No.

Government of Nepal
Ministry of Local Development

JAPAN INTERNATIONAL
COOPERATION AGENCY

THE STUDY
ON
THE SOLID WASTE MANAGEMENT
FOR THE KATHMANDU VALLEY
(Monitoring and Follow-up Phase)

FINAL REPORT

VOLUME II: MAIN REPORT

March 2007

NIPPON KOEI CO., LTD.

YACHIYO ENGINEERING CO., LTD.

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Shrawanta to Ashadha (Nepalese)

PREFACE

In response to a request from the Government of Kingdom of Nepal, the Government of Japan decided to conduct a study on “The Study on Solid Waste Management for the Kathmandu Valley” and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr.Toshiyuki UJIIE of NIHON KOEI Co., LTD. and consisted of experts from NIHON KOEI Co., LTD. and YACHIYO ENGINEERING Co., LTD. between January 2004 and July 2005. The study team conducted field surveys at the study area and held discussions with the officials concerned of the Government of Kingdom of Nepal. In September 2005, the final report was completed.

From November 2005, JICA started the Monitoring and Follow up phase of the project and dispatched the study team again in order to promote implementation of the proposed plan in the final report. This report binds up the activities and achievements during the Monitoring Follow up phase.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Kingdom of Nepal for their close cooperation extended to the study.

March 2007

Ariyuki Matsumoto
Vice President
Japan International Cooperation Agency

March 2007

Mr. Ariyuki Matsumoto
Vice President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Sir,

We are pleased to submit herewith the final report of the Monitoring and Follow-up for "The Study on Solid Waste Management for the Kathmandu Valley".

In the Kathmandu Valley in Nepal, the amount of solid waste generated is increasing and the living environment in the region has been steadily deteriorating because the capability of the municipalities concerned has not kept up with the increased demands of solid waste management. In order to tackle these problems, the study team together with the Nepalese counterparts conducted a series of filed surveys including the pilot projects implementation between January 2004 and July 2005. The final report of the Study containing the action plans on solid waste management, which were formulated by each of the five municipalities in the Kathmandu Valley, namely Kathmandu Metropolitan City, Lalitpur Sub-Metropolitan City, Bhaktapur Municipality, Madhyapur Thimi Municipality and Kirtipur Municipality, toward 2015, was submitted in September 2005.

From November 2005, the monitoring and follow-up of the action plans have been conducted. In the monitoring, the Nepalese counterparts together with the study team checked implementation status of the activities in the annual work plans which were prepared based on the action plans. For the follow-up, the study team supported environmental and social considerations on facility development such as a long-term landfill site, and provided technical training and recommendations such as for operation of short-term landfill site.

Although implementation of the action plans has just started, the activities in the action plans are expected to be continued and extended by the Nepalese counterparts themselves.

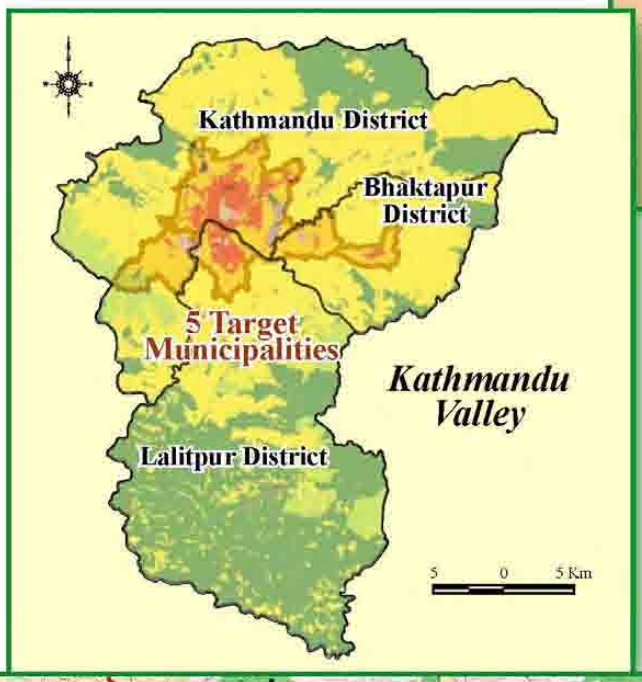
We wish to express our sincere appreciation to the officials of JICA, the JICA Advisory Committee, the Ministry of Foreign Affairs, the Ministry of Environment, the Embassy of Japan for Nepal, and JICA Nepal Office for their continuous support throughout the Study including the Monitoring and Follow-up. Also, we would like to express our great appreciation to Government of Nepal, especially the members of the Steering Committee, Technical Working Group, Task Forces, and NGOs/CBOs concerned for their active participation in the Study.

Finally, we hope that the outputs of the Study as well as the Monitoring and Follow-up will contribute greatly to improve solid waste management in the five municipalities of the Kathmandu Valley and to foster a long lasting partnership and friendship between the two nations of Japan and Nepal.

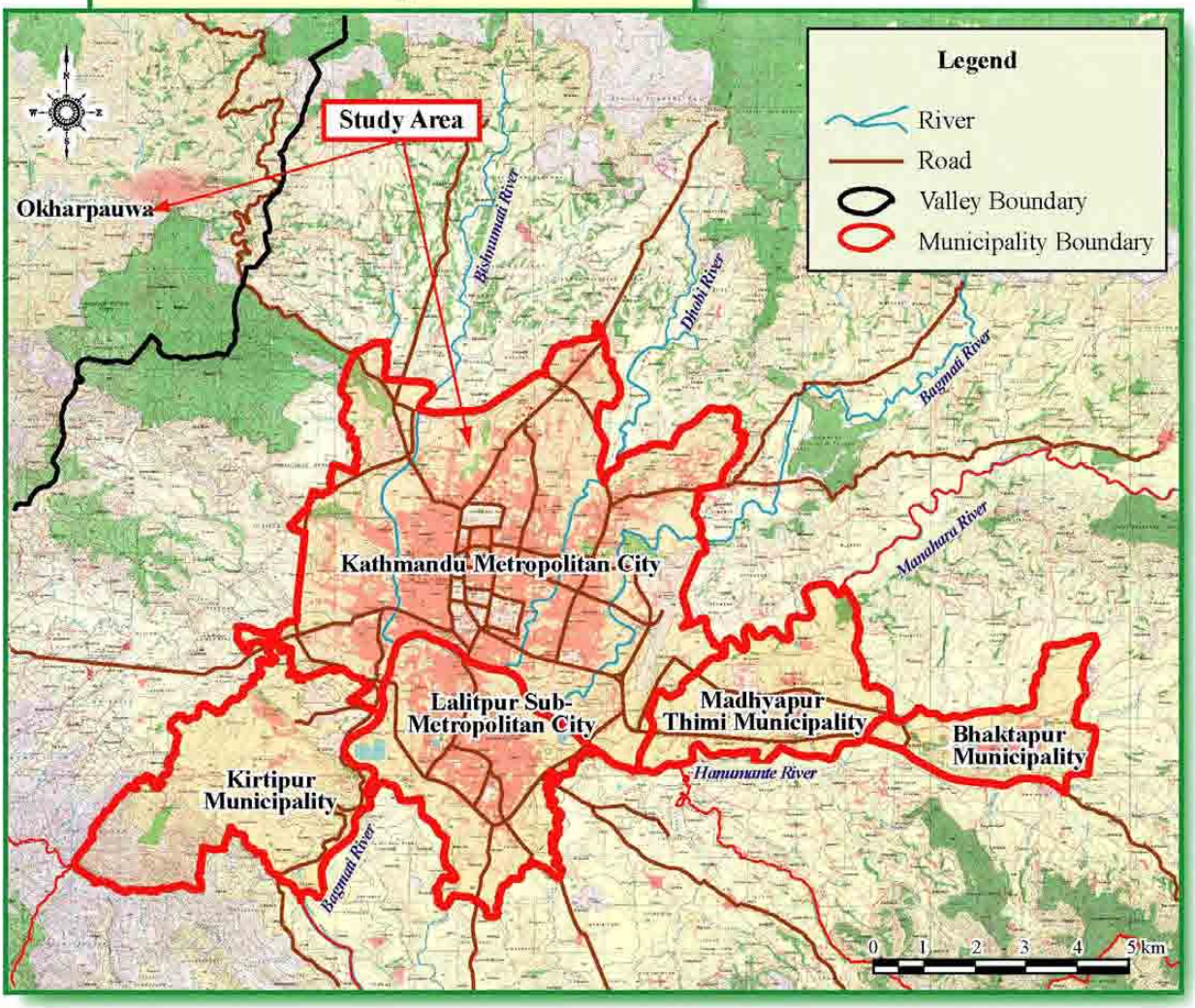
Yours faithfully,

Toshiyuki UJIIE
Leader for JICA Study Team


China
Nepal
India
Kathmandu Valley


Kathmandu District
Bhaktapur District
5 Target Municipalities
Kathmandu Valley
Lalitpur District
5 0 5 Km

Study Area


Legend
River
Road
Valley Boundary
Municipality Boundary
Study Area
Okharpauwa
Bishnumati River
Dhobi River
Bagmati River
Manahara River
Kathmandu Metropolitan City
Lalitpur Sub-Metropolitan City
Madhyapur Thimi Municipality
Bhaktapur Municipality
Hanumante River
Kirtipur Municipality
Bagmati River
0 1 2 3 4 5km

SUMMARY OF MONITORING AND FOLLOW-UP OF THE STUDY

1. Background of the Study

Solid waste management (SWM) in the Kathmandu Valley faces great challenges not only in relation to the management system but also in gaining public awareness and participation of the people. In order to improve the situation, the Government of Nepal and the Government of Japan undertook a joint study titled "The Study on the Solid Waste Management for the Kathmandu Valley (the Study)" with the technical assistance of the Japan International Cooperation Agency (JICA). The Study commenced in January 2004 and ran for a total of 20 months until August 2005.

In the course of the Study, Action Plans (A/Ps) were prepared on solid waste management (SWM) for five municipalities in the Kathmandu Valley, namely Kathmandu Metropolitan City (KMC), Lalitpur Sub-Metropolitan City (LSMC), Bhaktapur Municipality (BKM), Madhyapur Thimi Municipality (MTM), and Kirtipur Municipality (KRM), and technology transfer regarding SWM for the Nepalese counterpart personnel was carried out.

In the Monitoring and Follow-up phase of the Study, the progress of implementation of A/Ps was monitored and follow-up technical assistance provided to sustain activities targeted in the Study.

2 Objectives of the Monitoring and Follow-up

The Monitoring and Follow-up was basically carried out to achieve the following outputs:

1) Improvement in the capability of solid waste management based on implementing the AWP of each municipality and SWMRMC.
2) Improvement in the capacity regarding formulation of sustainable solid waste management system through the smooth operation of the transfer station and landfill site.

3 Monitoring of Action Plan Implementation

Monitoring sessions were carried out three times by the Task Force together with the JICA Study Team. The major items monitored were the actual implementation situation and budget execution after the commencement of this fiscal year. Each session was also open to municipal staff outside the Task Force, and the results have been fed back to the five municipalities and the SWMRMC.

- First Monitoring Sessions
  (Monitoring including support for finalization of the AWPs) : November, 2005
- Second Monitoring Sessions
  (Mid-term Monitoring and Evaluation) : February, 2006
- Third Monitoring Sessions (Final Monitoring and Evaluation) : July or August, 2006

In the 1st monitoring session, AWPs were thoroughly reviewed and some necessary changes of the plans were made as per the actual municipal situation such as viability of budget and other external circumstances. It was observed, in the 3rd session, that staff in charge has

high morale and enthusiasm to carry out the scheduled activities although the progress of some activities has been affected by the unavoidable circumstances of Nepal.

Finally, activities of the respective AWPs for the fiscal year of 2006/2007 (2063/64) were prepared by each Task Force through a series of AWP development sessions.

4 Follow-up for Action Plan Implementation

(1) Collection and Transportation in BKM and MTM

As the source separation activity in BKM has been continued and operated well, preparation has been made to apply this activity to other core areas. As for waste collection and transportation practice in MTM, it was reported that collection time was unstable, and that waste was not collected in holidays, which were recognized as points to be improved and tackled.

(2) Waste Minimization Activities

KMC has operated the medium-scale vermi-composting plant established in the Teku transfer station (T/S) premises since March 2005. The Community Recycling Center (CRC) has been also run by KMC at Ward-21 to buy and store recyclable materials as well as selling cut flowers and vermi-compost, etc. The following were recommended for ensuring the sustainability of medium-scale vermi-composting plant operation;

- Supplies of vegetable waste for the plant by KMC should be secured.
- Labor conditions should be improved, for example salary of staffs/workers should depend on amount of compost produced to increase motivation. It is recommended that the vermi-composting plant should be managed by a suitable NGO or private agency.
- Continuing effort is required to develop a market for the product and in public relations to enhance the marketing of vermi-compost.
- The use of animal excrement should be considered to improve the quality of the composting product.
- The vermi-composting plant should be utilized as a training center for composting.

After the Study, KMC, LSMC and KRM have been continuing home composting activities at their own expense. The following are recommended for this activity:

- Municipality should subsidize home compost bins as appropriate as possible so that residents can acquire one easily in cheaper price but can motivate composting operation by sharing a certain amount of bin cost. Other options such as utilization of water tanks as home compost bins should be considered and promoted to residents.
- Municipality should arrange places/opportunities, like the CRC, for those who want to sell the compost product for earning money. Since the result of the market survey revealed that there is a potential for use of compost by farmers in and around the valley, municipality should also monitor and encourage the sales market of the compost products continuously.

- Sharing of information, not only on home composting but also on waste minimization activities should be made periodically through CoMoN meetings.

In KRM, the activity of plastic separation has been implemented and extended. Since it was observed that employment of a motivator was effective for maintaining momentum on the activity, continued employment of a motivator was recommended for the monitoring and follow-up of the activity.

(3) Solid Waste Data Management

Follow-up workshops for data management were held twice and participants at the workshops concluded that the database should be further improved because establishment of a reliable database system is essential.

The management situation of database and the present skill of operators were assessed, and sample formats for the generation of annual reports based on the available data of LSMC and MTM were developed.

5 Follow-up for Environmental and Social Considerations for Facility Development

(1) Follow-up for EIA on Banchare Danda Long-term Landfill Site

1) Basic Considerations for the Concept Design

The basic considerations for the concept design of Bancahre Danda Long-term Landfill Site were set as follows:

- For the sanitary landfill the semi-aerobic type will be applied.
- The horizontal liner will be applied along the site bed and to a height of around 5 meters along the slopes.
- In order to estimate the leachate quantity, the average of rainfall data from both stations of Kakani and Dhunibeshi has been used.
- Leachate treatment will be by aeration and sedimentation ponds with re-circulation, and the ponds will have sufficient capacity so as not to discharge of the leachate to the adjacent river.
- The waste storage dams will be constructed by the soil-cement method.
- Passive venting of the landfill gas will be adopted.
- The access road under design by the SWMRMC should lead into the administration area proposed to be constructed on the western area of the site
- It was decided that the river diversion channel should pass the saddle point of the central plateau. A chute channel was selected as the most appropriate type for the river diversion scheme.
- The expected life span is between 19 and 20 years because the volume available for waste disposal was estimated as 3.96 million m^3.
- In order to reduce leachate production the area will be divided into four (4) sections.

2) Facilities Plan with Phased Development

The landfill will be developed in two phases. In Phase 1, there are two stages, and the waste disposal operations will start upon completion of Phase 1 - Stage 1. It was estimated that a total 20 months would be spent for development of the site including the rainy season when construction work might be affected by weather conditions.

Overall costs of the site were estimated at Rs 2.6 billion in total over the period of 32 years.

Cost Component		Million Rs	Remarks
1) Development		1,677.5	Phase-1 and Phase -2
2) Procurement of Equipment	Initial	106.4	Procurement in FY 2009/10
	Renewal	143.2	Procurement for replacement afterwards
	Total	249.6	
3) O&M		613.6	Total of 20 years from 2009/10 until 2028/29
4) Post-closure Maintenance		47.6	Total of 10 years from 2029/30 until 2038/39
Total		**2,588.3**	

Source: JICA Study Team

(2) Follow-up Survey for Other Facility Development

In the case of development of the permanent transfer stations, screening to determine the level of environmental assessment (EIA or IEE) should be conducted based on the scale and activities of each project. As the areas of both the Balaju T/S and the Afadole Temporary T/S are less than 3 ha, IEEs including environmental management and monitoring programs should be conducted. The IEEs need to be approved by the relevant authority, namely Ministry of Local Development.

6 Follow-up for Secondary Transportation and Sisdol Short-term Landfill Operation

(1) Follow-up for Secondary Transportation

The following were recommended for secondary transportation based on operational practice in Teku T/S during the follow-up activities:

- It is suggested that KMC need to find the most appropriate way to receive waste from the split level platform without over-spill and to consider ground markings so the drivers can gauge their positioning when stopping secondary transportation vehicles.
- The frequent changes of waste management policies from day-time to night-time, again to day-time collections and increased waste pickers' activities have affected the operation of Teku T/S. It is recommended that KMC should prepare an operation plan together with consideration of the fundamental waste collection and transportation policy and plan. KMC should also have meetings to let local residents around Teku T/S for the preparation of the operation plan.

(2) Follow-up for the Operation of Sisdol Short-term Landfill

The following were recommended to improve the current operation of Sisdol short-term landfill (Sisdol S/T-LF) through the follow-up activities:

- Blocked vertical vents should be repaired by excavating surrounding waste and tires installed. The vertical vents should be extended using gabion nets and surrounded by boulders. The boulders placed should be, at minimum, 1.0 m diameter.
- The operator should continue to improve the site internal access to ensure that the waste collection trucks can unload the waste near to the waste disposal area.
- In addition to the road developed at the commencement of the waste disposal, service roads should be developed periodically to ease the access of the waste collection trucks to the site.
- The silt in leachate pond should be removed periodically. The aerator in the leachate pond should be operated for at least six hours daily.
- The leachate, groundwater and river should be sampled and tested, as a minimum, on a bi-monthly basis.
- For the completed landfill areas, the final cover should be applied and drains should be made to divert the rainwater from penetrating to the waste layers.
- The site manager needs to spend more time at the landfill in order to make operation more efficient and to learn as much as possible from the site experience. Operation records, waste arrival records and visitors logs should be maintained continuously.

7 Recommendations

Although the unstable political situation of Nepal has much influenced the progress of scheduled activities in the AWPs for the fiscal year 2005/2006 (2062/2063), the following were recommended, as a result of lessons learned from the first year's experience, for further action plan implementation to be tackled independently by the SWMRMC and the five municipalities:

- As it may take time to enroot the annual work cycle consisting of planning – budgeting – implementation – evaluation in each of the five municipalities, it is recommended that the monitoring system should be practiced in the municipality as an official process.
- Considering the current changing situation of Nepal, amendments of the A/Ps based on the situation as well as progress of the scheduled activities may be necessary.

The JICA Study Team also recommended the following based on the follow-up and monitoring activities:

- As current full-scale transportation may be more than 100% operation capacity, efforts should be made continuously to develop additional transfer stations and a waste processing facility to minimize waste to be transported as well as to procure additional secondary transfer vehicles.
- During May to July 2006 when all the waste was transported to Sisdol S/T-LF and Bagmati dump site was closed, the number of waste pickers at Teku T/S almost doubled. Thus, the appropriate number of waste pickers that can work at Teku T/S, without hindering the operations and endangering their own safety, should be considered and

those allowable should be registered. It is also necessary to consider options for the remaining waste pickers.

- The SWMRMC and KMC should continue to make effort to solve the issues related to site selection as well as others for implementation of the development of a waste minimization facility. An authorized working group, which has been organized in the last fiscal year, should be functioning soon.
- The SWMRMC should advance EIA procedure to develop the Banchare Danda landfill and immediately start preparation and construction of the access road to the site. Also, the SWMRMC should carefully consider its capacity to cope with all the activities related to implementing this large project.
- The Sisdol S/T-LF will be completely filled by January 2008. On the other hand, Banchare Danda long-term landfill is expected to be ready to receive the waste by July 2009. It is therefore necessary to consider what measures need to be taken for landfilling during this period. One alternative that could be considered is to use the Aletar land, which was purchased by the SWMRMC, for a temporary landfill.
- BKM and MTM involve more of their general communities in discussions on establishing the landfill site and not only hold discussions with communities where the proposed site is located. The SWMRMC should play a larger role in this matter, as they are the government agency responsible for development of sanitary landfill within the valley.
- Nature is kind to Kathmandu Valley as witnessed by the quick growth of green areas around the Bagmati River dumpsite. However problems of methane gas generation as well as leachate still prevail. In the absence of effective safe closure, people should be warned of the dangers of tapping onto unpurified methane gas, building upon old dumpsites and playing in the river near these areas.

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Abbreviations

<Organizations>

BKM	Bhaktapur Municipality
CDS	Community Development Section
CDSS	Community Development and Sanitation Section
CEN	Clean Energy Nepal
CMU	Community Mobilization Unit
DOMG	Department of Mines and Geology
ENPHO	Environment and Public Health Organization
GTZ	German Technical Cooperation Agency
JICA	Japan International Cooperation Agency
KMC	Kathmandu Metropolitan City
KRM	Kirtipur Municipality
LSMC	Lalitpur Sub-Metropolitan City
MOAC	Ministry of Agriculture and Cooperative
MOEST	Ministry of Environment, Science and Technology
MOES	Ministry of Education and Sports
MOHP	Ministry of Health and Population
MOICS	Ministry of Industry, Commerce and Supplies
MOLD	Ministry of Local Development
MOPE	Ministry of Population and Environment
MOPPW	Ministry of Physical Planning and Works
MTM	Madhyapur Thimi Municipality
NPC	National Planning Commission
OSLSMCC	Okharpauwa Sanitary Landfill Site Main Coordination Committee
ST/C	Steering Committee
SWMS	Solid Waste Management Section
SWMRMC	Solid Waste Management and Resource Mobilization Center
T/F	Task Force
TWG	Technical Working Group
WEPCO	Women Environment Preservation Committee

<Metric Units>

g	Gram
g/L	Gram per liter
ha	Hectare
kg	Kilogram
kg/day	Kilogram per day
kg/d-capita	Kilogram per day per capita
km	Kilometre
km^2	Square Kilometer
L	Liter
mm	Millimeter
m^2	Square Meter
m^3	Cubic Meter
mg/L	Milligram per liter
m	Meter
ton/day	Ton per day
ton/year	Ton per year
%	Percentage

<Currency>

JPY	Japanese Yen
Rs	Nepalese Rupee
US$	US Dollar

<Others>

A/P	Action Plan
AWP	Annual Work Plan
BOD	Biochemical Oxygen Demand
CBO	Community Based Organization
CEO	Chief Executive Officer
CKV	Clean Kathmandu Valley
COD	Chemical Oxygen Demand
CoMoN	Community Mobilization Network
C/P	Counterpart
CRC	Community Recycling Center
DADO	District Agriculture Development Office
DfA/P	Draft Action Plan
DF/R	Draft Final Report
EIA	Environmental Impact Assessment
F/R	Final Report
FY	Fiscal Year
GIS	Geographic Information System
GRDP	Gross Regional Domestic Product
HCI	Health Care Institution
HH	Household
HRD	Human Resource Development
IC/R	Inception Report
IEC	Information, Education and Communication
IEE	Initial Environmental Examination
IT/R	Interim Report
KVMP	Kathmandu Valley Mapping Project
LF	Landfill
LFS	Landfill site
L/T	Long-term
M&E	Management and Evaluation
M/M	Minutes of Meeting
MTEF	Medium Term Expenditure Framework
NGO	Non Governmental Organization
ODA	Official Development Assistance
OEP	Overall Equipment Plan
OFP	Overall Facility Plan
OJT	on-the-job training
Off-JT	off-the job trainings
O&M	Operation and Maintenance
PPP	Public Private Partnership
S/T	Short-term
S/T-LF	Short-term Landfill
STV	Secondary Transportation Vehicle
SWM	Solid Waste Management
TOR	Terms of References

T/S	Transfer Station
UGR	Unit Generation Rate
VDC	Village Development Committee
WPF	Waste Processing Facility
3R	Reduce, Reuse, Recycle

CHAPTER 1 INTRODUCTION

1.1 Background of the Monitoring and Follow-up

1.1.1 The Study on the Solid Waste Management for the Kathmandu Valley

Solid waste management (SWM) in the Kathmandu Valley faces great challenges not only in relation to the management system but also in gaining public awareness and participation of the people. In order to improve the current situation, the Government of Nepal (GON) and the Government of Japan (GOJ) undertook a joint study titled "The Study on the Solid Waste Management for the Kathmandu Valley (the Study)" with the technical assistance of the Japan International Cooperation Agency (JICA). The Study commenced in January 2004 (Magh 2060[1]) and ran for a total of 20 months until August 2005 (Bhadra 2062). The final report of the Study was submitted to the Nepalese side in September 2005.

The Study was conducted with the following objectives;

1) To formulate Action Plans (A/Ps) on SWM for five municipalities in the Kathmandu Valley, namely Kathmandu Metropolitan City (KMC), Lalitpur Sub-Metropolitan City (LSMC), Bhaktapur Municipality (BKM), Madhyapur Thimi Municipality (MTM), Kirtipur Municipality (KRM), and Solid Waste Management and Resource Mobilization Center (SWMRMC), and
2) To pursue technology transfer regarding SWM for Nepalese counterpart (C/P) personnel.

In particular, capacity development of the Nepalese C/P personnel for planning and management of solid waste was carried out over the study period, which included the implementation of a series of pilot projects (P/Ps) as well as activities regarding information dissemination and public awareness raising. Through the Study, the solid waste management ratio[2] is expected to increase toward the target year of 2015.

1.1.2 Monitoring and Follow-up of the Study

In the course of the Study, A/Ps on SWM towards the target year of 2015, consisting of vision, approach, strategies and necessary activities, were developed by respective five municipalities and SWMRMC.

The adopted approaches on the A/Ps are A: Improvement of Collection and Transportation, B: Promotion of Waste Minimization, C: Improvement of Final Disposal Manner, D: Raising of Public Awareness/Community Mobilization, E: Organizational and Institutional Development, and F: Others. Various activities necessary short-, mid- and long-term

[1] Nepalese Year

[2] Solid waste management ratio is the ratio of "the quantity of waste" that is managed by waste generators or municipalities in the appropriate ways such as source reduction, recycling, appropriate collection, treatment and disposal after it has been generated from the sources to "the total quantity of generated waste".

activities were proposed with its respective implementation plans in order to achieve the targets. From the respective A/Ps, activities were broken down into the Annual Work Plans (AWPs) with assignment of responsible staff and necessary budget.

In order to gear up for appropriate and steady implementation of the activities stipulated in the respective A/Ps by the Nepalese side, the Monitoring and Follow-up of the Study (the Monitoring and Follow-up) was conducted from November 2005 to March 2007 with the following main two components;

1) Monitoring of A/P Implementation (the Monitoring): to check the implementation progress of the activities stipulated in AWPs, and provide recommendations for steady implementation of the activities and for development of next fiscal year's AWPs
2) Follow-up: for A/P Implementation (the Follow-up): to provide technical assistances to implement the activities stipulated in AWPs including social and environmental considerations on development of proposed facilities and operation of secondary transportation and Sisdol short-term landfill (S/T-LF).

As the results of the Monitoring and Follow-up, recommendations for further implementation of the A/Ps were also provided by the JICA Study Team.

1.2 Objectives of the Monitoring and Follow-up

The Monitoring and Follow-up was basically carried out to achieve the following outputs:

1) Improvement in the capability of solid waste management based on implementing the AWP of each municipality and SWMRMC.
2) Improvement in the capacity regarding formulation of sustainable solid waste management system through the smooth operation of the transfer station and landfill site.

1.3 Target Area of the Monitoring and Follow-up

The Monitoring and Follow-up covered the jurisdiction of the five municipalities in the Kathmandu Valley, namely KMC, LSMC, BKM, MTM and KRM. In addition, "Okharpauwa" where a landfill site was proposed and developed was also covered.

1.4 Target Activities

The target activities for the Monitoring and Follow-up were the activities stipulated in the respective AWPs of the five municipalities and SWMRMC for the fiscal year 2005/2006.

The target solid waste of the Monitoring and Follow-up was mainly municipal solid waste and non-hazardous waste that is collected by the Municipality.

1.5 Organization and Staffing of the Monitoring and Follow-up

The Study established three implementation organizations on the Nepalese side, which were the Steering Committee (ST/C), Technical Working Group (TWG) and Task Force (T/F). These implementation organizations of the Study were continuously active during the Monitoring and Follow-up and their roles, tasks and members are shown in Figure 1.5-1 and Table 1.5-1, respectively.

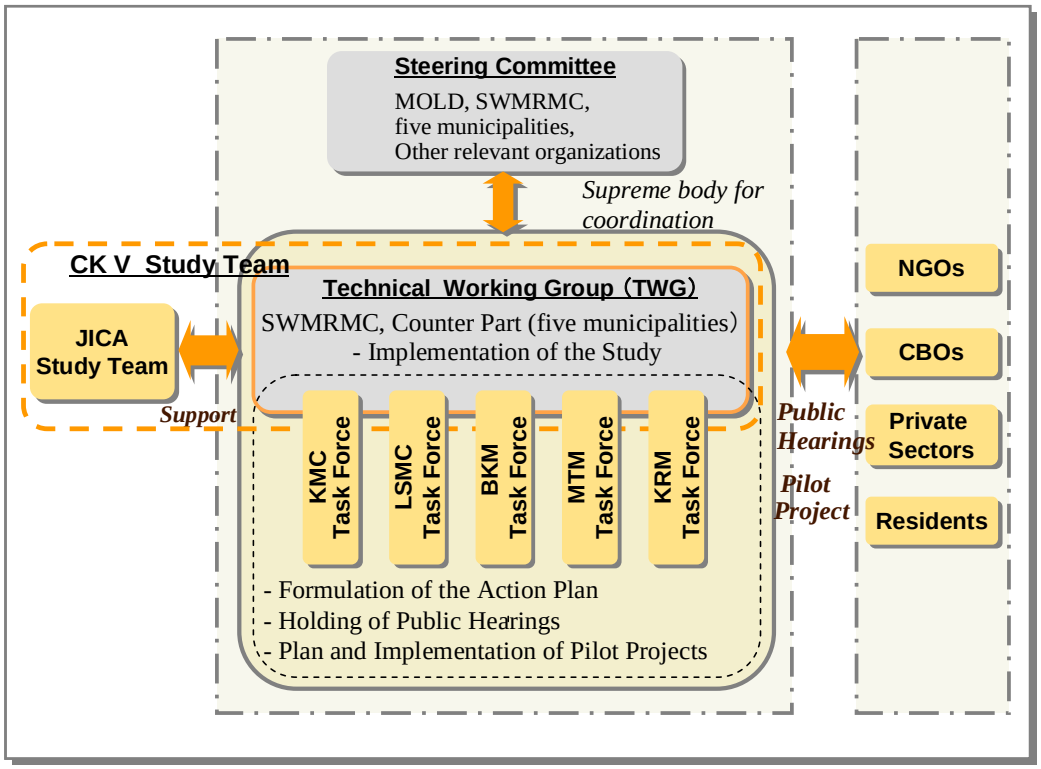


Figure 1.5-1 Implementation Organization of the Monitoring and Follow-up

Source: JICA Study Team

Table 1.5-1 Roles, Tasks and Members of Organizations of the Monitoring and Follow-up

Organi-zation	Roles	Tasks	Members
ST/C	Coordination of relevant organizations	- To confirm the overall policies of SWM in the Kathmandu Valley - To confirm and approve the contents of the reports to be submitted to the Nepalese side by the JICA Study Team - To discuss and approve the contents of the Monitoring and Follow-up and to make a commitment to implement the action plan as policy makers - To coordinate the organizations concerned for SWM in the Kathmandu Valley and exchange information and opinions between the organizations of central and local governments	- Ministry of Local Development (MOLD) - SWMRMC - Five municipalities - Ministry of Environment, Science and Technology (MOEST) (formerly MOPE) - Ministry of Physical Planning and Works (MOPPW) - Ministry of Industry, Commerce and Supplies (MOICS) - Ministry of Education and Sports (MOES) - Ministry of Agriculture and Cooperative (MOAC) - Ministry of Health and Population (MOHP) - Members of TWG (as observers)
TWG (C/P)	Implementation of capacity development and technology transfer from the JICA Study Team	- To carry out the Monitoring and Follow-up together with the JICA Study Team. - To prepare necessary documents and materials for discussion by the ST/C - To organize and operate a T/F	- MOLD - SWMRMC - Staff of KMC - Staff of LSMC - Staff of BKM - Staff of MTM - Staff of KRM
T/F	Coordination of opinions within the relevant departments, and implementation of action plans	- To implement an Action Plan for the municipality with support from the JICA Study Team. - To coordinate opinions among the relevant sections of each municipality	- Members of TWG - Planning (relevant section) - Environmental and Public Relations (relevant sections) - Community mobilization/development section - Financial section - NGOs/CBOs - Private sectors - Intellectuals

Source: JICA Study Team

The JICA Study Team for the Monitoring and Follow-up was comprised of the following members as listed below:

Name	Assignment
Mr. Toshiyuki UJIIE	Team Leader/Solid Waste Management Policy/Environmental and Social Considerations
Mr. Shungo SOEDA	Deputy Team Leader / Collection & Transportation /Recycling System Analysis
Mr. Mahmoud RIAD	Solid Waste Management Facility Plan and Operation
Mr. Shigeru KAWANABE/ Mr Kenichiro YOKOTA	Solid Waste Management Facility Plan and Operation (2)
Mr. Masahiro SAITO	Landfill Site Design
Mr. Kiyoshi SHIMIZU	Solid Waste Minimization Facility Plan and Design
Mr. Hideo TSUTA	Environmental and Social Considerations (River Engineering/ Hydrology)
Mr. Yasushi MOMOSE	Environmental and Social Considerations (Geology/ Disaster Prevention)

Name	Assignment
Mr. Satoshi HIGASHINAKAGAWA	Environmental and Social Considerations (Field Workshop)
Ms. Minako NAKATANI	Organization and Institution /Human Resources Development
Mr. Noboru OSAKABE	Financial Analysis
Mr. Takahiro KAMISHITA	Coordinator / Public Relations

1.6 Work Flow of the Monitoring and Follow-up

The Monitoring and Follow-up includes works in Japan as well as works in Nepal that have been implemented since November 2005 as Phase 4. The overall workflow of the Monitoring and Follow-up is shown in Figure 1.6-2, while the detail work schedule is illustrated in Figure 1.6-1 which is divided into two terms.

Phase 4-1:

- Works in Japan November 2005
- Works in Nepal November 2005 - March 2006

Phase 4-2:

- Works in Nepal May - September and December 2006, January and March 2007
- Works in Japan March 2007

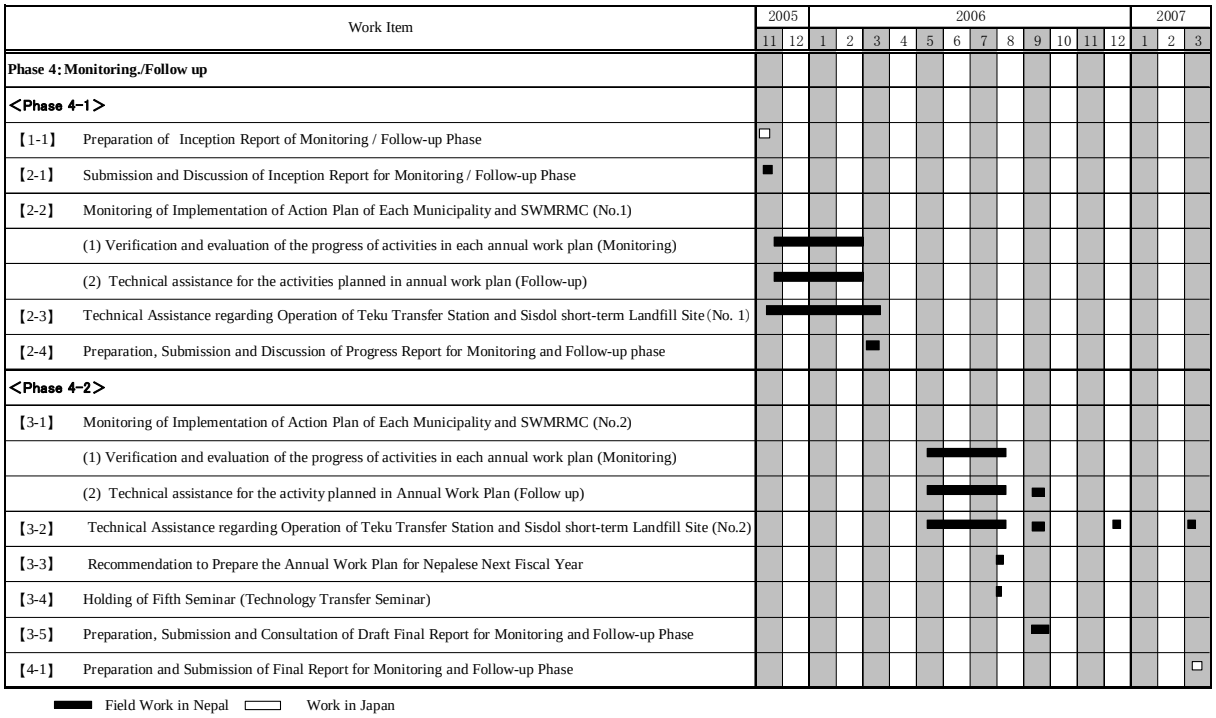


Figure 1.6-1 Work Schedule of the Monitoring and Follow-up (Phase 4)

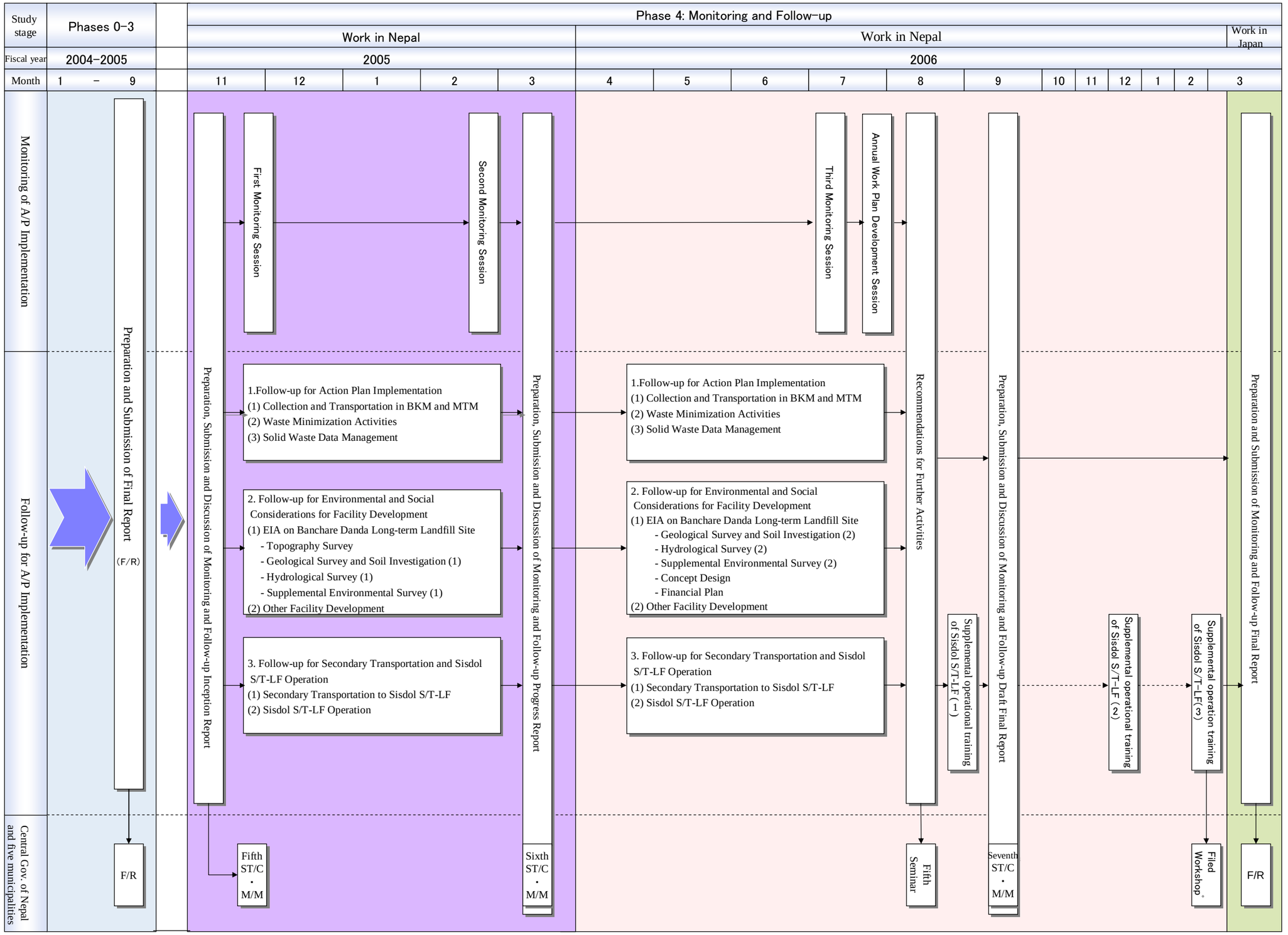


Figure 1.6-2 Overall Work Flow of the Monitoring and Follow-up

CHAPTER 2 MONITORING OF ACTION PLAN IMPLEMENTATION

2.1 Overall Monitoring System of Action Plan

The A/P is a long-term strategic plan to be implemented starting fiscal year 2005/2006 (2062/63) to 2014/15 (2071/2072). The A/Ps established by the respective municipalities and SWMRMC are as per attached in Appendix 2.

In order to ensure that the A/P is implemented in an effective and sustainable manner, a mid- and long-term monitoring system needs to be put in place to bind together both individual and collective achievements of the SWMRMC and the five municipalities. Such system should be installed both at the municipal level, as well as the valley level, in line with the institutional arrangements.

In principle, monitoring of A/P implementation should be conducted at two levels. The first level of monitoring of the A/Ps should be conducted at the benchmarked years of 2008 and 2011, which are the final fiscal years within short- and mid-terms, respectively. This end of term monitoring is recommended to holistically review the A/Ps implementation from perspectives such as relevance, effectiveness, efficiency, impact and sustainability of municipal activities. The solid waste management ratio should be calculated at individual municipalities, to assess the progress of SWM activities as indicated in the targets of the respective A/Ps. In 2015, the final evaluation should be also conducted to examine whether the ultimate target of 93% solid waste management ratio is achieved, and to draw best practices and lessons learned for future SWM programs.

The second level of monitoring of the A/Ps should be conducted when each municipality and SWMRMC formulates their respective annual work plans (AWPs), which in fact are a breakdown of activities as identified for short-, med- and long-terms. The monitoring exercises in this level are mainly to check the progress of the activities of the AWPs as well as budget allocation and execution. During the monitoring exercise, necessary measures can be considered if there is any constraint to implement the activities. Based on the result of this level monitoring, together with influences from external factors, the contents of next fiscal year's AWPs should be developed.

The overall monitoring system of A/P is as illustrated in Figure 2.2-1. This system should allow enough flexibility so that the activities stipulated in the A/Ps can be changed, dropped or added insofar as the overall effect on the SWM program would be to increase the solid waste management ratio. Furthermore, this exercise would serve to update the A/Ps so that it would enhance the relevance of the A/Ps for continued sustainability.

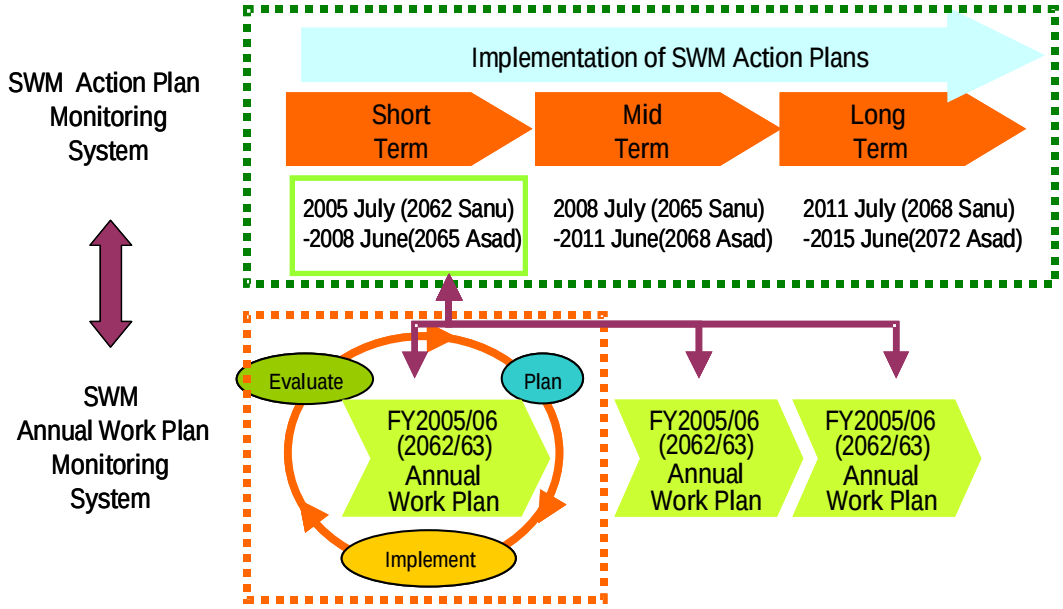


Figure 2.2-1 Overall Monitoring System of Action Plan

Source: JICA Study Team

2.2 Monitoring of Phase 4

The Monitoring of Phase 4 (the Monitoring) was conducted as the first practical exercise of the second level monitoring. The objectives of the Monitoring were:

- To assist effective and steady implementation of the activities of AWPs of the five municipalities and SWMRMC
- To support the five municipalities and SWMRMC to foster a culture of monitoring and evaluation exercises

For the effective operationalization of the A/Ps, AWPs of the fiscal year of 2005/06 (2062/63) were drafted by inter-sectional task forces mobilized within each municipality and the SWMRMC (Task Force), and then finalized including budget allocation. The major monitoring items were the actual implementation progress of the activities of respective AWPs and budget execution after the commencement of the fiscal year.

Basically, the monitoring sessions were carried out by task force together with the JICA Study Team by using a monitoring sheet. Each session was open to municipal staffs outside the Task Force, who are assigned to SWM-related responsibilities. Any other participants identified by the municipalities as key personnel were included accordingly. An appropriate local consultant was selected to support the JICA Study Team to carry out the Monitoring.

The following three times monitoring sessions were conducted as the Monitoring followed by sessions for development of AWP of fiscal year 2006/07 (2063/64). The results were fed back to the five municipalities and SWMRMC.

2.2.1 First Monitoring Sessions (First Monitoring including support for finalization of the AWPs)

At the time of finalization of the A/Ps in June/July 2005, the budget of the each municipality for the fiscal year of 2005/06 (2062/63), which influences the implementation and realization of activities in the AWPs, had still not been finalized. For the steady implementation of the activities, it was initially necessary for the AWPs to be finalized as official ones based on the budget arrangement of the each municipality and SWMRMC. In this connection, the JICA Study Team organized a half or one day monitoring session at each of the five municipalities to facilitate finalization of the respective AWPs. At the sessions, the JICA Study Team together with the Task Force confirmed the staff (responsible persons) and budget arrangement for the implementation of the activities, and then confirmed the activities to be implemented in the fiscal year of 2005/06 (2062/63).

2.2.2 Second Monitoring Sessions (Mid-term Monitoring and Evaluation)

During the implementation of the activities in the AWPs by each of the municipalities and SWMRMC, the JICA Study Team supported the monitoring activities on the AWPs in order to strengthen the monitoring practices in the municipal system. In half of Phase 4, the JICA Study Team organized a half or one day second monitoring session at each of the five municipalities as mid-term monitoring together with the Task Force. At the sessions, the JICA Study Team together with the Task Force confirmed the progress of the activities in the AWPs by facilitating self-performance evaluation by each task force. The JICA Study Team also provided necessary suggestions and recommendations for steady implementation of the activities based on the results of the mid-term monitoring.

2.2.3 Third Monitoring Sessions (Final Monitoring and Evaluation)

During the implementation of the activities in the existing AWPs by each of the municipalities, the JICA Study Team supported the evaluation of the AWPs in order to strengthen the management practices in the municipal system. At the end of Phase 4, the JICA Study Team assisted with the organization of a one day workshop at each of the five municipalities for final evaluation by the Task Force. At the workshops, the JICA Study Team together with Task Force confirmed the progress of the activities in the AWPs by facilitating self-performance evaluation by each task force. The JICA Study Team also provided necessary suggestions and recommendations for future SWM activities based on the results of the final evaluation.

2.3 Results of First Monitoring Sessions

2.3.1 First Monitoring Sessions

The AWP of the five municipalities was monitored by organizing half day monitoring sessions. The dates of monitoring sessions at the five municipalities were as follows, while a series of discussions were held at the SWMRMC instead of the session.

Municipalities	KMC	LSMC	BKM	MTM	KRM
Date	Nov. 18, 2005	Nov. 17, 2005	Nov. 16, 2005	Nov. 16, 2005	Nov. 22, 2005

In the beginning of the sessions, objectives and highlights of the Study were presented to newly appointed Chief Executive Officer by the participants. After the brief presentation on the activities of the Study, focal persons were asked to present the status of concerned activities. Activities and sub activities of the annual work plan were reviewed and monitored by the focal persons in the session. Availability of the budget to implement the activities was also considered in the monitoring process.

2.3.2 Results of First Monitoring Sessions

In the first monitoring sessions, AWPs were thoroughly reviewed and some necessary changes of the plans were made as per the actual municipal situation such as viability of the budget and other external circumstances. Except for LSMC, the other municipalities had not obtained official approval of the Annual Municipal Budget before the beginning of the fiscal year. BKM still had to obtain approval of their annual budget. In many cases, participants of the sessions suggested that the reason for delays in implementing activities of AWPs in time was the delay of the budget approval.

The status of the activities including sub-activities (broken-down activities) of the respective AWPs can basically be categorized into the following headings:

- Completed : those activities which had been completed
- Continued: those activities which had been continued from the last fiscal year.
- Started : those activities which had been started since this fiscal year.
- Not started : those activities which are not started yet.
- Canceled: those activities which became unnecessary because of changes of situation
- Postponed: those activities which became impossible to implement this fiscal year because of the lack of budget or equipment or human resource.

The progress of the activities of the five municipalities and SWMRMC under the respective AWPs as of November 2005 is given in Supporting Report A, while noteworthy observations about the progress are listed up below:

- The commencement of scheduled activities was delayed due to delays in the budget approval process. However, except BKM, the other four municipalities had recently allocated budgets to implement the AWPs.
- Except BKM, the four other municipalities and SWMRMC had allocated enough budget to implement almost all activities in the respective AWPs. Meanwhile, the Municipal Board of BKM had approved only NRs 100,000 to implement the activities in the AWP mainly because of low percentage of the expenditure for solid waste management in the last fiscal year. BKM explained that the budget proposed by the Board could be changed at the municipal council or the general budget could be allocated in order to implement the activities in the AWP.

- KMC and LSMC had approved the budget by adopting a program based budgeting system, which had been introduced under the pilot project of the Study. Meanwhile, MTM and KRM had allocated block amount of budgets to implement SWM activities. The budgets had not been broken down into the activities in the annual budget documents.
- Newly appointed CEOs of MTM, LSMC and BKM expressed much interested in the Study.

2.4 Results of Second Monitoring Sessions

2.4.1 Second Monitoring Sessions

In the same manner as the first monitoring sessions, the second monitoring sessions were organized. Half or one day monitoring sessions at the respective municipalities were organized on the following dates, while a series of discussions was held at the SWMRMC instead of the session:

Municipalities	KMC	LSMC	BKM	MTM	KRM
Date	Feb. 24, 2006	Feb. 23, 2006	Feb.22, 2006	Feb.22, 2006	Feb.23, 2006

At the beginning of the session, the objectives of the monitoring were presented and confirmed. After a brief presentation on the objectives of monitoring, a monitoring work sheet was distributed to concerned focal persons in the respective sessions, to review the present status of activities of AWPs.

2.4.2 Results of Second Monitoring Sessions

Activities including sub-activities (broken-down activities) of the respective AWPs were reviewed by the Study Team together with each Task Force and the status of the activities was basically categorized into the same headings as the first sessions. The progress of the activities of the five municipalities and SWMRMC under the respective AWPs as of February 2006 is given in Supporting Report A, while noteworthy observations of the progress are listed below. In the tables, the progresses since the first monitoring sessions in November 2005 are marked in boldface in the columns of status and remarks. In general, the progress of some activities has been affected by the unavoidable circumstances in Nepal such as municipal elections and the other external factors.

- Approval of the SWM budgets by adopting Program Based Budgeting system made it easy and clear to implement SWM activities (KMC).
- On the other hand, BKM, MTM and KRM have approved block amounts to implement SWM activities resulting in flexibility in the implementation of SWM activities.
- Frequent changes of CEOs tended to be delay major activities of AWPs, such as procurement of heavy equipment and organization restructuring (KMC).
- Activities of Public Private Partnership (PPP) and waste minimization should be more focused (KMC).
- The budget release process has been lengthy and it is one of the demotivating factors (LSMC).

- Door to door collection has been newly introduced in Ward No. 2 and Ward No.3 starting Poush (mid December). The number of sweepers working in the above wards had been decreased (LSMC).
- Ward No. 20 and Ward No. 5 had been identified as pilot wards for mobilization of Ward Environment Conservation Committee (WECC) on a pilot basis (LSMC).
- Establishment of the SWM section was emphasized as being necessary in MTM, while the SWM unit had been established officially in KRM and is located at the store house for separated collected plastic which was developed under the Pilot Projects of the Study.
- Necessity for a solid waste collection vehicle was confirmed (MTM).
- KRM had recently called for proposals (published in Gorkhapatra) from private sector organizations with an interest in waste collection.
- A message board had been set up at Sundarighat informing the public of the site's future usage as a composting site. KRM planned to assess the feedback from the public.
- KRM had extended its home composting activities and plastic separation collection to Ward No. 2 and Ward No. 6.
- Examination of the future roles of SWMRMC had started (SWMRMC)
- As newly elected representatives had not been informed about the SWM activities, it was important to familiarize them with the AWPs as well as the A/Ps.

2.5 Results of Third Monitoring Sessions

2.5.1 Third Monitoring Sessions

The third, which were the final, monitoring sessions were organized in the same manner as the first and second monitoring sessions. Half or one day monitoring sessions at the respective municipalities were organized on the following dates, while a series of discussions was held at SWMRMC instead of the session:

Municipalities	KMC	LSMC	BKM	MTM	KRM
Date	July 9, 2006	July 6, 2006	July 7, 2006	July 4, 2006	July 3, 2006

After a brief presentation on the objectives of the monitoring, a monitoring work sheet was distributed to focal persons concerned in the respective sessions to review the present status of activities of AWPs.

2.5.2 Results of Third Monitoring Sessions

(1) Results of Third Monitoring Sessions (Final Monitoring and Evaluation)

Activities including sub-activities (broken-down activities) of the respective AWPs were reviewed by the Study Team together with each TF and the status of the activities was basically categorized into the same headings as the first and second sessions. The progress of the activities of the five municipalities and SWMRMC under the respective AWPs at the end of fiscal year of 2005/2006 (2062/63) is given in Supporting Report A, while noteworthy observations of the progress are summarized below:

- -The Study has been successful in establishing clarity on SWM approaches and strategies in the municipalities. The AWP preparation and budgeting support has had a distinct

impact on the municipal program and budget. The community development section chief of LSMC mentioned that the approval of the SWM program and budget was obtained by adopting the Program Based Budgeting (PBB) system, which made it easier and clearer to implement SWM activities.

- It seems that responsible program staff have high morale and enthusiasm to carry out the implementation of the scheduled activities but the policy level staff are not so committed.
- KRM, MTM and LSMC have achieved high levels of community participation and awareness despite the unfavorable situation whereas lower levels have been achieved in BKM and KMC.
- However, political unrest (absence of elected representatives, nomination of Mayors, election of representatives, people's movement and dissolution of the elected body) and frequent changes in CEOs have heavily affected the scheduled activities in the AWPs.
- Low commitment and confidence of higher authorities like CEOs has made it difficult to implement the PPP concept in SWM in all municipalities. The CEO of KRM mentioned that he would make this policy decision during this situation of political unrest and absence of people representatives in the municipality. However, the municipalities are moving ahead informally in working with the private sector and communities/CBO/NGOs in all municipalities.
- The changes in CEOs have delayed the implementation of improved organization structures and human resources, nevertheless, staff for the SWM section has been assigned like Tulshi Tako in MTM and Anuj Pradhan in KRM. During the monitoring session an agenda on structural adjustment has been strongly put forward and CEOs have taken it positively.

(2) Budget and Expenditure

Currently, municipalities have been spending a significant portion of their annual budget for SWM. SWM expenditure is growing annually at relatively higher rates. In the last FY 2005/2006, municipalities spent about 30% of their budget in SWM.

Table 2.5-1 Expenditure of Municipalities for Solid Waste Management

In NRs ' 000,000

Municipality	2003/04 (2060/61)			2004/05 (2061/62)			2005/06 (2062/63)		
	Total Expenditure	SWM Expenditure	%	Total Expenditure	SWM Expenditure	%	Total Expenditure	SWM Expenditure	%
KMC	579.53	57.54	9.93	649.29	114.00	17.56	550.00	210.00	38.18
LSMC	114.45	24.80	21.67	104.05	22.76	21.87	144.87	34.52	23.83
BKM	122.88	14.85	12.08	144.49	16.41	11.36	117.31	17.99	15.34
MTM	17.87	0.10	0.56	28.75	0.60	2.09	36.02	1.13	3.14
KRM	na	0.00		19.53	0.09	0.46	23.06	0.09	0.39
Total	834.73	97.29	11.66	946.11	153.86	16.83	871.26	263.73	30.27

Source: Each municipality

As for the Program Based Budget (PBB), which was formulated by the Task Force together with the AWPs, most of the proposed activities as well as the PBB have been approved by the Municipal Councils except BKM. The actual status of the PBB is summarized in Table 2.5-2.

Table 2.5-2 Status of PBB Prepared by the Task Force

In NRs ' 000,000

Municipality	2004/05 (2061/62)			2005/06 (2062/63)		
	Proposed PBB	Approved PBB	Actual Expenditure	Proposed PBB	Approved PBB	Actual Expenditure
KMC	58.69	58.00	na	32.39	32.39	na
LSMC	2.00	2.00	na	2.96	2.32	2.16
BKM	7.28	1.50	0.08	6.64	0.10	0.10
MTM	2.87	1.50	0.60	2.17	1.50	1.13
KRM	0.86	0.65	0.09	0.95	0.70	0.09
Total	71.7	63.65	0.77	45.11	37.01	3.48

Source: Each municipality

2.6 Results of Annual Work Plan of FY 2006/07 (2063/64) Development Sessions

2.6.1 Annual Work Plan Development Sessions

Each municipality was requested to prepare the AWPs for 2006/2007 (2063/2064) after the implementation and evaluation of progress of that for 2005/2006. As well as being the first fiscal year for the A/Ps, the AWPs are quite important for arranging the budget of each municipality for the fiscal year of 2006/07. In this connection, the JICA Study Team assisted by organizing a half or one day workshop at each of the five municipalities to facilitate preparation of the respective AWPs as shown below; while a series of discussions was held at SWMRMC instead of the session:

Municipalities	KMC	LSMC	BKM	MTM	KRM
Date	July 26, 2006	July 12, 2006	July 27, 2006	July 25, 2006	Aug.4, 2006

At the workshops, the JICA Study Team together with Task Force members confirmed the staff (responsible persons) and possible budget arrangements for solid waste management, and then confirmed the activities to be implemented in the fiscal year of 2006/07(2063/2064).

2.6.2 Results of Development Sessions

Activities including sub-activities (broken-down activities) of the respective AWPs of fiscal year of 2006/2007 (2063/64) were prepared by each Task Force together with the JICA Study Team through a series of the AWP development sessions. The respective AWPs developed by the Task Force are given in Supporting Report B.

The main concerns of the participants of each municipality presented in the sessions were as follows:

(1) KMC

In KMC, the SWM AWP has been prepared considering the need for various activities and development in SWM. Regular activities and their budgeted costs such as collection and transportation costs should be included in the AWP. The department and sections have to work out the programs and budget.

Construction of Balaju Transfer Station is required urgently to overcome increased transportation cost. KMC/LSMC will be able to use Valley-1 of Sisdol S/T-LF for about six months more and construction of Valley-2 should be completed before this time.

KMC is now facing difficulties of leachate treatment and solid waste compaction. An additional treatment plant and provision of one extra dozer is required immediately and provision should be made in the budget. Due to solid waste being transported from Teku to Sisdol, the expenditure on oil and maintenance has increased significantly. The budget for oil and maintenance should be increased.

PPP, which is essential as a long-term solution, in SWM and waste minimization programs is the major concern. KMC would like to pay more attention to these programs. On the other hand, the responsibility of medical waste treatment should be clarified as to whether it lies with the municipality or Ministry of Health.

(2) LSMC

The AWP has been prepared based on the development needs of existing SWM practice. LSMC is dependent on KMC for final disposal of solid waste and providing necessary support to KMC for the operation of LFS. A separate transfer station, Afadole, for LSMC is necessary, preparatory works for the transfer station are required for this fiscal year. Community participation in SWM should continue in this fiscal year. The Community Development Section (CDS) is working efficiently in SWM with community mobilization and public awareness.

(3) BKM

Although the municipality itself has prepared the A/P, more understanding among the municipal staff including peoples' representatives and stakeholders is necessary.

As LFS is one of major issues of the municipality, BKM has made a request to the SWMRMC on this issue. BKM is expecting special consideration and support on this matter from the SWMRMC and the ministry.

The progress on the last year's activities in the AWP was unsatisfactory. However, the Solid Waste Management Section has been established with the placement of staff. The implementation status of this fiscal year's activities in the AWP is expected to improve.

A need is felt to prepare a consolidated AWP covering all SWM activities, rather than limiting it to the A/P. Thus, a consensus was made to prepare the AWP by covering all SWM activities including regular SWM activities and develope the AWP accordingly.

(4) MTM

The municipality has formulated the SWM AWP as a consolidated plan by incorporating all SWM activities. In the FY 2006/07, MTM will try to solve the problems of arranging a collection vehicle. MTM has also prepared a plan to develop a temporary LFS for the short-term management of solid waste. Although it is difficult without a people's representatives, MTM has planned preparatory works for the LFS.

Regarding institutional arrangements for SWM activities, a plan is considered necessary to change the organization structure and recruit staff. Further intensive activities on waste minimization and public awareness are also felt necessary to improve current situation.

(5) KRM

Although, preparatory works on PPP were completed last fiscal year, agreement with the private sector has not been achieved yet. It should be done as soon as possible. The municipality has proposed the building of a composting facility; the investment cost should be included in the SWM budget.

Waste minimization and public awareness programs are considered to be effective tools for SWM. The municipal staff felt that the public awareness activities were effective and that it was rather easy to understand the approach and put into the AWP for the implementation.

2.7 Recommendation for Further Effective Implementation of Action Plans

Based on the results of the monitoring and evaluation, and AWP development, the following are recommended for further effective implementation of APs:

- Planned or scheduled activities in AWPs have been heavily affected by the political unrest (absence of elected representatives, nomination of Mayors, election of representatives, people's movement and dissolution of the elected body) and frequent change of CEOs. It is recommended that structure and components of the AWPs be reviewed and reformulated in the present changed context. The formulation process, representatives and TOR of the Task Force should be based on the present situation, rules and regulations.
- The internal monitoring system has not been fully established in municipalities. It may take time to entrench such organizational culture in each of the five municipalities. It is therefore recommended to introduce merit-based support linked to a mandatory planning, monitoring and reporting system. The long-term planning- annual programming - budgeting - implementing - evaluation cycle should be practiced in the municipality as a process.
- It seems that responsible staff have high morale and enthusiasm to carry out the implementation plan but policy level staff have less commitment to the activities. The Study has emphasized the influence of the structural provisions for SWM and its effective operation. However, the SWM Section/Sub section/Unit in BKM, MTM and KRM need to be more effectively operationalised. One reason is that the staff previously had different SWM roles and responsibility of the old roles dominates or marginalizes the new roles. LSMC has assigned an engineer solely to the SWM section to clarify

roles and make it more effective. It is therefore recommended to have fully dedicated staff for the SWM section/subsection/unit with clear roles, responsibility and SWM plan.

- The Study has established clarity on SWM approaches and strategies in the municipality. AWP preparation and budgeting has distinct impact on the municipal program and budget for SWM. However, daily activities, such as regular operation (maintenance) and development aspect, have not been covered in the AWP. All aspects of SWM should be covered in the AWP and the program based budget so that the institutionalization of the AWP will be stronger. Therefore it is recommended that the AWP should cover all SWM activities and be fully integrated with a program based budget.
- The SWM Action Plan should be formulated on the basis of the present reality. Periodic review of the A/P and necessary amendments are necessary in a certain interval of time. In reality, provision for periodic review and mid term review of the AP from the central government may help implementation of the A/P.

CHAPTER 3 FOLLOW-UP FOR ACTION PLAN IMPLEMENTATION

3.1 Follow-up for Collection and Transportation in BKM and MTM

3.1.1 Source Separated Collection in BKM

(1) Current Situation

The pilot project "Source Separated Collection" was launched in May 2005. So far the project has been implemented in two wards of BKM, that is, ward No. 14 (Tanani) and Ward No. 17 (Bharbacho) but not in Ward No. 15 (Itachhen), where this pilot project was also proposed. The target number of households in Tanani is 50 and 134 in Bharbacho. Two nature clubs (Tanani Prakriti Club and Tara Prakriti Club) in Tannani and another two clubs (Gyan Vijaya Prakriti Club and Ganesh Prakriti Club) in Bharbacho have been formed to motivate and accelerate the source separation activities. The households were supported by providing them with two buckets, one red and one green. The members of the nature clubs and individual households were trained about source separation methods and its importance in daily life. As instructed to the members, the green bucket is for organic waste (kitchen waste) and red bucket for inorganic waste such as papers, plastic waste, glass, metal and other indecomposable materials. Every morning, BKM workers come to the site for waste collection and collect the organic waste and inorganic waste separately. At each site, two persons come for collection, one with a tricycle and one as helper for collection and recording the information. The BKM waste collector collects the waste separately and records the numbers of buckets that have been poured into the waste in the tricycle or the waste sack.

(2) Implemented Follow-up Activity

1) Tanani Source Separation Area

There are 50 households in Tanani and all households are around the chowk (Tanani Chowk) and the waste collector goes to the chowk for collection. The tricycle cannot reach the chowk, so collectors just go with plastic sacks and collect the waste and come out with the collected waste and put into the tricycle. The waste stays there for about an hour or a little more until the collection is completed. The organic waste and inorganic waste are collected separately and a record is kept of the number of buckets that have been poured into the waste. The collector does not have to move here and there to individual households for waste collection, as the household members come to the collecting site.

A time and motion survey was carried out. Two BKM staff members with a tricycle moved from the Composting Plant BKM at about 6:00 am and reached Tanani Chowk at 6:15 am and stayed there for an hour for waste collection and left the site at about 7:15 am and reached the Composting Plant at about 7:30 am. The total time taken for waste collection from start to coming back to the Composting Plant was 1 hour and 30 minutes. As they reached the Composting Plant they recorded the weight of organic and inorganic waste and a

detailed breakdown of the weight of inorganic waste. The average time and motion of collection and transportation of waste in Tanani is presented in Supporting Report C-1.

With the start of source separation activities, data collection on organic and inorganic waste was initiated and the data collected on organic waste in different months are given in Supporting Report C-2. The average production of organic waste is 0.693 kg/day/family but that ranged from 0.330 kg (Dec.-Jan.) to 0.856 kg (Oct.-Nov.).

The inorganic waste collected in source separation in Tanani is presented in Supporting Report C-3. The average inorganic waste production was 0.414 kg/day/family but it ranged from 0.327 kg/day/family (July-August) to 0.459 kg/day/family (Oct.-Nov.).

2) Bharbacho Source Separation Area

There are 134 households in Bharbacho and collector has to go down several small streets (gally) to collect the waste. The collector takes the tricycle from one street to another and whistles to alert the household members that the waste collector is close to his/her house. The waste collector will stay about 10 minutes at each stop and whistle several times to alert the members to bring waste quickly.

The BKM staff with the tricycle move early in the morning from the composting plant at about 6:00 am and reach to Bharbacho after 15 minutes. It takes about 2 minutes to go from one stop to the next with a waiting time of 10 minutes at each stop. They collect the organic waste and inorganic waste separately and record the number of buckets that have been poured into the waste. After the collection is completed, they leave Bharbacho at about 7:25 am and reach the composting plant at about 7:40 am. The total time for collection of waste in Bharbacho is one hour and 40 minutes, 40 minutes for travel and one hour for waste collection. The average time and motion of waste collection and transportation is given in Supporting Report C-4.

With the start of source separation activities, data collection on organic and inorganic waste was initiated and the data collected on organic waste in different months are given in Supporting Report C-5. The average production of organic waste is 1.870 kg/day/family but that ranged from 1.420 kg (July-Aug.) to 3.610 kg (Dec.-Jan.) and the average inorganic production was 0.710 kg/day/family. The Bharbacho area has produced relatively higher amounts of organic and inorganic waste.

The inorganic waste collected in source separation in Bharbacho is presented in Supporting Report C-6. The table shows that average inorganic waste production was 0.413 kg/day/family but it ranged from 0.345 kg/day/family (July-August) to 0.574 kg/day/family (Oct.-Nov.).

3) Operational Cost of Source Separation

Four peon level BKM staff members are doing the waste collection and data generation work. They work from 6:00 am to 9:00 am in waste collection and separation of waste, weighing and data recording work and from 12:00 to 5:00 pm they are working in the composting

plant. The collected organic waste is kept piled up in a corner of compost plant. The compost prepared from the source separation are placed in the office for demonstration and distributed to the visitors who are interested in composting or friends and relatives who want it for demonstration. BKM has not updated the compost production record but the amount sold was obtained from the account ledger book. The annual production of compost was 213 tons in 2003/04, 155 tons in 2004/05, and 213 tons in 2005/06 as shown in Table 3.1-1

Table 3.1-1 Compost Sale in BKM Composting Plant

Month (Nepali)	Month (Gregorian)	Compost Sale								
		July16, 2005 to July 15,2006 (2062)			July16, 2004 to July 15,2005 (2061)			July16, 2003 to July 15,2004 (2060)		
		Amount (Rs)	Quantity (kg)	Quantity (kg/day)	Amount (Rs)	Quantity (kg)	Quantity (kg/day)	Amount (Rs)	Quantity (kg)	Quantity (kg/day)
Shrawan	Jul.-Aug.	0	0	0	220	1,100	37	1,200	6,000	200
Bhadra	Aug.-Sept.	1,000	4,000	133	100	500	17	500	2,500	83
Ashwin	Sept.-Oct.	7,000	28,000	933	200	1,000	33	1,445	7,225	241
Kartic	Oct.-Nov.	15,500	62,000	2,067	900	4,500	150	4,530	22,650	755
Mansir	Nov.-Dec.	8,800	35,200	1,173	7,610	38,050	1,268	3,745	18,725	624
Paush	Dec.-Jan.	5,400	21,600	720	14,765	73,825	2,461	18,405	92,025	3,068
Magh	Jan.-Feb.	10,000	40,000	1,333	1,100	5,500	183	2,700	13,500	450
Falgun	Feb.-Mar.	3,400	13,600	453	300	1,500	50	3,200	16,000	533
Chaitra	Mar.-Apr.	0	0	0	910	4,550	152	2,040	10,200	340
Baishakh	Apr.-May	400	1,600	53	2,560	12,800	427	3,400	17,000	567
Jestha	May-Jun.	1,400	5,600	187	1,670	8,350	278	1,000	5,000	167
Ashadh	Jun.-Jul.	0	0	0	700	3,500	117	500	2,500	2,500
Total		52,900	211,600	588	31,035	155,175	431	42,665	213,325	592

Source: Ledger from Account Section, BKM

Note: Quantity of compost production is estimated by back calculation, amount sale to quantity (compost sale price=Rs 0.20/kg in 2003 to 2005, Rs 0.25/kg in 2005 to 2006)

The workers sell the recyclable materials or outsiders come to the compost premises to collect whatever waste materials they like which they sell to the Kawadi.

Four staffs are involved in source separation activities and working for half day (morning shift) so we count that as two man-day of working for collection and transportation and data generation. The monthly salary for peon level staff is Rs 3,600. The operational cost for source separation is 2 persons x Rs 3,600 = Rs 7,200 and per annum cost will be Rs 86,400.

For the sustainability of source separation activities, about 4,800 kg of organic waste (160 kg organic waste/day) has to be collected and that will produce 1,440 kg compost/month (48 kg of compost per day). To meet the operational cost of source separation, more than 50 kg of compost has to be produced and about 170 kg organic waste has to be collected every day and should be properly composted for compost production.

Table 3.1-2 Estimate for Source Separation Sustainability

Estimate of Production	Months											
	1	2	3	4	5	6	7	8	9	10	11	12
Present Compost Production and Return Situation												
O. Waste Prod. in W. No. 14	300	300	400	400	400	400	400	400	400	400	400	400
O. Waste Prod. in W. No. 17	1600	1600	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Organic Waste	1900	1900	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200
Compost Production (30% of O.W)	570	570	660	570	570	660	660	660	660	660	660	660
Total Return (Rs 5/kg)	2850	2850	3300	2850	2850	3300	3300	3300	3300	3300	3300	3300
Operational Cost (Rs)	7200	7200	7200	7200	7200	7200	7200	7200	7200	7200	7200	7200
Benefit/Loss (Rs/Month)	-4350	-4350	-3900	-4350	-4350	-3900	-3900	-3900	-3900	-3900	-3900	-3900
Compost Production Estimate for 1:1 Ratio of Expenditure and Return												
Compost to be Produced for 1:1	0	0	0	0	0	0	0	0	0	0	0	0
Total Return (Rs 5/kg)	7200	7200	7200	7200	7200	7200	7200	7200	7200	7200	7200	7200
Compost Production/Month	1440	1440	1440	1440	1440	1440	1440	1440	1440	1440	1440	1440
O. Waste Needed/Month	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800	4800
Per Day O. Waste Needed	160	160	160	160	160	160	160	160	160	160	160	160

Source: JICA Study Team

(3) Perception of Beneficiaries on Source Separation

1) Sampling Size and Sample Site of Household Survey

The household survey was conducted and people that were involved in source separation activities were interviewed in the Tanani and Bharbacho areas. Seventeen households were interviewed in each ward to gauge the opinion of local people on source separation activities and as well as the performance of source separation activities. The sample households were deliberately selected for interview from those who were involved in the source separation activities.

Table 3.1-3 Sample Site and Sample Size of Households interviewed

Sample Site	Sample Size (HH)
Tanani area, Ward No. 14 in BKM	17
Bharbacho area, Ward No. 17 in BKM	17
Total	34

Source: JICA Study Team

2) Organic Waste Production Rate in the Households

Organic waste production rate, proportion of organic and inorganic waste and households' behavior in giving organic waste for collection were the main concern of the survey. The household survey has indicated that about 0.880 kg of organic wastes are produced per household and the proportion of organic and inorganic waste was 56 to 44 % (organic 56% and inorganic 44%) respectively (Table 3.1-4). The respondents indicated that about 68% of households are providing all their organic waste for collection but the rest of the households (32%) have not provided all their organic waste for collection probably because they might be saving the good organic waste and preparing their own compost. If they give

all organic waste for collection they will not be left with any composting material and, as they are all agricultural families, they need compost to manure crops. The people prefer to give inorganic waste rather than organic waste, as the inorganic waste has to be thrown out and has no economic value.

Table 3.1-4 Organic Waste Production in Households

Sample Site	Home Organic Waste Production (kg/day)			Proportion of Waste in House (%)			All Waste given for Collection (% HHs)	
	Green	Red	Total	Organ.	Inorg.	Total	Yes	No
Tanani Area (W. No. 14)	0.695	0.673	1.369	53.9	46.1	100.0	52.9	47.1
Bharbacho Area (W. No. 17)	1.071	0.866	1.938	58.3	41.7	100.0	82.4	11.8
Overall	0.883	0.770	1.653	56.2	43.8	100.0	67.6	29.4

Source: JICA Study Team

3) Segregation of Recyclable Materials and its Purpose

In the questionnaire, a set of questions was asked about recyclable materials and about the purpose of material separation. The information reported by respondents is illustrated in the Table 3.1-5. As shown in the table, 65% of the households were segregating recyclable materials to get benefits from the waste materials, which were usually thrown out. About 35% of households reported that they are using organic waste for composting, another 33% of households said that they are separating materials to keep their houses clean and tidy. In the same way, 26% of households said that they are getting some economic benefit out of the waste materials and 18% of households said they did it for a clean environment. As indicated in the table, 21% of households reported that organic materials were separated for composting, 18% reported for economic benefit and 12% said that separation was done for waste minimization and a better environment.

Table 3.1-5 Segregation of Recyclable Materials and its Purpose

Sample Site	Recyclable Materials are Segregated (%)		Benefit from Material Separation* (%)				Purpose of Segregation** (%)		
	Yes	No	1	2	3	4	1	2	3
Tanani Area (W. No. 14)	64.7	35.3	23.5	23.5	5.9	29.4	23.5	5.9	0.0
Bharbacho Area (W. No. 17)	64.7	35.3	47.1	41.2	23.5	23.5	17.6	17.6	35.3
Overall	64.7	35.3	35.3	32.4	14.7	26.5	20.6	11.8	17.6

Source: JICA Study Team

Note: *1=Compost production; 2=To keep clean Home; 3=Good Environment; and 4=economic benefit.
**1=Use for agriculture purpose (compost); 2= Economic benefit; and 3= Better environment.

4) Utilization and Use of Recyclable Materials

The recyclable materials are separated with some purpose and objective in mind. About 82% of the households are found selling recyclable materials such as old shoes, papers, bottles and metals. About 80% of households said that they are selling different kinds of papers, 62% selling bottles, 44% selling old shoes and other 32% of households said they also sell metals. The amount earned by selling recyclable materials is not high but the

removal of waste from the house is an important factor. At the same time as cleaning your house you have earned some money by throwing out materials.

Table 3.1-6 Utilization and Use of Recyclable Materials

Sample Site	Frequency of visit of Scrappers (%)				Do you sell recyclables (%)		Which matter do you sell *(%)					How much is earned from sales, monthly
	Daily	Alternate	Weekly	Others	Yes	No	1	2	3	4	5	
Tanani Area (W. No. 14)	52.9	41.2	0.0	5.9	76.5	17.6	29.4	70.6	64.7	41.2	0.0	19.2
Bharbacho Area (W. No. 17)	70.6	29.4	0.0	0.0	88.2	11.8	58.8	88.2	58.8	23.5	0.0	14.3
Overall	61.8	35.3	0.0	2.9	82.4	14.7	44.1	79.4	61.8	32.4	0.0	16.6

Source: JICA Study Team

Note: *1=Old shoes; 2=Papers; 3=Bottles; and 4=Metals.

5) Collection and Transportation of Waste

In the source separation area the wastes are collected and information is recorded daily. About 68% of households reported that waste is taken by the waste collector daily, 26% said that waste was picked up after each third day and some (6%) said alternate days and others (3%) said weekly. The information given in the table appears to indicate the household behavior rather than the frequency of the collection. Generally, people are bound to clean the room once it becomes dirty, in the same way, individuals take the waste to the collector once the bucket is full or half full and this condition may come every day, alternate day or once in a week depending on the size of the family.

About timing of pick-up of the waste, 94% households reported that the pick-up of wastes is timely and 97% of the households expressed their appreciation by saying that waste collection is going properly and effectively. The reasons given by the respondents for the effectiveness of the operation were that organic wastes were used for composting, minimization of waste helped to keep locality or area clean and tidy, and resulted in good environment.

Table 3.1-7 Collection and Transportation of Waste

Sample Site	When is your waste taken by collector? (%)				Pick-up waste timely? (%)		Is waste collection effective? (%)		Reasons for effectiveness? (%)			
	Daily	Alt. day	After 2 days	Weekly	Yes	No	Yes	No	1	2	3	4
Tanani Area	88.2	0.0	11.8	0.0	100.0	0.0	94.1	5.9	35.3	35.3	64.7	5.9
Bharbacho Area	47.1	11.8	41.2	5.9	88.2	11.8	100.0	0.0	0.0	52.9	94.1	47.1
Overall	67.6	5.9	26.5	2.9	94.1	5.9	97.1	2.9	17.6	44.1	79.4	26.5

Source: JICA Study Team

Note: *1=Organic for compost preparation; 2=Waste minimization; 3=Clean Tole/locality; and 4=Good environment.

6) Opinion on Source Separation

The main objective of source separation is to promote reuse or recycle or reduce waste. With concern to these issues, 94% of households said that source separation has helped to

clean area/locality and 26% said that they are using organic waste for composting and 9% said it has helped provide a good environment (Table 3.1-8). The entire group of respondents was in favor of continuing the program and expanding the program into other localities. The evidence shows that the program is starting to pick-up and doing better.

Table 3.1-8 Opinion on Source Separation

Sample Site	Good Point of Source Separation* (%)				You are supportive to Source Separation (%)		Opinion about Source Separation Activities**(%)			
	1	2	3	4	Yes	No	1	2	3	4
Tanani Area	41.2	88.2	5.9	0.0	100.0	0.0	100	0.0	0.0	0.0
Bharbacho Area	11.8	100.0	11.8	0.0	88.2	11.8	100	0.0	5.9	0.0
Overall	26.5	94.1	8.8	0.0	94.1	5.9	100	0.0	2.9	0.0

Source: JICA Study Team

Note: *1=Organic and Inorganic separated; 2=To keep clean Home/area; and 3=Good Environment.

**1=Continue program 2= Economic benefit; and 3= Better environment.

7) Management of Broken Glasses and Problems Faced in Source Separation

Some members of source separation program are properly managing broken glass, which is, put in a corner of a bucket after packaging in plastic bags. 62% of households are managing broken glasses by putting it in a corner of a bucket and some (24%) are mixing it other waste in buckets and some others (18%) are throwing the broken glasses outside. More than 50% of the households have no idea about the penalty for haphazardly throwing waste. 68% households did not report any problems but the beneficiaries expressed different problems such as it being a tedious job, not full time working; high whistling sound, the worker going earlier than the specified time and the collector not being properly behaved (Table 3.1-9). 47% of households did not suggest any things but others suggested that the program to be expanded and mentioned issues such as management of container; lack of space; separate bucket for broken glasses and worker going early.

Table 3.1-9 Management of Broken Glasses and Problem Faced in Source Separation

Sample Site	How You Manage Broken Glass*				Idea about Penalty		Problems in Source Separation**						Suggestion for Improvement in Source Separation***					
	1	2	3	4	Yes	No	1	2	3	4	5	NP	1	2	3	4	5	NS
Tanani Area	88.2	17.6	0.0	0.0	41.2	58.8	35.3	17.6	0.0	0.0	0.0	64.7	52.9	5.9	17.6	11.8	0.0	35.3
Bharbacho Area	35.3	17.6	47.1	0.0	52.9	47.1	0.0	0.0	0.0	11.8	23.5	70.6	5.9	0.0	0.0	5.9	29.4	58.8
Overall	61.8	17.6	23.5	0.0	47.1	52.9	17.6	8.8	0.0	5.9	11.8	67.6	29.4	2.9	8.8	8.8	14.7	47.1

Source: JICA Study Team

Note: *1=Kept separate; 2=Thrown haphazardly; and 3=Mix with other waste

**1=Tedious job 2=Not full time working; 3= High whistling sound.; 4=Go earlier than time; 5=Not properly behaved; and NP= no problems.

***1=program to be expanded; 2= management of container; 3=Lack of space; 4=Separate bucket for broken glasses; 5=Worker go early; and NP=no problems

3.1.2 Collection and Transportation Practice in MTM

(1) Current Situation

The pilot project "Practice of Waste Collection and Transportation" was launched in June 2005. The target areas for collection were determined by MTM in the core areas of the Municipality, which are currently covered by the municipal sweeping service, and Kathmandu-Bhaktapur High Areas (Arniko Highway). The collection sites in core areas were MTM Chowk, Bakahabazar, Chapacho, Hatimanakal, Duipokgari, Balkumari and Naya Thima (Shankhardhar Chowk) and in the Highway areas (only at bus stops) were Gathaghar, Kausaltar and Lokanthali. MTM hired a mini truck, which collects the waste from defined areas with the help of two loaders. The collection starts from 6:30 am and take the collection route from MTM Chowk, Bakahabazar, Chapacho, Hatimanakal, Duipokgari, Balkumari and Naya Thima (Shankhardhar Chowk) and in the Highway areas (only at bus stops) via Gathaghar, Kausaltar and Lokanthali (final collection point) with the waste directly transported to the Teku Transfer Station (T/S) in KMC. The sweepers collect waste and dirt in each collection point prior to the truck reaching the point and the loader just picks up the waste and puts it into the truck. Others neighboring also can put their waste directly on the truck when it is moving on the collection route.

(2) Implemented Follow-up Activity

1) Time and Motion of Waste Collection and Transportation Activities

Two loaders and a truck driver are doing the waste collection and transportation of waste from MTM Chowk to Lokanthali and finally to the Teku T/S in KMC. Normally, the truck reaches MTM Chowk at about 5:30 am and leaves at about 5:40 am and goes round each site staying for few minutes and finally reaches to the Teku T/S, where they weigh the waste and then they go on to their destination taking the paper slip of waste weight given by Teku T/S. This ends a day's collection and transportation. The time and motion of collection and transportation activities provided by MTM are given in Supporting Report C-7.

The time and motion of transportation was monitored starting from MTM Chowk to Teku T/S. The truck arrived MTM Chowk at 5:25 am and started its collection work with two loaders; the truck left MTM chowk at 5:35 (10 minutes collection time) and moved to Bhakhabazar then to Chapacho and via different collection sites until reaching Lokanthali (final collection point) at 6:41 am; left Lokanthali at 6:44 and reached Teku at 7:05. The truck weight was taken and unloaded within 13 minutes and truck left T/S at 7:18 am and went on to its destination. The total time taken for whole activities was one hour and 53 minutes, collection time 57 minutes, movement time 56 minutes and total distance covered was 11.5 km. The details of time and motion of collection and transportation is given in Supporting Report C-8.

2) Waste Collected and Transported to Teku T/S

The total waste record received from MTM was based on data of Teku T/S. The average monthly weight and daily weight is given in the Table 3.1-10. The monthly average weight ranged from 26,125 kg (Dec./Jan.) to 42,755 kg (Sept./Oct.), the monthly average (average of 6 month) was 32,916 kg, and the daily average of waste collected was 1,097 kg. Since the collection amount was about half of the amount expected, it was considered that there may be some problems somewhere either in sweeping, or the truck not being regular enough in timing of waste collection, or the point of waste collection not being centrally located.

Table 3.1-10 Waste Collected and Transported to T/S, Teku.

Month (Nepali)	Month (English)	Total Solid Waste Transported (kg/month)	Average Solid Waste Transported (kg/day)
Bhadra	Aug.-Sept.	34,200	1,103
Ashwin	Sept.-Oct.	42,755	1,379
Kartik	Oct.-Nov.	34,235	1,181
Mangsir	Nov.-Dec.	28,435	948
Paush	Dec.-Jan.	26,125	901
Magh	Jan.-Feb.	31,745	1,058
Total/Average		197,495	1,097

Source: MTM, records from data from Teku Transfer Station, KMC

3) Operational Cost of Collection and Transportation of Waste

The operational cost includes the salary of the two loaders (half time) and truck hiring cost. The loaders work morning shift in the collection and transportation and in the afternoon work in the office as sanitary staff. The truck is hired costing Rs 41,000/month (inclusive of driver and fuel). The operational cost for collection and transportation is Rs 44,000/month (two loaders (half time) = Rs 3,000 and truck cost Rs 41,000).

(3) Perception of People on Waste Collection and Transportation

1) Household Survey

Thirty target households (30 households) were interviewed in the core area and highway area and another 20 households were interviewed from the private collection area. The sample households were deliberately selected for interview from those whose houses are close to or near to a collection site and people of private collection sites.

Questionnaires were designed to acquire the opinion and perception of households' on waste collection and transportation. The basic features of the questionnaire were that the organization of collecting and transporting waste to the disposal site or transfer station, timing of the transporting van, service fee of collection and transportation, performance of collection and transportation, discharge manner of waste from the households (waste production per household) and problems faced in waste collection and transportation.

Table 3.1-11 Sample Size and Household Survey Sites

Sample Area	Sample Size	Sample Collection Tole/Area	Sample Size in each Site/Tole
MTM Collection Area	30	Municipality Chowk, Bahakhabazar, Chapcho, Hatimahakal, Duipokhari, Balkumari, New Thimi, Gathaghar, Kausaltar, Lukanthali	2 to 4 samples from each site
Private Collection Area	20	Lukanthali, Gathaghar, Bahakhabazar, Balkumari/New Thimi, Sano Thimi	3 to 5 samples from each site
Total	50		

Source: JICA Study Team

2) Waste Collection Timing and Performance

The survey result has shown that 74% of households have reported that collections are being done daily and rest of the households (40%) said that waste collection is done on alternate days. 83% of MTM collection people said that collections were done daily but 60% of people of private collections reported collection as daily and 40% reported it as being on alternate days. The waste collection timing and performance as responded by the beneficiaries is presented in the Table 3.1-12

With concern to the timely pick-up of the waste, 78% households reported that the van comes in time. 97% of household of MTM collection expressed a timely coming of the van for waste pick-up and 50% households of private collection said pick-up was timely. Since the private collectors are collecting waste from door-to-door, coming for collection in a timely manner is not of much concern.

As shown in the table, 80% of the MTM beneficiaries reported that they have their waste collected from the road side, 7% households said that the van comes for collection (van comes closer to house), 13% reported they have to take their waste to the van (waste taken to van) and 3% people said wastes are cleared and taken by sweeper to waste collection area.

The respondents have expressed their views saying that the private collector has given better service than MTM service but also that MTM is now performing better. 95% of the private collection beneficiaries expressed their opinion that they are satisfied with private collectors while 80% of MTM beneficiaries said that they are also satisfied with MTM service but 20% said MTM service has not improved.

Table 3.1-12 Waste Collection Timing and Performance

Sample Area	Waste Collection (%)			Vehicle come in time for Collection (%)		Where do you take waste for Collection (%)				Waste Collection Performance (%)		
	Daily	Alter.	1/W	Yes	No	Road Side	Come for Collection	Take to Van	Sweeper Pick-up	Good	Sats.	Not Improved
MTM Collection Area	83.3	16.7	0.0	96.7	3.3	80.0	6.7	13.3	3.3	30.0	50.0	20.0
Private Collection Area	60.0	40.0	0.0	50.0	50.0	10.0	70.0	20.0	0.0	20.0	75.0	5.0
Overall	74.0	26.0	0.0	78.0	22.0	50.0	32.0	16.0	2.0	26.0	60.0	14.0

Source: JICA Study Team

3) Payment Service Fee and Interest of Households in Source Separation

The information observed in the household survey regarding payment of the collection service fee and interest on source separation is presented in the Table 3.1-13. The result has indicated that 76% households were ready to pay a collection service fee and the rest of the households were not in the favor of service fee payment. Similarly, 74% households were found to be interested in source separation activities. The interested people requested logistic materials for source separation such as gloves, tools and aprons and the people who were not interested explained their reasons saying that they did not have time to work in source separation, it was dirty work and that it was a tedious job.

Table 3.1-13 Payment of Service Fee and Interest of Households in Source Separation

Sample Area	Ready to pay Service Fee for Collection? (%)		Ready for Source Separation? (%)		If interested, What things do you need?* (%)						If not willing: Reasons?** (%)				
	Yes	No	Yes	No	1	2	3	4	5	NN	1	2	3	4	5
MTM Collection Area	66.7	36.7	93.3	16.7	53.3	10.0	10.0	0.0	10.0	20.0	6.7	6.7	6.7	0.0	0.0
Private Collection Area	90.0	10.0	60.0	40.0	45.0	5.0	0.0	0.0	0.0	20.0	5.0	0.0	20.0	10.0	0.0
Overall	76.0	24.0	74.0	26.0	50.0	8.0	6.0	0.0	6.0	20.0	6.0	4.0	12.0	4.0	0.0

Note: *1=Bucket; 2=Gloves; 3=Tools; and 4=Aron; 5=others; and NN=No need (manage themselves)
**1=Not easy job 2= Dirty work; and 3= No time (busy); and 5=others
Source: JICA Study Team

4) Involvement Private Agency in Waste Collection and Collection Performance

The beneficiaries of MTM service have no idea of existence of the private collector but three private agencies were found involved in private collection. 38% of households responded that private agencies are performing better than MTM service and 56% did not responded anything about either of them (Table 3.1-14)

Table 3.1-14 Involvement of Private Agency in Waste Collection and Collection Performance

Sample Area	Is there Private Collector? (%)		Private Collector* (%)				Effective Performance between (%)		
	Yes	No	MTM	1	2	3	MTM	Private	NE
MTM Collection Area	0.0	100.0	100.0	0.0	0.0	0.0	6.7	0.0	93.3
Private Collection Area	100.0	0.0	0.0	10.0	20.0	70.0	10.0	95.0	0.0
Overall	40.0	60.0	60.0	4.0	8.0	28.0	8.0	38.0	56.0

Note: *1=Home International Clinic Service; 2=EPC; and 3=Phoolbari Environment Control Center;
Source: JICA Study Team

5) Service Fee and Waste Pick-up Time

The MTM beneficiaries are not paying anything in cash in response to MTM service but the beneficiaries of private collectors are paying Rs 100/month. As shown in the table below, with the MTM truck pick-up, the waste is cleared by 7.30 am while private collectors are not picking-up the waste till 11 am (Table 3.1-15).

Table 3.1-15 Service Fee Charge Paid by the Beneficiary and Waste Pick-up Time

Sample Area	How much pay to Private				When pick-up the waste (am time)						
	<100	100	>100	NE	6-30	7	7-30	8	10	11	NR
MTM Collection Area	0.0	0.0	0.0	100	0.0	80.0	20.0	0.0	0.0	0.0	0.0
Private Collection Area	0.0	100	0.0	0.0	10.0	5.0	15.0	50.0	15.0	5.0	0.0
Overall	0.0	40.0	0.0	60.0	4.0	50.0	18.0	20.0	6.0	2.0	0.0

Source: JICA Study Team

6) Waste Pick-up

As indicated in the table (Table 3.1-16), mostly households reported that waste pick-up is timely by both agencies (MTM and private collectors).

Table 3.1-16 Waste Production and Waste Pick-up

Sample Area	When do you take your waste to Collector? (%)			Is collection pick-up of waste timely? (%)	
	Daily	Alternate day	After Full Bucket	Yes	No
MTM Collection Area	73.3	6.7	20.0	93.3	3.3
Private Collection Area	55.0	40.0	5.0	95.0	5.0
Overall	66.0	20.0	14.0	94.0	4.0

Source: JICA Study Team

7) Separation of Recyclable Materials and Performance of Collection and Transportation

As reported by household survey, 64% of the households are not separating recyclable materials but others are separating (Table 3.1-17). 82% of the households gladly reported that waste collection activities help them to keep their locality clean and tidy and they also further expressed that they thought that the performance of collection by both MTM and private was good. The beneficiaries of the private collectors thought that their performance was better than that of MTM.

Table 3.1-17 Separation of Recyclable Materials and Performance of Collection and Transportation

Sample Area	Do you separate recyclable materials?		Good points of waste collection and transportation?*				How do you feel about their performance?		
	Yes	No	1	2	3	4	Good Perf.	Satis.	Worst than before
MTM Collection Area	43.3	56.7	80.0	13.3	0.0	6.7	73.3	23.3	0.0
Private Collection Area	25.0	75.0	85.0	0.0	5.0	10.0	100.0	0.0	0.0
Overall	36.0	64.0	82.0	8.0	2.0	8.0	84.0	14.0	0.0

Note: *1=Clean tole; 2=Good Improvement; 3=Good Environment; and 4=others

8) Problems Faced in Waste Collection and Transportation and Suggestion Given for Improvement

The households have not reported any definite problems on waste collection and transportation activities. The views are scattered depending on their individual ideas and necessities rather than being common problems. Problems mentioned by the households were: need for a collection bucket, private contractor does more dirty work, lack of awareness, area coverage is small, not coming in time for collection, van does not stay long enough for collection and no cleaning on holidays. Problems faced in waste collection and transportation and suggestions given for improvement are presented in the Table 3.1-18. In the same way, respondents suggested their views on improvements. The suggestions reported by the beneficiaries were; the collector should come with whistling, more awareness of the people in waste management, requested the cleaning of the temple area, expand collection area, request for better management, the collector should stay for little longer time and cleaning in holidays needed.

Table 3.1-18 Problems Faced in Waste Collection and Transportation and Suggestion Given for Improvement

Sample Area	Problems in Waste Collection and Transportation* (%)									Suggestion for improvement in waste collection and transportation** (%)							
	1	2	3	4	5	6	7	8	NP	1	2	3	4	5	6	7	NS
MTM Collection Area	3.3	3.3	3.3	23.3	16.7	13.3	6.7	3.3	30.0	13.3	3.3	3.3	10.0	46.7	3.3	3.3	23.3
Private Collection Area	0.0	0.0	0.0	15.0	10.0	45.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	75.0	0.0	5.0	15.0
Overall	2.0	2.0	2.0	20.0	14.0	26.0	4.0	2.0	28.0	8.0	2.0	2.0	6.0	58.0	2.0	4.0	20.0

Note: *1=No collection bucket; 2=Private collector does more dirty work; 3=Lack of awareness; and 4=Not well managed; 5=Area coverage is small; 6=Not come in time for collection; 7=Van does not stay longer for collection, 8=Holidays no cleaning and NP=No problems

**1=should come with whistling; 2= Aware the people; and 3= Clean the temple area; 4=Expand the coverage; 5=Do better management; 6=should stay for longer; 7=Cleaning in holidays needed; and NS=No suggestions.

(4) Suggestions and Further Activities

1) Source Separation Activities

- The source separation collection activities have been running well and the source separation activity has to be expanded in other core areas, which helps to educate people on the importance of source separation.
- The sustainability is the main concern of the project. The operational cost is high. The BKM collector should collect a higher quantity of organic waste, and try to produce more than 50 kg of compost per day to help sustain the project.
- BKM should strengthen the composting capacity or employ an expert for its operation and production and marketing of solid waste compost.
- BKM should maintain records of source-separated compost production and compost sales.

2) Waste Collection and Transportation

- It is the responsibility of MTM to keep the city area clean, so the municipality has to arrange a vehicle and manpower to continue collection and transportation.

- MTM has to manage manpower and other resources for sweeping and collecting the waste materials and also city waste and dumping them in a proper site.
- The collection areas have to be increased and a new collection method for the other core areas, which currently do not have a municipal transportation service, has to be considered.
- The starting time and arrival time at each of the sites has to be well fixed by MTM and strictly enforced.
- The schedule of dump truck has to be fixed as well and there should be clear instructions that the truck cannot move anywhere else before a given time. Otherwise the driver will go freely and as fast as possible to complete the round in the earliest possible time and then go for other business.
- The quantity transported by the truck should be monitored closely.

3.2 Follow-up for Waste Minimization Activities

3.2.1 Development of Waste Minimization Facility

The SWMRMC has made efforts to locate candidate sites for the waste minimization facility including Alter near Sisdol Landfill in Okharupauwa. A community group of Taudaha, Ward 15 of KRM, which is about 8.7 km south from Teku Transfer Station in KMC, made a proposal for SWMRMC and KMC to rent their site for the facility for twenty years.

SWMRMC and KMC made some field visits to the proposed site. However, not much progress has been made with further activity regarding the development of the facility.

It is unfortunate that the waste minimization facility has not been implemented. The SWMRMC and KMC should continue with efforts to solve the issues related to the site selection, as well as others, for construction of the waste minimization facility.

3.2.2 Local Level Waste Minimization Activities

(1) Operation of medium-scale Vermi-composting

1) Vemi-composting

Vermi-composting is a process of making compost with the help of special types of earthworm. Eisenia foetida is the popular earthworm used for vermi-composting in Nepal. In Nepal, vermi-composting has been tried at a household level to convert kitchen organic waste into relatively high quality compost but for large and medium-scale vermi-composting is still in an experimental stage. The main objective of vermi-composting is to prepare compost for household use to manure garden flowers or pot flowers. As manure, vermi-compost can be used for agricultural purpose. Therefore, KMC has established a medium-scale vermi-composting plant in the Teku T/S's premise and it has been in operation since March 2005; receiving vegetable waste from the vegetable market in Kalimati in order to reduce the disposal volume. The plant was designed to receive about 500 kg/day of vegetable waste from Kalimati and produce about 200 kg/day of vermi-compost.

2) Objectives

The objective of the medium-scale vermi-composting:

- Up-scaling of the vermi-composting technology
- To demonstrate use of vermi-compost
- To reduce the waste amount to be transferred to landfill site
- To disseminate vermi-compost technology to the interested persons

3) Vermi-composting Plant

A permanent vermi-composting shed was built at the Teku T/S premises. There are 20 vermi-composting beds (chambers) in the shed. The beds are 1.0 meter wide, 0.6 meter high and 3 meter long. Two beds are placed next to each other and in between each set of beds there is a passageway of about 0.6m wide for comfortable working of the beds. The beds have a layer of coconut fibers at the bottom to facilitate drainage, aeration and worm movement.

4) General composting at Vermi-composting Premises

KMC is also working with general composting, such as pile, heap, chamber and box composting in vermi-composting premises. KMC is also selling the general compost produced by general composting methods.

5) Input of Composting Materials and Compost Production

The input of composting materials, compost production (vermi-compost and general compost) and compost sale is presented in the Table 3.2-1 and 3.2-2. The total composting materials used for composting in 13 months (June-July to June-July) was 77.375 tons and in same period compost production was 6.421 tons (3.371tons vermi-compost and 3.051tons general compost) and gross return from sale of both types of compost was Rs 36,184. The average compost production was about 16 kg/day and gross return from compost sale was Rs 91.4/day. The per day production of vermi-compost and general compost and gross return from compost sale is summarized in the table on a monthly basis.

Table 3.2-1 Input for Composting and Compost Production in the Vermi-compost Plant

Year	Month		Input for Composting (kg)	Compost Production (kg)			Compost Sale (kg)			Return from Compost Sale (Rs)		
	(Nepal)	(Gregorian)		Vermi	General	Total	Vermi	General	Total	Vermi	General	Total
2005/2062	Ashaf to Shrawan	Jun.-Jul. Jul.-Aug.	(12000)*	-	-	916	55	0	55	575	0	575
	Bhadra	Aug.-Sept.	5260	327	118	445	496	0	496	4474	0	4474
	Ashwin	Sept.-Oct.	7810	299	310	609	38	1	39	466	10	476
	Kartic	Oct.-Nov.	5648	341	232	573	5	20	25	70	140	210
	Mansir	Nov.-Dec.	7450	368	87	455	30	200	230	317	1220	1537
	Paush	Dec.-Jan.	6500	295	178	473	67	45	112	764	315	1079
2006	Magh	Jan.-Feb.	16520	219	227	446	543	1179	1722	4956	7014	11970
	Falgun	Feb.-Mar.	4670	343	102	445	-	-	-	-	-	3017
	Chaitra	Mar.-Apr.	9003	134	564	698	-	-	-	-	-	6449
2063	Baisakh	Apr.-May	1850	258	510	768	-	-	-	-	-	3311
	Jestha	May-Jun.	664	121	212	333	-	-	-	-	-	2571
	Ashad	Jun.-Jul.	0	200	62	262	-	-	-	-	-	515
		Total	77375	3371	3051	6421	-	-	-	-		36184

Source: Vermi-composting Plant, Teku, KMC

* Estimated value

Table 3.2-2 Per Day Input for Composting, Compost Production and Return from Compost sale

Year	Month		Average Input for Composting (kg/d)	Average Compost Production (kg/d)			Average Return from Compost Sale (Rs/d)		
	(Nepal)	(Gregorian)		Vermi	Others	Total	Vermi	Others	Total
2005/2062	Ashaf/Shrawan	Jun.-Aug.	-	-	-	15.3	9.0	0	9.0
	Bhadra	Aug.-Sept.	169.7	10.5	3.8	14.8	144.3	0	144.3
	Ashwin	Sept.-Oct.	251.9	9.6	10.0	19.6	15.0	0.3	15.4
	Kartic	Oct.-Nov.	194.8	11.8	8.0	19.8	2.4	4.8	7.2
	Mansir	Nov.-Dec.	248.3	12.3	2.9	15.2	10.6	40.7	51.2
	Paush	Dec.-Jan.	224.1	10.2	6.1	16.3	26.3	10.9	37.2
2006	Magh	Jan.-Feb.	550.7	7.3	7.6	14.9	165.2	233.8	399.0
	Falgun	Feb.-Mar.	161.0	-	-	15.3	-	-	104.0
	Chaitra	Mar.-Apr.	290.4	-	-	22.5	-	-	208.0
2063	Baisakh	Apr.-May	59.7	-	-	25.0	-	-	106.8
	Jestha	May-Jun.	22.1	-	-	10.7	-	-	85.7
	Ashad	Jun.-Jul.	0.0	-	-	8.2	-	-	16.1
		Total	196.3	-	-	16.0	-	-	91.4

6) Operational Cost of the Plant

The average operating cost of the plant is about Rs 496/day and monthly is about Rs 15,000. The salary cost is about 96.8% of the total cost. The operational cost of plant is elucidated in Table 3.2-3

Table 3.2-3 Operation Cost of Vermi-composting Plant

Year	Month		Cost (Rs)*			Per Day Cost (Rs/d)
	(Nepal)	(English)	Salary**	Materials	Total	
2005 / 2062	Bhadra	Aug.-Sept.	17200	500	17700	571
	Ashwin	Sept.-Oct.	17200	39	17239	556
	Kartic	Oct.-Nov.	13587	25	13612	469
	Mansir	Nov.-Dec.	15200	230	15430	514
	Paush	Dec.-Jan.	15200	112	15312	528
2006	Magh	Jan.-Feb.	15200	1722	16922	564
	Falgun	Feb.-Mar.	16000	525	16525	570
	Chaitra	Mar.-Apr.	14390	740	15130	488
2063	Baisakh	Apr.-May	11398	839	12237	395
	Jestha	May-Jun.	12220	287	12507	417
	Ashad	Jun.-Jul.	12200	271	12471	390
		Average	14527	481	15008	496
			(96.8%)	(3.2%)	(100%)	

Source: Vermi-composting Plant, Teku, KMC
* Cost does not include Rs 7,020 for compost quality analysis of 10 samples by Agricultural Technology Center (ATC)
** Salaries were as follows;
Supervisor: Rs 5,000/momth, compost maker: Rs 3,600/momth

7) Support Staff

Five staff, one supervisor, two full-time compost workers and two part-time compost workers have been working in the plant. These staffs work on vermi-compost and general compost production and some research work. From May to beginning of August 2006 three staff, one supervisor, two compost makers have been working because two compost workers left at end of April. From mid-August the plant has been temporarily operated by two compost workers only under the management by CMU staff.

8) Quality of Vermi-Compost Produced in the Plant

The results of chemical analysis of the produced compost are presented in Table 3.2-4.

Table 3.2-4 Chemical Analysis of Produced Compost

Sample No.	pH	N (N %)	P (P_2O_5 %)	K (K_2O %)	Organic Matter (%)	Moisture (%)	CN Ratio
1	6.7	2.88	1.20	3.60	26.22	61.81	5
2	7.0	2.79	1.20	3.51	22.80	59.62	5
3	6.6	2.45	1.19	2.20	21.28	63.85	5
4	8.8	2.31	1.18	2.20	15.98	68.45	4

Source: Vermi-composting Plant, Teku, KMC

9) Evaluation and Recommendation

Medium-scale vermi-composting of vegetable market waste is technically and financially feasible because the plant is operated without basic problems. However the following are recommended for ensuring the sustainability of the plant operation:

1) Supplies of vegetable market waste to the plant by KMC should be secured.
2) The plant should be operated in a suitable manner as described in operation manual.
3) The working environment conditions should be improved, especially for rainy season.
4) Labor conditions also should be improved, for example salary of staff/workers should depend on amount of compost produced to increase motivation and working wear should be supplied.
5) Marketing of vermi-compost should be done effectively with attractive brand, product launch, and promotional activities.
6) Improvement of compost quality should be studied, for example using cow-dung as raw material.
7) Considering above-mentioned matters, it is recommended that the vermi-composting plant should be managed by a suitable NGO or private agency.
8) The plant can be also set-up as a training institute for vermi-composting technology under KMC or any private agency.

(2) Operation of Community Recycle Center

1) Outline of Community Recycling Center

A Community Recycling Center (CRC) is run by KMC at Lagan, Ward 21. Staff is employed for the collection of recyclable materials. There is a booth (a small house) made of zinc sheet and the booth is labeled with "Community Recycling Center". The main work of this center is to buy and store recyclable materials. The recyclable materials come mainly from Lagan, Brahma Tole and Gophal. The collection time is in the morning from 6 am to 9 am and in the evening 1 pm to 6 pm but people generally come on Saturday. The main recyclable materials are different types of papers, glass bottles, plastic and metals. The Center is also selling flower, flower cuts, compost (vermi-compost and general compost). It has one rented room for collection of the recyclable materials. The materials are accumulated in the room until they amount to a mobile truckload.

2) Recyclable Materials Purchased Amount and Quantity

The quantities of different types of recyclable materials purchased from the collectors in the CRC are given in the Table 3.2-5 and Table 3.2-6. The amount of recyclable materials purchased by the CRC is very low; on average the amount comes to less than Rs 750/month. If the materials were sold to dealers with 25% profit, the total amount would be about Rs 187.0. The CRC is also dealing with other business as flower plants sale, mineral water and compost sale so as to sustain the business.

Table 3.2-5 Recyclable Materials Purchased by the CRC in Different Months

Month		Recyclable Materials Collected and Sold in the CRC								
		Plastic		Papers		Metals		Bottles		Total
(Nepal)	(English)	Quantity (kg)	Amount (Rs)	Quantity (kg)	Amount (Rs)	Quantity (kg)	Amount (Rs)	Quantity (No.)	Amount (Rs)	Amount (Rs)
Ashadh	Jun.-Jul.	49.5	405.0	87.1	337.0	10.5	168.0	75.0	75.0	985.0
Shrawan	Jul.-Aug.	46.7	280.0	28.0	95.0	10.3	155.0	44.0	110.0	640.0
Bhadra	Aug.-Sept.	30.7	313.0	114.2	352.0	41.0	294.0	82.0	200.0	1159.0
Ashwin	Sept.-Oct.	34.7	279.0	80.5	204.0			129.0	244.0	727.0
Kartic	Oct.-Nov.	34.8	411.0	30.2	121.0	6.5	64.0	62.0	159.0	755.0
Mansir	Nov.-Dec.	43.0	368.0	25.6	66.0	20.0	169.0	27.0	50.0	653.0
Paush	Dec.-Jan.	51.3	461.0	4.0	13.0	2.6	32.0	50.0	85.0	591.0
Magh	Jan.-Feb.	24.2	326.0	0.5	5.0	2.5	21.0	11.0	22.0	374.0
Total		314.9	2843.0	370.1	1193.0	93.4	903.0	480.0	945.0	5884.0

Source: KMC/CMU

Table 3.2-6 Other Sales to Sustain the CRC

Month		Alternate Enterprises Selling of Compost, Flower Plants etc						
		Mineral Water		Compost		Flower Plants		Total
(Nepal)	(English)	Quantity (No.)	Amount (Rs)	Quantity (kg)	Amount (Rs)	Quantity (No.)	Amount (Rs)	Amount (Rs)
Ashadh	Jun.-Jul.			13.0	130.0			130.0
Shrawan	Jul.-Aug.	16.0	240.0	38.0	440.0			680.0
Bhadra	Aug.-Sept.	22.0	330.0	21.0	238.0			568.0
Ashwin	Sept.-Oct.	7.0	105.0	33.0	390.0	76.0	660.0	1155.0
Kartic	Oct.-Nov.	9.0	135.0	54.0	535.0	68.0	890.0	1560.0
Mansir	Nov.-Dec.	1.0	15.0	16.0	160.0	19.0	540.0	715.0
Paush	Dec.-Jan.			39.0	390.0	28.0	913.0	1303.0
Magh	Jan.-Feb.	3.0	45.0	21.0	240.0	9.0	265.0	550.0
Total		58.0	870.0	235.0	2523.0	200.0	3268.0	6661.0

Source: KMC/CMU

3) Operational Cost

Kawadi of Teku financially supports the CRC. When the amount of recyclable materials is a truckload, they are transported to Teku. This CRC can be taken as a depot of the Kawadi Dealer, Teku. This Kawadi Dealer pays the salary of the staff. The salary paid by the dealer is Rs 3,400/month.

Operation cost of the CRC in 2062/2063 was Rs156,000 in total, Rs104,000 from KMC, Rs 46,000 from the local Youth Corner Club (YCC), a NGO, and Rs 6,000 from the local community.

4) Perception of Local People on the Community Recycling Center

As expressed by the local people, people are selling recyclable materials to the CRC and earning some money out of waste materials as well as helping to reduce pollution and

haphazard dumping of waste materials. This CRC has reduced pollution caused by plastics. By providing raw materials to the recycling plants, the waste materials have been turned into a moneymaker rather than producing pollution.

During discussions, the local people did not express any objection about the CRC being in their locality. There were no bad reports about the CRC and they further added that the CRC has not created pollution in the locality but it has provided a service for the collection of recyclable materials, selling flowers and compost, and the staff is guiding the local people on how to plant and manure flower plants.

5) Problems at the CRC

There is no problem running the CRC but it is not able to collect sufficient recyclable materials. The main problems in the collection of recyclable materials are given below:

- The quantity of recyclable materials produced in the households is very limited and low quantity;
- The level of collection of recyclable materials is very low so amount received is also very low;
- People think it is dirty work as well as not high paying work so hesitate to do the collection;
- Individuals have to carry the waste materials from their house to the CRC to sell them for recycling and they find this transportation a problem.

6) Evaluation and Recommendation

The CRC established in Lagan in Ward 21 of KMC is one of the successful Pilot Projects under the CKV study, because the CRC is very convenient for recycling of waste for the public and very popular. Specifically, the local people are happy that recyclable materials can be sold to the CRC so they can earn some money out of their waste materials. The CRC is doing other business such as selling flowers, compost and mineral water and further looking for alternatives for sustainability. However the following are recommended for sustainable CRC operation:

1) A catch phrase on recycling of waste such as “Recycling solves the waste issue and changes trash to cash.” should be shown on the CRC booth.
2) The purchase price list for recyclable waste including household made compost should be indicated on the CRC booth and distributed with above-mentioned catch phrase.
3) Opening hours also should be indicated on the CRC booth.
4) It is desirable to provide phone and newspaper services at the CRC in the future.
5) The CRC should not only be a recycling center, but also an information center on solid waste management at the community level.

6) For the sustainability of the CRC, the scope of work of the CRC has to be expanded in addition to collecting recyclable materials.
7) KMC should arrange some funds to support the recycling center, because all activities cannot be judged in economic profitability. Reduction of waste at the source and reuse the materials is itself a great activity to reduce pollution.
8) CRCs should be established at other wards based on experience of this CRC.

(3) Plastic Separation Activities

1) Plastic Separation Activities

A pilot project "Plastic Separation Activity" was started in October 2004 in some of the wards of KRM. For the implementation of program, three wards of KRM were selected and the program was launched. The selected wards were: wards no. 1, 5 and 14 and groups were formed in all wards. The numbers of club members and distribution of Suiro in each ward are given in the Table 3.2-7. First of all, the youth groups and women were trained on "3R Concepts (Recycle, Reuse and Reduce)" and "Plastic Collection by using Suiro". The program has targeted at different types of areas as; the core area (ward no. 1), semi-market area (ward no. 5) and rural area (ward no. 14) and the program has involved youth groups and women. The program was initiated with the view to reduce plastic pollution or reduce plastic materials in the total waste and convert the waste into a moneymaker.

Table 3.2-7 Distribution of Members in the Groups and Suiro Distribution

Name of Group	Ward	Total Members in the ward	Suiro Distribution (Nos.)	Remarks
Thambahal Misa Puchaa	No. 1	60	60	
Community Youth Club	No. 5	40	50	
Yuba Jankalyan Youth Club	No. 14	35	75	
Shansriti Jagaran Samuh	No. 7	29	70	Newly formed
Total	-	164	255	

2) Plastic Collection and Sale

Local women's group members separate plastic from waste in each house and these are collected by youth groups. Then KRM collect the plastic from the groups and store it in the store; the "Plastic Collection Center". The first time KRM sold collected plastic was in March and June 2005, and the second time was in February 2006, which was plastic collected in July, August and September 2005. The total quantity sold the first time was 81 kg, which amounted to Rs 745, and second time it was 171 kg, which gave Rs 1,529 (Table 3.2-8). The plastic is collected by KRM's vehicle going to each group and Plastic Collection Center before being finally sold to the scrap dealers (Kawadi). The whole management as plastic separation, two-way contact with scrap dealer and groups is done by KRM and KRM is providing vehicle for plastic collection.

Unit sales prices of recovered plastic are Rs 5/kg for polythene bag, Rs 6/kg for general plastic bag and Rs 14/kg for milk pack. The sales amount (money) from Kawadi finally returns to the local women's group's fund.

Table 3.2-8 Amount of Plastic Collected and Sold to Scrap Dealers

Collection Times	Month	Plastic Sale	Plastic Sold	
			Quantity (kg)	Amount (Rs)
1st	Mar-05	1st	81	745
2nd	Jun-05			
3rd	Jul-05	2nd	171	1529
4th	Aug-05			
5th	Nov-05			
Total		-	252	2,274

Source: KRM

3) Staff and Operational Cost

The cost incurred for the plastic separation activities and social mobilization and amount spent during plastic transportation to the loaders is given in the Table 3.2-9 and Table 3.2-10. In total, four motivators were involved in the program- one as central motivator and three as local motivators who were responsible for the whole plastic separation activity. The total cost for six month was Rs 23,600 (Rs 18,000 for salary and Rs 5,600 for miscellaneous cost).

Table 3.2-9 Staff Cost for Project Period for Plastic Separation

Staff	Staff No.	Duration (Month)	Salary (Rs/Month)	Salary Amount (Rs)
Central Motivator	1	6	1,500	9,000
Local Motivator	3	6	500	9,000
Total				18,000

Source: KRM

Table 3.2-10 Other Cost for Program Operation

Staff	No. /Times	Item Cost (Rs/Items)	Cost (Rs)
Cost of snacks	3	100	300
Balance	1	300	300
Suiro (Iron Rod)	400	8	3,200
Snack	80	20	1,600
Others	LS		200
Total			5,600

Source: KRM

4) Problems Faced in Plastic Separation Activities

The following are the problems faced in the plastic separation activities. The main problems are that the quantity of plastic collected was not large and it takes long time to sell after collection.

- The quantity of plastic collected from the households was very low and consequently received amount from the sales of those was also very low;
- People thought it was a dirty work as well as not high paying work so hesitated to do the job;
- Individuals had to carry the waste materials from their house to the club for collection;
- There was a long time between collection and the sale of plastic;
- The collection of plastics from the groups was not regular due to the lack of a vehicle;
- Mixed collection of recyclable and non-recyclable plastic.

5) Evaluation and Recommendation

Plastic separation activities have been conducted continuously with motivated people doing source separation and earning some money out of waste materials. The total amount of plastic collected and sold to the scrap dealer was 252 kg and the amount received was Rs 2,274 for six months. Through the sales of collected plastic, women's groups or youth groups could reap the benefits for their grass roots activities and continuous implementation of plastic separation activities could lead to improve their local activities such as public awareness on the sanitation and environment.

However, the total operational cost for six months of Rs 23,600 was higher than the sales amount. In order to make the activities more self-sustaining ones, the activities should be conducted more effectively. For this, KRM should support to improve quantity of plastic collected from the households such as through further training of motivators and awareness promotion to the residents and to arrange effective collection system which may be done together the routine waste collection service.

(4) Home Composting Activities

1) Sample Site and Size for Monitoring Bin User Households

In total, 1,320 Home Compost Bins (HCB) were procured for distribution to KMC (500 bins), LSMC (700 bins) and KRM (120 bins), of which 1,300 bins were distributed. SOUP, WEPCO, CDS/LSMC and KRM were the main agencies involved in home composting training, bin distribution and monitoring activities of home composting. The sample sites and size is presented in the Table 3.2-11.

Table 3.2-11 Sample Site and Sample Size for Compost Sample Collection from HCBs

(Unit: number)

No.	Sample Site		Ward Nos.	Total No. of HCB		Sample Size of June 2005	No. Samples Taken
				Provided	Distributed		
1	KMC	SOUP	21	500	499	27	7
2	LSMC	WEPCO	1, 2	200	200	66	20
		CDS	5, 7, 8, 20	300	287		
		SOUP	11, 12, 18	200	200		
		Sub-total		700	700	66	20
3	KRM		1, 5 and 14	120	111	7	3
	Total			1,320	1,297	100	30

Source: JICA Study Team

As above mentioned, in total, 30 households were interviewed during January to March 2006, 7 in KMC, 20 in LSMC and 3 in KRM. A semi-structured questionnaire was designed and each household or HCB user interviewed to get information on the present use situation of distributed HCBs, composting performance of HCBs, attitude of households on HCBs, purpose of composting, continuity of home compost production, problems with HCBs (structure) in home composting, problems with HCBs for composting and suggestions to improve the present situation for better home composting.

2) Waste Amount in Home Compost Bins

The households put home organic waste (kitchen waste) into bins to produce compost. Based on information obtained from the HCB users, 53% of the bins were at full capacity (one-fourth of bin's volume) and 47% of bins were found half full. This showed that everyone was actively working at home composting. Compost preparation is a continuous process of filling the bins and removing compost from lower compartment (bin door). Therefore bins should always be filled to more than half their volume but not full. The amount of waste in HCBs during the survey is presented in Table 3.2-12.

Table 3.2-12 Amount of Waste for Composting in HCB

(Unit: %)

	Waste Amount in Bin			Size of Waste (cut size)			Waste Balance	
	Few	Half	Full	Small	Medium	Large	Good	No good
KMC Average	0.0	14.3	85.7	28.6	71.4	0.0	85.7	14.3
LSMC Average	0.0	60.0	40.0	25.0	65.0	10.0	80.0	20.0
KRM Average	0.0	33.3	66.7	33.3	66.7	0.0	100.0	0.0
Overall Average	0.0	46.7	53.3	26.7	66.7	6.7	83.3	16.7

Source: Household Survey

3) Piece Size of Waste Materials in HCB for Composting

The larger the surface area of composting materials may lead to the greater the contact of organisms with composting materials, and the better the decomposition in shorter duration. It was instructed to the trainees during training that the waste materials should be cut into

pieces (1 to 2 inches) before putting them into the HCB to result in better decomposition. The result of survey about piece size of materials in HCBs is presented in Table 3.2-12. The table shows that in 66.7% of bins it was found that the waste was not well enough chopped, in 26.7% the waste was well chopped, and in 6.7% chopping was neglected or large pieces were kept in bins.

4) Waste Balance of Green and Brown Waste Materials in HCBs

Waste with a narrow range of C: N ratio decays rapidly and yields more humus than do tissues with a smaller amount of nitrogen. The proportion of green and brown waste materials plays great role in decomposition and finally the quality of compost. As indicated in Table 3.2-12, 83.3% of bins were found to have a good combination of green and brown waste material and in the rest of the bins (16.7%) there had been negligence in putting waste materials in the proper proportion.

5) Air Flow or Air Circulation in HCBs

The decomposition process can be accomplished with aerobic decomposition (decomposition in the presence of oxygen) and anaerobic decomposition (decomposition in the absence of oxygen). Organic material decomposition is an oxidation process associated with microbial activities. Aerobic decomposition is the most beneficial for processing of organic waste for quality compost production while anaerobic decomposition leads to nutrient losses and produces bad odors and leachate problems. The anaerobic process is induced by lack of airflow or lack of air circulation inside the biomass, which is caused by high moisture content. As reported by bin users, 93.3% of households responded that bins are managed so they are well aerated but sometimes it is suspected that they are more aerated than necessary (Table 3.2-13).

Table 3.2-13 Air Flow or Air Circulation in HCB

(Unit: %)

	Air Flow		Temperature			Moisture		
	Good	Not Good	High	Suitable	Low	Moist	Suitable	Dry
KMC Average	100.0	0.0	0.0	100.0	0.0	0.0	85.7	14.3
LSMC Average	90.0	10.0	0.0	100.0	0.0	5.0	75.0	20.0
KRM Average	100.0	0.0	0.0	100.0	0.0	0.0	100.0	0.0
Overall Average	93.3	6.7	0.0	100.0	0.0	3.3	80.0	16.7

Source: Household Survey

6) Temperature of Biomass in the HCB

As indicated in the above (Table 3.2-13), all the bin users (100% households) has placed and managed the bins so that all bins have suitable temperatures, neither too warm nor cold temperature. The temperature inside the biomass indicates that there a suitable decomposition environment. The atmospheric temperature might play some role in temperature equilibrium but the temperature in the biomass is produced by an oxidation process or microorganism action.

7) Moisture Content of Biomass in the HCB

Low and high moisture content of the biomass reduces the microbial activities and at saturation condition induces anaerobic decomposition. Thus, 35 to 60% moisture content of biomass is appropriate for organic decomposition. During monitoring the bins, 80% of the bins were found to have suitable moisture content, a few bins (16.7%) with dry conditions and 3.3% bins having high moisture or leachate problems. The high moisture or leachate problems occurred when the bins were placed in the ground floor where there was no light transmission and the bulk of the biomass was stored without first being partially dried (Table 3.2-13).

8) Organic Home Waste Production

The HCB program was initiated for minimization of solid waste produced from households and for the productive purpose of making compost. The monitoring result showed that less than one (1) kg (0.790 kg/day) was produced from households and used in home composting. It is also observed that 53.3% of households produce less than one (1) kg organic waste and about 16.7% households produce more than one and half kilogram of organic waste. Most of the households were found to be using kitchen waste for composting and very few of them were using farm waste for composting. The amount of home waste production in monitored households is presented in Table 3.2-14.

Table 3.2-14 Organic Waste Production and Inoculums Used for Biomass Decomposition

(Unit: %)

	Home Waste Produced by Households/Day (kg)					HHs Using Inoculums		Types of Inoculums Used by HHs					
	Amt. (kg)	<0.5	0.5	1.0	>1.5	Yes	No	EM	Bokasi	T. Soil	Comp.	Ash	NU
KMC Average	0.59	42.9	28.6	14.3	14.3	100	0.0	0.0	0.0	0.0	85.7	28.6	0.0
LSMC Average	0.89	5.0	40.0	35.0	20.0	60.0	40.0	5.0	0.0	5.0	50.0	0.0	40.0
KRM Average	0.67	0.0	66.7	33.3	0.0	0.0	100	0.0	0.0	0.0	0.0	0.0	100
Overall Average	0.79	13.3	40.0	30.0	16.7	63.3	36.7	3.3	0.0	3.3	53.3	6.7	36.7

Source: Household Survey, May 2006

9) Use of Inoculums for Home Composting

In total 63.3% households were found to be using inoculums and rest of the households has not used any inoculums. The different types of inoculums used by the households were EM (Effective Microorganisms), Bokasi (made from EM), topsoil (surface soil), compost (old compost) and ash. Out of the inoculums users, about 53.3% of households were found to be using compost, some has use ash (6.7%), some top-soil (3.3%) and EM (3.3%). Ash itself is not an inoculum but it helps to create a congenial environment for microbes. The households using inoculums for home composting and types of inoculums used by households is given in Table 3.2-14.

10) Time Taken for Home Compost Preparation and Compost Quality

a. Duration for Home Compost Preparation

Compost production is the decomposition of biomass, which requires certain bio-environment conditions for better and quicker decomposition. As the first experience of compost production in Home Compost Bins many things are not rightly known. The Bin users were asked about their experiences on composting time in HCBs, quality of compost produced in HCBs, purpose of making compost and their attitudes towards HCBs. 66.7% of households responded that the compost preparation takes about 2.5 months, 13.3% reported compost was prepared in 3 months, 20% said compost was prepared in 2 months and about none households reported more than 3.5 months (Table 3.2-15).

Table 3.2-15 Time Taken for Home Compost Production and Compost Quality

(Unit:%)

	Duration for Compost Preparation Months				Happiness of HHs with HCB Use			Quality of Produced Compost			Purpose of Compost Making			
	<2.0	2.5	3	3.5	Happy	NH	FD	Good	Average	NI	Home Garden	Agri. Use	Income Gener.	Envir. & Pollution
KMC Average	0.0	100.0	0.0	0.0	100.0	0.0	0.0	71.4	28.6	0.0	71.4	0.0	14.3	85.7
LSMC Average	30.0	50.0	20.0	0.0	100.0	0.0	0.0	40.0	60.0	0.0	90.0	5.0	5.0	30.0
KRM Average	0.0	100.0	0.0	0.0	100.0	0.0	0.0	66.7	33.3	0.0	100.0	100.0	0.0	100.0
Overall Average	20.0	66.7	13.3	0.0	100.0	0.0	0.0	50.0	50.0	0.0	86.7	13.3	6.7	50.0

Source: Household Survey, May 2006

Note: NH = Not happy, FD = Family disagree ness, NI = No idea, NG = Not good.

b. Attitude of HCB Users' towards HCBs

The attitude of households towards HCBs is presented in Table 3.2-15. Almost all users (100%) have expressed their satisfaction about having the HCB for compost preparation. The two main reasons were that firstly; one of the family members previously had a regular duty to take home waste daily to the waste container for disposal, which is no longer required, and secondly; they are now preparing compost and using it for productive purposes, either for garden or agriculture purposes.

c. Quality of Compost Produced in HCBs

The impression of HCB users about the compost quality produced in HCBs is gathered and presented in Table 3.2-15. The result has indicated that 50% of households considered that the produced compost is of good quality and 50% of households considered the compost to be of average quality.

d. Purpose of Home Compost Production

A question was inserted in the questionnaire to find out the purpose of home composting. The response of households to this question is presented in the Table 3.2-15. About 87% of households answered that question saying that home composting is done to manure the garden (manure for flowers either in garden or pot), 50% said to reduce home pollution or

improve the environment, 13% expressed that they are using it in farming (manure for crops) and about 6.7% of households suggested it could be an income generating activity.

11) Home Composting Training

a. Home Composting Training

The result of the survey on home composting training is presented in Table 3.2-16. The survey result indicated that all households have been trained in home composting. Each household has used the HCB for composting and making best use of it.

Table 3.2-16 Home Compost Training

(Unit: %)

	Attaining Compost Training in HCB		Received HCB Manual		Reading HCB Manual		If can not read manual Who helps to Explain about HCB Manual					
	Yes	No	Yes	No	Yes	No	Son	Daug.	Husb	G.Dau	Friend	DIL
KMC Average	100.0	0.0	85.7	14.3	85.7	14.3	0.0	0.0	0.0	14.3	0.0	0.0
LSMC Average	100.0	0.0	100.0	0.0	80.0	20.0	0.0	15.0	0.0	0.0	0.0	5.0
KRM Average	100.0	0.0	100.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Overall Average	100.0	0.0	96.7	3.3	83.3	16.7	0.0	10.0	0.0	3.3	0.0	3.3

Source: Household Survey, May 2006

Note: DIL = Daughter in-law

b. HCB Manual

The Table 3.2-16 shows that 97% of trainees have received the manual "How to Use Home Compost Bin" during training.

The training manual consists of self-explanatory figures and common and simple words are used to make it easy to understand. The training manual was distributed to all trainees during training. One of the aims of the survey was to find out what percentage of the trainees could read and understand the manual. As indicated by the survey, 83.3% of the participants could read the manuals themselves and 16.7% of them (illiterate) had to take the help from others to understand the contents of manual (Table 3.2-16). Daughter (10%), grand daughter (3.3%), and daughter in-law (3.3%) were the main helpers to educate about manual.

12) Problems Encountered in Home Compost Production

a. Problems Faced in HCB (Bin structure)

The main problems faced with the bins are presented in Table 3.2-17. About 66.7% of bin users did not have any problems with the bins or bin structure (manufacture design) but the rest of users (33.3%) listed some problems in bin design. Seventeen (17) percent of users complained about insect problems, 19% of users argued that there were too many holes in the bin, and others pointed out problems of the long time for compost preparation, bad smell and weak tools.

Table 3.2-17 Problems Encountered in Home Composting

(Unit: %)

	Problems of Bin for Composting*						Problems to Prepare Compost in HCB**					
	1	2	3	4	5	NP	1	2	3	4	5	NP
KMC Average	42.9	14.3	28.6	14.3	0.0	14.3	28.6	28.6	14.3	0.0	0.0	28.6
LSMC Average	5.0	0.0	0.0	0.0	0.0	95.0	0.0	5.0	0.0	0.0	0.0	95.0
KRM Average	33.3	0.0	33.3	0.0	33.3	0.0	0.0	66.7	33.3	0.0	0.0	100.0
Overall Average	16.7	3.3	10.0	3.3	3.3	66.7	6.7	16.7	6.7	0.0	0.0	80.0

Source: Household Survey, January 2006

Note:*. Problems in HCBs are: 1.Insect, 2. Longtime for compost preparation; 3. Many holes in bin; 4. Bad smell; 5. Weak tools with bin and NP = No Problems

**. Problems in composting in HCBs are: 1. Waste could not be cut due to being busy, 2. Insects, 3. Drying problems, NP=.No problems

b. Problems Encountered in Compost Preparation in HCBs

The bin users raised a number of problems such as the waste could not be cut due to being busy, insect and drying problems (Table 3.2-17). As presented in the table, 80% of users advise that they did not have any problems in preparing compost in the HCB and the rest of users reported a range of problems. 16.7% of users complained about insect problems near the bin and sometimes around the house, 6.7% as insect and bin drying problems.

13) General Comments and Suggestion given by HCB Users

a. General Comments on HCB

Bin users have no big single comment on HCBs. 80% of users did not report any comments and are satisfied with the present design of bins and few users (10%) said that bins are of good looking, (3.3%) said compost is good for manure of flowers and others said that there were too many holes in the bin which caused drying of waste. The general comments and suggestion informed by bin users is presented in Table 3.2-18.

Table 3.2-18 General Comments and Suggestions given by HCB Users

(Unit: %)

	General Comments on HC*						Suggestions on HCB**					
	1	2	3	4	5	NC	1	2	3	4	5	NS
KMC Average	42.9	14.3	0.0	0.0	0.0	57.1	57.1	14.3	0.0	0.0	0.0	28.6
LSMC Average	0.0	0.0	5.0	0.0	0.0	90.0	0.0	0.0	0.0	5.0	0.0	95.0
KRM Average	0.0	0.0	0.0	0.0	0.0	66.7	33.3	0.0	33.3	0.0	0.0	33.3
Overall Average	10.0	3.3	3.3	0.0	0.0	80.0	16.7	3.3	3.3	3.3	0.0	73.3

Source: Household Survey, January 2006.

Note: *. Comments are: 1. Good looking, 2. Manure in flowers; 3. Many holes in bin causing drying and NC = no comments.

**. Suggestions are: 1. Expand program, 2. Information on technology to others, 3. Larger bin needed, 4. Holes to be reduced, and NS = No comments

b. General Suggestion on HCB

Suggestions by the users are presented in the Table 3.2-18. 73.3% of the users did not suggest anything; they are satisfied with present conditions but 16.7% of users strongly suggested that the distribution of bins should be further expanded and made available to others who are interested in home composting and others suggested that the composting technology be disseminated to other areas, larger bins should be distributed and hole numbers in the bins should be reduced.

14) Waste Reduction Effect from HCBs

After the Study each municipality has been continuing home composting activities under their own budget. The number of households using HCBs is estimated to be approximately 3,120 households in total in the five municipalities as shown in Table 3.2-19. Approximately 1.6% of households are making compost from organic waste, and it is estimated that discharged waste is reduced by approximately 1.1%.

Table 3.2-19 Number of HCBs being Used in Five Municipalities (March 2006)

Municipality	KMC	LSMC	BKM*[1]	MTM*[2]	KRM	Total
No. of Households using HCB (A)	2,000	800	10	150	120	3,08
No. of Households in total (B)	132,000	32,000	14,000	10,000	8,000	196,000
Composting Household Ratio (A/B %)	1.5%	2.5%	0.1%	1.5%	1.5%	1.6%
Type of HCB	CKV/JICA KMC/CMU DED NGO/SOUP	CKV/JICA LSMC/CDS NGO/WEPCO	BKM	CKV/JICA GTZ	CKV/JICA KRM	

Source: Each municipality's information, August 2006.

*[1] LSMC have 50 units of HCB in the CDS's space as of August 2006.

*[1] BKM have 80 units of HCB in the storehouse in the municipality's garage as of August 2006

15) Evaluation and Recommendation

The HCB program has been conducted effectively and it can be considered that the HCBs have a potential to play a great role in waste minimization at the source and supplement to fertilizer and curtail expenses in fertilizer. The HCB program is recommended to be expanded massively because certain amount of waste can be reduced from discharging to the waste collection stream and also the quality of compost produced in HCBs is found to be better for manure garden flowers or pot flowers chemically and physically.

Not much improvement is needed in the design and structure, but some improvements are suggested about problems that have to be rectified such as a stronger bin door (it is weak and rats enter the bin and edge of door has to be rounded), better fitting of the compartmental iron frame (weak and not adjusted well in its position) and nominal hole numbers in bins (many holes which result in loss energy in heat). Handles should be attached to bin so that it can be moved when needed.

For sustaining and expanding home composting, the following are recommended:

- Municipality should subsidize HCBs as appropriate as possible so that residents can acquire one easily in cheaper price, but should also motivate composting operation by sharing a certain amount of bin cost.
- Periodical monitoring and advice should be done by employing motivators. Trouble shooting for composting operation should also be done quickly and surely.
- HCBs and the operation manual should be improved according to operational experiences.
- Municipality should arrange places/opportunities, like the CRC, for those who want to sell the compost product for earning money.
- Considering the present situation that some compost products are being sold at markets/shops, the sales market of the compost products is expected to be secured. Since the result of the market survey conducted in the Study revealed that there is a potential for use of compost by farmers in and around the valley, Municipality should also monitor and encourage the sales market of the compost products continuously.
- Effectiveness of the home compost product in crop growth should be studied continuously and demonstrated to bin users.
- Information on not only home composting but also other waste minimization activities should be shared through CoMoN meeting periodically.

3.3 Follow-up for Solid Waste Data Management

3.3.1 Current Situation

A Database Management System (DBMS) for the solid waste management activity, which was developed and installed in the previous phase of the Study, has now been put in operation at all the five municipalities.

At the beginning of this follow-up exercise, the present status of utilization of the DBMS was monitored through the meetings and interviews. The summarized status is shown in Table 3.3-1.

Table 3.3-1 Status of DBMS at the Five Municipalities

Municipality	Status
KMC	・ KMC is using DBMS developed under the Study. ・ However, besides DBMS, other systems at Teku transfer station and Sisdol Landfill are also used in addition to the existing system that used to be used. This situation adds some confusion to the SWM section. ・ Lack of skilled manpower because the trained staff were transferred to another section.
LSMC	・ DBMS is being used by environmental section very successfully. ・ Up to now, the database is always updated by the daily collected data. ・ LSMC is preparing monthly reports on solid waste from the updated database ・ Additional manpower for data entry is required.
BKM	・ There is a hardware problem to be fixed with the PC ・ However, BKM started preparing the database using DBMS in another PC. ・ BKM prefers to use DBMS as the database for the source-separated collection pilot project. ・ There is still lack of skilled manpower to enter the data into the system
MTM	・ MTM has used DBMS only to keep inventory of their handbarrows. ・ MTM does not collect the day-to-day data to keep the database updated. ・ Data to be managed by MTM is very limited, only the waste quantity transported to Teku transfer station in KMC
KRM	・ Waste is only collected by the private sector in KRM, but there is no coordination of database management between the private sector and municipality. ・ It has not been determined who should have responsibility of data entry to DBMS, KRM or the private sector.

Source: JICA Study Team

3.3.2 Implemented Follow-up Activity

In addition to above confirmation of current status, issues to be considered were also identified through a meeting with each municipality. Detail meeting records are attached in Supporting Report D-1.

A First Follow-up Workshop was held on March 1, 2006, to discuss what kind of modification is needed in DBMS and what further training is needed to operate the system more sustainably. The purpose of the workshop was originally to estimate the waste generation quantity from the collected data. However, the participants of the workshop discussed and concluded that the focus should be to improve the DBMS more because establishment of the reliable database system should be prior to the estimation practices for the waste generation.

The First Follow-up Workshop record is also attached in Supporting Report D-2.

In June 2006, a monitoring meeting was held at each municipality. The following shows the progress of DBMS status at the time but, due to the confused situation in Nepal in April 2006, there had been little progress.

Table 3.3-2 Interim Status of DBMS at the Five Municipalities

Municipality	Monitoring date	Interim Status
KMC	Jun 6	From July 2006 KMC had started inputting data in SW Database. Before July 2006 KMC had only one staff who was busy in other regular jobs. There were some temporary or voluntary staff but their input was not sufficient.
LMC	Jun 6	DBMS is being used very successfully from January 2006 to date. All the records to date are updated and being used. Municipality has been generating monthly and annual reports of solid waste from the database as needed
BKM	Jun 5	From June 2006 BKM had started inputting data in SW Database and now it will be continued. Before June 2006 database application could not be started due to hardware problems on computer, virus on computer, electricity problem in Sanitation Department, and the trained database operator had been moved to another department and a new one had not been appointed.
MRM	Jun 5	Records of one vehicle to transfer station have been recorded in SWM Database to date. No data available on records of door-to-door collection from concerned persons.
KRM	Jun 6	All the waste is being carried out by a private sector company. There is no coordination of database management between KRM and Private Sector. Due to lack of contract agreement the private sector has not provided data to KRM. So the database entry could not be started, however the trained database operator is interested to start data entry.

Source: JICA Study Team

Based on this monitoring meeting, the general training schedule was determined as follows:

Table 3.3-3 Expected Outputs and Training Schedules

Items	Output
Expected output	(a) Enhance knowledge on Operating System (OS). (b) Develop skill to manage proper File Management and record keeping. (c) Good knowledge on backup system (internal and external backup). (d) Be able to work faster than pervious. (e) Be able to design good data fields independently. (f) Enhance knowledge on filtering, sorting, pivot table and report printing on MS-Excel. (g) Able to make database on MS-Access. (h) Able to create table, fields and store data in the tables. (i) Able to query data from the exiting table. (j) Able to convert every manual database (filing system) to computerized system. (k) Able to work on existing Solid Waste Database Management System. (l) Can retrieve the data from tables as per the need in the future and print them. (o) Can generate monthly, weekly, and annual reports of Solid Waste Database.

Items	Output
Training Schedule	Training Contents
A) Basic Computer System	(a) Computer operation (Hardware and Software). (b) Knowledge on user file management system. (c) Short-cut keys to work faster. (d) Knowledge on control panel. (e) Knowledge on system file management. (f) Knowledge on network management. (g) Knowledge on internet system. (h) Knowledge on data backup system. (i) Knowledge on Anti-virus system and protection.
B) Database in Microsoft Excel	(a) Knowledge on Excel. (b) How to create manual database (paper works) to Excel database. (c) Inserting data in Excel database using forms. (d) Using function and formula commands. (e) How to filter data from existing database. (f) How the pivots table can be generated. (g) How the charts can be generated. (h) How the database can be sorted.
C) Database in MS-Access	(a) Sound knowledge on MS-Access. (b) Concept on Database Management System (DBMS). (c) Concept on Relational Database Management System (RDBMS). (d) Concept on tables, fields, record set. (e) Concept on inserting, updating, deleting. (f) Concept on data query (using Structure Query Languages -SQL). · Select Statement - To select the records from database · Function - Using function like sum, avg, max, min, count · Where Clause - Conditional operator >,>= ,<. <=, Between · Group Clause - Getting the data in group forms · Having Clause - Conditional clause · Order by Clause - To get the data order(ascending, descending) · Join multiple table · Sub queries (g) Concept on exporting query data to Excel. (h) Concept on printing query data.

Source: JICA Study Team

A training needs assessment (TNA) was also carried out in each monitoring meeting and the training details customized for each municipality based on the result of the assessment. The following table is the result of TNA and the contents of training provided to each municipality. Details of training activities provided are attached in Supporting Report D-3.

Table 3.3-4 Result of Training Needs Assessment and Training Contents Provided

Municipalities	Trainee's Computer knowledge at present	Trainee's Expectation	Content of Training provided
KTM Trainee Name: Ram Krishna Karki Sanjay K.C.	Basic knowledge on File Handling. Basic knowledge on MS-Office Package. Can operate fully Solid Waste Database Application. No idea on how the data are stores in table format and how to generate necessary repots.	Use of third party software. Proper File Management System. Architecture of Database. Management System. Convert Manual Database(Paper base) to Computerized System. Getting knowledge on data storing format and generate different types of reports.	Tips and tricks on Windows system Database concept and utilization. Database in Excel and Access. SQL queries. Annual database reports.
LSMC Trainee Name: Raju Shakya	Little knowledge on Windows Operating System Little knowledge on File Handling Little knowledge on MS-Office Package Can operate fully solid Waste Database Application No idea on how the data are stores in table format and how to generate necessary reports.	Fast Working Methods on Windows Operating system Proper File Management System Convert Manual Database (Paper base) to Computerize System Architecture of Database Management System Getting knowledge on data storing format and generate different types of reports.	Tips and tricks on Windows system Basic Computer Fundamental Trainings. File Management Trainings Database concept and utilization. Database in Excel and Access. SQL queries. Annual database reports.
BKM Trainee Name: Shree Krishna Nyaichyai Rameshor Koju Ramesh Twitwi Ram Krishna Prajapati	Little knowledge on Windows Operating System Little knowledge on File Handling Little knowledge on MS-Office Package Little knowledge on Solid Waste Database Application No idea on how the data are stores in table format and how to generate necessary repots.	Fast Working Methods on Windows Operating system Proper File Management System Convert Manual Database(Paper base) to Computerize System Full Training on Solid Waste Database Application Architecture of Database Management System Getting knowledge on data storing format and generate different types of reports.	Basic Computer Fundamental Trainings. Tips and tricks on windows system Proper File Management Trainings (User and system files Database concept and utilization. Full Training on Solid Waste Database (for Solid Waste Staff) Real Data inputting. Annual and other database reports.
MTM Trainee Name: Tulsi Bhakta Tako Krishna Shrestha	Basic knowledge on File Handling Can operate fully solid Waste Database Application No idea on how the data are stores in table format and how to generate necessary repots.	Proper File Management System Convert Manual Database(Paper base) to Computerize System Architecture of Database Management System Getting knowledge on data storing format and generate different types of reports	Tips and tricks on windows system Proper File Management Trainings (User and system files) Database concept and utilization. Database in Access. SQL queries. Annual database reports.

Municipalities	Trainee's Computer knowledge at present	Trainee's Expectation	Content of Training provided
KRM Trainee Name: Chandra Maya Maharjan Gyan Bajra Maharjan	Little knowledge on Windows Operating System Little knowledge on File Handling Little knowledge on MS-Office Package Can operate fully solid Waste Database Application No idea on how the data are stores in table format and how to generate necessary repots.	Fast Working Methods on Windows Operating system Proper File Management System Architecture of Database Management System Convert Manual Database(Paper base) to Computerize System Training on Working with Solid Waste Database Management Getting knowledge on data storing format and generate different types of reports	Basic Computer Fundamental Trainings. File Management Trainings Database concept and utilization. Training on Solid Waste Database Management Data inputting and reporting from Solid Waste Database Annual database reports.

Source: JICA Study Team

A Second Follow-up Workshop was held on July 31, 2006 with the focal points from each municipality. Those focal points presented the progress of the DBMS, the present skill of the trainees and sample formats for the generation of annual reports based on the available six month data of LSMC and MTM. The Workshop Report has been presented in Supporting Report D-4. Sample annual report presented at the workshop is also attached in Supporting Report D-5.

3.3.3 Recommendations

Through the follow-up and monitoring activity for DBMS for solid waste, the following are recommendations for the future activities:

- Additional machine required for the data recording of the weighing bridge at Teku Transfer Station, the recording system of which should be compatible with the computer's data recording system.
- Preparation of a data merging and integration system for combining the recording system of the weighing bridge at Sisdol Landfill and Teku Transfer Station with the DBMS used by the municipalities. At the final stage of the DBMS particularly, KMC has demanded fully automatic data recording from weighing bridges at Sisdol and Teku through an online network system.
- More training to improve the basic computer skills of the operators in BKM is needed.
- Database accumulated by DBMS is quite important for not only to prepare the report to disclose the solid waste management situation to policy makers and public, but also to prepare the future plan. Solid waste situation has fluctuated by urbanization, seasons or solid waste management system, therefore sustainable operation of the DBMS is surely crucial. In order to secure such sustainability, the municipality should maintain the DBMS itself, the operational staff who operate the system and the technical staff who will use the data for reporting and future plan. Therefore, it is strongly recommended

for municipalities to secure budgets for maintenance and upgrade of the system and to resist sudden/irresponsible transfer of staff which interrupts the continuation of operation and utilization of skills.

- Another expected outcome from this DBMS activity is to compile the solid waste data at each municipality to prepare the "Solid Waste Management White Paper" by SWMRMC. Therefore, it is recommended for SWMRMC to organize the information exchange meeting among the municipalities and SWMRMC at least once a year around the end of fiscal year.

CHAPTER 4 FOLLOW-UP FOR ENVIRONMENTAL AND SOCIAL CONSIDERATIONS FOR FACILITY DEVELOPMENT

4.1 Overall Facility Plan in the Kathmandu Valley

4.1.1 Umbrella Concept for Solid Waste Management in the Kathmandu Valley

Action plans (A/Ps) of each of the five municipalities should be developed reflecting their characteristics in terms of solid waste flow, waste quality and quantity, collection methods, waste minimization activities and the associated requirements such as promotion of public awareness and behavior change, and organizational and institutional arrangements. However, it is recommended that some activities to be included in the respective A/Ps should be conducted in a valley-wide manner in order to maximize the effect of these activities. In addition, in terms of facilities and equipment for intermediate treatment or landfill, the developments need to be done taking into consideration potential for inter-municipal coordination and sharing of these facilities and equipment so that development loads as well as investment and O&M costs be minimized. Table 4.1-1 indicates the components of the A/Ps that need to be addressed by each respective municipality or that may be combined for more than one municipality (zone).

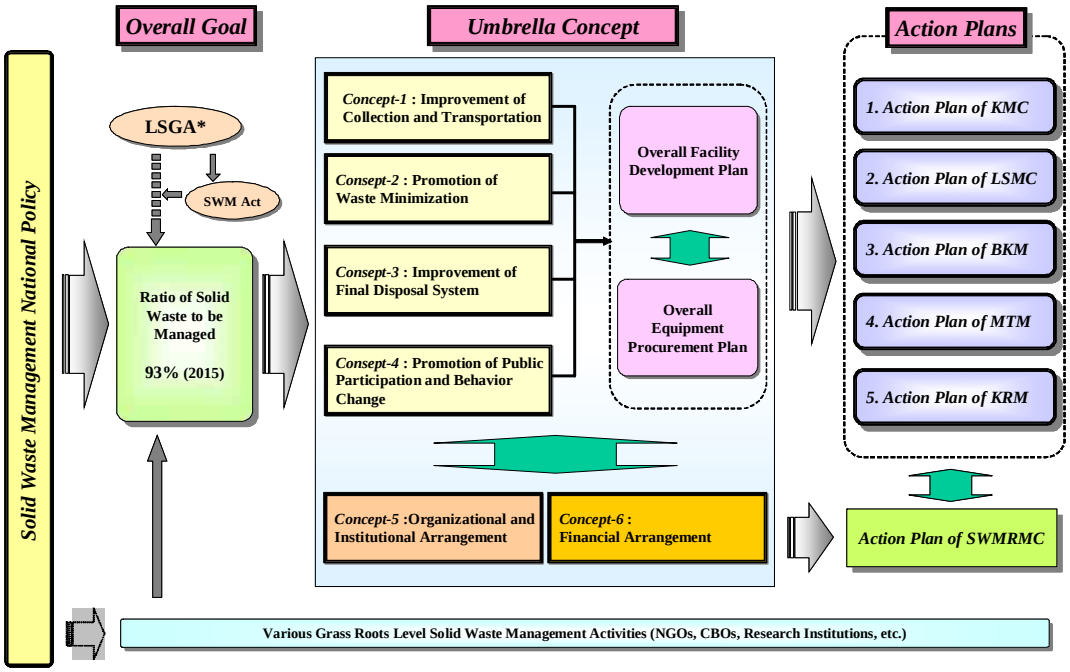
Table 4.1-1 Components of Action Plans

Components of A/Ps	Individual Municipality or Zone
1. Primary and secondary collection	Individual municipality
2. Transportation (transfer haul)	Individual municipality or zone
3. Waste minimization (composting and recycling)	Individual municipality or zone
4. Waste disposal	Zone
5. Public participation and behavior change	Individual municipality and zone
6. Organizational and institutional arrangement	Individual municipality and zone

Source: JICA Study Team

In this connection, a basic concept common for all five municipalities, ***an umbrella concept for solid waste management in the Kathmandu Valley (Umbrella Concept)***, has been proposed to clarify the administrative responsibilities of each municipality and to show a basic direction (road map) for effective solid waste management.

As parts of the Umbrella Concept, four basic concepts have been proposed i.e. improvements of collection and transportation, improvements to the final disposal system, promotion of waste minimization, and public participation and behavior change. In order to achieve these basic concepts, an overall facility plan (OFP) and overall equipment plan (OEP) in the Kathmandu Valley have also been discussed. In addition, guidelines for financial arrangements as well as organizational and institutional arrangements including the involvement of the private sector regarding SWM have been proposed. The overall framework of the Umbrella Concept is shown in Figure 4.1-1.



* Local-self Governance Act

Figure 4.1-1 Overall Framework of the Umbrella Concept for the Kathmandu Valley

Source: JICA Study Team

4.1.2 Overall Facility Plan in the Kathmandu Valley

(1) Principle for the Overall Facility Plan in the Kathmandu Valley

Three principles were adopted to develop the OFP:

Principle 1 : Waste Hierarchy; The SWM facilities should contribute to a more balanced SWM system that first works to reduce the waste at source, re-use, recycle and recover, treat and finally dispose of the waste.

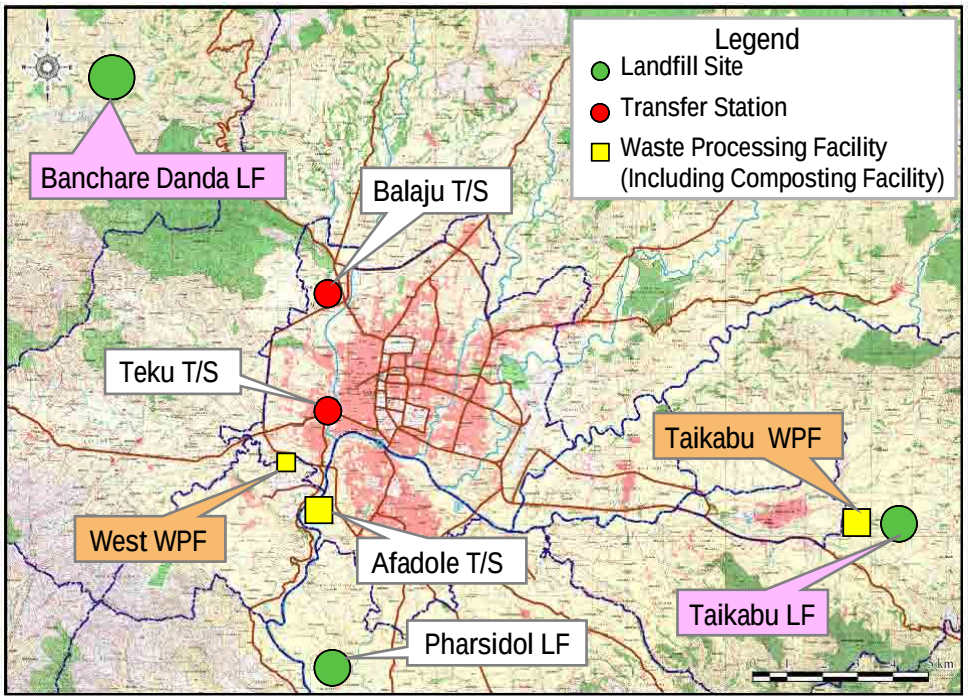
Principle 2 : Sustainable Facilities; Facilities should be sustainable both financially and technically and should suit the existing Nepalese conditions.

Principle 3 : Urgent Implementation; To avoid delays in providing necessary facilities, a step-wise approach should be adopted. Past studies and plans were taken into consideration as much as possible.

(2) Alternative Evaluation of the OFP

As a first step, a short list of candidates for long-term landfill sites (L/T-LFSs) was prepared based on the 1998 study by the Department of Mines and Geology (DOMG). It is noted that six years have passed since the implementation of that study and development has been rapidly progressing. The four candidate sites, Pharshidol South, Pharshidol North, Taikabu, and Okharpouwa, for development of long-term sanitary landfill were selected. Ranking of these sites was made taking into account field visits and available information.

The facilities to be incorporated in the formulated alternatives mostly reflect existing plans and nine alternatives, to suit the number of landfills, were analyzed. Alternatives 1a, b and c call for one sanitary landfill to serve the whole the Kathmandu Valley with provision of Waste Processing Facilities (WPFs). Alternatives 2a, b and c call for two landfills to be developed. Alternative 2c is an offshoot of Alt. 2b but without WPFs. Alternatives 3a and b provide three landfills, and once more Alt. 3b is an offshoot of Alt. 3a but without WPFs. Alternative 4 has each individual municipality developing its own SWM facilities in the absence of the Umbrella Concept. Figure 4.1-2 shows the locations of these facilities.



Source: JICA Study Team

Figure 4.1-2 Facilities incorporated in the Alternatives 1-3

The developed alternatives are described in the following Table 4.1-2.

Table 4.1-2 Formulation of Alternatives

Alt	LF	WPF	T/S	Comments
1a	Okharpauwa	West Taikabu	Teku Balaju Taikabu	Alt. 1a: examines one landfill for the total valley, located outside the valley and the effect of waste reduction by two compost plants. Three transfer stations are required.
1b	Taikabu	West Taikabu	Teku Balaju	Alt. 1b: locates one landfill within the valley at Taikabu LF candidate site, which is under EIA process. The WPF is proposed on an unidentified site west of the two cities to reduce transfer haul distances.
1c	Pharsidol	West Taikabu	Teku Balaju	Alt. 1c: locates the sole landfill for the valley at a site proposed in the Pharsidol area, Pharsidol of LSMC, and close to the municipalities.

Alt	LF	WPF	T/S	Comments
2a	Okharpauwa Taikabu	West Taikabu	Teku Balaju	Alt. 2a: proposes two landfills, in Okharpauwa outside the valley and Taikabu. Two WPFs are also proposed.
2b	Taikabu Pharsidol	West Taikabu	Teku Balaju	Alt. 2b: proposes two landfills, Taikabu and Pharsidol, both located within the valley, and two compost plants.
2c	Taikabu Pharsidol		Teku Balaju West	Alt. 2c: is an offshoot of Alt. 2B without WPFs, in order to study the effect of waste reduction.
3a	Okharpouwa Taikabu Pharsidol	West Taikabu	Teku Balaju	Alt. 3a: proposes three landfills and two WPFs.
3b	Okharpauwa Taikabu Pharsidol		Teku Balaju Aphodal	Alt. 3b: is an offshoot of Alt. 3A without the WPFs, in order to study the effect of waste reduction.
4	Okharpauwa Taikabu Pharsidol Thimi Kirtipur	Aletar Afadol Taikabu Thimi Kirtipur	Teku Balaju	Alt. 4: proposes that each municipality achieves its targets through construction of individual compost plants and sanitary landfills.

Source: JICA Study Team

The main comparison items considered were:

- SWM factors: How the alternative reflected the proposed waste hierarchy and satisfied the "Proximity Principle"[1]
- Transportation factors: The transfer haul costs represent the largest portion of the O&M cost and this is reflected in the ton・km produced by each alternative

(3) Overall Facility Plan in the Kathmandu Valley

Since the analysis indicated that two landfills and two WPFs would provide stable and sustainable SWM service for the Kathmandu Valley, Alt. 2b or 2a should be considered.

In terms of waste transportation and related costs; Alt. 2a would entail an added O&M cost of Rs 278.9 million over the period of 2007 to 2015 or average Rs 24.9 million annually. On the other hand Alt. 2a holds an edge over Alt. 2b in terms of the site allocation. Out of the two sites required and still to be selected, the EIA for the Taikabu site is already in process, and barring any unforeseen circumstances, it is expected that it will be found suitable for the construction of a landfill. This study has narrowed the candidates for the remaining landfill site to two sites; in Pharsidol and the Banchare Danda site in Okharpauwa.

The Pharsidol north site was preferred over Banchare Danda in view of the shorter transport distance and other factors. However three major issues may delay the development of this site. These are the Pharsidol wellfields, the direction of Tribhuvan Airport runway and the close proximity of the culturally important village of Khuipa. A long time may be required

[1] The principle whereby waste should be treated and disposed of as close as possible to the generation area to encourage responsibility of the waste generator for its management, environmental issues, and decrease transportation costs

to resolve these issues. On the other hand the major advantage that the Banchare Danda site has is the committment of the Central Government to develop this site as a landfill (as underlined in the Government's National Plan). Social and cultural issues are much less critical here and development is expected to be much faster. However the Government needs to carefully discuss ways of bridging the high haulage costs with the beneficiaries of the site, namely KMC and LSMC. The Overall Facility Plan (OFP), therefore, has been developed based on Alt. 2a in order to expedite the process of developing long-term landfill by building on all the effort that has been applied so far, and also to clarify the costs incurred.

Accordingly the OFP in Zone A (KMC, LSMC and KRM) and Zone B (BKM and MTM) is described in Table 4.1-3.

Table 4.1-3 Overall Facility Plan under the Umbrella Concept

Facilities		Descriptions
ZONE A – KMC, LSMC and KRM		
1	Sisdol LF	
	(1) Valley 1	Valley 1 (PP C-2) will be operated for about 12-14 months
	(2) Valley 2	Valley 2 to be developed and operated for about 12 months
	(3) Post closure	Upon completion of disposal operations at Sisdol proper site closure will be implemented and environmental monitoring will continue as required
2	Bagmati Dumping Site	Bagmati dumping site will cease operation once the new transfer trucks arrive and all the waste is transported to Sisdol LF. For a couple of years thereafter, safe closure works will be implemented along the Bagmati River banks where waste has been deposited.
3	Banchare Danda L/T-LF	This LF is expected to be developed within the next three years. It will be operated as a Level 3, semi-aerobic landfill.
4	Waste WPF	A WPF, basically for compost production but that will also include recyclable materials separation facilities to be developed west of KMC and LSMC and within 7-10 Km distance. The facility will be developed in three phases, starting with an input capacity of 100 t/d and reaching 300 t/d. Residues will be transported from the plant to the landfill
5	Teku T/S	Teku T/S has been improved with a capacity of 200 t/d (40 t at peak hour). Tipping at the station will continue to be mixed with some loading by wheel loaders.
6	Balaju T/S	Balaju T/S will be developed on the allocated land. It will be a split level unloading system without compaction. It will have a capacity of 120 t/d.
7	Afadol Temporary T/S	For the first 2-3 years of the Action Plan period, a temporary T/S will be developed for LSMC waste at Afadol. Upon completion of the waste processing facility the LSMC waste will be transported there.
Zone B – BKM and MTM		
1	Hanumante dumping site	For the next 2-3 years waste will continue to be dumped at Hanumante River bank, with the application of cover soil.
2	MTM temporary LF	The solid waste collected in the central areas will be transported to Teku T/S, while remaining waste will be disposed of at a temporary landfill with the application of cover soil.
3	Taikabu LF	The Taikabu LF will be developed within the next 2-3 years as a Level 3, semi-aerobic landfill.
4	Taikabu WPF	Within the same Taikabu LF site, a compost plant will also be developed. The plant will have an initial capacity of 10 t/d and expand to 15 t/d.

Source: JICA Study Team

4.1.3 Environmental and Social Considerations for Facility Development

(1) Type and Scale of SWM-related Projects Requiring IEE/EIA

The legal framework of the EIA system in Nepal is basically composed of the Environmental Protection Act, 1997 (EPA) and the Environmental Protection Rules, 1997 (EPR). Article 3 of the EPR stipulates that a project proponent should conduct an IEE or EIA study before the commencement of project. Table 4.1-4 shows the project type and activity in the SWM sector for which the IEE/EIA is a prerequisite in accordance with the EPA and EPR.

Table 4.1-4 IEE/EIA Requirement on SWM Sector in Nepal

Project Type and Activity		Size/capacity requiring IEE	Size/capacity requiring EIA
1	SWM activities*1	Population under service: 2,000-10,000	Population under service: More than 10,000
2	Landfill	Receiving waste: 100-1,000 ton/year	Receiving waste: More than 1,000 ton/year Population under service in urban area: More than 10,000
3	Transfer station and resource recovery	Area: Not more than 3 ha	Area: More than 3 ha
4	Facility for selecting, picking, disposing, and recycling through chemical, mechanical or biological techniques	Area: Not more than 2 ha	Area: More than 2 ha
5	Compost plant	Area: 1-5 ha	Area: More than 5 ha
6	Construction of waste plant, recovery plant, landfill site, storing facility and treatment facility for hazardous waste	-	Any scale
7	Final disposal of infectious waste	-	Hospital, health center, etc.: More than 25 beds
8	Incinerating or recycling any lethal substances	-	Area: More than 1 ha

Note *1: Although there is no legal definition in EPA/EPR in terms of SWM-related activities, it can be technically said to include waste collection, transportation, processing, final disposal and any combination of them, according to MOEST.
Source: Environmental Protection Act, 1997, and Environmental Protection Rules, 1997, HMG Nepal

(2) IEE/EIA Processes of Nepal

According to the EPA and EPR, the project proponent should obtain approval from the Ministry of Environment, Science and Technology (MOEST) in the case of the EIA process, while from the concerned agency (superior ministry) in the case of the IEE process, before project implementation. The general process in both cases is shown in Table 4.1-5.

Table 4.1-5 Overview of IEE/EIA Process in Nepal

IEE Process	EIA Process
- Submission of TOR for IEE to concerned agency - Evaluation and approval of TOR by concerned agency - IEE study and draft IEE report preparation - 15-day public notice by proponent and opinions/suggestions from the public - Submission of IEE report to concerned agency - Evaluation and approval of IEE by concerned	- 15-day public notice by proponent and opinions/suggestions from the public - Submission of Scoping Report and TOR for EIA to MOEST through concerned agency - Evaluation and approval of TOR by MOEST - EIA study and draft EIA report preparation - Public hearing by proponent - Submission of EIA report to MOEST through

IEE Process	EIA Process
agency	concerned agency - 30-day public notice by MOEST and opinions/suggestions from the public - Evaluation and approval of EIA by MOEST

Note: "Concerned agency" means basically MOLD in case of municipal SWM-related projects.
Source: JICA Study Team, referring to Environmental Protection Act, 1997 and Rules, 1997, HMG Nepal

(3) EIA Guidelines for SWM Projects

The SWMRMC developed EIA Guidelines for Solid Waste Management Projects in the municipalities of Nepal (SWMRMC EIA Guidelines) in 2004. Expected users of the guidelines are developers of SWM-related projects such as municipalities including the technical supporters/consultants. The guidelines mainly cover the scope of municipal SWM and introduce the following technical and procedural content:

- Requirement of the IEE/EIA process and documents for SWM projects based on EPA, EPR and other legislation
- Technical and procedural introduction for screening, scoping and TOR preparation for SWM projects
- Technical methodology for i) understanding of environmental/social baseline conditions, ii) identification and prediction of environmental/social impacts, and iii) development of mitigation measures and management/monitoring plan.
- Methodology of public involvement not only into the IEE/EIA process but also into the whole project stage.

In the course of preparation of the guidelines, the SWMRMC organized several consultative workshops inviting the various bodies. After finalizing, the SWMRMC distributed the guidelines to all 58 municipalities in Nepal.

(4) Land Acquisition and Resettlement Systems in Nepal

A legal framework on land acquisition and resettlement in Nepal is mainly formed by the Land Acquisition Act 1961 (amended in 1977) and Land Acquisition Rules 1969. The Act empowers the government to acquire any land for public purposes and works on the payment of compensation. The acquisition of and compensation for privately owned property are undertaken according to a formal procedure, consisting of i) initial procedure, ii) preliminary investigation process, iii) notice of acquisition, and iv) compensation. This framework is also applied to the property or other assets under the registered tenancy.

In the course of the land acquisition and compensation procedure, a compensation determination committee (CDC) is generally organized at district level involving a land administration/revenue office, the project proponent, and a representative of the district from the public. The CDC performs and supervises key activities or steps of the procedure, such as investigation of property/assets to be acquired, determination of compensation rate and amount, and issuance of official notices.

According to the Act and Rules, the following should be taken into account when determining the compensation amount, prevailing or market price of the land, loss of standing crops, loss of structure such as a house, damage due to being compelled to shift their residence or business places.

There is no specific legislation on involuntary resettlement in Nepal. The resettlement or relocation due to public purposes or works is practically operated in the conceptual framework of land acquisition and compensation.

(5) Preliminary Screening

Among various proposed activities in the A/Ps, the activities associated with facility development are selected as the projects (activities) necessary for preliminary screening as shown in Table 4.1-6.

Table 4.1-6 Target Activities for Preliminary Screening

Municipalities	Target Activities based on the A/Ps	Activity Number
KMC	Development of Balaju T/S	PS-1
	Development of a waste processing facility (WPF) (specific site is not decided yet.)*1	PS-2
	Development of long-term LF (Banchare Danda site in Okharpauwa)*2	PS-3
LSMC	Development of Afadol temporary T/S	PS-4
	Development of a waste processing facility (WPF) (specific site is not decided yet.)*1	PS-2
	Development of long-term LF (Banchare Danda site in Okharpauwa)*2	PS-3
BKM	Development of Taikabu LF	PS-5
MTM	Arrangement of temporary LF (specific site is not decided yet.)	PS-6
KRM	Development of a community composting facility (Specific site is not decided yet.)	PS-7

Note: *1: Both activities are the same under the umbrella concept
*2: Both activities are the same under the umbrella concept

Source: JICA Study Team

Based on the available data and information in terms of the existing environmental and social conditions in and around the areas of each target activity, a preliminary examination of the magnitude of impacts was conducted considering the expected characteristics of each activity. The environmental items to be examined were selected according to the new guideline of JICA, 2004. The results of the preliminary screening are summarized in Table 4.1-7.

Table 4.1-7 Summarized Results of Preliminary Screening

Environmental Items	Activity Number						
	PS-1	PS-2	PS-3	PS-4	PS-5	PS-6	PS-7
Air pollution	B	B	B	B	B	C	C
Water pollution	B	B	A	C	A	B	B
Soil pollution	C	C	B	C	B	C	C
Waste	-*1	-*1	-*1	-*1	-*1	-*1	-*1
Noise and vibration	B	B	B	B	B	C	C
Ground subsidence	C	C	B	C	B	C	C
Offensive odor	A	A	A	A	A	A	A
Geographical features	C	C	A	C	B	C	C

Environmental Items	Activity Number						
	PS-1	PS-2	PS-3	PS-4	PS-5	PS-6	PS-7
Bottom sediment	C	C	C	C	C	B	C
Biota and ecosystem	C	U	B	C	B	C	C
Water usage	C	C	B	C	A	C	C
Accidents	B	B	B	B	B	B	B
Global warming	C	C	C	C	C	C	C
Involuntary resettlement	C	B	B	C	U	B	B
Local economy such as employment and livelihood	B	B	B	B	B	B	B
Land use and utilization of local resource	C	B	B	C	A	B	B
Social institutions such as infrastructure and local decision-making process	C	C	C	C	C	C	C
Existing social infrastructures and services	C	C	C	C	C	C	C
The poor, indigenous of ethnic people	C	C	C	C	C	C	C
Misdistribution of benefit and damage	C	C	C	C	C	C	C
Local conflict of interests	A	A	B	A	A	A	A
Gender	C	C	C	C	C	C	C
Children's rights	C	C	C	C	C	C	C
Cultural heritage	C	U	C	C	C	U	U
Infectious diseases such as HIV/AIDS	B	B	B	B	B	B	B
Necessity of IEE or EIA	I	I	I	I	I	II	II

Note: A: Relatively high magnitude of impact is expected.
B: Impact is expected, but its magnitude will not be quite as significant.
C: No or negligible impact is expected.
U: Magnitude of impact is unclear.
*1: The overall goal of the activities is to improve solid waste management.
*2: I: Legal IEE/EIA of Nepal is required. II: Requirement of legal IEE/EIA of Nepal depended on the scale and location.
Source: JICA Study Team

(6) Target Facilities of the Follow-up

Among the above discussed facilities, the EIA procedures of Taikabu LF have been taken by BKM including a series of consultations with local people and communities with support from the SWMRMC. Under the pilot project of the Study, the concept design and supplemental environmental survey was conducted as part of technology transfer to the counter parts concerned. The specific locations for a WPF, a temporary LF in MTM, and a community composting facility in KRM have so far not been fixed. On the other hand, locations of a long-term landfill for zone A (KMC, LSMC and KRM) and transfer stations at Balaju in KMC and Afadole in LSMC have been identified and commencement of the procedures to develop these facilities is urgently required. However, careful environmental and social impact studies and considerations for the development of these facilities including official procedures for the IEE/EIA are also required. Also, the Government of Nepal has requested follow-up of the environmental and social considerations for the development of these facilities. By providing technical support to the Nepalese counterparts, it is expected that the implementation of the A/Ps can go forward with the appropriate environmental and social considerations through the IEE/EIA procedures.

4.2 Follow-up for EIA on Banchare Danda Long-term Landfill Site

4.2.1 Guidelines for Environmental and Social Considerations of JICA

(1) Guidelines for Environmental and Social Considerations of JICA

JICA first developed environmental guidelines on a sector-specific basis in the early 1990s. As upstream decision making with integration of adequate environmental and social considerations became important, JICA revised its guidelines and made a universal one to be applied to all of JICA's functions and duties. The Guidelines for Environmental and Social Considerations (JICA Guidelines) started to come into force from April 2004. The JICA Guidelines aim at encouraging a recipient government to conduct appropriate environmental and social considerations in various stages of the study or project preparation, through making clear the responsibility and process to be taken by JICA and a necessary conditions to be fulfilled by the recipient country. It is also stipulated that adequate support and confirmation will be provided by JICA.

The major requirements to be fulfilled by the recipient country can be summarized as follows:

- Integration of environmental and social considerations into planning of the project and decision-making process for its implementation
- Preparation of various EIA-related documents in the official or familiar language in a host country as well as an understandable language and form for local people
- Openness of EIA-related documents and availability for stakeholders to access and copy at any time

The key points of the process on the environmental and social considerations in line with the JICA Guidelines are as follows:

- Categorization of each project to determine the requirement level for ensuring appropriate environmental and social considerations
- Examination of various impacts and measures on environmental and social aspects, including examination of multiple alternatives
- Information disclosure and consultation with stakeholders for social acceptability
- Appropriate consideration to be paid to socially vulnerable groups, to those subject to involuntary resettlement and indigenous peoples
- Monitoring after project implementation for confirmation of the effectiveness of measures and occurrence of unforeseen situations

(2) Category of the Study under the JICA Guidelines

The Study was conducted as a category B although the JICA Guidelines were not considered to apply fully to the Study. However, the category has been changed to "A" in which strict environmental and social considerations are required under the JICA Guidelines since the Monitoring and Follow-up Phase. This is because the planned long-term landfill sites need EIA under the EIA regulations of Nepal and may have adverse impacts on the environment. The documents related to the EIA such as Scoping Report, TOR for EIA and Draft EIA report as well as reports produced by the JICA Study Team will be reviewed by the Advisory

Council of Environmental and Social Considerations Review of JICA (Advisory Council). The Nepalese side is kindly requested to incorporate comments, which may be made by the Advisory Council, into the EIA report.

(3) Comparison and Verification between Nepalese EIA System and JICA Guidelines

Table 4.2-1 shows the consistency of the Nepalese system and experience in SWM projects with the JICA Guidelines.

Table 4.2-1 Comparison and between Nepalese EIA System and JICA Guidelines

Requirements/key points of JICA Guidelines	Nepalese system and experience in SWM sector projects
Integration of environmental and social considerations into planning and decision-making process	- There is no system specifically for the SWM sector. However, public involvement is provided by EPA/EPR in the scoping stage of EIA (15-day public notice) - SWMRMC EIA Guidelines point out the importance of as much as possible stakeholder involvement from an early stage of project planning.
Openness of EIA-related documents in understandable language	- EIA-related documents are basically prepared in English in order to make their content clear technically. At a practical level, a summarized document in the local language (Nepali) is usually prepared for public notice/hearing.
Categorization of the proposed project	- EPA/EPR provides criteria for categorization of the projects of various sectors including the SWM sector, based on the project type and scale.
Examination of various impacts and measures	- EPA/EPR provides the general scope for examination of impacts and measures, such as physical, biological and social-economic aspects. Alternative analysis is also considered in EPA/EPR. - SWMRMC EIA Guidelines cover the various environmental and social elements to be examined. Technical instruction for examining the impacts and measures is provided in line with the project type in the SWM sector.
Information disclosure and stakeholder consultation	- EPA/EPR stipulates that opportunities be provided to stakeholders especially for local communities/people (public notice, public hearing, etc.). - At a practical level, MOEST sometimes requests the project proponent to attach a letter from local communities or other key stakeholders, in order to show the general acceptance toward the project. - Recently there has been a tendency to organize a local coordination committee for LFS development in order not only to ensure the stakeholder involvement but also to have good mutual understanding.
Consideration for socially vulnerable groups, involuntary resettlement, etc.	- IEE/EIA covers the ethnicity, caste, poverty status, etc. as one of the socio-economic aspects. - There is no system specifically for involuntary resettlement. However, the legal system for land acquisition and compensation is enacted separately from the IEE/EIA system.
Monitoring after project implementation	- EPA/EPR stipulates that a monitoring plan be included in IEE/EIA. - SWMRMC EIA Guidelines provide the technical instruction for establishing the monitoring plan.

Source: JICA Study Team, referring to Environmental Protection Act, 1997 and Rules, 1997 (HMG Nepal), and to EIA Guidelines for Solid Waste Management Project, SWMRMC, 2004

Based on the above comparison, it can be said that the Nepalese EIA system as well as experience on environmental and social considerations in SWM-sector projects more or less fulfill the JICA Guideline requirements.

4.2.2 Contents of the Follow-up Survey for EIA on Banchare Danda Landfill Site

(1) Scope of Work of the EIA Study and Contents Supported by JICA Study Team

The EIA procedures on the Banchare Danda landfill site including detail study on the environmental impacts and its mitigation measures will be completed by the SWMRMC. However, since careful studies and examinations on the environmental and social considerations are required to develop the landfill site, the JICA Study Team has been providing technical support for topography, soil investigation, geological, hydrological and supplemental environmental surveys, and concept design for going forward with the EIA procedure appropriately as a follow-up activity based on the request of the GON. In this connection, it has been confirmed that the demarcation of the EIA study between the Nepalese side and JICA Study Team is as shown in Table 4.2-2 according to the Scope of Works discussed in the TOR for the EIA.

Table 4.2-2 Scope of Works of EIA Study and Contents Supported by JICA Study Team

Scope of Works	Descriptions (To be done by SWMRMC)	Support by JICA Study Team as Follow-up
I. Introduction		
1. Policy, Laws and Institution 2. Site Description 3. Project Description ▪ Site selection ▪ Concept design	▪ Collection and arrangement of secondary data and information ▪ Obtaining basic consensus of the project design among the stakeholders	▪ Concept design
II Baseline Environmental Conditions		
1. Physical Environment 2. Biological Environment 3. Socio-economic and Cultural Environment	▪ Collection and arrangement of secondary data and information ▪ Documentation of baseline environmental condition	▪ Topography survey ▪ Geological study ▪ Soil investigation survey ▪ Hydrological survey ▪ Water quality survey (surface water, ground water)
III. Environmental Impact Assessment		
1. Physical Issues **1.1 Construction Stage** ▪ Landscape disturbance, land stability, landslide, soil erosion, etc, due to topographic change ▪ Change in air quality due to dust and exhaust emission, change in water quality due to civil/concreting works sedimentation, and noise level ▪ Location and operation of quarries and borrow pits ▪ Drainage alteration and associated erosion and sediment; hydraulic change and river bank protection due to river diversion works ▪ Safety measures	▪ Assessment of the physical, biological, socio-economic and cultural impacts on the environment by using standard methods and techniques. ▪ In particular, quantitative assessment of likely impacts, taking into consideration lessons learned from the Sisdol Landfill Site; both during the construction and operational stages. ▪ Documentation of impact assessment using appropriate symbols and definitions with details of the impacts including nature, magnitude (site specific, local, regional), extent and duration (short, mid, and long terms).	▪ Geological study ▪ Hydrological study of the river diversion including supplemental survey on the land use of the down stream and river works ▪ Other necessary measures to be examined as part of concept design

Scope of Works	Descriptions (To be done by SWMRMC)	Support by JICA Study Team as Follow-up
1.2 Operation and Maintenance Stage ▪ Land stability, landslide and soil erosion, including geological hazard ▪ Surface water hydrology ▪ Air quality ▪ Bad Smell ▪ Water quality (both surface and ground water) related to leachate generation and control ▪ Noise and vibration; ▪ Leachate generation and control ▪ Gas generation emission and migration; ▪ Availability of cover material ▪ Human health associated with the change in air quality and noise level along the road alignment.		▪ Ditto
2. Biological Issues **2.1 Construction Stage** ▪ Loss of forest area as part of land acquisition ▪ Possible impact on flora fauna (biodiversity) ▪ Disturbance to wildlife movement, and possible hunting and poaching; ▪ Use of forest products by the construction workers and construction activities ▪ Community forests and associated issues		-
2.2 Operation and Maintenance Stage ▪ Birds hazard Impact on and growth of community forest ▪ Loss of aquatic life ▪ Disturbance to the wild life		-
3. Socio-economic and Cultural Issues **3.1 Construction Stage** ▪ Loss of agricultural land ▪ Loss of agricultural products ▪ Effect on irrigation schemes ▪ Effect on health, sanitation and safety of local people and workers ▪ Availability of local construction workers, employment opportunities and ▪ Mobilization of local people for construction		-
3.2 Operation and Maintenance Stage ▪ Impact on local economy including the issues on the waste pickers ▪ Community infrastructures ▪ Aesthetic values ▪ Public health hazard ▪ Quality of life values		-

Scope of Works	Descriptions (To be done by SWMRMC)	Support by JICA Study Team as Follow-up
4. Management Issues ▪ Project execution ▪ Land acquisition and resettlement	▪ Consideration of management organization ▪ Implementation of preliminary investigation (preparation of cadastral maps) ▪ Preparation of land acquisition notice ▪ Preparation of compensation plan	▪ Suggestion for the resettlement plan
5. Other Issues	▪ Study of the issues raised during scoping notice	-
6. Alternative Analysis ▪ Project site ▪ Technology, management methods, schedule, required raw materials ▪ Design ▪ Acceptability ▪ Other relevant points	▪ Comparison of the alternatives using cost benefit analysis and recommendation of the best alternative. ▪ Proposing of mitigation measures for costs involved. ▪ Comparing the *No Action* option with modification of the proposed project.	▪ Technology and design alternatives analysis as part of concept design
7. Mitigation Measures	▪ Inclusion of mitigation measures against adverse impact in the EIA report. ▪ Suggestion of EPMs (Environment Protective Measures) for both construction and operational stages considering the lessons learned from Sisdol Landfill Site operation. ▪ Discussion of cooperation and consultation mechanism involving the OSLSMCC and local communities as part of the EMP (Environment Management Plan).	▪ Suggestions based on the mitigation measures examination as part of concept design
8. Costs and Benefits of the Project	▪ Implementation of cost benefits analysis and environmental cost sharing, if any	▪ Cost estimation as part of concept design
9. Environmental Management Plan (EMP)	▪ Preparation of Environment Management Plan (EMP) including environmental monitoring plan.	▪ Suggestions based on the field surveys and concept design
11. Other Information	▪ Inclusion of other relevant information such as references, maps, photos and questionnaires into the EIA report.	-

Source: JICA Study Team

The JICA Study Team has recommended that the SWMRMC included the following conditions into the TOR for the consultant procurement:

- Detail description of site selection process for the landfill in the EIA report
- Detail description of public involvement such as public hearings in the EIA report
- Detail description of land acquisition and resettlement procedures and plan in the EIA report
- Incorporation of the results of the follow-up survey into the EIA report
- Close coordination with the JICA Study Team for the EIA study

(2) Comments on Scope of Work of the EIA Study from Review Committee

In addition to the above Scope of Works, the following comments were provided to the SWMRMC from MOEST as the result of discussion at the Review Committee organized by

MOEST on February 27, 2006. These comments have been taken into consideration in the EIA Study by the SWMRMC.

- Organizations and institutions relating to the proposed project that may have potential affect on people's lives should be duly addressed and analyzed.
- Any issues relating to the construction of the access road to the proposed site needs to be studied.
- Acts relating to waste segregation, land acquisition, water resources, labor, health, bio diversity and the Basel convention should be reviewed.
- Baseline data on mosses, which could be a sensitive indicator, should be included in the EIA report.
- Information on communicable diseases should be provided.
- Post closure measures for the landfill site, leachate treatment and its proper disposal method should be clearly mentioned.
- Latitude and altitude of the proposed site should be included in the EIA report. Sources of data related to population, health and waste should be mentioned clearly. The river water should be tested for heavy metals.
- The affected VDCs should be clearly marked on the topographic map
- Data on biodiversity should be collected using appropriate measures and data on the existing varieties of fish both upstream and downstream should also be collected.
- The EIA study should also include a study on the possible effects on cultural heritage of the region.
- Alternative sites and technologies should be included in the EIA report.
- Studies should be carried out on aquatic life, acts relating to health and labor, and agreements on biodiversity.
- A detailed study should be done on possible steps that could be taken towards waste reduction at source and composting in order to increase the lifespan of the proposed landfill site.
- Policy recommendations geared towards appropriate management of hazardous medical and industrial waste should be included.

(3) Comments on Scope of Work of the EIA Study from Advisory Council of JICA

Scoping and TOR for the EIA were reviewed at the Advisory Council of JICA on April 10, 2006 because the Study had been categorized as "A" in which strict environmental and social considerations are required under the JICA Guidelines. The following comments were provided from Advisory Council and the SWMRMC promised to incorporate them into the EIA report:

- Process of site selection should be discussed in the EIA
- Management of harmful waste such as medical waste and industrial waste should be considered carefully
- Lessons learnt from the Gokaruna landfill site should be taken into consideration in the EIA especially heavy metal pollution of the groundwater

- Careful treatment of leachate should be considered including the capacity of treatment to cope with rainfall intensity
- A water quality survey including heavy metals should be conducted to determine current conditions
- Impact caused by the river diversion should be considered carefully
- The community forest should be taken into consideration from the viewpoint of socio-economy of local people
- Careful attention should be paid to waste pickers

4.2.3 Progress of EIA Procedures on Banchare Danda Landfill Site

According to the SWMRMC, the progress of the EIA on the Banchare Danda landfill site is shown below:

- Public notice: August 8, 2005
- Pasting of public notice in VDCs: August 8, 2005
- Submission of Scoping Report and TOR for EIA to Ministry of Environment, Science and Technology (MOEST): October 31, 2005
- Submission of a letter to Ministry of Forest and Soil Conservation (MOFSC) for the approval of forest/tree clearance by the Project: December 8, 2005
- Organization of Review Committee by MOEST: February 27, 2006
- Official approval from MOEST on Scoping Report and TOR for EIA: March 3, 2006
- Selection of a local consultant and conclusion of contract between SWMRMC and the selected local consultant: May 2006
- Commencement of EIA study by the selected local consultant: May 2006
- Submission of Inception Report on EIA by the selected local consultant: July 7, 2006
- Preparation of a cadastral map (as part of land acquisition): July 2006
- Un-official public consultations: June 2006 - to date

When the EIA procedures started, in accordance with the cabinet decision of the Government Nepal (GON) dated on April 6 2005, the official approval for forest/tree clearance was requested from MOFSC before official approval of the Scoping Report and TOR for the EIA by MOEST. However, this cabinet decision was canceled in March 2006 because of policy changes, although the SWMRMC submitted a letter with the Scoping Report and TOR for the EIA on December 8 2005.

In April 2006, the SWMRMC prepared the tender document for consultant procurement for the EIA study and noticed the tender. After that, a local consultant was selected and the contract between the SWMRMC and the selected local consultant was concluded in May 2006. Finally the EIA study by the local consultant has started since the middle of May 2006. However, mainly because of the unstable social conditions around the site, the EIA study has been suspended frequently although unofficial consultation between the SWMRMC and local people has been conducted for contents of EIA as well as concept design of the site including extent of buffer area.

The latest schedule of the EIA procedures for the Banchare Danda Landfill site is shown in Figure 4.2-1. According to the SWMRMC, the EIA study would be re-started soon. In this case, the final approval of the EIA report is expected to be issued by MOEST at the end of August 2007 as of March 12, 2007.

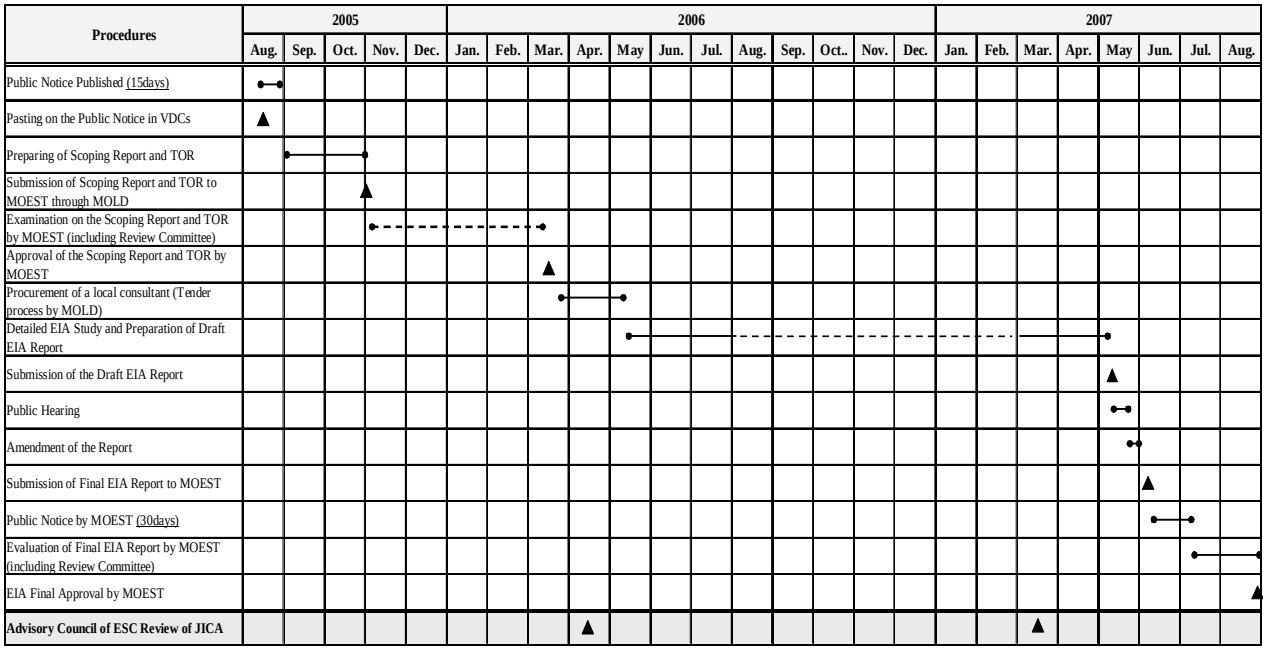


Figure 4.2-1 Schedule of EIA Procedures for Banchare Danda Landfill Site (As of March 12, 2007)

Source: JICA Study Team

The progress of the follow-up for the Bancahre Danda Landfill Site including the progress of the EIA was explained at the Advisory Council of JICA on March 12 2007. At the Advisory Council, systems of leachate treatment and surface water drain, possible risks by the floods at the site were mainly discussed in addition to the general question and answer on sold waste management system in the Kathmandu Valley.

4.3 Results of Follow-up Survey for EIA on Banchare Danda Long-term Landfill Site

4.3.1 Topography Survey

The topography survey for a total area of approximately 65 hectares was done at the Banchare Danda candidate LF site using the total stations method. The reference point was taken from the benchmarks located at Sisdol LF.

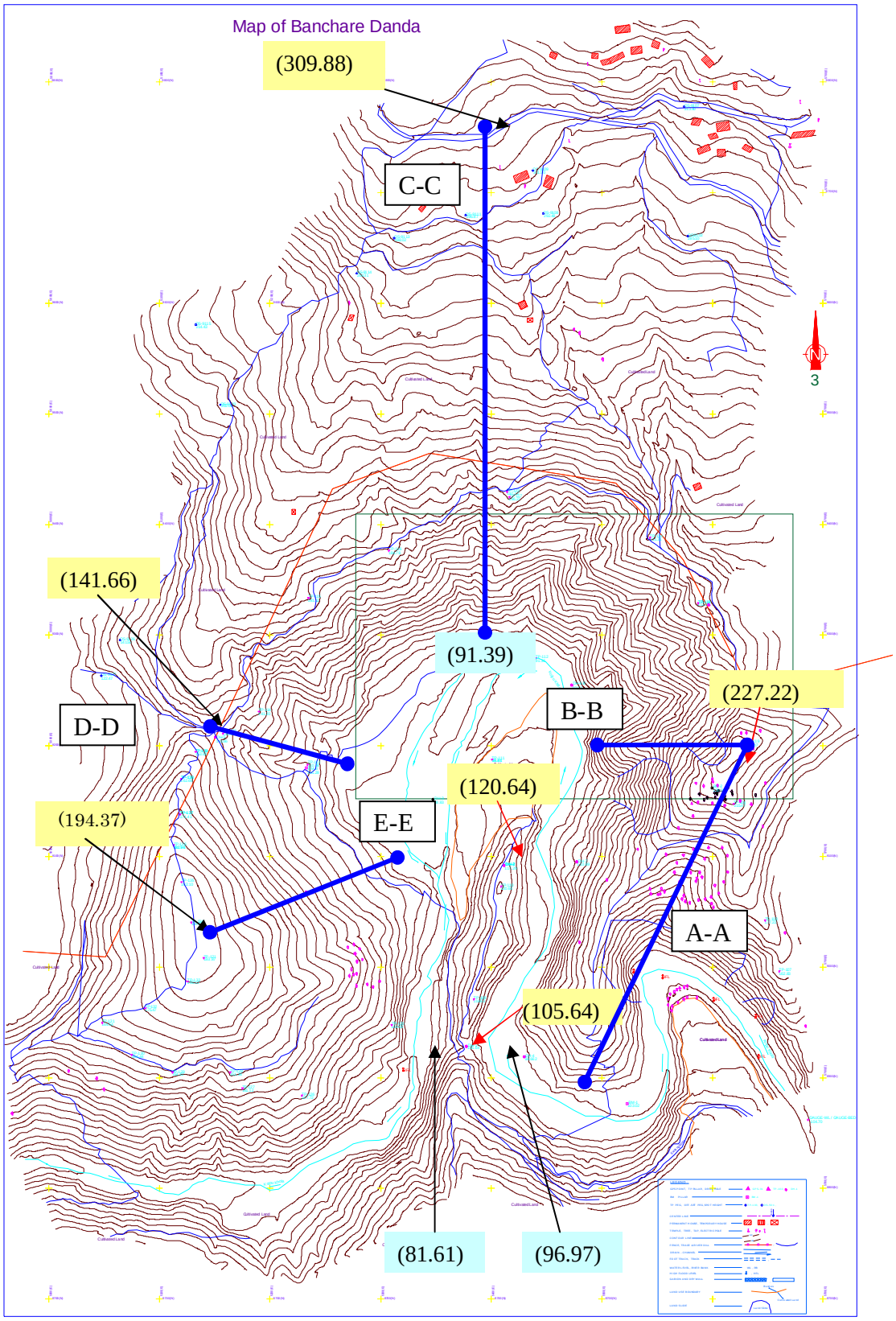
Contour lines were drawn at five (5) meter minimum intervals. Three permanent benchmarks were installed at the site. River cross sections were surveyed at approximately every 10 meter intervals. The maps were produced in Autocad files. The topography map produced is shown in the following Figure 4.3-1.

The site is formed by the meandering river, with a plateau in the middle in the north-south direction. There are two distinct ridges in the north-south directions along the east and west borders of the site, which may form the natural eastern and western boundaries of the site. However the site continues its ascension towards the north and up to the dirt road running east – west, where the topography survey was terminated. A distinct feature of this site is that it is difficult to delineate the northern boundary at present based on the natural topography. South of the river the terrain is ascending southwards.

The highest point along the western ridge is 194.37m (approx. height of 102m from the river edge) and 227.22 m along the eastern ridge (or 135m high). Along the northern side the elevation at the east – west road is 310m.

Slope inclinations are milder along the eastern slope (around 18o along section A-A and 13 o along section B-B in the figure). Along the northern and western slopes the inclinations are slightly steeper at 26o, 23o and 30o along sections C-C, D-D and E-E respectively.

The central plateau has a low level of 105.64m at the southern tip, with the highest point of 124.26m in the mid area. Just east of the plateau low point of the river level is 96.97m (i.e. a height difference of 8.67m) and on the west side the river level is 81.61 (i.e. 24.03m).



Source: JICA Study Team

Figure 4.3-1 Topography Map for Banchare Danda Site

4.3.2 Geological Survey and Soil Investigation

The Kolpu Khola River rises on the west slope of the mountain area, about 2,200 m high, at the north west edge of Kathmandu Valley, forms a steep V-shape valley, and meanders and flows westward around the Banchare Danda long-term Landfill site. The landfill site will be constructed on the riverbed of the Kolpu Khola River about 10 km westward of Kathmandu City after changing the river channel.

The riverbed with width is 20 m at an elevation of approximately 85-95 m at the proposed waste storage dam site and about 100 m in width at the waste landfill area.

The inclinations of the both banks at 85-200 m and above 200 m in elevation are about 45 degrees and 20 degrees respectively.

Two small terraces of about 3 m and 7 m in height above the riverbed occur on the center ridge of the site.

(1) Geology

1) Geological Component

The Banchare Danda long-term Landfill site is underlain mainly by meta-sandstone and schist belonging to Tistung Formation of the Kathmandu Complex. The ratio of meta-sandstone/schist is about 70/30 at riverbed of the Kolpu Khola and the ratio of meta-sandstone decreases towards the northern mountainous area.

Thick blocks (less than 5 m) or lenses of quartzite and gneiss are intercalated by meta-sandstone or schist, and a fairly large dyke of pegmatite is found in the middle flank of the northern slope of the proposed landfill site. These intercalated thin layers are generally highly weathered and deteriorated.

Two small terraces of 3 m and 7 m in height above the riverbed and covered with thin deposits are on the center ridge of the site.

Colluvium covering north-side and east-side slopes is less than one meter in general. Relatively thick, 3-5 m in parts, colluvium covers west-side hill area.

Alluvium occurs along the recent river, less than four meters thick in general, while relatively extended deposits are present on the riverbed at the west side of the landfill site.

Stratigraphy of the Banchare Danda long-term Landfill site is shown in Table 4.3-1.

Table 4.3-1 Stratigraphy of the Banchare Danda Long-term Landfill Site

Geological Age (Ma)	Formation	Description
Holocene (0.00-0.01)	Alluvium	Sand and gravel, loose. Less than four meters thick in general, while relatively extended deposits on the riverbed at the west side of the landfill site.
	Colluvium	Soil with gravel, loose in general. Less than one meter thick on north-side and west-side slopes of the proposed landfill site. Relatively thick colluvium covers west-side hill area.
Pleistocene (0.01-1.64)	Terrace deposit	Soil with rounded gravels, relatively loose. Small terraces of 3 m and 7 m in height above riverbed covered with thin deposits are on the center ridge of the site.
Lower Paleozoic (500 ?)	Tistung Formation	
	Rock Types of Tistung Formation in the Banchare Danda long-term Landfill Site (No stratigraphic order implied)	
	Alternation of Meta-sandstone and schist	(Meta-sandstone portion) Gray color, solid. Crack spacing ranges 5-10 cm in general, and the rock is relatively resistant to weathering and hard. (Schist portion) Dark gray, moderately solid Crack spacing is less than 5 cm in general. Weak and brittle biotite rich portions are distributed mainly on the northern part of the proposed landfill site.
	Gneiss (Quartzite)	Light grey color, highly weathered and deteriorated in general. Less than 5 m thick blocks or lenses.
	Pegmatite	Light grey color, highly weathered and deteriorated in general. Less than 5 m thick dykes.

2) Structure

The strikes of the bedding planes of the project area are basically extending E-W to ENE-WSW direction.

The bedding plans of meta-sandstone and schist dip 80-90 degrees northward at the proposed waste storage dam side, whereas the dip is about 50 degrees north-westward at the north side slope of the proposed landfill site.

An anticline structure is anticipated at the neck of the small ridge on which diversion facilities will lie.

3) Fault

No visible and continuous fractures are detected in the Banchare Danda long-term Landfill site except for small scale and minor discontinuities. An E-W trending fault separating the Tistung Formation of low-grade metamorphic rocks from gneissic rocks (high-grade metamorphic rocks) is inferred to lie to the north of the landfill site.

(2) Engineering Assessment

1) Waste storage dam

a. Site Geology

The waste storage dam site is underlain by alternation of meta-sandstone and schist dipping about 80-90 degrees northward. Relatively thick colluvium of about four meters covers the right bank of the waste storage dam (See Figure 4.3-2). Site conditions of Banchare Danda are summarized as below. See Supporting Report E for the criteria of Rock classification.

Table 4.3-2 Summary of Geological Condition of Waste Storage Dam Site

Location	Right Bank	Riverbed	Left Bank
Rock Type	Meta-sandstone, schist Dips 80-90 degree northward 0-4.35 m colluvium	Meta-sandstone, schist Dips 80-90 degree northward	Meta-sandstone, schist Dips 80-90 degree northward
Rock Condition	0-4.35 m colluvium 4.35-8 m D class 8-13 m CL class 13 m~ CM-CL class	River deposits 3.5 m upstream 0-1 m downstream Bedrock CM class	0-5~6 m CL class 5-6m~ CM class
Permeability	(10-15 Lu)	Less than 2 Lu 10 m~ about 1Lu	About 5 Lu

High Lugeon values of the right bank are probably caused by leakage during the permeability test.

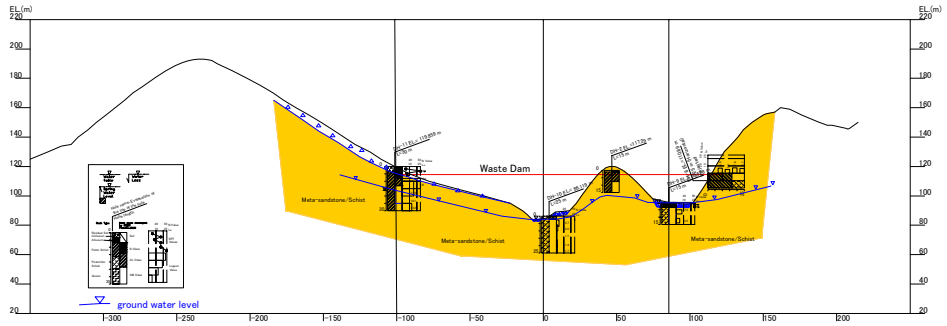


Figure 4.3-2 Geological Section of Waste Storage Dam Axis (View from Downstream side)

b. Expect Shear Strength

Expected shear strength of each rock class is as follows:

CM class : $\tau 0 = 10\ kgf/cm^2$

CL class : $\tau 0 = 4\ kgf/cm^2$

The above shear strength might be modified according to any new information following the geological investigations at the detail design stage.

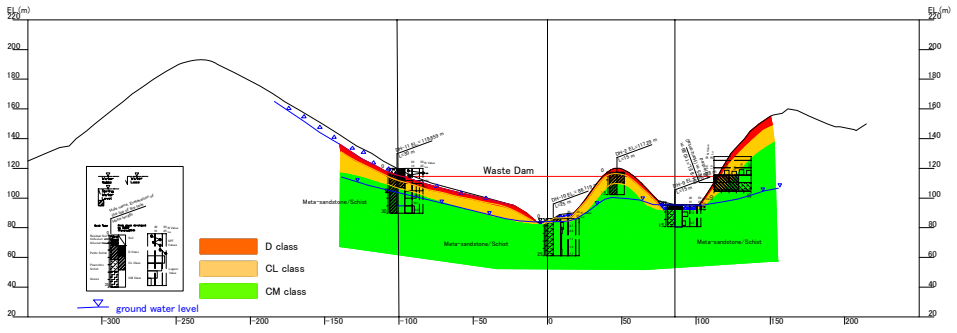


Figure 4.3-3 Rock Condition of Waste Storage Dam Axis (View from Downstream side)

c. Foundation Treatment

An impermeable layer of the bedrock (permeability coefficient: about 1.0 x 10 -5 cm/s, less than 1 Lu), occurs at the depth of about 10 m below riverbed. In addition, the geological structure of bedrock parallel to the dam axis and dipping 80-90 degrees will provide conditions that effective towards water shielding.

A vertical liner system with grouting works will be appropriate both technically and economically for foundation treatment, although additional drilling works to check the permeability of the foundation of the waste storage dam are still required.

In addition, a downstream-ward shift of the dam axis on the right bank side is preferable for the dam foundation, since the right bank of the waste storage dam is covered by relatively thick colluvium, which is relatively permeable.

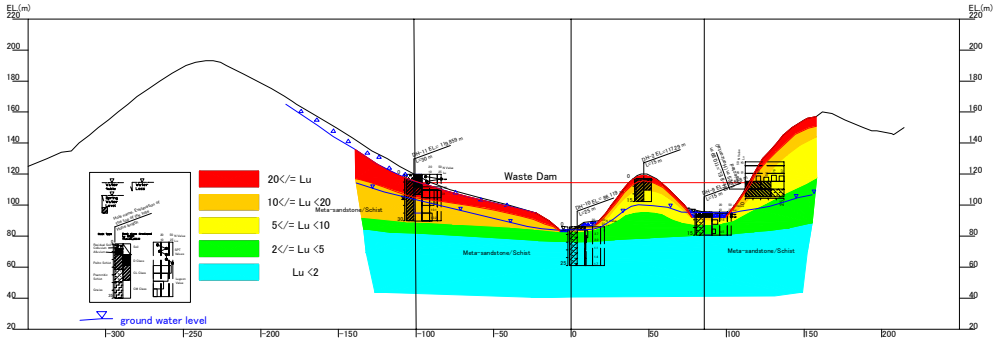


Figure 4.3-4 Lugeon Map of Waste Storage Dam Axis (View from Downstream side)

2) Landfill Area

a. Site Geology

The proposed landfill site lies on meta-sandstone and schist dipping northward steeply near the riverbed and relatively brittle biotite schist dipping 40-50 degrees north-westward dominates at the northern portion. A thin layer of highly weathered gneiss extends west-eastward at the west side saddle of the landfill site.

b. Leakage Risk of Polluted Water

There is no possibility of the polluted water leakage from north and east side, because a permanent spring is observed at the flanks of the slopes and the ground water level will be higher than impoundment level of landfill site (See Figure 4.3-5).

However, the leakage risk from the saddle of west-side slope cannot be denied due to the low groundwater level, based on drilling hole DH-12 data.

Therefore, seepage control works using impermeable clay etc. will be required at the saddle to prevent infiltration of polluted water from the landfill site.

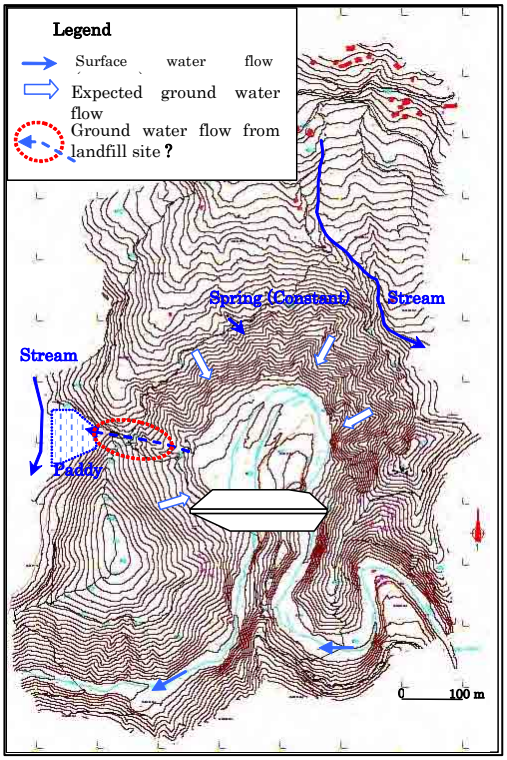


Figure 4.3-5 Image of Groundwater Flow at the Banchare Danda long-term Landfill Site

c. Slope Stability

No large-scale landslides, which are harmful to waste landfill works, have been detected in the landfill area.

3) Diversion

a. Site Geology

The site of the diversion facilities is underlain by meta-sandstone and schist rocks, whose fresh portions (CM class) are solid and suitable for the foundation of the diversion facilities (See Figure 4.3-6).

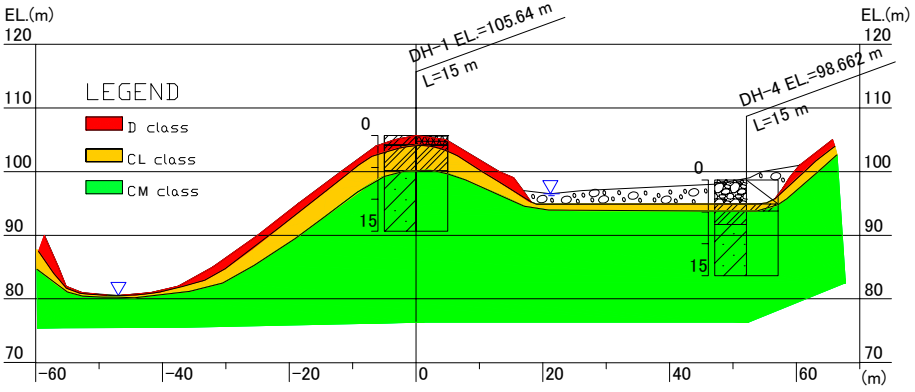


Figure 4.3-6 Rock Condition along the Center Line of Diversion

b. Slope Stability

The recommended stable gradient for cut slope based on field geotechnical assessment and the experiences in Japan is:

D class	H:V=1.0:1.0
CL class	H:V=1.0:0.8
CM class	H:V=1.0:0.6

Above stable gradient might be revised based on the observation on the cut slope.

4) Construction Materials

River deposits are suitable for concrete aggregates. However, obtainable quantities are roughly estimated to be 20,000 m3 and river deposits alone will be insufficient in quantity for the material resources. Excavated materials during the construction are also utilizable, although yield loss will be high since relatively thin-bedded meta-sandstone dominated around the waste storage dam site. Soil materials to cover solid wastes will be obtained from the hill on the west side of the landfill site.

5) Access Road

Although solid meta-sandstone and schist rocks are exposed on the riverbed, old landslide scars are distributed on the flank of the Kolpu Khola River immediately downstream of the Banchare Danda long-term landfill site and some slopes are covered by loosened materials. The road excavation at the toe of the slope would trigger slope failures. The access road on the left bank of Kolpu Khola is not advisable either technically or economically. It is recommended that the approach road be from the north side of the site for slope stability.

4.3.3 Hydrological Survey

(1) Objectives of the Hydrological Survey

The main objectives of the hydrological survey were (i) to gauge the natural condition of present land use, water use, meteorology and hydrology in/around the proposed landfill site, (ii) to assess potential impact to the surrounding lands before/after the river diversion and (iii) to carry out a river cross section survey. Collected data will be effectively used for design of the landfill site and formulation of O&M schemes for the landfill facilities.

(2) Methodology of the Study

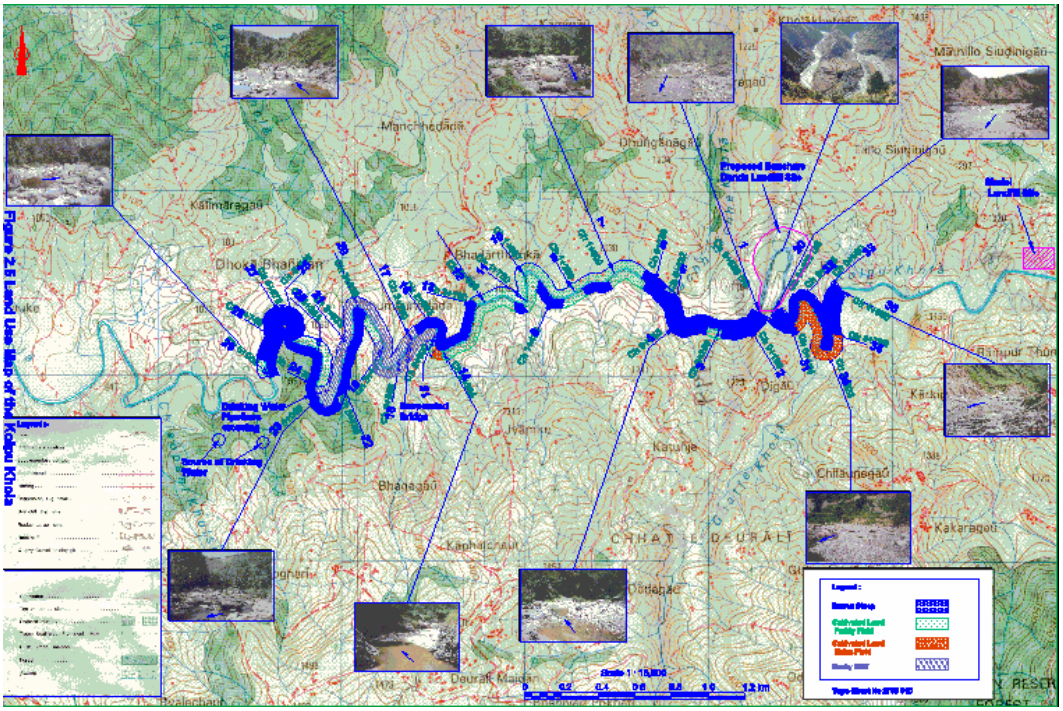
The survey area was set at 1 km upstream to 5 km downstream from the proposed landfill site. A field survey was conducted to confirm present land use and water use along the river. A river cross-section survey was also carried out during the field survey by using anAbney level. The river cross-section data was mainly used for hydrological analysis modeling of HEC-RAS to compute the water surface profile.

For meteorological observation, a new meteorological station was established at the Sisdol landfill site in June 2006. Observation equipment consists of a daily maximum and minimum thermometer, wet bulb and dry bulb thermometer and rainfall gauge. An evaporation pan has not been installed as of August 31 due to delay of procurement and administrative problems at the Sisdol landfill site. Daily maximum and minimum temperature, relative humidity and precipitation have been observed since middle of June. River water level has been measured three times a day since February 2006 whereas river discharge is measured once a week. The present gauging station was established in February 2006. In addition, riverbed materials were sampled at three points upstream of the diversion section to assess the potential of scouring the riverbed.

(3) Result of Land Use and Water Use

Throughout the field survey, two types of land use were mainly found in the survey area. One is barren land and the other one is cultivated land. Terrace lands are developed along the river and normally used for cultivation of paddy and corn. The major land use in the survey area is shown in Figure 4.3-7.

Regarding water use, it was reported that water use for irrigation purposes was found in some areas but it was not found to be used for drinking purposes anywhere. It is assumed that local people normally take their drinking water from streams and springs because the water quality of those is better than river water and it is heavy work to convey water to their houses on the hill. No use of groundwater was found throughout the field survey. The ground condition, which is composed of hard rocks, is not suitable for digging wells.



Source: JICA Study Team

Figure 4.3-7 Present Land Use Map along the Kolpu Khola

(4) Meteorological Observation at Sisdol Landfill Site

Results of meteorological observation at Sisdol landfill site since 1 July, 2006 are summarized as shown in the following table:

Table 4.3-3 Summary of Meteorological Observation

Sl	Item	Result
1	Mean Maximum Temperature	26.7 ^{0}C
2	Mean Minimum Temperature	21.8 ^{0}C
3	Highest Maximum Temperature	29.0 ^{0}C
4	Lowest Maximum Temperature	19.0 ^{0}C
5	Monthly mean Temperature at 8.45 AM	24.3 ^{0}C
6	Monthly mean Temperature at 5.45 PM	25.7 ^{0}C
7	Monthly Total Rainfall	558.6 mm
9	Mean Monthly Relative Humidity at 8.45 AM	81 %
10	Mean Monthly Relative Humidity at 5.45 PM	76 %

Source: JICA Study Team

(5) River Discharge of Kolpu Khola

River discharge has been measured at existing gauging station established in January 2006. Greater discharge was observed after heavy rainfall. Results of discharge measurements are summarized in the following table:

Table 4.3-4 Weekly Discharge Measurement

Month	Minimum Discharge		Maximum Discharge		Average Discharge
	Lps	Date	Lps	Date	Lps
June	84	Jun. 17	133	Jun. 24	109
July	177	Jul. 01	2,459	Jul. 08	1,300
August	777	Aug. 12	3,321	Aug. 26	1,448
Total	84	Jun.17	3,321	Aug. 26	952

Source: JICA Study Team

(6) Design Flood Discharge Estimation

For estimation of design flood discharge, the probable maximum 24-hrs rainfall was firstly estimated on the basis of past rainfall data for the last 30 years at three meteorological stations in the vicinity of the river catchment area of the proposed landfill site. The resulting probable rainfall is tabulated below:

Table 4.3-5 Probable Maximum 24-hrs Precipitation

Return Period (yr)	2	5	10	20	50	100
24-hr Rainfall (mm)	81	103	120	139	164	185

Source: JICA Study Team

The design flood discharges for various return periods were established during the last study term using some computation methods. The results for design flood discharge are tabulated as follows:

Table 4.3-6 Probable Flood Discharges in Various Return Periods

Return Period (year)	2	5	10	20	50	100
Probable Discharge (m3/sec)	150	190	220	260	300	350

Source: JICA Study Team

(7) Water Surface Profile

Water surface profiles under the various probable floods were computed employing HEC-RAS, which has been developed as a one-dimensional hydraulic calculation model by the Hydraulic Engineering Center of the U. S. Army Corps of Engineers. Table 4.3-7 presents the water level for different flood discharges at adjacent points in the upstream and downstream of the river diversion channel.

Table 4.3-7 Water Level for Different Probable Floods with Project

Location	Riverbed Level (m)	2-yr Flood Water Level/depth (m)	50-yr Flood Water Level/depth (m)	100-yr Flood Water Level (depth) (m)
Upstream	97.0 m	99.2 m/2.2 m	99.9 m/2.9 m	100.1 m/3.1 m
Downstream	81.0 m	83.7 m/ 2.7 m	84.9 m/3.9 m	85.2 m/4.2 m

Source: JICA Study Team

The flood water surface profile of design flood discharge with a 100-year return period is presented in Figure 4.3-8. According to the result of computation, the water level might be lower than present land before and after the river diversion. It was concluded that projected impact to the surrounding area would not be serious.

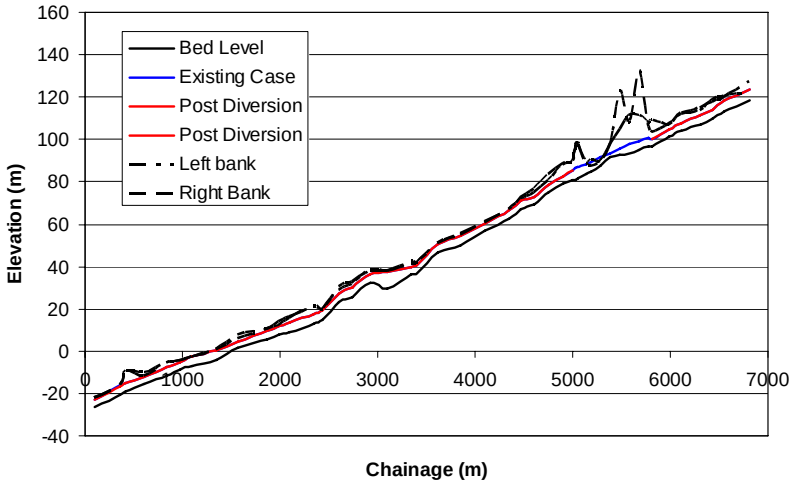


Figure 4.3-8 Flood Water Profile for 100-year Return Period

(8) Riverbed Material Survey

Riverbed materials surveys were conducted at three locations in the upstream side of the diversion point as shown in Figure 4.3-9. Grain distribution tests were done using collected materials at each sampling point as shown in the following figure. As a result of the tests, the

mean grain diameter for riverbed material (Dm) was estimated at around 35 mm by reading grain diameter at 50% percent passing.

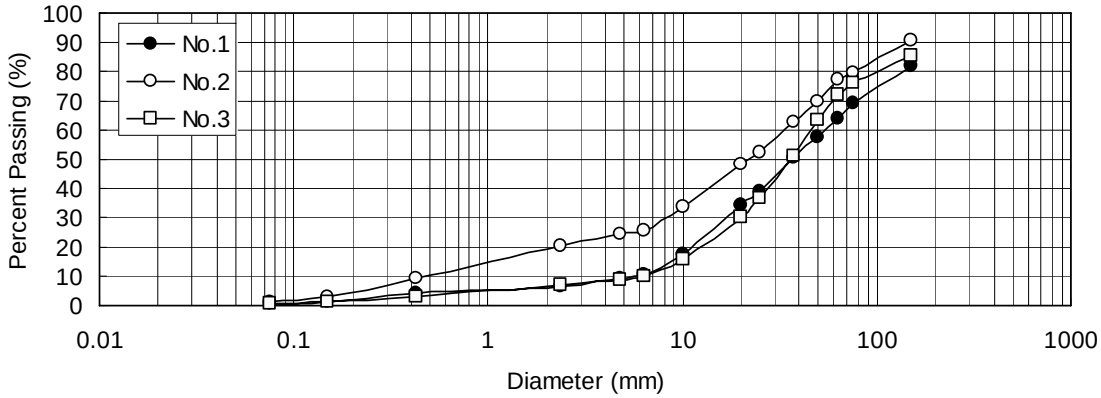


Figure 4.3-9 Grain Distribution of Riverbed Material

Degradation of riverbed can be assumed around the mouth of the diversion channel because the critical velocity, which has a greater attractive force, will arise at the beginning of the drop section. It was assumed that the attractive force of the river flow might be greater than the critical attractive force of the riverbed material when the taking proposed design of the diversion channel into account. As a result the riverbed protection is recommended.

4.3.4 Supplemental Environmental Survey

A supplemental environmental survey was organized for sampling river water at five points, two from groundwater and three from river water, around the proposed landfill site and an analysis carried out in accordance with designated parameters. Water sampling was held two times in each dry season and rainy season. Results of the water quality analysis are summarized in the following table:

Table 4.3-8 Result of Water Quality Analysis

Parameter	River		Groundwater	
	Dry	Rainy	Dry	Rainy
pH	8.5	8.4	7.7	7.4
Dissolved Oxygen (DO): mg/l	8.7	8.3	4.7	3.0
Total Dissolved Solids (TDS): mg/l	131	116	139	138
Total Suspended Solids (TSS): mg/l	327	81	1,859	2,073
Biochemical Oxygen Demand (BOD): mg/l	7.7	4.4	18.6	17.5
Chemical Oxygen Demand (COD) : mg/l	20.0	28.8	65.4	80.4
Iron as Fe mg/l	0.17	0.17	47.3	13.1
Manganese as Mn mg/l	0.05	0.05	1.39	0.69
Ammonia- Nitrogen (NH_4-N) mg/l	1.67	0.12	1.44	0.63
Fecal Coliform (MPN/100ml)	2,400	329	5,100	584

Source: JICA Study Team

In general, it was found that the water quality of the dry season becomes worse than that of the rainy season because the river discharge is quite a lot less during the dry season.

4.3.5 Concept Design

(1) Basic considerations for the design

The Banchare Danda Sanitary Landfill is required to store and speed up the decomposition of the disposed municipal waste within a confined space and mitigate negative impacts to the surrounding environment.

A workshop was held on June 1st, 2006 and the following items were adopted as basic considerations for the design:

1) For the sanitary landfill the semi-aerobic type shall be applied.
2) A horizontal liner shall be applied along the site bed and to a height of around 5 meters along the slopes. The potential adoption of a vertical liner as an alternative shall be considered.
3) In order to estimate the leachate quantity, the average rainfall data from the stations at both Kakani and Dhunibeshi shall be used.
4) Leachate treatment shall be by aeration and sedimentation ponds with re-circulation, and the ponds shall have sufficient capacity to limit discharge of the leachate to the adjacent river. In this regard effective measures should be taken to restrict disposal of unacceptable waste types at the site.
5) The waste storage dams shall be constructed by the soil-cement method.
6) Passive venting of the landfill gas shall be adopted in the concept design[1].
7) The access road under design by the SWMRMC should lead into the administration area proposed to be constructed on the western area of the site.

(2) Site characteristics to be considered in the design

The characteristics of the Banchare Danda site were carefully studied and considered within the concept design. The main points considered were as follows:

1) Slopes

The slopes of the hills circling this site are steep, uneven and have experienced landslides in some areas. Therefore no works were planned on the slope surfaces to ensure the stability was not disturbed. It is considered that as the waste disposal progresses, the weight of the landfilled waste will support the slope and assist stability.

2) Reduction of leachate generation

This site has very high precipitation and measures for reduction of leachate are important.

[1] The Nepalese side reserved the option at a later design stage to consider the potential for introduction of a flaring system to link as a CDM project.

a. Surface drainage of slope

In order to reduce the generation of leachate, it is necessary to install a rainwater drain along the slope rim to stop the rainwater from running into the waste disposal area. However due to the nature of the slopes, installation of such drains in many parts is not possible. Accordingly it was decided to install the drain at the level of RL + 115m, and on top of the waste dam.

b. Installation of block embankment

The designed block embankment will function to drain away rainwater falling outside the active disposal area.

3) Liner facility

Due to the nature of the slopes it was difficult to install the liner along the slopes, and therefore a horizontal liner was designed only on the bed of the site. Since the coefficient of permeability of the soil along the slope is small the possibility that leachate will permeate to the groundwater from the slope is considered low.

The design also considers the potential for installation of a vertical liner which, although it may not provide cost saving, will be much easier to construct and maintain. Detailed soil and hydro-geological surveys should be done to ensure the integrity of the vertical liner system.

4) Waste slippage

This site is located adjacent to the river and therefore there is valid fear that the waste may slide into the river. In order to reduce this danger the design requires the waste slope to be slight, and with limited heights.

(3) River Diversion

1) General

The proposed diversion channel will cut the central plateau at the neck of a deep bend in the river. The diversion section has to connect a horizontal gap of 80 m and vertical gap of 18 m between both riverbeds. Geology in the proposed diversion route is mainly composed of meta-sandstone and schist rocks, which are confirmed to be fresh and solid. Such bedrocks are exposed in many places along the riverbanks and riverbed especially downstream of the diversion section.

2) Design Conditions

The design conditions of the river diversion channel are summarized as follows:

Table 4.3-9 Design Conditions

Subject	Conditions
Design Flood Discharge	350 m^3/sec (100-year return period)
Channel Bed Level	EL 97.0 m (upstream), EL 81.0 m (downstream)
Flood Level	WL 100.1 m (upstream), WL 85.2 m (downstream)
Drop Height	17 m
Geology	Hard rock (CM Class)

Source: JICA Study Team

3) Layout Plan of the Diversion Channel

The proposed route of the river diversion has been studied from geological, technical, and economical points of view. The channel should be made as short and shallow as possible for reduction of construction cost. In addition, the channel alignment should avoid any geological negative impact to past landslide scars on both banks downstream of the diversion section as shown in the following figure:

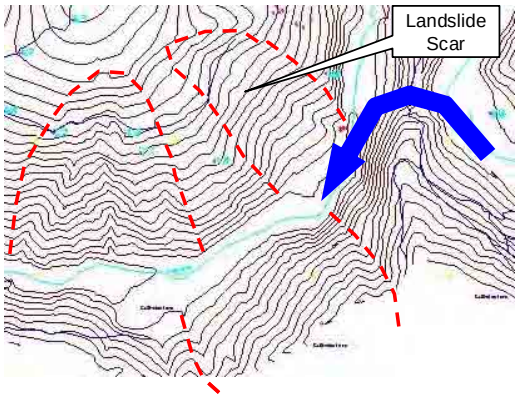


Figure 4.3-10 Location of Past Landslide Scars

Throughout the study, the route passing the saddle point of the central plateau was selected from technical and economic points of view. The structural type for the diversion channel was selected through the comparative study as shown in the following table:

Table 4.3-10 Comparative Study of Drop Channel Type

Aspect	Cascade Type	Chute Type
1.**Technical**	***Advantage:*** i) Effective energy dissipation against operating head more than 15m ensures. ii) Design is relatively easier compared to others. iii) Lesser basin length and protection works can be requested. ***Disadvantage:*** i) Scouring of bed in the apron is bigger than chute type. ii) Low height of cascade cannot be adopted in the current site space.	***Advantage:*** i) Effective energy dissipation against operating head more than 15m ensures a hydraulic jump in the stilling basin. ii) Prospective risk of scouring in the channel bed is less than cascade type. ***Disadvantage:*** i) Channel length becomes longer than cascade type.
2.**Environmental**	i) Serious damage for floating life in the river due to the higher drop. ii) Excavation volume becomes more than chute type.	i) From the landscape viewpoint, chute is more suitable than cascade. ii) Excavation volume becomes less than cascade type.
3.**Economic**	NRs. 39,450,000	NRs. 62,590,000

Source: JICA Study Team

The construction cost of the cascade channel was considerably cheaper than that of the chute channel. But structural and environmental disadvantages of the cascade channel were more serious problems for sustainable operation. In the end, the chute channel was selected as the appropriate option for the river diversion scheme. The proposed layout plan is shown in Figure 4.3-11. Details of the concept design of the river diversion channel are illustrated in the Drawings.

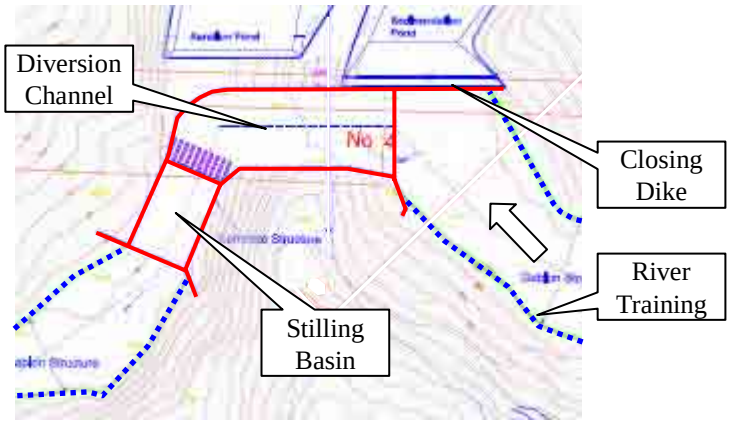


Figure 4.3-11 Proposed Layout of Diversion Channel

4) Related Structures

Gabion is basically recommended for the river training work from the viewpoint of cost reduction and easy maintenance. The filling stones in adequate size are readily available at the site. The gabion protection is common for river training works in Nepal.

The closing dike will be constructed as a permanent structure to cut and turn the present river flow into the river diversion section. The proposed location of the closing dike is shown in Figure 4.3-11. At the beginning of the layout planning, it was proposed that the closing dike would be separate from the leachate pond facilities. Eventually it was recommended that the closing dike be combined with the leachate pond structure so that it functioned as a guide wall for the river flow and a side wall of the leachate pond as shown in Figure 4.3-11

5) Small Hydropower Generation

There is 18 m vertical gap at the river diversion section. Potential of small hydropower generation was briefly studied during study period. As a result of the study, potential of small hydropower was estimated at 30 kW with 95% dependability on the basis of the long-term flow rate of the Kolpu Khola at the Banchare Danda landfill site. Small hydropower was not basically recommended under this project

(4) Design Capacity

The Banchare Danda LF will function to dispose of the municipal wastes collected from KMC, LSMC and KRM. The estimated disposal waste amounts have been prepared based on

the Umbrella Concept presented in the Final Report for the earlier phases of this study in September 2005, and are shown in Table 4.3-11.

Table 4.3-11 Estimated Waste Disposal Capacity required from KMC, LSMC and KRM up to Year 2029

No.	YEAR	Waste Disposal Quantity		Compacted Volume (m^3/year) (Density=1t.m^3)	Soil Cover (m^3/year) (20% of Waste Volume)	Accumulated Volume of waste and cover (m^3)
		t/d	t/year			
1	2009	351	128,115	128,115	25,623	153,738
2	2010	308	112,420	112,420	22,484	288,642
3	2011	332	121,180	121,180	24,236	434,058
4	2012	357	130,305	130,305	26,061	590,424
5	2013	312	113,880	113,880	22,776	727,080
6	2014	336	122,640	122,640	24,528	874,248
7	2015	353	128,845	128,845	25,769	1,028,862
8	2016	376	137,240	137,240	27,448	1,193,550
9	2017	398	145,270	145,270	29,054	1,367,874
10	2018	432	157,680	157,680	31,536	1,557,090
11	2019	466	170,090	170,090	34,018	1,761,198
12	2020	433	158,045	158,045	31,609	1,950,852
13	2021	472	172,280	172,280	34,456	2,157,588
14	2022	507	185,055	185,055	37,011	2,379,654
15	2023	545	198,925	198,925	39,785	2,618,364
16	2024	584	213,160	213,160	42,632	2,874,156
17	2025	624	227,760	227,760	45,552	3,147,468
18	2026	667	243,455	243,455	48,691	3,439,614
19	2027	711	259,515	259,515	51,903	3,751,032
20	2028	759	277,035	277,035	55,407	4,083,474
21	2029	809	295,285	295,285	59,057	4,437,816

Notes:

1) The disposal waste quantities up to 2015 were estimated in the Study
2) For the period from 2016, the waste quantity was estimated considering the increase of population and unit generation rate.
3) Expansion of the capacity of WPF is planned to be 200 t/d in 2010, 300 t/d in 2013, and 400 t/d in 2020.
4) It is recommended that waste quantity and quality surveys be made on a regular basis in order to make more accurate waste amounts forecasts. Monitoring of actual waste disposal quantity should be done by using weigh bridges.

On the other hand the volume of the landfill has been estimated to be 3.96 million m^3. Accordingly the Banchare Danda Landfill is expected to have a life span of between 19 and 20 years.

(5) Leachate Quantity Estimates

1) Calculation Method

The quantity of leachate has been calculated use the following rational formula. The calculation period duration was fixed at 30 years (20 years for landfill operation and 10 years for operation and maintenance).

$$Q = 1 / 1000 \times (C1 \times A1 + C2 \times A2) \times I - Q1$$

where,

Q : Leachate quantity in the pond (m^3)
C1: Coefficient for seepage into disposal area
C2: Coefficient for seepage into soil covered area (C2 = C1 X 60%)
A1: Waste disposal area (m^2)
A2: Soil covered area (m^2)
I : Daily rainfall intensity (mm) : past 30 years
Q1 : Amount of evaporation (m^3)

2) Daily rainfall

There is no meteorological station located in the vicinity of the project site. The nearest stations were in Kakani (elevation 2,064m, distance 5km) and Dhunibeshi (elevation 1,085m, distance 6.5km). The elevation at the project site is 1,100m, which is similar to Dhunibeshi station, but the site is closer to Kakani. Therefore at this time the average rainfall data from both stations were used in the estimation.

It should be noted, however that a meteorological station has been set up by the Study at Sisdol and data should be collected for at least one year. Thereafter the rainfall intensity should be once more re-estimated.

3) Coefficient for Seepage

The coefficient for seepage has been calculated applying the Bleaney and Criddle method. The formula is as follows:

$$C = I / E_{pt}$$

where,

C : Coefficient for monthly seepage into disposal area
I : Monthly rainfall
E_{pt}: Monthly Evapotranspiration (= 25.4 x K x S x t)
K: Empirical crop and meteorological coefficient (landfill = 0.7)
S: Monthly percent of annual sunshine hours
t: Monthly average temperature (^oF)

4) Target Area

The target area has been fixed at the 115 m level[2] where the area is the largest. In order to reduce leachate production the area is divided into four (4) sections, as shown in Figure 4.3-12.

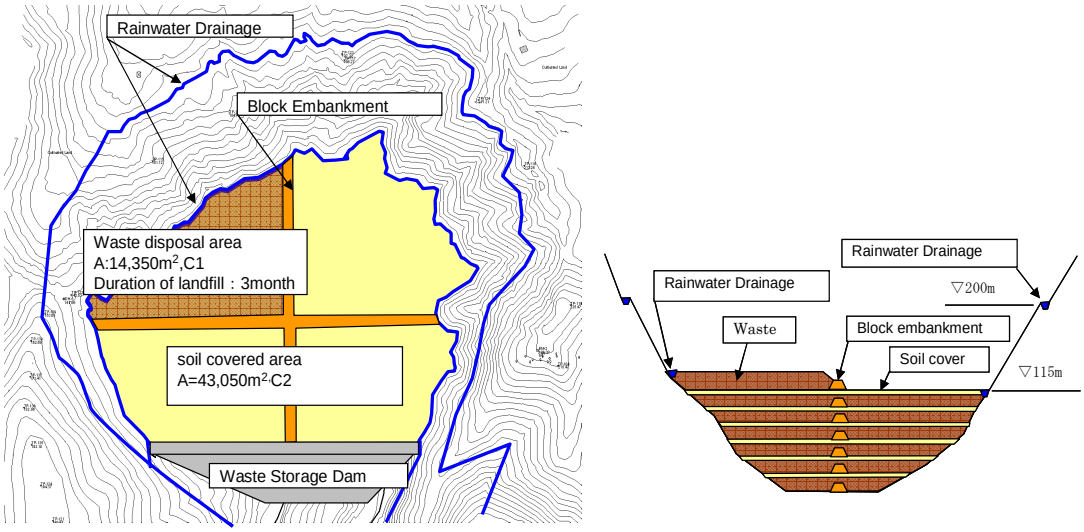


Figure 4.3-12 Plan and Section of Landfill at 110m level

5) Amount of Evaporation

The amount of evaporation resulting from re-circulation of the leachate back into the landfill site is estimated as follows:

- Wet season : 10% of the re-circulated leachate amount
- Dry season : 30% of the re-circulated leachate amount

6) Estimation result

In order to determine the size of the aeration and sedimentation ponds the rainfall data for the past 30 years has been used. The generated leachate amount is estimated daily for this period, allowing for losses by evaporation. The results are graphically presented in Figure 4-3-13.

The results show that an aeration pond and sedimentation pond with a combined capacity of 60,000 m^3 will be sufficient to handle 30 years' of leachate generation, after losses by evaporation, and because they can be secured within the site there should be no reason for discharge into the adjacent river.

[2] Levels at the site do not correspond to the level of 1,100m mentioned earlier which is taken from the 1:25,000 maps

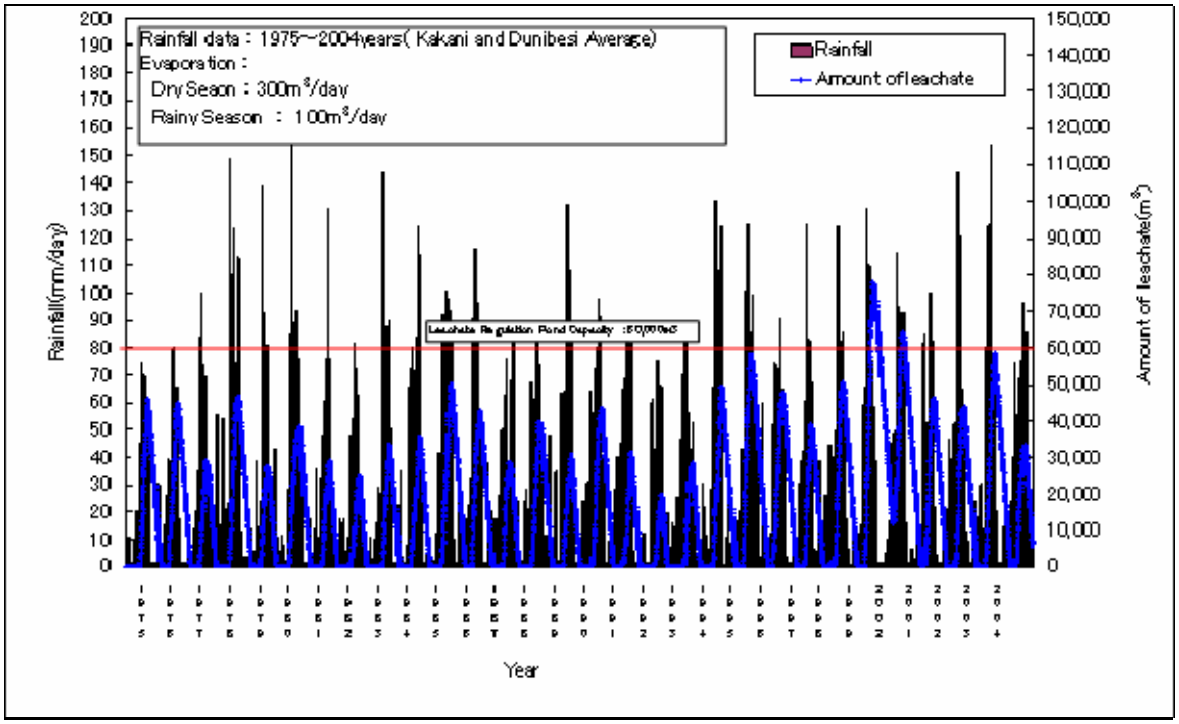


Figure 4.3-13 Quantity of Generated Leachate using past 30 Years' Rainfall Data

(6) Facilities Plan with Phased Development

It is necessary to start the waste disposal activities at Banchare Danda Landfill, considering the remaining capacity of the Sisdol S/T LF. Therefore the landfill shall be developed in two phases. In Phase 1, there are two stages, and the waste disposal operations will start upon completion of Phase 1 – Stage 1. In order to function as a sanitary landfill, facilities need to be provided. These may be broadly categorized into main, administrative and secondary facilities.

Figures 4.3-15, 16, 17 show the layouts for the landfill before commencement of waste disposal operation in Phase 1, completion of the landfill operation and longitudinal section respectively.

A description of the facilities and their respective functions is given in Table 4.3-12.

Table 4.3-12 Functions and Structural Description of the Landfill Facilities

Items	Function	Structure
Main Facilities		
1.Waste storage facility		
Waste storage dam	In order to prevent the waste out-flowing from the landfill site and maintain the waste accumulation at a certain height during landfill operation, the Waste storage dam shall be constructed downstream of the landfill site.	Materials for dam construction shall be excavated soil (gravel and soil) mixed with cement. Shape is a trapezoid, upper base is 5m, height is 20 to 30m, and grade of slope 1:1. The dam is to be constructed in two phases. Phase-1 will be to an elevation of 100m, Phase-2 to an elevation of 115m.
Block Embankment	Block embankment will be provided along the center of the disposal area for leachate reduction, and efficient landfill operation.	Construction of embankment with soil. Shape is a trapezoid, upper base is 3m, lower base 15m, and height 3m.
Saddle dam	The saddle dam will be constructed at the saddle along the western border of the landfill, to prevent waste from flowing out of the site.	Materials for dam construction shall be excavated soil (gravel and soil) mixed with cement. The Saddle dam shall be constructed in Phase 2.
2.Liner facility	Impermeable facility within the landfill for preventing leachate from infiltrating into ground and flowing into the river. Two alternatives of horizontal liner and vertical liner have been examined. In this concept design the horizontal liner was adopted, however it is recommended to continue study of vertical liner applicability based on a detailed soil and hydro-geological investigation.	Horizontal liner From the ground upwards; (1) compacted clay liner (t=50cm, permeability coefficient<10^{-6}cm/s), (2) Geotextile layer (t=10mm), (3) Geo-membrane liner (t=1.5mm), (4) Geotextile layer (t=10mm), and (5) protection layer of clay soil (t=50cm)
3.Rainwater drainage facility	To drain the rainwater running off the slope of the landfill site and prevent rainwater collected having access to the waste areas.	U-shaped gutter of bottom width 300mm x depth 600-700mm in the trench
4.Leachate collection	A facility installed above the liner facility to collect leachate and convey it to a leachate treatment facility. The leachate collection system, in combination with the landfill gas collection vents will serve to convey air into the waste layers to enhance semi-aerobic conditions.	Main pipe: Installation of perforated RC pipes of dia. 1000 mm surrounded by gravel. Branch pipe: Installation of perforated RC pipes of dia. 400mm surrounded by gravel.

Items	Function	Structure
5.Leachate treatment	This facility will treat/ purify leachate to mitigate impact on the surrounding environment. The leachate treatment system adopted is the aeration treatment and sedimentation treatment.	The capacity of aeration pond is 20,000m^3 and sedimentation pond 40,000m^3. Eight blowers (7.5kW per unit) shall be set up in the Aeration pond. Each pond is constructed with RC walls and concrete spraying.
6.Leachate Re-circulation facility	This facility will re-circulate leachate back to the disposal site, contributing to reduction of the leachate amount, and providing further treatment of leachate under anaerobic conditions.	Installation of re-circulation pump of capacity 15KW, sprinkler and portable flexible hose pipes (80mm dia).
7.Gas collection facility	In order to prevent fire and/ or explosion hazards, impact on ecological system, and offensive odor to surrounding areas caused by produced gases; i.e. methane carbonic dioxcide, nitrogen, ammonia, etc., gas removal facilities shall be installed.	Install perforated RC pipes of dia. 300mm vertically at 20m spacing and surrounded by stone boulders inserted within encircled wire mesh to heights of 2.5m.
Administrative Facilities		
1.Administration building	A building office for the site staff, including space for visitors.	Two-story RC and Brick structure with area of approx. 200m^2
2.Operation road	Roads are built from the administration area to the landfill site bed for construction and landfill operation purposes.	Construction of concrete paved roads with carriageway widths of 5m.
3.Weighbridge	Measures the gross weight of trucks loaded with waste and measures the tare weight again after they dump the waste to control the landfill volume.	Installation of weighbridge (1set). In the future, weighbridge of Sisdol landfill site will be used, too. The specification for max. capacity of 30 tons. The foundation has concrete pits.
4.Vehicle Wash Facility	A facility for washing the tires of waste trucks before they exit the site.	Installation of car wash pool and High-pressure washing machine in two sets. The specification of High-pressure washing machine ; Motor: 3.7kw, and Discharge pressure: 50kgf/cm^2～
Related Facilities		
1.Enclosure facility	Enclosure facility is built along the boundary of landfill site premises and the outer circumference of the landfill to provide access control and prevent waste scattering.	Chain Link fencing of 800 mm high over 1200 mm high Brick wall. Gates at the site entrance

(7) Landfill Operation and Maintenance Guidelines

The operation and maintenance is important in order to manage the final disposal site appropriately and decrease the required O&M efforts during the post-closure management (PCM) stage.

1) O&M Activities

For operation and maintenance of the final disposal site, the following activities are necessary:

- Collection vehicles control: Control waste collection trucks coming to the site.
- Departing vehicles control: Control the departing vehicles
- Facilities maintenance operation: Operate and manage the facilities of the landfill site as well as the road system, preparation of waste cells and extension of the vertical gas vents, etc.
- Landfill operation management: Daily operation activities as waste placement, compaction, application of soil cover, leachate treatment system operation, etc.
- Environmental monitoring: Monitoring in order to gauge and provide timely countermeasures for any impacts generated from the disposal activities

2) Operating days and time

- Daily operating hours: 6:30 to 15:00
- Saturday and National holidays: 6:30 to 13:00
- These hours will apply to all seasons

3) Collection vehicles control

In order to properly plan and implement the landfill operations efficiently, it is necessary to understand the quantity of landfill waste and its properties. It is also necessary to maintain an adequate information recording system.

The quantity and the composition of carried waste and cover soil shall be recorded for each hauling vehicle and tallied. The measurement of the waste and the cover soil shall be implemented using the weighbridge.

4) Departing vehicles control

It is necessary to wash vehicle tires in the car washing facilities before their departure because the waste may adhere to the tires of the vehicles carrying waste and others entering the landfill site. Traffic flow control of the entering and departing vehicles shall also be managed.

5) Facilities maintenance management

The final disposal will function properly only when each of the individual facilities is well maintained and operated.

For appropriate management of the individual facilities, each shall be checked daily and when an abnormality is found and a prescribed function is not demonstrated, necessary action shall be immediately taken. Mechanics shall be included within the site operation staff, and sufficient budget should be made available for the maintenance and repair activities.

6) Landfill operation management

Along with securing the quantity of disposed waste, and from the view point of the rapid stabilization of the landfilled waste as well as improving the quality of leachate and gas generated, proper operation should be enforced.

a. Operation procedure

Wastes coming to the landfill site shall be measured and checked. Afterward, wastes are unloaded, spread and compacted with bulldozer to a certain thickness. Wastes are covered with daily soil at the end of operating hours.

This daily operation will continue to form the prescribed landfill shape.

b. Landfill operation plan

① Landfill Operation

Landfill method: Cell method is applied. In this method, wastes will be covered with soil at the end of daily operation hours, to form a waste disposal cell. The height of cell should be 2-3 m.

Thickness of each waste layer: within 50 cm

② Cover soil

Cover soil is the basic and the most effective countermeasure against environmental impact generated at the landfill site; such as waste scattering, offensive odor, harmful insects, waste self-burning reduction, reduction of leachate etc.

Covering will be carried out as follows;

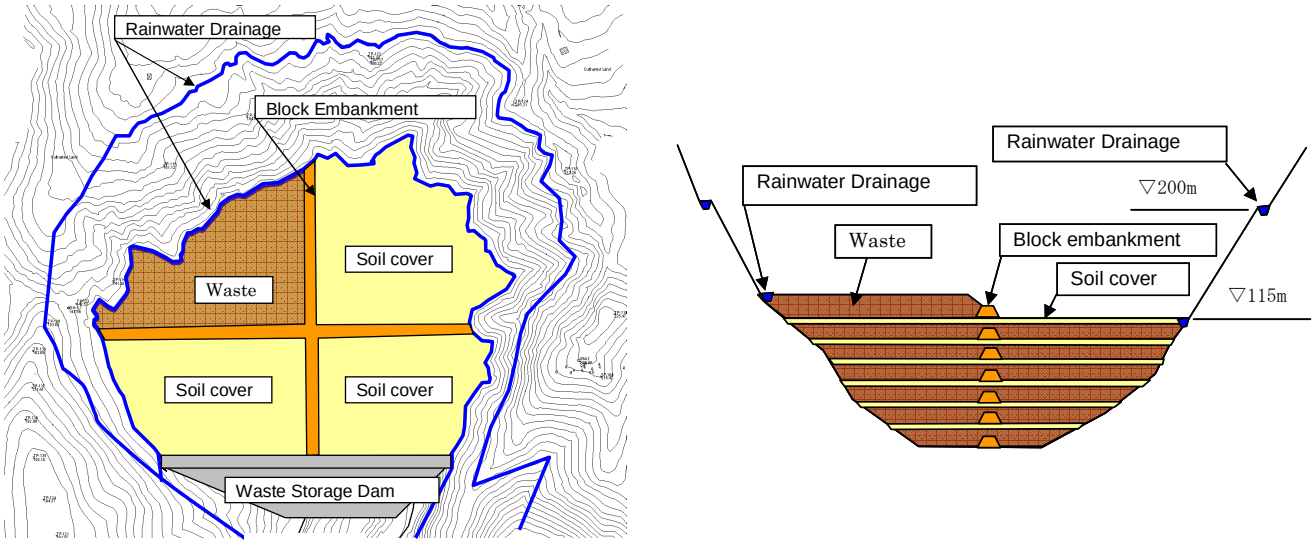
Daily cover: minimum 10 cm.

Intermediate cover: minimum 50 cm

Final cover: minimum 150 cm

③ Landfill plan

A block embankment will be provided along the center of the disposal area for leachate reduction, and efficient landfill operation. (Refer to Figure 4.3-14);



Plan Section

Figure 4.3-14 Landfill Operation Plan

(8) Operation and Maintenance Structure

In order to provide the necessary operation and maintenance as described above, sufficient staff and heavy equipment shall be allocated to the site.

Table 4.3-13 shows the proposed staff and their respective duties. The second part of the table describes the heavy equipment requirements.

Table 4.3-13 Landfill Staff and Heavy Equipment

Item		No.	Duty/ Function
A. Landfill O&M Staff			
1)	Manager/ Engineer	1	Overall site operation management including environmental monitoring
2)	Engineer	2	Plan daily operations, maintain records, analyze data, and survey works for waste height control
3)	Clerk/ Secretary	1	Manage petty cash, maintain site operation records, spare parts inventories, etc.
4)	Weighbridge operator	1 (2)	Operate weighbridge facility and keep records of incoming wastes
5)	Heavy equipment operators	8 (9)	Operate heavy equipment used at the site and area from where materials for soil cover are taken.
6)	Mechanic	2	Maintain and repair landfill equipment and heavy equipment
7)	Workers	4	Undertake miscellaneous works in connection with the operations
8)	Truck drivers	2	Drive the soil trucks and maintenance pick-up
9)	Guards	2	Maintain site security
Total STAFF		23 (25)	

Item		No.	Duty/ Function
B. Heavy Equipments			
1)	Bulldozer	1 (2)	Description: 220 HP, 24t, track height 550mm Function: Waste spreading and compacting
2)	Compactor	1	Description: 35t Function: Waste spreading and compacting
3)	Wheel loader	1	Description: 3.5m^3, 200-230 HP, 18t Function: Transport soil cover materials from the source area of the soil materials to the truck
4)	Excavator	2	Description: 0.8m^3, 18t, 125-130 HP Function: Excavate in soil and waste to clear ditches, prepare cells, and dig materials for cover
5)	Dump truck	2	Description: 10t class Function: Transport materials for soil cover, other functions such as equipment and labor transport, etc.
6)	Water tanker	1	Sprinkle water on the waste as countermeasure against scattering, road maintenance, and fire prevention

Note: Figures in brackets indicate value after year 2019

(9) Environment Monitoring

The environmental impact on the surrounding area shall be measured and observed regularly so that the landfill site does not pollute the surrounding environment. Sound environmental management that prevents environmental pollution before it occurs is necessary. The environmental management is as follows:

1) Water quality monitoring (inspection) of groundwater

Water quality test of groundwater is performed to make sure that the liner facility of the landfill site is functioning properly and that groundwater is not being contaminated. Groundwater samples shall be collected and analyzed from two or more observation wells or groundwater collection/drainage facilities on a periodic basis.

2) Water quality monitoring (inspection) of generated and treated leachate

In case the leachate is not treated properly, it may influence the river water quality. Therefore leachate samples shall be collected directly from the outlet pipe and from within the pond to determine the treatment effect.

3) Monitoring (Inspection) of generated gas

The properties of the discharged gas from gas collection pipe shall be investigated regularly as an index that observes the stabilization of waste at site or for the safety control due to the fire and etc.

4) Offensive odor prevention

As a countermeasure against offensive odor, daily soil cover shall be applied.

5) Insect and pest prevention

As countermeasure against attraction of insects and other pests, daily soil cover shall be applied.

(10) Project Implementation Schedule

The Project implementation schedule may be broadly divided into Pre-Construction Works and Construction. The Construction period is further divided into Phase 1 – Stage 1, Phase 1 – Stage 2 and Phase 2. The Project Implementation Schedule is shown in Table 4.3-15.

Construction cannot commence before completion of certain items, which are classified as Pre-construction Works. These are briefly described in the following Table 4.3-14:

Table 4-3-14 Pre-construction Works

No.	Item	Period (months)	Description
1	EIA Process	6	Includes completion of all field works, public hearings, reporting and obtaining approval of the concerned authorities
2	Detailed design tender	5	Includes announcement for EOI, short listing, proposals evaluation, and necessary approvals
3	Detailed design and Bid documents	7	Includes additional soil and topography surveys as may be required, detailed designs, BOQ, cost estimation, preparation of bid documents, and assistance in P/Q procedure for preparation of contractors short list
4	Tender for construction	3	Includes invitation to short listed contractors, project explanation meetings and site visits, preparation of proposals, their evaluation, and preparation of Tender Evaluation Report, and contract negotiations
TOTAL		21	This period may be extended to 24 months considering that construction work cannot start during the Monsoon season (3 months)
The following pre-construction works (5) and (6) should be implemented during the above period of 21 months.			
(5)	Land acquisition process	15 (available)	Includes ownership assessments, identifying beneficiaries, determining compensation and resettlement payments and re-settlement.
(6)	Access road	18 + (6 Monsoon months)	The access road needs to be completed before the start of construction at the landfill. The activities included are tender for detailed design, detailed design, tender for construction, and construction.

The construction works are divided into two phases with the bulk of the works implemented during Phase 1 – Stage 1. The total construction period is estimated to be 20 months, including the three Monsoon months when construction is not expected to progress.

Heavy and light equipment needs to be procured and installed at the site, as required by the time of waste disposal operations at the completion of Phase 1 – Stage 1. Most of the equipment will need to be imported and the duration set for this procurement, training on the equipments and handing over is set at 10 months, from the date of signing of the construction contract.

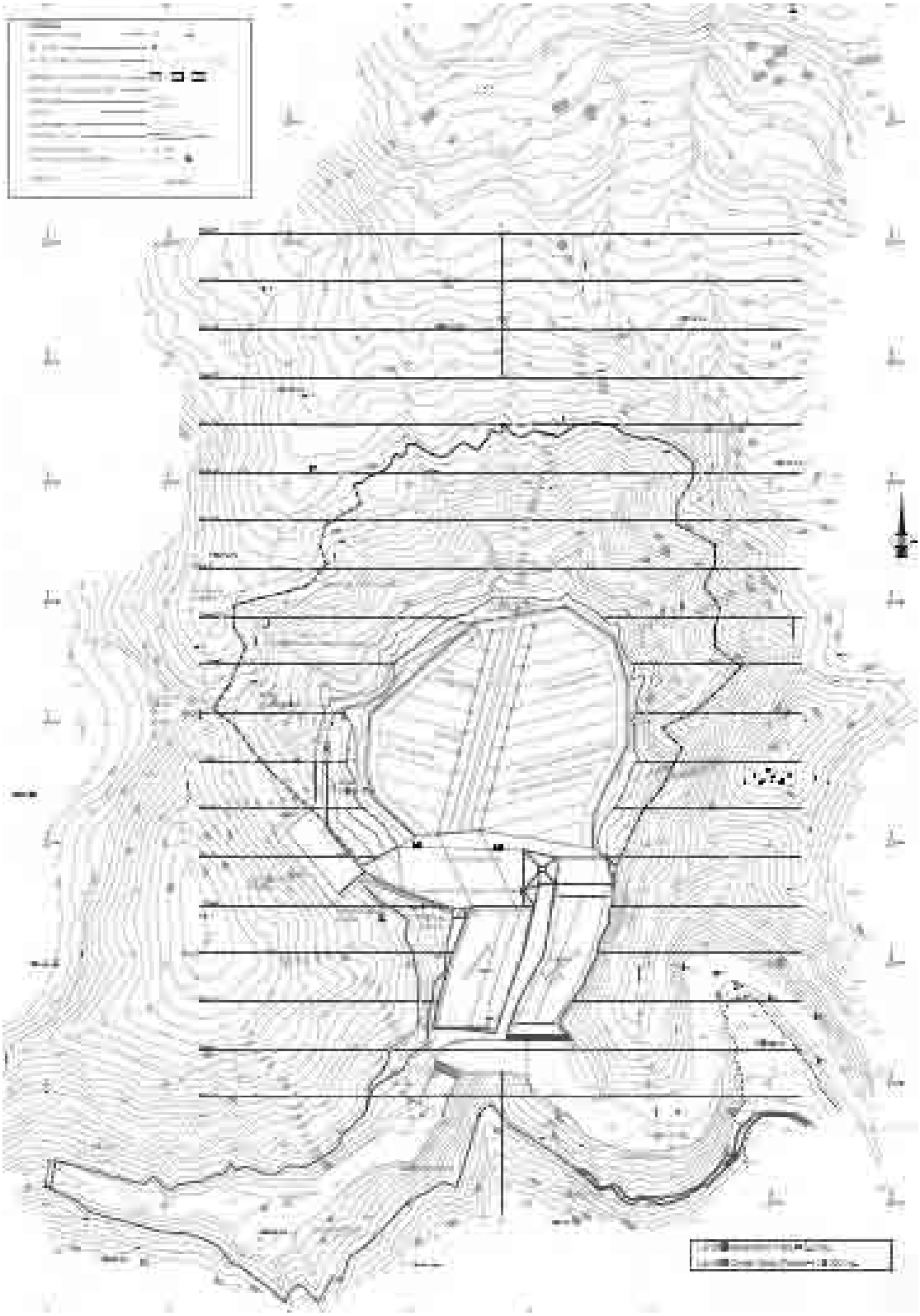


Figure 4.3-15 Layout Plan of Phase 1

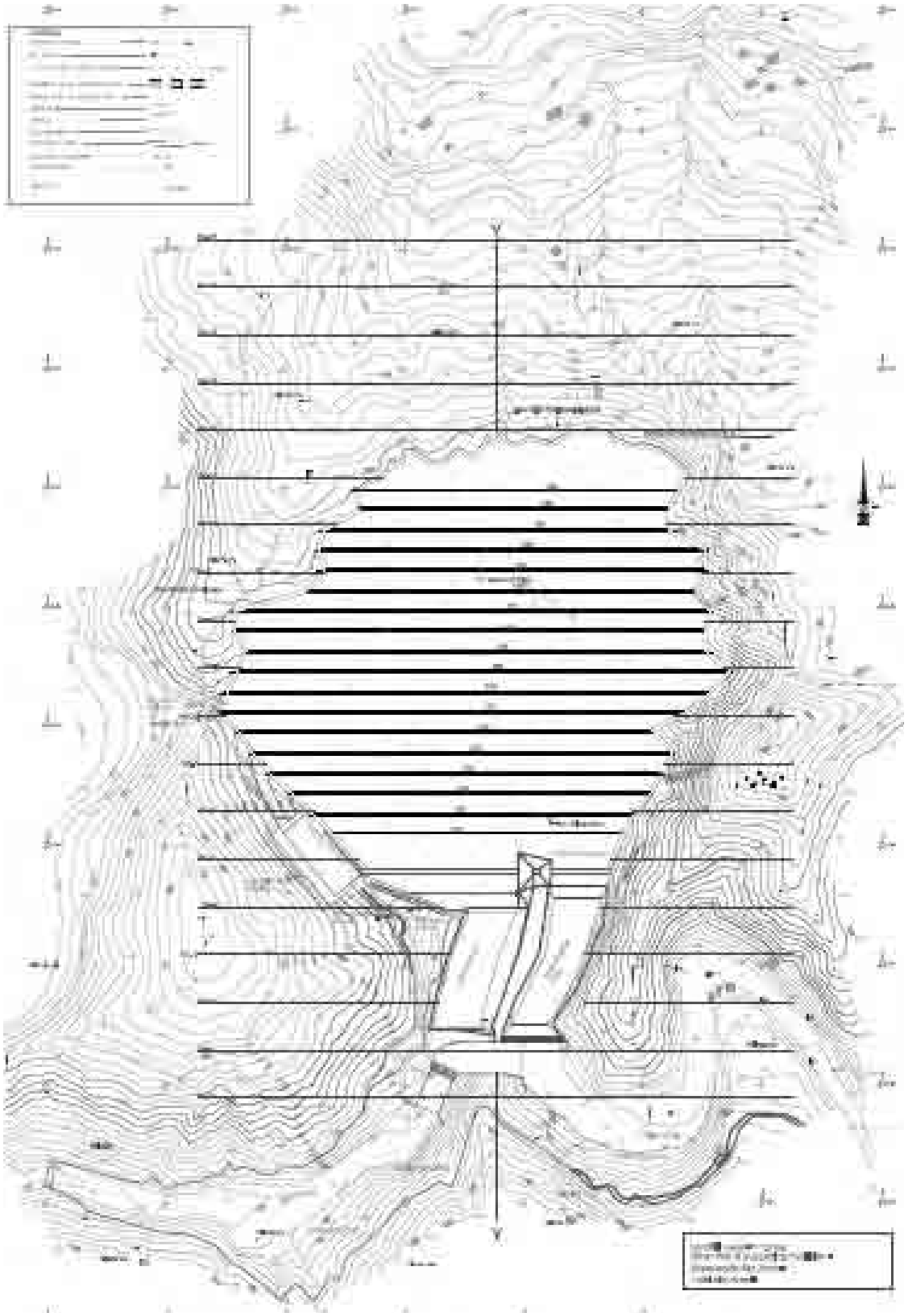


Figure 4-3-16 Layout Plan after Disposal Completion

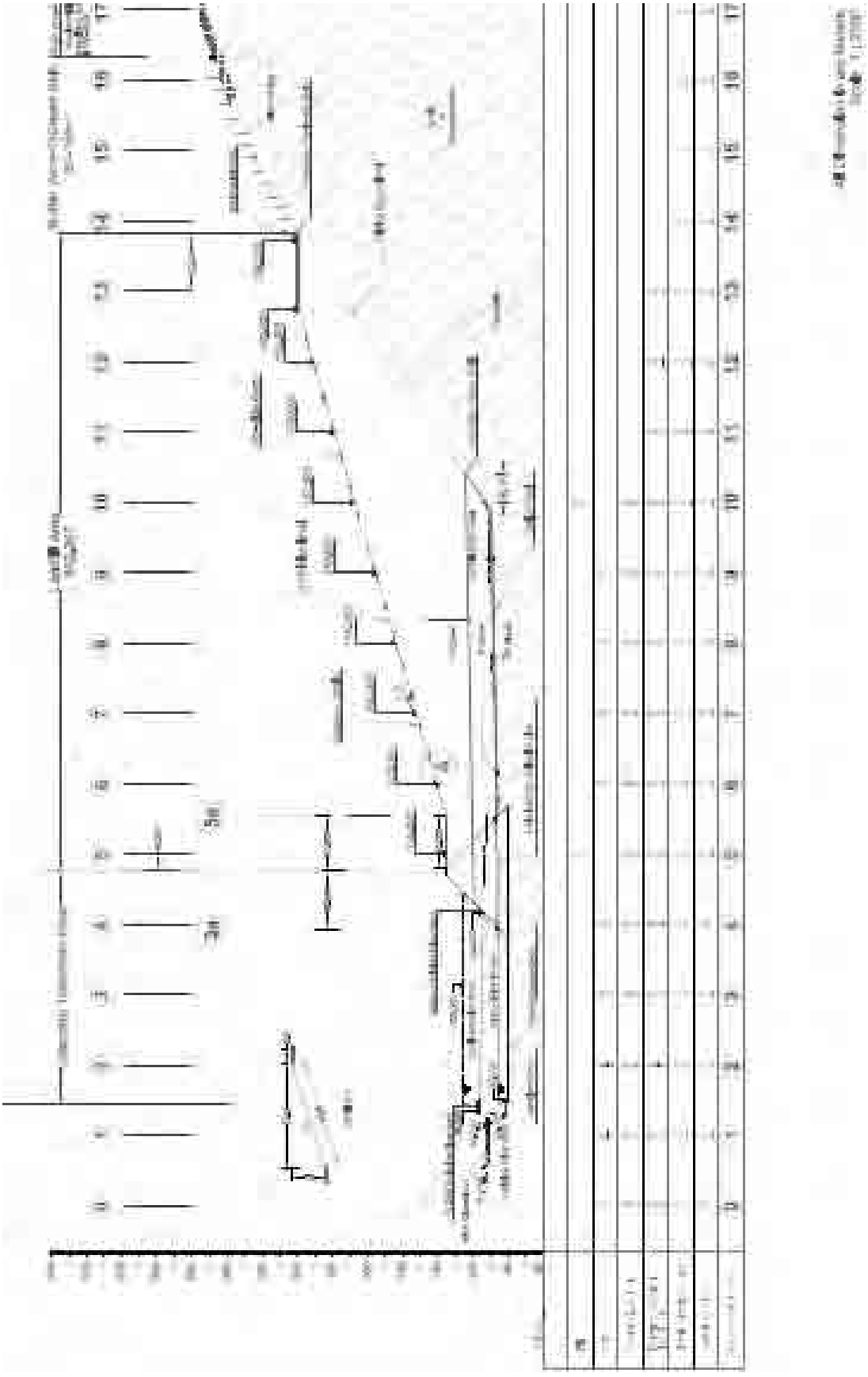


Figure 4-3-17 Longitudinal Section of the Landfill

Table 4.3-15 Project Implementation Schedule

S.No.	Item	Pre-Construction Works																								Phase I/Stage - I									Phase I/Stage - II							Phase II			
		2006			2007												2008												2009													2010			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
		O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M
	PRE-CONSTRUCTION																																												
1)	EIA Process (including official approvals, etc)																																												
2)	Selection of Consultants for Detailed Design																																												
	a) Expression Of Interest (EOI)										Monsoon												Monsoon																						
	b) Shortlisting																																												
	c) Technical Proposal																																												
	d) Approval																																												
3)	Detailed Design and Bid Documents																																												
4)	Tender for Construction																																												
5)	Land acquisition process (Buffer Zone, LF Site and Soil Cover)																																												
6)	Access Road																																												
	a) Tender for Detailed Design																																												
	b) Detailed Design																																												
	c) Tender for Construction																																												
	d) Construction																																												
	CONSTRUCTION																																												
(I)	Contractor Mobilization																																												
1	Ground Improvement																																												
2	Block Embankment																																												
a	Block Embankment																																												
b	Slope Embankment																																												
3	Waste Storage Dam																																		Monsoon										
4	Saddle Dam																																												
5	Liner System Facility																																												
6	Leachate Collection system																																												
7	Landfill Gas Vent System																																												
8	Leachate Recirculation System																																												
9	Aeration Pond wth aeration system																																												
10	Sedimentation Pond																																												
11	Blower House																																												
12	Operation Road – 1 (to landfill site)																																												
13	Operation Road – 2 (to Saddle Dam)																																												
14	Rain Water Drainage																																												
15	Administrative Building																																												
16	Weighbridge																																												
17	Vehicle Wash Pool																																												
18	Guard House																																												
21	Fencing																																												
22	Utilities (Water Supply System)																																												

4.3.6 Financial Plan

(1) Overall Cost of the Banchare Danda LF

The overall cost of the Banchare Danda LF consists of 1) development cost, 2) procurement cost of equipment and its renewal, 3) operation and maintenance (O&M) cost, and 4) post-closure maintenance cost, and is estimated at Rs 2,588.3 million in total over the period of 32 years from FY2007/08 until FY2038/39 as shown in Table 4.3-16.

Table 4.3-16 Summary of Overall Cost

Cost Component		Million Rs	Remarks
1) Development		1,677.5	Phase-1 and Phase -2
2) Procurement of Equipment	Initial	106.4	Procurement in FY 2009/10
	Renewal	143.2	Procurement for replacement afterwards
	Total	249.6	
3) O&M		613.6	Total of 20 years from 2009/10 until 2028/29
4) Post-closure Maintenance		47.6	Total of 10 years from 2029/30 until 2038/39
Total		**2,588.3**	

Source: JICA Study Team

Each component of overall cost is summarized below.

1) Development Cost

Banchare Danda LF site will be developed in 2 phases; that is, the phase 1 in FY2007/08 and FY2008/09, and the phase 2 in FY2009/10.

Total cost of development is estimated at Rs 1,677.5 million. The phase-wise development cost is presented in Table 4.3-17 (see Supporting Report H-1 for more detail).

The development cost is mainly broken down into Construction and Engineering Fee portions. The construction cost covers the landfill and the river diversion, at 94% and 6% respectively of the total cost. The largest portion of the construction cost is the share of both the waste dam and the saddle dam at 67% of the total cost.

The Engineering Fee is broken down into (1) detailed design and construction supervision, and (2) development of the environmental training unit and training of officials as well as the local people. The first accounts for 10% of the total construction cost while the latter covers 1.5% of the construction cost. Details of the Development Costs are provided in Supporting Report H-1.

Table 4.3-17 Summary of Development Cost (million Rs)

Cost Items	Phase 1-1	Phase 1-2	Phase1	Phase 2	Total
	2007/08	2008/09	Total	2009/10	
Land Acquisition	11.2	-	11.2	-	11.2
Construction	703.9	219.1	923.0	226.9	1,149.9
Engineering Fee	81.0	25.2	106.2	26.1	132.3
Others including VAT	235.1	73.2	308.3	75.8	384.1
Sub-total	1,020.0	317.5	1,337.5	328.8	1,666.3
Total	**1,031.2**	**317.5**	**1,348.7**	**328.8**	**1,677.5**

Note: Land acquisition cost of 11.2; information from year 2006/07 program of SWMRMC
Source: JICA Study Team.

2) Procurement Cost of Equipment and its Renewal

Procurement costs consist of 1) light equipment and machinery, 2) heavy equipment including dump truck and 3) spare parts and others.

Total cost is estimated at Rs 106.4 million for initial procurement, and at Rs 143.2 million for the renewal as shown in Table 4.3-18 (see Supporting Report H-2 for more detail). It is noted that initial procurement cost of light equipment and machinery is disregarded here because the cost is already included in the above development cost.

Table 4.3-18 Summary of Procurement Cost (million Rs)

Cost Items	Initial	Renewal			
	2009/10	2013/14	2018/19	2023/24	Total
Light Equipment and Machinery	Included in development cost	0.2	11.8	0.2	12.2
Spare Parts and Others (including VAT)		0.1	3.3	0.1	3.5
Sub-total		0.3	15.1	0.3	15.7
Heavy Equipment including Dump Truck	83.1	0	99.5	0	99.5
Spare Parts and Others (including VAT)	23.3	0	28.0	0	28.0
Sub-total	106.4	0	127.5	0	127.5
Total	**106.4**	0.3	142.6	0.3	**143.2**

Source: JICA Study Team

3) O&M Cost

O&M costs consist of 1) personnel, 2) repair and maintenance of equipment and machinery, 3) civil work maintenance, 4) fuel, and 5) others, and are summarized in Table 4.3-19 (see Supporting Report H-3 for more detail).

Total cost of O&M is estimated at Rs 613.6 million over the period of 20 years from FY2009/10 until FY2028/29. Fuel accounts for the largest share at 48% of the costs.

Table 4.3-19 Summary of O&M Cost (million Rs)

Cost Items	1st Decade 09/10-18/19	2nd Decade 19/20-28/29	Total	
1) Personnel	28.4	31.0	59.4	9.7%
2) Repair & Maintenance	44.6	53.8	98.4	16.0%
3) Civil Work Maintenance	29.2	86.4	115.6	18.8%
4) Fuel	140.2	154.7	294.9	48.1%
5) Others	21.4	23.9	45.3	7.4%
Total	**263.8**	**349.8**	**613.6**	100%

Note: Diesel oil is set at Rs 60/liter provided by the Government in spite of present compulsory price of Rs 53.15/liter.
Source: JICA Study Team

4) Post-closure Maintenance Cost

After the closure of the Banchare Danda LF site, post-closure maintenance should be done for careful collection and treatment of leacheate for at least 10 years from FY2029/30.

Total cost necessary for post-closure maintenance is estimated at Rs 47.6 million including renewal cost (see Supporting Report H-2 for more detail) of blower and pumps as shown in Table 4.3-20.

Table 4.3-20 Summary of Post-closure Cost (million Rs)

Cost Items		2029/30-2038/39
O&M	Personnel	4.3
	Repair & Maintenance	5.3
	Fuel	9.7
	Others	1.9
	Sub-total	21.2
Procurement (Light Equipment and Machinery for Renewal)		26.4
Total		47.6

Source: JICA Study Team

5) Cost Sharing

a. Between Municipality and Government

The municipalities have been continuously facing financial difficulties because revenue is not enough to satisfy the increasing demand on municipality services. Also the municipalities have to face the serious financial problem of the Local Development Fee (LDF) that will fade out by December 2013. Some municipalities such as KMC and LSMC have already started to strengthen revenue systems; however there are no specific and immediate solutions. So it may be too much of a burden for the municipalities to carry the full cost of the Banchare Danda LF. Meanwhile, the need is rising to develop an SWM infrastructure, which is indispensable for the growing metropolitan area of the Kathmandu Valley.

Considering the above, the Government must accept the development cost, heavy equipment cost and post-closure maintenance cost. On the other hand, in principle, municipalities should bear the rest of cost from their own revenues; that is, equipment renewal cost and O&M cost.

With this criteria set for a cost sharing concept for the Banchare Danda LF, the resulting cost burden for the Government and municipalities is presented in Table 4.3-21:

Table 4.3-21 Cost Sharing for Banchare Danda LF

Component	SWMRMC			Municipalities	
	Concept	million Rs	External Sources	Concept	million Rs
Land acquisition	Full	11.2	-	-	-
Development Phase 1	Full	1,337.5	Expected	-	-
Development Phase 2	Full	328.8	-	-	-
Heavy Equipment (Initial)	Full	106.4	Expected	-	-
Renewal of Equipment	-	-	-	Full	143.2
O&M	-	-	-	Full	613.6
Post-closure Maintenance	Full	47.6	-	-	-
Total	-	**1,831.5**	-	-	**756.8**

Note: Full – full share, and Expected –financial support be expected
Source: JICA Study Team

b. Among the Municipalities

With equipment renewal cost and O&M cost as burdens on the municipalities, each municipality has to bear costs originally generated by the municipality itself. Meanwhile, the costs generated by joint work among municipalities should be negotiated and shared among the municipalities concerned. In this connection, it is proposed that the costs generated by joint work should be divided among the municipalities concerned on the basis of the amount of solid waste transported from each municipality to the LF site as shown in Table 4.3-22.

Table 4.3-22 Cost Sharing Ratio for Banchare Danda LF (%)

Municipality	09/10	10/11	11/12	12/13	13/14	14/15	Afterwards
KMC	84.7	88.3	88.7	87.3	89.4	89.6	89.6
LSMC	14.5	10.7	11.2	11.7	9.4	9.2	9.2
KRM	0.8	1.0	1.0	1.0	1.2	1.2	1.2

Source: JICA Study Team

As a result, each municipality should carry the following costs as presented in Table 4.3-23. The ratio of the cost to their own revenues will be 4.6% for KMC, 2.7% for LSMC and 1.9% for KRM.

The financial analysis of the overall SWM operation including the costs of landfill is discussed in the following section (2).

Table 4.3-23 Cost Sharing among Municipalities (million Rs)

Municipality	Cost Items	1st Decade	2nd Decade	Total		Own Revenue
		09/10-18/19	19/20-28/29	09/10-28/29	Average	
KMC	O&M	233.7	313.4	547.1		
	Renewal of Equipment	128.0	0.2	128.2		
	Total	361.7	313.6	675.3	33.8	742.2
	(% of Own Revenue)				**(4.6%)**	
LSMC	O&M	27.2	32.2	59.4		
	Renewal of Equipment	13.2	0.1	13.3		
	Total	40.4	32.3	72.7	3.6	133.3
	(% of Own Revenue)				**(2.7%)**	
KRM	O&M	2.9	4.2	7.1		
	Renewal of Equipment	1.7	-	1.7		
	Total	4.6	4.2	8.8	0.4	20.7
	(% of Own Revenue)				**(1.9%)**	
Total		406.7	350.1	756.8	37.8	896.2
	(% of Own Revenue)				**(4.2%)**	

Note: Own revenue; average of own revenue during 10 years from FY2005/06 till 2014/15 estimated by JICA Study Team
Source: JICA Study Team

(2) Financial Analysis on Overall SWM Operation

The financial conditions of the overall SWM operation of the three municipalities over the period of 10 years from 2005/06 until 2014/15 are analyzed in this section.

Overall SWM costs of the three municipalities consist of 1) collection/transportation, 2) landfill, and 3) others, and are estimated respectively at Rs 1,229.4 million for KMC, Rs 354.0 million for LSMC, and Rs 19.7 million for KRM as presented in Table 4.3-24.

Overall the three municipalities own revenues excluding donations and bank loans consist of 1) LDF (local development fee), 2) property tax, and 3) others, and are estimated at Rs 7,421.6 million for KMC, Rs 1,332.8 million for LSMC, and Rs 207.1 million for KRM as presented in Table 4.3-24 (see Supporting Report H-4 in detail).

Based on the above figures, “cost-to-revenue ratio (that is; overall SWM costs divided by overall own revenues)” of the three municipalities can be calculated at 16.6% for KMC, 26.6% for LSMC, and 9.5% for KRM on average over 10 years. Accordingly, the “cost-to-revenue ratio” of the three municipalities can be judged to be moderate or rather low because it is said that the “cost-to-revenue ratio” of the municipalities in the developing countries generally ranges between 20% and 50%.

However, it should be noted that every municipality has to take immediate measures to enhance revenue to make up for LDF that will fade out by 2013 year end, although the Government has started to take into consideration the some financial relief to local municipalities. (For reference, see Supporting Report H-5 for actual fiscal balance of the municipalities from FY2000/01 to FY2004/05.)

Table 4.3-24 SWM Costs and Own Revenues (million Rs)

Cost and Revenue Items		05/06 62/63	06/07 63/64	07/08 64/65	08/09 65/66	09/10 66/67	10/11 67/68	11/12 68/69	12/13 69/70	13/14 70/71	14/15 71/72	Total
		Sisdol and Other LF				Banchare Danda LF						
1. KMC												
SWM O&M Cost	Collection & Transport	83.2	78.4	83.1	93.9	97.8	91.5	96.4	97.4	90.4	91.5	903.6
	Landfill	10.3	10.2	10.2	10.6	21.7	20.7	22.6	22.9	29.2	21.0	179.4
	Others	3.5	5.2	4.3	4.1	3.2	2.2	2.2	1.3	1.0	1.1	28.1
	Total	97.1	93.8	97.5	108.6	122.7	114.4	121.3	121.5	120.6	113.6	1,111.1
SWM Investment Cost		14.1	50.8	0.0	2.4	33.8	4.3	0.0	10.0	0.0	3.0	118.3
Total (A)		111.1	144.6	97.5	111.0	156.6	118.7	121.3	131.5	120.6	116.6	**1,229.4**
Overall Own Revenue	LDF	237.5	237.5	237.5	213.8	192.4	173.1	129.9	86.6	43.3	0	1551.6
	Alternatives to LDF	0	0	0	11.9	22.6	32.2	53.8	75.5	97.1	118.8	411.9
	Property Tax	163.3	198.9	236.7	276.8	319.1	330.3	341.5	352.7	363.8	375.0	2,958.1
	Others	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	2,500.0
Total (B)		650.8	686.4	724.2	752.5	784.1	785.6	775.2	764.8	754.2	743.8	**7,421.6**
Ratio (=A/B)		17.1%	21.1%	13.5%	14.8%	20.0%	15.1%	15.6%	17.2%	16.0%	15.7%	**16.6%**
2. LSMC												
SWM O&M Cost	Collection & Transport	12.7	25.5	27.9	33.1	33.5	32.3	34.6	36.9	36.4	38.1	310.9
	Landfill	2.0	2.0	2.1	1.7	3.7	2.5	2.9	3.1	3.1	2.2	25.2
	Others	1.5	1.5	-0.2	-0.2	-0.7	-1.0	-1.0	-1.6	-1.4	-1.5	-4.5
	Total	16.2	29.1	29.8	34.7	36.5	33.8	36.4	38.4	38.0	38.7	331.6
SWM Investment Cost		0	11.2	0.0	1.4	0.0	2.5	0.0	5.7	0.0	1.7	22.4
Total (A)		16.2	40.3	29.8	36.0	36.5	36.3	36.4	44.1	38.0	40.5	**354.0**
Overall Own Revenue	LDF	52.4	52.4	52.4	47.2	42.4	38.2	28.6	19.1	9.5	0	342.2
	Alternatives to LDF	0	0	0	2.6	5.0	7.1	11.9	16.7	21.4	26.2	90.9
	Property Tax	21.3	28.1	35.4	43.2	51.4	53.3	55.2	57.1	58.9	60.8	464.7
	Others	43.5	43.5	43.5	43.5	43.5	43.5	43.5	43.5	43.5	43.5	435.0
Total (B)		117.2	124.0	131.3	136.5	142.3	142.1	139.2	136.4	133.3	130.5	**1,332.8**
Ratio (=A/B)		13.8%	32.5%	22.7%	26.4%	25.7%	25.5%	26.1%	32.3%	28.5%	31.0%	**26.6%**
3. KRM												
SWM O&M Cost	Collection & Transport	0.7	0.8	0.9	1.4	1.6	1.5	1.6	1.8	1.6	1.7	13.5
	Landfill	0.2	0.2	0.2	0.1	0.2	0.2	0.3	0.3	0.4	0.3	2.3
	Others	0.2	0.2	0.1	0.1	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	0.1
	Total	1.0	1.2	1.2	1.5	1.7	1.7	1.8	1.9	1.9	1.9	15.9
SWM Investment Cost		0	1.9		0.2		0.4		0.9		0.3	3.8
Total (A)		1.0	3.1	1.2	1.8	1.7	2.1	1.8	2.8	1.9	2.2	**19.7**
Overall Own Revenue	LDF	11.9	11.9	11.9	10.7	9.6	8.7	6.5	4.3	2.2	0.0	77.7
	Alternatives to LDF	0	0	0	0.6	1.1	1.6	2.7	3.8	4.9	6.0	20.7
	Property Tax	1.7	2.5	3.3	4.2	5.0	5.2	5.3	5.4	5.5	5.6	43.7
	Others	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	65.0
Total (B)		20.1	20.9	21.7	22	22.2	22	21	20	19.1	18.1	**207.1**
Ratio (=A/B)		5.0%	14.8%	5.5%	8.2%	7.7%	9.5%	8.6%	14.0%	9.9%	12.2%	**9.5%**

Note: 1) Collection and transportation: Basic concept for cost estimate is the same as applied in Chapter 10.9.1 of "Final Report" of this Project on September 2005; however, diesel oil is changed to Rs 60/liter provided by the Government in spite of present compulsory price of Rs 53.15/liter.

2) Landfill: Basic concept for cost estimate until 2008/09 is the same as applied in Chapter 10.9.1 of "Final Report" of this Project on September 2005

3) Other cost: the same as above 1)

4) LDF, Alternatives to LDF, and Property Tax: See Supporting Report H-4

5) Other revenue: Total of actual own revenue of FY2004/05 excluding LDF and property tax

Source: JICA study Team

4.4 Follow-up Survey for Other Facility Development

The follow-up survey has been conducted for the development as well as temporary use of Balaju and Afadole transfer stations. The follow-up survey includes:

- Field reconnaissance of the areas surrounding both sites (within a radius of around 150-200 meters) depicting baseline environmental conditions including land use in the areas surrounding the sites.
- Identification of future environmental and social issues that may result from the operation of transfer stations, recommend measures for mitigating immediate environmental and social concerns generated by operating the sites as temporary transfer stations (container yards), and consideration of such factors in the concept designs to be implemented under the works.
- Implementation of the concept design including identification of the capacities required with site measurements and leveling survey, development of concept plans and design.
- Recommendations on required further studies for the IEE including environmental management and monitoring programs in the case of developing the two sites as permanent transfer stations.

4.4.1 Results of the Follow-up Survey for Balaju Transfer Station

(1) Environmental Issues Identified and Necessary Countermeasures

The reconnaissance survey of the surrounding area of the planned transfer station site at Balaju (within radius of 150 – 200 meters) was conducted on February 02, 2006. Based upon the reconnaissance survey including discussions with the relevant officials of KMC, the existing environmental conditions assessed are as follows:

1) Bio-Physical Environment

The planned transfer station site at Balaju is located along the right bank of the Bishnumati River. The site area is rectangular in shape elongated north-east to south-west direction (around 240 m) having a constrained width in average of around 27 meters. The area of the planned site is around 8,000 m^2 (0.8 ha). Figure 4.4-1 presents the location of the site and details of its surrounding area.

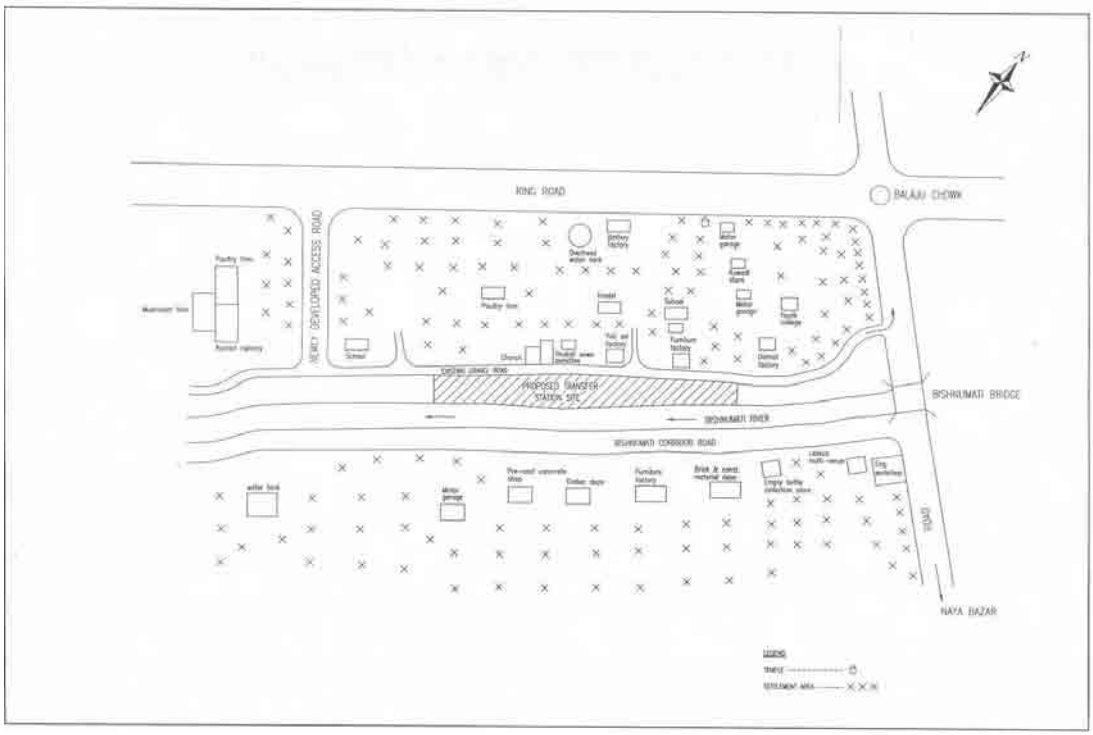


Figure 4.4-1 Location of Planned Balaju Transfer Station and its Surrounding Area

Basically three appropriate approach roads connect the site. The first, is a narrow earthen road, which runs south-west along the right bank of the Bishnumati River, that is entered by taking a sharp left turn after crossing Nayabazar Bridge on the paved road approaching towards Balaju crossing. The second approach, a newly developed earthen road begins from the Ring Road that runs initially south and meets the earthen road that runs north-east along the right bank of the Bishnumati River. The third is from Sobha Bagwati following the earthen road that runs in a north-east direction along the right bank of the Bishnumati River.

It was originally planned for the site to be developed as a transfer station site under the Kathmandu Valley Mapping Project conducted during 1994 - 1995. Only a boundary wall was constructed at that time along the narrow earthen road and it was not used for transfer operations as it was viable for KMC to use Teku transfer station for dumping of waste along the Bagmati River bank.

Presently, under the land pooling project, the narrow earthen road has been widened to 11 meters and accordingly, the boundary wall was dismantled and the barbed wire fence was installed allocating the width necessary for widening. The remaining width necessary for widening has been acquired from the other side of the road. The land pooling project also developed an earthen road downstream of the site perpendicular to the existing road and

leading north to the Ring Road, but upgrade of these earthen roads to a gravel standard has not been finished yet.

The Bishnumati is the only perennial river near the site. The site topography in general is flat while a strip of around 12 meters along the river bank bears low land. The difference in level between general ground surface and dry season water level noted is around 2.5 meters. The site area possesses an open grass field, but a ruined masonry toilet and a shed are located at the north-east corner of the site.

The land use pattern near to and surrounding the site is general residential settlement with a Thakali Guthi (community organization) and a Christia Samudaik Mandali Nepal (church) located just besides the site across the Bishnumati link road. The soil within the vicinity is an alluvial deposit consisting fine clayey silt.

The site does not consist of any forest associations (vegetation) and is a quiet and calm environment. The area is seldom visited by wild mammals.

The climate of the project area is temperate with temperature variation between 35°c and -2°c. April is the warmest month while January is the coldest. The relative humidity is on average 80% with estimated average annual rainfall of 1,407 – 1,736 mm. The maximum rainfall within 24 hour is noted to be 99 mm.

2) Socio-economic and Cultural Environment

The land use pattern of the surrounding area of the site within 200 meters radius consists in general of the residential settlements including small scale business settings. However, the site area is owned and secured by KMC.

Around 75 and 170 households were noted on the left and right banks of the Bishnumati River, respectively. The major ethnic groups noted are Newar, Brahman and Chettri. Small-scale factories and workshops surrounding the area are as follows:

On the right bank of the Bishnumati River		On the left bank of the Bishnumati River	
Yeti Sal Factory	1 nos.	Engineering workshop	1 nos.
Motor Garage	3 nos.	Furniture Factory	1 nos.
Eveready Battery Factory	1 nos.	Pre-cast Concrete Shop	1 nos.
Furniture factory	1 nos.	Motor Garage	1 nos.
Dalmot factory	1 nos.		

Schools and Colleges noted are as follows:

On the right bank of the Bishnumati River	
Youth Mission College	1 nos.
Public English School	1 nos.
New Pascal International Academy	1 nos.
Hostel – Sidhartha Banasthali School	1 nos.

One RCC ground water tank on the left bank and one RCC elevated water tank on the right bank of the river are located in an around 150 meters distance from the planned site. Community organizations and sites of ethnic value, noted are as follows:

On the right bank of the Bishnumati River	
Thakali Sewa Samittee (community organization)	1 nos.
Christia Samudaik Mandali Nepal (church)	1 nos.
Ganesh Temple	1 nos.

Other features noted are as follows:

On the right bank of the Bishnumati River		On the left bank of the Bishnumati River	
Kumari Nursery	1 nos.	Las Kus Multi Venue	1 nos.
Poultry Firm	2 nos.	Empty Bottle Collection Store	1 nos.
Mushroom firm	1 nos.	Brick & Construction Materials Depo	1 nos.
Kawadi Store	1 nos.	Timber Depo	1 nos.

3) Identified Environmental and Social Issues, and Recommended Measures

The identified major environmental and social issues that may result from the construction and operation of the planned Balaju transfer station, and recommended measures for mitigating anticipated adverse impacts on the environment are as follows:

Table 4.4-1 Identified Major Environmental Issues and Recommended Measures (Balaju Transfer Station)

Issues	Activities	Mitigation Measures
Air Pollution and Offensive Odor	• Operation and increase in heavy vehicle movements will emit air pollutants including particulates, hydrocarbons, nitrogen oxides, carbon monoxide and sulfur dioxide. • Increase in concentration of airborne dust affecting locals residing along the approach and nearby to the site. • Operation in a more or less permanent mixture of moisture and the waste may generate bad smell.	• Either paved or at least graveled with frequent maintenance. Maintain the surface moisture by frequent spray of water. • Paving of traffic circulation route and waste handling area within the site and maintaining it regularly. • During construction, approach roads, working area and stockpiled construction material be slightly wetted with frequent spray of water. • Heavy vehicles and machinery used to be fitted with air pollution control devices and kept in good condition by regular maintenance, holding green sticker complying to the regulatory law enforced by the Ministry of Labour & Transport Management • Efficient and effective waste management practices be maintained to minimize the duration in accumulation and storage of wastes in the site. Provision for covering of accumulated waste with plastic sheets to reduce bad smells. • As a mitigation to reduce odor & bad smell, the transfer station should accept only municipal waste. • Appropriate design for direct loading and unloading platform to minimize littering and air pollution.

Issues	Activities	Mitigation Measures
Water Pollution	• Leachate produced due to ineffective, inefficient and improper management in transfer of waste may possess pollution potential to ground and surface water. • Runoff and migration from spills/leaks and improper discarded used oils and lubricants may result in fire/explosion hazard and ground and surface water pollution. • Siltation and pollution of surface water resulting from uncontrolled runoff from storage piles. • Unsanitary waste disposal practices by workforce camp, employees, waste picker activity and their accommodation nearby the site during construction and operation of the site.	• Operation of site being direct loading of waste adopting open top system without any compaction system, anticipated leachate generation is minimal and its treatment provision may not be required. Introduce efficient waste handling and management including regular cleaning of waste handling area. However, provision of the collection and storage system for the leachate as possible if included will be better. • Provision for proper storage of petrol, diesel, oil and lubricants with proper disposal of used lubricants and oils. • Proper mechanism for storage of construction materials with protection measures against erosion. • Provision of adequate drainage system with proper outlet to sustain stormwater as well as waste water produced during operation of transfer station. • Provision and maintenance of toilets for workforce camp, employees and waste pickers involved in waste separation activity to maintain sanitary waste disposal practices.
Noise and vibration	• Trucks engines, squeaking brakes, and hydraulic equipment will induce noise. • More profound effect is visualized in Balaju site being located near to the residential and business settlements.	• Heavy equipments and machinery being used be fitted with noise dampening devices and ensure correct operation. • Avoid late hour operation of transfer station. • Avoid blowing horn unnecessarily. • Maintain the access roads regularly
Traffic congestion and accidents	• Concentrated heavy vehicle movements causing disruption to general traffic. • The capacity of the transfer station has been designed to cope with the daily waste generation of around the peak hour waste (25% of daily waste generated). Transfer vehicles and collection vehicles will need to maneuver around the site during peak hour. • Risk of traffic accidents may be increased due to new traffic generation of waste collection and transportation vehicles	• Assess carefully all available approaches and design appropriate route for collection / transfer vehicle including smooth traffic circulation within the transfer station with least traffic conflict point and comfortable available parking space. • Provision of appropriate de-acceleration and turning lanes. • Provision of adequate sight lines and queuing space within the site to prevent interruption to general traffic movement on narrow earthen approach road outside. • Provision of adequate width to minimize congestion of trucks trying to enter or leave the site.
Impairment to Infrastructure	• Regular use of heavy vehicles may impair existing community infrastructure	• Paving or at least gravelling of earthen approach road to a considerable length and maintained regularly during operation. In case of gravel, the municipality should maintain the surface moist by frequent spray of water.
Visual and Unsightly Look	• Bad management will degrade the visual quality of present land use comprising recreational and residential area. • Litter due to dumping of waste delivered out of working hours outside the entrance to the TS. • Wind blown litter from the waste transfer operation. • Spread of litter by disorganized waste pickers, birds and animals.	• In case of Balaju site, a buffer zone with reasonable higher boundary wall seems appropriate. • Maintain the body of waste carrying vehicles intact to avoid leak and littering. • Restrict working hours and dumping of waste outside the entrance to the site. • Maintain proper coverage of stored waste with plastic sheets. • Regulate, maintain and control waste pickers activity through a registration system and demarcate allowable working, storing and transfer of recovered material.

Issues	Activities	Mitigation Measures
Infectious disease	• Improper and inefficient management of waste • Introduction and accommodation of external workforce (labor during construction, municipality employees and waste pickers during operation), their unsanitary waste disposal practices including toilet effluent and stagnant wastewater generated from bathing/cooking and waste handling process itself may propagate conducive environment for breeding of mosquitoes. • These could create public health hazard to the surrounding area.	• Provision of adequate drainage system for storm and waste water generated during and operation of TS. • Provision of proper accommodation and management for workforce, municipality employees and waste pickers within and outside transfer station at appropriate locations. • Provision and maintenance of toilets for workforce camp, transfer station employees and waste pickers involved in waste separation activity to maintain sanitary waste disposal practices. • Strong supervision to restrict littering of waste in the surrounding area.
Local Conflict (Local economy and interest)	• Though KMC intends to restrict waste pickers' activity at Balaju T/S, the waste pickers are anticipated to approach the newly developed transfer station. Other than Teku transfer station, there could be other sources of the migration of the waste pickers and the number may increase further. • Outside workforce involvement in the local area may initiate conflict between the locals and outsiders on cultural settings due to bad habit practices.	• Regulate the activities of workforce and waste pickers. • Supervise and control the good practices to preserve the social setting and cultural harmony of the planned area.

Source: The JICA Study Team

(2) Concept Design of Balaju Transfer Station

1) Site Location and Characteristics

The proposed Balaju Transfer Station at Balaju in KMC is located along the right bank of the Bishnumati River. The site area is rectangular in shape elongated north-east to south-west direction (around 240 m) having a narrow width on average of around 27 meters. The area coverage of the proposed site is around 0.8 ha.

Basically three approach roads connect the site. The first, is a narrow earthen road, which runs south-west along the right bank of the Bishnumati River, that is entered by taking a sharp left turn after crossing Nayabazar Bridge on the paved road approaching towards Balaju crossing. The second approach, an earthen road newly developed begins from the ring road that runs initially south and meets the earthen road that runs along the north-east along the right bank of Bishnumati River. The third approach is Sobha Bagwati following the earthen road that runs in the northeast direction along the right bank of Bishnumati River.

The site is an open grassy area encircled by a barbed wire fence. A ruined masonry toilet room and a shed are located at the northeastern corner with few discarded waste containers. The topography is generally flat with a narrow 12 meter strip of lower land along the riverbank. The soil observed within the site is alluvial deposit of fine sandy clay type.

2) Alternatives for the Development

Considering space limitations, environmental concerns and costs; five alternatives were formulated, as described in Table 4.4-2, and shown in Figures 4.4-2-1 to 5 respectively.

Table 4.4-2 Balaju Transfer Station Alternatives

Alt.	Unloading Platform		Tipping Area	Remark
	Platform height	Reloading stations		
1	GL+3.45m – Loading to container mounted on truck	2 stations x 3 bays	Small	Handling Capacity: Highest Cost: High Environment: Mitigation of waste storage at site
2	GL+3.45m – Loading to container mounted on truck	1 station x 3 bays	Medium	Handling Capacity: Medium Cost: High (not much saving compared to Alt. 1) Environment: Some delay in waste transport from station may occur
3	GL+2.0m – Loading to detached container	1 station x 3 bays	Medium	Handling Capacity: Medium to low Cost: Medium (slightly more saving compared to Alt. 2) Environment: More delay in waste transport from station may occur Some noise and other concerns due to container mounting – detachment operations at the station
4	GL+1.72m, GL-1.72m – Depressed bay for transfer trucks – Loading to container mounted on truck	1 station x 3 bays	Medium	Handling Capacity: Medium Cost: Medium to low (savings in fill works with expenses in drainage works at depressed bays) Environment: Some delay in waste transport from station may occur Lower platform height improves visual aspect. Drainage system of depressed bay potential pollution hazard to river
5	None	None	Large	Handling Capacity: Lowest Cost: Lowest (however wheel loader(s) need to be procured) Environment: Fear of waste storage at site Odor and insects generation fear.

In terms of cost, Alternative 5 is the least expensive one; however there are environmental concerns that may arise if the station is not operated very efficiently with the waste speedily removed. On the other hand, Alternative 1 offers the best waste handling capacity at the highest cost. Concept designs for both alternatives have been developed and are attached in the Drawings B.

3) Salient Features of Balaju Transfer Station

A summary of the salient features for both Alternatives 1 and 5 of the site are given in Table 4.4-3.

Table 4.4-3 Salient Features of Balaju Transfer Station

No.	Item	Description	
		Alternative 1	**Alternative 5**
1	Project Name	Balaju Transfer Station	
2	Location	Ward 16, Balaju, KMC	
3	Type	Open Top, Direct Loading including Tipping Area	Storage load system with tipping area only
4	Area	0.8 ha	
5	Daily waste arrival	75 t/d (assumed for design)	
6	Peak hour waste	18.75 t/hr	
7	Transfer truck capacity	15 m^3 (size 8m x 2.5m x 2.8m)	
8	Collection truck capacity	Average 6m^3 (size 6m x 2.5 m)	
9	Unloading platform	33m x 14.5m raised 3.45m above GL (Embanked with stone masonry retaining wall along both sides, i.e. reloading station and boundary to existing road, R.C.C. paved surface with nominal reinforcement). 0.25m R.C.C. guide wall of height 0.25m along three sides with extension of boundary wall along road side. 0.50m space left along the edge of embankment where there is no wall.	None
10	Reloading stations	Two at design ground level.	None
11	Approach and exit ramps	Length along centre line 33m. Embanked with stone masonry retaining wall on outer edge along transfer road side. Total width 5.0m, carriageway width 4m, 0.25m R.C.C. guide wall at both sides with 0.25m high, and remaining 0.5m space left along the edge of embankment where there is no wall.	None
12	Weighbridge	Space provision of 17.85 x 4.30 for weighbridge having weighing platform, approach and exit ramp.	
13	Scale house	Space provision of 4.5m x 2.5m.	
14	Tipping Area	698 m^2 RCC paved surface with nominal reinforcement.	1,600 m^2 RCC paved surface with nominal reinforcement. Total 15 tipping bays (6m x 4m per bay) provided
15	Administration Building	Three rooms with one bathroom/toilet covering 64 m^2.	
16	Guardhouse	Existing guardhouse to be renovated covering 15 m^2.	
17	Public bathroom/ toilets	Existing bathroom/ toilet to be renovated covering 7.5 m^2.	
18	Drains	One drain Type E is proposed. Rectangular open stone masonry catch drain draining entire transfer station surface runoff to waste collection tank of size 3.5m x 3.5m x 3.0m.	
19	Well and overhead tank	Provision of well and overhead tank kept at the corner of tipping area for vehicle washing purpose.	
20	Parking area	Parking adequacy for 4 vehicles allocating space of 8m x 3m for one vehicle. R.C.C. paved surface with nominal reinforcement.	Parking adequacy for 8 vehicles allocating space of 8m x 3m for one vehicle. R.C.C. paved surface with nominal reinforcement.
21	Traffic Circulation Route	All traffic circulation routes within the transfer station R.C.C. paved with nominal reinforcement.	
22	Buffer zone	Boundary wall with net fencing along the roadside and riverbank protection wall with net fencing along the riverbank.	

4) Proposed Facilities

Based on the discussions held between LSMC, the JICA Study Team and CEMAT (the local consultant) the facilities described in Table 4.4-4 have been incorporated in the concept design.

Table 4.4-4 Facilities of Balaju Transfer Station

No.	Facility	Comment
1	Administration Building (3 rooms & Bathroom)	
2	Guard House	Renovate existing structure
3	Weighbridge	Space provision(1
4	Work shop	Space provision, only small facility for tire repairs
5	Water well and tank	Space provision, with consideration on water supply system to be provided
6	Vehicle washing	Space provision
7	Lights	For office and working area
8	Embanked unloading and reloading platform	(Not included in Alt. 5)
9	Embanked ramps	(Not included in Alt. 5)
10	Paved waste tipping area	
11	Paved parking area	For 4 vehicles
12	Buffer	Boundary wall with appropriate fencing
13	River bank protection	Masonry wall
14	Paved traffic circulation route within station	
15	Drainage system for storm water and waste water	
16	Extension of existing RCC sewer pipe of dia. 60 cm for proper outfall to the Bishnumati River.	Extension length around 29m.
17	Leachate storage	Collection drains and storage tank
1) Space provision indicates that the facility will not be included in the concept design at this time		

The draft concept design drawings are included in the Drawings B.

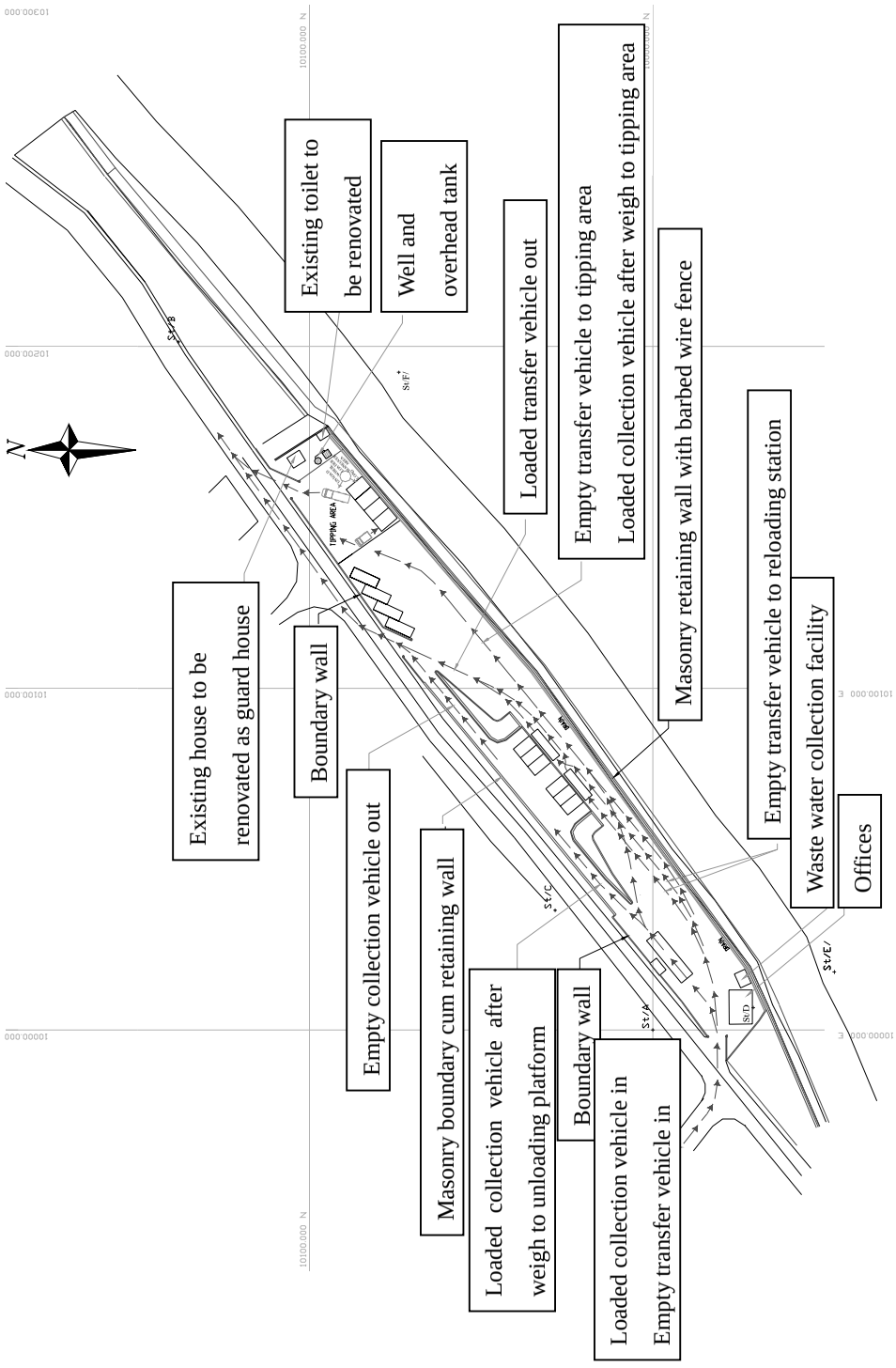


Figure 4.4-2-1 Balaju Transfer Station – Alternative 1

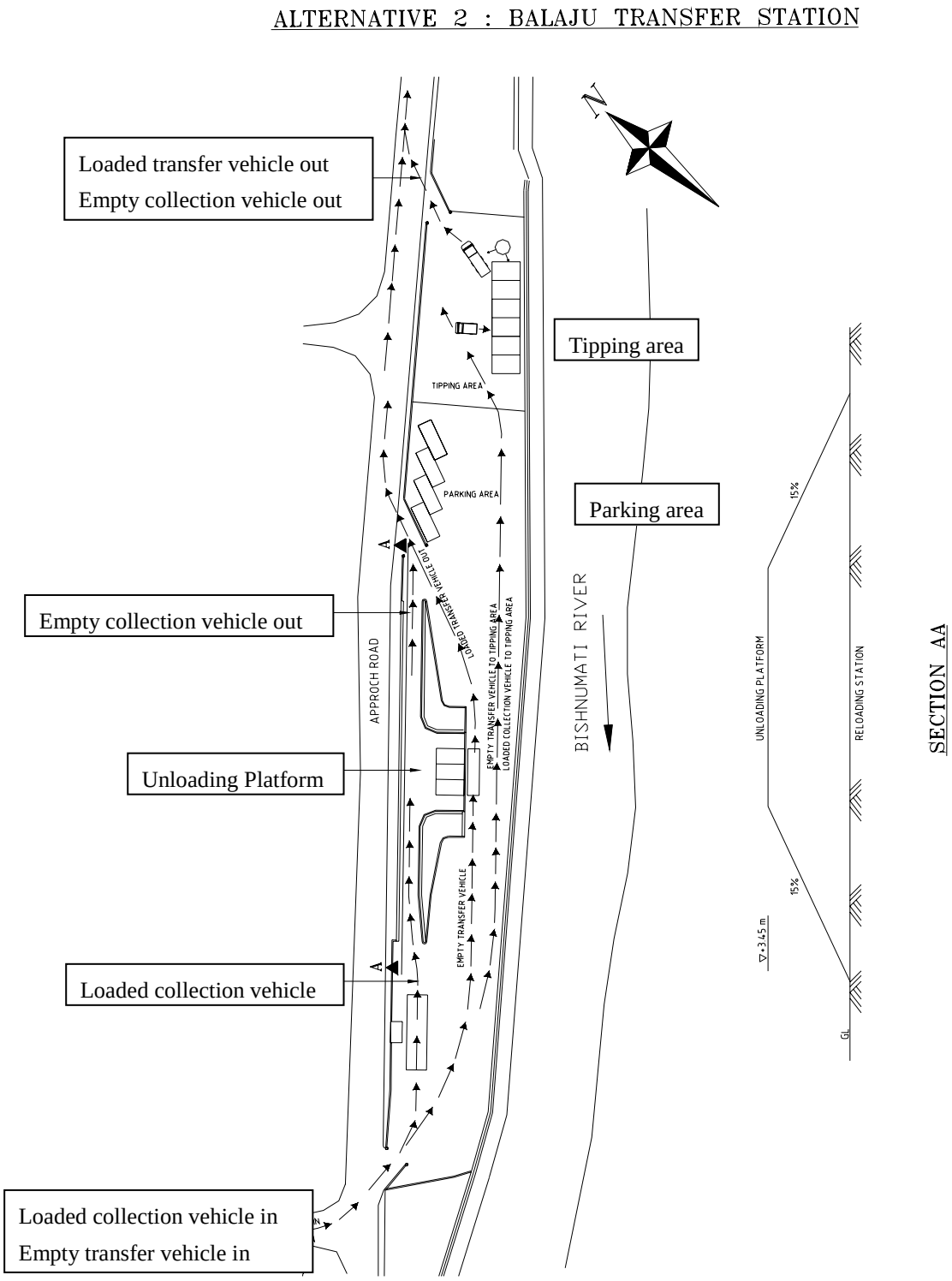


Figure 4.4-2-2 Balaju Transfer Station – Alternative 2

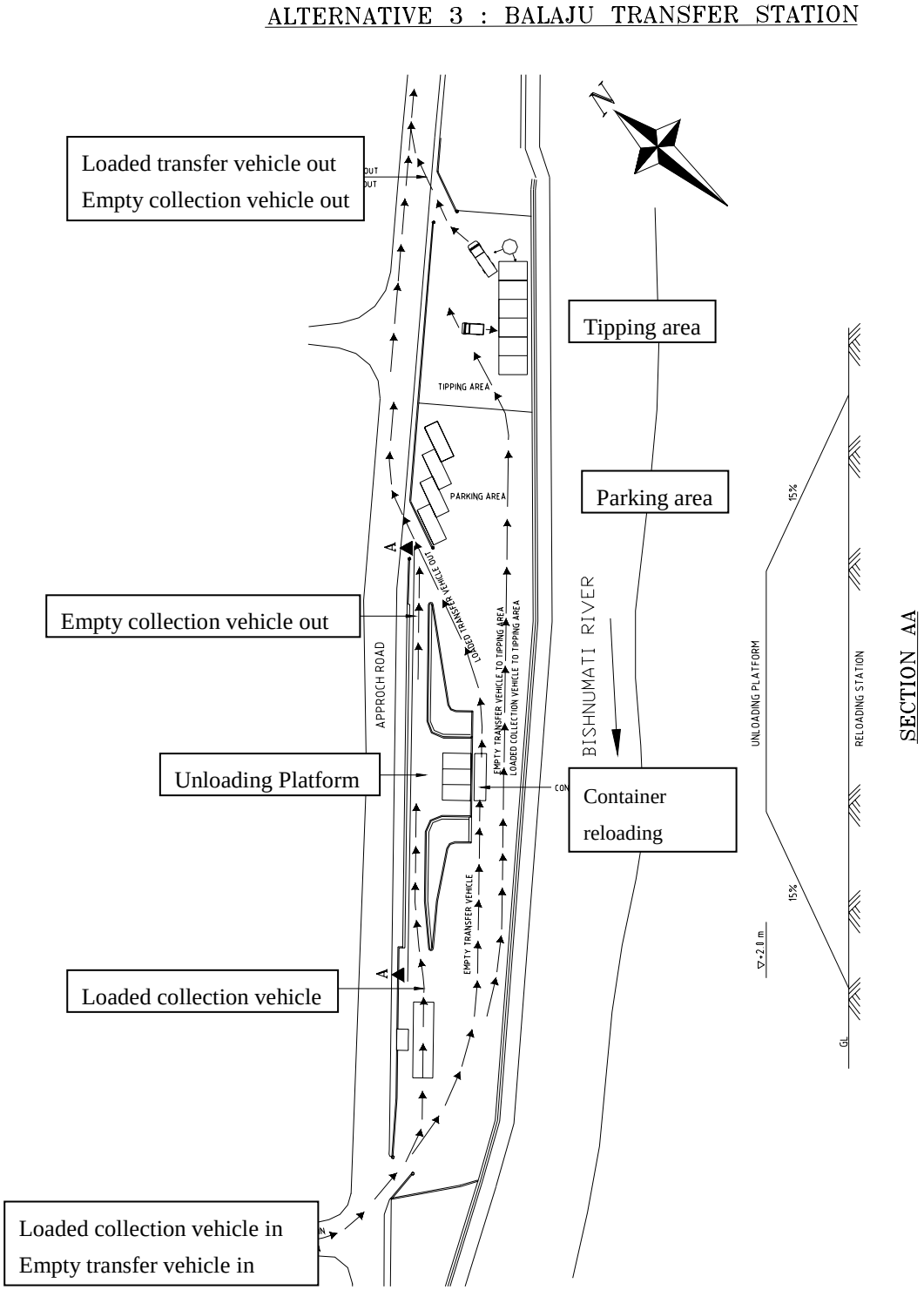


Figure 4.4-2-3 Balaju Transfer Station – Alternative 3

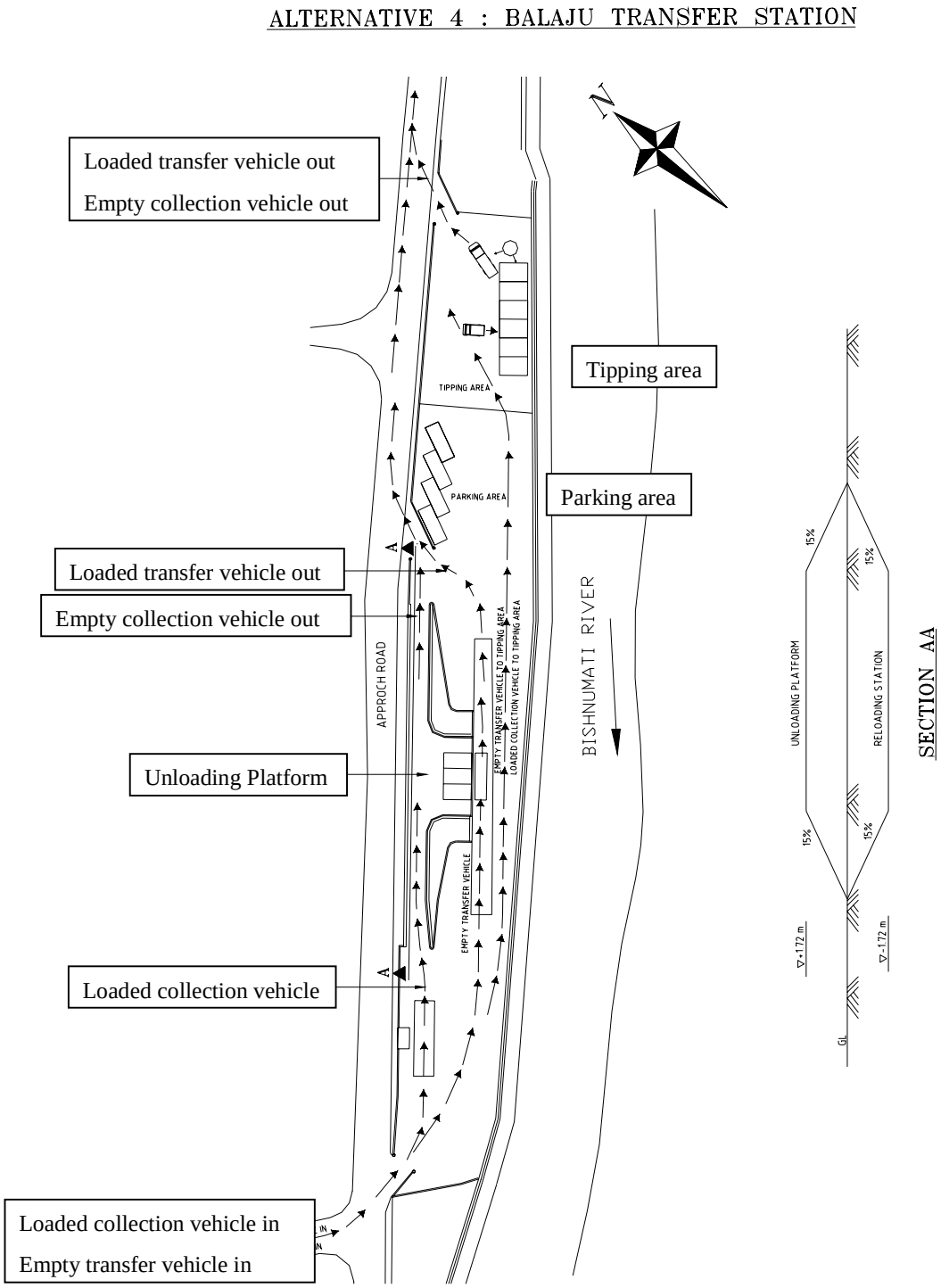


Figure 4.4-2-4 Balaju Transfer Station – Alternative 4

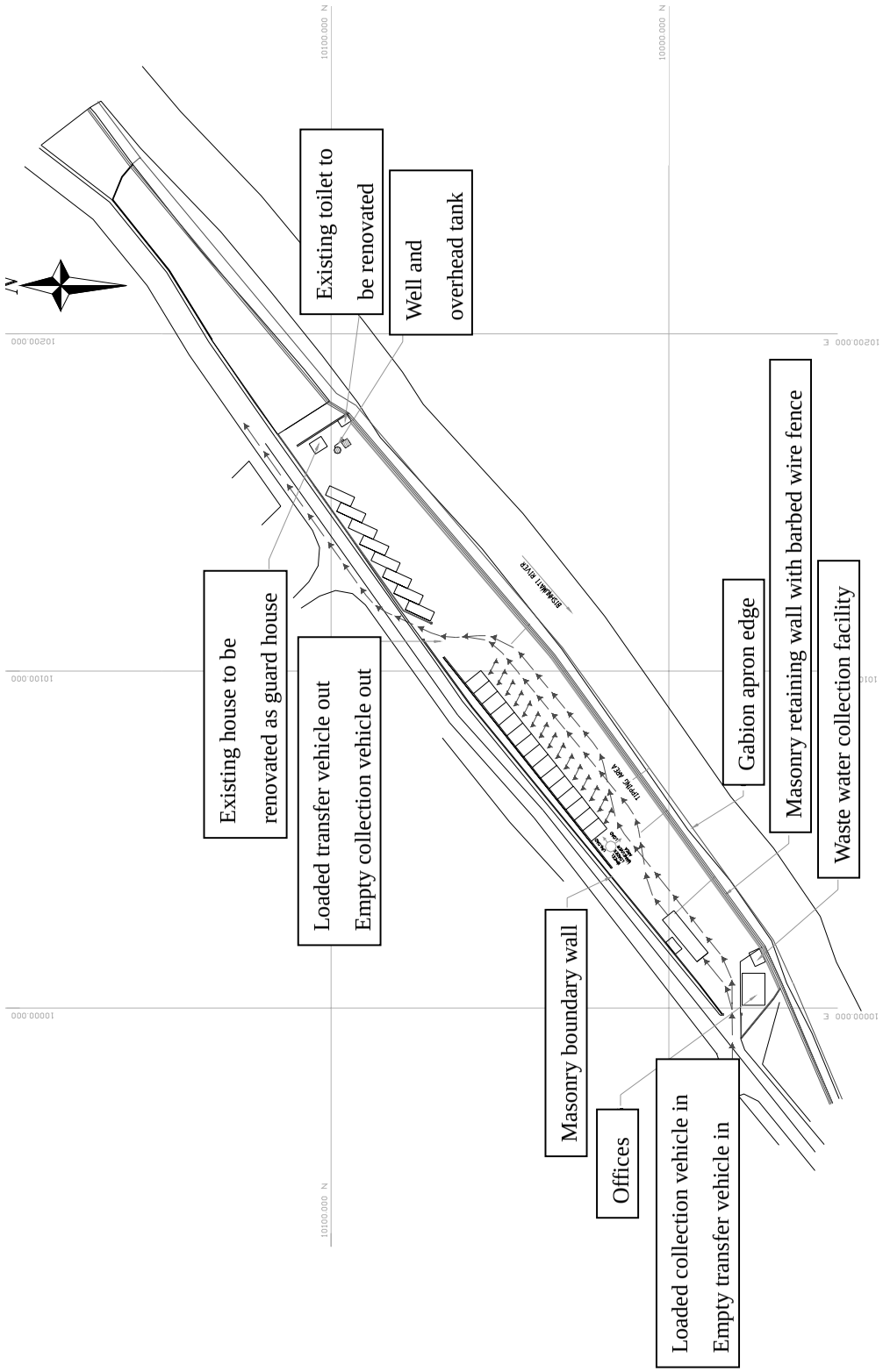


Figure 4.4-2-5 Balaju Transfer Station – Alternative 5

(3) Suggestions from the JICA Study Team for Balaju Transfer Station

1) Suggestions on the Environmental and Social Considerations

a. Requirements of IEE

In the case of developing the site as a permanent transfer station, the screening to determine the level of environmental assessment (EIA or IEE) should be conducted as per the scale and activities in accordance to EPR Rule 3, Schedule 1 and 2. As the area coverage of the Balaju Transfer Station is planned to be 0,8 ha (less than 3 ha threshold value for IEE), the **Initial Environmental Examination (IEE) including environmental management and monitoring programs** should be conducted. Referring to schedule 1 and 2 of EPR, the above condition requires Initial Environmental Examination and its approval from the concerned Ministry (Ministry of Local Development Rule 11).

The legal process for undertaking IEE has been described in rules (3), (5), sub rule (2) of rule (7), rule (10) and sub rule (1) of the rule (11) of EPR 1997 and amended, 1999. These are applicable to Solid Waste Management Projects and the following is an outline of the steps:

- The proponent, KMC for Balaju should undertake the IEE study as a permanent transfer station as specified in schedule (1) of EPR, 1997 and table 1 of National Environmental Assessment (EIA) Guidelines for Solid Waste Management project for the municipalities of Nepal.
- Prepare Terms of Reference (TOR) based on the format given in schedule (3) of EPR to be submitted to the concerned department for approval.
- Upon approval of TOR, advise a 15 days notice to concerned institutions and individuals to offer their written opinions and suggestions, pertaining to the possible impacts on the local environment from the implementation of the proposed project. The public notice is to be published in a daily newspaper. Opinions and suggestions, recorded as response to the notice, shall be included in the IEE report as per rule (7).
- Conduct field study to generate and collect project baseline information related to Physical, Biological, Socio-economic and Cultural Environment of the project area using various applicable survey tools.
- Analyze, assess and determine the environment in conjunction with the project activity, project impacts (beneficial/adverse) as envisaged in the IEE TOR.
- Identify, predict and evaluate positive and negative impacts of the proposed project.
- Suggest and design mitigation measures for elimination or minimization of the adverse impacts.
- A simple checklist may be used to obtain the necessary information on the existing environmental conditions, identify potential impacts and suggest suitable mitigation measures.
- Develop Environmental Management and Monitoring Plan.
- Prepare IEE report in the format as given in schedule (5) of EPR 1997.
- Upon submission of 15 copies of the IEE report along with all necessary documents including recommendation of concerned municipality, the concerned agency (Ministry of Local Development) should approve the report within 21 days of submission.

- The IEE may recommend an EIA study, in cases where the IEE is not able to resolve all the issues.
- Upon submission of 15 copies of the IEE report along with all necessary documents including recommendation of concerned municipality, the concerned agency (Ministry of Local Development) should approve the report within 21 days of submission.
- The IEE may recommend an EIA study, in cases where the IEE is not able to resolve all the issues.

b. Suggested Key Points to be considered for the IEE Study

Based on the above discussions, the following are suggested key points to be considered by the proponent from the environmental and social viewpoints when the IEE study is conducted:

- The traffic circulation route for entry of loaded collection vehicles and empty transfer vehicles is planned via a newly developed earthen approach road from the ring road. Similarly, the exit route for empty collection vehicles and loaded transfer vehicles is planned via using the widened earthen road that leads to Balaju crossing. These approaches developed under the land pooling project are planned to be upgraded to gravel standards within this year (2006). Detail traffic surveys and further studies to confirm the acceptability of using these approaches particularly for waste carrying vehicles should be dealt with correctly with the surrounding residents and land pooling project.
- As Balaju transfer station is located within the residential settlement, it is anticipated that there will probably be social conflict due to its location. A brief and thorough formal consultation should be conducted with the local residents while addressing pertinent social issues and prescribing appropriate mitigation measures. This is vital in making the site socially acceptable.
- Environmental pollution especially of water quality and odor should be reduced as much as possible through mitigation measures, which are to be examined in every project stage. It is also essential that environmental monitoring be incorporated into the projects' design and implementation. In order to reduce the impact of odor, it is proposed to examine i) the effective unloading/loading work of waste handling, and ii) platform cleaning and drainage management. Regular or ad hoc observation of the odor condition is also suggested in and around the site. It is also suggested that access road maintenance, speed limit and heavy equipment maintenance be provided to reduce the impact of air pollution and noise.
- Outside workforce conflict (influx of waste pickers) is an aspect that needs to be carefully considered. Despite the restriction, the waste pickers are anticipated to approach to newly developed transfer station. Although the situational analysis of Teku T/S could contribute to predict situation, there may be other sources for the migration of the waste pickers and the number may increase further. Detail study in this regard is essential to figure out the probable influx numbers and to outline appropriate mitigation measures for preservation of the social and cultural situation.
- A thorough study is required for identification of all parties, likely to be involved in the development and operation of the transfer station, and assigning them with specific environmental responsibilities for effective implementation of mitigation measures and monitoring requirements during design, construction and operation phases of the project.

2) Technical Aspects

- KMC will require a transfer station to be located in the north of the city and Balaju T/S should be developed for this purpose in the absence of any other alternative site.
- The site location is satisfactory and the access to the ring road is being developed. However, the road adjacent to the site needs to be upgraded and paved.
- Direct loading with a tipping area offers the best development alternative for the new transfer station but to meet the high cost for development KMC may develop the station over a longer period in phases.
- Accordingly development may start with the tipping area provided that most of the waste collected in the northern area is done using non-tipping collection vehicles.

4.4.2 Results of the Follow-up Survey for Afadole Temporary Transfer Station

(1) Environmental Issues Identified and Necessary Countermeasures

The reconnaissance survey of the surrounding area of the planned transfer station site at Afadole (within radius of around 150 - 200 meters) was conducted on January 31, 2006. Based upon the reconnaissance survey including discussions with the relevant officials of LSMC, the existing environmental conditions are assessed as follows:

1) Bio-Physical Environment

The planned site at Afadole, Ward 4 in LSMC, is located along the left bank of the Bagmati River besides an earlier constructed oxidation pond that is presently dry and not functioning. The area of the site is around 14,000 m^2 (1.4 ha). Figure 4.4-3 presents the location of the site and detail of its surrounding area. The site is located comparatively far away from residential settlement.

In general there are two approach roads to the site. One is from Dhobighat chowk that initially, in gravelly pavement, runs towards the west and then, upon taking a southwards turn, becomes an earthen track that follows along the left bank of the Bagmati River. The approach initially is narrow

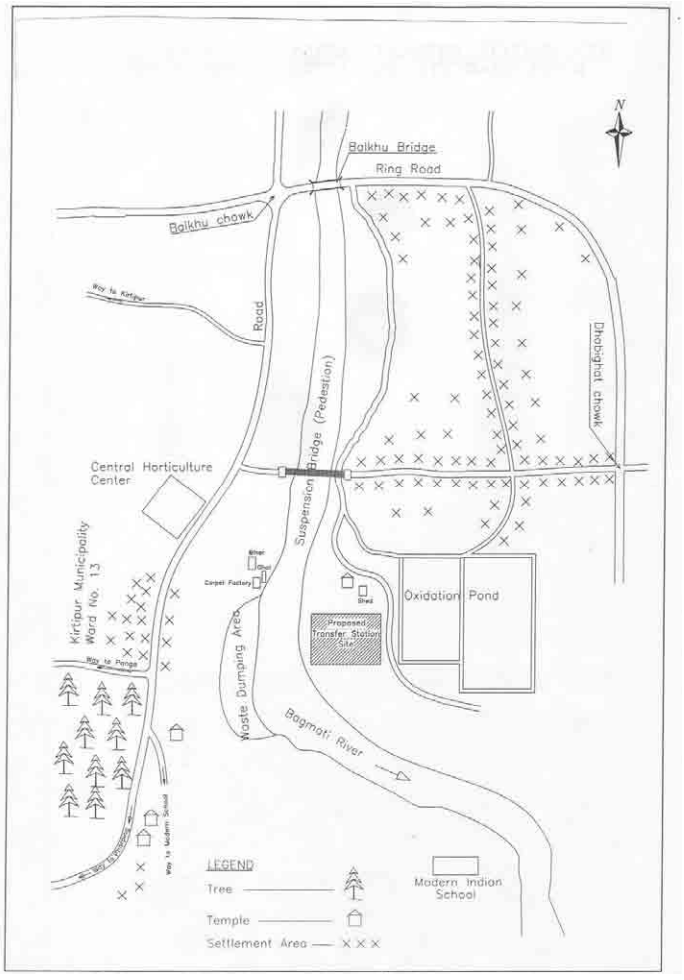


Figure 4.4-3 Location of Afadole Transfer Station and its Surrounding area

and passes through residential settlement of Dhobighat. Another approach is a gravelly/earthen track that runs southwards along the left bank of the Bagmati River upon taking a sharp right turn after crossing the Balkhu Bridge at the ring road while traveling towards Sanepa.

Basically the site topography is flat, possessing a gentle slope of around 4 to 5 percent towards the river bank. A sharp drop in level of around 4 meters in average is noted near to the riverbank. The maximum flood level of the Bagmati River is anticipated to be around 2.5 – 3.0 meters high compared to the dry season water level.

The site area possesses an open grass field resting over waste fill materials. The soil composes of fine silt, sand, brickbats and other dumped materials. The site was previously used as a dumping ground for municipal waste from LSMC and KMC. The dumping activity ceased in the year 2004 and was shifted to another area. The fill materials are around one year old. Because of the waste fill materials, cracks in the ground were observed at certain locations with emission of gas generated by the fill. Sand quarrying along the riverbank (small scale, localized) is a frequently noted activity leaving traces of minor riverbank erosion.

Since the riverbank along the other side (west to the site) has been transformed into a dumping site for municipal waste generated and transported from KMC and LSMC, there is noticeable odor, litter, exposure of solid waste to the environment together with pollution of the Bagmati River, which is the only perennial river within the vicinity. Dust pollution within the site is minimal due to rare vehicular movement.

The planned site area itself does not consist of any forestation (vegetation). The area habitats have been disturbed and it is seldom visited by wild mammals. However, due to the ongoing waste dumping activity on the other side of the river bank, a considerable number of eagles were noted encircling the sky.

The climate of the project area is temperate with a temperature variation between 32°c and 0°c. April/May is the warmest month while January is the coldest. The relative humidity is in average 80% with an estimated average annual rainfall of 1770 – 1,968 mm. The maximum rainfall within a 24 hour is noted to be 98 - 109 mm.

2) Socio-economic and Cultural Environment

The site and its surrounding area within a radius of 150-200 meters does not contain any notable settlements and it is open river-side barren land owned by the Government. Two previously built oxidation pond, which are at present not functioning and frequently used by children of the nearby settlement as a playground, exist besides the planned site.

A temporary mud-built hut having a CGI sheet roofing for the purpose of running a tea stall is located near the site besides earthen approach road. A small open Mahadevi temple (without roof cover) is located besides the earthen approach road north of the site. The temple is frequently used for worship by nearby settlements. Nearby features visible beyond 200 meters from the planned site are as follows:

- Settlement comprising around 25 households on the other side of the Bagmati River, towards west of the site. These include a Sundarighat, Sulakchyan Kirti Bihar, Carpet Dying Factory and three temples namely Swasthani, Bishwambhareswor and Mahadev/Parbati.
- Modern Indian School located on the other side of the Bagmati River towards south of the site.
- The major ethnic groups noted are Newar, Brahman and Chettri.

3) Identified Environmental Issues and Recommended Measures

The identified major environmental and social issues that may result from the construction and operation of the planned Afadole transfer station, and recommended measures for mitigating anticipated adverse impacts on the environment are as follows:

Table 4.4-5 Identified Major Environmental Issues and Recommended Measures (Afadole Transfer Station)

Issues	Activities	Mitigation Measures
Air Pollution and Offensive Odor	• Operation and increase in heavy vehicle movements will emit air pollutants including particulates, hydrocarbons, nitrogen oxides, carbon monoxide and sulfur dioxide. • Increase in concentration of airborne dust affecting locals residing along the approach and nearby to the site. • Operation in a more or less permanent mixture of moisture and the waste may generate bad smells.	• Either paved or at least graveled with frequent maintenance. Maintain the surface moist by frequent spray of water. • Paving of the traffic circulation route and waste handling area within the site and maintaining it regularly. • During construction, approach roads, working area and stockpiled construction material should be slightly wetted with frequent sprays of water. • Heavy vehicles and machinery used be fitted with air pollution control devices and kept in good condition by regular maintenance and holding green sticker complying to the regulatory law enforced by the Ministry of Labor & Transport Management • Efficient and effective waste management practices be maintained to minimize the duration of accumulation and storage of wastes in the site. Provision for covering of accumulated waste with plastic sheets to reduce bad smells. • As a mitigation to reduce odor & bad smell, the transfer station should accept only municipal waste. • Appropriate design for direct loading and unloading platform to minimize littering and air pollution.
Water Pollution	• Leachate produced due to ineffective, inefficient and improper management in transfer of waste may provide pollution potential to ground and surface water. • Runoff and migration from spills/leaks and improper discarded used oils and lubricants will result in fire/explosion hazard and ground and surface water pollution. • Siltation and pollution of surface water resulting from uncontrolled runoff from storage piles. • Unsanitary waste disposal practices by workforce camp, TS employees, waste pickers activity and their accommodation nearby the site during construction and operation of the TS.	• Operation being direct loading of waste adopting open top system without any compaction system, anticipated leachate generation is minimal and its treatment provision may not be required. Introduce efficient waste handling and management including regular cleaning of waste handling area. However, provision for the collection and storage system for the leachate is possible and, if included will be better. • Provision for proper storage of petrol, diesel, oil and lubricants with proper disposal of used lubricants and oils. • Proper mechanism for storage of construction materials with protection measures against erosion. • Provision of adequate drainage system with proper outlet to sustain stormwater as well as wastewater produced during operation of transfer station. • Provision and maintenance of toilets for workforce camp, TS employees and waste pickers involved in waste separation activity to maintain sanitary waste disposal practices.

Issues	Activities	Mitigation Measures
Erosion and Soil Instability	The following activities induce high potential for soil instability, riverbank and embanked surface erosion. • Frequent sand quarrying along the riverbank as noted specifically in Afadole site. • Construction activity including excavation and fill operation nearby to the riverbank. • Routine heavy vehicle movement during operation. • Gas generated by the fill material specifically noted in Afadole site has the potential to exert pressure on natural soil condition inducing soil instability and fire/explosion hazard.	• Provision of adequate riverbank protection measures. • Restrict riverbank sand quarrying activity. • Provide appropriate cut and fill batter. • Appropriate surface lining (i.e. stone pitching, grass turf etc.) for cut and embanked slopes. • Paving all waste handling areas and traffic circulation route within the TS. • Areas susceptible to erosion be protected by temporary and permanent drainage works during construction and operation phase respectively. • Proper disposal of excess and unsuitable materials in appropriate locations. • Very economic and simple but effective under ground gas collection and draining out system be introduced in Afadole site.
Noise and Vibration	• Trucks engines, squeaking brakes, and hydraulic equipment will induce noise.	• Heavy equipment and machinery being used by the Municipality be fitted with noise dampening devices and ensure for correct operation. • Avoid late hour operation of transfer station. • Avoid blowing horn unnecessarily.
Traffic Congestion and Accidents	• Concentrated heavy vehicle movements causing disruption to general traffic. • The capacity of the transfer station has been designed to cope with the daily waste generation around the peak hour waste (25% of daily waste generated). This requires that transfer vehicles and collection vehicles can maneuver on the site during the peak hour. • Risk of traffic accidents may be increased due to new traffic generation of waste collection and transportation vehicles	• Assess carefully all available approaches and design appropriate routes for collection / transfer vehicles including smooth traffic circulation within the TS with the least traffic conflict points and comfortable available parking space. • Provision of appropriate de-acceleration and turning lanes. • Provision of adequate sight lines and queuing space within the TS to prevent interruption to general traffic movement on narrow earthen approach roads outside. • Provision of adequate width to minimize congestion of trucks trying to enter or leave the site.
Impairment to Infrastructure	• Regular use of heavy vehicles will impair existing community infrastructure in particular the earthen approach roads.	• Paving or at least gravelling of earthen approach road to a considerable length and maintaining them regularly during operation. In case of gravel, the municipality should maintain the surface moist by frequent spray of water.
Land Acquisition	• Planned site at Afadole constitutes barren government land. LSMC is required to acquire the land ownership • A temporary hut built near to the site needs evacuation.	• Initiate the process of transferring land ownership of the site from concerned government institution. • Initiate necessary action for evacuation of temporary hut built near to the site in the government land.
Visual and Unsightly Look	• Bad management will degrade the visual quality of present land use comprising recreational and residential area for Afadole. • Litter due to dumping of waste delivered out of working hours outside the entrance to the site. • Wind blown litter from the waste transfer operation. • Spread of litter by disorganized waste pickers, birds and animals. • These may invite public opposition as both sites have areas of ethnic value (temples etc)	• In case of Afadole site, develop vegetative buffer zone with adequate barbed wire fencing. • Maintain the body of waste carrying vehicles intact to avoid leakage and littering. • Restrict working hours and dumping of waste outside the entrance to the TS. • Maintain proper coverage of stored waste with plastic sheets. • Regulate, maintain and control waste pickers activity through a registration system and demarcate allowable working, storing and transfer of recovered material. Impose punishment for littering of materials during handling for storage and transfer.

Issues	Activities	Mitigation Measures
Infectious Diseases	• Improper and inefficient management of waste • Introduction and accommodation of external workforce (labor during construction, municipality employees and waste pickers during operation), their unsanitary waste disposal practices including toilet effluent and stagnant wastewater generated from bathing/cooking and waste handling process itself may propagate conducive environment for breeding of mosquitoes. • These could create public health hazards to the surrounding area.	• Provision of adequate drainage system for storm and wastewater generated during and operation of TS. • Provision of proper accommodation and management for workforce, municipality employees and waste pickers within and outside transfer station at appropriate location. • Provision and maintenance of toilets for workforce camp, transfer station employees and waste pickers involved in waste separation activity to maintain sanitary waste disposal practices. • Strong supervision to restrict littering of waste in the surrounding area.
Local Conflict (economy and interest)	• Waste pickers are anticipated to approach to newly developed transfer station at Afadole, where a tipping area will be provided for vehicles without direct tipping facilities. • Outside workforce involvement in the local area may initiate conflict between the locals and outsiders on cultural grounds due to bad habit practices.	• Regulate the activities of workforce and waste pickers by introducing a registration system • Supervise and control the good practices to preserve the social setting and cultural harmony of the planned area.

Source: The JICA Study Team

(2) Concept Design of Afadole Temporary Transfer Station

1) Site Location and Characteristics

Afadole site is located at Afadole ward 4 in LSMC, along the left bank of the Bagmati River, and adjacent to two earlier constructed oxidation ponds for sewage treatment (which are presently not in use).

Two approach roads serve the site, one from Dhobighat Chowk that runs initially in a westward direction then follows an earthen track along the left bank of Bagmati River upon taking a southward turn. The road is initially narrow and passes through residential settlements of Dhobighat. The second approach runs southward along the left bank of Bagmati River upon taking a sharp turn after crossing Balkhu Bridge along the ring road while approaching Sanepa. Both roads are unpaved gravel roads.

The proposed site is an open grass field that has been reclaimed by waste disposal activity along the river and has an area of 1.4ha. The topography is basically flat with a gentle slope of around 4 to 5% towards the riverbank. Sand quarrying is observed along the riverbank.

2) Alternatives Development

Considering location aspects within the site, environmental concerns and costs; four alternatives were formulated, as described in Table 4.4-6, and shown in Figures 4.4-4-1 to 4 respectively.

Table 4.4-6 Afadole Transfer Station Alternatives

Alt.	Unloading Platform		Platform location	Remark
	Platform height	Reloading stations		
1	GL+3.45m – Loading to container mounted on truck	2 stations x 3 bays	Center	Handling Capacity: High Cost: High Environment: Mitigation of waste storage at site and smooth traffic flow within the site
2	GL+3.45m – Loading to container mounted on truck	2 stations x 3 bays	South-east corner	Handling Capacity: High Cost: High Environment: Mitigation of waste storage at site but problem of traffic flow within the site
3	GL+3.45m – Loading to container mounted on truck	1 station x 3 bays	Center	Handling Capacity: Medium Cost: Medium (slightly more saving compared to Alternatives 1 and 2) Environment: Some delay in waste transport from station may occur
4	GL+2.00m – Loading to container detached from truck	1 station x 3 bays	Center	Handling Capacity: Medium to low Cost: Least costly Environment: Some delay in waste transport from station may occur Some noise and other concerns due to container mounting – detachment operations at the station

Alternative 1 offers the best handling capacity and lesser environmental concerns and was therefore selected by LSMC for development of the concept design, as attached in the Drawings C.

3) Salient Features of Afadole Temporary Transfer Station

A summary of the salient features of the site is given in Table 4.4-7.

Table 4.4-7 Salient Features of Afadole Temporary Transfer Station

No.	Item	Description
1	Project Name	Afadole Temporary Transfer Station
2	Location	Ward 4, Afadole, LSMC
3	Type	Open Top, Direct Loading including Tipping Area
4	Area	1.4 ha
5	Daily waste arrival	75 t/d (assumed for design)
6	Peak hour waste	18.75 t/hr
7	Transfer truck capacity	15 m^3 (size 8m x 2.5m x 2.8m)
8	Collection truck capacity	Average 6m^3 (size 6m x 2.5 m)
9	Unloading platform	48.214m x 14.5m raised 3.45m above GL (Embanked with stone masonry retaining wall along reloading station, R.C.C. paved surface with nominal reinforcement). 0.25m R.C.C. guide wall of height 0.25m all around. 0.50m space left along the edge of embankment where there is no wall.
10	Reloading stations	Two at design ground level.
11	Approach and exit ramps	Length along centre line 28m. Embanked with stone masonry retaining wall on inner side along transfer vehicle traffic circulation route. Total width 5.0m, carriageway width 4m, 0.25m R.C.C. guide wall at both sides with 0.25m high, and remaining 0.5m space left along the edge of embankment where there is no wall.

No.	Item	Description
12	Weighbridge	Space provision of 17.85 x 4.30 for weighbridge having weighing platform, approach and exit ramp.
13	Scale house	Space provision of 4.5m x 2.5m.
14	Tipping Area	2667 m^2 RCC paved surface with nominal reinforcement.
15	Administration Building	Three rooms with one bathroom/toilet covering 64 m^2.
16	Guardhouse	One room with one bathroom/toilet covering 18.80 m^2.
17	Public bathroom/ toilets	Four toilets with two bathrooms covering 39.12 m^2.
18	Drains	Total four types of drain proposed. Type A is rectangular stone masonry drain with R.C.C. slab covered. Type B is rectangular masonry open drain. Type C is masonry trapezoidal catch drain draining entire transfer station surface runoff to waste collection tank of size 3.5m x 3.5m x 3.0m. Type D is earthen trapezoidal roadside drain for approach road outside the transfer station.
19	Landfill gas collection pipes	100mm dia perforated PVC horizontal pipe laid underneath the drainage line covered by stone filled box extending to width of drain and 1.0m below drainage invert level. Vertical legs are to be kept at appropriate locations to vent out the gas.
20	Well and overhead tank	Provision of well and overhead tank kept at the corner of parking area for vehicle washing purpose.
21	Parking area	Parking adequacy for 31 vehicles allocating space of 8m x 3m for one vehicle. R.C.C. paved surface with nominal reinforcement.
22	Traffic Circulation Route	All traffic circulation routes within the transfer station R.C.C. paved with nominal reinforcement.
23	Buffer zone	6.2 m vegetative buffer zone all around, barbed wire fence on three sides and boundary wall with net fencing along approach road at eastern side.

4) Proposed Facilities

Based on the discussions held between LSMC, the JICA Study Team and CEMAT (the local consultant) the facilities described in Table 4.4-8 have been incorporated in the concept design.

Table 4.4-8 Facilities of Afadole Temporary Transfer Station

No.	Facility	Comment
1	Administration Building (3 rooms & Bathroom)	
2	Guard House	1 room with toilet
3	Weighbridge	Space provision(1
4	Work shop	Space provision
5	Water well and tank	Space provision, with consideration on water supply system to be provided
6	Vehicle washing	Space provision
7	Lights	For office and night work
8	Embanked unloading and reloading platform	
9	Embanked ramps	
10	Paved waste tipping area	
11	Paved parking area	For 30 vehicles
12	Buffer	Vegetative buffer with barbed wire fence
13	River bank protection	Gabion protection wall
14	Paved traffic circulation route within station	
15	Drainage system for storm water and waste water	
16	Leachate storage	Collection drains and storage tank

No.	Facility	Comment
17	Scavengers working space	Required for around 50 scavengers
18	Toilets for scavengers	
19	Space for recovered materials	
20	Underground gas collection and venting system	
1) Space provision indicates that the facility will not be included in the concept design at this time		

The draft concept design drawings are included in the Drawings C.

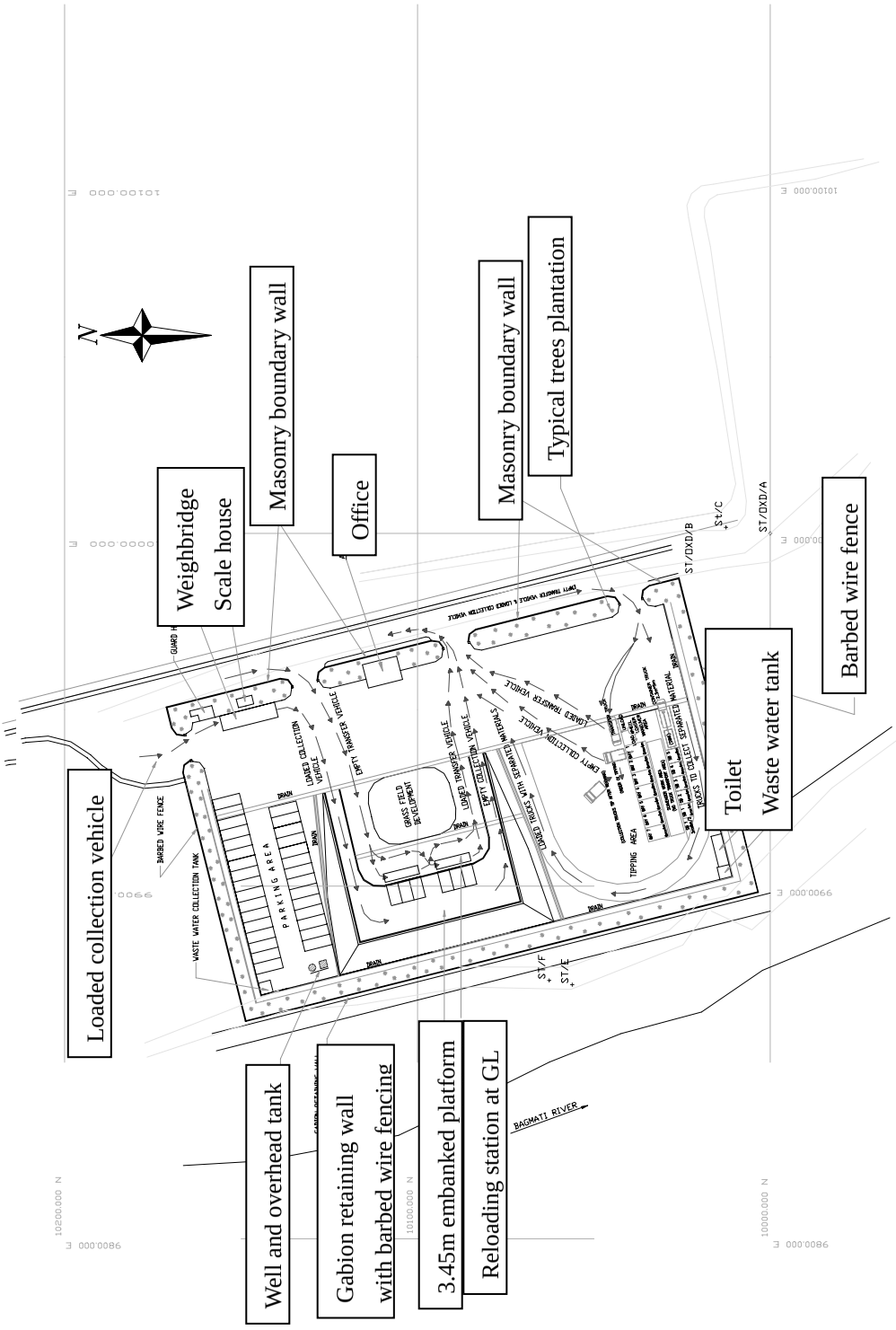


Figure 4.4-4-1 Afadole Transfer Station – Alternative 1

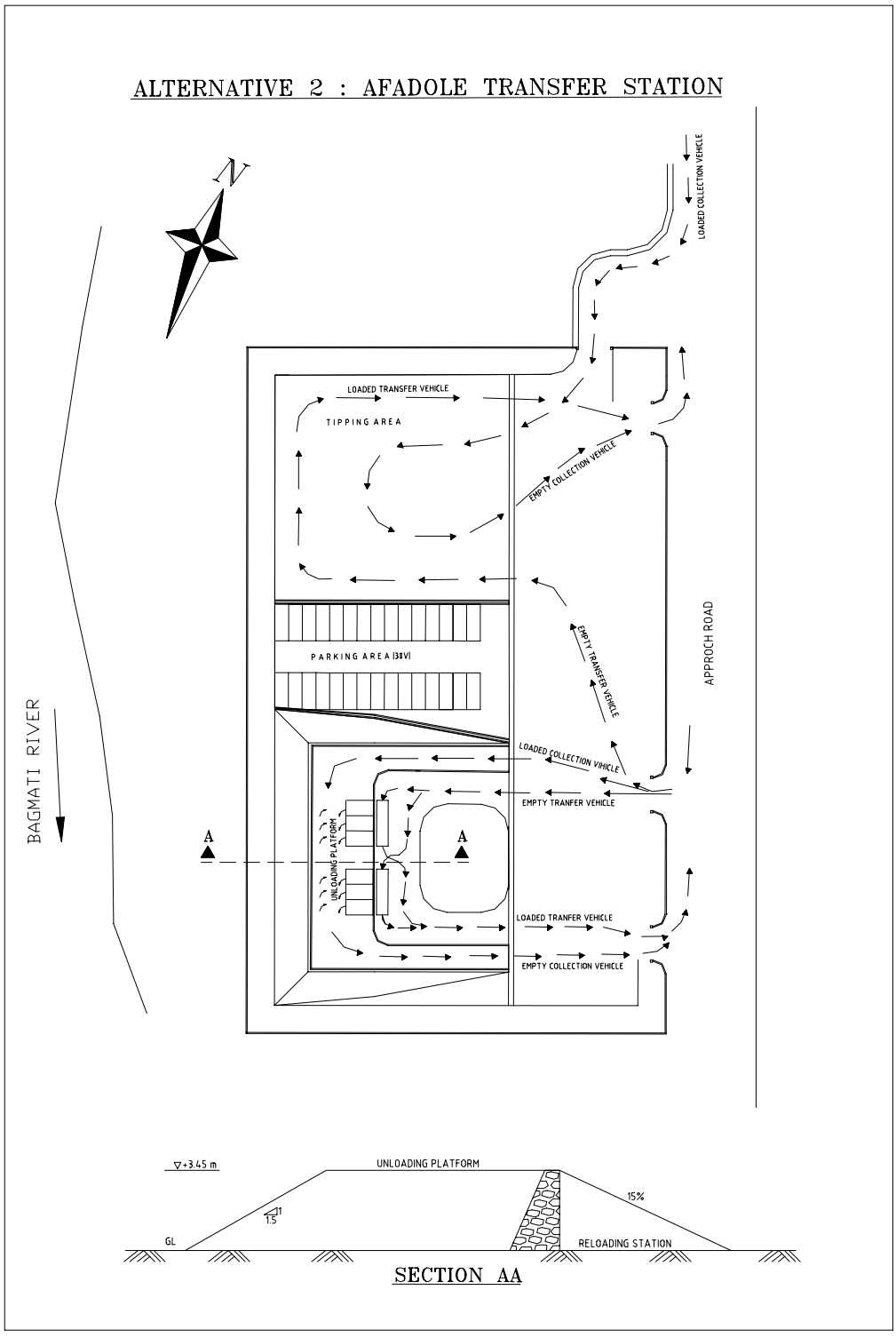


Figure 4.4-4-2 Afadole Transfer Station – Alternative 2

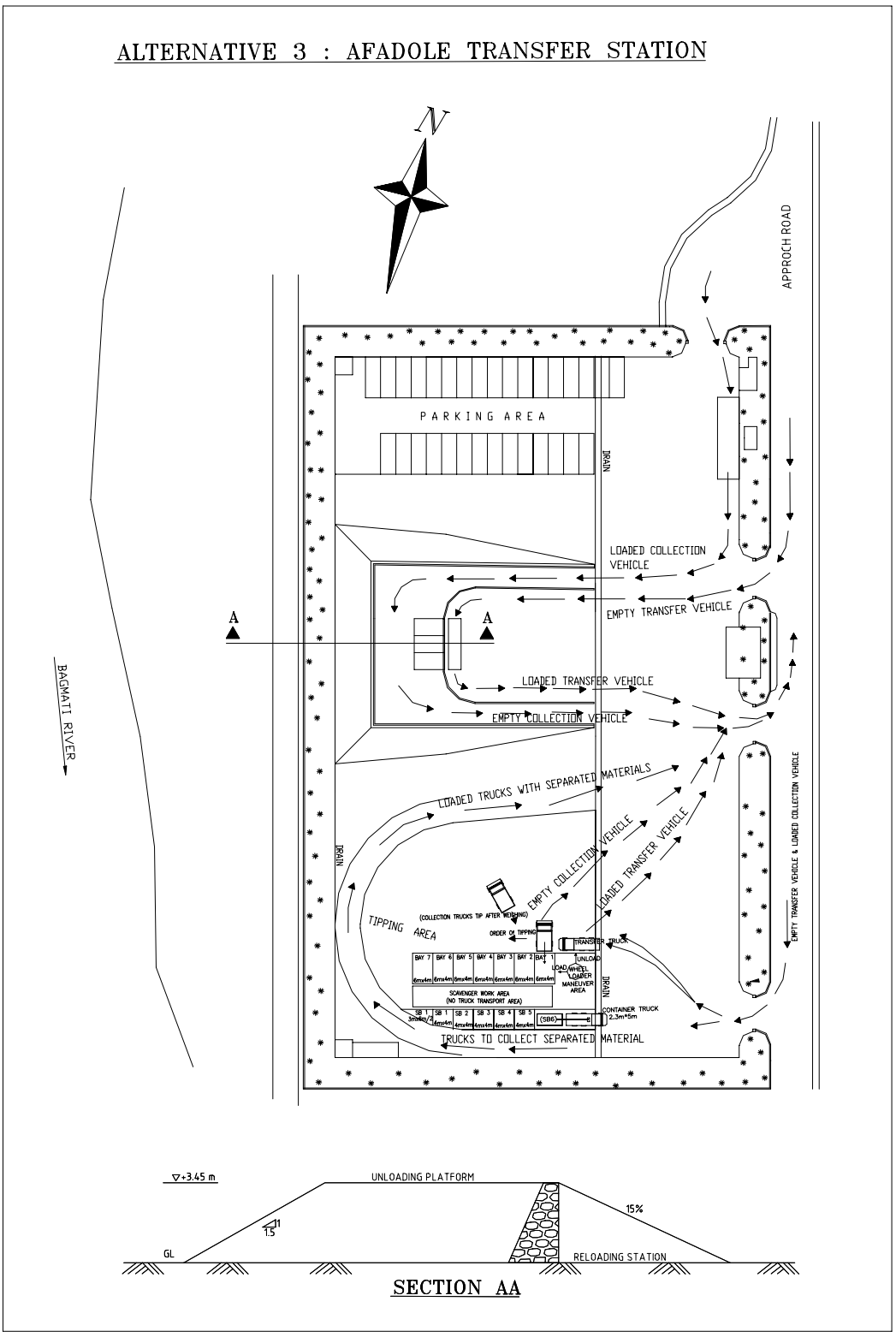


Figure 4.4-4-3 Afadole Transfer Station – Alternative 3

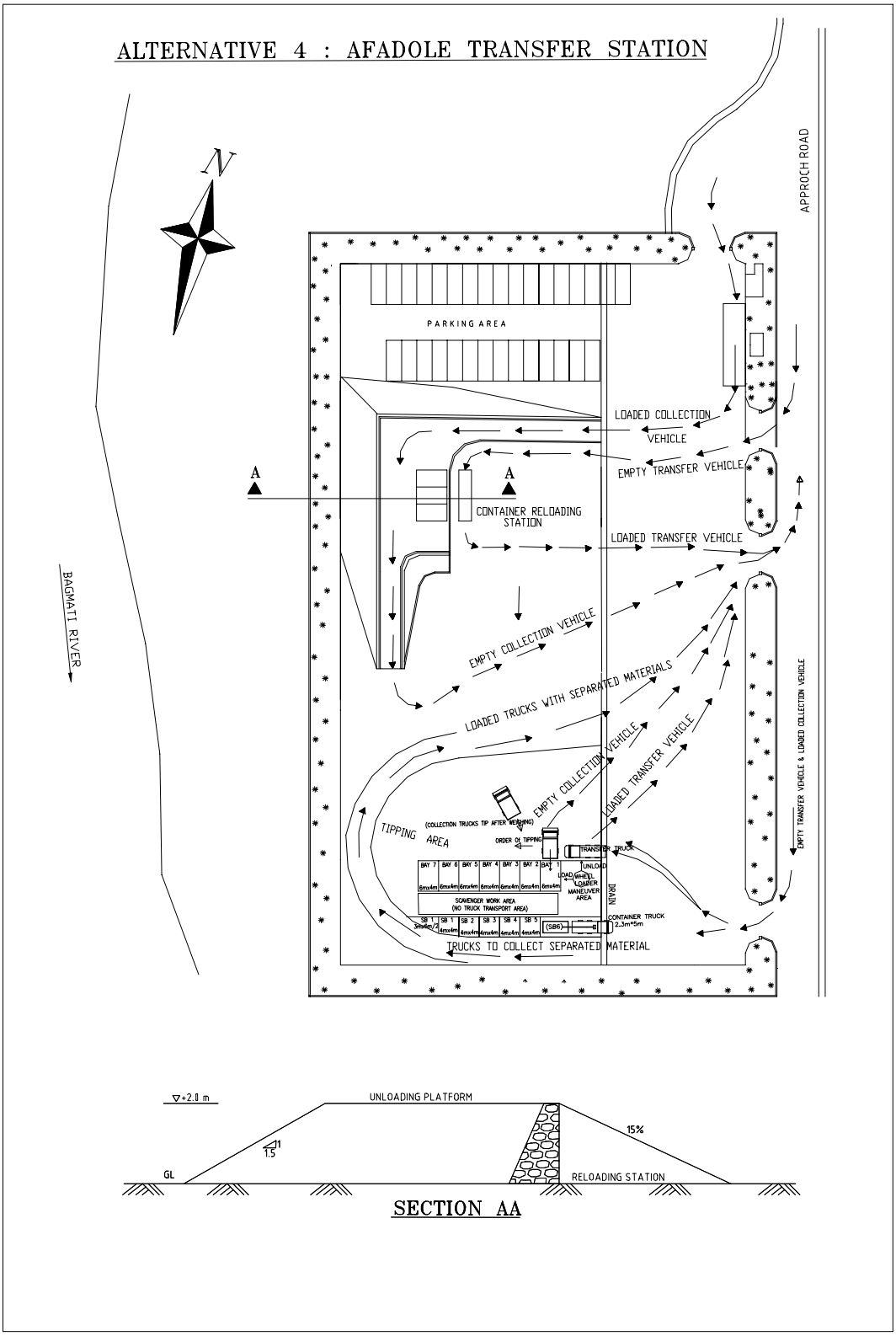


Figure 4.4-4-4 Afadole Transfer Station – Alternative 4

(3) Suggestions from the JICA Study Team for Afadole Transfer Station

1) Suggestions on Environmental and Social Considerations

a. Requirements of the IEE

Same as the Balaju transfer station, the screening to determine level of environmental assessment (EIA or IEE) should be conducted as per the scale and activities in accordance to EPR Rule 3, Schedule 1 and 2. As the area coverage of the Afadole transfer station is planned to be 1.4 ha (less than 3 ha threshold value for IEE), the **Initial Environmental Examination (IEE) including environmental management and monitoring programs** should be conducted. Referring to schedule 1 and 2 of EPR, the above condition requires Initial Environmental Examination and its approval from the concerned Ministry (Ministry of Local Development Rule 11). The legal process for undertaking the IEE is as discussed for the Balaju transfer station.

b. Suggested Key Points to be considered for the IEE Study

Based on the above discussions, the following are suggested key points to be considered by the proponent from the environmental and social viewpoints when the IEE study is conducted:

- As the site is located at the riverbank, the designed ground level of the transfer station should be carefully established considering maximum anticipated river flood level. In any case, river flooding must not affect the transfer operation and adequate riverbank protection measures should be provisioned accordingly. The concept design presumes a maximum flood level of 2.5-3.0 meters in the Bagmati River compared to the dry season river flow. However, further available hydrological studies should be reviewed carefully to designate appropriate design flood levels.
- In the case of Afadole transfer station, the site was previously used as a dumping ground for municipal waste. The dumped depth extends to around 3.0 meters. Being waste fill materials, ground cracks with emission of gas generated by the one year of old fill was noted at certain locations. The waste characteristics of the fill material, its potential for leachate and gas generation studies seems essential for design of appropriate mitigation measures while developing the site as a permanent transfer station.
- Environmental pollution especially of water quality and odor should be reduced as much as possible through mitigation measures, which are to be examined in every project stage. Environmental monitoring is also essential to be incorporated into the projects' design and implementation. In order to reduce the impact of odor, it is proposed to examine i) the effective unloading/loading work of waste handling, and ii) platform cleaning and drainage management. Regular or ad hoc observation of the odor condition is also suggested in and around the site. It is also suggested that the access road maintenance, speed limit and heavy equipment maintenance be provided to reduce the impact of air pollution and noise.
- Outside workforce conflict (influx of waste pickers) is an aspect that needs to be carefully considered. The waste pickers are anticipated to approach the newly developed transfer station at Afadole, where a tipping area will be provided for vehicles without having direct tipping facilities. However, the waste pickers may be overloaded in Afadole where LSMC intends to allow a maximum of 50 waste pickers to sort a daily waste amount of around 35 tons. Although the situational analysis of Teku T/S could help predict the situation, there could be other sources for the migration of the waste

pickers and the number may increase further. Detail study in this regard is essential to figure out the probable influx number and to outline appropriate mitigation measures for the preservation of the social and cultural situation.

- A thorough study is required for identification of all likely parties to be involved in the development and operation of the transfer station with specific environmental responsibilities for effective implementation of mitigation measures and monitoring requirements during design, construction and operation phases of the project.

2) Technical Aspects

- Afadole site is suitably located for the development of the transfer station there, but improvement of the access road along the Bagmati River should be implemented.
- If the site is developed from the start as planned in the concept design, the capacity of the station may initially be over developed. Some agreement may be made with KMC and KRM to receive some of their wastes at the site. This would fall well in line with the Umbrella Concept developed for the Kathmandu Valley.
- In view of the above, and should LSMC consider the high cost for immediate development of the total concept design as an obstacle, as well as the number of transfer trucks available to LSMC, it may be advisable for LSMC to consider developing the site under Alternative 4.