7. Solid Waste Management Master Plan

7 Solid Waste Management Master Plan

7.1 Goal

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".

The establishment of such a system will:

- Maintain the urban environment and public health of MUB, which is the center of economic and industrial activities in Mongolia and has 40% of the national population, and to contribute to the sound development of urban life.
- Motivate foreign investment and tourism whereby the economic development of Mongolia will be promoted.

In the environmentally sound SWM system, the 3Rs (Reduce, Reuse and Recycle) of waste are promoted and the following situation should be established.

- Waste reduction is encouraged at the generation source such as households and business enterprises.
- Waste generated after the attempt of waste reduction is reused or recycled as much as possible.
- 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 proper manner without negative environmental impacts.
- 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.

7.2 Quantitative Targets

The aforementioned goal will be achieved progressively and the Master Plan is divided into the three stages listed below for the goal to be realized.

- Phase 1 Short Term Improvement： from 2006 to 2010（F/S target year）
- Phase 2 Medium term Improvement： from 2011 to 2015
- Phase 3 Long Term Improvement： from 2016 to 2020

The targets for the components of the main technical system are proposed below in order to attain the M/P fundamental goal.

Table 7-1: M/P Quantitative Targets for Ulaanbaatar SWM

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				
• Separate collection rate (%)	0	15	40	70
• Covered population (person)	0	83,587	289,809	634,432
Percentage of separate collection in generation amount (%)*2				
• Winter	0	4.9	17.7	40.4
• Summer	0	8.5	25.4	48.9
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): *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.
*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.

7.3 Strategy

In order to achieve the Master Plan goal, there are strategies for each of the three stages of the plan as shown as follows.

Table 7-2: Strategy for Implementing SWM M/P

Item	Activity
First Phase (2006-2010)	
Technical Perspective	**Eliminate Improper Disposal:** • Improper disposal at source, for example illegal dumping and improper self-disposal, will be eliminated by 2010 through an intensive citizen education campaign and enforcement of regulations (sufficient provision of the collection service is a prerequisite).
	Improve Collection System: • Necessary funds will be secured including overseas support, existing outdated collection vehicles will be gradually renewed and new vehicles will be purchased which is essential for providing the collection service to all residents. • The use of dust chutes will be prohibited, waste discharge rules demonstrated in this study's Pilot Project (P/P) will be spread to all residents in the Apartment Area, waste scattering will be prevented in the town area and the collection rate will be substantially improved. • Waste discharge rules will be established in the Ger Area and the waste collection service will be provided to all residents in that area. • Separate discharge of recyclable and non-recyclable waste will begin in 2007 in accordance with the results of the P/P. Separated collection will be carried out in 2010 15% of residents in the Apartment Area. • Necessary funds will be secured, a central workshop will be established and a maintenance system will be put in place. • The current public area cleaning system is conducted focused on manual labor and this will be maintained. The resident education campaign and regulations will be strongly promoted so that waste is not scattered within the city.
	Recycling and Intermediate Treatment: • A public sector participated 3Rs system will be commenced by starting source separation in order to re-use and recycle municipal waste and recover resources, while promoting waste reduction at generation sources. • A system will be established to develop and maintain private sector recycling activities. One of the policies for this will be to construct a recycling complex (NERC) adjacent to the Narangiin Enger disposal site (NEDS) and attract private enterprises investment for recycling. • A detailed design (the F/S project of this study) will be carried out for the sorting yard and the RDF production facility. The necessary funds will be secured and the sorting yard (4,620ton/year) and the RDF production facility (3,920ton/year) will be constructed in the NERC. The plant will operate from January 2010. The recycled percentage of the generated waste amount will rise from 3.3% (winter) and 7.4% (summer) in 2006 to 4.8% in winter (RDF shares 1.0%) and 8.4% in summer (RDF shares 1.7%) in 2010.

Item	Activity
	Final Disposal: • The P/P that is being carried out at the current Ulaanbaatar disposal city (UCDS) will be continued, sanitary landfill will be carried out and organization of waste pickers will be promoted. UCDS will be used until operation commences at NEDS. • Necessary funds will be secured and a detailed design (F/S project of this study) will be conducted for the new Narangiin Enger disposal site (NEDS). NEDS will be constructed and heavy machinery, vehicles and equipment will be purchased. The final disposal site is scheduled to commence operation from the first quarter of 2009. • An improvement plan will be formulated for the other disposal sites and an EIA will be received in 2007. In 2008, the improvement plan will be executed, essential heavy machinery, vehicles and equipment will be secured and semi-sanitary landfill will be implemented. **Medical Waste and Hazardous Industrial Waste Management:** • Source separation, source treatment and separated discharge/collection will be ensured for medical waste (infectious/hazardous waste). Medical waste management will be strictly carried out at the disposal site and improper disposal will be eliminated by 2008. General waste (non-infectious/hazardous waste) from medical institutions is continued to be disposed of at municipal landfills. • Through international cooperation, classifications and management criteria will be legally defined for Hazardous industrial waste. In addition, waste generation, treatment and disposal will be studied to grasp the current situation in order to formulate a suitable treatment and disposal plan. Furthermore, in conjunction with medical waste a suitable treatment and disposal plan will be formulated. The possibility of using an existing cement factory as a treatment facility for some of the hazardous industrial waste will be examined. • Necessary funds will be secured and construction of a hazardous industrial and medical waste treatment and disposal facility will be promoted. Source treatment and source storage will be fully introduced until the construction of the treatment and disposal facility has been completed.
Institutional Perspective	• The roles, jurisdiction and responsibilities of Municipality of Ulaanbaatar (MUB), districts and Khoroos will be revised in accordance with the proposed technical system, namely the provision of the collection service to all residents, thorough discharge rules, separate collection, public sector participated 3Rs system, and sanitary landfill, and the current waste administration system will be improved. • The current organization of the city and districts responsible for SWM will be strengthened both quantitatively and qualitatively in order to properly operate and manage the proposed technical system, namely the provision of the collection service to all residents, thorough discharge rules, separate collection, sorting yard/RDF production plant. • The introduction of private companies will be promoted not only for the future cleaning service but also for the proposed new technical system with careful regard to the capability of those private companies. A suitable contracting method will be created with the aim of introducing private companies through international cooperation, etc. • Systematic monitoring and an information management system for SWM will be established for both the city and districts. Firstly, the operating costs will be identified in order to assess the cost/benefits, cost/efficiency and cost/effectiveness. In parallel with this, a database will be constructed for all activities relating to SWM and it will be possible to continuously check the quality and costs of both public and private cleaning services. • A personnel capacity development program will be developed to train specialists for SWM. The program will include support activities from specialists to laborers, aimed at involving all affiliated persons from management to operations. • The current laws, regulations and ordinances will be revised and strengthened as necessary in order to properly operate the proposed new technical system. • A waste service fund will be established for the city and districts and a system will be constructed to appropriately collect and manage the waste fee. The waste service fund will act as a cross-subsidy to provide the service to the Ger Area. A database will be constructed with the city and districts to clearly and fairly manage the waste service fund.
	• Practical regulations (Code of Practice) will be formulated for proper medical waste management. • The current SWM structure will be strengthened to establish a suitable regulation/enforcement system for medical waste and hazardous industrial waste.
Second Phase (2011-2015)	
Technical Perspective	• The separate collection system will be extended to cover 40% of the Apartment area by 2015. The classification of separately discharged waste will be revised taking into account demands from the operation of the sorting site/RDF production facility. • Labor costs will rise and if road conditions are improved then the rate of mechanical road cleaning will increase. If employment and road conditions allow it, then the main road cleaning system will be replaced by a mechanical system. • Waste reduction at generation will be further promoted, and a public sector participated 3Rs system will be strengthened to increase the rate of source separation for re-use, recycling and recovery of valuables. • The necessary funds will be secured and the capacity of the sorting yard and the RDF production facility will be build up to 18,890 ton/year and 16,060 ton/year respectively. The recycling rate will rise to 9.3% in winter (RDF shares 3.8%) and 13.6% in summer (RDF shares 5.3%) in 2015. • Inappropriate treatment and disposal of hazardous industrial waste and medical waste will be regulated. Treatment and disposal of hazardous industrial waste and medical waste will be carried out at the constructed hazardous industrial waste and medical waste treatment facility and disposal site.

Item	Activity
Institutional Perspective	• The SWM administration system including the roles of the city, districts and Khoroos will be reviewed and improved to respond to changes in demand arising from an increase in the Not in My Back Yard Syndrome (NIMBY). • The administrative and management capacities for municipal waste, as well as hazardous and industrial waste, of the organizations responsible for SWM will be strengthened. • The participation of private companies will be further promoted and more efficient and lower cost SWM will be realized. The government will promote private participation even for the construction of SWM treatment facilities such as the sorting yard/RDF production facility. • The database for SWM will be maintained and managed. The cost comparison data obtained from the database and other evaluation data will be used to assess the efficiency of the service, appropriate management and decision-making. • All staff related to SWM, including employees from private companies, will undertake training and the specialist training program. Occupational qualifications will be created as a means to assess the capabilities of the people responsible for operations of SWM equipment and facilities. • A thorough public education and campaign will be carried out to boost public cooperation in order to extend separate collection, recovery of valuables and recycling.
Third Phase (2016-2020)	
Technical Perspective	• The separate collection system will be expanded and in 2020 it will cover 70% of the Apartment Area population. The separate discharge and collection system will be improved to correspond to changes in social and economic conditions in order to achieve the goal of the Master Plan.
	• Employment and road conditions will be carefully examined for adopting the most appropriate rate of mechanic and manual road cleaning work. • The public sector participated 3Rs system will be fully established and the M/P goal will be realized. • The necessary funds will be secured and the capacity of the sorting yard and the RDF production facility will be build up to 49,400 ton/year and 41,990 ton/year respectively. The recycling rate will rise to 16.9% in winter (RDF shares 8.9%) and 20.5% in summer (RDF shares 10.5%) in 2020. • It will be possible to use NEDS until 2020. Site selection for the next disposal site after the closure of NEDS, preliminary design, F/S study and EIA will be carried out. Furthermore, necessary funds will be secured and a detailed design will be carried out for the next disposal site. The next disposal site will be constructed and heavy machinery, vehicles and equipment will be purchased. • Inappropriate treatment and disposal of Hazardous industrial waste and medical waste will be regulated. Treatment and disposal will be carried out at the constructed hazardous industrial waste and medical waste treatment and disposal site.
Institutional Perspective	• The administration and organization of the recycling oriented society for SWM will be completely established. • Private companies will fully participate in the operation of the cleaning service as well as construction of facilities such as the sorting yard/RDF production facility, and hazardous waste and medical waste treatment/disposal facility. The administration will appropriately control and monitor the activities of the private companies. • The database for SWM will be fully functioning and it will be possible to instantly elicit data essential for operation, policy decisions, control/monitoring, residential policies and financial management. • Continuous public education and campaign will be carried out and resident cooperation will be promoted to realize the recycling oriented society. • By 2020 the waste fund will cover 100% of the SWM costs.

7.4 Future Waste Flow

The waste flows for winter and summer in Ulaanbaatar City in 2010, 2015 and 2020 are shown in the following figure.

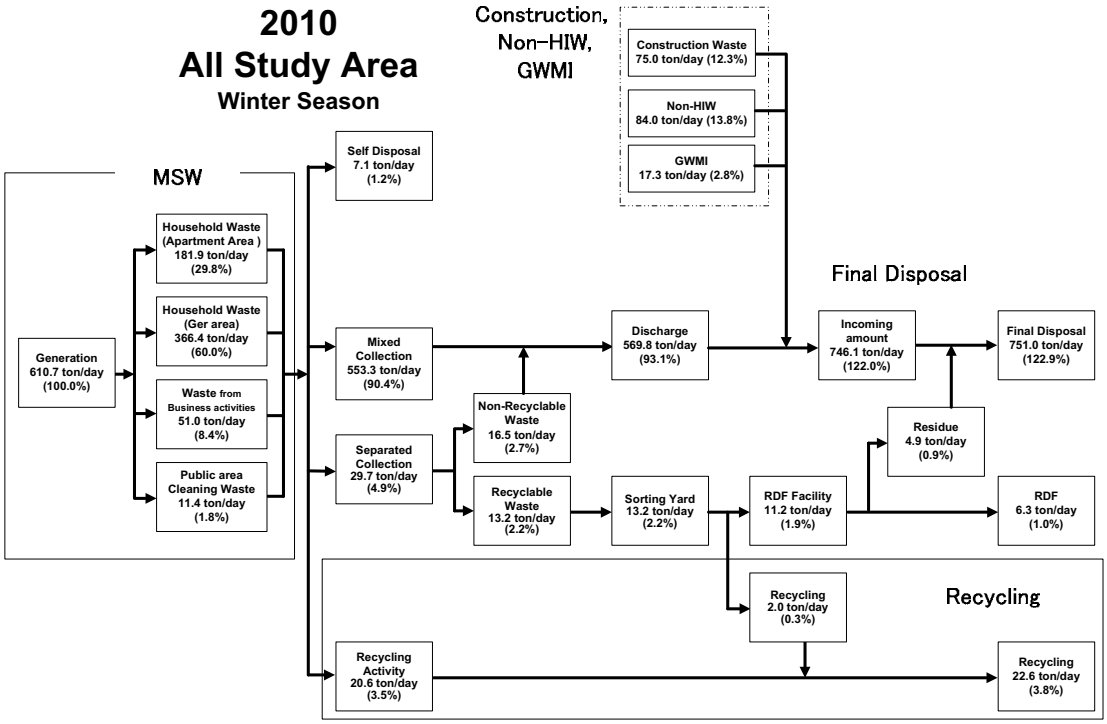


Figure 7-1: Waste Flow in Winter Season in 2010

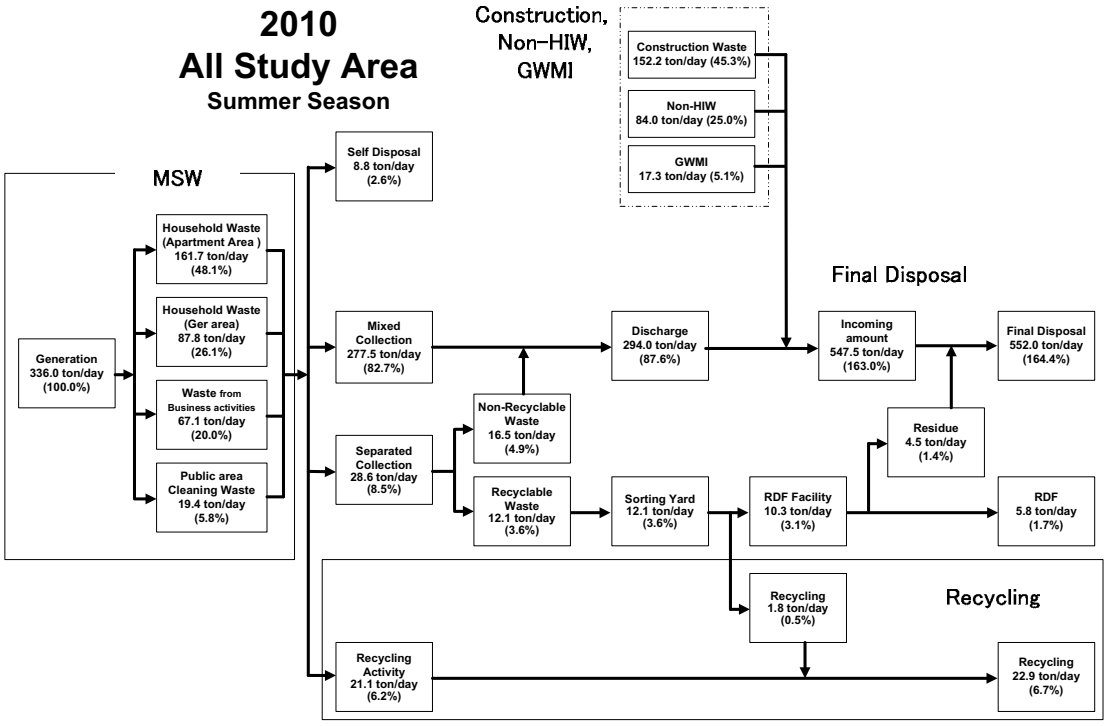


Figure 7-2: Waste Flow in Summer Season in 2010

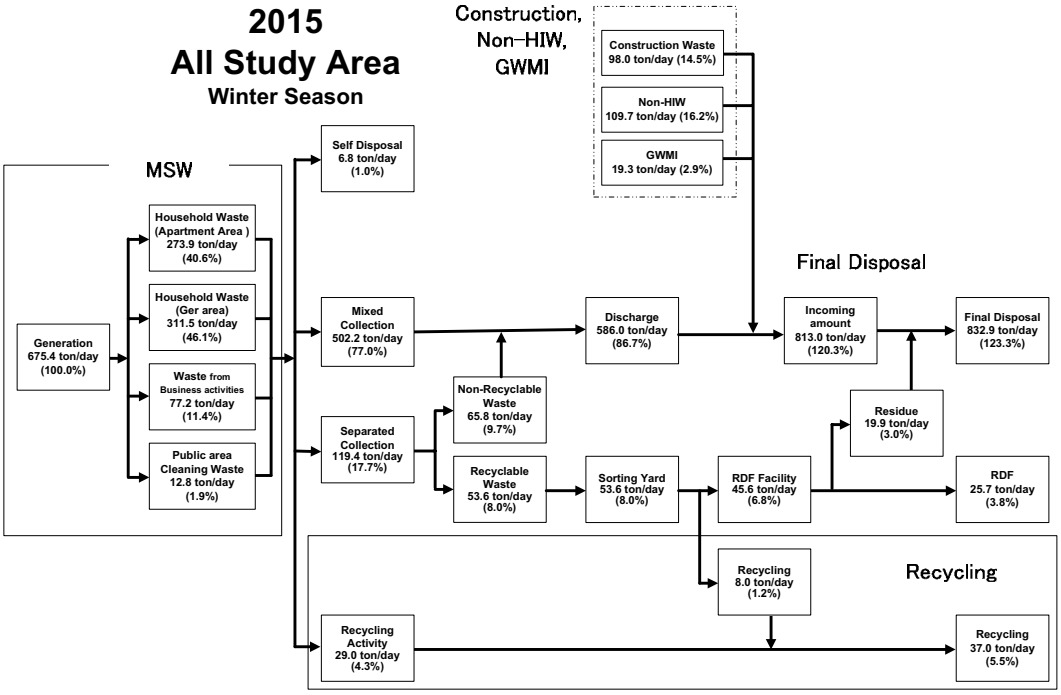


Figure 7-3: Waste Flow in Winter Season in 2015

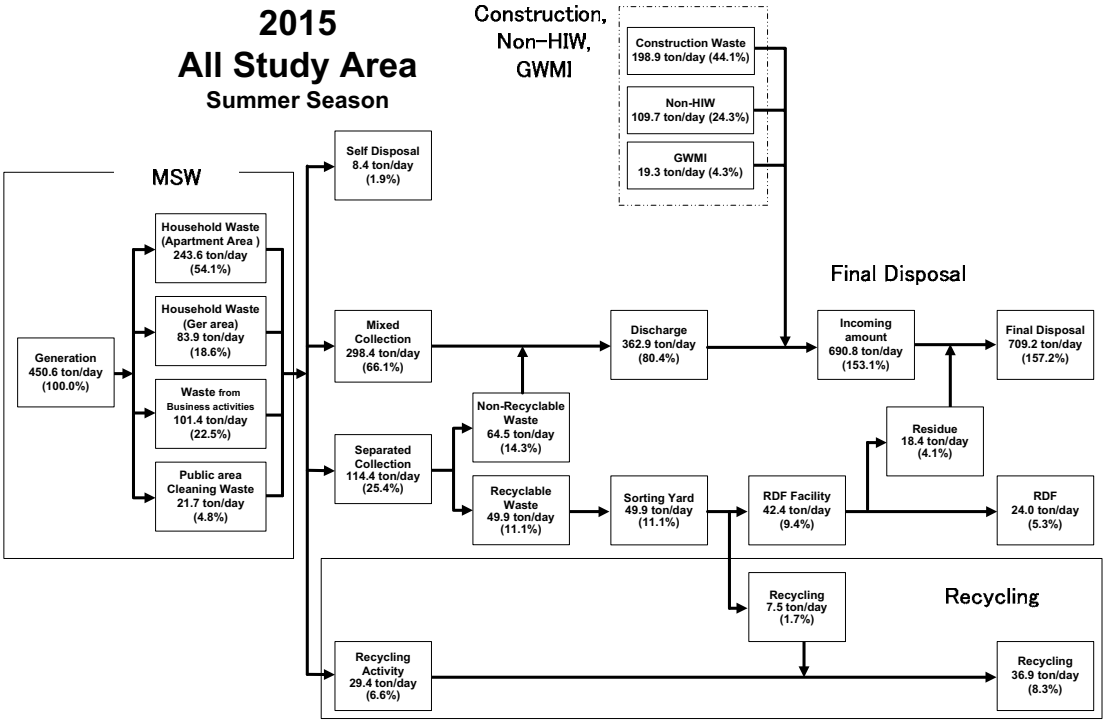


Figure 7-4: Waste Flow in Summer Season in 2015

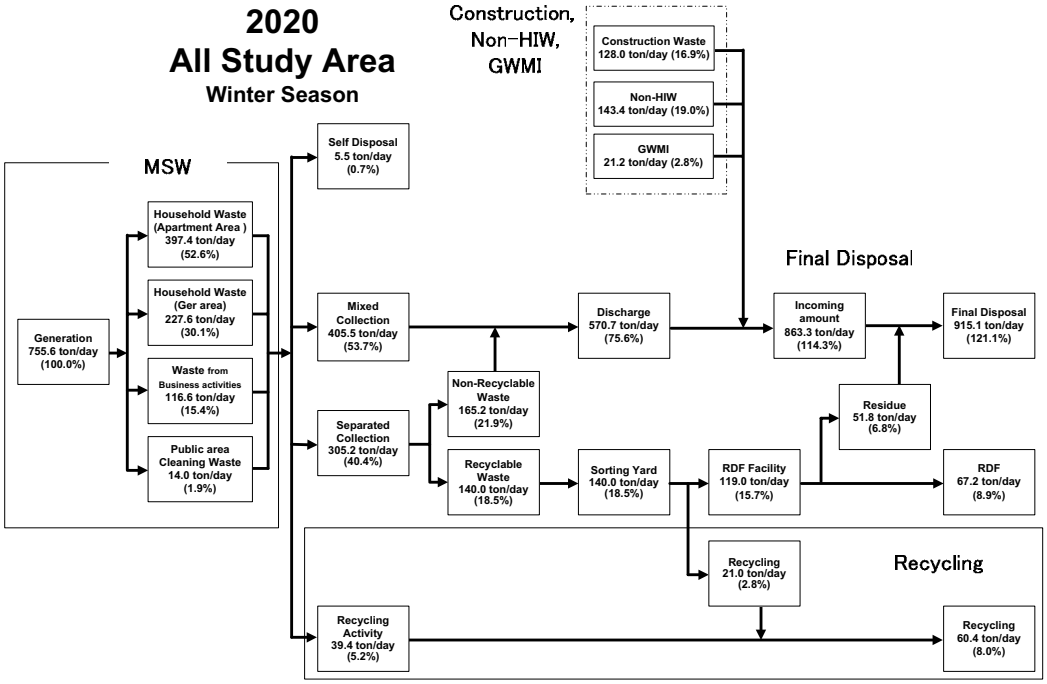


Figure 7-5: Waste Flow in Winter Season in 2020

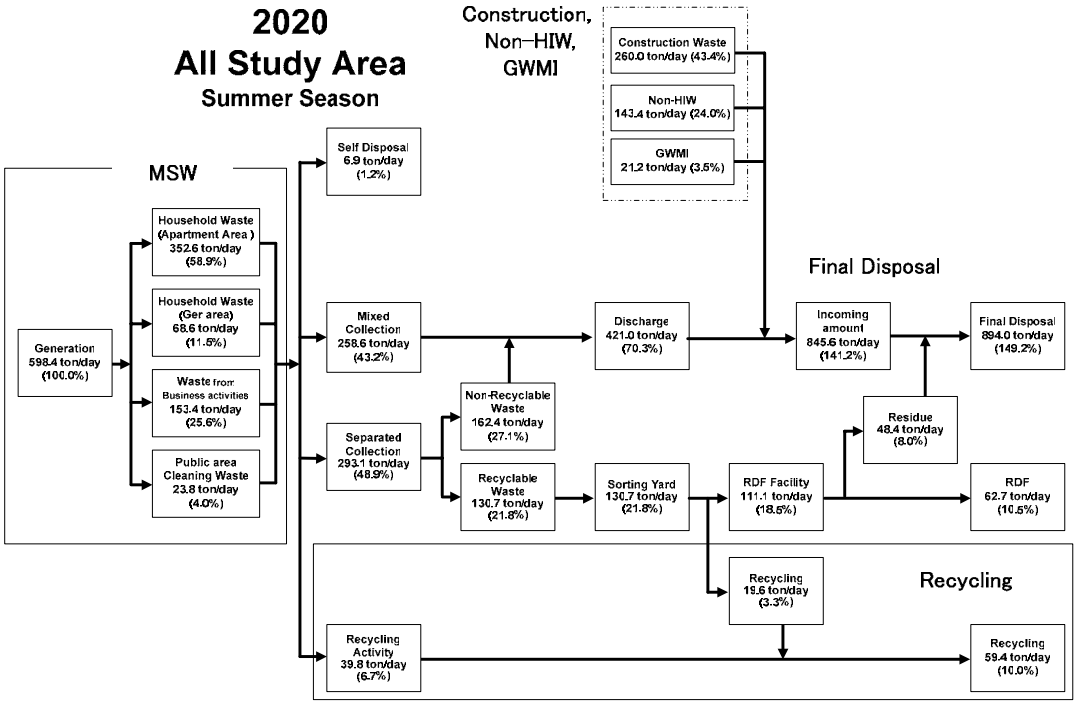


Figure 7-6: Waste Flow in Summer Season in 2020

7.5 SWM Master Plan for UBC

Table 7-3: SWM Master Plan for UBC

Components \ Phase	Present (2006)		Phase 1 (2010)		Phase 2 (2015)		Phase 3 (2020)	
	winter	summer	winter	summer	winter	summer	winter	summer
1. Generation of MSW								
Population (7 District)	Apart Area: 481,037 Ger Area: 409,772 Total: 890,809		Apart Area: 612,362 Ger Area: 375,318 Total: 987,680		Apart Area: 796,180 Ger Area: 309,625 Total: 1,105,805		Apart Area: 995,970 Ger Area: 218,628 Total: 1,214,598	
Generation of MSW (ton/day)	565.8	263.9	610.7	336.0	675.4	450.6	755.6	598.4
Total:	174.0	178.7	244.3	248.2	363.9	366.7	528.0	529.8
• Apart Area:	391.8	85.2	366.4	87.8	311.5	83.9	227.6	68.6
• Ger Area:								
Waste Composition of Apart Area: (%)								
• Recyclable	43.9	42.7	44.2	42.6	45.1	43.6	45.8	44.6
• Non-Recyclable	56.1	57.3	55.8	57.4	54.9	56.4	54.2	55.4
Waste Composition of Ger Area: (%)								
• Recyclable	6.6	42.8	7.0	43.4	8.2	44.2	9.5	45.2
• Non-Recyclable	93.4	57.2	93.0	56.6	91.8	45.8	90.5	54.8
2. Collection and Transportation								
Collection Cover Rate in Population (%)								
• Apart Area:		100		100		100		100
• Ger Area:		42		100		100		100
Improper Disposal Rate in Generation Amount (%)								
• Apart Area:	0	0	0	0	0	0	0	0
• Ger Area:	27.0	6.5	0	0	0	0	0	0
Separate Collection Rate in Generation Amount (%)								
• Apart Area:	0	0	15	15	40	40	70	70
• Ger Area:	0	0	0	0	0	0	0	0
Amount of Separated Waste (ton/day)								
• Apart Area:	0	0	29.7	28.6	119.4	114.4	305.2	293.1
• Ger Area::	0	0	0	0	0	0	0	0
Collection Frequency								
• Apart Area:	* Range from everyday to once a month		* Twice a week for non-recyclable once a week for recyclable		* Twice a week for non-recyclable once a week for recyclable		* Twice a week for non-recyclable once a week for recyclable	
• Ger Area:	* Once a month in average		* Twice a month		*Twice a month		*Twice a month	
Collection System	Apart Area Point collection Bell collection Dust chute collection Public container coll. Curb side collection Ger Area Door to door coll.		Apart Area Point (Entrance) Coll. Curb side collection Ger Area Door to door		Apart Area Point (Entrance) Coll. Curb side collection Ger Area Door to door		Apart Area Point (Entrance) Coll. Curb side collection Ger Area Door to door	
Collection Vehicle (Unit)								
CT: Compactor truck	CT :	38	CT (15m3):	23	CT (15m3):	31	CT (15m3):	45
DT: Dump truck	DT:	98	CT (8m3):	7	CT (8m3):	10	CT (8m3):	12
SL: Skip loader truck	SL:	12	DT (6ton):	113	DT (6ton):	108	DT (6ton):	98
Nos of Collection Worker		444		429		447		465
Transportation System	Direct haulage		Direct haulage		Direct haulage		Direct haulage	
Executing Body	• 7 TUK • Khoroo (very few)		• MUB/CMPUA • 7 TUK		• MUB/CMPUA • 7 TUK		• MUB/CMPUA • 7 TUK	
Unit Cost (MNT/ton)	13,514 in 2004		15,376		14,192		13,321	
3. Public Area Cleaning								
Method	Mainly manual labor and machinery		Mainly manual labor and machinery		Mainly manual labor and machinery		Machinery and manual labor	
Service Area (m^2)	3,430,451		3,801,370		4,254,938		4,674,808	
Executing Body	Budget of district Service done by TUK		Budget of district Service done by private contractor		Budget of district Service done by private contractor		Budget of district Service done by private contractor	
Nos of Cleaning Worker	382		424		474		520	
Unit Cost (MNT/m^2)	18		50		50		50	
4. Recycling and Intermediate Treatment								
Sorting Yard								
Location	None		NERC		NERC		NERC	
Incoming Amount (ton/year)	0		4,620		18,890		49,400	
Recover Amount (ton/year)	0		700		2,830		7,410	
Unit Cost (MNT/ton)	None		13,645		7,527		5,756	
RDF Production Facility								
Location	None		NERC		NERC		NERC	
Incoming Amount (ton/year)	0		3,920		16,060		41,990	
RDF Amount (ton/year)	0		2,210		9,070		23,710	
Unit Cost (MNT/ton)	None		57,914		31,827		24,353	

Phase / Components	Present (2006)		Phase 1 (2010)		Phase 2 (2015)		Phase 3 (2020)	
	winter	summer	winter	summer	winter	summer	winter	summer
Recycling Amount at Generation (ton/day)	16.5	17.3	22.6	22.9	37.0	36.9	60.4	59.4
Recycling Rate in Total	3.0%	6.6%	4.8%	8.4%	9.3%	13.6%	16.9%	20.5%
Recycling System	No government initiated recycling but mainly done by private sector		Government initiated recycling system be established.		Government initiated recycling system be expanded.		Government initiated recycling system be expanded.	
5. Final Disposal								
Operation Method	Open dumping		NEDS: Sanitary Landfill (SLF) Level 4 Others: SLF Level 2		NEDS: Sanitary Landfill (SLF) Level 4 Others: SLF Level 2		NEDS: Sanitary Landfill (SLF) Level 4 Others: SLF Level 2	
Location	UCDS MDDS NDS KH21DS		NEDS MDDS NDS KH21DS		NEDS MDDS NDS KH21DS		NEDS MDDS NDS KH21DS	
Distance from City Center (km)	UCDS: 13 MDDS: 23 NDS: 38 KH21DS: 60		NEDS: 14 MDDS: 23 NDS: 38 KH21DS: 60		NEDS: 14 MDDS: 23 NDS: 38 KH21DS: 60		NEDS: 14 MDDS: 23 NDS: 38 KH21DS: 60	
Executing Body	UCDS: Nuuts MDDS: Nuuts NDS: NaD KH21DS: Khoroo 21		NEDS: CMPUA MDDS: CMPUA NDS: NaD KH21DS: Khoroo 21		NEDS: CMPUA MDDS: CMPUA NDS: NaD KH21DS: Khoroo 21		NEDS: CMPUA MDDS: CMPUA NDS: NaD KH21DS: Khoroo 21	
Disposal Amount (ton/day) *1	UCDS: 340 (485) MDDS: 19 (26) NDS: 11 (16) KH21DS: 4 (6)		NEDS: 683 (502) MDDS: 38 (28) NDS: 23 (17) KH21DS: 8 (6)		NEDS: 755 (643) MDDS: 43 (37) NDS: 26 (22) KH21DS: 9 (7)		NEDS: 825 (806) MDDS: 50 (49) NDS: 30 (29) KH21DS: 10 (10)	
Nos of Worker	UCDS: 9 MDDS: 1 NDS: None KH21DS: None		NEDS: 22 MDDS: 3 NDS: 1 KH21DS: 1		NEDS: 23 MDDS: 3 NDS: 1 KH21DS: 1		NEDS: 23 MDDS: 3 NDS: 1 KH21DS: 1	
Unit Cost (MNT/ton)	UCDS: 703 in 2004 MDDS: NA NDS: NA KH21DS: NA		NEDS: 2,231 MDDS: 970*2 NDS: 970*2 KH21DS: 970*2		NEDS: 1,685 MDDS: 970*2 NDS: 970*2 KH21DS: 970*2		NEDS: 1,436 MDDS: 970*2 NDS: 970*2 KH21DS: 970*2	
Tipping Fee (MNT/ton)	UCDS: 100MNT/m^3 MDDS: 100MNT/m^3 NDS: - KH21DS: -		NEDS: 2080 MDDS: 970*2 NDS: 970*2 KH21DS: 970*2		NEDS: 2080 MDDS: 970*2 NDS: 970*2 KH21DS: 970*2		NEDS: 2080 MDDS: 970*2 NDS: 970*2 KH21DS: 970*2	
Main Landfill Equipment	**UCDS:** Bulldozer 2, Water tank truck 1, Dump truck 2 **MDDS:** None **NDS:** None **KH21DS:** None		**NEDS:** Bulldozer 3, Excavator 1, Water tank truck 1, Dump truck 2 One Wheel Shovel with Excavator for **MDDS, NDS and KH21DS**		**NEDS:** Bulldozer 4, Excavator 1, Water tank truck 1, Dump truck 2 One Wheel Shovel with Excavator for **MDDS, NDS and KH21DS**		**NEDS:** Bulldozer 4, Excavator 1, Water tank truck 1, Dump truck 2 One Wheel Shovel with Excavator for **MDDS, NDS and KH21DS**	
6. Maintenance for Equipment								
Preventive Maintenance and Small-scale Repair	By driver of TUK		By Central Workshop of CMPUA		By Central Workshop of CMPUA		By Central Workshop of CMPUA	
Large-scale Repair	By driver of TUK		By private workshop		By private workshop		By private workshop	
Executing Body	TUK		CMPUA		CMPUA		CMPUA	
Staff of Central Workshop	A few staff in each TUK		Manager: 1 Technician: 1 Mechanic, etc.: 6 Store keeper, etc.: 2 Office clerk, etc.: 2		Manager: 1 Technician: 1 Mechanic, etc.: 6 Store keeper, etc.: 2 Office clerk, etc.: 2		Manager: 1 Technician: 1 Mechanic, etc.: 6 Store keeper, etc.: 2 Office clerk, etc.: 2	
7. Financial Matters on SWM excluding Public Area Cleaning (The figure of the present is it in 2004.)								
Unit Cost (MNT/ton) except it for Public Area Cleaning	13,384		19,908		20,703		20,298	
Revenue Source (million MNT)	* Collection service fee: 1,506 * District budget: 0		* Collection service fee: 4,005 * District budget: 0		* Collection service fee: 5,541 * District budget: 0		* Collection service fee: 6,221 * District budget: 0	
	* MUB budget: 28 * Tipping fee: 18		* MUB budget: 225 * Tipping fee: 153*3 * RDF: 22		* MUB budget: 156 * Tipping fee: 153*3 * RDF: 91		* MUB budget: 10 * Tipping fee: 153*3 * RDF: 237	
Total Revenue (million MNT) *4	1,553		4,405		5,941		6,621	
Fee Collection Rate • Household (Apart): • Household (Ger): • Business:	86 % 17 % NA		90% 33.1 % 100 %		97 % 53.2% 100 %		97 % 53.2 % 100%	
Percentage of Fee Collected in Total Revenue for SWM	97.0 %		94.1%		95.7%		96.1 %	
Percentage of Intermediate Treatment Cost to Total Revenue for SWM	0 %		4.5 %		3.7 %		3.3 %	
Percentage of Final Disposal Cost to Total Revenue for SWM	3.0 %		11.8 %		8.0 %		7.2 %	
Total Revenue per Capita (MNT/year)	1,743		4,278		5,237		5,328	
Budget of MUB (million MNT) *5	13,100		17,555		22,405		28,596	

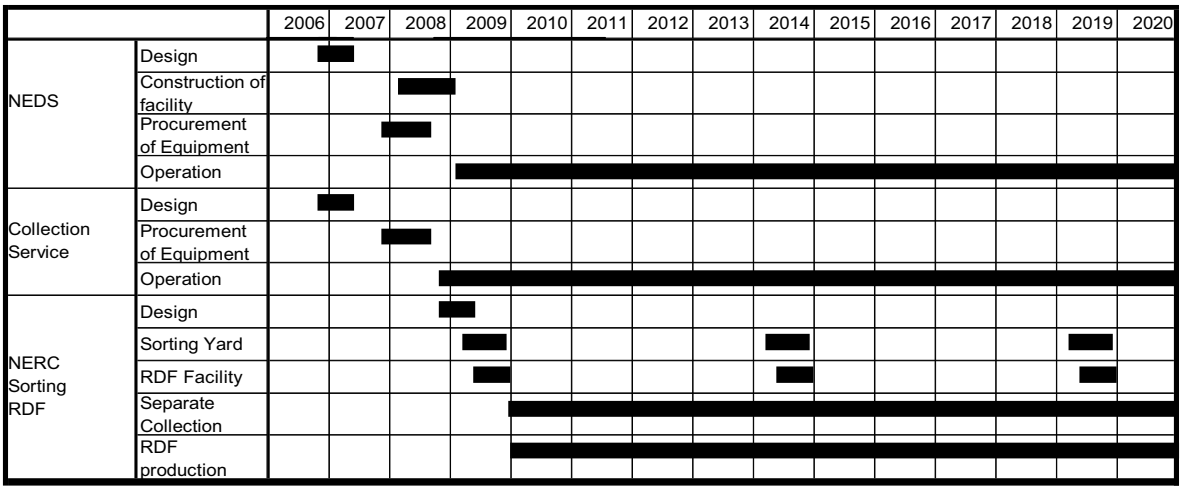
Components \ Phase	Present (2006)		Phase 1 (2010)		Phase 2 (2015)		Phase 3 (2020)	
	winter	summer	winter	summer	winter	summer	winter	summer
Percentage of SWM Budget in MUB Budget	0.21 % *6		?? %		?? %		?? %	
8. Medical Waste Management								
Generation Amount (ton/day)	General Waste: 15.2 Medical Waste: 1.6		General Waste: 16.9 Medical Waste: 1.8		General Waste: 18.9 Medical Waste: 2.0		General Waste: 20.8 Medical Waste: 2.2	
Treatment at generation	General Waste: Collection by TUK Medical Waste: Partly incinerated at generation sources		General Waste: Collection by private company Medical Waste: Treat at generation or entrust to treatment outside		General Waste: Collection by private company Medical Waste: Treat at generation or entrust to treatment outside		General Waste: Collection by private company Medical Waste: Treat at generation or entrust to treatment outside	
Final Disposal	General Waste: Open dumping Medical Waste: Untreated waste at generation is burnt at disposal site		General Waste: Sanitary landfill Medical Waste: Untreated waste is prohibited to enter disposal site		General Waste: Sanitary landfill Medical Waste: Untreated waste is prohibited to enter disposal site		General Waste: Sanitary landfill Medical Waste: Untreated waste is prohibited to enter disposal site	
Executing Body of Final Disposal Site	Nuuts		CMPUA		CMPUA		CMPUA	
9. Industrial Waste								
Generation Amount (ton/day)	Non-HIW: 67.8 HIW: 0.1 *7		Non-HIW: 83.9 HIW:: 0.1 *7		Non-HIW: 109.6 HIW: 0.1 *7		Non-HIW: 143.4 HIW: 0.1 *7	
Treatment and Final Disposal	Non-HIW: Final disposal at municipal landfills HIW: Unknown		Non-HIW: Final disposal at municipal landfills HIW: Storage at generation until HW treatment and disposal facility open.		Non-HIW: Final disposal at municipal landfills HIW: Treated and disposed at the HW treatment and disposal facility		Non-HIW: Final disposal at municipal landfills HIW: Treated and disposed at the HW treatment and disposal facility	
Executing Body	Non-HIW: Nuuts HIW: Unknown		Non-HIW: CMPUA HIW: Discharger until HW treatment and disposal facility open.		Non-HIW: CMPUA HIW: Operator of HW treatment and disposal facility (probably private company)		Non-HIW: CMPUA HIW: Operator of HW treatment and disposal facility (probably private company)	
10. Construction Waste								
Generation Amount (ton/day)	60.6	123.0	75.0	152.2	98.0	198.9	128.0	260.0
Final Disposal	Most of the waste (80% by the Team estimate) was not disposed of at municipal landfills, i.e. illegally dumped.		Control of the waste will be established by regulating submission of waste management plan when a construction work applies for permission, and checking incoming waste amount at municipal landfills comparing the waste amount informed in the plan..		Strengthening enforcement of illegal dumping.		Strengthening enforcement of illegal dumping.	

(Note) *1: The figure outside ( ) is for winter and it inside ( ) is summer.
*2: The unit cost of UCDS in 2006 is applied.
*3: The figure is calculated assuming that current disposal amount by private enterprises will not change and tipping fee will change from 100MNT/m^3 to 2,080MNT/ton.
*4: Since present (2004) budget from a District includes not only for public area cleaning but also for sludge collection, city decoration, etc., it is difficult to identify the budget for public area cleaning. Therefore the budget from the District is not counted.
*5: The figures of year 2010, 2015 and 2020 are calculated supposing the budget will increase in accordance with GDP increase (5.5%).
*6: In 2006 the MUB budget for the disposal site was increased more than 5 times from 28 million to 150 million MNT.
*7: This figure should be re-examined by future study.
*8: Unit cost in this table does not include depreciation cost of facility and equipment.

7.6 Implementation Plan of the M/P

Schedule for implementation of M/P is shown as follows.

Table 7-4: Implementation Plan of M/P



7.7 Financial Analysis of M/P

7.7.1 Project Cost

Based on the above implementation schedule, Project costs for the M/P since 2008 to 2020 are presented at following table.

Table 7-5: Project Cost for the M/P

Unit: 1,000,000MNT

			2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Collection	Collect. Truck	Invest.	13	4,123	0	342	210	228	0	534	342	3,658	228	673	534
		O&M	0	0	3,775	3,807	3,915	4,044	4,086	4,258	4,411	4,533	4,517	4,609	4,683
Intermediate Treatment	Sorting, RDF	Invest.	0	588	0	0	0	0	3,245	0	0	76	0	1,580	0
		O&M	0	0	191	191	191	191	196	431	431	431	431	441	862
Final Disposal	Equip. & Facility	Invest.	209	4,936	0	0	0	0	0	0	0	289	0	0	0
	Landfill	O&M	0	0	501	517	530	463	589	463	469	565	463	610	463
Total		Invest.	222	9,647	0	342	210	228	3,245	534	342	4,023	228	2,253	534
		O&M	0	0	4,467	4,515	4,636	4,698	4,871	5,152	5,311	5,529	5,411	5,660	6,008
		Total	222	9,647	4,467	4,857	4,846	4,926	8,116	5,686	5,653	9,552	5,639	7,913	6,542

Following financial analysis was done based on the condition that initial investment in year 2008 and 2009 is covered under grant aid and no investment is required.

7.7.2 Cost for SWM

Cost of each component for SWM excluding depreciation in each stage of the M/P is presented as follows.

Table 7-6: Cost for SWM in the M/P

Component	Current	2010	2015	2020
Collection	13,514MNT/ ton *1	15,376MNT/ton	14,192 MNT/ ton	13,321 MNT/ ton
Cleansing	18 MNT/m^2*2	50 MNT/m^2*3	50 MNT/m^2	50 MNT/m^2
Sorting	−	13,645MNT/ ton	7,527 MNT/ ton	5,756 MNT/ ton
RDF plant	−	57,914MNT/ ton	31,827 MNT/ ton	24,353 MNT/ ton
Final Disposal	100MNT/m3	2,231MNT/ ton	1,685 MNT/ ton	1,436 MNT/ ton

(Note) *1: collection cost in 2004
*2: contract rate between TUK and Duureg in 2004
*3: contract rate set on Sep 2006

7.7.3 Revenue

The following revenues for SWM are considered:

- Waste collection fee
- Revenue from MUB and/or Duureg government
- Tipping fee at a disposal site
- Sales income of RDF and Valuables from sorting yard

7.7.4 Waste Collection Fee

Waste collection fee and its fee collection rate are presented as follows.

Table 7-7: Waste Collection Fee and Fee Collection Rate

Area	Current		2010		2015		2020	
	Fee	Collection rate	Fee	Collection rate	Fee	Collection rate	Fee	Collection rate
Apartment Area	200 MNT/ person/ month	86%	1,200～ 2,000*2 MNT/ household/ Month	90%	1,200～ 2,000 MNT/ household/ month	97%	1,200～ 2,000 MNT/ household/ month	97%
Ger Area	1,000～ 1500 MNT/ household/ month	12%*1	2,000～ 2,500*2 MNT/ household/ Month	30%*3	2,000～ 2,500 MNT/ household/ month	53%*4	2,000～ 2,500 MNT/ household/ month	53%
Business	4,750 MNT/t	NA	8 750*2 MNT/ton	100%	8 750 MNT/ton	100%	8 750 MNT/ton	100%

(Note)
*1： This figure was obtained by the JICA ST in 2004 by the interview survey to each TUK. It was 41.6% in 2006 when JICA ST interviewed to each Khoroo Government.
*2： Waste fee which was revised in Sep 2006
*3： Effective Collection Rate in 2010（percentage of the people who can afford to pay）was set to 45％. The rate of the household who will be able to pay for the fee is 67 % according to the Statistical Handbook “Ulaanbaatar-XX Century”.
*4： Effective Collection Rate in 2015 was set to 80％

7.7.5 Revenue from MUB and Duureg Governments’ Budget for SWM

Revenue from MUB and Duureg Government relating to SWM is presented as follows.

Table 7-8: Revenue from MUB and Duureg Government

Unit: 1,000MNT

City or District	Current	2010年	2015年	2020年
MUB	150,000*1	375,000	306,000	160,000
Duureg	870,766*2	－	－	－

(Note)
*1: Budget of Nuuts Co. for operating disposal site in 2006. There are a few budget allocated CMPUD but it is very small. So that it is not included in the Revenue.
*2: District budget for cleansing in 2004: Cleansing of road, park, extraction of sludge, renovation works were covered under this budget. Assume that expense and income were balanced, and these amount were excluded in this financial analysis.

7.7.6 Final Disposal Fee

Final disposal fee at each stage of the M/P is presented below.

Table 7-9: Disposal Fee at each stage of M/P

Unit:1,000 MNT

	Present	2010	2015	2020
Disposal Fee	100MNT/m3	2,080 MNT/ton*1	2,080 MNT/ton	2,080 MNT/ton
Expected Income	50,484*2	153,088*3	153,088*3	153,088*3

(Note)
*1 : Revised fee in Sep 2006.
*2 : Budget for landfill operation of Nuuts Co. in 2004, 55% of this amount is from MUB.
*3 : Disposal fee times disposal amount at NEDS and MDDS. The disposal amount is assumed the same as it of the private enterprises who paid tipping fee at UCDS and MDDS.

7.7.7 Income from Valuables at Sorting Yard and Sales of RDF

Income from sales of valuables at sorting yard and RDF production facility is presented below.

Table 7-10: Income from Sales of Valuables at Sorting Yard and RDF at RDF Production

Unit : 1,000 MNT

Item	Present	2010	2015	2020
Valuables	-	57,720	248,960	708,448
RDF	-	22,090	90,700	237,070

Since incomes of the sales of valuables will be used for the salary of workers (waste pickers), the incomes and costs will be balanced out in financial analysis. The current coal price is 12,000MNT/ton and transportation cost is assumed 2,000MNT/ton. Consequently the sales price of RDF is set 10,000MNT/ton in financial analysis.

7.7.8 FIRR and Cash Flow

FIRR is calculated as 1.4 % based on the above conditions.

There will be a continuous deficit from 2010 till 2011 but there will be annual profit from 2012 onward.

Big investment in 2014 for NERC development and in 2017 for replacement of collection trucks will be necessary and appropriate financial arrangement such as overseas soft loan will be required.

Table 7-11: Cash Flow of the M/P

Unit : 1,000,000MNT

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Investment	0	342	210	228	3,245	534	342	4,023	228	673	534
O&M	4,467	4,515	4,636	4,698	4,871	5,152	5,311	5,529	5,411	5,660	6,008
Revenue	4,405	4,649	4,897	5,149	5,406	5,941	6,078	6,233	6,381	6,545	6,621
Profit & Loss	-62	-208	51	223	-2,710	255	425	-3,319	742	212	79

7.7.9 Conclusion

The Master Plan for SWM in Ulaanbaatar City targeted for year 2020 is feasible financially based on the conditions set above.

7.8 Institutional Development Plan

Institutional development plan such as improvement of collection fee system, strengthening the CMPUD as an executing agency and development of the legal system and standards for

establishing an appropriate SWM are indispensable to smoothly implement a master plan for SWM in the municipality of Ulaanbaatar.

7.8.1 Legal System

a. Development of Detailed Solid Waste Classification

The Law on Household and Industrial Waste classifies solid waste (SW) into non-hazardous waste (non-HW) and hazardous waste (HW) and the classification is reasonable. However, more detailed classification is necessary for proper SWM. The Study team has proposed a detailed classification of SW for the study as shown in the table below in order to establish a proper SWM system. Because proper management for each waste differs each other, i.e. collection, treatment, disposal, management fee, responsible body, etc. The Team recommends responsible officers of the MOE to refer the table for the establishment of detail classification.

Table 7-12: Solid Waste Classification

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	4. Commercial (shop, office, restaurant, hotel, etc.) waste 5. Market waste
	General Waste from Medical Institution	General Medical Waste	6. Non-infectious and non-hazardous medical waste
	Industrial (Factory) Waste	Non-hazardous Industrial Waste (Non-HIW)	7. Non-HIW from non-production sources 8. Non-HIW from production process
	Construction waste		9. Construction waste
Hazardous Waste (HW)	Municipal Waste*1	Hazardous Municipal Waste	10. Domestic HW 11. Commercial HW
	Industrial (Factory) Waste	Hazardous Industrial Waste (HIW)	12. Hazardous factory waste
	Medical Waste	Medical Waste	13. Infectious waste 14. Hazardous medical waste
	Construction Waste*1	Hazardous Construction Waste	15. Hazardous construction waste

(Note) *1: This study does not cover these wastes. The amount of these wastes is very limited.

b. Guidelines for SWM

MOE is establishing several guidelines for proper SWM, the following guidelines need to be gradually prepared in collaboration with relevant organizations:

- Technical guidelines for landfill design and operation
- Technical guidelines for treatment and disposal of hazardous waste
- Detailed regulations and guidelines for the collection and treatment of medical waste
- Detailed regulations and guidelines for the management of hazardous waste other than medical waste
- Guidelines for environmental impact analyses and public hearings

The Team recommends MOE and other responsible organizations to ask for foreign technical cooperation for the preparation of the above guidelines.

7.8.2 SWM of Municipality of Ulaanbaatar

In order to smoothly implement the M/P Municipality of Ulaanbaatar (MUB) needs to execute the following institutional development:

- Strengthening responsible organization for SWM in MUB;
- Improvement of financial system for SWM

a. Strengthening Responsible Organization

In order to strengthen the current organization for SWM in Ulaanbaatar, the mayor of the city issued the Capital City Mayor Order No. 445 which instructed to establish a new organization, CMPUA (City Maintenance and Public Utility Agency) from September 15, 2006.

In response to the Order, CMPUA commenced to build up a new organization structure for it according to the figure below. The CMPUA plans to employ the following staffs.

Schedule	Staffs to be Employed and Paid by MUB	Staffs to be Employed and Paid by CMPUA	Total
By the end of 2006	30	To be advised by the JICA B/D Study Team	NA
By the end of 2008	45	To be advised by the JICA B/D Study Team	NA

b. Improvement of Financial System for SWM

b.1 Waste Management Service Fee

Based on the financial analysis made by the study, the waste management service fee was revised and enacted from September 1, 2006. The table below presents previous and revised fee tariff.

Table 7-13: Waste Management Service Fee

Service Items	Previous Tariff	New Tariff
Collection of Business Waste	19,000 MNT per a truck or 4ton	35,000 MNT per a truck or 4ton
Collection of Household Waste in Apartment Area	200 MNT/person/month (equivalent to 600 -1,000 MNT/household/month)	1,200 -2,000 MNT/household/month (depending on the District)
Collection of Household Waste in Ger Area	1,000 -1,500 MNT/household/month (depending on the District)	1,500 -2,500 MNT/household/month (depending on the District)
Collection of Household Waste in Summer House Area	2,000 MNT/household/month	2,500 MNT/household/month
Public Area Cleaning	18 MNT/1m2	50 MNT/1m2
Final Disposal	100 MNT/1m3	2,080 MNT/ton

b.2 Waste Service Fund

With reference to the Article 28.1 and 28.3 of the "Law on Administration, Territorial Division, and its Management", and the Article 21.1 of the "Law on Household and Industrial Waste", and the Decree 248 of the "Approval of the Waste Service Fund Regulation" issued by the Presidium of the Capital Citizen's Representatives, on 30th November 2006 the Mayor of the Ulaanbaatar ordered to establish the Waste Service Fund as follows:

- Establish the city waste service fund at the Mayor's Office of MUB, and districts' waste service fund at District's Governments.
- Oblige the Ulaanbaatar City General Manager and District Governors to prepare necessary measurers for the organization of the Waste Service Fund according to the

approved Regulation, and to start the operation of the Fund from 1 January 2007, and to ensure the monitoring.

Based on the Waste Service Fund the MUB/CMPUA plans to improve the current financial system for SWM as shown in the following Figures. The following issues are main differences between old and new system.

- The Waste Service Fund is established in the City and Districts named as City Waste Service Fund (CWSF) and District Waste Service Fund (DWSF).
- Instead of TUKs staff of the DWSF will collect waste collection fee from Business establishment.
- Instead of TUKs officers of Khoroo or Kheseg will collect waste collection fee from household in the Ger Area.
- Waste Collection Section or Unit of CMPUA will be able to provide waste collection service according to the order of District and be paid for the service by DWSF.
- Instead of Nuuts Co., Disposal Site Operation and Management Section of CMPUA will conduct operation of the disposal sites.

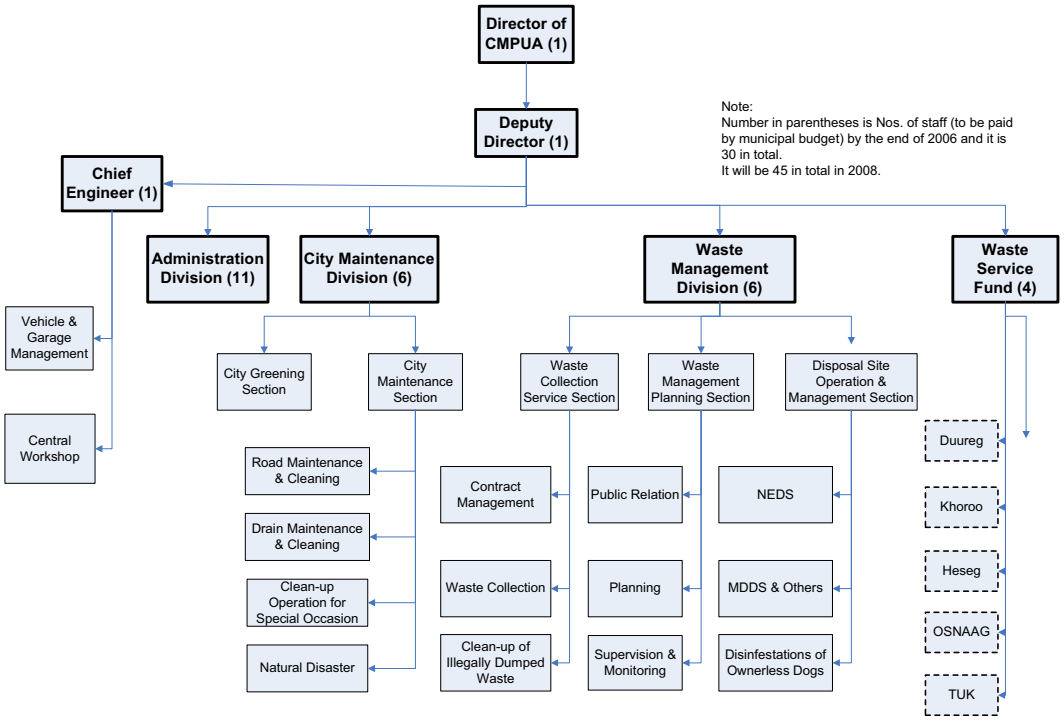


Figure 7-7: Organization Chart of CMPUA

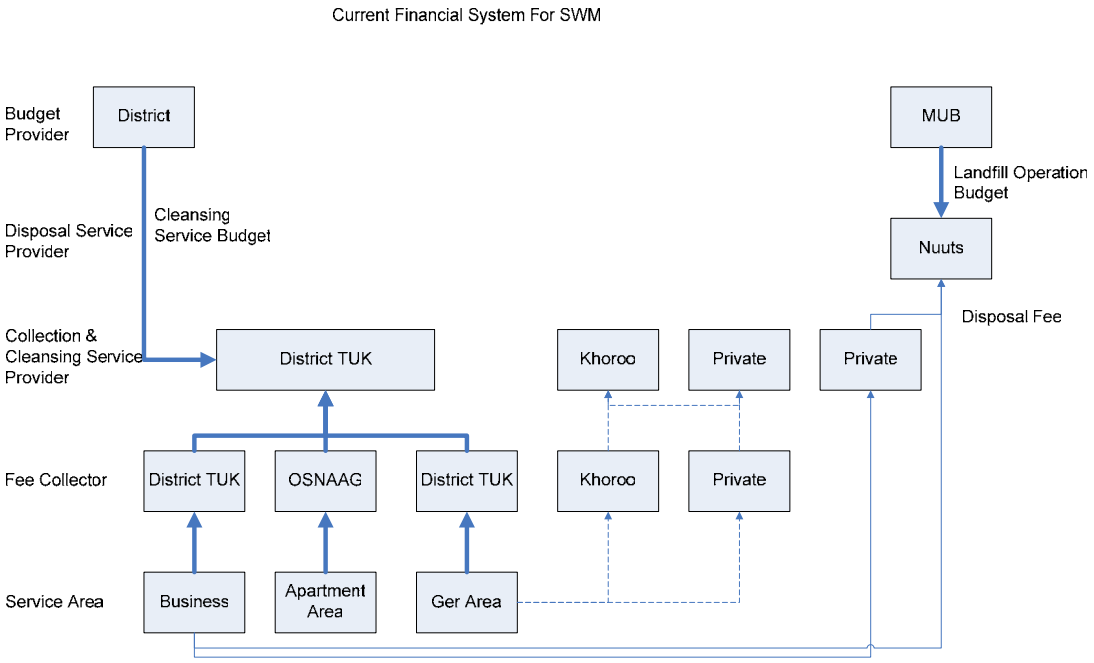


Figure 7-8: Current Financial System for SWM

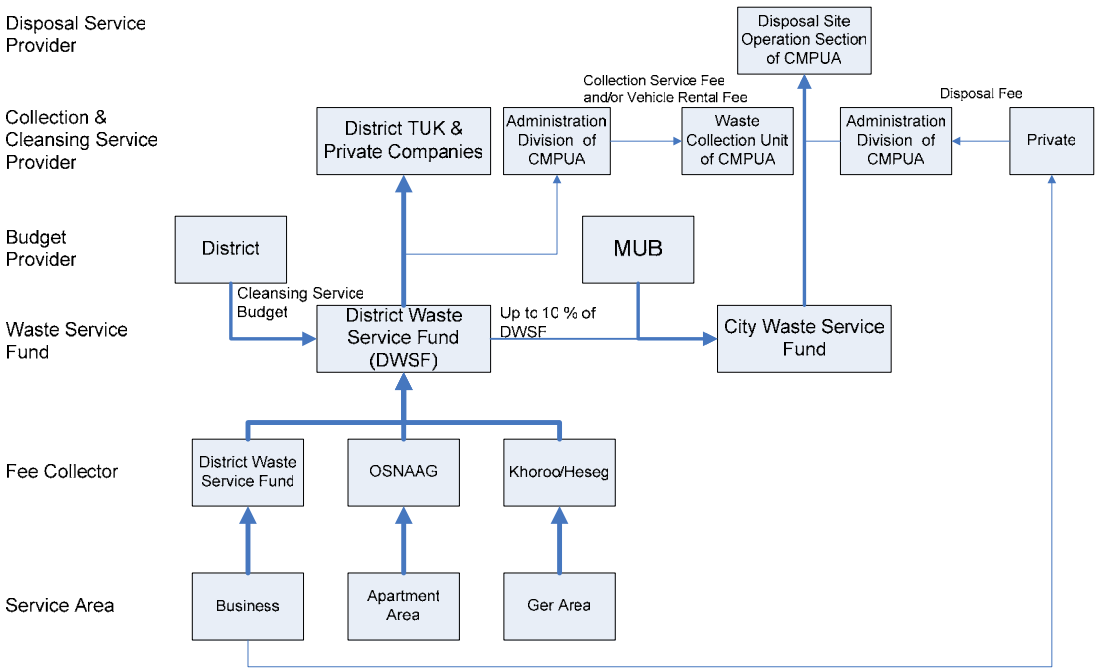


Figure 7-9: Future Financial System for SWM

7.8.3 Contract Management for Private Companies

Duureg Governments need to entrust waste service to private companies. Therefore, it is very important for them to conduct proper contract management for private companies. The following issues are important issues for the management.

a. Proposed Contract System

There are three common contract systems for the waste collection and transportation work.

Table 7-14: Advantages and Disadvantages of Contract Systems

Type of contract	Description	Advantages and Disadvantages for Client
Lump sum contract	The total contract price is determined based on the waste collection amount for a certain area for a certain period which is forecast based on the trend. This system is, therefore, applicable for the waste which can be forecast, for example the residential waste which can be forecast based on the population and the waste discharge rate.	Advantages: Monitoring and supervision work is easy. Disadvantages: The client has to estimate the entire cost for the collection and transportation to fix the contract price. The cost estimation is a little difficult.
Weight-distance base contract	The payment is determined based on the weight and the transportation distance of waste. Because taking the transportation distance into account precisely is too difficult, the price for a certain area is often determined. The payment is calculated by the total waste amount collected which is measured by a weighbridge and the contract price.	Advantages: The concept of this contract system is very fair for both parties. This contract system can be applicable for the various waste types of which generation amount vary. Disadvantages: Contractors often cheat the waste amount because there can be many ways to cheat. The payment, therefore, often increases. It is quite difficult to understand from which area the truck collected this waste. The monitoring work is quite difficult.
Trip base contract	The payment is determined by the number of trips, specified waste amount carried by a truck per trip and the transportation distance. Because taking the transportation distance into account precisely is too difficult, the price for a certain area is often determined. The payment is calculated by the total number of trips.	Advantages: The concept of this contract system is fair for both parties. This contract system can be applicable for the waste of which generation amount vary. Disadvantages: It is quite difficult to understand from which area the truck collected this waste. The monitoring work is quite difficult.

The best contract system, which depends on the management capabilities of MUB and the type of waste, is proposed in the following tables.

Table 7-15: Proposed Contract System for Planned Area

Type of waste	Financial source	Responsible body	Executing body	Payment method	Remarks
Residential waste	Waste Fund	Duureg	TUK	Lump Sum payment	The waste generation amount in the every khoroo can be estimated by the population and the waste discharge rate. The transport distance from the every khoroo to the disposal site can be determined. Then the collection cost can be calculated. The data, fuel price, population, the discharge rate, should be updated every year.
Park, Road cleaning	Present source	Duureg	TUK	Lump Sum payment	Same as present.
Business waste (Non-movable dischargers) Ex. Hotel, restaurant, office, shops, factory	No governmental budget	Duureg	TUK	Duureg collects the waste fee from establishments.	Duureg collects the waste fee for business waste CMPUA is in charge of designing the proper waste collection fee tariff of business waste for each Duureg considering the difference of travel distance and waste amount.
Business waste (Movable dischargers) Ex. Construction waste	Directly collect from dischargers (construction company or client)	Duureg	TUK	Per volume	Refer to the other page.
Temporary public waste Ex. Nadam waste, event waste		Duureg	TUK	Proper payment method should be selected depend on the condition. ● Per trip ● Per weight and distance or ● Lump sum	The budget should be estimated for the each case and Duureg employ TUK.
Temporary private waste Ex. Balky waste, large amount waste	No governmental budget	Duureg	TUK	Duureg directly collect the waste fee from dischargers.	This is dealt with as the same as business waste.

Table 7-16: Proposed Contract System for Unplanned Area

Type of waste	Financial source	Responsible body	Executing body	Payment method	Remarks
Residential waste	Waste Fund	Duureg	TUK or other private company	Per trip or Lump Sum payment	Per trip contract has the following advantages in this case. ● It is suitable to employ small companies and even a private person who has a truck. ● Therefore, the collection truck can be arranged by even khoroo. ● Per trip contract is fair for the ger area because the seasonal difference of the waste discharge amount is large. When the small company is employed, the manifest system to check their proper waste disposal has to be strictly done.
Park, Road cleaning	Present source	Duureg	TUK	Lump Sum payment	Same as present.
Business waste (Non-movable dischargers) Ex. Hotel, restaurant, office, shops, factory	No governmental budget	Duureg	TUK	Duureg collects the waste fee from establishments.	Duureg collects the waste fee for business waste. CMPUA is in charge of designing the proper waste collection fee tariff of business waste for each Duureg considering the difference of travel distance and waste amount.
Business waste (Movable dischargers) Ex. Construction waste	Directly collect from dischargers (construction company or client)	Duureg	TUK	Per volume	Refer to the other page.
Temporary public waste Ex. Nadam waste, event waste		Duureg	TUK	Proper payment method should be selected depend on the condition. ● Per trip ● Per weight and distance or ● Lump sum	The budget should be estimated for the each case and Duureg employ TUK.
Temporary private waste Ex. Balky waste, large amount waste	No governmental budget	Duureg	TUK	Duureg directly collect the waste fee from dischargers.	This is dealt with as the same as business waste.

b. Prevention System of illegal dumping of Construction waste

Two measures should be taken at the same time.

a) Measure to control the public space where construction waste is often dumped.

b) Measure to control the construction waste generation site.

b.1 Establishment of the Control System of the Pubic Space

a) The Duureg should be responsible for maintaining the public space clean.

b) The private person has to get the approval from Duureg for using the public space for their private purpose and always display the permission to public at the site. Duureg should collects the certain amount of deposit money and lease fee of the public space from applicants.

b.2 Establishment of the Control System of the renovation work of apartment

a) The client of renovation work of the apartment has to submit the application of the renovation to Duureg office with the certain amount of deposit money which is enough to cover the disposal of construction waste. The client has to display the permission in from of the door. If no permission is found, Duureg punishes the owner. Duureg should get the cooperation of housing associations to monitor the renovation work permission.

b) The deposit money is kept in the construction waste fund operated by Duureg.

c) The client has to submit the evidence showing their construction waste properly disposed to the Duureg after the construction work completed. If the contractor employs TUK for the waste disposal, the receipt can be used for this purpose. If the contractor carries waste to the disposal site for disposal, the receipt of Nuuts can be used for this purpose.

d) If the evidence is submitted to Duureg, Duureg return the money deposited in the construction waste fund to the client.

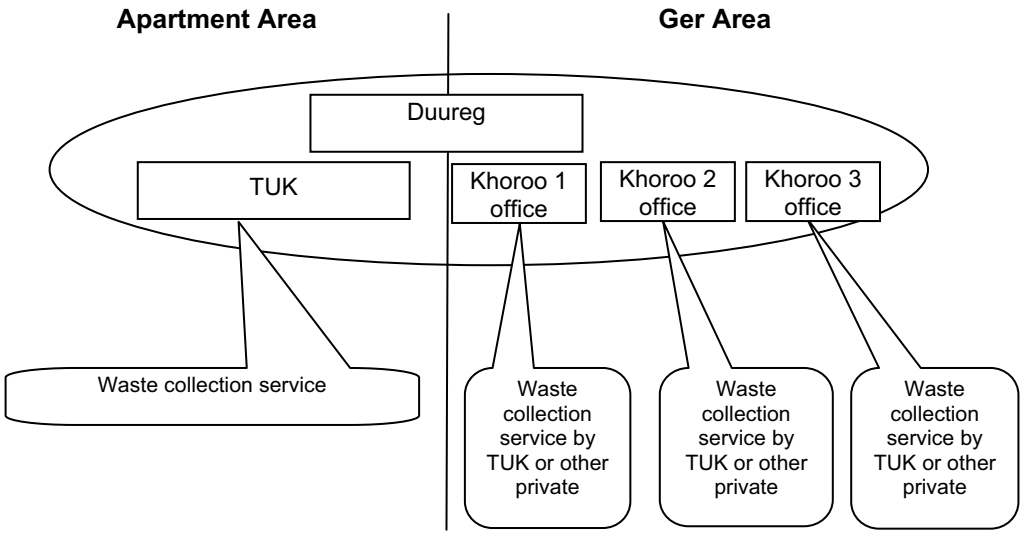
e) If the owner did not submit the evidence to the Duureg, the deposit money is remained in the construction waste fund and Duureg can use this fund for clearing the illegally dumped waste.

f) The reason why the client of the work is responsible for the construction waste in stead of the contractor, it is too difficult to identify the contractor because they are too small and movable.

c. Involvement of Private sector

The objective of solid waste management is to obtain sanitation and environmental protection in the cheapest cost. The private sector's objective is the maximization of the profit. It is, therefore, very hard for the client to achieve SWM's objective by using private companies.

We recommend that TUK should be Duureg's department or the company owned by Duureg or MUB and that the private sector should be involved under the TUK.



d. Requirements for the Contract

The contract price will be decided upon between the interested parties, as the result of public bidding or negotiations. The following are the proposed basic contract prices, taking into account the cost items needed for the stable provision of high quality service, including reasonable profits for the service providers.

e. Contract Management System

e.1 Bidding

The bids can be open or specified competitive. In the case of the open bid, MUB, by means of public call, invites bidders, while in the case of the specified competitive bid MUB invites companies that are generally inscribed in the contractor registrations of the Municipality.

Bidding Process

In most cases, the contracts for collection and transport service are the result of a bidding process. Administrative and technical conditions are fixed through the bidding process. The following table shows the most outstanding aspects to consider in a bidding process. The whole bidding process should be monitored by the Juridical Consultancy in order to verify the legal validity of the process.

Table 7-17: Bidding Process for Collection and Transport Services

Activities	Specifications
Diagnostic	Before making the bid document for the collection service, it is necessary to evaluate the current situation of the service, as for: coverage of service / serviced population, collection frequency, characteristic of the vehicles and equipments, quantities and volumes of waste collected and transported, characteristic of this waste, etc.
Decision Making	With the evaluation of the current situation, the decision on service conditions should be made, and at the same time service quality should be established. In the evaluation it should be considered the analysis of whether it is necessary to pass the activity over to the private sector.
Estimate the Service Costs	The costs of the service to bid will be considered with the purpose of evaluating the proposals. It should be also considered whether MUB could afford the costs of the service. If not, the conditions and quality of the service should be modified to reach a value that is adjusted to the budget of MUB that assures the sustainability of the service.

Activities	Specifications
Elaboration of the administrative and technical documents	Once the decision of the characteristics of the service is made, the administrative and technical documents for bidding should be elaborated. The elaboration of strict and adjusted administrative document will allow MUB to have a mechanism that assures the recruiting of a solid company. In this sense, the administrative document should define the juridical, economic and technical conditions of the companies. On the other hand, it defines the legal framework and the applicable jurisprudence, the duration of the contracts, the evaluation mechanisms of the proposals, the tickets, the guarantees, procedures of recruiting etc. With regards to the technical document, it should be elaborated requesting to specify details of the types, models and technical data of the vehicles and equipments, details of the operation plan, organization chart of the company, administrative structures, maintenance programs and prevention of risks, budget and communication plan with the community, etc.
Establishment of the Inspection System	According to the characteristics of the service subject to bidding, the inspection program of the contract should be designed, for both the technical and administrative aspects.
Bidding of the Service	Once the bases are made, the bidding process begins and includes the following activities: invitation to companies or competition call, sale of bases, reception and opening of offers, evaluation of the offers, award, contracts signing, setting and implementation of the services.

e.2 Bidding Documents

The following are minimum required documents for the bidding.

Administrative Document

General Aspects

- Objectives of the bid,
- Description of the applicable juridical normative
- Acceptance of preconditions
- Knowledge of the land or project
- Acquisition of bid document and consultations (for open bid)
- Duration of the contract
- Budget
- Description of the questions and answers process to the bidding document
- Jurisdiction and Domicile

Form of Proposal

- Requirements that the bidder should complete to participate in the process
- Documents that demonstrate the experience, capital and financial state of the bidder
- Bid bond
- Duration of the proposal
- Truthfulness and sufficiency of the offer
- Way of presenting the proposal

Award Process

- Process of opening of the proposal
- Analysis and evaluation procedures of proposal
- Award procedures
- Contract signing
- Contract guarantees
- Surrender, Transfer, Association and Sub-contracting

Execution of the Contract

- Documents that regulate the contract
- Initiation and execution of the works
- Increases or decreases of the works

- Sanction and penalty
- Claim procedure in front of sanctions and penalty
- Technical and administrative responsibility
- Insurance, indemnity
- Service payment, readjustments, contract increase
- Taxes, rates and contributions

Ending of the Contract

- Extinction, suspension and handover of the contract

Technical Bases

General Aspects

- Description of the services
- Definitions of terms used in the bases
- Description of the waste that is subject of the contract
- Minimum quantity of waste to collect monthly.

Technical Aspects

- Area and sectors of service:
  - boundaries of total area and sectors covered by the service
  - Inventory of waste dischargers such as population, households, organizations, etc.
  - waste composition
  - estimation of trips and tons collected monthly
  - destination of the waste
  - property of the waste collected
- Modality of the service
- Frequency, schedules and days of attention
- Daily work programs
- Explanation of how should be organized and develop the works that are part of the service
- Minimum requirements of the operations plan that the bidder should present in its proposal
- Equipments, definition, requirements, quantity of plant and reserves, useful life, etc.
- Description of the facilities (workshops, offices, etc.)
- Personnel assignment
  - number of drivers and collectors per truck,
  - reserve personnel
  - salaries,
  - training plans,
  - labor security,
  - inspection system of the service, etc.
- Procedure for implementation and starting up of the service
- Registration system and reports

Documents of the Technical Proposal

- Detailed description of technical proposal

Annexes

- Plans and any other outstanding information for the elaboration of the proposal should be submitted.

Once awarded the contract, the bidding document (administrative and technical), the questions and answers and the awarded bidder's offers become part of the contract.

e.3 Contract Auditing

Once the contract is signed, Duureg should pursue the execution of the contract. The Operations and Inspection Unit will be in charge of monitoring and evaluating the execution of the service, establishing evidences of infractions for non fulfillment of the contract, and elaborating the monthly report in relation to the service so that Duureg proceeds with the payment and apply penalties if they exist.

f. Unified Contract

In the implementation organization plan proposed by MUB, Duureg is responsible for budgeting to all works required for waste management and only TUK is responsible for the execution in the Planned area and TUK or other private companies are responsible for the .execution in Un-planned area. If both parties of the contract is the same, the contracts can be unified. Table 7-18 shows the proposed wastes covered by the unified contract for the waste collection and transportation work.

Table 7-18: Proposed Wastes Covered by Unified Contract

Type of waste	Description	Applicability to Unified Contract
Residential waste	The variation of estimated waste quantity for a year is quite small.	Unified contract
Park, Road cleaning	The variation of estimated waste quantity for a year is quite small.	Unified contract
Business waste (Non-movable dischargers) Ex. Hotel, restaurant, office, shops, factory	The variation of estimated waste quantity for a year can be large.	It can be included in the unified contract, but the inventory of dischargers should be monitored and updated seasonally.
Business waste (Movable dischargers) Ex. Construction waste	Very difficult to estimate the waste amount.	Separate contract
Temporary public waste Ex. Nadam waste, event waste	It may be difficult to estimate the waste amount.	Separate contract
Temporary private waste Ex. Balky waste, large amount waste	Very difficult to estimate the waste amount.	Separate contract

According to this proposal, the unified contract has to include the following information to determine the scope of work.

a) Boundary
b) Population and the number of households to be covered.
c) Inventory list of business organizations to be covered.
d) Inventory list of parks and green area to be covered.
e) Inventory list of roads to be covered.

Business waste (Movable dischargers) such as construction waste, the temporary public waste such as Nadam waste and event waste, and the temporary private waste such as furniture waste should be made contract separately and occasionally between Duureg and TUK.

7.8.4 Capacity Building

Capabilities of officers responsible for SWM in UBC have been developed significantly through the study. However, it is still not enough for the establishment of environmentally sound SWM in UBC, especially the following issues:

- Prepare, conduct and disseminate waste discharge rules
- Plan, prepare, conduct and disseminate separate collection
- Plan, prepare, operate a sorting yard and PDF production facility
- Plan, prepare, operate a sanitary landfill
- Plan, prepare, operate a hazardous waste treatment and disposal facility

The Study Team recommends MUB in cooperation with other organizations to ask for foreign technical cooperation for the Capacity Development of the above issues.

8. Capacity Development

8 Capacity Development

8.1 Approach for Capacity Development

In order to pursue the objective of the study "To enhance the institutional, organizational, and human capacity related to solid waste management in Ulaanbaatar City", in the discussion of the Inception Report the C/P and the study team set up the structure of the study as described in the Section 1.3.2.

In order to develop the capacities of stakeholders in UBC, the study team proposes a framework for capacity development as shown in the figure below.

a. Weekly Meetings with Technical Working Group

The St/C assigned 21 personnel as the members of the technical working group (TWG). 62 weekly meetings in total were held from the beginning of the study in December 2004 to the end of December 2006. Participants of the meeting normally consisted of permanent members of the TWG. Depending of the topics of each meeting, non-permanent members were invited for discussions. The meeting aimed at developing SWM plan by applying PLA (Participatory Learning and Action). Each meeting spent two to three hours and main agenda discussed were as follow;

- Progress of the study and problems during works, and countermeasures to overcome them;
- Schedule for the following week and its contents,
- Specific topics for certain SWM planning process, such as selection of candidate sites, methodology of finding Waste Flow from WACS results, Alternatives of M/P, etc.

The TWG meetings contributed not only to smooth conduct of the study but also for the core members to understand how to make SWM M/P, and to enhance individual capacity development on SWM. All the topics of the TWG meeting are available in the Data Book.

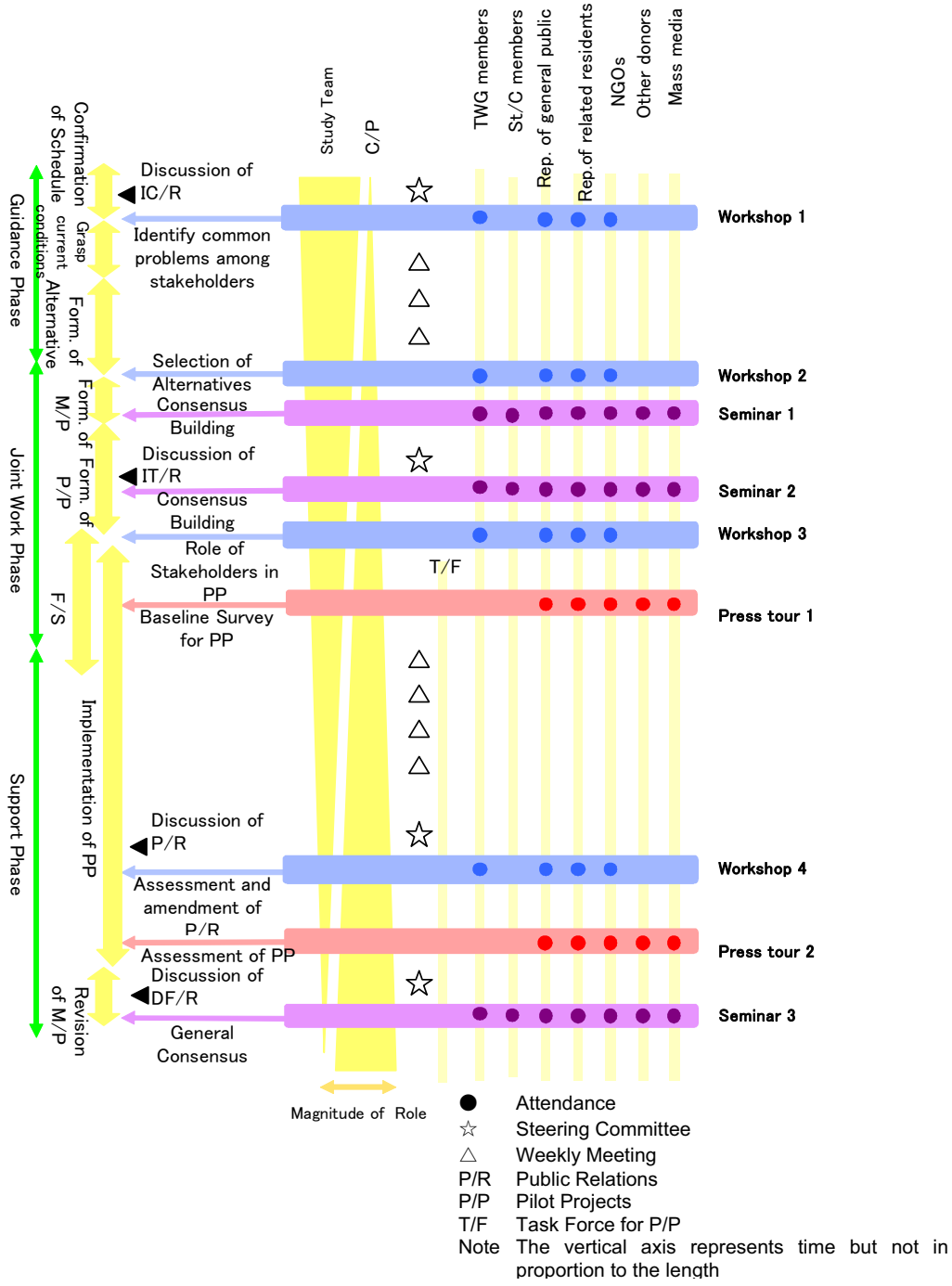


Figure 8-1: Frameworks of Capacity development in the Study

b. Steering Committee (St/C) Meetings

Many organizations are involved in SWM in Ulaanbaatar. There are certain conflicts among them and these need to be solved in order to reach certain consensus. The St/C meeting aimed at bringing decision of a policy for solutions.

For this purpose, St/C meetings were held five times as follows:

- Discussion and confirmation of the Inception Report;

- Presentation of six candidates for a future disposal site for the central six Districts and confirmation of implementation of the Pilot Project on "Urgent Improvement of the Ulaan Chuluut Disposal Site" which was scheduled to close by the order of the Minister of Environment in January 2005;
- Decision on the selection of Narangiin Enger site as the future disposal site for the central six Districts;
- Discussion of the Interim Report and policy of the M/P, and decision on the priority projects for the Feasibility Study and pilot projects; and
- Decision of the conduct of the Phase 3 study.

c. Pilot Projects Task Forces

As presented in the next Chapter, many pilot projects (P/Ps) were conducted in this study. The C/P took the initiative in conducting the P/Ps.

Task forces, which consist of the C/P, TWG, NGOs, residents around the project areas, and so on, are formed for Pilot Projects of Urgent Improvement of UCDS and Raising Public Consciousness on Waste issues. The detailed schedule, role of stakeholders, monitoring methods, assessment of the projects, and know how of the projects were discussed.

Task forces will be formed for each Pilot Project. The detailed schedule, role of stakeholders, monitoring methods, assessment of the projects, and know how of the projects will be discussed. At least one C/P will be a member of the Task Forces and manage them. Expected participants are the C/P, TWG, NGOs, residents around the project areas, and so on.

d. Workshop

The purpose of the workshops is to achieve consensus among the officers in charge of SWM in relevant organizations, and the stakeholders who have an interest in the plan. The following four workshops were held. TWG members, NGOs, and residents and businessman around priority projects and pilot projects areas were participated.

Explanation of the topics and the Question & Answer session were conducted mainly by the C/P while the coordination and facilitation of the workshops was conducted mainly by the Study team. Active participation of the C/P to the Weekly Meetings contributed their successful presentation in the workshops.

Table 8-1: Outline of Workshops

Workshop	Date	Objectives	Nos. of Attendants
First	Dec 9 & 10, 2004	• To share experience and problems; • To increase awareness of and links to problems elsewhere in the sector; and • To begin to build consensus through co-operation in improving Solid Waste Management in Ulaanbaatar.	50 persons
Second	April 11, 2005	• To understand the needs of siting future disposal sites for the formulation of the SWM Master Plan (M/P); • To examine and discuss the advantages and disadvantages of the SWM technical system alternatives for six candidates for future final disposal site(s); and • To make recommendations regarding future final disposal site(s) for SWM in Ulaanbaatar City.	45 persons
Third	Oct 18, 2005	• To evaluate the progress of two pilot projects in Khoroo 4 of Songinokhairkhan District, Urgent Improvement of the UCDS and Raising Public Consciousness on Waste Issues, by local residents and waste pickers	Part 1 for Local Residents • Residents 56 • NGOs 10 Part 1 for Waste Pickers • 80 persons

Fourth	May 17, 2006	• To mainly investigate degree of negative impacts that may be caused by mixed combustion of RDF with coal at the existing heating plant; • To demonstrate citizens in UB city both negative and positive impacts of the mixed combustion of RDF with coal at the existing heating plant in order to obtain the consensus to implement proposed M/P regarding thermal recycle "RDF"; and • To examine economic viability of the use of RDF at the existing heating and/or power generation plant.	About 100 persons

e. Seminar

The purpose of the seminars is to explain the selected plan to the public and try to achieve consensus among the stakeholders in the study area. Three seminars were held with the objectives as shown in the Table below. St/C members, TWG members, NGOs, residents around the project areas, the general public and mass media have participated.

The coordination and facilitation of the seminars were conducted by the C/P and Study team but explanation of the topics and the Question & Answer session were conducted by the C/P. The Weekly Meetings contributed their successful presentation in the seminars.

Table 8-2: Outline of Seminars

Workshop	Date	Objectives	Nos. of Attendants
First	April 26, 2005	• To present decision on futures final disposal site(s) in order to achieve consensus among the stakeholders.	61 persons
Second	July 6, 2005	• To present the proposed M/P and priority projects in order to achieve consensus among the stakeholders; and • To explain the pilot projects to ask active cooperation from relevant stakeholders.	75 persons
Third	January 5, 2007	• To present the results of the Study to stakeholders; • To share the important experiences of the Study in order to implement the proposed M/P; and • To exchange opinions among stakeholders in order to smoothly implement the M/P.	123 persons

f. Selection of the Future Final Disposal Site

The selection work of the future final disposal site for the central six Districts were conducted mainly by the Mongolian side except for the examination works of environmental and economic comparison for the six candidate sites.

g. Execution of EIA Study for the Priority Projects and Public Hearing Meetings

A disposal site and recycling facilities of solid wastes could have a lot of impacts on the surrounding areas. In order to identify the impacts, to find out mitigation measures of them and to get consensus on the development of the new Narangiin Enger Disposal Site (NEDS) and recycling complex (NERC), the MUB conducted the EIA survey according to the laws and regulations in Mongolia. Since local residents and local authorities are concerned about the consequences of the construction of the proposed disposal site and recycling facilities, due to the results of the UCDS, the MUB, the project owner held the three public hearing meetings as shown in the Table below, inviting all the stakeholders such as local residents, local authorities and NGOs.

Explanation of the topics and the QA session were conducted by the C/P and the consultant employed by the MUB while the Study team gave necessary advices to the C/P. Active participation of the C/P to the Weekly Meetings contributed their successful presentation in the meetings. The C/P training in Japan also supported the C/P to explain and reply the questions come from the participants on the development of the recycling complex, especially on impacts by RDF combustion.

Table 8-3: Outline of Public Hearing Meetings

Workshop	Date	Objectives	Nos. of Attendants
First	April 26, 2005	• To reflect opinion of stakeholders in both the EIA survey plan and the proposed NEDS and recycling complex development project.	111 persons
Second	Oct. 18, 2005	• To show the results of the EIA survey on the development plan including mitigation measures; and • To discuss about the result with stakeholders such as local residents and NGOs.	88 persons
Third	May 10, 2006	• To explain development projects of the new NEDS and recycling complex and mitigation measures for the impacts by the projects; and • To achieve consensus on the projects among the stakeholders.	129 persons

h. Public Relations (P/R) Activities

Public relations activities are important for both the C/P and the citizens of UBC in terms of sharing common and accurate information. In the study the study team in collaboration with the C/P elaborated eight newsletters, home pages, and press tours to achieve optimum effect.

8.2 Contents of Support and Monitoring Items for Capacity Development

8.2.1 Contents of Capacity Development

In order to monitor and assess the degree of capacity development the following factors were considered.

a. Acquisition, Evaluation and Management of Basic Data on SWM

Due to insufficient basic data on the SWM such as generation, collection, recycling and final disposal amount, the current SWM is not fully grasped. Methodologies of basic field survey, evaluation of obtained data and its meanings had to be learned through the study.

It is also very important to evaluate the data obtained and manage it for the improvement of actual SWM.

b. Planning of Technically Appropriate SWM Components

Basic planning methods of SWM system in collection and haulage, intermediate treatment, and final disposal, need to be understood. Planning and modification process had to be experienced by observing the improvement of solid waste management through pilot projects of improvement of existing disposal site and improvement of collection system.

c. Participatory Approach in Planning

The current SWM system does not sufficiently reflect public opinions to the policy. To encourage effective coordination efforts among government, citizens, and business establishments, and participatory approach in planning had to be promoted. The activities include; receiving public opinions toward the government PR activities through the study, and execution of various activities related to the pilot project for improvement of current SWM system.

d. Encourage their own Initiatives and Ensure Accountability

Operational institutions have a responsibility to explain about their present status and future vision to the citizens since the collection fees are collected for SWM. To establish accountability, the institutions in charge must develop their initiatives. By expanding P/R

activities, or through workshops/seminars, the institutions are expected to gain presentation skills, to improve the effectiveness of their plans.

e. Strengthening of Partnership among the Organizations

SWM is undertaken by several different institutions in Mongolia, which makes difficult in coordination among the institutions. Participating meetings such as St/C or being involved with the P/Ps can give an opportunity to build partnership among the organizations by sharing roles.

8.2.2 Contents of Support and Monitoring Items for Capacity Development

Following table shows the contents of supports and monitoring items for capacity development.

Table 8-4: Supports and Monitoring Goals in Capacity Development

Capacity Component to be Developed	Contents of Support	Monitoring Items
1. Acquisition, Evaluation and Management of Basic Data on SWM	• Planning, implementation and evaluation of the field investigation • Planning, implementation and evaluation of pilot projects (P/Ps)	• To understand how to acquire basic data on SWM and to evaluate the current SWM by using the data, and to be able to make presentations on it. • To be able to calculate the basic data, such as waste amount, operational performances, etc.
2. Planning of Technically Appropriate SWM Components	• Establishment of M/P alternatives • Formulation of M/P • Planning, implementation and evaluation of P/Ps, and modification of M/P based on the results of P/Ps • Implementation of F/S	• To be able to make presentations about outline of plans knowing the process of planning • To be active in evaluating P/P, and feed-back to M/P
3. Participatory Approach in Planning	• P/R activities • Planning, implementation, and evaluation of P/Ps	• To respect the public opinions, and correspond appropriately • To reflect the public opinions into the P/Ps through entire operations
4. Initiatives and Accountability	• P/R activities • Planning, operation, and presentation of seminars and workshops	• To create contents of newsletters and web site for P/R voluntarily • To establish agenda for meetings, and writing minutes voluntarily • To make presentations of study progress and discussed items
5. Strengthening of Partnerships among the Organizations	• Participation of seminars and workshops • P/R activities • Planning, implementation, and evaluation of P/P	• To build consensus on role sharing through meetings • To be aware of importance of fulfilling roles dispatched to each organization, through P/Ps operations

8.3 Evaluation of Capacity Development

8.3.1 Evaluation of Capacity Development on Individual Level

Based on the above table, the important issues for the capacity development of the "direct target" are sorted out and monitoring items are set as described in the main report. Then, the Study Team asked the C/P in the mid-February 2006 to evaluate the degree of their capacity development and the results of the evaluation are presented in the following table and figure. There are 32 items for detailed evaluation and two evaluation methods, i.e. A and B. Method A is for knowledge and capacity of the individual and has scores of Excellent: 4, Good: 3, Fair: 2 and Poor: 1. Method B is the capability to conduct specific works by employing experts and has scores of Without any assistant: 4, With some assistant from the experts: 3, With the instruction by the experts: 2 and Impossible: 1.

Table 8-5: Evaluation of Capacity Development by C/P

Capacity Component to be Developed		Evaluation by C/P	
Items	Detailed Evaluation Items	At Beginning of the Study, Dec 2004	Mid-February 2006
1. Acquisition, Evaluation and Management of Basic Data on SWM	Evaluation Method A: • Knowledge on: 1. Basic data on SWM, 2. Field investigations to acquire the basic data on SWM, 3. Evaluation of the current SWM by using the basic data • Capacity: 1. To make presentations on the field investigation, 2. To make presentations on evaluation of the current SWM by using the basic data Evaluation Method B: • Implementation capacity on: 1. Field investigations to acquire the basic data on SWM, 2. Evaluation of the current SWM by using the basic data, 3. Presentations on evaluation of the current SWM by using the basic data	1.88	3.06
2. Planning of Technically Appropriate SWM Components	Evaluation Method A: • Knowledge on: 1. Method and procedure of selection of future final disposal site(s), 2. Formulation of master plan (M/P), 3. Planning implementation and evaluation of pilot projects (P/Ps), 4. Modification of M/P based on the results of P/Ps, 5. Implementation of Feasibility (F/S) for priority projects • Capacity: 1. To make presentations on planning method and plan formulated by the Study Evaluation Method B: • Implementation capacity on: 1. Selection of a future final disposal site and/or site for a SWM facility, 2. Modification of M/P, 3. Implementation of F/S for a priority project, 4. Presentations on the above-mentioned planning	1.45	3.70
3. Participatory Approach in Planning	Evaluation Method A: • Knowledge on: 1. Public Relation (PR) activities for the establishment of proper SWM such as Newsletters, web-site, public hearing, workshops, seminar, etc., 2. How to make PR activities, 3. How to respect the public opinions, and correspond appropriately, 4. How to reflect the public opinions into the SWM planning • Capacity: 1. To make presentations on how to make PR activities for the establishment of a proper SWM	2.20	3.60
4. Initiatives and Accountability	Evaluation Method A: • Capacity: 1. To establish agenda for meetings, and writing minutes, workshops, seminar, etc., 2. To make presentations of study progress and discussed items • Implementation capacity on: 1. Planning of PR activities such as workshop, seminar, newsletter, contents of homepage, etc., 2. Conduct of PR activities, 3. Explanation of current SWM, issues on it, improvement plan, cooperation requirement for the improvement, etc. when necessary, 4. Strengthening capacity of organization, which you belongs to, for the establishment of a proper SWM	2.38	3.63
5. Strengthening of Partnerships among the Organizations	Evaluation Method A: • Understanding on: 1. Coordination and partnerships among the organizations concerned • Capacity: 1. To build consensus on role sharing through meetings with various organizations concerned, 2. To fulfill roles dispatched to each organization	2.58	3.25
Average		2.10	3.45

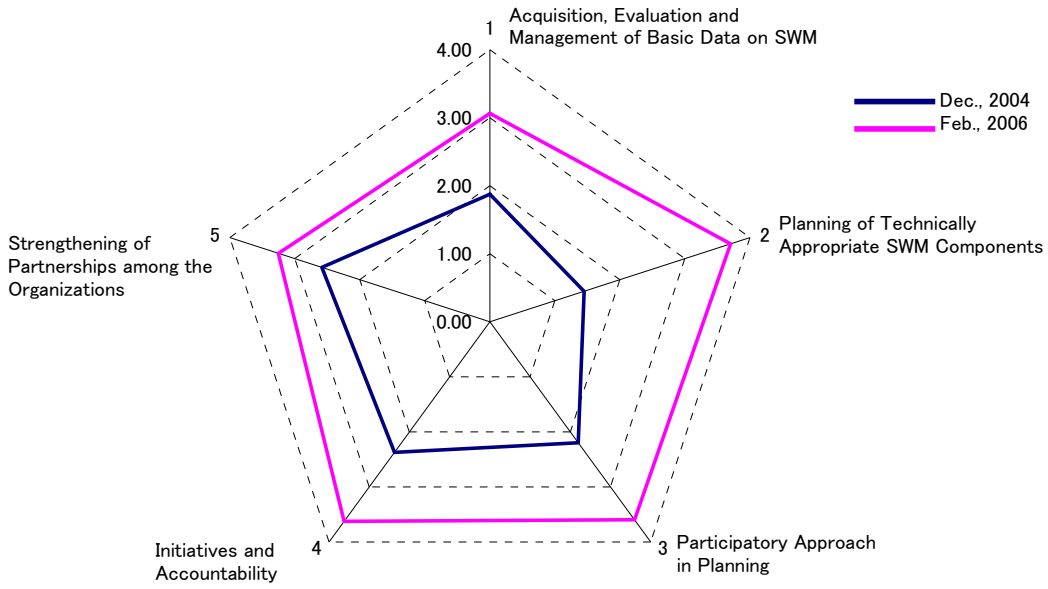


Figure 8-2: Evaluation of Capacity Development by C/P

According to the evaluation by the C/P, it brings the following findings:

- According to their evaluation the capacity of C/P has been developed significantly, i.e. their average score after the study is 3.45 (between Good and Excellent or between With some assistant from the experts and Without any assistant) while before the study is only 2.10 (Fair or With the instruction by the experts).
- Regarding evaluation items 4. Initiatives and Accountability and 5. Strengthening of Partnerships among the Organizations, the C/P had high level of capacity even before the study.
- On the other hand, evaluation items 1. Acquisition, Evaluation and Management of Basic Data on SWM and 2. Planning of Technically Appropriate SWM Components, the C/P had few knowledge and capability on them before the study.
- The most improved capacity through the study is item 2. Planning of Technically Appropriate SWM Components and followed by item 1. Acquisition, Evaluation and Management of Basic Data on SWM.
- On the contrary, least improvement item is 5. Strengthening of Partnerships among the Organizations. This fact proves that the most difficult issues is to coordinate and make consensus among different parties. It also indicates difficult coordination between MUB and MOE on the selection of future disposal site.

8.3.2 Evaluation of Organization, Institution and Social Level Capacity Development

Through the study capacity development for organization, institution and social level is summarized in the Table below.

Table 8-6: Evaluation of Organization, Institution and Social Level Capacity Development

Level	Organization	Contents of Capacity Development
Organization	MUB/CDPPD	• SWM plan is established in the City Development M/P and in mid-July 2005 the mayor of the MUB ordered the Narangiin Enger candidate site as the future disposal site for the 6 central Duuregs to secure the site as landfill.
	MUB/CMPUD CMPUA From Sep. 2006	•
	MUB/CSIA	• A monitoring committee for USDS was established. CSIA will able to conduct periodical monitoring of the disposal site, and evaluate and publicize the results of the monitoring according to the need.
	Nuuts Co., Operator of the UCDS and MDDS	• The budget of Nuuts in 2006 was raised five times more than it in 2005 to operate disposal sites properly.
	Ministry of Health (MOH)	• Based on the recommendation of the study, the MUB established City Maintenance and Public Utility Agency (CMPUA) in September 2006 of which core personnel (5 persons) came from the City Maintenance and Public Utility Division (CMPUD) and takes responsibility on SWM in UBC. CMPUA employed 25 staffs paid by MUB by the end of 2006 and has a plan to employ 15 staffs more to be paid by the municipality. CMPUA is autonomous body which has its own budget and employs its own staffs. • With the approval of the mayor and Citizen's Representatives Khural, CMPUD succeeded to increase the budget for SWM, especially to acquire large amount of budget for the Pilot Project (P/P): Urgent Improvement of UCDS. Actually CMPUD received 67,000US$ for the P/P of UCDS and raised budget of Nuuts Co. in 2006 five times than it in 2005. • A future disposal site of the proposed Narangiin Enger disposal site (NEDS) for the 6 central Duuregs was selected by the collaboration and consensus of various organizations concerned. The EIA of the development of NEDS has been approved by MOE. • CUPUD conducted three public hearing for the development of NEDS and Narangiin Enger Recycling Complex (NERC).
	Ministry of Construction and Urban Development (MOCUD)	• A survey on construction waste was conducted in the study and generation amount of it and issues of its management were identified.
Institution and Society		• In November 2005 the Citizen's Representatives Khural regulated the current UCDS and MDDS and future NEDS and their surrounding areas as especially reserved areas to prevent the sites from the expansion of Ger area. • Based on the financial analysis of the study the waste management fee was revised and enacted from September 1, 2006. • In response to the recommendation made by the study, City Waste Service Fund (CWSF) for MUB and District Waste Service Fund (DWSF) for each District were established and commenced operation from January 1, 2007. The WSF improves current waste collection service fee system and enable a cross-subsidy which is the precondition for the expansion of waste collection service to Ger area. • The establishment of the WSF significantly improves the current financial system for SWM as shown in the Figure 3.12 of the Section 3.3.8. • CMPUD/Nuuts Co. issued ID cards to the 300 waste pickers working in UCDS, the biggest disposal site in UBC. It gives a certain guarantee to the weak of the society. Furthermore, CMPUD/Nuuts Co. organized waste picker and established a Waste Picker Fund which enables them to help each other.

9. Pilot Projects

9 Pilot Projects

9.1 Selection of Pilot Projects

9.1.1 Objectives of Pilot Projects

The M/P projects may encounter many difficulties when they are implemented. To determine the problems that may arise and to find a way to overcome these difficulties, pilot projects were conducted during the course of this study in cooperation with the counterparts and many concerned parties. The objectives of the pilot projects are summarised below.

- To **support construction of organizations to resolve SWM issues in the UBC** through the planning, preparation, execution and evaluation of the pilot projects;
- To assess the feasibility of the technical system proposed in the M/P (i.e., establishment of discharge rules, verification of separate collection, etc.).
- To acquire base data so that the design outline of the F/S can be devised (i.e., design of a sanitary landfill reflecting conditions of the study area, examination of mixed combustion method of RDF with coal, etc.).
- Raise public awareness and increase public participation in SWM.
- Demonstrate improvement measures to residents and authorities concerned with SWM.

9.1.2 Selection of Pilot Projects

After the discussion with C/P the following pilot projects were selected and approved by the St/C. The pilot projects were conducted in Phase 2 and Phase 3 study stages as follows:

Phase 2 Study Stage:

P/P 1	Urgent Improvement of the Ulaan Chuluut Disposal Site
P/P 2	Thermal Recycling “RDF”
P/P 3	Recycling Pilot Project: Movable Recyclable Collection System “Chirigami Kokan”
P/P 4	Examination of the Loading Device for Heavy Waste
P/P 5	Raising Public Consciousness on Waste Issues

Phase 3 Study Stage:

P/P 1	Continuation of Urgent Improvement of the Ulaan Chuluut Disposal Site
P/P 2	Continuation of Thermal Recycling “RDF”
P/P 6	Collection System Improvement (Establishment of Waste Discharge Rules and Introduction of Separate Collection)
P/P 7	Organization of Waste Pickers

9.2 P/P 1: Urgent Improvement of the Ulaan Chuluut Disposal Site

9.2.1 Project Outline

a. Justification

There are four official final disposal sites in the study area. All of the sites are operated in so-called open dumping, posing serious negative impacts on the surrounding environments. Air pollution by smoke caused by fire and scattering wastes by wind especially in spring season is particularly serious not only for the surrounding area but also a wide area in the city.

Among the four, Ulaan Chuluut disposal site (UCDS), where wastes are dumped at everywhere without control, is the biggest one receiving more than 90 % of the wastes generated in the study area. The adverse impacts, therefore, very serious and sometimes the fire occurred in the site spread to neighboring houses by strong wind. MOE cautioned MUB to close it unless MUB improves it. The improvement of the site is therefore an urgent matter.

One of the most important targets of the M/P is to conduct a safe disposal of wastes discharged after 3Rs efforts; sanitary landfill operation. It is, however, neither being conducted in the study area nor the country.

Under the above situation MUB has requested the study team to assist to conduct the pilot project on the Urgent Improvement of UCDS in order to mitigate the current environmental problems and to conduct sanitary landfill operation. Under this pilot project the counterpart, Nuuts Co. and the City Maintenance and Public Utilities Department of MUB, will take initiative to implement sanitary landfilling and the study team will provide timely technical assistance with some financial assistance of JICA for the initial investment.

b. Objectives

The objectives of the Pilot Project (P/P) for the Urgent Improvement of Ulaan Chuluut Disposal Site (UCDS) are:

Objective 1. To establish a control and management system of collected waste in order to avoid illegal dumping; i.e. to dispose of all collected waste in the central 6 Duuregs at the authorized disposal site, i.e. UCDS;

Objective 2. To dispose of the waste at the designated area of the UCDS. This is the first step of the sanitary landfill operation; and

Objective 3. To rehabilitate completed landfill area of the UCDS and conduct a sanitary landfill operation as much as possible.

c. Improvement Plan and Achievement of P/P 1

The improvement plan and achievement of the P/P 1 is presented in the following figure and table. In the implementation of P/P 1 the JICA Study Team prepared an improvement plan and constructed facilities, and MUB/Nuuts Co. rehabilitated the completed landfill area and conducted sanitary landfill operation. Both parties cooperated closely each other.

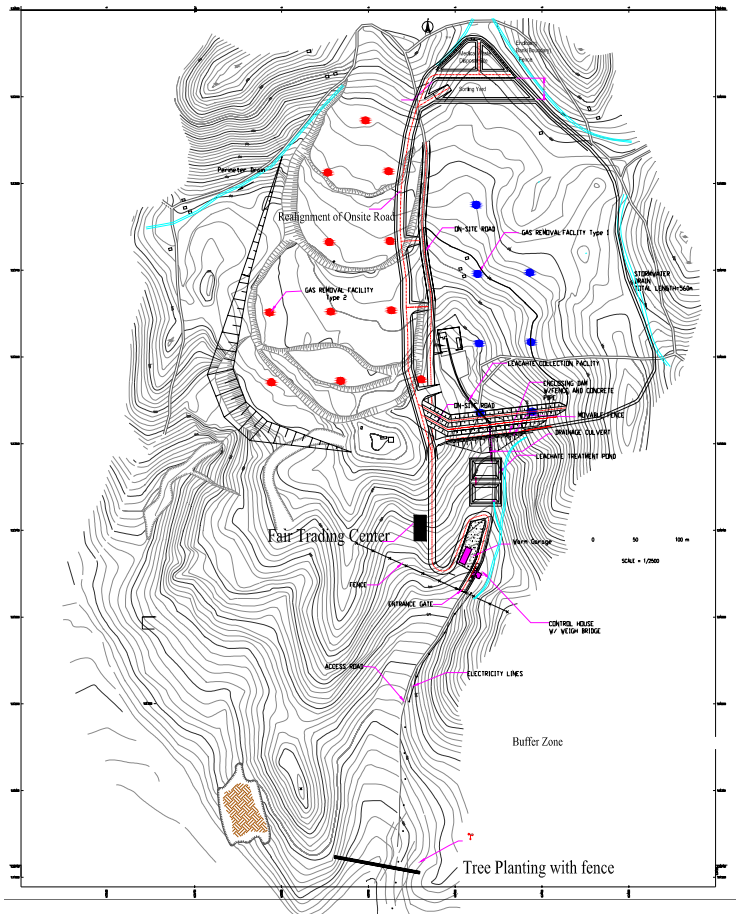


Figure 9-1: Plan of Urgent Improvement of UCDS

Table 9-1: Improvement Plan, Work Assignment and Achievement of PP 1

Objective	Improvement Plan	Work Assignment	Achievement
Objective 1	• Registration of collection service organizations and establishment of control system of them	MUB/ Nuuts	Operation of weighbridge (WB) started on 26 Dec 2005 and registration of collection trucks including TUKs and other organizations started digitally using PC in WB control building.
	• Strengthening control and management capability of Nuuts Co., Ltd. including increase of budget for it	MUB	Control and management capability of Nuuts Co., Ltd. is being strengthened through the pilot project, C/P training in Japan, etc. Budget of Nuuts has increased to 4 times from Jan 2006 which is 150,000,000 MNT in the year for 2006.
	• Construction of a new control building	JICA ST	The new building is fully completed together with WB and operational from 26 Dec 2005.
	• Unification of access to the southern road	MUB/ Nuuts	As enclosing bank and fences were completed, no access other than the southern road is possible.
	• Installation of a weigh bridge	JICA ST	Installation of a weigh bridge is completed on 26 Dec 2005
	• Development of a database for control & management of waste collection and disposal	JICA ST	Nuuts staffs have received on the job training in control building by JICA ST continuously for around one year. Three persons who are in charge of WB operation are now familiar to operate. Development of a database for control & management of waste collection and disposal is in progress and monthly report was submitted to MUB using WB data base.
	• Development of monitoring and control system for illegal dumping	MUB/ Nuuts	MUB is examining monitoring and control system for illegal dumping. The study on construction waste was done by the JICA ST and the results of the study have been analyzed.
	• Reexamination of tipping fee	C/P & JICA ST	The tipping fee was examined together with fee collection system and tariff setting. New tariff was set and enforced from 1st September 2006.
	• Strengthening enforcement	C/P & JICA ST	System of controlling illegal dump was examined and proposed in the Final Report.

Objective	Improvement Plan	Work Assignment	Achievement
Objective 2	2.1. Establishment of boundary of the UCDS by installation of a gate, a fence and an enclosing bank	JICA ST	A Gate, a fence and an enclosing bank were constructed to surround the UCDS. Consequently the boundary of the site was established.
	2.2. Prevention of UCDS from expansion of ger area by installing fence or buffer zone	MUB	A buffer zone to protect UCDS from expansion of ger area was approved by the Standing Committee for Environment of the Citizens' Representatives Khural of MUB and necessary measures such as the setting of sign board and boundary structures were conducted. It is being regulated by the Citizens' Representatives Khural of MUB. Green belt was constructed with tree planting to indicate the buffer zone and it was proved that tree can be glowed with proper maintenance.
	2.3. Construction of an enclosing dam and bank to establish waste disposal operation area (working face)	JICA ST	An enclosing dam and bank to establish waste disposal operation area (working face) has been completed. 1st working face was filled with waste 2nd enclosing bank was constructed on Dec 2005. 3rd enclosing bank was constructed on September 2006.
	2.4. Improvement of on-site road	JICA ST & Nuuts	A main on-site road has been completed. But due to the break down of bulldozer, collection truck could not reach to the working face and some part of the road was blocked by the waste. On site road was realigned to further west in order to avoid blockage by the wastes.
	2.5. Cleaning waste dumped along the access road and surrounding areas	MUB & JICA ST	MUB contractor and JICA contractor cleaned up waste dumped along the access road and surrounding areas. Cleaned up waste is used for the filling material of enclosing dam. Cleaning waste along access road is being done periodically.
Objective 3	3.1. Installation of gas removal facilities	JICA ST	In total 18 units of gas removal facilities were installed at the UCDS. Some removal facilities need to be extended.
	3.2. Construction of storm water drain	JICA ST	The storm water drain was constructed together with the enclosing bank.
	3.3. Installation of leachate treatment facility	JICA ST	Leachate treatment facility that consists of leachate collection facilities and treatment ponds was constructed. There was no leachate outflow observed.
	3.4. Construction of a warm garage	JICA ST	In order to facilitate smooth operation of landfill equipment in the winter season a warm garage was constructed. Water truck and bulldozer are stored inside.
	3.5. Construction of Medical Waste Pits	JICA ST	In order to separately dispose medical waste from MSW, medical waste pits are constructed.
	3.6. Rehabilitation of completed landfill area by re-shaping, slope trimming of existing landfill surface and soil covering	MUB/ Nuuts	MUB contractor has completed the rehabilitation works and about 8ha of land was rehabilitated. One wheel shovel, one excavator and three dump trucks were mobilized and it took around one month to complete. This work should be done during the summer time because soil will be frozen in winter time and it is impossible to excavate cover material.
	3.7. Plan and conduct of waste disposal plan	Nuuts & JICA ST	A rule of UCDS and preliminary disposal plan is drafted by JICA ST. The Nuuts commenced to apply the rule and plan from November 1, 2005.
	3.8. Conduct of waste compaction and leveling	Nuuts	There are two bulldozers to push and compact wastes in the end of 2006. But both are very old and frequent breakdown and this caused difficulty for the proper operation
	3.9. Conduct of soil covering	Nuuts	Since almost all facilities required for sanitary operation are completed, MUB/Nuuts could conduct sanitary landfill operation, which shall conduct daily soil covering on waste disposed. However, due to lack of basic equipment for soil cover such as an excavator, dump truck, etc., Nuuts hardly conduct soil covering. Furthermore, it is almost impossible to take soil in winter season because soil is frozen.
	3.10. Control of waste picking activities	Nuuts	Nuuts conducted registration of waste pickers except new comers in August 2005 and drafted a rule of the UCDS in cooperation with JICA ST. Waste pickers meetings were conducted since May 2006 at weekly basis and around 220 WPs were registered. Those registered WPs received ID card with photo.
	3.11. Establishment of a monitoring committee of disposal sites and conduct of periodical monitoring	MUB and JICA ST	The monitoring committee that consists of 9 members was established. The periodical monitoring was conducted 4 times in July, October of 2005 and May, Sep of 2006. Chairman of the committee was changed to the City Specialized Inspection Agency in UB.

9.2.2 Lessons and Recommendations

a. Results

Most of the stakeholders such as MUB, Nuuts Co., residents near UCDS and waste pickers working at UCDS appreciate the project very much. In particular, the negative environmental impacts such as offensive odor, waste scattering, and vermin were significantly reduced.

Many facilities were constructed and it looks better than before. But it is very important now going forward whether operation and maintenance can be improved or not. For instance, it was experienced in December 2005 that, due to the break down of a bulldozer and lack of proper instructions, collection trucks could not reach to the designated landfill area and they started to dispose of waste on the onsite road. As a result, no trucks could enter the landfill area and they disposed waste outside the fence as shown in the following pictures.

Waste Disposed at onsite road

Waste Disposed outside Fence

It is winter now and problems at the disposal site such as smoke, odor, scattering, are not significant due to coldness and relatively gentle winds compare with those of spring. Therefore, preparation for the coming spring time is essential.

b. Recommendation

We have experienced landfill operation using improved facilities for a few months now and found the following recommendations:

b.1 Replacement of Old Bulldozers

Bulldozers are one of most important and essential items of equipment for landfill operation. As of end of 2005, there were two Russian made very old bulldozers which are more than 15 years old. But one has completely broken down and used for taking spare parts. The other also frequently breaks down and once it has broken down, it needs a few weeks for repair. In fact, they have already exceeded machinery life time and it is strongly recommended to replace it with a modern one. Because using existing machinery is wasting both time and money.

As of end of 2006, following the recommendations by JICA ST, MUB purchased one second hand Chinese made bulldozer and there are two bulldozers in UCDS.

b.2 Consensus of Waste Pickers on Controlled Landfill Operation and Proposed M/P

The controlled landfill operation being conducted in the pilot project restricts the waste picking activities and the sanitary landfill operation proposed in the M/P prohibits waste picking activities at the landfill. It is, therefore, necessary to conduct the following measures as a phase 3 pilot project to get consensus of waste pickers on both controlled and sanitary landfill operation as shown in the Figure below.

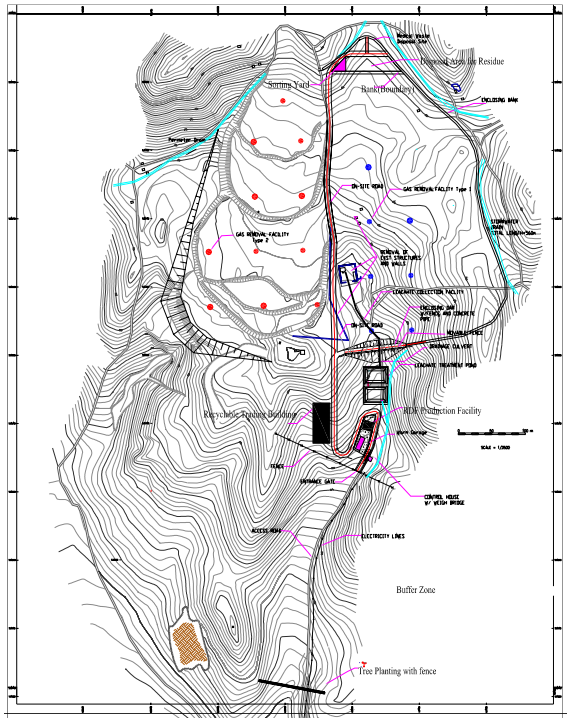


Figure 9-2: Additional Pilot Project at the UCDS in Phase 3 Study

b.2.1. Consensus of Waste Pickers on Controlled Landfill Operation

Under the controlled landfill operation, the main objective of this pilot project, collection vehicles can unload waste only at the designated place. This makes the waste picking area much smaller than before, and makes waste picking more difficult. Therefore, it is understandable that many of waste pickers are dissatisfied with the progress of the project.

Since the controlled landfill operation is the core of the concept of the project and it is impossible to make a concession to them. In stead, it is necessary to make some measures for fair trade and better sanitary conditions in order to gain more support from them.

According to the opinion of waste pickers mentioned in the previous section, there are many requests for the improvement of their working conditions. It is difficult to realize all of them but it might be necessary to provide some of them such as fair trade place of materials recovered by them. It may also include some shelters especially for winter time in exchange for the prohibition of fire in the landfill site.

b.2.2. Sorting Yard Operation in UCDS

In order to implement sanitary landfill operation as proposed in the M/P, it is critical to prohibit waste picking activities at the landfill. In stead of prohibiting waste picking activities in the landfill, the M/P will provide a sorting yard for the waste pickers to work and also conduct the separate collection in order to facilitate efficient waste picking at the yard. Therefore, in order to reach a consensus on the sanitary landfill operation and work at the sorting yard, it is worth examining the provision of a pilot sorting yard at UCDS for separated waste.

In case that separate collection is implemented under the pilot project, the separated waste contain more valuables than others. Therefore, the pilot project will contribute to get consensus from waste pickers on the sanitary landfill operation and work at the sorting yard

as proposed in the M/P.

b.2.3. RDF Production in UCDS

In the M/P, residue from the sorting yard such as low quality plastic and paper will be sent to the RDF plant. Then RDF will be produced by the residue and be used as an auxiliary fuel of coal at the power plant and/or heating plants.

In Phase 2 of the Study, 12 tons of RDF was experimentally produced for the mixed combustion test with coal at Nalaikh Heating Plant. In Phase 3 of the Study, in order to examine the economic viability of the use of RDF at the existing heating and/or power generation plant, more RDF needs to be produced and a combustion test shall be carried out for a longer time.

In order to produce more RDF, residue from the above sorting yard will be used as raw materials for the production of RDF to reduce the procurement cost of raw materials. It is, therefore, recommended to produce RDF at UCDS in order to examine the viability of the proposed M/P. But due to the budget constrain, RDF was produced outside UCDS for phase 3 RDF combustion test.

b.3 Organization of Waste Picker

According to the interview survey, there is no organization of the waste pickers. According to the M/P, these waste pickers will work at the sorting yard in an organized manner. Lack of a head or organization makes it difficult to control them.

Another problem in UCDS is the existence of child waste pickers. They are very disobedient and do not follow the rules. They climb up to the collection truck on the weighbridge and the weight of the truck is affected by this. Furthermore, it is very dangerous and other adult waste pickers also complain of these activities.

To solve these problems, not only enforcement of rules and/or punishment but also some support and assistance is necessary. Canadian consultant with the World Bank fund was supposed to implement "Waste Picker Project" but the project was not implemented, therefore, JICA ST conducted Organization of Waste pickers in phase three study.

c. Lessons Learnt

The implementation of the pilot project has found the following lessons.

- To set up clear a boundary of the disposal site is the first step in sanitary landfilling
- To measure the weight of incoming waste is the first step in doing proper SWM.
- To secure the budget for a running bulldozer is essential for sanitary landfilling
- In order to conduct sanitary landfilling, several heavy machines including excavators and dump trucks are required and further technical assistance for the operation and maintenance of them is important.
- In order to solve the waste pickers` problems, long term assistance will be required.

9.2.3 Closure of Ulaan Chuluut Disposal Site (UCDS)

a. Design Concept

The UCDS is approaching its capacity limit, and it will cease landfill operations in a few years. It is necessary for MUB to formulate a closure plan in order to demonstrate the appropriate closure of UCDS.

The key elements for the formulation of the closure plan of the UCDS are shown in the following table.

Table 9-2: Key Elements of the UCDS Closure Plan as of year 2005

Item	Unit	Qty
The area of disposal site	ha	17.0
Old Working Face (Western half): A1	ha	8.0
Existing Working Face (Eastern Half) : A2	ha	9.0
Landfill Operation Period	years	3 years
Estimated Landfilling Volume		
• 2005	m^3	85,000
• 2006	m^3	108,000
• 2007	m^3	120,000
• 2008	m^3	132,000

b. Closure Plan

b.1 Landfill Operation Plan until Closure

b.1.1. Basic Idea

The area of the UCDS consists of old working face (hereinafter call A1) located in the western half and existing working face (hereinafter call A2) which is located in the eastern half. Since A1 was covered with soil and rehabilitated, the operation shall be conducted in A2.

b.1.2. Annual Disposal Amount

Annual disposal amount from 2005 onwards is shown as follows based on the record of Nuuts Co. and Study JICA ST estimation before installing weigh bridge..

Table 9-3: Final Disposal Amount

	Daily Disposal Amount	Annual Disposal Amount		Landfill Amount after Compaction	Accumulate Amount
	ton/day	ton/year	m3/year	m3/year	m3
2005	232.9	85,009	106,261	85,009	85,009
2006	295.4	107,821	134,776	107,821	192,830
2007	329.2	120,158	150,198	120,158	312,988
2008	362.5	132,313	165,391	132,313	445,300

b.1.3. Landfill Capacity

Landfill capacity at A2 is calculated as follows.

Table 9-4: Landfill Capacity at Eastern Half Section

	Area of Wastes	Average Area	Height of Wastes	Volume of Wastes	Volume of Dam	Total Volum	Accum. Volume
	m2	m2	m	m3	m3	m3	m3
original	0.0						
1st Fill	7,540.0	3,770.0	4.4	16,588.0	3,125.0	19,713.0	19,713.0
2nd Fill	10,210.0	8,875.0	2.5	22,187.5	4,125.0	26,312.5	46,025.5
3rd Fill	11,770.0	10,990.0	2.5	27,475.0	5,250.0	32,725.0	78,750.5
4th Fill	13,200.0	12,485.0	2.5	31,212.5	6,500.0	37,712.5	116,463.0
5th Fill	16,400.0	14,800.0	2.5	37,000.0	7,500.0	44,500.0	160,963.0
6th Fill	19,230.0	17,815.0	2.5	44,537.5	8,500.0	53,037.5	214,000.5
7th Fill	24,600.0	21,915.0	2.5	54,787.5	9,250.0	64,037.5	278,038.0
8th Fill	36,080.0	30,340.0	2.5	75,850.0	10,250.0	86,100.0	364,138.0
9th Fill	52,240.0	44,160.0	2.5	110,400.0	11,250.0	121,650.0	485,788.0

Based on the above calculation, UCDS can be used for three years until 2008. After then, appropriate closure operation will be required.

b.1.4. Final Shape of the UCDS

Final shape of the UCDS is as follows as a result of the above filling operation.

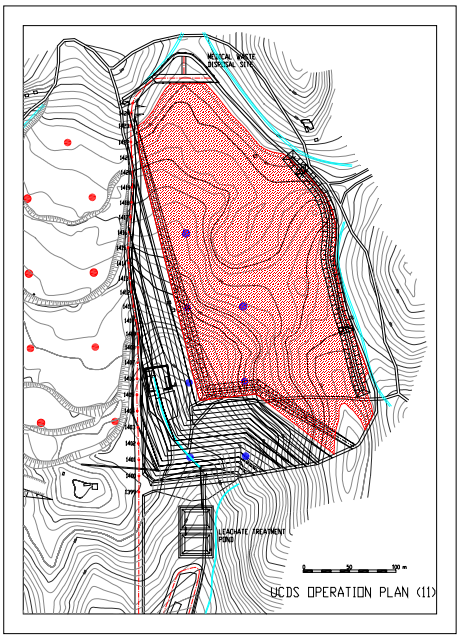


Figure 9-3: Final Shape of UCDS

b.2 Closure Plan

b.2.1. Final Soil Covering Plan

Soil shall be excavated and stockpiled in summer time for use in winter time.

It is possible for MUB to acquire the necessary soil for covering by excavated soil in its own land near UCDS. The thickness of soil should satisfy the following value.

- Flat part : 50 cm
- Sloping part: 50 cm

At the time of closure, the entire area of UCDS will be covered with soil. The amount of soil necessary for final soil covering is calculated as follows.

9 ha x 0.50 m thk = 45,000 m^3

Since the sloping part of the embankment dam shall be covered with soil during landfilling operation, the amount of the soil covering at the time of closure should be less than the above figures.

In order to save the amount of soil covering, the shaping by the bulldozer before soil covering will be essential.

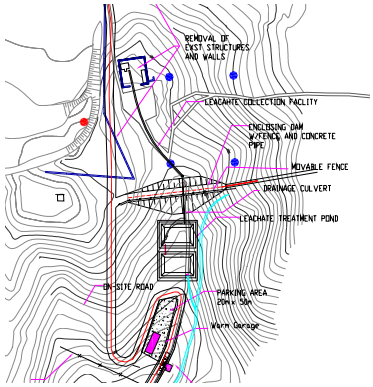


Figure 9-4: Layout of Leachate Collection System

b.2.2. Water Pollution Control

Leachate is collected through leachate collection facilities which were buried in the lowest area of original ground before landfilling is started. Then the collected leachate is stored in the leachate treatment pond which was constructed south of the embankment dam. The layout of the leachate collection facilities and leachate treatment pond is

shown below.

b.2.3. Management Plan of Generated Gas

Generated gas is controlled by installing vertical gas removal pipes.

It is preferable to install vertical gas removal pipes according to the progress of the landfill operation. It is necessary for MUB to set up a vertical pipe at a planned spot before the landfill operation starts.

The installation plan of vertical gas removal pipes at A2 is shown below.

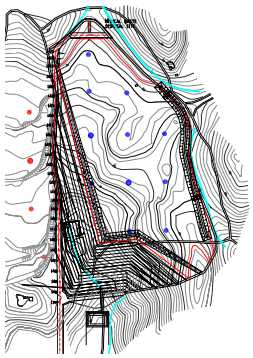


Figure 9-5: Installation Plan of Gas Removal Pipes in UCDS

b.2.4. Future Land Use Plan

A future land use plan shall be formulated and discussed among the relevant authorities. Since the closed UCDS is next to the future disposal site, which is NEDS, the use of this area as a buffer zone to the NEDS is strongly recommended. Necessary measures such as planting trees and fences shall be taken to prevent further expansion of ger towards UCDS.

b.2.5. Monitoring Plan

Monitoring shall be conducted after closure of the UCDS until the landfill area becomes stable. (it is normally around 15 years after its closure). The items of monitoring are shown in following table.

Table 9-5: Monitoring Plan of UCDS

Items	Facility	Frequency	Measuring Items
Appearance	Landfill area	once in a month	• Covering soil • Landfilled waste (subsidence, change of shape etc.) • Maintenance of drain • Others
Underground Water	Well nearby	twice in a year	Electric conductivity, Cl^-, pH
Leachate	Leachate Pond	in case of generation of leachate	Electric conductivity, Cl^-, pH
Landfill Gas	Gas removal pipe	four times a year	CH_4, CO_2, H_2O, Temperature
Settlement	Settlement board	four times a year	Settlement Level

9.3 P/P 2: Thermal Recycling "RDF"

9.3.1 Introduction

a. Background

Municipal Solid Waste (MSW) in UBC contains a large portion of plastic and paper wastes. Especially in apartment area the portion of plastic and paper wastes is 36% and exceeds it of kitchen waste, 34%. Only very small portion of plastic and paper wastes such as PET bottles and cardboard paper are recycled and remaining large portion is subject to disposal sites. These wastes cause many problems to landfill operation such as waste scattering and creation of unstable land due to difficulty of decomposition and compaction. According to the UBC Development Master Plan, the rate of population live in Ger area and Apartment area will change from 46:54 in 2006 to 18:82 in 2020. The fact will increase the portion of plastic and paper wastes. Consequently the problems caused by plastic and paper wastes will be more and more serious.

Plastic and paper wastes scattering in UCDS

Plastic and paper wastes caught by movable fence

In order to solve the above-mentioned problems, paper and plastic waste, which are not recycled at present, will be collected and RDF (RDF: Refuse Derived Fuel) will be produced by using these wastes as raw materials. Produced RDF will be burned at the existing high temperature continuous combustion facilities (power generation plants and heating plants) together with coal and necessary data will be obtained. As a result the problem wastes will be thermally recycled and contribute reduction of energy consumption, i.e. coal consumption.

b. Objectives

The objectives of the P/P 2 are:

- To produce RDF by using paper and plastic waste, which are neither reused nor recycled at present in UBC, as raw materials;
- To burn produced RDF at the existing high temperature continuous combustion facilities (power generation plants and heating plants) together with coal and to examine the impacts of mixed combustion of RDF with coal such as quality of emission gas, reduction of coal consumption and issues for operation; and
- To demonstrate citizens of UBC the technology of RDF production and combustion, and understand them on RDF.

9.3.2 Production of RDF

a. Production

RDF can be produced by compacting and heating raw materials. In Japan compaction method is commonly applied to the production of RDF, which melts plastics by the heat generated by pressure. However, to bring compaction type RDF production machine from Japan it difficult in terms of available budget and time. Therefore, we produced RDF by melting plastics by giving heat from outside. The mixed combustion test of RDF with coal was conducted twice, February and October 2006. Prior to the test 12 tons of RDF was produced between December 2005 to January 2006, and 24 tons of RDF was produced between August 2006 to September 2006.

Production of RDF is contracted to a local company in Ulaanbaatar, TUV MORIT HANGAI Co., Ltd.

b. Results

The table below presents quality of RDF and Coal which was used for the combustion test.

Table 9-6: Quality of RDF and Coal

Physical composition			RDF		Coal	
			1st test	2nd test	1st test	2nd test
Higher calorific value (HCV)		(kcal/kg)	5,820	3,320*1	3,875	4,700*1
Lower calorific value (LCV)		(kcal/kg)	5,290*1	3,200	2,470*1	3,680
Industrial chemical analysis	Moisture	(%)	8.3	0.9	31.3	19.2
	Combustible	(%)	86.0	74.9	59.9	61.2
	Non combustible (ash)	(%)	5.7	24.2	8.8	19.6
Apparent density*2		(ton/m3)	0.41	0.43	0.86	0.87

Note *1: Calculation value
*2: Measurement value by Study team

The table presents the following findings:

- The lower calorific value of RDF produced for the 1st test is more than two times higher than the coal used. It is the quality which we expected.
- The lower calorific value of RDF produced for the 2nd test is only 60% of it of the 1st test due to burning of plastics at production process.
- On the other hand, the lower calorific value of coal used for the 2nd test is 1.5 tomes higher than it of the 1st one.

<Combustion RDF at the Production Stage>

Pod for Plastics Melting

Inside of Pod

9.3.3 Mixed Combustion Test

a. Schedule of the Test

The mixed combustion test of RDF with coal was conducted twice at the Nalaikh Heating Plant as shown in the tables below.

Table 9-7: Schedule of the First Combustion Test

February, 2006	12	13	14	15	16	17	18	19
	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1. Preliminary Test		■						
2. Baseline Test (Coal only burning)			■					
3. Mixed Combustion Test (RDF 2% Mixture)				■				
4. Mixed Combustion Test (RDF 4% Mixture)					■			
5. Occasional Date						■		

Table 9-8: Schedule of the Second Combustion Test

October	16	17	18	19	20	21	22
	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Operation	100% Coal		RDF 2%		RDF 4%		100% Coal
Measurement of Emission gas (exclude Dioxins)		Test 1		Test 2		Test 3	
Measurement of Dioxins							
Physical Composition of RDF and coal				RDF, Coal	RDF	RDF, Coal	
Physical Composition of Ash							
Collection of Operation data							

b. Impacts on Emission Gas

The impacts of the two tests are summarized below. There was no impact on the furnace by the tests.

b.1 Analysis of Emission Gas

Emission gas quality including dioxins was measured at two combustion tests. The study team was worried about the sampling equipment and method applied to the 1st test which used an available sampler in UBC. In order to confirm the data obtained, the team brought sampling tools from Japan and sampled emission gas according to the method specified in JIS (Japan Industrial Standard). In both tests analysis of dioxins was conducted laboratories in Japan.

b.1.1. Measurement of Air Pollutants in Emission Gas (excluding Dioxins)

The following tables present the results of the measurement of air pollutants in emission gas excluding Dioxins.

Table 9-9: Measurement of Air Pollutants in Emission Gas (excluding Dioxins) in First Combustion Test

			100% Coal	Mixed combustion test	
				RDF2% Mixture	RDF4% Mixture
	Furnace Number		No.3	No.3	No.3
	Examination date		14, Feb	15, Feb	16, Feb
1.	Amount of emission gas (Wet)	m^3N/h	103,440	103,370	103,270
2.	Amount of emission gas (Dry)*1	m^3N/h	96,000	94,000	94,800
3.	Temperature of emission gas	^0C	207.4	203.2	204.1
4.	Moisture	%	7.2	9.1	8.2
5.	Dust concentration	g/m^3N	0.228	0.245	0.216
	Dust concentration of conversion equivalent of O_2 12%	g/m^3N	0.315	0.431	0.380
6.	O_2	%	14.5	15.9	15.9
7.	CO	ppm	228	982	221
8.	CO_2	%	14.79	14.50	11.31
9.	SO_2	ppm	254.8	137.3	116.7
10.	NO_X	ppm	242.8	183.7	184.7
	NOx concentration of conversion equivalent of O_2 12%	ppm	336.2	324.2	325.9
11.	HCl	ppm	0.08	0.11	0.09
	HCl concentration of conversion equivalent of O_2 12%	ppm	0.11	0.19	0.16

Note : *1: Calculation value

Table 9-10: Measurement of Air Pollutants in Emission Gas (excluding Dioxins) in Second Combustion Test

			100% Coal	Mixed combustion test	
				RDF2% Mixture	RDF4% Mixture
	Furnace Number		No.1	No.1	No.1
	Examination date		17, Oct	19, Oct	21, Oct
1.	Amount of emission gas (Wet)	m^3N/h	43,930	35,820	35,910
2.	Amount of emission gas (Dry)*1	m^3N/h	41,600	34,060	34,260
3.	Temperature of emission gas	^0C	130.8	153.7	141.3
4.	Moisture	%	5.3	4.9	4.6
5.	Dust concentration	g/m^3N	7.5	8.0	4.3
	Dust concentration of conversion equivalent of O_2 12%	g/m^3N	11.8	7.3	5.4
6.	O_2	%	15.3	11.2	13.8
7.	CO	ppm	1,069	504	687
8.	CO_2	%	5.8	9.2	6.8
9.	SO_2	ppm	209	333	110
10	NO_X	ppm	118	148	108
	NOx concentration of conversion equivalent of O_2 12%	ppm	186	136	135

Note : *1: Calculation value

b.1.2. Measurement of Dioxins in Emission Gas

Table 9-11: Results of Emission Gas Analysis (Dioxins) in First Combustion Test

		100% Coal	Mixed combustion test	
		pg/m^3N	RDF2% Mixture pg/m^3N	RDF4% Mixture pg/m^3N
PCDDs	2,3,7,8-TeCDD	N.D.	N.D.	N.D.
	1,3,6,8-TeCDD	2	129	14
	1,3,7,9-TeCDD	1	76	7
	TeCDDs	4	233	24
	1,2,3,7,8-PeCDD	N.D.	N.D.	N.D.
	PeCDDs	N.D.	141	18
	1,2,3,4,7,8-HxCDD	N.D.	N.D.	N.D.
	1,2,3,6,7,8-HxCDD	N.D.	N.D.	N.D.
	1,2,3,7,8,9-HXCDD	N.D.	N.D.	N.D.
	HxCDDs	3	125	15
	1,2,3,4,6,7,8-HpCDD	N.D.	15	2
	HpCDDs	N.D.	23	4
	OCDD	3	4	4
	Total PCDDs	9	525	65
PCDFs	2,3,7,8-TeCDF	N.D.	N.D.	1
	1,2,7,8-TeCDF	N.D.	2	1
	TeCDFs	N.D.	12	6
	1,2,3,7,8-PeCDF	N.D.	N.D.	1
	2,3,4,7,8-PeCDF	N.D.	N.D.	N.D.
	PeCDFs	N.D.	N.D.	1
	1,2,3,4,7,8-HxCDF	N.D.	N.D.	N.D.
	1,2,3,6,7,8-HxCDF	N.D.	N.D.	N.D.
	1,2,3,7,8,9-HxCDF	N.D.	N.D.	N.D.
	2,3,4,6,7,8-HxCDF	N.D.	N.D.	N.D.
	HxCDFs	N.D.	N.D.	N.D.
	1,2,3,4,6,7,8-HpCDF	N.D.	N.D.	N.D.
	1,2,3,4,7,8,9-HpCDF	N.D.	N.D.	N.D.
	HpCDFs	N.D.	N.D.	N.D.
	OCDF	N.D.	N.D.	N.D.
	Total PCDFs	N.D.	12	7
Total（PCDDs＋PCDFs）		9	537	72
Co-PCBs	3,4,4',5-TeCB (IUPAC#81)	N.D.	N.D.	N.D.
	3,3',4,4'-TeCB (IUPAC#77)	N.D.	N.D.	N.D.
	3,3',4,4',5-PeCB (IUPAC#126)	N.D.	N.D.	N.D.
	3,3'4,4',5,5'-HxCB (IUPAC#169)	N.D.	N.D.	N.D.
	Non-ortho PCBs	N.D.	N.D.	N.D.
	2',3,4,4',5-PeCB (IUPAC#123)	N.D.	N.D.	N.D.
	2,3',4,4',5-PeCB (IUPAC#118)	38	18	13
	2,3,3',4,4'-PeCB (IUPAC#105)	18	8	5
	2,3,4,4',5-PeCB (IUPAC#114)	N.D.	N.D.	N.D.
	2,3',4,4',5,5'-HxCB (IUPAC#167)	N.D.	N.D.	N.D.
	2,3,3',4,4',5-HxCB (IUPAC#156)	4	N.D.	N.D.
	2,3,3',4,4',5'-HxCB (IUPAC#157)	N.D.	N.D.	N.D.
	2,3,3',4,4',5,5'-HpCB (IUPAC#189)	N.D.	N.D.	N.D.
	Mono-ortho PCBs	60	27	18
Total（Co-PCBs）		60	27	18
Total（PCDDs +PCDFs +Co-PCBs）		71	563	89

IUPAC : International Union of Pure and Applied Chemistry

Table 9-12: Results of Emission Gas Analysis (Dioxins) in Second Combustion Test – 100% Coal (Particle + Gas)

		Actual value*1	Quantitation limit value	Detection limit value	Toxic Equivalency Factor	Toxic Equivalent (TEQ)
Unit		ng/m^{3}N	ng/m^{3}N	ng/m^{3}N	(TEF)	(ng-TEQ/m^{3}N)
PCDDs	1,3,6,8-TeCDD	(0.006)	0.008	0.002	0	0
	1,3,7,9-TeCDD	(0.004)	0.008	0.002	0	0
	2,3,7,8-TeCDD	ND	0.008	0.002	1	0
	other-TeCDDs	0.010	-	-	-	-
	1,2,3,7,8-PeCDD	ND	0.008	0.003	1	0
	other-PeCDDs	(0.006)	-	-	-	-
	1,2,3,4,7,8-HxCDD	ND	0.02	0.007	0.1	0
	1,2,3,6,7,8-HxCDD	ND	0.02	0.007	0.1	0
	1,2,3,7,8,9-HXCDD	ND	0.01	0.004	0.1	0
	other-HxCDDs	ND	-	-	-	-
	1,2,3,4,6,7,8-HpCDD	ND	0.02	0.006	0.01	0
	other-HpCDDs	ND	-	-	-	-
	OCDD	(0.012)*1	0.03	0.009	0.0001	0
	Total PCDDs	0.039	-	-	-	-
PCDFs	1,2,7,8-TeCDF	0.021	0.007	0.002	0	0
	2,3,7,8-TeCDF	0.034	0.007	0.002	0.1	0.0034
	other-TeCDFs	0.19	-	-	-	-
	1,2,3,7,8+1,2,3,4,8-PeCDF	0.009	0.007	0.002	0.05	0.00045
	2,3,4,7,8-PeCDF	0.0073	0.0008	0.0002	0.5	0.00365
	other-PeCDFs	0.048	-	-	-	-
	1,2,3,4,7,8+1,2,3,4,7,9-HxCDF	ND	0.02	0.005	0.1	0
	1,2,3,6,7,8-HxCDF	ND	0.02	0.007	0.1	0
	1,2,3,7,8,9-HxCDF	ND	0.01	0.004	0.1	0
	2,3,4,6,7,8-HxCDF	ND	0.01	0.004	0.1	0
	other-HxCDFs	ND	-	-	-	-
	1,2,3,4,6,7,8-HpCDF	(0.003)*1	0.01	0.003	0.01	0
	1,2,3,4,7,8,9-HpCDF	ND	0.007	0.002	0.01	0
	other-HpCDFs	ND	-	-	-	-
	OCDF	ND	0.007	0.002	0.0001	0
	Total PCDFs	0.33	-	-	-	-
Total（PCDDs＋PCDFs）		0.37			-	-
Co-PCBs	3,3',4,4'-TeCB (#77)*2	0.067	0.01	0.003	0.0001	0.0000067
	3,4,4',5-TeCB (#81) *2	0.014	0.01	0.004	0.0001	0.0000014
	3,3',4,4',5-PeCB (#126)*2	ND	0.008	0.003	0.1	0
	3,3'4,4',5,5'-HxCB (#169)*2	ND	0.006	0.002	0.01	0
	Non-ortho PCBs	0.081			-	-
	2,3,3',4,4'-PeCB (#105)*2	0.5	0.007	0.002	0.0001	0.000050
	2,3,4,4',5-PeCB (#114)*2	0.028	0.004	0.001	0.0005	0.0000140
	2,3',4,4',5-PeCB (#118)*2	1.1	0.01	0.003	0.0001	0.00011
	2',3,4,4',5-PeCB (#123)*2	0.029	0.007	0.002	0.0001	0.0000029
	2,3,3',4,4',5-HxCB (#156)*2	0.12	0.01	0.004	0.0005	0.000060
	2,3,3',4,4',5'-HxCB (#157)*2	0.031	0.005	0.001	0.0005	0.0000155
	2,3',4,4',5,5'-HxCB (#167)*2	0.038	0.01	0.004	0.00001	0.00000038
	2,3,3',4,4',5,5'-HpCB (#189)*2	ND	0.01	0.003	0.0001	0
	Mono-ortho PCBs	1.9	-	-	-	-
Total（Co-PCBs）		2.0	-	-	-	-
Total（PCDDs +PCDFs +Co-PCBs）		2.3	-	-	-	-
Total TEQ						0.0078

*1 : It is shown that measurement value is between quantitation limit value and detection limit value. This analysis item does not calculate the equivalent of TEQ.
*2 : IUPAC : International Union of Pure and Applied Chemistry

Table 9-13: Results of Emission Gas Analysis (Dioxins) in Second Combustion Test – RDF 2% Mixture (Particle + Gas)

		Actual value*1	Quantitation limit value	Detection limit value	Toxic Equivalency Factor	Toxic Equivalent (TEQ)
Unit		ng/m^{3}N	ng/m^{3}N	ng/m^{3}N	(TEF)	(ng-TEQ/m^{3}N)
PCDDs	1,3,6,8-TeCDD	0.34	0.005	0.002	0	0
	1,3,7,9-TeCDD	0.23	0.005	0.002	0	0
	2,3,7,8-TeCDD	ND	0.005	0.002	1	0
	other-TeCDDs	0.074	-	-	-	-
	1,2,3,7,8-PeCDD	(0.004)	0.006	0.002	1	0
	other-PeCDDs	0.34	-	-	-	-
	1,2,3,4,7,8-HxCDD	ND	0.02	0.005	0.1	0
	1,2,3,6,7,8-HxCDD	(0.005)	0.01	0.004	0.1	0
	1,2,3,7,8,9-HXCDD	(0.006)	0.008	0.002	0.1	0
	other-HxCDDs	0.30	-	-	-	-
	1,2,3,4,6,7,8-HpCDD	0.033	0.01	0.004	0.01	0.00033

	other-HpCDDs	0.027	-	-	-	-
	OCDD	0.027	0.02	0.006	0.0001	0.0000027
	Total PCDDs	1.4	-	-	-	-
PCDFs	1,2,7,8-TeCDF	0.077	0.005	0.001	0	0
	2,3,7,8-TeCDF	0.091	0.005	0.001	0.1	0.0091
	other-TeCDFs	0.64	-	-	-	-
	1,2,3,7,8+1,2,3,4,8-PeCDF	0.027	0.005	0.001	0.05	0.00135
	2,3,4,7,8-PeCDF	0.019	0.0005	0.0002	0.5	0.0095
	other-PeCDFs	0.16	-	-	-	-
	1,2,3,4,7,8+1,2,3,4,7,9-HxCDF	(0.007)	0.01	0.003	0.1	0
	1,2,3,6,7,8-HxCDF	(0.005)	0.02	0.005	0.1	0
	1,2,3,7,8,9-HxCDF	ND	0.009	0.003	0.1	0
	2,3,4,6,7,8-HxCDF	(0.003)	0.009	0.003	0.1	0
	other-HxCDFs	0.023	-	-	-	-
	1,2,3,4,6,7,8-HpCDF	(0.005)	0.007	0.002	0.01	0
	1,2,3,4,7,8,9-HpCDF	ND	0.004	0.001	0.01	0
	other-HpCDFs	(0.003)	-	-	-	-
	OCDF	ND	0.005	0.001	0.0001	0
	Total PCDFs	1.1	-	-	-	-
Total（PCDDs＋PCDFs）		2.5	-		-	-
Co-PCBs	3,3',4,4'-TeCB (#77)*	0.20	0.007	0.002	0.0001	0.000020
	3,4,4',5-TeCB (#81)*	0.013	0.008	0.003	0.0001	0.0000013
	3,3',4,4',5-PeCB (#126)*	0.017	0.006	0.002	0.1	0.0017
	3,3'4,4',5,5'-HxCB (#169)*	ND	0.004	0.001	0.01	0
	Non-ortho PCBs	0.23	0.23		-	-
	2,3,3',4,4'-PeCB (#105)*	3.3	0.005	0.001	0.0001	0.00033
	2,3,4,4',5-PeCB (#114)*	0.21	0.003	0.0009	0.0005	0.000105
	2,3',4,4',5-PeCB (#118)*	7.2	0.007	0.002	0.0001	0.00072
	2',3,4,4',5-PeCB (#123)*	0.16	0.005	0.001	0.0001	0.000016
	2,3,3',4,4',5-HxCB (#156)*	0.62	0.008	0.002	0.0005	0.000310
	2,3,3',4,4',5'-HxCB (#157)*	0.15	0.003	0.0009	0.0005	0.000075
	2,3',4,4',5,5'-HxCB (#167)*	0.23	0.008	0.003	0.00001	0.0000023
	2,3,3',4,4',5,5'-HpCB (#189)*	0.010	0.007	0.002	0.0001	0.0000010
	Mono-ortho PCBs	12	-	-	-	-
Total（Co-PCBs）		12	-	-	-	-
Total（PCDDs +PCDFs +Co-PCBs）		15	-	-	-	-
Total TEQ						0.024

*1 : It is shown that measurement value is between quantitation limit value and detection limit value. This analysis item does not calculate the equivalent of TEQ.
*2 : IUPAC : International Union of Pure and Applied Chemistry

Table 9-14: Results of Emission Gas Analysis (Dioxins) in Second Combustion Test – RDF 4% Mixture (Particle)

		Actual value*1	Quantitation limit value	Detection limit value	Toxic Equivalency Factor	Toxic Equivalent (TEQ)
Unit		ng/m^{3}N	ng/m^{3}N	ng/m^{3}N	(TEF)	(ng-TEQ/m^{3}N)
PCDDs	1,3,6,8-TeCDD	0.92	0.005	0.001	0	0
	1,3,7,9-TeCDD	0.65	0.005	0.001	0	0
	2,3,7,8-TeCDD	0.007	0.005	0.001	1	0.007
	other-TeCDDs	0.29	-	-	-	-
	1,2,3,7,8-PeCDD	0.022	0.005	0.002	1	0.022
	other-PeCDDs	1.2	-	-	-	-
	1,2,3,4,7,8-HxCDD	(0.019)	0.02	0.005	0.1	0
	1,2,3,6,7,8-HxCDD	0.033	0.01	0.004	0.1	0.0033
	1,2,3,7,8,9-HXCDD	0.028	0.008	0.002	0.1	0.0028
	other-HxCDDs	1.0	-	-	-	-
	1,2,3,4,6,7,8-HpCDD	0.15	0.01	0.004	0.01	0.0015
	other-HpCDDs	0.12	-	-	-	-
	OCDD	0.11	0.02	0.006	0.0001	0.000011
	Total PCDDs	4.6	-	-	-	-
PCDFs	1,2,7,8-TeCDF	0.078	0.004	0.001	0	0
	2,3,7,8-TeCDF	0.058	0.004	0.001	0.1	0.0058
	other-TeCDFs	0.91	-	-	-	-
	1,2,3,7,8+1,2,3,4,8-PeCDF	0.043	0.004	0.001	0.05	0.00215
	2,3,4,7,8-PeCDF	0.035	0.0005	0.0002	0.5	0.0175
	other-PeCDFs	0.35	-	-	-	-
	1,2,3,4,7,8+1,2,3,4,7,9-HxCDF	0.030	0.01	0.003	0.1	0.0030
	1,2,3,6,7,8-HxCDF	0.022	0.01	0.004	0.1	0.0022
	1,2,3,7,8,9-HxCDF	(0.003)	0.008	0.002	0.1	0
	2,3,4,6,7,8-HxCDF	0.021	0.009	0.003	0.1	0.0021
	other-HxCDFs	0.15	-	-	-	-
	1,2,3,4,6,7,8-HpCDF	0.040	0.006	0.002	0.01	0.00040
	1,2,3,4,7,8,9-HpCDF	0.009	0.004	0.001	0.01	0.00009
	other-HpCDFs	0.031	-	-	-	-
	OCDF	0.021	0.004	0.001	0.0001	0.0000021
	Total PCDFs	1.8	-	-	-	-
Total（PCDDs＋PCDFs）		6.4	-		-	-

Co-PCBs	3,3',4,4'-TeCB (#77)*	0.13	0.007	0.002	0.0001	0.000013
	3,4,4',5-TeCB (#81)*	0.009	0.008	0.002	0.0001	0.0000009
	3,3',4,4',5-PeCB (#126)*	0.014	0.005	0.002	0.1	0.0014
	3,3'4,4',5,5'-HxCB (#169)*	0.004	0.004	0.001	0.01	0.00004
	Non-ortho PCBs	0.16			-	-
	2,3,3',4,4'-PeCB (#105)*	0.15	0.004	0.001	0.0001	0.000015
	2,3,4,4',5-PeCB (#114)*	0.010	0.003	0.0009	0.0005	0.0000050
	2,3',4,4',5-PeCB (#118)*	0.31	0.007	0.002	0.0001	0.000031
	2',3,4,4',5-PeCB (#123)*	0.011	0.005	0.001	0.0001	0.0000011
	2,3,3',4,4',5-HxCB (#156)*	0.034	0.008	0.002	0.0005	0.0000170
	2,3,3',4,4',5'-HxCB (#157)*	0.0083	0.003	0.0009	0.0005	0.00000415
	2,3',4,4',5,5'-HxCB (#167)*	0.012	0.008	0.002	0.00001	0.00000012
	2,3,3',4,4',5,5'-HpCB (#189)*	(0.005)	0.007	0.002	0.0001	0
	Mono-ortho PCBs	0.54		-	-	-
Total（Co-PCBs）		0.69	-	-	-	-
Total（PCDDs +PCDFs +Co-PCBs）		7.0	-	-	-	-
Total TEQ						0.071

*1 : It is shown that measurement value is between quantitation limit value and detection limit value. This analysis item does not calculate the equivalent of TEQ.
*2 : IUPAC : International Union of Pure and Applied Chemistry

Table 9-15: Results of Emission Gas Analysis (Dioxins) in Second Combustion Test – RDF 4% Mixture (Gas)

		Actual value*1	Quantitation limit value	Detection limit value	Toxic Equivalency Factor	Toxic Equivalent (TEQ)
Unit		ng/m^3N	ng/m^3N	ng/m^3N	(TEF)	$(ng\text{-}TEQ/m^3N)$
PCDDs	1,3,6,8-TeCDD	0.008	0.005	0.001	0	0
	1,3,7,9-TeCDD	0.006	0.005	0.001	0	0
	2,3,7,8-TeCDD	ND	0.005	0.001	1	0
	other-TeCDDs	ND	-	-	-	-
	1,2,3,7,8-PeCDD	ND	0.005	0.002	1	0
	other-PeCDDs	0.018	-	-	-	-
	1,2,3,4,7,8-HxCDD	ND	0.02	0.005	0.1	0
	1,2,3,6,7,8-HxCDD	ND	0.01	0.004	0.1	0
	1,2,3,7,8,9-HXCDD	ND	0.008	0.002	0.1	0
	other-HxCDDs	(0.016)	-	-	-	-
	1,2,3,4,6,7,8-HpCDD	(0.004)	0.01	0.004	0.01	0
	other-HpCDDs	(0.004)	-	-	-	-
	OCDD	ND	0.02	0.006	0.0001	0
	Total PCDDs	0.057	-	-	-	-
PCDFs	1,2,7,8-TeCDF	ND	0.004	0.001	0	0
	2,3,7,8-TeCDF	ND	0.004	0.001	0.1	0
	other-TeCDFs	0.009	-	-	-	-
	1,2,3,7,8+1,2,3,4,8-PeCDF	ND	0.004	0.001	0.05	0
	2,3,4,7,8-PeCDF	0.0009	0.0005	0.0002	0.5	0.00045
	other-PeCDFs	0.004	-	-	-	-
	1,2,3,4,7,8+1,2,3,4,7,9-HxCDF	ND	0.01	0.003	0.1	0
	1,2,3,6,7,8-HxCDF	ND	0.01	0.004	0.1	0
	1,2,3,7,8,9-HxCDF	ND	0.008	0.002	0.1	0
	2,3,4,6,7,8-HxCDF	ND	0.009	0.003	0.1	0
	other-HxCDFs	ND	-	-	-	-
	1,2,3,4,6,7,8-HpCDF	(0.003)	0.006	0.002	0.01	0
	1,2,3,4,7,8,9-HpCDF	ND	0.004	0.001	0.01	0
	other-HpCDFs	ND	-	-	-	-
	OCDF	ND	0.004	0.001	0.0001	0
	Total PCDFs	0.024	-	-	-	-
Total（PCDDs＋PCDFs）		0.081	-		-	-
Co-PCBs	3,3',4,4'-TeCB (#77)*	0.012	0.007	0.002	0.0001	0.0000012
	3,4,4',5-TeCB (#81)*	ND	0.008	0.002	0.0001	0
	3,3',4,4',5-PeCB (#126)*	ND	0.005	0.002	0.1	0
	3,3'4,4',5,5'-HxCB (#169)*	ND	0.004	0.001	0.01	0
	Non-ortho PCBs	0.012			-	-
	2,3,3',4,4'-PeCB (#105)*	0.019	0.004	0.001	0.0001	0.0000019
	2,3,4,4',5-PeCB (#114)*	ND	0.003	0.0009	0.0005	0
	2,3',4,4',5-PeCB (#118)*	0.042	0.007	0.002	0.0001	0.0000042
	2',3,4,4',5-PeCB (#123)*	ND	0.005	0.001	0.0001	0
	2,3,3',4,4',5-HxCB (#156)*	(0.004)	0.008	0.002	0.0005	0
	2,3,3',4,4',5'-HxCB (#157)*	ND	0.003	0.0009	0.0005	0
	2,3',4,4',5,5'-HxCB (#167)*	(0.002)	0.008	0.002	0.00001	0
	2,3,3',4,4',5,5'-HpCB (#189)*	ND	0.007	0.002	0.0001	0
	Mono-ortho PCBs	0.068		-	-	-
Total（Co-PCBs）		0.080	-	-	-	-
Total（PCDDs +PCDFs +Co-PCBs）		0.16	-	-	-	-
Total TEQ						0.00046

*1 : It is shown that measurement value is between quantitation limit value and detection limit value. This analysis item does not calculate the equivalent of TEQ.
*2 : IUPAC : International Union of Pure and Applied Chemistry

b.1.3. Limit Value of Dioxins in Japan and EU

Toxic Equivalency Factor (TEF) and Toxic Equivalent (TEQ)

In order to evaluate emission gas on dioxins it is necessary to understand the Toxic Equivalency Factor (TEF) and Toxic Equivalent (TEQ) as fokkows:

<Toxic Equivalency Factor (TEF)>

- 222 kinds of dioxins are identified at present and they are broadly categorized into three groups, i.e. Polychlorinated Dibenzo-para-Dioxins (PCDDs), Polychlorinated Dibenzo-Furans (PCDFs) and Co-planar Polychlorinated Bipheyls (Co-PCBs).
- Among about 222 dioxins, 29 are identified as toxic and degree of toxicity differs each other. However, toxic or not of the other dioxins than 29 are not determined yet.
- Toxicity of each dioxins (isomer) is defined as TEF of which the strongest is 1 for 2, 3, 7, 8-TeCDD.

<Toxic Equivalent (TEQ)>

- Toxicity of dioxins is presented as Toxic Equivalent (TEQ) which is the sum of each toxic amount to be calculated by multiplying amount of each dioxin by each TEF of it.

b.1.4. Limit Value of Dioxins from Solid Waste Incinerator in Japan and EU

As for dioxins both Japanese and EU standards regulate emission limit value by TEQ (Toxic Equivalent). The table below presents the limit value of dioxins from solid waste incinerator in Japan and EU.

Table 9-16: Limit Value of Dioxins from Solid Waste Incinerator in Japan and EU

Standard	Source	Capacity of Incinerator	Emission standard (ng-TEQ/m^{3}N)	
			Case of New Incinerator	Case of Existing Incinerator
Japan	Incinerator of Solid Waste	> 4 ton/hour	0.1	1.0
EU	Incinerator of Solid Waste	---	0.1	

As shown the table below, the EU standard regulates only 17 types of TEF (Toxic Equivalency Factor) for PCDDs and PCDFs excluding PCBs while Japanese standard regulates 29 types of TEF for PCDDs, PCDFs and Co-PCBs. The Implementation of European Council Directive 2000/76/EC on the Incineration of Waste states that although Co-PCBs have similar toxicity with PCDDs and PCDFs, it could not regulates TEF and shall collect further information on toxicity of them.

Table 9-17: Equivalence Factors for PCDDs, PCDFs and Co-PCBs

		TEF	
		Japan	EU*1
PCDDs	2,3,7,8-TeCDD	1	1
	1,2,3,7,8-PeCDD	1	0.5
	1,2,3,4,7,8-HxCDD	0.1	0.1
	1,2,3,6,7,8-HxCDD	0.1	0.1
	1,2,3,7,8,9-HXCDD	0.1	0.1
	1,2,3,4,6,7,8-HpCDD	0.01	0.01
	OCDD	0.0001	0.001
PCDF	2,3,7,8-TeCDF	0.1	0.1
	1,2,3,7,8-PeCDF	0.05	0.05
	2,3,4,7,8-PeCDF	0.5	0.5
	1,2,3,4,7,8-HxCDF	0.1	0.1
	1,2,3,6,7,8-HxCDF	0.1	0.1
	1,2,3,7,8,9-HxCDF	0.1	0.1
	2,3,4,6,7,8-HxCDF	0.1	0.1
	1,2,3,4,6,7,8-HpCDF	0.01	0.01
	1,2,3,4,7,8,9-HpCDF	0.01	0.01
	OCDF	0.0001	0.001

Co-PCBs	Non-ortho PCBs	3,4,4',5-TeCB	(IUPAC#81) [2]	0.0001	-
		3,3',4,4'-TeCB	(IUPAC#77)	0.0001	-
		3,3',4,4',5-PeCB	(IUPAC#126)	0.1	-
		3,3'4,4',5,5'-HxCB	(IUPAC#169)	0.01	-
	Mono-ortho PCBs	2',3,4,4',5-PeCB	(IUPAC#123)	0.0001	-
		2,3',4,4',5-PeCB	(IUPAC#118)	0.0001	-
		2,3,3',4,4'-PeCB	(IUPAC#105)	0.0001	-
		2,3,4,4',5-PeCB	(IUPAC#114)	0.0005	-
		2,3',4,4',5,5'-HxCB	(IUPAC#167)	0.00001	-
		2,3,3',4,4',5-HxCB	(IUPAC#156)	0.0005	-
		2,3,3',4,4',5'-HxCB	(IUPAC#157)	0.0005	-
		2,3,3',4,4',5,5'-HpCB	(IUPAC#189)	0.0001	-

Note : *1 Implementation of European Council Directive 2000/76/EC on the Incineration of Waste (August 2002, Paper 2002/24)
*2 IUPAC : International Union of Pure and Applied Chemistry

b.1.5. Comparison with Emission Standard Value of Waste Incinerator in Japan and EU

The results of the emission gas analysis were presented in the tables below with the comparison with emission standard value of waste incinerator in Japan and EU.

Table 9-18: Comparison of Emission Gas Analysis Data with Japanese and EU Standard

Items	Limit value					Results of the 1st Mixed Combustion Test of RDF with Coal			Results of the 2nd Mixed Combustion Test of RDF with Coal			Unit
	Japan (Maximum)		EU*4 (Daily average value)			100% Coal	Coal + RDF (2%)	Coal + RDF (4%)	100% Coal	Coal + RDF (2%)	Coal + RDF (4%)	
Total dust	40*1	mg/m3N	10	mg/m3N		315*5	431*5	380*5	11,800*5	7,300*5	5,400*5	mg/m3N
Hydrogen chloride (HCl)	700	mg/m3N	10	mg/m3N		0.18*5	0.30*5	0.25*5	NA (HCl could not analyzed in Mongolia)			mg/m3N
Sulphur dioxide (SO2)	K value *2		50	mg/m3N		255 (729) *3	137 (391) *3	117 (334) *3	209 (597) *3	333 (751) *3	110 (314) *3	ppm (mg/m3N)
Nitrogen oxide (NOx)	250 (513)*3	ppm mg/m3N	200	mg/m3N		336 (690) *3	324 (665) *3	326 (669) *3	186 (382) *3	136 (276) *3	135 (277) *3	ppm (mg/m3N)
Standard percentage oxygen concentration	12	%	11	%		---	---	---	---	---	---	---
Dioxins	0.1	ng-TEQ /m3N	0.1	ng-TEQ /m3N	Japanese Standard*6	0.000008	0.000153	0.000172	0.0078	0.024	0.071	ng-TEQ /m3N
					EU's Standard*7	0.000003	0.000154	0.000174	0.0075	0.020	0.070	ng-TEQ /m3N

Note *1: Incineration capacity is more than 4ton/hour.
*2: Japanese standard regulates maximum concentration of SO_2 at certain point (it differs place.) departed from an emission source. K value is regulated according to the location with the range of 17.5-3.0.
*3: Although unit of limit value is set in ppm, we convert it in (mg/m^3N) for comparison.
*4: "Implementation of European Council Directive 2000/76/EC on the Incineration of Waste (August 2002, Paper 2002/24)"
*5: The figure is converted supposing that the concentration of oxygen is 12%.
*6: Calculation value base on Japanese standard
*7: Calculation value base on EU's standard

b.2 Evaluation of Emission Gas

General

- Data obtained by 2nd combustion test is more than reliable because of gas suction instrument brought from Japan.

Dust

- No significant difference on measured values between 100% coal and RDF mixed combustion.
- The measured values far exceed the regulation value for the incinerator in Japan and EU.
- It is necessary to improve the dust precipitator of the furnace.

Sulfur Dioxide (SO_2)

- Measured value shows mixed combustion may improve emission gas on SO_2.
- The measured values exceed the EU emission standard.

Nitrogen Oxide (NO_x)

- No significant difference on measured values between 100% coal and RDF mixed combustion.
- The measured values over the regulation value for the incinerator in EU.

Hydrogen Chloride (HCl)

- No significant difference on measured values between 100% coal and RDF mixed combustion.
- The emission gas satisfied the Japanese and EU emission standard.

Dioxins

- Since concentration of dioxins for mixed combustion are 3.1 – 9.1 times (2^{nd} test) more than it of 100% coal, RDF mixed combustion impacts on generation of dioxins.
- However, TEQ (Toxic Equivalent) value of RDF mixed combustion, according to the calculation method of the Japanese and EU standard for a solid waste incinerator, is less than 0.1 ng, the strictest value of the Japanese and EU emission standard. It is below the regulation value set in the emission standards in Japan and EU for solid waste incinerators.
- The 2nd combustion test analyzed two states of dioxins in RDF 4% mixture test; i.e. of particle state and gaseous, which is commonly done in Japan. Based on the results, most of dioxins are in the particle state as follow.

  Particle state dioxins: 0.071 ng-TEQ/m^3N
  Gaseous dioxins: 0.00046 ng-TEQ/m^3N

- This indicates that good bag filter could catch most of dioxins generated by the mixed combustion of RDF with coal.

c. Evaluation of Boiler Efficiency

c.1 Operation Data of the Furnace used for Combustion Test

The operation data of the furnace used for combustion test are presented in the tables below.

Table 9-19: Operation Data of the Furnace used for First Combustion Test

	Total amount of network water	Total amount of network water coming out of furnace	Temperature of water going to user	Temperature of water coming from user	Amount of supplement water	Temperature of supplement water	Temperature of boiler effluent water	Temperature of heat exchanger effluent gas	Air temperature	Retention time of Fuel in the furnace	Feeding amount of the Coal	Feeding amount of the RDF
	ton	ton/h	oC	oC	t/h	oC	oC	oC	oC	min	ton/hour	ton/hour
14 Feb 100% Coal	529	240	80	53	25	30	117	NA	-14	19	15.3	-
15 Feb Coal + RDF(2%	530	240	83	56	25	27	116	NA	-16	36	10.6	0.24
16 Feb Coal + RDF(4%)	536	240	82	55	28	23	118	NA	-11	39	8.4	0.48

Table 9-20: Operation Data of the Furnace used for Second Combustion Test

	Total amount of network water*1	Total amount of network water coming out of furnace*1	Temperature of water going to user*1	Temperature of water coming from user*1	Amount of supplement water*1	Temperature of supplement water*1	Temperature of boiler effluent water*1	Temperature of heat exchanger effluent gas*1	Temperature of inside of furnace*2	Air temperature*2	Retention time of Fuel in the furnace*1	Feeding amount of the Coa*1	Feeding amount of the RDF*1
	ton	ton/h	oC	oC	t/h	oC	oC	oC	oC	oC	min	ton/hour	ton/hour
100% Coal	443	235	58	43	17	17	72	245	727	8	49	3.4	-
Coal + RDF(2%	438	230	61	43	17	18	77	271	749	4	49	3.6	0.09
Coal + RDF(4%)	439	230	60	42	16	18	74	280	744	2	49	3.9	0.18

Note: *1 Number of Data : 44-48
*2 Number of Data : 8-14 (Day time only)

c.2 Examination of Material Balance and Heat Balance

c.2.1. Hot Water Supply System

In order to find out boiler efficiency the heat balance of the hot water system is examined. The hot water supply system of Nalaikh Heating Plant is presented in the figure below.

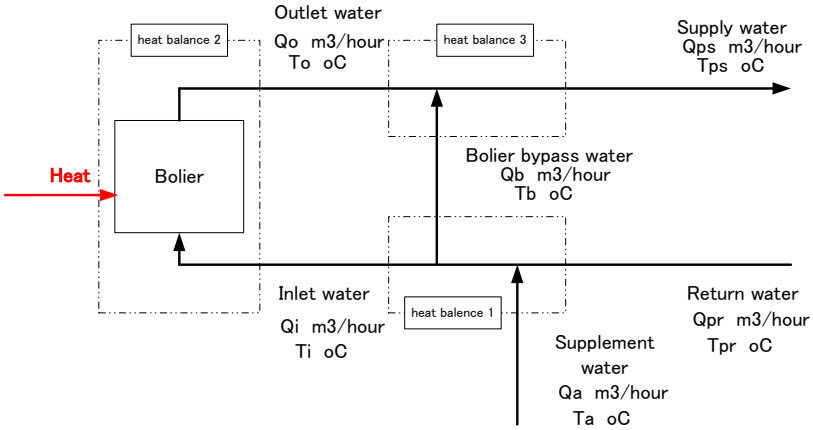


Figure 9-6: Hot Water Supply System of Nalaikh Heating Plant

c.2.2. Material Balance of Hot Water Supply System

Based on the data obtained the combustion test material balance of the hot water supply system on each combustion test is calculated and shown in the tables below.

Table 9-21: Material Balance of Hot Water Supply System in First Test

Items			unit	100% Coal	Mixed combustion test		Note
					RDF2% Mixture	RDF4% Mixture	
Return water	Qpr	Amount	m^3/hour	504	505	511	Calculated value = supply water – supplement water
	Tpr	Temp.	°C	53	56	55	Actual value
Supplement water	Qa	Amount	m^3/hour	25	25	25	Actual value
	Ta	Temp.	°C	30	27	23	Actual value
Inlet water	Qi	Amount	m^3/hour	240	240	240	Actual value
	Ti	Temp.	°C	52	55	54	Calculated value
Boiler bypass water	Qb	Amount	m^3/hour	289	290	296	Calculated value =Return water + supplement water - Inlet water
	Tb	Temp.	°C	52	55	54	Calculated value
Outlet water	Qo	Amount	m^3/hour	240	240	240	Actual value
	To	Temp.	°C	117	116	118	Actual value
Supply water	Qps	Amount	m^3/hour	529	530	536	Actual value
	Tps	Temp.	°C	80	83	82	Actual value

Table 9-22: Material Balance of Hot Water Supply System

Items			unit	100% Coal	Mixed combustion test		Note
					RDF2% Mixture	RDF4% Mixture	
Return water	Qpr	Amount	m^3/hour	426	421	423	Calculated value = supply water – supplement water
	Tpr	Temp.	°C	43	43	42	Actual value
Supplement water	Qa	Amount	m^3/hour	17	17	16	Actual value
	Ta	Temp.	°C	17	18	18	Actual value
Inlet water	Qi	Amount	m^3/hour	235	230	230	Actual value
	Ti	Temp.	°C	42	42	41	Calculated value
Boiler bypass water	Qb	Amount	m^3/hour	208	208	209	Calculated value =Return water + supplement water - Inlet water
	Tb	Temp.	°C	42	42	41	Calculated value
Outlet water	Qo	Amount	m^3/hour	235	230	230	Actual value
	To	Temp.	°C	72	77	74	Actual value
Supply water	Qps	Amount	m^3/hour	443	438	439	Actual value
	Tps	Temp.	°C	58	61	60	Actual value

c.3 Boiler Efficiency

The boiler efficiency is calculated by the following formula.

Boiler efficiency = (Total calorific value of Outlet water – Total calorific value of Inlet water) / (Total calorific value of Fuel)

The results of calculation of boiler efficiency are shown in the following table.

Table 9-23: Boiler Efficiency of the Combustion Test

	100% Coal	Mixed combustion test	
		RDF2% Mixture	RDF4% Mixture
1st combustion test	41.3 %	53.3 %	67.0 %
2nd combustion test	56.3 %	59.5 %	50.8 %

The table above presents the following findings:

- If the calorific value of RDF is higher than coal, mixed combustion of RDF with coal improve efficiency of boiler.

=> The calorific value of RDF (3,200 kcal/kg) used for the 2nd combustion test is lower than coal (3,680 kcal/kg) due to burning when produced.

=> If RDF made by compaction method calorific value is much higher than it, i.e. more than 5,000 kcal/kg.

- It should be examined carefully whether increase of mixture rate of RDF may cause decease of efficiency or not.

9.4 P/P 3: Recycling Pilot Project: Movable Recyclable Collection System

"Chirigami Kokan"

9.4.1 Objectives

The objective of the Recycling Pilot Project: Movable Recyclable Collection System is to supplement "Buy Back Station" system which is very popular in UBC for recovery recyclable wastes at generation. However, the buy back station system is not so convenient for common residents because it focuses on buying recyclables from waste pickers. The P/P 3 is planned to involve general public for recovery of recyclable wastes at generation.

9.4.2 Execution, Results and Findings

a. Execution

P/P 3 aimed at the planned area and selected Khoroo 12, 13 and 14 of Bayangol District of which population is 22,676 in total. P/P 3 commenced in October 2005 and ended in March 2006. The P/P 3 was divided into 2 phases as shown in the Table below.

Table 9-24: Contents of P/P 3: "Chirigami Kokan"

Phase	Period	Khoroo	Assignment of the Study Team	Working Days
1st Phase	From Oct 2, 2005 to Jan 5, 2006	12, 13, 14	The Study Team provided UNDRAGA with a truck including a driver and petrol required for the operation and the specified number of goods to be swapped with recyclables.	Wednesday and Sunday
2nd Phase	From Jan 6, 2006 to March 5, 2006	12, 13, 14, 15, 17, 19	The Study Team provided UNDRAGA for only petrol required for the operation.	Saturday and Sunday

b. Results

The buy back station operators have the highest potential to execute the Chirigami Kokan recycle system in future because their business style is the closest to the Chirigami Kokan recycle system. Therefore, one of the buy back station operators, UNDRAGA, was selected as an executing body. UNDRAGA stopped the operation due to the following reasons when all members of the Study Team were out of Mongolia.

1. The only truck owned by UNDRAGA which was used for the Chirigami Kokan operation was broken down due to the traffic accident. It has not been repaired yet as of August 2006.
2. UNDRAGA judged the operation is not profitable due to the following reasons.

- Maintenance cost of a truck including the rental of warm garage amounting more than 60,000 MNT/month and is too expensive.

- Boost of the gasoline price.
- Lack of cooperation by residents in the khoroo15, 17 and 19 where the project extended in January 2006.

c. Findings

The findings through the implementation of the project are summarized as follows:

- Common residents more prefer the method of swapping recyclable for goods rather than for money while poor people prefer money. Swapping for goods makes them comfortable to participate in recycling. The gratitude card attached with goods expressing "thanks for your cooperation to the environmental protection" encourages them for the participation.
- The movable system is inappropriate for the planned area, especially for high rise apartments because they need some time to carry recyclable down to the truck due to wearing warm clothes and taking a lift, etc. The truck often has gone when they came down with recyclable to the truck.
- Use of a truck makes the recyclable collection financially infeasible. Use of a kiosk shop may be more feasible and convenient for residents in the developed area.
- In order to promote common residents to do the separation of recyclables for private recycle route, the environmental education should be given to the residents by the governmental organization such as MUB.

9.5 P/P 4: Examination of the Loading Device for Heavy Waste

9.5.1 Objectives

The waste collection work in the unplanned area is very labor intensive and slow. One of the causes of this problem is that waste discharged in the unplanned area is heavy throughout the year, because the waste contains a high percentage of ash and wastewater in winter and garden waste with soil in summer.

It is necessary to overcome the issue how to load such heavy waste onto the carrier in order to improve the collection efficiency and the hard working conditions for collection workers. The pilot project aims to find a simple practical system of loading heavy waste onto the carrier.

9.5.2 Implementation and Results

The eight devices used for loading waste, which were designed and fabricated by the Study team, were distributed to TUKs for trial usage. The results of trial usage are as follows:

- The workers of TUKs found out that the usage of the device creates more work than the work saved by the device. It doesn't reduce their work load much, taken altogether.
- Therefore the workers of TUKs stopped to use the device.

Loading Device for Heavy Waste

d. Conclusions

The results of trial usage bring the following conclusions:

- In order to develop the device which can be practically used by the collection workers, the works necessary for the use of device shall be as less as possible.
- For the development of such device, the hydraulic system, which may be much more expensive than the device of this P/P, should be adopted.
- Considering the above conclusions, it appears to be better strategy to increase the collection frequency to reduce the waste collection amount from one household at once.

9.6 P/P 5: Raising Public Consciousness on Waste Issues

9.6.1 Objectives

There are the following two objectives in this pilot project:

- Establishment of a regular participatory monitoring system at the UCDS; and
- Reduction of illegal dumping.

9.6.2 Implementation

a. Establishment of Regular Participatory Monitoring System at the UCDS

The main objective of the project is to empower local people by raising their awareness and deepening their knowledge on SWM issues, in particular final disposal of waste, so that they would continue to oversee the operation and management of the UCDS after the pilot project at the disposal site is completed.

In order to ensure the continuous proper operation, an institutional system, a regular monitoring system with the participation of local representatives, was established. The monitoring committee, which consists of the environmental authorities and local representatives, implements a regular monitoring.

b. Reduction of Illegal Dumping

The project has also a long-term object to reduce illegal dumping by changing people's manner of discharging waste. Without the actual improvement of the collection service, however, it is almost impossible to force them to stop dumping waste in an open space. Therefore, under the pilot project, the team provided a place for both local residents and a collection service provider (TUK of Songinokhairkhan District) to discuss about the current problems and possible solutions in order to share a sense of problems among all the stakeholders. The result of the discussion was reflected in the master plan.

9.6.3 Findings and Recommendations

a. Establishment of Regular Participatory Monitoring System at the UCDS

a.1 Responsible Organization

It is preferable that the locals take a main role in conduction a regular monitoring. At this moment, few local organizations have enough ability to take responsibility of the regular monitoring. In the case of Sri Lank, a Buddhist monk was appointed as the chairperson of the monitoring committee, but in the project site the team could not find an individual, such as a religious leader, who can take a socially responsible role. The team drew a conclusion that the City Specialized Inspection Department was the most suitable body to organize the regular monitoring at this moment.

On the other hand, MUB has a plan to assign one officer in charge of environment issues to all the Khoroos in UB in a future. This could make it possible for the Khoroo government to take on the role of the responsible organization in the future. The team expects that through the monitoring activity the staff of Khoroo 3 & 4 government could acquire the skills and experience in order to assume the responsible role for the monitoring of the new disposal site.

a.2 Data management and information disclosure

The participatory evaluation of the pilot project raised the awareness of the local participants. It is necessary to keep the level of this awareness. In addition, it is important to continue to take an effort to promote further public participation. The disclosure of the data of the regular monitoring and sharing it with local residents are very critical in order to realize them.

In general, the disclosure of environment data is not promoted much in MUB. It is necessary for MUB to examine the data management and information disclosure system of the environment data.

b. Reduction of Illegal Dumping

Every time, several dozens of local residents participated in meetings and activities. There were a core group of people, who attended almost all activities. Considering the population of the Khoroo 4, it can be said that the influence of the pilot project was limited to some specific people. The team hopes that these people will take a leading role when discharging rules or source-separation is introduced in the future.

In order to expand the effect of the pilot project and to increase the awareness level in the whole community, it is necessary to take another step: introducing discharge rules while improving actual collection system.

During the socialist era, there were regular collection services and local people followed discharge rules. Local people in their 40's and older, with the exception of newcomers, remembered it well. At a community meeting, some of them expressed their willingness to follow new discharge rules if they were introduced. Therefore, once the collection schedule is fixed by increasing or upgrading equipments, it will be possible to introduce discharge rules and then to decrease illegal dumping.

9.7 P/P 6: Collection System Improvement

9.7.1 Objective

In order to promote 3Rs in Ulaanbaatar, in the M/P the team proposes the introduction of a separate collection system in the planned area. Under the current collection system, however, it is difficult to introduce a separate collection system because the collection schedule is not fixed and people discharge waste at any time they want and as they like. Therefore, the team and MUB decided to introduce the separate collection system in two phases.

First Phase:

- to improve the collection system (fix the collection schedule)
- to introduce discharge rules

Second Phase:

- to examine the applicability of separate collection system