ULAANBAATAR CITY MONGOLIA

Strengthening the Capacity for Solid Waste Management in Ulaanbaatar City

FINAL REPORT
DATA BOOK

September 2012

JAPAN INTERNATIONAL COOPERATION AGENCY（JICA）
Project Team for SWM in Ulaanbaatar City
KOKUSAI KOGYO CO.,LTD.

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Content

Section A

Activities for Policy Making and Planning

A Activities for Policy Making and Planning

A.1 EPWMD Action Plan（Year 2013 up to 2016）

Action Plan (A/P) of Solid Waste Management (SWM) in MUB from 2013 to 2016

A.1.1 Goal and Strategies

a. Goal

The fundamental goal of the A/P for SWM in MUB is:

"To establish an environmentally sound SWM system in MUB by 2016 through the promotion of 3R (reduce, reuse, recycle)".

b. Strategies

The above-mentioned goal shall be achieved by implementation of the following strategies:

Strategy 1. Establishment of proper waste management and recycling at generation sources

- Establishment of discharge rules
- Promotion of 3Rs at generation sources

Strategy 2. Improvement of collection and transportation system

- Strengthening of waste collection and transportation capacity
- Improvement of waste collection fee management system

Strategy 3. Improvement of public area cleaning system

- Strengthening of public area cleansing services
- Elimination of littering

Strategy 4. Promotion of recycling

- Operation of RPF plant
- Support of recycling industries

Strategy 5. Improvement of final disposal system

- Implementation of sanitary landfill operation
- Construction of a new disposal site (TDDS) for eastern districts

Strategy 6. Establishment of hazardous waste management

- Improvement of legal background
- Establishment of hazardous industrial waste management

Strategy 7. Establishment of construction waste management

- Improvement of legal background

A.1.2 Action Plan

a. Waste Generation and Target

Action Plan Quantitative Targets for Ulaanbaatar SWM

Items	2013	2014	2015	2016
Population				
Apartment Area	460,619	473,434	486,605	500,142
Ger Area	740,564	761,551	782,183	802,448
Total	1,201,183	1,234,985	1,268,788	1,302,590
Waste Generation Amount (Winter) ton/day				
Apartment Area	162.1	173.3	185.4	198.6
Ger Area	781.3	809.5	837.7	865.8
Business	216.0	230.9	247.0	264.6
Public Cleansing	12.9	13.2	13.6	13.9
Total	1,172.3	1,226.9	1,283.7	1,342.9
Waste Generation Amount (Summer) ton/day				
Apartment Area	137.7	147.2	157.1	168.5
Ger Area	176.3	188.9	201.8	215.9
Business	260.5	278.5	298.4	318.8
Public Cleansing	21.9	22.5	23.1	23.7
Total	596.4	637.1	681.1	726.9
Waste Collection Rate (%)				
Apartment Area	100	100	100	100
Ger Area	91	92	93	94
Incoming Amount of Waste to Sorting Yard at NERC (ton/year)				
• Operation days (days/year)	300	300	300	300
• Incoming Amount (ton/day)	0.69	2.07	5.52	13.79
• Incoming Amount (ton/year)	207	621	1,656	4,137
Salvage Amount of Valuables at Sorting Yard of NERC (ton/year)				
• Salvage amount of recyclables with cardboard (ton/year)	0.34	1.03	2.74	6.85
• Salvage amount of recyclables without cardboard (ton/year)	0.08	0.23	0.62	1.55
Production of RPF				
• Operation days	300	300	300	300
• Production Amount (ton/day)	0.20	0.59	1.58	3.96
• Production Amount (ton/year)	60	177	474	1,188
Separate collection in apartment area				
• Separate collection rate (%)	4.3	8.4	16.4	32.0
• Covered population (person)	20,000	40,000	80,000	160,000

b. Action Plan

A/P for SWM in MUB

Strategies	Approach	Projects	2013		2014		2015		2016		Budget
1.Establishment of proper waste management and recycling at generation sources	1.1Establishment of discharge rules	1.1.1 To study and provide discharge rules according to the area conditions.									T & M Survey
		1.1.2 To make educational tools for public cooperation for discharge manner		10 mil.							
		1.1.3 To conduct public education and campaign for discharge manner dissemination				10 mil.		10 mil.		10 mil.	1 mil Tg per khoroo
	1.2 Promotion of 3Rs at generation sources	1.2.1 To make educational tools for public cooperation for 3R promotion		10 mil							
		1.2.2 To conduct public education and campaign to avoid using excess packages such as plastic shopping bags				10 mil.		10 mil.		10 mil.	
		1.2.3 To conduct public education and campaign to separate recyclable wastes				10 mil		10 mil.		10 mil.	
		1.2.4 To collaborate with MONET to amend “Law on Household and Industrial Waste” to promote 3R and proper treatment and disposal									
2.Improvement of collection and transportation system	2.1 Strengthening of waste collection and transportation capacity	2.1.1 To replace old collection vehicles									
		2.1.2 To purchase additional collection vehicles for collection service expansion									
		2.1.3 To strengthen capability of central workshop									
	2.2 Improvement of waste collection fee management system	2.2.1 To review and modify the collection fee considering inflation, etc.									
		2.2.2 To review and modify the collection payment system considering inflation, etc.									
		2.2.3 To disseminate tendering system for selection of collection service contractor.									
		2.2.4 To support CMPUA to operate weigh bridges (NEDS, MDDS, TDDS) and manage weigh bridge data									
3.Improvement of public area cleaning system	3.1 Strengthening of public area cleansing services	3.1.1 To study and formulate expansion plan for public area cleansing services									
		3.1.2 To replace old equipment and purchase new equipment for service expansion									
		3.1.3 To employ additional cleaners for service expansion									
	3.2 Elimination of littering	3.2.1 To purchase public containers for public area.									
		3.2.2 To conduct public education and campaign to eliminate littering									
4. Promotion of recycling	4.1 Operation of RPF plant	4.1.1 To find, discuss and negotiate with possible users of RPF									

		4.1.2 To decide separate collection area and conduct separate collection for RPF production										
		4.1.3 To operate and produce RPF.										
	4.2 Support of recycling industries	4.2.1 To make a study and a plan for possible improvement of recycling industries										Training
		4.2.2 To support recycling industries of their business improvement.										10 bil. Tg
5. Improvement of final disposal system	5.1 Implementation of sanitary landfill operation	5.1.1 To support CMPUA to replace old landfill equipment for NEDS and MDDS	Bulldozer	200 mil.					Bulldozer	600 mil.		
		5.1.2 To support CMPUA to purchase additional landfill equipment for NEDS and MDDS										
		5.1.3 To provide CMPUA O&M budget to conduct sanitary landfill operation in NEDS, MDDS and TDDS	242,091ton	726milTg	255,135ton	765milTG	268,918ton	807milTg	283,304ton	850milTG		3000 Tg/ton x 1,049,448 ton
		5.1.4 To conduct public education and campaign to understand need of sanitary landfill for proper SWM										
	5.2 Construction of a new disposal site (TDDS) for eastern districts	5.2.1 To support CMPUA to construct TDDS	Civil engineering facility	1 bil.	Access road	0.5 bil.						1.5 bil. Tg
		5.2.2 To support CMPUA to conduct sanitary landfill operation	80,697ton	242milTg	85,045ton	255milTg	89,639ton	270milTg	94,435ton	283milTg		3000 Tg/ton x 349,816 ton
6. Establishment of hazardous waste management	6.1 Improvement of legal background	6.1.1 To collaborate with MONET to amend “Law on Household and Industrial Waste” to promote proper management and disposal of hazardous waste										
		6.1.2 To collaborate with MONET to provide necessary laws and decrees for proper management and disposal of hazardous waste										
		6.1.3 To enforce laws and decrees for proper management and disposal of hazardous waste										
	6.2 Establishment of hazardous industrial waste management	6.2.1 To collaborate with MONET to make a study and a plan for proper management of hazardous industrial waste										2 bil. Tg (FS)
		6.2.2 To collaborate with MONET to construct a proper hazardous industrial waste management facility										10 bil. Tg
7. Establishment of construction waste management	7.1 Improvement of legal background	7.1.1 To collaborate with MORTCUD to amend “Law on Household and Industrial Waste” to promote proper management and disposal of construction waste										
		7.1.2 To collaborate with MORTCUD to provide necessary laws and decrees for proper management and disposal of construction waste										
		7.1.3 To enforce laws and decrees for proper management and disposal of construction waste										

A.2 Workshop for formulation and implementation of SWM Master Plan for Central Provincial Cities based on the experience of UBC

A.2.1 Background and Objectives

a. Background

The Japan International Cooperation Agency (JICA) is implementing technical cooperation project "Strengthening the Capacity for Solid Waste Management (SWM) in Ulaanbaatar City" from September 2009 and it will continues until September 2012.

Prior to this project, "The Study on SWM Plan for Ulaanbaatar City in Mongolia" for the duration of 2 years from 2004 had been implemented and a Master Plan (M/P) for Ulaanbaatar City (Target Year 2020) was formulated.

The fundamental goal of the M/P for SWM in Municipality of Ulaanbaatar (MUB) is: "To establish an environmentally sound SWM system in MUB by the target year 2020". In the environmentally sound SWM system, the 3Rs (Reduce, Reuse and Recycle) of waste are promoted and the following situation should be established.

(1) Waste reduction is encouraged at the generation source such as households and business enterprises.

(2) Waste generated after the attempt of waste reduction is reused or recycled as much as possible.

(3) Waste is properly collected only after the efforts of waste reduction, reuse or recycling at the generation source, and recycled/treated, then finally disposed of in a manner without negative environmental impacts.

(4) Such a SWM system will be established by requiring the governmental sector, private sector and general public to bear adequate responsibilities under a transparent and fair rule is achieved.

In Mongolia, due to rapid economic growth, urbanization in many provincial cities are progressing. Provincial cities as well as UBC are facing serious environmental problems due to inappropriate solid waste management caused by rapid urbanization.

In order to improve these situations, MONET requested all provincial cities to formulate M/P on SWM and organized National Seminar on Waste calling all representatives from provincial cities on 15 February 2011. This time, in order to ensure the proper formulation of M/P at provincial cities, MONET requested JICA and MUB/EPWMD/CMPUA to provide technical support to formulate M/P on SWM in central provincial cities based on the experience of formulating M/P on SWM in UBC.

As a result, JICA and MUB/EPMWD/CMPUA in cooperation with MOMNT decided to organize "Workshop for Formulation and Implementation of SWM Master Plan based on the

Experience in UBC" with responsible officers for SWM of provincial cities in central region.

b. Objective

The objectives of the workshop are:

To learn how to formulate and implement SWM M/P based on the experience of MUB/EPWMD/CMPUA,

To share the experiences on the improvement of SWM in MUB, and

To prepare concept of SWM M/P for 10 provincial cities and an action plan (A/P) for formulation of the M/P.

A.2.2 Outline of the Workshop

a. Date and Venue

Date: June 28 (Tue), 29 (Wed) and 30 (Thu), 2011

Place: Mongolia- Japan Center

b. Participants

Mongolia is divided into 22 major administrative units comprising of 21 Provinces (Aimags) and the capital city of Ulaanbaatar. Each Province (Aimag) has a provincial city (Aimag Center) as the capital city of the Aimag. In total 10 central provincial cities as shown below have participated in the workshop. In addition to the officers from 10 provincial cities, officers from MONET, EPWMD/MUB and CMPUA/MUB have attended as lecturers and instructors for the participants of Aimags. The following table presents all participants in the workshop.

Table A-1: Workshop Participant List

No	Aimag or Organization	Name	Position
1	Arkangai Aimag	D.Chuluun-Erdene	Officer, DONET of Arkangai Aimag
2	Arkangai Aimag	Ts.Erdenechimeg	Manager, CMPUA of Tsetserleg City
3	Bulgan Aimag	A.Gantumur	Director, DONET of Bulgan Aimag (Bulgan City)
4	Bulgan Aimag	M.Altantsetseg	Manager, Bulgan Aimag (Bulgan City)
5	Dornogobi Aimag	D.Bolormaa	Officer, DONET of Dornogobi Aimag (Sainshand City)
6	Dornogobi Aimag	B.Yalaltbayar	Officer, Governor's Office of Dornogobi Aimag (Sainshand City)
7	Orkhon Aimag	N.Erdenebaatar	Director, CMPUA of Erdenet City
8	Orkhon Aimag	P.Enkhselenge	Officer, DONET of Orkhon Aimag (Erdenet City)
9	Uvurkhangai Aimag	B.Ankhtuya	Officer, Governor's Office of Uvurkhangai Aimag (Arvaikheer City)

10	Uvurkhangai Aimag	G.Bold	Officer, DONET of Uvurkhangai Aimag (Arvaikheer City)
11	Khuvsgul Aimag	B.Khandarmaa	Officer, DONET of Khuvsgul Aimag (Murun City)
12	Khuvsgul Aimag	Ch.Erdenechimeg	Officer, Governor's Office of Khuvsgul Aimag (Murun City)
13	Darkhan-Uul Aimag	B.Lkhasuren	Officer, DONET of Darkhan-Uul Aimag (Darkhan City)
14	Tuv Aimag	M.Tseepil	Officer, DONET of Tuv Aimag (Zuunmod City)
15	Tuv Aimag	Kh.Enkhbayasgalan	Director, CMPUA of Tuv Aimag (Zuunmod City)
16	Bayankhongor Aimag	L.Mandal	Director, DONET of Bayankhongor Aimag (Bayankhongor City)
17	Bayankhongor Aimag	G.Ulziimaa	Officer, DONET of Bayankhongor Aimag (Bayankhongor City)
18	Govisumber Aimag	N.Erdenetsestseg	Officer, DONET of Govisumber Aimag (Choir City)
19	MONET	Batsuuri	State Secretary
20	MONET	Munkhbat	Officer
21	MONET	Zayatogtokh	Intern
22	EPWMD/MUB	Ariguun	Senior Officer
23	EPWMD/MUB	Odjargal	Officer
24	CMPUA/MUB	Vandanmagsar	Disposal Site Manager
25	CMPUA/MUB	Altangerel	Deputy Director
26	JICA Mongolia Office	Toshinori Isogai	Resident Representative
27	JICA Mongolia Office	Kazue Minami	Representative
28	JICA Mongolia Office	Solongo	Program Administrative Officer
29	JET	Ichiro Kono	Chief Advisor
30	JET	Susumu Shimura	Financial Management
31	JET	Hiroshi Fujita	Landfill Management
32	JET	Mie Nagayasu	Waste Separation & Recycling
33	JET	Timuujin	Project staff
34	JET	Gantumuur	Project staff
35	JET	Enkhbadral	Project staff

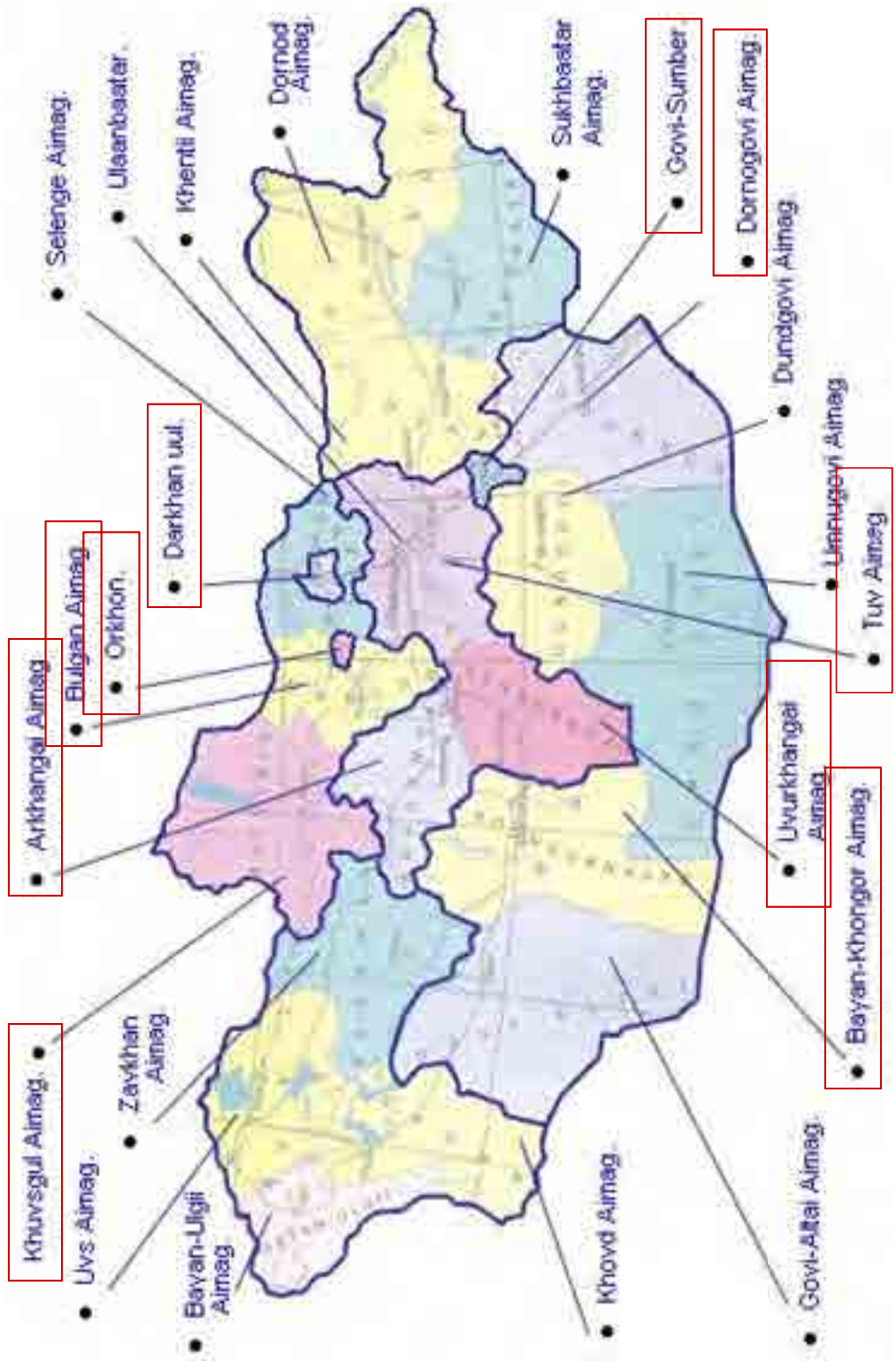


Figure A-1: Location of Provinces (Aimags) in Mongolia

c. Workshop Program

The workshop program has was planned and implemented as shown in the table below.

Table A-2: Workshop Program

Subject	Responsible Personnel	Time
The First Day (June 28, 2011)		
Registration		8:30 – 9:00
P.1 Opening Speech	MONET, MUB, JICA	9:00 – 9:30
P.2 Objectives and contents of the workshop	JET	9:30 – 10:00
P.3 Need and work flow of M/P formulation	JET	10:00 – 10:50
Coffee break		10:50 – 11:10
P.4.1 Formulation of M/P for MUB (1): Site selection	EPWMD/JET	11:10 – 12:00
P.4.2 Formulation of M/P for MUB (2): Planning of 3R system	EPWMD/JET	12:00 – 12:50
Lunch		12:50 – 14:00
P.5 Plan and operation of NEDS and NERC	CMPUA/JET	14:00 – 14:50
P.6 Site visit of NEDS and NERC	CMPUA/JET	14:50 – 17:30
The Second Day (June 29, 2011)		
P.7 M/P framework: Forecast of waste amount and composition, etc.	JET	9:00 – 9:45
P.8 Plan and operation of collection system	CMPUA/JET	9:45 – 10:30
P.9 Site visit of 3R promotion sites, workshop, etc.	CMPUA/JET	10:30 – 12:50
Lunch		12:50 – 14:00
P.10 Workshop (1): Preparation of framework for SWM M/P for each city	JET/EPWMD	14:00 – 15:00
P.11 Workshop (2): Collection system planning for SWM M/P for each city	JET/EPWMD	15:00 – 16:00
P.12 Workshop (3): Final disposal system planning for SWM M/P for each city	JET/EPWMD	16:00 – 17:00
The Third Day (June 30, 2011)		
P.13 Workshop (4): Recycling system planning for SWM M/P for each city	JET/EPWMD	9:00 – 10:00
P.14 Workshop (5): Formulation of concept of SWM M/P for each city and an action plan (A/P) for formulation of the M/P	JET/EPWMD	10:00 – 12:50

Lunch		12:50 – 14:00
P.15 Presentation of the concept of SWM M/P and the A/P for formulation of the M/P by 10 cities	Representatives of 10 cities	14:00 – 16:00
Evaluation of A/Ps and the training	JET	16:00 – 16:20
Hand out of workshop certificate	MONET	16:20 – 16:30
Closing speech	JICA, MUB, MONET	16:30 – 17:00

d. Workshop Documents

In order for the participants to understand the lectures and conduct tasks to be done in the workshop, the following workshop documents were prepared by the JET and delivered to all participants at the time of registration. In addition, several files in the form of Excel, Word and Power Point programs were provided to the participants for their works, i.e. preparation of concepts of their SWM M/P and A/P for formulation of the M/P.

Table A-3: Lists of Workshop Documents

Document No	Lecture
Doc 1	P.2 Objectives and contents of the workshop
Doc 2	P.3 Need and work flow of M/P formulation
Doc 3	P.4.1 Formulation of M/P for MUB (1): Site selection
Doc 4	P.4.2 Formulation of M/P for MUB (2): Planning of 3R system
Doc 5	P.5 Plan and operation of NEDS and NERC
Doc 6	P.6 Site visit of NEDS and NERC
Doc 7	P.7 M/P framework: Forecast of waste amount and composition, etc.
Doc 8	P.8 Plan and operation of collection system
Doc 9	P.9 Site visit of 3R promotion sites, workshop, etc.
Doc 10	P.10 Workshop (1): Preparation of framework for SWM M/P for each city
Doc 11	P.11 Workshop (2): Collection system planning for SWM M/P for each city
Doc 12	P.12 Workshop (3): Final disposal system planning for SWM M/P for each city
Doc 13	P.13 Workshop (4): Recycling system planning for SWM M/P for each city
Doc 14	P.14 Workshop (5): Formulation of concept of SWM M/P for each city and an action plan (A/P) for formulation of the M/P

Doc 15	P.15 Presentation of the concept of SWM M/P and the A/P for formulation of the M/P by 10 cities
Doc 16	Comparison table of candidate sites for future disposal site
Doc 17	Calculation sheet for population forecast and future waste generation
Doc 18-1	Calculation Sheet for Required Landfill Volume
Doc 18-2	Calculation Sheet for Disposal Site Volume
Doc 19	Calculation Sheet for Collection System Planning

The documents provided to the participants presented below.

d.1 Document 1: Objectives and contents of the workshop

Doc 1

Objectives and Contents of the Workshop

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

June 28, 2011

JICA Expert Team

For the Project for Strengthening the Capacity for SWM in Ulaanbaatar City

1

Background

- Provincial cities are facing serious environmental problems due to inappropriate SWM caused by rapid urbanization.
- To improve these situations, MONET requested all provincial cities to formulate M/P on SWM and organized National Seminar on Waste on 15 February 2011.
- To ensure the proper formulation of M/P at provincial cities, MONET requested JICA and MUB/EPWMD/CMPUA to provide technical support to formulate M/P on SWM in selected provincial cities based on the experience of formulating M/P on SWM in UBC.

2

Objectives

- To learn how to formulate and implement SWM M/P based on the experience of MUB/EPWMD/CMPUA,
- To share the experiences on the improvement of SWM in MUB; and
- To prepare concept of SWM M/P for 10 provincial cities and an action plan (A/P) for formulation of the M/P.

=> Consequently the workshop will facilitate each provincial city to prepare its own SWM M/P and to implement the plan

3

Workshop and M/P Formulation and Implementation

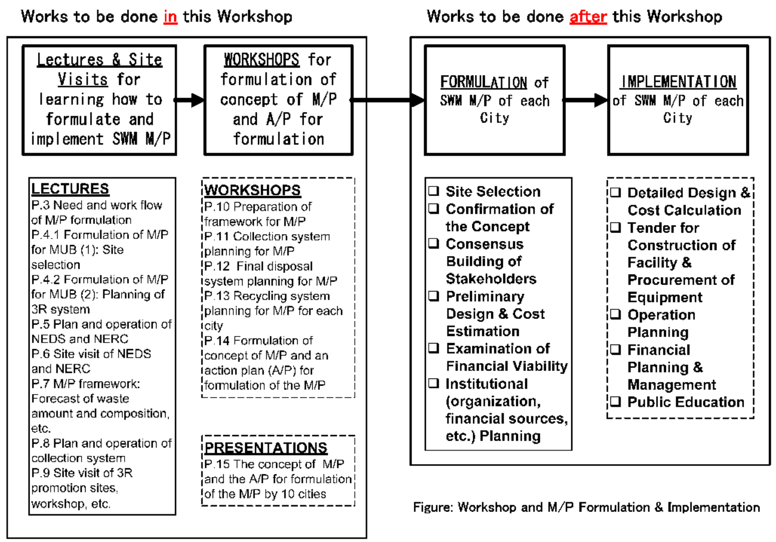

Works to be done in this Workshop
Works to be done after this Workshop
Lectures & Site Visits for learning how to formulate and implement SWM M/P
WORKSHOPS for formulation of concept of M/P and A/P for formulation
FORMULATION of SWM M/P of each City
IMPLEMENTATION of SWM M/P of each City
LECTURES
P.3 Need and work flow of M/P formulation
P.4.1 Formulation of M/P for MUB (1): Site selection
P.4.2 Formulation of M/P for MUB (2): Planning of 3R system
P.5 Plan and operation of NEDS and NERC
P.6 Site visit of NEDS and NERC
P.7 M/P framework: Forecast of waste amount and composition, etc.
P.8 Plan and operation of collection system
P.9 Site visit of 3R promotion sites, workshop, etc.
WORKSHOPS
P.10 Preparation of framework for M/P
P.11 Collection system planning for M/P
P.12 Final disposal system planning for M/P
P.13 Recycling system planning for M/P for each city
P.14 Formulation of concept of M/P and an action plan (A/P) for formulation of the M/P
PRESENTATIONS
P.15 The concept of M/P and the A/P for formulation of the M/P by 10 cities
Site Selection
Confirmation of the Concept
Consensus Building of Stakeholders
Preliminary Design & Cost Estimation
Examination of Financial Viability
Institutional (organization, financial sources, etc.) Planning
Detailed Design & Cost Calculation
Tender for Construction of Facility & Procurement of Equipment
Operation Planning
Financial Planning & Management
Public Education

Figure: Workshop and M/P Formulation & Implementation

Tasks of Workshop Participants

- The MONET requested all provincial cities to formulate M/P on SWM.
- First, participants learn the experiences of MUB on how to formulate and implement the M/P.
- Second, participants prepare concept of SWM M/P and A/P for formulation of the M/P.
- Then after the workshop participants shall formulate their SWM M/Ps using the lectures, materials and works provided by this workshop.
- We are expecting your active participation to the workshop

5

How to Conduct the Tasks (1)

- In the workshop, participants will be able to make the concept (outline) of M/P, i.e. framework like future population and waste amount & composition, suitable technical and institutional system.
- After the workshop, participants shall conduct some supplement works for completion of the M/P, i.e. site selection, consensus building of stakeholders, etc. according to the requirements.

6

How to Conduct the Tasks (2): Notes

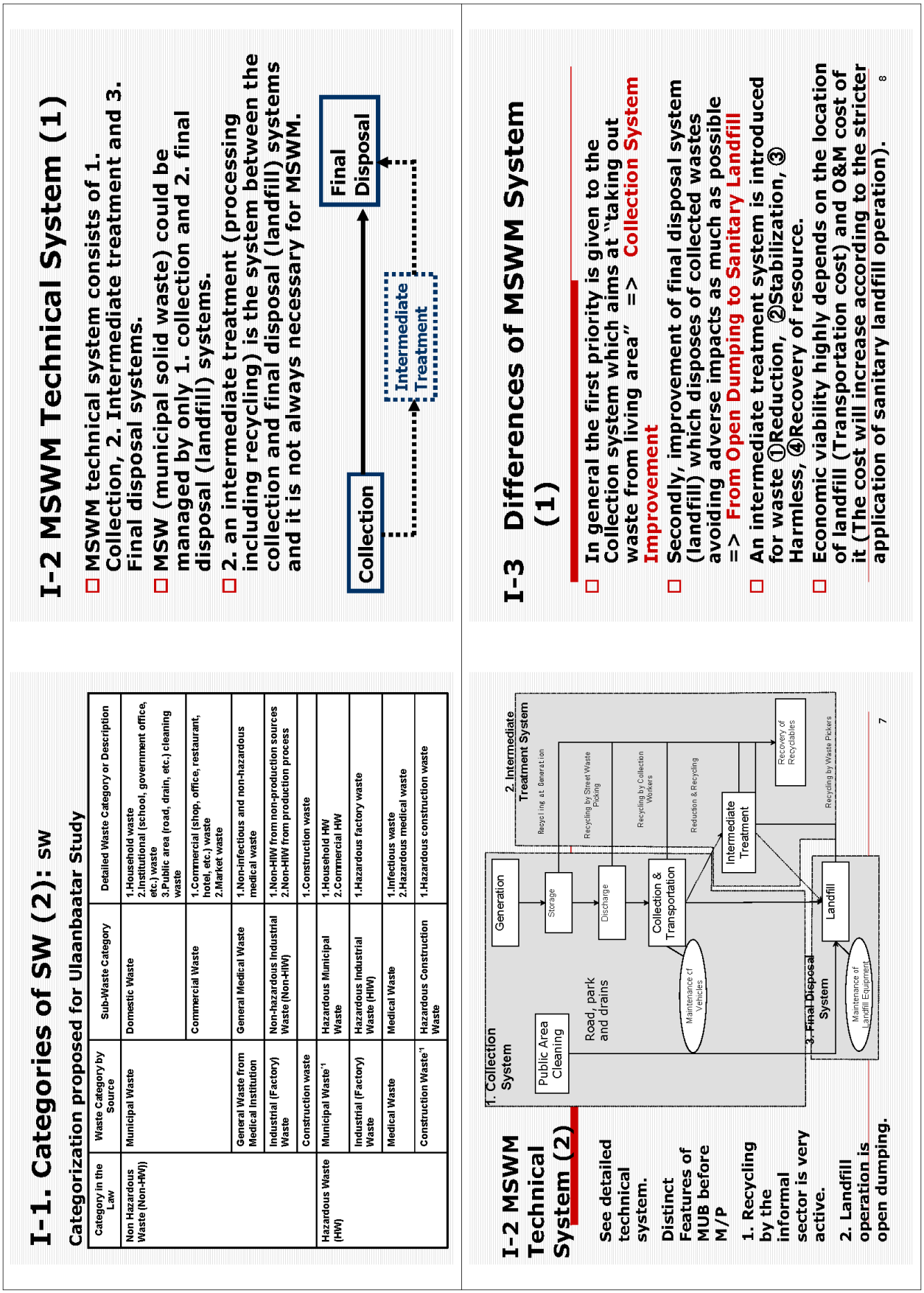
1. Participants shall make the M/P formulation work as simple as possible. Because the M/P of MUB has been formulated by the assistance of JICA experts and spent a considerable time and efforts.
2. To do so participants will avoid time & money consuming works like field investigations. In stead participants will be able to apply the results of field investigations conducted for the MUB M/P.
3. Participants will be able to use some useful materials made by the MUB M/P formulation and implementation.

7

Thank you very much for your attention

8

d.2 Document 2: Need and work flow of M/P formulation



I-1. Categories of SW (2): SW

Categorization proposed for Ulaanbaatar Study

Category in the Law	Waste Category by Source	Sub-Waste Category	Detailed Waste Category or Description
Non Hazardous Waste (Non-HW))	Municipal Waste	Domestic Waste	1.Household waste 2.Institutional (school, government office, etc.) waste 3.Public area (road, drain, etc.) cleaning waste
		Commercial Waste	1.Commercial (shop, office, restaurant, hotel, etc.) waste 2.Market waste
	General Waste from Medical Institution	General Medical Waste	1.Non-infectious and non-hazardous medical waste
	Industrial (Factory) Waste	Non-hazardous Industrial Waste (Non-HW)	1.Non-HW from non-production sources 2.Non-HW from production process
	Construction waste		1.Construction waste
Hazardous Waste (HW)	Municipal Waste*1	Hazardous Municipal Waste	1.Household HW 2.Commercial HW
	Industrial (Factory) Waste	Hazardous Industrial Waste (HW)	1.Hazardous factory waste
	Medical Waste	Medical Waste	1.Infectious waste 2.Hazardous medical waste
	Construction Waste*1	Hazardous Construction Waste	1.Hazardous construction waste

I-2 MSWM Technical System (1)

- MSWM technical system consists of 1. Collection, 2. Intermediate treatment and 3. Final disposal systems.
- MSW (municipal solid waste) could be managed by only 1. collection and 2. final disposal (landfill) systems.
- 2. 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.

Collection → Intermediate Treatment → Final Disposal

I-2 MSWM Technical System (2)

See detailed technical system.

Distinct Features of MUB before M/P

1. Recycling by the informal sector is very active.
2. Landfill operation is open dumping.

1. Collection System: Generation; Public Area Cleaning; Road, park and drains; Storage; Discharge; Collection & Transportation; Maintenance of Vehicles
2. Intermediate Treatment System: Recycling at Generation; Recycling by Street Waste Picking; Recycling by Collection Workers; Reduction & Recycling; Intermediate Treatment; Recovery of Recyclables; Recycling by Waste Pickers
3. Final Disposal System: Landfill; Maintenance of Landfill Equipment

7

I-3 Differences of MSWM System (1)

- In general the first priority is given to the Collection system which aims at "taking out waste from living area" => Collection System Improvement
- Secondly, improvement of final disposal system (landfill) which disposes of collected wastes avoiding adverse impacts as much as possible => From Open Dumping to Sanitary Landfill
- An intermediate treatment system is introduced for waste ①Reduction, ②Stabilization, ③Harmless, ④Recovery of resource.
- Economic viability highly depends on the location of landfill (Transportation cost) and O&M cost of it (The cost will increase according to the stricter application of sanitary landfill operation).

8

IV-3 Differences of MSWM System (2)

- Since the public sector should not neglect environmental protection (it costs a lot), no intermediate treatment facility in the world, owned by the public, is being operated without receiving a tipping fee that a user pays for reduction of transportation and landfill costs.
- Profit from sales of by-product (compost, electricity, recyclables, etc.) by the operation of a waste recycling facility can not cover real cost (depreciation + O&M costs).
- *The reason why 78% of SW are subject to the incineration in Japan is because tipping fee (landfill price) is extremely high (> 300 US$/ton).*

9

I-3 Differences of MSWM System (3): Why incineration is popular in Japan?

- Landfill cost is so expensive.
- Volume reduction by incineration reduce tipping fee (disposal cost).

Country	A. Unit Cost for Landfill (US$/ton)	B. Unit Cost for Incineration (US$/ton)	C. Benefit by Sales of By-product Electricity & Heat (US$/ton)	D. Benefit by Reduction of Landfill Cost (A x 0.8) (US$/ton)	E. Profit or Loss (C +D - B) (US$/ton)
Japan	300	150	5	240	+ 95.0
Bangkok in Thailand	10	60	2	8	- 50.0
UBC	4	60	3	3.2	- 53.8

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I-3 Differences of MSWM System (4): Situation in Bagdad in Iraqi (2008) => Urgent Improvement of Collection System

I-3 Differences of MSWM System (5): Situation in Sri Lanka (2002) => Collection System

Collection service is hard work and cost a lot

No discharge rule and insufficient collection service => Waste heaps

I-3 Differences of MSWM System (6): Situation in Adana in Turkey (1999) => Open dumping

Hard to extinguish fire due to landfill gas burning

25ha of the landfill was burning. => Smoke covered the city of 1.2 million population.

I-3 Differences of MSWM System (7): MSW collection service in Tokyo (1)

In 1955 with public cooperation

In 1954 without public cooperation

I-3 Differences of MSWM System (8): MSW collection service in Tokyo (2)

Community Collection for Recyclable Waste was Started from 1955 in Tokyo (1960's)

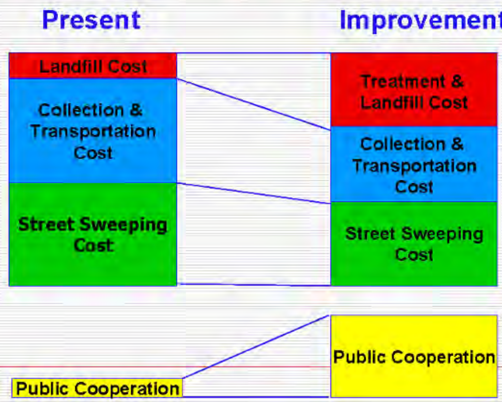
Collection by vehicle in 1955 with public cooperation

I-3 Differences of MSWM System (9): MSW collection service in Tokyo (3)

Community Collection of Recyclable Waste

Recyclable Waste for Community Collection: Recyclable wastes generated from a household with 6 persons

I-3 Differences of MSWM System (10): Public cooperation reduces costs of collection and road sweeping costs. => Saved costs can be used for sanitary landfill and recycling operation.



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I-3 Differences of MSWM System (11): Landfill in Tokyo (1964-1971) and it of Jakarta in Indonesia (2000)

Landfill operation in Tokyo (1964-1971)

Landfill operation in Jakarta (2000)

I-4 Needs of M/P (1)

- Available financial and human resources for improvement of SWM is limited.
- MSWM problems could not be solved immediately.
- It takes time and needs step-wise approach for improvement.
- While formulating the M/P, consensus among the stakeholders will be obtained.
- A M/P is the essential tool for the step-wise approach since it should include short, medium and long-term improvement issues.

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I-4 Needs of M/P (2)

- M/P includes a short, medium and long term improvement plan with priorities.
- Some priority projects shall be subject to the feasibility study (F/S) for financial assistant.
- A F/S identifies cost (expenditure) and benefit (income) of the projects.

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I-4 Needs of M/P (3): Lack of consensus (1): A new landfill for Ankara was constructed in 1999 but it has not used (at least until 2004) after a week operation

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I-4 Needs of M/P (4): Lack of consensus (2): A new landfill for Ankara was constructed in 1999 but it has not used (at least until 2004) after a week operation

Only medical waste landfill was used.

The landfill nearby the city, which should be closed, has been used.

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II. Work Flow of M/P Formulation

1. **Work Flow of the MUB SWM Study**
2. **Proposed Work Flow of M/P Formulation for Provincial Cities**

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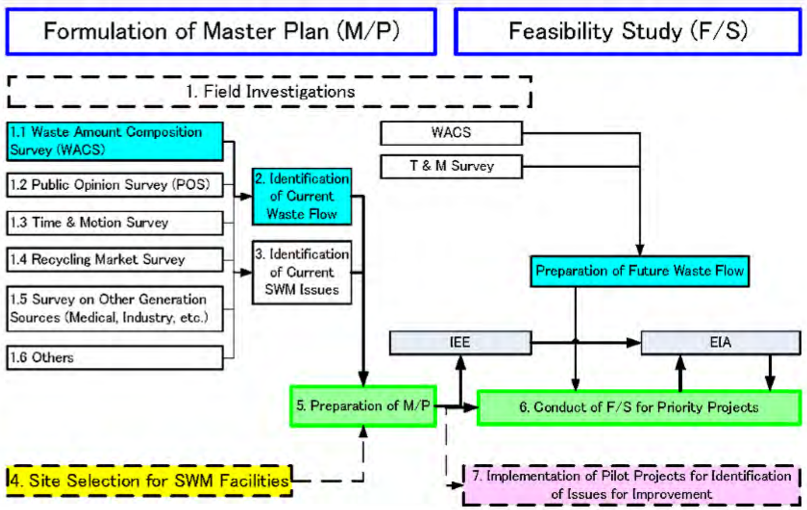
II-1 Work Flow of the MUB SWM Study (1)



II-1 Work Flow of the MUB SWM Study (2)

1. At first various field investigations were conducted according to the need.

a. WACS (Waste amount and composition survey)
b. POS (Public opinion survey)
c. T&M (Time and motion) Survey
d. Recycling Market Survey
e. Survey on Other Generation Sources: Factory, medical institution, construction site, etc.
f. Others

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II-1 Work Flow of the MUB SWM Study (3)

2. Based on the results of field investigation, a waste flow (see next screen) was identified.
3. Referring to the waste flow, current issues and problems of MUB SWM was understood.
4. While conducting the above works, site selection works for landfill and recycling facilities were done.
5. Formulation of M/P: Improvement plans to solve current issues and problems were made. Then, required finance /human resources and duration for the implementation of the plan were identified.
6. After the formulation of M/P, the priority of each improvement plan was made. Then, Feasibility Study (F/S) for priority projects was conducted.

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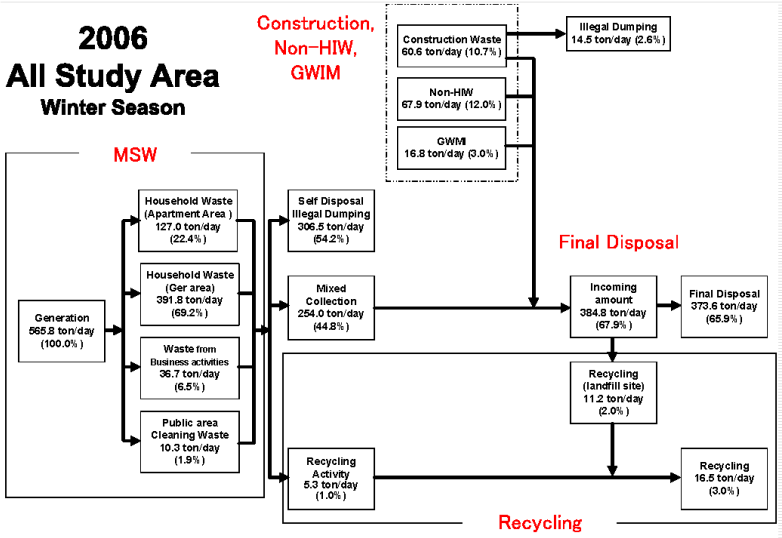
II-1 (4) Waste Stream of UBC (Winter) in 2006



II-2 Proposed Work Flow of M/P Formulation for Provincial Cities (1)

1. Field Investigations => Skip and use some useful results of MUB study.
2. Identification of current waste stream => Prepare a simple one like next screen
3. Identification of current SWM issues => Describe issues for technical system (discharge, collection, recycling, public area cleaning, final disposal and maintenance of equipment) and institutional system (legal system, organization, financial system and public cooperation)

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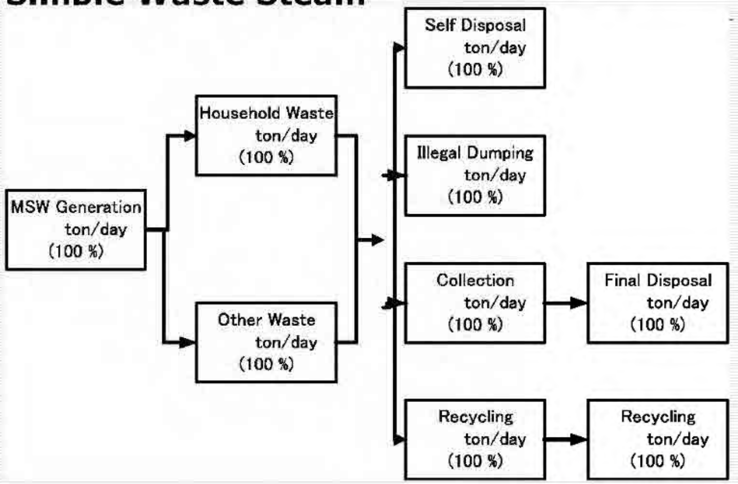
II-2 Proposed Work Flow of M/P Formulation for Provincial Cities (2): Simple Waste Steam



II-2 Proposed Work Flow of M/P Formulation for Provincial Cities (3)

4. Site Selection => If necessary, you may conduct referring lecture P.4.1.
5. Preparation of M/P => Participants prepare concept of SWM M/P in the workshop. After the workshop participants shall formulate their SWM M/Ps using the lectures, materials and works provided by this workshop.
6. For the formulation of M/P, at first participant is recommended to prepare important characteristics (Area conditions) of your city referring next screen.

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II-2 (4): UBC Area Conditions (1):

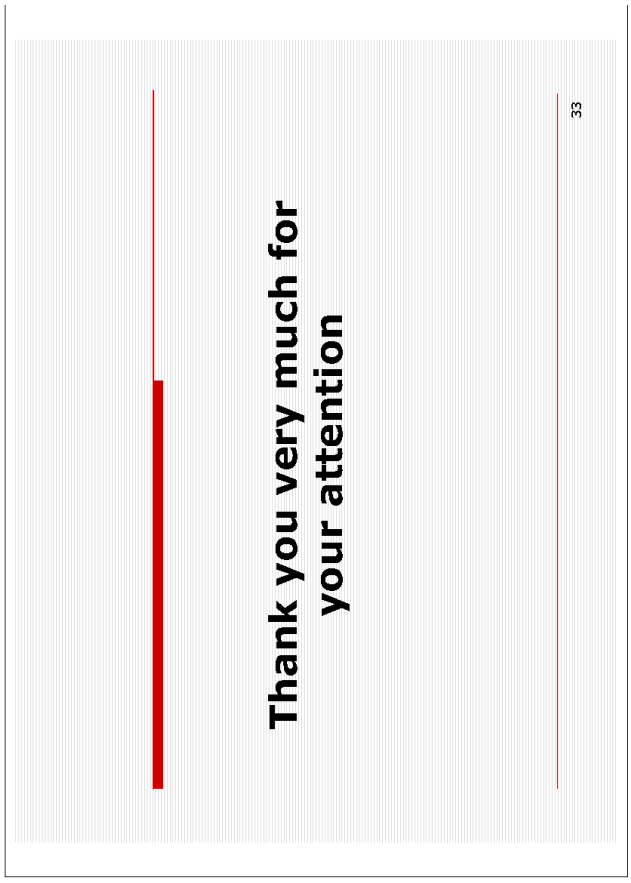
Area:4,700km²
Population: 900,000
Density: 1.91 person /ha => Land rich
Climate:
Summer: 30 ℃
Winter: - 40 ℃

II-2 (5): UBC Area Conditions (2): Urban Structure

City Consists of Two areas: Apartment area and Ger area

Item	Apartment Area	Ger Area
Urban Structure	Created based on town planning	Randomly created
Building	Multistory	One-story
Water Supply	Equipped with Household water supply	Purchased from a water kiosk and transported by wheelbarrow
Toilet	Drainage sewers are installed	Toilet in the residence garden *1
Waste	100% Collection	Collection service is provided at the same time as fee collection

Note) *1:As the pumping service is not fully diffused, there is an issue with human waste being disposed together with waste in the cold months.


Thank you very much for
your attention
33

d.3 Document 3: Formulation of M/P for MUB (1): Site selection

Doc 3

Formulation of M/P for MUB (1): Site Selection for Final Disposal Site

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

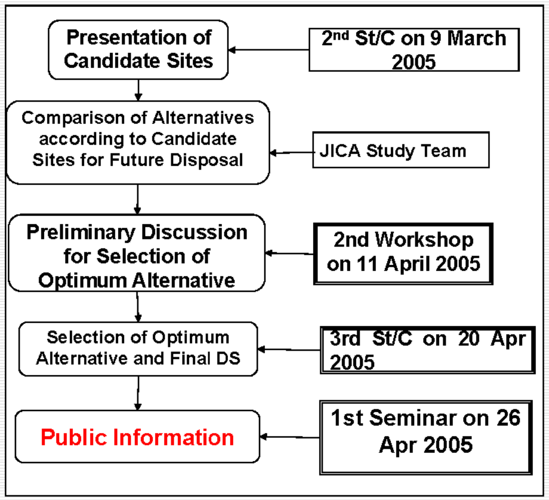
Jun 28, 2011

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

Contents

1. Procedure of the Site Selection
2. Conditions for comparison
3. Introduction of candidates
4. Environmental issues
5. Technical and financial issues
6. Final Selection through Workshop

1 Procedure of the Site Selection



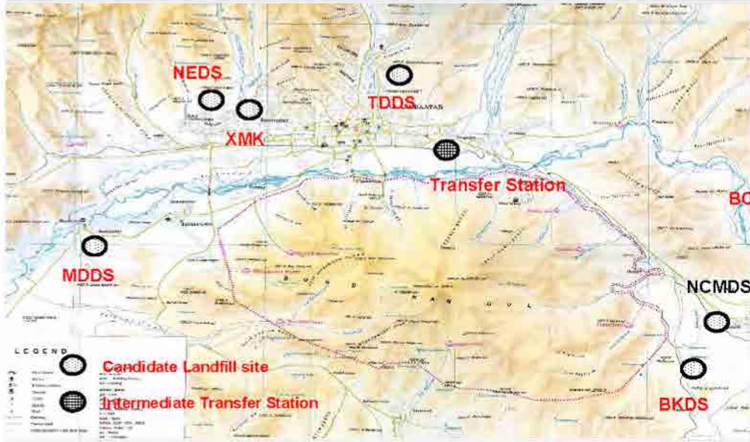
2. Conditions for comparison

1. Due to time limitation a preliminary environmental study was conducted base on:
   - ☐ Field reconnaissance (FR) to the six candidate sites; and
   - ☐ Literature study (LS) by the collection of available data on the candidates
2. The new disposal site(s) will be open in 2008.
3. SWM cost in the year 2010 was estimated based on the waste flow in 2010.
4. Comparison will be made based on Social Aspects, Natural Environment, Pollution Aspects, Technical Aspects, and Financial Aspects.

3. Introduction of Candidate Sites : Examination of Alternatives

Alternative (Site)	System
Alt 1 NEDS	6 Districts ➪ NEDS Nalaikh District ➪ NCMDS
Alt 2 XMKDS	6 Districts ➪ XMKDS Nalaikh District ➪ NCMDS
Alt 3 MDDS	6 Districts ➪ T/S ➪ MDDS Nalaikh District ➪ NCMDS
Alt 4 TDDS	6 Districts ➪ TDDS Nalaikh District ➪ NCMDS
Alt 5 BKDS	6 Districts ➪ T/S ➪ BKDS Nalaikh District ➪ BKDS
Alt 6 BCMDS	6 Districts ➪ T/S ➪ Railway ➪ T/S ➪ BCMDS Nalaikh District ➪ NCMDS

Location of Candidates for Future Disposal Site(s) and Transfer Station



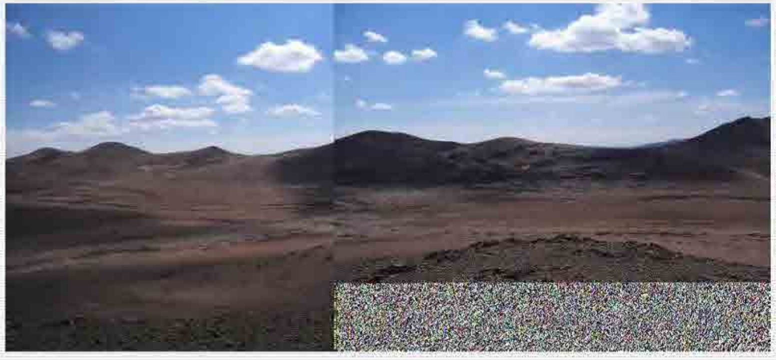
4. Environmental issues

1. Current photo of each site
2. In order to evaluate environmental aspects of the candidate sites a preliminary environmental study was conducted by the National University based on the following survey:
   - ☐ Field reconnaissance to the six candidate sites; and
   - ☐ Literature study including collection of available data such as topographic maps, geological profile, etc.
3. Environmental evaluation was made on social aspects, natural environment and pollution

NEDS (Narangiin Enger Disposal Site): A large and deep valley in SKH District

XMKDS (XMK Disposal Site): Soil Borrow Pit

MDDS (Morin Daava Disposal Site): A shallow valley



BKDS (Bayangiin Khonkhor Disposal Site): A very shallow valley

TDDS (Tsagaan Davaa Disposal Site): A large and deep valley

BCMDS (Baganuur Coal Mining Disposal Site): A coal mining pits

NCMDS (Nalaikh Coal Mining Disposal Site): A coal mining pits in Nalaikh District Only use for disposal of waste generated in Nalaikh District

Social aspects (1)

Items	NEDS	XMKDS	MDDS
1. Location	SKH District, Khoroo 4: Area 2,226 ha, Population 8,160	SKH District, Khoroo 7: Area 1,292ha, Population 11,179	KHU District, Khoroo 12: Area 10,740 ha, Population 4,719
2. Inhabitants	2 families and 7 persons in total live in the site.	Densely populated area within 1 km and closest 50 m.	No population within 2 km.
3. Economic Activities	No specific activities except for grazing.	A factory with license mines soil for the production of bricks, etc. A number of individuals also mine clay.	No specific activities except for grazing.
4. Traffic and Public Facilities (PF)	Medium to heavy traffic volume of 9km of 13km access from the City. A hospital locates in the center of Khoroo.	Large traffic volume of 10km of 11km access from the City. A high school, a kindergarten and a hospital locate in the center of Khoroo.	Large traffic volume of 19km of 23km access from the City. It may affect traffic to Airport. A secondary school, a kindergarten and a hospital locate in the center of Khoroo.
5. Cultural Property (CP)	No CP within 4 km	No CP within 4 km	No CP within 4 km
6. Public Health Condition	Possibility of some specific diseases caused by the UCDS	No specific disease	Possibility of some specific diseases caused by the MDDC.

Social aspects (2)

Items	TDDS	BKDS	BCMDS
1. Location	BZ District, Khoroo 2: Area 25,442 ha, Population 22,963	Na District, Khoroo 1: Area 5,700ha, Population 5,807	BN District, Khoroo 2: Area 10,000ha, Population 1,008
2. Inhabitants	No population within 1 km.	No population within 1 km except workers in the Anti-air Strike Base	No population within 2 km.
3. Economic Activities	3 brick manufacturing factories with license of mining clay locate between 1.2 and 1.9 km from the site.	Department for Protection from Air Strike in 600 m.	The site locates inside of currently operating coal mine. Coordination of mining work is critical.
4. Traffic and Public Facilities	Medium to heavy traffic volume of 6km of 10km access from the City. A hospital locates in the center of Khoroo.	Medium to light traffic No PF within 3.2 km	By road 130 km from the center of UBC. By rail 150 km and 5 - 6 hours. 4 schools and a hospital locates in the center of District.
5. Cultural Property (CP)	No CP within 4 km	No CP within 4 km	No CP within 4 km.
6. Public Health Condition	Possibility of some specific diseases caused by the previous Dari Ekh DS.	No specific disease.	Foot and mouth disease through cattle.

Natural environment (1)

Items	NEDS	XMKDS	MDDS
7. Topography and Geology	A mountain valley. Mainly consists of clayey soils.	Originally gentle hill changed to a big hole by soil mining. Mainly consists of clayey soils.	A small shallow valley. Mainly consists of sandy soils.
8. Groundwater	4 wells in 2.9 -3 km south of the site do not satisfy the sanitary requirement.	Because of clayey soil layer movement of groundwater might be less.	Direction of flow is from south to north, the Tuul river.
9. Hydrological Situation	Nearest river is 6km west.	2.8 km from Bayankhoshuu river.	4km from Tuul river of which water used by people for drinking.
10. Fauna and Flora	No important or rare species registered.	Hard to grow and live due to mining	Important or rare species have not been found within 4-5 km radius.
11. Meteorology	Need to protect the site from strong wind.	Less impacts by wind due to a deep hole.	Less impacts by wind due to dominant wind direction.
12. Landscape	Though no specific property, it may affect natural view.	Less impacts on landscape because of current land condition, a big hole.	Less impacts on landscape because of existence of current MDDS

Natural environment (2)

Items	TDDS	BKDS	BCMDS
7. Topography and Geology	A mountain valley. Mainly consists of clayey soils. Geological profile alluvial sandy-clay and clayey coarse breccia deposit.	Gentle concave land covered with dark brown soil.	Originally gentle valley changed to big holes by coal mining. Alkaline soil containing heavy metals like lead and copper.
8. Groundwater	Part of the Selbe river basin. But no data available.	Part of the Tuul river basin. But no data available.	Coal mining affects groundwater systems seriously.
9. Hydrological Situation	Land surface erosion observed. 6 km from Selbe river.	6km from Nalaikh river and 7km from Tuul river.	In the center of coal mine, there is a Nuurent spring.
10. Fauna and Flora	No important or rare species registered.	No important or rare species registered.	Hard to grow and live due to mining.
11. Meteorology	Need to consider measures to protect the site from flood by thawing and heavy rainfall.	70% of a year considered as windy days. Need to protect the site from strong wind.	Less impacts by wind due to a deep hole.
12. Landscape	Though no specific property, it may affect natural view.	Though no specific property, it may affect natural view.	No impacts on landscape because of current land condition, a big hole by coal mining.

Pollution (1)

Items	NEDS	XMKDS	MDDS
13. Air Pollution	Impacts of odor and dust will not be serious because of less populated area.	Odor and dust will affect populated area.	Impacts of odor and dust will not be serious because of wind direction.
14. Water Pollution	Possibility of polluting wells which locate south of the site because flow direction is north to south.	Possibility of polluting wells nearby the site.	Possibility of polluting surface and ground water because the site mainly consists of sandy soil.
15. Noise and Vibration	No serious impact due to less populated area	Noise and vibration will affect populated area.	No serious impact due to less populated area
16. Others	The rapid expansion of Ger areas may close to the site in near future.	Location of the site will violate the Law of "Household and Industrial Waste"	Impacts to the Biocombinate shall be examined.

Pollution (2)

Items	TDDS	BKDS	BCMDS
13. Air Pollution	Less impacts of odor except for workers of 3 brick manufacturing factories	Less impacts of odor except for workers of anti-air strike base	Less impacts of odor except for workers in the coal mine.
14. Water Pollution	Possibility of polluting surface and ground water which locate east side or down stream of the site.	Possibility of polluting surface and ground water.	High possibility of pollution due to relatively rich in surface and ground water which are connected each other through hydraulic system.
15. Noise and Vibration	Less impacts except for workers of 3 brick manufacturing factories	Less impacts except for workers of anti-air strike base	Less impacts than mining operation.
16. Others	The rapid expansion of Ger areas may close to the site in near future. Location of the site may violate the Law of "Household and Industrial Waste"	Difficult to get permission from the anti-air strike base	Location of the site will violate the Law of "Household and Industrial Waste" Require to coordinate with railway and mining operation.

5. Technical and financial issues

- Conditions for costing
1. General
2. Collection and transportation system
3. Final disposal system

1. General conditions

1. Costing based on the waste amount in 2010
   - 464 ton /day
   - 169,251ton/year
2. One Transfer Station is required when disposed to BKDS
3. Wastes will be transported to Baganuur by Train, so there are one transfer loading station and one unloading transfer station. 23 wagons will be purchased to transport wastes by train
4. Both of them are assumed to be constructed in Bayanzurkh
5. Nalaikh District will dispose to his own disposal site (NCMDS), which is former coal mining pit, except disposing to the BKDS together with wastes from other Districts
6. Indirect cost is considered for collection and transportation services; i.e. 35% of direct cost

2. Collection and transportation system

Haulage Distance from each District to 6 Disposal Site

unit: km

	Haulage	NEDS	TDDS	XMDS	MDDS	BKDS	BCMDS
Bayangol	1st	11.7	12.8	8.3	24.0	11.3	11.3
	2nd	-	-	-	-	30.7	128.4
Bayanzurkh	1st	17.9	10.7	14.5	25.3	5.3	5.3
	2nd	-	-	-	-	30.7	128.4
Nalaikh	1st	2.0	2.0	2.0	2.0	8.0	2.0
	2nd	-	-	-	-	-	-
Songinokhairkhan	1st	7.3	20.1	1.0	21.2	18.7	18.7
	2nd	-	-	-	-	30.7	128.4
Sukhbaatar	1st	18.1	8.0	15.4	27.0	10.4	10.4
	2nd	-	-	-	-	30.7	128.4
Chingeltei	1st	15.6	9.7	12.2	25.0	10.9	10.9
	2nd	-	-	-	-	30.7	128.4
Khan Uul	1st	14.8	17.3	11.4	15.0	15.7	15.7
	2nd	-	-	-	-	30.7	128.4

Note: Nalaikh will utilize his own disposal site which is abandoned coal mining pit except transporting to the New BKDS disposal site.

Type of Truck Used for Costing-1

1. Compactor Truck

- 15 m3 Compactor
- Waste carried by trip : 5.4 ton per trip
- Used for Planned area Collection
- Basic Price : 100,000 US$
- 7 years depreciation, 10% remaining value

Type of Truck Used for Costing-2

2. Tipper Truck

- 10 m3 Dump Truck
- Waste carried by trip : 2.7 ton per trip
- Used for Gel Area Collection
- Basic Price : US60,000$
- 7 years depreciation, 10 % remaining value

Haulage Cost per ton of Waste by Compactor

MNT/ton

District	Dispose to					
	NEDS	TDDS	XMDS	MDDS	BKDS	BCMDS
Bayangol	13,286	13,691	12,033	17,945	13,139	13,139
Bayanzurkh	15,571	12,917	14,318	18,424	10,927	10,927
Nalaikh	10,816	10,816	10,816	10,816	10,816	10,816
Songinokhairkhan	11,664	16,382	9,342	16,913	15,866	15,866
Sukhbaatar	15,903	11,922	14,650	19,050	12,807	12,807
Chingeltei	14,723	12,549	13,470	18,313	12,991	12,991
Khan Uul	14,429	15,350	13,175	14,627	14,760	14,760

Haulage Cost per ton of Waste by Tipper Truck

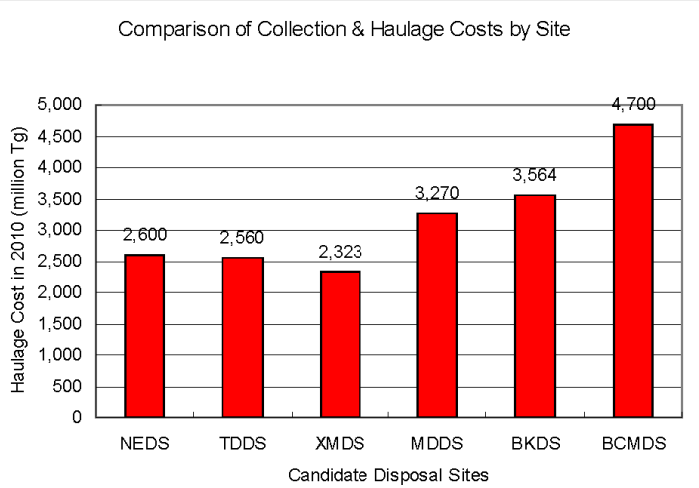
MNT/ton

Destrict	Dispose to					
	NEDS	TDDS	XMDS	MDDS	BKDS	BCMDS
Bayangol	15,812	16,313	14,263	21,667	15,630	15,630
Bayanzurkh	18,637	15,356	17,088	22,259	12,896	12,896
Nalaikh	12,759	12,759	12,759	12,759	12,759	12,759
Songinokhairkhan	13,807	19,639	10,936	20,391	19,002	19,002
Sukhbaatar	19,047	14,126	17,498	23,034	15,219	15,219
Chingeltei	17,589	14,901	16,040	22,122	15,447	15,447
Khan Uul	17,224	18,364	15,675	17,566	17,635	17,635

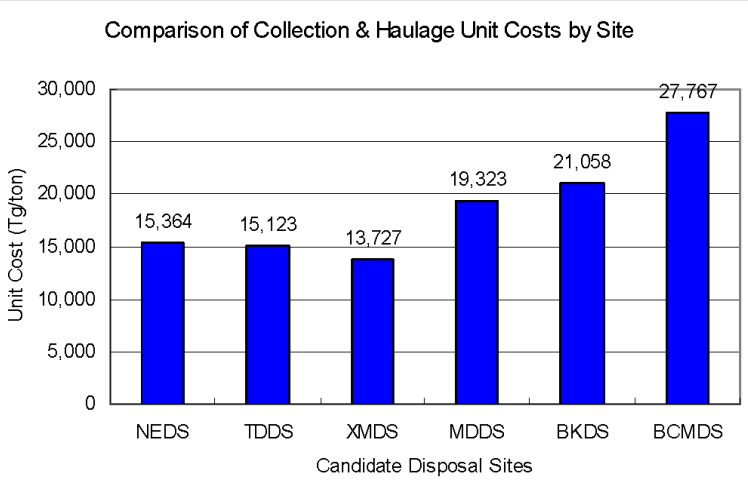
Annual Haulage Cost

District	Area	NEDS	TDDS	XMDS	MDDS	BKDS	BCMDS
Bayangol	Planned	290	298	262	391	286	286
	Gel	100	103	90	137	99	99
Bayanzurkh	Planned	292	242	269	346	205	205
	Gel	273	225	251	327	189	189
Nalaikh	Planned	5	5	5	5	5	5
	Gel	39	39	39	39	39	39
Songinokhairkhan	Planned	137	192	109	198	186	186
	Gel	341	485	270	504	470	470
Sukhbaatar	Planned	156	117	143	186	125	125
	Gel	259	192	238	313	207	207
Chingeltei	Planned	134	115	123	167	119	119
	Gel	304	257	277	382	267	267
Khan Uul	Planned	88	94	80	89	90	90
	Gel	184	196	167	187	188	188
Transfer haulage		-	-	-	-	1,091	-
Railway haulage		-	-	-	-	-	2,226
Total cost	million Tg	2,600	2,560	2,323	3,270	3,564	4,700
Unit cost	Tg/ton	15,364	15,123	13,727	19,323	21,058	27,767
Unit cost	$/ton	12.8	12.6	11.4	16.1	17.5	23.1

Annual Collection and Haulage Costs by Site



Collection and Haulage Unit Costs by Site



3. Final disposal system

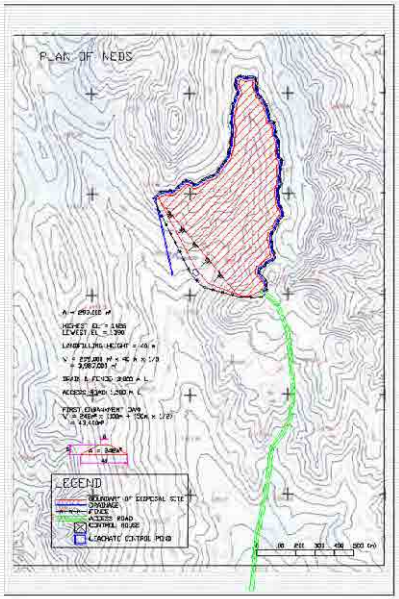
Conditions of Each Disposal Site (1)

Items	NEDS	XMKDS	MDDS
1. Current land use	A large and deep valley north of current UCDS	Soil borrow pit of about 20 meter deep	A small shallow valley south of current MDDS
2. Future land use	No specific use	Residential area	No specific use
3. Available area	more than 50 ha	about 20 ha Only two years operation	more than 50 ha
4. Direction and direct distance from city center	Northwest 9.7 km	Northwest 7.1 km	Southwest 20.3 km
5. Distance from city center by road	13 km	11 km	23 km
6. Access distance from paved road	1.5 km	0.05 km	2.0 km
7. Access distance for electric supply	1.5 km	0.5 km	1.7 km

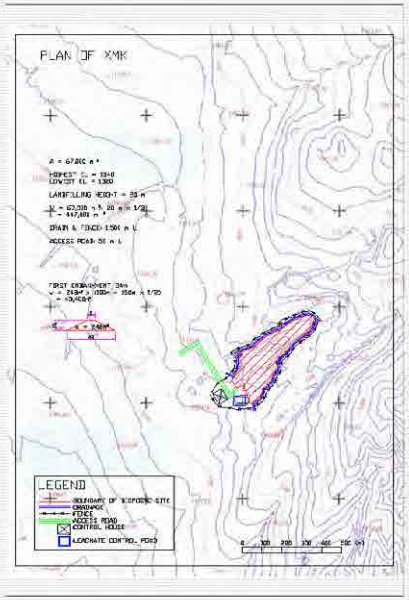
Conditions of Each Disposal Site (2)

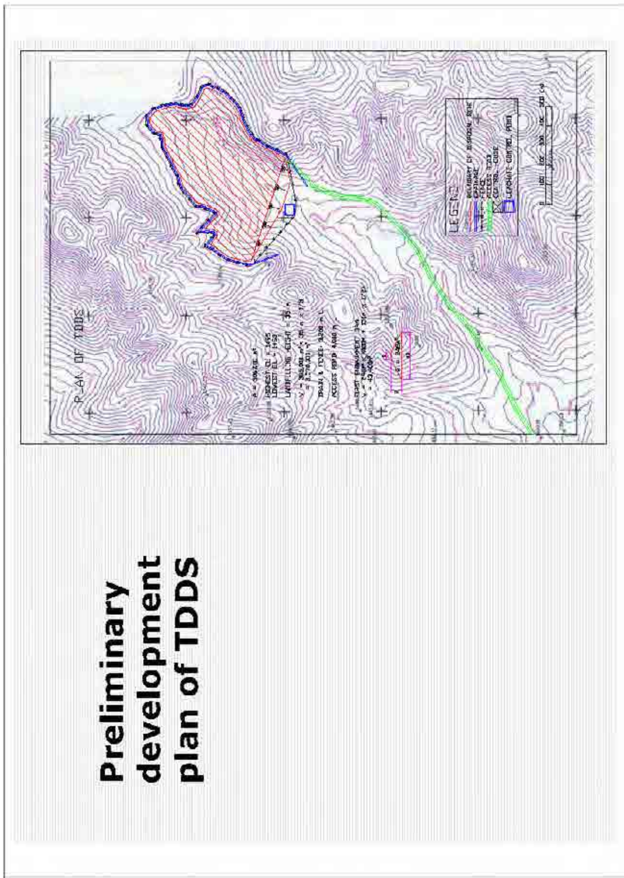
Items	TDDS	BKDS	BCMDS
1. Current land use	A large and deep valley	Gentle concave area and pasture land	Big holes by coal mining.
2. Future land use	No specific use	No specific use	No specific use
3. Available area	more than 50 ha	about 20 ha	more than 50 ha
4. Direction and direct distance from city center	Northeast 6.6 km	Southeast 29.4 km	Southeast 107.9 km
5. Distance from city center by road	10 km	38 km	130 km
6. Access distance from paved road	4.0 km	0.6 km	3.0 km
7. Access distance for electric supply	1.2 km	0.6 km	0.3 km

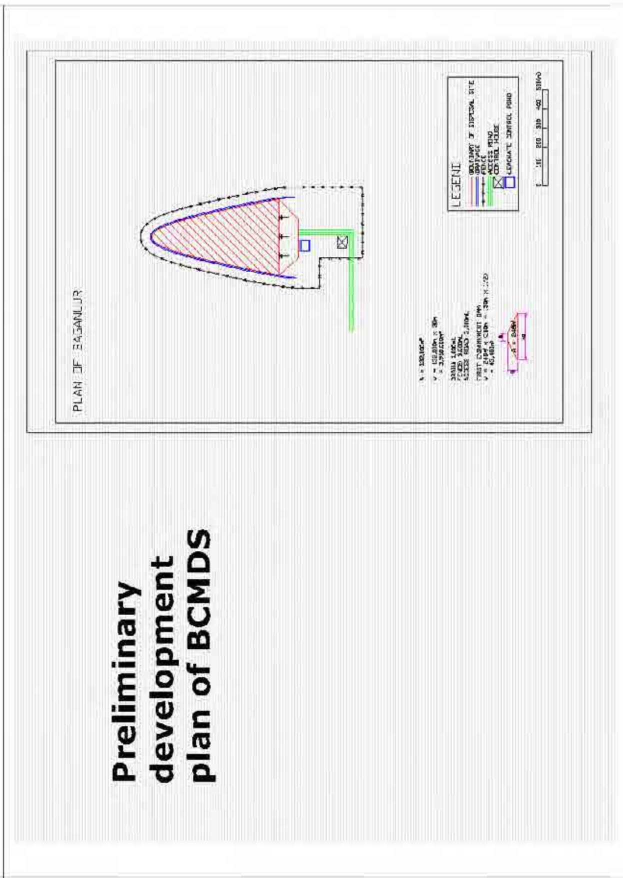
Preliminary development plan of NEDS

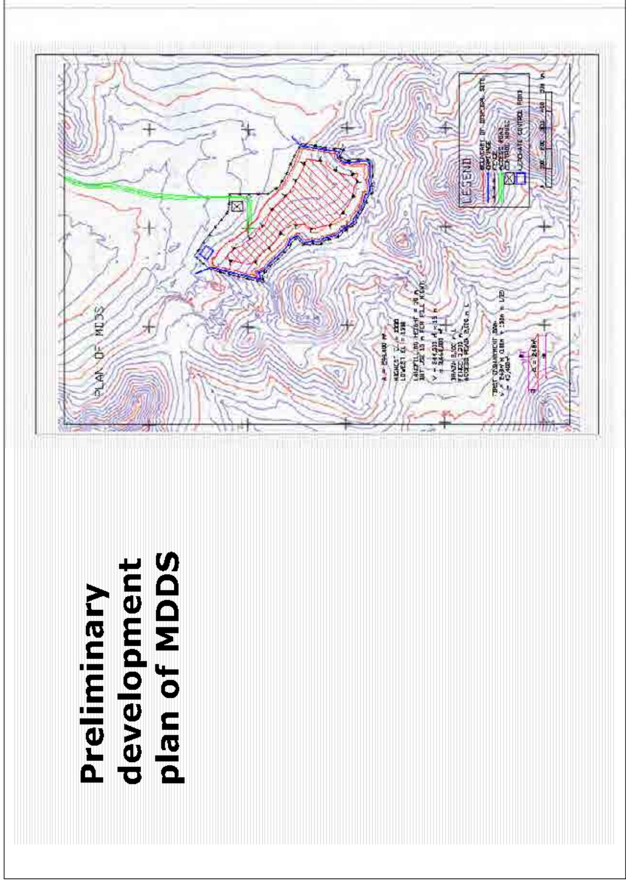


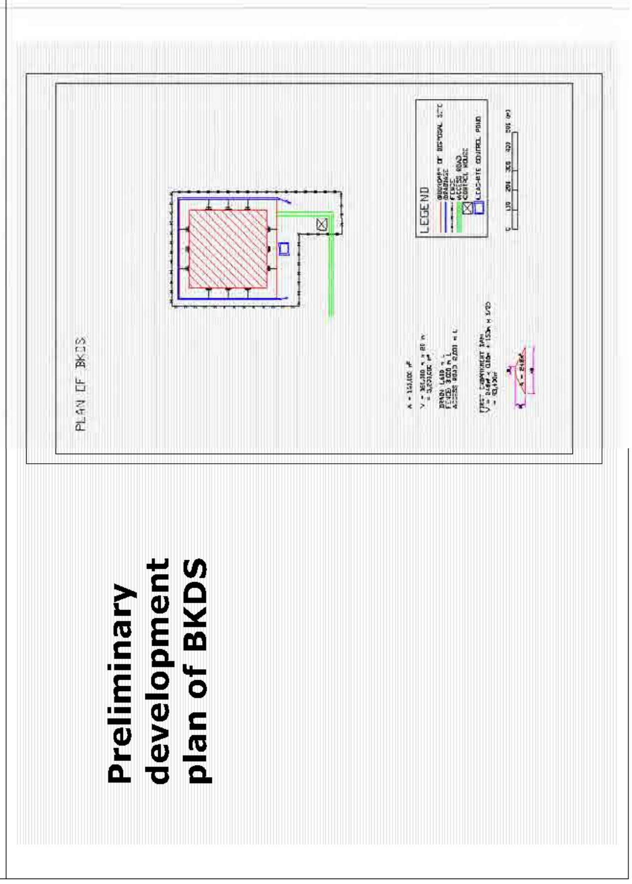
Preliminary development plan of XMKDS




Preliminary development plan of TDDS
PLAN OF TDDS
LEGEND


Preliminary development plan of BCMDS
LEGEND


Preliminary development plan of MDDS
PLAN OF MDDS
LEGEND


Preliminary development plan of BKDS
PLAN OF BKDS
LEGEND

Particulars of Each Disposal Site

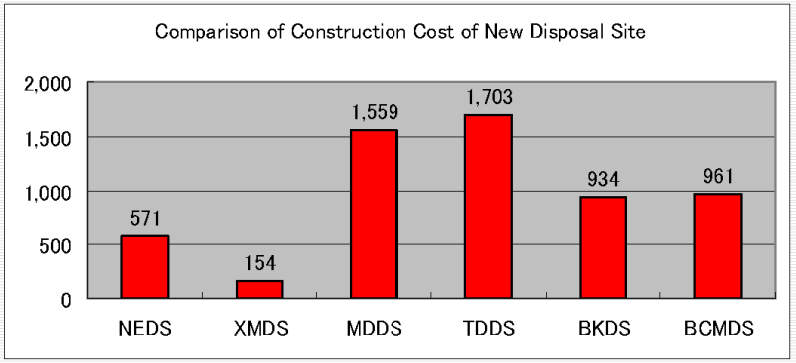
Description	Unit	NEDS	XMDS	MDDS	TDDS	BKDS	BCMDS
Area	ha	30	7	25	31	16	14
Landfill Capacity	m3	3,987,000	447,000	3,660,000	3,570,000	3,200,000	3,960,000
	ton	2,954,000	331,000	2,712,000	2,645,000	2,371,000	2,934,000
Expected Service Life	year	16	2	15	14	13	16

Initial Construction Cost of 6 Disposal Sites

Description	NEDS	XMDS	MDDS	TDDS	BKDS	BCMDS
Construction Cost	Amount (Tg)					
Clearing Site	10,800,000	2,520,000	9,000,000	11,160,000	5,760,000	5,040,000
Cut Off Drain	36,000,000	18,000,000	25,200,000	38,400,000	19,200,000	12,000,000
Boundary Fence	72,000,000	48,000,000	72,000,000	76,800,000	72,000,000	72,000,000
Leachate Treatment Facility	12,000,000	12,000,000	12,000,000	12,000,000	12,000,000	12,000,000
Embankment Dam	208,320,000	0	1,075,200,000	302,400,000	672,000,000	336,000,000
Access Road from main paved road	214,200,000	7,140,000	285,600,000	856,800,000	85,680,000	428,400,000
Weighbridge and Control Building	0	60,000,000	60,000,000	345,600,000	60,000,000	60,000,000
Electricity Supply	18,000,000	6,000,000	20,400,000	60,000,000	7,200,000	36,000,000
Total	571,320,000	153,660,000	1,559,400,000	1,703,160,000	933,840,000	961,440,000
Million Tg	571	154	1,559	1,703	934	961
Cost per ton of waste	193	464	575	644	394	328

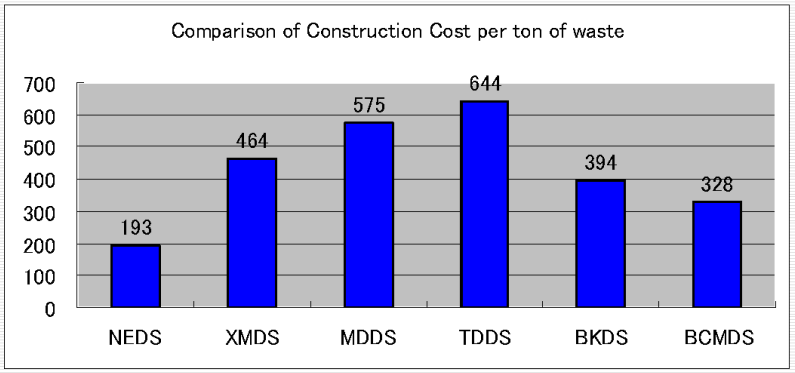
Comparison of Construction Cost

Million MNT



Comparison of Construction Cost per ton of Waste

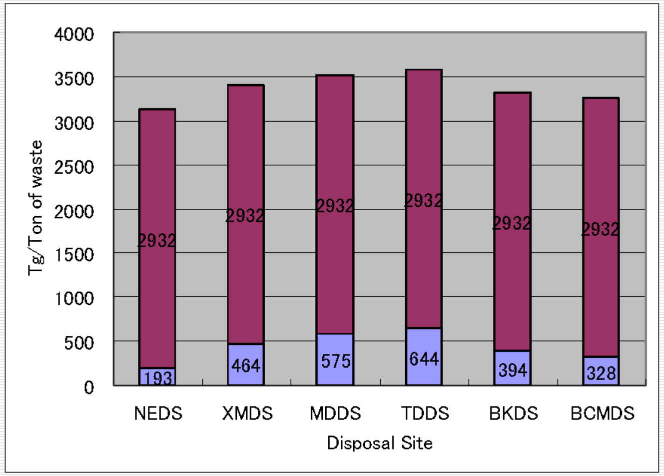
MNT/ton



Monthly Operation Cost of Sanitary Landfill

	Description of Work	Monthly Cost (Tg/Month)	Remarks
1	Planning Daily Operation	180,000	Planner
2	Sanitary Landfilling Operation	37,908,000	Bulldozer, Excavator, Dump truck, Water Truck, Supervision, Control Traffic, Control Waste Pickers
3	Collection Control	1,116,000	Weighbridge Operation, Analysis of Data, Education, Monitoring Illegal Dump
4	Monitoring/Safety Control	54,000	Monitoring Committee, Safety Control
	Sub Total	39,258,000	
	Operation Cost per ton of wastes	2,932 Tg/ton	Final Disposal Amount in 2010 = 13,353 ton/month

Comparison of Construction and Operation Cost per ton of Waste MNT/ton



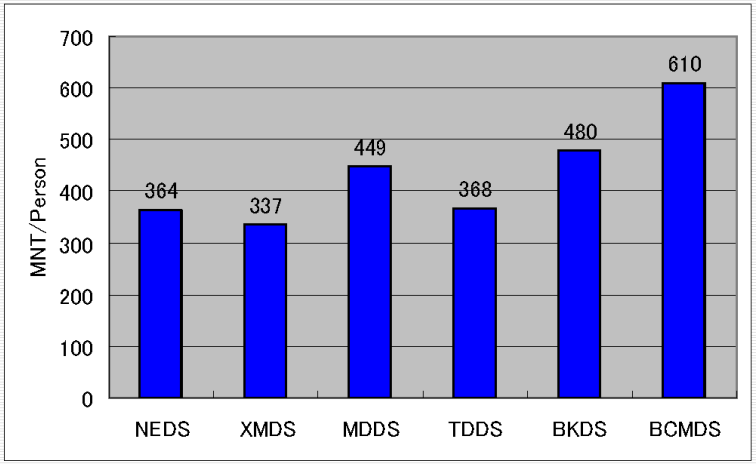
Summary of financial analysis (1)

Items	Unit	NEDS	XMKDS	MDDS
1. Collection and Transportation Cost	MNT/ton	15,364	13,727	19,323
2. Final Disposal Cost	MNT/ton	3,125	3,396	3,507
3. 1+2	MNT/ton	18,489	17,123	22,830
4. Administration Cost	MNT/ton	1,849	1,712	2,283
5. Total Cost	MNT/ton	20,338	18,835	25,113
6. Waste Generation per Person in 2010	kg/day	0.596	0.596	0.596
7. Average Collection Fee per Person	MNT/month	364	337	449
8. Average Collection Fee per Household	MNT/month	1,636	1,515	2,021
9. Initial Investment	Million MNT	7,035	6,234	8,719
10.Total Annual Cost in 2010	Million MNT	4,874	4,595	5,961

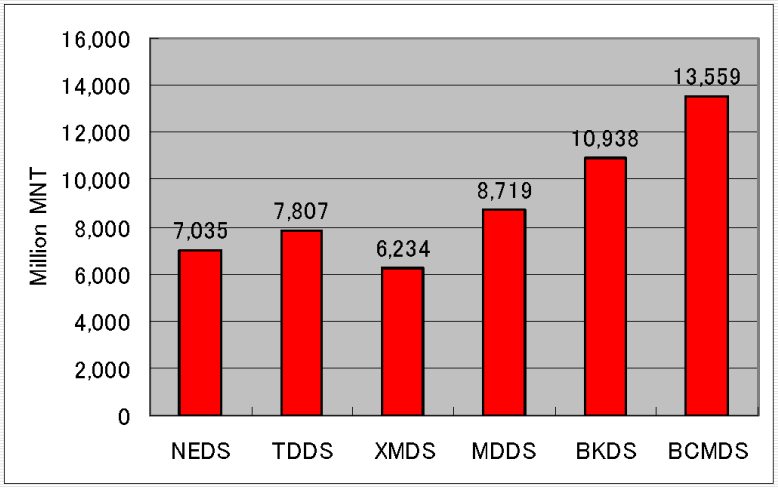
Summary of financial analysis (2)

Items	Unit	TDDS	BKDS	BCMDS
1. Collection and Transportation Cost	MNT/ton	15,123	21,058	27,767
2. Final Disposal Cost	MNT/ton	3,576	3,326	3,260
3. 1+2	MNT/ton	18,699	24,384	31,027
4. Administration Cost	MNT/ton	1,870	2,438	3,103
5. SWM Unit Cost	MNT/ton	20,569	26,822	34,130
6. Waste Generation per Person in 2010	kg/day	0.596	0.596	0.596
7. Average Collection Fee per Person	MNT/month	368	480	610
8. Average Collection Fee per Household	MNT/month	1,655	2,158	2,746
9. Initial Investment	Million MNT	7,807	10,938	13,559
10.Total Annual Cost in 2010	Million MNT	4,997	6,299	7,857

Average Monthly SW Fee per person



Initial Investment Cost



6 Final Selection through Workshop

- Participants of Workshop: 55 people
  1. Ministry of Environment
  2. Ministry of Health
  3. Municipality of Ulaanbaatar City
  4. District Offices
  5. Waste Collection Company
  6. Residents living near proposed disposal sites
  7. NGOs

6.1 parallel approaches:

- **Workshop participants divided into 4 groups with mixed interests for group discussion and conclusion**
- **Rational approach of Difference Analysis with Group input**

6.2 Groups asked to select the 5 most important criteria Summarized as:

- General Site Conditions
- Costs
- Social Impacts
- Pollution Impacts
- Life of the Site

3.3 Conclusion of Group Presentations and Evaluations

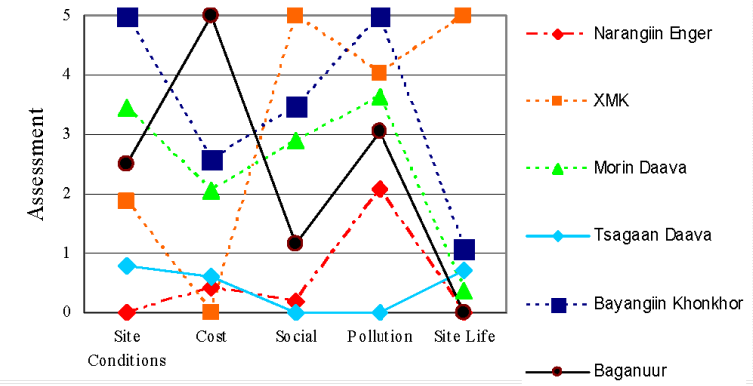
Group	First Choice	Second Choice
A	Narangiin Enger	No preference expressed
B	Narangiin Enger	Tsagaan Davaa
C	Narangiin Enger	Tsagaan Davaa
D	Narangiin Enger	Tsagaan Davaa

3.4 Difference Analysis

- Criteria Assessment:

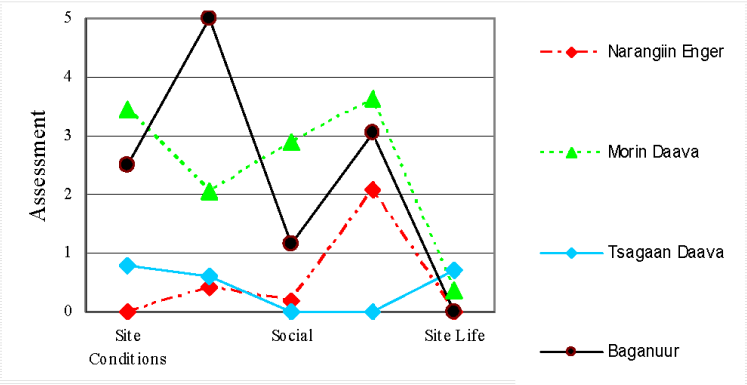
1. General Site Conditions – Group assessment on scale of 0 for the best to 5 for the worst
2. Costs - best indicator Total Annual Cost in 2010
3. Social Impacts – Group assessment on scale of 0 for the best to 5 for the worst
4. Pollution Impacts – Group assessment on scale of 0 for the best to 5 for the worst
5. Life of the Site – assessed by Study Team

3.5 Average of assessments for the 6 sites and 5 criteria.



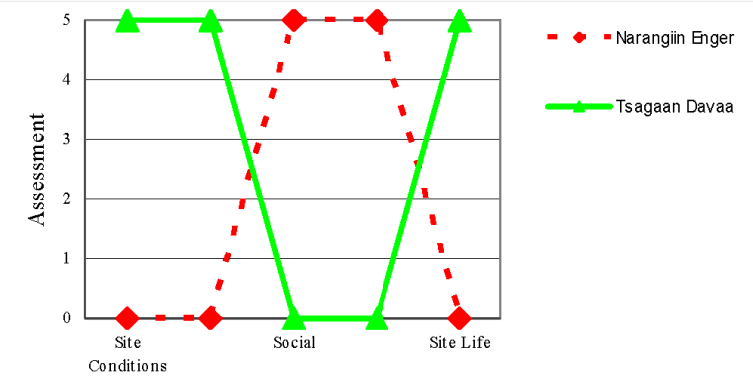
Bayangiin Khonkhor can be discounted since 3 sites are assessed as being better for all variables. XMK has a very short life – not a long-term solution.

3.6 Assessment of Four Sites



Site lives range from 14 to 16 years - within the margin of error of site investigations. Therefore Baganuur and Morin Davaa can be dismissed because the other two sites are clearly superior to them on all other criteria.

3.7 Assessment of Two Sites

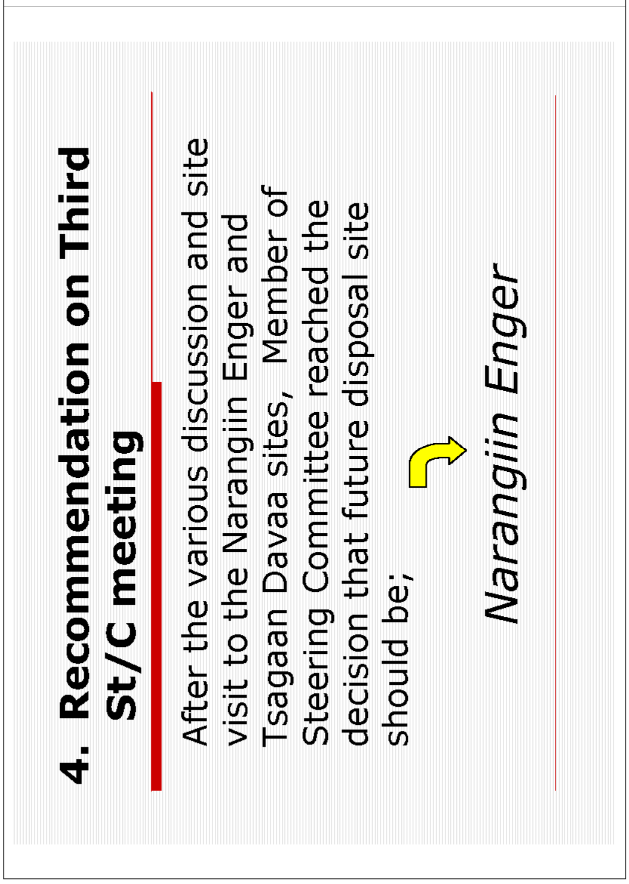


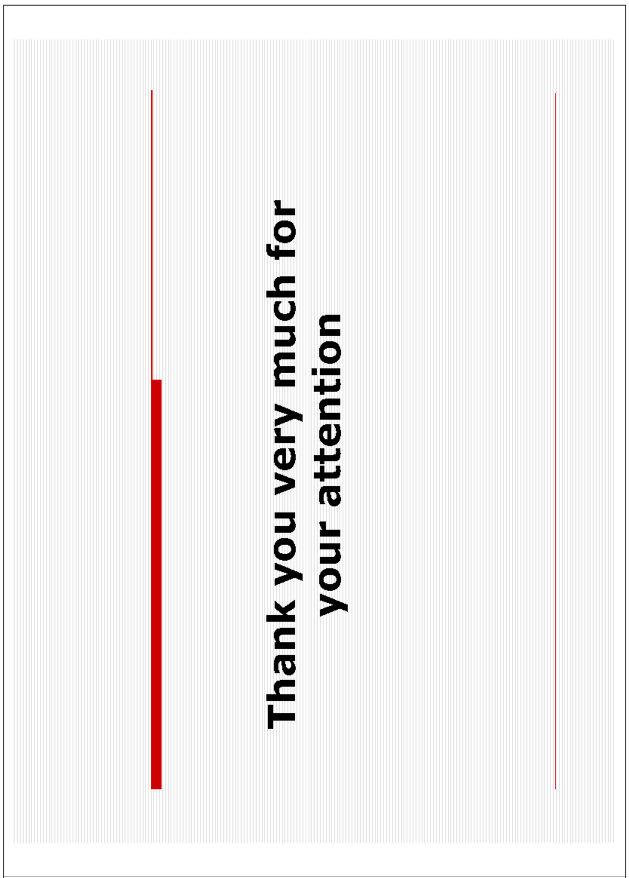
Narangiin Enger preferred for Site Conditions, Cost and Site Life. Tsagaan Davaa preferred for Social and Pollution.

- **Comparing Social: no one lives within 1km of Tsagaan Davaa but there are 3 brick factories between 1.2 and 1.9 km. 7 people live at the Narangiin Enger site, where grazing is the only economic activity. Thus Social differences are small and are certainly not strongly in favor of Tsagaan Davaa.**
- **Cost difference is MNT123 mill for 2010 increasing each year to a total of MNT1.5 bill of Net Present Value when discounted over a 15 year life of the sites at 8%.**
- **Narangiin Enger probably has a longer site life, and its general Site Conditions are regarded as being superior to those of Tsagaan Davaa. The cost advantage outweighs any Pollution disadvantage.**
- **Thus for Difference Analysis, Narangiin Enger should be preferred over Tsagaan Davaa.**

Workshop Decision

- **Group discussions and Difference Analysis came to the same conclusion**
- **At the end of the Workshop participants confirmed that Narangiin Enger and Tsagaan Davaa should be recommended for consideration by the Steering Committee.**


4. Recommendation on Third St/C meeting
After the various discussion and site visit to the Narangiin Enger and Tsagaan Davaa sites, Member of Steering Committee reached the decision that future disposal site should be;
Narangiin Enger


Thank you very much for your attention

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

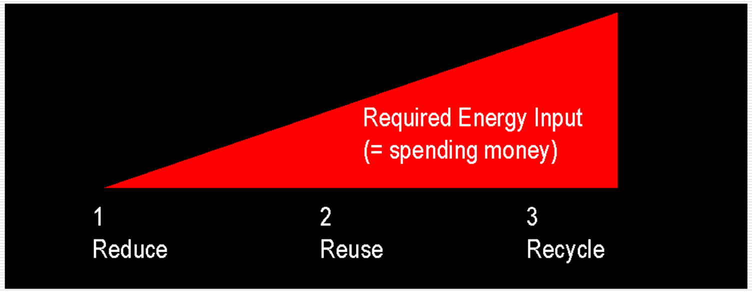
The objectives of solid waste management change as social development progresses.

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

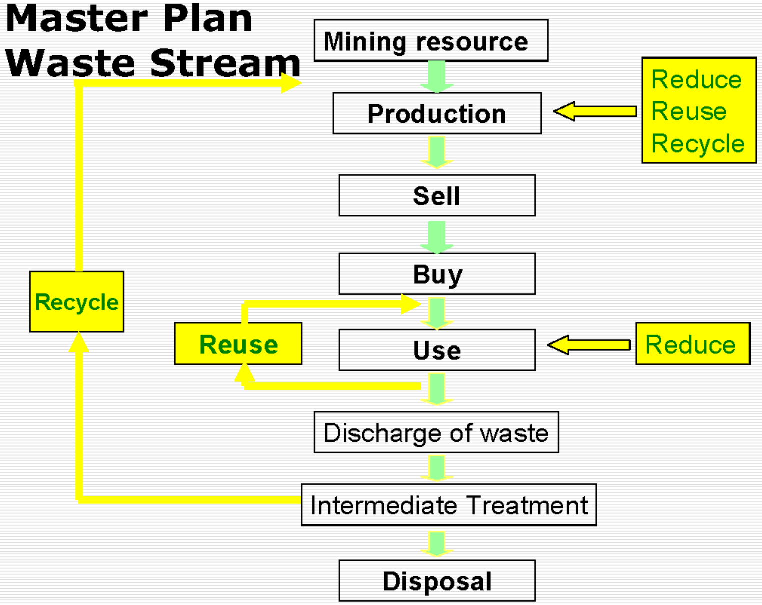
Reduce is the best because it requires the least energy input.



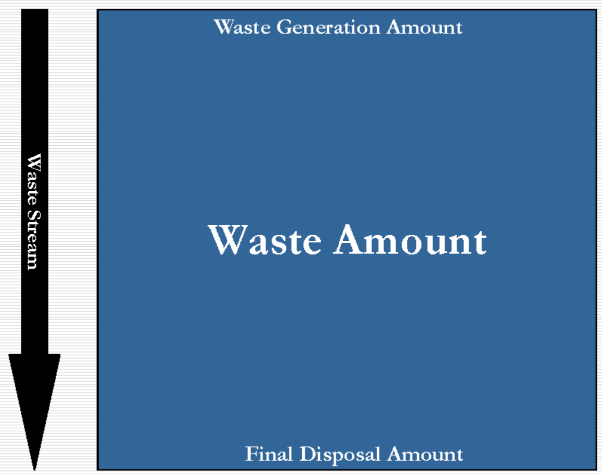
MSWM Policy
Priority Ranking of Measures

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

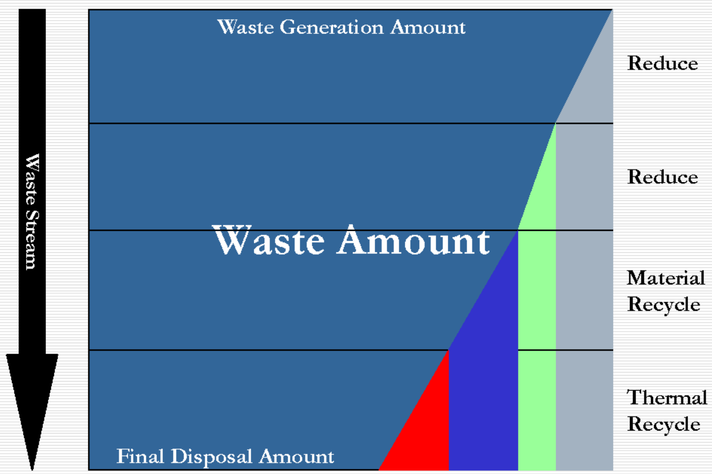
Master Plan Waste Stream



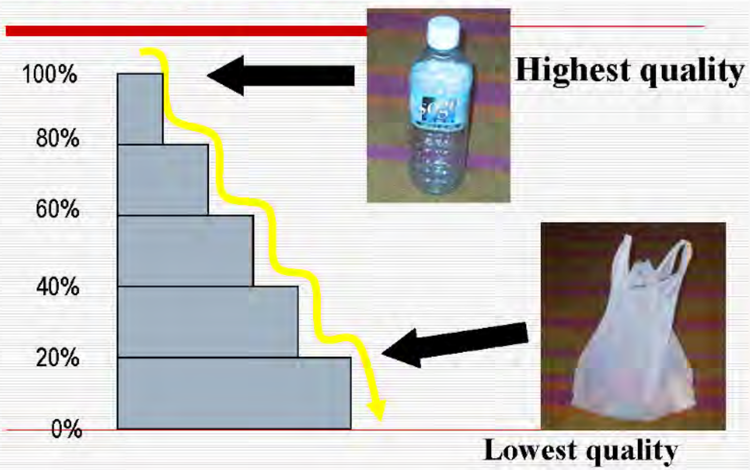
Present Waste Stream



Master Plan 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.

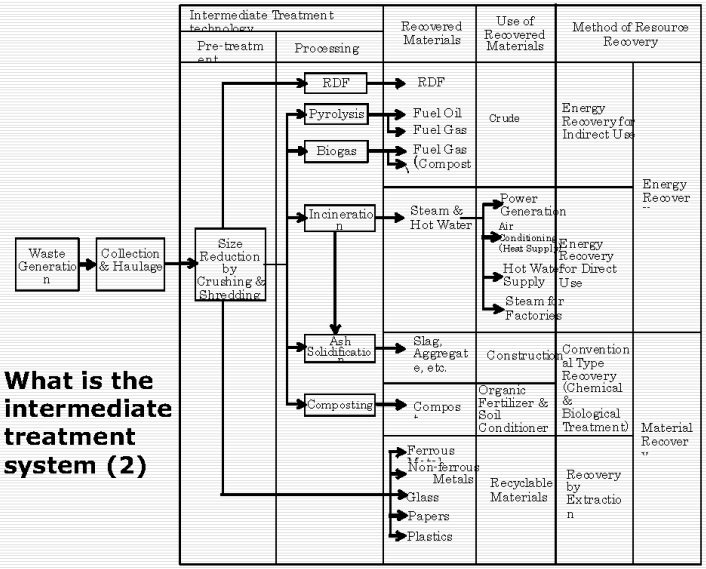
Intermediate treatment system (2)

- 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

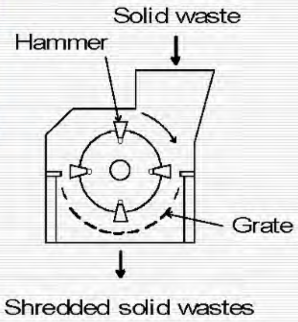
Advantages:

- ☐ 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:

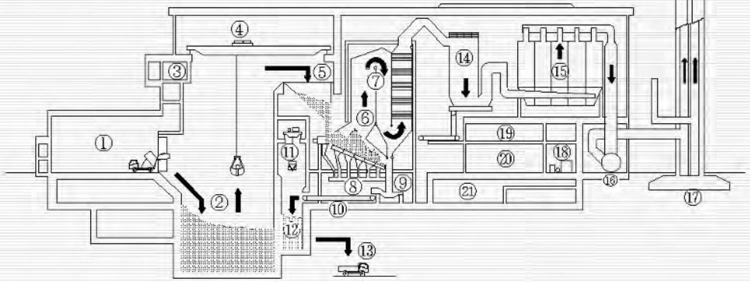
- High volume reduction efficiency; 90 to 95 %
- Elimination of offensive odor of putrescible wastes
- High stabilization efficiency
- Energy recovery

Disadvantages:

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

Incineration (2)

① Unloading platform
② Refuse bunker
③ Refuse crane control room
④ Refuse crane
⑤ Refuse feeding hopper
⑥ Furnace
⑦ Steam boiler
⑧ Under-grate conveyor
⑨ Ash extractor
⑩ Ash conveyor
⑪ Ash crane
⑫ Ash bunker
⑬ Ash truck
⑭ Gas cooler
⑮ Bag filter
⑯ Induced draft fan
⑰ Stack
⑱ Steam turbine generator
⑲ Central control room
⑳ Electric facilities room
㉑ Pump room



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

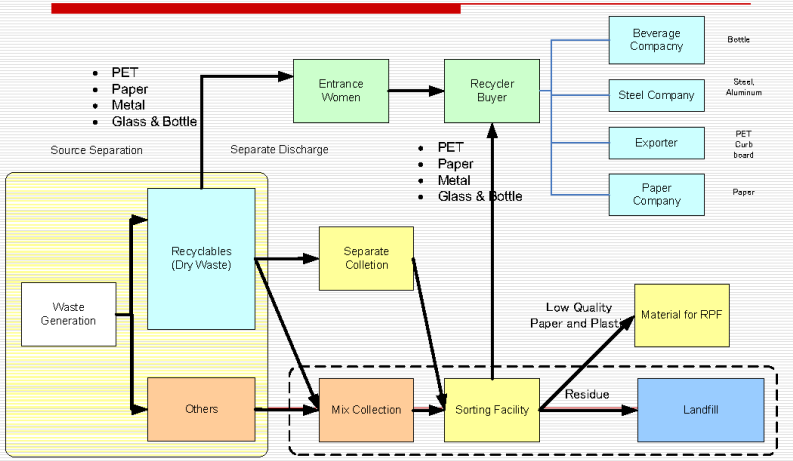
- **Limited final users in terms of capacity and categories**
- **Most of recyclables are transported to China => huge transportation cost**
- **Current final users in UBC limit generation sources of recyclable wastes. Because wastes as raw materials for them should be pure and clean as much as possible.**
- **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.**

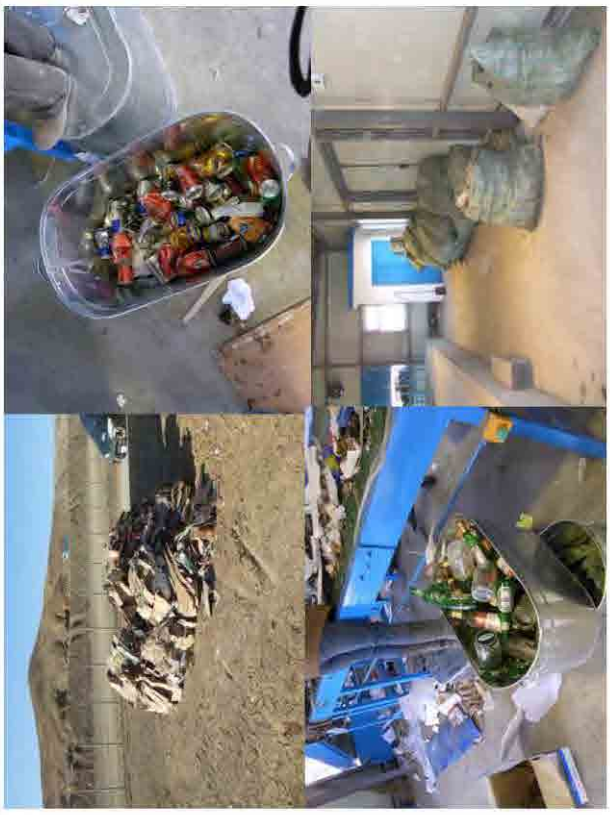
5. Pilot Project for Selecting Optimum Recycling System in UBC

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