d.5 Document 5: Plan and operation of NEDS and NERC

Doc 5

Plan and Operation of NEDS and NERC

for Formulation and Implementation of SWM Master Plan for Central Provincial Cities based on the Experience in UBC

June 28, 2010
JICA Expert Team
For the Project for Strengthening the Capacity for SWM in Ulaanbaatar City

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◆Contents (1)

[Plan and Operation NEDS]

I. Plan
  A) Concept of the landfill site
  B) Contents of NEDS facilities
  C) Purpose of the facilities
II. Operation
  A) Plan of landfill operation
  B) Operational equipment
III. Good practice (MDDS)

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I Plan for NEDS

A) Contents of NEDS facilities

1. Landfill site
2. Administrative office and warm garage
3. Weight bridge
4. Leachate collection facility

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A) Contents of NEDS facilities

1. List of the facilities for Landfill site

a. Earth embankment dam
b. Internal road
c. Leachate collection pipe
d. Impermeable wall
e. Gas removable pipe
f. Administrative office and warm garage
g. Weight bridge

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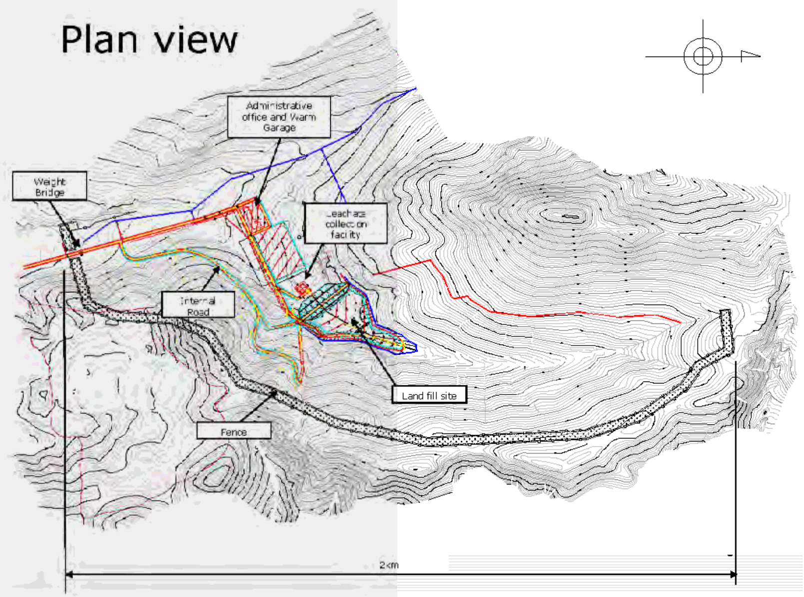
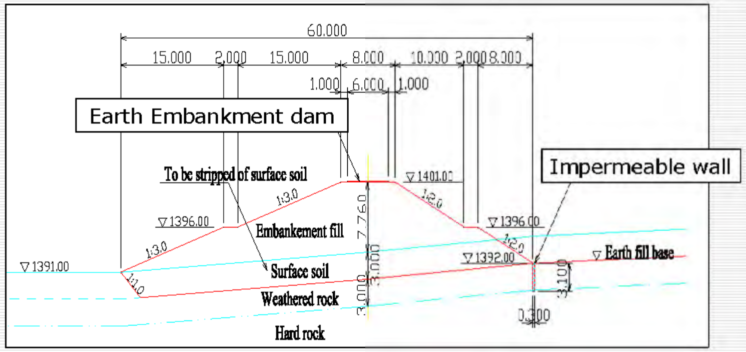
Plan view



Sectional view



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A) Contents of NEDS facilities

2. Purpose of the facilities (1)

a. Earth embankment dam
- □ To hold filling waste

b. Internal road
- □ To transport of the waste
- ✓ Two type of the road
  - ◆ For waste transportation vehicles (Asphalt)
  - ◆ For landfill heavy equipment (Gravel)

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A) Contents of NEDS facilities

2. Purpose of the facilities (2)

c. Leachate collection facilities
- □ To prevent waste leachate contamination into grand water
  - ◆ Waste leachate will collect by leachate collection pipe and discharge to collection pond.
  - ◆ Collected leachate will circulate to landfill site for dry off.

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A) Contents of NEDS facilities

2. Purpose of the facilities (3)

d. Impermeable wall
- To collect and discharge waste leachate and rainfall water which contaminated with leachate to collection pond. It is one of the environmental protection.

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A) Contents of NEDS facilities

2. Purpose of the facilities (4)

e. Gas removable pipe
- To exhaust flammable gas etc for prevention of spontaneous firing.
  - Kitchen waste is generate many kind of gas. (Methane, hydrogen sulfide etc.) It may cause of spontaneous firing in landfill site.

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A) Contents of NEDS Facilities

2. Purpose of the facilities (5)

e. Administrative office and warm garage
- (Warm Garage)
  To prevent damage from extreme cold weather from equipment.
- (Administrative office)
  To control easily for daily operation activity

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A) Contents of NEDS Facilities

2. Purpose of the facilities (6)

f. Weight bridge
- To measure incoming waste weight for monitoring of daily waste discharge in UBC and monitoring of landfill life time.

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1st Step

Waste Collection Truck shall go down to the landfill area and start to dispose. Do not dump from top of the Embankment

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II Operation for NEDS

A) Landfill operation

- Landfill operation sequence are divided into 5 steps.
  1. Waste disposing
  2. Leveling, compaction and soil covering
  3. Continuing 1 and 2 up to top of earth embankment
  4. Construction of new earth embankment
  5. Repeat from 1

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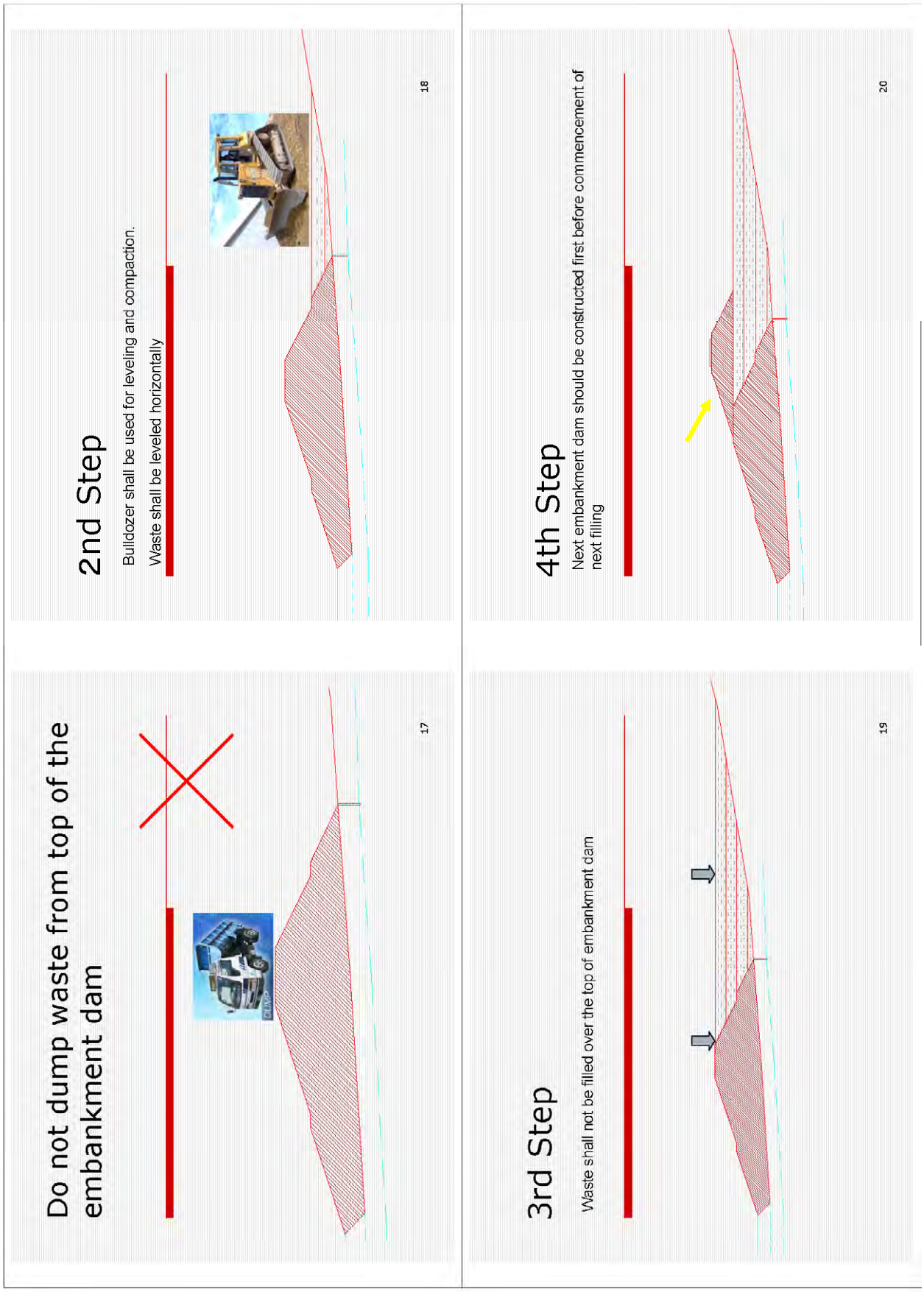
Do not dump waste from top of the embankment dam
17
2nd Step
Bulldozer shall be used for leveling and compaction.
Waste shall be leveled horizontally
18
3rd Step
Waste shall not be filled over the top of embankment dam
19
4th Step
Next embankment dam should be constructed first before commencement of next filling
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II Operation for NEDS

B) Area wise landfill phase

- Land filling operation are area wise divided into 8 phases.
- NEDS will be received 3,176,000m³
- NEDS operation will be utilized until 2020.

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5th Step

Waste shall be filled up to the level of embankment dam. Continue previous steps up to the final level which is 45 m higher than the original ground level

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II Operation for NEDS

B) Operational equipment

- ✓ Dump truck (Payload 15tonnes) – 2 units
  To transport excavated soil for soil covering

a. Supporting equipment

- ✓ Water tank lorry (with water gun) – 1 unit
  To prevent dust for internal road and to use for firefighting in case of fire in landfill site

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II Operation for NEDS

B) Operational equipment

a. Landfill equipment

- ✓ Bulldozer (D65) – 3 units
  To leveling and compaction of discharged waste
- ✓ Excavator (bucket capacity 0.8m3) – 1 unit
  To excavate soil for covering of waste (sanitary land filling method)

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Before improvement (1)
Before improvement (3)
Before improvement (2)
Ⅲ Good practice
☐ Morin Davaa Disposal site
a. Improvement works
CMPUA has conducted MDDS improvement work from 1st May, 2011. It may complete first week of July 2011. Major improvement works are as below.
✓ Installation of weight bridge
✓ Expansion of landfill area
✓ Construction of new internal road
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Improvement works in progress (2)

Contents (2)

[Plan and Operation of NERC]

- Concept of NERC in Master Plan
- MP Quantitative Target relating to Recycling
- Implementation Schedule and Layout of NERC in M/P
- Future Plan by KOICA

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Improvement works in progress (1)

Improvement works in progress (3)

1. Concept of NERC in M/P

1. Fundamental Goal of M/P is
   - To establish environmental sound SWM system in MUB by the target year of 2020
2. In the environmental sound SWM, 3Rs(Reduce, Reuse, Recycle) should be promoted
3. Thus, NERC was planned to promote 3Rs, especially Recycling, through Government Initiative.

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2. M/P Quantitative Targets -1

Items	Present (2006)	First Phase (2010)	Second Phase (2015)	Third Phase (2020)
Waste Collection Rate (%)				
Apartment Area	100	100	100	100
Ger Area	42*1	100	100	100
Percentage of self-disposal and improper disposal in generation amount (%)				
•Winter	54.2	1.2	1.0	0.7
•Summer	20.2	2.6	1.9	1.2
Separate collection in apartment area	0	15	40	70
•Separate collection rate (%)	0	83,587	289,809	634,432
•Covered population (person)				
Percentage of separate collection in generation amount (%)*2				
•Winter	0	4.9	17.7	40.4
•Summer	0	8.5	25.4	48.9

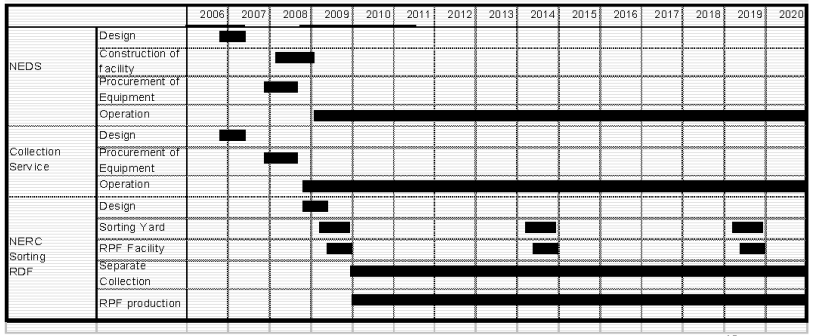
(Note): *1: Service fee collection rate identified by the Questionnaire survey to the Khoroo governors in ger area in August 2006
*2: This rate includes recyclable and non-recyclable wastes separated.

2. M/P Quantitative Targets -2

Items	Present (2006)	First Phase (2010)	Second Phase (2015)	Third Phase (2020)
Percentage of intermediate treatment in generation amount (%)*3				
Winter	0	2.2	8.0	18.5
Summer	0	3.6	11.1	21.8
Percentage of recycling in generation amount (%)*4				
Winter	3.0	4.8 (1.0)	9.3 (3.8)	16.9 (8.9)
Summer	6.6	8.4 (1.7)	13.6 (5.3)	20.5 (10.5)
Final Disposal Method				
NEDS	Open Dumping	Sanitary Landfill Level 4		
Other 3 disposal sites	Open Dumping	Sanitary Landfill Level 2		

(Note): *3: This rate means it of recyclable waste which will be processed at the sorting yard and RDF facility.
*4: Figures in ( ) are rate of RDF production.

3.Implementation Schedule and Layout of NERC in the M/P



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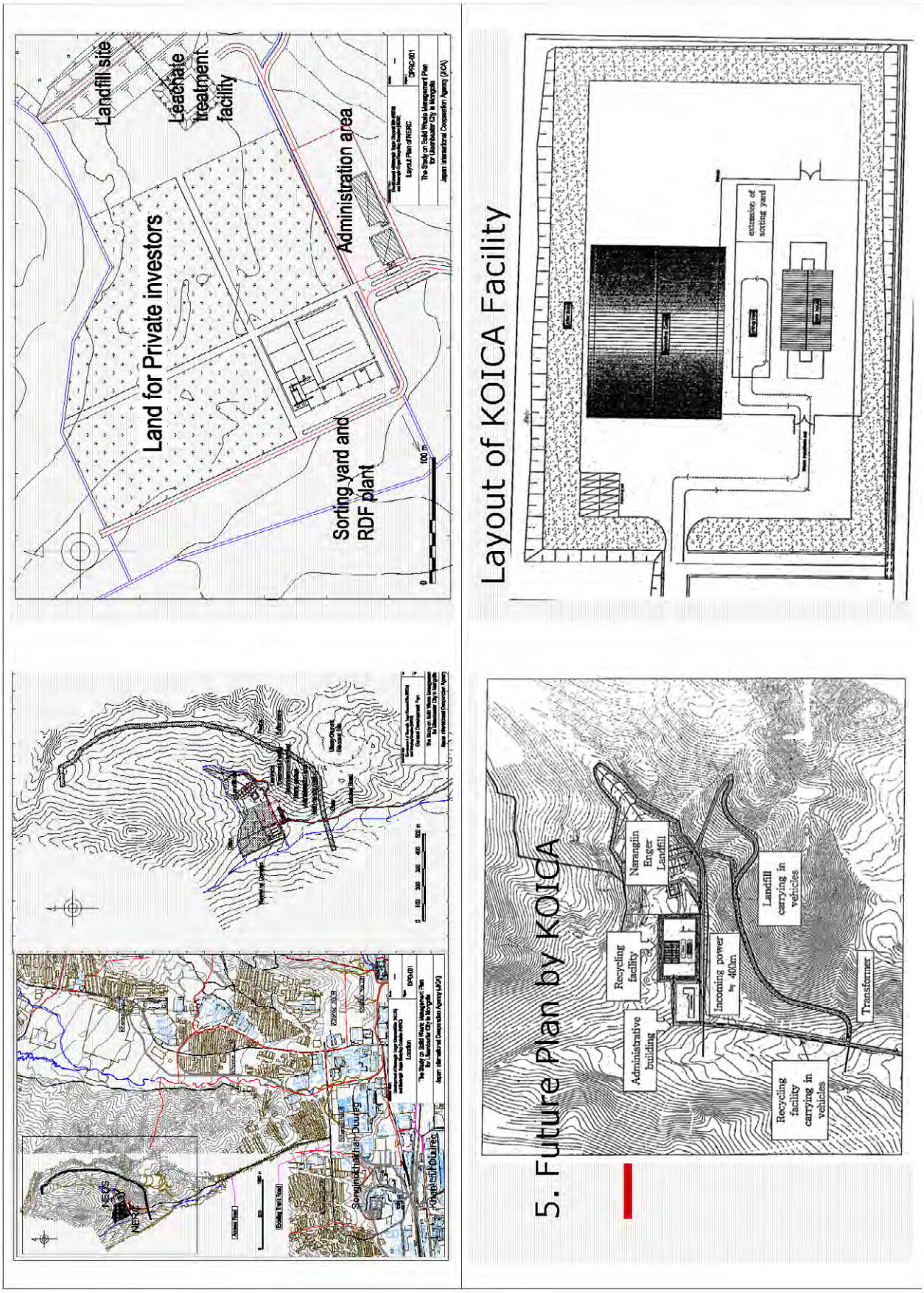
Landfill site
Leachate treatment facility
Land for Private investors
Administration area
Sorting yard and RDF plant
Layout of KOICA Facility
extension of sorting yard
5. Future Plan by KOICA
Recycling facility
Administrative building
Incoming power
Landfill carrying in vehicles
Transformer
Recycling facility carrying in vehicles

Operation of NERC

- Sorting and RPF facility will be constructed by KOICA and expected to be completed in early 2012
- Operation will be commenced in 2012
- Detailed operation plan should be formulated utilizing results of JICA pilot project and KOICA F/S including necessary budget for operation and plant which incinerate RPF.

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Layout of Equipment

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Thank you very much for your attention

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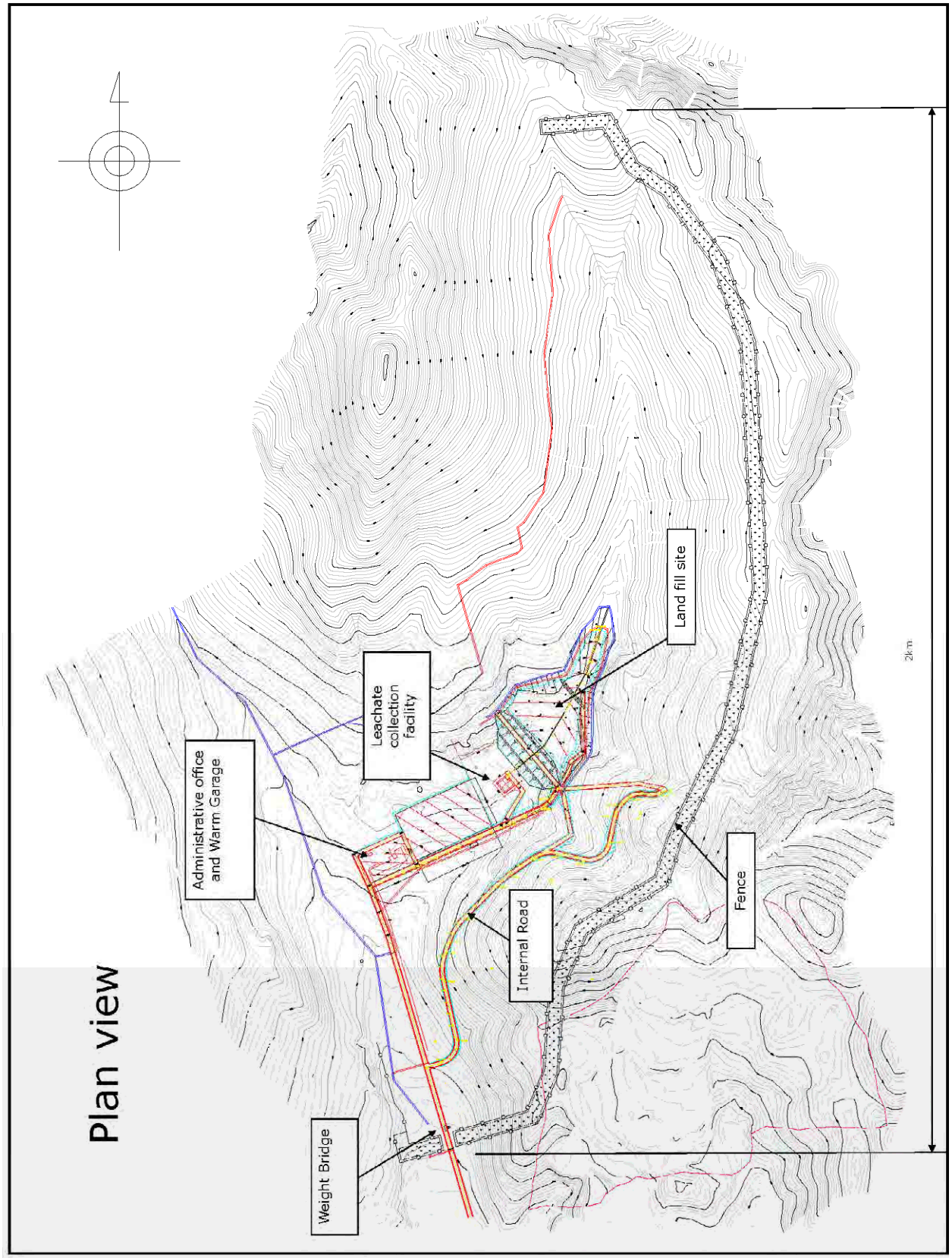
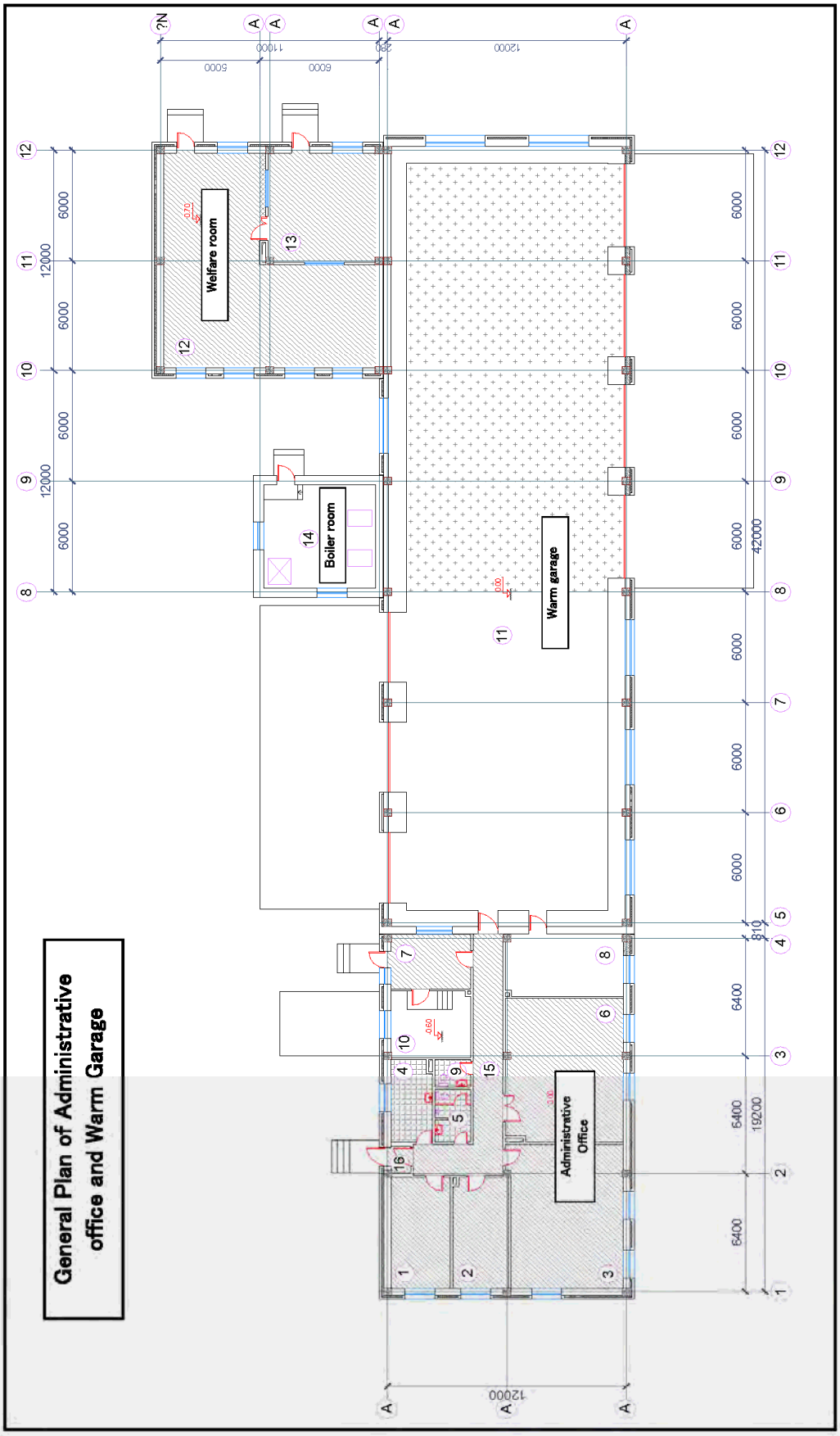
d.6 Document 6: Site visit of NEDS and NERC




General Plan of Administrative office and Warm Garage
Welfare room
Boiler room
Warm garage
Administrative Office
42000
19200
12000
6000
6400

d.7 Document 7: M/P framework: Forecast of waste amount and composition, etc.

Doc 7

M/P Framework: Forecast of Waste Amount and Composition, etc.

for Formulation and Implementation of SWM Master Plan for Central Provincial Cities based on the Experience in UBC

June 29, 2011
JICA Expert Team
For the Project for Strengthening the Capacity for SWM in Ulaanbaatar City

1

Outline of the Lecture

I. Results of Field Investigations (FIs)
II. Framework of MUB SWM M/P

2

I. Results of Field Investigations (FIs)

- Results of field investigations (FIs) were used to understand current SWM and set up framework of the M/P

1. WACS => MSW amount and composition
2. POS => MSWM, collection fee setting, etc.
3. T&M Survey => Efficiency and problems of collection system
4. Recycling Market Survey => Recycling plan
5. Survey on Other Generation Sources
6. Waste Stream of UBC in 2006
7. Current Status & Issues of SWM in UBC

3

I-1. Waste Amount Composition Survey (WACS) (1)

- Carried out once in summer and winter seasons to identify the generated MSW (Municipal Solid Waste) amount and composition.
- Generation rate (g/person/day) in 2005.
- Figures in parentheses are obtained in 2011.

	Household (Apart Area)	Household (Ger Area)	MSW
Summer	228 (276)	202	286
Winter	256 (312)	951 (1034)	640

I-1. WACS (2): Waste Generation Amount in UBC (2006)

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	481,037	g/person/day	264	235	127.0	113.0
	Ger*1	409,772	g/person/day	956	208	391.8	85.2
	Total	**890,809**	**g/person/day**	**582**	**222**	**518.8**	**198.2**
Commercial Waste (Restaurant)		44,112	g/chair/day	258	278	11.4	12.3
Commercial Waste (Other Shop)		3,174	g/shop/day	1,236	1,689	3.9	5.4
Office Waste		111,172	g/employee/day	134	185	14.9	20.6
Market Waste		4,593	g/stall/day	876	1,772	4.0	8.1
School Waste		278,977	g/student/day	3.1	1.5	0.9	0.4
Hotel Waste		12,139	g/room/day	134	113	1.6	1.4
Business Total		-	-	-	-	**36.7**	**48.2**
Public Area Cleaning Waste		3,430,451	g/m2/day	**3.0**	**5.1**	**10.3**	**17.5**
Total						**565.8**	**263.9**

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I-1. WACS (3): Comparison of Household Waste Composition

Country / Physical Composition	Unit	Mongol Ulaanbaatar*1		Turkey	Cambodia	Poland		Paraguay	Philippines	Honduras
		Winter	Summer	Adana	Phnom Penh	Lublin With ash	Lublin Without ash	Asuncion	Manila	Tegucigalpa
Kitchen waste	%	32.7(4.9)	35.7(30.4)	75.53	63.6	45.25	65.26	36.60	45.82	47.20
Paper	%	12.7(2.4)	21.7(13.9)	9.88	4.6	13.67	11.11	6.40	15.39	11.50
Textile	%	4.5(1.0)	4.1(8.2)	1.77	2.5	2.10	3.77	1.30	4.33	2.80
Plastic	%	22.4(2.2)	14.5(18.3)	5.87	18.0	4.40	3.80	3.90	15.60	7.10
Grass & Wood	%	1.1(0.2)	5.3(3.9)	1.62	6.0	1.61	2.30	22.20	7.45	11.60
Leather & Rubber	%	0.7(0.1)	0.4(0.8)	0.29	0.1	2.67	1.83	0.70	0.80	2.20
Combustible Total		**74.2(10.8)**	**81.7(71.5)**	**94.96**	**94.8**	**69.7**	**88.07**	**71.1**	**89.39**	**82.4**
Metal	%	4.3(0.6)	1.8(8.4)	0.53	0.7	3.31	3.05	1.30	5.47	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
Ceramic & Stone	%	4.4(0.9)	6.5(7.1)	1.14	1.6	21.74	2.38	2.50	1.26	12.10
Miscellaneous	%	5.0(1.8)	0.5(2.1)	0.04	2.3	-	-	22.00	1.19	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**	**17.6**
Total	%	100.00	100.0	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	0.20

I-1. WACS (4): Survey on final disposal amount

- A survey on number of incoming collection vehicles of the four existing disposal sites in Ulaanbaatar City (UBC) was conducted in 2006.
- The final disposal amount of UBC was estimated.
- In order to find out precise final disposal amount and details information of generation sources, a weighbridge was installed at the Ulaan Chuluut disposal site (UCDS which receives over 90% of MSW in UBC) and a managing system to know the final disposal amount of UCDS according to the generation sources was established.

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I-1. WACS (5): Final Disposal Amount for Disposal Site(2006)

Name of the Landfills	Disposal Amount (tons/day)	Disposal Amount (tons/day)
	Winter	Summer
UCDS (NEDS)	338.4 (936.0)	483.0 (936.0)
MDDS	18.5 (112.0)	26.1 (112.0)
NDS	11.3	16.1
KH21DS	3.8	5.5
Total	372.0	530.7

Note: Figures in parentheses are obtained in 2011.

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I-2. Public Opinion Survey (POS)

- To identify the residents' and business establishments' awareness of issues on SWM, level of satisfaction, payment and non-payment of the collection fee, willingness to pay, the waste discharge methods, etc.
- Willingness and Amount to Pay for Waste Collection Service in Ger Area.

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

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

I-3. Time and Motion (T&M) Survey

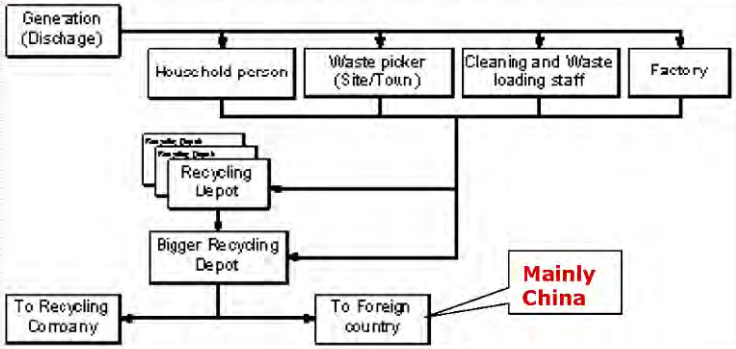
- Carried out once in the summer and winter seasons to identify efficiency and problems with the collection and transport system and issues.

Apart Area: Collection workers load waste from a container onto the truck due to no skip container truck => Compactor truck but not container (waste is frozen in winter)

Ger Area: Coal ash collection => No compactor truck, but dump truck

I-4. Recycling Market Survey

- To survey the people collecting recyclables, recycling shops and recycling factories and identify the market trend for recyclables and the potential demand.
- Distribution of Recycled Items in UBC



I-5. Survey on Other Generation Sources (1): Medical Waste

1. Survey on medical institutions
- To understand the volume of waste discarded by medical institutions and their disposal system.
- Medical Waste and General Waste generated from medical institutions (2006)

Type of waste	Generation Rate (kg/bed/day)	Number of Beds	Generation amount (ton/day)
Medical Waste(Infectious/ Hazardous waste)	0.207	7,937	1.6
General Waste	1.917	7,937	15.2

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I-5 Survey on Other Generation Sources (2)

2. Factory survey

- To understand the volume of non-hazardous and hazardous waste discharged from factories and their disposal system.
- Non-HIW: 67.9 tons/day
- HIW: 0.1 tons/day

3. Survey on construction waste

- To identify the waste volume generated from the construction industry and their disposal system.
- Winter Generation Amount: 60.6 tons/day
- Summer Generation Amount: 123.0 tons/day

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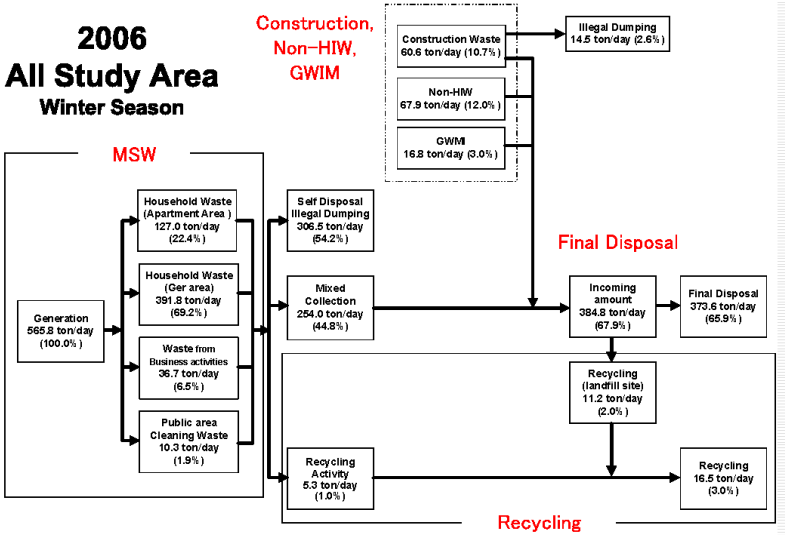
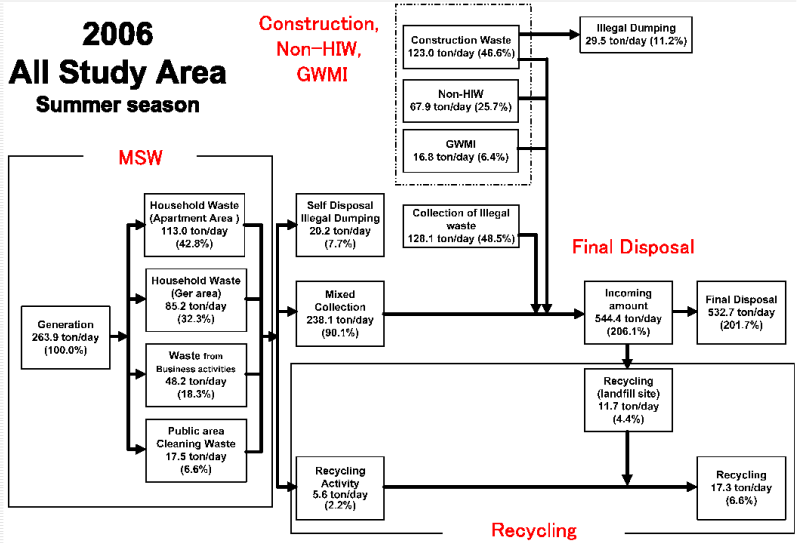
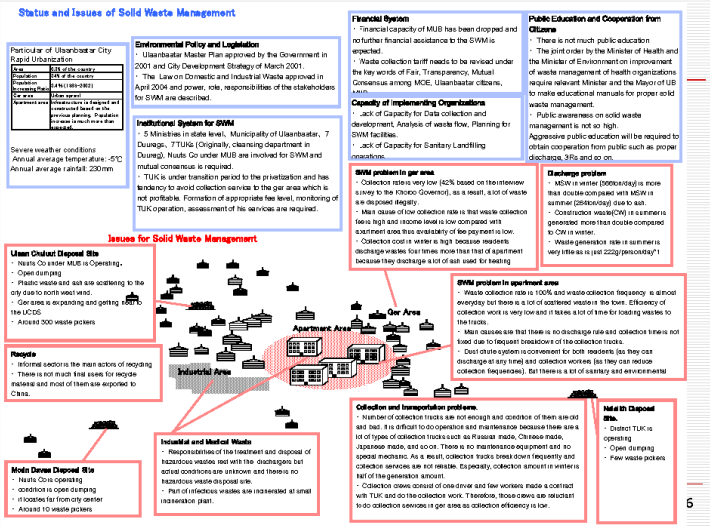
I-6. (1) Waste Stream in UBC (Winter) in 2006



I-6. (2) Waste Stream in UBC (Summer) in 2006



I-7. Current Status & Issues of SWM in UBC



II. Framework of MUB SWM M/P

1. Location of SWM Facilities in Future
2. Social Framework
3. Forecast of Future Waste Flow

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II-1. Location of SWM Facilities in Future (1)

- Location of SWM Facilities in Future (target year 2020) are one of the most important issue for M/P
- In order to identify the future location of SWM facilities, a site selection work has been conducted. => Details are explained in the Lecture P.4.1.
- The location of SWM facilities for UBC in 2020 is presented in the next screen.
- As for the main facility site, NEDS/NDRC is selected.

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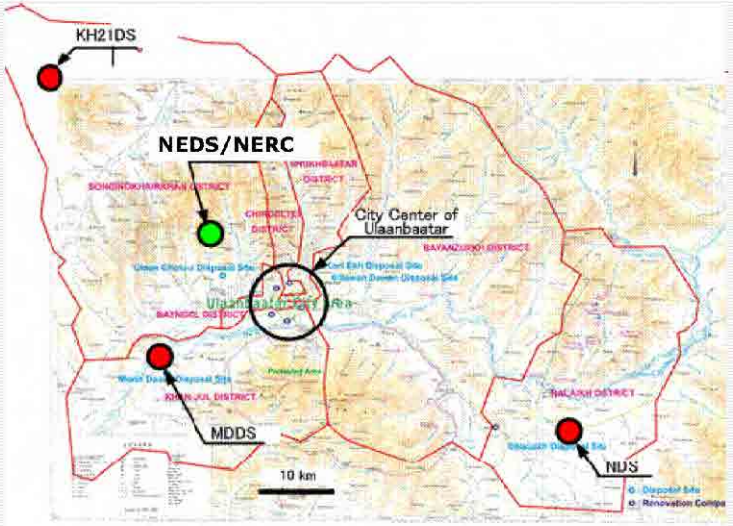
II-1. Location of SWM Facilities in Future (2)



II-2. Social Framework (1): Population Forecast

- Proportion of Apartment area vs. Ger area based on City Development M/P:

* 50.4 : 49.6 in 2004

* 82 : 18 in 2020

- Forecast of future population based on "Population Projections of Mongolia, National Statistic Office of Mongolia"

Note: 4:6 in 2010 due to increase in Ger population. 1.1 million in 2010.

	2006		2010		2015		2020	
Area	Ratio	Population	Ratio	Population	Ratio	Population	Ratio	Population
	(%)	persons	(%)	persons	(%)	persons	(%)	persons
Apartment Area	54	481,037	62	612,362	72	796,180	82	995,970
Ger Area	46	409,772	38	375,318	38	309,625	18	218,628
Study Area	**100**	**890,809**	**100**	**987,680**	**110**	**1,105,805**	**100**	**1,214,598**

II-2. Social Framework (2): Economic Conditions

- The GDP growth rate of UBC is forecasted to fall from 13.0% in 2006 to 4.3% in 2020. However, a GDP growth rate of 5.5% (base case scenario in Mongolia's "Economic Growth Support and Poverty Reduction Strategy, Poverty Reduction Strategy Paper") was used to forecast the amount of waste generated.
- The waste service fund to be established by the "Household and Industrial Waste Management Law" enforced in July 2004, was used for formulating the M/P financial plan.

II-3. Forecast of Future Waste Flow (1): MSW Generation Amount (1)

- Future MSW generation amount (WGAx) is forecasted to increase in proportion to the increase in number of generation sources (NGSx) : population in case of household waste, number of students in case of school, etc.
- Accordingly, the future MSW generation amount is calculated by multiplying the future generation rate (GRx) by the future number of generation sources (NGSx).

  WGAx = GRx X NGSx
- The future MSW generation rate (GRx) is deemed to increase in proportion with economic growth (GRDP = 5.5%).

II-3. Forecast of Future Waste Flow (2): MSW Generation Amount (2)

- The MSW generation rate (GRx) of each generation source may increase in proportion to the growth of GDP per capita.
- The Japanese statistics, which were recorded from 1963 to 1988 and are the available data of its kind in the world, show the trend of the rate due to the development of the economy as follows:

1. At the time of developing economy (1963-1970): Increase of GRx = 0.55 of GDP growth rate
2. At the time of developed economy (1975-1988): Increase of GRx = 0.29 of GDP growth rate

Note: After 1990, generation rate has been constant, about 1.1 kg/person/day due to promotion of 3Rs

II-3. Forecast of Future Waste Flow (3): MSW Generation Amount (3)

1. Future Number of Generation Sources (NGSx)
   - Future NGSx for Households and School (students) will increase in proportion to the increase of population.
   - Future NGSx for other sources than Households and Schools will increase in proportion to the increase of GRDP, i.e. 5.5 % per annum. But road cleaning length will not changed.
2. Future Generation Rate (GRx)
   - GRx will increase according to the economic growth rate. The coefficient of 0.55 for (GRx/GDP growth rate) obtained in Japan is applied to the forecast.
   - Consequently, GRx of MSWs will increase 3.0 % per annum.

     5.5 x 0.55 = 3.025 => Say 3.0 %

II-3. (4): Future MSW Generation Amount (Winter)

Category	2005	2006	2010	2015	2020
Household Waste	511.0	518.8	548.3	585.4	625.0
General	(183.2)	(195.9)	(252.5)	(341.4)	(452.7)
Ash	(327.8)	(322.9)	(295.8)	(244.0)	(172.3)
Commercial Waste (Restaurant)	10.5	11.4	15.8	24.1	36.4
Commercial Waste (Other Shop)	3.6	3.9	5.5	8.3	12.6
Office Waste	13.7	14.9	20.7	31.5	47.8
Market Waste	3.7	4.0	5.6	8.5	12.9
School Waste	0.8	0.9	1.1	1.4	1.7
Hotel Waste	1.5	1.6	2.3	3.4	5.2
Road Cleaning Waste	10.0	10.3	11.4	12.8	14.0
Total	554.8	565.8	610.7	675.4	755.6

Decrease of ash due to reduce of Ger area population affects very much for future generation.

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II-3. (5): Future MSW Generation Amount (Summer)

Category	2005	2006	2010	2015	2020
Household Waste	186.7	198.2	249.5	327.5	421.2
General	(186.7)	(198.2)	(249.5)	(327.5)	(421.2)
Ash	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Commercial Waste (Restaurant)	11.3	12.3	17.1	25.9	39.3
Commercial Waste (Other Shop)	4.9	5.4	7.5	11.3	17.2
Office Waste	19.0	20.6	28.8	43.6	65.9
Market Waste	7.5	8.1	11.3	17.2	26.0
School Waste	0.4	0.4	0.5	0.5	0.6
Hotel Waste	1.3	1.4	1.9	2.9	4.4
Road Cleaning Waste	17.0	17.5	19.4	21.7	23.8
Total	248.1	263.9	336.0	450.6	598.4

II-3. Forecast of Future Waste Flow (6): Future MSW Composition

- The future waste composition is forecasted by comparing the results of the WACS with the waste data on other countries. The forecast is mainly based on the following assumptions:

1. The generation rates (amount) of wastes used for containers and package (paper, plastics, bottles & glass and metals) and kitchen waste are assumed to increase in accordance with economic growth rate (GRDP= 2%). => 3.0%
2. The generation amount of textile, leather and rubber which are extremely low in the current generation amount, are also assumed to rise in accordance with the economic growth rate. However, the growth rate is supposed as half that of the above mentioned waste. => 1.5%
3. Furthermore, the generation amount of grass & wood, ceramic & stone, soil, and miscellaneous will not change. => 0.0%

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II-3. (7) Future MSW Composition (Winter)

Waste Composition of MSW	2005 (%)	2006 (%)	2010 (%)	2015 (%)	2020 (%)
Kitchen Waste	12.6	13.2	16.3	20.7	25.7
Paper	5.2	5.4	6.7	8.5	10.6
Textile	2.0	2.1	2.4	2.9	3.3
Grass and Wood	0.5	0.5	0.6	0.6	0.6
Plastic	7.8	8.2	10.1	12.8	15.8
Leather and Rubber	0.2	0.3	0.3	0.3	0.4
Combustibles	28.3	29.7	36.4	45.8	56.4
Metal	1.5	1.6	2.0	2.5	3.1
Bottle and Glass	5.4	6.0	7.2	9.3	11.3
Ceramic and Stone	1.9	1.9	2.1	2.3	2.5
Miscellaneous	2.7	2.7	3.0	3.3	3.5
Non-combustibles excluding ash	11.5	12.2	14.3	17.4	20.4
MSW Other than Ash (%)	39.8	41.9	50.7	63.2	76.8
Ash (%)	60.2	58.1	49.3	36.8	23.2
Total	100.0	100.0	100.0	100.0	100.0

Rate of Ash affects MSW composition in winter.

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II-3. (8) Future MSW Composition (Summer)

Waste Composition of MSW	2005 (%)	2006 (%)	2010 (%)	2015 (%)	2020 (%)
Kitchen Waste	**33.8**	**33.9**	**34.5**	**35.2**	**35.8**
Paper	**18.9**	**19.0**	**19.3**	**19.7**	**20.0**
Textile	4.8	4.8	4.6	4.3	4.1
Grass and Wood	4.8	4.7	4.2	3.7	3.3
Plastic	**15.2**	**15.2**	**15.5**	**15.8**	**16.1**
Leather and Rubber	0.6	0.6	0.6	0.6	0.5
Combustibles	**78.1**	**78.2**	**78.7**	**79.3**	**79.8**
Metal	3.5	3.5	3.6	3.6	3.7
Bottle and Glass	10.5	10.6	10.7	11.0	11.2
Ceramic and Stone	6.8	6.6	6.0	5.3	4.6
Miscellaneous	1.1	1.1	1.0	0.8	0.7
Non-combustibles excluding ash	**21.9**	**21.8**	**21.3**	**20.7**	**20.2**
MSW Other than Ash (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Ash (%)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Rate of kitchen waste is relatively small while rate of paper and plastic is high compare to the other countries.

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II-3. (9): Other Wastes than MSW

- **The future generation amount of industrial, medical and construction waste was forecasted based on the following assumptions:**

1. **Generation rate does not change.**
2. **Industrial waste will increase in proportion to the economic growth rate. => 5.5%**
3. **Waste from medical institutions will increase in proportion to the population growth rate.**
4. **Construction waste will increase in proportion to the economic growth rate.**

	2006 (ton/day)	2020 (ton/day)
Non-Hazardous Industrial Waste	**67.8**	**143.3**
Hazardous Industrial Waste	**NA**	**NA**
General Waste from Medical Institutions	**15.2**	**20.8**
Infectious/Hazardous Medical Waste	**1.6**	**2.2**
Construction Waste in Winter	**60.6**	**128.0**
Construction Waste in Summer	**123.0**	**260.0**

II-3. (10): Forecast of Future Waste Flow without 3Rs Promotion (M/P)

- **The following hypothetical situations were set prior to the formulation of the Master Plan and the future waste flow without 3Rs promotion (without M/P) for the winter and summers seasons in 2020 was forecasted as shown below.**

1. **The collection service is provided to all residents in Ulaanbaatar City (UBC).**
2. **There is no public sector waste treatment or recycling facility, as is the present situation, and recycling is carried out by the private sector based on economic principles.**
3. **Waste picking activities are prohibited at the disposal site because sanitary landfill is carried out.**

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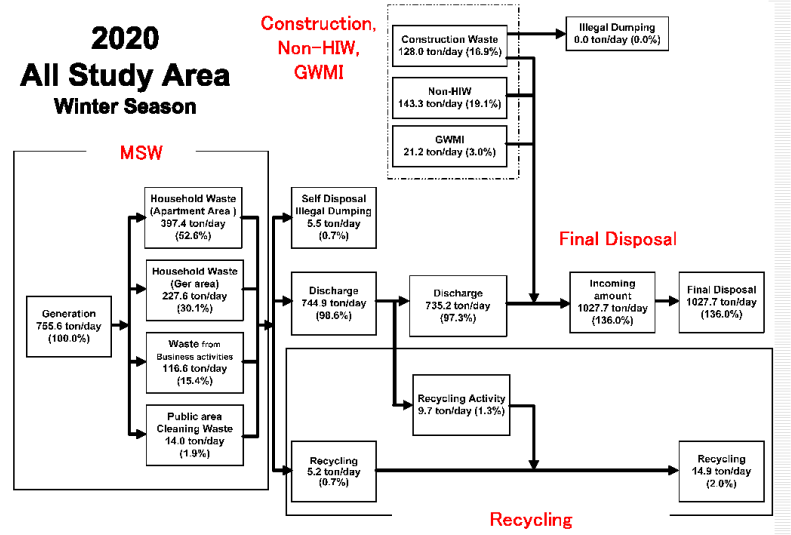
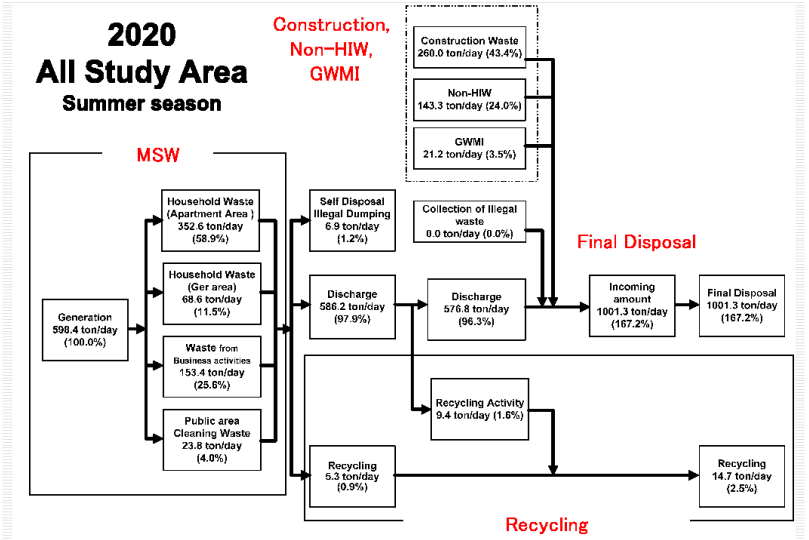
II-3. (11): Waste Stream in 2020 in Winter: without M/P



II-3. (12): Waste Stream in 2020 in Summer: without M/P

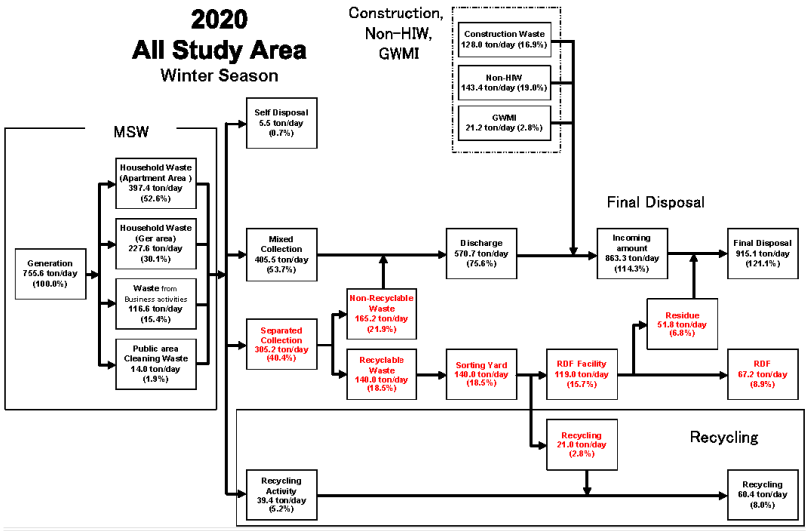


II-3. (13): Forecast of Future Waste Stream with 3Rs Promotion (M/P)

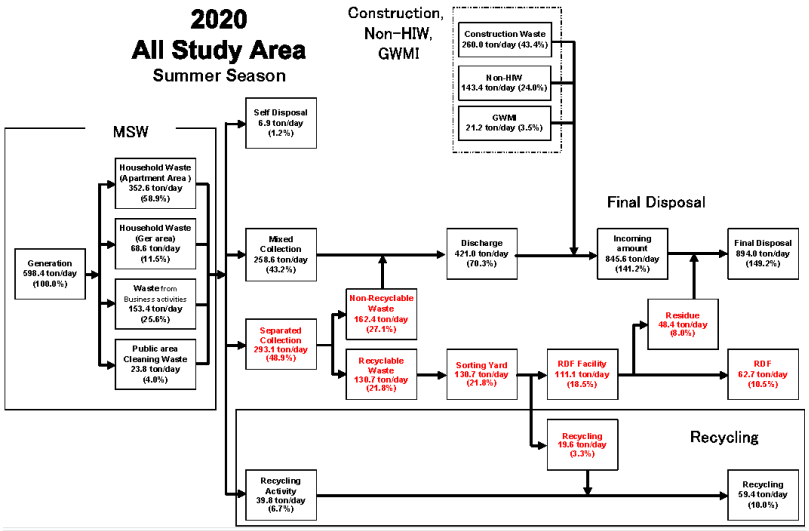
Future waste stream with M/P implementation was drawn up after the selection of optimum technical system. Then, target of M/P technical system was set as follows:

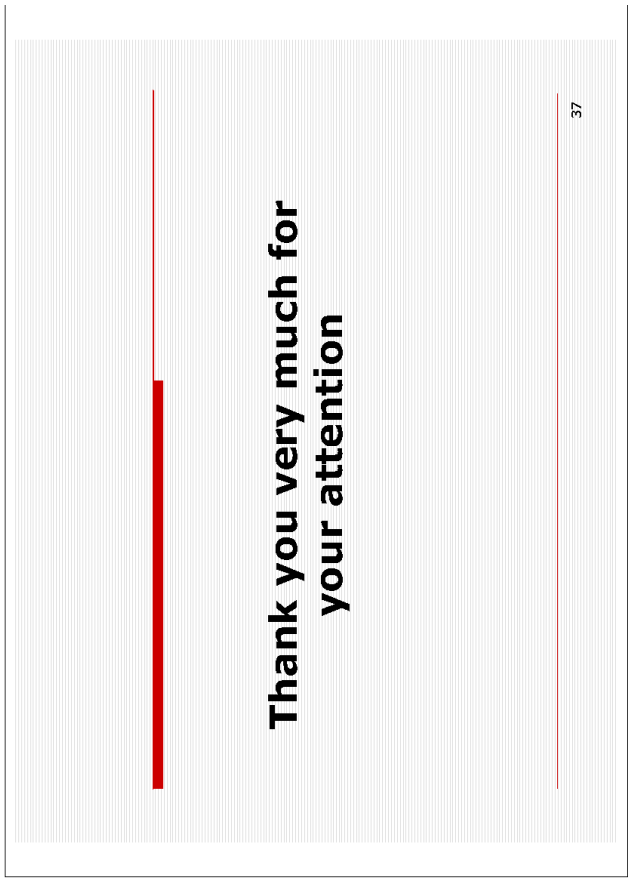
Items	Present (2006)	1st Phase (2010)	2nd Phase (2015)	3rd Phase (2020)
Waste Collection Rate (%) • Apartment Area • Ger Area	100 42*1	100 100	100 100	100 100
Self-disposal and improper disposal (%) • Winter • Summer	54.2 20.2	1.2 2.6	1.0 1.9	0.7 1.2
Separate collection in apartment area • Separate collection rate (%) • Covered population (person)	0 0	15 83,587	40 289,809	70 634,432
Recycling Rate (%) • Winter • Summer	3.0 6.6	4.8 (1.0) 8.4 (1.7)	9.3 (3.8) 13.6 (5.3)	16.9 (8.9) 20.5 (10.5)
Final Disposal Method • NEDS • Other 3 disposal sites	Open Dumping	Sanitary Landfill Level 4 Sanitary Landfill Level 2		

II-3. (14): Waste Stream in 2020 in Winter: with M/P



II-3. (15): Waste Stream in 2020 in Summer: with M/P




Thank you very much for
your attention
37

d.8 Document 8: Plan and operation of collection system

Doc 8

Plan and Operation of Collection System

of the Workshop
for Formulation and Implementation of SWM M/P at selected provincial level based on the experience in UBC

Jun 29, 2011
Counterparts and JET of the Project for Strengthening the Capacity on SWM in UBC

Contents

1. Outline of Collection and Haulage System
2. Time and Motion Survey
3. Applicable Collection and Haulage System
4. Master Plan of Collection and Haulage System in MUB
5. Strategy for the Collection Improvement
6. Costing for Implementation of MP

Old SWM was Easy and Simple.

SWM was just
- **collection waste**
- **carrying waste**
- **disposing of waste.**

This was enough
- **when the waste amount was little.**
- **when most waste were biodegradable**
- **when the objective was only sanitation.**

1. Outline of Collection and Haulage System

They have caused:

- Many waste scattering and heaps.
- Many illegal dumping of waste.
- Huge SWM expenditure.
- Serious environmental impacts by landfill.
- Many complains by people.
- Negative impacts to the tourist industry.

Old Fashion Solid Waste Management

Very Simple

The Situation has Changed!

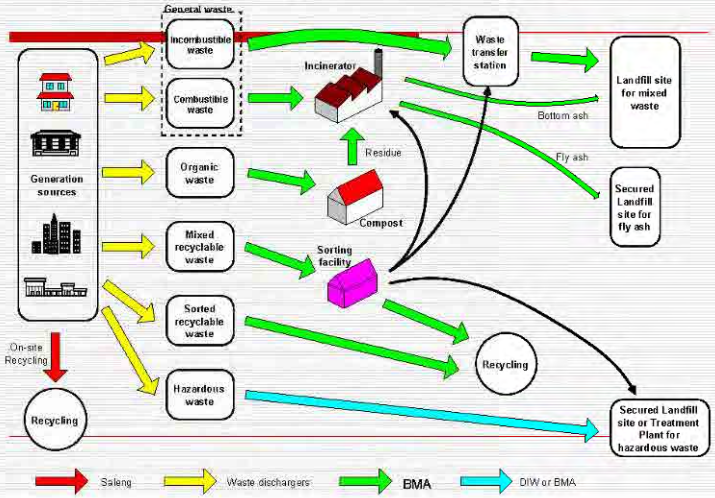
- Population has increased.
- People have got richer. They buy more and dispose more.
- The waste amount has been rapidly increasing.
- Packaging wastes (paper, plastic, metal, glass) have increased due to supermarkets.
- Improvement of roads has highlighted the ugly view of waste scattering.
- SWM has to target not only "Sanitation" but also "Good and Beautiful Environment".
- People have got more selfish. Less cooperation.

Privatization solve these problems?

- Private sector's objective is only maximization of profit.
- SWM's objective is sanitation, environmental protection, beautiful town, etc.
- Both parties' objectives never match.
- Unless UBC strictly control and supervise private companies, the situation become much worse.

Very complicated, especially collection and transportation.

Proposed SWM for Bangkok



Why Complicated? Because All Technologies Require Separate Collection.

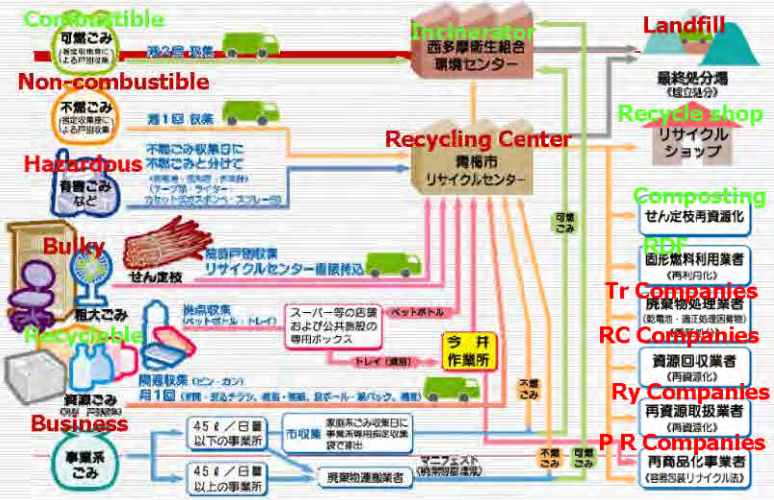
Incineration Plant accept only combustible waste.

Recycling center accept only recyclables.

Compost plant accept only bio-degradable waste.

- You have to educate people to discharge waste separately.
- Separated wastes have to be transported to the different plants and disposal sites.
- Can you force waste collection company to do so?

SWM in Ome City in Japan



2. Time and Motion Survey conducted in 2005 at UBC

Collection System

- Bell collection
- Apartment with dust chute
- Communal container collection
- No proper collection system
- Ger area collection

Survey

- Survey Period
  - From 17 January till 28 January 2005
- Survey Sites
  - Byanzurukh
    - Apartment: 2 khoroo
    - Gel: 3 khoroo
  - Chingeltei
    - Apartment: 2 khoroo
    - Gel: 3 khoroo

Apartment: Dust Chute Collection

- Garbage Collection after 1 month.
- Nobody notice it full.
- Chute often clogs.
- Garbage often burn both in the chamber and in the chute.
- Very difficult to load garbage to the truck.
- Very unsanitary.
- It is very convenient system for residents, but nobody care garbage after dropping it to the chute.
- Dust chute should be banned!

Apartment: Bell Collection

- When the truck come, it made horn to inform of its arriving. Then people carry their garbage to the truck.
- Cleaners and guards mainly carry garbage.
- This system is well functioning.

Apartment: No Discharge & Collection Rule

- Waste scattered due to no garbage storage system.
- Unsanitary
- Difficult to collect garbage.

Ger Area

- People are responsible for loading their garbage. Good public cooperation.
- Cover garbage with sheet to prevent waste scattering.
- Many people cooperate for loading garbage.

Apartment: Communal Container Collection System

- Nobody take care public containers due to no ownership feeling.
- Garbage can't drop to the truck due to being frozen.
- Waste pickers scatter garbage to collect cans and plastic bottles.
- People burn garbage in containers for warming.
- Wheels and a cover are easily damaged.
- Using communal container for Apartment should be banned!
- This system is suitable for business waste.

Ger Area: Fee Collection

In Tokyo: **Using plastic bags**

Garbage Discharge Rule in Tokyo

The notice board showing the waste discharge rule is placed at every collection station.

In Tokyo
Garbage Discharge System

In Tokyo: **Plastic bag must be semitransparent to protect collection workers from accidents.**

Recyclable Waste

Container is loaded on a dump truck with a crane.

Garbage Discharge Rule in Katsushika-ward, Tokyo

- Paper, glass, tins on Mon. before 8am
- Combustible waste on Wed.& Sat before 9:30am
- Incombustible waste on Fri before 8am
- Bulky waste apply to the office by phone (disposal fee depending on items)
- Pet bottles carry to recycle bins at shops (producers are responsible for collection)
- Nonresidential waste pay as you throw

Primary collection by Tricycles in Viet Nam

Findings (1)

1. Very long working hours, from 9am until 7-9pm.
2. No authorized collection route.
3. No authorized collection schedule.
4. Residents don't know the collection days.
5. In Bayanzurukh, only one collection worker per truck. Rental contract system minimize workers and petrol but lengthen the working hours.
6. Most of collection trucks use gasoline.
7. Russian trucks consume lots of gasoline. 4 to 5 times of Japanese trucks.
8. Driver repair trucks. → Difficult for drivers to repair modern trucks.

3. Screening of Applicable Collection and Haulage System

Garbage Hopper at a Local Market

Findings (2)

9. TUK strictly control petrol.
10. Recoding of trucks at the Ulaan Chulute landfill is not so accurate.
11. Most collection crew take no lunch due to no money.
12. In Apartment area, the Bell collection functions very well. This should be the standard collection system for Apartment.
13. In Ger area, the fee collection is the main constrain for the collection work.
14. Present condition of fee collection function well. But it creates many problems as well.
15. TUK and rental contract is the big constrain for the improvement of collection system.

Storage System

- Dust Chute
- Disposable Containers (sackcloth, paper sacks, plastic bags)
- On site waste storage
- Small containers (about 0.2 m3)
- Medium Containers (1 to 2 m3)
- Large Containers (5 to 10 m3)

Screening Results of Storage System

	Residential waste in Apartment Area	Residential waste in Ger Area	Other waste
Dust Chute	Unsuitable	Not applicable	Unsuitable
Disposable containers (Paper or plastic sacks)	Suitable	Suitable	Suitable
On-site refuse storage	Suitable	Unsuitable	
Small containers (about 0.2 m3)	Unsuitable	Suitable	Suitable
Medium containers (1 m3)	Unsuitable	Unsuitable	Suitable
Large containers (5 to 10 m3)	Unsuitable	Unsuitable	Suitable

Discharge System

- Discharge system is closely related to the storage system and collection system

1. Mixed Discharge System
2. Separate Discharge System
3. Discharge to the drop off station
4. Bring to buy back station

Collection and Haulage System

- Collection Frequency
- Mixed or Separate Collection
- Collection System
  - Door to door, Road kerb, Entrance to entrance,
- Collection Schedule
- Collection Equipment
  - Tricycle, CT, DT, Railway, Ship
- Direct Transportation or Transfer station

Master Plan of Waste Stream
for Planned Area
Disposal Site for general waste
To Power Plant Thermal Recycle RDF
Disposal Site for coal ash
Production of RDF
Sorting yard for Material Recovery
Material Recycle
Non-Recyclable waste
Recyclable waste (Unwanted)
Recyclable waste (Sell)
Discharge & Collection System
Planned Area
1. Separate collection
General waste: 2 days/week, fixed days
Recyclable waste: 1 day/week, fixed days
2. Compactor truck
3. Entrance collection with bell system
Residents discharge their waste inside of the entrance of the apartment.
When a compactor truck comes, it informs of its arrival by playing music.
Then guards and cleaners of apartments carry waste to the compactor truck for loading.
4. Master Plan of Collection and Haulage System in MUB
Master Plan of Waste Stream
for Unplanned Area
Disposal Site for general waste
Recyclable waste (Sell)
Recycle

Discharge & Collection System
Special Order

- Waste which are not suitable for regular collection
- Large amount of waste
  - Factories, Supermarkets, Hotels, Restaurants, large amount of waste from residence, etc.
- Bulky waste
  - Furniture, TV, Refrigerator, Washing machine, Computer, etc.
- Request collection by telephone
- Special fee

5. Strategy for the Collection Improvement

Discharge & Collection System
Unplanned Area

1. **Mixed collection**
   1 day/2 weeks, fixed days
2. **Dump truck**
3. **Door to door collection with bell system**
   - Residents store their waste inside of the Hasha.
   - When a truck come, it informs of its arrival by playing music.
   - Then residents carry waste to the truck for loading.

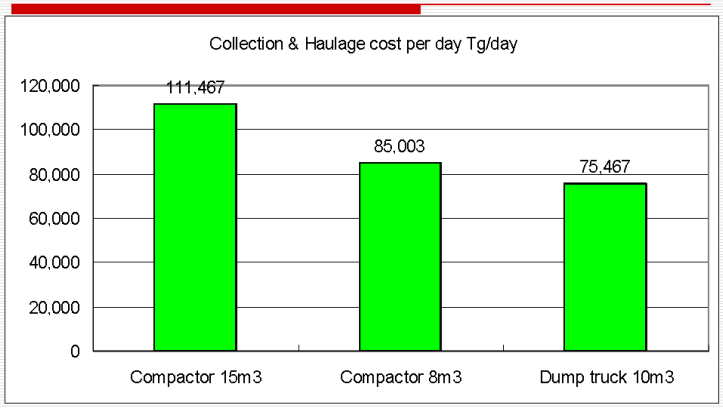
Or, Curb-side collection with bell system.

Special Collection

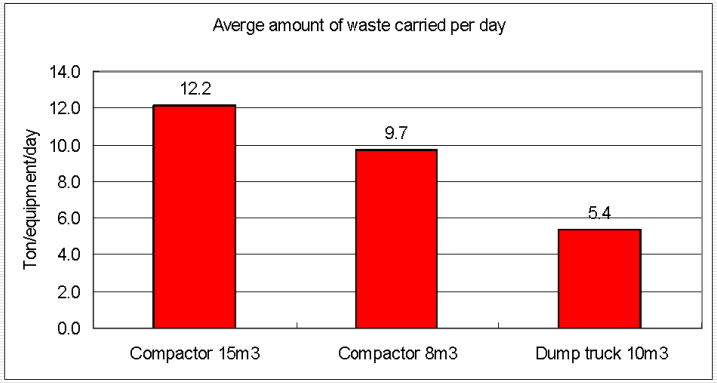
Assumed Bulk density of waste

	Area	Original condition	After compaction
Compactor $15m^3$ & $8m^3$	Planned	0.20 t/m^3	0.45 t/m^3
Dump truck $10m^3$	Un-planned	0.30 t/m^3	-

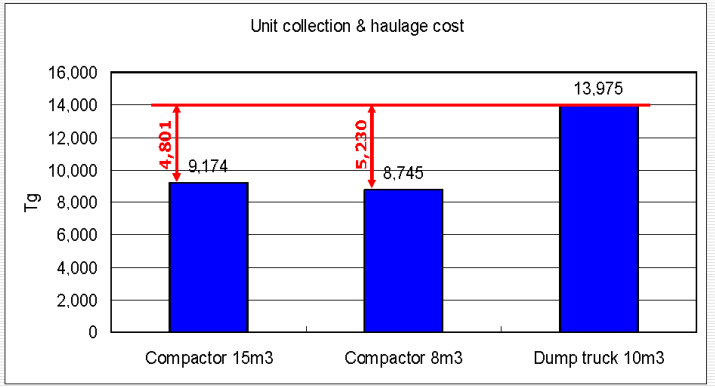
Collection & Haulage Cost per Equipment per Day



Average Amount of Waste Carried per Day



Collection & Haulage Cost per Ton of Waste



Compactor is cheaper by 5000Tg per ton of waste.

Waste Collection Amount vs Unit Collection Cost

How much can Collection Cost is reduced?

- Waste amount in planned are in 2015: 133,000 ton
- The difference of unit cost between a dump truck and a compactor: 5,000Tg/ton
- Different amount in 2015: 133,000ton x 5,000Tg/ton= 665million Tg. can be saved in 2015.

6. Costing for Implementation of Master Plan

Strategy to achieve 100% collection rate at the minimum cost.

1. To minimize the total collection cost, all waste in Planned Area is collected by compactor trucks.
2. Extra budget squeezed in Planned area is spent for un-planned area.
3. Common 6 ton dump truck is used for un-planned area because compactor is unsuitable for waste there.

1.Caluculation of Necessary Equipment-1
(ex. Sukhbaatar District)

Waste generation amount per day

Season	Type of area	Waste source	unit	2005	2010	2015	2020
Winter	Planned area	Apartment area	t/d	11.8	18.5	27.9	40.5
		Business area	t/d	6.2	9.0	14.0	21.1
		Roads and Parks	t/d	2.4	2.7	2.9	3.0
		Sub-total Aw	**t/d**	**20.4**	**30.2**	**44.8**	**64.6**
	Unplanned area	Ger area General	t/d	10.2	10.6	10.2	8.3
		Ger area Ash	t/d	49.3	44.5	36.7	25.9
		Sub-total Bw	**t/d**	**59.5**	**55.1**	**46.9**	**34.2**
	Total		**t/d**	**79.9**	**85.3**	**91.7**	**98.8**
Summer	Planned area	Apartment area	t/d	10.5	16.5	24.8	35.9
		Business area	t/d	7.4	11.2	17.1	26.0
		Roads and Parks	t/d	4.1	4.5	4.8	5.1
		Sub-total As	**t/d**	**22.0**	**32.2**	**46.7**	**67.0**
	Unplanned area	Ger area General	t/d	12.7	13.2	12.6	10.3
		Ger area Ash	t/d	0.0	0.0	0.0	0.0
		Sub-total Bs	**t/d**	**12.7**	**13.2**	**12.6**	**10.3**
	Total		**t/d**	**34.7**	**45.4**	**59.3**	**77.3**

Waste Collection Amount per day by type of the collection vehicle

Waste collection amount per day by type of the collection vehicle

Season	Type of area	Waste source	unit	2005	2010	2015	2020
Winter	Compactor	Apartment	t/d		18.5	27.9	40.5
		Small business	t/d		4.5	7.0	10.6
		Roads and Parks	t/d		2.7	2.9	3.0
		Large business	t/d		4.5	7.0	10.6
		Sub-total Aw	**t/d**		**30.2**	**44.8**	**64.6**
	Dump truck	All waste	t/d		55.1	46.9	34.2
		Sub-total Bw	**t/d**		**55.1**	**46.9**	**34.2**
	Total		**t/d**		**85.3**	**91.7**	**98.8**
Summer	Compactor	Apartment	t/d		16.5	24.8	35.9
		Small business	t/d		5.6	8.6	13.0
		Roads and Parks	t/d		4.5	4.8	5.1
		Large business	t/d		5.6	8.6	13.0
		Sub-total As	**t/d**		**32.2**	**46.7**	**67.0**
	Dump truck	All waste	t/d		13.2	12.6	10.3
		Sub-total Bs	**t/d**		**13.2**	**12.6**	**10.3**
	Total		**t/d**		**45.4**	**59.3**	**77.3**

Waste Collection Amount per day by type of Vehicle

Waste collection amount per day by type of the collection vehicle (7days/week)

Season	Vehicle type	Waste source	unit	2005	2010	2015	2020
Winter	Compactor	Sub-total Aw	t/d		30.2	44.8	64.6
	Dump truck	Sub-total Bw	t/d		55.1	46.9	34.2
	Total		t/d		85.3	91.7	98.8
Summer	Compactor	Sub-total As	t/d		32.2	46.7	67
	Dump truck	Sub-total Bs	t/d		13.2	12.6	10.3
	Total		t/d		45.4	59.3	77.3

Waste collection amount per day by type of the collection vehicle (6days/week)

Season	Vehicle type	Waste source	unit	2005	2010	2015	2020
Winter	Compactor	Sub-total Aw	t/d		35.2	52.3	75.4
	Dump truck	Sub-total Bw	t/d		64.3	54.7	39.9
	Total		t/d		99.5	107.0	115.3
Waste c	Compactor	Sub-total As	t/d		37.6	54.5	78.2
	Dump truck	Sub-total Bs	t/d		15.4	14.7	12.0
	Total		t/d		53.0	69.2	90.2

% of Waste carried by each type of collection vehicle

% of waste carried by each type of collection vehicle

Season	Type of area	Type of vehicle	unit	2005	2010	2015	2020
Winter	Planned area	Compactor 15m3	%		80%	80%	80%
	Planned area	Compactor 8m3	%		20%	20%	20%
	Unplanned are	Dump truck 10m3	%		100%	100%	100%
Summer	Planned area	Compactor 15m3	%		80%	80%	80%
	Planned area	Compactor 8m3	%		20%	20%	20%
	Unplanned are	Dump truck 10m3	%		100%	100%	100%

% of waste carried by each type of collection vehicle

Season	Type of area	Type of vehicle	unit	2005	2010	2015	2020
Winter	Planned area	Compactor 15m3	t/day		28.2	41.8	60.3
	Planned area	Compactor 8m3	t/day		7.0	10.5	15.1
	Unplanned are	Dump truck 10m3	t/day		64.3	54.7	39.9
	Total		t/day		99.5	107.0	115.3
Summer	Planned area	Compactor 15m3	t/day		30.1	43.6	62.5
	Planned area	Compactor 8m3	t/day		7.5	10.9	15.6
	Unplanned are	Dump truck 10m3	t/day		15.4	14.7	12.0
	Total		t/day		53.0	69.2	90.2

Average trip per day by type of vehicle

			Average trip no. per day			Average haulage amount per trip		
			trips/d	trips/d	trips/d	t/trip	t/trip	t/trip
	unit	Haulage distance	Compactor 15m3	Compactor 8m3	Dump truck 10m3	Compactor 15m3	Compactor 8m3	Dump truck 10m3
Planned	km	15.5	2	3	2	6.08	3.24	2.70
Unplanned	km	18.5	1	2	2	6.08	3.24	2.70

Number of Vehicle required

Roundup required number of equipment

Season	Type of vehicle	unit	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Winter	Compactor 15m3	nos	3	3	3	3	4	4	4	5	5	5	5
	Compactor 8m3	nos	1	1	1	1	2	2	2	2	2	2	2
	Dump truck 10m3	nos	12	12	12	11	11	11	10	10	9	8	8
		nos	16	16	16	15	17	17	16	17	16	15	15
Summer	Compactor 15m3	nos	5	6	6	7	7	8	8	9	10	10	11
	Compactor 8m3	nos	2	2	2	2	2	2	2	2	3	3	3
	Dump truck 10m3	nos	3	3	3	3	3	3	3	3	3	3	3
		nos	10	11	11	12	12	13	13	14	16	16	17

Price of Each Equipment

	Basic price	Basic price	Life year	Salvaged value
	USD	Tg	years	Tg
Compactor truck 15m3, 10ton	95,000	114,000,000	8	11,400,000
Compactor truck 8m3, 6ton	80,000	96,000,000	8	9,600,000
Dump truck 10m3, 6ton	65,000	78,000,000	8	7,800,000
Skipper truck 5m3		0	8	0
Wheel loader	130,000	156,000,000	12	15,600,000
Wheel backhoe	100,000	120,000,000	12	12,000,000

Number of Vehicles and Amount to be Invested

Number of equipment procured

Season	Type of vehicle	unit	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Winter	Compactor 15m3	nos	3	0	0	0	1	0	0	1	3	0	0	0
	Compactor 8m3	nos	1	0	0	0	1	0	0	0	1	0	0	0
	Dump truck 10m3	nos	0	0	0	0	0	0	0	0	0	0	0	0
		nos	4	0	0	0	2	0	0	1	4	0	0	0

Investment for equipment (cash base)

Season	Type of vehicle	unit	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Winter	Compactor 15m3	1000Tg	342,000	0	0	0	114,000	0	0	114,000	342,000	0	0	0
	Compactor 8m3	1000Tg	96,000	0	0	0	96,000	0	0	0	96,000	0	0	0
	Dump truck 10m3	1000Tg	0	0	0	0	0	0	0	0	0	0	0	0
		1000Tg	440,009	0	0	0	210,000	0	0	114,000	438,000	0	0	0

O&M cost per each truck

O&M Cost

	Items	Unit	Compactor 15m3	Compactor 8m3	Dump truck 10m3
A	Distance	km	15.5	15.5	18.5
B	Diesel consumption per	km/l	2	5	3
C	Collection and discharge	minutes	125	69	125
D	Effeciency for working hours		0.9	0.9	0.9
E	Diesel consumption per	min/l	15	30	30
F	Diesel quantity for trave	liter/trip	15.5	6.2	12.3333333
G	Diesel quantity for colle	liter/trip	7.5	2.07	3.75
H	Total consumption quant	liter/trip	23	8.27	16.0833333
I	Unit rate of diesel	Tg/liter	840	840	720
J	Fuel cost per trip	Tg/trip	19,320	6,947	11,580
K	Trip nos per day	Trip/day	2	3	2
L	Fuel cost per day	Tg/day	38,640	20,840	23,160
	Depreciation cost	Tg/day	0	0	24,041
	Maintenance cost	Tg/day	21,863	18,411	14,959
	Salary	Tg/day	16,667	16,667	16,667
	O&M cost per day	Tg/day	77,170	55,918	78,827
	Unit cost per ton of was	Tg/ton	6,346	5,753	14,598

O & M Cost

O&M Cost der day

Season	Type of vehicle	unit	2010	2015	2020
Winter	Compactor 15m3	Tg/d	231,509	308,679	385,848
	Compactor 8m3	Tg/d	55,918	111,836	111,836
	Dump truck 10m3	Tg/d	945,920	867,093	630,613
		Tg/d	1,233,347	1,287,608	1,128,298
Summer	Compactor 15m3	Tg/d	385,848	617,357	848,866
	Compactor 8m3	Tg/d	111,836	111,836	167,754
	Dump truck 10m3	Tg/d	236,480	236,480	236,480
		Tg/d	734,164	965,673	1,253,101

O&M Cost per year

Season	Type of vehicle	unit	2010	2015	2020
Winter	Compactor 15m3	1000Tg/y	56,257	75,009	93,761
243	Compactor 8m3	1000Tg/y	13,588	27,176	27,176
days/y	Dump truck 10m3	1000Tg/y	229,859	210,704	153,239
		1000Tg/y	299,703	312,889	274,176
Summer	Compactor 15m3	1000Tg/y	47,074	75,318	103,562
122	Compactor 8m3	1000Tg/y	13,644	13,644	20,466
days/y	Dump truck 10m3	1000Tg/y	28,851	28,851	28,851
		1000Tg/y	89,568	117,812	152,878
		1000Tg/y	**389,271**	**430,701**	**427,055**

Summary of Cost

	Investment	O&M
2009	4,296,054	0
2010	0	3,045,706
2011	228,000	3,087,680
2012	96,000	3,098,026
2013	666,000	3,065,632
2014	288,000	3,182,776
2015	342,000	3,146,114
2016	342,000	3,231,304
2017	4,125,595	3,276,581
2018	324,000	3,298,203
2019	433,200	3,337,283
2020	-3,611,625	3,364,134

Thank you for your Attention

d.9 Document 9: Site visit of 3R promotion sites, workshop, etc.

Doc 9

Site visit to SBD #7

PP1: PP of Public cooperation for improvement of waste discharging manner and waste separation

Procedure:

1. Improvement of waste discharging manner of the residents
2. Fix the waste collection schedule
3. Introduce of bell collection
4. Closure of dust chutes and ODP
5. Promoting waste separation at source and community recycling

Selected Khoroo

Weekly AOU Meeting
Business meeting
Public meeting
Waste education

New Collection Schedule

Once/week → 3times/week with bell collection

	Odd days	Even days
Morning (9:00-12:30)	Selba township	Selba township
	Apart-9#1 & 5/1	Apart-9
	Apart-12 & 39	Apart-8
	Apart-4	Apart-7
	Apart-6	Apart-10
	Apart-5	
	Apart-5A	
Afternoon (14:50-18:00)	Apart-18	Apart-36
	Apart-7A	Tegsh AOU
	Apart-26	Apart-13
	Tegsh AOU	

Monitoring Results -3

Tegsh AOU

Before closure of ODP, not only the residents but those bars and restaurants nearby discharge the waste. Street waste pickers or stray dogs scattered the waste and make the area insanitary condition.

Monitoring Results -1

Waste collection before closure of dust chute: Wastes were not in the bags and accumulated inside. Collection worker needed to crape out the waste and load on the vehicle, it took few hours. Collection frequency was once a week

Waste collection after closure of dust chute: Watchmen take out the wastes in the bags on curbside before the collection vehicle comes. Collection worker only load those bags on the vehicle. The collection efficiency was drastically improved, it takes few minutes. Collection frequency is three times a week.

Monitoring Results -2

Closed dust chute at Apt.6 SBD#7
Notice to inform about the closure and discharging rule was put on.

Beside the closed dust chute: The resident put out the waste only once a day by designated time, the waste shall be put into the bag, put beside the dust chute or the landing and Watchmen collect them.