Dhaka North City Corporation

The People's Republic of Bangladesh

Japan International Cooperation Agency

FUTURE VISION OF SOLID WASTE MANAGEMENT IN DHAKA NORTH CITY

Environmentally Advanced City with Integrated and Sustainable Solid Waste Management: toward Zero-Waste

NEW CLEAN DHAKA

MASTER PLAN 2018–2032

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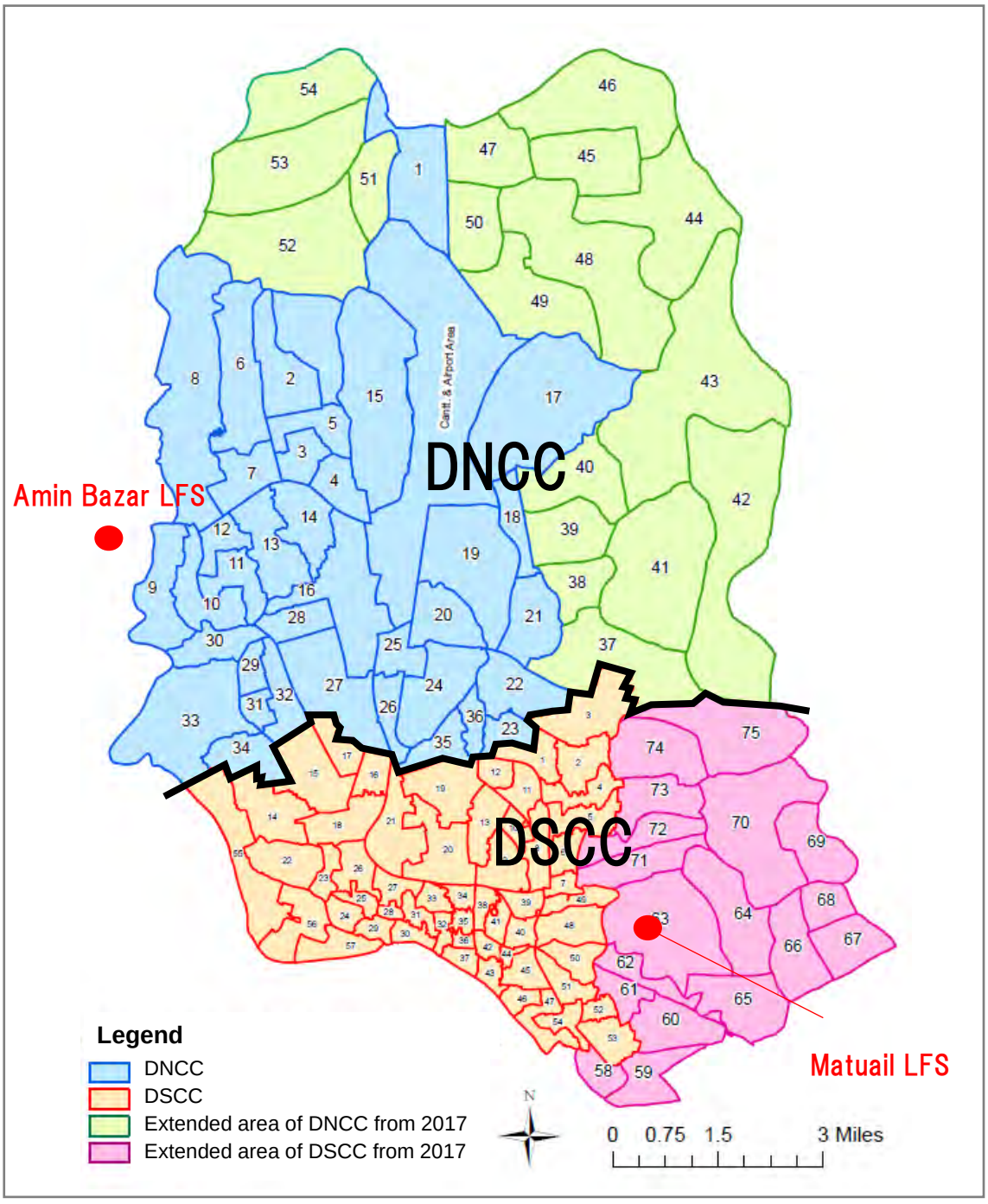
August 2019

The following foreign exchange rate is applied in the Master Plan:

US$ 1 = Tk. 83 (Bangladeshi Taka) as of the end of August 2018.



Source: JICA Project Team

Areas of Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC)

List of Abbreviations and Acronyms

AAP	Annual Activity Plan
ACWMO	Assistant Chief Waste Management Officer
Ad. CWMO	Additional Chief Waste Management Officer
ADB	Asian Development Bank
AE	Assistant Engineer
BBS	Bangladesh Bureau of Statistics
BCC	Barisal City Corporation
BDT	Bangladesh Taka
BPDB	Bangladesh Power Development Board
CAP	Community Action Plan
CBO	Community Based Organization
CC	City Corporation
CCC	Chittagong City Corporation
CEO	Chief Executive Officer
CI	Conservancy Inspector
CNG	Compacted Natural Gas
CO	Conservancy Officer
COCC	Cumilla City Corporation
CUWG	Community Unit Working Group
CWMO	Chief Waste Management Officer
DCC	Dhaka City Corporation
DGHS	Directorate General of Health Services, Ministry of Health and Family Welfare
DNCC	Dhaka North City Corporation
DoE	Department of Environment, Ministry of Environment and Forests
DPP	Development Project Proposal
DSCC	Dhaka South City Corporation
ECC	Environmental Clearance Certificate
ECNEC	Executive Committee of National Economic Council
ED	Engineering Department
EE	Executive Engineer
EGAP	Environmental Grand Aid Project
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ERD	Economic Relations Division, Ministry of Finance
FTFP	Fixed-Time and Fixed-Place Collection
FY	Fiscal Year
GAP	Grant Aid Project
GCC	Gazipur City Corporation
GDP	Gross Domestic Product
GHG	Greenhouse Gas

GIS	Geographic Information System
GoB	Government of Bangladesh
HCEs	Health Care Establishments
JDCF	Japan Debt Cancellation Fund
JICA	Japan International Cooperation Agency
JOCV	Japan Overseas Cooperation Volunteers
KCC	Khulna City Corporation
LFS	Landfill Site
LGD	Local Government Division, Ministry of Local Government, Rural Development and Co-operatives
LGED	Local Government Engineering Department
LMU	Landfill Management Unit
MCC	Mymensingh City Corporation
MD	Mechanical Division of Engineering Department
MTBF	Mean Time Between Failure
MLGRD&C	Ministry of Local Government, Rural Development and Cooperatives
MLSS	Member of Lower Subordinate Staff
MoEF	Ministry of Environment and Forests
NCC	Narayanganj City Corporation
NEDO	New Energy and Industrial Technology Development Organization
NGO	Non-Governmental Organization
O&M	Operation and Maintenance
OHSE	Occupational health, safety and environment
PAPS	Public Awareness Planning Section
PCG	Public Consultative Group
PCSP	Primary Collection Service Provider
PRD	Public Relation Department
PRISM	PRISM Bangladesh Foundation
PWD	Public Works Department
RACC	Rangpur City Corporation
RAJUK	Rajdhani Unnayan Katripakkha: Capital City Development Authority
RCC	Rajshahi City Corporation
SAE	Sub Assistant Engineer
SCC	Sylhet City Corporation
SCP	Secondary Collection Point
SPD	Store and Purchase Department
SPM	Suspended Particulate Matter
SREDA	Sustainable and Renewable Energy Development Authority
SSC	Safety and Sanitation Committee
STS	Secondary Transfer Station
SWM	Solid Waste Management
SWMSC	Solid Waste Management Standing Committee
TD	Transport Department

TOR	Terms of Reference
UNDP	United Nations Development Program
UPD	Urban Planning Department
WB	World Bank
WBA	Ward-based Approach
WHO	World Health Organization
WMD	Waste Management Department
WOM	Ward Office Manager
WtE	Waste to Energy
ZO	Zone Officer
3R	Reduce, Reuse, Recycle

Glossary

Bangladesh Climate Change Trust: The Bangladesh Climate Change Trust is a government trust in Bangladesh that utilizes funds to take action against problems caused by climate change. The trust fund has operated since 2010, and collaborates with government ministries as well as NGOs and the private sector to implement and evaluate climate change mitigation projects.

Consultation: the process of seeking the views of interested or affected stakeholders and engaging them in constructive two-way dialogue.

Clean Development Mechanism (CDM): CDM is one of the Flexible Mechanisms defined in the Kyoto Protocol (IPCC, 2007) that provides for emissions reduction projects, which generate Certified Emission Reduction units (CERs) which may be traded in emissions trading schemes.

Development Project Proposal (DPP): A DPP is an outline of the entirety of the development project plan.

Emission: The total amount of solid, liquid or gaseous pollutant emitted into the atmosphere from a given source within a given time, as indicated, for e.g., in grams per cubic meter of gas or by a relative measure, upon discharge from the source.

Environmental Impact Assessment (EIA)/Environmental Assessment: The systematic, reproducible and interdisciplinary identification, prediction and evaluation, mitigation and management of impacts from a proposed development and its reasonable alternatives, sometimes known as environmental assessment.

Environmental Impact*:* An estimate or judgment of the significance and value of environmental effects for natural, socio-economic and human receptors.

Environmental Management Plan (EMP): A plan to undertake an array of follow-up activities, which provide for the sound environmental management of a project/intervention so that adverse environmental impacts are minimized and mitigated; beneficial environmental effects are maximized; and sustainable development is ensured.

Environmental Management: Managing the productive use of natural resources without reducing their productivity and quality.

Executive Committee of the National Economic Council (ECNEC): ECNEC is a wing of Planning Commission, which is in charge of coordinating meetings of the ECNEC, and monitoring the implementation of decisions taken at the meetings.

Field Reconnaissance: A field activity that confirms the information gathered through secondary sources. This field study is essentially a rapid appraisal.

Fiscal Year: Fiscal year is also called the financial year or sometimes called budget year. It is used by government accounting and budget purposes, which varies between countries. In Bangladesh, the fiscal year is 01 July to the next 30 June.

Gross Domestic Product (GDP): It is a monetary measure of the market value of a country for all the final goods and services produced in a specific time period, often annually.

Greenhouse Gas (GHG): GHG is a gas that absorbs and emits radiant energy within the thermal infrared range. Greenhouse gases cause the greenhouse effect. The primary greenhouse gases in Earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide and ozone.

Household: A household is defined as a dwelling unit where one or more persons live and eat together with common cooking arrangement. Persons living in the same dwelling unit by having separate cooking arrangements constitute separate households.

Japan Overseas Cooperation Volunteers (JOCV): JOCV is a system of dispatching Japanese volunteers overseas operated by Japan International Cooperation Agency (JICA).

Landfill Site (LFS): A landfill site is also known as a tip, dump, rubbish dump, garbage dump or dumping ground. Landfill is the oldest form of waste treatment, although the burial of the waste is modern; historically, refuse was simply left in piles or thrown into pits.

Land Use: Types of land includes agriculture, horticulture, settlement, pisciculture, industries etc.

Master Plan: A master plan is a dynamic long-term planning document that provides a conceptual layout to guide future growth and development. It includes analysis, recommendations, and proposals for a specific area's population, economy, housing, transportation, community facilities, and land use.

Non-Governmental Organizations (NGOs): NGO is a non-profit, voluntary citizens' group, which is organized on a local, national or international level.

Natural Gas: Flammable gas, consisting largely of methane and other hydrocarbons, occurring naturally underground (often in association with petroleum) and used as fuel.

Public Involvement/ Public Consultation: A range of techniques that can be used to inform, consult or interact with stakeholders affected/to be affected or benefitted by a proposal or intervention.

Solid Waste Management (SWM): SWM is the collecting, treating, and disposing of solid material that is discarded because it has served its purpose or is no longer useful.

Stakeholders: Those who may be potentially affected by a proposal/intervention e.g. Local people, the proponent, government agencies, NGOs, donors and others, all parties who may be affected by the project or take an interest in it.

Social Impact Assessment: The component of EIA concerned with changes in the structure and functioning of social orderings. In particular the changes that a development would create in: social relationship; community (population, structure, stability etc.); people's quality and way of life; language; ritual; political/economic processes; attitudes/values.

Sustainability: Applied to positive impacts only and could be of three different types sustainable, sustainable with mitigation and non-sustainable.

Waste-To-Energy (WTE): WtE is the process of generating energy in the form of electricity and/or heat from the primary treatment of waste, or the processing of waste into a fuel source. It is a form of energy recovery.

Zero Waste: Zero-Waste is a slogan for promoting Reduce, Reuse, and Recycle (3R). It is the conservation of all resources by means of accountable production, consumption, reuse, and recovery of all products, packaging, and materials, without burning them, and without discharges to land, water, or air that threaten the environment or human health.

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CHAPTER 1 INTRODUCTION

1.1 Background

Dhaka[1], the capital and the largest city of Bangladesh, has experienced remarkable economic development since the 1990s in association with the country's rapid Gross Domestic Product (GDP) growth. Accordingly, waste generation has increased rapidly, and its composition has becomes complicated. Such economic growth leads to higher living standards for residents, who pay more attention to waste cleaning services provided by the local government. It is fundamentally vital for local governments to equip a communication channel to connect the government's cleaning activities with communities for mutual understanding and cooperation.

Considering such critical circumstances of waste management in Dhaka, the Japan International Cooperation Agency (JICA) in 2003 began to support the Dhaka City Corporation (DCC) for improving Solid Waste Management (SWM). In most cases, the need for SWM becomes apparent after economic development. However, the DCC has developed its SWM system without delay, in tandem with the rapid economic growth.

For example, in correspondence to the increased waste generation, not only did the DCC reform its institution to fit a new waste management operation; it also improved the 25 ha open dump site, located in the southeastern part of Dhaka City, into a sanitary landfill and built a new 25 ha sanitary landfill in the northwest region. Furthermore, the DCC successfully closed two huge illegal dumping sites. For waste collection improvement, the conventional collection methods were modified to be more efficient, and the institution for waste collection within the Waste Management Department (WMD) of the DCC was strengthened. The people's participation in SWM was then realized over time through a community participatory framework known as the Ward-based Approach (WBA). As a result, requests and complaints from citizens were handled gradually with by the WMD and ward offices, which oversee the SWM on-site. The SWM activities of the DCC thus became connected with the society in Dhaka, and the social interest and responses instilled job pride in the DCC staff members.

After the DCC established the system for SWM through the implementation of the previous Master Plan (2005–2015), Dhaka City was administratively divided into two areas in 2011, and the DCC was

[1] "Dhaka" or "Dhaka City" in this Master Plan indicates the geographical area of Dhaka administered by the DNCC and DSCC, formerly by the DCC.

also split into Dhaka North City Corporation (DNCC)[2] and Dhaka South City Corporation (DSCC)[3]. However, a serious issue remained in that the capacities of both existing landfills in DNCC and DSCC were only two years, and no location would be available for waste disposal in the near future.

Therefore, DNCC, as a way to solve this issue, has devised a subsequent Master Plan by newly introducing an integrated waste management and advanced technology. Looking toward the future of DNCC, this new Master Plan essentially includes administrative public awareness, WBA dissemination, efficient and hygienic waste collection, life extension of the existing landfill sites (LFSs), legal and institutional reform, and stakeholder's capacity development.

1.2 Review of the Previous Master Plan (2005–2015)

The previous Clean Dhaka Master Plan (2005–2015) aimed to improve the SWM of Dhaka City based on social acceptability and technical capacity to achieve Clean Dhaka status. This plan has seven parts including three technical and four institutional and social components. The technical components include Primary Collection, Secondary Collection and Transport, and Disposal. The institutional/social components, which were integrated with the three technical components, are Legal Aspect, Organizational Aspect, Financial Aspect, and Privatization.

The following overall objectives were identified to achieve the goal of the Master Plan (2005–2015):

(i) To expand DCC service coverage and quality.
(ii) To enhance DCC operation capacity with sufficient manpower, equipment, and facilities.
(iii) To facilitate well-managed operation by relevant departments.
(iv) To encourage progressive involvement of public participation.
(v) To pursue proper work sharing with the private sector and the community.

The progress of this plan was monitored in 2013 targeting a seven-year period from 2006 to 2012. At that time, almost all priority projects and programs were implemented by the DCC with JICA's assistance, such as the technical cooperation project, Environmental Grand Aid Project (EGAP), Japan Debt Cancellation Fund (JDCF), and Japan Overseas Cooperation Volunteers (JOCV).

The main outcome during the seven-year period is summarized as follows.

(i) The SWM organization was strengthened by establishment of the WMD and introduction of the WBA.
(ii) The WMD Directives (2007–2012) plan was developed, and an administrative procedure book was drafted for enforcement of law and regulations.

[2] North Dhaka City Corporation (DNCC) is a public administrative body for the northern part of Dhaka City.
[3] South Dhaka City Corporation (DSCC) is a public administrative body for the southern part of Dhaka City.

(iii) Community participation in SWM was encouraged through WBA 3, and Fixed-Time and Fixed-Place (FTFP) collection by compactors began with the support of the community. The FTFP collection contributed to close crowded unsanitary containers and dustbins on the road. In addition, the new collection system was strengthened by introducing 35 new compactors in corporation with Primary Collection Service Providers (PCSPs).

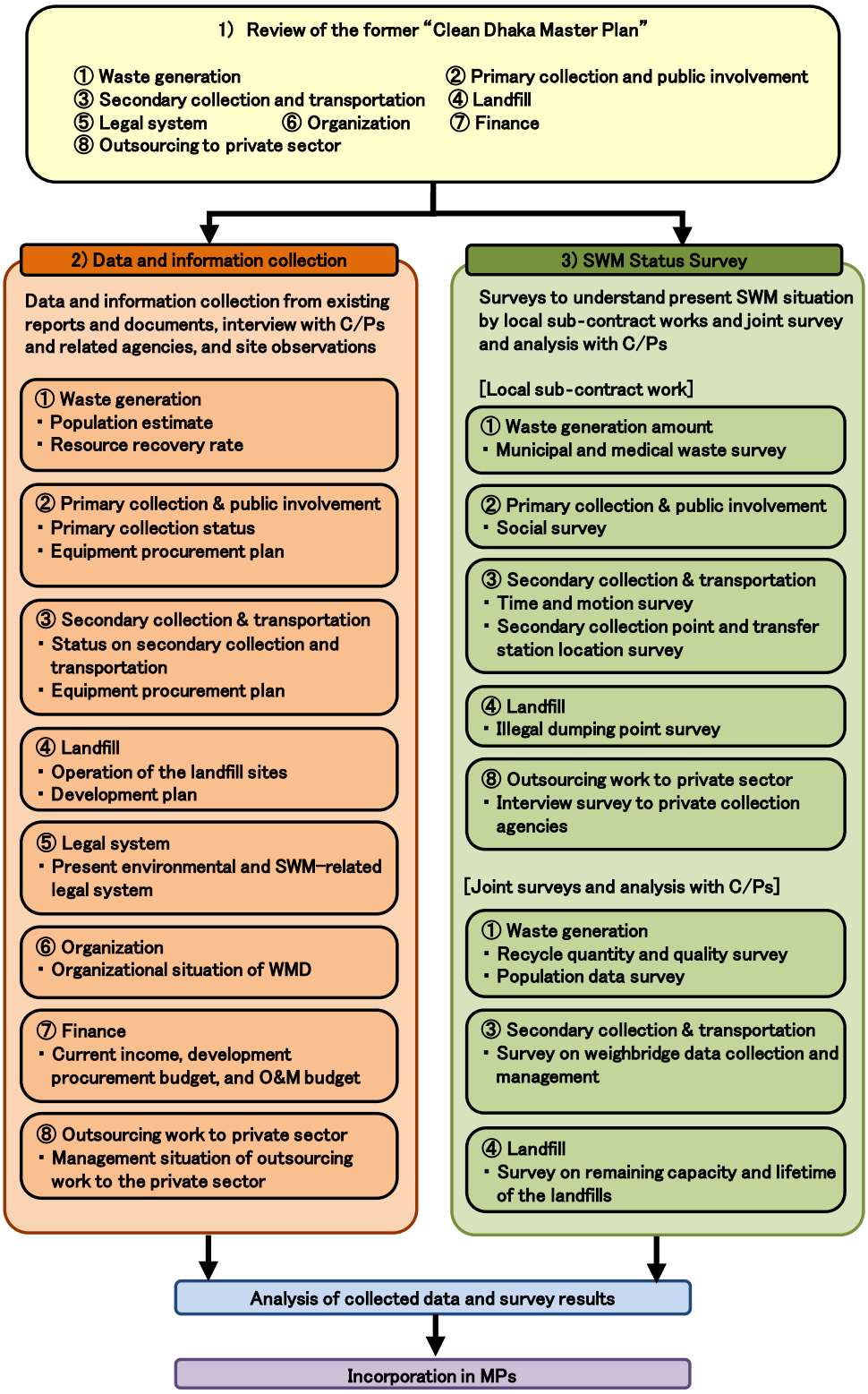
(iv) Amin Bazar Landfill Site was constructed as a sanitary landfill site, which operational condition has been improved gradually.

However, after the monitoring period and evaluation from 2014 to 2017, the progress of the Master Plan appeared to decrease, and several critical issues remained unresolved such as the importance of extending the lifespan of existing LFS and finding new landfill site location. , In these regards, DNCC managed to submit the DPP to acquire new land for the extension of Amin Bazar LFS. Nevertheless, the need for this lifespan extension has become crucial. In addition, unfortunately, even though the knowledge and experience of the WBA is widespread, its promotion has not been well managed by the WMD member staff including conservancy inspectors (CIs).

1.3 Preparation Process of the Master Plan

For preparation of the new Master Plan, basic information and data on SWM in DNCC was collected and was then analyzed after reviewing the former Master Plan, as shown in Fig. 1-1. After preparing the Master Plan draft, DNCC established a committee to review the draft and to finalize the Master Plan.

This master plan is a dynamic document and will therefore be revised every three to five years or at any suitable time as per requirement of the authority (LGD or City Corporation) with updated data and information in order to meet the current conditions of the city's situation and needs of the society.



Source: JICA Project Team

Fig. 1-1 Preparation Process of the Master Plan

1.4 Target Area and Waste

1.4.1 Target Areas

As mentioned in Section 1.1, Dhaka, together with the DSCC area, is facing the enormous population and economic growth with modernization of people's living, resulting in skyrocketing waste generation, and it is very likely to continue for a while. Although many efforts have been taken to make the city cleaner as a pioneer of waste management in Bangladesh, the DNCC jurisdiction became larger in 2017 corresponding to autonomous expansion of the urban area, and various issues have yet to be solved. The master plan therefore intends to tackle various kinds of issues on waste management systematically and strategically for the sustainable Dhaka City.

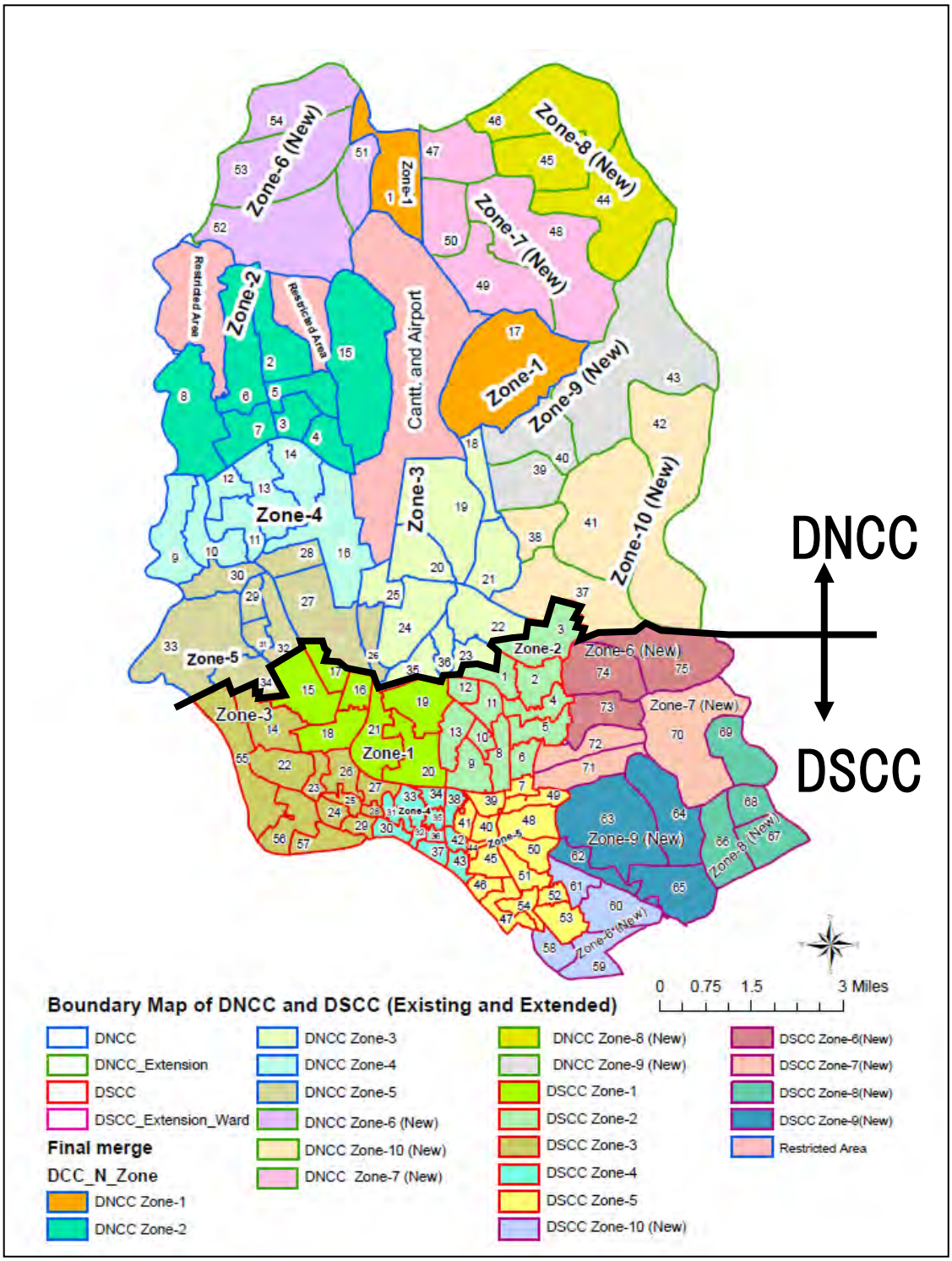
The Master Plan covers the entire jurisdiction of DNCC as of 2018, including new DNCC area, which is composed of 54 wards in 10 zones. The total land area is approximately 197 km^2, as estimated by the JICA Project Team based on Geographic Information System (GIS) data, including an expansion area of 114 km^2 in 18 wards.[4] This Master Plan also covers the Amin Bazar LFS and future LFSs.

1.4.2 Target Year

The reference year of the Master Plan is fiscal year (FY) 2017 (FY[5] 2017–2018), and the target year is set as 2032 (FY 2032–2033).

[4] DNCC's jurisdiction area is expanded in 2017.

[5] Twelve months from July 1 in the reference year to June 30 the following year. In the case of FY 2017, the term is from July 1, 2017, to June 30, 2018, and is referred to as FY 2017–2018.



Note: “New” indicates the extension area added to DNCC in 2017.

Fig. 1-2 DNCC Jurisdiction of Dhaka

1.4.3 Target Waste

The target waste in this Master Plan comprises three types of waste: municipal solid waste, business waste, and medical waste, as shown in Table 1-1. The DNCC recognizes that some construction waste is received at the DNCC's LFS, whereas some other portion is likely to be dumped illegally. In general, no hazardous and industrial wastes are collected and therefore disposed at Amin Bazar LFS, whilst some private companies have already established their own disposal systems without the involvement of DNCC. DNCC will further investigate the detail of these wastes including generation, collection and transport, and final disposal to incorporate them into the future Master Plan for appropriate solutions.

Table 1-1 Target Waste in This New Master Plan

Waste Category	Contents
Waste	"Waste" refers to any solid, liquid, gaseous, or radioactive substance, the discharge, disposal, and dumping of which may cause harmful changes to the environment
Solid Waste	Non-hazardous and non-poisonous waste (solid or partially solid) which may have value or no value
Municipal Solid Waste	Waste generated from residences and collected by local government
Household Waste	Solid waste collected from households
Street Waste	Solid waste collected from streets, including sludge from drainage
Industrial Waste	General term of waste from business properties, which sometimes includes chemical components, generated from business, commerce, agriculture, building construction, and other activities
Business Waste	Industrial waste collected from restaurants, hotels, markets, and offices
Construction Waste	Industrial waste collected from building construction
Other	Industrial waste collected from other businesses
Hazardous Waste	Waste having particular physical and chemical properties or that mixed with other waste and materials to cause poisonous effects, viral transmission, flaming, explosive effects, radioactivity, corrosiveness, and other destructive effect on the environment
Medical Waste	Waste emitted, generated, or accumulated from the treatment, vaccination, or diagnosis of diseases or research related to the diagnosis of human health
Non-hazardous waste	Non-hazardous waste generated in HCE
Hazardous waste	All other wastes apart from non-hazardous waste such as infectious, sharp, radioactive waste

: Target waste in this Master Plan

CHAPTER 2 REGULATORY FRAMEWORK AND PREVIOUS PROJECTS FOR SOLID WASTE MANAGEMENT

2.1 Regulatory Framework

2.1.1 Central Government Policies, Acts, Rules and Regulations

The Government of Bangladesh (GoB) has formulated various regulatory documents such as policies, acts, rules, and strategies related to waste management, as shown in Table 2-1. Solid Waste Management Rules 2018 has been drafted as a fundamental law of waste management and are currently in the process of endorsement. In addition, recently, the GoB is planning to incorporate Waste-to-Energy (WtE) or incineration-based waste management solutions in Dhaka and Chattogram (Chittagong) as a powerful intermediate treatment tool.

Table 2-1 Regulatory Documents related to Solid Waste Management

Title/Contents	Year	Organization
Bangladesh Environment Conservation Act 1995, amended in 2000, 2002, and 2010	1995	DoE
National Environmental Management Action Plan	1995	DoE
Environmental Conservation Rules 1997	1997	DoE
Lead Acid Battery Recycling Related Circular	2006	DoE
Medical Waste (Management and Handling) Rules 2008	2008	DoE
National 3R Strategy for Waste Management 2010	2010	DoE
Local Government (City Corporation) (Amended) Act 2011	2011	LGD
Hazardous Waste and Ship Breaking Waste Management Rules 2011	2011	DoE
Ship Breaking and Recycling Rules 2011	2011	Ministry of Industries
National Environmental Policy 2013	2013	DoE
Seventh Five Years Plan (FY 2016–FY 2020)	2015	Ministry of Planning
Electrical and Electronic Product Induced Waste (E-waste) Management Rules 2017	2017	DoE
Solid Waste Management Rules 2018[1]	2018	DoE

[1] This rule is in the process of endorsement as of July 2019.

2.1.2 Responsibility Defined in the Regulatory Documents

The waste management-related laws define the responsibility of SWM regarding waste collection and transport in addition to waste treatment and disposal, as shown in Table 2-2. Despite the case that the

regulation appoints the central government agencies as a supervisional authority, CCs and municipalities are often involved in its supervision.

Table 2-2 Responsibility of Agencies Regarding Solid Waste Management

Type of Waste*	Responsibility		Supervision
	Collection and Transport	Treatment and Disposal	
Municipal solid waste[1]	Licensed contractor, society, association, community or private company (primary collection) and local government: CC and municipalities (secondary collection and transport)	Local government: CC and municipalities	Local government: CC and municipalities
Industrial waste[1,3]	Discharger and licensed entities	Discharger and licensed entities	DoE, CC
Construction waste[1]	Discharger and licensed entities	Discharger and licensed entities	Local government: CC and municipalities
Hazardous waste[3]	Discharger and licensed entities	Discharger and licensed entities	DoE, CC
Household hazardous waste[1]	Licensed contractor, society, association, community or private company (primary collection) and local government: CC and municipalities (secondary collection and transport)	Local government: CC and municipalities	Local government: CC and municipalities
Medical waste[2]	Discharger or licensed entities of skilled personal/company/contractor	Discharger or licensed entities of skilled personnel/company/contractor	DGHS, DoE, and Local government: CC
E-waste[4]	Discharger and licensed entities (producer, collection center, collector or transporter)	Discharger and licensed entities (dealer/dismantler/recycler/refurbished)	DoE, CC
Leachate	Discharger and licensed entities	Discharger and licensed entities	DoE, CC
Flammable Waste[3,4]	Discharger and licensed entities	Discharger and licensed entities	DoE, CC

* The type of waste here is based on the regulations; thus, it may be different from the categorization used in this Master Plan as described in Table 1-1.

Source:

[1] Solid Waste Management Rules 2018 (Draft)

[2] Medical Waste (management and processing) Rule (Amendment) 2014

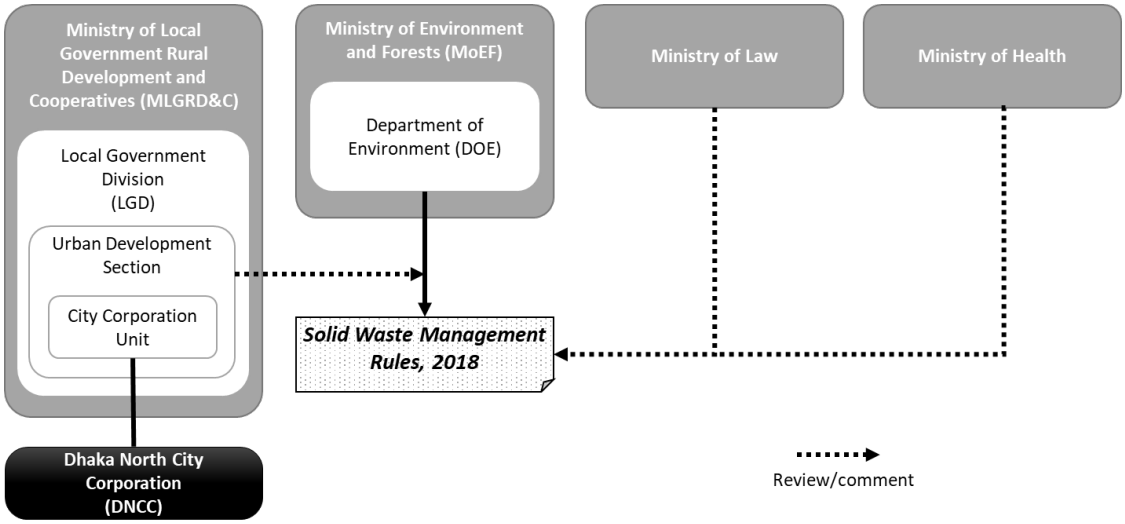
[3] Hazardous Waste and Ship Breaking Waste Management Rules 2011

[4] Electrical and Electronic Waste (Management and Handling) Rule 2017

2.1.3 Structure of Central and Local Government in Solid Waste Management

In general, the supreme authority of local government management lies in the central government, which is essentially responsible for policy and decision making, planning, finance, and human resources management. Local government is a delivery organization for executing or implementing a service.

DNCC is responsible for SWM service delivery through SWM planning. From the perspective of the country-level governance structure, the LGD is responsible for managing all city corporations (CCs) and municipalities in administrative aspects and provides budgetary support. The major central government organizations and departments and their roles in SWM are shown in Fig. 2-1.



Source: JICA Project Team based on "Solid Waste Management Rules 2018 (draft)"

Fig. 2-1 Structure of Central and Local Government in Solid Waste Management

Local government is responsible for SWM in CCs and municipalities in formulating a project and obtaining approval from the Planning Commission or ECNEC.

For SWM, the role of Department of Environment (DoE) under the Ministry of Environment and Forests (MoEF) is vital in a legal aspect. The DoE has been formulating various environmental laws in close association with the LGD and other related department and ministries.

The Solid Waste Management Rules 2018, which details the process of SWM in households and commercial purposes, is still in the draft stage; the MoEF has requested DNCC and DSCC through the LGD for providing comment. This shows an example of how different ministries, departments, divisions and local government organizations work together.

Because local government organizations such as CCs and municipalities are service delivery organizations for municipal solid waste, staff with sufficient knowledge and skills for understanding the coordination with other departments and divisions is crucial for formulating various waste management-related policies, rules, or strategies and for materializing different new projects in waste management. However, the first 12CC's SWM information exchange meeting held in December 2018 revealed that there are no CCs which have established an executive department of integrated waste

management including waste collection, landfill site management, and 3R, other than DNCC and DSCC. Besides, there are little waste management data maintained in the CCs.

2.1.4 Local Government Rule and Regulations

(1) Waste Management Department Directives

Among the various departments of DNCC, the WMD is responsible for providing daily SWM services to citizens. Initially, the directives for WMD was formulated with the support of the previous technical cooperation project financed by JICA in August 2008, under the Local Government (City Corporation) Act. The objective of preparing the WMD directives is to declare the policy of SWM for five years, and the WMD directives enable the chief waste management officer (CWMO) can manage the WMD in a consistent manner, and DNCC dwellers can learn techniques of proper waste management. The WMD should renew the directives every five years based on the Master Plan for SWM and it will help to form a policy consensus among the WMD, community, cleaners, and other stakeholders. The current WMD directives renewed in November 2012, and eight main points were stressed, as listed in Table 2-3.

Table 2-3 Components of WMD Directives 2012

WBD Directives	
1. Strengthening of the WMD's Institutional Capacity	5. Evaluation of New Waste Treatment System
2. Promotion of Public Private Partnership	6. Optimization of Allocation and Enhancing Efficiency of SWM Equipment
3. Implementation of City-Wide Awareness Raising Program	7. Expansion of WBA considering 3Rs
4. Improvement of Existing System of Waste Collection and Final Disposal	8. Improvement in Work Environment and Occupational Health as Part of WBA 2

Source: WMD Directives 2012

(2) Solid Waste Management Administrative Procedure Book

The SWM administrative procedure book, hereafter referred to as "Admin Book," is a support guide that describes the administrative rules and procedures. The Admin Book was developed on the basis of the enacted laws, regulations, and rules related to SWM. The first draft was prepared in 2012 with the support of JICA. On the basis of the first draft, the first edition of the Admin Book was prepared in Bengali in 2018.

2.2 Projects Related to Solid Waste Management

2.2.1 Projects by Bangladesh Side

(1) Development Project Proposal for Solid Waste Management Improvement

DNCC submitted two development project proposals (DPPs): one to secure the budget for extension of the Amin Bazar LFS and the other to secure the budget for Nasirabad new LFS and the development of new city area waste collection. Construction of the LFS and land development of intermediate treatment facilities are included in each DPP. The status of the DPPs are summarized below.

(i) DPP-1: Extension of Aminbazar LFS

#	Item	Information
1	Purpose	・ Expansion and Modernization of Aminbazar LFS
2	Components	・ Securing land extention for: - Additional LFS - Intermediate treatment system (recycling plant, composting plant, biogas plant, and WtE plant etc.)
3	Application status	・ December 2017 the application was firstly submitted. ・ The DPP has not been approved by the ECNEC yet, and is now at the planning commission and waiting for Pre-ECNEC meeting. ・ Expected approval: December 2019

(ii) DPP-2: Construction of New Nasirabad LFS and New city area waste collection

#	Item	Information
1	Purpose	1) Construction and modernization of Nasirabad LFS 2) Development of Waste Collection system in the extended DNCC area
2	Components	1) Construction and modernization of Nasirabad LFS - Securing land for New LFS and intermediate treatment system (recycling plant, composting plant, biogas plant, medical waste treatment plant, WtE plant etc.) 2) Development of Waste Collection system in the extended DNCC area - Private firm recruitment for waste collection - Purchase of waste collection equipment - Construction of STS - Deployment of manpower for the extension area waste collection activities etc.
3	Application status	・ Application was firstly submitted on March 2018. ・ The DPP has not been approved by the ECNEC yet, and is now at review stage by the LGD. ・ Expected approval: Unknown

(2) Projects by Bangladesh Climate Change Trust

The GoB under Bangladesh Climate Change Trust[6] has allocated public funds to the DoE toward the cost of the Programmatic Clean Development Mechanism (CDM) Project Using Municipal Organic Waste of Towns (CCs/municipalities) in Bangladesh. The fund disbursement is shown in Table 2-4.

Table 2-4 Bangladesh Climate Change Trust Fund Disbursement

1st Phase	2nd Phase
● Approval Date: April 2010 ● Closing Date: June 2017 ● Total project cost: Tk. 139,158,000	● Approval Date: July 2016 ● Closing Date: June 2019 ● Total project cost: Tk. 139,158,000

(3) Projects by Bangladesh Power Development Board

The Bangladesh Power Development Board (BPDB) in affiliation with the Sustainable and Renewable Energy Development Authority (SREDA) is currently attempting to implement the country's first WtE project with the technical support of the German Development Cooperation Agency (GIZ) to produce 1 MW of electricity and heat (430 kW electricity and 480 kW heat). The project will be set up on BPDB-owned land in Keraniganj. The GIZ was requested by SREDA at the beginning of 2015 to conduct a detailed feasibility study to identify prospective energy solutions from waste in Keraniganj. International experts appointed by the GIZ conducted the study for six months in collaboration with SREDA officials, local government officials, and public representatives from Keraniganj. BPDB has already started a procurement process for the project on a pilot basis.

Apart from this, several non-governmental organizations (NGOs) are working in various municipalities with small-scale waste management and biogas projects under different donors.

(4) Programmatic Clean Development Mechanism Project Using Municipal Organic Waste of 64 Districts of Bangladesh

The project is the first large-scale attempt to improve waste handling by composting on a national scale. As a pioneering effort by the project proponent and the municipalities to be involved in the activities, the project will contribute to the sustainable development of Bangladesh. The following environmental, economic, and social benefits will be achieved by executing the project.

[6] Bangladesh Climate Change Trust organized under the MoEF manages funds to be utilized for climate change related issues.

(i) Environmental benefits

These benefits include assistance in preventing uncontrolled greenhouse gas (GHG) generation and emission from waste that would have been disposed of at the landfill as well as the production of a soil improver (compost) to battle soil degradation.

(ii) Economic benefits

Composting on this scale may be a new industrial activity for Bangladesh, and the projects will contribute to partial replacement of imported chemical fertilizer by locally produced compost.

(iii) Social benefits

The project will increase jobs for local workers, and staff training will improve their skills. The project includes the design and building of composting plants at cities throughout Bangladesh with a daily input capacity of between 5 and 100 more tons/day. Apart from compost, the project will reduce methane emissions by diverting high organic waste from being dumped at a landfill, where anaerobic processes occur, to a composting plant to promote aerobic processes.

2.2.2 Foreign Aid Provided by International Donors

Several projects are in progress for SWM in DNCC. The project outlines are shown in Table 2-5. Different donor agencies have supported SWM activities in DNCC.

Table 2-5 SWM-related Projects Supported by International Donors

Project	Donor	Contents
Project for Strengthening of Solid Waste Management in Dhaka North City, Dhaka South City, and Chittagong City (2017–2021)	JICA	JICA has initiated its support on SWM of Dhaka city since 2003. The knowledge and experiences of the "WBA Promotion," "Waste Collection," and "Workshop Operation and Management" in the previous JICA's projects are applied in this project, with emphasizing on institutional development of the WMD.
Demonstration Project for Proper Management of Electronic Waste and Metal Recycling	NEDO	This project aims to introduce an appropriate waste disposal system and to commercialize metal recycling by utilizing separation and concentration technology for ferrous and nonferrous metals from electronic waste in cooperation with DNCC, DSCC, and local companies. The feasibility study was conducted in 2017.
Urban Public and Environmental Health Sector Development Program	ADB	This project supports DNCC, DSCC, Chittagong, Barisal, Khulna, Rajshahi, and Sylhet from 2010 to 2018. The program includes activities for constructing landfills, transfer stations, and food laboratories; introduces an electronic accounting system; and implements a capacity-building program.

Project	Donor	Contents
Community-based Solid Waste Management in Dhaka	UNDP	This project produces compost from kitchen waste collected from communities for improvement of the sanitation environment and waste reduction. However, because the target area and target waste are limited, this project did not improve the waste management of entire Dhaka city. In particular, some of the composting factories installed in residential areas were forced to close owing to the lack of understanding on continuous use of land from cooperating organizations.

CHAPTER 3 OVERVIEW OF SOLID WASTE MANAGEMENT IN DHAKA NORTH CITY

3.1 Profile of Dhaka North City Corporation

Dhaka is located in the middle of the country's territory with the Old City at the south, the New City at the north, and downtown, where government offices, company headquarters, and commercial buildings are situated at the center. In 2011, Dhaka was divided into two administrative jurisdictions, DNCC and DSCC.

In this city, the world's second-largest textile industry after China has led to increase in middle- and high-income classes. Economic growth in the country has skyrocketed, with 4.1 million people (2.7% of the population) in the high-income group, and 47 million (31.3%) at the middle-income, according to research by the University of Dhaka in 2012. A profile of DNCC is summarized in Table 3-1.

Table 3-1 Profile of Dhaka North City Corporation

Item	Description
Area	Approximately 197 km^2 [1]
Population	4,832,346 (FY 2017–2018) [2]
Population density	24, 365 people/km^2
Geography	- Located on the eastern banks of the Buriganga River - Lies on the lower reaches of the Ganges Delta - Tropical vegetation and moist soils - Flat and close to sea level - Susceptible to flooding during the monsoon seasons owing to heavy rainfall and cyclones - Bounded by DSCC, the districts of Gazipur, Tangail, Munshiganj, Rajbari, Narayanganj, and Manikganj
Climate	- Hot, wet, and humid tropical climate - Monsoon season from May until the end of September - Nearly 80% of the annual average rainfall of 1,854 mm occurs in the Monsoon season
Economic growth rate (GDP)	7.3 % (FY 2017–2018) [3]

Source:
[1] JICA Project Team measured based on the GIS data
[2] Bangladesh Bureau of Statistics (BBS)
[3] World Bank (WB) Open Data

3.2 Organizational Structure in Solid Waste Management

Although DNCC's WMD was developed to provide a unified agency considering the conservancy and engineering aspects of waste management, it has yet to be fully materialized. However, the WMD has been successfully managing about 4,000 tons of waste per day in close coordination with other departments, including the Transport Department (TD), Engineering Department (ED), and Store and Purchase Department (SPD). The organizational structure of DNCC is shown in Fig. 3-1.

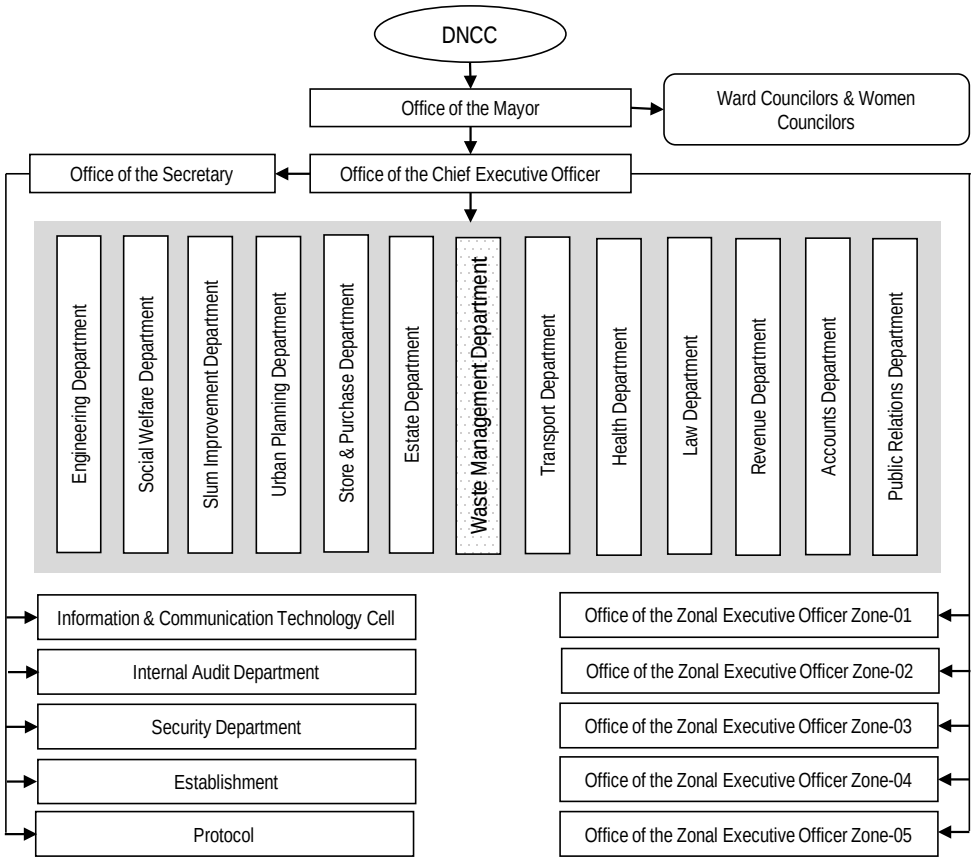
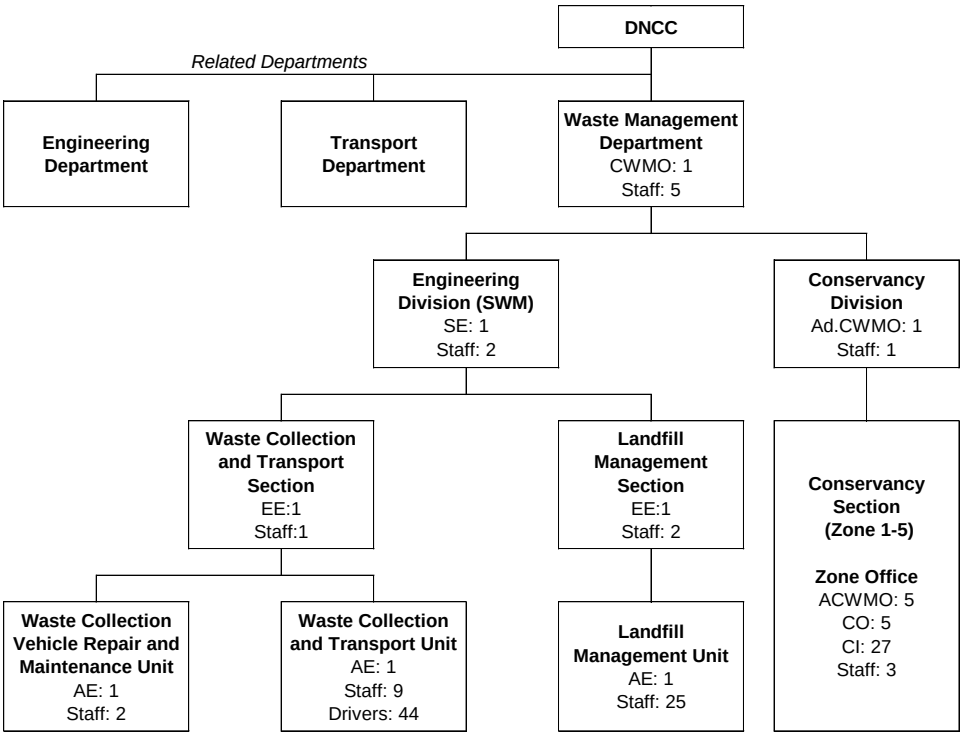


Fig. 3-1 Organization Structure of DNCC

Fig. 3-2 shows an organogram of the WMD and related departments in DNCC. The WMD is composed of the Engineering Division and the Conservancy Division. In general, the Engineering Division manages waste collection and transport, including the repair and maintenance of waste collection vehicles; the Conservancy Division manages road and drain cleaning based on the WBA.



Source: Information updated by JICA Project Team based on "Provision Survey Report of Solid Waste Management Equipment (2015)"

Fig. 3-2 Organization Structure of WMD and Related Departments in DNCC

Table 3-2 shows the approved posts and number of staff members of the WMD in DNCC. A huge shortage of manpower exists in this agency; although 257 positions have been approved, 118 positions (46%) are currently vacant. DNCC is composed of 54 wards, including 18 newly added, which makes the coverage area of DNCC nearly twice as large as the original coverage area. Additional positions, especially CIs, conservancy officers (COs), and assistant chief waste management officers (ACWMOs), have not been allocated owing to approval procedure by the government authority. DNCC needs to fill the vacant posts immediately to provide and sustain proper SWM service, especially important management positions.

Table 3-2 Approved Posts and Number of Staff Members of the WMD in DNCC

Organization	Approved Posts	Number of Staff	Vacancies	Staffing Rate
Headquarters	**8**	**6**	**2**	**75%**
Conservancy Division	**71**	**42**	**29**	**59%**
Engineering Division	**178**	**91**	**87**	**51%**
Waste Collection and Transport Section	*131*	*59*	*72*	*45%*
Landfill Management Section	*43*	*29*	*14*	*67%*
Others	*4*	*3*	*1*	*75%*
TOTAL	**257**	**139**	**118**	**54%**

Source: JICA Project Team based on "Provision Survey Report of Solid Waste Management Equipment (2015)"

3.3 Financial Information

3.3.1 Budget and Revenue

Annual budget and revenue of DNCC from FY 2014–2015 are shown in Table 3-3. The revenue income of DNCC was Tk. 6.7 billion and the development income was Tk. 7.1 billion in FY 2017–2018. The main source of the revenue income is holding tax. Conservancy tax, which is the exclusive revenue of SWM, is collected as a part of holding tax. The conservancy tax for FY 2017–2018 was Tk. 480 million, or 4% of the total revenue. Development income is funded by the central government and foreign aid; part of this income increased gradually to 42% in FY 2017–2018.

Table 3-3 Budget and Revenue of DNCC

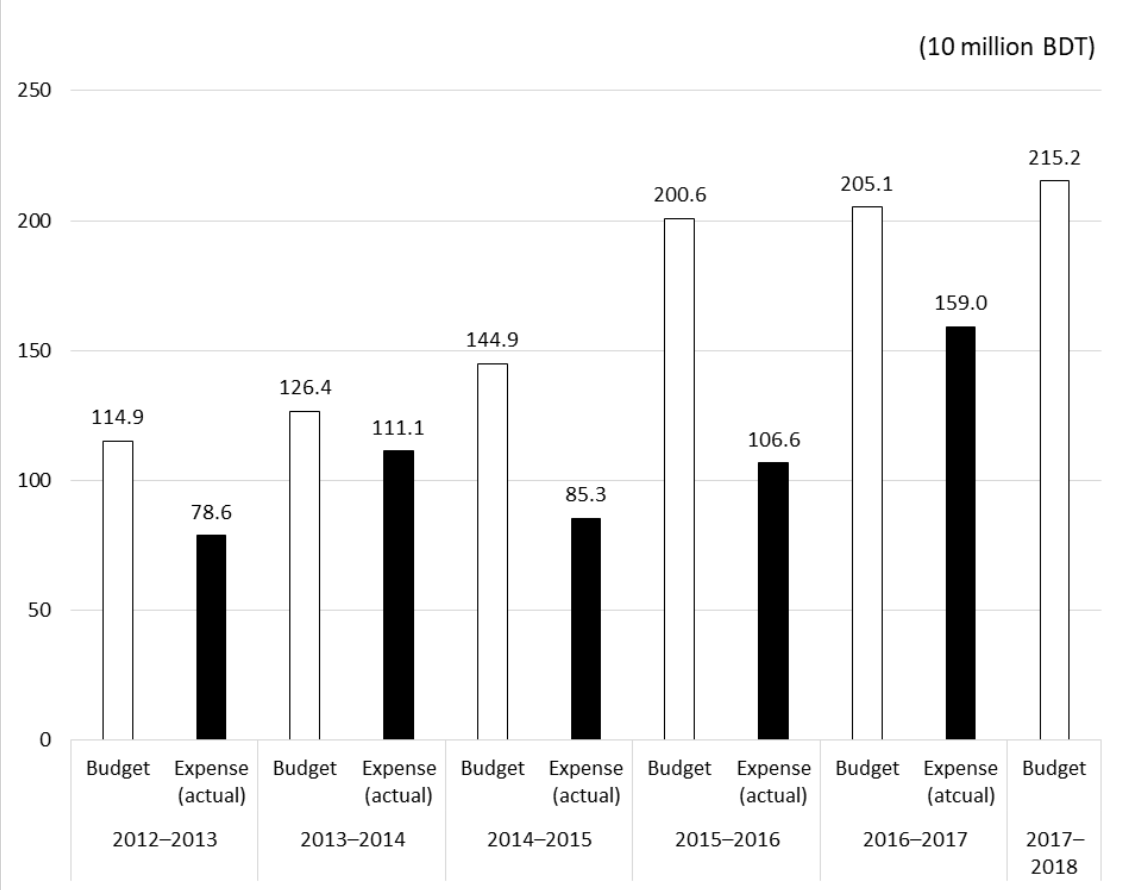
Unit: 10 million BDT

	2014–2015		2015–2016		2016-2017		2017-2018		2018-2019	
Item	Budget	Revenue (Actual)	Budget	Revenue (Actual)	Budget	Revenue (Actual)	Budget	Revenue (Actual)	Budget	Revenue (Actual)
Initial Status	40	75	90	156	234	355	216	294	203	-
Revenue Income	853	524	901	562	968	590	989	672	864	-
Holding Tax	390	260	410	275	480	290	485	285	400	-
Consevancy	**65**	**43**	**68**	**46**	**80**	**48**	**81**	**48**	**67**	**-**
Others	325	217	342	229	400	242	404	238	333	-
Others	463	264	491	287	488	300	504	387	464	-
Development Income	1,149	204	611	292	882	286	1,180	713	1,500	-
Governent Grant (Lump sum)	35	9	35	12	20	38	100	22	150	-
Governent Special Grant	10	55	100	118	50	0	50	31	50	-
Government, Foreign Aid & PPP Projects	1,104	140	476	163	812	248	1,030	660	1,300	-
TOTAL	2,042	803	1,602	1,010	2,083	1,231	2,385	1,678	2,567	-

Source: DNCC Budget Book 2018–2019

3.3.2 Expenditures Related to Solid Waste Management

The expenditures of the WMD during the last five years are shown in Fig. 3-3, and the breakdown is shown in Table 3-4. The total SWM expenditures increased in FY 2012–2013 and reached approximately Tk. 1.59 billion in FY 2016–2017, of which 86% and 14% were revenue and development expenditures, respectively. DNCC set a budget of Tk. 23.9 billion for FY 2017–2018 as shown in Fig. 3-3; of this, the SWM budget accounted for 9%, at Tk. 2.15 billion. The conservancy tax income was Tk. 670 million, which is insufficient for covering the total expenditures of SWM.



Source: DNCC Budget Book 2017–2018

Fig. 3-3 Expenditures Related to Solid Waste Management in DNCC

Table 3-4 Breakdown of Expenditures Related to Solid Waste Management in DNCC

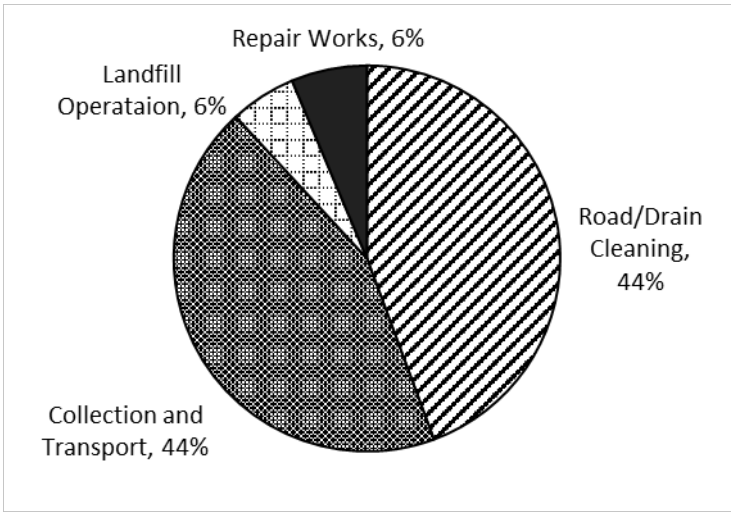
Unit: 10 million BDT

Item	2012–2013		2013–2014		2014–2015		2015–2016		2016–2017		2017–2018	
	Budget	Expense (actual)	Budget	Expense (actual)	Budget	Expense (actual)	Budget	Expense (actual)	Budget	Expense (atcual)	Budget	Expense (atcual)
Salary (WMD)	48	44	50	45	58	45	55	45	51	58	61	–
vehicle fuel, gas (WMD)	9	9	9	10	12	11	13	12	17	14	15	–
Central	21	2	22	22	25	0.7	51	0.4	26	0.5	0.5	–
Salary	0.4	0.4	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.5	0.5	–
Improvement SWM low carbon society project and zero waste	16	0	16	20	1	0.4	0	0	0	0	0	–
Cleaners colony management	5	2	6	2	24	0	51	0	25	0	0	–
Road/Drain Cleaning	48	42	51	42	57	42	56	42	80	69	74	–
Salary	40	37	41	37	48	37	45	37	42	48	50	–
Facility and equipment (ward office, hand trolley, cleaning machine etc.)	5	2	5	5	6	5	9	4	11	6	17	–
Beautification, cleaning program & community SWM	2	3	2	0.4	1	1	2	1	15	9	6	–
Drain cleaning and development	2	1	2	0.1	2	0	1	0.2	12	6	1	–
Collection and Transport	31	22	29	29	34	30	54	46	57	50	74	–
Salary	5	4	5	4	6	4	5	4	5	6	6	–
vehicle fuel	8	8	8	8	10	9	11	10	14	12	13	–
Private waste management	18	9	15	15	15	15	20	17	30	27	55	–
Facility and equipment (transfer station, waste bin etc.)	1	1	2	2	3	1	17	14	8	6	0	–
Landfill	7	8	14	10	14	5	24	11	27	30	55	–
Landfill operation (salary, vehicle fuel etc.)	3	3	4	3	4	3	5	7	5	7	8	–
Landfill development and asset acquisition	4	6	10	7	10	2	19	5	22	23	47	–
Repair and Maintenance	8	5	11	8	15	8	16	7	15	9	12	–
SWM Garage/Workshop (salary etc.)	3	3	4	4	6	3	6	3	5	5	6	–
Spareparts and repairing material cost	5	2	7	4	9	4	11	4	10	4	6	–
TOTAL	**115**	**79**	**126**	**111**	**145**	**85**	**201**	**107**	**205**	**159**	**215**	**–**

Source: DNCC Budget Book 2017–2018

3.3.3 Operation-wise Solid Waste Management Expenditure

The operation-wise expenditures of SWM were analyzed as shown in Fig. 3-4. The SWM operation in DNCC is categorized into four types: i) Cleaning of roads and drains, ii) Collection and transport, iii) Landfill operation, and iv) Repair works. The first two categories account for 44% each, and the second two account for 6% each.



Source: JICA Project Team analysis based on the DNCC Budget Book 2016–2017

Fig. 3-4 Operation-wise Solid Waste Management Expenditures (FY 2016–2017)

Table 3-5 Operation-wise Solid Waste Management Expenditure per ton (FY 2016–2017)

Operation	Waste Amount	Yearly Expenditure (BDT)	Cost per ton (BDT)
Cleaning of roads and drains	631 tons/day	696 million	3,024
Collection and transport	2,288 tons/day	687 million	832
Landfill operation	2,616 tons/day	87 million	91
Repair works	-	99 million	-
Total*	2,616 tons/day	1,570 million	1,644

* Itemized totals may not agree exactly with those in Fig. 3-4 owing to rounding of the fractional amounts.
Source: JICA Project Team analysis based on the DNCC Budget Book 2016–2017

3.4 Municipal Solid Waste and Business Waste

3.4.1 Solid Waste Generation

(1) Household Waste

Households waste is divided into three categories depending on income level: high income, medium income, and low income[7]. The waste generation amount, population, and unit generation rate in each

[7] According to the BBS "Preliminary Report on Household Income and Expenditure Survey (HIES) 2016," the average monthly income per household was Tk. 15,945 in 2016. Under this Master Plan, the clarification of income level is defined in accordance with UNDP "Politics, Governance and Middle Income Aspirations Realities and Challenges (2016)." That is, high income is Tk. 80,000 or more, middle income is more than Tk. 10,000 and less than Tk. 80,000, and low income is Tk. 10,000 or less.

category are summarized in Table 3-6, based on the survey results collected in 2018 by the JICA Project Team. As of FY 2017–2018, total waste generation amount was estimated to be 2,137 tons/day associated with a population of 4.8 million; this does not include the population of the expansion area newly added in DNCC in mid-2017. However, the population and amount of waste generated in FY 2018–2019 considers this expansion area.

Table 3-6 Estimated Household Waste Generation by Income Level in FY 2017–2018 and FY 2018–2019

Category	Unit Generation Rate[1]	Population[2] (2017–2018)	Waste Generation (2017–2018)	Population[2] (2018–2019)	Waste Generation (2018–2019)
High income	496 g/person/day	1,469,237	728 tons/day	1,511,913	747 tons/day
Medium income	483 g/person/day	2,595,168	1,253 tons/day	3,209,816	1,551 tons/day
Low income	193 g/person/day	767,941	151 tons/day	1,383,935	269 tons/day
Total	—	4,832,346	2,132 tons/day	6,105,664	2,567 tons/day

Source:
[1] JICA Project Team, “Waste Amount and Composition Survey Report (2018)”
[2] BBS “Population Census 2011” and “Population Projection of Bangladesh 2011–2061”

Table 3-7 shows the household waste generated in FY 2017–2018 and FY 2018–2019; the amount of waste in the latter includes the extension area. The waste generated in the existing 36 wards by a population of 4.8 million was 2,132 tons/day in FY 2017–2018; 2,567 tons/day was generated by 6.1 million people in the total 54 wards.

Table 3-7 Estimated Household Waste Generation by Ward in FY2017–2018 and FY2018–2019

		2017–2018		2018–2019				2017–2018		2018–2019	
Category	No.	Population	Waste (tons/day)	Population	Waste (tons/day)	Category	No.	Population	Waste (tons/day)	Population	Waste (tons/day)
Existing Ward	1	200,104	96	202,613	96	Existing Ward	29	59,758	26	60,507	27
	2	165,792	81	167,871	82		30	203,751	90	206,306	91
	3	103,343	50	104,639	51		31	56,095	27	56,799	27
	4	82,145	40	83,175	41		32	79,664	39	80,662	40
	5	128,939	63	130,556	64		33	125,278	53	126,848	54
	6	178,785	87	181,027	88		34	116,317	49	117,775	49
	7	124,179	60	125,736	61		35	80,860	35	81,874	36
	8	121,451	59	122,974	60		36	77,492	33	78,464	33
	9	77,794	34	78,769	34	New ward	37	28,384	10	95,799	32
	10	95,936	38	97,139	38		38	30,749	11	103,780	35
	11	105,930	44	107,258	46		39	72,215	24	243,735	83
	12	127,229	52	128,825	52		40	75,162	25	253,683	86
	13	171,620	65	173,771	65		41	21,288	7	71,849	25
	14	178,815	89	181,057	90		42	4,896	2	16,524	6
	15	189,781	93	192,160	95		43	9,825	3	33,161	11
	16	155,470	77	157,420	78		44	13,739	5	46,370	16
	17	214,493	98	217,183	100		45	17,685	6	59,690	21
	18	69,449	31	70,319	31		46	14,427	5	48,692	17
	19	105,120	50	106,438	50		47	43,358	15	146,340	49
	20	107,660	51	109,010	51		48	42,726	14	144,207	48
	21	104,923	51	106,239	52		49	43,329	14	146,241	49
	22	175,015	83	177,209	83		50	44,000	15	148,507	49
	23	69,609	28	70,482	28		51	12,447	4	42,011	14
	24	112,743	26	114,156	26		52	14,266	5	48,150	17
	25	108,871	45	110,236	45		53	12,737	4	42,988	14
	26	74,099	36	75,028	37		54	12,072	4	40,744	13
	27	98,496	48	99,731	49	Total		4,832,346	2,132	6,105,664	2,567
	28	72,034	31	72,937	32						

Source: JICA Project Team analysis based on BBS "Population Census 2011," "Population Projection of Bangladesh 2011–2061," and "Waste Amount and Composition Survey Report (2018)"

(2) Street Waste

In the survey results gathered by the JICA Project Team in 2018, variation occurred in unit generation rate of street waste by zone. As of the FY 2017–2018, the total waste generated was estimated to be 331 tons/day with a population of 4.8 million; that in FY 2018–2019 was 431 tons/day with a population of 6.1 million. The increments of the street waste were set at 1% per year.

Table 3-8 Estimated Street Waste Generation in FY 2017–2018 and FY 2018–2019

Unit Generation Rate by Ward[1]	Population[2] (2017–2018)	Waste Generation (2017–2018)	Population[2] (2018–2019)	Waste Generation (2018–2019)
24–427 g/person/day	4,832,346	331 tons/day	6,105,664	431 tons/day

Source:

[1] JICA Project Team, "Waste Amount and Composition Survey Report (2018)"

[2] BBS "Population Census 2011" and "Population Projection of Bangladesh 2011–2061"

(3) Business Waste

In the Master Plan, waste from markets, restaurants and hotels, and offices are considered as business waste. The total waste from the abovementioned business sources was estimated to be 900 tons/day in FY 2017–2018, and 922 tons/day in FY 2018–2019, as shown in Table 3-9. The waste increment was set at 1% per year, and the generation rate in the expansion area was estimated to be 10% of the existing area owing to limited business activities in the expansion area.

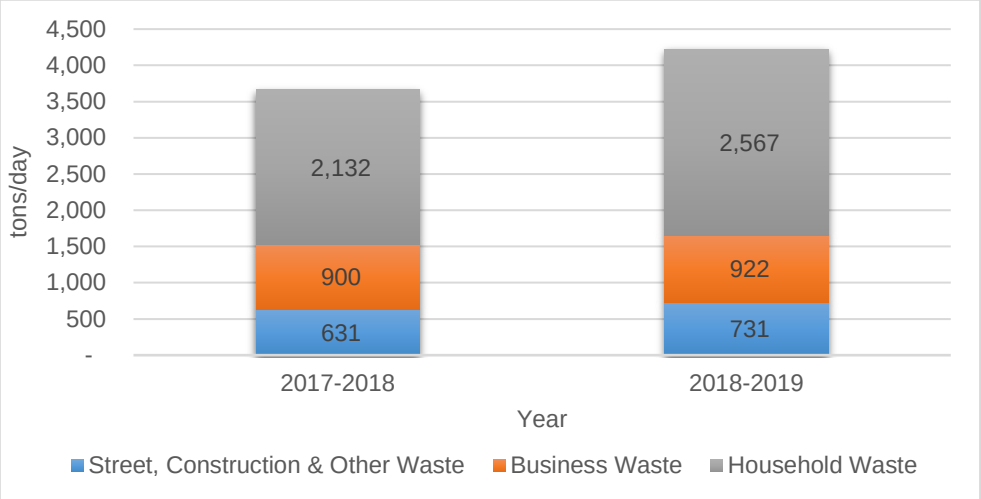
Table 3-9 Estimated Business Waste Generation in FY 2017–2018 and FY 2018–2019

Category	Population[1] (2017–2018)	Waste Generation (2017–2018)	Population[1] (2018–2019)	Waste Generation (2018–2019)
Markets	4,832,346	395 tons/day	6,105,664	405 tons/day
Restaurants and Hotels	4,832,346	378 tons/day	6,105,664	387 tons/day
Offices	4,832,346	127 tons/day	6,105,664	130 tons/day
Total	—	900 tons/day	—	922 tons/day

Source:
[1] BBS, "Population Census 2011" and "Population Projection of Bangladesh 2011–2061"

(4) Total Waste Generation

The total waste generation of the three aforementioned waste types—household waste, street waste together with partial construction waste, and business waste—was approximately 3,663 tons/day in FY 2017–2018 and 4,220 tons/day in FY 2018–2019.

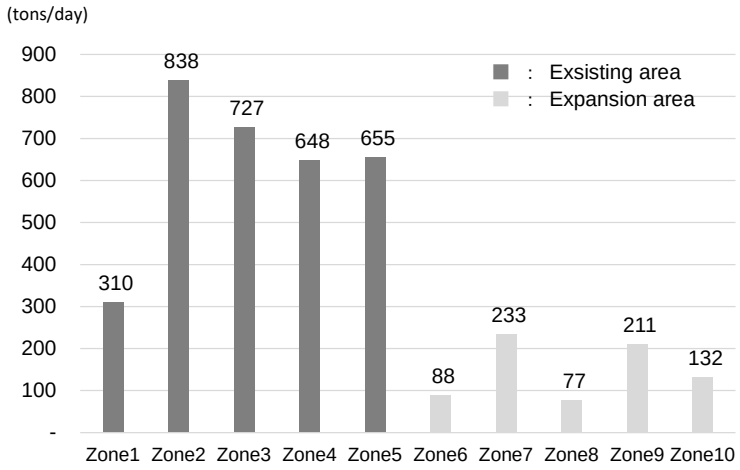


Source: JICA Project Team analysis based on BBS "Population Census 2011," "Population Projection of Bangladesh 2011–2061," "Economic Census 2013," and "Waste Amount and Composition Survey Report (2018)"

Fig. 3-5 Estimated Waste Generation by Waste Type

(5) Waste Generation by Zone

The waste generation by zone in the FY 2018-19 is shown in Fig. 3-6. The zonal average of waste generation is estimated at 392 tons/day with the maximum at 838 tons/day in Zone 2, and the minimum at 77 tons/day in Zone 8. Waste generation in the existing area is 3,179 tons/day, and 741 tons/day in the expansion area (81% and 19% of the total waste generation respectively). The zonal waste generation reflects the population size and business activities in each zone.



Source: JICA Project Team analysis based on BBS "Population Census 2011," "Population Projection of Bangladesh 2011–2061," "Economic Census 2013," and "Waste Amount and Composition Survey Report (2018)"

Fig. 3-6 Estimated Waste Generation by Zone

3.4.2 Solid Waste Composition

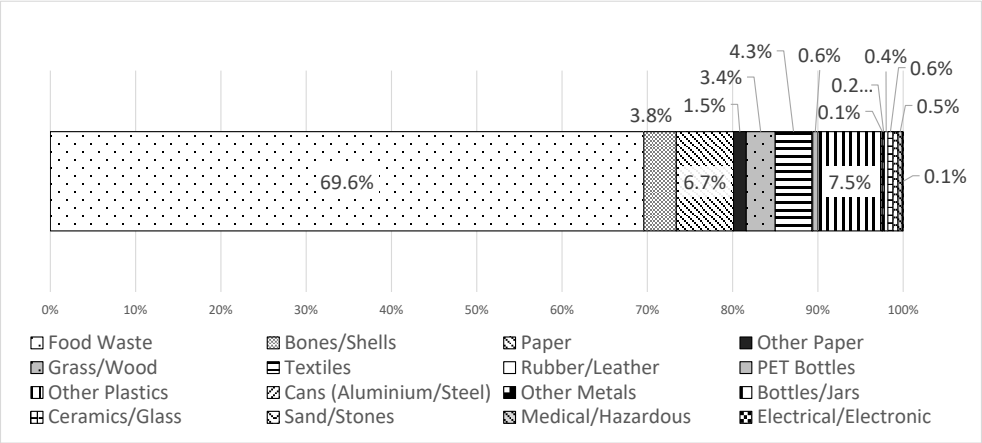
The waste composition survey was conducted during the Master Plan preparation by the JICA Project Team. The collected waste in the survey was sorted into 16 types, as shown in Table 3-10.

Table 3-10 Types of Waste by Composition

Waste Type	
1. Food Waste	9. Other Plastics
2. Bones/Shells	10. Cans (Aluminum/Steel)
3. Paper	11. Other Metals
4. Other Paper (including disposable diapers and sanitary napkins)	12. Bottles/Jars
5. Grass/Wood	13. Ceramics/Glass
6. Textiles	14. Sand/Stones
7. Rubber/Leather	15. Medical/Hazardous
8. PET Bottles	16. Electrical/Electronic

(1) Household Waste

The composition of household waste is shown in Fig. 3-7. Food Waste accounted for 69.6% of the total waste, which is the highest proportion. Other Plastics and Paper each accounted for approximately 7%.

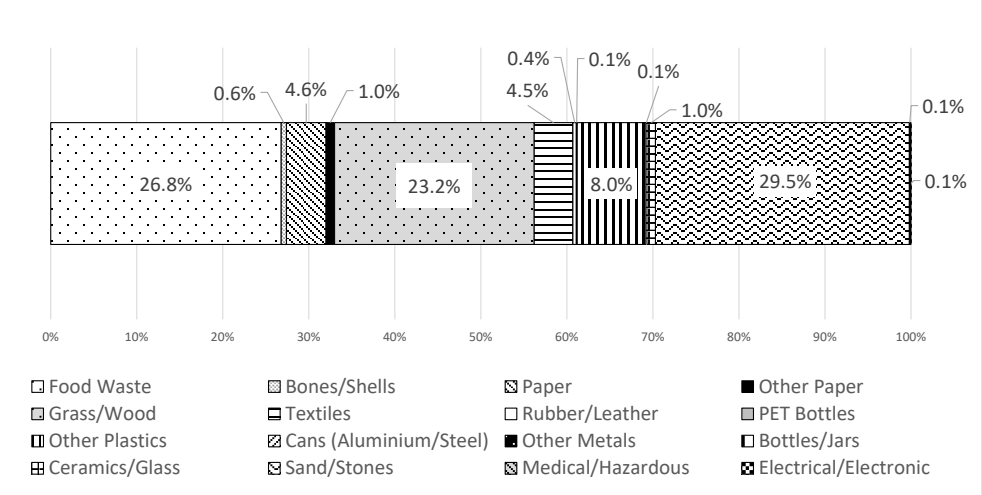


Source: JICA Project Team, "Waste Amount and Composition Survey Report (2018)"

Fig. 3-7 Composition of Household Waste

(2) Street Waste

The composition of street waste is shown in Fig. 3-8. Sand/Stones, Food Waste, and Grass/Wood accounted each for more than 20% of the street waste generated. Paper, Textiles, and Other Plastics also made up significant proportions.



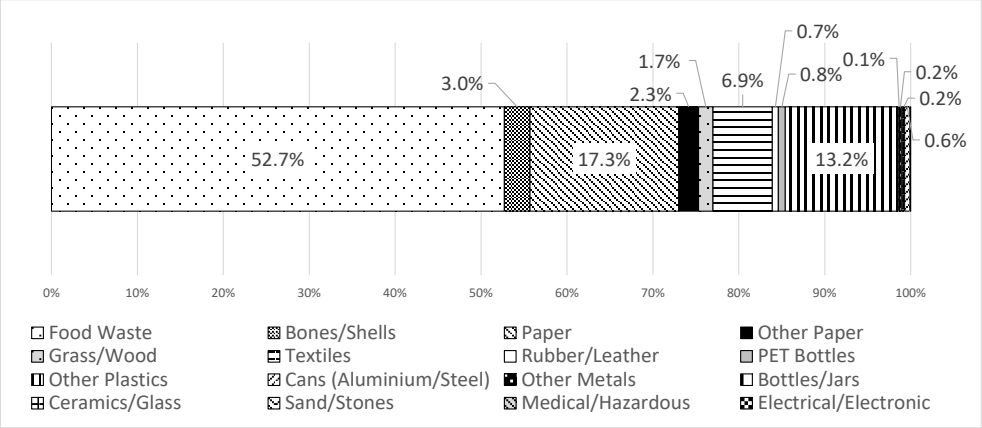
Source: JICA Project Team, "Waste Amount and Composition Survey Report (2018)"

Fig. 3-8 Composition of Street Waste

(3) Business Waste

1) Market

The composition of market waste is shown in Fig. 3-9. The items having large proportions were Food Waste, Other Plastics, and Paper, at 52.7%, 13.2%, and 17.3%, respectively, which is the same trend shown in household waste and restaurant and hotel waste. However, the percentages of Other Plastics and Paper were more than 10% higher than those of household waste and restaurant and hotel waste.

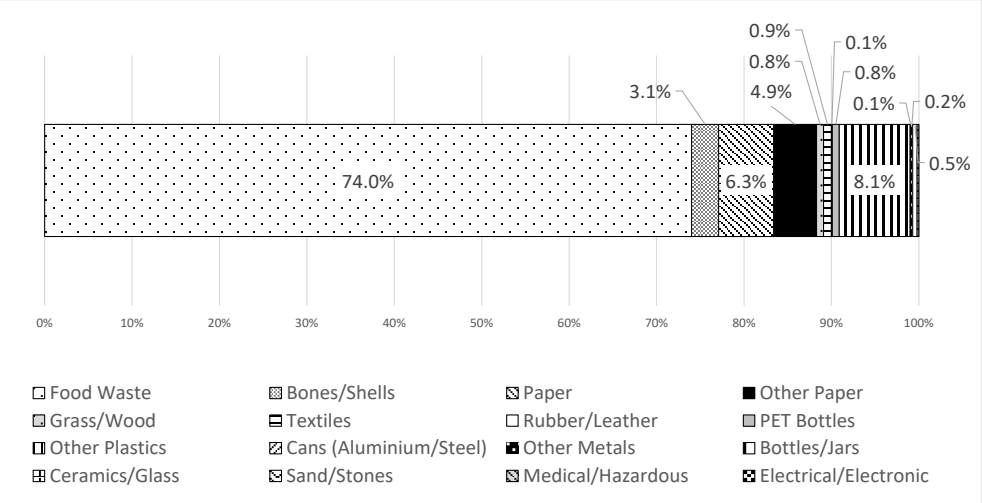


Source: JICA Project Team, "Waste Amount and Composition Survey (2018)"

Fig. 3-9 Composition of Market Waste

2) Restaurant and Hotel

The composition of restaurant and hotel waste is shown in Fig. 3-10. Similar to that in household waste, Food Waste accounted for the highest proportion followed by Other Plastics and Paper at 74.0%, 8.1%, and 6.3%, respectively.

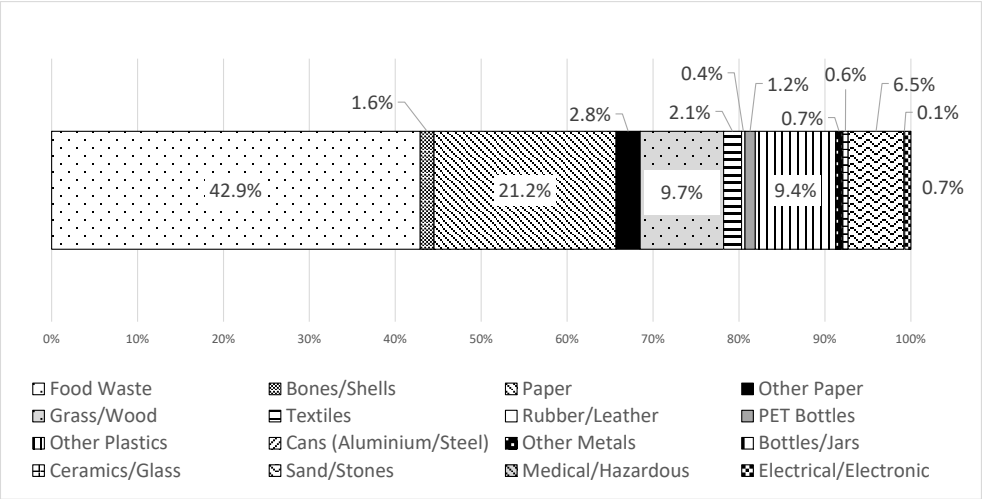


Source: JICA Project Team, "Waste Amount and Composition Survey Report (2018)"

Fig. 3-10 Composition of Restaurant and Hotel Waste

3) Office

The composition of office waste is shown in Fig. 3-11. Food Waste made up the highest proportion, at 42.9%, followed by Paper at 17.3%. Grass/Wood and Other Plastics each accounted for approximately 10%.



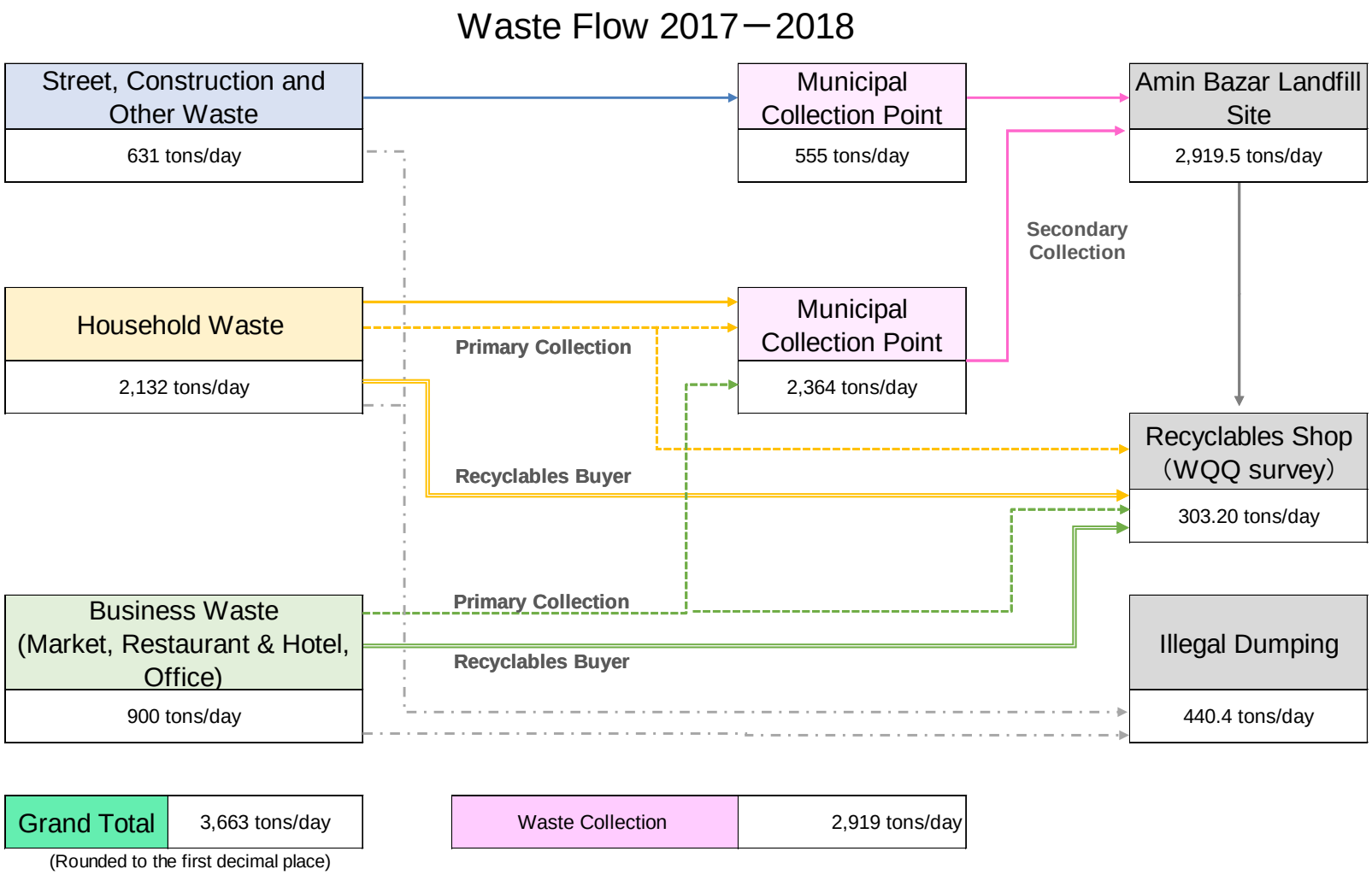
Source: JICA Project Team, "Waste Amount and Composition Survey Report (2018)"

Fig. 3-11 Composition of Office Waste

3.4.3 Waste Flow

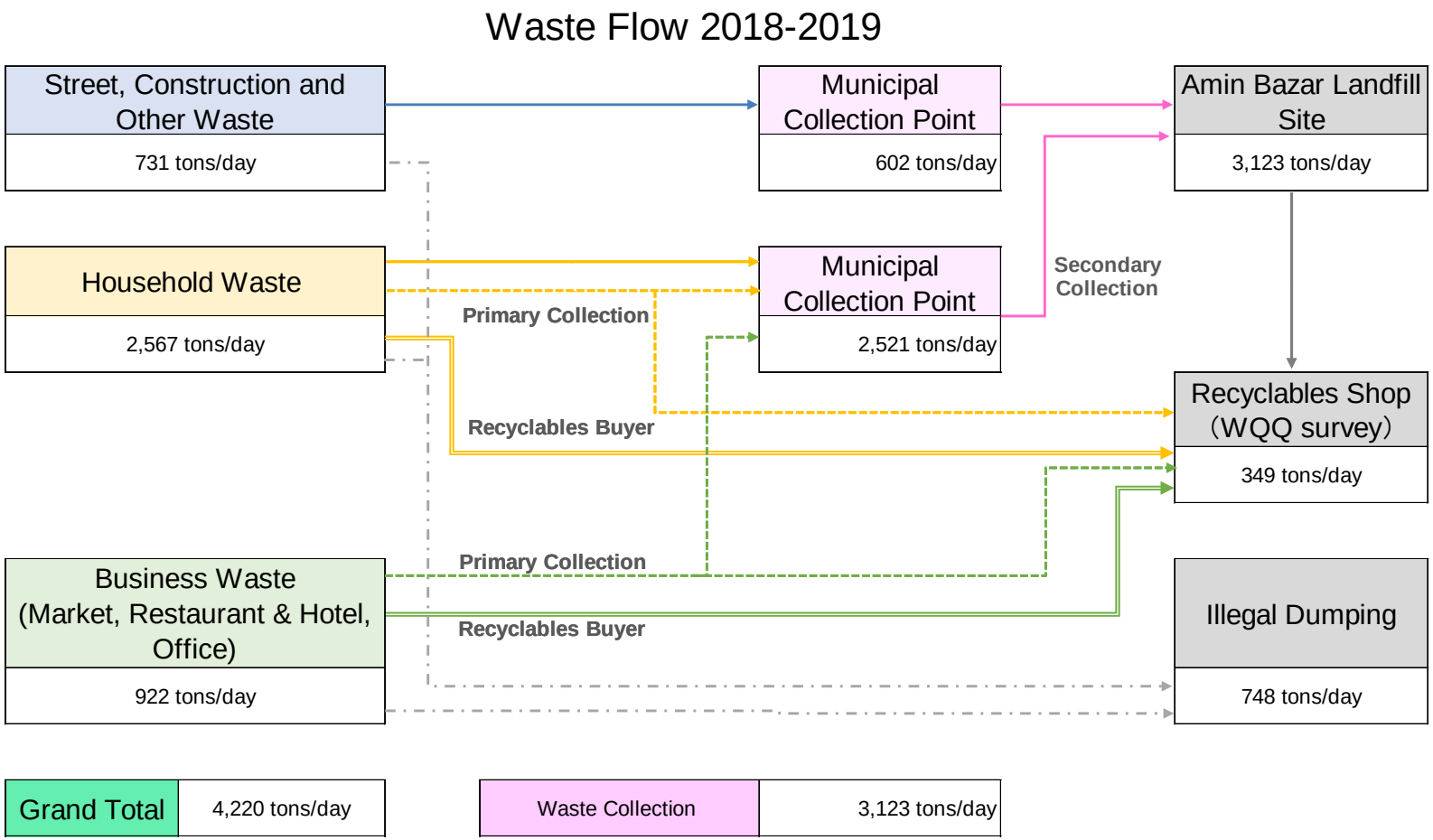
The waste flow diagram of the DNCC area, from waste generation to final disposal, and the sum of the waste in FY 2017–2018 at each point are shown in Fig. 3-12. This diagram considers waste generated only in the existing wards and excludes the extended wards because DNCC expanded in mid-2017. Street waste transported by the WMD, and construction waste carried by the private sector are taken directly to the Amin Bazar LFS. Non-recyclable waste generated from households and local businesses is collected mainly by primary collectors and is transported to the landfill via municipal collection points. Recyclable waste is collected in three ways by recyclable buyers, primary collectors, and waste pickers at the LFS. In FY 2017–2018, the total waste generated was 3,663 tons/day; this includes 2,678 tons/day of incoming waste to the LFS and 303 tons/day sent to the recyclables shop.

The waste flow for FY 2018–2019, which includes the waste generated from the extended area, is shown in Fig. 3-13. The total waste generated increased to 4,220 tons/day, which is approximately 1.15 times more than that of the previous year.



Source: JICA Project Team

Fig. 3-12 Waste Flow in DNCC in FY 2017–2018



Source: JICA Project Team

Fig. 3-13 Waste Flow in DNCC in FY 2018–2019

3.5 Public Relations and Awareness

3.5.1 Public Relations Department of Dhaka North City Corporation

The Public Relations Department (PRD) of DNCC is generally responsible for public relations and awareness activities and sometimes represents the CC. The PRD's main activities are listed below.

(i) Publishes tender notices, press releases, rejoinders, advertisements, and other information related to DNCC
(ii) Arranges press briefings, press conferences, rejoinders, and other activities as desired by higher authorities and prepares press release and speeches
(iii) Produces short films, telecasts, documentaries, and other media for public awareness of DNCC activities and arranges with the mass media for telecasting/broadcasting these programs
(iv) Clips all information about various DNCC departmental activities and relays it concerned departments for necessary steps
(v) Creates/raises awareness of mosquito eradication and information of conservancy, street lights, birth certificates, holding taxes, and other items.
(vi) Performs any other lawful duties desired by higher authorities

The PRD works actively and sincerely to provide any information related to DNCC activity. When an interview of the PRD is requested by the mass media regarding a specific topic, the PRD forwards the request to the appropriate department. In the case of waste management, when the WMD issues tender notices, press releases, or press invitations to waste management events, journalists sometimes contact WMD personnel directly for interviews.

3.5.2 Waste Management Department Public Relations Strategies and Activities

Despite the lack of a comprehensive public relations and awareness strategy in addition to the vacant position of ACWMO (Community) who is in charge of community relations and awareness, the WMD pursues public awareness activities not only through WBA but also at the CC level. The WMD performs its duties by collecting complaints or suggestions from city dwellers/organizations through following systems.

(i) Letters, phone calls, or in-person conversations from residents regarding different issues in various locations
(ii) CIs, who receive complaints directly from the community
(iii) Zone Officers (ZOs), ACWMOs who occasionally receive complaints from their community
(iv) Different organization and authorities such as Public Works Department (PWD)

(v) Various print media and electronic media outlets
(vi) DNCC's Facebook page

In addition, the following activities have been recently performed.

(i) Clean Dhaka Festival: The previous technical cooperation project of JICA arranged "Clean Dhaka week" for the "Clean Dhaka Ward Contest" with participation of communities, PCSPs, Community-based Organizations (CBOs)/NGOs, JOCV, and DNCC. The project gave the best cleaning award to PCSPs and communities. After the project, however, the DNCC was unable to organize this contest. Instead, it arranged several cleaning campaigns as public relations and awareness raising activities.
(ii) PCSP meetings and workshops: DNCC organizes a zonal PCSP meeting for Eid-ul-Adha every year attended by the mayor, chief executive officer (CEO), CWMO, chairperson of the SWM standing committee, and WMD officials.
(iii) Ward-based workshops: The ACWMO sometimes arranges a ward-wise cleaner workshop to make cleaners aware of their duties and responsibilities, especially during Eid-ul-Adha.

The PRD has been involved in large-scale festivals. In other cases such as PCSP workshops, cleaner workshops, and zonal workshops, however, it has not been involved.

3.5.3 Stakeholder Participation

DNCC has re-established the SWM standing committee as per Local Government (City Corporation) Act 2011 to oversee the corporation's waste management, involving 11 councilors and one executive engineer of the WMD. This committee has no positions with voting power for academic and other experts such as NGOs and research organizations thus far. However, the committee may involve academic personnel, professors, and experts from NGOs and research organizations to express their expertise.

DNCC has continued to periodically hold public meetings in which the mayor, councilors, and WMD officials respond to the community's opinions and stakeholder concerns in zones and wards. In addition, Eid-related workshops, PCSP meetings and workshops, special cleaning programs, and environmental education programs in schools are occasionally organized by the WMD to increase the awareness of the citizens.

3.5.4 Information Disclosure System

In the past, the WMD offered a webpage within the DNCC website to describe its function and to provide short activity overviews. However, the updated DNCC website[8] is still under construction, and no WMD website is presently active. To enhance the efficiency of the WMD, other social media such as the DNCC's Facebook page[9] and WhatsApp are operated by the PRD in cooperation with WMD as social communication tools regarding solid waste issues. Various types of video and television and radio broadcasts are sometimes offered by private organizations supervised by the PRD. Moreover, leaflet distribution, logistic support for programs or seminars, and rallies for public awareness are organized through outsourcing. The PRD has begun to publish a newsletter titled "NOGORIA," which introduces DNCC activities including waste management, with quarterly publication planned. In the WMD, the department's officials and CIs sometimes personally advertise and report WMD's activities on social media such as Facebook. Other than these offerings, passive information disclosure and sharing is rarely provided by the WMD.

3.6 Ward-based Approach

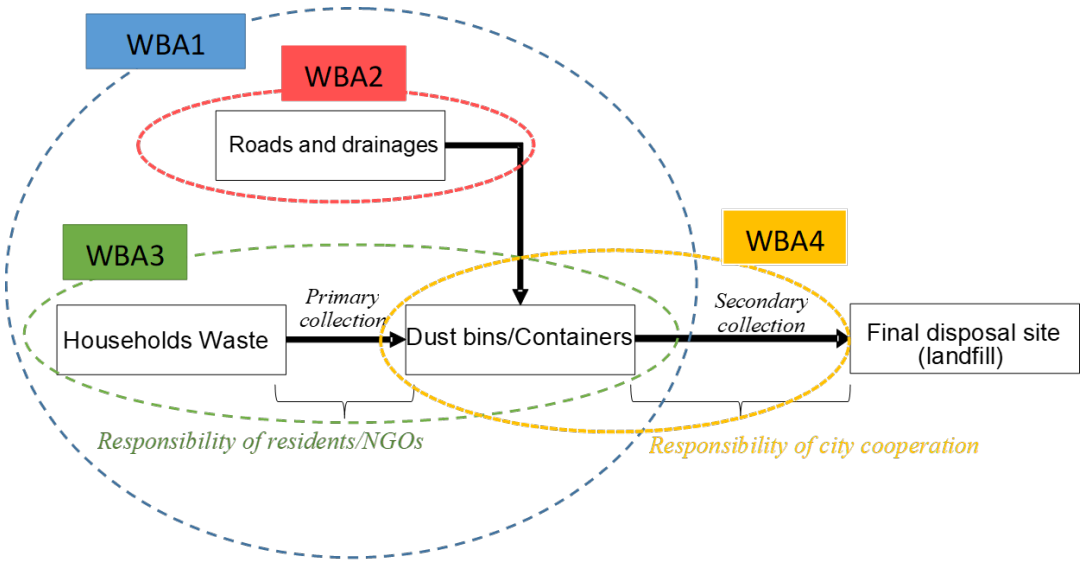
3.6.1 Definition of Ward-based Approach

The WBA was first introduced to Dhaka city as part of the previous JICA project and was launched in 2007 with a pilot project in two wards. This approach was then expanded actively to other wards throughout the project period. The WBA aims to build synergy of related activities in the wards and the CC by synchronized intensive resource input, which includes the four main components described in Table 3-11. All components of the WBA are interlinked; the relationship between WBA activities and the target location of waste is shown in Fig. 3-14. All stakeholders for the WBA including DNCC officers, CIs, COs, and cleaners as well as ward councilors need to jointly work together for successful WBA activities.

Table 3-11 Definition of WBA

Activity	Ripple Effects
WBA 1: Construction and management of ward SWM office **WBA 2:** Safety education for cleaners and establishment of safety and sanitation committee **WBA 3:** Public awareness raising **WBA 4:** Improvement of waste collection service in each ward	● Community-based SWM in wards to cultivate mutual cooperation ● Establishment and implementation of an administrative command system between the headquarters and ward offices ● Word-of-mouth awareness raising in communities ● Training for staff, officers, and residents ● More democratic local autonomy in wards

[8] http://www.dncc.gov.bd
[9] https://www.facebook.com/dncc.gov.bd



Source: JICA Project Team

Fig. 3-14 Structure and Activity Contents of WBA

3.6.2 Office Order Related to the Ward-based Approach

The WBA has been officially implemented in DNCC, in support initially with JICA, for community-based SWM improvement with related office orders. This approach considers field-level experiences and ideas. DNCC has issued three office orders and has proposed two orders related to the WBA to make the activities official.

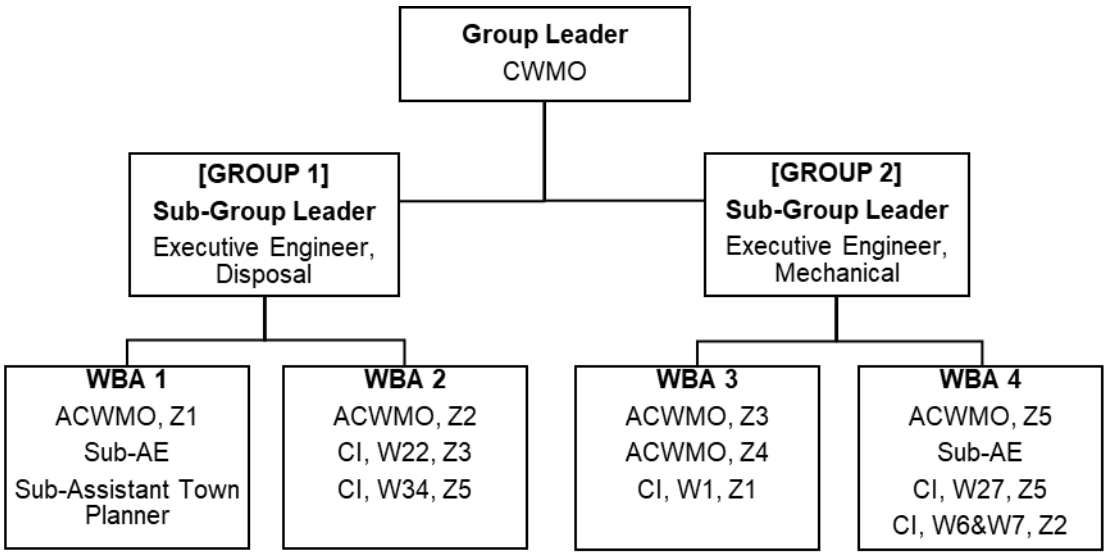
Table 3-12 WBA-related Office Orders in DNCC

Office orders	Status	Date
1) WBA activity implementation as an official project of the CC	Issued (by DCC)	March 9, 2010
2) WBA Core Group formulation	Issued	July 4, 2018
3) Preparation of WBA Annual Activity Plan (WBAAAP)	Issued	July 11, 2018
4) CI's duty to report SWM data to Zone Officer on a daily basis	Proposed	-
5) Safety and Sanitation Committee Formation	Proposed	-

3.6.3 Organization and Staffing

(1) Organization of the Ward-based Approach

DNCC issued an office order to formulate a WBA core group in July 2018 to encourage WBA activities together with field managers. As shown in Fig. 3-15, the WBA Core Group is composed of two sub-groups led by EEs. Each of these sub-groups include ACWMOs and CIs as WBA team members.



Source: Office Order issued on July 4, 2018

Fig. 3-15 WBA Core Group as of 2018

(2) Staffing

Currently, 35 staff members related to the WBA, including CWMO, 5 ACWMOs, 5 COs, and 27 CIs, work under the conservancy division of the WMD. Although DNCC consists of 54 wards, only 27 CIs are assigned, with some oversees more than two wards.

3.6.4 Current Situation of Ward-based Approach

The WBA was initially introduced more than 10 years ago in Dhaka City; thus, some CIs and DNCC officers who were involved in the previous project have a good understanding of this approach. According to the WBA-related survey conducted in 2017, the concept of ward-level SWM is unconsciously infiltrated in some wards, especially through the CI's perception, despite the fact that the WBA does not appear to be sufficiently active. The current situation of the WBA is summarized below.

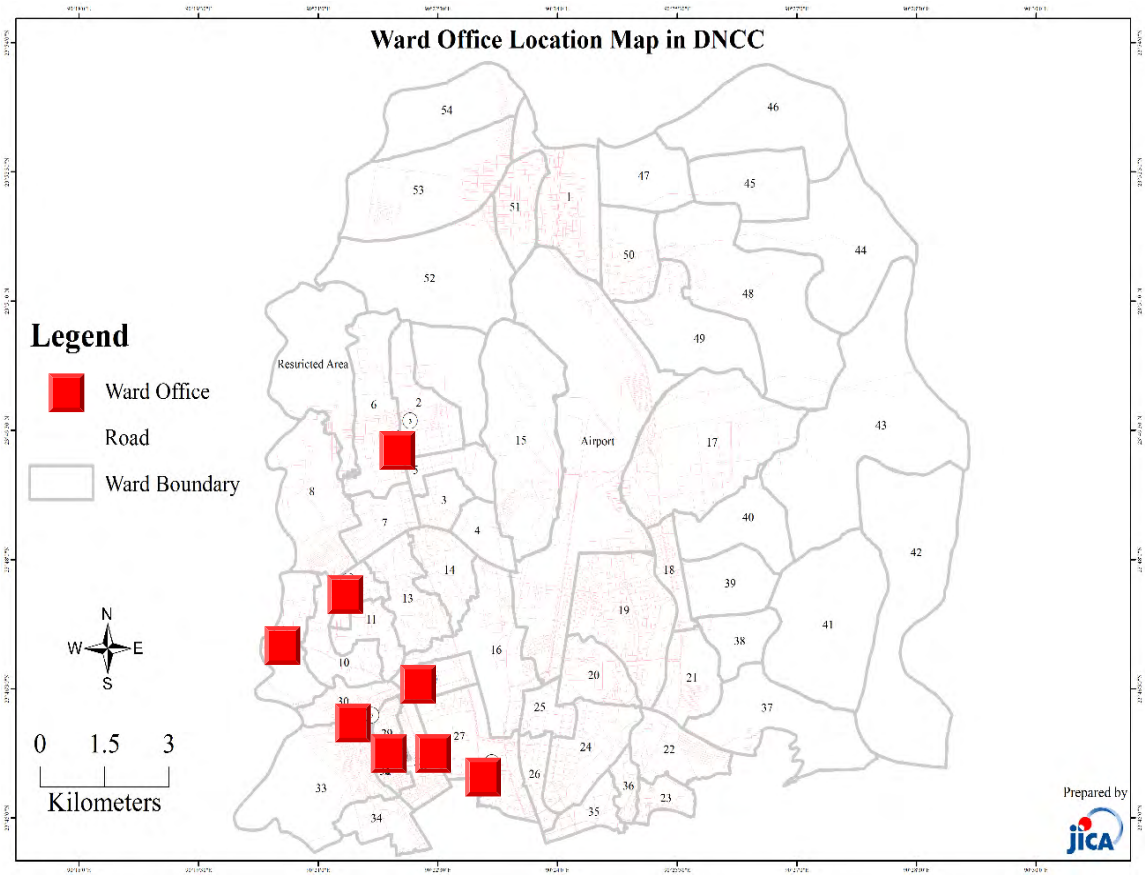
(1) Ward Office Management (WBA 1)

The objective of WBA 1 is to strengthen the ward office management for handling various types of SWM activities in each ward office such as SWM data management, cleaner management, and communication with communities for problem solving and complaint response. The function of the CI shall be consequently changed from mere supervision of cleaner's work to overarching ward-wide SWM, aiming to make DNCC less centralized.

The first ward office in Dhaka was constructed in 2008; eight ward offices have been built in DNCC

since then (Fig. 3-16). However, office equipment is not sufficient in each ward office. Most CIs use small sheds and small spaces as temporary offices or have no office. Currently, DNCC plans to construct 30 additional ward offices, but acquisition of private land for ward office construction is a problem owing to complicated and unclear land ownership rules.

As a regular job function, the CI maintains a daily record of cleaner attendance but does not maintain other records such as incident records or community complaint reports. Instead, the CI reports daily activity and other important notices to the ACWMO by using a commercially available SNS application. Some zonal officers manage and maintain ward office data reported from CIs. In some zones, CIs and ACWMOs hold a meeting at a zone office on a weekly basis for sharing issues related to the WBA and daily job issues.



No. of Wards	No. of Ward Offices	Under Planning
54 Wards	8 Ward Offices	30 Ward Offices

Source: JICA Project Team based on Ward Office Survey (2018)

Fig. 3-16 Location of Ward Offices

(2) Safety and Sanitary Education for Cleaners (WBA 2)

Improvement on the working environment of cleaners is important for better Occupational Health, Safety and Environment (OHSE). It is also essential for cleaners to learn knowledge on OHSE to protect themselves. The components of WBA 2 are given below.

(i) To provide safety gear to raise awareness on OHSE
(ii) To formulate a Safety and Sanitation Committee (SSC)
(iii) To introduce a Cleaners Working Manual for reference
(iv) Periodic Health Checkup

Currently, WBA 2 differs somewhat from the original. In cases in which the SSC is ineffective in some wards, the CI gives instruction to cleaners on a daily basis, and some ACWMOs regularly patrols their wards to provide supervision. In addition, DNCC and the ACWMO hold a special cleaning workshop every year in each zone prior to Eid-ul-Adha week to motivate cleaners for immediate cleanup and a safe working environment. Some ACWMOs and CIs who are very active occasionally hold a ward-wide cleaner workshop for communication with DNCC. However, the recent survey revealed that most ward offices have rarely replenished the first-aid kits or safety gear provided in the previous JICA project owing to the DNCC's complicated financial disbursement system, which is not widely known or practiced.

(3) Community Participation (WBA 3)

WBA 3 originated from the concept of participatory SWM by organizing a community group, known as Community Unit Working Group (CUWG), and by increasing public awareness locally. These measures are intended to engage the community regarding the ward's SWM. The following principles guide the implementation of WBA 3.

(i) Implementation of a community-led planning and decision-making process known as the Community Action Plan (CAP)
(ii) Encouragement of participation by women and men
(iii) Flexibility in approaches according to local situations and lessons learned from the field
(iv) Community sustainability
(v) Coordination and collaboration among various stakeholders

WBA stakeholders have become diversified in one decade. Almost all CIs have been transferred to other wards, which means they must start over to build up relationships with their new communities. Nevertheless, some CI who learned how to promote the community-based SWM in the previous JICA project have organized community meetings regularly with the ward councilor to discuss SWM and

other issues. Activities to increase community awareness have been implemented by NGOs in some wards using a participatory method similar to that used in WBA 3. In some communities, an active housing society has taken the initiative in the area's SWM by holding community gatherings and SWM environmental education.

(1) Waste Collection Improvement (WBA 4)

The objective of WBA 4 is to harmonize primary and secondary collection and to promote a safe and sanitary work environment. WBA 4 consists of two categories: WBA 4A and WBA 4B. Their functions are given below.

(i) WBA 4A: Introduces new collection system to improve efficiency and sanitary conditions of collection and transport
(ii) WBA 4B: Improves the present collection system with the involvement of the community and the PCSP

The activities of WBA 4 are strongly related to those in WBA 3 because the community's understanding and engagement are necessary for improving the collection system.

Dustbin and dumping site closure is ongoing with the DNCC initiative. Thus far, 175 dustbins and more than 20 containers have been removed from the streets. Some collection routes have been reformed accordingly to improve the collection efficiency by introducing compactors with FTFP collection. The PCSP often discusses and collaborates with CIs and ACWMOs for work efficiency, especially during special events such as Eid-ul-Adha. PCSP training is offered in some wards and zones, although this practice is not systematically organized.

3.7 Waste Reduction

Currently, no formal recycling system is provided for households in DNCC. A flow diagram of recyclables and mixed waste in DNCC generated by households is shown in Fig. 3-17.

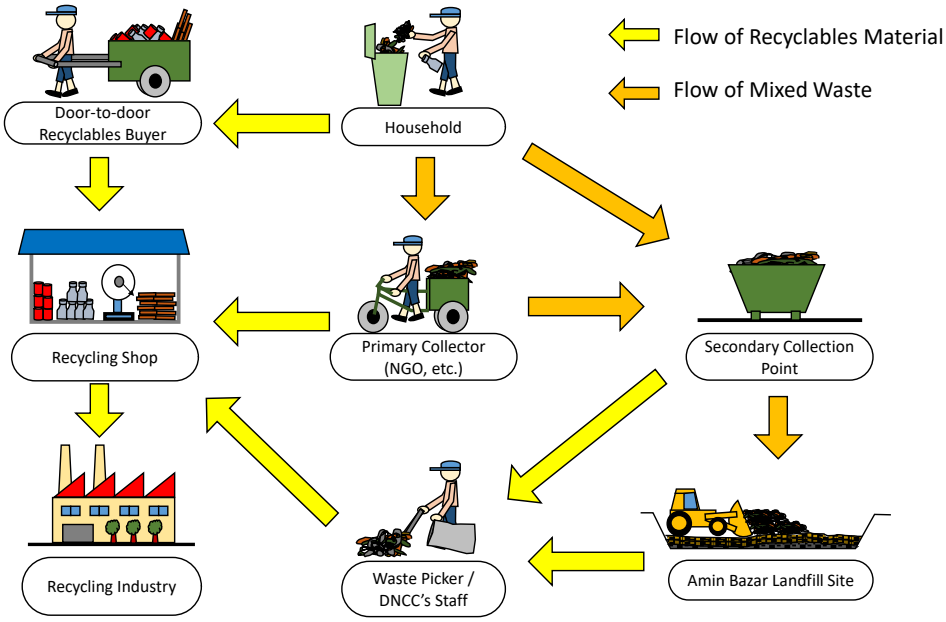


Fig. 3-17 Flow Diagram of Household Waste in DNCC

Although some households separate recyclables and sell them to buyers, most households combine their waste for discharge. This mixed waste is collected by primary collectors or is taken to secondary collection points (SCPs) by a household member. However, some households still dump their waste in open spaces, drains, or rivers.

The primary collectors separate some recyclables from the mixed waste and then sell them to recycle shops. In this way, they earn extra income from the shops in addition to regular salaries paid by the PCSP. After collecting the recyclables, they bring the remaining waste to the SCP from which the waste is transported to the Amin Bazar LFS.

Waste pickers separate some recyclables at the SCP or the LFS. Supporting staff members in charge of loading the waste from the SCP to collection vehicles sometimes take recyclables from the accumulated mixed waste to recycle shops. Finally, the recycle shops sell these items to recycling industry in Dhaka.

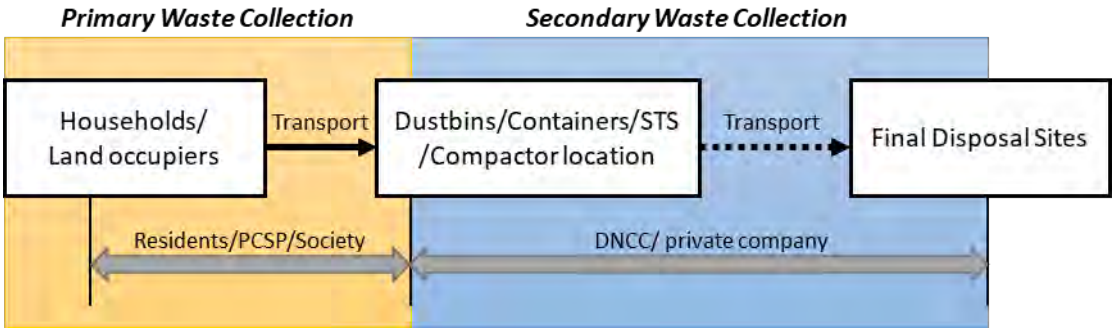
3.8 Collection and Transport

3.8.1 Waste Collection System

(1) Current Waste Collection System

Waste collection in CC is stipulated in the law titled "Local Government (City Corporations) Act 2011." According to Section 41 of the act, waste collected in dustbins/containers is an asset of the CC. In addition to overall management, the waste-related responsibilities of CC include collection of waste

from dustbins/containers for transport to its final disposal sites. Heads of households and land occupiers under CCs, as waste generators in other words, are responsible for carrying their waste to CC's waste collection points where dustbins or containers are located and to secondary transfer stations (STSs). This activity is accomplished by the PCSP. DNCC began to privatize the waste collection system through private companies in March 2012. After the PCSP's activity, secondary collection of the waste from SCPs and STSs is the CC's responsibility, as shown in Fig. 3-18.



Source: "Clean Dhaka Master Plan 2005–2015"

Fig. 3-18 Current Waste Collection System

(2) Transition of Waste Collection System

The waste collection system has improved in the last 10 years, as shown in Fig. 3-19. Prior to JICA's technical cooperation project in 2005, waste was collected by an open truck from a dustbin composed of concrete blocks without a lid. This collection style caused scattering of waste and strong odor because the waste was dumped anytime and was left until a collection vehicle came.

(i) Waste collection from dustbin by open truck (before 2005)
At dustbins in which people dispose of waste, unsanitary condition was present all day long, and waste loading by cleaners from the dustbins to the truck was difficult.

(ii) Waste collection by container carrier (from 2005 to 2010)
Although the efficiency of the collection by container carrier is high, the containers still created unsanitary condition and aggravated traffic congestion.


(iii) FTFP collection by compactor (after 2010)
The exposure time of discharged garbage on the street was shortened in urban area, which improved the sanitation environment.


Source: JICA Project Team

Fig. 3-19 Transition of Waste Collection System

Loading waste from the dustbin to the open truck is a harsh task for cleaners. The cleaner scoops the waste from the dustbin to a hand bucket, and lifts it to the loading platform of the truck at the same height as the cleaner. The work efficiency as well as the cleaner's working environment is obviously unfavorable. Therefore, DNCC began to abolish the dustbins as part of the JICA's technical cooperation project. DNCC has thus far removed 175 dustbins and replaced them with containers. However, the replaced containers are also problematic because they also cause strong odors when waste is left.

After 2010, new waste collection equipment and compactors were procured by EGAP, and FTFP collection was introduced accordingly. FTFP allows direct collection of the waste from PCSPs, rather than keeping the waste outside in urban area. As part of this measure, 20 containers that caused waste scattering and traffic congestions were then removed.

3.8.2 Primary Waste Collection

Waste collection from the points of generation, or households and buildings, is generally considered to be primary collection if such waste is disposed of to the SCPs of DNCC. A door-to-door waste collection system is common in almost all wards of DNCC to accommodate the high population density and long distances to SCPs. The business entities providing primary collection or door-to-door collection services are recognized as PCSPs or primary waste collection service providers (PWCSP).

According to the survey conducted by the JICA Project Team in 2018, approximately 454 PCSPs are regularly working in the DNCC area.

PCSPs collect waste door-to-door and transport the waste by rickshaw vans/motorized vehicles to dustbins/containers, and sometimes to vacant land for illegal dumping, whereas PCSPs near the LFS and in the extension area of DNCC take the waste directly to the LFS. Various types of STPs are used by PCSPs, such as compactors, containers, and a combination of these. In some cases, however, they take the waste to open dumping or illegal collection points.

(1) Status of Primary Collection Service Providers

The PCSP is defined as an entity providing door-to-door waste collection service. They are registered or unregistered individual persons, organizations, or associations with one or more rickshaw vans with or without hand trolleys. The forms of PCSPs are variable among the wards and according to the characteristics of the community. In general, CBOs, NGOs, private companies, housing societies, and individuals are common PCSPs.

An association of PCSPs in DNCC, known as the Primary Waste Collection Service Providers Association (PWCSP Association), was formed cater to the wellbeing of PCSPs and their workers. However, the participation of PCSPs is currently only 55%; that is, of 454 PCSPs, 206 PCSPs do not belong to the PWCSP Association.

(2) Registration of Primary Collection Service Providers

The permission and registration system of PCSPs was developed as part of JICA's first technical cooperation project from 2007 to 2013. DNCC adopts the same system for its application and monitoring with minor changes in the registration process. The PWCSP Association is newly incorporated in the permission and registration system. However, the selection and acknowledgement process of the PCSP is neither fully transparent nor legitimate. To make a transparent and legitimate selection process, the registration i.e. licensing of PCSP as well as the household rate vetting should be performed through the DNCC.

PCSPs are gradually shifting from informal to formal sectors in association with increasing recognition by different government bodies despite the fact that conflicts in PCSP ownerships and area demarcation still prevail in many wards. Local political leaders often control the primary collection business because many PCSPs are not registered at DNCC. This situation is considered to be a severe problem that hinders the improvement of PSCPs to be legally and properly controlled. The registration

entities of PCSPs in DNCC are shown in Table 3-13. Currently, 16% of PCSPs are not registered in the DNCC registration system.

Table 3-13 Registration Entities of PCSPs in DNCC

Registration Entities		Counted Registered PCSPs in DNCC	Proportion
Registered [1]		**382**	**84%**
	DNCC	*340*	*75%*
	Ministry of Social Welfare	*16*	*4%*
	Union (Parishad) [2]	*6*	*1%*
	Other	*20*	*4%*
No Registration		**72**	**16%**
Total		**454**	**100%**

Note:
[1] PCSP may have multiple registrations.
[2] Union (Parishad) is a form of local government
Source: JICA Project Team analyzed based on the primary collection survey (2018)

(3) Distribution and Coverage of Primary Collection Service Providers

In total, 454 PCSPs work in DNCC and provide the services to 3,687 fieldworkers, including 352 supervisory staff members who collect service charges from households, buildings, and other establishments. The PCSP coverage information for each zone, including the collection trip distance and household coverage, is shown in Table 3-14. PCSPs use 1,785 rickshaw vans covering 516,552 of households and 14,501 businesses per day at an average of two trips per day per van. Rickshaw vans cover 137 households/trip at 274 households per day per van on average.

Table 3-14 PCSP Information in DNCC

Zone No.	Counted PCSP	Rickshaw Van	Household Coverage	Commercial Coverage		
				Shops	Hotels/Restaurants	Total
DNCC	**454**	**1785**	**516,552**	**9,253**	**1,374**	**14,501**
1	56	277	58,624	737	177	1,243
2	86	225	77,815	2,315	80	2,401
3	111	575	128,070	3,042	470	6,563
4	97	300	90,259	836	346	1,251
5	68	287	113,559	1,525	181	2,003
6	9	26	11,860	281	30	367
7	11	36	12,450	216	52	305
8	4	8	2,700	75	8	99
9	4	8	1,715	0	3	8
10	7	28	14,600	26	24	53
3, 10	1	15	4,900	200	3	208

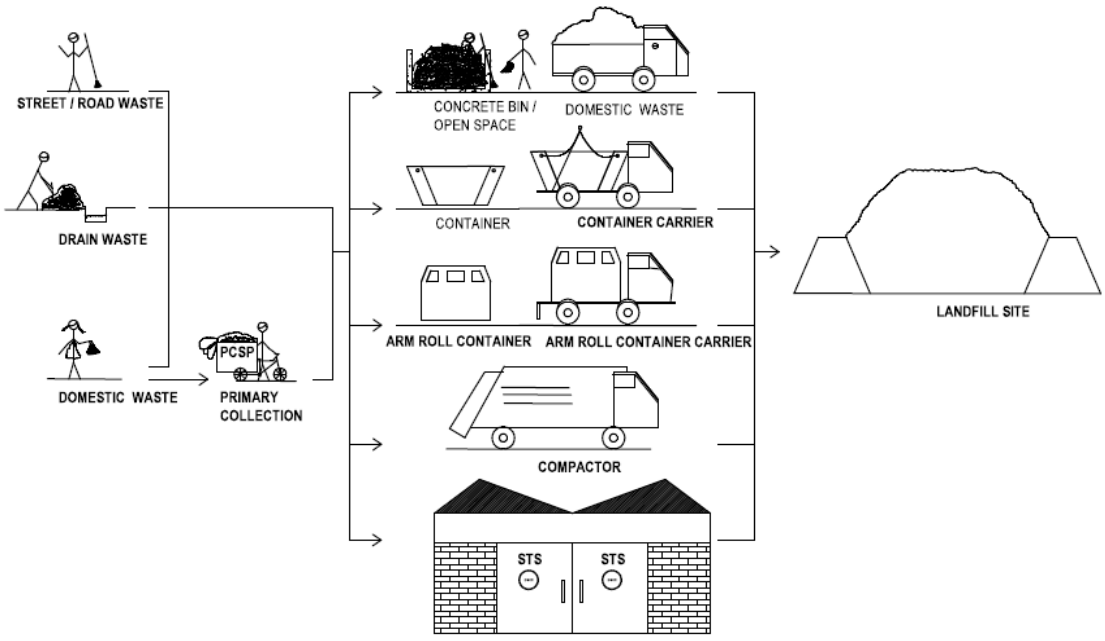
Source: JICA Project Team analysis based on the primary collection survey (2018)

3.8.3 Secondary Waste Collection

(1) Secondary Waste Collection System

Waste accumulated in SCPs, STSs, and dustbins are categorized in three major types based on the source of waste: household waste, street waste including sludge from drainage, and business waste. Street waste and drain waste are collected daily by DNCC cleaners after road sweeping and drain cleaning. The cleaners then take the waste by a trolley to a nearby SCP such as an STS, compactor, or dustbin. Domestic waste generated in households and commercial and office spaces is collected at the sources by PCSPs and is carried to the SCPs. There are four different types of secondary collection receptacles: concrete bins, containers, arm roll containers, and compactors for direct transport without waste storage. Open curbside waste accumulation is sometimes used at designated points for areas in which container placement is not suitable. The accumulated waste at STSs is then transported to final disposal by dump trucks and compactors.

STS facilities have been newly constructed in DNCC, and conventional and arm roll containers are stored at the STS facilities. PCSPs collect waste in their rickshaw vans and transfer it into containers stored in the STS facilities from 11 a.m. to 4 p.m. local time. Then, the filled-up containers and compactors are transported to the LFS. Compactors receive collected waste directly from PCSPs and businesses and transport the waste directly for final disposal.



Source: JICA Project Team

Fig. 3-20 Waste Collection and Transport Flow from Source to Final Disposal

(2) Organization Related to Secondary Waste Collection

The WMD is the core organization responsible for secondary solid waste collection from SCPs such as dustbins, containers, STSs, and compactors and for loading and unloading the waste at Amin Bazar LFS. The TD is responsible for transporting waste from SCPs to LFS. Allocation of the waste collection vehicles to wards is executed by TD after formal proposal from the WMD.

(3) Secondary Collection Points

With the exception of STSs, SCPs are designated spots in which PCSPs keep the collected waste every day and include containers, open spots, dustbins, and compactor locations. There are 240 SCPs identified in the DNCC. Dustbins composed of concrete blocks on roadsides are increasingly becoming obsolete; only eight concrete bins are functional in Ward 2, 27, and 32. Moreover, 147 open spots and 37 containers are also functional in the DNCC. In general, SCPs are located in densely populated areas or narrow roads, which prevent frequent access by a waste collection vehicle; unmanaged waste creates unsanitary conditions in the surrounding environment.

(4) Secondary Transfer Station

There are 48 STSs in the DNCC. Ward 13, Ward 14, Ward 25, and Ward 35 have no STSs, whereas 20 wards have an STS in each ward area. In addition, nine wards have two STSs; Ward 1 and Ward 19 have three STSs, and Ward 17 has four.

(5) Current Operation of Secondary Waste Collection

The container carrier can make a maximum of five trips per day, whereas arm roll and compactors can make four trips. Dump trucks and open trucks can complete only two trips per day. Table 3-15 shows the vehicle type and average trips per day of DNCC waste collection vehicles.

Table 3-15 Average Number of Trips by Vehicle Type

Vehicle type	Capacity (tons)	Average trips per day
Arm Roll	7	4
Compactor	5	4
Compactor	2	4
Container Carrier	5	5
Dump Truck	3	2
Open Truck	5	2
Open Truck	3	2

Source: JICA Project Team, “Time and Motion Survey Report (2018)”

(6) Working Conditions and Occupational Safety

The waste collection staff normally works under considerably unsafe conditions. A limited number of collection staff members wear typical safety gear such as masks, hand gloves, and sometimes boots. Nonetheless, violations of traffic rules occur. All staff members work on roads day and night mostly aside heavy traffic in many areas without special traffic signs, signals, or markings.

3.8.4 Privatization

(1) Private Company Information

Before DCC was split in two CCs, Urban Planning Department (UPD) of DCC began an initiative for private sector involvement in waste collection and successfully introduced outsourcing of the collection activity in two zones, Zones 1 and Zone 9. After the enforcement of Public Procurement Act 2006 and Public Procurement Rule 2008, the procurement system was reformed to the current one.

At present, the waste collection and transport system has been outsourced to and implemented by private sectors in eight wards of DNCC. A summary of the private sector operation is presented in Table 3-16. Four private companies (or organizations) are outsourced for the waste management program in Ward 1, Ward 17, Ward 18, Ward 19, Ward 20, Ward 21, Ward 24, and Ward 25.

Table 3-16 Summary of Private Company Information

Name of Company	Working Area	Total Staff	Total Vehicles & Equipment	Years of Experience in Waste Collection
Cleantech Limited	Zone 1: Ward 1	391	72	12
Rakib Enterprise	Zone 3: Ward 21 and 25	262	74	5
MESAS Multi International	Zone 3: Ward 18, 19, and 20	615	137	5
Khandokar Brothers and Network	Zone 1: Ward 17	224	27	7
	Zone 3: Ward 24	103	19	7

Source: JICA Project Team summary based on contracts with private companies in DNCC

(2) Contract Type

The three types of the outsourcing contracts for private waste collectors are listed below.

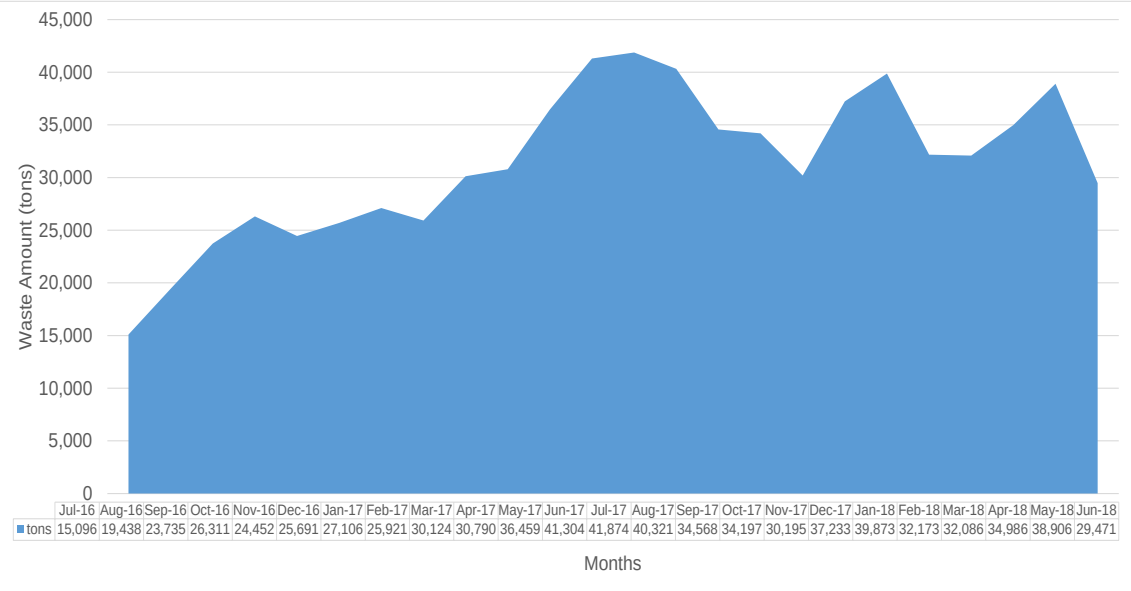
(i) Ton-based contract
(ii) Person-, vehicle-, and equipment-based contract
(iii) Ton-, and person-based contract

Cleantech Limited, the first contractor of the outsourcing in DNCC, began waste collection activity in March 2012. In principle, the private collectors can contract for one year only. Three companies have been contracted with contract type (ii); Rakib Enterprise is the only company that contracts with type (iii).

(3) Waste Collection Amount

1) Collection Amount by Private Companies

Private companies in DNCC collected the maximum amount of waste in July 2017, at almost 50%. The amount of waste was 41,874 tons which is 47% of the total collected waste of DNCC.

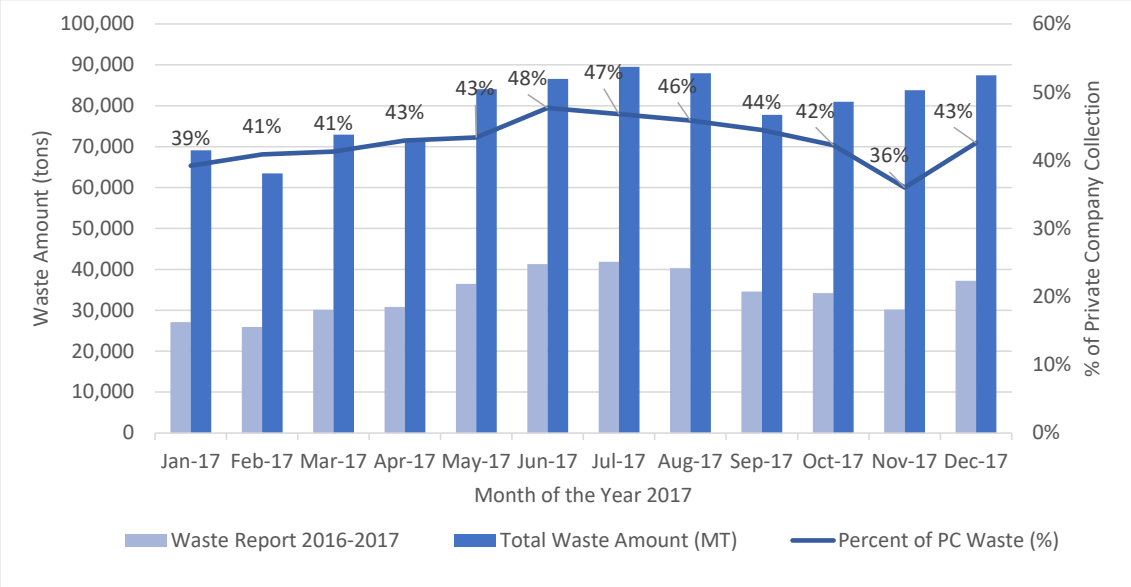


Source: JICA Project Team analysis based on reports by private contractors

Fig. 3-21 Private Company Waste Collection in DNCC

2) Comparison between Dhaka North City Corporation and Private Companies

Waste collection data of the private waste collection companies are compared with the data of DNCC in 2017 in Fig. 3-22. Approximately 36–48% of the waste was collected by these companies, with the maximum amount collected in June 2017.



Source: JICA Project Team

Fig. 3-22 Waste Collected by Private Companies and the Total Waste Collected

3.9 Waste Collection Vehicle Maintenance

3.9.1 Waste Collection Vehicle Information

Maintenance of vehicle is conducted at the workshop in Dhalphur. The number of waste collection vehicles in DNCC is shown in Table 3-17. Currently, WMD has 47 vehicles provided by EGAP, or 37% of the total, whereas the ED has 81 vehicles, or 63%, including 35 open trucks. Waste collection vehicles are generally procured by ED with DNCC's own budget and are then transfer to TD for operation. Compactors were procured and introduced in DNCC by EGAP for the first time.

Table 3-17 Number of Waste Collection Vehicles by Type

Vehicle type	WMD	ED
Arm roll	8	0
Container Carrier	14	29
Compactor	25	0
Open Truck	0	35
Dump Truck	0	17
Total	**47**	**81**
Grand Total		**128**

Source: JICA Project Team analysis based on the DNCC waste collection inventory

Most of the open trucks of the DNCC became obsolete. Accordingly, ED has prepared a plan for replacing the old vehicles with new types of waste collection vehicles. Approximately 116 vehicles of the total 128 are ready for sale at auction. WMD is also planning to purchase 25 new compactor-type

vehicles, subject to budget allocation and approval of the central authority. In addition, JICA has extended its cordial cooperation toward DNCC for easing the waste collection pressure by providing new vehicles such as compactors and dump trucks through the GAP of JICA, as shown in Table 3-18.

Table 3-18 Type, Capacity, and Number of Waste Collection Vehicle of Grant Aid Project

Lot No.	Types of Vehicles	Capacity (tons)	No. of Vehicles
1	Dump Truck (small)	2.5	4
	Dump Truck (4WD)	5.4	4
	Dump Truck (large)	6.8	5
2	Container Carrier	6.0	20
3	Compactor (small)	3.2	10
	Compactor (large)	7.5	13
Total			**56**

Source: JICA Project Team, "Implementation Report of Grant Aid Project (GAP) Plan (2018)"

3.9.2 Relationships and Responsibility for Operation and Maintenance of Waste Collection Vehicles

Four organizations are directly related to the operation and maintenance (O&M) of the waste collection vehicles: WMD, TD, Mechanical Division (MD) of ED, and SPD. Their responsibilities are summarized in Table 3-19.

Allocation of the waste collection vehicles is executed by the TD after formal proposal from the WMD. Fuel coupons for the collection vehicles are issued by the TD and are handed out to the drivers. For vehicle repair and maintenance, the drivers may receive a job card from the TD and can submit it to the DNCC workshop located in Dhalpur. Regular vehicle maintenance service and repair of the containers and body parts are performed at the workshop.

Normally, the WMD and ED implement periodical inspection and maintain their own vehicles in each department, whereas the TD is responsible for daily inspection. The SPD is responsible only for the procurement process. It purchases spare parts including tire tubes and batteries for the collection vehicles and equipment in accordance with requests from the ED and WMD, and supplies the necessary items to the DNCC workshop annually.

Table 3-19 Responsibility for Operation and Maintenance of Waste Collection Vehicles

	WMD	ED	TD
Vehicle Allocation		✓ DT in ED	✓ Vehicles except DT in ED
Purchase and Auction of Vehicle		✓	
Purchase of Fuel		✓ DT in ED	✓ Vehicles except DT in ED

	WMD	ED	TD
Driving Vehicle		✓ DT in ED	✓ Vehicles except DT in ED
Daily Inspection		✓ DT in ED	✓ Vehicles except DT in ED
Periodical Inspection	✓ (EGAP Vehicle and Others)	✓ (Except WMD Vehicles)	*Issuing Job Card
Purchase and Replacement of Parts (Oil and Filters, etc.)	✓ (EGAP Vehicle and Others)	✓ (Except WMD Vehicles)	*Issuing Job Card
Purchase and Replacement of Parts (Tires and Batteries)		✓ (All Vehicles)	*Issuing Job Card
Purchase and Replacement of Parts (Engine, Brakes, etc.)		✓ (All Vehicles)	*Issuing Job Card
Workshop Management	✓ (EGAP Workshop)	✓ (ED Workshop)	
Spare Parts Management	✓ (Parts for EGAP Vehicle and Others)	✓ (ED Workshop)	

Note) DT: Dump Truck
Source: JICA Project Team

3.9.3 Staffing for Repair and Maintenance of Waste Collection Vehicle

All collection vehicle drivers for waste collection, including the WMD vehicle drivers, belong to the TD. However, a shortage of drivers still exists, with insufficient staff available to handle available open trucks, container carriers, and other collection vehicles. To fill the gap, some drivers work two shifts or overtime. In addition, the DNCC workshop staff of the ED has not been recruited for many years; currently, only two mechanics are available to work in the workshop, whereas approximately 500 vehicles are now functional including office vehicles. Spare parts are procured by the SPD and are maintained by the respective storekeepers at the DNCC workshop office.

3.9.4 Vehicle Inspection and Maintenance Condition

Vehicle inspection and maintenance condition is summarized in Table 3-20. The vehicle inspection in DNCC is broadly classified as (i) daily inspection, (ii) periodical inspection, and (iii) inspection when drivers report trouble. Drivers prepare a job card, and the mechanics inspect the subject vehicle for (ii) and (iii). Minor repairs such as replacement of lubricants and filters are completed by mechanics. When a severe breakdown occurs that requires replacement of major parts such as an engine or brakes, the repair and maintenance service is outsourced. Periodical inspection by outsourcing is used for compressed natural gas (CNG) vehicles, which are difficult to operate and maintain. The WMD has an agreement with NAVANA limited for periodical inspection.

The TD issues a job card for all services. The period for replacement of parts is not standardized and is determined by drivers or mechanics.

Table 3-20 Vehicle Inspection and Maintenance Condition

		WMD	ED
1. Inspection			
Daily Inspection	Inspector	Driver (TD)	
	Location	Garage	
	Inspection items	Engine oil, coolant, battery, and other items; investigates abnormal noises	
	Remarks	- Issues job card if any abnormal items are found - No standard and recording sheet is needed for the inspection	
Periodical Inspection	Frequency	Every three months, or two month for old vehicles	Every three months
	Inspector	Mechanic (WMD) Twice a week	Mechanic (ED)
	Location	Garage	
	Inspection items	Grease, lubricants, filters, etc.	
	Remarks	- Recording sheet - No standard for inspection	- Recording sheet - No standard for inspection
2. Repair and Maintenance			
Replacement of parts (lubricants, filters etc.)	Repair staff	Mechanic (WMD)	Mechanic (ED)
	Location	Garage (workshop for emergencies)	Garage
	Frequency of Service	1. Parts are replaced if required after periodical inspection 2. Parts are replaced if drivers report trouble	
	Remarks	Recording sheet: records the parts to be replaced	
Replacement of parts (tires, tubes, and batteries)	Repair staff	Implemented by ED	Mechanic (ED)
	Location		Garage or workshop
	Frequency of Service		The part will be replaced if drivers report trouble
	Remarks		- Recording sheet: history book. Date, replaced parts, and cost are recorded.
Replacement of parts (engines, brakes, etc.)	Repair staff	Implemented by ED	Mechanic (ED)
	Location		Garage or workshop
	Frequency of Service		The part is replaced if drivers report trouble
	Remarks		- Recording sheet: history book. Date, replaced parts, and cost are recorded.

Source: JICA Project Team

3.9.5 Spare Parts Management (Inventory Management)

The WMD or ED purchases spare parts for periodical maintenance such as various filters, lubricants, batteries, tires, and tubes, which are stored in the department's own storage facility in the workshop. Each department receives these parts from the SPD or market after procurement and keeps the spare

parts as inventory. The current situation of spare parts management in the WMD and ED is described in Table 3-21.

Table 3-21 Spare Parts Management in WMD and ED

	WMD	ED
Stored spare parts	- Various lubricants - Various filters - Tires - Tubes - Parts supplied in EGAP	- Various lubricants - Various filters - Tires - Tubes
Location of spare parts storage	- Storage owned exclusively by WMD in DNCC workshop	- Storage owned exclusively by ED in DNCC workshop
Recording item	[Incoming items] - Procurement company - Number of procured parts - Date of part procurement	[Outgoing items] - Delivery date - Delivered vehicle No. - Number of delivered parts

Source: JICA Project Team

3.9.6 Outsourcing Process for the Collection Vehicle Maintenance

DNCC has its own process for outsourcing vehicle maintenance to private companies, except for periodical maintenance. The outline of the process is given below.

(i) The WMD or MD selects a private company by the official tendering process. A company is selected for each vehicle model of container carrier (5 tons) or compactor (3 tons).

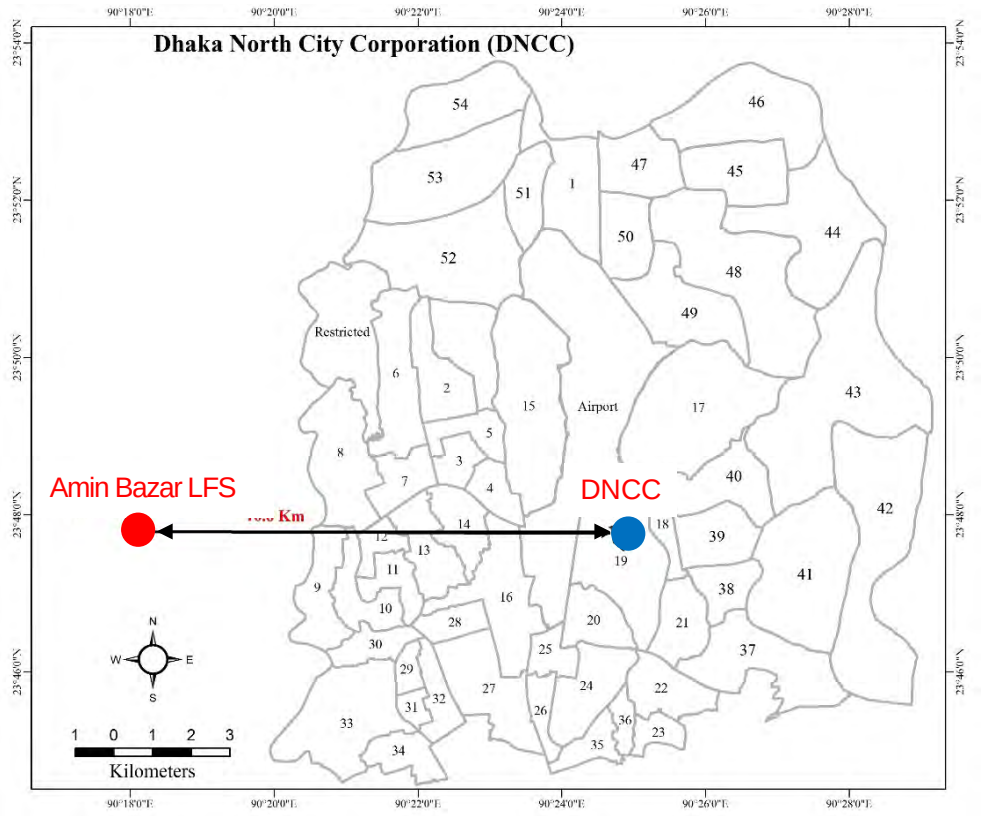
(ii) After the tendering process, a service agreement for one year is prepared. The WMD/ED determines the upper limit of the total price for servicing the vehicle in the agreement. The WMD/ED is unable to ask the company to provide services exceeding the upper limit of the price.

(iii) The companies cannot service vehicles for non-listed items, as stated in the agreement.

3.10 Landfill

3.10.1 Overview of Amin Bazar Landfill Site

Amin Bazar LFS is located about 17 km west of the DNCC headquarters, as shown in Fig. 3-23. DNCC built the LFS on 53 acres of land in 2005, which became operational in 2006. Amin Bazar LFS is the only LFS for DNCC.



Source: JICA Project Team

Fig. 3-23 Location of Amin Bazar LFS

A layout of Amin Bazar LFS is shown in Fig. 3-24, and its basic information is given in Table 3-22. Currently, Amin Bazar LFS receives all types of waste in DNCC except for tannery and medical waste. As per high court injunction, the waste is transported to Amin Bazar LFS only at night from 10:00 p.m. to 6:00 a.m. However, daytime dumping is ongoing because of the following reasons.

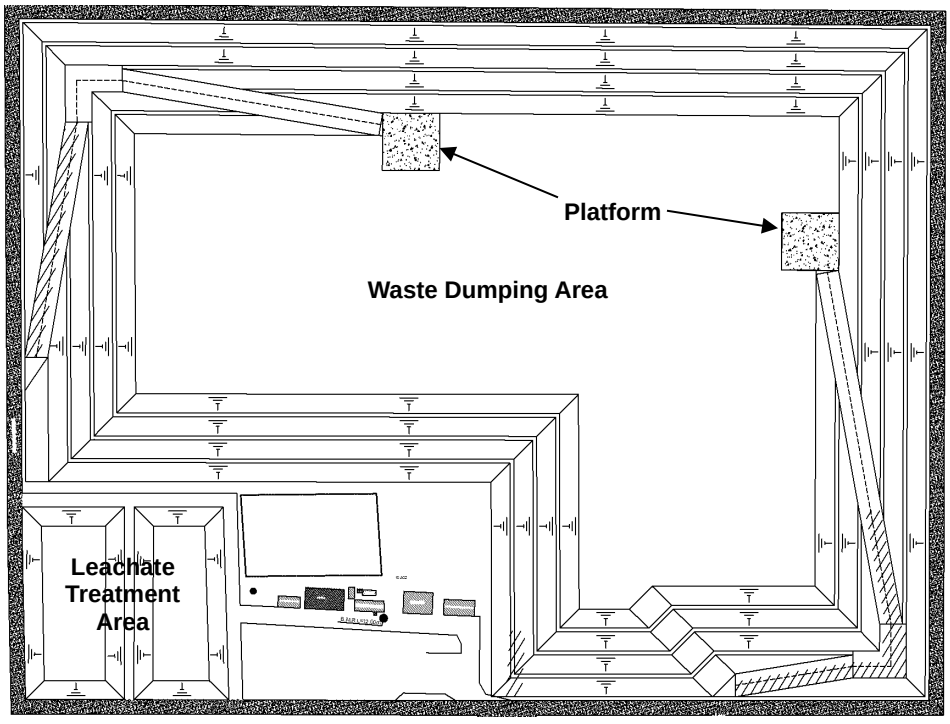
- Lack of awareness;
- Difficulties of matching time between duration of collection and transport of high amount of waste and
- Shortage of working crews, and vehicles

Amin Bazar LFS is composed of an embankment, gas vent pipes, a leachate pond and blower system, access and operation roads, dumping platforms, rainwater drainage, a weighbridge, a car washing pool and equipment, an administrative building, a workshop, and a diesel generator house. The anaerobic method is applied inside and under the embankment, whereas the semi-aerobic method is used above the embankment.

Amin Bazar LFS is expected to be filled up by 2020. Therefore, DNCC is in the process of acquiring 80 acres of land nearby for extension. The DPP for this purpose has already been prepared and sent to the relevant ministries for approval which includes intermediate treatment facilities' provision such as land development for incineration plant construction, medical waste treatment plant, compost plant etc.

Table 3-22 Basic Information of Amin Bazar LFS

Item	Description
Current Situation	Ongoing waste dumping
Type of Receiving Waste	All types of waste (mostly domestic waste and business waste) except for tannery waste and medical waste of DNCC
Target Receiving Area	Entire DNCC jurisdiction composed of 54 wards.
Operating Hours	Nighttime only, from 10:00 p.m. to 6:00 a.m.; daytime dumping is still ongoing.
Area and Capacity for Disposal	A = 20 ha V = 4 million m^3
Disposal Method	Under and inside the embankment: anaerobic method Above the top of the embankment: semi-aerobic method
Main Facilities	- Embankment - Leachate treatment facility (with anaerobic treatment system) - Leachate collection / drainage facility - Rain water collection facility (open ditch) - Gas vent pipes - Landfill management office - Truck scale - Car wash facility - Dumping platform - Access road - Workshop



Source: JICA Project Team

Fig. 3-24 Layout of Amin Bazar LFS

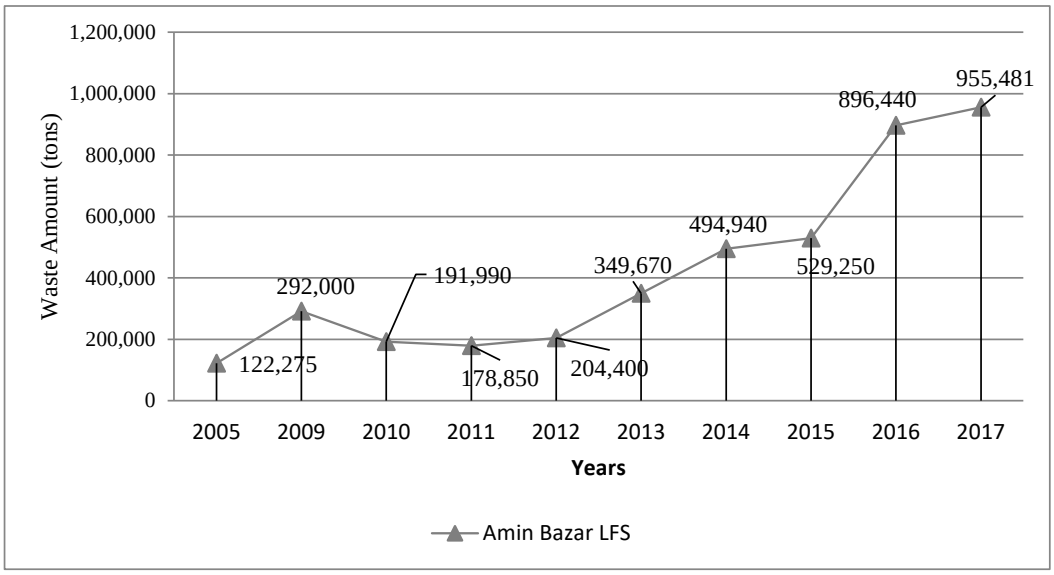
3.10.2 Roles and Responsibility of Waste Management Department and Related Departments

In DNCC, WMD owns landfill equipment, and are solely engaged in the LFS operation. The roles and responsibilities of the WMD are shown below.

- Landfill-related procurement, operation and maintenance
- Yearly budget preparation
- Construction and installation of weighbridge, peripheral embankment, car wash pool, lighting tower, dumping platform, leachate treatment plant, gas vent pipe, etc.
- Environmental management by cover soil layering of the dressed waste of the LFS
- Ensures the security of the LFS by preventing unwanted entry of unauthorized people
- Operates heavy equipment with fuel and driver for landfill operation
- Spreads and compacts waste and soil cover

3.10.3 Disposal Amount

The annual disposal amount of waste is shown in Fig. 3-25. In 2011, the amount of waste decreased owing to the jurisdiction division of DCC into DSCC and DNCC. A high growth of waste disposal from 2015 to 2016 occurred because private companies were used for collection and because new waste collection vehicles were introduced.



Source: Weight bridge data from Amin Bazar LFS

Fig. 3-25 Disposal Waste Amount in Amin Bazar LFS (tons/year)

3.10.4 Remaining Capacity of Amin Bazar Landfill Site

As of 2017, the estimated remaining landfill capacity above the embankment is 1,954,495 m^3, as shown in Table 3-23. The estimated completion date of waste disposal in Amin Bazar LFS is July 2020.

Table 3-23 Estimated Disposal Amount and Remaining Landfill Capacity

	Capacity			
	2017	**2018**	**2019**	**2020**
Estimated Disposal Amount		630,219 m^3	868,069 m^3	864,656 m^3
Remaining Landfill Capacity	1,954,495 m^3	1,324,276 m^3	456,207 m^3	-408,450 m^3

* Compacted density 0.80 m^3/ton

Source: JICA Project Team

3.10.5 Amin Bazar Landfill Site Rehabilitation Plan

Currently, the accumulated waste in the dumping area has already reached the top of the embankment, up to 7 m. DNCC is planning to accumulate waste up to 20 m more above the embankment with 5 m intervals for work efficiency, environmental conservation, and expected efficient land use after the completion of waste disposal. The Amin Bazar LFS rehabilitation plan is shown in Fig. 3-26.

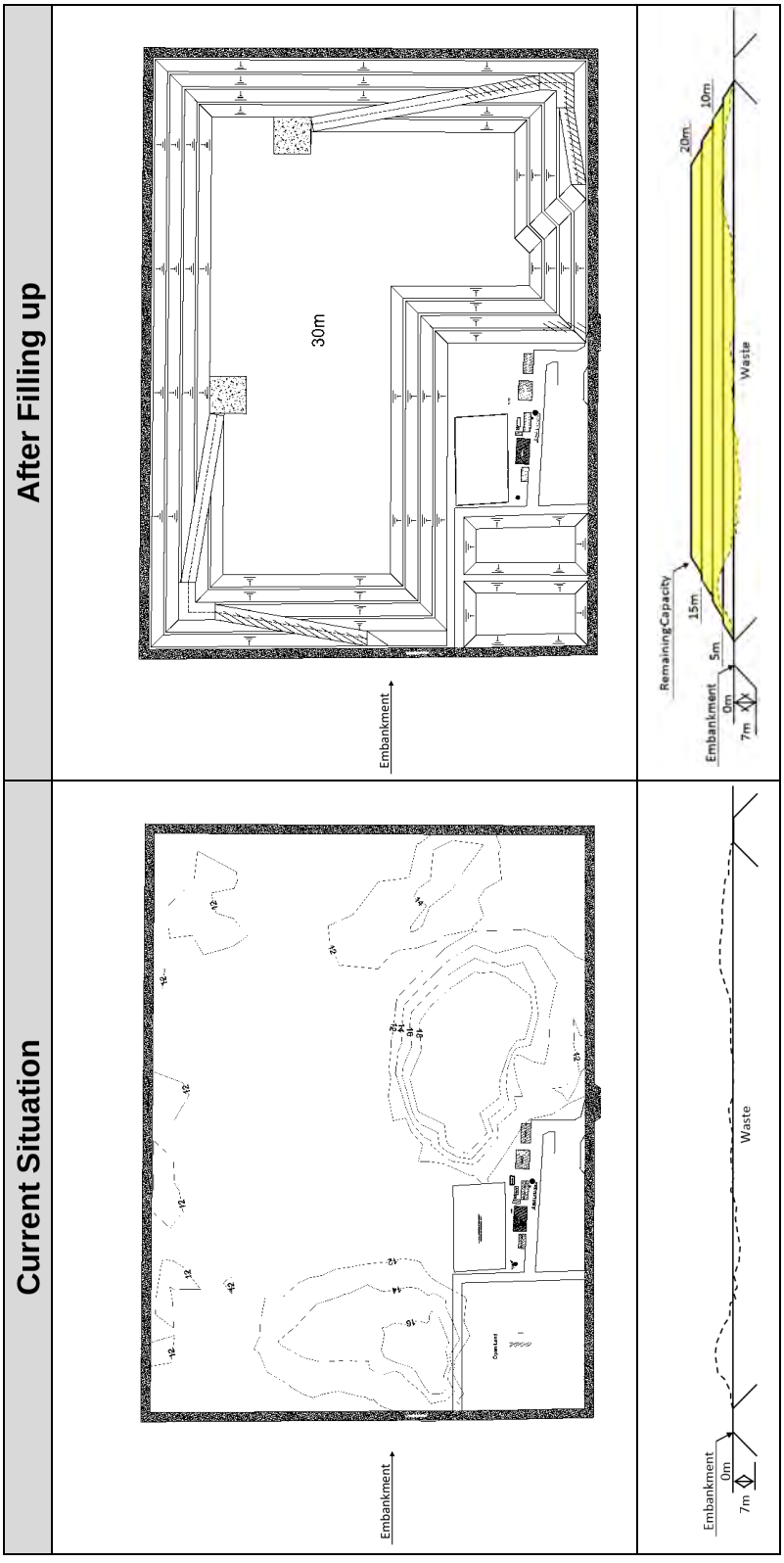


Fig. 3-26 Amin Bazar LFS Rehabilitation Plan

3.10.6 Heavy Equipment for Landfill Operation

The general characteristics of heavy equipment for landfill operation are shown in Table 3-24. The bulldozer is superior for pushing and placing waste and is appropriate for compacting the waste in any type of ground. The wheel dozer is also superior for pushing and placing the waste and mobility, although its compaction performance is worse than that by the bulldozer. The wheel loader is used mainly for loading waste. The excavator (power shovel) is used for digging soil cover in the natural ground. The landfill compactor can effectively be used for crushing and compaction, although it could become stuck if used on soft ground such as an LFS.

Table 3-24 Characteristics of Heavy Equipment Needed for Landfill Operation

Heavy Equipment	Capacity	Waste		Covering Soil				Diposal Scale
		Pushing & Placement	Compaction	Excavation	Pushing & Placement	Compaction	Transportation	
Bulldozer	Weight: 3.5-40 tons Running Speed: 0-14 km/h Bucket Capacity: 0.5-10 m^3	◎	○	△	◎	○	×	Large to Small
Wheel Dozer	Weight: 5-6.2 tons Running Speed: 0-35 km/h Bucket Capacity: about 1m^3	◎	△	△	○	○	×	Large to Small
Wheel Loader	Bucket Capacity: 0.2-9m^3 Running Speed: 0-40km/h	○	△	△	○	△	×	Large to Small
Excavator (Power Shovel)	Bucket Capacity: 0.2-9 m^3	×	×	◎	△	×	×	Large to Small
Landfill Compactor	Weight: 20-34 tons Height of Gear Tooth: 15 cm	◎	◎	×	○	○	×	Large to Small

◎ Best function ○ Good function △ Applicable but function is not sufficient × Inadequate

Source: JICA Project Team

3.10.7 Current Situation of Operation and Management

(1) Landfill Operation and Management

The main roles of Amin Bazar LFS are to receive waste, to place the waste in systematically arranged cells, to protect the environment, and to stabilize and return the waste to the soil. Amin Bazar LFS should be managed and operated properly to fulfill these roles. The five major activities of landfill operations and management are given below.

- Vehicle Management
- Disposal Management

- Landfill Facility Management
- Safety Management
- Environmental Management

(2) Ongoing Project in Amin Bazar Landfill Site Development Project Proposal

At present, no project work is being conducted in the Amin Bazar LFS, as per prepared DPP.

3.10.8 Illegal Dumping

Although considerable efforts have been made by the WMD for closing illegal dumping sites, 18 sites remain in DNCC as of 2018[10]. The smallest and the largest sizes of the illegal dumping sites are 29.2 m^2 and 6,172 m^2, respectively.

3.11 Medical Waste Treatment

3.11.1 Categories of Medical Waste

In-house medical waste management, i.e., segregation at source according to the color codes, internal transport, and storage, is the responsibility of respective government hospitals, private hospitals, and clinics. However, medical waste collection and transport from the medical facilities is the responsibility of CC or municipality (Pourashava). PRISM Bangladesh Foundation (PRISM) has been working on behalf of DNCC since 2005 to collect medical waste from all government and private health care establishments (HCEs).

PRISM executes intermediate treatment to the collected medical waste at medical waste treatment plants allocated by DNCC. The overall program activities are monitored by the DNCC medical waste management committee (WMC). Environmental compliance at the treatment plants is regulated by DoE. An Environmental Clearance Certificate (ECC) is issued by DoE and is renewed every year.

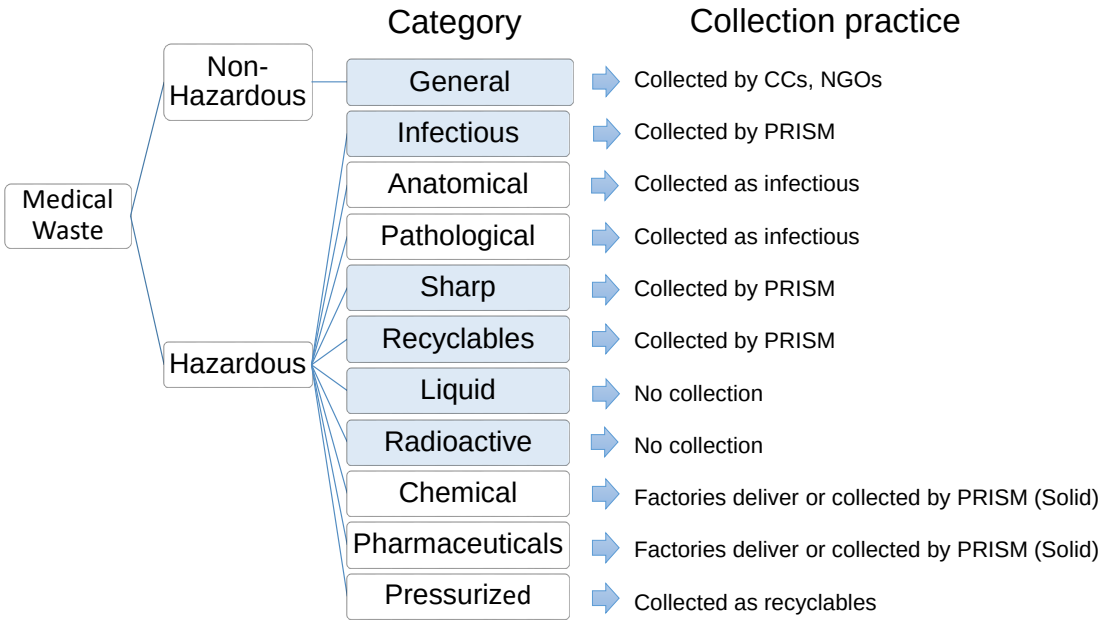
Medical Waste (Management and Processing) Rules defines the type of waste as shown in Fig. 3-27. In practice, general waste generated in the HCEs are collected by DNCC or designated NGOs by DNCC. Anatomical and pathological wastes are collected as a part of infectious waste without specific segregation because the treatment methods are almost same. Sharp waste and recyclables are collected separately, and some of pressurized waste are partially collected as recyclables.

Chemical and pharmaceutical waste are mostly generated in the pharmaceutical factories and they deliver these waste to PRISM only a few times a year. PRISM collect these sometimes upon request

[10] Source: JICA Project Team, Illegal dumping site survey (2018)

but not on regular basis. PRISM receives only solid form of chemical or pharmaceutical waste owing to the available treatment facility.

There are mostly no separated bins available for liquid and radioactive waste, no collection in place. Liquid waste is mostly discharged to drain or sewerage directly, and radioactive waste is not properly collected or mostly discharged as general waste. As a situation on the ground, infectious, sharp and recyclables are collected in separate bins and treated.



Source: JICA Project Team, "Survey Report on Medical Waste Management in Dhaka South and North City (2018)"

Fig. 3-27 Category of Medical Waste and Collection Practice

DNCC has 806 HCEs including hospitals, clinics, dental clinics, and laboratories with 13,965 inpatients and 65,461 outpatients. Currently, only six color codes are used to separate waste generated in categories of general, infectious, sharp, recyclables, liquid, and radioactive. Table 3-25 shows the categories of medical waste and the responsible organizations. The general waste, including non-infectious waste, is collected by DNCC or NGOs, the liquid waste is discharged into drains and sewerage system by the HCEs, and radioactive waste is managed under the jurisdiction of Bangladesh Atomic Energy Commission without proper collection in place; hence, only infectious, sharp, and recyclable waste are discussed in this section.

Table 3-25 Categories of Medical Waste and Responsible Organizations

Color Code	Category of Waste	Responsible Organization	Present Situation
Black	General	CC/Pourashava	CC/Pourashava
Yellow	Infectious	CC/Pourashava	PRISM on behalf of CC
Red	Sharp	CC/Pourashava	PRISM on behalf of CC
Green	Recyclable	CC/Pourashava	PRISM on behalf of CC
Blue*	Liquid	Hospital Effluent Treatment Plan (ETP)	No Treatment
Silver*	Radioactive	Bangladesh Atomic Energy Commission	Bangladesh Atomic Energy Commission

* No data is available for liquid and radioactive waste.
Source: JICA Project Team, "Survey Report on Medical Waste Management in Dhaka South and North City (2018)"

3.11.2 Medical Waste Generation

The medical waste generated in DNCC in 2018 was about 6.1 ton/day, whereas around 3,362 ton/year generated in HCEs in total of both city corporation. Table 3-26 shows the daily medical waste generated from 2013 to 2018.

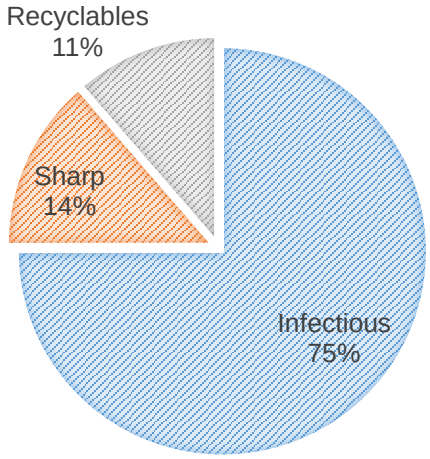
Table 3-26 Daily Medical Waste Generated in DNCC from 2013 to 2018

Year	Infectious (kg)	Sharp (kg)	Recyclables (kg)	Total (kg)
2018	4,567	834	689	6,090
2017	3,941	594	541	5,076
2016	3,658	610	494	4,761
2015	3,517	560	484	4,562
2014	2,963	513	439	3,915
2013	2,130	354	308	2,792

Source: JICA Project Team, "Survey Report on Medical Waste Management in Dhaka South and North City (2018)"

3.11.3 Medical Waste Composition

Fig. 3-28 shows the medical waste composition in DNCC based on a composition study conducted in 2018. Of the medical waste, 75% was infectious, at 4,504 kg/day; 14% was sharp, at 822 kg/day; and 11% was recyclable, at 690 kg/day.

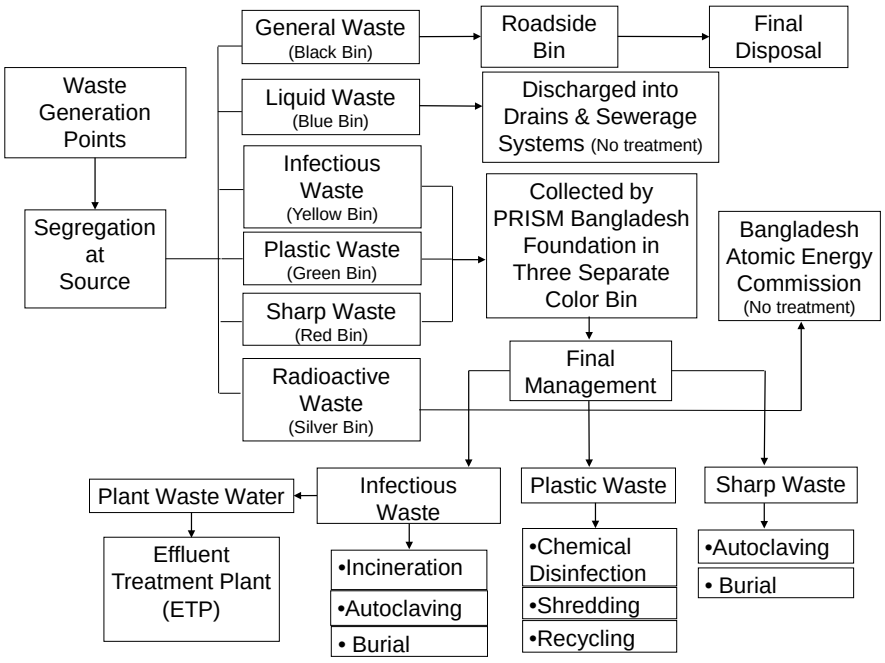


Source: JICA Project Team, "Survey Report on Medical Waste Management in Dhaka South and North City (2018)"

Fig. 3-28 Medical Waste Composition in DNCC

3.11.4 Medical Waste Flow

Fig. 3-29 shows a waste flow diagram of medical waste in DNCC. Different treatment methods are selected or combined depending on characteristics of the waste.



Source: JICA Project Team, "Survey Report on Medical Waste Management in Dhaka South and North City (2018)"

Fig. 3-29 Medical Waste Flow

3.11.5 Treatment Process

(1) Waste Discharge

Medical waste is categorized into six categories and disposed into corresponding colored bins. General waste, liquid waste, and infectious waste go in black, blue, and yellow bins, respectively. Plastics (recyclables), sharp and radioactive waste go in green, red, and silver bins, respectively.

(2) Collection and Transport

1) Collection Frequency

In general, medical waste is collected once per day for hygienic reasons. PRISM has collected medical waste from HCEs on a daily basis. However, these HCEs are very small and generate small quantities of waste infrequently. On the contrary, large HCEs generate huge quantities of medical waste, and thus PRISM collects the waste there sometimes twice per day.

2) Type and Number of collection vehicle

PRISM collects medical waste by using eight vehicles with special specifications, each of which has a fixed route for collection.

Table 3-27 Collection Equipment of PRISM

Name of equipment	Specification	No. of equipment units	Remarks
Collection truck	3-ton capacity	5	Covered van
Collection truck	1.5-ton capacity	3	Covered van
Total		**8**	-

Source: Survey Report on Medical Waste Management in Dhaka South and North City (2018)

3) Loading Method

According to the manual, medical waste is separated at source, contained into bins, and loaded to the collection vehicles.

4) Collection Fee

PRISM collects a service charge from HCEs on a monthly basis for the collection, transport, and final treatment or final disposal; however, the collection fee is not clarified because it is combined with other fees. The service charge varies according to the HCE's size or number of beds.

(3) Intermediate Treatment

Table 3-28 shows the type of treatment method, process, and available facilities in PRISM, according to the waste category. Some of the waste require additional segregation prior to treatment, and

sometimes different treatment methods are combined depending on the characteristics of the waste. All treatment facilities in the table are located in the Matuail LFS of DSCC.

Table 3-28 Treatment Method and Process of Medical Waste

Method	Category of Waste	Capacity and Year of Purchase	After Treatment
Autoclaving	Infectious with high moisture content	2,500 L × 1 (2012) 1,500 L × 1 (2006)	Landfilling in the special cell
Incineration	Infectious without moisture or low moisture	135 kg/h × 2 (2007, 2018) 60 kg/h × 1 (2006)	Landfilling in the special cell
Chemical disinfection	Recyclables	Tank 1 m^3 ×3 (2004)	Shedding
Effluent treatment *	Generated waste water	2,000 L/h ×1 (2013)	Discharge into drains
Shredding	Recyclables	1 (2019)	Sale to manufacturer
Deep Burial	Infectious, sharp	12 pits	-

*Effluent treatment is applied only for waste water generated from the autoclaving and chemical disinfection process, not for liquid waste..

Source: Survey Report on Medical Waste Management in Dhaka South and North City (2018)

1) Autoclaving

Infectious waste is disinfected by autoclaving at 135–140 °C and 3 bars atmospheric pressure for 45 min, following the method recommended by the World Health Organization (WHO). Then, the treated waste is dumped directly into the special cell for medical waste with 2–3 inches of soil cover and is decomposed for at least six months. In some cases, infected recyclable waste is also disinfected through the autoclaving process.

2) Incineration

Infectious waste containing less than 33% moisture as well as expired medicine is incinerated by using a double-chamber pyrolytic incinerator. This incinerator uses fossil fuels to maintain a temperature range of 800–1250 °C. Operational guidelines are strictly followed to minimize dioxin gas within the limit of Bangladesh emissions standards. The residue is finally kept in a concrete pit.

3) Chemical Disinfection

Recyclable waste as plastics, glass, and metals are disinfected in a three-chambered tank with chlorinated water. Recyclable waste is sunk into the first chamber with 50–250 ppm chlorine water for about 30-45 min and then in the second chamber with 20–50 ppm chlorine water for 15–20 min. The materials are next transferred to the third chamber for rinsing with fresh water. If the materials are closed tubes or containers, they should be cut into small pieces so that all surfaces can be disinfected. The disinfected materials are then categorized into different types according to their materials.

4) Deep Burial

Some of infectious waste and sharp waste are kept in concrete pits that are completely closed. In addition, bleaching powder is used as a disinfectant for additional safety measures. Amputated body parts and other recommended waste are also managed by using this process. When the tank or pit is completely filled, it is then permanently sealed.

(4) Final Disposal and Recycling

Medical waste after successful autoclaving and ash or residue application after the incineration process is buried in a deep hole and is disposed of in the LFS after being covered with soil to aid decomposition.

The recyclables are segregated according to the category of raw materials after chemical disinfection. Some recyclables are shredded to create chips for use in molding machines to prepare final products; others are sold to manufacturers.

3.11.6 Financial Information

(1) Fee collection

The treatment fees are not particularly specified in the monthly service charge because they are fixed by the management committee. The approved monthly service charge list is shown in Table 3-29.

Table 3-29 Approved Monthly Service Charge

Unit: thousand BDT

Beds of HCE	Service Charge excluding VAT & Tax	VAT 15%	Income Tax 1.5%	Total Service Charge including VAT & Tax
1–20	1,200	180	18	1,398
21–50	2,400	360	36	2,796
51–100	5,400	810	81	6,291
101–200	7,200	1,080	108	8,388
201–250	14,400	2,160	216	16,776
251–350	18,000	2,700	270	20,970
351–500	36,000	5,400	540	41,940
501–750	42,000	6,300	630	48,930
751+	48,000	7,200	720	55,920
Diagnostic Center				
A Category	14,400	2,160	216	16,776
B Category	6,000	900	90	6,990
C Category	3,600	540	54	4,194
D Category	2,400	360	36	2,796
E Category	1,200	180	18	1,398

Source: Survey Report on Medical Waste Management in Dhaka South and North Cities (2018)

(2) Income and Expenditures

Operation of medical waste treatment is financed by the service charges for HCEs. Table 3-30 shows the income and the expenditures from 2014 to 2018. As the amount of waste increase, income and expenditures also increase. According to the data of the past five years, the expenditures exceeded the income for four of the five years.

Table 3-30 Medical Waste Income and Expenditures from 2014 to 2018

Unit: thousand BDT

Year	2014	2015	2016	2017	2018
1. Income					
Income	8,841	13,622	13,961	18,941	22,450
2. Expenditure					
Collection	4,735	6,828	7,266	9,317	11,143
Treatment	1,990	2,950	2,914	4,060	4,761
Disposal	2,868	4,698	4,601	5,339	7,596
Total	9,593	14,476	14,781	18,716	23,500

Source: Survey Report on Medical Waste Management in Dhaka South and North City (2018)

3.12 Current Issues

Through the long-term support of the JICA on SWM using the program approach, establishment of the WMD and proper collection, transport, and disposal of waste were organized during the last 15 years. Accordingly, DNCC needs to shift from simply removing the waste in the city to a higher-level SWM including intermediate treatment such as recycling and incineration. One of the urgent issues is lack of land for LFS in DNCC; WtE can serve as an effective solution.

3.12.1 Organization of Solid Waste Management

The WMD still has empty positions with unappointed staff. To reform the organizational structure of the WMD in an integrated and systematic manner, the planning capacity including coordination, monitoring, and evaluation of the process should be enhanced. In addition, capacity development of management personnel is required to encourage ward-wise and zone-wise management in building on the fundamental planning skill, which will reactivate field-level activities. Although the promotion system is stagnant, exchange of human resources among management personnel and field officers may be effective.

3.12.2 Financial Conditions of Solid Waste Management

The budget plan does not reflect the actual conditions; therefore, the budget plan and the actual SWM expenditures are not consistent. Actual SWM expenditures are not managed by category, and the validity of the cost cannot be assessed. The SWM cost is appropriated from the conservancy tax, although the amount of income is not sufficient for covering all of the WMD's expenditures. Considering the large-scale investment and operation of new intermediate treatment facilities, new income sources must be found.

3.12.3 Public Relations and Public Awareness

(1) Organizational Structure for Public Relations and Public Awareness Raising

The position of assistant CWMO (Community), in charge of community relations outlined in the WMD organogram, has been vacant for a long time. In addition, no personnel has officially been assigned to work with the PRD. This situation makes it difficult for the WMD to effectively and strategically promote public relations and awareness activities.

(2) Public Relations and Awareness Strategy of Waste Management Department

PR activities for waste management are conducted occasionally by the WMD and its staff without an officially established strategy for public relations and awareness. To consolidate and link together all such activities targeting toward a vision and objectives stated in this Master Plan for more effective involvement of citizens and stakeholders, it is essential to develop an officially recognized strategy and system of public relations and awareness raising.

(3) Information Disclosure

An information disclosure and sharing system should be systematically installed for transparency and accountability and as a communication tool. The Right-to-Information (RTI) Act 2009 has been issued in Bangladesh and a number of initiatives toward this act have been taken. Providing necessary information to people in a timely manner enhances their continuous engagement for SWM. Stakeholder's response to the information provided also helps the WMD to discuss further waste management planning.

3.12.4 Ward-based Approach

(1) Waste Management Department and Conservancy Inspector's Mindset as Official Work

After the previous JICA project, WBA activities have been slowed down owing to lack of support from the headquarters. WBA drives field-level activities that cover the entire DNCC jurisdiction under the WMD and is a key tactic for boosting the community participatory SWM for Dhaka's clean environment as well as the CI's work efficiency. The WBA activities are outlined as an official work of DNCC by office order. The headquarters, WMD, CI and every field officer should strongly recognize of the importance of WBA activities, and the community participation should be greater enhanced by the CI's proactive management.

(2) Planning Skills and Community Budget Disbursement

The community budget for first-aid kits and safety gear on WBA 2 and for community meetings on WBA 3 has not been properly allocated to the wards. Such budget requests and disbursement processes for WBA activities should be properly recognized and practiced. Most CIs have strong implementation skills at the field level, but have little planning skills. This is also observed in the entire conservancy division and prevents a community budget to be acquired for WBA-related activities. To enhance the planning skill of the WBA, SWM administrative procedures and the DNCC's chain of command should be clarified.

(3) Conformity with Rules and Orders

Ward offices should be operated in compliance with rules, regulations, and orders in a systematic manner. In addition, the Admin Book, which includes all administrative processes necessary for SWM operation in DNCC, should be prepared by discussion with CIs and DNCC officers to facilitate understanding by the internal stakeholders for proper implementation.

(4) Data Collection and Practical Use

Despite daily and occasional reporting from the CIs to the ACWMOs at the field level, these data have not been fully utilized for SWM improvement. Operation and management based on these acquired data are fundamental for improving the current situation by analyzing data and implementing measures where Research, Development and Planning Wing of WMD should facilitate.

3.12.5 Waste Reduction

Promotion of waste reduction is not active in DNCC. Instead of CCs, waste pickers collect recyclables at the waste collection point and at Amin Bazar LFS. In addition, the primary waste collectors, who deliver waste from houses to collection points, also collect recyclables during their work.

Many waste pickers in DNCC collect recyclables to earn their livings. Therefore, introduction of source segregation for promoting recycling may destroy their livelihoods. In general, the number of waste pickers is expected to decrease as the economy grows. However, co-existence and co-prosperity system with waste pickers still needs to be considered.

3.12.6 Collection and Transport

(1) Issues of Primary Collection

DNCC is attempting to improve the PCSP's service through capacity building and empowerment activities such as a registration system, training, stakeholder dialogue, and other programs. Despite this effort, many issues remain in association with the DNCC's primary collection service management. However, such issues are not common to all wards or areas, and the severity of the issues differs among the wards. Typical categories these issues are given below.

(i) Organizational
- Lack of coordination among community, PCSP, DNCC, and private companies
- Very limited motivational or capacity building efforts
- Ownership of the PCSP and control of the coverage area conflicts between PCSPs in some cases

(ii) Financial
- The actual service charge is not fixed by DNCC.
- The salaries of rickshaw van pullers and helpers are limited.
- Maintenance cost is sometimes borne by drivers rather than PCSP owners.

(iii) Occupational health and safety
- Insufficient or no safety gear
- Lack of safe working environment and prevalence of injuries
- Limited or no uniforms or personal protective clothing
- Almost no health care such as vaccinations or primary treatment

(iv) Political/local power
- Pressure by local leaders to take control in some cases
- PCSPs may likely to lose business or ownership or coverage areas with the change of political power.

(v) Legislation

- Lack of specific policy documents for primary collection service standards
- Lack of specific policy documents for controlling, supporting, or managing PCSPs

(vi) Technical/logistics

- No standards for waste collection or handling practices
- Equipment is not standardized or certified.
- Weak harmonization of primary and secondary collections in STSs, compactor stations, and containers to shift waste from primary collection rickshaw vans to secondary collection facilities

(vii) Social

- Scavenging in and near containers or other SCPs
- PCSPs go up and down stairs in building floors to collect waste in some cases.
- PCSP is not perceived as a noble job in some cases.
- Buildings do not have storage facilities downstairs or drums in some cases.
- Some low-income communities pay lower collection fees; therefore, the waste often remains uncollected or is not served by PCSPs.
- Open dumping and existence of dustbins reduce the PCSP demand.

(2) Issues of Secondary Collection

(i) Short term

- An adequate amount of manpower should be appointed for proper handling of the waste collection system.
- Improvement is needed in coordination among the different divisions of DNCC related to the waste collection system.
- WMD facilities are needed for repairs and regular maintenance of spare parts, tires, and tubes for their vehicles.
- Minimization is needed for the long queue when purchasing spare parts and other regular important servicing items.
- Drivers need adequate training facilities.
- Training needed for maintaining new vehicles.
- Unauthorized people should not be allowed to drive waste collection vehicles of DNCC.
- Safety of the drivers as well as the helpers, and waste collectors should be ensured.
- Safety gear should be provided to waste collectors on a regular basis.
- Overweight waste should not be carried by any vehicles.
- Road safety of the transported vehicles should be ensured.
- Safe transport of waste on the road requires proper covering of the waste and monitoring.

(ii) Long term

- The budget allocation for repair and maintenance of vehicles should be increased.
- The regular and special repair of compactors or hydraulic parts of dump trucks should be conducted on a regular basis.
- Emergency repair/maintenance facilities of the waste collection vehicles should be available.
- Job satisfaction of waste collection drivers should be ensured through allocation of funding and facilities.
- Health risks to drivers, helpers, and cleaners working with secondary collection vehicles should be recognized.
- An adequate number of mechanics for the WMD should be ensured.
- Efficient vehicles should be allowed for the waste collection system.
- Road conditions should be improved for maintaining the vehicles.

(3) Issues of Privatization of Waste Collection

- In the initial stage of privatization in 2013, three private collection companies out of four were declined their contract due to poor performance pointed out by the evaluation result of DNCC.
- Contact type of tipping fee (unit cost contract per ton) and short-term contract (annual renewal of contract) prevents long-term business plan including procurement of waste collection vehicles.

3.12.7 Waste Collection Vehicle Maintenance

(1) Unintegrated Management System

The WMD, ED, and TD are separately responsible for the management of workshops and for operating and maintaining waste collection vehicles. Procurement of collection vehicles and equipment is not organized well among the related departments. Possession of vehicles and equipment, the procurement process, and O&M should be integrated and managed in the same department to increase the efficiency of SWM.

(2) Unclear Institutional Process

The rules and regulations for workshops such as work rules, safety and sanitary standards, budget approval process, and reporting format are not organized. The inventory of spare parts is managed by handwriting, which should be computerized. To introduce a preventive maintenance system, a standard for repair/replacement of parts is required.

3.12.8 Landfill

(1) Main Issues

As of June 2017, the following issues have been confirmed.

(i) Waste is being disposed of outside of Amin Bazar LFS.
(ii) Site staff members except for operators of heavy equipment and the weighbridge do not work properly.
(iii) An operation road and dumping platform to dispose of waste have not been constructed yet which makes proper waste dumping difficult.
(iv) The leachate treatment facility is malfunctional because it is filled up with dumped waste.
(v) Leachate has not been collected or treated at the treatment facility, resulting in uncontrolled leachate seepage everywhere.
(vi) Leachate is also leaking from the broken embankment of the east side.
(vii) Because the perimeter road on the embankment of the south and east sides is damaged, waste collection vehicles cannot pass through for proper waste dumping.
(viii) The expected lifespan of the LFS is only a few years.

In addition to the above issues, the following problems have been confirmed.

(2) Vehicle Management

1) Vehicle Control

Owing to lack of site staff, some vehicles do not go through the weighbridge. Therefore, it is very likely that the waste amount data is not precise.

2) Weighbridge Operation

The weighbridge is sensitive equipment, and is sometimes broken down, causing non-accurate weighbridge data.

(3) Disposal Management

1) Guide Vehicle

The dumping instructors and platform instructors are not permanent staff members of the WMD.

2) Waste Spreading and Compaction

Waste pickers sometimes cause problems in the operation because they surround the heavy equipment in order to collect recyclable waste. To ensure efficient operation of the equipment and the safety of

the waste pickers, they must be instructed to not gather around heavy equipment that spreads and compacts waste.

(4) Landfill Facility Management

1) Landfill Area

Because no leachate collection or gas vent pipe is present, the leachate is not being treated properly, and landfill gas is being spread out around the site.

2) Leachate Treatment Facility

It is necessary to conduct leachate quality testing. The leachate is not being treated properly because the treatment facility is not in use owing to the following reasons.

(i) Lack of efficient manpower
(ii) Lack of coordination between project authority and the WMD
(iii) Inefficient leachate collection system
(iv) Malfunctional aeration system owing to inadequate manpower for operation

(5) Safety Management

Safety management in the Amin Bazar LFS is quite poor. A list of issues for safety management is given below.

(i) Safety training is not conducted for all site staff members.
In order to prevent accident at the site, it is highly important to conduct safety training for all site staffs. However, it is quite difficult to hold the regular training sessions under the current situation.
(ii) Site staff members are not wearing sufficient personal protective equipment (PPE).
In order to prevent injuries to all staff members working at the site, PPE such as helmets, safety gloves, and safety shoes are important. However, some site staff members are not wearing sufficient PPE.
(iii) Waste pickers are not wearing sufficient PPE.
Waste pickers are wearing only safety boots, which is insufficient protection.

(6) Environmental Management

Environmental monitoring of water quality, landfill gas, and air quality are not conducted at Amin Bazar LFS. In addition, waste is not covered by soil. In order to protect the environment and to maintain site sanitation, these problems must be resolved.

(7) Deployment of Staff

Although the number of staff members proposed for Amin Bazar LFS is 84, only 22 actually work at the site. Owing to such staff member shortage, especially operation staff, the site conditions became worsen.

3.12.9 Medical Waste Treatment

(1) Institution

Currently, medical waste management is not recognized as priority issues in the government or public. Supervision of DoE on medical waste management is limited and also there is no specific section designated from the CCs. Institutional set up needs to be considered for the CCs to actively handle medical waste management instead of PRISM; otherwise, at least regular inspection is necessary.

(2) Proper Segregation

Out of 11 categories of medical waste in the rule, only six have separate bins. At the moment, liquid and radioactive waste are neither collected nor treated. PRISM collects only three categories of waste which the treatment facilities are available. In order to treat liquid waste and radioactive waste properly, special facilities and transport equipment needs to be procured, and segregation needs to be instructed to the staffs in HCEs. Pharmaceutical and chemical waste also needs to be separately collected based on the rule. Liquid form of such waste needs different means of transport and treatment facility. To minimize the risk of infection and accident, further segregation conducted in PRISM before treatment needs to be stopped, and proper segregation at source needs to be enhanced.

(3) Improvement of Facilities

Some of the equipment installed in the PRISM plant are operating for more than 10 years and became old. Facilities need to be renewed and upgraded in order to process medical waste properly since it has been increasing year by year. Preferably, autoclave can be replaced with incinerator to reduce the volume of waste in more hygienic way. As mentioned above, available facilities at present cannot cover all types of medical waste. Suitable treatment facilities need to be procured.

(4) DNCC's Medical Waste Treatment Facility

Currently, the waste is collected throughout Dhaka City and is treated only in facilities of Matuail LFS in DSCC. Considering the jurisdiction of DNCC and DSCC and efficient waste collection, another similar facility needs to be established in the DNCC area.

CHAPTER 4 FRAMEWORK OF MASTER PLAN

4.1 Vision of the Master Plan

Vision is an ideal state showing the optimal long-term direction for DNCC. The new Clean Dhaka Master Plan was designed for the next 15 years on the basis of the vision, envisaged for the next 30 years.

VISION:

Environmentally Advanced City with Integrated and Sustainable Solid Waste Management: toward Zero-Waste

Environmentally Advanced City

As a capital city of Bangladesh, DNCC has been undertaking ambitious efforts to address the challenges of waste management and material cycling. However, the DNCC acknowledges that environmental countermeasures are still insufficient, and the health and quality of life of citizens may be adversely affected. Therefore, the DNCC shall take an initiative to meet the global standards of solid waste management by introducing advanced technology, and to protect the health and sanitary environment for the residents.

Integrated and Sustainable Solid Waste Management

The current rapid economic growth and overflow of population has caused SWM to increasingly complicated and diverse. Each process of SWM such as waste generation, collection and transport, intermediate treatment, and final disposal should be planned and implemented in a balanced and integrated manner, in consideration of economic, social, and environmental impacts to sustain the system. The WBA is a consolidated method for managing cross-field activities. The DNCC shall strive to enhance the level of governance, including institutional and financial capacities, as a basis for integrated and sustainable SWM.

Zero-Waste

Zero-Waste is a slogan for promoting Reduce, Reuse, and Recycle (3R). Public awareness will be strengthened to encourage community participation and Public Private Partnership. DNCC shall work on establishing an effective intermediate treatment system such as Eco-Town, an intermediate

treatment zone with various provisions of treatment facilities (WtE, biogas, composting, recycling etc.), as an iconic symbol of Zero-Waste.

4.2 Goals

Goals were set to realize the vision. Three goals of the Master Plan are given below.

(i) Environmental impact caused by waste is mitigated with environmentally advanced technology.
(ii) Integrated and sustainable SWM system in a megacity is established.
(iii) Participatory SWM is promoted with a slogan of "Zero-Waste."

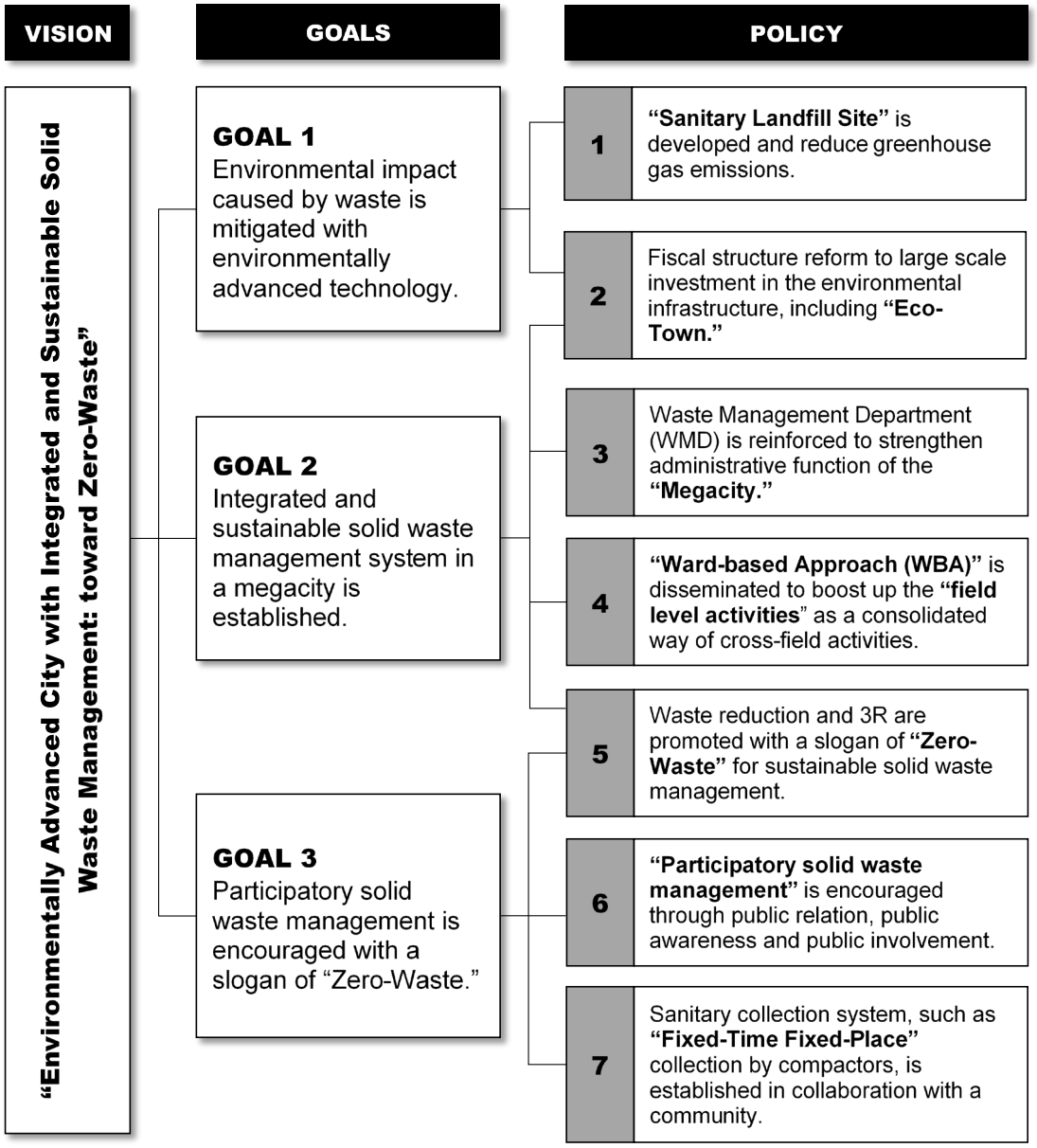
4.3 Policy and Target

4.3.1 Policy

The Master Plan has seven policies for fulfilling the goals.

(i) A **"Sanitary Landfill Site"** is constructed to reduce GHG emissions.
(ii) Fiscal structure reform to large scale investment is provided in the environmental infrastructure, including **"Eco-Town."**
(iii) The WMD is reinforced to strengthen the administrative function of the **"Megacity."**
(iv) **The Ward-based approach** is disseminated to boost the **"Field-level activities"** for consolidating cross-field activities.
(v) Waste reduction and 3R are promoted with a slogan of **"Zero-Waste"** for sustainable SWM.
(vi) **"Participatory solid waste management"** is encouraged through public relation, public awareness, and public involvement.
(vii) A sanitary collection system, such as **"Fixed-time and Fixed-place"** collection by compactors, is established in collaboration with the community.

The framework of this Master Plan is structured as shown in Fig. 4-1, with illustrating a relationship between the abovementioned vision, goals, and policies.



Eco-Town: an intermediate treatment zone with various provisions of treatment facilities (WtE, biogas, composting, recycling etc.)

Fig. 4-1 Framework of the Master Plan

4.3.2 Target

In principle, appropriate solid waste management is accomplished by (i) collecting more waste generated at households with increasing the collection capacity, (ii) reducing waste with introducing waste separation and recycling, and (iii) minimizing the volume of the remaining waste that goes to LFSs with intermediate treatment so that LFSs can be used longer. This Master Plan highlights four indicators, waste collection, waste reduction, recycling, and landfill disposal, to quantitatively monitor the DNCC's achievement in consideration with the framework toward the proper waste management.

The targets toward 2032 are set for each indicator as shown below, based on the population and waste generation projections described in Chapter 5. The indicators require periodic monitoring to assure the progress.

(1) Waste Collection

The DNCC currently collects 80% of solid waste with using all available vehicles. If more efficient collection system and new vehicle introduction is applied, the waste collection rate can increase up to 90% by 2032.

Current situation (2017)	80%	Intermediate target (2025)	83%	Final target (2032)	90%

(2) Waste Reduction

The WBA activities contribute to reducing waste at source, which can make the waste reduction achievable to 12 % by 2032.

Current situation (2017)	0%	Intermediate target (2025)	7%	Final target (2032)	12%

* Waste reduction is the amount of waste reduced at the generation source.

(3) Recycling

Introducing Eco-Town as an intermediate treatment zone can drastically change the recycling business in the DNCC, enough to achieve 44% of waste recycling by 2032.

Current situation (2017)	10%	Intermediate target (2025)	44%	Final target (2032)	44%

*The recycling rate consists of the waste processed through Eco-Town facilities and informal recycling.

(4) Landfill Disposal

Putting together all efforts to diverse and minimize waste by means of the abovementioned activities, the final disposal will be 30 % of the waste generated by 2032.

Current situation (2017)	73%	Intermediate target (2025)	40%	Final target (2032)	43%

4.4 Scenario for Improvement of Solid Waste Management

4.4.1 Scenario Setting

Prior to setting the policies mentioned above, this Master Plan first examined possible long-term SWM scenarios which the DNCC may move forward to the vision and goals. Owing to the limited land availability and high land prices, two fundamental scenarios were given for improvement of SWM, as shown below:

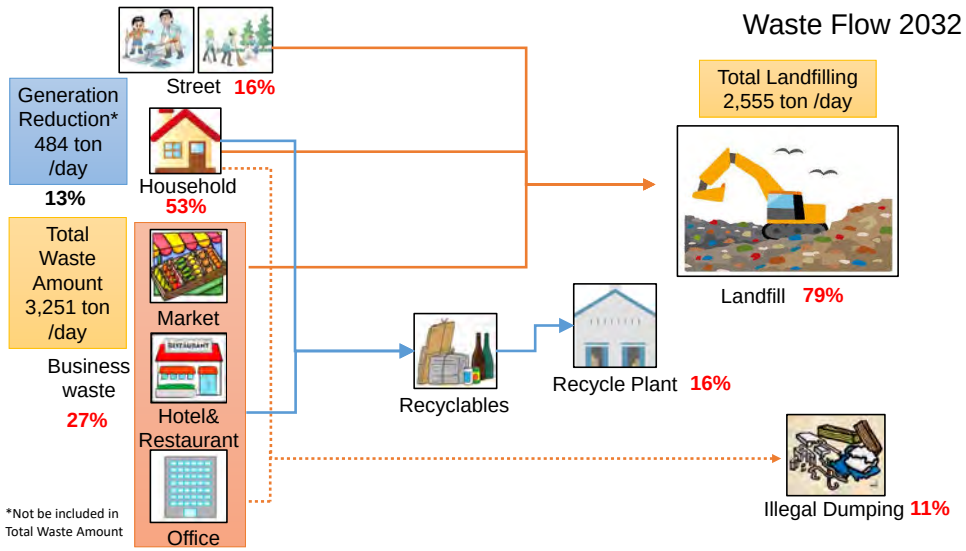
Scenario 1: Keep on building new LFS (LFS Scenario)
Scenario 2: Introduce 3R with intermediate treatment system (Eco-Town Scenario)

These scenarios were compared to determine a long-term direction up to 2032, assuming the same waste generation and reduction at source in both scenarios. Note that medical waste is not included in either scenario because it has to be collected and transported separately from other wastes and incinerated in a designated medical waste incinerator, as a closed system.

4.4.2 Scenario 1: Keep on Building New LFS (LFS Scenario)

(1) Overall Concept

In the LFS Scenario, which is equivalent to a Business-as-usual, all collected waste is received at the DNCC's LFS. A conceptual waste flow of the LFS scenario in 2032 is shown in Fig. 4-2. Recycling activities are done as private companies and waste pickers.

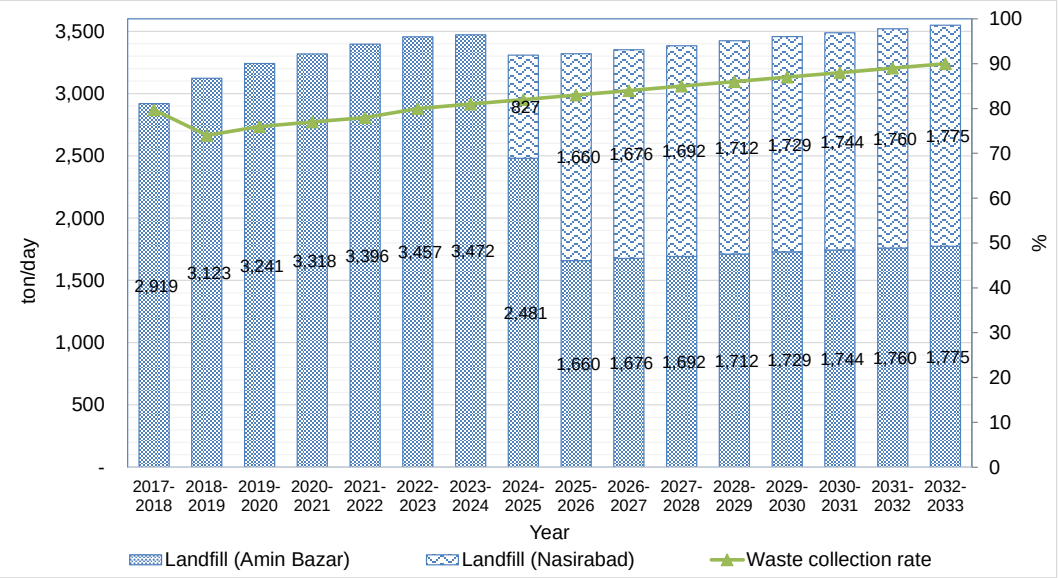


Source: JICA Project Team

Fig. 4-2 Conceptual Waste Flow of the Landfill Site Scenario in 2032

(2) Final Disposal

The estimated amount of final disposal until FY 2032–2033 in the LFS Scenario is shown in Fig. 4-4. Because of no solutions or technologies in place which give significant waste reduction, waste disposal rate becomes high year by year as more waste collection is achieved.

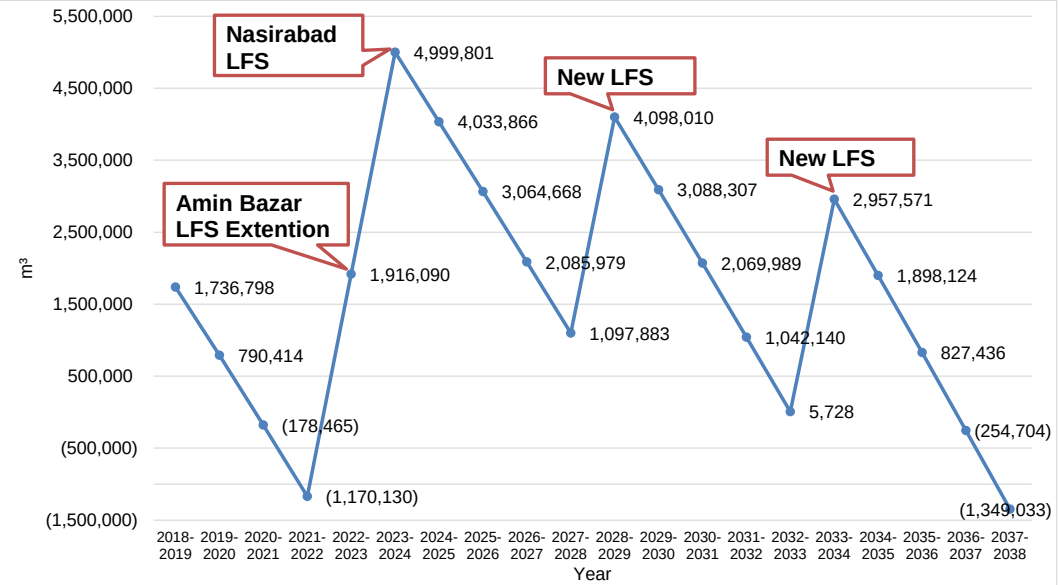


Source: JICA Project Team analysis based on BBS "Population Census 2011," "Population Projection of Bangladesh 2011–2061," "Economic Census 2013," "Waste Amount and Composition Survey Report (2018)"

Fig. 4-3 Estimated Final Disposal at Landfill in the LFS Scenario

(3) Remaining Lifespan and Capacity of the Landfill Sites

Fig. 4-4 describes the remaining landfill capacity in the LFS Scenario. After the construction of Nasiabad LFS, a new LFS construction would be required periodically, e.g. every five years with a new 4,000,000 m^3 site. As previously mentioned, land acquisition in the DNCC area is very challenging; therefore, this scenario seems unrealistic for the future SWM in DNCC, and more dramatic waste reduction is necessary to save the landfill capacity.



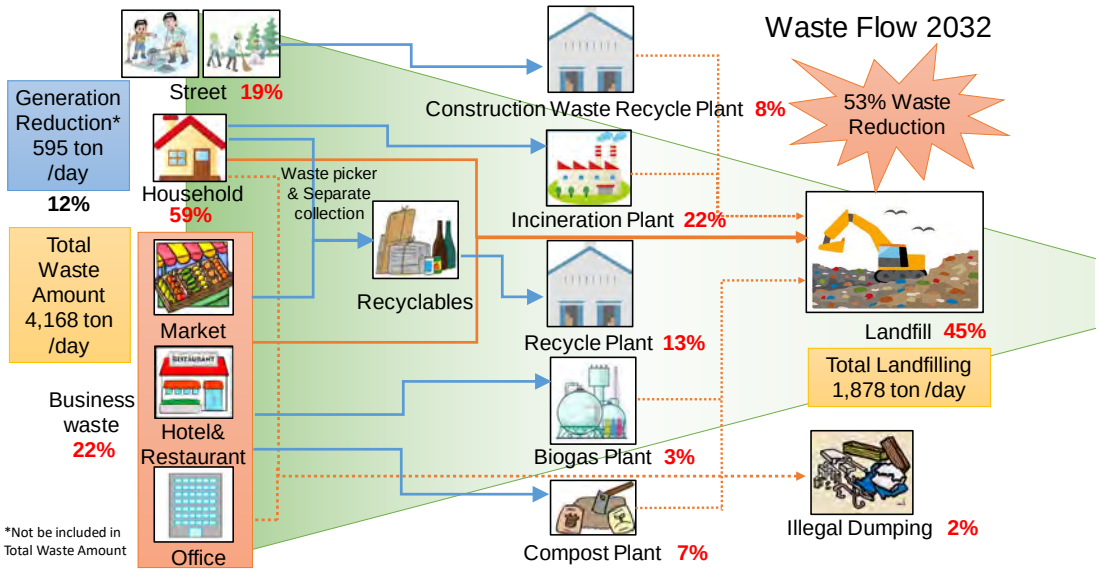
Source: JICA Project Team

Fig. 4-4 Remaining LFS Capacity in the LFS Scenario

4.4.3 Scenario 2: Introduce 3R with Intermediate Treatment System (Eco-Town Scenario)

(1) General Information

Considering lack of land availability in Dhaka, source separation as well as a significant waste reduction through intermediate treatment is unavoidable to secure final disposal sites. As a most powerful solution to reduce and diversify waste, the 3R concept with WtE is introduced here as the Eco-Town scenario. Fig. 4-5 shows a conceptual waste flow of the Eco-Town Scenario which contains various intermediate treatment options, such as WtE, food waste treatment, recycling, and medical waste treatment. Altogether with these waste reduction menus in assumption with reasonable treatment capabilities, the Eco-Town scenario could achieve 57% of waste reduction by waste recycling and source reduction.



Source: JICA Project Team

Fig. 4-5 Conceptual Waste Flow of the Eco-Town Scenario

The following intermediate treatment methods can be considered in the Eco-Town Scenario.

1) Waste-to-Energy Plant

WtE plant, or incineration plant with electricity production, has significant potential to reduce waste to one tenth of the original volume. It is costly on both the construction and operation and the DNCC does not have any experience on such a high-end technology implementation. Biogas from a biogas plant may be used as supplemental fuel to WtE.

2) Food Waste Treatment

Food waste from restaurants and markets who produce large amount of food waste with less contamination can be treated in a composting plant. The compost is used as organic fertilizers.

3) Recycle Plant

Waste from drainage, road cleaning, and construction sites is sorted and recycled at the recycle plant. After waste sorting, some of organic items such as construction waste, can be used as raw materials or filling materials for the LFS. Sorted recyclables such as paper, bottles, cans, and plastics are sent further to process for recycling.

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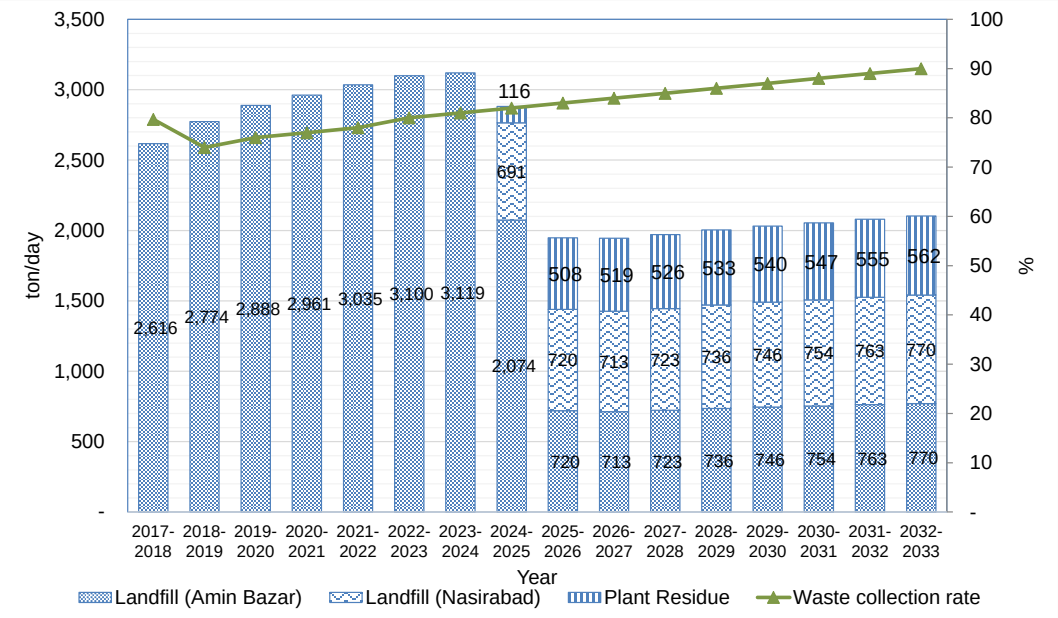
(2) Final Disposal

Fig. 4-6 shows the estimated final waste disposal amount up to FY 2032–2033. If the intermediate treatment system described in Fig. 4-5 is constructed in FY 2024–2025, the volume of waste for waste disposal would drastically decrease to about a half of the collected volume.

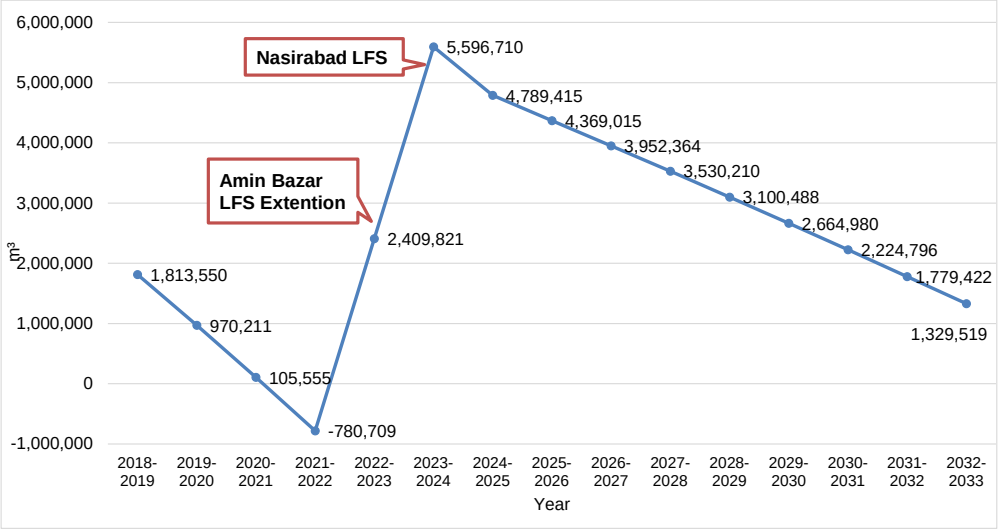


Source: JICA Project Team analysis based on BBS "Population Census 2011," "Population Projection of Bangladesh 2011-2061," "Economic Census 2013," "Waste Amount and Composition Survey Report (2018)"

Fig. 4-6 Estimated Final Disposal at Landfill in the Eco-Town Scenario

(3) Remaining Lifespan and Capacity of Landfill Site

Fig. 4-7 describes the remaining landfill capacity in the Eco-Town Scenario. After the construction of Nasirabad LFS, the Eco-Town scenario could reduce new landfill construction needs owing to significant waste reduction resulting in longer lifespan of the LFSs.



Source: JICA Project Team

Fig. 4-7 Remaining LFS Capacity in the Eco-Town Scenario

4.4.4 Scenario Analysis

Based on the abovementioned characteristics of two scenarios, the comparison between two scenarios are summarized below.

Table 4-1 Summary of Scenario Comparison

	Scenario 1: Keep on building new LFS	Scenario 2: Introduce 3R with intermediate treatment system
Landfill capacity	・ Securing landfill becomes more problematic as waste generation increased year by year.	・ Landfill capacity is saved because WtE plant significantly reduce waste volume.
Cost	・ The construction cost is affordable but construction of landfill is more frequent. ・ Land acquisition is necessary as per new site construction.	・ WtE plant implementation costs very high in general, although depending on the incineration capacity. ・ Operation and maintenance cost have to be newly secured.
Organizational capacity	・ LFS operation and construction is a part of WMD's current work, so no difficulty is observed although the capacity building is still necessary.	・ Organizational setup for intermediate treatment system is necessary. ・ WtE plant construction and operation has never been done in Bangladesh; therefore, WMD and related organization's capacity development is vital.
Social acceptance	・ LFS is not new in DNCC so no difficulties are observed. ・ Involuntary resettlement may be associated with a new site construction more frequently than the Scenario 2.	・ Citizens have little knowledge on WtE plant and other intermediate treatment facilities, so they might become suspicious.
Environmental impact	・ Sanitary LFS with proper wastewater treatment, lining, and soil covering prevents environmental impacts.	・ By-product from incineration such as pollutants may affect surrounding environment if not treated properly.

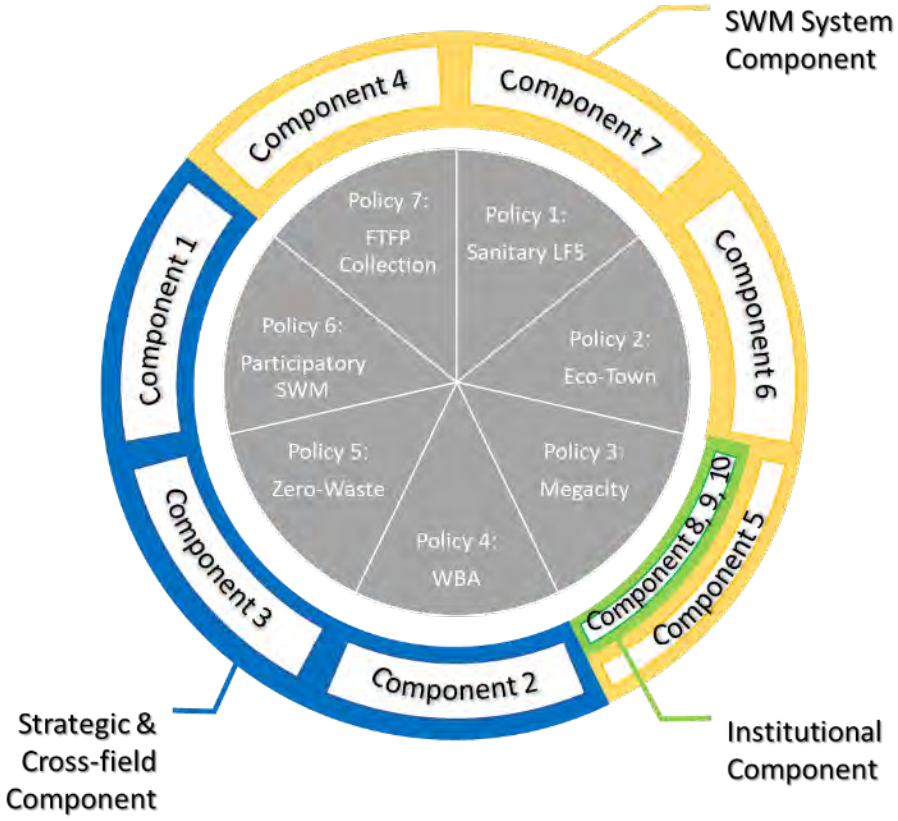
The most considerable issues on the LFS scenario is more LFS construction associated with land acquisition which is very difficult to proceed in Dhaka, and growing population with waste generation. Considering the future sustainability of the DNCC's SWM, the Scenario introducing 3R with an intermediate treatment system (Eco-Town Scenario) is a preferred option in this Master Plan.

4.5 Key Components

There are still many challenges the DNCC faces to move forward. In order to fill gaps between the current WMD's situation and the ideal state which fulfills the vision and goals, the DNCC sets the policies as stated in Section 4.3, and takes off with 10 associated components to accomplish better SWM introducing 3R with an intermediate treatment system and stronger WMD as listed below.

Component 1: Public relations, public awareness, and public involvement
Component 2: WBA activities
Component 3: Waste reduction
Component 4: Waste collection and transport
Component 5: Vehicle maintenance system
Component 6: Intermediate treatment system (Eco-Town: WtE, composting, recycling etc.)
Component 7: Sanitary landfill
Component 8: Rules and regulations
Component 9: Organizational capacity
Component 10: Financial management

The relations between the policies and the components are described in Fig. 4-8. The components, which can be categorized simply into "SWM system," "institutional," and "strategic and cross-field" aspects, are vital to structure the DNCC's business sustainable and solid. Most of the policies correspond to one component, except Policy 3: *the WMD is reinforced to strengthen the administrative function of the "Megacity*, which consists of four components. This Master Plan highlights development of a strong and consolidated institutional foundation correlating various functions of the WMD for sustainability. Each component includes corresponding objectives and strategies, as further detailed in Section 4.6.



Source: JICA Project Team

Fig. 4-8 Policies and Key Components of the Master Plan

4.6 Objectives and Strategy

The Master Plan identifies the objectives and strategies in 10 key components of SWM in DNCC, as summarized in Table 4-2.

Table 4-2 Objectives and Strategies

Objective	Strategy
Component 1: Public relations, public awareness, and public involvement [C1]	
C1-O1. Establish DNCC's capacity to promote public involvement in SWM	- Strengthen the WMD's organizational structure of public relations and awareness raising
C1-O2. Enhance public knowledge and understanding to work together	- Open communication channels with various stakeholders for active involvement and mutual understanding - Promote collaboration among DNCC, universities, and companies to strengthen the country's SWM field
C1-O3. Stimulate public participation for waste management	- Systemize DNCC's public relations and awareness activities - Develop and implement information disclosure and sharing system in WMD
Component 2: WBA activities [C2]	
C2-O1. Improve quality and efficiency of field-level SWM	- Encourage CO/CIs to implement WBA activities through WBA core group meeting and other activities - Develop WBA AAP in each ward for the proper community budget allocation to cooperate with the community
C2-O2. Enhance institutional capacity of the conservancy division	- Hold training sessions and workshops for CO/CI, cleaners, PSCP, the community, and other stakeholders to promote community and stakeholder participatory SWM - Educate cleaners for occupational safety in wards - Organize proper administrative procedure and chain of command in the conservancy division within the WMD
Component 3: Waste reduction [C3]	
C3-O1. Reduce waste amount generated	- Prepare a waste reduction plan - Introduce 3R activities through WBA activities
Component 4: Waste collection and transport [C4]	
C4-O1. Promotion of community participatory waste collection	- FTFP collection by compactor in all residential area by community participatory waste management
C4-O2. Expand the capacity of collection/transport	- Procure waste collection vehicles and equipment - Replace old vehicles with new vehicles - Examine collection and transport operation methods for expansion area - Increase storage capacity of waste containers - Implement capacity development of workers and drivers
C4-O3. Prepare for receiving the GAP vehicles	- Introduce GAP vehicles and the new collection system

Objective	Strategy
	- Increase employment of drivers and workers for the GAP vehicles - Prepare vehicle allocation plan of the GAP vehicles and containers
C4-O4. Unify DNCC's waste collection management system	- Discuss and coordinate among related departments in DNCC for unification - Propose unification to decision makers for official approval
Component 5: Vehicle maintenance system [C5]	
C5-O1. Improve maintenance workshop operation and management and develop the capacity of workers and drivers	- Examine outsourcing of maintenance - Standardize maintenance works - Introduce new maintenance system
Component 6: Intermediate treatment system (Eco-Town: WtE, composting, recycling etc.) [C6]	
C6-O1. Develop Eco-Town (WtE, composting, recycling etc.) for sustainable waste management in Dhaka	- Propose the Eco-Town and obtain approval from related organization - Conduct a feasibility study for Eco-Town - Secure construction and operation cost - Obtain ECC
C6-O2. Establish the intermediate treatment (Eco-Town) section in the WMD	- Examine operation and management strategy and methods of Eco-Town - Establish intermediate treatment (Eco-Town) section in the WMD to implement proper operation and management - Implement capacity development of intermediate treatment (Eco-Town) section and related parties
Component 7: Sanitary landfill [C7]	
C7-O1. Improve Amin Bazar LFS	- Properly dispose of and contain waste inside the LFS - Repair the periphery embankment with access road - Install rainwater drainage, gas ventilation pipes, and leachate collection facilities - Introduce final soil cover on the top - Repair the leachate pond - Continue to prepare dumping platforms and operation roads - Compact a waste layer and shape its surface in a gentle slope
C7-O2. Conduct safety closure at Amin Bazar LFS	- Prepare safety closure plan - Secure budget for safety closure
C7-O3. Establish a management section in the WMD for Amin Bazar LFS	- Examine operation methods of the site - Establish a management section to improve site operation and management - Implement capacity development of management section and related parties

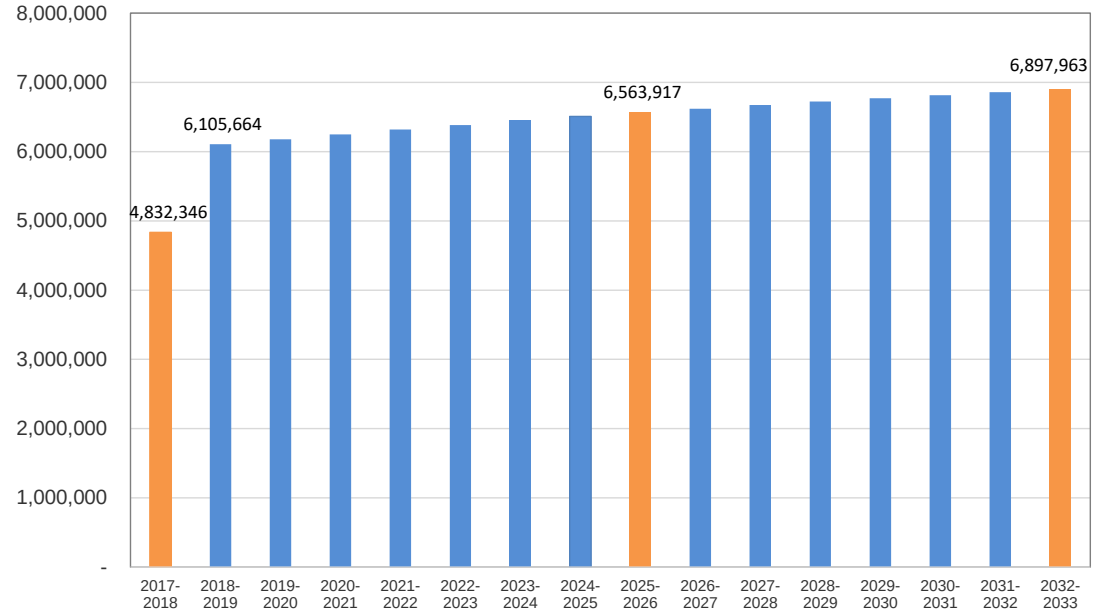
Objective	Strategy
C7-O4. Develop a future LFS	- Prepare DPP and obtain approval from Executive Committee of National Economic Council (ECNEC) - Acquire land by facilitating the necessary legal procedures - Obtain ECC
Component 8: Rules and regulations [C8]	
C8-O1. Conduct daily SWM work in compliance with the administrative procedure book	- Prepare the administrative procedure book in accordance with related laws and regulations - Disseminate the process written in the administrative procedure book in daily SWM practice through training and field work
C8-O2. Enact SWM-related orders and WMD directives	- Develop and issue SWM-related orders and WMD directives in a timely manner to smoothly and efficiently proceed with DNCC activities - Disseminate the orders and WMD directives for CC staff
Component 9: Organizational capacity [C9]	
C9-O1. Strengthen planning, coordination, monitoring, and evaluation capacity of DNCC	- Consolidate organizational functions of planning, coordination, monitoring, and evaluation in the WMD
C9-O2. Cover collection and transport work, collection vehicle operation, and landfill operation work exclusively in the WMD	- Enhance the function of Zone Offices for secondary collection and transport - Conduct study on the procedure for repair of conservancy vehicles and heavy equipment - Reorganize the WMD organizational structure to include sections for collection vehicle management, waste collection, and landfill operation
Component 10: Financial management [C10]	
C10-O1. Reform SWM accounting system for budgeting and cost control	- Introduce a modified accounting system for actual SWM cost - Prepare WMD annual budget report - Introduce financial assessment system
C10-O2. Enhance financial capacity for Master Plan implementation	- Increase revenue by reassessing estate tax system, raising conservancy rate of holding tax, and improving the tax collection rate and user fee collection - Prepare a financial plan to cover the cost for implementation of the Master Plan

CHAPTER 5 MASTER PLAN FOR SOLID WASTE MANAGEMENT IN DHAKA NORTH CITY

5.1 Planning Basis

5.1.1 Population Projection

Fig. 5-1 shows the projected population for 15 years in DNCC. The population is estimated on the basis of the 2011 population census, and its growth rate is applied in accordance with the "Population Projection of Bangladesh 2011–2061" calculated by the Bangladesh Bureau of Statistics (BBS). In 2032, which is the target year of the Master Plan, the total population is estimated to increase to about 6.8 million, including the expansion area.



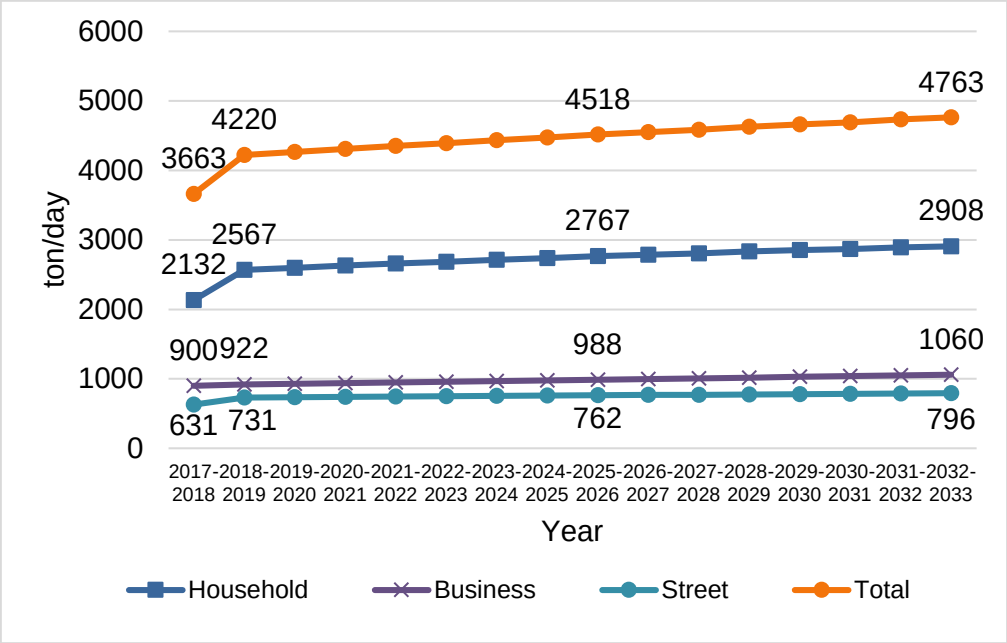
Source: JICA Project Team analysis based on BBS "Population Census 2011," and "Population Projection of Bangladesh 2011–2061"

Fig. 5-1 Population Projection in DNCC (2017–2032)

5.1.2 Solid Waste Generation

Municipal solid waste generation from FY 2017–2018 to FY 2032–2033 was estimated as shown in Fig. 5-2. The waste generation is estimated to increase from 3,663 tons/day to 4,763 tons/day for 15 years, which is calculated on the basis of the unit generation of household waste; business waste

including that from markets, restaurant and hotels, and offices; and street waste mentioned in Section 3.4.1 and the future population mentioned in Section 5.1.1. Business waste and street waste were calculated to increase 1% per year.[11]



Source: JICA Project Team analysis based on BBS "Population Census 2011," "Population Projection of Bangladesh 2011–2061," "Economic Census 2013," and "Waste Amount and Composition Survey Report (2018)"

Fig. 5-2 Estimation of Municipal Solid Waste Generation

5.1.3 Target Waste Collection Rate

The target waste collection rate was set as 90% of waste generation compared with 80% for the current waste collection rate. Table 5-1 shows the annual target waste collection amounts and rates. The waste collection rate dropped in FY 2018–2019 owing to expansion of the service area.

Table 5-1 Target Waste Collection Rate

Year	Total Waste Amount (tons/day)	Total Waste Collection* (tons/day)	Waste Collection Rate (%)
2017–2018	3,663	2,919	80
2018–2019	4,220	3,123	74
2019–2020	4,265	3,241	76
2020–2021	4,309	3,318	77
2021–2022	4,354	3,396	78
2022–2023	4,321	3,457	80

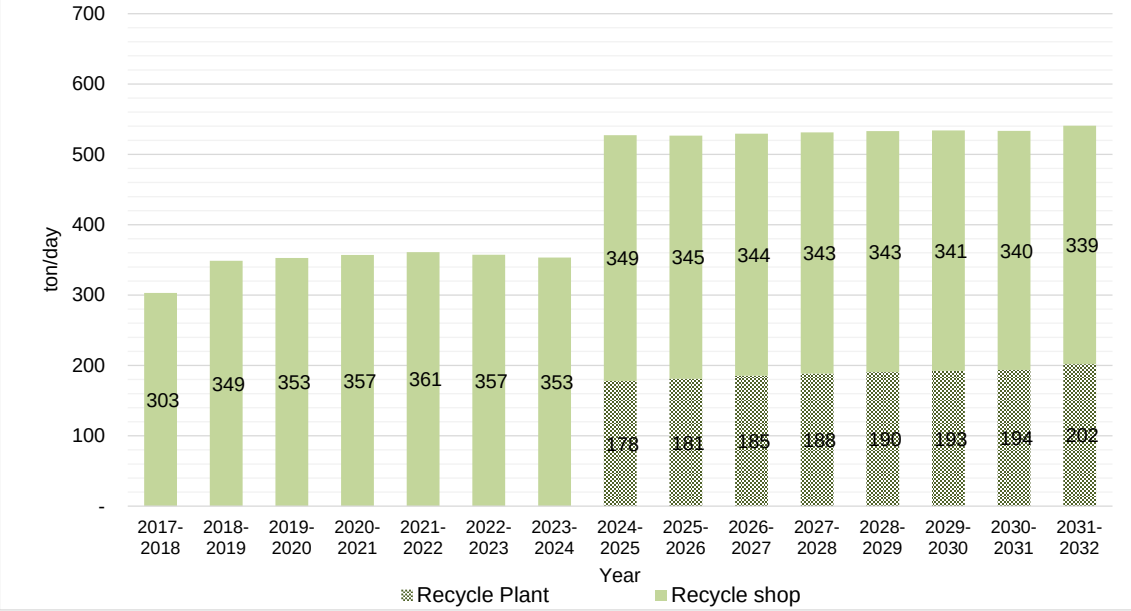
[11] Business waste and street waste is set as increasing 1 % per year, based on the population projection and economic growth rate.

Year	Total Waste Amount (tons/day)	Total Waste Collection* (tons/day)	Waste Collection Rate (%)
2023–2024	4,287	3,472	81
2024–2025	4,251	3,486	82
2025–2026	4,217	3,500	83
2026–2027	4,211	3,537	84
2027–2028	4,203	3,572	85
2028–2029	4,203	3,615	86
2029–2030	4,196	3,650	87
2030–2031	4,183	3,681	88
2031–2032	4,182	3,722	89
2032–2033	4,168	3,751	90

*Total waste collection excludes the amount of generation reduction and informal recycling
Source: JICA Project Team

5.1.4 Estimate of Waste Recycling

On the basis of the recycling survey, the recycling amount was estimated to be 10% of household and business waste, and the amount of recycling was estimated to be 303 tons/day in FY2017–2018. By the year of 2023, when centralized waste recycling will begin at Eco-Town, separate collection of recyclables is expected to begin from markets, hotels, and restaurants. By this term, the recycling amount will increase to 1,982 tons/day in FY2025–2026 and 2,113 tons/day in FY2032–2033.



Source: JICA Project Team

Fig. 5-3 Estimation of Recycling

5.2 Public Relations, Public Awareness, and Public Involvement (Component 1)

5.2.1 Establish DNCC's Capacity to Promote Public Involvement in SWM [C1-O1]

(1) Establishment of Public Awareness Planning Section

Democratic local governance in the field of SWM are enhanced not only by public awareness raising activities but also through public relations, which connects local authorities and citizens. Establishment of Public Awareness Planning Section (PAPS) in WMD is indispensable to strategically build close partnerships and strong connections among DNCC, the community, NGOs, news media, and other governmental entities for socially acceptable SWM; The PRD is in charge of DNCC's overall public relations.

1) Roles and Responsibility

The PAPS intends to take responsibility solely in waste management to plan and implement DNCC's awareness raising activities, to lead in the related information disclosure, to communicate with the news media in coordination with the PRD, and to promote corporate communications, as shown below.

i) Public awareness raising activities
- Outline, supervision, and other support work of WBA activities
- Environmental education and 3R promotion to citizens
- Planning of city-wide awareness activities such as the Clean Dhaka festival, promotion activities, special workshops, etc.
- Public relations and public awareness strategy development, including regional public relations programs

ii) Information disclosure
- Information disclosure and sharing system planning (items, methods, timing workflow, etc.)
- Management of distributing information through various media tools such as press conferences, social media, websites, newspapers, annual reports, stakeholder consultation
- Coordinating key stakeholder group consultation such as Public Consultative Group (PCG) and Solid Waste Management Standing Committee (SWMSC)
- Development of information disclosure policy

iii) Media relations
- Liaising with the news media
- Media monitoring and analysis for proactive public relation strategy
- Providing media training to spokespeople

- Development of media relations policy

iv) Corporate communications

- Coordination with stakeholders across DNCC for public relations and increasing awareness
- Sharing information among DNCC staff
- Liaising with LGD, DNCC, and other CCs for information exchange meetings

2) Staff Allocation and Official Approval

At least one full-time staff member should be allocated for PAPS, and work closely with and lead other WMD staff for the PAPS activities. The official approval of PAPS by DNCC and staff allocation is expected after 2021. Until then, preparation and negotiation for the PAPS setup will continue by DNCC staff who is officially appointed for this purpose. The appointed staff will also begin PAPS work in accordance with the aforementioned roles and responsibility as the pilot phase so that PAPS will smoothly operate immediately after its approval.

(2) Coordination with Public Relations Department

PAPS works closely with the PRD in accordance with the DNCC's PR strategy. The PRD, at the forefront of DNCC public relations, releases an official announcement related to waste management such as a press release and public notice, whereas PAPS plans the contents in coordination with related parties. The PRD also reviews other public relations content and disclosure materials as needed. Table 5-2 summarizes the work relationships of public relations for waste management.

Table 5-2 Work Relationships of Public Relations for Waste Management

Public relation activities in WBD	PRD	PAPS	Ward office
i) Public awareness raising activities – CC level	Support →	Plan & Implement ←	Support
Public awareness raising activities – WBA		Support →	Plan & Implement
ii) Information disclosure	(Review &) Implement ←	Plan	
Official announcement (press release, public notice etc.)	Release ←	Plan & coordinate	
iii) Media relation	(Support &) work as contact point ↔	Plan & implement	
iv) Corporate communication		Plan & Implement	

Source: JICA Project Team

(3) Financial Allocation by Dhaka North City Corporation or Sponsors

Funds for DNCC's public relations and awareness raising activities should be secured and allocated sufficiently in a timely manner. Major items for which financial allocation is necessary from DNCC's annual budget or external financial sources such as donors, private companies, and other organizations are listed below.

(i) PAPS operation: staff salary, office equipment, etc.
(ii) Key stakeholder group consultation: PCG and SWMSC meeting expenses
(iii) SWMSC operation: meeting expenses, etc.
(iv) Public relations activities: public consultation meeting expenses, publishing, advertisement, public relations tools, etc.
(v) Public awareness raising activities: city-wide and regional SWM campaign expenses, etc.

Concurrently, WBA activities are secured within DNCC's annual budget separately from the PAPS budget and are disbursed by each ward through the proper administration process.

5.2.2 Enhance Public Knowledge and Understanding to Work Together [C1-O2]

(1) Public Consultative Group for Solid Waste Management Facilities

The PCG for a SWM facility will be introduced first here to provide multiple channels of communication among the project proponent, operator, DNCC, and community for socially acceptable and sustainable facility operation. PCG meeting results such as discussion minutes should be publicly available for accountability and transparency. The framework of the PCG is summarized below.

(i) Target facility
- SWM facility such as an LFS, intermediate treatment plant such as an incineration plant and recycling facility, transfer station, and other facilities are critical for its operation wherever discussion among stakeholders occurs

(ii) Purpose
- To report the status of the facility operation
- To consult with residents and other group members for improvement of facility operation

(iii) Group members
- WMD CWMO, MoEF, representatives of nearby residents, an SWM facility manager, environmental experts from universities

(iv) Information to be provided from the facility side (examples)

[Planning phase]
- Background of the development

- Conceptual design and schedule
- Environmental and social impact assessment

[Construction phase]

- Construction plan, schedule, and status
- Environmental and social measures to be implemented during construction

[Operation phase]

- Operation status of the facility including environmental and social monitoring data
- Financial information of its operation

(2) Information Exchange Meeting with Other City Corporations

CCs other than the DNCC and DSCC do not have the WMD, and their waste management is operated by the conservancy division or the health department. Their operation has not been well-established, and importance of the waste management service to citizen with proper field-level implementation is not clearly recognized even internally within the CCs. On the other hand, considering the situation in Bangladesh, all CCs must be facing similar issues such as shortage of LFS, and improper waste collection with increasing waste volume.

Proper waste management requires collection vehicle procurement, securing a sufficient landfill capacity, their maintenance, skilled personnel, and more importantly, enormous investment and O&M costs enough to continue the services. It indicates that the organization responsible for waste management should have a strong governance among other departments and organizations within the CC to secure such costs. The DNCC and DSCC have experienced the WMD establishment from the very beginning since 2003, and built a new era of waste management in Bangladesh. Considering the future solid waste management in the country, information exchange among the CCs is worthful to discuss the emerging issues, stimulate each other, and to come up solutions for the better practice.

The LGD will therefore organize a national SWM conference annually to share information and support among 12 CCs and nearby local governments. PAPS will closely support the LGD as a liaison for the meeting preparation, and the WMD will take a leading role in the meetings as a high-level waste management practitioner. The meeting framework is summarized in Table 5-3. Initially as a startup, regional cooperation meetings may be held in Dhaka and surrounding areas including Gazipur, DSCC, and Narayanganj.

Prior to the meeting of the 12 CCs, general information on SWM will be reported by each CC to understand how SWM is being practiced in terms of organizational, financial, and operational aspects. The information is then used as a reference in forthcoming meetings for improvement. It is preferable

that all reported data are consolidated into one data book to be officially published by the LGD and updated periodically, which would make LGD's governance monitoring of the CCs more efficient.

Table 5-3 Information Exchange Meeting for 12 CCs

Host Organization and secretariat	Host organization: LGD Secretariat: DNCC and DSCC
Members	LGD and 12 CCs (BCC, CCC, COCC, DNCC, DSCC, GCC, NCC, KCC, MCC, RCC, RACC, SCC)
Schedule	Annually (The 1st meeting in December 2018)
Venue	LGD meeting room
Topics (example)	- Lessons learned from Clean Dhaka Project - WMD establishment - WBA activities - Waste management technology implementation

Note: BCC: Barisal City Corporation; CCC: Chittagong City Corporation; COCC: Cumilla City Corporation; DNCC: Dhaka North City Corporation; DSCC: Dhaka South City Corporation; GCC: Gazipur City Corporation; NCC: Narayanganj City Corporation; KCC: Khulna City Corporation; MCC: Mymensingh City Corporation; RCC: Rajshahi City Corporation; RACC: Rangpur City Corporation; SCC: Sylhet City Corporation

5.2.3 Stimulate Public Participation for Waste Management [C1-O3]

(1) Planning Framework

The WMD will develop a communication plan as public relations and public awareness strategy based on this Master Plan, which illustrates activity frameworks and comprehensive methodology including the following topics (Table 5-4).

Table 5-4 Planning Framework of Public Relations and Public Awareness

Planning Framework	Remarks
Public Awareness Planning Section (PAPS)	- PR section establishment as part of WMD reform
Mission, vision, and strategies of public relation and awareness raising	- Zero-waste campaign, 3R campaign, etc.
Promotion of community participation and environmental education	- Mass media relations - Marketing and promotions
Risk communication and grievance mechanism	- Responses and procedures to community complaints regarding environmental pollution, etc.
Information disclosure system	- Based on Bangladesh's Right-to-Information Act and incoming bylaws
Public Consultancy Group for SWM facility (including Eco-Town, LFSs, etc.)	- Promoting community participatory facility development and operation
Information exchange meetings	- Coordinated by LGD and subsequently led by DNCC - Initial regional cooperation among DNCC, Gazipur, DSCC, and Narayanganj

Source: JICA Project Team

(1) Public Relations and Awareness Raising Activities

Public awareness raising activities should be implemented in an effective and cost-saving manner mainly through WBA 3 or community-level activities on the ground. PAPS, as a control tower, will outline and supervise community activities implemented ward-by-ward in accordance with PAPS's supervision or WMD's public relations and public awareness strategy. PAPS covers and implements the CC-level awareness activities.

According to the current DNCC practices and future prospects, the following city-wide public awareness activities are implemented during this Master Plan period. PAPS is responsible for securing and allocating funds for these activities.

(i) Public awareness activity and PCSP and cleaner's workshops for Eid-ul-Adha
(ii) Clean Dhaka Campaign/Festival
(iii) Information sharing via the DNCC's website, magazine, and SNS
(iv) Environmental education at schools

(2) Information Disclosure

Information disclosure is needed not only to increase transparency and accountability but also to boost the level of public understanding of DNCC's waste management. Currently, a bylaw on information disclosure is under discussion in DNCC in relation to the RTI Act that was enacted in 2009. The information disclosure strategy of the WMD needs to consider the upcoming bylaw.

The information coverage for proactive and request-based disclosure may vary and needs to be determined. The procedure of information disclosure with applicable methods and tools will be carefully discussed. Table 5-5 shows examples of the methods and tools pertaining to information.

Table 5-5 Examples of Methods and Tools Used for Information Disclosure

Information	Methods	Tools	Timing
Annual budget, annual activity plan, annual report	- Issue annual basis report and distribute to interested parties - Publish a summary on appropriate media - Explain to stakeholders	- Annual report (hard copy) - Newspaper - DNCC website - Stakeholder meeting	To be determined (annually)
SWM plan	- Issue a summary and explain to stakeholders - Publish a summary on appropriate media	- SWM plan summary (hard copy) - Newspaper - DNCC website - Stakeholder meeting	One month after release
Environmental monitoring data	- Process raw data and visualize them to facilitate understanding	- DNCC website - Stakeholder meeting	To be determined (annually)

Information	Methods	Tools	Timing
	- Provide a summary on appropriate media - Explain to stakeholders		
EIA and Environmental Management Plan (EMP) for SWM facilities	- Disclose publicly for certain days at appropriate locations after issuing a notice in the newspaper - Explain to stakeholders	- Draft EIA report (hard copy) - Final EIA report (hard copy) - DNCC website - Stakeholder meeting	Immediately after release

Source: JICA Project Team

5.3 Ward-based Approach Activities (Component 2)

5.3.1 Improve Quality and Efficiency of Field-level SWM [C2-O1]

(1) Philosophy of Ward-based Approach

The WBA is an innovative solution for enlightened thinking to strengthen the field activities of SWM. This approach enables field officers to think and act independently and to simultaneously function in a well-organized and systematic matter. In megacities such as DNCC, decentralization of organization is inevitable; otherwise, public cleaning services and administrative works for SWM would fail to function. The philosophy of WBA is summarized below in four points.

Philosophy of WBA

(i) ***"Field-oriented"*** *Solid Waste Management*
(ii) ***"Bottom-up"*** *and* ***"Decentralized"*** *Management Style*
(iii) ***"Cross-organizational"*** *Structure*
(iv) ***"Participatory"*** *Solid Waste Management with Multiple Stakeholders*

"Field-oriented" Solid Waste Management

The WBA defines the practical roles and responsibilities of field officers to establish the foundation of SWM as a public service. Cleaning and waste collection services are performed in practice by field officers such as CIs and cleaners. The community evaluates the quality of cleaning services through everyday practices in neighboring areas. Field officers are first to receive complaints from citizens. Ward SWM offices function as the center of field activities in the designated area and it should be open to the community to sustain SWM harmony with society.

"Bottom-up" and "Decentralized" Management Style

The SWM system for a megacity must be different from that in a small town. The large population of a megacity makes decision making slow down by the leaders. Quality control of SWM is difficult, and

penetration of the policy from the top to the bottom takes time. Decentralization in the WMD is necessary to avoid a malfunction of the administration. Bottom-up management style is also a characteristic of the WBA. To realize decentralization and bottom-up management of the WMD, the terms of reference (TOR), CI/CO/ACWMO, and chain of command in the WMD should be reassessed, and the authority should be transferred to enable them to handle the issues in their wards. In particular, middle management must be strengthened. Considering the current capacities of field officers, training on ward-wise planning, SWM data management, and monitoring of WBA activities as a ward SWM officer is required.

"Cross-organizational" Structure

Several types of issues occur at the field level, which are not fully covered by the existing scope of the work. For example, before the WBA was introduced, CI's work includes neither management of the working environment of cleaners nor community awareness raising. The WBA provides a solution for filling the gaps in the existing work and enables connection of the related department/division such as transport, mechanics, law, finance, and public relations.

"Participatory" Solid Waste Management with Multiple Stakeholders

WBA 3 is intended to promote "community participatory SWM" through CUWG. The community is involved in the process of selecting the SWM system suitable for that area in consideration of social, environmental, cultural, and economic aspects. Even though SWM is a public service, cooperation of the community is inevitable. WBA 3 enables development an ownership of a CAP. The community is not the only target; also multiple stakeholders such as universities, journalists, cleaners and PCSPs should be involved in the process of SWM.

(2) WBA Field Activity Implementation

WBA activities will be promoted and disseminated in all 54 DNCC wards. For strengthening the WBA concept onsite, 14 major field activities will be implemented, as shown in Table 5-6.

TARGET	***WBA is in practice in every ward of DNCC (54 wards).***

Table 5-6 WBA Field Activities

	Main activities
WBA 1	● Reinforcement of zone management ● Strengthening of planning and management capacity - Ward-level WBA AAP based on WMD directives - Budget request and disbursement for WBA activities - SWM administrative procedure book ● Improvement of data management system ● Construction of a ward office in all 54 wards of DNCC
WBA 2	● Provision of safety gear and awareness raising on OHSE ● Formulation of Safety and Sanitation Committee (SSC) ● Distribution of Cleaners' Working Manual ● Training of cleaners regarding the new concept of WMD directives, such as waste reduction
WBA 3	● Promotion of community action with CUWG ● Public awareness regarding the new concept of WMD directives, such as waste reduction ● Receipt of complaints by community
WBA 4	● Unsanitary dustbin and container closure ● Improvement of primary and secondary collection based on the SWM data ● FTFP collection by compactor in extension area

Source: JICA Project Team

(3) Safety and Sanitation Committee (WBA 2)

A safety and sanitation committee (SSC) will be organized for each workplace such as the landfill and ward office for creating a safe and sanitary working environment. An example of the SSC structure and activities at a ward office is shown in Table 5-7.

Table 5-7 Examples of Safety and Sanitation Committee at Ward Office

Member	CI, leader of the cleaners, six representative cleaners
Frequency	Once a month
Activity	● Confirm the safety and sanitation of work (cleaner manual) ● Analyze the cause of injury ● Analyze the cause of accident ● Safety patrol (work supervision) ● Report to zone office; zone office compiles a report of SSC and shares it with other zones. The report is filed in the zone office. ● Organize a zone level SSC annually and issue a report to each ward in the meeting.

(4) Community Unit Working Group (WBA3)

The CUWG is responsible for collection improvement and waste reduction. The CI will activate the WBA 3 activities more with the CUWG in accordance with the Master Plan. WBA 3 will be further promoted in collaboration with PAPS and PRD.

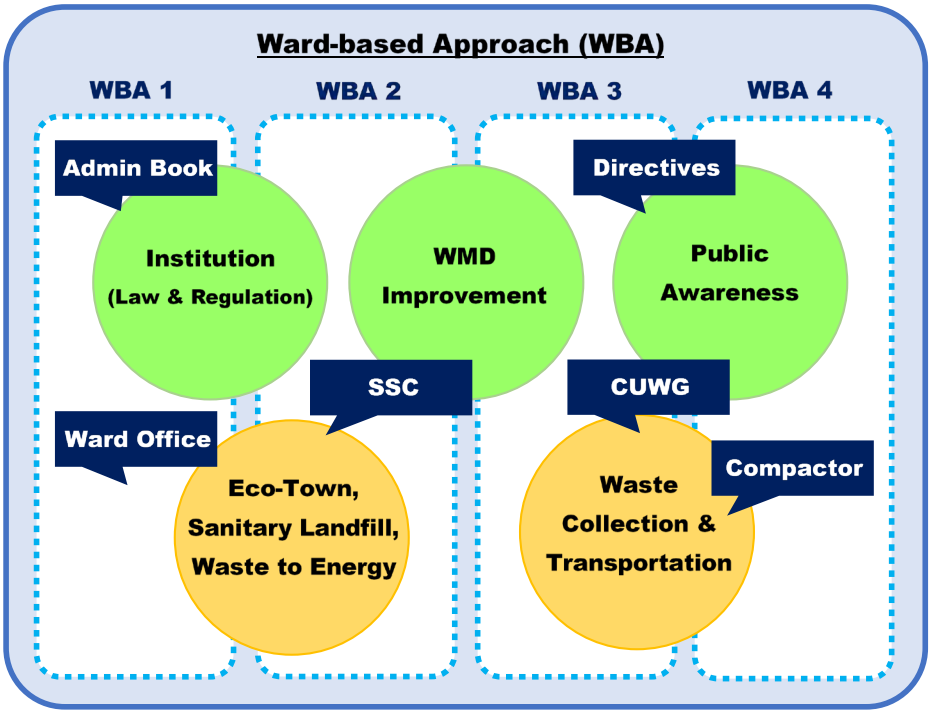
(5) Cross-organizational Structure

The WBA includes a cross-organizational structure and requires implementation of cross-field activities. WBA 1 to WBA 4 clarify the core domain and activities, which strongly motivated CIs to promote field activities in the previous project. However, it has been more than 10 years since the WBA was first introduced in Dhaka City. Considering the change of social circumstances and SWM needs, the WBA concept must be renewed or reinterpreted.

Owing to the rapid economic growth and population overflow, SWM will become more complicated and diverse. Expectations for quality in the public cleaning service from the community and society will be higher. Field officers need flexibility and proper judgment in the field; otherwise, SWM cannot be sustained appropriately. In principle, the WBA aims for complete ward-wise SWM under the ward office for preparing policy and budget execution. This also requires flexibility in daily works and tolerance in the scope of the work to handle all issues occurring in a ward, which in turn requires creative actions to fill the gap among existing assignments, organizations, and relationships with stakeholders. Social, cultural, and economic backgrounds also must be considered. In the Master Plan, five domains which closely relates the WBA are found, as shown in Fig. 5-4.

[Main domains closely related to the WBA]

- Institution (law and regulations)
- WMD organization improvement
- Public awareness and public relations
- New concept and facility of waste treatment, including Eco-Town, sanitary landfill, and WtE
- Waste collection and transport, including FTFP collection by compactor



Source: JICA Project Team

Fig. 5-4 Main Domains Closely Related to WBA and Its Function

5.3.2 Enhance Institutional Capacity of the Conservancy Division [C2-O2]

(1) Bottom-up and Decentralized Management

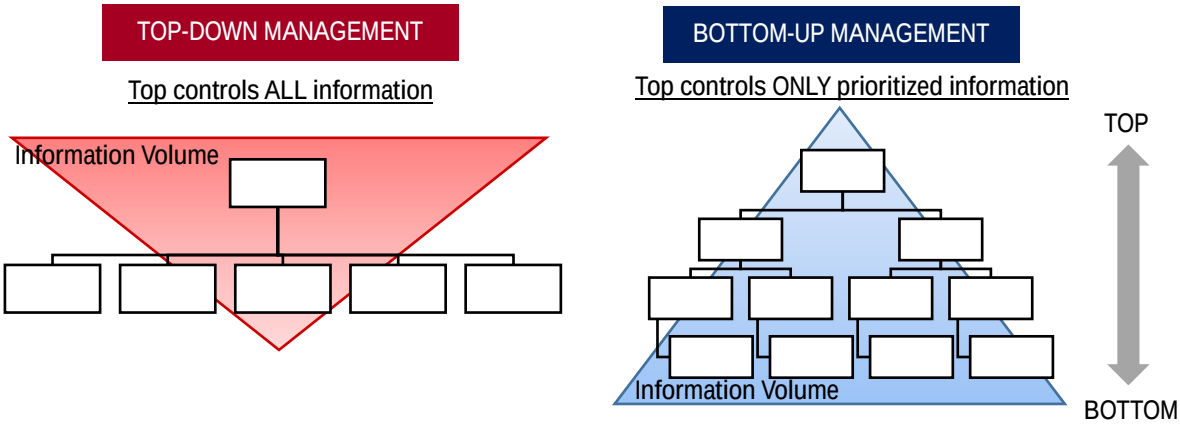
1) Reinforcement of Zone Management

The top-down management style has been in practice for a long time in DNCC. The CWMO manages every issue regardless of the volume or quality. This management style is suitable especially when initiated by strong leadership in emergency situations.

The suitable population size for SWM is said about 100,000 to 150,000; higher population creates difficulties in SWM. DNCC has a population of 8.9 million, and the cleaning services are managed by the CWMO only. In contrast, the average population of the 54 wards was about 120,000 in FY 2018–2019, with maximum and minimum populations of 271,270 in Ward 40 and 17,670 in Ward 42, respectively. Ward-wise SWM is an effective and proper management method considering the manageable population size.

The WBA is bottom-up management style. Field activities are promoted independently by the CO/CI. The WBA functions in a well-organized and systematic manner because field officers such as COs/CIs fully understand their responsibilities, middle-management officers such as ACWMOs manage and

monitor their work properly. In this context, the job description and chain of command should be reviewed and reformed. Several training programs are proposed for developing management skills in the WMD.



Source: JICA Project Team

Fig. 5-5 Top-down and Bottom-up Management Styles

2) Strengthening of Planning and Management Capacity

An annual activity plan of SWM should be prepared at each level, including 54 wards, 5 zones, and the WMD, based on WMD directives. The WMD directives should be revised in line with the Master Plan. One of the main topics that must be reflected in field activities is "Waste Reduction." Such activity planning helps the WMD to disseminate the new concept and policy.

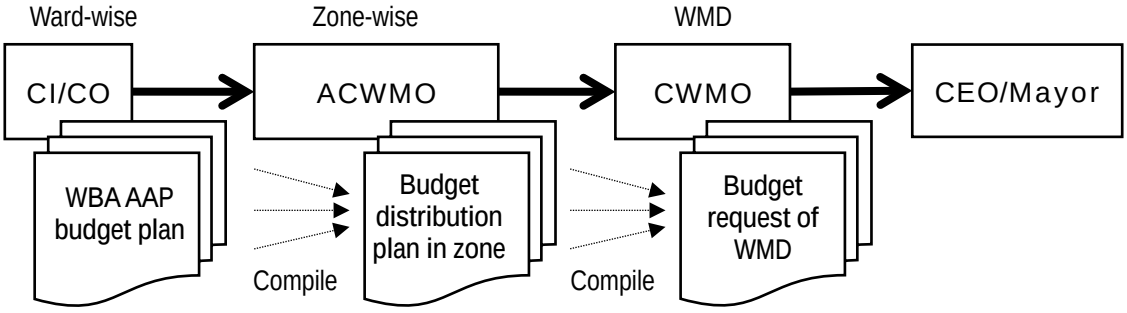
The annual activity plan will urge proper budget disbursement. In 2018, the community budget was approximately Tk. 5 million. However, this budget and the WBA-related budget had not been properly allocated previously owing to the lack of a proper financial management system. The budget plan should be prepared and assessed on the basis of the annual activity plan and should proceed in accordance with the SWM administrative procedure book. The key factors for strengthening the planning and management capacity are summarized below.

[Key factors for strengthening the planning and management capacity]

- WMD directives and SWMSC
- Ward-level WBA AAP based on WMD directives
- Budget request and disbursement for WBA activities
- SWM administrative procedure book

Examples of the budget request and approval process are shown in Fig. 5-6. For example, when each ward office drafts a WBA budget at the end of the fiscal year and submits it to ACWMO, the ACWMO

compiles a budget distribution plan in each zone and submits to the CWMO. The CWMO then assesses the plan and submits it to the CEO and mayor for approval. An office order will be issued and endorsed for this process in DNCC. The SWM administrative procedure book should be reviewed periodically to reflect new orders or regulations.



Source: JICA Project Team

Fig. 5-6 Example of Budget Approval Process in DNCC

3) Improvement of Data Management System

The daily and occasional reporting system from CIs to the ACWMO requires recording to utilize the information for SWM improvement. Operation and management based on the acquired data are fundamental for improving the current situation by analyzing data and implementing measures. Examples of data management items are shown below. DNCC issues an annual SWM Report that includes ward-wise population and waste collection amounts. These SWM data will be useful for better communication with the CSP, cleaners, and the community.

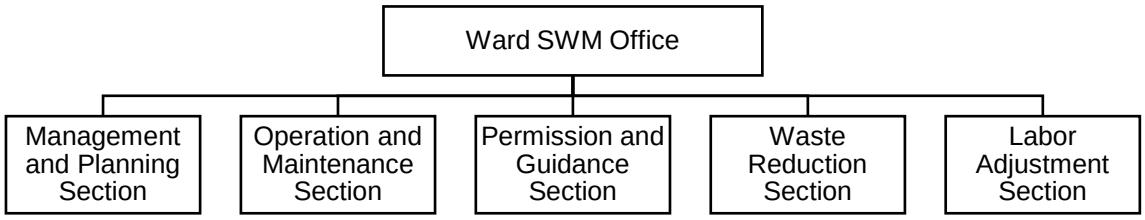
[Example of Data Management Items]

1. Annual activity plan and report
2. Primary and secondary waste collection
3. Management of cleaners
4. Local cleanliness
5. Cooperation with community
6. Management of cleaning appliance and equipment
7. SSC activities
8. Budget plan and report

4) Organization of Ward Office Management

A ward office is the center of field level activities, and CI is expected to be a ward office manager. For an appropriate ward management, a ward office should have a management organization which enables CI to extend his capacity and authority in the ward. Table 5-7 shows an example of organizational structure with 5 sections in a ward office; the management and planning section, the

operation and maintenance section, the permission and guidance section, the waste reduction section and the labor adjustment section.



Source: JICA Project Team

Fig. 5-7 Example of Organization for Ward Office Management

(2) Training and Workshop

1) WBA related trainings

WBA training programs are planned to involve various stakeholders. Table 5-8 shows examples of the WBA related trainings. These programs will be developed on the basis of existing training modules. A training module for drainage cleaners and that for planning/SWM data management will be newly set.

Table 5-8 Examples of WBA training

Training Program	Contents
1) WBA Training (CI Training)	- Training of Trainers (ToT) for Workshop
2) Zone Level Training	- WBA Introduction
3) Road Cleaner Workshop	- WBA 2
4) Drainage Cleaner Workshop	- Safety and Sanitation (WBA 2) - Risk Management
5) CUWG Workshop	- WBA 3
6) Drivers Workshop	- WBA 4a
7) PCSP Workshop	- WBA 4b
8) WMD Directives/Planning Seminar	- WMD Directives - Planning of Ward-wise Annual Activity Plan - SWM Data Management
9) Admin Book Seminar	- How-to of practical SWM Admin Book use
10) Medical Waste Seminar	- Awareness Raising on Medical Waste - Risk Preparation

[Related Programs]

- Training: ToT for CI provided by WMD
- Workshop: Interactive information exchange with stakeholders initiated by CI
- Seminar: Lecture on the specific topics initiated by WMD

Source: JICA Project Team

5.4 Waste Reduction (Component 3)

5.4.1 Reduce Waste Amount Generated [C3-O1]

Waste reduction, often described as 3R, is a key tactic used to minimize the disposal waste to LFSs. Table 5-9 shows examples of 3R activities.

Table 5-9 Examples of 3R Activities

Category	Activities
Reduce	・ Stop using disposable materials Examples: Use my-cup instead of paper cup or bottled drinks Bring my-bag for shopping instead of receiving shopping bag ・ Do not waste food Examples: Go food shopping after conducting inventory of your refrigerator Use up your food by freezing or use for multiple menus Order dishes at restaurants only if you can finish it ・ Dry up food waste before you throw it out so that the waste volume can be reduced ・ Choose products that can be used for a long time
Reuse	・ Use products many times and repair them if necessary ・ Donate unnecessary toys, clothing, furniture, and electrical products to those who need them
Recycle	・ Separate recyclable waste such as cans, bottles, PET bottles, plastics, paper, food waste, and electrical waste at the source

For promoting waste reduction activities such as 3R, the cooperation of citizens is indispensable. Therefore, DNCC will implement such activities efficiently and effectively, taking advantage of the WBA function. The waste reduction activity plan in the WBA is summarized in Table 5-10.

Table 5-10 Waste Reduction Activity Plan in WBA

WBA	Activities
WBA 1	*Ward Office Management*
	・ WMD directives are revised to emphasize the importance of waste reduction. ・ Measures for waste reduction are clarified by each ward in the WBA AAP based on the WMD directives. ・ ACWMO monitors the progress of WBA activities and promotes waste reduction regularly.
WBA 2	*Safety and Sanitation Education for Cleaners*
	・ Cleaners are trained to persuade citizens to contribute to waste reduction.
WBA 3	*Community Participation*

WBA	Activities
	・ CUWG of each ward takes responsibility for promotion of waste reduction in a target area. ・ Main activities are for reduction and source separation at household. Details of these activities are discussed by CUWG and are determined on the basis of social and cultural backgrounds of each area.
WBA 4	*Waste Collection Improvement*
	・ Collection of recyclables separated at source is introduced for improvement of the conventional waste collection system. ・ FTFP collection system encourages participation of the community, which helps the WMD to interact with the community for waste reduction.

Many waste pickers work in DNCC. Prior to introducing waste reduction activities, DNCC will study the state of their work and will consider hiring additional waste pickers as, for example, Eco-Town staff, if their livelihood is adversely affected by waste reduction activities depending on the study results.

5.5 Waste Collection and Transport (Component 4)

5.5.1 Promotion of Community Participatory SWM [C4-O1]

Although aimed toward implementation of efficient and sanitary waste collection and transport, conventional waste collection methods such as container collection has disturbed the landscape of the city and causes traffic congestion. To resolve these issues, expansion of FTFP collection by using plastic bins and compactors need to be considered to replace the existing collection method.

FTFP collection requires cooperation of communities. WBA3 encourages communication between the DNCC and residents, and promotion of FTFP collection is carried out through WBA4. Target areas of FTFP collection will be extended and cover all residential area.

5.5.2 Expand the Capacity of Collection and Transport [C4-O2]

(1) Vehicle Procurement

WMD will procure waste collection vehicles and equipment and in principle, aged arm roll trucks and container careers will be replaced with compactor trucks, while dump trucks will be allocated for street and drainage cleaning. 70% of the DNCC's waste collection vehicles is the target to replace into compactor truck. Considering the fact that the collection vehicles are managed not only by WMD but also other departments, discussion and coordination have to be strongly encouraged among related departments in DNCC for the efficient management.

In addition, collection and transport operation methods for the expansion area should be examined carefully and immediately. There is only little practice of SWM in the expansion area. Recruitment and capacity development of new collection workers and drivers for the expansion area is necessary.

A vehicles procurement plan will be prepared to achieve FTFP collection by using plastic bins and compactors for the entire area of the DNCC by FY 2022–2023. Table 5-11 shows the precondition for calculating the number of necessary vehicles. Dump trucks are assumed to be used for street and drainage cleaning.

Table 5-11 Assumption for Calculating Necessary Number of Vehicles

Item	Assumption
Vehicle lifetime	20 years (50% of the procured vehicles are scrapped after 15 years, 50% after 20 years)
Replacement condition	Arm roll and container carriers are replaced with compactor trucks.
Vehicle type	Compactor : Dump truck = 7 : 3 (Dump truck is allocated for street and drainage cleaning)
Number of trips/day	Container Career: 4; Compactor truck: 3; Dump/Open truck: 2; Arm Roll: 4

Source: JICA Project Team, "Time and Motion Survey Report (2018)"

The necessary number of waste collection vehicles by vehicle type in FY 2022–2023 is estimated, as shown in Table 5-12, taking into account the vehicle lifetime and waste generation. Table 5-13 shows the number of necessary vehicles for FY 2027–28, and Table 5-14 shows that for FY 2032–2033. By FY 2032–2033, the DNCC need to have the vehicles doubled in FY 2022–2023.

Table 5-12 Waste Collection Vehicle Planning in FY 2022–2023

Type	Capacity (tons)	Vehicles				Total
		Existing	DNCC 2015–2017	Provided by GAP	Procured by DNCC	
Compactor	2	2	-	10	35	47
Compactor	5	14	10	13	-	37
Compactor	7	8	-	-	-	8
Container Carrier	3	2	-	-	-	2
Container Carrier	5	8	5	20		33
Dump Truck	3	-	11	4	11	26
Dump Truck	5	-	6	-	-	6
Dump Truck	7	4	-	5	-	9
Dump Truck (4WD)	6	-	-	4	-	4
Open Truck	3	-	2	-	-	2
Arm Roll Truck	7	6	-	-	-	6
Total	-	45	34	56	2	181

Source: JICA Project Team

Table 5-13 Waste Collection Vehicle Planning in FY 2027–2028

Type	Capacity (tons)	Vehicles				Total
		Existing	DNCC 2015–2017	Provided by GAP	Procured by DNCC	
Compactor	2	1	-	10	66	77
Compactor	5	9	10	13	0	32
Compactor	7	6	-	-	-	6
Container Carrier	3	1	-	-	-	1
Container Carrier	5	5	5	20		30
Dump Truck	3	-	11	4	20	35
Dump Truck	5	-	6	-	-	6
Dump Truck	7	3	-	5	0	8
Dump Truck (4WD)	6	-	-	4	-	4
Open Truck	3	-	2	-	-	2
Arm Roll Truck	7	4	-	-	-	4
Total	-	29	34	56	86	205

Source: JICA Project Team

Table 5-14 Waste Collection Vehicle Planning in FY 2032–2033

Type	Capacity (tons)	Vehicles				Total
		Existing	DNCC 2015–2017	Provided by GAP	Procured by DNCC	
Compactor	2	-	-	7	137	118
Compactor	5	-	10	9	-	19
Compactor	7	4	-	-	-	4
Container Carrier	3	-	-	-	-	0
Container Carrier	5	-	5	15	-	20
Dump Truck	3	-	11	3	41	109
Dump Truck	5	-	6	-	-	6
Dump Truck	7	2	-	3	-	5
Dump Truck (4WD)	6	-	-	3	-	3
Open Truck	3	-	2	-	-	2
Arm Roll Truck	7	-	-	-	-	0
Total	-	6	34	40	195	286

Source: JICA Project Team

(2) Storage Capacity of Waste Containers

A container carrier can generally have four trips on average, and eight trips at a maximum. However, the number of the trips is limited owing to shortage of the containers in the DNCC area. This situation is a bottleneck to increase the waste collection rate. Therefore, the WMD will locate more containers in the DNCC area for efficient use of the container carriers.

(3) SWM Framework in Extension Area

In the extension area, FTFP collection by compactor will be introduced proactively. PCSP is effective under certain circumstances, especially in the initial stage of SWM. On the contrary, open dustbins and containers easily make the surroundings dirty with scattered waste. Odor emitted and flies bred from dustbins and containers result in the unsanitary environment.

The SWM framework in the extension area is shown in Table 5-15. In the framework, the DNCC will make contracts with private companies for waste collection and vehicle maintenance. Waste treatment including recycling will be implemented by five zones, and ward offices are responsible for the WBA activities and awareness raising. The SWM cost will be financed by the DNCC headquarters.

Table 5-15 SWM Strategy in Extension Area

Item	Responsible Organization	Remarks
Waste collection system	Private	FTFP collection system by compactor without PCSP
Maintenance of collection vehicles	Private	―
Treatment of waste	Private by zone	WtE, recycling
WBA activity	Ward office	―
Awareness raising	Ward office	―
Finance	DNCC Headquarters	―

Source: JICA Project Team

(4) Capacity Development of Cleaners and Drivers

The DNCC street cleaner's and drainage cleaner's ability is about 300 m per day and 200 m per day respectively.[12] They work with a group of four cleaners as instructed by the DNCC, continue the cleaning in an assigned area for two to four hours until streets get clean, and then go back home afterward.

The WMD encourages each cleaners and cleaner's group to support each other by, for example, helping other group's work after finishing own work. The drivers are also to be advised to help cleaners to load waste into compactors. Such an on-job training contributes to changing mind setting of the cleaners and drivers for mutual assistance and respect, and to better organizational governance.

[12] Data from the previous Clean Dhaka Plan

5.5.3 Prepare for Receiving the GAP Vehicles [C4-O3]

The DNCC has received total of 56 GAP vehicles which consist of container carriers, compactors, and dump trucks, as mentioned previously. The GAP vehicle allocation is planned for their efficient use as follows.

(1) Container Carriers

The old container carriers that are currently operational will be substituted to the GAP vehicles. New driver recruitment for the GAP container carriers is not necessary.

(2) Compactors

The GAP compactors will be assigned in the densely populated areas in the city for FTFP collection system with introducing 70L plastic bins. Some of the WBA wards are selected for this collection system because communities in a WBA ward are relatively active and cooperative. The compactor is planned to travel to the LFS two trips per day.

These compactors are additions to expand the compactor collection area. The DNCC must hire new drivers and provide proper training for the compactor operation, and also instruct them to help cleaner's loading work at correction points.

(3) Dump Trucks

The old dump trucks that are currently operational will be substituted to the GAP vehicles. Dump trucks are used for transport of drainage sludge, food waste from restaurants and shops, green waste, and construction waste. New driver recruitment for the GAP dump trucks is not necessary.

5.5.4 Unify DNCC's Waste Collection Management System [C4-O4]

In the DNCC, most of the collection vehicles are managed by TD, not by the WMD, based on the TD's official work statement. This situation makes the WMD very hard to allocate the vehicles flexibly to collect unscheduled waste wherever necessary. The WMD has few collection vehicles, and they are not enough to cover all DNCC area.

The collection vehicles and their drivers should be transferred to the WMD's responsibility for more efficient waste collection and sound waste management. The WMD would face challenging issues to achieve it such as securing the drivers' welfare and paying off vested interests; thus, decision making in high level official is vital, and the discussion should be strongly encouraged among related departments for the smooth transfer.

5.6 Vehicle Maintenance System (Component 5)

5.6.1 Improve Maintenance Workshop Operation and Management [C5-O1]

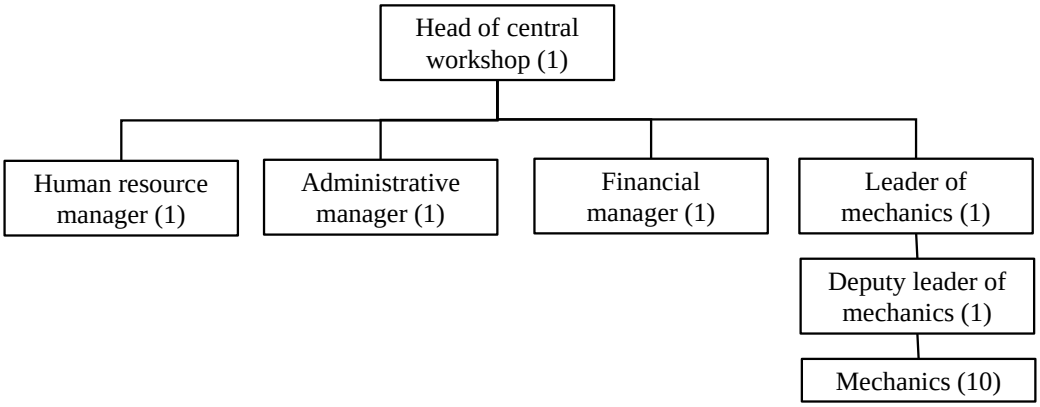
(1) Workshop Management Rules Development

WMD should formulate workshop management rules to standardize operation and to make an effective organization of the workshop. Example contents of the management rules and the organizational structure of the workshop are shown in Table 5-16 and in Fig. 5-8.

Table 5-16 Examples of Workshop Management Rules

Contents
(1) Job Description of each level
(2) Rules on General Affairs
(3) Work Rules
(4) Rules on Working Time and Holidays
(5) Guidelines for Reporting System and Forms
(6) Safety and Sanitation Standards
(7) Guidelines for Safety and Sanitation Improvement a. General Rules b. Chief Manager of Safety and Sanitation c. Safety and Sanitation Committee d. Safety Gear e. Medical Examination and Other Health Management Methods f. Education and Training for Safety and Sanitation
(8) Rules on Staff Training

Source: JICA Project Team



Source: JICA Project Team

Fig. 5-8 Example of New Workshop Structure

(2) Workshop and Maintenance System Reform

Three departments, namely the WMD, ED, and TD, currently manage, maintain, and operate collection vehicles; however, no comprehensive maintenance plan, procurement plan, or repair plan is in place. To unify management, maintenance and operation of the collection vehicles should be performed solely by the WMD. That is, the workshop, which is currently owned by the ED for collection vehicles, should belong to the WMD together with the vehicle ownerships, and the collection vehicle operation including drivers should be transferred gradually to the WMD.

(3) Introduction of Preventive Maintenance Method

Periodic daily or monthly inspection and maintenance is very important for preventing serious accidents or breakdowns. Preventive maintenance is a method for maintenance by controlling the expiration date of each vehicle part. Main items for the preventative maintenance is summarized below.

1) Type of Inspection

(i) Daily inspection before work
(ii) Daily inspection after work
(iii) Weekly inspection
(iv) Monthly inspection
(v) Annual inspection
(vi) Two-year inspection

2) Steps of Inspection

(i) The standard replacement interval is determined on the basis of inspection records, and replacement will be implemented periodically.
(ii) Inspection is based on a check sheet, which includes the previous replacement time.
(iii) The mechanic in charge of inspection decides whether parts replacement is needed.
(iv) The inspection results are analyzed to evaluate parts replacement.
(v) Vehicle condition is confirmed with the driver.
(vi) Repairs beyond replacement of filters or oil are outsourced.

3) Annual Inspection/Two-Year Inspection

If a vehicle is procured within the last 5 years, inspection of the vehicle is conducted by the WMD. For vehicles procured more than 5 years ago or before, the inspection is outsourced.

4) Spare Parts Management System

Software for an inventory management system should be developed.

(4) Introduction of Preventive Maintenance Method

As mentioned above, preventative maintenance is introduced for the workshop operation so as to improve the work efficiency of the collection vehicles. The preventative maintenance basically aims at avoiding a serious failure by replacing parts at the workshop in advance. When a serious failure occurs, the vehicle is sent to an outsourced private workshop for repair. This method leads to improve the Mean Time Between Failures (MTBF) as well. It is important that the further data be accumulated and analyzed to establish a better maintenance system.

5.7 Intermediate Treatment System (Eco-Town: WtE, Composting, Recycling etc.) (Component 6)

5.7.1 Develop Eco-Town (WtE, composting, recycling etc.) for Sustainable Waste Management in Dhaka [C6-O1]

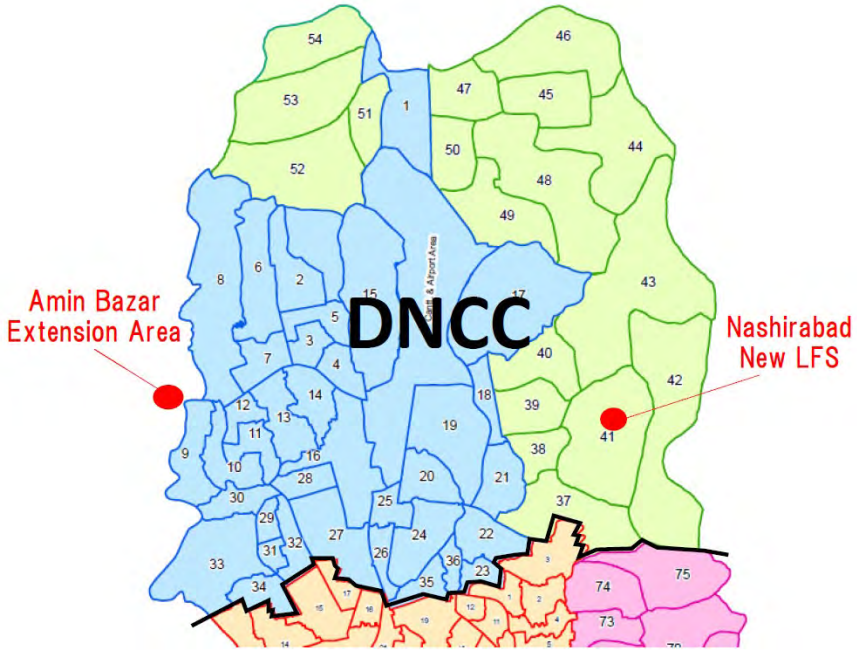
(1) Necessity of Intermediate Treatment

Currently, the maximum remaining lifespan of the existing LFS is only 2 years, while the amount of generated waste is increasing as a result of population growth and expansion of the city area. Under such conditions, for example, even if 20 ha of a sanitary LFS were constructed for the DNCC, which is the same size as the existing LFS, it would only extend the lifespan of landfilling to 2–3 years, resulting in starting another landfill site construction within 3 years. Owing to limited land availability and high land prices, land acquisition for a new LFS is becoming difficult. DNCC therefore must change its waste treatment process to divert waste from the LFS. To achieve the objective, it is vital to develop an intermediate treatment system such as an Eco-Town, an intermediate treatment zone with various provisions of treatment facilities (WtE, biogas, composting, recycling etc.).

(2) Intermediate Treatment System (Eco-Town) Planning

The planning conditions for Eco-Towns are initially set as follows in this Master Plan. The detail of the intermediate treatment system (Eco-Town), including plant type and its capacity, will be determined later depending on actual development planning and project characteristics.

(i) Two Eco-Towns will be constructed, i.e., one at Amin Bazar LFS extension area as Amin Bazar Eco-Town and the other at Nasirabad new LFS area as Nasirabad Eco-Town. DNCC has already submitted a DPP for each land development. The locations of both sites are shown in Fig. 5-9.



Source: JICA Project Team

Fig. 5-9 Location of Eco-Town

(ii) Each DPP includes LFS construction and land development for intermediate treatment facilities. The layout plans of both LFSs with the Eco-Towns are shown in Fig. 5-10 and Fig. 5-11. Although DNCC is planning to have a more comprehensive intermediate treatment system in Nasirabad Eco-Town than Amin Bazar site, the contents and capacity of the intermediate treatment facilities in the Amin Bazar Eco-Town and the Nasirabad Eco-Town are assumed to be the same at this moment.

(iii) The target waste for the intermediate treatment and recycling includes municipal waste, medical waste, and electronic waste (E-waste) etc. Medical waste and E-waste are not treated by DNCC but by private entities. It is expected that private entities will invest recycling and treatment facilities in the Eco-Towns for these wastes.

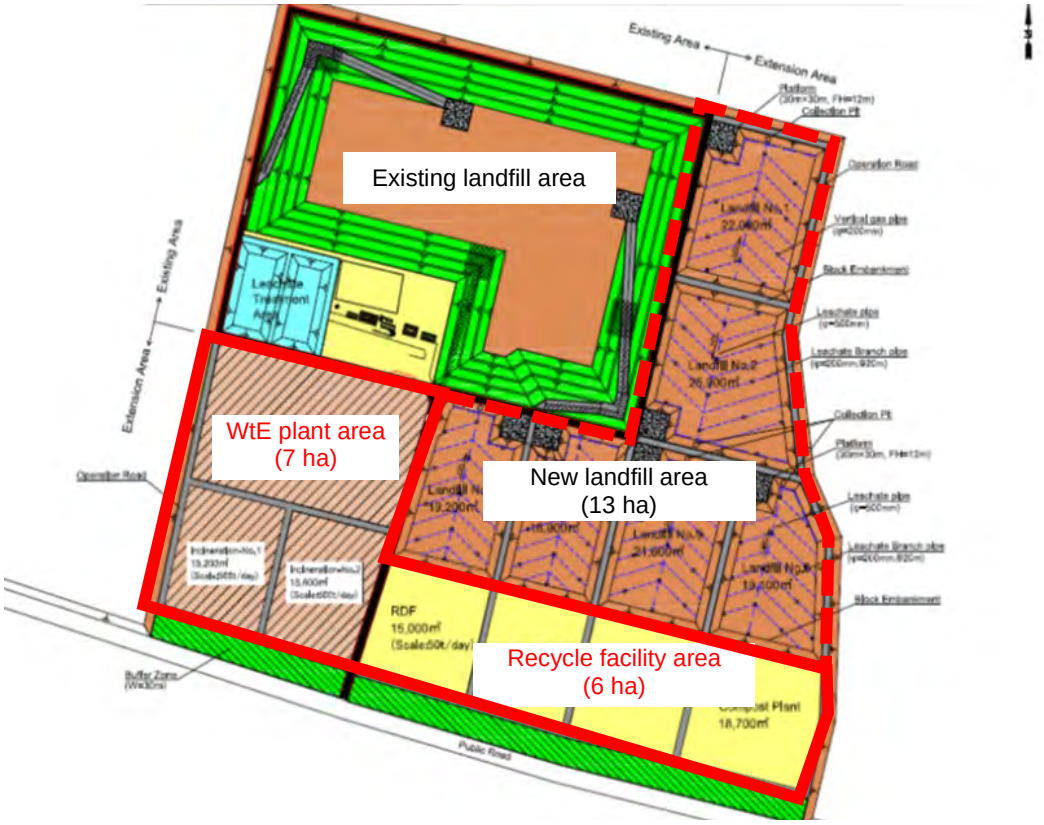
(iv) The capacity of each facility in the Eco-Town is set to satisfy the target recycling rate and landfill rate, as shown in Section 4.3.2.

(v) Primary collectors and waste pickers sell recyclables from mixed waste discharged from households. When source separation is introduced, they will possibly lose this source of income. Therefore, until the number of them decreases as the economy grows, coexistence with these workers is desired. Source separation at households will be less prioritized to reduce waste.

(vi) In order to increase the available capacity of the LFSs, it is highly important to promote food waste recycling, which accounts for a large portion of municipal waste. Therefore, source separation will be introduced at restaurants and markets where the generation of food waste is

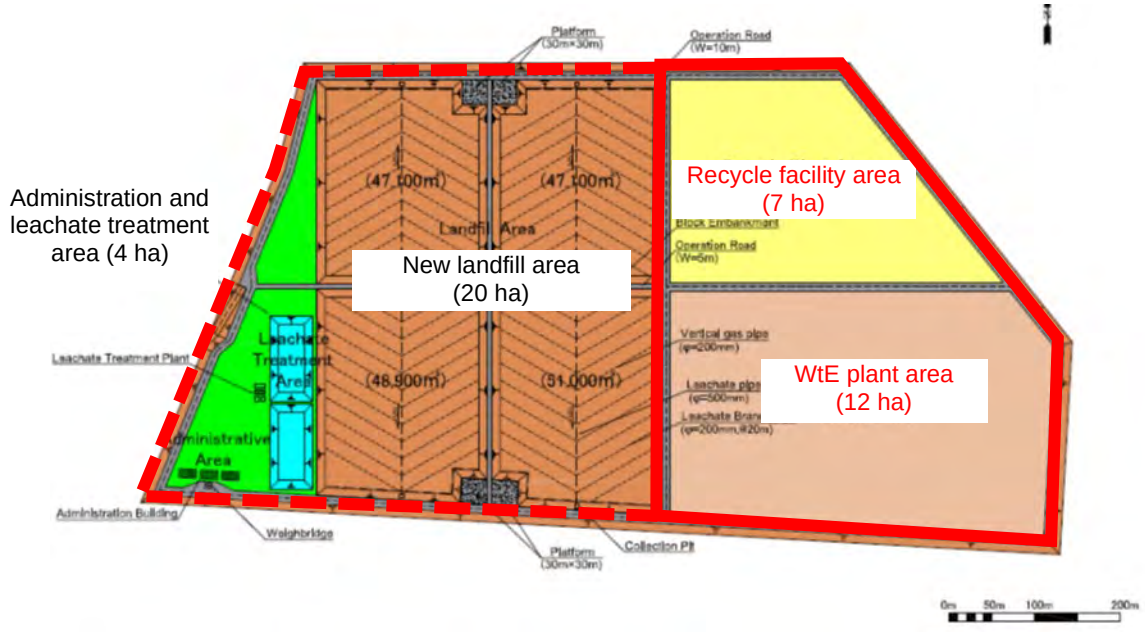
high, and the waste separation is relatively easy to implement. Recycling methods for food waste include composting and biogasification, both of which have proven results in Bangladesh.

(vii) In the Eco-Towns, a priority is given to materials recycling to reuse waste as product materials. The remaining waste from the material recycling will be treated at a WtE facility as thermal recycling.



Source: JICA Project Team

Fig. 5-10 Layout Plan of Eco-Town in Amin Bazar LFS Extension Area



Source: JICA Project Team

Fig. 5-11 Layout Plan of Eco-Town in Nasirabad New LFS Area

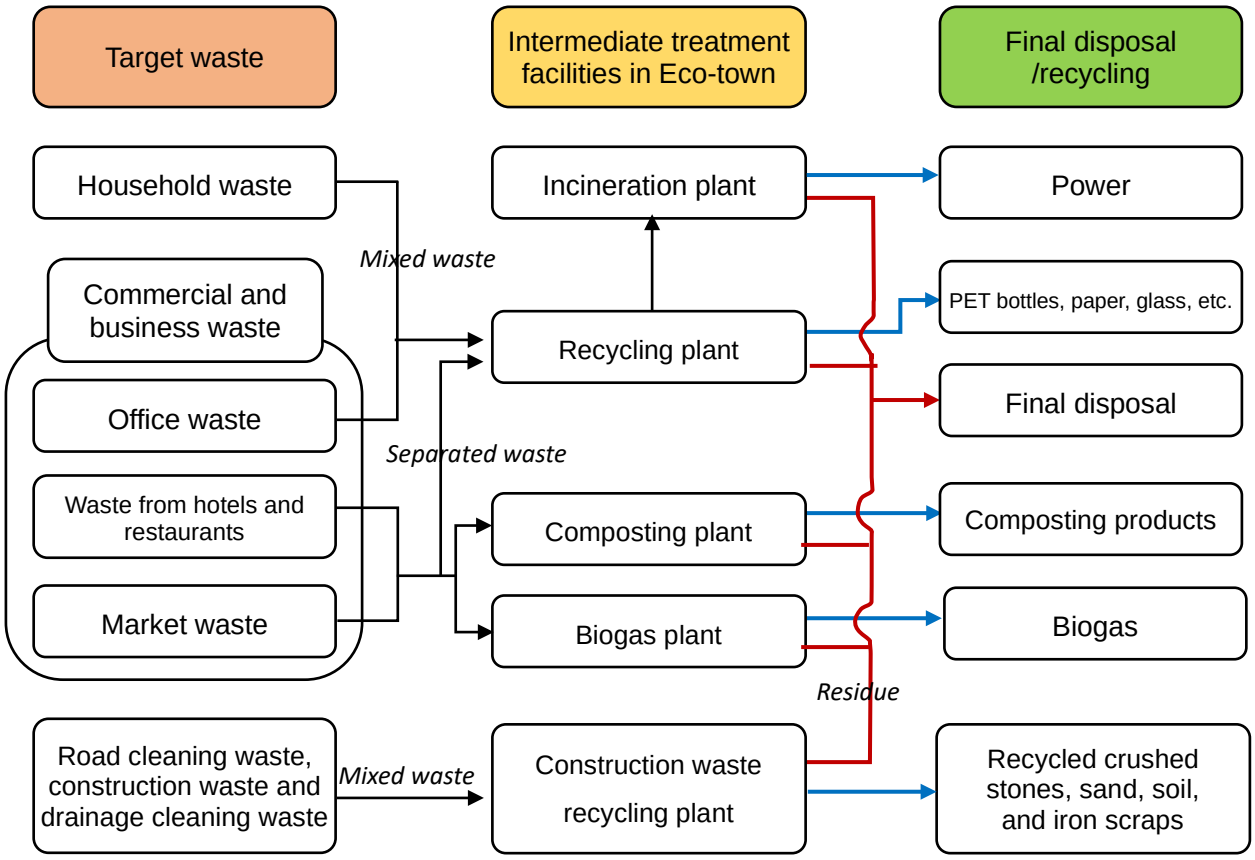
(3) Waste Management Flow

The waste management flow of intermediate treatment in Eco-Town is described below.

(i) Household waste and office waste: These wastes are collected as mixed waste, and transported to the recycling plant. PET bottles, paper, glass bottles and other valuable materials are separated at the plant for recycling, and the remaining waste is incinerated at the WtE facility for power generation or transferred directly for final disposal to landfill.

(ii) Market waste and food waste from restaurants and hotels: These wastes are discharged separately into organic waste and non-organic waste. The organic waste is used as a raw material for composting products at the composting plant or for biogas at the biogas plant. The other waste will be transported to the recycling plant to collect valuable materials.

(iii) Street waste (road and drainage cleaning waste), and construction waste: These wastes are collected as mixed waste and transported to the construction waste recycling plant, and crushed stones, sand, soil, iron scraps, and other valuable materials are separated at the plant. The remaining waste are transferred for final disposal to landfill.



Source: JICA Project Team

Fig. 5-12 Waste Management Flow Diagram of Intermediate Treatment in Eco-Town

(4) Contents of Intermediate Treatment Facilities in Eco-Town

In this Master Plan, the following treatment facilities are considered to be constructed in each Eco-Town area. Table 5-17 shows the facilities and their capacities for satisfying the interim target values of recycling rate and final disposal rate. Fig. 5-13 shows the waste generation and treatment flow diagram in the mid-term target year of 2025. The components of the Eco-Towns and capacities in this Master Plan are a prototype, and it can be changed depending on development planning, urgency, and budget constraints.

(i) Recycling Plant

The target wastes of the recycling plants include household waste, and commercial and business waste. The planned facility capacity in this Master Plan is 500 tons/day each in Amin Bazar Eco-Town and Nasirabad Eco-Town. Each plant includes a trommel, belt conveyor, crusher, grinder, cutting machine, and ancillary equipment.

(ii) Composting Plant

The target waste of the composting plants is organic waste, and the planned facility capacity in this Master Plan is 160 tons/day each in Amin Bazar Eco-Town and Nasirabad Eco-Town. The windrow composting process is adopted, and each plant uses heavy equipment for turning over, and furnishes a trommel, a vibrating screening machine, a bagging machine for composting products, and ancillary equipment.

(iii) Biogas Plant

The target waste of the biogas plants is organic waste, and the planned facility capacity in this Master Plan is 200 tons/day each in the Amin Bazar Eco-Town and the Nasirabad Eco-Town. The wet digestion process is adopted, and each plant includes facilities for waste receiving/supply, pretreatment, methane fermentation, biogas storage, biogas utilization, and deodorization, and ancillary equipment.

(iv) Construction Waste Recycling Plant

The target wastes of the construction waste recycling plants are street waste (road cleaning waste and drainage cleaning waste), and construction waste. The planned facility capacity in this Master Plan is 360 tons/day each in the Amin Bazar Eco-Town and the Nasirabad Eco-Town. Each plant includes a trommel, belt conveyor, crusher, grinder, cutting machine, and ancillary equipment.

(v) Incineration Plant

The target wastes of the incineration plants are household waste, and commercial and business waste. The planned facility capacity in this Master Plan is 500 tons/day each in the Amin Bazar Eco-Town and the Nasirabad Eco-Town, and the incinerator is stoker-type. Each plant is composed of facilities for waste receiving, combustion and gas cooling, exhaust gas treatment, water supply, drainage treatment, power generation, and ancillary equipment.

Table 5-17 Outline of Intermediate Treatment Facilities in Eco-Town (2025 year)

Facility	Capacity *	Outline
	1,000 tons/day (500 tons/day per Eco-Town)	**Recycling Plant** ・Target waste: household waste, and commercial and business waste ・Construction cost: approximately Tk. 820 million ・Operation and maintenance (O&M) cost: approximately Tk. 12 Million per year ・Facility outline: trommel, belt conveyor, crusher, grinder, cutting machine, etc.
	320 tons/day (160 tons/day per Eco-Town)	**Composting Plant** ・Target waste to be received: organic waste ・Construction cost: approximately Tk. 820 million ・O&M cost: approximately Tk. 8 million per year ・Process type: windrow composting ・Facility outline: heavy equipment using for turning over compost, trommel, vibrating screening machine, bagging machine for composting products, etc.
	200 tons/day (100 tons/day per Eco-Town)	**Biogas Plant** ・Target waste to be received: organic waste ・Construction cost: approximately Tk. 4,900 million ・O&M cost: approximately Tk. 120 million ・Process type: wet digestion ・Facility outline: facilities for waste receiving/supply, pretreatment, methane fermentation, biogas storage, biogas utilization, and deodorization, etc.

Facility	Capacity *	Outline
	720 tons/day (360 tons/day × 2 units)	**Construction Waste Recycling Plant** ・Target waste: street waste (road cleaning waste and drainage cleaning waste), and construction waste ・Construction cost: approximately Tk. 820 million ・O&M cost: approximately Tk. 12 million per year ・Facility outline: trommel, belt conveyor, crusher, grinder, cutting machine, etc.
	1,000 tons/day (500 tons/day × 2 units)	**Incineration Plant** ・Target waste: household waste, and commercial waste and business waste ・Construction cost: approximately Tk. 13,000 million ・O&M cost: approximately Tk. 640 million per year ・Process type: stoker type incinerator ・Facility outline: facilities for waste receiving, combustion and gas cooling, exhaust gas treatment, water supply, drainage treatment, power generation, etc.

* The capacities here are only examples, and it should be determined depending on actual development planning and project characteristics.

Source: JICA Project Team

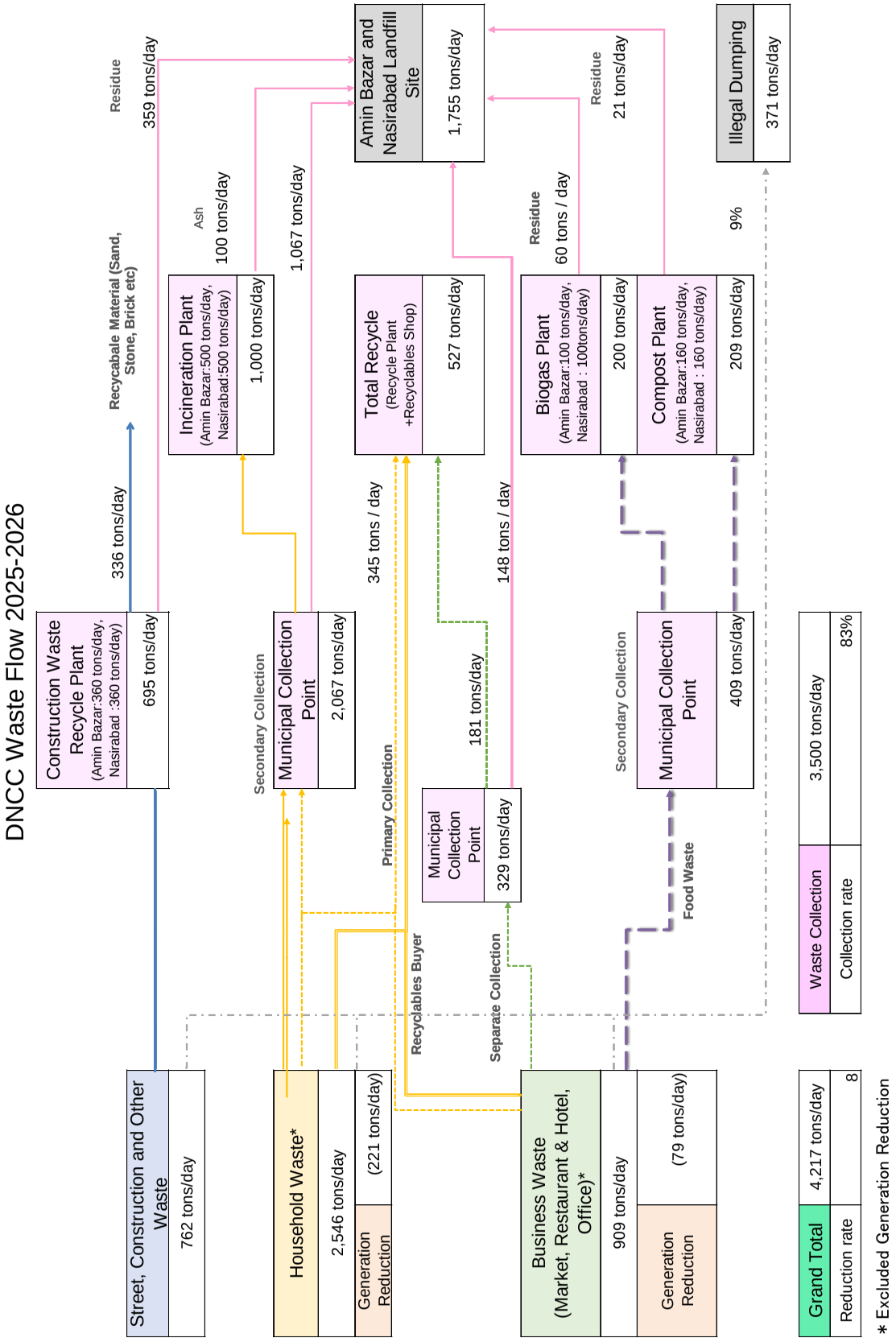


Fig. 5-13 Waste Generation and Treatment Flow in 2025

(5) Project Implementation Schedule

Because the remaining lifespan of the existing Amin Bazar LFS is short and construction the of new sanitary LFS takes time, the Eco-Town (WtE, composting, recycling etc.) construction project should be commenced immediately on a designated land once the land is developed in accordance with the ongoing LFS development DPPs. Construction of Amin Bazar LFS extension and Nasirabad LFS are expected to be completed in 2021 and 2022 respectively; hence, the feasibility study needs to start in 2019, as shown in Table 5-18 in order to start the Eco-Town construction soon after finishing the land development. The period includes 1 year for the feasibility study, 2 years for the basic design, and 3 years for the construction.

Table 5-18 Project Implementation Schedule

Item	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
【New Sanitary Landfill Development Project】															
(1) Extension of Amin Bazar	←	—	—	→											
(2) Nasirabad		←	—	—	→										
【Eco-town Development Project】															
(1) Feasible Study		←	→												
(2) Basic Design (Preparation of Tender etc.)			←	→											
(3) Construction															
1) Exension of Amin Bazar					←	—	→								
2) Nasirabad						←	—	→							
(4) Operation															
1) Exension of Amin Bazar								←	—	—	—	—	—	—	→
2) Nasirabad									←	—	—	—	—	—	→

Source: JICA Project Team

(6) Required Cost of Eco-Town (WtE, Composting, Recycling etc.)

The total proposed budget for implementing all beforementioned Eco-Town facilities, including the feasibility studies, consultant services, construction, and initial O&M, is approximately Tk.21,000 million. The total O&M cost for the Eco-Towns from 2024 to 2032 is approximately Tk. 6,500 million. The O&M cost is expected to be covered by fee collection and by selling electricity produced at the incineration plant. The sources of the funds for the construction and operation cost are summarized in Table 5-19. If the incineration plant, i.e. WtE plant is constructed and operated by a private company, the construction cost (approx. Tk. 13,000 million) and O&M cost (approx. Tk. 640 million per year) will be considered as zero. However, in Dhaka, where the calorific value of waste is low, the amount of electricity generation could be small, and there is a possibility that the business is not sustainable if the purchase price of electricity is low. As a private company carries out financing, increased interest rate would burden compared to a public design-build and a design-build-operate systems, resulting in difficulty of reducing costs.

Table 5-19 Required Cost of Construction and Operation of Eco-Town

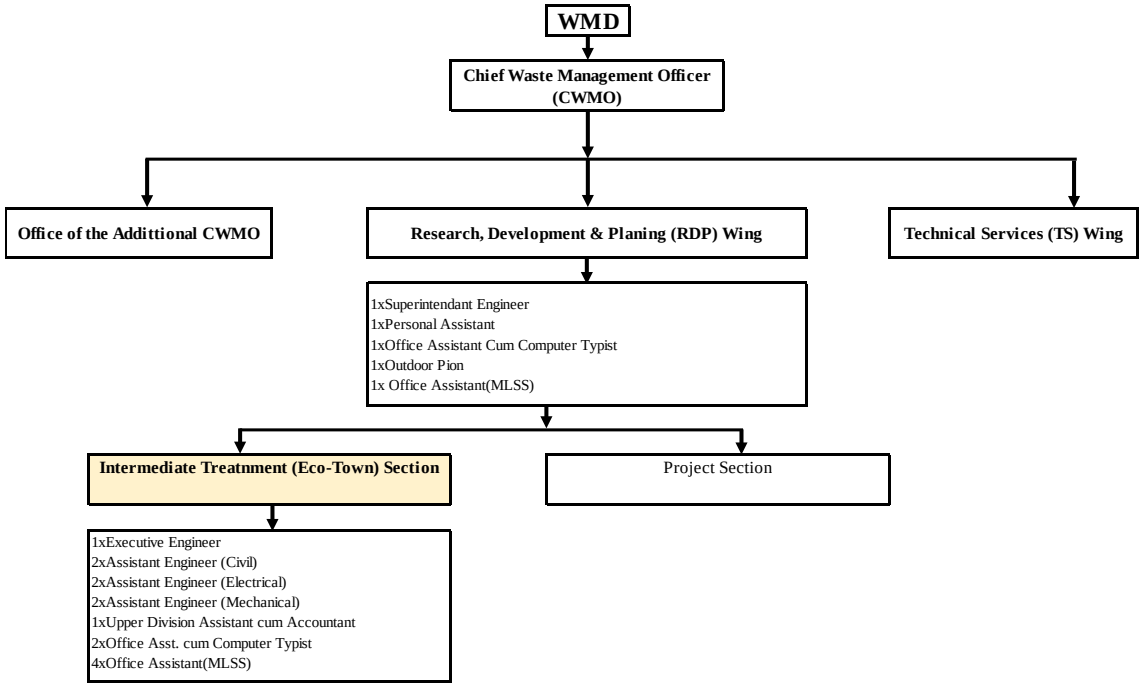
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total
Feasibility Study	●														–
Consultant Service		●	●	●	●	●									–
Construction				●	●	●									–
Operation & Maintenace						●	●	●	●	●	●	●	●	●	–
DNCC Own Revenues						50	800	800	800	800	800	800	800	800	6,500
Grant from Central Government / International Donors	70	60	60	60	1,300	10,300	9,000								21,000

Note) This table shows the case that the GoB bears all cost of the intermediate facilities in the Eco-Towns.
Source: JICA Project Team

5.7.2 Establish the Intermediate Treatment (Eco-Town) Section in WMD [C6-O2]

(1) Intermediate Treatment (Eco-Town) Section

Considering complicated operation of an incineration plant, it is recommended that a private company operate the plant under an agreement with the DNCC, and it can be applicable to other facilities as well. DNCC should organize an O&M section for intermediate treatment, called “Eco-Town Section,” to manage planning, designing, construction, operation, and management for the intermediate treatment facilities in the Eco-Towns. In the planning stage, the superintendent engineer in the WMD is responsible, and the EEs for landfill management and for waste collection will support him. In the basic design stage, three EEs and four AEs should be newly assigned, and an administrative staff member should join in. Finally in the construction stage, SAEs will be assigned in the section. Fig. 5-14 shows the organizational structure of the Eco-Town Section and Table 5-20 shows the required staff members.



Source: JICA Project Team

Fig. 5-14 Management Structure of Eco-Town in Future

Table 5-20 Required Staff for Intermediate Treatment (Eco-Town) Section

Position	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
[Project Schedule]															
-Planning (Feasibility Study) Stage	←	—	→												
-Basic Design (Preparation of Tender Document etc.)				←	→										
-Construction Stage					←	—	→								
-Operation Stage								←	—	—	—	—	—	—	→
[Required Staff]															
-Executive Engineer			1	1	1	1	1	1	1	1	1	1	1	1	1
-Assistant Engineer (Civil)			2	2	2	2	2	2	2	2	2	2	2	2	2
-Assistant Engineer (Electrical)			2	2	2	2	2	2	2	2	2	2	2	2	2
-Assistant Engineer (Mechanical)			2	2	2	2	2	2	2	2	2	2	2	2	2
-Upper Division Assistant cum Accountant			1	1	1	1	1	1	1	1	1	1	1	1	1
-Office Asst. cum Computer Typist			2	2	2	2	2	2	2	2	2	2	2	2	2
-Office Assistant(MLSS)			4	4	4	4	4	4	4	4	4	4	4	4	4
Total Staff			**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**
Note: Superintendent Engineer (SE) of RDP wing will supervise the Planning Stage Feasibility Study from 2018 to 2020															

Source: JICA Project Team

(2) Capacity Development for Intermediate Treatment (Eco-Town) Section

At each stage, the capacity development of O&M organization will be implemented by collaborating with external knowledgeable parties such as a consultant. At the operation stage, DNCC should closely cooperate with a company which will operate the Eco-Town facilities.

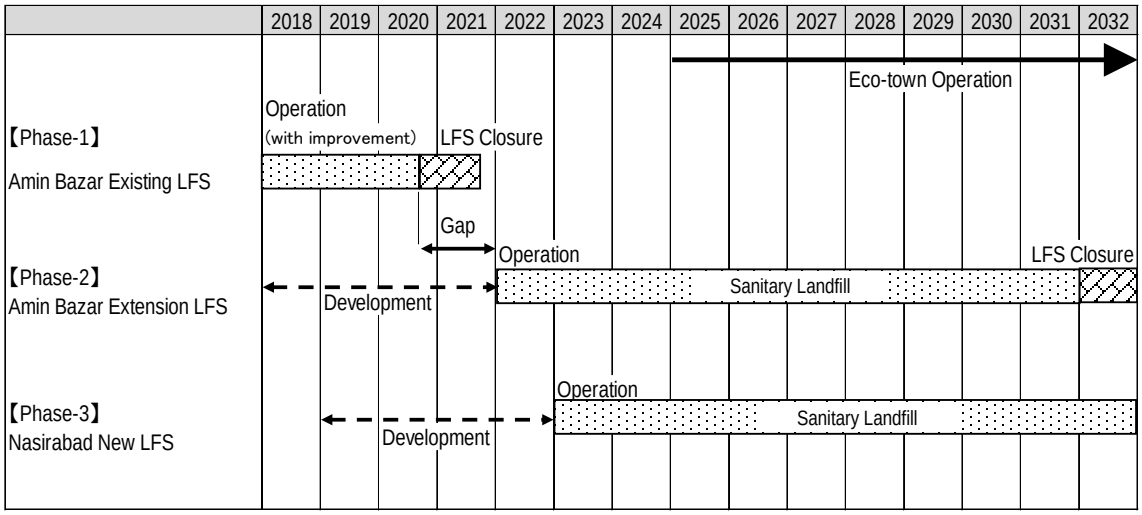
5.8 Sanitary Landfill (Component 7)

5.8.1 Landfill Development Plan Overview

In order to fulfill the DNCC's urgent needs for waste disposal, the landfill development is planned in this Master Plan. The development plan consists of three phases listed below, considering the Eco-Town development and commencement.

- ✓ Phase-1: Improvement of Amin Bazar existing LFS
- ✓ Phase-2: Construction of Amin Bazar extension LFS
- ✓ Phase-3: Construction of Nasirabad LFS

In Phase-1, improvement and safety LFS closure of the existing Amin Bazar LFS will be implemented. In Phase-2, the Amin Bazar new extension area will be prepared and operated, and then Nasirabad new LFS will be constructed and operational as Phase-3. The schedule of the development is proposed as shown in Fig. 5-15. In each Phase, land acquisition and necessary legal requirements including ECC approval have to be properly proceeded in a timely and an appropriate manner.



Source: JICA Project Team

Fig. 5-15 Proposed Landfill Development Schedule

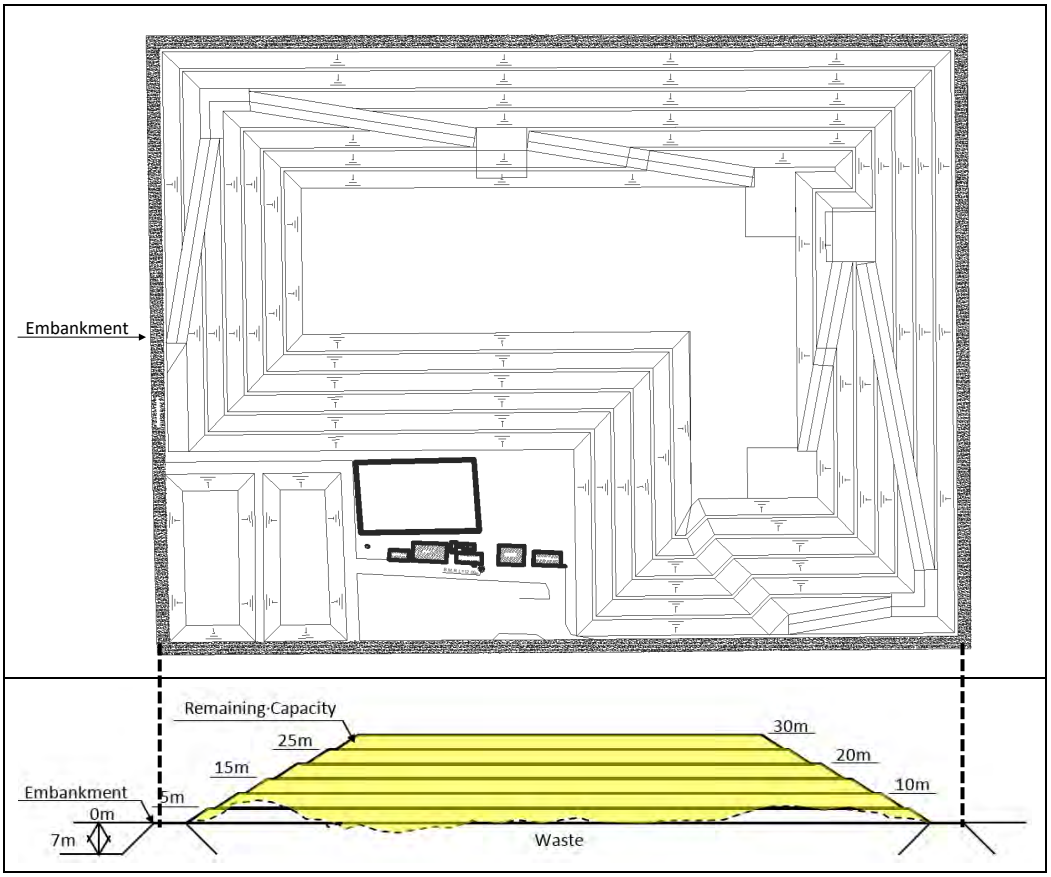
5.8.2 Improve Amin Bazar LFS [C7-O1]

(1) Site Layout

As previously mentioned, the Amin Bazar existing LFS is expected to be full by July 2020, whereas construction of the Amin Bazar new extension area will fully be completed at the end of 2021 if the DNCC start the construction work in 2018. Therefore, change of the landfill height from 20 m to 30

m is proposed, as shown in Fig. 5-16. The Phase-1 activity increases the LFS capacity to extend the lifespan so as to minimize the 17-month gap.

The remaining capacity after the rehabilitation will be 36,897 m^3 at the end of 2020, and the lifespan will be extended to January 2020. Even if this improvement is completed, it would still be insufficient for securing the required amount of dumping area to fulfill the gap; thus, the Amin Bazar extension area in Phase-2 should be partially operational in advance with the minimum construction of embankment.



Source: JICA Project Team

Fig. 5-16 Proposed Design Layout of Amin Bazar Existing LFS

(2) Leachate Treatment

Leachate treatment by using physical and chemical methods will be introduced in Amin Bazar LFS after completing the leachate pond repair. The schematic flow diagram of leachate treatment is shown in Fig. 5-17. Raw leachate is released into an anaerobic pond (Pond 1), and the treated leachate is transferred through pumps to a chemical mixing tank. At that point, some chemicals such as polymers, ferrous sulfate, and lime are added with purified water. Afterward, the leachate is transferred to a

primary clarifier to remove the sludge. The leachate is then transferred to a secondary aerobic unit (Pond 2) that uses 24 h aeration to keep the aerobic bacteria alive. The leachate is again transferred to a secondary clarifier, and the treated leachate is discharged to a sump to discharge into ambient water.

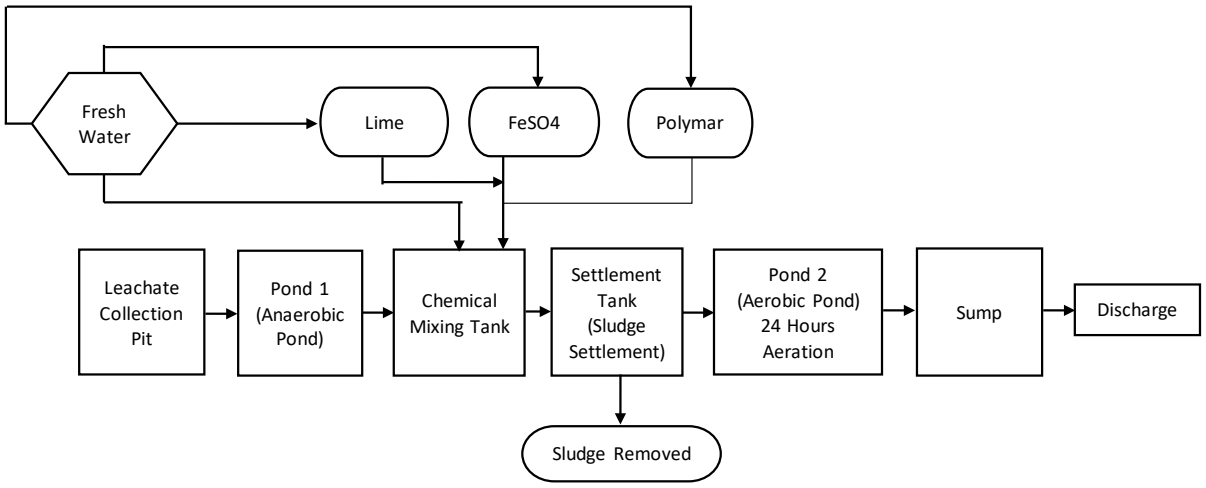


Fig. 5-17 Schematic Flow Diagram of Leachate Treatment in Amin Bazar LFS

(3) Other Activities for the Improvement

Other operation and construction works for the improvement of the existing LFS are shown below.

- Operation work
  - Proper disposal and containment of waste
  - Final soil covering at the top of waste surface
  - Compaction of a waste layer and levelling and grading
- Construction and rehabilitation work
  - Repair of the periphery embankment with access road
  - Installation of rainwater drainage and gas ventilation pipes
  - Preparation of dumping platforms and operation roads

5.8.3 Conduct Safety Closure at Amin Bazar LFS [C7-O2]

After completion of waste disposal in the existing Amin Bazar LFS, safety closure of the LFS should be properly implemented in a timely manner. The DNCC will prepare a safety closure plan of the Amin Bazar LFS with closure activities, including installation of gas vent pipe and rainwater drainage ditch, 50 cm-thick soil cover on the slope and the top of the dumping site surface, and stabilization of the landfill side slope with 1:2 (H:V). In addition, planting trees on the top and lawn on the slopes is

recommended for environmentally and socially friendly landscape. The closed landfill site can be renovated to post-closure use such as a parking lot and a park. The DNCC will prepare a DPP to acquire the necessary cost of the landfill closure plan implementation to be borne by GoB.

5.8.4 Establish Management Section in WMD for Amin Bazar LFS [C7-O3]

(1) Landfill Management Unit

Currently, there is no system to continuously improve site operation and management in Amin Bazar LFS; thus, DNCC will establish a management section, named as Landfill Management Unit (LMU) in WMD. The proposed assignment plan of Amin Bazar LFS and Nasirabad new LFS is shown in Table 5-21. Assistant Engineer (AE) of leachate treatment is proposed as a new position.

The total number of staff members proposed by DNCC in 2018 for the Amin Bazar LFS is 88 until 2032. The existing staff members in Amin Bazar LFS will continuously manage the extension LFS. DNCC has decided to carry out O&M of the both Amin Bazar extension LFS and Nasirabad LFS directly; that is, when both LFSs begin their operation parallel after 2023, the total number of staff members will be doubled. In case of the lifetimes of both LFSs being extended, the total number of requested staff members would essentially be the same. The DNCC should flexibly change the staff number depending on the situation. At present, DNCC has applied to LGD to fill up insufficient staff numbers. For Amin Bazar LFS, the O&M is considered to be outsourced until the LGD's approval and DNCC is preparing for its budget.

Table 5-21 Proposed Deployment Plan of Staff

Position/Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Amin Bazar LFS															
Operation	←	—	—	→											
Amin Bazar-Extension LFS															
Design & Construction	←	—	—	→											
Operation					←	—	—	—	—	—	—	—	—	→	
Nasirabad New LFS															
Design & Construction		←	—	—	→										
Operation						←	—	—	—	—	—	—	—	—	—
New LFS															
Design & Construction														←	—
Staff (Total)	85	85	85	85	85	166	166	166	166	166	166	166	166	166	166
Office of Executive Engineer	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Amin Bazar LFS (Existing and Extension)	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81
Nasirabad LFS or New Landfill Site	0	0	0	0	0	81	81	81	81	81	81	81	81	81	81

(2) Replacement of Heavy Equipment

The estimated replacement years of the operational heavy equipment in Amin Bazar LFS is shown in Table 5-22. 2 bulldozers have to be replaced in 2022, and 6 bulldozers, 2 wheel loaders, and 5 excavators to be replaced in 2026, 2027, and 2026, respectively.

Table 5-22 Replacement of Heavy Equipment

Year	Amin Bazar LFS		
	Bulldozer	Wheel Loader	Excavator
Class (Average)	21 tons	1.2 m^3	35.9 m^3
Total Number	8	2	5
Year of Replacement	2022: 2 Bulldozers 2026: 6 Bulldozers	2027: 2 Wheel Loaders	2026: 5 Excavators

Source: JICA Project Team

(3) Capacity Development for Landfill Management Section

Organizational capacity development of the landfill management section including Amin Bazar LFS Management Unit will be conducted in the technical cooperation project implemented from 2017 until 2021 by JICA. Engineers will learn O&M skill of LFSs through the training in Japan and in other countries. Capacity development for the staff members will be conducted through on-the-job training by using the operation manual. Trained staff members through technical cooperation project of JICA will be deployed in Amin Bazar extension LFS and Nasirabad new LFS.

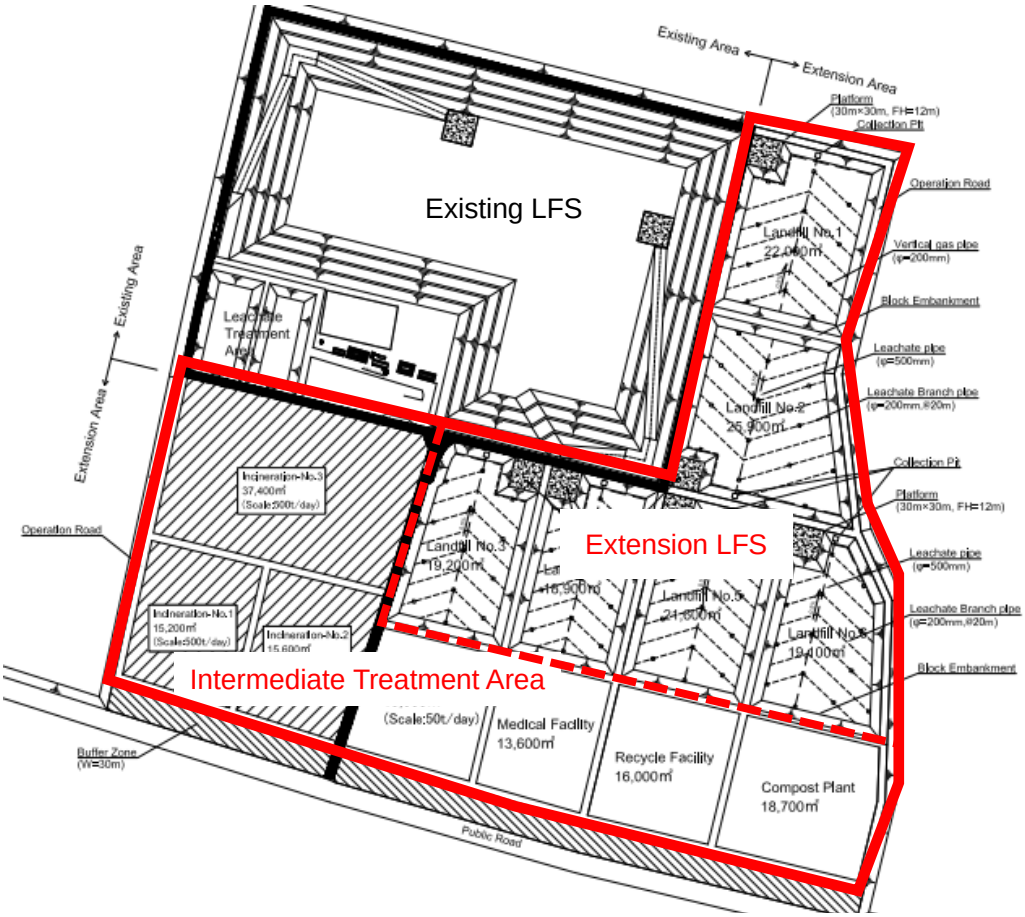
5.8.5 Develop Future LFS [C7-O4]

(1) Amin Bazar Extension Area

1) Layout and Outline

DNCC is preparing to develop an extension of the existing Amin Bazar LFS, and to install intermediate treatment facilities within the site (Amin Bazar Eco-Town). DNCC submitted the DPP to the LGD in December 2018 to apply for a grant from GoB. The grant covers the land acquisition and development cost; however, the construction cost of the facility is not included.

The layout plan of the extension LFS is shown in Fig. 5-18, and the outline of the extension area is summarized in Table 5-23. At the extension area, the semi-aerobic method will be introduced, and municipal waste in DNCC will be received. The extension LFS is composed of an embankment, liner, leachate collection pipe, gas vent pipes, access road, operation road, and dumping platform.



Source: JICA Project Team

Fig. 5-18 Layout Plan of Amin Bazar Extension LFS

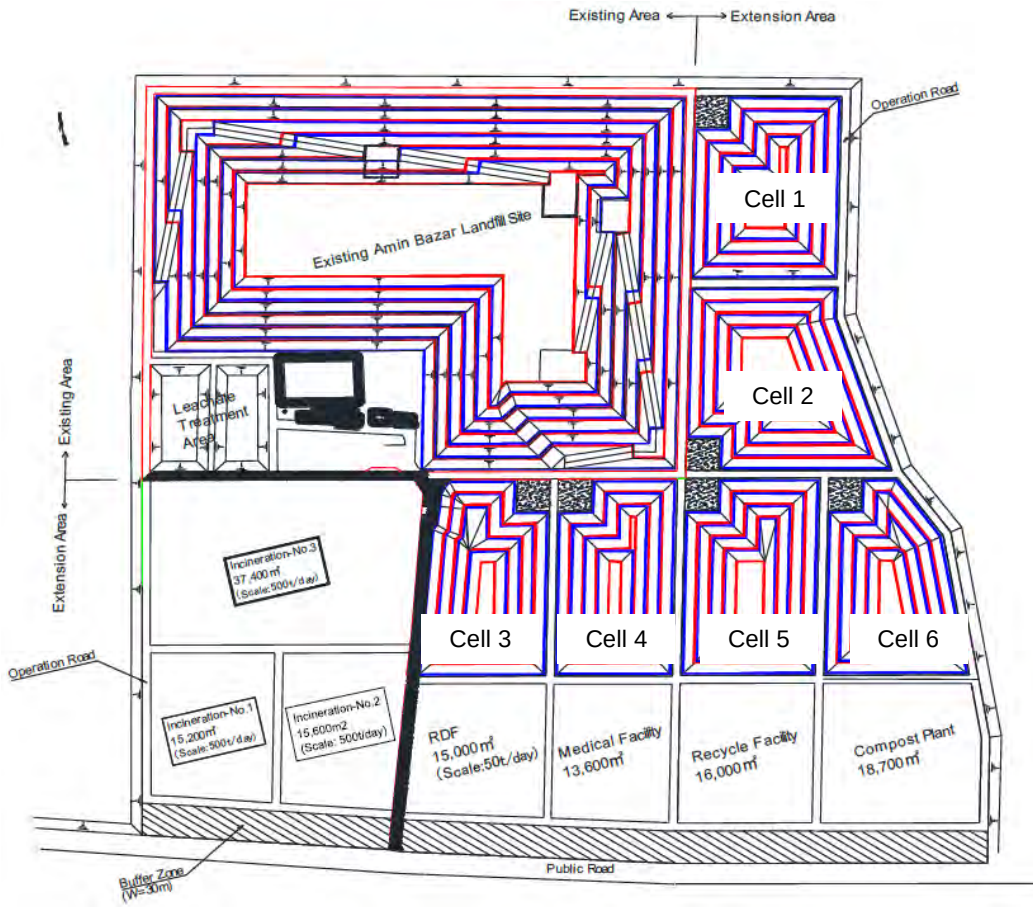
Table 5-23 Outline of Amin Bazar Extension Area

Item	Description
Current situation	DPP has been submitted to GoB and now under review (as of July 2019)
Type of receiving waste	Municipal waste
Target receiving area	Entire DNCC area including new 36 wards
Operating hours	From 10:00 p.m. to 6:00 a.m. local time
Area	26 ha (New landfill area:13 ha, Intermediate treatment (Eco-town) area:13 ha)
Landfill system	Semi-aerobic method
Main facilities	Embankment, liner, leachate collection pipe, gas vent pipes, access road, operation road, dumping platform

2) Waste Disposal Plan

(i) Utilization of Each Landfill Cell (Height up to 20 m)

The extension area includes six landfill cells. At first, waste will be disposed in each cell up to a height of 20 m. To treat leachate as little as possible, it is highly important to use the cells one by one. The capacity for waste disposal in the extension area will be 1,676,863 m^3 in total.



Source: JICA Project Team

Fig. 5-19 Proposed Final Layout of Extension LFS (Height of 20 m)

(ii) Integration of All Landfill Cells (Height up to 30 m)

Integration of the whole extension cells as one large landfill cell up to a height of 30 m is proposed to further extend the lifespan of the LFS. Waste will be disposed of in the gap space between the existing LFS and the extension LFS cells. After the height reaches 20 m high, the extension LFS will be filled to 10 m more, the same height as the existing landfill. The proposed final layout is shown in Fig. 5-20. The capacity for waste disposal in the integrated area will be 4,095,613 m^3 in total.

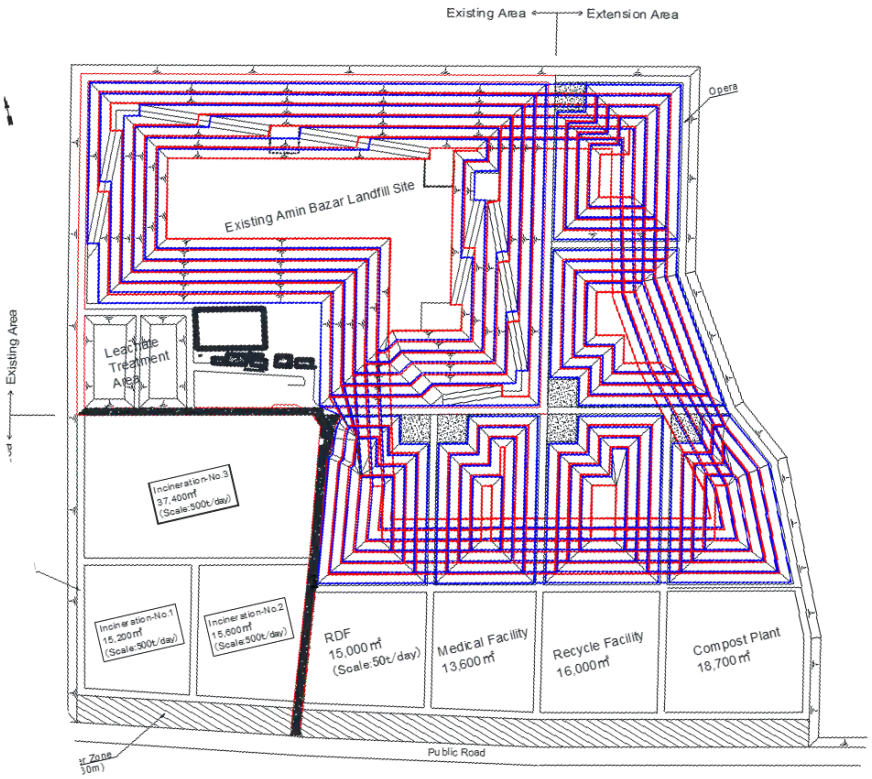


Fig. 5-20 Proposed Final Layout of Extension Area (Height of 30 m)

(2) Nasirabad New Landfill Site

1) Layout and Outline

The Nasirabad new LFS is planned for establishment in Nasirabad and includes installation of intermediate treatment facilities (Nasirabad Eco-Town). DPP for the Nasirabad new LFS is currently under preparation by the DNCC. The cost of the land acquisition and development would be borne after the DPP is approved by the ECNEC.

The layout plan of the proposed new LFS is shown in Fig. 5-21, and the outline is summarized in Table 5-24. All types of waste except tannery waste and medical waste in DNCC will be received in the new LFS, introducing the semi-aerobic method. The new LFS is composed of an embankment, liner, leachate collection pipe, gas vent pipes, access road, operation road, and dumping platform.

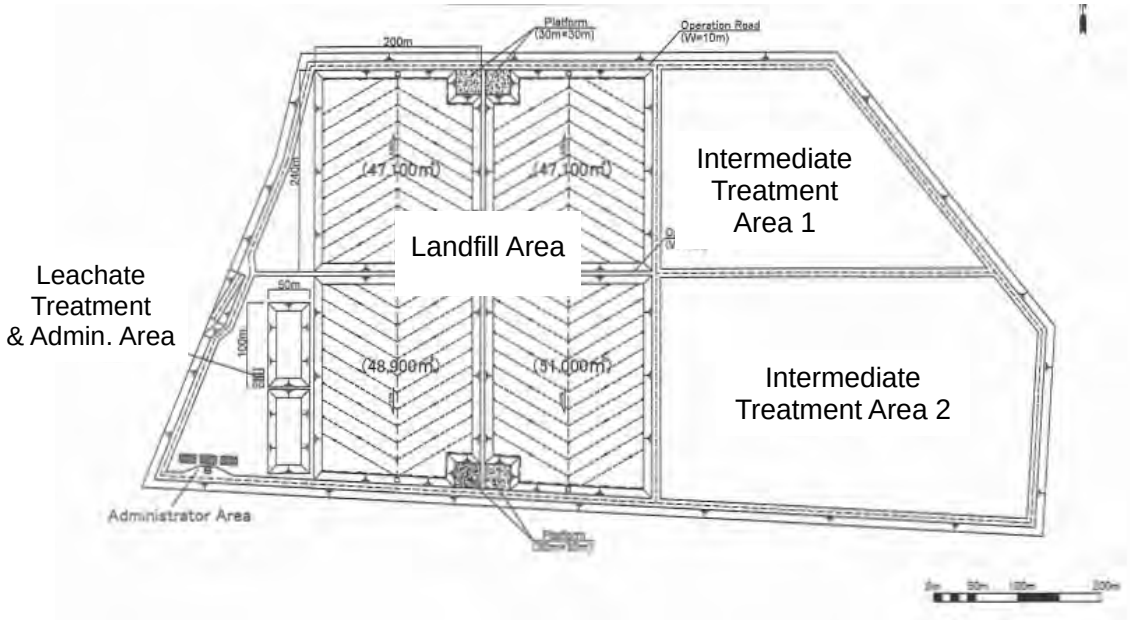


Fig. 5-21 Layout Plan of Nasirabad New LFS

Table 5-24 Outline of Nasirabad New LFS

Item	Description
Current situation	DPP has been submitted to GoB and is now under review (as of July 2019)
Type of receiving waste	All types of waste (mostly domestic waste and business waste, except tannery waste and medical waste)
Target receiving area	Entire DNCC area including new 36 wards.
Operating hours	From 10:00 p.m. to 6:00 a.m. local time
Area	39 ha (New landfill area: 20 ha, Intermediate Treatment (Eco-town) area:19 ha)
Landfill system	Semi-aerobic method
Main facility	Embankment, liner, leachate collection pipe, gas vent pipes, access road, operation road, dumping platform

2) Waste Disposal Plan

(i) Utilization of Each Landfill Cell (Height up to 20 m)

As shown in Fig. 5-22, the new LFS includes four landfill cells, and each cell is planned to be filled until reaching 20 m in height. In order to treat the leachate as little as possible, it is highly important to use the cells one by one. The capacity for waste disposal in the new LFS will be 3,250,157 m^3 in total.

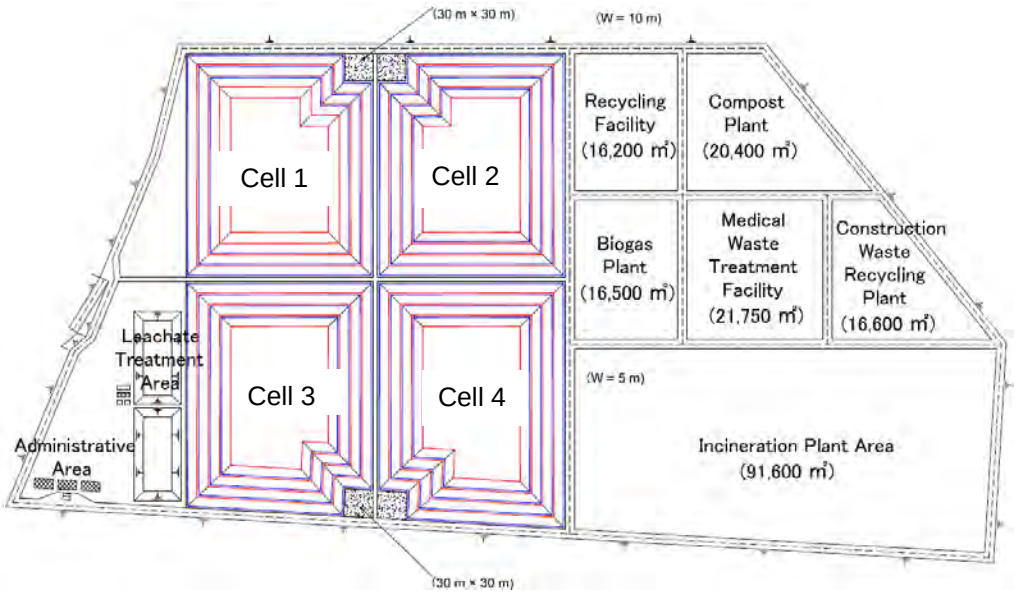


Fig. 5-22 Proposed Final Layout of Nasirabad New LFS (Height of 20 m)

(ii) Integration of All Landfill Cells

Integration of all cells as a large landfill cell up to a height of 30 m is proposed to further extend the lifespan of the new LFS. The proposed final layout is shown in Fig. 5-23. The capacity for waste disposal in the integrated area will be 4,097,620 m^3 in total.

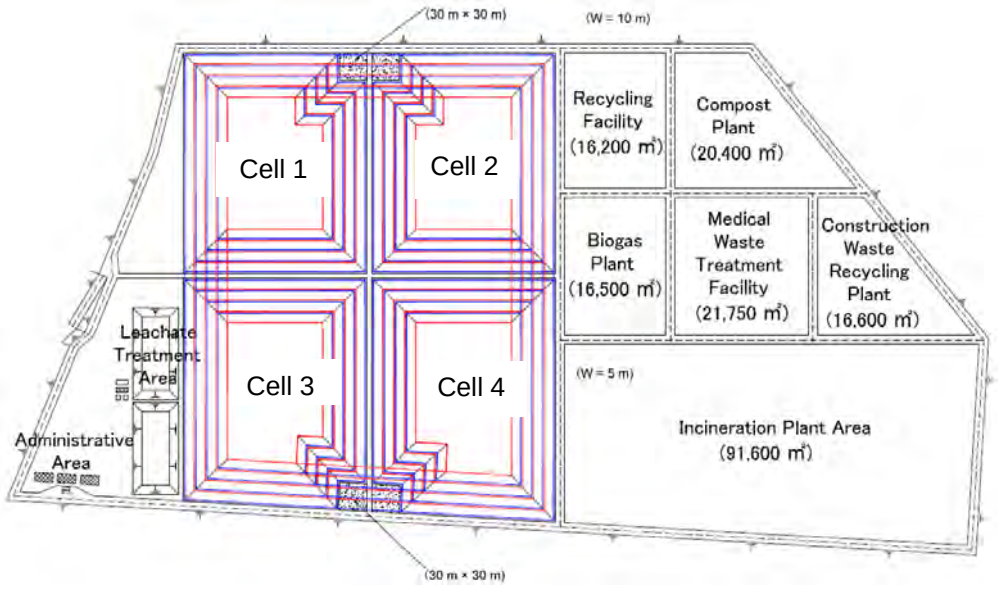


Fig. 5-23 Proposed Final Layout of Nasirabad New LFS (height of 30m)

5.8.6 Estimated Final Disposal Amount

The estimated annual final disposal amount until 2032 is shown in Fig. 5-24. The amount of waste will increase until 2023 owing to population growth. After the installation of an incineration plant in 2024, the amount of waste for final disposal will decrease drastically to about half.

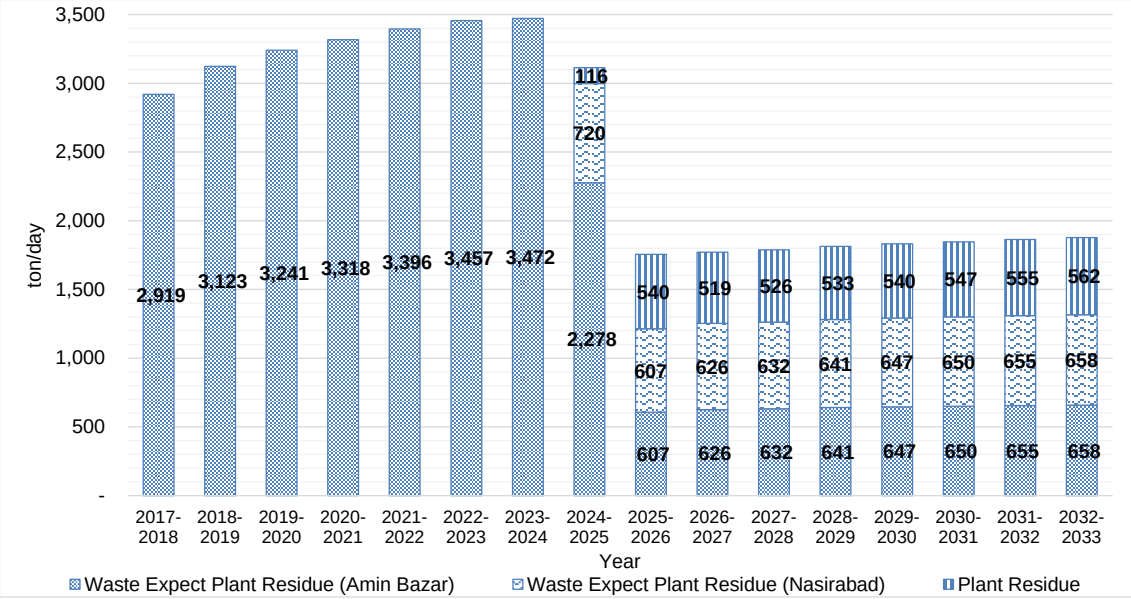


Fig. 5-24 Transition of Estimated Final Disposal Amount

5.8.7 Budget Plan for Landfill Development, Operation, and Maintenance

The budget plan for landfill development, operation, and maintenance is proposed as shown in Table 5-25. The staff salary is estimated on the basis of the abovementioned staff deployment plan. Fuel cost is estimated based on the actual cost in 2017 and the increasing rate of the final disposal amount. Electricity is estimated according to the actual cost in 2017 multiplied by the number of the LFSs. Other costs are estimated according to the actual unit cost in the past based on the estimated final disposal amount. Proposed budget is about Tk. 30,898 million in total, expecting to be prepared by GoB and international donors. Operation maintenance budget is about Tk. 5,946 million in total, borne by DNCC. In 2030, when the Amin Bazar extension LFS is nearly full, the DNCC should start another new landfill site preparation; thus, the cost of the new LFS development is expected from 2030.

Table 5-25 Budget Plan of Landfill Development, Operation, and Maintenance

DNCC	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total
Priority Project	←	—	→														
Amin Bazar LFS																	
Existing LFS																	
Operation	←	—	—	—	→												
Extension LFS																	
Design & Construction		←	—	—	→												
Operation						←	—	—	—	—	—	—	—	→			
Nasirabad New LFS																	
Design & Construction			←	—	—	→											
Operation							←	—	—	—	—	—	—	—	—		
New LFS																	
Design & Construction															←	—	
DNCC Own Revenues	305	327	329	330	332	348	388	390	393	396	399	402	406	409	413	378	5946
Grant from GoB/International Donors	554	8133	13808	0	135	0	0	0	0	0	0	0	0	8133	135	0	30898

Source: JICA Project Team analysis of DPP draft submitted to LGD

5.9 Rules and Regulations (Component 8)

5.9.1 Conduct Daily Solid Waste Management Work in Compliance with Administrative Procedure Book [C8-O1]

The SWM Administrative Procedure Book, or the Admin Book, describes the formal steps and the authority of the administrative procedures. Moreover, it helps to provide a mutual understanding between the applicants and approvers of the proposal, such as the CI, CO, EE, and CWMO.

Training sessions and workshops for DNCC staff and related stakeholders are required to disseminate the process written in the Admin Book. The Admin Book will be revised regularly in accordance with the revision of laws and orders, and with practical experiences. A review committee for the development of the Admin Book will be established to include the CWMO, sub-group leaders of the WBA Core Group, legal staff, and financial staff.

5.9.2 Enact Solid Waste Management related Orders and Waste Management Department Directives [C8-O2]

Office orders are one of effective tools to stimulate the WMD's work. The WMD should issue them in a timely manner in order to avoid delaying important waste management activities.

The existing WMD directives, approved in 2012, states the framework of WMD's activities for the following five years. The updated version of the directives should be in place for maintaining the consistency of the current activities, based on this Master Plan. It is essential that the draft of new WMD directives be discussed thoroughly and endorsed by the SWMSC, and then officially approved by the mayor. SWMSC, which was originally planned as part of the previous JICA project in 2011, basically aims to monitor the overall WMD activities and to offer advice for waste management improvement. The SWMSC is responsible for discussing not only WMD directives but also other WMD's rules and regulations, and the institutional system. The committee consists of representatives from DNCC management officials, ward councilors, experts from academia, NGOs, and other related

organizations, and communities, and holds meetings regularly. The PAPS takes a liaison role for committee activities and prepares the meeting minutes for public disclosure.

5.10 Organizational Capacity (Component 9)

5.10.1 Strengthen Planning, Coordination, Monitoring, and Evaluation Capacity of DNCC [C9-O1]

(1) Organizational Reform of Waste Management Department

Before the first Master Plan, the Conservancy Department was established to deliver the solid waste management services of the Dhaka City Corporation. However, this department had severely suffered from the lack of engineering and technical staffs, and operational logistics management.

With the passage of time, through the formulation of the first Master Plan in 2005 and the efforts of JICA's technical cooperation project, the aforementioned crisis was gradually minimized. The unified conservancy service and engineering activities for solid waste management gradually started. MLGRD&C approved the new organogram as Waste Management Department (WMD) in 2008. In this organogram, the engineering wing was newly added to the traditional conservancy wing to form a new upgraded waste management department, where engineering activities like landfill management, workshop management, collection management etc. were included. In the conservancy wing, ACWMOs to promote WBA were introduced as new posts. This organogram dissolves the Chief Conservancy Officer post by CWMO.

In this Master Plan, the Research, Development & Planning (RDP) wing is proposed to facilitate the Intermediate Treatment (Eco-Town) Section and Project Section. Under the office of Additional CWMO, Public Awareness Planning Section and Human Resource Development Section are proposed parallel to the initially established Zone circles.

In addition to the Engineering Division and the Waste Collection Division in the WMD, establishment of the Management Division is newly proposed in this Master Plan to enhance the planning, coordination, monitoring, and evaluation capacity of the department. Fig. 5-25 and Fig-5-26 describes the new organizational structure of the WMD. Most of the sections are to be newly established.

The Management Division includes four sections as described below.

- Planning and strategy Section: This section is responsible for SWM planning, business operation and improvement, short-term business policy, data collection and management, coordination with other departments, business administration, internal audit, research and technological development, and emergency response.

- Rules and Regulation Section: This section works for regulatory related issues such as WMD directives development and revision, the admin book development and revision, office order issuance and management, and other document management.
- Personnel Management Section: This section is responsible for staff allocation planning, capacity building of WMD staff and training, labor management and welfare, and occupational safety.
- Public Awareness Planning Section: This section is responsible for public awareness solely in waste management to plan and implement DNCC's awareness raising activities. The detail of the section is referred as to Section 5.2.1.

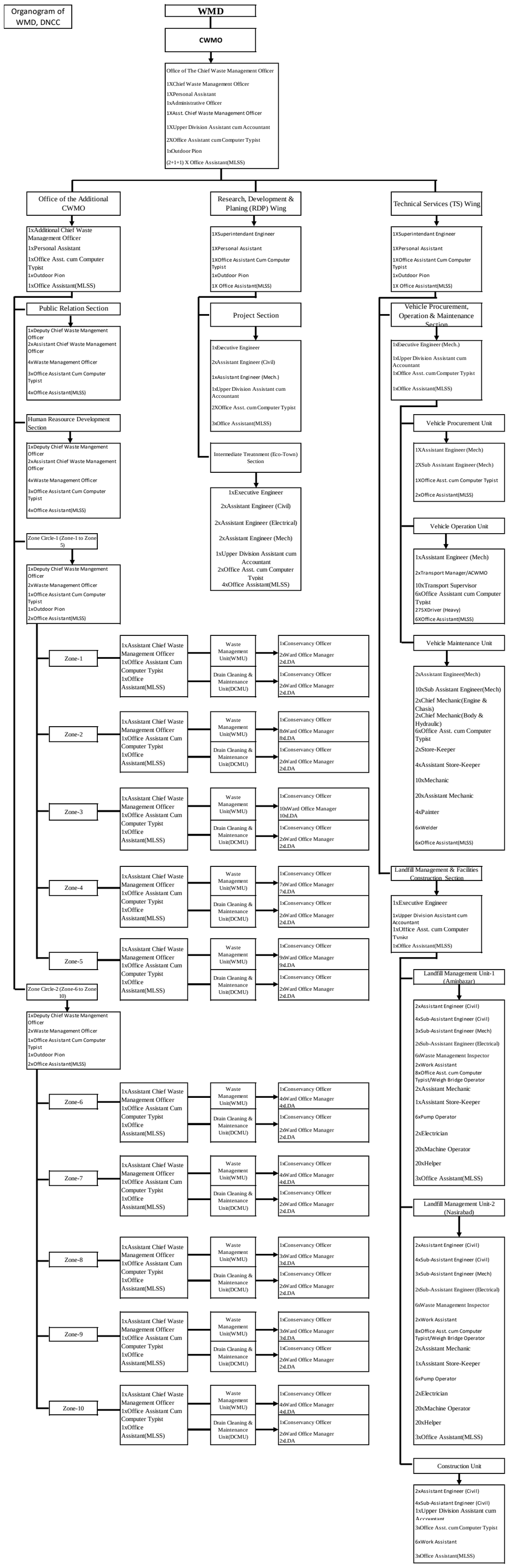


Fig. 5-25 Proposed Organization Structure of WMD

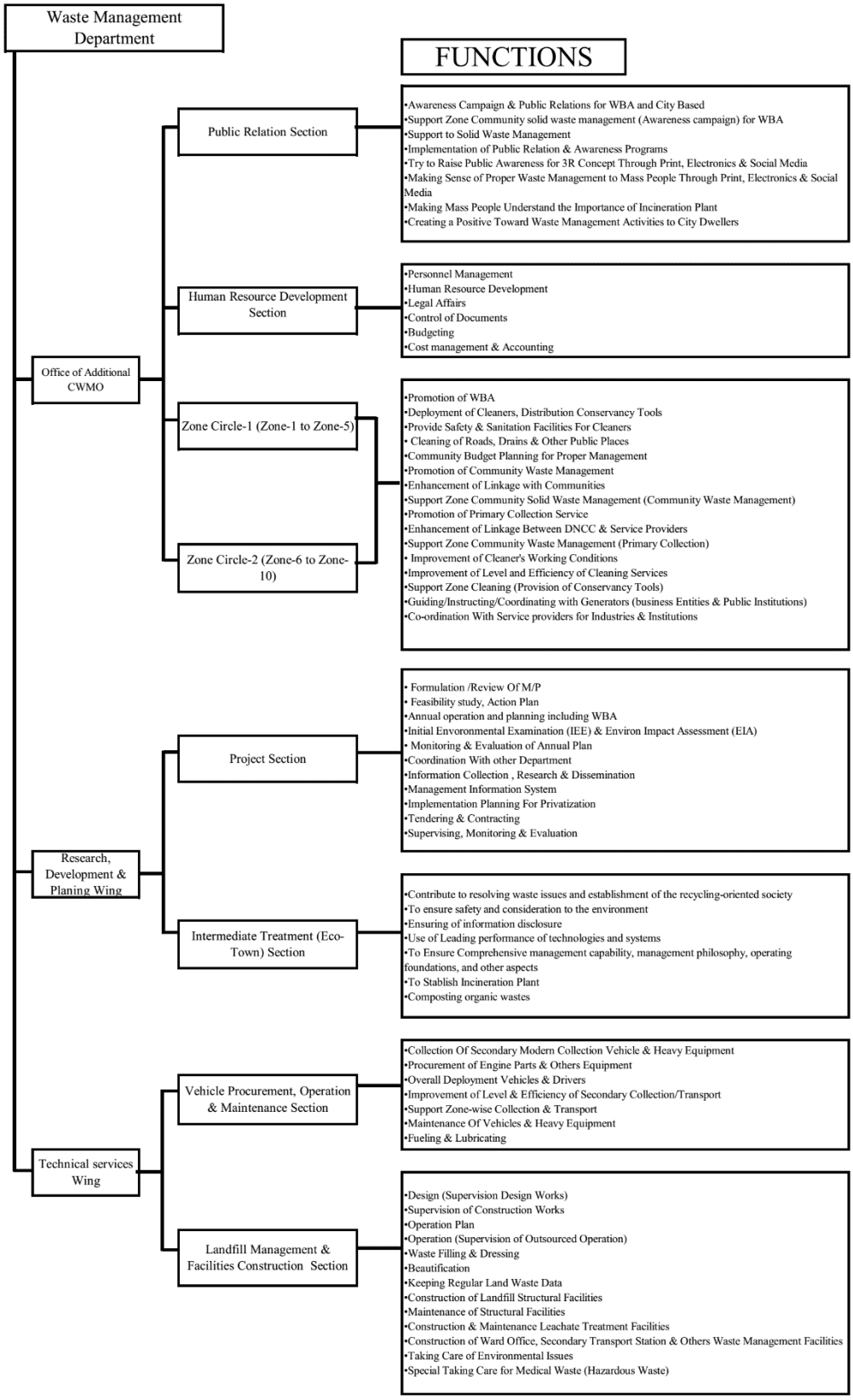


Fig. 5-26 Proposed Organization Structure of WMD with Functions

(2) Capacity Development Program

1) Capacity Development of Management Personnel

Capacity development of the WMD staff, especially management personnel, is inevitable to reinforce the organization and human resources management for providing continuous service to citizen.

Job descriptions and the roles and responsibilities of each position as well as the command chains in the WMD need to be clarified to establish a smooth and dependable SWM system from top management to the field level and vice versa. This will enhance the institutional resilience of the WMD in response to the rapid economic growth and social changes. Temporary exchange of staff among management personnel and field officers may be considered for mutual understanding of their works in a practical manner.

2) Occupational Safety and Sanitation Management (WBA 2)

Risk for occupational accidents and disease must be avoided. For improvement of the cleaner's working environment, three objectives are implemented in WBA 2 to raise awareness on safety and sanitation: i) to provide safety gear, ii) to formulate the "Safety and Sanitation Committee (SSC)," and iii) to introduce the "Cleaner's working manual." For further improvement, it is necessary to develop rules and regulations on occupational safety such as safety regulations and accident compensation.

3) Staff Training Course

Staff training depending on their positions in the WMD is very important to strengthen individual and institutional capacities. The training unit of the Personnel Management Section provides SWM training courses regularly for the staff. An example of the training course for management personnel is shown below. In addition to such a program, technical training courses for technical personnel are provided.

[Example of Staff Training Course]

- Labor management
- Organization management
- Time management
- Presentation skill
- Logical thinking
- Budget management
- Policy making
- Strategy development
- Risk management
- Leadership
- Personnel management
- Personnel evaluation
- Information disclosure
- Basic theory of SWM

4) Collaboration with Educational and Research Institution

SWM is an emerging field for research and development in public administration, universities, and companies for new technology and its implementation. DNCC therefore promotes collaboration with universities and companies to strengthen the SWM field in terms of waste management sustainability.

5.10.2 Cover Collection and Transport Work, Cooperation Vehicle Operation and Landfill Operation Work Exclusively in WMD [C9-O2]

(1) Engineering Division

The Engineering Division is expected to lead the installation of modern technology, including development of the intermediate treatment in Eco-Town. The division includes five sections as described below.

- Technical Procurement Section: This section is responsible for procurement of collection-related equipment, heavy vehicles for landfill management, spare parts, maintenance tools, and expendables, and for purchase processing, record keeping, and efficient purchase planning.
- Vehicle Maintenance Section: The section is originally in the ED and expected to be transferred to the WMD. Once transferred and unified to the WMD, this section should be more systematic and strategic for vehicle maintenance. The section is responsible for maintenance-related works not only implementation of vehicle maintenance, but also budget planning, regulation compliance, occupational safety, staff trainings, policy making, development of a maintenance plan, internal restructuring, and staff allocation and management.
- Intermediate Treatment (Eco-Town) Section: This section is established for intermediate treatment including WtE plants and Eco-Towns, responsible for their planning and construction, operation and maintenance, data collection and management, legal processing, staff allocation, and securing budget.
- Landfill Management Section: This section is responsible for landfill planning and construction, operation and maintenance, data collection and management, legal processing and coordination, staff allocation, and securing budget.
- Facility Construction Section: This section works for facility planning, development and management such as ward offices, workshops, parking lots, and facility management. Facilities such as landfill sites, and Eco-Towns are out of its responsibility but for the Intermediate Treatment Section and the Landfill Management Section, as mentioned above. The section is also responsible for data collection and management, legal processing and coordination, staff allocation, and securing budget.

(2) Waste Collection Management Division

The Waste Collection Management Division is proposed to unify conservancy (cleaning) services and waste collection in a consolidated manner. All waste collection vehicles have to be managed by the WMD, which is the critical point to realize the organizational reform as proposed. The Waste Collection Management Division includes four sections as described below.

- Waste Collection and Transport Section: The section is responsible for waste collection planning, data collection and management, and effective collection system development,

execution of waste collection, legal processing and coordination, staff allocation, and securing budget.

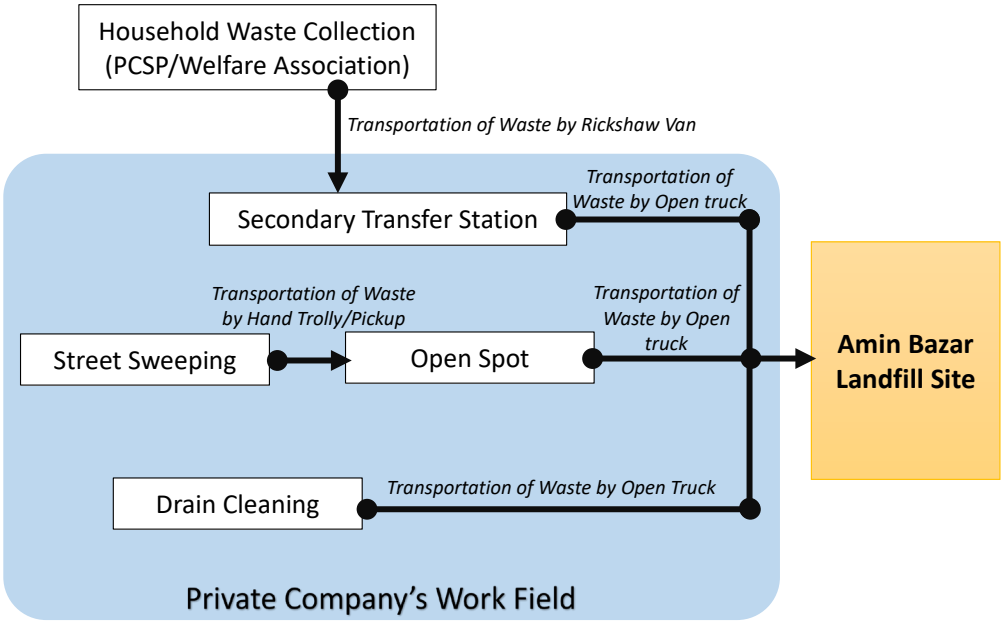
- WBA Management Section: The section is responsible for WBA planning and implementation, data collection at ward level, WBA maintenance, ward office administrations, coordination with WBA related stakeholders, CI allocation, securing budget, and field level implementation of the admin book.
- Community Budget Management Section: The section works for community budget allocation for WBAs to ward offices, and management of the budget.
- Public Cleaning Section: The section is responsible for management planning on road, drainage cleaning, and market wastes, staff allocation, securing budget, and cleaning tool procurement planning.

(3) Privatization

Privatization of a certain field of SWM is effective, although proper management of the contract and supervision of the daily operation of the private waste management company by the WMD are essential. Examples of the potential privatized roles are given below.

(i) Collection of household waste from STSs
(ii) Street cleaning of designated ward area
(iii) Transport of street waste to open spots by hand trolley/pickup van
(iv) Transport of waste at STSs and open spots to Amin Bazar LFS
(v) Transport of drain cleaning waste to Amin Bazar LFS
(vi) Management of Amin Bazar LFS

A potential working field of privatization is shown in Fig. 5-26.



Source: JICA Project Team

Fig. 5-27 Potential Field of Privatization

5.11 Financial Management (Component 10)

5.11.1 Reform SWM Accounting System for Budgeting and Cost Control [C10-O1]

(1) Accounting System Modification and Annual Budget Report

In the current accounting system, the actual SWM cost is not managed by category, and the validity of the cost cannot be assessed. Such accounting system should be modified to explicitly exhibit the actual SWM cost, and DNCC should prepare an annual budget report to secure accountability to citizens as a public service and to enlighten the validity and issues of the expenditure, while considering the budget of the following year.

(2) Financial Assessment

Financial assessment should be introduced with two objectives: i) to secure the accountability to citizens and ii) to enhance the accuracy of the WMD's budget request. Standard values for the budget planning need to be set, which enable the WMD to assess the validity of the draft budget plan. Examples of the standard value are show in Table 5-26.

Table 5-26 Example of Standard Value for Financial Assessment

Item	Standard value
Road working distance per cleaner	0.3 km/person/day
Drainage cleaning distance per cleaner	0.2 km/person/day
Waste collected daily per cleaner	2.0 tons/person/day
Fuel consumption by compactor per ton of waste	2.0 L/ton
Fuel consumption by container carrier per ton of waste	2.5 L/ton

Source: Project Completion Report of "Project for Strengthening of Solid Waste Management in Dhaka City (Extension) (2013)"

5.11.2 Enhance Financial Capacity for Master Plan Implementation [C10-O2]

(1) Reassessment of Conservancy Tax Rate

DNCC collects holding tax including four types of taxes from citizens: i) building and land tax, ii) water tax, iii) lighting tax, and iv) conservancy tax rate. Holding tax is calculated by multiplying the holding tax rate per square foot, which is officially set in each ward, and the house or flat size. The housing or flat value is assessed annually by the Revenue Department and is based on the valuation, to determine the amount of tax payment.

The waste treatment cost is allocated from the conservancy tax. However, the four abovementioned taxes are not managed separately, and it is unclear how much in fact is collected as conservancy tax. Currently, conservancy tax is collected only for 2% of the housing or flat value, although it can be increased up to 7% in line with the tax regulation[13]. In case of large-scale investment by the GoB in SWM infrastructure such as a WtE facility, the operation cost of such infrastructure should be borne essentially by citizens, and the "polluter pay" principle should apply to the conservancy tax. Increase of the conservancy tax rate should be carefully considered in the long term.

(2) Financial Allocation for the Master Plan Implementation

DNCC will prepare a long-term financial plan to realize this Master Plan. For large-scale investment mentioned in this document such as Eco-Town construction, subsidies from the national government and foreign donors may be considered, depending on the development characteristics. However, the operation cost of the WMD facilities and regular public cleaning services should be covered thoroughly by DNCC with the conservancy tax income. The required capital and operation costs are discussed further in Chapter 6.

[13] "City Corporation Ideal Tax Schedule, 2015" defines that the conservancy tax rate is up to 7%.

5.12 Medical Waste Treatment

5.12.1 Establishment of Proper Organizational Structure

Medical waste management is basically a responsibility of DNCC, and PRISM is partially covering this area at present under the contract. The current privatized system may be sustained under the proper supervision of the DNCC because it is autonomously operated up to today. However, the DNCC should implement an audit system for medical waste treatment operated by private companies or NGOs, with regular inspection to make sure their operation.

5.12.2 Improvement of Existing Medical Waste Treatment

Table 5-27 shows the estimated daily amount of medical waste from 2018 to 2032, which is expected to increase 12.56%[14] per year.

Table 5-27 Estimated Daily Amount of Medical Waste

Year	Infectious (kg)	Sharp (kg)	Recyclables (kg)	Total (kg)
2018	4,567	834	689	6,090
2019	5,141	939	776	6,855
2020	5,786	1,057	873	7,716
2021	6,513	1,189	983	8,685
2022	7,331	1,339	1,106	9775.8
2023	8,252	1,507	1,245	11,004
2024	9,288	1,696	1,401	12,386
2025	10,455	1,909	1,577	13,941
2026	11,768	2,149	1,775	15,692
2027	13,246	2,419	1,998	17,663
2028	14,910	2,723	2,249	19,882
2029	16,782	3,065	2,532	22,379
2030	18,890	3,450	2,850	25,190
2031	21,263	3,883	3,208	28,354
2032	23,934	4,371	3,611	31,915

Source: JICA Project Team

(1) Waste Treatment Method

1) Waste Discharge

Waste segregation by using different bins has been already introduced. When the number of target HCEs increase, the same methodology can be applied.

[14] Growth rate is set based on the average growth rate of medical waste amount generated from 2013 to 2018 and the draft of "Medical Waste Management Policy" issued by the Ministry of Health and Family Welfare in 2016.

2) Waste Collection and Transport

Current waste collection covers 450 HCEs in DNCC and 350 in DSCC. Both wastes are transported to Matuail LFS for treatment. To collect waste efficiently, separation of the waste collection system in DNCC and DSCC needs to be considered.

3) Intermediate Treatment

Infectious waste has to be autoclaved (having the moisture content more than 33%) and incinerated (moisture less than 33%). It is assumed, based on the existing proportion of waste composition and treatment options, that 65% of infectious waste will be incinerated, 30% will be autoclaved and 5% will be buried.

It is desirable to separate an intermediate treatment in the DNCC from the Matuail LFS in DSCC. As one of intermediate treatment facilities in Nasirabad Eco-Town, the Nasirabad new LFS can be considered as a location of a new treatment plant. Table 5-28 shows the estimated amount of infectious and sharp waste and the necessary capacity of the treatment facility. When 80% of all infectious waste is incinerated, which is the same as the current state and capacity of incinerator when set as 3,000 kg/day, two to eight incinerators will be needed.

Table 5-28 Estimated Infectious and Sharp Waste Generation and Required Treatment Facility

Year	Annual Incineration (Infectious, Sharp)	Incinerator (Operation : 240 days*, 24 hours) (Capacity of Unit : 3,000 kg/day/unit)	
		Required Capacity	Required Incinerator
	Ton	kg/day	Unit
2018	1,971	4,271	2
2019	2,219	4,808	2
2020	2,498	5,412	2
2021	2,811	6,091	3
2022	3,165	6,857	3
2023	3,562	7,718	3
2024	4,009	8,687	3
2025	4,513	9,778	4
2026	5,080	11,006	4
2027	5,718	12,388	5
2028	6,436	13,945	5
2029	7,244	15,696	6
2030	8,154	17,667	6
2031	9,178	19,886	7
2032	10,331	22,385	8

*Except holidays
Source: JICA Project Team

4) Final Disposal and Recycling

A final disposal pit can be allocated within the area of Nasirabad LFS. Shredded and incinerated waste can be disposed of at the LFS in the same manner as other general waste. Recycling may also be performed easily in the Eco-Town with other recycling companies.

(2) Cost of Construction, Operation, and Maintenance

The budget for eight incinerators by 2032 is estimated to be Tk. 1.5 billion. The O&M cost for future medical waste management is estimated in Table 5-29. Apart from the cost of the incinerators, a budget increase up to the doubled, that is around 0.84 million BDT/day is required in DNCC in 2032. Tariff will need to be reviewed if PRISM looks after its operation by the time.

Table 5-29 Annual Cost Estimation for Medical Waste Treatment

Year	Amount of Waste for Incineration	Incinerator (million BDT)			Other cost (million BDT)	Total (million BDT)
	kg/day	Purchase	Operation	Maintenance		
2018	4,271	384	66	15	19	484
2019	4,808		66	15	21	102
2020	5,412		66	15	24	105
2021	6,091	192	99	23	27	341
2022	6,857		99	23	30	152
2023	7,718		99	23	34	156
2024	8,687		99	23	38	160
2025	9,778	192	132	30	43	397
2026	11,006		132	30	49	211
2027	12,388	192	165	38	55	450
2028	13,945		165	38	62	265
2029	15,696	192	198	46	69	505
2030	17,667		198	46	78	322
2031	19,886	192	231	53	88	564
2032	22,385	192	264	61	99	616

Source: JICA Project Team

5.12.3 Improvement of Segregation and Enhancement of Facilities

As mentioned earlier, medical waste segregation is implemented only six categories out of 11. For the liquid waste, an effluent treatment plant needs to be installed in large hospitals or established as a centralized facility. Proper waste water tankers and storage tanks in the hospital need to be equipped when the centralized facility is established. Size of facilities and equipment needs to be determined after the survey of liquid waste generation. Required facilities differs according to the type of liquid such as infectious, examination and dialysis.

Bangladesh Radioactive Energy Commission needs to instruct HCEs for proper segregation and storage of radioactive waste. Specialized containers, storages and trucks need to be provided as well as proper disposal site.

Solid pharmaceutical, chemical, anatomical and pathological waste can be collected together with the infectious waste when proper incinerators are installed and no further segregation after collection is desirable to avoid hazards in operation. Liquid pharmaceutical and chemical waste need specialized treatment plant separately from the liquid waste and separate collection is required.

Most of the facilities for medical waste are highly specialized. Hence, it is desirable to be privatized for each category of waste after proper survey and cost estimation. Capital investment of facilities is potentially high, thus the public-build-private-operate scheme together with financing by international donors can be considered. Overall plan needs be discussed in key stakeholders, such as the Medical Waste Management Committee of DNCC.

CHAPTER 6 FINANCIAL REQUIREMENTS

6.1 Total Budget

The required total budget to achieve the goal of the Master Plan is estimated at Tk. 98,300 million for 15 years, including Tk. 52,300 million for the capital cost and Tk. 46,300 million for the operating and management cost, as shown in Table 6-1 and Table 6-2. This budget considers all intermediate treatment facilities (Eco-Towns), described in the previous Chapter, to be constructed and operated by the DNCC, private sector, or other entities, with assuming a WtE facility by DNCC. This Chapter discusses on financial requirements of DNCC in this case.

Table 6-1 Capital Cost and O&M Cost from FY 2018–2019 to FY 2032–2033

Unit: million BDT

Cost and Financial Sources		Budget
Capital Cost (Intermediate treatment (Eco-Town), collection vehicles and equipment, etc.)		**52,300**
	DNCC (Revenue Income) (4%)	2,092
	Central Government, Foreign Donors and Private (Development Income) (96%)	5,208
Operating and Management Cost (for 15 years)		**39,855**
	DNCC (Revenue Income) (100%)	39,855
	Central Government, Foreign Donors and Private (Development Income) (0%)	–
	Total Budget	**92,155**

Source: JICA Project Team analysis based on "DNCC Budget Book 2017–2018" and information from DNCC

Table 6-2 Breakdown of Capital Cost from FY 2018–2019 to FY 2032–2033

Unit: million BDT

Capital Cost		Budget
(1)	**Landfill Construction Cost**	**30,898**
	Priority Project	554
	Development of Amin Bazar New Extension LFS	8,133
	Development of Nasirabad LFS	13,808
	Development of New LFS	8,133
	Safety Closure	270

(2)	**Total Eco Town Construction Cost**	**20,360**
	Recycling Plant	820
	Composting Plant	820
	Biogas Plant	4,900
	Construction Waste Recycling Plant	820
	Incineration Plant	13,000
(3)	**Waste Collection Vehicle Procurement Cost**	**986**
(4)	**Ward Office Construction Cost**	**36**
(5)	**STS Construction Cost**	**90**
	Total Capital Cost	**52,300**

Source: JICA Project Team analysis based on "DNCC Budget Book 2017–2018" and information from DNCC

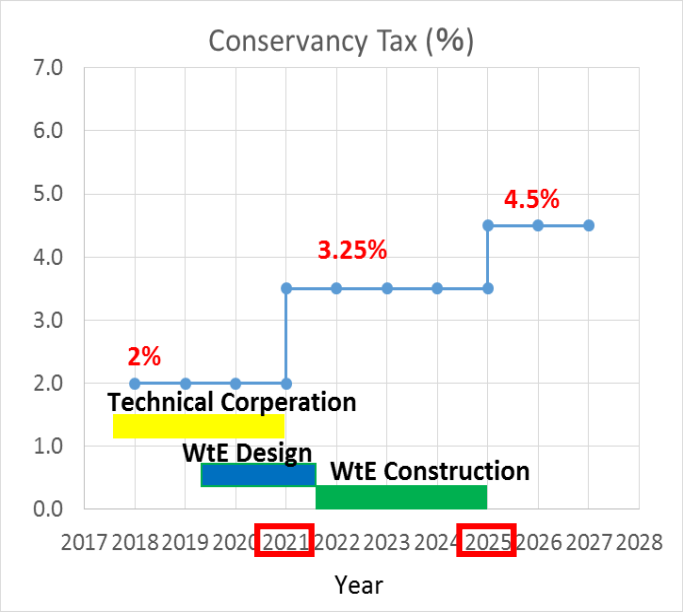
6.2 Financing Plan

6.2.1 Securing Capital and O&M Cost

In order to secure capital and O&M cost of the DNCC for the next 15 years as mentioned in Table 6-1, three measures are considered: i) increase in the conservancy rate, ii) sale of excess electricity generated in the WtE facility, iii) fee collection from large scale waste dischargers.

(1) Conservancy Tax Rate Raise

The conservancy tax rate can be legally defined from 2% to 7%. Currently, DNCC has adopted 2%, the lowest tax rate. The conservancy tax will be raised from the current 2% to 4.5%, and the raised portion will be used for O&M for the intermediate treatment facilities in the Eco-Towns. As shown in Fig. 6-1, the plan is to raise the rate in two steps: the first step to 3.25% at the design stage of the WtE facilities, and the second step to 4.5% by the time of the construction completion. The tax collection, estimated at approximately Tk. 475 million or 5.7 million USD per year with the rate of 2% in 2017, will be increased to Tk. 1,163 million or 14 million USD per year with the rate of 4.5% in 2025, taking into consideration the population increase. The DNCC will thus further secure additional Tk. 688 million or 8.3 million USD per year.



Source: JICA Project Team based on Ideal Tax Schedule 2015

Fig. 6-1 Timing of Conservancy Tax Increment

(2) Sale of Excess Electricity

Electricity generated at the WtE facility will be used as a power source for its equipment, and the surplus electricity will be supplied to the adjacent facilities in the Eco-Town and the landfill site, and neighboring lighting. The annual income of the DNCC from such electricity sales is expected to approximately Tk. 360 million or 4.4 million USD in total, based on the calculation below.

Sales of electricity (USD/year)

= Surplus electricity (kW) x 24 (hrs)
x Days of operation (days/year)
x Unit price (¢/kWh)
x Number of WtE facilities

= 2,500 (kW) x 24 (hrs) x 280 (days/year) x 13 (¢/kWh) x 2 (facilities)*

= Approximately 4.4 million (USD/year)

(3) Fee Collection from Large Volume Waste Dischargers

Waste disposal fees will be collected from large volume waste dischargers such as markets, hotels, restaurants, in order to be used for O&M expenses of the WtE facilities. As shown in Table 6-3, the number of the large dischargers in 2017 was 983. If the fee is collected with an average of 2,000

USD/year per discharger, it will be approximately Tk. 170 million or 2.0 million USD/year. Considering 5% increase in the value per annum, in an average annually 240 million BDT or 2.9 million USD can be secured from 2018 to 2033.

Table 6-3 Fee Collection Plan for Large Volume Waste Dischargers

Discharger	Number	Fee per discharger (USD/year)	Total (million USD/year)
Market	256	2,000	0.5
Hotel and Restaurant	727	2,000	1.5
Total	983	-	2.0

Source: JICA Project Team

6.2.2 Financing Plan from FY 2018–2019 to FY 2032–2033

Details of the financial requirements and budgetary provision of operation and management cost are shown in Table 6-4.

Table 6-4 Budgetary Provision of Operation & Management Cost from FY 2018–2019 to FY 2032–2033

Serial No.	Category	O&M Annual (Million BDT)	Financial Source	Outside Capital Rate
1	**Management**			
(1)	Salary	23	DNCC	0%
(2)	Personnel Training	2	DNCC	0%
(3)	Management Training Cost	3	DNCC	0%
2	**Collection & Transport**			
(1)	Salary	620	DNCC	0%
(2)	Cleaning Tools & Safety Gears	20	DNCC	0%
(3)	Outsourcing / Privatization	800	DNCC	0%
(4)	Drain Cleaning	60	DNCC	0%
(5)	Vehicle Operation(Fuel, Lubricant)	235	DNCC	0%
(6)	Maintenance (Workshop)	140	DNCC	0%
(7)	Special Cleaning Program	100	DNCC	0%
(8)	Collection & Transport Equipment	250	DNCC	0%
(9)	Public Relation & Public Awareness	5	DNCC	0%
3	**Intermediate Treatment Plant (Eco Town)**			
(1)	Salary	6	DNCC	0%
(2)	Facility Maintenance Cost	20	DNCC	0%
(3)	Operation and Maintenance Cost	790	DNCC	0%
4	**Disposal**			
(1)	Salary	58	DNCC	0%
(2)	Fuel	35	DNCC	0%

Serial No.	Category	O&M Annual (Million BDT)	Financial Source	Outside Capital Rate
(3)	Landfill & Heavy Equipment	100	DNCC	0%
(4)	Landfill Maintenance (Civil Structure, Electrical & Leachate Treatment)	150	DNCC	0%
(5)	Electricity	30	DNCC	0%

6.2.3 Validity of Financing Plan

Annual SWM expenditure to be borne by the DNCC is estimated at Tk. 3,447 million per year, while the total income from three measures, mentioned in Section 6.2.1, amounts to approximately Tk. 1,763 million per year which can cover 51 % of the expenditure.

Table 6-5 Total Income from the Measures for O&M

Measures	Income (million BDT/year)
(1) Conservancy Tax Increment (up to 4.5%)	1,163
(2) Sale of Electricity	360
(3) Fee Collection from Large Volume Waste Dischargers	240
Total	1,763

CHAPTER 7 PRIORITY PROJECTS AND PROGRAMS

7.1 Priority Projects and Programs

This Master Plan is focused on 10 major components of waste management in DNCC. Of these, some projects and programs are prioritized and extracted, as shown in Table 7-1, considering the urgency of its implementation. The projects and programs will be a key for opening a new era of "Zero-Waste" that will promote SWM to the highest level ever achieved by its own capacity.

Table 7-1 Priority Projects and Programs

Project and Program		Executing Body	Concerned Body	Time of Execution (FY)
Component 1: Public relations, public awareness, and public involvement				
(1)	Preparation of Public Awareness Planning Section establishment in WMD	WMD	PRD	2017–2021
(2)	Development of information disclosure system	WMD	PRD	2017–2021
(3)	Active involvement on information exchange meetings among all CCs	LGD	All CCs	2018–2032
(4)	Establishment of a PCG for SWM facilities	WMD	PRD, ED, TD	2018–2019
Component 2: WBA activities				
(1)	Improvement and expansion of WBA implementation in wards with encouraging CO/CIs	WMD	-	2017–2032
(2)	Proper community budget allocation with WBA AAP	WMD	-	2018–2032
(3)	Daily work practice in accordance with the administration procedures book	WMD	-	2018–2032
Component 3: Waste reduction				
(1)	Preparation of a waste reduction plan	WMD	DoE	2017–2021
(2)	3R activities through WBA activities	WMD	-	2017–2032
Component 4: Waste collection and transport				
(1)	Examination of collection and transport operation method for the expansion area	WMD	ED, TD	2017–2018
(2)	Introduction of new waste collection system including harmonization of primary collection and secondary collection system	WMD	TD	2017–2021
(3)	Unification of waste collection management	WMD	ED, TD	2017–2021
(4)	Improvement of management for maintenance workshops	WMD	ED, TD	2017–2021
(5)	Capacity development of workers and drivers	WMD	ED, TD	2017–2021

Project and Program		Executing Body	Concerned Body	Time of Execution (FY)
Component 5: Vehicle maintenance system				
(1)	Formulation of workshop management rules	WMD	LGD, ED, TD	2018–2021
(2)	Reform of workshop and maintenance system	WMD	ED, TD	2018–2032
(3)	Introduction of preventive maintenance method	WMD	ED, TD	2018–2032
Component 6: Intermediate treatment system (Eco-Town: WtE, composting, recycling etc.)				
(1)	Propose Eco-town and obtain approval from related organization	WMD	LGD, ERD, DoE	2018–2019
(2)	Implementation of feasibility study for Eco-Town	WMD	LGD, ERD, DoE	2019–2020
(3)	Preparation of construction and operation cost	WMD	LGD, ERD	2020–2021
(4)	Establishment of Intermediate Treatment (Eco-Town) section in the WMD	WMD	LGD, ED	2020–2021
(5)	Capacity development of Intermediate Treatment (Eco-Town) section	WMD	ED	2020–2024
Component 7: Sanitary landfill				
(1)	Improvement of Amin Bazar LFS	WMD	ED	2017–2018
(2)	Securing future LFSs	WMD	LGD, RD, UPD, DoE, RAJUK	2017–2023
(3)	Closure of Amin Bazar LFS	WMD	ED	2020–2021
(4)	Establishment of landfill management section in the WMD	WMD	ED	2017–2018
(5)	Capacity development of the landfill management section	WMD	ED	2017–2021
Component 8: Rules and regulations				
(1)	Preparation and release of the administration procedures manual	WMD	-	2017–2018
(2)	Development of WMD directives through SWMSC	WMD	SWMSC	2018–2032
(3)	Training for rules and regulations provided to DNCC staff, and related stakeholders	WMD	-	2018–2021
Component 9: Organizational capacity				
(1)	Reform of the WMD organizational structure	WMD	ED, TD	2018–2021
(2)	Preparation of an annual activity plan in accordance with the new Master Plan	WMD	ED, TD, RD, AD	2018–2032
(3)	Capacity development of implementing organizations in the WMD for the new Master Plan through training and workshops	WMD	ED, TD	2018–2021
Component 10: Financial management				
(1)	Modification of accounting system to explicitly exhibit the actual SWM cost	WMD	AD, RD	2017–2021

Project and Program		Executing Body	Concerned Body	Time of Execution (FY)
(2)	Securing operation and maintenance cost for intermediate treatment (Eco-Town) development	WMD	LGD, AD, RD	2017–2021
(3)	Financial allocation for Master Plan implementation	WMD	AD, RD	2017–2032
(4)	Development of financial assessment system	WMD	AD, RD	2018–2021

7.2 Schedule for Implementation

Despite the short lifespan of the Amin Bazar LFS at less than 2 years, DNCC faces difficulties in securing land for new LFSs owing to the high cost. Therefore, it is indispensable for DNCC to move from the conventional landfill practice to a new waste treatment system that will reduce the amount of waste disposal while seeking to secure land for a new LFS. This situation indicates that DNCC should begin this Master Plan with no delay.

Table 7-2 shows the schedule of priority projects and programs that should be started during the next five years.

Table 7-2 Implementation Schedule of Priority Projects and Programs

No.	Priority Projects and Programs	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Component 1: Public relations, public awareness, and public involvement																	
(1)	Establishment of a unit for increasing public awareness in the WMD																
(2)	Development of information disclosure system																
(3)	Active involvement in information exchange meetings among all CCs																
(4)	Establishment of a PCG for SWM facilities																
Component 2: WBA activities																	
(1)	Improvement and expansion of WBA implementation in wards with encouraging CO/CIs																
(2)	Proper community budget allocation with WBAAAP																
(3)	Daily work practice in accordance with the administration procedures manual																
Component 3: Waste reduction																	
(1)	Preparation of waste reduction plan																
(2)	Introduce 3R activities through WBA activities																

No.	Priority Projects and Programs	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Component 4: Waste collection and transport																	
(1)	Examination of collection and transport operation methods for expansion area																
(2)	Introduction of new waste collection system including harmonization of primary and secondary collection																
(3)	Unification of waste collection management																
(4)	Improvement of management for maintenance workshops																
(5)	Capacity development of workers and drivers																
Component 5: Vehicle maintenance system																	
(1)	Formulation of workshop management rules																
(2)	Reform of workshop and maintenance system																
(3)	Introduction of preventive maintenance method																
Component 6: Intermediate treatment system (Eco-Town: WtE, composting, recycling etc.)																	
(1)	Propose Eco-Town and obtain approval from related organization																
(2)	Implementation of feasible study for Eco-Town																
(3)	Preparation of construction and operation cost																
(4)	Establishment of intermediate treatment (Eco-Town) section in the WMD																
(5)	Capacity development of intermediate treatment (Eco-Town) section																
Component 7: Sanitary landfill																	
(1)	Improvement of Amin Bazar LFS																
(2)	Secure future LFSs																
(3)	Closure of Amin Bazar LFS																
(4)	Establishment of landfill management section in the WMD																
(5)	Capacity development of the landfill management section																

No.	Priority Projects and Programs	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Component 8: Rules and regulations																	
(1)	Preparation and release of the administration procedures manual	■	■														
(2)	Development of WMD directives through SWMSC		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
(3)	Training for rules and regulations provided to staff and related stakeholders		■	■	■	■											
Component 9: Organizational capacity																	
(1)	Reform of WMD organizational structure		■	■	■	■											
(2)	Preparation of an annual activity plan in accordance with the new Master Plan		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
(3)	Capacity development of implementing organizations in the WMD for the new Master Plan through training and workshops		■	■	■	■											
Component 10: Financial management																	
(1)	Modification of accounting system to explicitly exhibit the actual SWM cost	■	■	■	■	■											
(2)	Securing operation and maintenance cost for intermediate treatment (Eco-Town) development	■	■	■	■	■											
(3)	Financial allocation for the Master Plan implementation	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
(4)	Development of financial assessment system		■	■	■	■											

7.3 Budget

The proposed budget for implementing the priority projects and programs is estimated approximately Tk. 44,000 million in total. The sources of the funds for development and procurement costs are summarized in Table 7-3. This budget considers all intermediate treatment facilities (Eco-Town) to be constructed and operated by the DNCC. This Chapter discuss on the budget in this case. Some of these funds have already been budgeted.

Table 7-3 Proposed Budget for Priority Projects and Programs

Projects and Programs		Source of Funds (million BDT)		
		SWM Own Revenues	Grant from Central Government/ Foreign Donors	Total
Component 1: Public relations, public awareness, and public involvement				
	All projects and programs	5 (per year)	—	75
Component 2: WBA activities				
(1)	Construction and renovation of Ward office	51	36	87
(2)	Community budget for WBA activities	5 (per year)	—	75
Component 3: Waste reduction				
	All projects and programs	5 (per year)	—	75
Component 4: Waste collection and transport				
(1)	Equipment for new waste collection (New type rickshaw van, hand cart and equipment)	4	—	4
(2)	Training for workers and drivers	1	1	2
Component 5: Vehicle maintenance system				
(1)	Training for workshop staffs (Rules, new maintenance system, preventive maintenance)	1 (per year)	1	16
Component 6: Intermediate treatment system (Eco-Town: WtE, composting, recycling etc.)				
(1)	Feasible study for Eco-Town	—	72	72
(2)	Preparation of construction and initial operation cost	—	20,800	20,800
Component 7: Sanitary landfill				
(1)	Improvement of Amin Bazar LFS	—	554	554
(2)	Secure future LFSs	—	21,940	21,940
(3)	Closure of Amin Bazar LFS	—	135	135
Component 8: Rules and regulations				
	All projects and programs	1 (per year)	—	15
Component 9: Organizational capacity				
	All projects and programs	1 (per year)	—	15
Component 10: Financial management				
	All projects and programs	1 (per year)	5	20

Source: JICA Project Team

CHAPTER 8 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

In DNCC, waste generation and waste composition have changed dramatically owing to the population growth and economic development. However, it is necessary for DNCC to introduce integrated waste management with various kinds of technologies and methods considering the short lifespan of the existing landfill. Although the previous Master Plan of 2005–2015 focused on organizing a system to promote waste management from the beginning, this Master Plan aims to establish a sustainable waste management system.

The Master Plan emphasizes the necessity of waste reduction to save the landfill capacity so as to sustain its operation. The policy of waste reduction must be strongly enforced by the WMD with public relations and public awareness through WBA. Promotion of waste reduction at source is a key for achieving 10% waste reduction, which depends on the field-level efforts by the CIs.

The concept of Eco-Town (WtE, composting, recycling etc.), an intermediate treatment system that can treat various types of waste, was introduced in the Master Plan for the first time. This would contribute to reduce the large volume of waste and to mitigate the impact of environmental pollution. The establishment of such a consolidated intermediate treatment system including a WtE plant requires strengthening of human resources with high technical and management skills.

The Master Plan suggests the following various directions for approaching a sustainable administration for SWM.

(i) Establishment of an intermediate treatment system (Eco-Town) to extend the life of the landfill
(ii) Administrative efforts made for enhancing the governance capabilities
(iii) Strengthening of the WMD organization, expansion of WBA, and revision of the WMD directives that details the DNCC's policy on SWM
(iv) Necessity of staff participation in human resources development activities through social learning
(v) Introduction of the SWM administrative procedure book that utilizes existing laws and office orders
(vi) Implementation of participatory waste management through public relations, public awareness, and WBA activities.

8.2 Recommendations for Future Solid Waste Management

The conclusion of the Master Plan suggests the direction beyond 2032. Essentially, the trend of main issues on solid waste, such as the lack of landfill space, will not dramatically change. Therefore, the policy of waste reduction and strengthening of institutional capacity as an administrative authority could be better prioritized and accelerated. In addition, the following points are raised as potential issues that may occur in the near future, which can be discussed in the future Master Plan for the next term.

8.2.1 Promotion of Waste Reduction

Waste reduction at source would be promoted by the CIs through WBA 3 in collaboration with communities, business enterprises, and other stakeholders, which is explained repeatedly in the Master Plan. Responsibility of each stakeholder for waste reduction, including DNCC, should be clarified.

Obviously, community awareness is important, and should be continued regularly. In addition, public awareness for large-scale buildings should be a focus for the next step. A reporting system of large-scale buildings, where the waste discharge amount depends on waste type and discharge method, should be established with better communication of administrative guidance.

Moreover, extended producer responsibility, a policy under which producers are given significant responsibility for the treatment and disposal of post-consumer products, should be considered in the planning stage. DNCC may need to consider the establishment of regulations for promotion of eco-friendly products and penalties for single-use disposable products. The charging of service fees for waste collection is an option worth considering to secure the financial source. In this Master Plan, industrial waste and hazardous waste cannot be covered owing to lack of information. The plans for these waste types should be developed in the future.

8.2.2 Appropriate Technology of Solid Waste Treatment

(1) Waste-to-Energy for Waste Reduction

In general, an incinerator reduces the volume of the solid mass of the original waste to about one-twentieth of its former size. This method is the most effective way to save a landfill space, and therefore to extend lifespan of the LFS. The pollution control technology is becoming mature significantly to purify HCl, NOx, SOx, and dioxin contained in incineration exhaust gas. Consequently, WtE technology is inevitable for the future SWM in DNCC. Promotion of research and development based on collaboration of industry, academia, and government should be accelerated.

(2) Electronic Waste Recycling

Full recovery of materials from E-waste requires a complicated treatment process using an expensive facility. At this time, DNCC should focus on the recycling of plastics to reduce the incoming landfill volume. The target of E-waste, such as TVs, refrigerators, air conditioners, washing machines, PCs and other products, should be clarified before the DNCC starts E-waste recycling.

8.2.3 Sustainability of Solid Waste Management

(1) Decentralization of Waste Management

SWM in a big city such as DNCC requires a strong foundation of governance to make important decisions, and solid organization to enforce and disseminate regulations at the field level. As mentioned repeatedly, establishment and strengthening of the WMD, and promotion of WBA are a core competence of DNCC, which makes SWM of DNCC sustainable and independent. Decentralization is the key concept for promotion of WBA. The CI must be an office manager for each ward, which has to be endorsed by legislation to justify the authority of planning, finance, and human resources management. Continuous capacity development of the CI is also needed. Exchange of human resources between the Conservancy Division and the Engineering Division is an innovative and effective option for capacity development to overcome the rigid structure of organization.

The WMD directives describes the policy of the WMD for 5–10 years and secure the consistency of administrative decisions based on the policy. The process for developing WMD directives should be open to the public such as communities, universities, and NGOs; however, this cannot be achieved without active involvement of public relations.

(2) Solid Waste Management Rules of the City Corporations

Bangladesh has already drafted “Waste Management Rules 2018, which shall be gazetted soon. This draft rules will be enacted as per the power given in Section 20 of Bangladesh Environment Conservation Act 1995, and executed by the DoE. To strengthen the SWM of CCs more systematically, an SWM rule exclusively for DNCC is desirable to interpret the DoE’s rules into the practical field. LGD should prepare separate SWM rules having more stringent and adjuvant for the CCs as per the powers given in Section 40 under the Local Government (City Corporation) Act 2009, for the sustainable and efficient SWM.

(1) Ordinance and Guidelines for Waste-to-Energy

In Section 7 of the draft Solid Waste Management Rules 2018, three types of standards i.e., operation standards, emission standards, and radioactivity standards have been described. These standards may be applied to the WtE projects including incineration; however, there is no specific ordinance or guidance exclusively for WtE or waste incineration in Bangladesh. Such a regulatory framework for incinerators and WtE facilities must be developed immediately.

8.2.4 Spatial Coverage of DNCC's Waste Management

The Dhaka metropolitan area was expanded recently, as seen in the extension area newly added into the DNCC jurisdiction in 2017. It is conceivable that more area will be taken in the DNCC jurisdiction in near future, considering the current infrastructure and new town development inside and outside of Dhaka such as the Dhaka Metro project and Purchabal New Town development.

DNCC has just started to work on SWM planning in the extension area, and still needs some time to develop it because of data and information deficiency; on the other hand, the DNCC currently has the following long-term idea for the extension area.

- Set up a zonal SWM office at each zone
- Outsource waste collection to private companies
- Construct a WtE plant in each zone for intermediate treatment, and dispose of the ash in the Nashirabad LFS

The DNCC will detail SWM in the extension area and include a framework for the potential DNCC area in the time of this Master Plan revision scheduled in 2020. In the meanwhile, to the extent possible, information sharing and technical support to not only the other CCs, but also the outer townships of Dhaka is encouraged to disseminate better solid waste management practice.