottles, cans, waste metal, paper and plastic bags from the sources listed below.

- Household person
- Waste picker on site and in the town
- Cleaning staff
- Waste collection staff
- Factory

The sales point and the transaction volume which 92 out of the 108 recycling depots responded are as follows.

Table 2-138: Recycling Depot Sales Point

Sales Point	Number of Recycling Depot	Amount(ton/day)*1	
Other recycling depot	40	10.9	
Other recycling depot + End-user	2	0.2	
Other recycling depot + Export depot	6	2.2	
End-user	20	21.2	25.7
Export depot	24	4.5	
Total	92	39.0	

(Note) *1: As the recycling depots reported the number of glass bottles, PET bottles and cans they deal with, the Study team referred to the weight of those items in Japan and tabulated the weight by converting the weight as 20g, 32g, and 20g respectively.

From these results it is though that the recycling volume per day is 25.7ton/day because the amount sold to end-users is 21.2ton/day and the exported amount is 4.5ton/day. However, one recycling depot reported that they received 16ton/day of waste metal from a factory and taking this into account, it is estimated that 10ton/day of recycled items are in common route. As the the law against trans-border export of metal came into effect on the 1st August 2005, at the same time as the survey, there were periods when the waste metal market distribution was not active.

d. Findings of 2nd Survey

- **Laws and Regulations for recycling;** No laws or regulations for recycling are legislated at present in Mongolia although there are laws for companies to obtain registration certificates and special permission to operate. The certificate is issued from the office of the Duureg in which the company is located.
- **Associations or Organizations for recycling;** No associations or relevant organizations for recycling have been established yet. Some of the recycling companies consider that the formation of an organization for recycling activity is necessary.

- **Distribution of Recycled Items in UBC;**

The distribution of recycled items in UBC is illustrated in the following figure. The daily amount of recycled items can be estimated as approximately 25.7tons.

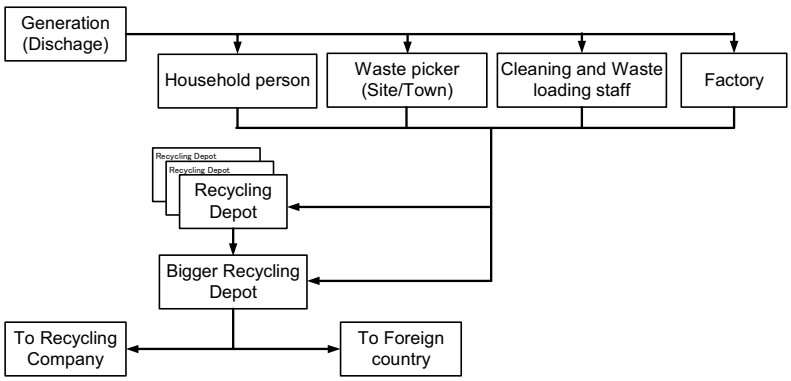


Figure 2-19: Distribution of Recycled Items in UBC

Recycling Company and Depot in UBC;

- One hundred and eight (108) waste buyers among 228 were visited and surveyed. Since the law against trans-border export of metal came into effect on the 1st August 2005, many of the buyers who were trading metal closed.
- Recyclable waste is purchased mainly from waste pickers (on the site and in the city), drivers of waste collection vehicles and factories and sold to other waste buyers (43%), end users (22%) and export companies (26%).
- Glass bottles, PET bottles and metal are principally bought and sold and only three (3) buyers trade paper and plastic. The amount of trading by 108 buyers a day is approximately 39.0 tons in total.

End users in UBC;

- Among twenty-three (23) factories which utilize recycled waste as raw material for production, three (3) plastic processing factories, four (4) ferrous metal factories and one (1) paper processing factory were selected and interviewed.
- Total amount of recyclable materials utilized by 8 factories above mentioned is 0.5 tons/day of plastic, 7tons/day of ferrous metal and 1.75tons/day of paper. These materials are purchased from waste buyers, factory and business enterprise.
- Glass bottles recycled are sold and reused at vodka and beer production companies. PET bottles are, after washing, cutting in pieces and packing up, exported to foreign countries (mainly China). Ferrous metal and non-ferrous metal had been exported actively to foreign countries before effectuation of trans-border export prohibition law. Most of big buyers are funded by Chinese capital and there are little buyers supported by Mongolian capital.

2.8 Study on Construction Waste

2.8.1 Current Condition of Construction Wastes

a. Registration System of Construction Industry

The companies doing business in each district have to be registered in the District Office and have to get a registration certificate from District Office. Beside this registration, the construction companies have to get special permission from the Ministry of Construction and Urban Development.

The Construction and Public Utilities Development Center（CPUDC）under the Ministry of Construction and Urban Development (MOCUD) is responsible for the registration and issuance of the Special Permission for organization and companies to undertake construction related operations. Under CPUDC, there is a Commission that regulates above operation. This Commission has a Regulation to issue Special Permission on design of buildings and facilities, installation, repair and services of construction works, public utilities, elevators, crane operation, heater, boiler and utility pipes.

This special permission is valid for three years and the company needs to submit an annual report to the CPUDC.

This regulation has following annexes

Annex 1. Application Form to request Special Permission

Annex 2. Compilation of technical documents on professional staff, work experience, machinery and mechanism, equipment, technology, tools and standards (normative)

1. within the framework of the design of building and facilities:
    a. to design urban development;
    b. to design buildings and facilities;
    c. to design roads, airports and bridges;
    d. to design civil construction facilities;
    e. to design engineering geology works;
    f. to design production technology.
2. within the framework of the installation, repair and service of construction works, elevator, carne, heater boiler and pipes:
    a. building structure;
    b. civil construction facilities, pipes;
    c. water facilities;
    d. open and underground mining's building and facilities.
3. within the framework of the installation of heater, boiler and relevant pipes;
4. within the framework of the installation, repair and service of elevators and cranes;
5. within the framework of the production and service of public utilities.

b. Institutional System of Controlling Construction Wastes

b.1 Law and Regulation

Law of Mongolia on Households and Industrial Waste stipulates about the Construction Wastes in Chapter 10.4:

If citizens, companies and organizations are going to construct, destruct or renovate their properties, they must transfer generated waste to authorized private person, company or organization after prior contract establishment and payment of waste fee.

This is the only law to control transportation of construction waste at this moment. So far TUK companies are the only authorized waste transportation companies. MUB is the one to

authorize those private persons, companies or organizations. CMPUD is the responsible department to authorize and finally approved by General Manager of MUB.[9]

b.2 Controlling Organization

Basically, after the completion of construction work, the "acceptance commission" approves it for commercial utilization. During the examination of that acceptance commission all construction related technology requirements are checked, among them the commission's relevant official is supposed to check the handling of the construction waste.

Acceptance committee is formed under the State Specialized Inspection Agency (SSIA) or Ulaanbaatar City Specialized Inspection Agency (UBCSIA) depending on the size of a certain construction. The members of the acceptance committee from UB City are comprised of the following organizations.

- Chairman : Secretary of UBCSIA
- Member 1 : Inspector for Environment, Electricity and Construction of UBCSIA
- Member 2 : National Emergency Management Agency
- Member 3 : Water Supply and Sewage Utilization Agency
- Member 4 : Ulaanbaatar Electricity Supply Company
- Member 5 : Heating Pipeline Utilization Department of MUB

The members of the above committee are supposed to check the construction company which handled its construction waste during the construction operation, and the waste collection companies that were contracted to collect waste from the site, or any other means that were used to dispose waste.

However, among the members of the current acceptance commission, the official responsible for waste is not represented. Instead, the environment inspector in charge for the air quality of the Agency is represented at the commission, which significantly reduces the ability of the Agency to check construction waste handling.

At this moment this is an only means to monitor construction waste generated from construction sites.

c. Current Construction Industries

c.1 Number of Construction Companies

All the construction companies have to be registered in the Ministry of Constructions and Urban Development.

As of Sep 2005, 1024 companies are registered in Construction & Public Utilities Development Centre under MOCUD in all over the Mongolia. Out of that 717 companies are registered in UB city.

Table 2-139: Registered Construction Companies in UB City[10]

District	Number of Construction Companies
Bayangor	163
Bayanzurkh	95
Chingeltei	136
Khan uul	54
Songinokhairkhan	69
Sukhbaatar	190
Nalaikh	3
Baganuur	6
Bagakhangai	1
Total	717

[9] Information obtained from CMPUD in MUB.
[10] List from CPUDC of MOCUD

There may be a number of companies doing renovation work without obtaining special permission from MOCUD. For example, there are 15 companies which put advertisements for renovation works in the Newspaper[11] and only two companies out of 15 companies (13%) have special permission. Besides this there are 78 individuals who put advertisements to do small renovation work in the same newspapers.

c.2 Amount of Construction Works

There are number of sources publishing the annual amount of construction works. One of these is the data from statistical office. Completed construction and renovation works by sectors are shown in the following table.[12]

Table 2-140: Amount of Construction Works in 2004

(Million Tg)

	Apartment	Commercial	Hospital, School, Cultural	Office, Storage Facilities	Energy	Communication	Road Works	Dams, Drainage	Others	Renovation Works	Total
Private Individuals	0	0	0	0	0	0	0	0	0	0.6	0.6
State Enterprises	1341	0	0	53	0	0	0	0	639	0	2032
Joint Stock Company	3	5	106	700	504	0	0	0	449	0	1767
Company Limited	34989	7147	4404	2990	6392	412	1853	3387	2369	3635	67558
Total	36333	7152	4510	3743	6896	412	1853	3387	3456	3635	71377
Million US$ 1US$=1,200Tg	30.3	6.0	3.8	3.1	5.8	0.3	1.5	2.8	2.9	3.0	59.5
%	51	10	6.3	5.2	9.7	5.8	2.6	4.7	4.8	5.1	100

According to this data, in terms of money, half is the construction of new buildings and renovation work is only 5 % of the total and its amount is 3 million US$. It is estimated that there are a lot of renovation works not included in this data.

Another available data is the list of construction amount at each company in year 2004. According to the data, 21 companies has constructed worth more than 1 billion Tg and the lest 135 companies has done less than 1 billion Tg. Average is 457 million Tg per company and the highest amount is around 5 billion Tg per year.

c.3 Volume of Construction Works

c.3.1. Apartment Construction

There are several sources to trace the volume of construction works. Firstly, the data obtained from statistical office is as follow. However there is only number of newly construction buildings and no floor area is presented.

Table 2-141: Number of New Buildings under Construction[13]

Number of New Buildings under construction by starting years (million Tg)				
Construction Starting Year	Number of New Buildings	Budget Cost	Expenditure since started	Expenditure as of 2004
1999	1	2,500	2,325	684
2001	7	350	1,584	1,246
2002	23	11,032	9,097	3,093
2003	102	52,184	35,036	26,430
2004	310	67,174	48,330	39,924

[11] Shuurkhai Zar No.66/1476/Sep 06 2005, Zar Medee Newspaper 08.26-08.30, 09.01-09.05
[12] Economic & Social Statistic Handbook in 2004
[13] Economic & Social Statistical Hand Book in 2004

Apartment floor area and its number of household in relevant year are summarized as follows.

Table 2-142: Apartment floor area and its population

Year	Apartment Floor Area (m2)	Number of Residents who live in Apartment	
		Households	Population
1970	533,000	21,400	98,300
1980	1,030,300	35,100	175,500
1990	1,967,500	81,200	393,100
2000	2,468,800	77,000	409,300
2001	2,487,800	77,800	412,200
2002	2,542,400	80,300	419,700
2003	2,648,500	82,800	427,300
2004	2,790,400	91,600	458,200

Based on this data, the net increased floor area in apartment will be obtained

c.3.2. Road and Bridge Construction

Secondly, there is information on road and bridge construction.[14]

Table 2-143: Volume and Amount of New Road and Bridge Constructions

Year	New Road (km)	New Bridge (Nos)	Amount (Million Tg)
2001	3.3	2	920
2002	4.4	6	1,753
2003	9.2	1	1,854
2004	6.76	2	3,230

Following is a volume and amount of the renovation of roads in each year.

Table 2-144: Volume and Amount of Road Renovation Works

Year	Renovation Area (m2)	Amount (Million Tg)
2001	29,242	253
2002	56,580	556
2003	26,388	261
2004	79,935	1,300

2.8.2 Construction Wastes Survey

Interview survey to the construction sites and companies were carried out under sub contract bases to the local consultant.

a. Objective

One of the biggest problems relating to the SWM in Ulaanbaatar is the illegal dumping and prevention of it is one of the most important targets of the Master Plan.

It is estimated that the construction wastes are the main cause of the illegal dumping and occupy biggest part of it. Nevertheless, there is no data available relating to the amount and quality of construction wastes so far.

Construction wastes survey was carried out in order to grasp above conditions and data obtained by the survey is utilized for making future plan to prevent illegal dumping.

b. Survey Area

Survey area is 7 districts in Ulaanbaatar out of 9 districts, excluding Baganuur and Bagakhangai district.

[14] Road Department in MUB

c. Survey Item

50 construction companies and sites are visited by the local consultant together with study team and conduct interview survey according to the questionnaire. Contents of the questionnaire include followings.

- Amounts of the construction wastes
- Type of construction wastes
- Method and location of disposal of wastes
- Recycling
- Method of transportation of wastes

d. Questionnaire

Questionnaire sheet is as follows.

Questionnaire Sheet for Construction Waste Survey

i) General

Date of survey: _____
Name of company: _____
Name of the project: _____
Address of the project site: _____

Q1. Type of the project:
☐A: Construction of apartment or office building,
☐ B: Renovation of apartment rooms,
☐ C: Renovation of Underground Infrastructure,
（Heating Pipe, Water Pipe, Sewage Pipe, Electricity）
☐ D: Road Work
（New Pavement, Repair Pavement）
☐ E: Others (_____)

Q2. Scale of the project:

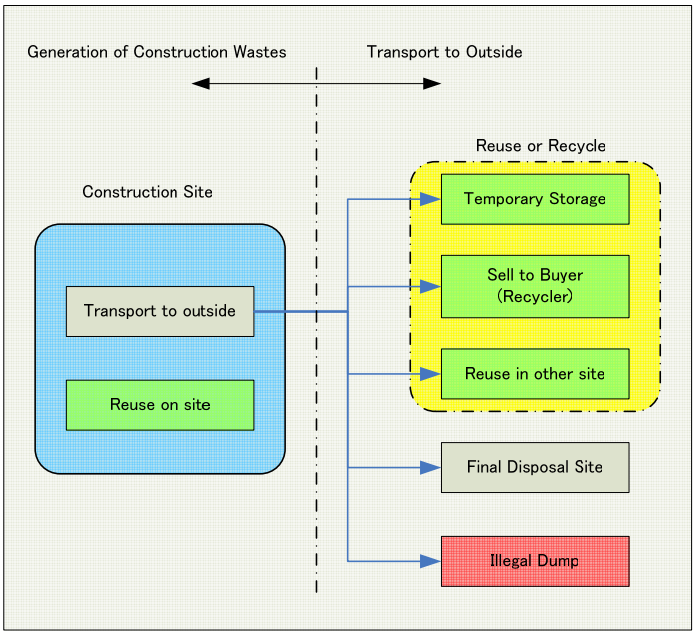
For A New Building
Total floor area: _____m^2
Total Floor Number _____Floors
Total project amount: _____Tg
For B Renovation Work
Total Floor Area _____m2
Renovation area: _____m2
Total project amount: _____Tg
For C Renovation of Underground Infrastructure
Total Length _____m
Total project amount: _____Tg
For D Road Work
Total Width x Length _____
Total project amount: _____Tg

Q3. Who carry the construction waste from your site to the outside?
☐A: Our own truck.
☐B: Employed sub-contractor's truck.
☐C: TUK, ☐D: Others. Specify （_____）

ii) Amount and Type of Construction Waste

	Q4	Q5	Q6	Q7	Q8
Waste materials generated in your site	Is it generated in your site?	If yes, What is generation amount? (ton, m3, number of truck,)	What is the amount to transport outside?	Where to transport? 1:Keep in Storage 2:Other Const. Site 3:Sell to Others 4:Ulaan Chuluut DS 5:Others, Specify 6: Don't Know	Who is the buyer
1. Excavated Earth					
2. Asphalt debris					
3. Concrete debris					
4. Wood debris					
5. Brick mixed with others					
6. Water Proof Material					
7. Insulation Material (Polystyrene Foam)					
8. Reinforcement Bar					
9. Miscellaneous Metal					
10. Others（specify）					
11.					
12. General waste from site office					
13.					
14.					
15.					

iii) Construction Waste Flow



2.8.3 Results of the Survey

a. Generation Amount of Construction Waste

The result of the construction waste survey is shown as in Table 2-148, Table 2-149and Table 2-150.

Twelve (12) companies were selected out of companies that construct new apartment houses or office buildings. These companies have been conducting 6.2million m^2 in total of floor size construction works and the total budget cost was 6.083 billion tugrugs.

Regarding waste from renovation works seven (7) companies and twenty one (21) private individuals were selected. These companies and individuals have been conducting 6,800m^2 in total of floor size renovation works and the total budget cost was 242.7 million tugrugs.

The survey covered seven (7) companies carrying out renovation of underground infrastructure and three (3) companies doing road construction works. These companies have been conducting underground infrastructure renovation works of 2,300m long and 78.3 million tugrugs, and road construction works of 351,571m long and 42,078 million tugrugs in total.

The correlation of waste generated and area of construction works or budget cost can be seen based on the survey result and discharge rates of construction waste by project area and project budget were obtained as shown in Table 2-145. The weight of unit volume (1m^3) of construction waste is assumed 1 ton for convenience. Excavated soil which is re-used at other construction site is included in generated waste amount, but excluded from discharged waste amount.

Table 2-145: Generation Rate of Construction Waste by Project Area and Project Budget

	Waste(t)	Project Site (m2)	Project Budget (1,000tg)	Generation Rate (ton/m2)	Generation Rate (ton/1,000Tg)
New building	903.88	6,238,006	6,083,000	0.000144898	0.00014859
Renovation	317.464	6,800	242,700	0.04668588	0.00130805
Underground infrastructure	190.14	2,300 (m)	78,300	0.047886957 (ton/m)	0.001406641
Road	1,742	351,571 (m)	42,077.6	0.004954902 (ton/m)	4.13997E-05

Construction waste generated in UBC is calculated using the waste generation rate by project budget as shown in Table 2-145 and amount of construction work in 2004 as shown in the Table 2-140. Construction waste generated daily in UBC is estimated at 82.5 tons/day as shown in Table 2-146

Table 2-146 Construction waste amount discharged in UBC

	Apartment	Commercial	Hospital, School, Cultural	Office, Storage Facilities	Energy	Communication	Road Works	Dams, Drainage	Others	Renovation Works	Total
Project Scale (million Tg)	36,333	7,152	4,510	3,743	6,896	412	1,853	3,387	3,456	3,635	71,377
Unit waste generation (tons/1,000 Tg)	1.4859×10^{-4}	1.4859×10^{-4}	1.4859×10^{-4}	1.4859×10^{-4}	14.0664×10^{-4}	14.0664×10^{-4}	4.13997×10^{-5}	14.0664×10^{-4}	13.3849×10^{-4}	13.0805×10^{-4}	---
Waste generation (tons/year)	5,398.7	1,062.7	670.1	556.2	9,700.2	579.5	76.7	4,764.3	4,625.9	2,667.3	30,101.6
Waste generation (tons/day)	14.8	2.9	1.8	1.5	26.6	1.6	0.2	13.1	12.7	7.3	82.5

b. Illegal Dumping of Construction Waste

Fifty (50) companies answered to the question "Where do you transport construction waste?" as shown in Table 2-147. It includes 16 companies which answered "We do not know where we transport construction waste." Local surveyors say that the companies answering "Do not know" may disposed of construction waste illegally. If it is true, 36% of construction companies are disposing of construction waste illegally every day in UBC.

Table 2-147 Disposal site for Construction Waste

NO	Disposal Site	Companies	%
	Ulaan Chuluut Disposal Site	27	54
	Morin Davaa Disposal Site	2	4
	Own storage facility	1	2
	Sell to buyer	1	2
	Unload at ger household	1	2
	Tsagaan Davaa /illegal/	1	2
	Disposal Site /illegal/	1	2
	Do not know	16	32

Table 2-148 Waste discharged from companies carrying out new construction of apartment, office or commercial buildings

No	Company title	Projetc type	Project scale /new building/			who carry waste outside of project site	Waste amount and composition											where to transport	who is the buyer	Waste generated (Exca-Asph)	Waste discharged	ton/m2	ton /thous.Tg
			total floor area /m2/	total floor number	total project amount		Excavated earth /m3/	Wood debris /m3/	sand, gravel, mortar /t/	concrete debris /m3/	brick mixed with others /m3/	water proof materail /t/	insulation material (polysterene foam) /t/	miscellaneous metal /t/	reinforcement bar /t/	asphalt debris /t/	others	general office waste at the site						
1	Aranzal Invest LLC	apartment building	648000	5	568	contractor' truck	770	7	40									paper 0.2	other construction sites, Morin davaa	road construction companies	817	0	0	0
2	West Global LLC	apartment building	670000	5	50	own transportation	300	0.1		0.2	0.2	0.3	0.01	0.1				food residue 0.3 paper 0.03	other construction sites, Ulaan Chuluut	metal scrap recycler	300.91	0.91	1.3582E-06	0.0000182
3	Urguu Engendering LLC	apartment building	2400000	10	1000	own transportation	400			8			0.2					paper, plastic-0.1	Ulaan Chuluut		408.2	408.2	0.00017008	0.0004082
4	And International LLC	apartment building	1800000	9	3000	contractor' truck	2000	18			12		1			10	used wallpaper 100m3 glass 0.3 t	food residue-15	Ger area ditch levelling, Ulaan Chuluut		2041	156	8.6667E-05	0.000052
5	Sertei LLC	family center building	216000	2	50	own transportation	58	0.4			3.5	0.01		0.02					Ulaan Chuluut	wood debris to households	61.93	61.89	0.00028653	0.0012378
6	MKO LLC	commercial building	500000	2	100	own transportation	120				3							paper, palstic, plastic bags- 5	Ulaan Chuluut		123	128	0.000256	0.00128
7	Turuu garav LLC	apartment building	875	4	278	own transportation	54	1.5		8	20	0.1	0.03	0.8	1.5		earth 25m3	food residue-1	own storage		85.93	0	0	0
8	Baganat Urguu LLC	school extension	1034	5	360	own transportation	450										earth powder and glass, tile waste 108m3		other construction sites, Ulaan Chuluut		450	108	0.10444874	0.0003
9	Materail Trade LLC	Ikh Zasag University extension	1334	4	288	own transportation	895	0.02		0.4	0.6		0.01	0.08	0.03			paper 0.05	other construction sites, Ulaan Chuluut	Construction companies	896.14	1.14	0.00085457	3.9583E-06
10	Bojana LLC	family center building	375	2	79	own transportation	1500										cement, glass debris - 16t	paper, food residue-4	other construction sites, Ulaan Chuluut		1500	16	0.04266667	0.00020253
11	Hadan Myangan LLC	School building construction	288	4	260	own transportation	216			10	0.03	0.01	0.05	1	0.5				other construction sites, Ulaan Chuluut		227.59	11.59	0.04024306	4.4577E-05
12	Altan Gorhi LLC	family center building	100	1	50	contractor' truck		2			10	0.05	0.1					paper,plastic bags,palstic containers-5 m3	Ulaan Chuluut		12.15	12.15	0.1215	0.000243
Total			**6238006**		**6083**		**6763**	**29.02**	**40**	**26.6**	**49.33**	**0.47**	**1.4**	**2**	**2.03**						6913.85	903.88	0.0001449	0.00014859

Table 2-149 Waste discharged from companies and private individuals carrying out renovation of apartment rooms and houses

No	Company title	Projetc type	Project scale /renovation works/: total floor area /m2/	total floor number	total project amount/mil.Tg	who carry waste outside of project site	Waste amount and composition: Excavated earth /m3/	Wood debris /m3/	Waste of bath tab, lavatory pan, tile /t/	concrete debris /m3/	brick mixed with others /m3/	water proof materail /t/	insulation material (polysterene foam) /t/	miscellaneous metal /t/	reinforcement bar /t/	asphalt debris /t/	others	general office waste at the site	where to transport	who is the buyer	Waste genrated	Waste discharged	ton/m2	ton/thousTg
1	Nyam Sar LLC	roof renovation	800	800	11.2	own transportation	0	0	0	0	0	0.07	0	0.5			tar residue 2.5 m3		Ulaan Chuluut		0.57	3.07	0.0038375	0.000274107
2	L and H LLC	building renovation	392	392	18	own transportation	0	3.2		0	32	0.192	0	0				paper 0.03	Sell, Ulaan Chuluut	Private individuals	35.392	35.422	0.090362245	0.001967889
3	Tovuu zasag LLC	apartment inside renovation	570	570	3	TUK	0	0		5.8			0				wallpaper-26 m2		do not know		5.8	31.8	0.055789474	0.0106
4	Naran Ord LLC	roof renovation	800	800	14	contractor's truck	0	0		6	0	0.8	0	0.15		0		0	Morin davaa		6.95	6.95	0.0086875	0.000496429
5	LSB LLC	roof renovation	1950	1950	30.2	TUK	0	0			0	35		0			Ëàâ 5 ò		do not know		35	35	0.017948718	0.00115894
6	Future Holding LLC	School gym hall renovation	172	172	9.8	contractor's truck	0				3	0.1					mortar, slit 2 m3		Tolgoit disposal site		3.1	5.1	0.029651163	0.000520408
7	Hurel Tsam LLC	building renovation, extension	440	440	13	own transportation	0	4		0	60	0.1	0	0	0		insulation ash-40m3		sell	Private individuals	64.1	44.1	0.100227273	0.003392308
8	Davaasuren /individual/	house extension, renovation	120	120	10	contractor's truck	3	0.5		2	3	0.02	0.09				sack,paper-200kg		other construction sites, Ulaan Chuluut	Private individuals	8.61	8.81	0.073416667	0.000881
9	Enkhtuya /individual/	House super renovation	68	68	4.8	own transportation	0	0.03	1.2	5	2.5		0.08	0.2	0.8		wallpaper-50 m2		Ulaan Chuluut		9.81	9.81	0.144264706	0.00204375
10	Chimidkhuu /individual/	apartment renovation	56	56	0.55	contractor's truck			0.2								wallpaper-40 m2		do not know		0.2	0.2	0.003571429	0.000363636
11	Erdenechuluun /individual/	house renovation	48	12	0.8	TUK			0.03								Mortar waste-2m3		do not know		0.03	2.03	0.042291667	0.0025375
12	Altantsetseg /individual/	apartment renovation	62	62	0.6	TUK			0.9		0.4								do not know		1.3	1.3	0.020967742	0.002166667
13	Dorj /individual/	apartment renovation	48	48	0.2	TUK		0.6									wallpaper-18 m2		do not know		0.6	0.6	0.0125	0.003
14	Enkhbold /individual/	apartment renovation	108	108	1.5	own transportation		2	0.08	3				1			wallpaper-38 m2		do not know		6.08	6.08	0.056296296	0.004053333
15	Sukhbaatar /individual/	apartment renovation	30	30	6	contractor's truck		0.6		2			0.03				grass debris-2 m3 wallpaper-8m2		do not know	Collection workers	2.63	2.63	0.087666667	0.000438333
16	Selenge /individual/	apartment renovation	48	48	8.5	contractor's truck		0.5	0.012	3							wallpaper-12 m2		at ger household		3.512	3.512	0.073166667	0.000413176
17	Munkhtuya /individual/	apartment renovation	48	48	0.45	waste pickers			0.04	4	0.8		0.01	0.07	0.05		wallpaper-30 m2		do not know		4.97	4.97	0.103541667	0.011044444
18	Delgertsetseg /individual/	1st floor extension renovation	100	100	20	own transportation				12	6							õààñ,õîîëîû ¿ëàÿãàÿë, øóóãàé-6 ì3	Ulaan Chuluut		18	18	0.18	0.0009
19	Badral /individual/	1st floor extension renovation	160	160	25	contractor's truck		6			5					15	paper,packaging materail-3 m3		Ulaan Chuluut		26	29	0.18125	0.00116
20	Baatartsogt /individual/	apartment renovation	40	40	1	TUK				6							putty-0.1 t wallpaper-46 m2		Ulaan Chuluut		6	6.1	0.1525	0.0061
21	Munkhbayar /individual/	billiard club renovation	200	200	9	TUK			0.04	20	3						plaster-3m3 wallpaper-52 m2		Ulaan Chuluut		23.04	26.04	0.1302	0.002893333
22	Javkhlan /individual/	apartment renovation	64	64	2.5	TUK			0.03	6							putty-0.01t		do not know		6.03	6.04	0.094375	0.002416
23	Bayaraa /individual/	apartment renovation	70	70	2	TUK		0.5	0.05	2							wallpaper-12 m2		do not know		2.55	2.55	0.036428571	0.001275
24	Chimid /individual/	1st floor extension renovation	150	80	25	own transportation	50	1.5	0.1	5	0.3	0.02	0.04				oil cloth- 48 m2		Ulaan Chuluut		56.96	6.96	0.0464	0.0002784
25	Jamsran /individual/	café renovation	110	110	16	contractor's truck		1	0.08		2	0.05	0.01				marble stone-0.08 t		do not know		3.14	3.22	0.029272727	0.00020125
26	Chuluuntsetseg /individual/	apartment inside renovation	64	64	8	contractor's truck		3	0.06	6	0.6		0.05				wallpaper-17 m2		do not know		9.71	9.71	0.15171875	0.00121375
27	Javsansuren /individual/	apartment renovation	64	64	1.4	contractor's truck			0.2	5							paint-0.02t wallpaper-23m2		do not know		5.2	5.2	0.08125	0.003714286
28	Dolgor /individual/	apartment renovation	18	18	0.2	own transportation		0.2	0.06	3							wallpaper-10m2		do not know		3.26	3.26	0.181111111	0.0163
	TOTAL		**6800**	**6694**	**242.7**		**53**	**23.63**	**3.082**	**95.8**	**118.6**	**36.352**	**0.31**	**1.92**	**0.85**	**15**					348.544	317.464	0.046685882	0.001308051

Table 2-150 Waste discharged from companies carrying out renovation of underground infrastructure and road works

No	Company title	Project type	Project scale /underground infrastructure works /		who carry waste outside of project site	Waste amount and composition												where to transport	who is the buyer	Waste generated	Waste discharged	ton/m	ton/thousTg
			total length /m/	total project amount		Excavated earth /m3/	Wood debris /m3/	sand, gravel, mortar, tile debris /t/	concrete debris /m3/	brick mixed with others /m3/	water proof materail /t/	insulation material (polysterene foam) /t/	miscellaneous metal /t/	reinforcement bar /t/	asphalt debris /t/	others	general office waste at the site						
1	Ritsa LLC	Kindergarten plumbing works	400	7	own transportation	80	1	0	0	3						metal, insulation materail- 5 t		Tsagaan Davaa		84	9	0.0225	0.001285714
2	Hatiltsag LLC	Hospital plumbing works	310	7.5	contractor's truck	2	0		0	0	0	0.8	1.1		0.2			Do not know	metal scrap recycler	4.1	4.1	0.013225806	0.000546667
3	Selen LLC	Plumbing pipe exchange	620	16.3	contractor's truck	0	0.2		0			1.2	2					Disposal site	metal scrap recycler	3.4	3.4	0.005483871	0.000208589
4	AABB LLC	plumbing works	650	3.5	own transportation	0	0.3		0.4	0.5		0.3	0.1	0.3	0			Ulaan Chuluut		1.9	1.9	0.002923077	0.000542857
5	Super Design LLC	heating pipe renovation	80	10	contractor's truck	0	3		10	1.2	0.01	0.08	0.07	0.06				Ulaan Chuluut	metal scrap stored in company storage facility	14.42	14.42	0.18025	0.001442
6	Nemeh Hasah LLC	heating pipe renovation	120	26	own transportation	0			70	1		0.1	3					Ulaan Chuluut	metal is reused by company	74.1	74.1	0.6175	0.00285
7	Konekom LLC	heating pipe renovation	120	8	own transportation	0	0		0	0	0.02	0.2	3	0				Ulaan Chuluut	metal is reused by company	3.22	3.22	0.026833333	0.0004025
8	Road supervision and research center	Road works	350000	42000	contractor's truck	6200			1200				2		6			Other constrction sites, Ulaan Chuluut	metal scrap recycler	7408	1208	0.003451429	2.87619E-05
9	UB road renovation and maintanance company	Road works	571	59.6	own transportation	0	0		0	0		0	0	0	484			Ulaan Chuluut	construction companies	484	484	0.847635727	0.008120805
10	Urgun Govi LLC	Road works	1000	18	own transportation	0									50			Other constrction sites, Ulaan Chuluut	individuals	50	50	0.05	0.002777778
Total			**10790**	**42156**		**6282**	**4.5**	**0**	**1280**	**5.7**	**0.03**	**2.68**	**11.27**	**0.36**	**540**								

Underground Infrastructure (Total)	2300	78.3										
Road (Total)	351571	42077.6										
Underground Infrastructure (Total)										185.14	110.14	0.047886957	0.00140664
Road (Total)										7942	1742	0.004954902	4.13997E-05

2.8.4 Survey for Illegal Dump Site

From 23 September and 29 October 2005 a survey was carried out of the illegal dump sites by the methods below.

a. Objective

The illegal dumping sites were surveyed and a large amount of information was obtained about the volume and quality of waste, illustrating the flow of waste in the survey area.

b. Survey Method

The Study Team visited the site and calculated the content through simple measurement. Furthermore, the general composition of the quality of waste was visually determined.

c. Survey Point

The survey point was decided through information obtained by the CMPUD of MUB. The figure below shows the Location of the Illegal Dump site in October 2005.

Figure 2-20: Location of the Illegal Dump Site in October 2005

Table 2-151: Particulars of Illegal Dump Site

Location No	Estimated Volume	Type of Waste	Contents of CW	Note
1	100m^3	CW:89% IW:8% GW:3%	Excavated Soil (64%) Concrete Debris (10%) Brick Debris (10%) Glass (1%) Ceramic Materials (3%) General Waste (3%) Rusty Steel (1%) Cloth and Old Rugs (5%) Fur (2 %) Animal Body Parts (1 %)	
2	30m^3	CW:100% IW:0% GW:0%	Brick Debris (90 %) Concrete Debris (5 %) Rocks (5 %)	The interview was conducted with a resident from the nearby area. She said that when the yellow building at the area was renovated, they took out all the waste and disposed it just outside of their fence last spring.
3	800m^3	CW:95% IW:5% GW:0%	Excavated Soil (34 %) Brick Debris (30 %) Concrete Debris (15 %) Glass (5 %) Rock (5 %) Glass wool (2 %) Cans (1 %) Bottles (1 %) Plastic sheets (1 %) Animal Fur (1 %) Ceramic Materials (2 %) Leather (2 %) Cardboard (1 %)	Waste has been illegally dumped since last year. The guard at the site said that the net fence was constructed in July this year to prevent trucks from entering the site. The area was the property of "BEGDU" Korean Construction Company.
4	3,000m^3	CW:87% IW:6% GW:7%	Concrete Debris (15%) Excavated Soil (30%) Rocks (10%) Brick Debris (20%) Cardboard (2%) Cement Bag (5%) Waterproof Sheets (1%) Animal Body Parts (2%) Ceramic Materials (5%) Glass (3%) Cotton (1%) Plastic (3%) Pipe Insulation (1%) General Waste (7%)	There are several hills of waste from Ger Areas. Two (2) Waste Pickers were collecting iron from the area. A guard of the area cannot stop trucks dumping waste in the area. He wants to inform the Ministry to stop the illegal dumping. The amount of dumped waste has been steadily increased since this summer.
5	20 m^3	CW:0% IW:0% GW:100%	General Waste (100%)	The area used to be an illegal dumping site but now the land is someone's property and it has been cleaned up. The waste was probably moved to site No. 6.
6	2,000 m^3	CW:29% IW:1% GW:70%	General Waste (80%) Excavated Soil (5%) Brick Debris (10%) Cardboard Walls (1%) Ash (1%) Tree Waste (1%) Wood Chips (1%) Concrete Debris (1%)	
7	500 m^3	CW:30% IW:0% GW:70%	General Waste (70%) Excavated Soils (25%) Concrete Debris (3%) Ceramic Materials (2%)	There were two (2) persons collecting clay from the construction waste. They saw trucks dumping waste at 11 am in the morning.
8	1,300 m^3	CW:95% IW:0% GW:5%	Excavated Soils (10%) Brick Debris (5%) General Waste (5%) Large Rocks (80%)	There is a fence and sign board saying "Do not dump waste in this area".
9	1,200 m^3	CW:80% IW:15% GW:5%	Brick Debris (27%) Excavated Soil (30%) Ceramic Materials (10%) Asphalt (3%) Clothes (5%) General Waste (5%) Glass (10%) Concrete Debris (10%)	

10	1,200 m^3	CW:90% IW:5% GW:5%	Brick Debris (27%) Excavated Soil (50%) Ceramic Materials (10%) Asphalt (3%) Clothes (5%) General Waste (5%)	General Waste is Ger Waste.
11	500 m^3	CW:90% IW:5% GW:5%	Brick Debris (20%) Excavated Soil (50%) Concrete Debris (10%) Fur (5%) General Waste (15%)	General Waste is Ger Waste.
12	500 m^3	CW:79% IW:11% GW:10%	Excavated Soil (40%) Brick Debris (16%) Ceramic Materials (5%) Sand Bags (2%) Concrete Debris (10%) Cans (3%) Leather/Fur (5%) Rock (5%) Steel (1%) Wood Chips (3%) General Waste (10%)	General Waste is Ger Waste.
13	1,200m3	CW:86% IW:4% GW:10%	Large Size Rocks (71%) Ash (5%) Brick Debris (10%) Rusty Steel (1%) Ceramic Cups (3%) General Waste (10%)	General Waste is Ger Waste.
14	250m3	CW:97% IW:3% GW:0%	Excavated Soil (40%) Brick Debris (20%) Glass (3%) Ceramic Materials (5%) Rock (32%)	
15	550m3	CW:99% IW:0% GW:1%	Excavated Soil (70%) Brick Debris (24%) Ceramic Materials (5%) Rock (1%)	General Waste is Ger Waste

CW: Construction Waste, IW: Industrial Waste, GW: General Waste

2.8.5 Findings

The findings of the summary are summarized below.

- According to the 2004 records, the yearly average construction waste amount, which is illegally dumped, is estimated as 82.5 ton/day.
- The temperature in winter in Ulaanbaatar City can drop below minus 20, as outdoor construction activities in particular are extremely restricted, the generation amount of construction waste is lower than in the summer season according to the data from the weighbridge at the disposal site and observation of collection at the disposal site.
- The proportion was determined, as shown in the table below, by referring to the market waste generation amount which is considered to have a similar generation pattern and the generation amount of construction waste in the summer season is estimated to be double that of the winter season.

Table 2-152: Estimated Generation Amount of Construction Waste（2004）

	Summer Season（Apr- Sep）	Winter Season （Oct-Mar）
Construction Waste Generation Amount	110.6 ton/day	54.5 ton/day

- According to the 2005 field survey results of the JICA Study Team, approximately 13,000m^3 of waste was illegally dumped in the survey area with the majority being disposed in the southern part of the city (Bayangol and Songinokhairkhan districts).

Furthermore, according to the CMPUD survey results[15], the amount will be 65,500m^3 in 2006, despite the survey location being different, the amount of waste shows an increasing trend alongside economic activity.

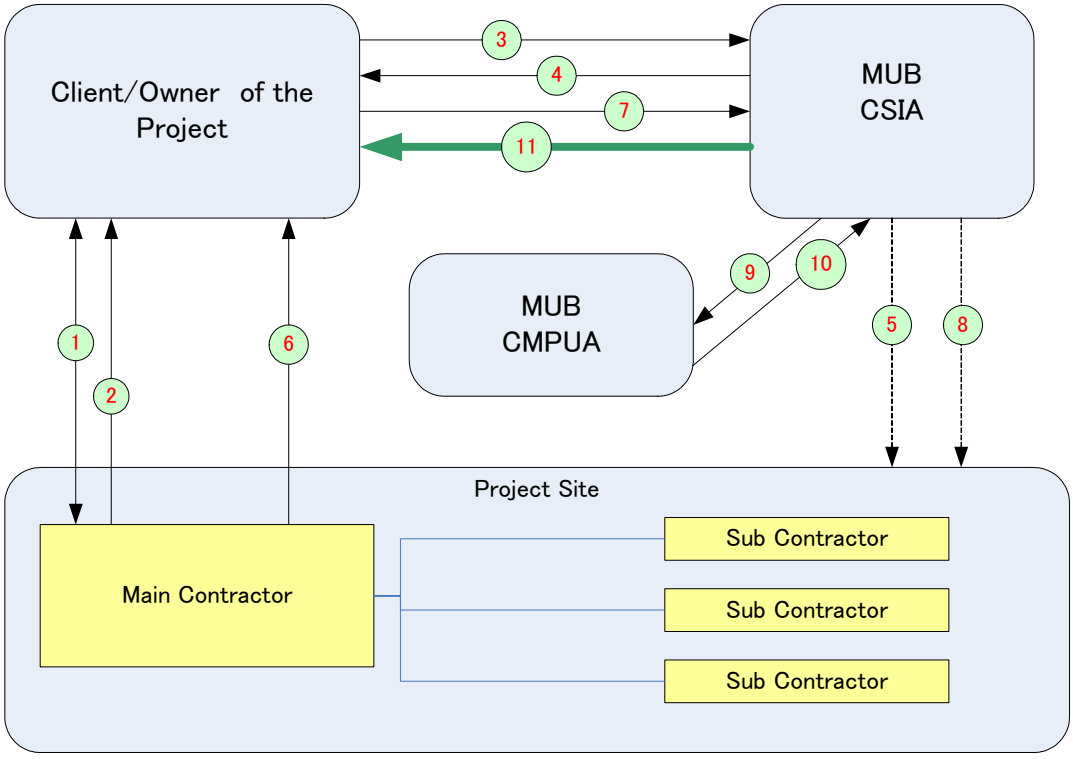
- Construction waste is identified as accounting for approximately 80% of the illegally dumped waste.

2.8.6 Plan for Control of Construction Waste

In the winter season, construction waste accounts for 10% of the weight of the city's waste generation amount and approximately 5% in summer. Strengthening the control of this waste is essential for eliminating illegal dumping and also improving the financial affairs of CMPUA.

Moreover, it is important for the generators, owner of the project, and the government to each fulfill their obligations in respect to their positions in order to appropriately dispose construction waste.

A proposed control system for appropriate disposal of construction waste is illustrated in the figure below.



CSIA: Ulaanbaatar City Special Inspection Agency,
CMPUA: City Maintenance and Public Utility Agency

Figure 2-21: Control System for Construction Waste

① Main contractor and client/owner of the project enter a construction contract.

② Main contractor presents a waste disposal plan to the client prior to the commencement of construction work.

[15] Presentation material for the explanation of new organization of CMPUA carried out on September 2006.

③ Client presents the waste disposal plan in ② to CSIA.

④ After confirming the contents, there will be changes instructed if there are any deficiencies and if everything is satisfactory, approval will be given to commence work.

⑤ Spot investigations will be carried out during the construction work, if required, to identify if the work is being implemented as scheduled in the plan.

⑥ At the time of work completion, the main contractor will submit a work completion report to the client, reporting whether or not waste was disposed of as set out in the plan.

⑦ The client will submit a work completion report to CSIA after confirming the contents as mentioned above in ⑥.

⑧ CSIA will inspect the site if required and confirm whether or not waste disposal has been carried out appropriately.

⑨ CSIA will refer to the CMPUA whether construction waste were transported to the designated disposal site or not.

⑩ CMPUA will confirm it based on the data from the weighbridge at the final disposal site.

⑪ If the above procedures have been performed then a construction completion certificate will be issued and commercial utilization will be allowed.

The major point of this control system is that there are limitations such as, unless the client presents the waste disposal plan then construction work cannot commence and in accordance with the approved waste disposal plan, if the waste is not disposed off then a construction completion certificate is not issued and the building cannot be used commercially.

2.9 Survey on Final Disposal Amount

2.9.1 Final Disposal Amount Survey at 3 Official Disposal Sites

a. Objectives

Waste amount survey was carried out in order to grasp final disposal amount in three disposal site (UCDS, MDDS and NDS) in the study area.

- To analyse the data, which incoming collection vehicles registered at the site office at three disposal site and to grasp the number and type of the vehicles
- To grasp the specific gravity of the wastes which carried by each type of collection vehicle and calculate weight of wastes disposed at disposal sites.

b. Survey method

- Data Analysis of Incoming Collection Vehicles

Following is the data obtained from each disposal site.

Table 2-153: Surveyed Data for Dumping Waste Amount

Disposal site	season	Year	Month
UCDS	Winter	2003	12
		2004	01
	Summer	2004	07
			08
MDDS	Summer	2004	07
			08
NDS	Winter	2003	12
	Summer	2004	07

(Source): Nuuts data on incoming collection vehicle to three disposal sites

- Measurement of Apparent Specific Gravity of Waste

12 different types of collection vehicle were selected and measure the weight and volume of wastes carried by vehicles in order to obtain apparent specific gravities. Weight is measure by weighbridge at construction material supplying company.

c. Results

c.1 Results of Data Analysis of each Disposal Site

Number of collection vehicle and waste volume which recorded at each disposal site is summarized in the following table.

Table 2-154: Numbers of Collection Vehicle for each Disposal Site

Disposal site	Year	Month	Nos. of Collection Vehicle		Waste Volume (m^3)	
			Nos./month	Nos./day	m^3/month	m^3/day
UCDS	2003	12	3,918	126	23,702	765
	2004	01	3,930	127	24,216	781
	2004	07	4,435	143	26,966	870
		08	4,798	155	29,423	949
MDDS	2004	07	230	7	1,404	45
		08	304	10	1,786	58
NDS	2003	12	227	7	807	26
	2004	07	142	5	652	21
Total	-	-	17,984	---	108,956	---

Following is the disposal amount from 7 Duuregs to the disposal sites.

Table 2-155: Disposal amount from 7 Duuregs

Unit : m^3

year	month	Duureg							
		BGD	BZD	CHD	KhUD	NaD	SBD	SkhD	Total
2003	12	4,867	---	3,006	2,223	807	3,748	9,858	24,509
2004	01	4,354	2,288	3,471	1,924	---	4,217	7,962	24,216
	07	4,289	6,198	3,422	3,735	652	4,037	6,689	29,022
	08	4,675	6,356	3,495	4,284	---	4,416	7,983	31,209
Total		18,185	14,842	13,394	12,166	1,459	16,418	32,492	108,956

note : ---;no data available.

Following is the disposal amount from each generation source.

Table 2-156: Disposal amount from each Source (7 Duuregs)

Unit : m^3

Source		Duureg							
		BGD	BZD	CHD	KhUD	NaD	SBD	SkhD	Total
1	Road cleaning	1,202	706	1,092	45		1,047	1,501	5,593
2	Apart area	9,900	8,518	4,741	3,379		10,506	5,244	42,288
3	Ger area	1,954	2,837	6,905	1,517	1,459	2,907	22,585	40,164
4	Institution	45	1,097	12	1,708		658	153	3,673
5	Direct-disposal	5,084	1,684	644	5,517		1,300	3,009	17,238
Total		18,185	14,842	13,394	12,166	1,459	16,418	32,492	108,956

c.2 Results of Apparent Specific Gravity of the Wastes in Collection Vehicles

Following is the results of apparent specific gravity in 12 collection vehicles.

Table 2-157: Results of Apparent Specific Gravity by each Collection Vehicles

Type	No.	Model of vehicles	Vehicle weight (kg)	Volume (m^3)	Apparent Specific gravity (ton/m^3)	Types of waste
Compactor	1	Mitsubishi	3,500	3.9	0.18	Apartments & institutions
	2	Isuzu (4 m^3)	3,600	3.7	0.48	Institutions
	3	M-53	4,100	9.6	0.17	Apartments
	4	Isuzu (8 m^3)	5,100	7.5	0.31	Apartments
	5	Isuzu (3 m^3)	3,550	2.9	0.50	Road/square cleaning
	6	Nissan	3,800	5.5	0.40	School & institution
	7	SA-3206	14,000	21.7	0.35	Apartments & institutions
	8	Ko 450	6,550	11.5	0.19	Apartments, domestic waste
Open Truck	9	Zil-554	4,900	20.1	0.28	Apartments, domestic waste
	10	Zil-130 (dump truck 45085)	5,300	10.0	0.22	Institutions, domestic waste
	11	Ko-440	4,800	8.6	0.23	Apartments & institutions
	12	Zil-555	5,200	15.0	0.37	Ger area, mainly ash

d. Findings of the Survey

d.1 Analysis of Collection Vehicles.

Average number of vehicles and waste volume carried by the vehicles at each disposal site in a month are shown in the following table.

Table 2-158: Number and Volume of Collection vehicles at each Disposal Site

Disposal site	Number of Vehicles		Waste Volume	
	Vehicles / month	%	m3/month	%
UCDS	137.8	90.4	841.3	91.8
MDDS	8.5	5.6	51.5	5.6
NDS	6.0	4.0	23.5	2.6
Total	152.4	100.0	916.3	100.0

It was observed that number of vehicles at UCDS and MDDS in summer are more than those in winter. But it was vice versa at Nalaikh Disposal Site. Further clarification was carried out in the next phase.

Discharged rate per person was calculated using discharged volume and population in each Duureg. Highest is the one in Sukhbaatar as 0.51m^3/person/year and lowest is the one in Chingeltei as 0.32m^3/person/year.

Table 2-159: Discharged Rate per Person in Each Duureg

Item	Duureg							Total
	BGD	BZD	CHD	KhUD	NaD	SBD	SkhD	
Disposal amount (m3/year)	53,464	58,181	39,378	35,768	8,594	48,269	95,526	339,180
Population (2005)	160,982	178,809	124,640	82,787	25,259	108,480	185,634	866,591
Discharge Rate (m3/porson/year)	0.33	0.33	0.32	0.43	0.34	0.44	0.51	0.39

d.2 Calculation of Apparent Specific Gravity of Wastes

Average apparent specific gravity of wastes in compactor truck and open truck is 0.32 ton/m3 and 0.28 ton/m3 respectively and there is not much different between these. The reason might be either compaction is not functioning well in the compactor truck or open truck used in Ger area carries a lot of ash especially in winter season or both.

Table 2-160: Apparent Specific Gravity of Wastes in each Type of Vehicle

Type of Vehicle	Apparent Specific gravity (ton/m^3)
Compactor (on average)	0.32
Open truck (on average)	0.28
Average	0.31

d.3 Total Final Disposal Amount in Existing Disposal Site

Final disposal amount is calculated using specific gravity of wastes at 0.31 ton/m^3 and incoming wastes volume which recorded by Nuuts company and summarised in the following table. As a result, the daily final disposal amount in the study area is estimated in the range of 250 ton to 320 ton per day.

Table 2-161: Total Final Disposal Amount

year	month	Volume (m^3/month)	Weight	
			ton/month	ton/day
2003	12	24,509	7,598	253
2004	01	24,216	7,507	250
	07	29,022	8,997	300
	08	31,209	9,675	323

2.9.2 Final Disposal Amount Survey at UCDS

a. Operation of Weighbridge

a.1 Construction and Installation of Weighbridge

Construction and installation of the weighbridge began in April 2005 and was completed in December 2005. The reasons why it took nearly nine months to complete are:

- There was no agent or distributor of weighbridge equipment in Mongolia since there is not much demand. Therefore, no technical support can be obtained in Mongolia.
- There was no electricity supply for the new control building and extension of electricity line was required.
- The construction market is very busy in summer because it is almost impossible to work outside in winter season due to severe conditions.

Actual construction schedule is shown as follow.

Work Item	2005									2006		
	4	5	6	7	8	9	10	11	12	1	2	3
Phase 1												
Design of Weighbridge and Control Building												
Procurement of WB loadcell												
Electricity Supply												
Phase 2												
Construction of WB Foundation												
Construction of Control Building												
Installation of WB												
Calibration of WB												
Registration and Training												
Operation of WB												

Figure 2-22: Construction Schedule for Weighbridge

Following are the relevant drawings of the weighbridge structures.

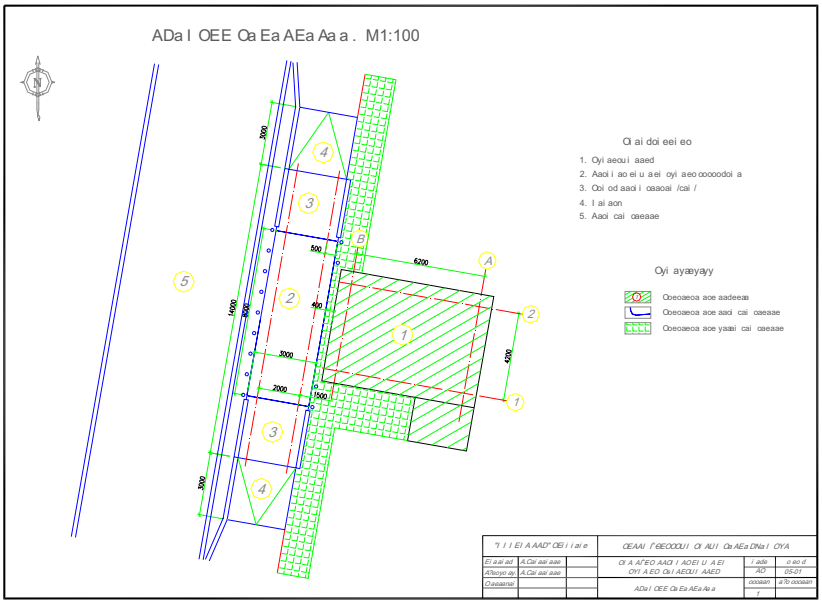


Figure 2-23: Layout of Weighbridge and Control Building

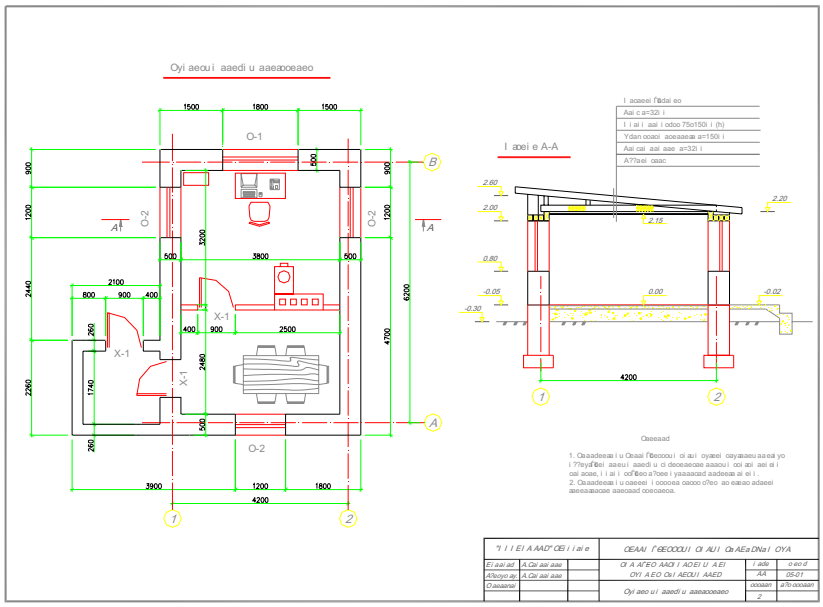


Figure 2-24: Internal Layout of Control Building

a.2 Operation of Weighbridge

Operation of Weighbridge (WB) started on 26 December 2005. There are three female staffs, who were formally working as dispatchers, are now working as WB operators. Each operator works 24 hours continuously and has the following two days off. In other words, they work one in three days. This is due to incoming trucks at midnight or early morning from Narantuun Market which is the biggest market in UB city.

The JICA Study team trained the local staff for the operation of WB and data input for creating database for the waste, then, this staff stationed in the control building for two weeks together with WB operator to give on the job training on how to use the WB equipment and how to input data to the PC.

One month has passed since the commencement of the Weighbridge operation, the operators are used to operating and all the necessary data has been obtained and analysis is made in the following section.

After the commencement of the WB operation, one accident has occurred.

Figure shows the accident happened on 3 Jan 2006. One of the tyres of the trucks was punctured and slipped out of the steel platform.
There was no injury or damage to the building luckily, and the following modifications of the steel platform and concrete approach were made.

- Fabrication and installation of steel pipe guardrail to the steel platform and concrete approach slab.
- Installation of bumps to reduce the speed of trucks.

Before Modification

After Modification

Figure 2-25: Accidents on 3rd of Jan 2006 and following Modification

a.3 Weighbridge Data Management System

All of the incoming vehicles are weighed by the weighbridge at the entrance of the UCDS, where the weight of it is transmitted from the weighbridge to the connected weight indicator in the control building. The connected indicator is installed with the "Digital Weight Indicator VC-402" developed by the weighbridge supplier.

The figure on the indicator is input to the PC manually, where the weighbridge database system was developed and installed by the Study Team. All the data obtained by this system is transferred to the CMPUD office by a USB memory stick, where the data is imported to the system developed by the team as shown in the following figure.

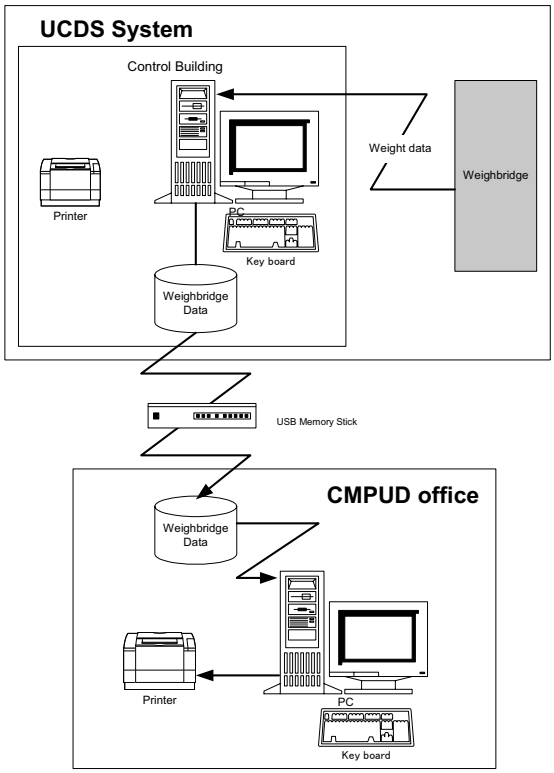


Figure 2-26: Weighbridge Data Management System

a.3.1. Development

(1) UCDS System (Digital Weight Indicator VC-402)

The "VC-402" developed by the weighbridge supplier receives the weight data automatically from the weighbridge.

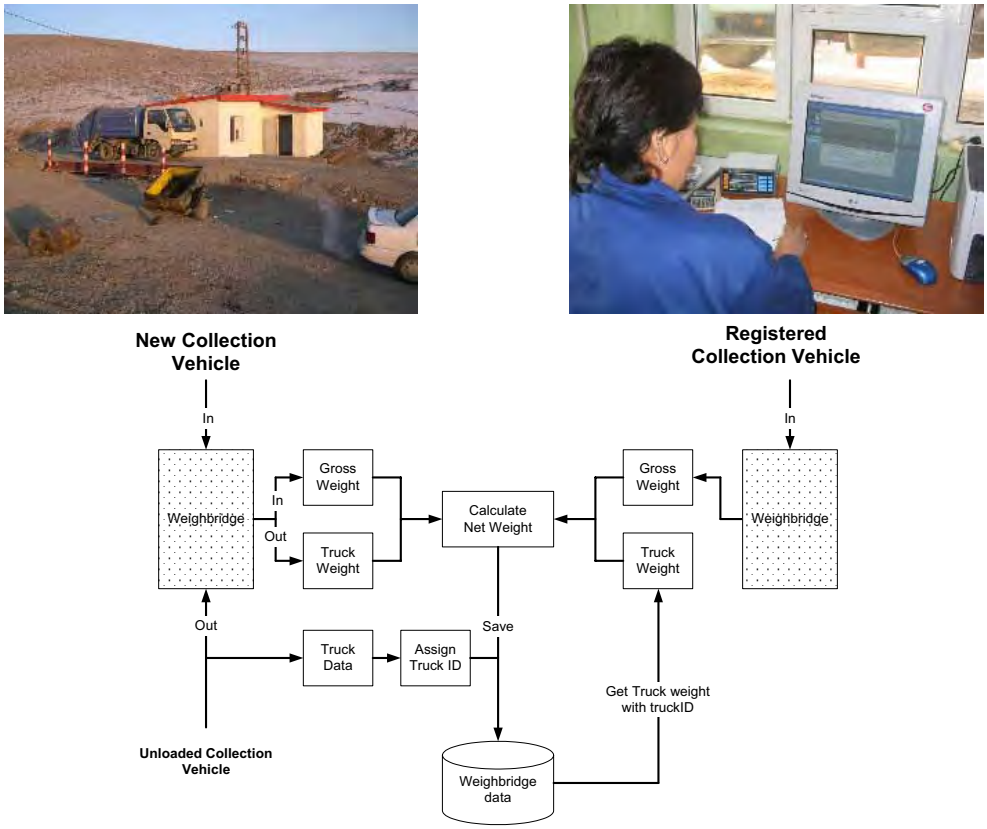


Figure 2-27: System Scheme of Weighbridge Data Management

As shown in the previous figure, vehicles that are not registered are weighed at the entrance to obtain the gross weight (waste weight + truck weight), and then weighed again on departure to obtain the weight of the empty truck (net weight). Once the weight of the truck is obtained, the truck is registered.

As for the vehicles that are registered, they are weighed at the entrance, the assigned code of the truck is entered, and the net weight (truck weight) is saved to the database.

In both cases, the name of the company, Duureg and Khoroo, the type of the waste are selected manually from the list of name appeared in the screen

The input items for weighbridge database system are shown below.

Table 2-162: Input Items for Weighbridge Database System

No.	Item	ID No.	Entry	Description
1.	Truck's Entry Number	SeqID	Automatic Input	Vehicles are numbered with SeqID by each entry to Weighbridge.
2.	Ticketing Number	TicketID	Automatic Input	TicketID is issued as an entry card.
3.	Truck's Registration Number	TruckID	Manual Input	TruckID is the vehicle identification number. It is the most important data because the system is controlled by this number.
4.	Company Name	CompanyID	Item Selection	Select a name of company the vehicles belong to.
5.	Collection Area	DistrictID	Item Selection	Select a district name of which vehicles collect waste.
6.	Khoroo Area	KhorooID	Item Selection	Select a khoroo name of which vehicles collect wastes. Enter "All" at this moment.
7.	Waste Category	WasteID	Item Selection	Select categoryies of waste.
8.	Date of Incoming	InDate	Automatic Input	-
9.	Time of Incoming	InTime	Automatic Input	-
10.	Date of Outgoing	OutDate	Automatic Input	-
11.	Time of Outgoing	OutTime	Automatic Input	-
12.	Gross Weight	GrossWeight	Manual Input	Enter GrossWeight = Truck Weight + Weight of Waste
13.	Truck Weight	TurckWeight	Manual Input	Enter Weight of Empty Truck
14.	Weight of Wastes	NetWeight	Automatic Input	NetWeight = GrossWeight – TruckWeight

(2) Backup and Restore System

(1) UPS(uninterrupted power supply) in case of electricity interruption

The system has a UPS in case of an interruption to the electricity supply. The UPS is connected to the computer and in the event of an electricity interruption the computer can work for a period of 10 minutes, which is enough time to shut down the system normally.

(2) Backup of the weighbridge data

All the incoming waste data is saved on two files in weighbridge database system. Those files have to be saved onto USB memory stick everyday. Those files on USB memory stick will be supplied to the CMPUD office and used for analysis of the waste data.

(3) System recovery

The most common cause of data loss is failure of the computer's hard disk. If this situation occurs, another PC shall be mobilised and both files will be saved on the PC. If the PC does not work properly, the figures on the indicator shall be written in the notebook temporarily and will be input at a later stage when the PC is recovered.

(3) CMPUD office System (Weighbridge database)

The study team developed a database system called Weighbridge Database System (WBDB). This database system will input the data from the weighbridge indicator manually and will import it to the DB and manage the data to obtain different reports. The WBDB has been developed with Microsoft Access 2003 because it is an application that is widely used and known all over the world. For that reason, it will be easy to manage and maintain.

- System structure

In the office, the WBDB system reads the file in "txt" format and converts it to DB format. Any error in the source data will be verified and then it will proceed again to be the WBDB system.

Once the data is imported to the WBDB, the system can print diverse reports and export the data to excel file formats, in which the data can be manipulated in other applications.

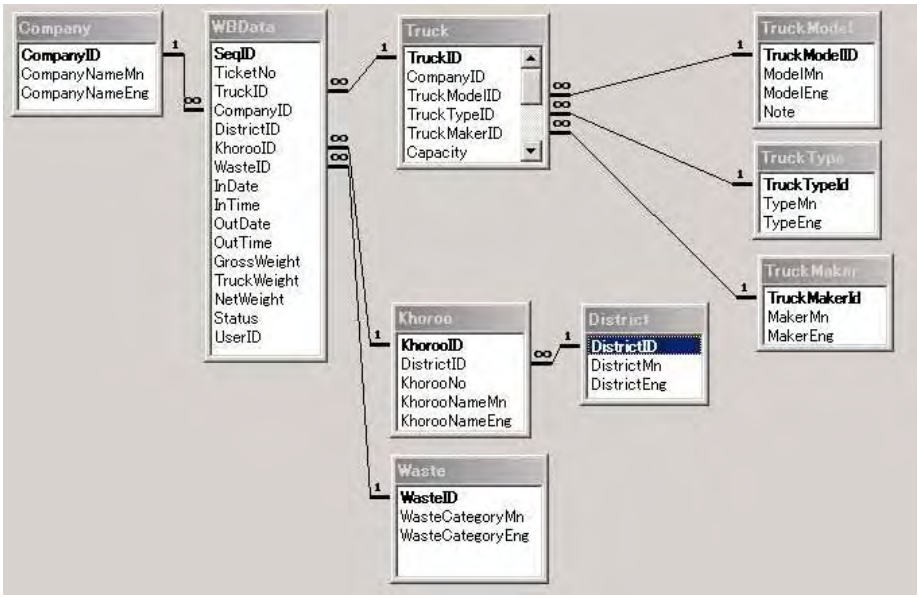
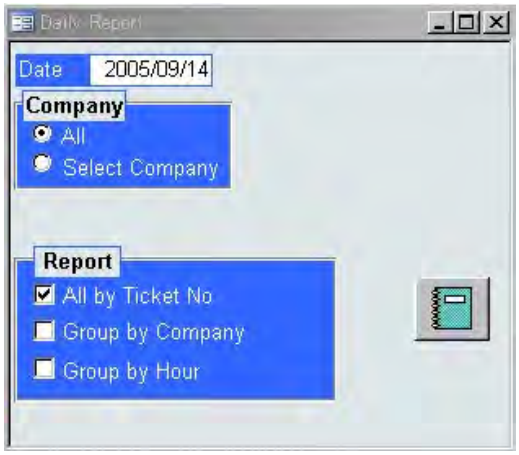


Figure 2-28: Table Relationships of Weighbridge Database System

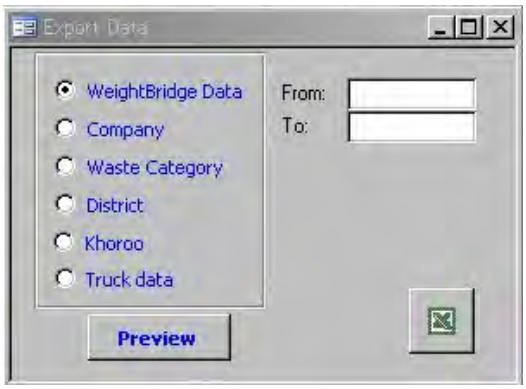
(4) Reports

The report that can be obtained directly from the WBDB are shown in the following figure.

Enter the time period and then select the type of report. For details, refer to the WBDB user manual.



The data can be exported from WBDB to Microsoft Excel for preparation of the report.



a.3.2. Plan for Weighbridge Database System Management

To ensure that the system runs smoothly, the system administrator will do the following:

- Check the truck code, especially when registering a new truck;
- Backup the data;
- Carry out computer maintenance, especially for the computer installed in the UCDS because there is a lot of dust;
- Check the weighbridge and its indicator

b. Analysis of Data Obtained

b.1 Basic Weighbridge Database

Items of the basic weighbridge database are shown in the following table.

Table 2-163: Items of Basic Weighbridge Database

TicketNo	TruckID	CompanyID	Company NameMn	CompanyNameEng	DistrictID	KhoroolD	WasteID	WasteCategory Mn	WasteCategory Eng	In Date	In Time	Out Date	Out Time	Gross Weight	Truck Weight	NetWeight
802	9673	03	Niiaeiioae doai O¯E	Songinokhairkan TUK	Niiaeiioaedoai (Songinokhairkhan)	0343 A?o oidii (All area)	02	Idii noooiu oia oayaaae	Apartment area Waste	02-Jan-06	10:37:36	02-Jan-06	11:11	5940	4740	1200
803	8970	05	Oai Ooe O¯E	Khan-Uul TUK	OaiOoe (Khan-Uul)	0582 A?o oidii (All area)	02	Idii noooiu oia oayaaae	Apartment area Waste	02-Jan-06	11:10:44	02-Jan-06	11:18	5540	3940	1600
804	9681	08	Aeaai aacad	Organization	Aayiaie (Bayangol)	011 A?o oidii (All area)	04	Ioen aaeaooeeaaui oia oayaaae	Institution/Office Waste	02-Jan-06	11:20:15	02-Jan-06	11:19	7960	4540	3420
805	0940	03	Niiaeiioae doai O¯E	Songinokhairkan TUK	Niiaeiioaedoai (Songinokhairkhan)	0343 A?o oidii (All area)	02	Idii noooiu oia oayaaae	Apartment area Waste	02-Jan-06	11:21:08	02-Jan-06	11:27	4620	3940	680
806	0873	01	Aayiaie O¯E	Bayangol TUK	Aayiaie (Bayangol)	011 A?o oidii (All area)	02	Idii noooiu oia oayaaae	Apartment area Waste	02-Jan-06	11:39:13	02-Jan-06	11:46	4860	3520	1340
807	5177	07	Ooaeei	Private	Niiaeiioaedoai (Songinokhairkhan)	0343 A?o oidii (All area)	03	Ayd oidiieieui oia oayaaae	Ger area Waste	02-Jan-06	11:44:31	02-Jan-06	12:24	2420	1580	840
808	4683	08	Aeaai aacad	Organization	Aayic?do (Bayanzurkh)	0222 A?o oidii (All area)	06	Caoui oia oayaaae	Market Waste	02-Jan-06	11:45:47	02-Jan-06	11:56	2320	1660	660
809	2079	06	Чeiayeoye O¯E	Chingeltei TUK	Чeiayeoye (Chingeltei)	0697 A?o oidii (All area)	05	Ooaaeaaaiu oia oayaaae	Commercial Waste	02-Jan-06	11:57:29	02-Jan-06	12:06	6520	5680	840
810	9476	06	Чeiayeoye O¯E	Chingeltei TUK	Чeiayeoye (Chingeltei)	0697 A?o oidii (All area)	02	Idii noooiu oia oayaaae	Apartment area Waste	02-Jan-06	12:10:45	02-Jan-06	12:22	5740	3800	1940
811	6133	01	Aayiaie O¯E	Bayangol TUK	Aayiaie (Bayangol)	011 A?o oidii (All area)	02	Idii noooiu oia oayaaae	Apartment area Waste	02-Jan-06	12:11:55	02-Jan-06	12:22	7780	4580	3200
812	4930	04	N?oaaaoad O¯E	Sukhbaatar TUK	N?oaaaoad (Sukhbaatar)	0465 A?o oidii (All area)	02	Idii noooiu oia oayaaae	Apartment area Waste	02-Jan-06	12:16:57	02-Jan-06	12:33	8700	4480	4220
813	8972	05	Oai Ooe O¯E	Khan-Uul TUK	OaiOoe (Khan-Uul)	0582 A?o oidii (All area)	02	Idii noooiu oia oayaaae	Apartment area Waste	02-Jan-06	12:26:29	02-Jan-06	12:50	5320	3600	1720
814	9913	03	Niiaeiioae doai O¯E	Songinokhairkan TUK	Niiaeiioaedoai (Songinokhairkhan)	0343 A?o oidii (All area)	03	Ayd oidiieieui oia oayaaae	Ger area Waste	02-Jan-06	12:33:50	02-Jan-06	12:39	6680	4440	2240
815	3528	07	Ooaeei	Private	Чeiayeoye (Chingeltei)	0697 A?o oidii (All area)	03	Ayd oidiieieui oia oayaaae	Ger area Waste	02-Jan-06	12:43:03	02-Jan-06	12:58	3180	1820	1360
816	3659	07	Ooaeei	Private	Aayic?do (Bayanzurkh)	0222 A?o oidii (All area)	04	Ioen aaeaooeeaaui oia oayaaae	Institution/Office Waste	02-Jan-06	12:55:39	02-Jan-06	13:06	4780	2100	2680

b.2 Analysis of Database

Following analysis was made using 176 days data which was obtained from 26th December 2005 to 19 June 2006.

- Daily disposal amount (number of trucks, weight of wastes, average weight per truck)
- Daily disposal amount per each TUKs, Private and Organizations
- Daily disposal amount per type of wastes
- Average daily disposal amount per type of waste in per each TUKs, Private and Organization
- Average daily disposal amount per type of waste in each Duureg
- Average daily disposal amount per collection area in each TUKs, private and organization
- Number of collection vehicles and waste disposal amount per day of the week
- Number of collection vehicles in each time

b.3 Analysis of Data Obtained

b.3.1. Daily Disposal Amount

Results are shown in the following table.

Few, sometime even five children waste pickers were observed to climb up to the collection vehicles at weighbridge. Because the vehicles stopped at weighbridge for weighing and it is easy for them to climb up. These things affected to the weighing results, so the adjustment to the data was made based on the following assumption.

- Waste pickers climbed up to the collection vehicles which carry apartment wastes and institution/office wastes

- average of 100 kg of the weights were added per vehicle due to waste pickers.

According to the above assumption, data was collected and shown in the following table. Thus average daily amount become 411.2 ton / day instead of 418.6 ton / day.

Corrected data was used for following analysis.

Table 2-164: Daily Disposal Amount

Year/Month	Days	Before Correction			After Correction		
		Number of Collection Vehicle (no)	Weight of Waste (ton/day)	Average Weight (ton/day/Vehicle)	Number of Collection Vehicle (no)	Weight of Waste (ton/day)	Average Weight (ton/day/Vehicle)
2005/12	6	120.7	350.6	2.9	120.7	343.1	2.8
2006/01	31	114.0	329.1	2.9	114.0	322.8	2.8
2006/02	28	112.7	315.3	2.8	112.7	308.5	2.7
2006/03	31	130.5	410.3	3.1	130.5	402.6	3.1
2006/04	30	135.7	473.2	3.5	135.7	465.4	3.4
2006/05	31	134.1	516.3	3.9	134.1	508.3	3.8
2006/06	19	126.0	506.7	4.0	126.0	498.7	4.0
Total	176	22,082	73,681.6	-	22,082	72,379.0	-
Average		125.5	418.6	3.3	125.5	411.2	3.3

b.3.2. Organization of collection service

Organization of collection services were obtained from truck driver directly. Operator of the WB asked driver and input into database.

But according to the familiarization of the operation, operator can identify the organization based on the truck registered number. Furthermore, only incoming trucks measure the weight and outgoing trucks (which do not carry wastes) are not necessary to measure a weight because bear weights were registered in advance.

The Data for household wastes and business wastes are sometime mixed and cot clearly differentiated. The organizations of collection services except TUK are classified as individual and organizations. But the differences between them are not clear. This issue has to be cleared with Nuuts in future.

(1) Category of Organization

Table 2-165: Category of organization of collection service for Weighbridge database

Category		Description
01	Bayangol TUK	Trucks belong to TUK
02	Bayanzurkh TUK	Trucks belong to TUK
03	Songinokhairkhan TUK	Trucks belong to TUK
04	Sukhbaatar TUK	Trucks belong to TUK
05	Khan-Uul TUK	Trucks belong to TUK
06	Chingeltei TUK	Trucks belong to TUK
07	Individual	The wastes carried by individual truck
08	Organization	The wastes carried by company trucks other than TUK

Table 2-166: Number of Total trip and Total Disposal amount by Organization of collection service (2005/12/26-2006/06/19 : 176 days)

	Organization of collection service	Number of Trip		Amount (ton/day)
		Total number of trip	(trip/day)	
01	Bayangol TUK	2,908	16.5	56.1
02	Bayanzurkh TUK	3,998	22.7	72.2
03	Songinokhairkhan TUK	3,939	22.4	73.6
04	Sukhbaatar TUK	2,691	15.3	52.4
05	Khan-Uul TUK	837	4.8	11.6
06	Chingeltei TUK	2,078	11.8	36.8
07	Private	1,907	10.8	40.9
08	Organization	3,724	21.2	67.5
Total		22,082	125.5	411.2

(2) Registered trucks

As of Jun 19, following trucks are registered under each category. The total numbers of the trucks registered are 674 trucks.

Company name		Registered Truck(no)	
01	Bayangol TUK	27	127
02	Bayanzurkh TUK	30	
03	Songinokhairkhan TUK	22	
04	Sukhbaatar TUK	20	
05	Khan-Uul TUK	11	
06	Chingeltei TUK	17	
07	Individual	213	
08	Organization	334	
Total		674	

b.3.3. Category of Waste

The category of waste was established partly use the existing category which was used by Nuuts Co., before.（There were 5 categories before.）Direct haulage wastes which carried by other than TUK are sub categorized to 5 as follows.

Table 2-167: Category of Waste in WB database

Category of Waste			Description	Weighbridge data
01	Road and Park Waste		Road and park wastes at public area	There is a possibility for mixture with other category of wastes. All the wastes are carried by TUK trucks.
02	Apartment area Waste		Wastes from Apartment area	There is a possibility for mixture with other category of wastes. Wastes are mainly carried by TUK trucks.
03	Ger area Waste		Wastes from Ger area	There is a possibility for mixture with other category of wastes. Some wastes are carried by individuals
04-01	Direct haulage	Institution /Office/Commercial Waste	Wastes form business, office	Trucks belong to the organization carried these wastes.
04-02		Market Waste	Wastes form market	Trucks belong to organization and TUK carry these wastes.
04-03		Medical Waste	Waste form hospital which carried by himself	Trucks belong to Individual and hospital carry these wastes
04-04		Industrial Waste	Waste from factories and carried by himself	Trucks belong to organization and TUK carry these wastes.
04-05		Construction Waste	Construction wastes carried by himself.	Trucks belong to organization and individual carry these wastes

(1) Apartment area

Number of daily trips and disposal amount for the apartment waste in each Duureg are presented below.

Table 2-168: Number of Daily Trip and Daily Disposal amount -- Apartment area (2005/12/26-2006/06/19)

Category of Waste	Organization of collection service	Number of Trip		Disposal amount (ton/day)
		Total trip	(trip/day)	
Apartment area waste	01 Bayangol TUK	2,019	11.5	38.0
	02 Bayanzurkh TUK	2,536	14.4	37.5
	03 Songinokhairkhan TUK	1,310	7.4	21.2
	04 Sukhbaatar TUK	2,246	12.8	43.5
	05 Khan-Uul TUK	467	2.7	6.3
	06 Chingeltei TUK	1,042	5.9	15.9
	07 Individual	21	0.1	0.4
	08 Organization	82	0.5	1.1
	Total	9,723	55.2	163.8

(2) Ger area

Number of daily trips and disposal amount for the ger area waste in each Duureg are presented below.

Table 2-169: Number of Daily Trip and Daily Disposal amount -- Ger area (2005/12/26-2006/06/19)

Category of Waste	Organization of collection service		Number of Trip		Disposal amount (ton/day)
			Total trips	(trips/day)	
Ger area waste	01	Bayangol TUK	353	2.0	8.3
	02	Bayanzurkh TUK	1,018	5.8	29.5
	03	Songinokhairkhan TUK	2,488	14.1	50.2
	04	Sukhbaatar TUK	151	0.9	3.5
	05	Khan-Uul TUK	33	0.2	0.7
	06	Chingeltei TUK	719	4.1	15.7
	07	Individual	1,766	10.0	38.6
	08	Organization	74	0.4	1.3
	Total		6,602	37.5	147.7

(3) Direct haulage

Number of daily trips and disposal amounts for which direct haulage wastes carried by each category are presented below.

Table 2-170: Number of Daily Trip and Daily Disposal amount – Direct haulage (2005/12/26-2006/06/19)

Category of Waste	Organization of collection service		Number of Trip		Disposal amount (ton/day)
			Total trips	(trip/day)	
Direct haulage waste	01	Bayangol TUK	194	1.1	3.9
	02	Bayanzurkh TUK	32	0.2	0.6
	03	Songinokhairkhan TUK	21	0.1	0.4
	04	Sukhbaatar TUK	59	0.3	1.3
	05	Khan-Uul TUK	333	1.9	4.7
	06	Chingeltei TUK	8	0.0	0.1
	07	Individual	118	0.7	1.9
	08	Organization	3,568	20.3	65.1
	Total		4,333	24.6	78.0

Number of trips and disposal amount by each category of wastes other than household wastes and by organization of collection services are presented below. The results showed that 86 % of the direct haulage wastes are carried by the individuals and organizations which engage by the discharger.

Table 2-171: Breakdown of Direct haulage waste (1)

Organization of collection service	Category of Waste		Number of Trip		Disposal amount	
			Total trip	Vehicle/day	ton/day	%
TUK	04-01	Institution/Office Waste	490	2.8	7.7	9.9%
	04-02	Market Waste	149	0.8	3.1	4.0%
	04-04	Industrial Waste	7	0.0	0.1	0.1%
	04-05	Construction Waste	1	0.0	0.0	0.0%
	Sub-total		647	3.6	10.9	14.0%
Individual Organization	04-01	Institution/Office Waste	2,838	16.1	49.3	63.3%
	04-02	Market Waste	532	3.0	9.9	12.7%
	04-03	Medical Waste	16	0.1	0.1	0.1%
	04-04	Industrial Waste	161	0.9	3.6	4.6%
	04-05	Construction Waste	139	0.8	4.1	5.3%
	Sub-total		3,686	20.9	67.0	86.0%
Total			4,333	24.5	77.9	100.0%

Number of trips and disposal amount by each category of wastes other than household wastes are presented below. The results showed more than 70 % of the wastes are form institution/office and construction waste are around 5 % and it is more than industrial wastes.

Table 2-172: Breakdown of Direct haulage (2)

Category of Waste		Organization of collection service	Number of Trip		Disposal amount	
			Total trips	Vehicle/day	ton/day	%
04-01	Institution/Office Waste	TUK	490	2.8	7.7	9.9%
		Individual /organization	2,838	16.1	49.3	63.3%
04-02	Market Waste	TUK	149	0.8	3.1	4.0%
		Individual /organization	532	3.0	9.9	12.7%
04-03	Medical Waste	Individual /organization	16	0.1	0.1	0.1%
04-04	Industrial Waste	TUK	7	0.0	0.1	0.1%
		Individual /organization	161	0.9	3.6	4.6%
04-05	Construction Waste	TUK	1	0.0	0.0	0.0%
		Individual /organization	139	0.8	4.1	5.3%
Total			4,333	24.5	77.9	100.0%

b.3.4. Daily Disposal Amount

(1) Daily Disposal Amount

Daily disposal amount is presented below. Disposal amount in winter time (average of Dec, Jan, Feb and Mar) is 345 ton/day, hence in spring (average of Apr, May and Jun) is 490 ton/day.

Table 2-173: Daily Disposal Amount

Year/ Month	Days	Number of Collection Vehicle		Disposal Amount	
		Total (no)	Average Vehicle/day	Total Weight of Waste (ton)	Weight of Waste (ton/day)
2005/12	6	724	120.7	2,058.8	343.1
2006/01	31	3,534	114.0	10,005.9	322.8
2006/02	28	3,156	112.7	8,639.0	308.5
2006/03	31	4,044	130.5	12,480.6	402.6
2006/04	30	4,072	135.7	13,963.0	465.4
2006/05	31	4,158	134.1	15,756.2	508.3
2006/06	19	2,394	126.0	9,475.6	498.7
Total	176	22,082	125.5	72,379.0	411.2

(2) Daily Disposal Amount per each Organization of Collection service

Daily disposal amount per each organization of collection services are presented below.

Table 2-174: Daily disposal amount per each Organization of Collection service

Unit : ton/day

Year/Month	01	02	03	04	05	06	07-01	07-02	Total
	Bayangol TUK	Bayanzurkh TUK	Songinokhairkhan TUK	Sukhbaatar TUK	Khan-Uul TUK	Chingeltei TUK	Direct haulage		
							Individual	Organization	
2005/12	75.1	63.7	58.7	43.9	12.1	46.7	8.7	34.2	343.1
2006/01	40.7	73.8	59.5	33.7	8.0	39.2	24.6	43.4	322.8
2006/02	46.2	68.7	53.0	41.7	8.3	34.5	20.0	36.1	308.5
2006/03	54.1	68.9	74.5	51.1	12.0	40.6	35.4	66.0	402.6
2006/04	59.8	62.8	87.0	54.8	11.4	35.8	58.2	95.6	465.4
2006/05	66.8	83.7	90.2	64.4	15.9	34.1	64.5	88.7	508.3
2006/06	70.0	78.9	82.4	80.3	15.2	32.7	51.9	87.3	498.7
Total	56.1	72.2	73.6	52.4	11.6	36.8	40.9	67.5	411.2
	13.6%	17.7%	18.0%	12.7%	2.8%	8.9%	9.9%	16.4%	100.0%

(3) Daily Disposal Amount per Category of Waste

Daily disposal amount per category of waste are presented below.

Table 2-175: Daily disposal amount per Category of Waste

Unit : ton/day

Year/Month	01	02	03	04-01	04-02	04-03	04-04	04-05	Total
	Road and Park Waste	Apartment area Waste	Ger area Waste	Institution/Office /Commercial Waste	Market Waste	Medical Waste	Industrial Waste	Construction Waste	
2005/12	18.1	138.5	132.0	46.9	4.9	0.1	2.4	0.3	343.1
2006/01	13.8	115.5	143.7	34.6	10.3	0.2	0.5	4.3	322.8
2006/02	16.2	135.7	114.2	33.4	6.7	0.1	1.7	0.6	308.5
2006/03	21.7	160.1	145.9	56.9	11.4	0.1	3.4	3.1	402.6
2006/04	23.6	169.4	167.6	73.1	13.7	0.1	11.4	6.5	465.4
2006/05	27.5	205.9	172.5	75.6	19.4	0.1	2.8	4.5	508.3
2006/06	32.9	220.4	139.3	76.4	20.4	0.3	1.5	7.5	498.7
Total	21.9	163.8	147.7	57.0	13.0	0.1	3.6	4.1	411.2
	5.3%	39.8%	35.9%	13.9%	3.2%	0.0%	0.9%	1.0%	100.0%

(4) Average Daily Disposal Amount per Category of Waste in each Organization of Collection Service

Daily disposal amount per category of wastes in each organization of collection services are presented below.

Table 2-176: Average Daily Disposal Amount per Category of Waste in each Organization of Collection Service

Unit : ton/day

Organization of collection service			01	02	03	04-01	04-02	04-03	04-04	04-05	Total	
			Road and Park Waste	Apartment area Waste	Ger area Waste	Institution/Office /Commercial Waste	Market Waste	Medical Waste	Industrial Waste	Construction Waste	ton/day	%
01	Bayangol TUK		5.9	38.0	8.3	1.1	2.8				56.1	13.6%
02	Bayanzurkh TUK		4.7	37.5	29.5	0.3	0.3				72.3	17.6%
03	Songinokhairkhan TUK		1.9	21.2	50.1	0.4					73.6	18.0%
04	Sukhbaatar TUK		4.2	43.5	3.5	1.3					52.5	12.8%
05	Khan-Uul TUK		0.0	6.3	0.7	4.6			0.1		11.7	2.8%
06	Chingeltei TUK		5.0	15.9	15.7	0.1				0.0	36.7	8.9%
07-01	Direct haulage	Individual	0.0	0.4	38.6	1.3	0.5	0.0	0.0	0.1	40.9	9.9%
07-02		Organization		1.1	1.3	48.0	9.3	0.1	3.6	4.0	67.4	16.4%
Total			21.7	163.9	147.7	57.1	12.9	0.1	3.7	4.1	411.2	100.0%
			5.3%	39.9%	35.9%	13.9%	3.1%	0.0%	0.9%	1.0%	100.0%	-

Table 2-177: Average daily disposal amount per type of waste in each Duureg (After correction)

Unit : ton/day

Collection area		01	02	03	04-01	04-02	04-03	04-04	04-05	Total	
		Road and Park Waste	Apartment area Waste	Ger area Waste	Institution/Office /Commercial Waste	Market Waste	Medical Waste	Industrial Waste	Construction Waste	ton/day	%
01	Bayangol	5.1	32.9	7.1	15.0	3.3		-	0.5	63.9	20.4%
02	Bayanzurkh	3.8	29.1	38.7	1.7	4.6	0.1		-	78.0	24.8%
03	Songinokhairkhan	0.6	15.1	41.2	5.0	-		0.1		62.0	19.8%
04	Sukhbaatar	2.4	29.0	15.3	3.6		-	0.2	0.9	51.4	16.4%
05	Khan-Uul	0.2	4.8	1.6	7.1			0.9	0.9	15.5	4.9%
06	Chingeltei	3.0	12.5	25.7	1.0	0.5	-		0.1	42.8	13.6%
07	Others area			0.1	0.2					0.3	0.1%
Total		15.1	123.4	129.7	33.6	8.4	0.1	1.2	2.4	313.9	100.0%
		4.8%	39.3%	41.3%	10.7%	2.7%	0.0%	0.4%	0.8%	100.0%	-

2.9.3 Estimation of Final Disposal Amount in the Study Area

a. Disposal Amount by Season

The average daily disposal amount per month at UCDS is summarized as follows. This data was obtained using weigh bridge data from December 2005 to Jun 2006.

Table 2-178: Average Daily Disposal Amount (ADDA) Per Month at UCDS

Year/Month	Daily Disposal Amount (ton/day)
2005/12	343.1
2006/01	322.8
2006/02	308.5
2006/03	402.6
2006/04	465.4
2006/05	508.3
2006/06	498.7
Average	411.2

The above results indicate the following tendency. The ADDA from December to February is almost equivalent to 300 to 340 tons/day. This starts to increase in March up to 400 ton/day. From April to June, the ADDA shows similar figures as 460 to 500 ton/day.

Based on the above result, there is the tendency that in the summer season the ADDA is much more than in the winter season. This result is contrary to the WACS survey result that the generation amount of MSW in winter season is much more than in the summer season. Following are the estimated reasons why the ADDA in summer was higher than the ADDA in winter.

(1) There are many activities called “Clean up campaign” after the winter season is over. It means the waste which is illegally disposed during the winter season is collected and transported to the disposal site in the summer season.

(2) Construction activities become very active during the summer season. → Generation of construction waste increases since construction and renovation of buildings is carried out in the summer season due to limited working time in severe weather conditions in the winter season.

Based on the weighbridge data and the above analysis, the tendency of the waste amount at the disposal site is categorized into two seasons as follows.

- Winter season: 6 months from October to March.
- Summer season: 6 months from April to September.

The average daily disposal amount in the winter and summer season is calculated as follows and these amounts will be used for working out the waste flow.

Table 2-179: Daily and Average Disposal Amount by Weighbridge Data

Year/Month	Season	Average Disposal Amount Per Season (ton/day)
2005/12	Winter	345.7
2006/01		
2006/02		
2006/03		
2006/04	Summer	489.9
2006/05		
2006/06		
Average	411.2	

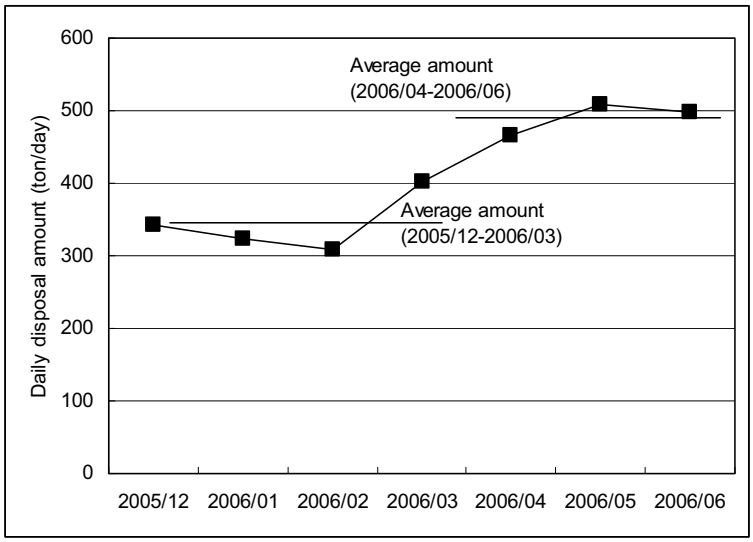


Figure 2-29: Daily and Average Disposal Amount by Weighbridge Data

b. Disposal Amount in the Study Area

b.1 Calculation of Disposal Amount at UCDS, MDDS and NDS

A comparison of the waste amount disposed at each disposal site is calculated based on the available data which is shown below. This data is accumulated before installation of the weighbridge and the number of trucks which come to disposal site and their official carrying volume is utilized for the calculation.

Table 2-180: Surveyed Data for Calculating Disposal Amount at Three Disposal Sites.

Disposal Site	Season	Year	Month
UCDS	Winter	2003	12
		2004	01
	Summer	2004	07
			08
MDDS	Summer	2004	07
			08
NDS	Winter	2003	12
	Summer	2004	07

Obtained from Nuuts Co.

UCDS :Ulaan Chuluut Disposal Site, MDDS:Morin Dava Disposal Site, NDS: Nalaikh Disposal Site

Using the above data, the average number of trucks and waste volume which was transported to each disposal site is shown below.

Table 2-181: Number of Trucks and Waste Volume Arriving at Each Disposal Site

Disposal site	Number of Trucks		Waste Volume		
	Trucks/ day	%	m^3/day	ton/day*1	%
UCDS	137.8	90.4	841.3	260.1	91.8
MDDS	8.5	5.6	51.5	16.0	5.6
NDS	6.0	4.0	23.5	7.3	2.6
Total	152.4	100.0	916.3	283.4	100.0

Note *1 : the apparent specific gravity of the wastes : 0.31 ton/m^3

b.2 Disposal Amount at Khoroo-21(KH-21) Disposal Site.

The disposal amount at KH-21DS is not available, thus the disposal amount at KH-21DS was estimated based on following calculations.

＜Input and basic conditions＞

- Population at Kh-21（year 2005）：4040 person
- Resident at Kh-21：all stay at Ger
- Unit generation amount in Ger in winter : 951 g/day/person (general waste 163 g/day/person, Ash 788 g/day/person)

＜Calculation result＞

- Waste Generation Amount at Kh-21 in winter（year 2005）
  3.8 ton/day (= 4040 x 951 /1,000,000)
- Waste Generation Amount the whole study area in winter（year 2005）
  554.8 ton/day
- Ratio of generation amount at Kh-21 to the whole study area
  0.7 % (= 3.8 / 554.8)

b.3 Proportion of Waste Disposal Amount at Four Official Disposal Sites in UBC

Based on the above calculation, the proportion of waste disposal amount at four official disposal sites was calculated as follows.

Table 2-182: Proportion of Waste Disposal Amount

Name of the landfills	Disposal Amount (ton/day)	Proportion of each Disposal Site(%)	Revised Portion of each Disposal Site (%)	Adopted Portion of each Disposal Site (%)
UCDS	260.1	91.8	91.1	91
MDDS	16.0	5.6	5.6	5
NDS	7.3	2.6	2.6	3
KH-21DS	NA	—	0.7*1	1
Total	283.4	100.0	100.0	100

(Note) *1: The portion is calculated based on the population of the Khoroo.

b.4 Final Disposal Amount in the Study Area

A weighbridge was installed at UCDS and commenced its operation from December 26, 2005. Since the weighbridge provides very precise final disposal amount at UCDS, the final disposal amount indicated in the Table above is revised as shown in the Table below based on the weighbridge data obtained from December 26, 2005 to June 19, 2006.

Table 2-183: Final Disposal Amount of Respective Disposal Site in 2006

Name of the Landfills	Disposal Amount (tons/day)	Disposal Amount (tons/day)
	Winter	Summer
UCDS	338.4	483.0
MDDS	18.5	26.1
NDS	11.3	16.1
KH21DS	3.8	5.5
Total	372.0	530.7