d.4 Document 4: Formulation of M/P for MUB (2): Planning of 3R system

Doc 4

Formulation of M/P for MUB(2):Planning of 3R System

of the Workshop for Formulation and Implementation of SWM M/P at Selected Provincial Center based on the experience in UBC

Jun 28, 2011

Counterparts and JET of the Project for Strengthening the Capacity on SWM in UBC

Contents

1. Concept of 3R system
2. Policy of M/P in UBC on 3R
3. Intermediate Treatment System
4. Possible Intermediate System in UBC
5. Pilot Project for Selecting Optimum Recycling System in UBC

Objectives of SWM

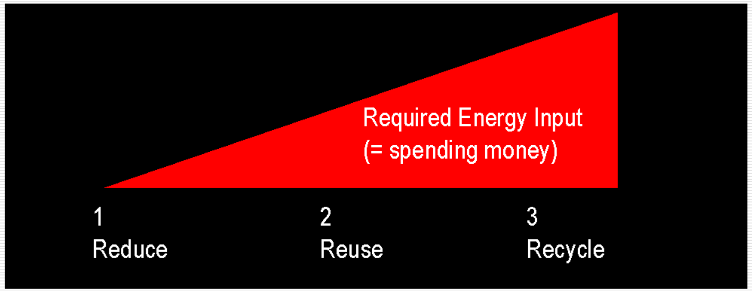
The objectives of solid waste management change as social development progresses.

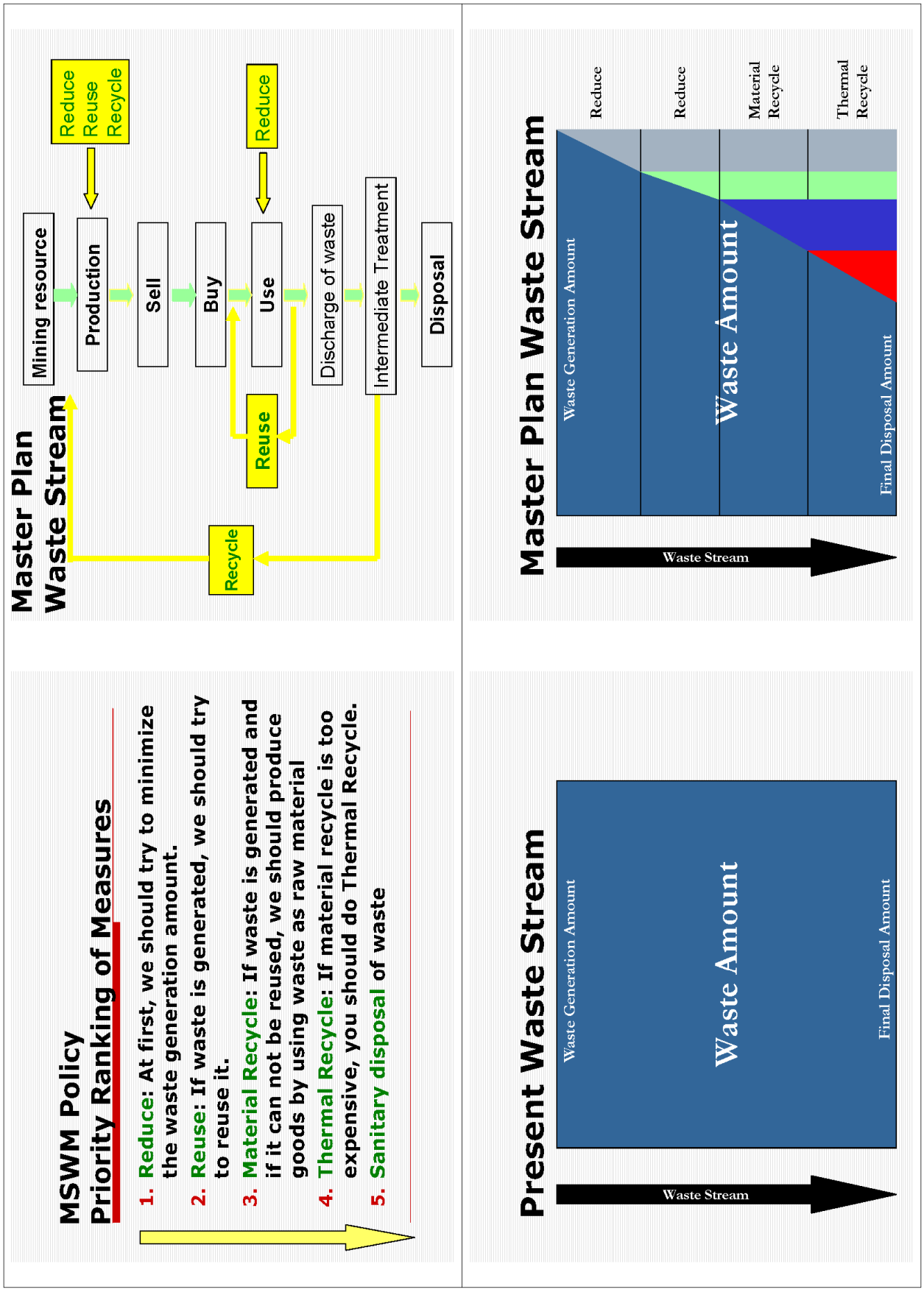
1st stage:Sanitation → Collection improvement
2nd stage:+ Environmental Protection (Sanitary Landfill) → Sanitary landfill
3rd stage: + Conservation of Natural Resource = Minimization of consumption of natural resources → 3 Rs

You should target the 3rd stage objective.
You can!

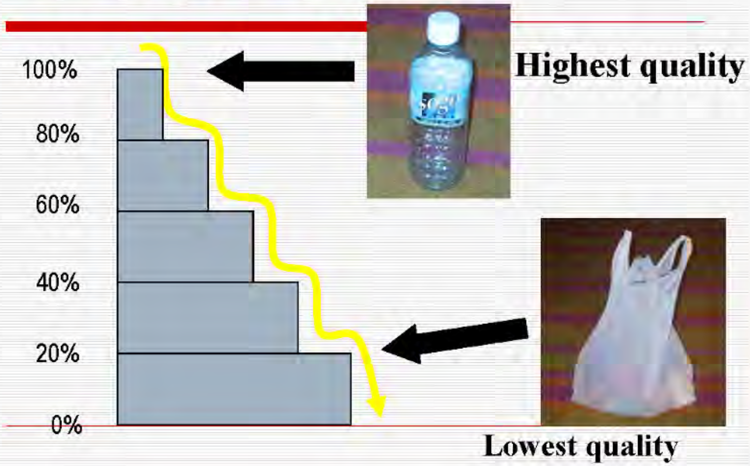
Required Energy Input

Reduce is the best because it requires the least energy input.




Master Plan
Waste Stream
Mining resource
Production
Sell
Buy
Use
Discharge of waste
Intermediate Treatment
Disposal
Reduce
Reuse
Recycle
Reduce
Reuse
Recycle
Master Plan Waste Stream
Waste Generation Amount
Waste Amount
Final Disposal Amount
Waste Stream
Reduce
Reduce
Material Recycle
Thermal Recycle
MSWM Policy
Priority Ranking of Measures
1. Reduce: At first, we should try to minimize the waste generation amount.
2. Reuse: If waste is generated, we should try to reuse it.
3. Material Recycle: If waste is generated and if it can not be reused, we should produce goods by using waste as raw material
4. Thermal Recycle: If material recycle is too expensive, you should do Thermal Recycle.
5. Sanitary disposal of waste
Present Waste Stream
Waste Generation Amount
Waste Amount
Final Disposal Amount
Waste Stream

Cascade Utilization



Recycle Marks Used in Japan

- □ To minimize the lowering of the quality through recycling, we have to sort materials very precisely. It requires recycle marks on every goods.

Importance of Thermal Recycle

- □ In Mongolia, it is difficult to use recycle marks because most of goods are imported. Possibility of material recycle is limited.
- □ Thermal recycle doesn't require precise sorting.
- □ Big demand for heat in Mongolia.

What are Recyclables?

- Paper
  - High quality => Material recycle "Toilet paper"
  - Low quality => Thermal recycle "RPF"
- Plastic
  - High quality => Material recycle
    - Plastic bottle go to China.
    - HDPE go to plastic bag factory in Ulaanbaatar.
  - Low quality => Thermal recycle "RPF"
- Can => Material recycle
- Metal => Material recycle
- Bottles => Material recycle

(Under the deposit system)

Material Recycle Targets These.

Thermal Recycle "RPF" Targets These.

2. Policy of M/P (1)

- Collection service will cover all the residents by 2010. The wastes collected will be disposed of at final disposal sites by sanitary landfill method to minimize negative effects on environment.
- The fundamental goal of the M/P for SWM in MUB is to establish an environmentally sound SWM system in MUB by the target year 2020. To achieve this goal, 3Rs (Reduce, Reuse, Recycle) will be actively promoted to reduce waste generation at first, then to reuse and recycle generated wastes as a resource as much as possible in order to reduce the amount of the solid waste to be disposed of at the landfills.

Policy of M/P (2)

- Recycling activities shall be conducted by the private sector in principle.
- The role of public sector (MUB) shall be limited to:

1. Promote, support and control the recycling activities of private sector.
2. Develop technologies to recycle the wastes that the private sector can not deal with, i.e. Thermal recycling by RPF

3. Intermediate treatment system (1)

- The objectives of intermediate treatment system are:
1. to perform volume reduction of wastes, especially those to be disposed of at landfill;
2. to make wastes stable in order to avoid adverse effects by them (for instance, to avoid odor by decomposition of putrescible waste like kitchen waste, make it inert by incineration, etc.); and
3. to recycle wastes to conserve natural resources.

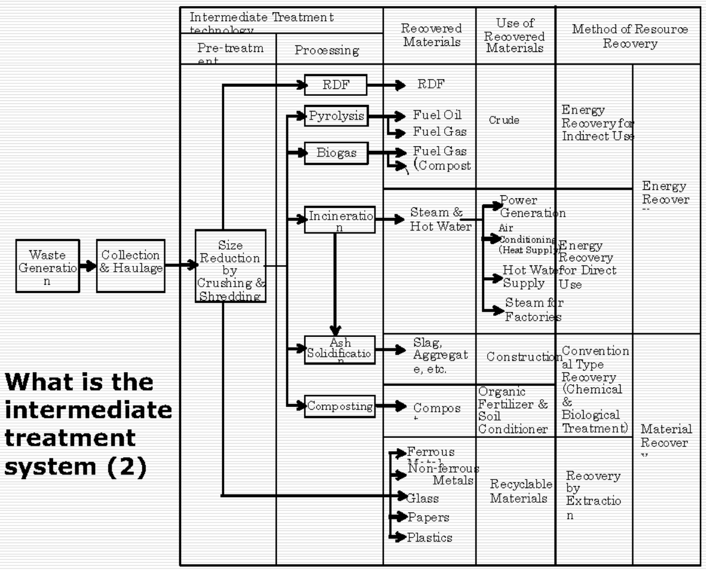
Intermediate treatment system (2)

- Needs of volume reduction is not high; sanitary landfill cost will be less than 3US$ while it in Japan is more than 300 US$/ton.
- Therefore, main objectives of treatment system are recycling and stability of landfilled wastes.
- The primary benefits of recycling are conservation of natural resources and landfill space; however, the collection and transport of materials requires substantial amounts of energy and labour, and historically, most recycling programs are subsidised economically.
- The requirements for a successful program are that a strong demand exists for recovered materials and that the market value of the materials plus benefit from landfill space saving be sufficient to pay for system investment/O&M costs including collection/transportation costs.

What is the intermediate treatment system? (1)

- MSW (municipal solid waste) could be managed by only collection and final disposal (landfill) systems.
- An intermediate treatment (processing including recycling) is the system between the collection and final disposal (landfill) systems and it is not always necessary for MSWM.

What is the intermediate treatment system (2)



Purpose of the intermediate treatment system (1)

System	Purpose
Crushing & shredding	1.Pre-treatment 2.Volume reduction
RPF (Refuse Plastic and Paper Fuel)	1.Thermal recycling by conversion of waste to fuel 2.Volume reduction 3.Stabilization
Biogas production	1.Thermal recycling by conversion of waste to fuel (methane gas) 2.Production of compost 3.Volume reduction 4.Stabilization

Purpose of the intermediate treatment system (2)

System	Purpose
Incineration	1.Volume reduction 2.Stabilization 3.Thermal recycling by energy recovery
Sorting	1.Material recovery 2.Pre-treatment 3.Volume reduction
Composting	1.Production of compost (soil conditioner & fertilizer) 2.Volume reduction 3.Stabilization

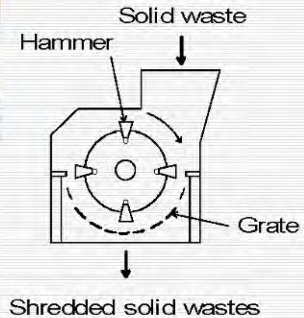
Crushing and Shredding (1)

The system is used for pre-treatment and mainly for bulky waste

Advantages:
- Effective volume reduction for bulky items
- Simple operation
- Not expensive

Disadvantages:
- Less volume reduction in case of non-bulky items
- Frequent change of blade parts

Crushing and Shredding (2)



RPF (Refuse Plastic and Paper Fuel) (1)

Combustible fraction of the waste is processed to produce the RPF.

Advantage:

- RPF can be burned with coal or as a primary fuel in a boiler
- RPF can be stored and is easy to handle

Disadvantages:

- Wastes can be converted to RPF is limited to high calorific ones
- Market for RPF is limited
- Incinerator for RPF needs special attention to air pollution, feeding system, etc.

RPF (2)

Biogas Production (1)

Biogas is the combustible gas developed when organic matter is degraded under anaerobic conditions. The system converts the organic wastes mainly into methane and residues (compost)

Advantages:

- Resource recovery of wastes into potentially useful products, i.e. methane and compost
- High contribution to the conservation of global environment

Disadvantages:

- Less operational experience of municipal SW (It for excreta is common and proven technologies.)
- Large amount of waste water treatment needs
- Requirement of strict pre-sorting of organic wastes

Biogas Production (2)

Colombo in Sri Lanka

Incineration (1)

Waste is converted into oxidized gases (CO_2) and inert (ashes) by high temperature combustion

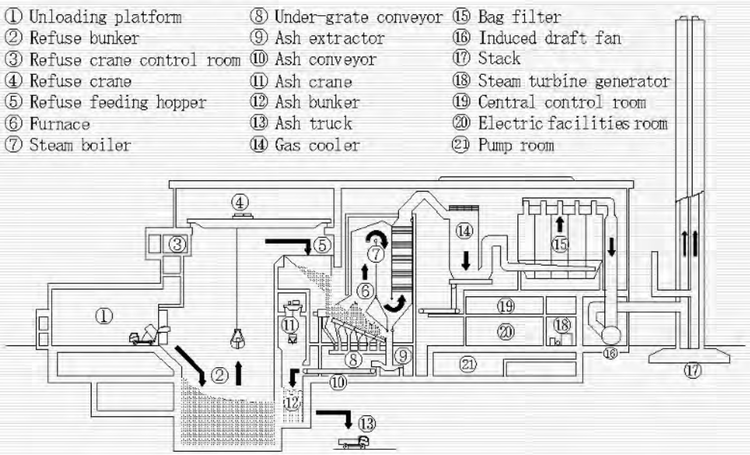
Advantages:

- High volume reduction efficiency; 90 to 95 %
- Elimination of offensive odor of putrescible wastes
- High stabilization efficiency
- Energy recovery

Disadvantages:

- Expensive both in construction and O&M
- Emission gases, dioxins, etc.

Incineration (2)



Sorting (1)

Mainly for materials recovery. There are manual and mechanical systems.

Advantages:

- Simple operation
- Desirable for pre-treatment of other system operation
- Not expensive
- If labor cost is cheap, the manual one is recommendable

Disadvantages:

- Less volume reduction
- In case of manual system, working condition is not convenient.
- Mechanical system is less efficient than manual one

Sorting (2)

System in Japan

System in Mexico

Composting (1)

Organic matters in waste is decomposed by the microbiological processes to compost for use in agriculture, gardens, parks, etc. as a soil conditioner.

Advantages:

- Relatively small capital investment if labor intensive one
- Simple technology

Disadvantages:

- Strict waste separation is required
- A large area is required
- Requires transportation of products (compost)
- Market for compost is very limited
- Possibility of secondary pollution by heavy metals

Composting (2)

Labor Intensive System in Chilaw in Sri Lanka

Mechanical System in Colombo in Sri Lanka

Important issues for the examination of possible intermediate treatment system (1)

1. Current and future waste composition

- Large portion of Ash => 60.2%
- Few portion of kitchen waste => with ash 12.5%, without ash 31.4%
- Few portion of compostable wastes (kitchen+ grass/wood) => with 13.0, without 32.6%
- Large portion of high calorific wastes (paper + plastic) => with ash 13.0%, without ash 32.6% => These waste are problem ones for landfill operation !!!
- Rather large portion of Metal, Bottle and Glass => with 7.0, without 17.8%

Current and future waste composition – With Ash

Category of MSW	2005	2010	2015	2020
Kitchen Waste (%)	12.5	15.5	19.3	23.7
Paper (%)	5.2	6.5	8.1	10.0
Textile (%)	2.0	2.5	3.1	3.8
Grass and Wood (%)	0.5	0.5	0.5	0.6
Plastic (%)	7.8	9.8	12.1	14.9
Leather and Rubber (%)	0.2	0.3	0.4	0.4
Combustibles (%)	28.2	35.1	43.5	53.4
Metal (%)	1.5	1.9	2.4	2.9
Bottle and Glass (%)	5.5	7.1	8.8	10.7
Ceramic and Stone (%)	1.9	2.0	2.1	2.3
Miscellaneous (%)	2.7	2.8	3.0	3.2
Non-combustibles (%)	11.6	13.8	16.3	19.1
Other Waste than Ash (%)	39.8	48.9	59.8	72.5
Ash (%)	60.2	51.1	40.2	27.5
Total	100.0	100.0	100.0	100.0

Current and future waste composition – Without Ash

Category of MSW	2005	2010	2015	2020
Kitchen Waste	31.4	31.8	32.3	32.7
Paper	13.1	13.4	13.6	13.8
Textile	5.0	5.2	5.2	5.3
Grass and Wood	1.2	1.1	0.9	0.8
Plastic	19.5	19.8	20.2	20.5
Leather and Rubber	0.6	0.6	0.6	0.6
Combustibles Sub-Total	70.8	71.9	72.8	73.7
Metal	3.8	3.9	3.9	4.0
Bottle and Glass	14.0	14.3	14.6	14.7
Ceramic and Stone	4.7	4.1	3.6	3.1
Miscellaneous	6.7	5.8	5.1	4.5
Non-combustibles Sub-Total	29.2	28.1	27.2	26.3
Total	100.0	100.0	100.0	100.0

Comparison of waste composition

Country/City	Year	GDP per Capita (US$)	Kitchen Waste (%)	Papers + Plastics (%)	Metal, Bottle and Glass
Tokyo in Japan	1994	31,961	25.1	50.9	11.9
Vientiane Lao	1991	290	35.1	16.3	8.9
Phnom Penh	2003	268	63.5	21.9	1.9
Dar es Salaam Tanzania	1996	280	45.0	6.1	4.6
Asuncion Paraguay	1994	1,450	37.4	14.4	4.8
Metro Manila Philippines	1997	1,040	45.4	32.4	8.6
Adana Turkey	1999	3,090	64.4	20.3	4.5
Mexico Mexico	1998	5,080	38.7	34.6	NA
Ulaanbaatar with Ash	2003	552	12.5	13.0	7.0
Ulaanbaatar without Ash	2003	552	31.4	32.6	17.8

Important issues for the examination of possible intermediate treatment system (2)

2. Needs of product & by-product (recycled and recovered items by treatment)

- For recycling, **demands of product/by-product and supply of wastes as raw materials** are critical.
- Small demand of compost => cow dung is disposed of at Khan-Uul District dump site with tipping fee
- Large demand of fuel for heating plants and power generation plants => **Thermal recycling** of waste is prospective
- Regarding scale of the country final users of reuse & recyclable materials from SW (paper, plastics, metals, bottles/glass) for a sorting facility will be limited.

Important issues for the examination of possible intermediate treatment system (3)

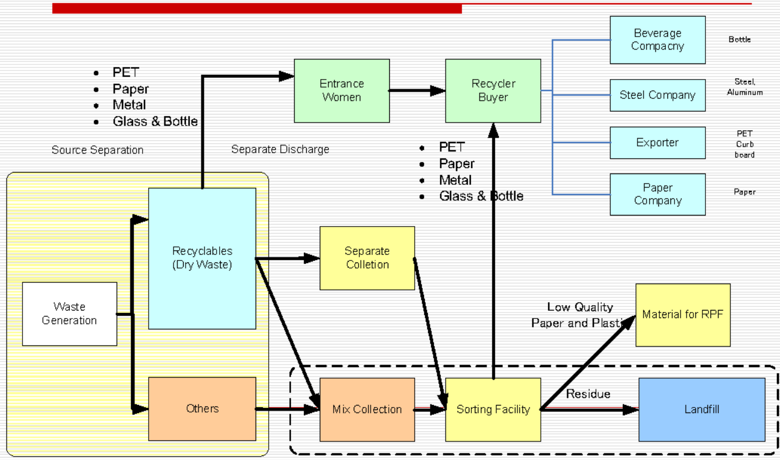
3. Important issues from current recycling
- **Limited final users in terms of capacity and categories**
- **Most of recyclables are transported to China => huge transportation cost**
- **Current final users in UBC limit generation sources of recyclable wastes. Because wastes as raw materials for them should be pure and clean as much as possible.**
- **If a recycling facility will not limit its sources of wastes, it will not be profitable due to cleaning and purification processes and costs. => At present final users in UBC face to the difficulty in supply of suitable waste.**

Conclusions

- **Application of yard sorting and RPF production to the recycling and intermediate treatment system is examined for M/P**
- **Applicability of RPF will be examined by pilot project including introduction of separate collection system**
- **Proposed location of both facilities is Narangiin Enger proposed new disposal site.**
- **For the planning of the site, private investment of the other recycling facilities will be examined.**

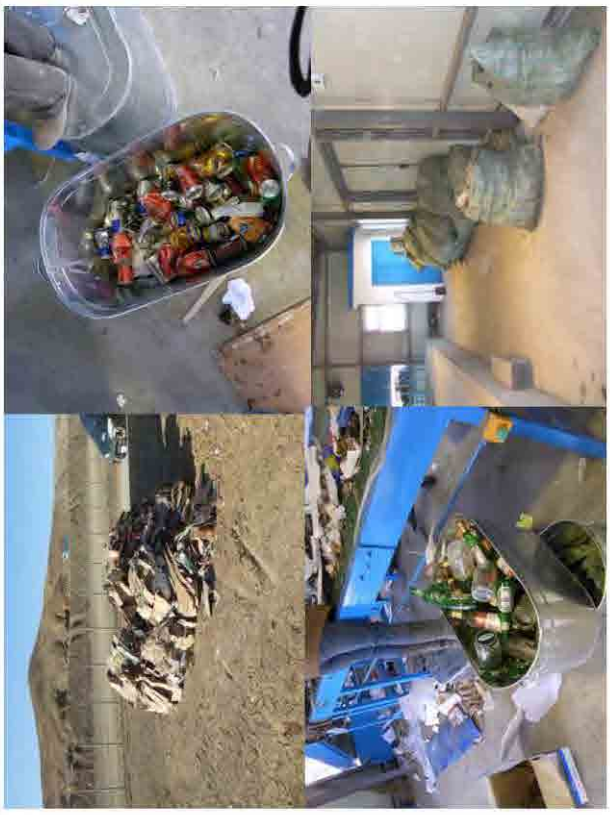
5. Pilot Project for Selecting Optimum Recycling System in UBC

Future Waste Flow in UBC




Sorting Operation with Mixed
Waste by Semi Mechanical Sorting


Sorting Operation with Mixed
Waste by Manual

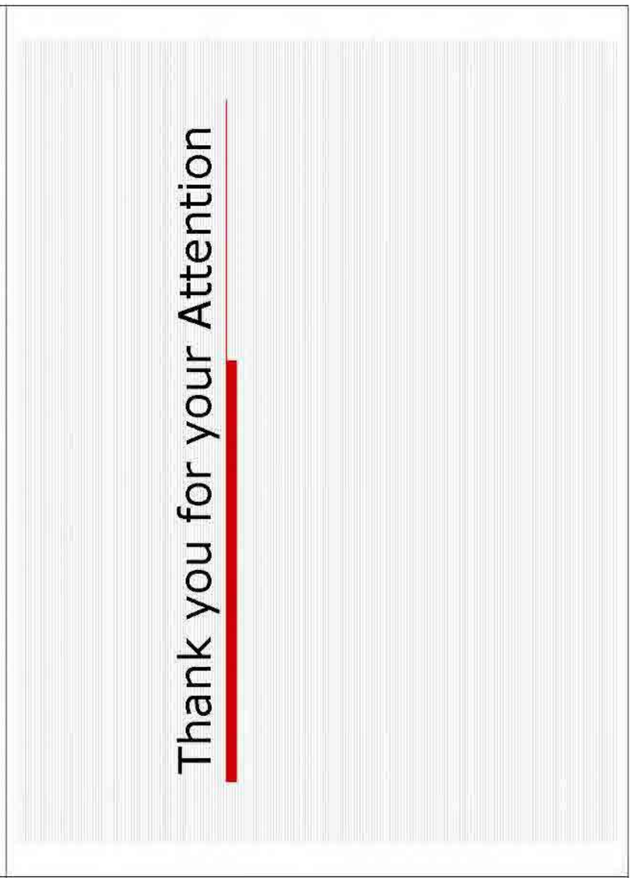


e. Separate Discharge, Separate Collection and Sorting at NEDS


2nd Separate collection : May 24 &25


Manual Sorting of Separated Waste


Belt Conveyor Sorting of Separated Waste


Thank you for your Attention

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

1

◆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)

2

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

3

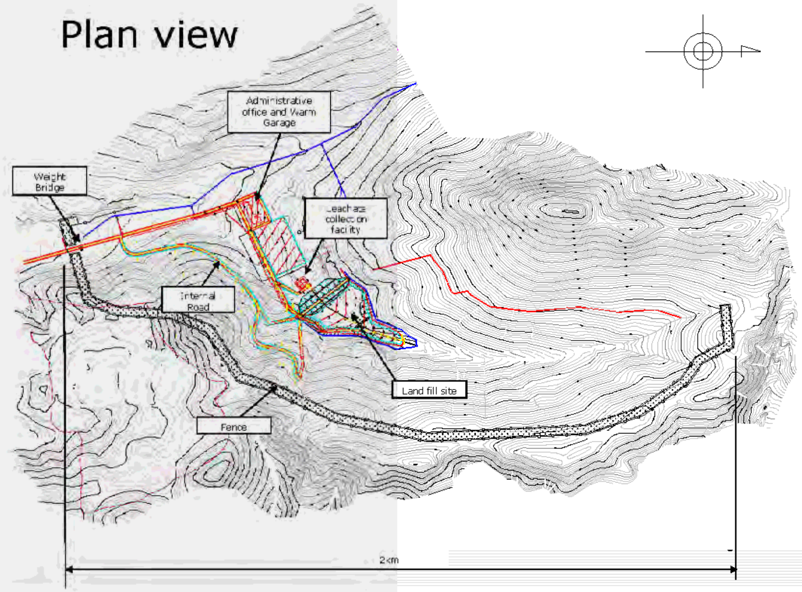
A) Contents of NEDS facilities

1. List of the facilities for Landfill site

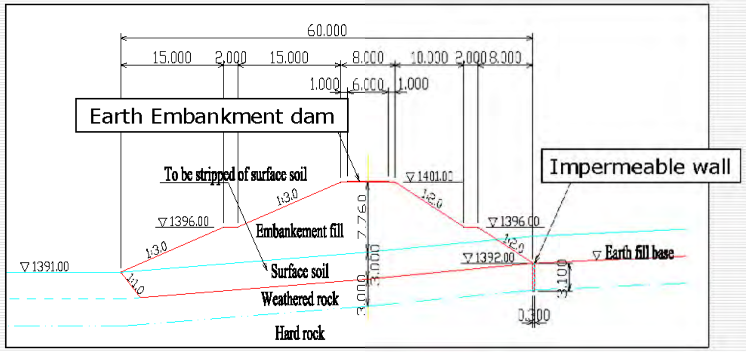
a. Earth embankment dam
b. Internal road
c. Leachate collection pipe
d. Impermeable wall
e. Gas removable pipe
f. Administrative office and warm garage
g. Weight bridge

4

Plan view



Sectional view



6

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)

7

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.

8

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.

9

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.

10

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

11

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.

12

Ⅱ Operation for NEDS

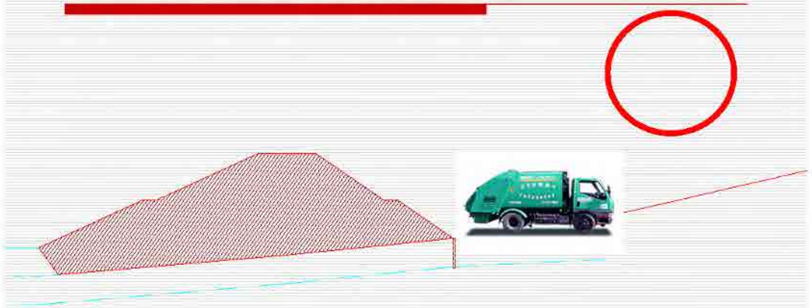
A) Landfill operation

- 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

15

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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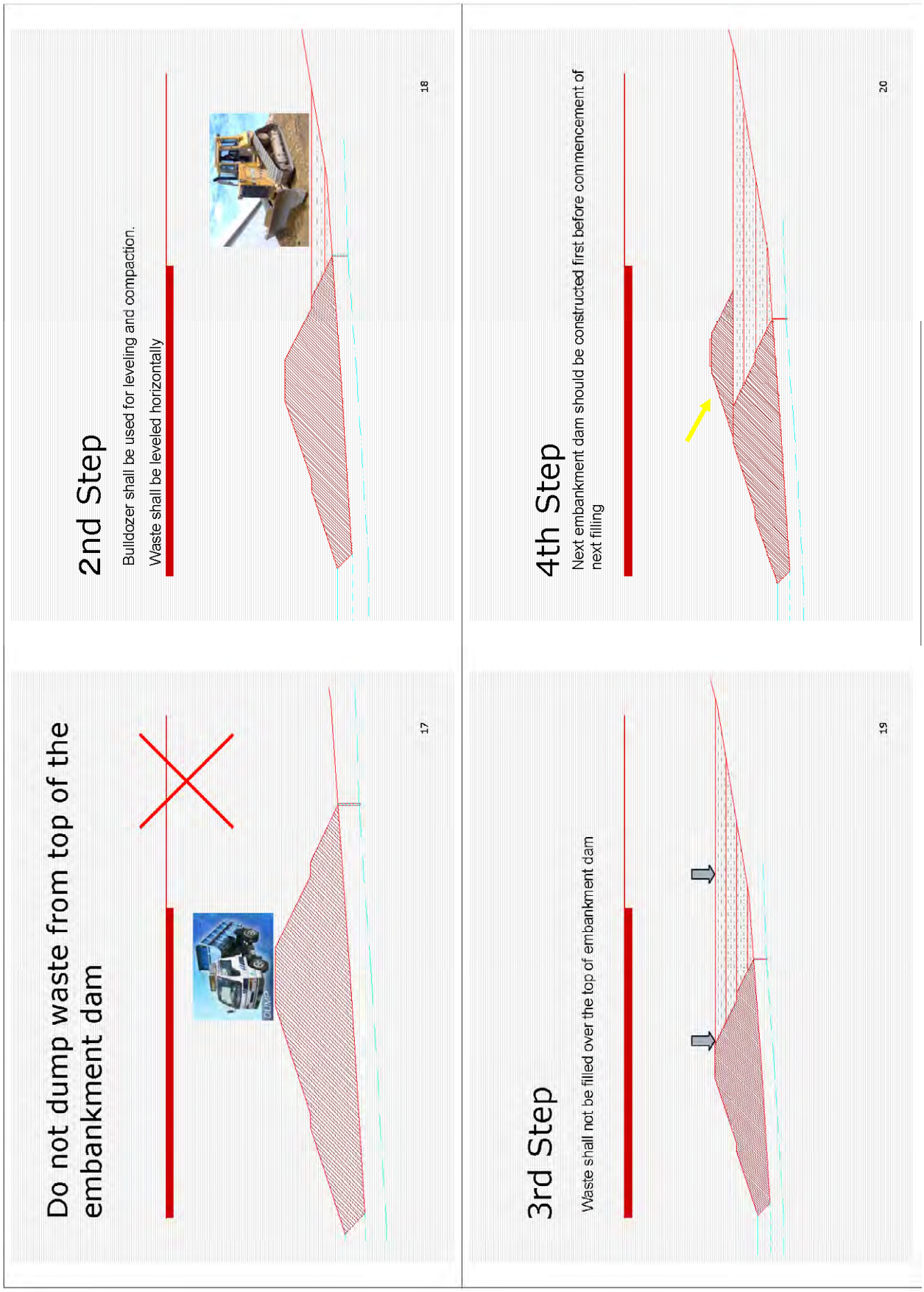
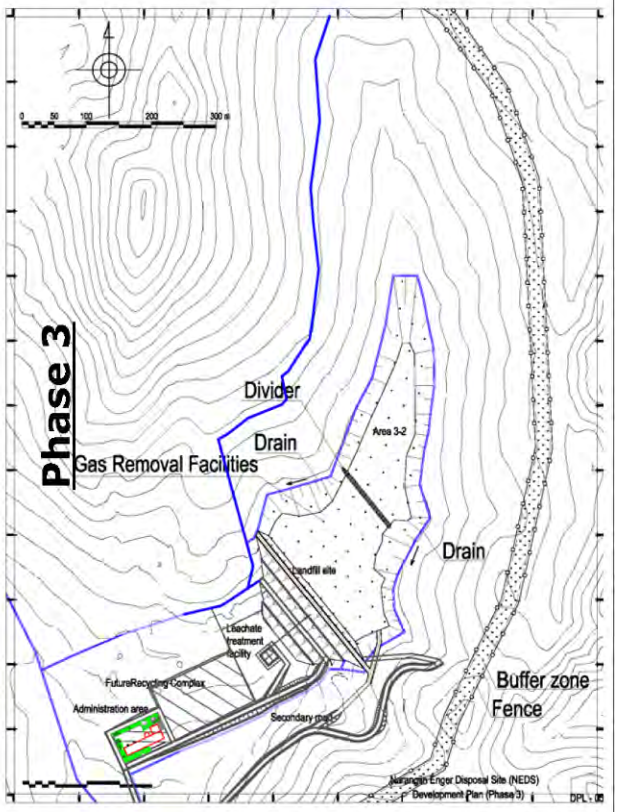

Do not dump waste from top of the embankment dam
17
3rd Step
Waste shall not be filled over the top of embankment dam
19
2nd Step
Bulldozer shall be used for leveling and compaction.
Waste shall be leveled horizontally
18
4th Step
Next embankment dam should be constructed first before commencement of next filling
20

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.

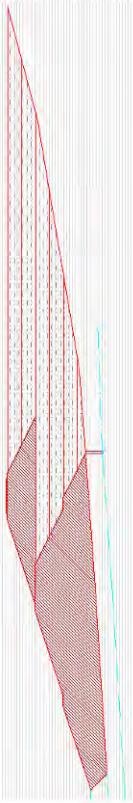
22

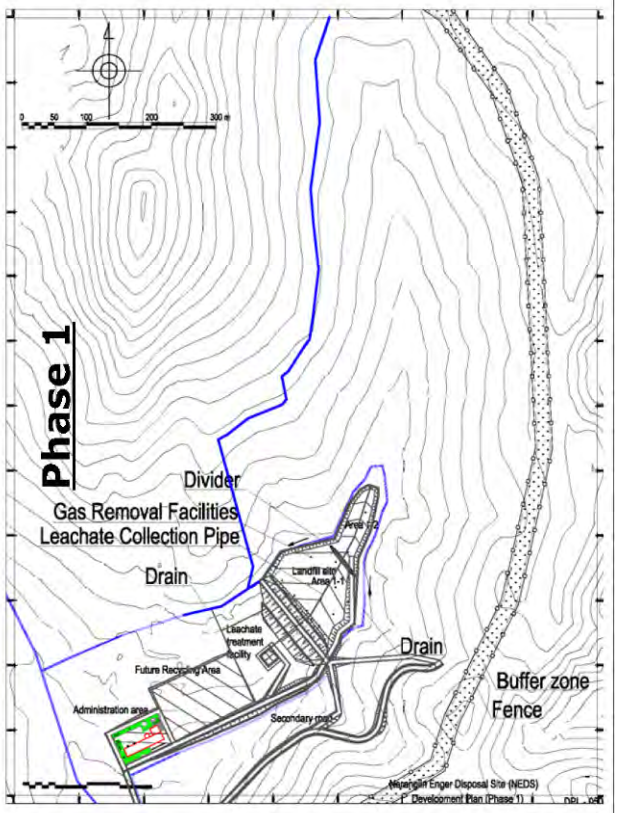


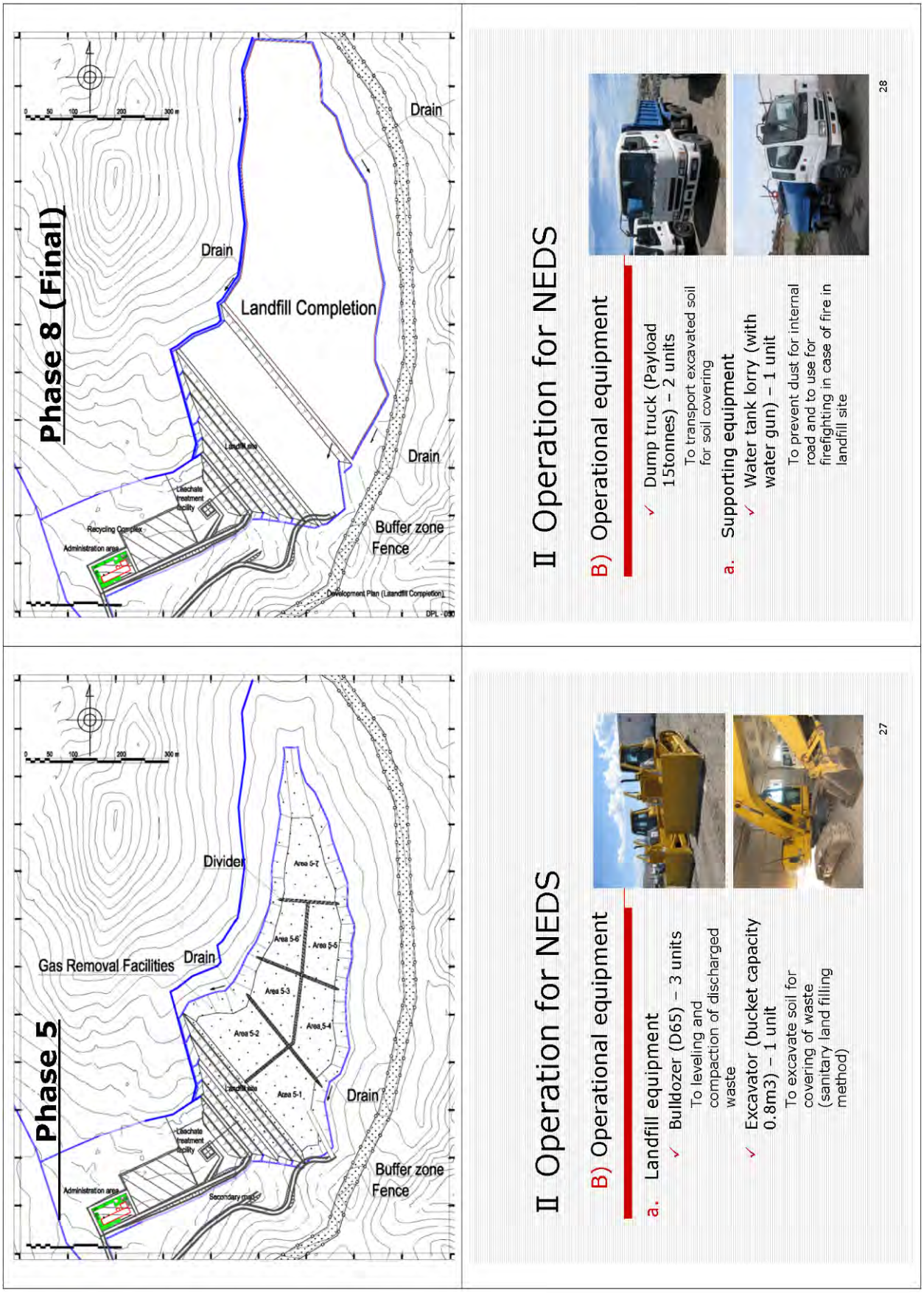
5th Step

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

21






Phase 8 (Final)
Drain
Drain
Landfill Completion
Drain
Buffer zone
Fence
Leachate treatment facility
Recycling Complex
Administration area
Development Plan (Landfill Completion)
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
28
Phase 5
Divider
Gas Removal Facilities
Drain
Drain
Buffer zone
Fence
Area 5-1
Area 5-2
Area 5-3
Area 5-4
Area 5-5
Area 5-6
Area 5-7
Leachate treatment facility
Administration area
Secondary road
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)
27

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

29

◆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

36

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.

37

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

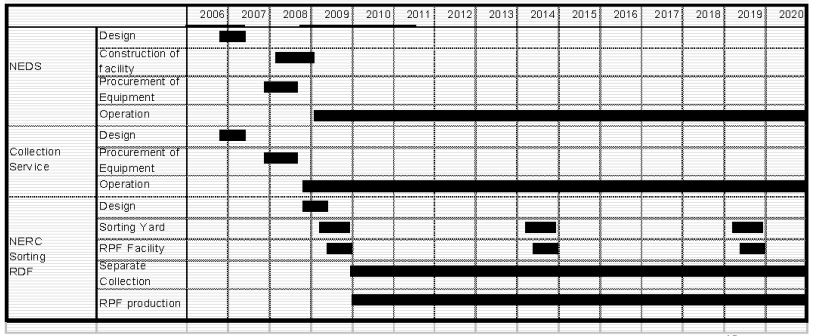
(Note): *1: Service fee collection rate identified by the Questionnaire survey to the Khoroo governors in ger area in August 2006
*2: This rate includes recyclable and non-recyclable wastes separated.

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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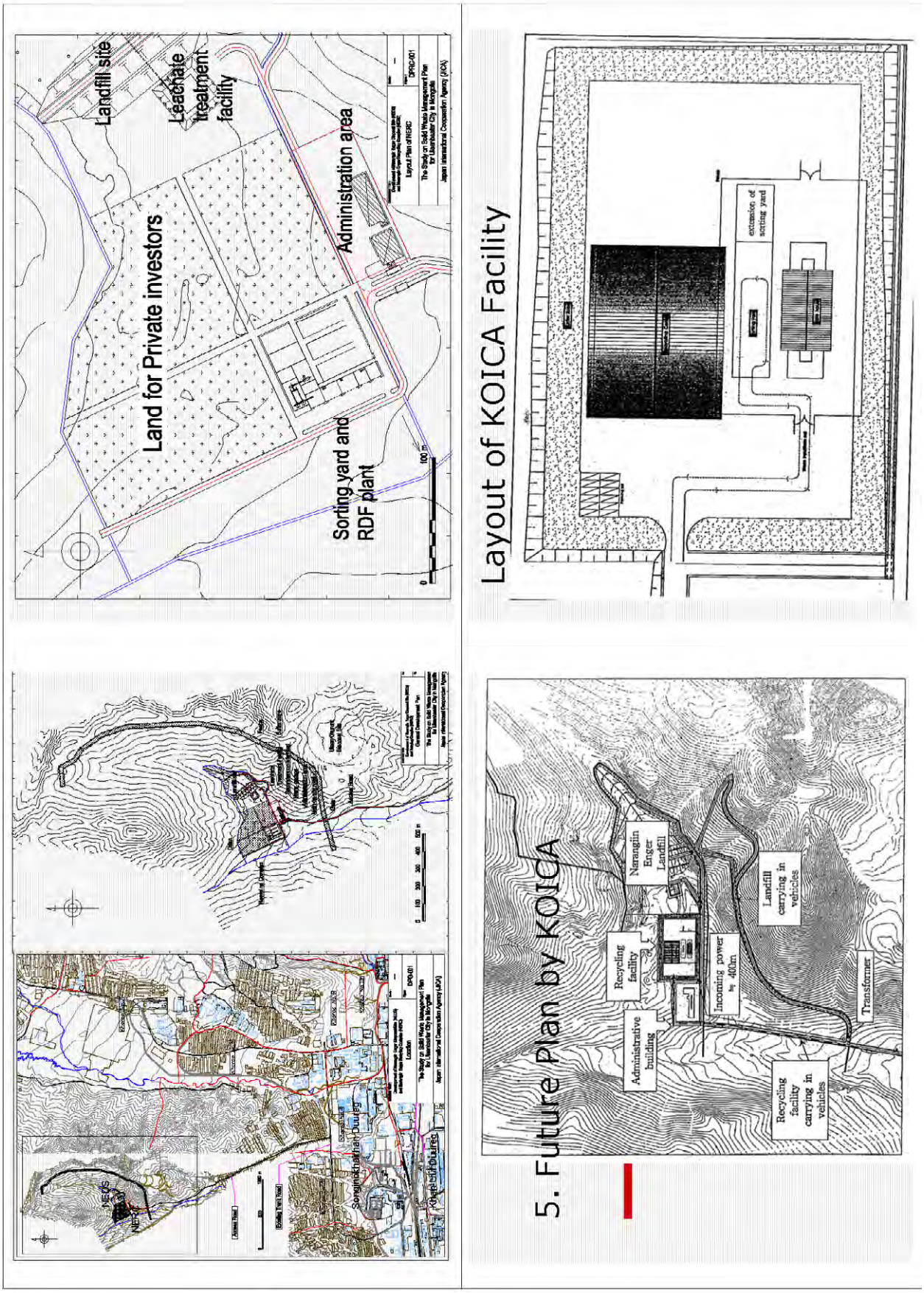
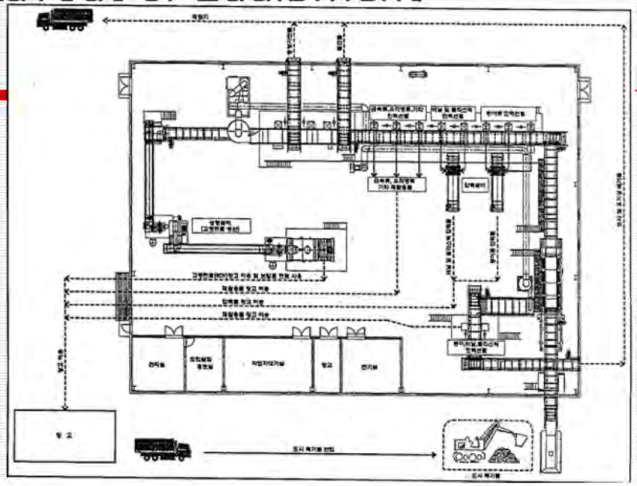

Landfill site
Leachate treatment facility
Land for Private investors
Administration area
Sorting yard and RDF plant
Layout of KOICA Facility
extension of sorting yard
5. Future Plan by KOICA
Recycling facility
Administrative building
Incoming power
Narangiin Enger Landfill
Landfill carrying in vehicles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

Layout of Equipment



45

Operation of NERC

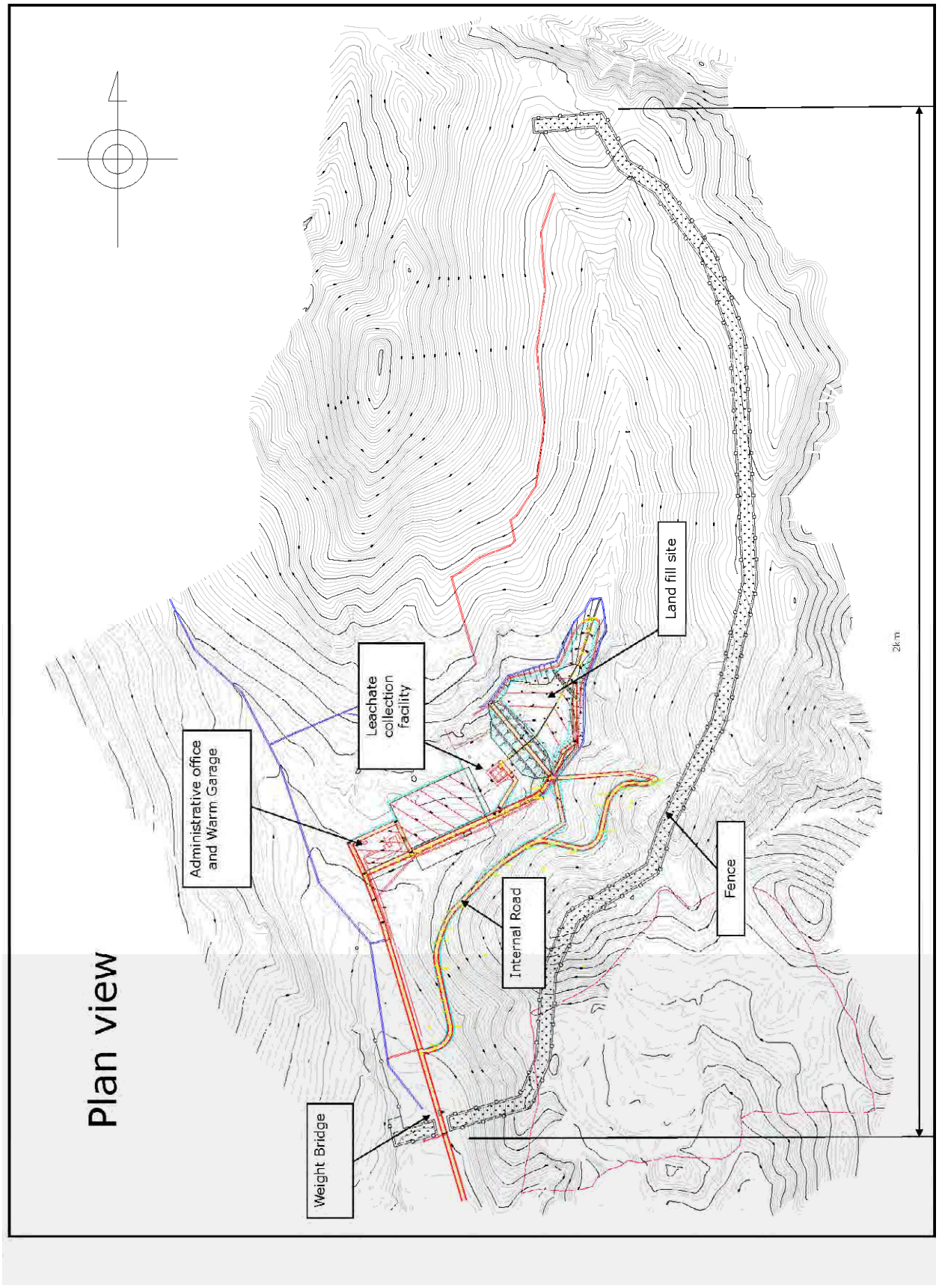
- Sorting and RPF facility will be constructed by KOICA and expected to be completed in early 2012
- Operation will be commenced in 2012
- Detailed operation plan should be formulated utilizing results of JICA pilot project and KOICA F/S including necessary budget for operation and plant which incinerate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

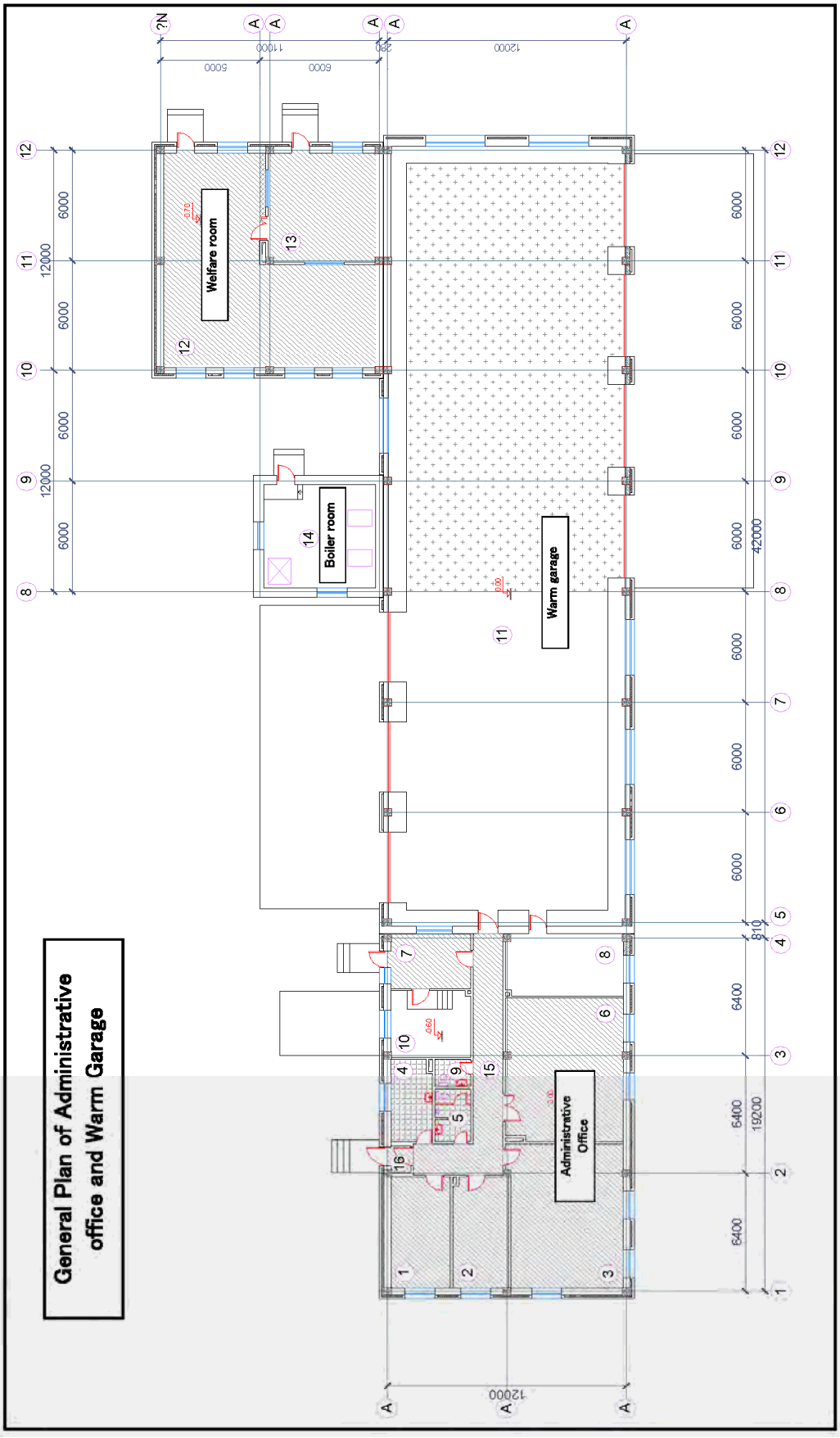
46

Thank you very much for your attention

47

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
12000
6000
42000
19200
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**

5

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		Asuncion	Manila	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	47.20
Paper	%	12.7(2.4)	21.7(15.9)	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.

7

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.

8

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

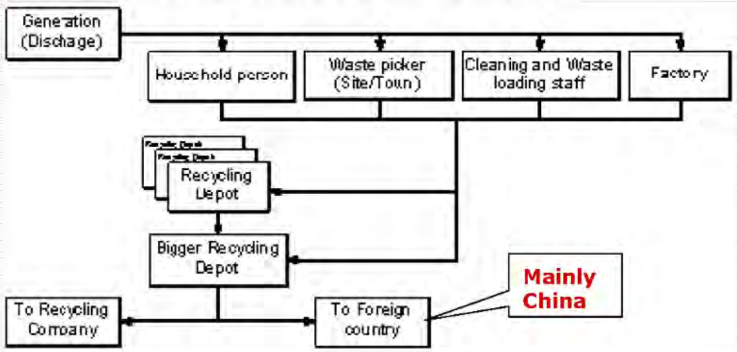
- Carried out once in the summer and winter seasons to identify efficiency and problems with the collection and transport system and issues.

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

12

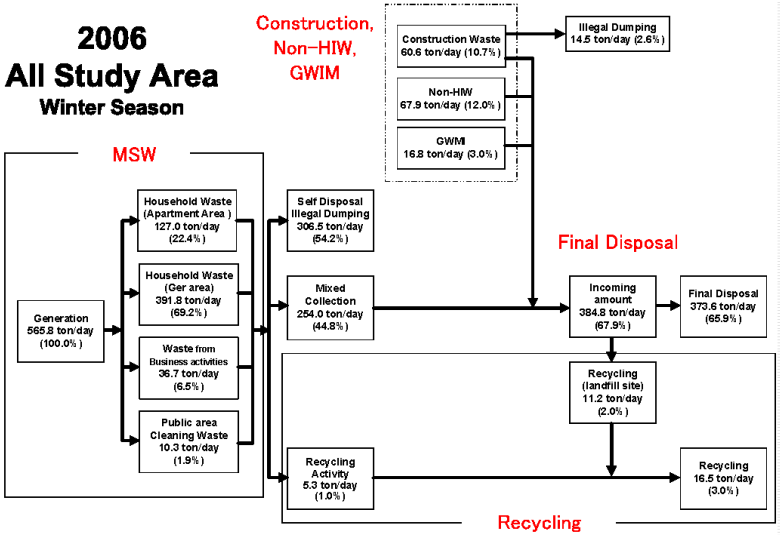
I-5 Survey on Other Generation Sources (2)

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

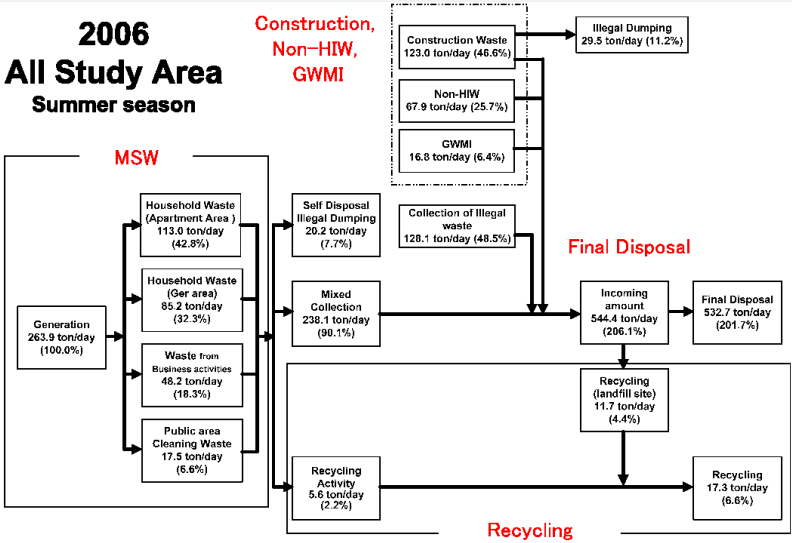
3. **Survey on construction waste**
- To identify the waste volume generated from the construction industry and their disposal system.
- Winter Generation Amount: 60.6 tons/day
- Summer Generation Amount: 123.0 tons/day

13

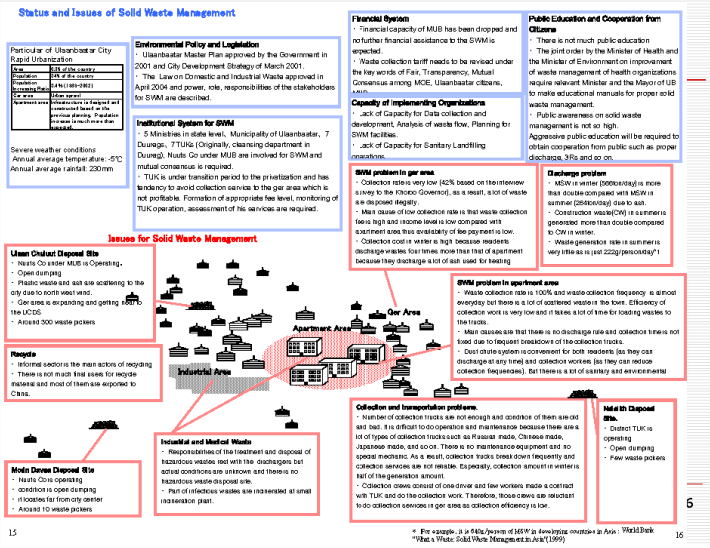
I-6. (1) Waste Stream in UBC (Winter) in 2006



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

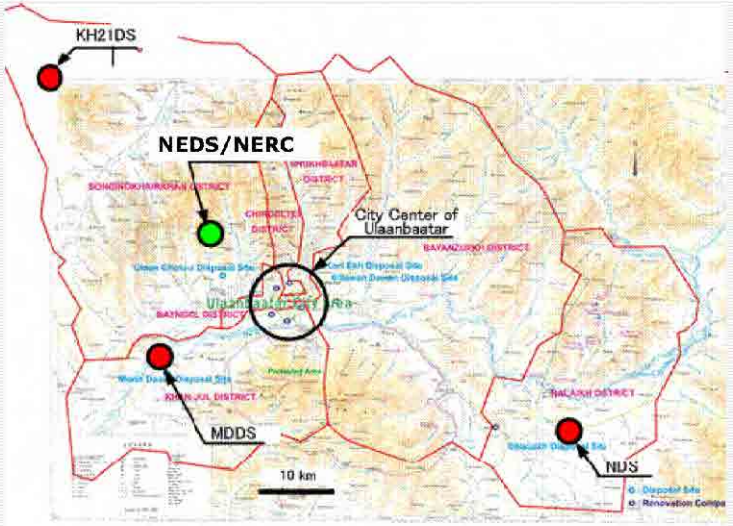
17

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.

18

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.

21

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%).

22

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

23

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 %

24

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.

25

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%

27

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.

28

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.

29

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**

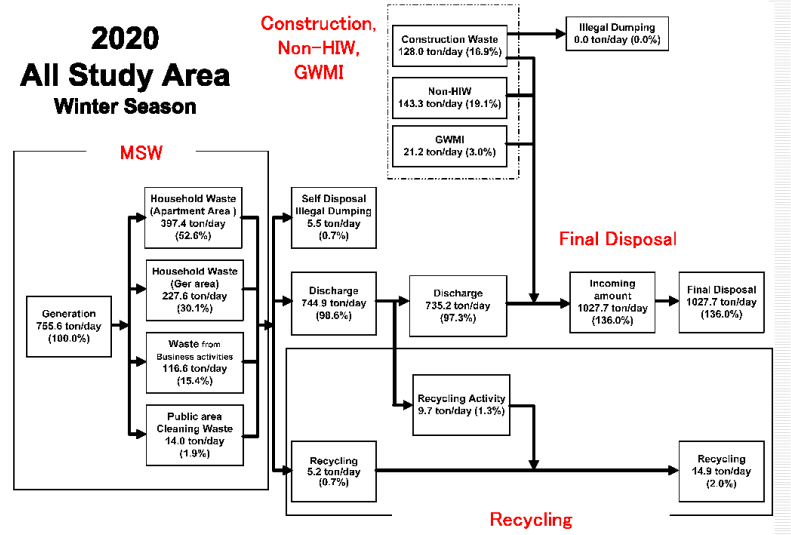
II-3. (10): Forecast of Future Waste Flow without 3Rs Promotion (M/P)

- **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.**

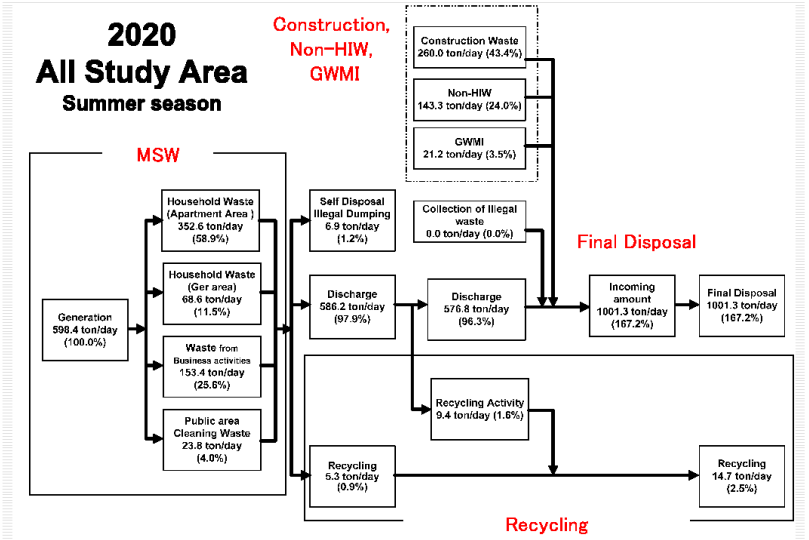
1. **The collection service is provided to all residents in Ulaanbaatar City (UBC).**
2. **There is no public sector waste treatment or recycling facility, as is the present situation, and recycling is carried out by the private sector based on economic principles.**
3. **Waste picking activities are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

31

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



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

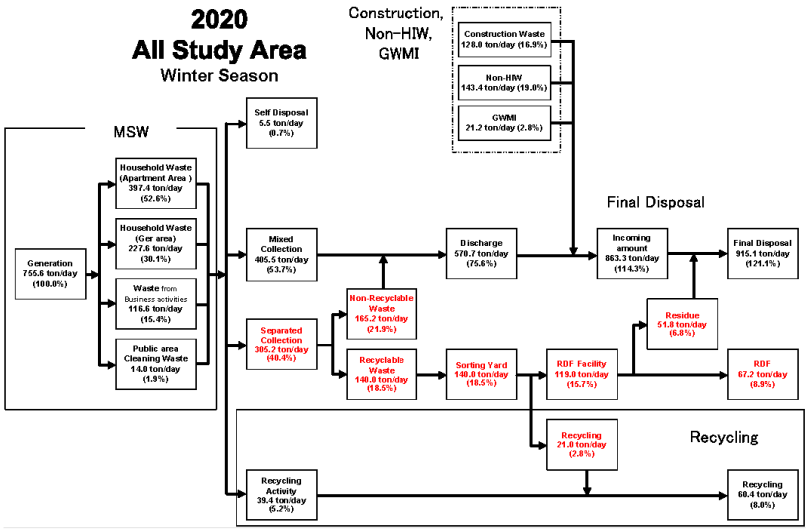


II-3. (13): Forecast of Future Waste Stream with 3Rs Promotion (M/P)

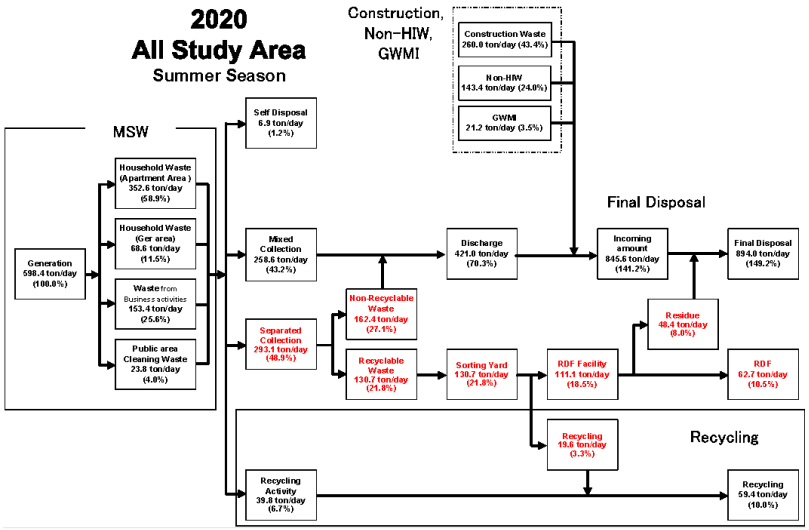
Future waste stream with M/P implementation was drawn up after the selection of optimum technical system. Then, target of M/P technical system was set as follows:

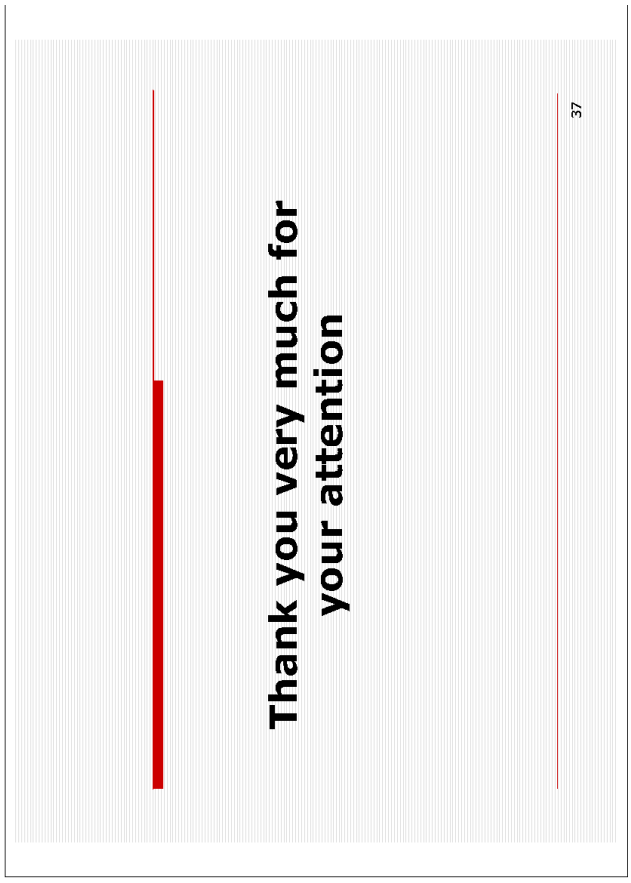
Items	Present (2006)	1st Phase (2010)	2nd Phase (2015)	3rd Phase (2020)
Waste Collection Rate (%) • Apartment Area • Ger Area	100 42*1	100 100	100 100	100 100
Self-disposal and improper disposal (%) • Winter • Summer	54.2 20.2	1.2 2.6	1.0 1.9	0.7 1.2
Separate collection in apartment area • Separate collection 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