No.

Dhaka City Corporation
The People's Republic of Bangladesh

Japan International Cooperation Agency

THE STUDY ON THE SOLID WASTE MANAGEMENT IN DHAKA CITY

Final Report

Volume 4

Data Book

CLEAN DHAKA MASTER PLAN

March 2005

Pacific Consultants International
Yachiyo Engineering Co., Ltd.

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The following foreign exchange rate is applied in the study:

US$ 1 = Tk. 58 (Bangladeshi Taka) as of end of September, 2004

List of Abbreviation and Acronyms

ABD	Apparent Bulky Density
ACCO	Assistant Chief Conservancy Officer
ADB	Asian Development Bank
BBS	Bangladesh Bureau of Statistics
BIEDF	Bangladesh Integrated Environmental Development Forum
BRAC	Bangladesh Rural Advancement Committee *(former name)*
BSCIC	Bangladesh Small and Cottage Industry Corporation
BSIC	Bangladesh Standard Industrial Classification
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CBM	Community Based Management
CBO	Community Based Organization
CCO	Chief Conservancy Officer
CEGIS	Center for Environment and Geographic Information Services
CEO	Chief Executive Officer
CI	Conservancy Inspector
CIDA	Canadian International Development Agency
CLAC	Central Land Allocation Committee
CMI	Census of Manufacturing Industries
CNG	Compacted Natural Gas
CO	Conservancy Officer
CPU	Counterpart Personnel Unit
CSI	Conservancy Supervising Inspector
DCC	Dhaka City Cooperation
DCCO	Deputy Chief Conservancy Officer
DG	Director General
Dhaka WASA	Dhaka Water Supply and Sewerage Authority
DMCH	Dhaka Medical College Hospital
DMDP	Dhaka Metropolitan Development Planning
DOE	Department of Environment, Ministry of Environment and Forests
DS	Deputy Secretary
DTCB	Dhaka Transport Coordination Board
DUTP	Dhaka Urban Transport Project
ECC	Environmental Clearance Certificate
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ERD	Economic Relations Division, Ministry of Finance
ETP	Effluent Treatment Plan
GDP	Gross Domestic Product
GIS	Geographic Information System
GNP	Gross National Product
GOB	Government of Bangladesh

GPS	Global Positioning System
HH	Household
ICDDR	International Centre for Diarrhea Diseases Research
IDA	International Development Association
IEB	Institution of Engineers Bangladesh
IEC	Information, Education and Communication
IEE	Initial Environmental Examination
IGES	Institute for Global Environmental Strategies
IT	Information Technology
JICA	Japan International Cooperation Agency
LGD	Local Government Division, Ministry of Local Government, Rural Development and Co-operatives
LGRD&C	Ministry of Local Government, Rural Development and Co-operatives
MCHTI	Maternity and Child Health Training Institute
MIS	Management Information System
MLSS	Member of Lower Subordinate Service
MOEF	Ministry of Environment and Forests
NGO	Non-Governmental Organization
NOC	Non-Objection Certificate
PCP	Project Concept Paper
PO	Personal Officer
PVC	Polyvinyl Chloride
RAJUK	Rajdhani Unnayan Katripakkha: Capital City Development Authority
RCV	Refuse Collection Vehicle
RHD	Roads and Highways Department
SEMP	Sustainable Environment Management Program
SOB	Survey of Bangladesh
SPARRSO	Bangladesh Space Research and Remote Sensing Organization
SPM	Suspended Particulate Matter
SWM	Solid Waste Management
SWMC	Solid Waste Management Cell
TOR	Term of Reference
TWG	Technical Working Group
UNDP	United Nations Development Program
UNFPA	United Nations Fund for Population Activities
UNICEF	United Nations Children's Fund
UPD	Urban Planning Department, Dhaka City Cooperation
WB	The World Bank
WHO	World Health Organization
WMC	Waste Management Committee
WMD	Waste Management Division
ZEO	Zonal Executive Officer

Final Report

Volume 4 Data Book

Table of Contents

List of Abbreviations and Acronyms

COMPOSITION OF THE REPORTS

This Report consists of 4 volumes as follows:

volume 1: Summary
volume 2: Main Report
volume 3: Supporting Report
volume 4: Data Book

1.Waste Amount And Composition Survey (Dry Season)

PART-A: INTRODUCTORY REPORT

PART-B: FINDINGS OF THE SURVEY

PART-A:

SOLID WASTE AMOUNT AND COMPOSITION SURVEY

1. INTRODUCTION

1.1 Background and Objective of the Study

Dhaka was founded in the year 1608 A.D as the Capital of the Province by Islam Khan Chisty during the regime of Mughal Emperor Zahangir and it was at that time renamed as Zahangir Nagar. Dhaka municipality was established on August 1, 1894. During the year 1830 Mr. Walter, the then Collector of Dhaka formed a committee for the management of Solid Waste in the town. But there have been no remarkable improvement in the collection and disposal of solid waste since 1830. There have been only two improvements since then- one is abolition of bullock carts and switch over to Refuse Collection Vehicles (RCV) in the year 1982 and the other is the night time collection in the old city in 1989. The Implementation support Consultants (ISC) of Support for Urban Management and Municipal services Programme funded by WB/UNDP conducted baseline survey during 1991 and it was revealed that collection/disposal efficiently of solid waste in Dhaka City was less than 45% within an area of 344 sq.km with a per capita generation of .5 kg.

Under the present circumstances of deteriorating environmental condition of the City the Government of the People's Republic of Bangladesh has taken the right step by requesting the Government of Japan for necessary technical help in order to conduct a study on Solid Waste Management. As an outcome of the request the Japan International Corporation Agency (JICA) has come forward with the objective to prepare a Master Plan on Solid Waste Management (SWM) for the City.

Objective of the Study:

The overall solid waste amount and composition survey consist of the following components:

1. Item B-7 : (i) Waste Generation amount and Composition Survey
   (ii) Final Disposal Amount at Land fill (LF) site
2. Item B-8 : Time and Motion Survey
3. Item B-10 : Re-cycling Market
4. Item B-11 : Water Quality Analysis Survey at LF site

Out of all the above mentioned items the components (i) waste generation amount and composition survey and (ii) Final Disposal Amount at LF site occupies a major portion of the total Survey. The objective of the Survey comprises - determination of the waste quantity/volume generated at different sources viz residential area, commercial sector,

market, street sweeping etc. The Survey will reflect the unit generation at different sources and even in the residential area the unit generation will vary, because the upper income group, lower income group, slum area etc are not using the same type of commodity for their daily use. This latter statement will be justified when the generated waste is segregated and individual amount/volume is measured through the composition survey. In Bangladesh cities and town major portion of the solid waste consists of organic waste. This organic waste if separated right at the source can be a good source of compost for agricultural purpose. The other part i.e inorganic portion many of the ingredients can be recycled for use in the different industries.

Thus, if the organic and inorganic portions are separated correctly at the sources and put to beneficial use the volume of total rest of the waste to be transported to LF site will be reduced which will eventually reduce the cost of transportation of the land required for controlled tipping.

This survey will also determine the weight and volume ratio i.e the density at different stage. The density viz, right at the source (as presented density), density at the communal bin and on-truck density and in-situ density at LF site will increase gradually. The knowledge of the density at different stages is required for designing the handling equipment, communal bins, and design of Sanitary Land Fill Projects. Thus, all those basic information will be required to formulate the Master Plan.

2. SCOPE OF WORK

2.1 General

The Consultant under the guidance of JICA Study Team and as per ToR shall conduct the survey so that realistic field data are obtained. The survey consists of the following sub-components:

i) Measurement of waste generation amount/volume;

ii) Waste composition physical and as well as laboratory analysis

iii) Measurement of incoming waste at landfill sites;

iv) Data analysis and

v) Preparation of the Draft and Final Report including furnishing of Raw Data.

2.2 Measurement of Waste Amount/Volume

1. The ToR provides that the waste is to be collected at different income levels within the City Corporation Area and following are different category that has been selected by the JICA Study Team.

The survey area has been classified into following 10 categories:

1.	Domestic	a. Upper (Gulshan, Banani)	= 50 Samples
		b. Middle (Dhanmondi, Lalmatia)	= 50 Samples
		c. Low Middle (Mohammadpur-Mirpur)	= 50 Samples
		d. Lower (Lalbag, Hazaribagh-Kotwali)	= 50 Samples
		e. Slum (Kuril)	= 50 Samples
			= 250 Samples
2.	Commercial	a. Restaurants	= 10
		b. Shops/ Hotel/ Guest house	= 10
3.	Public Facilities (School, DCC Office, Zone Office)		= 10
4.	Market		= 10
5.	Road Sweeping		= 10
			= 50

2. The Survey shall cover a period of 8 days and generated waste shall be measured every day.

3. The JICA Study Team will direct the location of survey area and the Consultant shall select exact sites/location in order to obtain the representative samples from the area/holdings.

4. The Consultant shall brief the purpose of the survey to each sample holding in order to get the representative data and necessary cooperation from the respective holding.

   The following Table gives the desired interview items and particulars.

Table-2.1: Interview items for each sampling area

Sampling area		Interview items
1.	Residential area	Number of families and inhabitants (including employee), Floor area of house monthly expenditure.
	a. Upper level	
	b. Middle level	
	c. Lower middle level	
	d. Low level	
	e. Slum	
2.	Commercial establishment	Number of employees, floor area Type of activity (to be classified into restaurant, hotel/guest house, food shop, cloth shop, electric shop and other shop)
	a. Restaurant	
	b. Shops, hotel/guest houses, etc.	
3.	Public facilities (school, DCC office, zone office, etc.)	Number of employees, floor area Type of activity (to be classified to school, public office and other public facility)
4.	Market	Number of stalls by type of activity, number of employees, floor area, land area of market
5.	Street waste	Name of sweeper (cleaner), street length and width to be sweep, (Street location shall be indicated on a map. Zone and ward number shall be recorded)

2.3 Waste Composition Analysis

1. Dhaka waste contains both organic and inorganic components and as such it is important that representative samples are obtained in order to analyse the physically segregated ingredients and to conduct laboratory tests for selected items. JICA Study Team recommended for determination of moisture contents of the selected items. Other parameter and contents will be determined by JICA Study Team.

2. The following are the components for physical composition and laboratory analysis.

Table-2.2 : Physical Composition

Sl. No.	Item
*1	*Recyclable paper
2	Other paper
3	Food waste/vegetable matter
4	Textile
5	Grass and yard waste
6	Wood
7	Plastic sheet
*8	*Polyethylene bottle
*9	*Other plastic bottle
*10	*Other plastics
11	Rubber
12	Leather
*13	Steel CAN
*14	Aluminum CAN
*15	Metal/Alloy
16	Glass, broken bottles, others
*17	Glass bottles
18	Stone and ceramics
19	Miscellaneous inert (sand, dust)
20	Unclassified

** Recyclable Items*

Table-2.3: Lab. Analysis

Sl. No.	Item
1	Recyclable paper
2	Other papers
3	Food waste/Vegetable Matter
4	Textile
5	Grass and yard waste
6	Wood
7	Plastic sheet
8	Polyethylene bottles
9	Other plastic bottles
10	Rubber
11	Leather
12	Others/Composite

3. Source of Samples

a. Source of sample is shown in Table 2.4

b. 30 samples collected for waste generation volume survey will be samples for physical composition (wet base) and specific weight analysis. And 10 samples of them shall be further analyzed on moisture contents of each component. Then proximate composition of sample shall be estimated.

c. Total 30 samples (3 samples from each zone) shall be taken from collection vehicles at landfill sites for physical analysis (wet base) and specific weight. And 10 samples of them shall be further analyzed on moisture contents of each component. Then proximate composition of sample shall be estimated.

(4) Number of analysis excluding estimation of proximate composition will be 320 as shown in Table 2.3.2

Table- 2.4 : Sample preparation for waste composition

Sampling area	Number of samples	Sample preparation
1. Sample from generation survey		
(1). Residential area		Collected waste in the same day from each level (50 households from each level) forms one (1) sample by mixing. Sampling shall be conducted for three days.
a. Upper level	3 (1)	
b. Middle level	3 (1)	
c) Lower middle level	3 (1)	
d. Low level	3 (1)	
e. Slum	3 (1)	
(2). Commercial establishment		
a. Restaurant	3 (1)	Collected waste in the same day from restaurants from one sample.
b. Shops, hotel/guest houses, etc	3 (1)	Collected waste in the same day from shops with the same activity forms will be one sample
(3). Public facilities (school, DCC office, zone office, etc.)	3 (1)	Collected waste in the same day from school/offices with same activity forms one sample.
(4). Market	3 (1)	Collected waste from one market forms one sample
(5). Street waste	3 (1)	Collected waste in the same day forms one samples
Sub-Total	30 (10)	
2. Sample from collection vehicle at	30 (10)	One collection vehicle provides one
Landfill site		Sample. One vehicle from a zone shall be taken for three (3) days.
Grand total	60 (20)	

Note 01): Figure ( ) is number of samples used for the analysis of moisture contents and estimation of proximate composition.

Note 02): A Sample volume shall be more than 200 kg if the sample is taken from collection vehicle and/or container.

Table-2.4.1 : Number of analysis

Analysis	Number of Analysis	Remarks
(1) Physical composition	60 analysis	1 analysis per 1 sample
(2) Specific weight	60 analysis	Same as above
(2) Moisture content	20 samplex12 components = 240 analysis	12 analysis (components) per 1 sample
Total	360 analysis	

Note: Estimation of proximate composition is excluded.

2.4 Survey on Incoming Waste at Landfill Site

This survey shall be conducted at Matuail, Berri Bund and Uttara landfill site. The survey shall be conducted daily 24 hours for 7 days, because the wastes are transporated to the dump site almost round the clock. The loaded weight of each truck shall be determined at the landfill site by portable weighing machine provided by the JICA Study Team. This weighing operation shall be available only at Matuail Site, because no weighing machine will be available at Berri Bund site. The amount carried by each truck at Berri Bund site shall be determined by noting the type and capacity of each truck.

At the Matuail site the following data shall be recorded

i) Vehicle Regn. Number
ii) Vehicle Type
iii) Vehicle Capacity
iv) Vehicle arrival time
v) Vehicle departure time
vi) Driver's Name
vii) Vehicle Empty weight
viii) Vehicle Loaded weight
ix) Collection Zone/Ward
x) Type of Waste

All these information shall be recorded in the presented format as provided by the JICA Study Team.

3 METHODOLOGY

3.1 General

The entire survey has been conducted through 20 surveyors, 3 supervising officers under the guidance of the survey team leader. In addition of the field staff/officer an experienced engineer is helping survey team leader for data processing/evaluation along with one computer operator. Initial mobilization took about 10 days for selection of men, materials and equipment/accessories. Prior to the field work the Project Manager met the JICA Study Team on several occasions to discuss the pros and cons of the survey. The Counter Part Unit (CPU) of DCC was also met in order to facilitate the survey work.

3.2 Specific Instructions to the Survey Team

A brochure was prepared for necessary instruction to the field staff and each was given a copy of the instruction brochure. Copy of this instruction was also submitted to the JICA Study Team and CPU of DCC. A copy of the this instruction is enclosed for ready reference in Annex (1). In addition to this brochure a list (Annex-2) of all the surveyor including Supervising Officers was prepared showing the allocation of their areas/responsibilities. This list also included the selected Commercial Holdings, Public Facility and Markets. In order to inform the public leaflet was prepared in Bengali/English (Annex-3) and was distributed a day ahead of the sampling to the selected holdings.

3.3 Allocation of Responsibility

Selection of category by JICA Study Team and specific area selection by the Consultant in consultation with the JICA Study Team and CPU/DCC is given below:

1.	Domestic	a. Higher Income Group (Gulshan, Banani)	= 50 Samples
		b. Middle Income Group (Dhanmondi, Lalmatia)	= 50 Samples
		c. Low/Middle Income Group (Mohammadpur-Mirpur)	= 50 Samples
		d. Lower Income Group (Lalbag, Hazaribagh-Kotwali)	= 50 Samples
		e. Slum (Kamlapur)	= 50 Samples
			= 250 Samples
2.	Commercial	a. Restaurants	= 10
		b. Shops/ Hotel/ Guest house	= 10
3.	Public Facilities (School, DCC Office, Zone Office)		= 10
4.	Market		= 10
5.	Road Sweeping		= 10
			= 50

Proposition

1. It was anticipated that in Item (1) above each surveyor will be able to execute 16/17 samples and as such category 1 will require 15 surveyors + 240 workers (8 days), 250 samples/day.
2. For item (2) 1 surveyor + 32 workers will execute 20 samples/ day for 8 days.
3-4 Similarly for item (3) and (4) one surveyor + 32 workers (8 days) will execute 20 samples/ day
5. For item (5) Road sweeping 1 surveyor + 16 workers (8 days) will conduct 10 different selected Highway /Roads
6. Landfill Incoming Waste Amount: This survey will be taken up as soon as the weighing machine is installed at Landfill site.

3.4 Accessories and Materials

A list of the materials and accessories (Annex-4) required was prepared and submitted to the Procurement Section of BETS prior to the field work. A basic tool (Annex-5) was also manufactured including the following measuring containers for measuring the volume and weight of the wastes at different sites:

i) Steel container 1 cu. ft. Vol.
ii) Steel container 0.125 cu.m. (0.5x0.5mx0.5m)
iii) Steel container 1 cu.m (1mx1mx1m)
(for special use at LF site)

3.5 Demonstration Survey

In order to acquaint with the field survey, demonstration survey was arranged for all the surveyors and to Supervising Officers. Initially on February 11, 2004 (Wednesday) in Gulshan residential area two holdings (one multistoried apartment and another single storied large family house) were surveyed.

On February 13, 2004 (Friday) a road demonstration survey was arranged at Mohammadpur area for the surveyors connected with the road survey where all 3 Supervising Officers were present under the guidance of the Project Manager between 7a.m. to 9 a.m. It may be mentioned here that road sweeping starts early morning and usually finish by 8 a.m. In some part of the old city street sweeping is also done at night.

4 SCHEDULE OF THE SURVEY

Initially a tentative schedule was prepared to conduct the survey, but the schedule could not be maintained due to several Govt. holidays, HARTAL and Friday. However, the Residential Area and Commercial Area survey was started on February 21, 2004 and continued for 5 days and finished February 25, 2004. Because of the closure of Govt. office and Schools the Public Facility component was started on February 23, 2004. The following Table gives a summary of the schedule.

Table-4.1: Schedule of Survey Operation

Item No. of ToR	Item	Date		Total no. of Days	Remarks.
		Start	Finish		
1+2	Res. and Com. Area	21.02.04	25.02.04	5	Weight and vol. Survey
5.	Road Sweeping	21.02.04	25.02.04	5	Ditto
3.	Public Facility	23.02.04	26.02.04	4	Ditto
		01.03.04	01.03.04	1	Ditto
4.	Market	21.03.04	25.03.04	5	Data Collection of Basic information and infrastructure data
	Do	07.03.04	09.03.04	3	Composition Survey
	Do	01.04.04	08.04.04	8	Weight and vol. Survey
	1,2,3 5	07.03.04	09.03.04	3	Composition Survey
	Incoming waste of all 10 zones	10.03.04	12.03.04	3	Do at LF sites
5.	Landfill Incoming Waste Amount	-	-	7	Awaited for weighing machine

It may be mentioned here that in the absence of weighing machine at LF site, demonstration at LF site could not be arranged and the survey for total generation from 10 markets and 10 zones are delayed.

Alternate arrangement has been made in order to assess the approximate generation of waste from the markets and zones. Surveyors have been deployed to ascertain the daily number of trips made by different capacity of trucks including Regn Number of the trucks.

PART-B:

FINDINGS OF THE SURVEY

1. MOBILIZATION

Mobilization was started on 11th February. This phase of the study consisted of the following:

- Selection of working personnels
- Procurement and manufacture of materials/accessories
- Liason with the concerning departments particularly with Dhaka City Corporation
- Internal discussion meetings and briefing of the Surveyors
- Preparation of appropriate proforma for entry of data in the field
- Arranging two demonstration survey - one in the residential area and another for road sweeping at Mohammadpur Area.
- Briefing the resident including distribution of leaflets to each holdings
- Acquainting with the conservancy staff of the respective zonal offices

After completion of all those prerequisites the survey began on 21st of February, simultaneously in all the areas including road sweeping except public facilities and market. Offices and Institutes were closed on Friday and govt. holiday and as such this particular survey was started on 23rd February. Collection of basic infrastructure data of 10 markets was also started.

2. WORK BRIEF

Dhaka City covers 360 sq.km area and officially the present population is 8.6 million within 1,75,000 holdings and 90 wards. The Survey did not cover all the wards, but covered those wards which are related according to the ToR classification viz. residential area upper income group, middle income group, slums, markets, selected roads etc. In this connection Fig.-2B.1, Fig.-2B.2 and Fig.-2B.3 which show the location of the area or spot of the intended survey components. Prior to the collection of the waste the residents were briefed and leaflets containing necessary instructions were distributed. In upper income group areas the access was not easy in some of the holdings. In some of the holdings the leaflet instructions were not followed and as a result the organic waste and inorganic waste were mixed up and the items were separated out by employing our own labour. Though the residential area, commercial sector and road sweeping survey was started from 21st of February and continued for 5 days, but in case of Public Facility viz. Schools, Office the above mentioned schedule could not be maintained due to Friday and other holidays. Due to this difficulty the composition survey for all generated waste was started again on 7th March and finished on 9th March. After completion of the composition survey for generated waste the incoming waste composition survey at L.F site was started on 10th March and finished on 12th March. A Bar Chart is available in Fig.-2B.4 which shows the progress of work at different stage of the study.

2.1 Data Collection and Processing

The field data was collected daily in the afternoon by the Field Supervisors and handed over to the Data Processor at BETS Head Office. The entry of the data was made either on the same day or in the early morning of the next day.

2.2 Laboratory

On 9th March 2004, i.e on the 8th Day of Survey, samples were collected from all of generated waste and as well as incoming waste from LF site on 11th March. The generated waste of 9th March and incoming waste of 11th March, were transported to the Laboratory of BUET for determination of moisture content of the samples.

The following samples have been analysed:

i) Physical composition Analysis at site;
20 (samples)x10 (areas of generated waste)x 3 (days)= 600
20 (samples)x10 Zone incoming waste x 3 (days) = 600

ii) Lab Analysis at Bangladesh University of Engineering & Technology
12 (samples)x 10(areas of generated waste)x 1(day) = 120
12 (samples)x10 Zone incoming waste x1 day = 120

It may be mentioned here that BUET has 8 ovens of different capacities to conduct the moisture content test and as such it was possible to accommodate all 120 samples in one day and finish the test within 24 hrs.

2.3 Testing Procedure: Moisture content of solid waste

i) Scope

This method describes the procedures for determining the moisture content of solid waste by microwave oven.

ii) Apparatus and Materials

The laboratory contains all necessary equipment for proper performance for solid waste testing. The laboratory environment has not adverse conditions such as dust, moisture, or vibration that could affect test results. The equipments are properly maintained and calibrated on a regular basis.

- Digital Balance - 0.01 g accuracy.
- Containers - suitable for use in microwave oven.
- Microwave oven equipped with timing device and heat intensity control.
  Specification of the equipments are described in Table-2B.1.

iii) Test Procedure

- A representative sample was taken from 0.5 kg of the material to be tested. The sample was placed in the container for which the weight is known and weighed
  and recorded as the "wet sample and tare.
- The sample was dried in the microwave oven for 24 hours at a temperature between 75^0C to 80^0C
- After weight loss ceases, the sample was removed from the oven, allowed to cool, weighed and recorded "dry sample and tare."

iv) Results and Calculations

The moisture content of the sample is determined using the following formula;

Weight of wet sample and tare (gm) - W_{WET+C}

Weight of dry sample and tare (gm) - W_{DRY+C}

Weight of tare (gm)- W_C

Weight of water (gm)-Ww = $(W_{WET+C}-W_C)-(W_{DRY+C}- W_C)$

Weight of dry sample (gm)-W_{DRY} gm = $W_{DRY+C}-W_C$

$$\text{Moisture Content – MC (\%)} = \frac{W_W}{W_{DRY}} x100$$

Table-2B.1 : Oven Specification

Characteristics	Type-1	Type-2	Type-3
Number	1	6	1
Phase	1	1	1
Cycle	50/80 Hz	50/60 Hz	50 Hz
Capacity	225 Liter	110 Liter	100 Liter
Volt	220~240 V	220 V	240 V
Watt	-	1.6 KW	2.0 KW
Tem. Rang	20^0C~300^0C ~ (Ambient temp to ~ 300^0C)	20^0C~300^0C ~ (Ambient temp to ~ 300^0C)	20^0C~300^0C ~ (Ambient temp to ~ 300^0C)
Manufacturer	ELE International, England	Blue Mountain, USA	ELE International, England.

3. DATA PRESENTATION

The Consultant has used 4 different proformas for preparation of the data which are as follows:

- Proforma "A" is used for entry of raw data during the general survey for determination of the quantity for 8 day. The raw data after analysis, the summary has been placed on the front page as per categorywise viz. Residential Area, Commercial establishment etc. This data is available in ANNEX-6.

- Proforma "B" is used during the composition survey for last 3 days both for the generated waste and as well as for the incoming waste.

- Proforma "C" is used to show the itemwise contribution of all 20 items from different category of generation sources viz generated waste and incoming waste during the composition survey.

- Proforma "D" is used to tabulate the laboratory results of all 12 selected items collected during the 8the days both for generated waste and as well as incoming waste. The raw data available from laboratory copy of which is also enclosed.

4. DATA EVALUATION

4.1 Quantity Survey

As mentioned in section 3 of this report that a summary (Proforma "A1) is available for Proforma "A", which shows the average contribution in Kg per capita per day and respective density separately for all residential areas. Similar summary is available for Commercial, Public Facilities category and Road Sweeping. In case of Market the infrastructure data and quantity generation is available in ANNEX-6.1.

4.2 Composition Survey

The composition survey consisted both for the generated waste and incoming waste. In each case there are twenty items. Contributing each item has been shown separately category wise viz. Residential, Commercial, Public Facilities, Market and Road Sweeping.

4.3 Laboratory Analysis

Though 12 items were selected for laboratory analysis and it was targeted to furnish 120 samples for generated waste and another 120 samples for incoming waste, but practically total 159 samples could be presented for the laboratory. Many of the items were not found in the waste. The laboratory data analysis is available in ANNEX-6.

5. COMMENTS

5.1 Generated Waste

A global summary is available in Table-5.1 and in addition to that the following summary is presented below:-

a. Per Capita waste generation is highest in Residential-Upper (0.5825 kg/c/d)
b. Per Capita waste generation is lowest in Residential – Lower Middle (0.2550 kg/c/d)
c. Per Capita waste generation in Residential Area average (0.3570 kg/c/d)
d. Average waste density is highest in Restaurant (623 kg/cu.m)
e. Average waste density is lowest in Public Facilities (93 kg/cu.m)
f. Average waste density in Residential Area (133 kg/cu.m)

The high density of food waste corroborates with the composition survey – food waste 97% (Commercial-Restaurant) and minimum at Public Facilities (19.5%). Excepting Steel CAN almost all the recyclable items are available in almost all the category of waste contribution. In the absence of weighing machine the market contribution was estimated which is shown in Table-5.2. Further data will be available on installation of the weighing machine.

5.2 Incoming Waste

The composition survey of incoming waste indicates that the food waste weight percentage varies between 23% (IV, Khilgaon Area) to 78% (Zone-X, Uttara Area) and the average of 10 zones is 57%. Recyclable items like polyethylene bottles, other plastic bottles, other plastics, leather, steel CAN etc are usually not available in all the zones. These items are usually either sold to the itenerary collectors or picked-up by the local waste pickers from the communal bins.

5.3 Composite Waste

Table-5.3 & Table-5.4 gives a vivid picture of the total generation of each component for 3 days and also the percentage generation. It is found that the highest contribution is from the Restaurant and the next is from market which are respectively 716 kg and 600 kg. The third highest is 570 kg from the Upper level Residential Area. In terms of percentage Food Waste/Vegetable matter is highest (97%) in Restaurant and amongst the residential category upper middle level occupies second highest (80%). It is interesting to note that in road sweeping component miscellaneous inert (sand, dust) occupies 73%.

5.4 Lab Analysis Report

Out of the targeted 240 samples to be sent to the laboratory 39 items and 42 items respectively for the generated waste and incoming waste were not available and mostly are of leather, Rubber items. Thus total 159 samples were analyzed for moisture content and the moisture content is highest in food waste/vegetable matter. The percentage is 51% and 74% in the generated waste and incoming waste respectively.

It may be mentioned here that the item **"Others"** in the generated waste does not contain any organic waste, because during holding to holding collection this latter item was separated out. The average percentage of moisture is only 3%. Whereas the item **"Composite"** of incoming waste contain organic portion and as a result the average percent of moisture content is 42.5% from 10 zones collection.

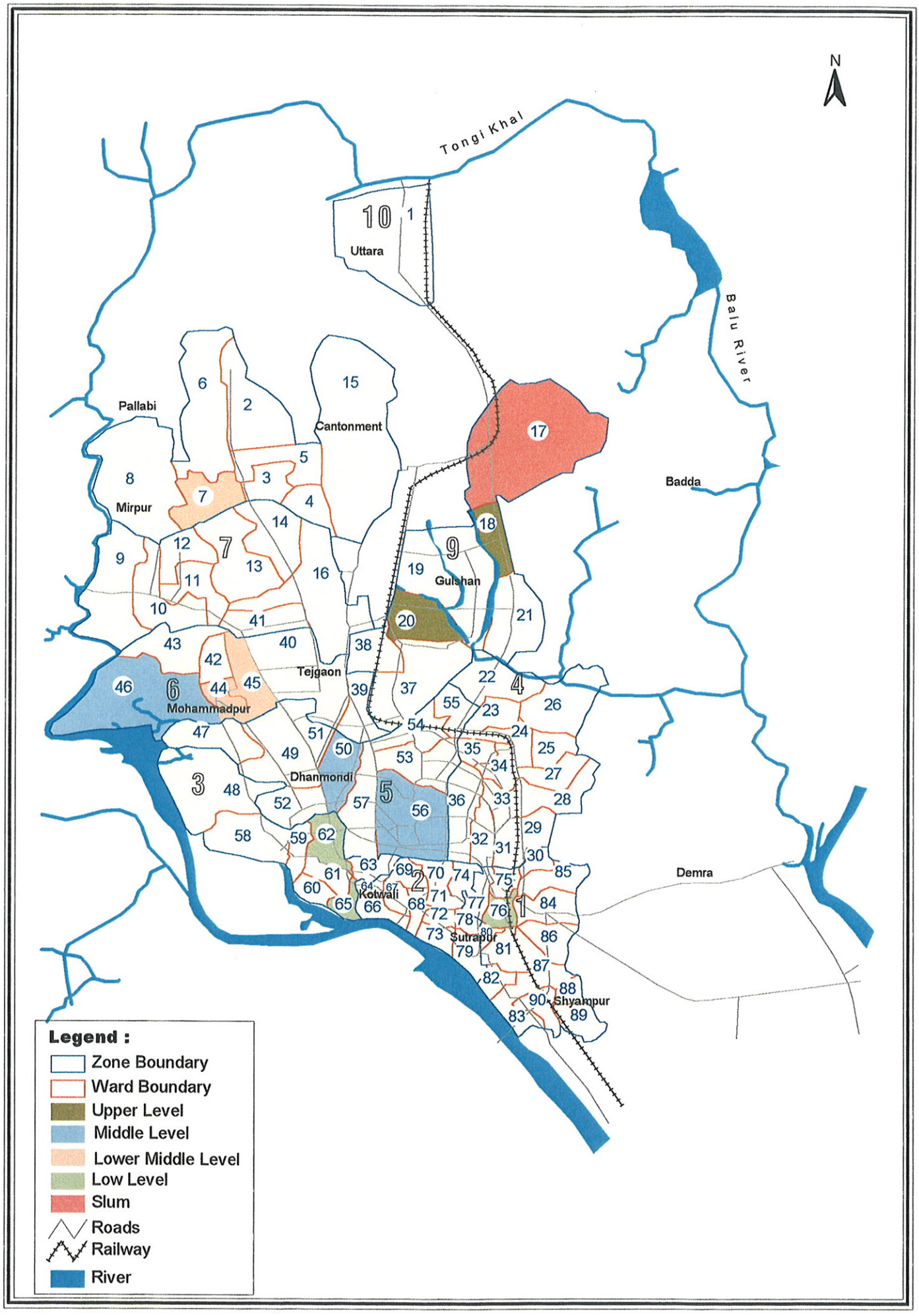


Figure 2B.1 : Survey of Residential Area
Solid Waste Amount and Composition Survey

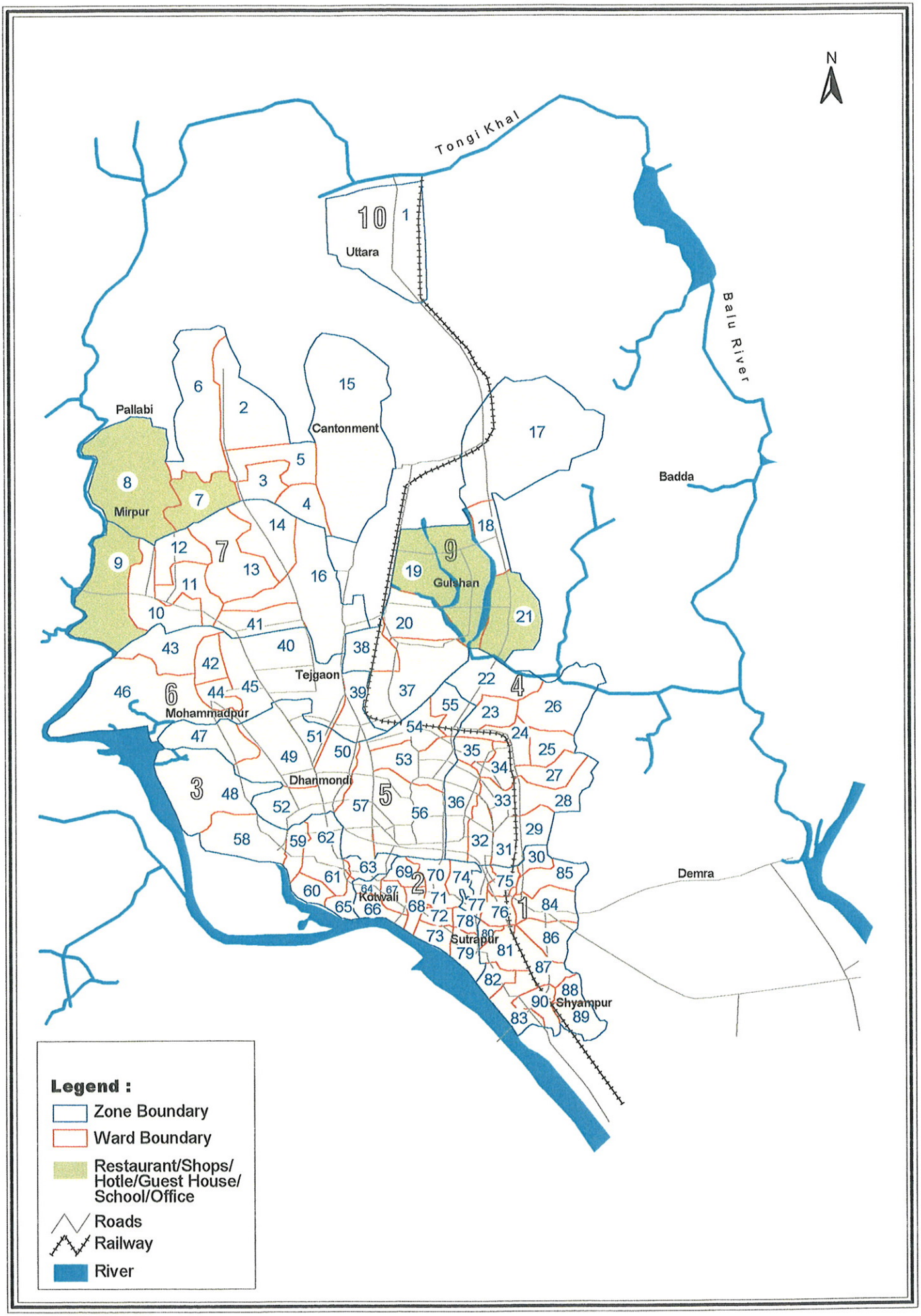


Figure 2B.2 : Survey Area Showing Commercial Solid Waste Amount and Composition Survey

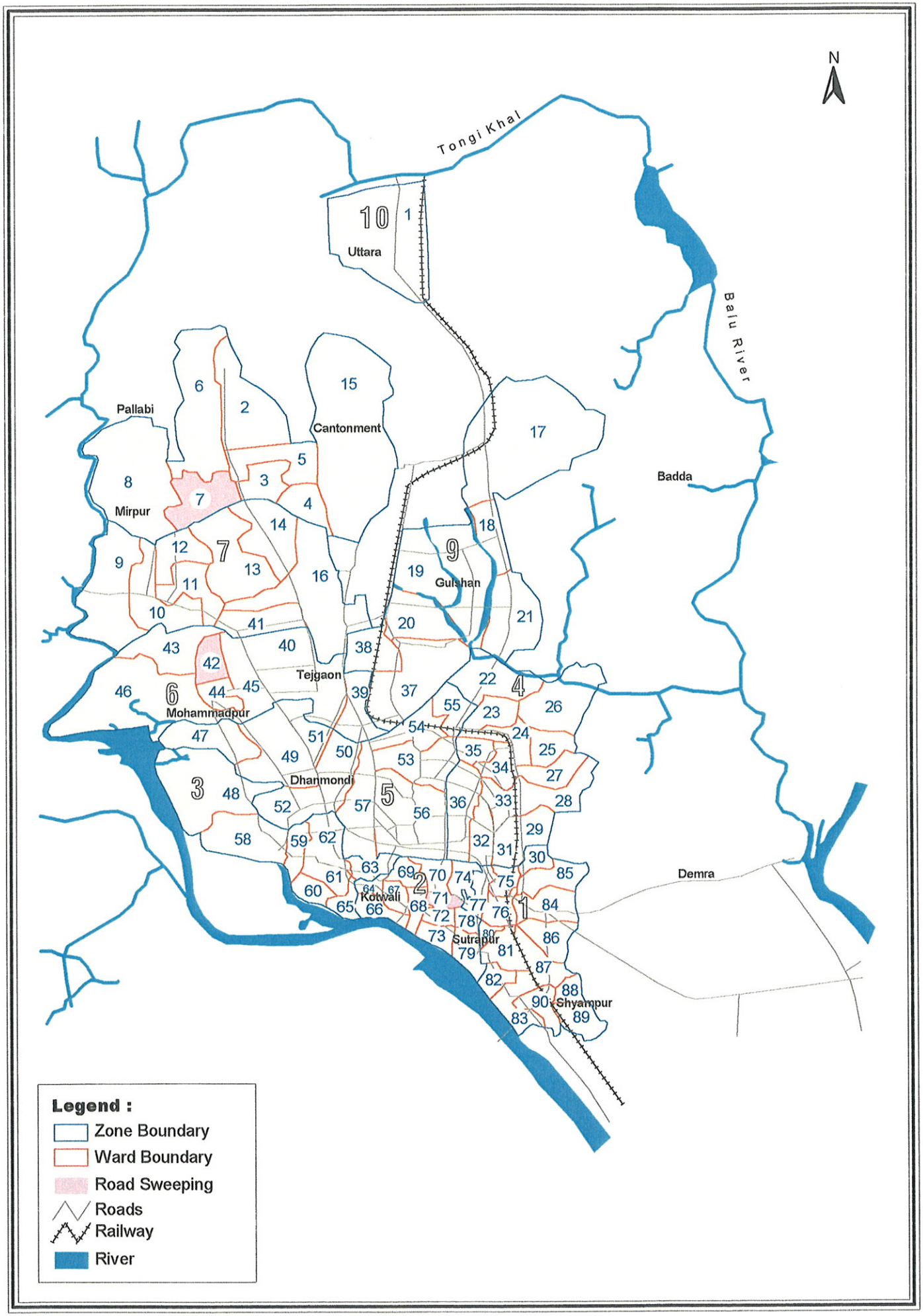
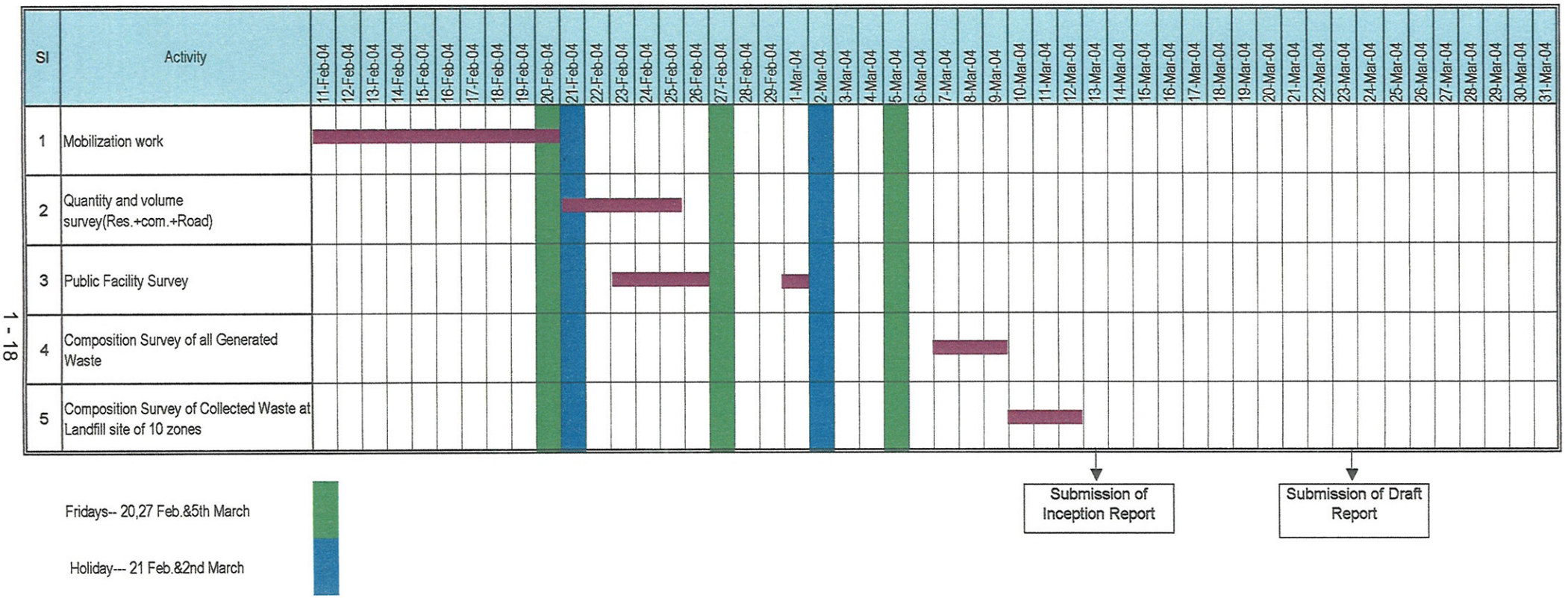


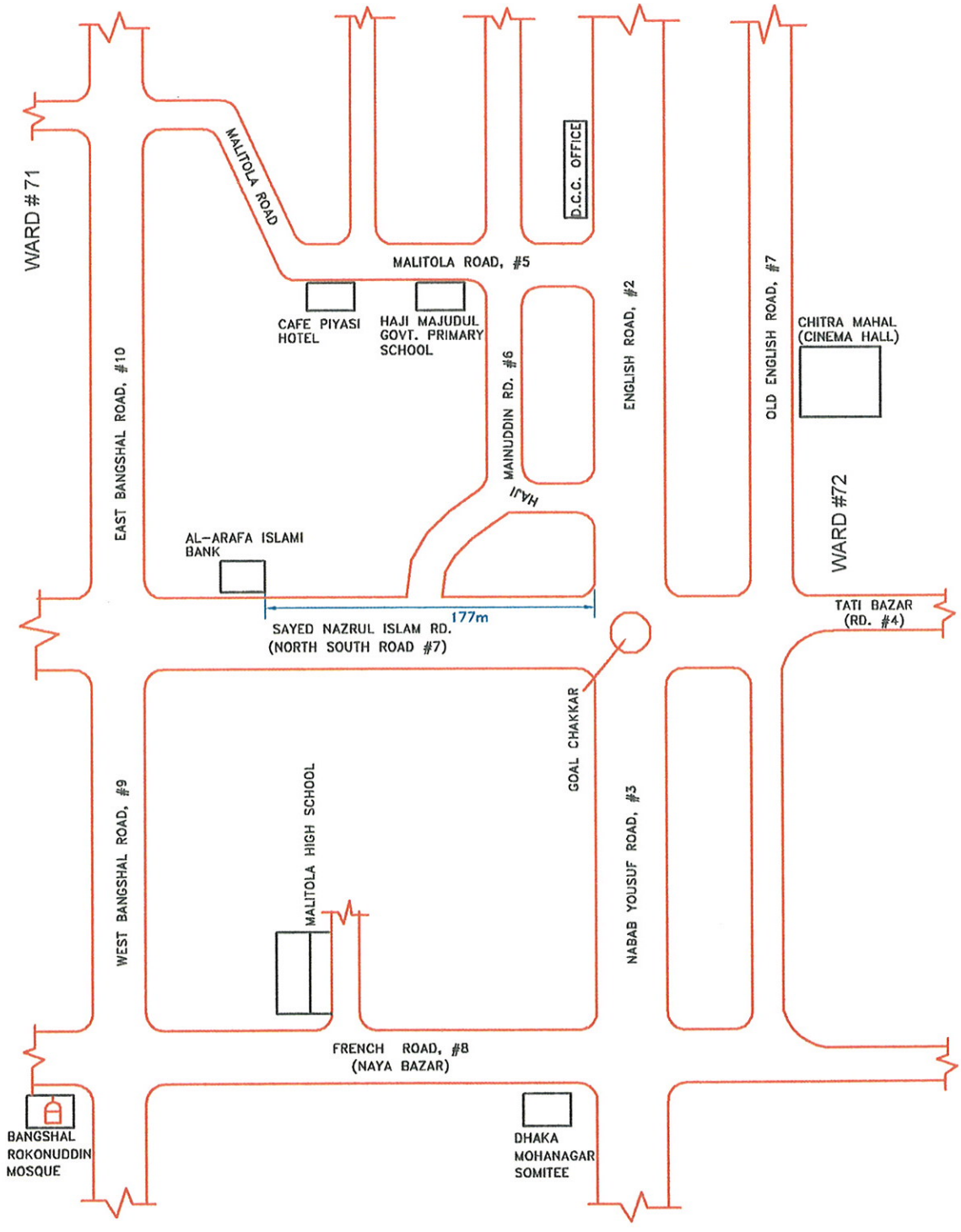
Figure 2B.3 : Survey of Road Sweeping Location
Solid Waste Amount and Composition Survey

Fig.-2B.4: Bar Chart of Progress of Work



N

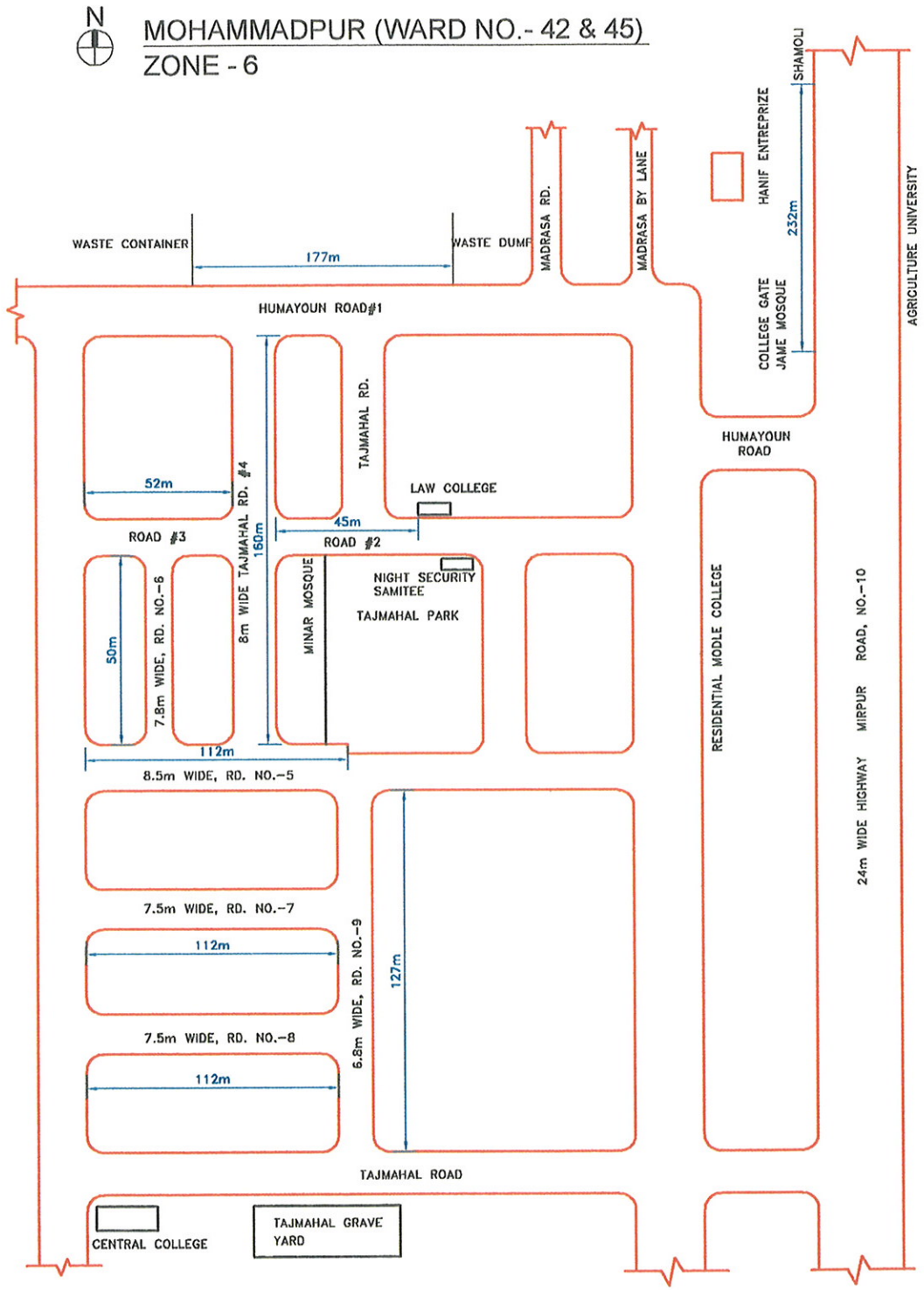
OLD TOWN (WARD NO.-71,72)
ZONE - 2



LOCATION OF ROAD SWEEPING SURVEY OF OLD-TOWN AREA

CONSULTANT :

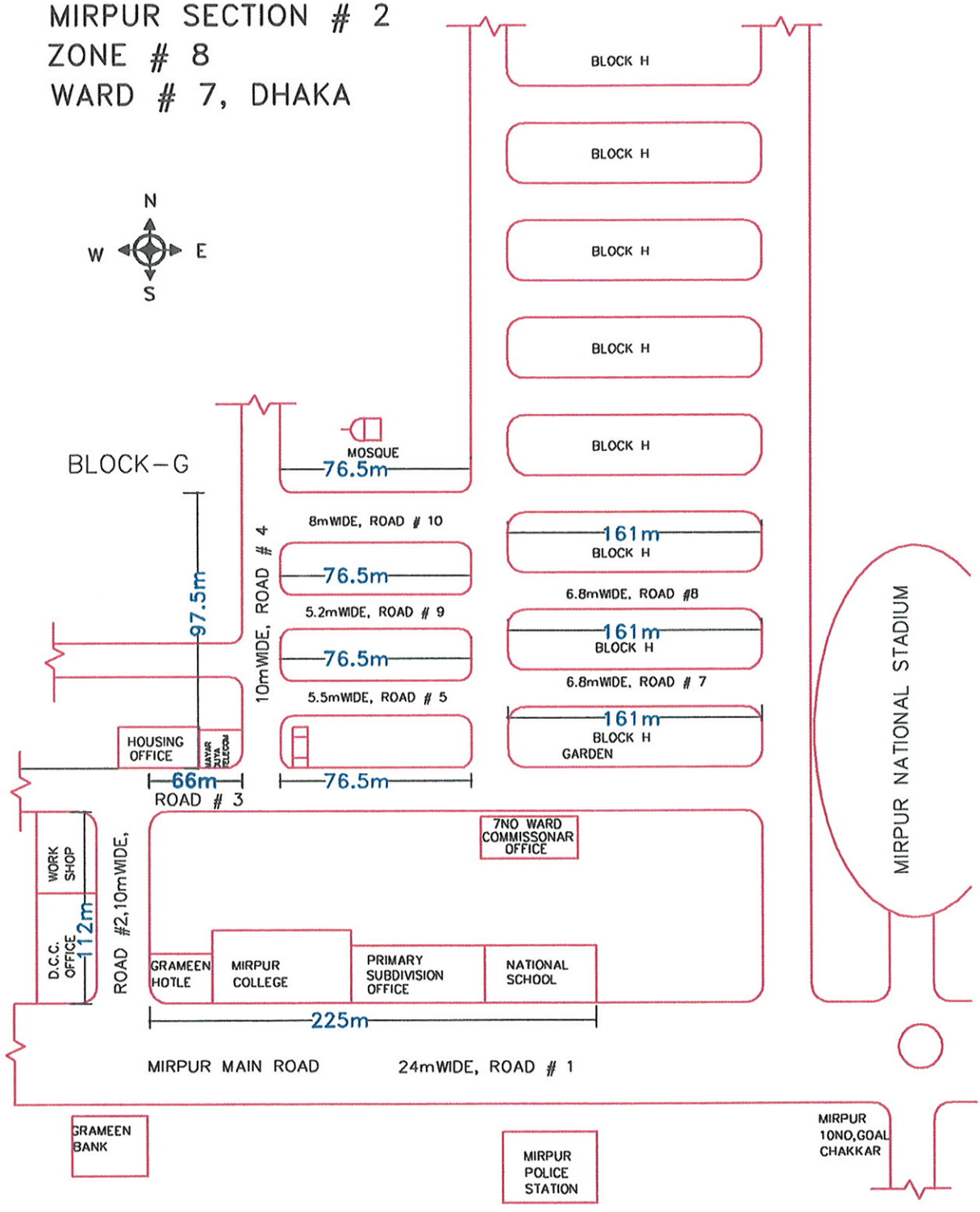
BANGLADESH ENGINEERING AND TECHNOLOGICAL SERVICES LTD.



LOCATION OF ROAD SWEEPING SURVEY OF MOHAMMADPUR AREA

CONSULTANT :

BANGLADESH ENGINEERING AND TECHNOLOGICAL SERVICES LTD.



LOCATION OF ROAD SWEEPING SURVEY OF MIRPUR AREA

CONSULTANT :

BANGLADESH ENGINEERING AND TECHNOLOGICAL SERVICES LTD.

Table-5.1: Global Summary of Generated Waste

Category	Cntributing Population (Nos.)	Floor/Lot Area (m^2)	Total lots/shops (Nos.)	Length (km)	Quantity of Waste (Kg)		Total waste (Kg)	Kg/C		Composite (Kg/C)	Composite (Kg/m^2)	Composite Kg/lot	Composite Kg/Km	Volume of Waste (m^3)		Total volume (m^3)	Density (Kg/m^3)
					Organic	Inorganic		Organic	Inorganic					Organic	Inorganic		
Residential	328	5738	-	-	79.19	39.01	118.20	0.2369	0.121	0.3578	0.0386	-	-	0.4182	0.5587	0.9769	121
Commercial	2074	3147	-	-	153.67	7.18	160.84	0.0763	0.0064	0.0827	0.1896	-	-	0.2943	0.1476	0.4419	364
Public Facilities	2426	5840	-	-	6.69	6.49	13.18	0.0017	0.0017	0.0034	0.0014	-	-	0.0593	0.1415	0.2008	66
Market	-	3434	542	-	-	-	4675	-	-	-	1.3615	8.6334	-	-	-	11.12	420
Road Sweeping	-	1140000	-	1.14	-	-	392.56	-	-	-	-	-	344.49	-	-	1.3783	285

1. Average quantity of Waste in Residential Area, Commercial & Public Facilities = **97.00 kg/day**
2. Average volume of Waste in Residential Area, Commercial & Public Facilities = **0.5399 cu.m/day**
3. Average density of in Residential Area, Commercial & Public Facilities = **180.00 kg/cu.m**
4. Average quantity of waste from Market = **1.3615 kg/sq.m**
5. Average quantity of waste from Market = **8.6334 kg/lot**
6. Average density of Market Waste = **420.00 kg/cu.m**
7. Average quantity of Waste from Road Sweeping = **393.00 kg/day**
8. Average quantity of waste from Road Sweeping = **344.00 kg/km**
9. Average volume of Waste from Road Sweeping = **1.3783 cu.m/day**
10. Average density of Road Seeping Waste = **285.00 kg/cu.m**

Table-5.2: Summery of Solid Waste from 10 (ten) Markets

Sl. No.	Name of The Markets	Type of Shops/Lots of the Markets	Employee (Nos)	Total Shops / Lots (Nos)	Total Lot Area (m^2)	Market Land Area (m^2)	Av. Qty. of Waste (Kg/day)	Av. Vol. of waste (m^3/day)	Waste Generation (Kg/lot)	Waste Generation (Kg/m^2)	Density kg/m^3	Av. Contribution (Kg./Lot/Day)	Av. Contribution ($Kg./m^2/Day$)	Av. Density of Market Waste (kg/m^3)
1	Mirpur Muktijuddha Market	i) Fresh & Dry Meat, Chicken, Fish ii) Fresh Vegetables iii) Grossary iv) Hardware & Painting v) Saloon vi) Restaurants & Confectionaries vii) Gift Shop viii) Crockaries ix) Cosmetics, Stationery & Books x) Studio, Photo xi) Jewelery xii) Bettle Nut xiii) Pharmacy, Medicine xiv) Readymade Garments & Garments Accessories xv) Electronics & Electrical xvi) Leather goods xvii) Clothes, Tailors, etc.	3850	1130	10200	15000.00	11000.00	22.20	9.73	1.08	495.50			
2	New Market	Do	6400	1900	6085	9000.00	7500.00	18.00	3.95	1.23	416.67			
3	Gulshan - 1	Do	1000	310	2400	3900.00	5000.00	12.00	16.13	2.08	416.67			
4	Gopibag	i) Meat & Fish ii) Vegetables iii) Grossary, rice, dry & fish iv) Chicken Shop	450	210	1800	2800.00	2500.00	6.00	11.90	1.39	416.67			
5	Hatirpul	Do	375	150	2100	3200.00	3500.00	9.00	23.33	1.67	388.89	**8.63**	**1.36**	**420.41**
6	Kaptan Bazar	Do	3000	750	5600	8000.00	6000.00	15.00	8.00	1.07	400.00			
7	Kawran Bazar	Wholesale Market for Fresh Vegetables	400	170	1700	2600.00	10000.00	24.00	58.82	5.88	416.67			
8	Raj Lakshmee Complex	i) Hardware & Painting ii) Saloon iii) Restaurants & Confectionaries iv) Gift Shop v) Crockaries vi) Cosmetics, Stationery & Books vii) Studio, Photo viii) Jewelery ix) Pharmacy, Medicine x) Readymade Garments & Garments Accessories xi) Electronics & Electrical xii) Leather goods xiii) Clothes, Tailors, etc.	350	110	1000	1500.00	500.00	2.00	4.55	0.50	250.00			
9	Eastern Plaza	Do	2000	550	2300	3800.00	250.00	1.00	0.45	0.11	250.00			
10	Malibag Super Market	Do	385	135	1150	1750.00	500.00	2.00	3.70	0.43	250.00			

1. Average quantity of waste = **8.63 kg/Lot/day**
2. Average quantity of waste = **1.36 Kg./m^2/day**
3. Average Volume of waste = **11.2 m^3/Market/day**
4. Average density of waste = **420.41 kg/cu.m**

Table-5.3: Summery of Composition Survey (Generated Waste)

Sl. No.	Item	Total Quantity for 3 days (Kg)										Total Quantity for 3 days (Kg) [% of total waste]									
		Level of Collection										Level of Collection									
		Residential					Commercial		Public Facilities	Market	Road Sweeping	Residential					Commercial		Public Facilities	Market	Road Sweeping
		Upper	Middle	Lower Middle	Lower	Slum	Restaurant	Shops/Hotels/Guest House	Schools/Offices			Upper	Middle	Lower Middle	Lower	Slum	Restaurant	Shops/Hotels/Guest House	Schools/Offices		
1	*Recyclable paper	36.20	12.45	2.85	8.70	0.00	0.55	6.00	8.10	8.00	0.00	6.35	4.48	1.16	2.97	0.00	0.08	2.67	11.59	1.33	0.00
2	Other paper	32.90	3.05	17.70	3.20	1.65	12.55	3.80	16.20	22.60	29.00	5.77	1.10	7.19	1.09	0.91	1.75	1.69	23.18	3.77	2.37
3	Food waste/veg matter	276.60	221.85	180.95	202.70	70.75	694.00	199.65	13.60	318.75	44.00	48.54	79.82	73.47	69.24	38.82	96.95	88.97	19.46	53.13	3.59
4	Textile	14.70	5.00	7.99	2.65	0.75	1.30	2.06	1.00	9.80	27.00	2.58	1.80	3.24	0.91	0.41	0.18	0.92	1.43	1.63	2.20
5	Grass & yard waste	111.40	0.00	14.77	2.15	6.30	0.75	0.30	17.40	137.20	112.50	19.55	0.00	6.00	0.73	3.46	0.10	0.13	24.89	22.87	9.18
6	Wood	7.80	0.00	0.50	0.20	0.60	0.00	1.40	0.00	1.50	6.00	1.37	0.00	0.20	0.07	0.33	0.00	0.62	0.00	0.25	0.49
7	*Plastic sheet	0.00	0.00	0.00	0.55	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	1.67	0.00
8	*Polyethylene bottle	10.90	1.65	1.55	2.65	0.15	1.50	0.99	0.00	5.95	2.00	1.91	0.59	0.63	0.91	0.08	0.21	0.44	0.00	0.99	0.16
9	*Other plastic bottle	0.20	1.35	0.40	3.10	0.95	1.00	1.60	0.00	4.85	0.00	0.04	0.49	0.16	1.06	0.52	0.14	0.71	0.00	0.81	0.00
10	*Other plastics	31.60	18.35	9.01	2.70	1.45	1.10	3.00	3.00	4.30	15.50	5.55	6.60	3.66	0.92	0.80	0.15	1.34	4.29	0.72	1.26
11	*Rubber	0.60	0.00	0.30	0.60	0.60	0.00	0.00	0.30	0.50	27.00	0.11	0.00	0.12	0.20	0.33	0.00	0.00	0.43	0.08	2.20
12	Leather	0.00	0.60	0.20	1.40	0.00	0.50	1.50	0.00	1.60	9.00	0.00	0.22	0.08	0.48	0.00	0.07	0.67	0.00	0.27	0.73
13	*Steel CAN	5.40	0.00	0.40	0.00	0.15	0.00	0.70	0.50	0.85	0.00	0.95	0.00	0.16	0.00	0.08	0.00	0.31	0.72	0.14	0.00
14	*Aluminium CAN	5.20	0.85	0.20	0.40	0.30	0.00	1.40	0.10	1.50	1.50	0.91	0.31	0.08	0.14	0.16	0.00	0.62	0.14	0.25	0.12
15	*Metal/Alloy	3.35	1.70	4.12	0.60	0.10	0.00	0.00	0.00	0.00	3.00	0.59	0.61	1.67	0.20	0.05	0.00	0.00	0.00	0.00	0.24
16	*Glass, broken bottles, others	10.20	2.50	2.10	3.60	0.45	1.80	0.00	0.00	13.40	9.00	1.79	0.90	0.85	1.23	0.25	0.25	0.00	0.00	2.23	0.73
17	*Glass bottles	8.20	3.90	1.50	0.65	3.35	0.00	0.00	0.00	0.00	0.00	1.44	1.40	0.61	0.22	1.84	0.00	0.00	0.00	0.00	0.00
18	Stone & ceramics	0.00	0.50	0.00	3.55	0.15	0.80	0.00	0.00	13.10	40.00	0.00	0.18	0.00	1.21	0.08	0.11	0.00	0.00	2.18	3.26
19	Miscellaneous inert (sand, dust)	14.60	2.50	1.75	48.35	84.25	0.00	0.00	9.70	35.90	896.50	2.56	0.90	0.71	16.52	46.23	0.00	0.00	13.88	5.98	73.12
20	Unclassified	0.00	1.70	0.00	5.00	10.30	0.00	2.00	0.00	10.20	4.00	0.00	0.61	0.00	1.71	5.65	0.00	0.89	0.00	1.70	0.33
TOTAL:		569.85	277.95	246.29	292.75	182.25	715.85	224.40	69.90	600.00	1226.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table-5.4: Summery of Composition Survey (Incoming Waste)

Sl. No.	Item	Total Quantity for 3 days (Kg)										Total Quantity for 3 days (Kg) [% of total waste]									
		Level of Collection										Level of Collection									
		Matuail Dump Site						Gabtoli Dump Site			Uttara Dump Site	Matuail Dump Site						Gabtoli Dump Site			Uttara Dump Site
		Zone-1	Zone-2	Zone-3	Zone-4	Zone-5	Zone-6	Zone-7	Zone-8	Zone-9	Zone-10	Zone-1	Zone-2	Zone-3	Zone-4	Zone-5	Zone-6	Zone-7	Zone-8	Zone-9	Zone-10
1	*Recyclable paper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.98
2	Other paper	26.10	25.20	20.40	35.90	24.80	14.20	13.90	41.20	27.50	30.30	4.35	4.20	3.40	5.98	4.13	2.37	2.32	6.87	4.58	5.05
3	Food waste/veg matter	209.50	393.60	345.40	138.20	334.65	416.30	442.90	417.40	261.00	471.80	34.92	65.60	57.57	23.03	55.78	69.38	73.82	69.57	43.50	78.63
4	Textile	29.90	68.00	26.40	49.40	22.60	41.70	23.40	42.90	57.00	13.90	4.98	11.33	4.40	8.23	3.77	6.95	3.90	7.15	9.50	2.32
5	Grass & yard waste	133.70	35.20	67.60	18.10	54.30	40.95	31.80	21.10	108.00	16.10	22.28	5.87	11.27	3.02	9.05	6.83	5.30	3.52	18.00	2.68
6	Wood	6.90	3.60	8.00	17.60	6.80	3.35	2.00	3.60	3.00	1.30	1.15	0.60	1.33	2.93	1.13	0.56	0.33	0.60	0.50	0.22
7	*Plastic sheet	0.00	0.00	0.00	44.30	33.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.38	5.56	0.00	0.00	0.00	0.00	0.00
8	*Polyethylene bottle	0.00	0.00	0.00	0.00	1.90	0.00	0.00	0.00	0.00	4.30	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.72
9	*Other plastic bottle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42
10	*Other plastics	44.60	28.80	18.80	0.00	0.00	15.80	23.00	50.00	29.00	16.50	7.43	4.80	3.13	0.00	0.00	2.63	3.83	8.33	4.83	2.75
11	*Rubber	7.90	6.40	5.60	49.80	14.00	3.80	4.40	7.00	8.50	0.00	1.32	1.07	0.93	8.30	2.33	0.63	0.73	1.17	1.42	0.00
12	Leather	0.80	0.00	0.00	0.00	0.10	0.00	3.00	0.90	4.50	5.10	0.13	0.00	0.00	0.00	0.02	0.00	0.50	0.15	0.75	0.85
13	*Steel CAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
14	*Aluminium CAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27
15	*Metal/Alloy	1.60	0.00	0.00	34.70	0.00	0.00	0.50	1.90	2.00	3.20	0.27	0.00	0.00	5.78	0.00	0.00	0.08	0.32	0.33	0.53
16	*Glass, broken bottles, others	8.80	0.00	0.00	16.40	10.60	8.25	1.00	5.00	1.00	1.90	1.47	0.00	0.00	2.73	1.77	1.38	0.17	0.83	0.17	0.32
17	*Glass bottles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57
18	Stone & ceramics	0.00	0.00	16.00	33.70	16.10	0.00	17.40	0.00	0.00	0.70	0.00	0.00	2.67	5.62	2.68	0.00	2.90	0.00	0.00	0.12
19	Miscellaneous inert (sand, dust)	130.20	33.20	91.80	155.50	50.70	17.35	35.70	9.00	98.50	6.50	21.70	5.53	15.30	25.92	8.45	2.89	5.95	1.50	16.42	1.08
20	Unclassified	0.00	6.00	0.00	6.40	30.10	38.30	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.07	5.02	6.38	0.17	0.00	0.00	0.00
TOTAL:		**600.00**	**600.00**	**600.00**	**600.00**	**600.00**	**600.00**	**600.00**	**600.00**	**600.00**	**600.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Summary of Lab Analysis Result of Generated Waste (Component wise)

Name of Laboratory : Bureau of Research, Testing and Consultation
Department of Civil Engineering, BUET, Dhaka

Component : Recyclable Papers — Sampling Date: 09.03.1004

Code	Item Name	Moisture Content (%)	Remarks
R-U-RP	Recyclable Papers	4.24	
R-M-RP	Do	7.01	
R-LM-RP	Do	9.23	
R-L-RP	Do	9.26	
R-S-RP	Do		Component was not Available
C-R-RP	Do		Do
C-SHG-RP	Do	5.74	
PF-RP	Do	11.55	
MR-RP	Do	4.46	
Rd-Sw-RP	Do		Component was not Available
Average - RP	**Recyclable Papers**	**7.36**	

Component : Other Papers — Sampling Date: 09.03.1004

Code	Item Name	Moisture Content (%)	Remarks
R-U-OP	Other Papers	12.95	
R-M-OP	Do	11.31	
R-LM-OP	Do	14.01	
R-L-OP	Do	7.75	
R-S-OP	Do	10.65	
C-R-OP	Do	5.47	
C-SHG-OP	Do	4.57	
PF-OP	Do	6.25	
MR-OP	Do	5.89	
Rd-Sw-OP	Do	9.06	
Average - OP	**Other Papers**	**8.79**	

Component : Food Waste/Vegetable matter — Sampling Date: 09.03.1004

Code	Item Name	Moisture Content (%)	Remarks
R-U-FW	Food Waste/Vegetable matter	59.44	
R-M-FW	Do	45.30	
R-LM-FW	Do	57.55	
R-L-FW	Do	53.93	
R-S-FW	Do	56.97	
C-R-FW	Do	60.03	
C-SHG-FW	Do	20.58	
PF-FW	Do	67.29	
MR-FW	Do	26.16	
Rd-Sw-FW	Do	62.09	
Average - FW	**Food Waste/Vegetable matter**	**50.93**	

Lab result-Summery

Component : Textiles **Sampling Date:** 09.03.1004

Code	Item Name	Moisture Content (%)	Remarks
R-U-T	Textiles	18.32	
R-M-T	Do	9.36	
R-LM-T	Do	27.81	
R-L-T	Do	33.07	
R-S-T	Do	11.22	
C-R-T	Do	8.83	
C-SHG-T	Do	1.59	
PF-T	Do	4.65	
MR-T	Do	12.71	
Rd-Sw -T	Do	4.04	
Average - T	**Textiles**	**13.16**	

Component : Grass & Yard Waste **Sampling Date:** 09.03.1004

Code	Item Name	Moisture Content (%)	Remarks
R-U-G	Grass & Yard Waste	41.23	
R-M-G	Do		Component was not Available
R-LM-G	Do	38.63	
R-L-G	Do	29.02	
R-S-G	Do	32.00	
C-R-G	Do		Component was not Available
C-SHG-G	Do		Do
PF-G	Do	17.02	
MR-G	Do	42.99	
Rd-Sw-G	Do	22.20	
Average - G	**Grass & Yard Waste**	**31.87**	

Component : Wood **Sampling Date:** 09.03.1004

Code	Item Name	Moisture Content (%)	Remarks
R-U-W	Wood	9.56	
R-M-W	Do		Component was not Available
R-LM-W	Do		Do
R-L-W	Do	5.85	
R-S-W	Do	13.02	
C-R-W	Do		
C-SHG-W	Do	6.23	
PF-W	Do		Component was not Available
MR-W	Do	4.96	
Rd-Sw-W	Do	12.52	
Average - W	**Wood**	**8.69**	

Lab result-Summery

Component : Plastic Sheet **Sampling Date:** 09.03.1004

Code	Item Name	Moisture Content (%)	Remarks
R-U-PS	Plastic Sheet		Component was not available
R-M-PS	Do		Do
R-LM-PS	Do		Do
R-L-PS	Do		Do
R-S-PS	Do		Do
C-R-PS	Do		Do
C-SHG-PS	Do		Do
PF-PS	Do		Do
MR-PS	Do	0.52	
Rd-Sw-PS	Do		Component was not Available
Average - PS	**Plastic Sheet**	**0.52**	

Component : Polyethylene Bottles **Sampling Date:** 09.03.1004

Code	Item Name	Moisture Content (%)	Remarks
R-U-PB	Polyethylene Bottles	1.36	
R-M-PB	Do	2.44	
R-LM-PB	Do	3.77	
R-L-PB	Do	1.59	
R-S-PB	Do	0.39	
C-R-PB	Do	4.10	
C-SHG-PB	Do	2.64	
PF-PB	Do		Component was not Available
MR-PB	Do	1.01	
Rd-Sw-PB	Do		Component was not Available
Average - PB	**Polyethylene Bottles**	**2.16**	

Component : Other Plastic Bottles **Sampling Date:** 09.03.1004

Code	Item Name	Moisture Content (%)	Remarks
R-U-OPB	Other Plastic Bottles	7.56	
R-M-OPB	Do	11.49	
R-LM-OPB	Do	2.51	
R-L-OPB	Do	4.44	
R-S-OPB	Do		Component was not Available
C-R-OPB	Do		Do
C-SHG-OPB	Do	4.95	
PF-OPB	Do		
MR-OPB	Do	1.72	
Rd-Sw-OPB	Do		Component was not Available
Average - OPB	**Other Plastic Bottles**	**5.45**	

Component : Rubber **Sampling Date:** 09.03.1004

Code	Item Name	Moisture Content (%)	Remarks
R-U-R	Rubber		Component was not available
R-M-R	Do		Do
R-LM-R	Do		Do
R-L-R	Do		Do
R-S-R	Do	2.01	
C-R-R	Do		Component was not available
C-SHG-R	Do		Do
PF-R	Do		Do
MR-R	Do	0.48	
Rd-Sw-R	Do	1.15	
Average - R	**Rubber**	**1.21**	

Component : Leather **Sampling Date:** 09.03.1004

Code	Item Name	Moisture Content (%)	Remarks
R-U-L	Leather		Component was not available
R-M-L	Do		Do
R-LM-L	Do		Do
R-L-L	Do		Do
R-S-L	Do		Do
C-R-L	Do	21.60	
C-SHG-L	Do	1.45	
PF-L	Do		Component was not available
MR-L	Do		Do
Rd-Sw-L	Do	7.80	
Average - L	**Leather**	**10.28**	

Component : Others **Sampling Date:** 09.03.1004

Code	Item Name	Moisture Content (%)	Remarks
R-U-O	Others	8.76	
R-M-O	Do	1.61	
R-LM-O	Do	0.56	
R-L-O	Do	8.87	
R-S-O	Do	1.96	
C-R-O	Do	1.87	
C-SHG-O	Do	2.07	
PF-O	Do		Component was not available
MR-O	Do	1.90	
Rd-Sw-O	Do	1.30	
Average - O	**Others**	**3.21**	

Summary Lab Analysis Result of Collected Waste (Component wise)

Name of Laboratory : **Bureau of Research, Testing and Consultation; Department of Civil Engineering, BUET, Dhaka**

Component : Recyclable Papers Sampling Date: 11.03.1004

Code	Item Name	Moisture Content (%)	Remarks
Zone-1-RP	Recyclable Papers		Component was not available
Zone-2-RP	Do		Do
Zone-3-RP	Do		Do
Zone-4-RP	Do		Do
Zone-5-RP	Do		Do
Zone-6-RP	Do		Do
Zone-7-RP	Do		Do
Zone-8-RP	Do		Do
Zone-1-RP	Do		Do
Zone-9-RP	Do		Do
Zone-10-RP	Do	16.33	
Average -RP	**Recyclable Papers**	**16.33**	

Component : Other Papers **Sampling Date:** 11.03.1004

Code	Item Name	Moisture Content (%)	Remarks
Zone-1-OP	Other Papers	61.64	
Zone-2-OP	Do	58.13	
Zone-3-OP	Do	8.84	
Zone-4-OP	Do	43.72	
Zone-5-OP	Do	48.81	
Zone-6-OP	Do	40.43	
Zone-7-OP	Do	43.88	
Zone-8-OP	Do	47.73	
Zone-9-OP	Do	43.48	
Zone-10-OP	Do	10.39	
Average - OP	**Other Papers**	**40.71**	

Component : Food Waste/Vegetable matter **Sampling Date:** 11.03.1004

Code	Item Name	Moisture Content (%)	Remarks
Zone-1-FW	Food Waste/Vegetable matter	69.99	
Zone-2-FW	Do	83.71	
Zone-3-FW	Do	86.43	
Zone-4-FW	Do	65.72	
Zone-5-FW	Do	64.19	
Zone-6-FW	Do	52.42	
Zone-7-FW	Do	80.19	
Zone-8-FW	Do	83.07	
Zone-9-FW	Do	79.46	
Zone-10-FW	Do	76.62	
Average - FW	**Food Waste/Vegetable matter**	**74.18**	

Lab result-Summery

Component : Textiles **Sampling Date:** 11.03.1004

Code	Item Name	Moisture Content (%)	Remarks
Zone-1-T	Textiles	37.22	
Zone-2-T	Do	57.18	
Zone-3-T	Do	45.50	
Zone-4-T	Do	37.97	
Zone-5-T	Do	16.92	
Zone-6-T	Do	18.66	
Zone-7-T	Do	25.35	
Zone-8-T	Do	59.66	
Zone-9-T	Do	52.10	
Zone-10-T	Do	16.50	
Average - T	**Textiles**	**36.71**	

Component : Grass & Yard Waste **Sampling Date:** 11.03.1004

Code	Item Name	Moisture Content (%)	Remarks
Zone-1-G	Grass & Yard Waste	45.54	
Zone-2-G	Do	51.97	
Zone-3-G	Do	59.52	
Zone-4-G	Do	44.79	
Zone-5-G	Do	37.71	
Zone-6-G	Do	38.14	
Zone-7-G	Do	12.12	
Zone-8-G	Do	55.14	
Zone-9-G	Do	42.91	
Zone-10-G	Do	33.14	
Average - G	**Grass & Yard Waste**	**40.10**	

Component : Wood **Sampling Date:** 11.03.1004

Code	Item Name	Moisture Content (%)	Remarks
Zone-1-W	Wood	28.69	
Zone-2-W	Do	38.57	
Zone-3-W	Do	16.15	
Zone-4-W	Do		Component was not available
Zone-5-W	Do	16.84	
Zone-6-W	Do		Component was not available
Zone-7-W	Do	7.86	
Zone-8-W	Do	7.83	
Zone-9-W	Do		Component was not available
Zone-10-W	Do	12.37	
Average - W	**Wood**	**18.33**	

Lab result-Summery

Component : Plastic Sheet **Sampling Date:** 11.03.1004

Code	Item Name	Moisture Content (%)	Remarks
Zone-1-PS	Plastic Sheet	36.54	
Zone-2-PS	Do	41.28	
Zone-3-PS	Do	40.92	
Zone-4-PS	Do	24.30	
Zone-5-PS	Do	37.72	
Zone-6-PS	Do	20.48	
Zone-7-PS	Do		Component was not available
Zone-8-PS	Do		Do
Zone-9-PS	Do		Do
Zone-10-PS	Do		Do
Average - PS	**Plastic Sheet**	**33.54**	

Component : Polyethylene Bottles **Sampling Date:** 11.03.1004

Code	Item Name	Moisture Content (%)	Remarks
Zone-1-PB	Polyethylene Bottles		Component was not available
Zone-2-PB	Do		Do
Zone-3-PB	Do		Do
Zone-4-PB	Do		Do
Zone-5-PB	Do		Do
Zone-6-PB	Do		Do
Zone-7-PB	Do		Do
Zone-8-PB	Do		Do
Zone-9-PB	Do		Do
Zone-10-PB	Do	2.70	
Average - PB	**Polyethylene Bottles**	**2.70**	

Component : Other Plastic Bottles Sampling Date: 11.03.1004

Code	Item Name	Moisture Content (%)	Remarks
Zone-1-OPB	Other Plastic Bottles		Component was not available
Zone-2-OPB	Do		Do
Zone-3-OPB	Do		Do
Zone-4-OPB	Do		Do
Zone-5-OPB	Do		Do
Zone-6-OPB	Do		Do
Zone-7-OPB	Do		Do
Zone-8-OPB	Do		Do
Zone-9-OPB	Do		Do
Zone-10-OPB	Do	1.73	
Average - OPB	**Other Plastic Bottles**	**1.73**	

Component : Rubber Sampling Date: 11.03.1004

Code	Item Name	Moisture Content (%)	Remarks
Zone-1-R	Rubber	3.65	
Zone-2-R	Do	1.58	
Zone-3-R	Do	5.53	
Zone-4-R	Do		Component was not available
Zone-5-R	Do	2.97	
Zone-6-R	Do		Component was not available
Zone-7-R	Do	1.66	
Zone-8-R	Do	1.58	
Zone-9-R	Do	2.44	
Zone-10-R	Do		Component was not available
Average - R	**Rubber**	**2.77**	

Component : Leather **Sampling Date:** 11.03.1004

Code	Item Name	Moisture Content (%)	Remarks
Zone-1-L	Leather	25.63	
Zone-2-L	Do		Component was not available
Zone-3-L	Do		Do
Zone-4-L	Do		Do
Zone-5-L	Do		Do
Zone-6-L	Do		Do
Zone-7-L	Do	33.60	
Zone-8-L	Do	13.40	
Zone-9-L	Do	33.79	
Zone-10-L	Do	8.49	
Average - L	**Leather**	**22.98**	

Component : Composite **Sampling Date:** 11.03.1004

Code	Item Name	Moisture Content (%)	Remarks
Zone-1-C	Composite	49.61	
Zone-2-C	Do	56.21	
Zone-3-C	Do	24.14	
Zone-4-C	Do	43.23	
Zone-5-C	Do	21.79	
Zone-6-C	Do	51.81	
Zone-7-C	Do	29.73	
Zone-8-C	Do	42.32	
Zone-9-C	Do	53.46	
Zone-10-C	Do	53.03	
Average - C	**Composite**	**42.53**	

Lab result-Summery

Table of Contents

Solid Waste Amount & Composition Survey

ADDENDUM

(Survey on Incoming waste at Landfill site and Transport Vehicles)

Abbreviations/Acronyms

AD	:	Anno Domini
BETS	:	Bangladesh Engineering & Technological Services Ltd.
BERI BUNDH	:	Circular Embankment
BUET	:	Bangladesh University of Engineering & Technology
DCC	:	Dhaka City Corporation
JICA	:	Japan International Cooperation Agency
LF	:	Land Fill
PF	:	Public Facility
SW	:	Solid Waste
SWM	:	Solid Waste Management
WB	:	World Bank
UNDP	:	United Nation Development Programme

1. INTRODUCTION

The Draft Survey report submitted on 24th March, 2004 contained the component "Amount and Composition survey" (which now has been submitted as Final Survey Report). As per ToR item 2.4, survey on incoming waste at land fill site and item 2.5, survey on transportation (collection) vehicles activity at the central garage were left behind, because the weighing machine was supposed to be installed at Matuail site could not be installed. The issue was discussed on 7th April, 2004 with the Deputy Team Leader of the survey Team in his office at Dhaka City Corporation. It was decided that item 2.4 & 2.5 shall be completed without the weighing machine. Accordingly 3 days continuous and synchronised surveys were conducted for 72 hrs from the morning of 9th April as the baseline survey. In addition to the baseline survey, another 4 days continuous survey was conducted for transport vehicles activity at central garage for 96 hrs from the morning of 20th April.(Hence this Addendum has been prepared incorporating the survey of Land Fill sites and vehicles activity at the central garage)

2. SCOPE OF WORK

2.1 Survey on Incoming Waste at Landfill site

At present there are three following sites where solid waste of DCC area are disposed off:

(i) Matuail
(ii) Beri Bundh, Turag River (near Gabtoli, Mirpur)
(iii) Beri Bundh, Tongi Khal (Ronobhola, Uttara)

In this connection Fig. 2.1 may please be seen where the location of the landfill sites have been shown.

In the absence of weighing machine the following data shall be recorded:

(i) Vehicle Registration Number
(ii) Vehicle Type
(iii) Vehicle Capacity
(iv) Vehicle Departure time
(v) Vehicle Arrival time
(vi) Collection Zone/Ward
(vii) Type of waste
(viii) Driver's Name

All these information shall be recorded in the prescribed format as provided by the JICA Study Team.

2.2 Survey on transportation (Collection) Vehicle activity at the Central Garage

Item 2.4 & Item 2.5 of ToR are interrelated studies. The refuse collection vehicles (RCVs) are usually stationed at the DCC Central Garage at Saidabad and their activity is for 24 hrs. The following data shall be recorded for all outgoing and incoming vehicles.

(i) Vehicle Registration Number
(ii) Vehicle Type
(iii) Vehicle Capacity
(iv) Vehicle Departure Time
(v) Vehicle Arrival Time
(vi) Number of Trips made/ shift
(vii) Collection Zone/ Stations
(viii) Disposal place
(ix) Name of driver

All these information shall be recorded in the prescribed format as provided by the JICA Study Team.

3. METHODOLOGY

Both the study required the presence of surveyors for 24 hrs and the entire time was divided in 3 shifts (8 hrs). On top of the surveyors supervising engineers were engaged to check their performance. The central pool (garage) activity and the activity at the landfill sites were started at on 6 Am & 7 Am respectively of 9th April 2004 & for second times another four days survey was conducted from 20th April morning (7 A.M) to 24th April morning (7 A.M) for the central pool only.

The basis of the estimated amount of the waste in each truck is by knowing the capacity of the truck/ demountatble container from the truck drivers and also viewing whether the carrier of the truck is overloaded or underloaded. Basically the following are the size of carriers of truck chassis in relation to their respective rated carrying capacity:

Table- 3.1: Rated Capacity of Trucks

Vehicle Type	Carrying Capacity (Ton)*	Carrying Vol. (m^3)
OT	1.5	2.5 cu.m
OT	2	3.4 cu.m
OT	3	4.75 cu.m
OT	5	6.5 cu.m
OT	22	28.5 cu.m
DCC	3	6 cu.m
DCC	5	12 cu.m

OT - *Open Truck*
DCC - *Demountble Container Carrier*
* *Source* - *Dhaka City Corporation*

4. SCHEDULE OF THE SURVEY

As stated earlier the survey was started at 6 A.M of 9th April (Friday) and finished in the morning of 11th April (Monday).& only for central garage another 4 days of survey was started from 20th April to 24th April .The recording of data was continuously taken after started the survey.

5. FINDINGS OF THE SURVEY

5.1 Incoming Waste at different Landfill Sites

The raw data was entered in Proforma (D) and the available data have been shown on Zone basis in Proforma (E). The survey of the available data is shown in Table 5.1 for Matuail Site, Beribundh Gabtoli Site and Beribundh Uttara Site. It may be seen that number of trips and consequently the amount of waste recorded at Matuail site on 9th April is much less compared to 10th April & 11th April. This happened due to heavy storm that took place on that night and as such average trips for other two days has been considered for 9th April as well.

The average incoming waste at Uttara landfill site is approximately 45 tons per day. A private organization is responsible for collection, transportation and disposal of the waste. The waste dumped at the campus area (river front) of IUBAT (International University of Business Agricultural & Technology) a private university. The university is maintaining a 24 hrs record of the incoming waste. From this record it is seen that average per day disposal is approximately 45 tonnes. The Survey Team engaged surveyor from 9th April, but due to development work of road infrastructure of the University only few trips are made every day and as result per day disposal is only 5-20 tonnes. However, in the present estimation normal disposal of 45 tones has been considered. Thus, the average per day disposal at different landfill site are as follows:

1.	Matuail Site	-	577 Tonnes
2.	Gabtoli Site	-	414 Tonnes
3.	Uttara Site	-	45 Tonnes
		Total:	1036 Tonnes

5.2 Transportation Vehicle Activity

Table 5.2 gives a summary of the activity of 168 hrs. It is seen that on the 1st day (09.04.04 to 10.04.04) 29 RCVs did not return, on the 2nd day (10.04.04 to 11.04.04) 43 RCVs did not return. On the 3rd day (11.04.04 to 12.04.04) 38 RCVs did not return to the central pool. Another four days survey was started from 20th April and finished at 24th April These last four days it was also seen that on the 1st day (20.04.04 to 21.04.04) 11 RCVs did not return, 2nd day (21.04.04 to 22.04.04) 10 RCV did not return, 3rd day (22.04.04 to 23.04.04) 11 RCVs excess returned and the 4th day (23.04.04 to 24.04.04) 1 RCVs excess returned .It may happen so that some RCVs were engaged to do some additional works and as a result did not return to the pool. First three days average outgoing and incoming shows 193 and 156 & last four days also shows 237 and 235 respectively of RCV participated in the whole operation.

6. DISCUSSIONS.

During 1991 the Implementation Support Consultant of Support for Urban Management and Municipal Services Programme, funded by World Bank conducted waste generation survey at landfill site (Jatrabari). A comparative summary of that study and the present study is given bellow.

Table-6.1: Comparative waste generation Survey

Period	No. of RCV used	Generated waste (Ton)	Remarks
May, 1991	80	713	Measured on truck density 600 Kg/cu m
April, 2004	180	1036	-

The Study made by Dhaka Metropolitan Development Planning (DMDP), October 1992 report indicates a population of 3,397,000 (1991 census) with a per capita generation of 0.47 kg/day. According to the present population of 8.6 within the DCC area the generation is estimated 8,600,000x0.47 = 4000 Tonnes/day. With this generation rate the present disposal efficiency is 34%.

Disposal Site

The present main disposal site located at Matuail, Figure 6.1 shows the location of the site which covers an area of approximately 24 ha. Additional area is being considered adjacent to the present site.

The second disposal at Gabtoli site is taking place in Turag River, (Point 2, fig.-2.1). The third disposal site (Pt. 3, fig. 2.1) is planned for development of the campus land belonged to International University of Business, Agriculture & Technology, a river front area of Tongi Khal.

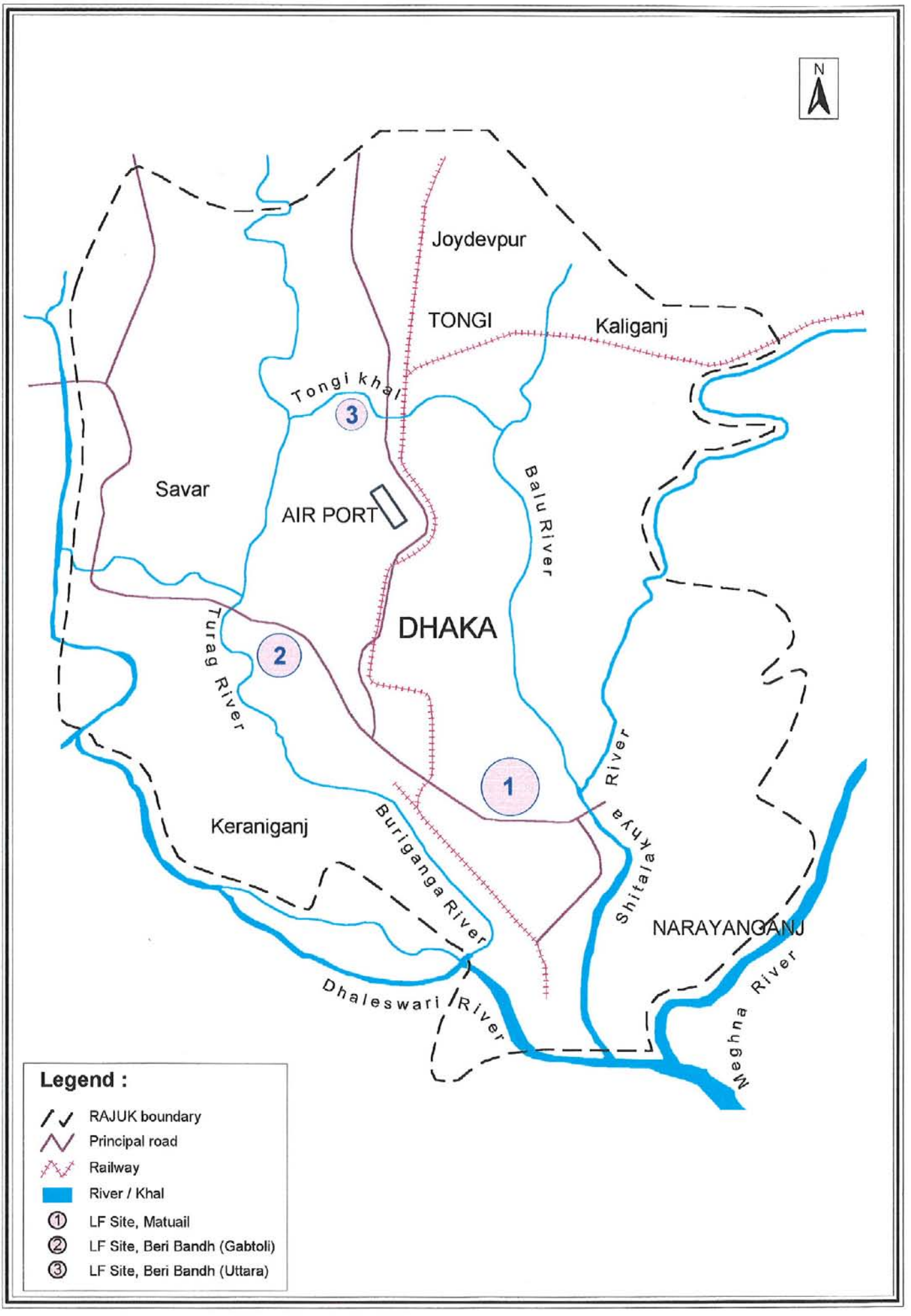
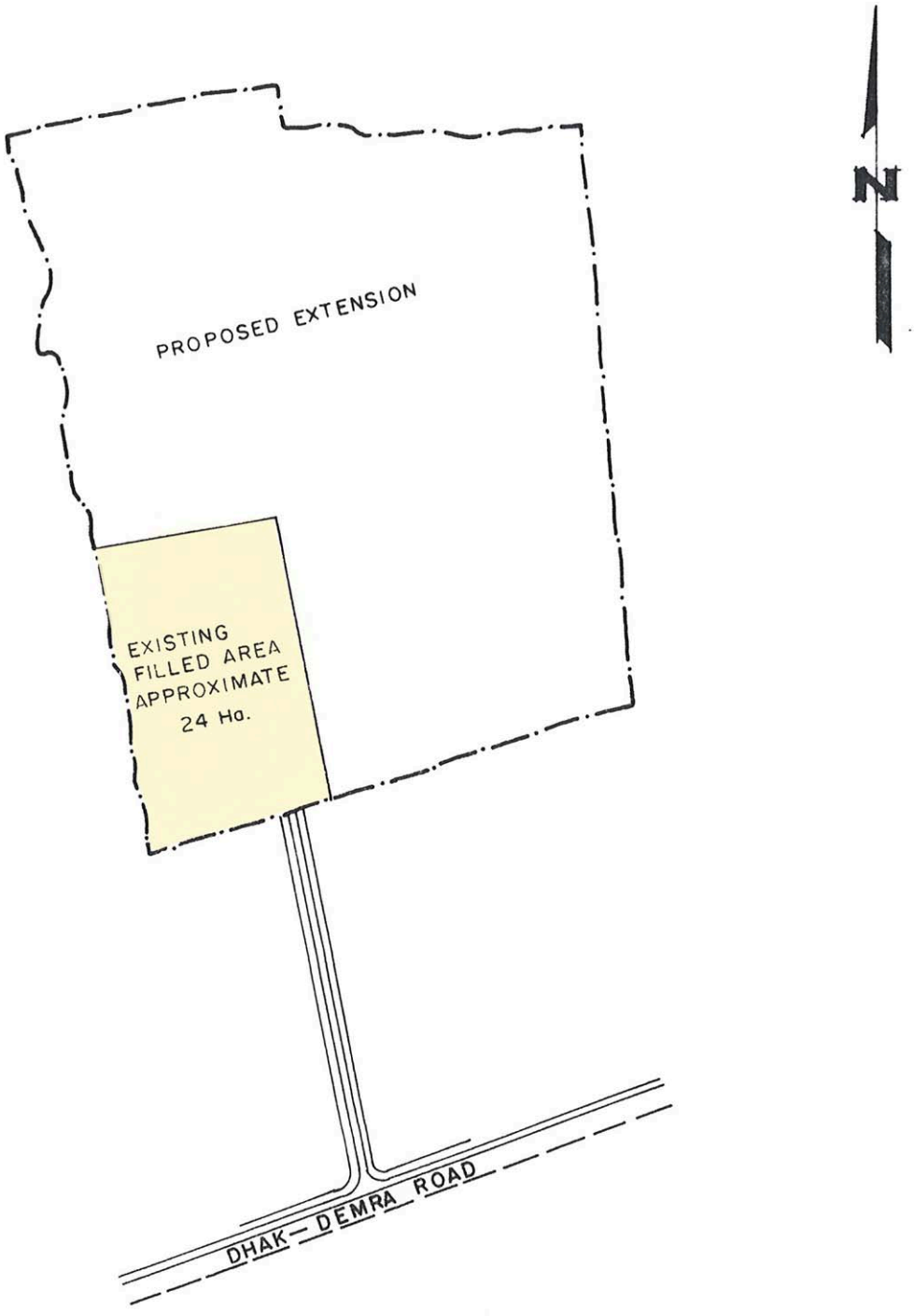


Figure 2.1 : Map of Greater Dhaka Showing Location of Existing Landfill Sites

Map Showing the existing L.F. site, Matuail



SOLID WASTE AMOUNT AND COMPOSITION SURVEY

Datewise Summary of Incoming Waste (Matuail, Gabtoli & Uttara)

Table 5.1

Date	Total No. of RCV used	Total No. of Trips made	Zonewise Waste Transported (Ton)										Total Waste Transported (Ton)	Remarks
			Zone-1	Zone-2	Zone-3	Zone-4	Zone-5	Zone-6	Zone-7	Zone-8	Zone-9	Zone-10		
9/4/04		208	56.70	72.45	20.90	54.10	59.15	136.20	137.59	81.43	67.73	15.00	**701.25**	
10/4/04		364	100.70	129.55	67.90	139.60	172.97	239.98	161.05	100.65	76.50	5.00	**1193.90**	
11/4/04		335	111.00	109.05	48.50	138.20	183.15	176.95	144.33	101.60	83.70	15.00	**1111.48**	

RCV Refuse Collection Vehicle

N.B.
(i) No. of RCV made single trip/shift (Av.) -7 (3.95%)
(ii) No. of RCV made two trips/shift (Av.) -150 (84.75%)
(iii) No. of RCV made three trips/shift (Av.) -20 (11.30%)

SOLID WASTE AMOUNT AND COMPOSITION SURVEY

Survey of Tranportation Vehicle

(Summary)

Table: 5.2

Date	No. of RCV Outgoing/Incoming								Remarks
	1st Shift		2nd Shift		3rd Shift		Total/Day		
	Outgoing	Incoming	Outgoing	Incoming	Outgoing	Incoming	Outgoing	Incoming	
9/4/04	67	57	29	19	65	56	161	132	29 RCV did not return
10/4/04	119	109	17	34	65	15	201	158	43 RCV did not return
11/4/04	115	84	18	37	84	58	217	179	38 RCV did not return
20/04/04	51	123	30	35	156	68	237	226	11 RCV did not return
21/04/04	70	138	30	41	164	75	264	254	10 RCV did not return
22/04/04	50	124	32	45	146	70	228	239	11 RCV excess returned
23/04/04	39	127	34	29	146	64	219	220	1 RCV excess returned

RCV Refuse Collection Vehicle

N.B. (i) Total Number of RCV operated/day (Av.) **210**