APPRAISAL NOTE

Name of Town: Mirzapur	**District / State: Mirzapur/Uttar Pradesh**
1. Name of the Project: Detailed Project Report for Collection and Transportation of Solid Waste Management for Mirzapur City.	
2. Capital Cost of the Project	**Rs. 7,98,28,190 (7.98 Cr)**
3. Existing Status	
-Primary Collection System	Door to door collection is going on by Nagar Palika and presently working in 25 wards out of 38 wards.
- Primary Storage System No. of Bins / Capacity	Not available
- Secondary Storage System No. of Bins / Capacity / type Dumper Placer Bins / Refuse Collector Bins / Tractor Trolleys	2 dumpers, 10 tipper, 1 refuse compactor, 5 small tractors, 1 jcb,3 tata magic
-Processing System (Brief details) Compost Plant / Vermi-Compost / Mechanical Compost	Not existing in Mirzapur. Only dumping ground in Tandgaon,Mirzapur is existing where all the waste has been dumped by different vehicles.
Disposal system landfill area	**Tandgaon,Mirzapur District-Mirzapur** is the dumping place for all kind of waste from the city.
4. Technical Details of Proposed System	
-Whether garbage generation has been studied and estimated, if so brief?	It has been surveyed and estimated with the quantity of 81.89 TPD which comes to 350 gms per capita per day.
Quantity of waste (%)	organic content is 38.45%, soil content is 19.40%, construction waste is 2.97%, Plastic (7.67%), Clothes (3.92%), Paper (13.69%), and Miscellaneous (13.90%) of total waste generated
- Whether Density / Moisture content estimated, if so details?	Moisture content (28.38% - 36.50%) Bulk density (245-380 Kg/m^3) calorific value (1450-1680 cal /g)
- Whether provision for primary collection of segregated waste made, if so details?	Yes
No. of Rickshaw Cart	80
No. of MS bins available with the capacity	120 MS bins (1.1 cum) 30 MS bins (4.5 cum) 105 MS bins (2.5 cum)
Whether provision for / design of secondary collection / transportation of garbage has been made? If yes, brief details, type of collection, type of equipment etc. Tractor / Dumper Placer / Refuse Collector Bins.	Transportation plan developed and provided in the DPR.
Landfill Site	Tandgaon Mirzapur, Distt-Mirzapur

EXECUTIVE SUMMARY

The detailed project report covered the Introduction to project, Background of the planning area, Status of the existing solid waste management system, Proposed MSW management system with cost estimates, equipment specifications and route plans, Design of waste (120 TPD) to compost plant with cost estimates, Conceptual Design of Sanitary landfill with cost estimates and Engineering drawings, Operational and Maintenance aspects, Cost of Proposed System, Financial Framework, Proposed Institutional Framework, Details of community participation through IEC.

An analysis of the extensive survey data indicates that a total quantity of 81.89 TPD waste is generated in Mirzapur out of which organic content is 38.45%, soil content is 19.40%, construction waste is 2.97%, Plastic (7.67%), Clothes (3.92%), Paper (13.69%), and Miscellaneous (13.90%) of total waste generated. The calculations also suggest that per capita per day waste generation is around 350gm/capita/day.

The MSW Management, Operation, primary & secondary collection and transportation system are proposed strictly in accordance with the guidelines issued by CPCB/ MoEFF, actual site conditions as depicted from the extensive surveys conducted and in line with MSW Rules 2016.

For integrated sanitary landfill facility there is no any geo-technical investigations done.

For the design of sanitary landfill purpose various important issues like waste to be handled, access road , land area, evaluation of geology and hydrology of the site, surface drainage, operational plan, layout of MSW landfill, completed waste fill features, estimation of landfill capacity, embankment, foundation, selection of liner systems , selection of leachate control facilities, selection of landfill gas control facilities, aesthetic considerations, post closure care, ground water protection, monitoring facilities, determination of equipment requirements, estimated cost of the project design life have been carefully analyzed and a rational conceptual developed.

The DPR envisages for IEC & capacity building of stakeholders, program implementation, approach to IEC implementation covering program communication, social mobilization, identification of areas where community participation, methodology for conducting training programs with schedule are provided in details.

The total project outlay is proposed at **Rs 7.98 Crores** including operation and maintenance cost of the project , in which the total cost of primary & secondary and Transportation cost is **Rs 5.91 Crores** and operational & maintenance cost Rs 2.07 crores per year. The cost operational and salary expenses of & secondary and Transportation is 2.34 Crore per annum.

NAGAR PALIKA PARISHAD MIRZAPUR

Detailed Project Report for Municipal Solid Waste Management Collection & Transpotation for Towns in Nagar palika Parishad, Mirzapur Uttar Pradesh Under SBM.

Presented By-

Urban Infrastructure Specialist

Nagar Palika Parishad Mirzapur

CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abbreviation List

CAA	Constitution Amendment Act
CAGR	Compound Annual Growth Rate
C&DS	Construction and Design Services
C&D Waste	Construction and Demolition Waste
CBOs	Community Base Organizations
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CH_4	Methane
CPHEEO	Central Public Health and Environment Engineering Organization
CPCB	Central Pollution Control Board
DPR	Detailed Project Report
EC	Environmental Clearance
EIA	Environmental Impact Assessment
EPA	Environment (Protection) Act, 1986
GoI	Government of India
GoUP	Government of Uttar Pradesh
GL	Ground Level
HCl	Hydrogen Chloride
HDPE	High Density Polyethylene
HPEC	High Powered Expert Committee
IEC	Information, Education and Communication
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
Kcal	Kilo Calorie
Kg	Kilo Gram
Km	Kilo Meter
LEL	Lower Explosive Limit
M	Meter
MSW	Municipal Solid Wastes
MS	Mild Steel
MSWM	Municipal Solid Waste Management
MT	Metric Tons

MoEF	Ministry of Environment and Forests
MoUD	Ministry of Urban Development
N	Nitrogen
NACO	National AIDs Control Organization
NGOs	Non-Governmental Organization
NPP	Nagar Palika Parishad
NO_2	Nitrous Oxide
NRCP	National River Conservation Plan
O_2	Oxygen
O&M	Operation & Maintenance
P	Phosphorus
PIL	Public Interest Litigation
PPE	Personal Protective Equipment
PPP	Public Private Partnership
RDF	Refuse Derived Fuel
SCP	Secondary Collection Point
SEIAA	State Environmental Impact Assessment Authority
SHGs	Self Help Groups
SO_2	Sulphur Dioxide
SPM	Suspended Particulate Matter
TDS	Tons Per Day
TPD	Total Dissolved Solids
ULBs	Urban Local Bodies
UPJL	Uttar Pradesh Jal Nigam
UPPCB	Uttar Pradesh Pollution Control Board
WHO	World Health Organization
WtE	Waste to Energy

CHAPTER 1
PROJECT BACKGROUND

1.1 Introduction

With the 74th amendment of the constitution of India in 1992, municipal authorities in the country have been recognized as a third tier of govt. The 12th schedule of the constitution has led down the functions envisaged to be performed by the municipal authorities. One among those functions is Solid Waste Management. As per Municipal acts, governing the local bodies in the country, it is an obligatory duty of the municipal authority in the country to keep cities and towns clean and provide good quality of life to citizens. However, the services provided by the municipal authorities are outdated and very ineffective. Domestic, commercial, biomedical and variety of toxic and domestic hazardous waste are generally disposed by the citizens on the streets, drains, open spaces and water bodies causing serious problems of health and environment. Problems of solid waste management are growing with rapid urbanization and change in the lifestyle of people. The situation is becoming critical with the passage of time. The urban population in India has gone up 5 times in the last 6 decades. As per 2011 census, 377,105,760 people live in urban areas in the country which accounts for 31.16% of India's Population.

Management of solid waste, though an essential service, and an obligatory duty is given low priority. This coupled with lack of financial resources, institutional weakness, improper choice of technology and rapid urbanization, whose ramifications are more pronounced with uncontrolled growth rate of population, has made the service far from satisfactory, thus creating serious environmental and health problems.

Solid waste is generated from a number of sources which include households, commercial areas, industries, institutions, construction and demolition sites, parks and streets.

Solid waste management (SWM) is a process of storage, segregation, collection, transportation, processing and disposal of solid waste in an environmentally acceptable manner. There are optional collection methods varied transportation equipment recyclable waste recovery mechanism, processing technologies as composting, refuse derived fuel, waste to energy, incineration etc. and disposal of residual waste in an engineered landfill.

During the recent past, the management of solid waste has received considerable attention from the Central and State Governments and local (municipal) authorities in India. A number of partnerships/alliances are found to exist in the field of solid waste management in Indian cities. These alliances are public-private, community-public and private-private arrangements. To identify the status of existing alliances in the study area, it is first necessary to identify the various actors working in the field of waste management. These actors can be grouped as under:

Initiatives to Improve SWM in India

• Public sector: this comprises of local authority and local public departments at city level;

• Private-formal sector: this constitutes large and small registered enterprises doing collection, transport, treatment, and disposal and recycling;

• Private-informal sector: this constitutes the small-scale, non-recognized private sector and comprises of waste-pickers, dump pickers, itinerant-waste buyers, traders and non-registered small-scale enterprises; and

• Community representatives in the form of NGOs, etc. These actors enter into partnerships for providing various activities related to solid waste management.

These partnerships can be as follows:

• Public-private (Local Authority and private enterprises);

• Public-community (Local Authority and NGOs); etc.

• Private-private (waste-pickers, itinerant-waste buyers, waste traders and dealers, wholesalers, small scale and large scale recycling enterprises); and

• Public-private-community (Local Authority, private enterprises and NGOs).

Current Status of SWM in Uttar Pradesh

Management of solid waste is one of the most challenging problems in India's cities and towns. Increasing population levels, rapid economic growth and rise in community living standards accelerate the rate of generation of municipal solid waste (MSW) in Indian cities. Most of the urban areas are currently facing a serious problem of land and water pollution due to the generation of huge quantities of solid waste and their open dumping.

In the present study an assessment is made of the existing situation of municipal solid waste management (MSWM) in UP (India). The current status of MSWM as per the MSW Rules, 2000 has also been appraised and an action plan for better management has been formulated. The quantitative and qualitative characteristics of MSW along with basic information have been evaluated UP state. The geographic information system has also been used to digitize the existing MSW dumping sites.

The present study has showed that there are many shortcomings in the existing MSWM practices. The Uttar Pradesh is one of the most densely populated, commercialized and urbanized state of India. This state is also adding on commercial centers and new urban extensions which are providing additional housing services and employment opportunities to increasing population resulting into generation of huge quantity of MSW. In the absence of sanitary landfills or other protected and lined dumping places, open dumping poses environmental and health hazards as leachate from open dumps are becoming major sources of groundwater contamination in the subsequent years of dumping MSW.

1.2 Need for the Project

Some of the issues which are applicable to the existing solid waste management system are highlighted below:

- Absence of any systematic waste collection and segregation process with complete coverage;
- Absence of any waste processing and treatment facility
- Open disposal of waste near to the roads and in open drains
- Generation of bulk quantity of waste during festive seasons and uncontrolled disposal of waste at the source of generation itself
- Absence of sufficient manpower and suitable infrastructural facilities for waste management
- No waste management practices for waste

- Lack of awareness among people towards waste management

1.3 Project Objectives and Scope

The project aims at developing a solid waste management facility for Agra in a scientific manner in pursuance to Swachh Bharat Mission and Municipal Solid Wastes (Management & Handling) Rules, 2016. The project activity would be focused on collection of municipal solid waste, segregation of solid waste, storage of solid wastes in systematic manner so as to prevent any unhygienic and insanitary conditions around the storage points, transportation of municipal solid waste, processing and disposal of the same at a scientific landfill site. The specific objective of the project can be listed as:

a) Prepare comprehensive Solid Waste Management (SWM) Action Plan with implementation options including public private partnership mode, covering all components of Solid Waste Management (SWM) for the Agra cluster
b) Prepare a detailed project report including financial feasibility for the overall project, which could be used for selection of a private operator and/or developer.

In line with the objectives, the broad scope of work, to be carried out, as part of this assignment will be in the following phases:

- **Phase I** DPR for primary waste collection, secondary storage and transport to processing plant. The Consultant shall include diagnostic report on ULBs, analyses of alternatives and justification for choice of proposed alternatives and provide details of tools, equipment and vehicle requirements for waste collection, secondary storage & transport to processing plants,
- **Phase II** DPR for waste processing facilities, materials recovery facility, separation and processing of biodegradables, recovery of recyclables for transfer to the waste trade, and recovery of RDF for developing waste to energy facility or for sale as feedstock for RDF including: a. Investment Plan for Processing Plant including (i) demand study for products from processed waste; (ii) Conceptual design, costs and technical specifications for processing and/or transfer station facility. b. Financial and Economic Analysis for DPR phases 1 and 2 including (i) cash flow analysis, (ii) payments analysis, (iii) user fees analysis; (iv) financing plan; and (v) economic analysis.
- **Phase III** DPR for the regional sanitary landfill comprising**:** a. Conceptual design, costs and technical specifications and cost estimates for landfill operation including all permanent infrastructure of roads and buildings at landfill site, one cell adequate for disposal of waste for 5 to 6 years, and initial requirements of equipment and vehicles for landfill operations and transport of inert waste from processing plants. b. Implementation Arrangements and Operator Models including (i) options assessment of the implementation arrangements and operator models; (ii) description of proposed implementation arrangements and contractual arrangements c. Comprehensive Financial and Economic Analysis including (i) cash flow analysis, (ii) payments analysis, (iii) user fees analysis; (iv) financing plan; and (v) economic analysis.
- **Phase IV** Capacity Building program and Operation Manual

1.4 Project Deliverables

The consultant recognizes that quality deliverables shall be the basis for the Client to make an informed decision on the subsequent actions to be taken for achieving the objective of improved solid waste management for the ULBs. Towards this, the following deliverables will be provided during the period of study.

- DPR Report 1: for primary collection, secondary storage and transport to processing plant
- DPR Report 2: for waste processing facilities
- DPR Report 3: for sanitary landfill and collection & transport of inert non-combustible waste from different processing plants in the cluster

Guidelines for Feasibility Studies/Detailed Project Report Preparation

- Consistency with World Bank, Swachh Bharat Mission, and GoI Requirements
- Comprehensive Analysis
- Analysis of Alternatives to Develop Least Cost Solutions
- Technical Proposals
- Institutional Analysis and Institutional Strengthening
- Financial Analysis
- Economic Analysis
- Consultation Process

1.5 Methodology: DPR for Primary Collection, Secondary Storage and Transport to Processing Plant

Task1: Review of Documents and Background Material

(i) GoI Solid Waste Management Rules, 2016, and subsequent revisions;

(ii) GoI SWM Toolkit and Guidelines;

(iii) GoI National Manual on SWM;

(iv) GOI Swacch Bharat Mission relating to support for SWM;

(v) SWM improvement Plan for UP prepared by COWI Consultants;

(vi) SWM Planning model prepared by COWI Consultants; and

(vii) SWM improvement projects (27#) implemented by GoUP under JnNURM.

Task 2: Diagnostic of Existing Conditions in ULBs in the Clusters

Profile of Each ULB and Cluster.

Collect following data from primary and secondary sources: Area and population; city map; area; population; decadal growth of last three decades; ward wise details of population area; ward wise details of slums and squatter settlements; density of city; and floating population in general and on special occasions; Main industries, tourist/pilgrim destinations. Provide details of current SWM and conduct analysis of: waste generation; street sweeping; and accessibility for collection vehicles.

Waste Generation:

Document number and types of waste generators in the city; annual, monthly and daily waste generation rates of past three years; per capita waste generation; waste generation from various sources such as households, commercial establishments, vegetable, fruit, meat, fish markets, offices, hotels and restaurants, from sweeping of streets and drain cleaning, etc.; and waste characterization - physical and chemical, if available. To the extent possible, primary survey data shall be used, with some extrapolation across ULBs in the cluster.

Streets Sweeping:

Document arrangements for street sweeping including principal commercial streets lengths; other important roads including length/width; and other streets, lanes and by lanes including length. Document the current means of disposal of swept debris and silt.

Waste Collection and Accessibility:

Provide details of waste collection arrangements and percentage of population/households living in inaccessible areas that cannot be served through motorized light commercial vehicle (LCV) for waste collection and need to be served through handcarts/tricycles or other manual devices.

Role of the Informal Sector:

Survey and document the role of the informal waste pickers, amount of recyclables extracted by them, and possible mechanisms to expand their role for door-to-door collection.

Secondary Storage of Waste:

Document ward-wise details of number of secondary storage depots, types of depots, open sites, masonry bins, dhalaos, bottomless containers, covered containers, etc., their size/capacity, and synchronization between waste collection and secondary storage.

Transportation of Waste:

Document number and type of vehicles used, their capacity, frequency of transportation, number of trips made and quantity transported by each type of vehicle, extent of manual loading vis a vis mechanical loading, quantity and percentage of waste transported each day, etc. Synchronization between primary collection, secondary storage and transportation of waste.

Processing of Waste:

Describe any waste processing done now, including the availability of land for processing of waste, processing technology, capacity of the plant, waste processed each day, percentage of product and rejects derived from the process and marketability of the product derived.

Final Disposal of Waste:

availability of land for waste disposal; current methodology of waste disposal; whether there is sanitary landfill duly constructed; tools and equipment available at site; capacity of landfill cell; and expected life of landfill.

Institutional Aspects.

Document arrangements in ULB for SWM. Provide details of institutional structure of the municipal department responsible for solid waste management, decision making process, delegation of powers, etc. Document the staff involved in solid waste management in various levels and categories such as technical, managerial, supervisory and field. Document the categories of employment such as permanent, on temporary or daily wage contract and personnel employed by contractors.; Document availability of tools, equipment and vehicles for SWM, their age and working condition.

Finances of ULBs:

(i) Collect data from ULB of at least last 4 years, for the following:

1. Own revenue income (both tax and non-tax revenue in different heads)
2. Revenue grants from State or Central Government
3. Own capital income (including sale of properties)
4. Capital grants from State or Central Government (including the heads under which grants are provided)
5. Revenue expenditure (under different heads)
6. Capital expenditure (under different heads)
7. Revenue deficit or surplus
8. Overall deficit or surplus

For these heads, make a comparison of budgeted Vs actual numbers.

For the three highest contributors to own-source revenue, analyses the demand and collection performance for the last four years

(ii) Identify the budgeting process for solid waste management.

(iii) For solid waste management functions, collect data on:

a) Budgeted and actual expenditure under various heads (salary, fuels, electricity, vehicles, contracted or outsourced costs, etc.)

b) Identify revenue streams, if any, for solid waste management including cess within or in addition to property tax, user charges, revenues from sale of recyclables or other by products, State or central government grants (both revenue and capital) earmarked for solid waste management

c) item-wise expenditure on street sweeping, door to door waste collection, transportation, processing, disposal of municipal solid waste; and

d) Expenditure on training and capacity building.

(iv) Identify the extent of cost recovery for solid waste management from
(a) user charges and other revenues from sale of recyclables or by-products,
(b) from cess or surcharge on property tax or other municipal revenue sources, and
(c) from State or central Government grants earmarked for solid waste management. Identify how the costs of solid waste management are financed by solid waste management related revenues, other municipal revenue sources and State or central Government grants. Identify the percentage of municipal revenue (own income as well as total revenue income) that is earmarked for solid waste management.

(v) Solid waste user fees:
Review whether SWM user fees or SWM (city cleaning) tax is levied; and full details of rates prescribed, billing performance, collection modalities, collection efficiency, mechanism is in place and measures are taken to recover the user fees from defaulters etc. Document if any charges are collected by outsourced contractors from households or commercial establishments.

(vi) Private sector participation outsourcing/PPP:
Describe whether outsourcing to private sector is practiced; document the contracting method, payment mechanism, contractor responsibilities and obligations, performance specifications, track record of performance and a summary of learnings from the identified private sector participation/outsourcing.

Task 3: Analysis of Alternatives to Improve Service Levels

Technical Criteria:

Based on document review and site investigations, provide recommendations for population projections for ULBs; waste generation rates; waste composition; waste characterization, percent of inert waste disposed in landfills and land requirements for 25 years.

Environmental Standards:

Based on Pollution Control Board requirements, provide details of environmental requirements for waste processing, including but not limited to, compost making, waste disposal, and treatment of leachate.

Alternatives Analysis.

Based on review of existing conditions, develop various scenarios for SWM improvements, and analyze them for adaptability in UP conditions, affordability, least cost and environmental safety. Scenarios described below, but not limited to, need to be analyzed:

(a) waste separation at source, with separate bins provided by owners or financed under the project;

(b) use of waste pickers for collection or only separation at a storage point, or transfer station or processing plant;

(c) secondary separation to recover more recyclables and improve quality of compost

(d) transfer stations necessary to economize on transportation costs

(e) processing in each ULB rather than in decentralized processing plants;

(f) labor intensive composting with some separation is more economical due to small volumes of waste and high transport costs not affordable by small ULBs;

(g) economics of combining processing plants at the same location as the landfills;

(h) separated inert street waste is more economical to transport direct to landfills or conveyed to the processing plants for separation and then transported to the landfills;

(i) economic justification for individual landfills for ULBs;

(j) revenue generation to meet O&M costs and timely payments to service providers;

(k) Guarantees from Go UP to assure successful operation of SWM.

(l) Institutional responsibilities

(m) Contracting models

Task 4: Investment Plan for Primary Collection, Secondary Storage and Transport (to Processing Plant

Waste separation at source:

(i) Number of waste categories which may be separated at source; number, type and size of bins to be used for storage of waste by waste generators; need for providing support, e.g., household bins, and awareness-raising (IEC), including costs; and (ii) provide a framework for involving informal sector in waste collection.

Primary collection to storage points:

(i) method, frequency, and time of collection; (ii) frequency and time of collection; type of vehicles and equipment required; (iii) requirements of manpower, total vehicles, equipment, including costs; (iii) options and method for use of informal sector of rag pickers for collection, recycling, waste separation, and waste processing.

Street sweeping:

(i) Total length of roads swept, and frequency; and (ii) costs of manpower, tools and equipment required for collection of inert waste, excluding street sweeping which will remain a function of ULBs outside the project.

Secondary storage:

Based on city area, road length and wards: (i) quantity of waste expected to be deposited at the depots; (ii) number and type of secondary storage points required to cover the city, including engineered stands, bin sizes, including costs; (iii) suitable/strategic locations for bins, distance between two bins; (iii) vehicle routes and bin locations; and frequency of clearance of bins; (iv) costs of manpower, civil works (for stands), tools and equipment required.

Waste Transportation.

For the quantity of waste to be transported daily, (a) develop least cost alternatives for different distance travelled, and factoring road conditions, for transport of wastes from storage area to a transfer station or processing facility; processing integrated with landfill location; and alternatives for distance of land fill from collection area/transfer station/processing facility; (b) number of trips required; (c) type, capacity and number of vehicles required, including costs, including the number of stand by vehicles required for preventive maintenance and during breakdowns. The Consultant will assess and recommend if there is the need for introduction of transfer/separation facilities to reduce transport costs.

Investment Plan:

Based on the above, to identify the investment needs for one life cycle of collection and transport. In particular, the consultant will define the investments needed for equipment including but not limited to: (i) household waste bins; (ii) secondary storage bins; (iii) collection bins for waste and selective/street collection; (iii) trucks for collection and transportation; (iv) collection carts; (v) uniforms and personal protective equipment. The consultant will develop the investment plan including the technical specifications and estimated costs.

Deliverables:

(i) Proposed investment needs for collection and transport services;

(ii) *Investment plan including cost estimates;*

(iii) *Technical specifications for the initial investments.*

CHAPTER 2
TOWN PROFILE

CHAPTER 2: TOWN PROFILE

2.1 Project Area Description

Mirzapur is a Nagar Palika Parishad in Mirzapur district in the state of Uttar Pradesh. Mirzapur is a class I town spread over an area of 38.5 sq. km with total population of 2,34,871 out of which 1,25,601 are males while 1,09,270 are females, as per report released by Census 2011. The Nagar Palika Parishad is divided into 35 wards, for which elections are held every 5 years.

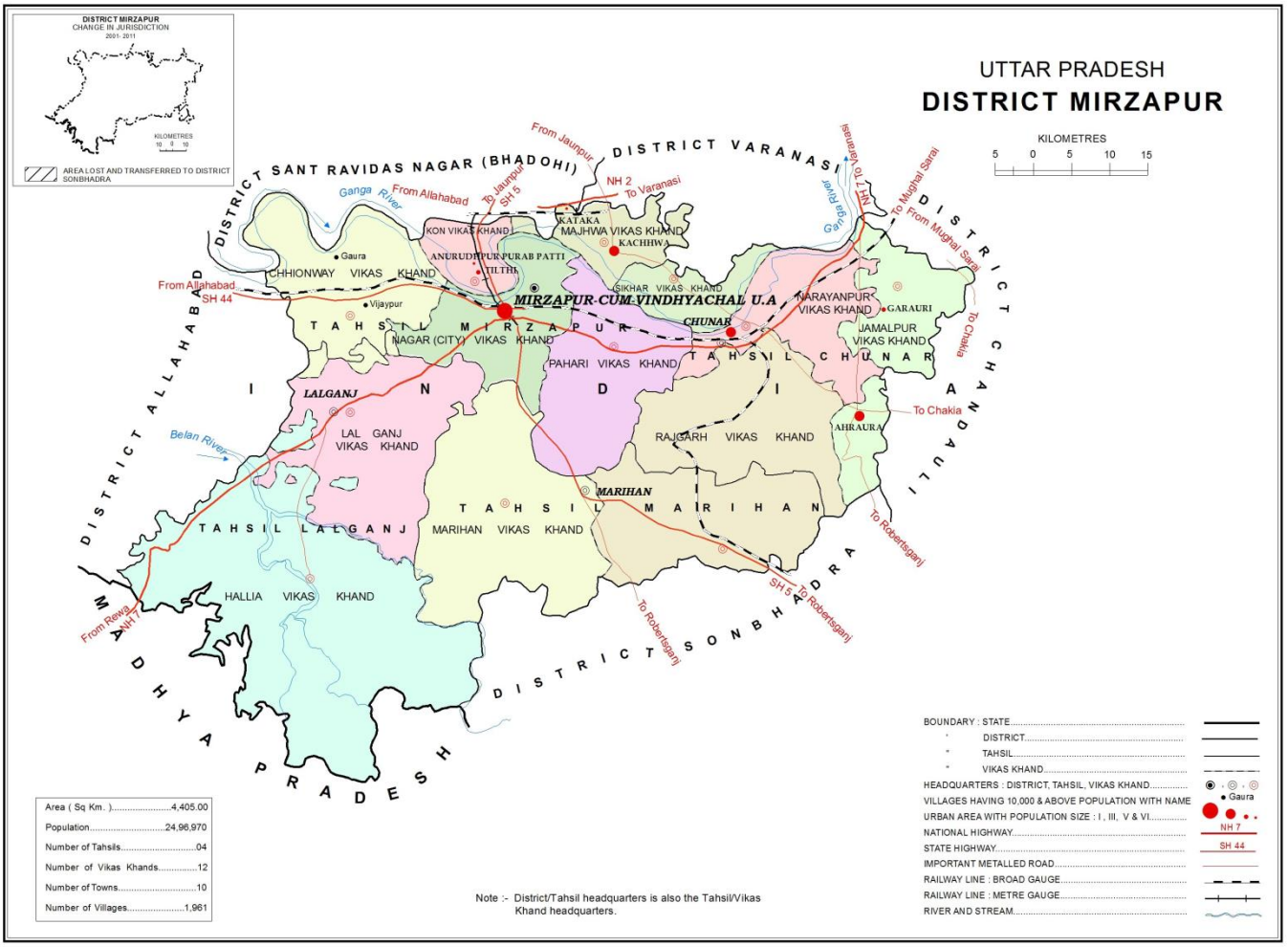
2.2 Geographical Location and Regional Linkages

Mirzapur is located at 25.15° N 82.58 °E . It has an average elevation of 80 metres(265feet). The District of Mirzapur lies between the parallels of 23.52 & 25.32 North latitude and 82.7 and 83.33 East longtitude. It forms a portion of the Varanasi district, on the north and north-east it is bounded by the Varanasi district; on the south bounded by Sonbhadra district; on the north-west by Allahabad district. The shape to the north and west is totally regular. In no direction, except for about 13km. In the north-west where the Ganges separates the Tahsil of Chunar from the district of Varanasi, has Mirzapur a natural frontier. The Chanvar fields, considered to be one of the most fertile lands tracts in India, are located on Gangetic flood planis of the district. Also, Indian standard Time is calculated on the basis of 82.5° E longitude, from a clock tower in Mirzapur.

Source: GOOGLE

MAP 2.1: GEOGRAPHICAL AREA

DISTRICT MAP OF UTTAR PRADESH



Source: GOOGLE

MAP 2.2: DISTRICT LOCATIONS

REGIONAL MAP OF MIRZAPUR DISTRICT

Source: GOOGLE

MAP 2.3: REGIONAL SETTINGS

TOWN MAP OF MIRZAPUR

Source: GOOGLE

MAP 2.4: MIRZAPUR TOWN

2.3 History/Growth of the Region

The East India Company named this place as Mirzapore. The word Mirzapur is derived from 'Mirza' which in turn is derived from the Persian term 'Trip Kalchu which literally means "child of the Amir" or child of the rular". In Persia Amirzad in turn consists of the Arabic title "Amir (English. "Emir"), meaning "commander", and the Persian suffix-zad, meaning "birth or "lineage". Due to vowel harmony in Turkic languages, the alternative pronounciation Morza (plural morzalar, derived from the Persian word) is also used. The word entered English in 1595, from the French emir. The meaning of Mirzapur is the place of King,

Most of the city was established by British officers, but the starting development was founded by the most famous officer of British East India Company "Lord Marquess Wellesley". As per some evidence the British construction was initiated from Burrier (Bariya) Ghat. Lord Wellesley has reconstructed the Burrier Ghat as a main entrance in Mirzapur by Ganga.

It is the place in India where the Holy River Ganges meets with Vindhya Range. This is considered significant in Hindu Mythology and has a mention in Vedas. Other sacred places in the town are Ashtbhuja temple, Sita Kund, Kali Khoh, Budeh Nath temple, Narad Ghat, Gerua talab, Motiya talab, Lal Bhairav and Kal Bhairav temples, Ekdant Ganesh, Spta Sarovar, Sakshi Gopal temple.

Guinness World Record certificate to Mirzapur Administration for largest Rangoli Pattern on Jan 25, 2017.

A step towards the awareness for voting the district of Mirzapur came with the Guinness World Record for the biggest Rangoli (Alpana) created in an area of 39,125 sq mts using apporx 120,000 kg of color by across 3500 students and teachers from 50 schools on occasion of National Voters Day.

2.4 COMMERCE:-

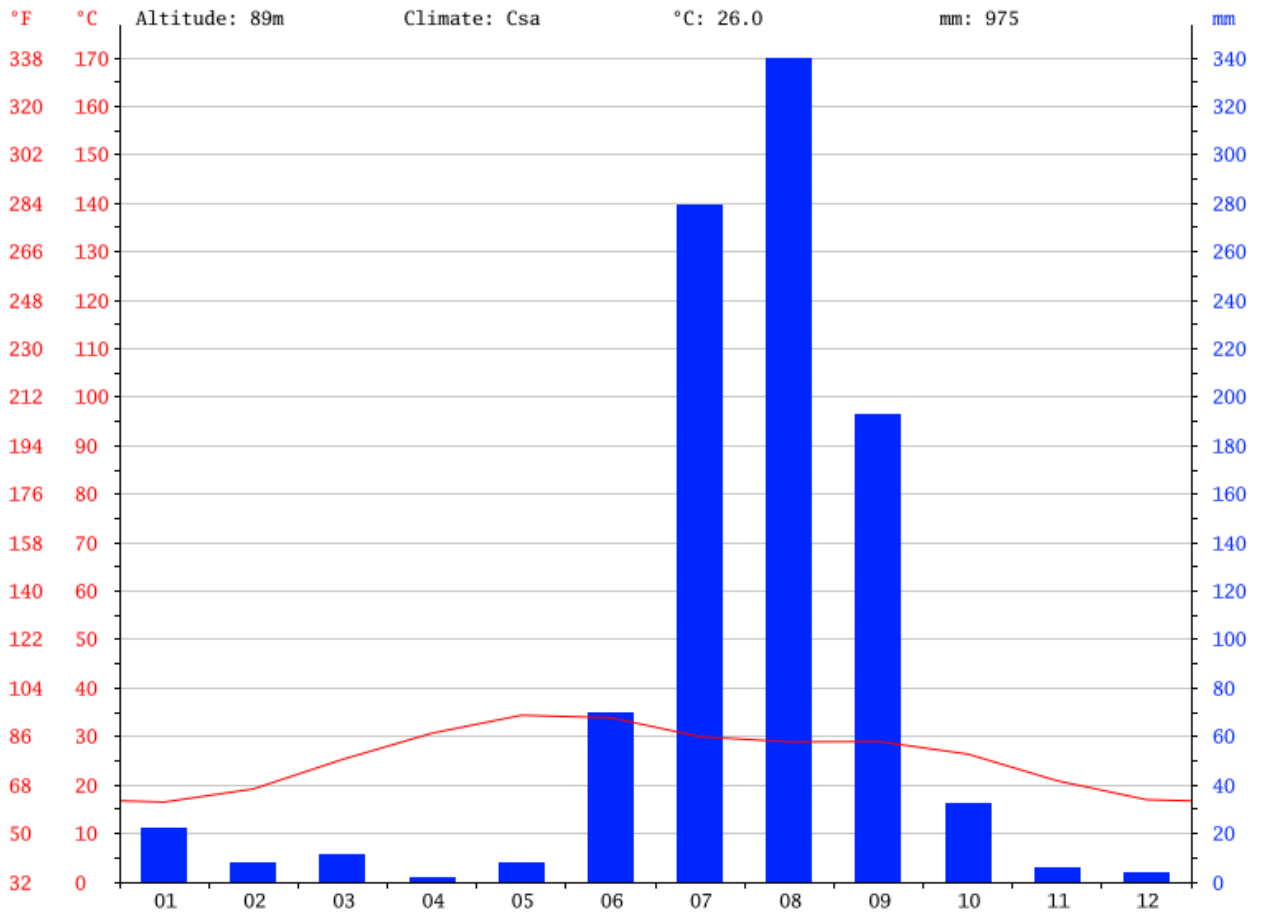
The main business in Mirzapur is carpet manufacturing. Manufactures range from very small (with less than $ 100,000 in assets) to medium-sized (with around $ 10 M in assets). Most of the carpets are sold internationally as India has a limited market for carpets. The second main business is of metal pots(brass).

2.5 Topography :-

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	16.5	19.2	25.3	30.7	34.4	33.9	30	28.9	29	26.4	20.9	17
Min. Temperature (°C)	9.3	11.7	17.1	22.4	27.1	28.5	26.6	25.9	25.3	20.4	13.1	9.4
Max. Temperature (°C)	23.8	26.7	33.5	39	41.8	39.3	33.4	32	32.7	32.4	28.7	24.7
Avg. Temperature (°F)	61.7	66.6	77.5	87.3	93.9	93.0	86.0	84.0	84.2	79.5	69.6	62.6
Min. Temperature (°F)	48.7	53.1	62.8	72.3	80.8	83.3	79.9	78.6	77.5	68.7	55.6	48.9

	January	February	March	April	May	June	July	August	September	October	November	December
Max. Temperature (°F)	74.8	80.1	92.3	102.2	107.2	102.7	92.1	89.6	90.9	90.3	83.7	76.5
Precipitation / Rainfall (mm)	22	8	11	2	8	70	279	340	193	32	6	4

Temperature and precipitation from January to December



2.6 Rainfall & Climatic Condition

The climate in Mirzapur is warm and temperate. In winter, there is much more rainfall in Mirzapur than in summer. This climate is considered to be Csa according to the Köppen-Geiger climate classification. The average annual temperature in Mirzapur is 26.0 °C. The rainfall here averages 975 mm. There is a difference of 338 mm of precipitation between the driest and wettest months. The average temperatures vary during the year by 17.9 °C.

CHAPTER 3 DEMOGRAPHIC & SOCIO-ECONOMIC PROFILE OF TOWN

Demography analysis includes details on size, structure and distribution of populations and spatial and or temporal changes in them in response to birth, migration, aging and death. The analysis helps in analyzing the previous and present conditions of population, growth, development and use of natural resources.

3.1 Population Growth rate and Spatial Distribution

As per the data available from Census 2011, total population of the town is 2,34,871 with average household size more than five persons. A significant growth rate of population over the decades (1971– 2011) can be seen in **Table 3-1**

Table 3-1: Decadal Population Growth Trend

Decadal Population Variation			
Census Year	**Population**	**Absolute**	**Percentage %**
1971	105939	---	
1981	127787	21848	17.09%
1991	169336	41549	24.53%
2001	205264	35928	17.50%
2011	234871	29607	12.60%

Source: Census of India, 2011

3.1.1 Population Distribution

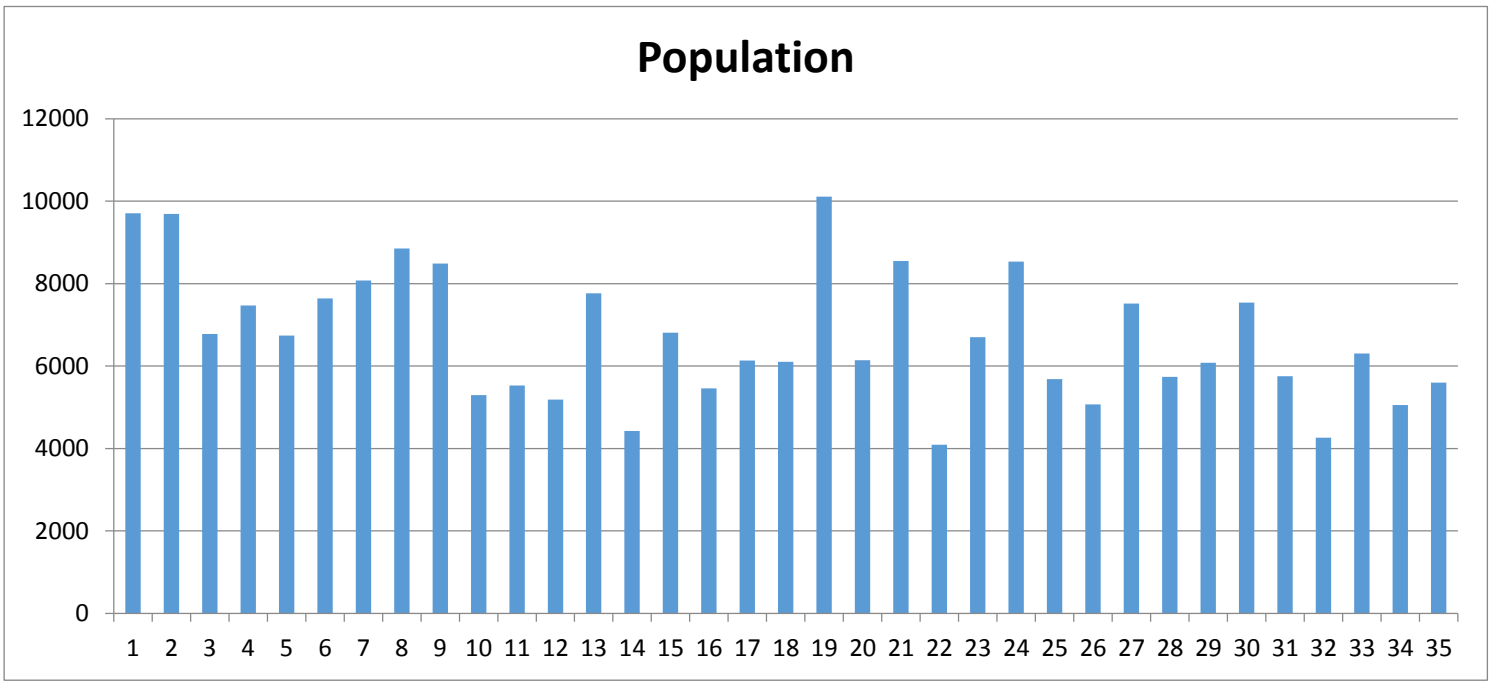
The ward-wise population distribution of Mirzapur is shown in **Table3-2**. Inwards with moderately or lowly populated areas, the development is constrained by land-use or other physical characteristics.

Table 3-2: Ward Wise Demographic Profile

WARD NO	POPULATION IN 2011	HOUSEHOLD	SHARE IN TOWN
1	9703	1611	1.55%
2	9691	1711	0.90%
3	6782	977	1.51%
4	7470	1179	1.93%
5	6743	1163	1.21%
6	7638	1207	1.75%
7	8074	1234	1.36%
8	8853	1493	1.75%
9	8490	1352	1.15%
10	5295	909	1.33%
11	5527	952	2.19%

12	5188	777	0.89%
13	7765	1197	1.24%
14	4428	800	0.72%
15	6812	972	1.47%
16	5456	925	0.81%
17	6137	1006	2.19%
18	6104	989	1.52%
19	10108	1744	1.28%
20	6138	1076	0.85%
21	8548	1321	0.74%
22	4089	680	1.31%
23	6703	1140	1.08%
24	8536	1291	0.90%
25	5682	986	1.06%
26	5073	801	1.36%
27	7517	1160	1.05%
28	5737	1010	0.66%
29	6077	903	1.01%
30	7543	1232	1.48%
31	5750	970	0.77%
32	4259	733	2.07%
33	6307	963	1.25%
34	5052	716	1.06%
35	5596	1005	1.43%
	2,34,871	**38,185**	

Source: Census of India, 2011



Source: ULB

Figure 3-2: Ward Wise Population Distribution

3.2 Population Projection

The census 2011 showed that the population of the Mirzapur is 234871; decadal growth rate of the Mirzapur has decreased from 60% to 39.58 %.Considering past trend of the population and present migration pattern of the city, the future population of city is projected and given in Table 5.1. It is estimated that the population of Mirzapur will reach up to 783806 by 2031; 873602 by 2041 and 918500 by 2046.

The population of town has been projected up to the horizon year 2038 taking into consideration the decadal population trend of Census of India and provisional figures of census from 1971 to 2011. There are several standard methods of population projection such as

- Arithmetical increase method,
- Geometrical increase method,
- Incremental increase method and
- Graphical method.
- All these different methods have different scope of applicability, depending upon the size and age of the town, current population of the town, population growth pattern for last few decades and future anticipated growth.

Different methods give different accuracy levels for population projection and it is difficult to use one single method as accurate. **Table 3-4** given below shows the various population projection methods for town.

Table 3-4: Population Projection till the Year 2038

YEAR	ARTHIMETIC INCREASE	INCREMENT INCREASE	GEOMETRIC PROGESSION	AVERAGE	POPULATION GROWTH RATE
2018	257,434	279,937	258,972	265,447	13%
2023	273,550	317,331	276,964	289,281	9%
2028	289,667	359,720	295,601	314,996	9%
2033	305,783	407,770	314,886	342,813	9%
2038	321,900	462,240	334,817	372,985	9%

Source: Author Calculation

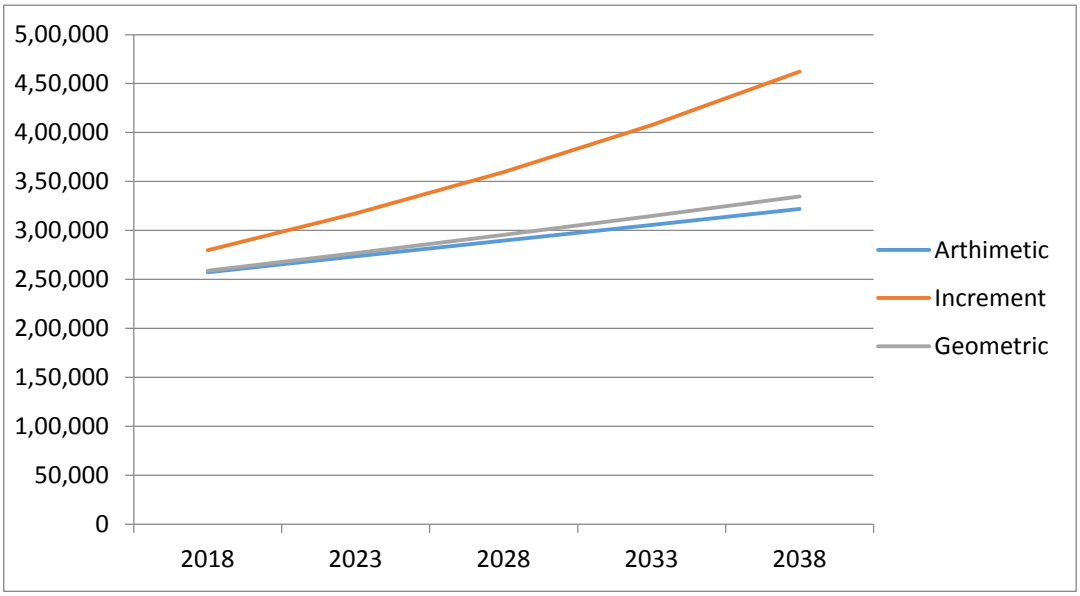


Figure 3-4: Various Methods of Population Projection

Source: Author calculation

Table 3-5: Projected Population

Year	Population	Decadal Growth Rate
1991	169336	-
2001	205264	17.5%
2011	234871	12.6%
2021	265404	11.5%
2026	282655	06.0%
2031	301027	06.1%
2036	320593	06.1%
2041	341431	06.1%
2046	363624	06.1%

Source: Author Calculation

3.3 Other Population Indicators

3.2.1 Gender ratio

Gender ratio in Mirzapur was 872 in 2011.At present, total population of Mirzapur constitutes of 52% male and 48% females.

3.2.2 Literacy rate

In Mirzapur the literacy rate as per the 2011 census is 57%, which is lower than state (75%). Both male and female literacy rate is 62% and 50%. The town has a good number of government and private schools, but efforts need to be made to raise literacy rate of town.

3.2.3 SC/ST population

In 2011 Mirzapur population was composed of 16.54% SC population and 0.39% ST population. In total about 16.93% of population was in SC/ST categories.

Table 3-6: Mirzapur – Sex Ratio, SC, ST and Literacy Rate

Sl. No.	Name	2011		
		Total	Male	Female
1	Population	2,34,871	1,25,601	1,09,270
2	Literates	1,56,408	89,938	66,470
3	Literacy Rate	66.59%	71.61%	60.83%
4	Gender ratio	869		
5	SC Population	26700	14495	12205
6	ST Population	391	204	187
7	Share of SC	8.33		
8	Share of ST	3.7		

Source: Census of India, 2011

Table 3-7: Ward Wise Literacy Rate and Sex Ratio

WARD NO.	LITERACY RATE %	SEX RATIO	SHARE OF SC POPULATION	SHARE OF ST POPULATION
1	62.8%	862	64.1%	0.00%
2	68.6%	875	77.9%	0.00%
3	47.3%	895	45.9%	0.00%
4	67.2%	901	39.5%	0.06%
5	62.2%	833	31.7%	0.00%
6	59.1%	836	18.7%	0.16%
7	64.5%	885	24.5%	0.07%
8	72.2%	841	17.4%	0.32%
9	54.8%	892	12.3%	0.00%
10	47.0%	806	9.6%	0.00%
11	70.9%	846	16.7%	0.00%
12	57.5%	862	9.8%	0.07%
13	64.0%	826	17.5%	0.00%
14	67.5%	889	12.0%	0.00%
15	49.1%	861	23.6%	0.00%
16	64.8%	901	10.0%	0.00%
17	80.8%	902	10.5%	0.02%
18	65.7%	850	7.8%	0.47%
19	64.6%	899	8.8%	0.01%
20	75.1%	880	16.6%	0.10%
21	60.7%	896	7.3%	0.65%
22	68.4%	867	9.5%	2.12%

23	77.7%	937	5.5%	0.40%
24	69.3%	722	11.5%	0.00%
25	75.7%	892	12.3%	0.97%
26	71.0%	839	5.6%	0.00%
27	73.8%	904	1.6%	0.00%
28	77.8%	900	2.6%	0.00%
29	53.4%	843	1.4%	0.12%
30	68.9%	862	0.6%	0.00%
31	76.4%	923	0.2%	0.00%
32	67.3%	865	13.1%	1.42%
33	77.5%	927	0.0%	0.08%
34	78.2%	915	0.0%	0.00%
35	79.9%	867	0.0%	0.00%

Source: Census of India, 2011

3.4 Economic Profile

The city of Mirzapur is an ancient one and referred to as 'Glass City of India'. The unique name of the city comes from its beautiful bangles, crafts, tableware and other exquisite items made of glass which are popular throughout the world.

Mirzapur's economic development is based on Glass Manufacturing Sectors, Agriculture and Handicrafts Sectors.

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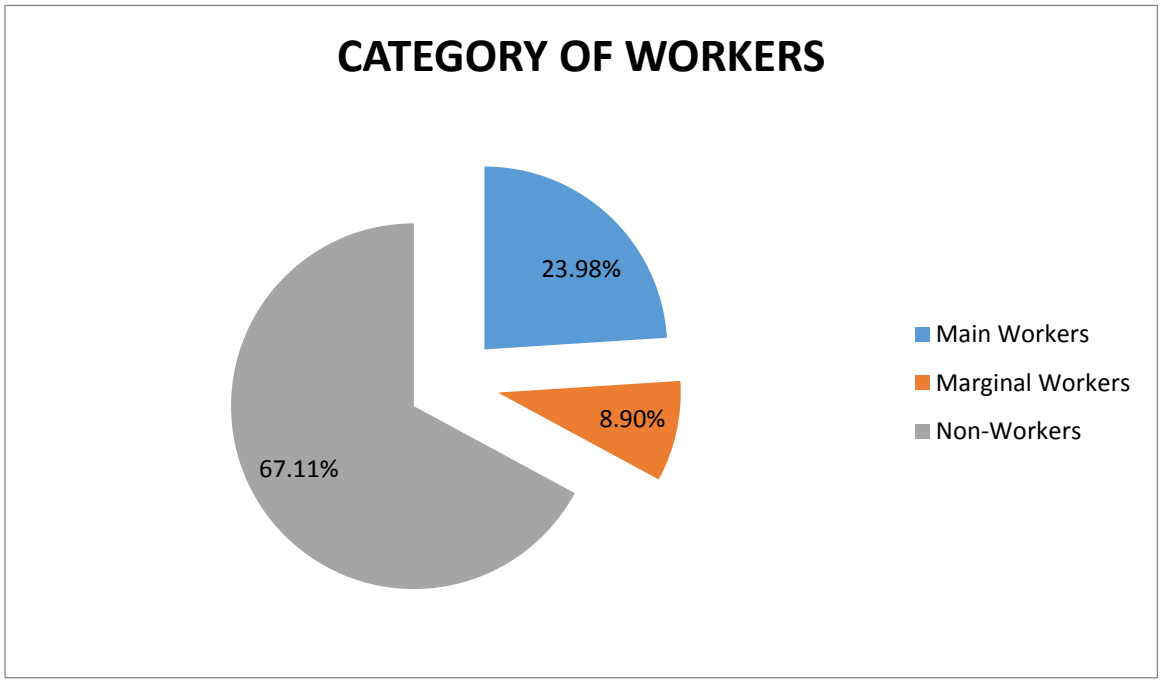
3.4.1 Workforce Participation Rate

As per census data 2011, analysis for working profile of the town has been done. As per 2011 census only 33.94% (79,621) of population is working. Main workers population was 23.98% of total population 8.90% were marginal workers and 67.11% was non-working population. In 2011 census, the economic profile of workers was defined in 4 sectors, which clearly indicates that major portion of the main workers i.e18.94% are engaged in various activities such as service, commercial activities etc. followed by cultivators, agriculture labors and household industries with 0.327%, 0.720% and 3.99% share respectively. This concludes that the town is gradually growing towards commercial, service and construction sector and dependency on agricultural activities is reducing. Work force participation details are provided in Table 3-8.

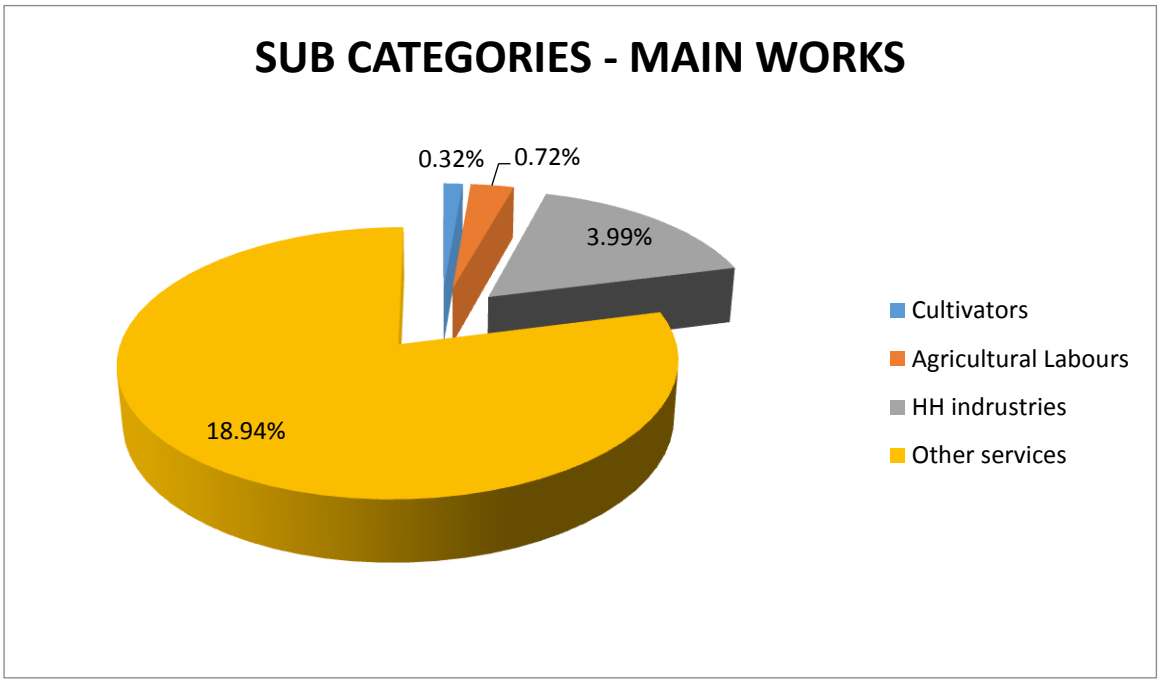
Table 3-8: Work Force Participation Details

Category	Number of Person	%
Main workers		
Cultivators	769	0.327
Agricultural Labours	1,692	0.720
HH industries	9,379	3.99
Other services	44,486	18.94
Sub Total Main Workers	56,326	23.98
Marginal Workers	20,921	8.90
Total Workers	77,247	32.88
Non-Workers	1,57,624	67.11
Grand Total Population	**2,34,871**	**100**

Source: Census of India, 2011



Source: Census of India, 2011



Source: Census of India, 2011

Figure 3-5: Distribution of Employment Categories

CHAPTER 4
EXISTING SWM SCENARIO IN THE TOWN

CHAPTER 4: EXISTING SWM SCENARIO IN THE TOWN

Municipal solid waste management is an obligatory function of the urban local bodies in India. As per the definition provided by the Solid Waste Management Rules, 2016 of Government of India, Municipal solid waste (MSW) includes commercial and residential wastes generated in municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes. With growing population and increasing waste generation, solid waste management has become a major environmental issue. ULBs across India face similar challenges in handling and disposal of municipal solid waste: lack of adequate financial and human resources, poor technology and lack of public participation to list a few. Processing and treatment of waste is not practiced, and final disposal is being made unscientifically in dumpsites, posing threats of ground and surface water contamination and air pollution. Existing solid waste management system of Mirzapur is presented in this section.

4.1 Sources of Waste Generation

Based on outcome of the discussions and incorporation of various viewpoints of the officials, Author identified major problematic areas related to waste generation & its management. After detailed discussions and understanding of the ground realities, the major sources of waste generation has been identified. This exercise was carried out to get the focus points of waste generation & its management. The major waste generating sources in MNNP are residential, commercial, institutional, market etc.

Based on the information received from Mirzapur Nagar Palika Parishad, total municipal solid waste generation in the town is 120 MT per day taking 350 gm per capita per day (gpcd). Quantity of waste has been calculated by Nagar Palika Parishad officials in the current year. Two methods have been considered while calculating the solid waste, one was weighing of tractors carrying waste to the dumpsite and another was multiplication of 2011 population with 300 gm of waste per capita per day (CPHEEO manual). Different waste generation sources are briefed out in the following section.

Household Level

The major land use in the study area is residential and comprises of about 38,185 households with a total population of 2,34,871 as per census of India, 2011. Major portion of the waste is generated by residential area only. Waste Generated is from households are normally kitchen waste (vegetable waste, fruit waste, paper, polythene, etc.) .

Hotel and Dhabas

In Mirzapur city, there are number of hotels and at present they have their own container for waste collection. After the container gets filled, it is transferred to secondary collection bins by the hotel owners.

Vegetable Market

Mirzapur has fruits and vegetable markets like Sabji Mandi Ganeshganj , Mukeri Bazar , Bus Stand , and Shuklaha Road several market yards located 12-13 km from disposal site. There is a management of solid waste under the Nagar Palika Parishad for such areas but there are no secondary collection bins located in and around the vegetable market area for vendors and shopkeepers. Waste is disposed openly by them. The waste is cleared by the SWM workers of Nagar Palika Parishad.

Marriage Garden

In wedding season mainly from November to February and from May to July, waste is generated from Marriage gardens which are openly dumped at roadside and vacant plots. Waste generated from gardens is generally organic wastes (leaves, paper and grass, etc.). This is managed by Nagar Palika Parishad. Municipal workers collect wastes and dump them in secondary collection bins. Sometimes they are also burnt.

Slaughter Houses

Slaughtering waste is daily generated from slaughter houses. There is a fish market 13-14 km from disposal site in Mirzapur. Waste Generated from Fish Market, Meat Market and Slaughter houses are collected by Nagar Palika Parishad. Secondary Collection bins are placed at such markets. The shop keepers dump their waste in the community bins once in a week by SWM workers of the cooperation.

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4.2 Primary Collection of Waste

MSW in Mirzapur is door to door collected by private company in 38 wards only and rest wards has dumped in nearby dustbins or secondary collection points. There is a mechanized door to door collection activity in residential sectors initially by deploying mini tipper vehicles. The house-holds of some areas individually transport the waste to the secondary collection points. The Safai Karamchari (Municipal Worker) and private sweepers collect waste from individual residences, commercial areas and dump it at the secondary collection points.

MNNP does not manage industrial waste and the solid waste generated from industrial units is collected, transported and disposed by the other private agency.

Waste collection is done through handcarts and tricycles and in some places by auto tippers. The Nagar Palika Parishad sanitation workers regularly collect the waste. The collected waste (not segregated) from the households is transferred to the designated secondary collection points of the respective wards. In addition, there are many unauthorized open collection points. Due to lack of proper collection system and civic sense, some of the households throw waste onto the streets, drains and open spaces within the localities, creating unhealthy conditions. Lack of door - to - door collection is also one the main reason for this situation. There are a number of open points along the drains, where people dump waste regularly.

Figure 4.1: Primary collection of Waste

Figure 4.2: Condition of streets in Mirzapur

4.3 Gap Analysis- Primary Collection

- Organized system of primary collection of waste is practically non-existent, as the system of storage of segregated wastes at source is yet to be developed.
- Segregation of the collected waste from households at source is not being practiced, leading to mixing of

waste and entrainment of recyclable waste being dumped without proper and full recovery

- Absence of adequate manpower, regulated transportation, narrow streets and financial constraints are some of the reasons that are deterring door to door collection
- Synchronizing with the storage of waste at source is first essential step towards better solid waste management.
- The system is non-functional as people throw the wastes on the streets and the ground outside the community waste storage points, forcing to double handle the waste through street cleansing.
- Sanitary workers beats are not decided as per any work norms. They are not working as per standard requirements.
- The charges levied are not in practice
- Sanitary workers sweep the streets and transport the waste up to collection points but drains abutting streets are not cleaned by them on time.
- The tools and equipment's are insufficient and improper. The design of equipment mainly un- containerized tricycles is required to be containerized
- Only few important roads and markets are swept on daily basis, while the other roads are not swept regularly.
- Handcarts are not properly distributed, nor are in sufficient numbers, which is one of the main reasons for reduced efficiency and productivity.
- Primary collection system is not adequate leading to backlog of waste at certain locations resulting in complaints from the public.

4.4 Secondary Storage System/Secondary Collection Points

In MNNP, there are two types of Community bins having capacity 1.5 cum and 2.5 cum. The frequency of clearing of these bins varies from daily, alternate day, twice a week or even once a week depending on the area. These community bins and dumper containers are placed at convenient locations for the residents to access and dispose their waste in an appropriate manner.

The waste collected from door to door is dumped at Containers and open spaces. There are two kinds of dust bins places by MNNP, small and big containers having capacity 1.5 cum to 2.5 cum capacity.

The collection Vehicle like dumper placers, truck and R.C. Compactor will pick up the waste from the Secondary open Collection points, containers and transfer the waste directly to dump site.

Presently inadequate number of MS containers/dhalaos is placed at the secondary collection points. These points are not located and distributed properly. These storage points not only facilitate the residents to deposit the wastes in these storage points, but also enable the municipal sanitary workers to carry and deposit the wastes swept by them.

Positioning of the containers is decided on availability of space, past practice and personal preferences. There is a lot of pressures against positioning of the MS containers as most of the containers are not cleared in time; more waste remains scattered around the containers rather than inside the containers, attracting stray animals scurrying through the waste in search of eatable. Few of the collection points are on open plots or along the roads which is a cause for bad odour, proliferation of flies, mosquitoes and other diseased vectors. The present secondary collection system is not sufficient to meet the requirement of waste generated in the town

Figure 4.3: Dhalao Ghar

Figure 4.4: Secondary Collection Bin

Figure 4.5: Secondary Collection Point

Figure 4.6: Secondary Collection Vehicle

4.5 Gap Analysis- Existing Storage System

- The MS containers without lid are found to be either damaged or toppled to horizontal positions and thereby not facilitating for the use
- No proper planning for deciding the no. of collection points
- Many of the collection points are located on the roadsides. The spill overs from these collection points are making the whole area filthy. Moreover, the lifting of the wastes from these areas is also done once in a day, keeping the dirt lying whole day creating nuisance and congestion to the passing traffic.
- Most of the households, shops and commercial establishments are often found throwing solid waste on the street at random hours and around the secondary collection points and not into it and thus wastes are found coming on the roads, streets etc.
- The spacing of the containers in many places is not satisfying the requirement of CPHEEO norms

4.6 Waste Transportation System

The Nagar Palika Parishad has 2 Dumper, 80 Tricycle, 5 Tractor, 3 Auto Tipper Small, 1 Refuse Collector, 1 JCB, which are in operation presently for transportation of waste to disposal site at Tand Gaon. The hydraulic tippers with manual loading are managed by drivers with 3 – 4 sweepers. There are various models of trucks, which implies that planning and inventory for spares is a costly proposition. These vehicles have been worked out to be about 3 – 4 trips per vehicle per day. Full utilization of existing fleet of vehicles for the purpose of transportation of solid waste in NPP has already been considered, while assessing additional number of vehicles for collection and transportation of solid waste from different areas/localities NPP area. Due to inaccessibility of some localities, there is multiple handling of waste and hence the type and design of vehicle used is to be evaluated but presently two nos. of refuse compactor and mechanized dumper placers are being used on a limited scale. There is also one mechanized street sweeping machine, which would act as a solution for cleaning the town like Mirzapur in case of large absence of street sweepers. There are also 1 back hoe loaders used for waste handling and loading.

Uncovered tractor–trailers are used for waste transportation. There have been complaints from localities because garbage spilling occurs frequently. Since tricycles/handcarts and manual lifting of waste is being practiced, the setting up of transfer points is much needed. Hydraulic vehicles need proper preventive maintenance and there is a need for specialized and trained personnel for the maintenance of such special types of vehicles like refuses compactors. There is a need for evaluation whether the maintenance of the vehicles would source for efficient and better services. Waste accumulated in the community containers are removed by open body tippers and tractor-trailers. The present system of waste transportation is a manual and multi-handling system.

Sanitary Inspectors decide the scheduling of trips and routing of the refuse vehicles in unscientific and uneconomical manners. Since all the tippers are functioning properly, manual loading and unloading has become a common practice. The number of trips made by the vehicles per day is reduced due to manual loading and unloading, which is time consuming. Hence most of the vehicles make only 2 – 4 trips per day against the scheduled 5 - 6 trips. The average waste carrying capacity of these vehicles ranges from 2-8 MT per trip and the total waste thus transported is about 30 - 35 MT per day from the NN areas. The list of the transportation vehicles is provided in the **Table 4-2**.

Table 4.2: Availability of Vehicles for Transportation of Waste

S.NO.	Vehicles Deployed for Secondary Waste Collection	No.

1	DUMPER (SWARAJ MAJDA)	2
2	TRICYCLE	80
3	TRACTOR (DUMPER)	5
4	AUTO TIPPER SMALL (TATA ACE + PIAGGIO + SUZUKI)	3
5	REFUSE COLLECTOR	1
6	JCB	1
	TOTAL	92

Source: ULB INFORMATION

Tractor Trailer

Refuse Compactor

Tipper Truck

Auto Tipper

Road sweeping machine

Back Hoe Loader

Figure 4.8: Secondary Transportation vehicles

4.7 Deficiency Analysis – Waste Transportation System

- No grouping is undertaken, and transportation is effected as per availability of fleet
- No dedicated transportation system for collection of drain silt from drains.
- Transport system is not fully synchronized with the system of waste storage facility.
- Transport vehicles are not covered
- Encroachments across the lanes also pose a problem. Transportation from the inner lanes of the Nagar Palika Parishad were found to be very difficult.
- All types of mixed waste including construction material are removed by transport vehicles.
- In addition to identified points, several temporary points are also created for collection at the ward level for which no record is available.
- There are no stand-by vehicles for deployment during periodical maintenance or breakdown of vehicles in service.
- The vehicles, especially tractor-trailers are not covered; as a result, the foul smell is found spreading around and lighter waste materials are found flying and falling down on the way
- In absence of any weighbridge for weight; exact information about actual waste transportation is not available.
- Most of the transport system is dependent on manual labor attached with each vehicle as well as on mechanized means

4.8 Treatment & Disposal System

There is no waste treatment facility in the current dumpsite as of now.

Collected waste from MNNP area is dumped at Chanaura, Kutukpur disposal site about an area 16 acre, 14 km away from Mirzapur City. The site is a low-lying area and is operational from last 6 years as shown in **Figure 4-9**. Since no sanitary landfill method is followed, waste is crudely dumped at the low-lying area, which is posing a high pollution threat from leachate and surface runoff during monsoon.

Other impacts associated with the site are:

(i) the site is a breeding ground for vermin and gives rise to foul odour and burning of waste is common

(ii) the health of the sanitary workers involved in manual unloading of wastes is affected, and

(iii) health of the rag pickers involved in waste segregation is also affected. In the absence of a

weighbridge, the quantity of waste transported to the site is not recorded, as informed by the NPP officials as well as local residents in that area.

Figure 4.10: DUMPING GROUND - MIRZAPUR

4.9 Gap Analysis -Waste Disposal Practices

- The disposal sites are neither demarcated nor fenced.
- A large quantity of waste ultimately finds access to a major source of environmental pollution. During monsoon, leachate directly enters into ground.
- Present method of operation of the landfill is very crude and unscientific. The waste in mixed form is dumped without any processing and covering by daily cover.
- Waste is only spread and leveled and that too is not done on regular basis. But due to poor supervision and control, lot of waste heaps is visible on all corners of the dump yard.
- Rules regarding site safety, environment and health are not followed. There is no control at the existing sites on the entry of the rag pickers, who while attempting to recover useful recyclable material, spread the waste all around spoiling the site and in turn are exposed to serious diseases.
- No studies have been carried out to determine the effect of the dumping operations on the environment and ground water.
- Construction waste and all kinds of waste are currently getting access along with other wastes.
- No attempts for leachate control or recovery of biogas is being made at the site. There is a tendency to burn the waste at the site.

4.10 Land Availability

Currently, the city disposes all of its waste at Kutukpur Chanaura disposal site. About 12 acres of land has been earmarked by MNNP for setting up integrated MSW processing facility.

However, during the construction phase of integrated soild waste management facilty at Kutukpur Chanaura, if there is no alternate site for temporary dumping of MSW, it may be dumped in the designated areas of the proposed site till the commissioning of the project.

4.11 Rag Picker/Kabadiwalas

In Mirzapur, the rag pickers collect the recyclables from the waste heaps dumped by the waste carrying vehicles. The rag pickers also collect the recyclables like plastic and metals from the container bins and open points of the city. There are considerable numbers of rag pickers in the city who collect and sell the recyclables to kabadiwalas. Rag pickers are also operational at dumping site.

4.12 Over all Gap Analysis of the Existing Solid Waste System

The gap analysis done for the existing solid waste system is presented below.

- Lack of Knowledge of the Local Bodies regarding Solid Waste Management
- Lack of Public Awareness
- Dependence on Departmental Staff causing Labor Related Problems
- Lack of coverage
- Poor collection system especially in the narrow and circuitous lanes, making the collection more difficult
- Mixed variety of organic and inorganic solid waste
- Unsanitary conditions in and around community bins.
- Handling of specialized wastes

- Shortage of vehicles
- Shortcomings at landfill sites
- Organizational inadequacies
- Shortage of equipment and committed supervisory staff

The table contains the options recommended to close the gaps

Table 4-3: Analysis of the Existing SWM System

Component	Existing Scenario	SWM Rules 2016	Recommendation
General	Waste from all categories including households, hotels, restaurants, commercial establishments, markets, institutions and street sweeping is mixed		Hotel/Restaurants, markets, temples to collect their waste separately.
	Bulk waste storage collection in some areas only		Installing roadside community bins at different locations for biodegradable and non-biodegradable waste separately.
			Provisions should be made to collect street sweeping and drain sweeping waste separately.
Segregation at source	Absence of segregation of waste at source of generation	All waste generators shall segregate and store the waste generated by them in three separate streams namely bio- degradable, non-bio- degradable and domestic hazardous wastes in suitable bins and handover segregated wastes to authorized rag- pickers or waste collectors	Usage of separate bins for collection of biodegradable and non-biodegradable waste from households and other waste generating sources like street sweeping/drain silt.
			Food / biodegradable to be stored in non-corrosive container with a cover/lid
			Dry recyclable wastes to be stored in bags/ sacks made of plastic/paper/cloth
	Recyclables including newspapers, plastics and metals are collected by rag pickers		Domestic hazardous waste to be stored in bags/sacks made of plastic/paper/ cloth to be disposed in a notified area for safe disposal
			Large containers are provided for Garden waste, Marriage Halls, Community Halls etc. to separate collection

Component	Existing Scenario	SWM Rules 2016	Recommendation
Primary Collection	Door to door collection of waste only limited to wards in Mirzapur	Door to door collection of segregated solid waste from all households including slums and informal settlements, commercial, institutional and other non-residential premises. From multi-storage buildings, large commercial complexes, malls, housing complexes, etc., this may be collected from the entry gate or any other designated location;	The sanitary workers are required to undertake door-to- door and/or doorstep collection to prevent littering of waste.
			Use handcarts/tricycles with detachable containers of 20 to 40 liter capacity would be used for easy handling with all necessary accessories.
			Placement of waste bins in major commercial areas (as per generation of waste according to the wards)
	Absence of dustbins at some places		the Nagar Palika Parishad to avoid waste dumping on road sides
	Littering of waste along streets		Increase the number of vehicles and subsequent manpower for collection of waste
			Encouraging and creating awareness among the local people not to throw garbage in the drains

			and public places
Secondary Collection	Insufficient number of secondary collection points	Setup material recovery facilities or secondary storage facilities with sufficient space for sorting of recyclable materials to enable informal or authorized waste pickers and waste collectors to separate recyclables from the waste and provide easy access to waste pickers and recyclers for collection of segregated recyclable waste such as paper, plastic, metal, glass, textile from the source of generation or from material recovery facilities; Bins for storage of bio-degradable wastes shall be painted green, those for storage of recyclable wastes shall be printed white and those for storage of other wastes shall be printed black	Community bins to be provided for storage of waste in the secondary collection points and dustbins should be given to all the houses with the information of segregation.
	Most of the collection points are open and unhygienic		Bins should be placed on cement concrete having gradual slope towards drains and flushing the road to facilitate easy transfer of wastes from tricycles.
	Existing containers are in damaged conditions		Identification of collection points/pick up points for collection of waste to processing/dumpsite
	Absence of provision to dump the waste in separate biodegradable and recyclable containers		
	Poor maintenance of collection points		
	Manual lifting of waste from collection points leading to spilling of waste		
Street Sweeping	Absence of need based sweeping	Collect separately waste from sweeping of streets, lanes and by-lanes daily, or on alternate days or twice a week	The streets for sweeping operation shall be classified based on requirements with the new automatic technologies.
	Inefficient street sweeping operations	population, commercial activity and local situation;	The time of sweeping operations should synchronize with that of generation

Component	Existing Scenario	SWM Rules 2016	Recommendation
		Set up covered secondary storage facility for temporary storage of street sweepings and silt removed from surface drains in cases where direct collection of such waste into transport vehicles is not convenient. Waste so collected shall be collected and disposed of at regular intervals as	Divide the town into sanitary worker beats
			Sanitary workers to use handcarts/tricycle with detachable containers of 20 to 40 liters capacity with necessary accessories

		decided by the local body	and handles for easy handling
			Long handled broom with metal plates monthly one to each sanitary worker
Community Participation & Public awareness	Community participation is absent except very small initiative at one or two places	Create public awareness through information, education and communication campaign and educate the waste generators on the following; namely:- (i) not to litter; (ii) minimize generation of waste; (iii) reuse the waste to the extent possible; (iv) practice segregation of waste into bio–degradable, non-biodegradable (recyclable and combustible), sanitary waste and domestic hazardous wastes at source; (v) practice home composting, vermi-composting, bio-gas generation or community level composting; (vi) wrap securely used sanitary waste as and when generated in the pouches provided by the brand owners or a suitable wrapping as prescribed by the local body and place the same in the bin meant for non -biodegradable waste; (vii) storage of segregated waste at source in different bins; (viii) handover segregated waste to waste pickers, waste collectors, recyclers or waste collection agencies; and (ix) pay monthly user fee or charges to waste collectors or local bodies or any other person authorized by the local body for sustainability of solid waste management.	Local Bodies may actively associate resident associations, trade & Industry associations, Community Based Organizations (CBOs) and NGOs in creating awareness among the people to segregate recyclable material at source and hand it over to a designated waste collector identified by NGOs. The local body may give priority to the source segregation of recyclable wastes by shops and establishments and later concentrate on segregation at the household level.
			Absence of significant educational programs, campaigns, NGO activities for public awareness on solid waste management, significance of recycling, reuse and segregation of MSW

Component	Existing Scenario	SWM Rules 2016	Recommendation

Treatment & Disposal	Unscientific waste disposal at Kutukpur Chanaura dumpsite and pits in Nagar Palika Parishad	Setup material recovery facilities or secondary storage facilities with sufficient space for sorting of recyclable materials to enable informal or authorized waste pickers and waste collectors to separate recyclables from the waste and provide easy access to waste pickers and recyclers for collection of segregated recyclable waste such as paper, plastic, metal, glass, textile from the source of generation or from material recovery facilities; Bins for storage of bio-degradable wastes shall be painted green, those for storage of recyclable wastes shall be printed white and those for storage of other wastes shall be printed black	Proposal of proper disposal method for various kinds of waste and bases on it characteristics.
			Proper leachate management system to be implemented in processing/dumpsite
			The inerts to be disposed in sanitary landfill on individual or cluster basis.
			Provision to provide proper fencing to the processing / dumpsite and appointment of security personnel for curb the menace of human / animal threats.
Land for Treatment & Disposal	Land sufficient for 15-20 years	Ensure identification and allocation of suitable land for setting up processing and disposal facilities for solid wastes within one year and incorporate them in the master plan	
		Ensure that a separate space for segregation, storage, decentralized processing of solid waste is demarcated in the development plan for group housing or commercial, institutional or any other non-residential complex exceeding 200 dwelling or having a plot area exceeding 5,000 square meters	
		Ensure that the developers of Special Economic Zone, Industrial Estate, Industrial park earmark at least 5% of the total area of the plot or minimum 5 plots/ sheds for recovery and recycling facility.	
		Notify buffer zone for the solid waste processing and disposal facilities of more than 5 tons per day in consultation with the State Pollution Control Board	

4.13 Finances of ULB

Table 4-4: Financial Details of Expenditure for the Year 2017 -2018

Item no	Name of Head	Actual expenditure of 2017-2018
1.	Street Light	544,369
2.	Road Construction / Drain	29,472,161
3.	Other Public Building	1,177,829
4.	Water Property	20,215,802
5.	Cleaning Equipment	3,663,725
6.	Other Expenditure on Tanda	
6.1	Water Supply	5,410,552
6.2	Animal Feed Store	216,612,009
6.3	Devlopment Of Slum/S.B.M	18,970,928
6.4	Stationery	304,230
6.5	Audit Fees	806,625
6.6	Expenses On Fair	2,228,972
6.6	Miscellaneous Expenses / Fuel	15,455,489
6.7	Pemsion/Substance	38,419,484
7.	General Administration	12,324,392
8.	Tax Collection	13,116,948
9.	Lighting Department	3,920,813
10.	Water Community	66,924,902
11.	Public Works Department	8,338,942
12.	Rent	1,794,231
13.	Safai Jamadaar	5,467,060
14.	Cleaning Transpotation	5,515,305
15.	Health Officer	5,093,915
16.	Permit	2,487,317
17.	Expenditure On Salary Allowances Of Lo, Ro,	40,840,430

	RPDF, GIS, INS Clame, Loan, Recovery & Other	
18.	Salary of Sweeper	117,391,961
	Total	**636,498,391**

MNNP developmental and operational requirements are funded mostly through its own revenues and partly by the state's devolution of funds in form of grants and assistances.

4.140. Manpower

Table 4-5: Availability of Manpower

Sr. No.	Type of Staff	Sanctioned Permanent	Sanctioned Temporary	Actual Permanent	Actual Temporary
1	Safai Karamchari	716	800	702	769
2	Supervisor	27	70	22	63
3	CSFI	2	3	3	0
4	SFI	12	1	3	1
	Total	**757**	**874**	**730**	**833**

In total 1563 persons are involved in SWM Activity in MNNP area.

CHAPTER 5
REGULATORY FRAMEWORK

CHAPTER 5: REGULATORY FRAMEWORK

5.1 Regulatory Framework for Waste Management

Historically, municipal solid waste management received little regulatory attention in India. However, rapid population growth and an increasing trend towards urbanization over the past forty years led to significant issues, particularly within the rapidly growing large urban population. This ultimately led to significant public concern and acted as the stimulus for regulatory reform.

However, the implementation of legislation has always been a problem either due to lack of resources to enforce the rules or change sin political priorities.Community pressure has played a significant role by way of Public Interest Litigations (PILs) [4] and therefore, the judiciary required that the authorities pay adequate attention to environmental and ecological concerns.

There are a number of regulatory instruments (Acts and Regulations) that establish both the responsibility and requirements for management of municipal solid waste. Key regulatory requirements that are pertinent to this study include:

- Constitution 74thAmendment – establishes overall responsibilities for MSW management;
- Solid Waste Management Rules, 2016: In super session of the Municipal Solid Waste Management Rules, 2000, the Central Government has issued the revised solid waste management rules, 2016. This is the primary regulation covering all functional elements of municipal solid waste management and establishes comprehensive requirements for collection, storage treatment and disposal of municipal waste;
- The Water (Prevention and Control of Pollution) Act, 1974: Under this act there are two aspects related to municipal solid waste management. Firstly, a consent to establish and operate from the Uttar Pradesh Pollution Control Board for establishment and operation waste processing and disposal facility and secondly no water pollution should be caused by the leachate that is emitted from the municipal waste processing and disposal facility;
- The Water (Prevention and Control of Pollution) Cess Act, 1977 and amendments thereon. The onlyaspectunderthisactrelatedtomunicipalsolidwastemanagementistheprovisionforlevying and collection of cess on water consumed for waste processing and disposal facility;
- The Air (Prevention and Control of Pollution) Act, 1981 and amendments thereon. The aspects to be considered under this act related to municipal solid waste management is the need for obtaining consent from Uttar Pradesh Pollution Control Board for establishment of the processing plants and disposal site and from an environmental aspect would be the air pollution caused by the waste processing and disposal facility;
- Plastic Waste Management (Handling & Handling) Rules, 2016 - provides specific rules for manufacture and re-use of plastic bags and containers: and

- The Environmental (Protection) Act, 1986 and its subsequent notifications. The aspect related to municipal solid waste management is the Environmental Impact Assessment(EIA) notification,

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[4] Public Interest Litigation is a judicial instrument initiated to redress public grievance over violation of human rights by the state or to vindicatethepublicpoliciesembodiedinthestatutesortheconstitutionalprovisionsandhasbeenfosteredbyjudgesoftheSupreme Court. Most environmental actions by the judiciary in India fall within this class

2006, which provides the requirement for environmental clearance from statutory authority for municipal solid waste processing and disposal facility.

The following sections provide a summary of the key regulatory instrument related to municipal solid waste management within the project area

5.2 The Constitution 74th Amendment – Responsibilities for Solid Waste Management

The Constitution (74th) Amendment Act of 1994 recognized the municipal governments as the third tier of governance to manage urban growth and development including the management of municipal solid waste. The 74th Amendment Act transfers significant authority and responsibility from the state government to the Urban Local Bodies (ULBs).

Under this Act, cities and towns are responsible for the delivery of primary health care, education, and urban infrastructure services. However, implementation of the act has been very slow and urban local governments are still not fully empowered or authorized to levy, collect, and appropriate taxes and duties to augment the revenue/resources by the respective state governments. A consensus among national, state, and local governments and external donors is emerging on reforms needed to improve the functioning of local governments

5.3 Solid Waste Management Rules, 2016

Solid Waste Management Rules, 2016 (SWM Rules) are the revised set of rules issued by the Central Government to supersede the Municipal Solid Waste (Management and Handling) Rules, 2000. SWM Rules2016 establishes consistent regulations governing collection, segregation, transportation, and disposal of all types of municipal solid wastes throughout India. The Rules are now applicable beyond Municipal areas and extend to urban agglomerations, census towns, notified industrial townships, areas under the control of Indian Railways, airports, airbase, Port and harbor, defense establishments, special economic zones, State and Central government organizations, places of pilgrims, religious & historical importance. Specific requirements under the SWM Rules are provided in the following sections.

5.4 Administrative Responsibilities

India has a multi-tiered, decentralized system of governance that includes the central (federal) government, state government and local administration by ULB. The ULBs include urban municipalities/municipal corporations. All three tiers have specific roles and responsibilities as established under the constitution and ensuing legislation for waste handling prescribed in the SWM Rules. The Central Pollution Control Board (CPCB) is responsible to monitor the implementation of the rules, whereas municipal authorities are responsible for implementation. The responsibility for granting authorization for setting up of waste processing and disposal facilities is with the State Pollution Control Board. The distribution of jobs and responsibilities of authorities at different levels is described below:

Central Level: Ministry of Environment Forest and Climate Change

The Ministry of Environment, Forest and Climate Change shall be responsible for overall monitoring the implementation of these rules in the country. The Central Monitoring

Committee formulated by the ministry shall monitor and review the implementation of these rules.

Central Pollution Control Board

- Co-ordinate with relevant state authority(UPPCB);
- Monitor the implementation of guidelines and standards;
- Review standards and guidelines;
- Compile monitoring data; and
- Prepare a consolidated annual review report based on UPPCB reports, for the Central Government.

State Level: Uttar Pradesh State Government

The Secretary, Urban Development Department, Uttar Pradesh through the Commissioner or Director of Municipal Administration or Director of local bodies is responsible for overall implementation of SWM Rules, 2016 in the state.

State Level: Pollution Control Board

- Authorize waste processing/disposal facilities and landfills and coordinate input from other review agencies including the Department of Housing & Urban development, Airport or Air Base Authority, the Ground Water Board or any other affected agency prior to issuing the authorization;
- As per the SWM Rules, 2016, UPPCB is the monitoring agency for implementation of SWM Rules, 2016 in UP.
- Ensure implementation of SWM Rules, 2016, in terms of issuing consent for establishment and operation of waste treatment and landfill facility and also scrutinize the annual reports on SWM submitted by ULBs to ensure their compliance with the SWM Rules,2016
- Monitor compliance with standards regarding groundwater, ambient air, leachate quality, compost quality and incineration standards;
- The UPPCB shall issue the authorization to the municipal authority or an operator of a facility stipulating compliance criteria and standards as specified and including such other conditions, as may be necessary;
- Consider a new authorization after the validity of existing authorization expires;
- Coordinate with Central Pollution Control Board; and
- Prepare an annual report for Central Pollution Control Board.

Uttar Pradesh Jal Nigam (UPJN)

UPJN is a line department of the Government of Uttar Pradesh, monitoring the responsibility of ULBs to prepare and execute the SWM projects, due to lack of its capacity, the preparation and execution of capital works is carried out by UPJN.

Local Level:

Nagar Palika Parishad is responsible for infrastructure development for collection, segregation, storage, transportation, processing and disposal of MSW;

- Apply for Grant of Authorization for setting up waste processing and disposal facilities including landfills from UPPCB. The application should be in Form-I (SWM Rules). A private operator of the facility should also apply in a similar manner.

- Notify the waste collection and segregation schedule to the generators of municipal waste, to help them comply;
- Organize awareness programs with citizens to promote reuse or recycling of segregated materials and community participation in waste segregation; and
- Prepare and submit annual report as per Form-II (SWM Rules) to the Secretary-in-Charge, Uttar Pradesh Department of Housing & Urban Development and to the UPPCB.

As noted above, the Secretary of Uttar Pradesh Housing & Urban Development Department has the overall responsibility for enforcement of the provisions of the SWM Rules within the extended area of Mirzapur Nagar Palika Parishad Area. The Uttar Pradesh State Pollution Control Board is responsible for monitoring compliance with the standards specified in the SWM Rules and also issue authorization for setting up waste processing and disposal facilities, and landfills. Mirzapur Nagar Palika Parishad is responsible to provide solid waste management services within their jurisdiction. As such, they must provide appropriate infrastructure and services in accordance with the SWM Rules.

5.4.1 Waste generation and Composition

Knowledge about the quantum of waste generation and composition of MSW is essential for determining collection, transportation, processing and disposal options that could be adopted for these ULB's in Uttar Pradesh. These factors are dependent on the population, demographic details, principal activities in the town, income levels and lifestyle of the community. Studies carried out in Indian cities by NEERI indicate that waste generation and its composition is strongly dependent on the local socio-economic condition, lifestyle & behavioral pattern and available infrastructure for solid waste management (SWM) in the urban center. It has been well established from such studies that waste generation of an area is directly proportional to average income of the people of that area.

5.5.1 Waste Generation

As informed by the Nagar Palika Parishad, there are few bins available in the city and waste is collected only from major roads and from the arterial roads connecting to main road. Street sweeping takes place once in day in morning hours. Waste mixing is common phenomena in these ULBs; not only at dumping yard but in open places also biomedical waste and slaughter waste is seen mixed with municipal waste. There is no weighbridge available at dumpsite; therefore, no records exist for the quantum of solid waste transferred to the dumpsite. In the absence of any records, the waste generated in these ULBs has been assumed based on waste generation estimates derived from secondary sources. The waste estimation is based on Central Public Health and Environmental Engineering Organization, 2000 (CPHEEO) Manual and India Urban Infrastructure Report, 2011 by High Powered Expert Committee (HPEC[3]).

CPHEEO Manual on SWM, 2000

As per CPHEEO anual, the per capita waste generation for a population range of **0.1 to 0.5 million is 210 gm/capita/day**. Other studies and observations indicate that waste generation rate is found to be between 200 and 300 gm/ capita /day in small towns / cities with population below 2,00,000. Based on the per capita waste generation of 210 gm/capita/day and current projected population, the solid waste generated in these ULBs is provided below in **Table 4-1**.

India Infrastructure Report 2011

As per the India Infrastructure Report 2006, towns having less than 1 lakh population fall under Class II,III and IV town and the per capita waste generation is 255 gm/capita/day and towns having population between 1 lakh to 10 lakh fall under Class IC and the per capita waste generation is 304 gm/capita/day

5.4.2 Requirements under the SWM Rules

Segregation at Source

- The new rules have mandated the source segregation of waste in order to channelize the waste to recovery, reuse and recycle. Waste generators would now have to now segregate waste into following streams- Biodegradables, Non-Biodegradable, Sanitary waste and Domestic Hazardous waste before handing it over to the collector.
- Institutional generators, market associations, event organizers and hotels and restaurants have been directly made responsible for segregation and sorting the waste and manage in partnership with local bodies.
- In case of an event, or gathering of more than 100 persons at any licensed/ unlicensed place, the organizer will have to ensure segregation of waste at source and handing over of segregated waste to waste collector or agency, as specified by the local authority.
- All hotels and restaurants will also be required to segregate biodegradable waste and setup a system of collection to ensure that such food waste is utilized for composting / bio-methanation. The rules mandate that all resident welfare and market associations and gated communities with an area of above 5,000 sq. m will have to segregate waste at source into material like plastic, tin, glass, paper and others and hand over recyclable material either to authorized waste-pickers and recyclers or to the urban local body.

Waste Collection, Storage and Transportation

The SWM Rules establish consistent requirements for the collection, storage and transportation of municipal waste with the intent of streamlining the technical and administrative methods in which solid waste is handled in the country. Requirements for collection, segregation, storage and transportation of municipal waste are as follows:

Collection of Waste: The Municipal Authority is responsible to provide door to door collection of segregated waste from the households including slums, informal settlements, commercial, institutional and other non- residential waste generators in compliance with the SWM Rules and notify the waste collection schedule and likely methods to be adapted to the generators. Littering of municipal solid waste is prohibited and generators are responsible to utilize the collection systems provided by the municipality and avoid littering. Municipality must provide the following collection services to facilitate compliance:

- Prepare solid waste management plan as per the state policy
- Arrange door to door collection of segregated waste from all households including slums and informal settlements, institutional, commercial and other non-residential premises.
- Integration of organization of waste picker or informal waste collector to facilitate their participation in providing SWM services.
- Prescription of appropriate user fee from the waste generator on its own or through the authorized agency.
- Ensure that bio-medical wastes and industrial wastes are not mixed with municipal solid wastes and managed in accordance with the Bio-Medical Waste (Management and Handling) Rules 2016 and the Hazardous Waste (Management and Handling) Rules2016.
- Provide separate collection/ disposal services for horticultural, construction and demolition waste in accordance with local legislation, bylaws or directives issued by concerned authorities;
- Prevent the burning of waste consisting of garbage and dry leaves.

- Sweeping of streets depending on density of population, commercial activity and local situation and separate collection of street sweeping waste.

*Storage Facilities***:** The Municipal Authority is required to establish and maintain municipal waste storage facilities taking into account the following criteria so that unhygienic and unsanitary conditions are not created around it:

- Setup secondary storage facility for temporary storage of street sweeping and silt removed from the drains.
- Setting up material recovery facility or secondary storage facility with sufficient space for sorting of recyclables.
- Establishwastedepositioncentersfordomestichazardouswasteandprovidedirectiontothewaste generators to deposit hazardous waste in the centers and also ensure safe storage and transportation of hazardous waste.

*Transportation***:** The SWM Rules specifies that vehicles used for transportation of wastes should be covered and the following compliance criteria should be taken into account to avoid visibility of waste to the public and exposure to open environment preventing their scattering:

- Transportation of segregated biodegradable waste to processing facilities like compost plant, bio-methanation plant. Preference to on site processing.
- Transportation of non-biodegradable waste to processing facility, material recovery facility or storage facility.
- Waste must be covered in transit such that the wastes are not visible to public, nor exposed to the environment. Transportation vehicles should be designed to minimize handling of wastes, prior to final disposal.

Treatment and Disposal of Municipal Solid Waste

The SWM Rules seek to minimize the burden on landfills for the disposal of municipal waste by adopting appropriate waste segregation and treatment technologies. The Municipal Authority has the responsibility to implement appropriate strategies and systems to minimize disposal volumes based on the following criteria:

- Facilitate construction operation and maintenance of municipal solid processing facilities and associated infrastructure for optimum utilization various component of waste adopting suitable technologies. Preference shall be given to de-centralize processing to minimize transportation cost and environmental impact.
- Technologies proposed included bio-methanation, microbial composting, vermi-composting, anaerobic digestion or any other appropriate biological processing for stabilization of waste and waste to energy process including refused derived fuel or combustible fraction of waste or supply as feed stock to solid waste based power plant or cement kilns.
- Phase out use of chemical fertilizer in two years and use compost in all parks, gardens maintained by local body.
- Alternative, state-of-the-art technologies may also be applied provided that the Municipal Authority or Private Operator obtains authorization from the Central Pollution Control Board.

The SWM Rules restrict landfill disposal to non-biodegradable, inert, and other wastes that are unsuitable for either recycling or biological processing. Residues of waste processing facilities, as well as pre- processing rejects, should be land filled. Land filling of mixed waste should only be permitted in situations where the waste stream is unsuitable for alternative processing or when additional time is required to establish appropriate waste diversion and treatment programs and technologies.

Specifications for Landfill Sites

Only non-biodegradable and non-recyclable waste should go to a landfill site. Municipal and hazardous waste should not be mixed by putting them in the same landfill.

- *Site for Landfilling:* The selection of a landfill will be based on examination of environmental issues. The following points are to be considered for landfill siting:
    - Before establishing any landfill site, baseline data of groundwater quality in the area needs to be collected and kept in record for future reference.
    - Hydrological attributes of the site as well as the water usage must be taken into consideration.
    - Proper documentation of various phases of its construction and closure plan. In case a new landfill facility is being established adjoining an existing landfill site, the closure plan of existing landfill should form a part of the proposal of such new landfill.
    - The landfill site shall be selected to make use of nearby waste processing facilities or incorporate appropriate facilities as an integral part of the development.
    - It should be large enough to last for twenty to twenty-five years.
    - Existing landfill sites, which continue to be used for more than five years, shall be improved in accordance with the specification of the SWM Rules.
    - The landfill site shall be large enough to last for at least 20-25 years and shall develop 'landfill cells' in a phased manner to avoid water logging and misuse.
    - The landfill should be away from habitation zones, forest areas, water bodies, monuments, national parks, wetlands and other places of cultural, historical or religious interest. Distance criteria has been specified in the rules.
    - The sites for landfill and processing and disposal of solid waste shall be incorporated in the Town Planning Department's land-use plans.
    - A buffer zone of no-development should be maintained around the landfill site and incorporated in the Town Planning Department's land use plans. The size of the buffer zone is to be decided on case to case basis in consultation with State Pollution Control Board.
    - It should be away from airports including airbase. Necessary approval of airport or airbase authorities is required when the site is located within 20 km of an airport or airbase.
    - Temporary storage facility for solid waste should be provided in each landfill site to accommodate waste in case of non-operation of waste processing or during emergencies or natural calamities.
- *Landfill Site Facilities and Maintenance:* The SWM Rules specifies guidelines for the maintenance of a landfill site. These are as follows:
    - Proper fencing/ hedging with a gate. Entry of stray animals and unauthorized persons should be prevented through protective measures.
    - Approach and other internal roads are required to facilitate movement of vehicles and other machinery.
    - Site facilities should include a wastes inspection station, office facility for record-keeping and shelter for maintaining equipment and machinery, including pollution monitoring equipment.
    - The operator of the facility shall maintain record of waste received, processed and disposed.
    - Weigh bridge to measure the quantity of waste disposed, Fire protection equipment and other facilities as may be required at the landfill site,
    - Utilities such as drinking water and washing facilities for workers. Adequate lighting for night operation.
    - Safety provisions (first aid stations) and regular health inspection camps for workers.

  Provisions for parking, cleaning, washing of transport vehicles carrying solid waste shall be provided. The wastewater so generated shall be treated to meet the prescribed standards.

  Procedures and Specifications for Landfilling: The SWM Rules provide specific instructions to be followed at a landfill site. These are as follows:

    - Wastes should be pressed (compacted) to achieve high-density.
    - Wastes should be covered immediately or at the end of each working day with a minimum 10 cm of soil, debris, or construction material until such time as waste processing facilities are established.
    - Prior to the commencement of monsoon season, an intermediate cover of soil approximately 40-65 cm thick should be placed on the landfill to prevent infiltration.

- Proper drainage system should be constructed to divert run-off water.

After the completion of landfill a final cover should be designed to prevent infiltration and erosion in corporation barrier, drainage and vegetative layers. The final cover shall meet the following specifications, namely:--

- The final cover shall have a barrier soil layer comprising of 60 cm of clay or amended soil with permeability coefficient less than 1 x 10^{-2}cm/sec.
- On top of the barrier soil layer, there shall be a drainage layer of 15cm.

  On top of the drainage layer, there shall be a vegetative layer of 45 cm to support natural plant growth and to minimize erosion.

➢ *Pollution Prevention*: The SWM Rules specifies the following measures in order to prevent pollution problems from landfill operations:

- Diversion of storm water drains to minimize leachate generation and prevent pollution of surface water to avoid flooding and creation of marshy conditions.
- Construction of a non-permeable lining system at the base and walls of waste disposal area. For landfill receiving residues of waste processing facilities or mixed waste or waste having contamination of hazardous materials (such as aerosols, bleaches, polishes, batteries, waste oils, paint products and pesticides) minimum liner specifications shall be a composite barrier having 1.5 mmhighdensitypolyethylene(HDPE)geo-membrane,orequivalent,overlying90cmofsoil(clayor amended soil) having permeability coefficient not greater than 1 x 10^{-7} cm/sec. The highest level of water table shall be at least two meters below the base of clay or amended soil barrier layer.
- Provisions for management of leachate collection and treatment shall be made. The treated leachate must meet the standards specified.
- Prevention of run-off from landfill area entering any stream, river, lake or pond, etc.
- Guidelines are also specified for plantation at the landfill site.

➢ *Water Quality Monitoring*: The SWM Rule requires that before establishing any landfill site, baseline data of ground water quality in the area shall be collected and kept in record for future reference. The Rule also specifies the following:

- The ground water quality monitoring within 50 metres of the periphery of landfill site is required periodically to ensure compliance with criteria set by the Ground Water Board or the SPCB. Such monitoring shall be carried out in different seasons i.e., summer, monsoon and post-monsoon period.
- Usage of groundwater in and around landfill sites for any purpose (including drinking and irrigation) is to be considered after ensuring its quality. **Table5-1** provides the specifications for drinking water quality to be applied for monitoring purpose:

Table 5-1: Specification for Drinking Water Quality

SN	Parameters	IS 10500: 2012 Desirable limit (mg/L except for pH)
1.	Arsenic	0.01
2.	Cadmium	0.01
3	Chromium^{+6}	0.05

4.	Copper	0.05
5.	Cyanide	0.05
6.	Lead	0.05
7.	Mercury	0.001
8.	Nickel	-
9.	Nitrate as NO_3	45.0
10	PH	6.5-8.5
11.	Iron	0.3
12.	Total hardness (as $CaCO_3$)	300.0
13.	Chlorides	250
14.	Dissolved solids	500
15.	Phenolic compounds (as C_6H_5OH)	0.001
16.	Zinc	5.0
17.	Sulphate (as SO_4)	200

Source: SWM Rules, 2016

- *Ambient Air Quality Monitoring:*
  - Landfill gas control system shall be installed at landfill to minimize odour, prevent off site migration of gases, to protect vegetation planted on rehabilitated landfill surface.
  - The concentration of methane gas generated at landfill site shall not exceed 25 percent of the lower explosive limit (LEL).
  - The landfill gas should be utilized for either direct thermal applications or power generation, as viable. Otherwise, it should be combusted (flared). Passive venting should only occur if gas utilization or flaring is not possible.
  - The SWM Rules requires regular monitoring of ambient air quality in the landfill and around landfill. Ambient air quality shall meet the standards prescribed by Central Pollution Control Board for Industrial area
- *Landfill Closure and Post-Closure Care*: The post-closure care of landfill sites should be conducted for at least fifteen years and long term monitoring or care plan should consist of the following:
  - Maintaining the integrity and effectiveness of final cover, making repairs and preventing run-on and run-off from eroding or otherwise damaging the final cover.
  - Monitoring the leachate collection system in accordance with the requirements.
  - Monitoring of ground water in accordance with requirements and maintaining ground water quality.
  - Maintaining and operating the landfill gas collection system to meet the standards.

  Use of closed landfill sites after fifteen years of post-closure monitoring can be considered for human settlement or otherwise only after ensuring that gaseous and leachate analysis comply with the specified standards.

- *Composting and Treated Leachate Quality*

  In order to prevent pollution problems from compost plant and other processing facilities, the following should be complied with:

- The incoming wastes at site should be stored properly and covered to the extent possible. If, such storage is done in an open area, an impermeable base and facilities should be provided to allow collection and proper management of leachate.
- Necessary precautions should be taken to minimize nuisance of odour, flies, rodents, bird menace and fire hazard.
- In case of breakdown or maintenance of plant, waste intake shall be stopped, and arrangements be worked out for diversion of wastes to the landfill site.
- Pre-process and post-process rejects should be removed from the processing facility on regular basis and should not be allowed to pile at the site. Recyclables should be routed through appropriate vendors. The non-recyclables should be sent for the landfill site
- For compost plants, the windrow area should be provided with impermeable base having a permeability coefficient less than 10^{-7} cm/sec. The base should be sloped (one to two percent) and circled by lined drains for collection of leachate or surface run-off.
- Ambient air quality monitoring should be conducted downwind of the facility to assess nuisance odour, etc.

In order to ensure the safe application of compost, the SWM Rules specify compost quality standards. Product that does not achieve the levels set out in the following table should not be used for food crops. However, it may be utilized for purposes other than growing food. In addition, specific standards have been established for leachate quality. The leachate quality standards depend on the disposal method used with the most stringent criteria specified for disposal to surface water bodies.

Relevant compost quality and leachate quality standards are provided in **Table 5-2** and **Table 5-3**.

Table 5-2: Compost Quality standards

S.no	Parameters	Organic Compost (FCO 2009)	Potash Rich Organic Manure (FCO 2013)
1	Arsenic (mg/kg)	10.00	10.00
2	Cadmium (mg/kg)	5.00	5.00
3	Chromium (mg/kg)	50.00	50.00
4	Copper (mg/kg)	300.00	300.00
5	Lead (mg/kg)	100.00	100.00
6	Mercury (mg/kg)	0.15	0.15
7	Nickel (mg/kg)	50.00	50.00
8	Zinc (mg/kg)	1000.00	1000.00
9	C/N Ratio	Less than 20	Less than 20:1
10	Ph	6.5-7.5	(1:5 solution) maximum 6.7
11	Moisture, percentage by weight, Maximum	15.0-25.0	25.0
12	Bulk density (g/cm^3)	Less than 1.0	Less than 1.6
13	Total Organic Carbon, percentage by weight, minimum	12.0	7.9
14	Total Nitrogen As N, percentage by weight, minimum	0.8	0.4
15	Total Phosphate as (P_2O_5), percentage by weight, minimum	0.4	10.4
16	Total Potassium as (K_2O), percentage by weight, minimum	0.4	-
17	Colour	Dark brown to black	-
18	Odour	Absence of Foul Odour	-

19	Particle size	Minimum 90% of material should pass through 4mm IS sieve	Minimum 90% of material should pass through 4mm IS sieve
20	Conductivity as dsm^{-1} , not more than	4.0	8.2

Source: SWM Rules, 2016

*Compost (final product) exceeding the above stated concentration limits shall not be used for food crops. However, it may be utilized for purposes other than growing food crops.

Table 5-3: Leachate Quality Standard

SN	Parameter	Standards (Mode of Disposal)		
		Inland Surface Water	Public Sewer	Land Disposal
1.	Suspended solids, mg/L, max	100	600	200
2.	Dissolved solids (inorganic) mg/L, max.	2100	2100	2100
3	PH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
4	Ammonical nitrogen (as N), mg/L, max.	50	50	-
5	Total Kjeldahl nitrogen (as N), mg/L, max.	100	-	-
6	Biochemical oxygen demand (3 days at 27°C) max.(mg/L)	30	350	100
7	Chemical oxygen demand, mg/L, max.	250	-	-
8	Arsenic (as As), mg/L, max	0.2	0.2	0.2
9	Mercury (as Hg), mg/L, max	0.01	0.01	-
10	Lead (as Pb), mg/L, max	0.1	1.0	-
11	Cadmium (as Cd), mg/L, max	2.0	1.0	-
12	Total Chromium (as Cr), mg/L, max.	2.0	2.0	-
13	Copper (as Cu), mg/L, max.	3.0	3.0	-
14	Zinc (as Zn), mg/L, max.	5.0	15	-
15	Nickel (as Ni), mg/L, max	3.0	3.0	-
16	Cyanide (as CN), mg/L, max.	0.2	2.0	0.2
17	Chloride (as Cl), mg/L, max.	1000	1000	600
18	Fluoride (as F), mg/L, max	2.0	1.5	-
19	Phenolic compounds (as C_6H_5OH) mg/L, max.	1.0	5.0	-

Source: SWM Rules, 2016

5.4 Plastics Waste Management & Handling Rules2016

Plastic waste Management and handling Rule 2016 has been formulated to provide a regulatory frame work for management of plastic waste generated in the country and to

provide thrust on plastic waste minimization, source segregation, recycling, involving waste pickers, recyclers and waste processors in collection of plastic waste fraction either from households or any other source of its generation or intermediate material recovery facility and adopt polluter's pay principle for the sustainability of the waste management system. Plastic waste management Rule 2016 specifies following responsibilities for the local bodies.

- Every local body shall be responsible for development and setting up of infrastructure for segregation, collection, storage, transportation, processing and disposal of the plastic waste either on its own or by engaging agencies or producers.
- The local body shall be responsible for setting up, operationalization and co-ordination of the waste management system and for performing the associated functions, namely:-
- Ensuring segregation, collection, storage, transportation, processing and disposal of plastic waste;
- Ensuring that no damage is caused to the environment during this process;
- Ensuring channelization of recyclable plastic waste fraction to recyclers;
- Ensuring processing and disposal on non-recyclable fraction of plastic waste in accordance with the guidelines issued by the Central Pollution Control Board;
- Creating awareness among all stakeholders about the irresponsibility;
- Engaging civil societies or groups working with waste pickers ; and
- Ensuring that open burning of plastic waste does not take place.
- The local body for setting up of system for plastic waste management shall seek
- The local body to frame bye-laws incorporating the provisions of these rules.

5.5 Hazardous and Other Wastes (Management & Trans boundary Movement) Rules,2016.

Hazardous and Other Wastes (Management and Trans boundary Movement) Rules,2016 has replaced the Hazardous waste (Management & Handling) Rules2008.

As per the definition, hazardous waste" means any waste which by reason of characteristics such as physical, chemical, biological, reactive, toxic, flammable, explosive or corrosive, causes danger or is likely to cause danger to health or environment, whether alone or in contact with other wastes or substances, and shall include - (i) waste specified under column (3) of Schedule I; (ii) waste having equal to or more than the concentration limits specified for the constituents in class A and class B of Schedule II or any of the characteristics as specified in class C of Schedule II; and (iii) wastes specified in Part A of Schedule III in respect of import or export of such wastes or the wastes not specified in Part A but exhibit hazardous characteristics specified in Part C of Schedule III;

Most of the solid waste generated from the residential, commercial and institutional areas cannot be classified as hazardous. Primarily hazardous waste from Industries falls under this category.

Hazardous and Other Wastes (Management and Trans boundary Movement)Rules, 2016 may not be directly applicable to the municipal waste management from extended area of Uttar Pradesh. However, the same has been discussed here for general reference.

Responsibility of occupier

For the management of hazardous and other wastes, an occupier shall follow the following steps, namely:-

(a) Prevention; (b) minimization; (c) reuse, (d) recycling; (e) recovery, utilization including co-processing; (f) safe disposal.

The occupier shall be responsible for safe and environmentally sound management of hazardous and other wastes.

The occupier shall be responsible for safe and environmentally sound management of hazardous and other wastes.

The hazardous and other wastes generated in the establishment of an occupier shall be sent or sold to an authorized actual user or shall be disposed of in an authorized disposal facility.

The hazardous and other wastes shall be transported from an occupier's establishment to an authorized actual user or to an authorized disposal facility in accordance with the provisions of these rules

Responsibilities of State Government for environmentally sound management of hazardous and other wastes.

Unlike Municipal Solid waste management Rules for which the management lies with the ULBs, the Hazardous waste Management is the responsibility of the state government.

Every State Government may prepare integrated plan for effective implementation of these provisions and to submit annual report to the Ministry of Environment, Forest and Climate Change, in the Central Government.

Grant of Authorization

Every occupier of the facility who is engaged in handling, generation, collection, storage, packaging, transportation, use, treatment, processing, recycling, recovery, pre-processing, co-processing, utilization, offering for sale, transfer or disposal of the hazardous and other wastes shall be required to make an application to the State Pollution Control Board and obtain an authorization from the State Pollution Control Board.

Storage of hazardous and other wastes.

The occupiers of facilities may store the hazardous and other wastes for a period not exceeding ninety days and shall maintain a record of sale, transfer, storage, recycling, recovery, pre-processing, co-processing and utilization of such wastes and make these records available for inspection

Transportation of hazardous and other wastes.

The transport of the hazardous and other waste shall be in accordance with the provisions of these rules and the rules made by the Central Government under the Motor Vehicles Act, 1988 and the guidelines issued by the Central Pollution Control Board from time to time in this regard.

Packaging and Labeling.

Any occupier handling hazardous or other wastes and operator of the treatment, storage and disposal facility shall ensure that the hazardous and other wastes are packaged in a manner suitable for safe handling, storage and transport as per the guidelines issued by the Central Pollution Control Board

Treatment, storage and disposal facility for hazardous and other wastes

The State Government, occupier, operator of a facility or any association of occupiers shall individually or jointly or severally be responsible for identification of sites for establishing the facility for treatment, storage and disposal of the hazardous and other waste in the State

5.6 Bio- Medical Waste Management Rules, 2016

These rules shall apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle bio-medical waste in any form and shall not apply to following waste type

- Radioactive wastes,
- Wastes covered under the SWM Rules, 2016,
- Lead acid batteries,
- hazardous wastes,
- E-waste,
- Hazardous microorganisms.

These rules also do not apply to the wastes covered under the SWM Rules, 2016 .However, the same has been discussed in the following section for general reference.

Duties of the Health care facilities

All the occupier of health care facilities shall have following responsibilities

- Take all necessary steps to ensure that bio-medical waste is handled without any adverse effect to human health and the environment and in accordance with these rules;
- Make a provision within the premises for a safe, ventilated and secured location for storage of segregated biomedical waste in coloured bags or containers in the manner as specified in Schedule I, to ensure that there shall be no secondary handling, pilferage of recyclables or inadvertent scattering or spillage by animals and the bio-medical waste from such place or premises shall be directly transported in the manner as prescribed in these rules to the common bio-medical waste treatment facility or for the appropriate treatment and disposal, as the case may be, in the manner as prescribed in Schedule I;
- Pre-treat the laboratory waste, microbiological waste, blood samples and blood bags through disinfection or sterilization on-site in the manner as prescribed by the World Health Organization (WHO) or National AIDs Control Organization (NACO) guidelines and then sent to the common bio-medical waste treatment facility for final disposal;
- Phase out use of chlorinated plastic bags, gloves and blood bags within two years from the date of notification of these rules;
- Establish a Bar- Code System for bags or containers containing bio-medical waste to be sent out of thepremisesorplaceforanypurposewithinoneyearfromthedateofthenotificationoftheserules;
- Ensure segregation of liquid chemical waste at source and ensure pre-treatment or neutralization prior to mixing with other effluent generated from health care facilities;
- Ensure treatment and disposal of liquid waste in accordance with the Water (Prevention and Control of Pollution) Act,1974;

Duties of the operator of a common bio-medical waste treatment and disposal facility.

It shall be the duty of every operator to take all necessary steps to ensure that the bio-medical waste collected from the occupier is transported, handled, stored, treated and disposed of, without any adverse effect to the human health and the environment, in accordance with these rules and guidelines issued by the Central Government or, as the case may be, the central pollution control board.

Treatment and disposal.

Bio-medical waste shall be treated and disposed of in accordance with Schedule I, and in compliance with the standards provided in Schedule-II by the healthcare facilities and common bio-medical waste treatment facility.

Occupier shall handover segregated waste as per the Schedule-I to common bio-medical waste treatment facility for treatment, processing and final disposal: Provided that the lab and highly infectious bio-medical waste generated shall be pre-treated by equipment like autoclave or microwave.

No occupier shall establish on-site treatment and disposal facility, if a service of common bio medical waste treatment facility is available at a distance of seventy-five kilometer.

Segregation, packaging, transportation and storage.

No untreated bio-medical waste shall be mixed with other wastes.

The bio-medical waste shall be segregated into containers or bags at the point of generation in accordance with Schedule I prior to its storage, transportation, treatment and disposal.

Prescribed authority.

The prescribed authority for implementation of the provisions of these rules shall be the State Pollution Control Boards in respect of States and Pollution Control Committees in respect of Union territories.

5.7 E-Waste Management Rules2016

These rules shall apply to every manufacturer, producer, consumer, bulk consumer, collection centers, dealers, e-retailer, re-furbisher, dismantler and recycler involved in manufacture, sale, transfer, purchase, collection, storage and processing of e-waste or electrical and electronic equipment listed in Schedule I of the rules, including their components, consumables, parts and spares which make the product operational.

Responsibilities

Responsibilities for the following stakeholders have been identified in the Rules

Responsibilities of the manufacturer.

Manufacturer of e waste is responsible for collection of e-waste generated during the manufacture of any electrical and electronic equipment and channelize it for recycling or disposal;

Responsibilities of the producer.

The producer of electrical and electronic equipment listed in Schedule I shall be responsible for implementing the Extended Producers Responsibility.

Responsibilities of collection centers.

Collection centers will collect e-waste on behalf of producer or dismantler or recycler or re-furbisher including those arising from orphaned products; Provided the collection centers established by producer can also collect e-waste on behalf of dismantler, re-furbisher and recycler including those arising from orphaned products ensure that the facilities are in accordance with the standards or guidelines issued by Central Pollution Control Board ensure that the e-waste collected by them is stored in a secured manner till it is sent to authorized dismantler or recycler as the case maybe;

Responsibilities of dealers.

In the case the dealer has been given the responsibility of collection on behalf of the producer, the dealer shall collect the e waste by providing the consumer a box, bin or a demarcated area to deposit e-waste, or through take back system and send the e-waste so collected to collection center or dismantler or recycler as designated by producer;

Responsibilities of the re-furbisher

Collect e-waste generated during the process of refurbishing and channelize the waste to authorized dismantler or recycler through its collection center;

Responsibilities of consumer or bulk consumer.

Consumers or bulk consumers of electrical and electronic equipment listed in Schedule I shall ensure that e-waste generated by them is channelized through collection center or dealer of authorized producer or dismantler or recycler or through the designated take back service provider of the producer to authorized dismantler or recycler.

Responsibilities of the dismantler.

Ensure that the facility and dismantling processes are in accordance with the standards or guidelines prescribed by Central Pollution Control Board from time to time

Responsibilities of the recycler.

The recycler shall ensure that the facility and recycling processes are in accordance with the standards or guidelines prescribed by the Central Pollution Control Board from time to time.

Responsibilities of State Government for environmentally sound management of E-waste.

Department of Industry in State or any other government agency authorized in this regard by the State Government, to ensure earmarking or allocation of industrial space or shed for e-waste dismantling and recycling in the existing and upcoming industrial park, estate and industrial clusters;

Procedure for seeking and grant of authorization for management of e-waste

Procedures for seeking and grant of authorization for various stakeholders is discussed in the rules which include

- Extended Producer Responsibility - Authorization of Producers.
- Authorization of Manufacturer
- Procedure for grant of authorization to dismantler or recycler
- Procedure for grant of authorization to re-furbisher

Procedure for storage of e-waste.

Every manufacturer, producer, bulk consumer, collection center, dealer, refurbisher, dismantler and recycler may store thee-waste for a period not exceeding one hundred and eighty days and shall maintain a record of collection, sale, transfer and storage of wastes and make these records available for inspection

5.8 Environmental Impact Assessment (EIA) Notification,2006

The requirement involved in setting up of select development projects (projects with potential to cause significant environmental impacts) in India is through the Environmental Clearance (EC) Process using Environmental Impact Assessment study as a decision-making tool. The EC process is mandated by the new EIA notification dated 14th September 2006 and is administered by the Ministry of Environment and Forests at the Central Government level involving the role of State level regulatory and Government bodies (as the State Pollution Control Board and the Environment Departments).

All Common Municipal Solid Waste Management Facilities (CMSWMF) listed under project /activity 7(i) of the EIA Notification have been classified as Category "B" projects. As per the new notification, all category "B" projects/ activities are required to obtain prior environmental clearances from the concerned State Environmental Impact Assessment Authority (SEIAA) through submission of prescribed application. Further environmental

studies requiring the preparation of EIA for project appraisal will be determined by SEIAA depending on the nature and location specificity of the project. Hence, depending on the requirement of EIA study, category "B" projects have been further classified into "B1" and "B2". All "B1" category projects require the preparation of an EIA report. In addition, projects which are required to get E Care al so subjected to mandatory Environmental Public Consultation as part of EIA process. However, for category "B" projects public consultation will be applicable only for "B1"projects.

The present project has to obtain an Environmental Clearance from the SEIAA. The Form I furnishing relevant information will have to be submitted to the SEIAA along with the Detailed Project Report. Based on the environmental sensitivity of the project, the SEIAA will grant EC on the merit of Form I (categorizing the project as B2) or will issue the Terms of Reference (ToR) for undertaking an EIA Study (categorizing the project as B1). After completion of the EIA study, based on the scope provided, the EIA will be submitted to the SEIAA for approval and subsequent grant of the EC. Construction activities can only commence after obtaining the EC.

CHAPTER 6

EXISTING STUDIES

6.1 SWM improvement Plan for UP prepared by COWI Consultants

COW I was appointed by World Bank as consultants to provide technical assistance to the Government of Uttar Pradesh for improvement of solid waste management in the ULBs in Uttar Pradesh as well as comply with applicable regulations MSW Rules 2000 (rule applicable during the report preparation).

Integrated Solid Waste Management Plan was developed for 17 ULBs in Uttar Pradesh. The improvement plan was focused on developing a planning model that can be used to create other city specific projects for solid waste management in other ULB's in UP. The consultants carried out feasibility assessment of treatment technologies. The main project activities included data collection, landfill site reconnaissance, social assessment survey and waste survey. The study also included technical and financial assessment. The various chapters of the report are presented in brief in this section.

6.1.1 Assessment of Current System

The existing waste system for collection & transportation of waste is similar in all the ULBs. Tractor with trailer is the most commonly used vehicle along with back hoe loader. Street containers are few and not placed strategically; the condition of the containers is in general poor. Manual loading and unloading of waste is a prevalent practice in these ULBs. Some of the ULBs are using containers of 1-3 m^3, which is required to be transported individually to the dumpsite. The wear and tear of the machines and vehicles involved in collection & transportation of waste is quite high due to poor quality and technical specifications.

Windrow composting is practiced in some of the ULBs but a majority of them are open dumpsites. Lack of sources aggregation and poor compost quality with no takers for the compost produced. In the design, priority has been given to minimum use of landfill. The plan proposes processing of entire biodegradable waste available at site to prevent stockpiling of waste at site. A World Bank technical assistance team had completed a field visit for some of the projects in Phase I improvement projects in second half of 2013.The study brought to focus that projects undertaken via PPP route were experiencing serious difficulties in operation of the system. The main reasons listed in the report are:

- Compost being produced from mixed waste which hampers the quality of compost leading to poor marketability.
- RDF marketing predictions were not correct which lead to piling of RDF at the sites and leading to contamination.
- Cap on the total quantity of waste that can be land filled. The 20% capping created serious problems for the developers/operators since the mixed waste contained street sweeping sand drains it which in turn affected the quality of the by-products i.e. RDF and compost.
- Low tipping fee being quoted by inexperienced developers/operators leading to imbalances in the competition for specific contracts.
- Non-payment of user fees and tipping fees to the operator on time led to cash flow issues.
- The grants available for these types of projects were limited to the initial capital investment for the implementation of the project. No grant was planned to support the project during operation of the project i.e. during development of new landfill cells or replacement of ageing infrastructures in the project

6.1.2 Improvement proposal along with Capex and Opex

- The improvement proposal covered all aspects of an integrated solid waste management system. Broad descriptions have been provided for the type of infrastructures to be employed for door to door collection of waste including primary & secondary collection of waste. 3 composting options has been described in brief which can be practiced for treatment of waste. Recommendations have been provided on the landfill filling strategy along with landfill management.
- Unlike the long contract period of 30 years in phase I smaller contract period of 10-15 years has been recommended for collection contracts considering not only vehicle life but also financial depreciation.
- Brief methodology for collection of user fees and availability of grant for construction of landfill cells in future has been discussed in the report.
- There port presents the total Capex & Opex requirement for collection of waste, treatment of waste and Sanitary landfill.

6.1.3 Opinion on Key issues

This section presents the formulation of concepts/principles for improvement of SWM in UP. The waste to energy concept in a global perspective has been described in the report along with a brief on global emerging technologies. The experience of WtE in India especially Delhi & UP has been presented highlighting the major contractual risks in WtE contracts. Applicability of WtE in UP has been presented along with risk mitigation measures for WtE projects in India. Emphasis has been given on source segregation, quality and calorific value of the waste.

The report also discusses the options for centralized and decentralized waste management facilities along with their pros and cons. No clear-cut recommendation has been provided in the report for developing centralized or decentralized waste management facilities

6.2 SWM Planning model prepared by COWI Consultants

The planning model prepared by COWI has not been shared with the consultants. The report discusses about the basic layout of the model, its applicability, how the model runs, user profile and the limitations of the model.

6.3 SWM Improvement Projects Implemented by GoUP under JnNURM

JnNURM was launched in December 2005, the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) is Government of India's (GOI) flagship programme for urban development. The programme consisted of 2 submissions that covered 65 large 'mission' cities, and 2 schemes for smaller cities and towns. These are as follows:- a) Urban Infrastructure and Governance (UIG) b) Urban Infrastructural Development Scheme for Small and Medium Towns (UIDSSMT) Basic Services for Urban Poor (BSUP) and Integrated Housing and Slum Development Programme (IHSDP).

Ministry of Urban Development (MoUD) was made the nodal ministry for 'Urban Infrastructure and Governance (UIG)' and 'Urban Infrastructure Development Scheme for Small & Medium Towns (UIDSSMT)'. Urban infrastructure projects relating to water supply (including sanitation), sewerage, solid waste management, road network, urban transport,

redevelopment of inner (old) city areas etc. were executed under UIG and UIDSSMT. Ministry of Housing Urban Poverty Alleviation (MoHUPA) was made the nodal ministry for 'Basic Services to the Urban Poor (BSUP)' and 'Integrated Housing and Slum Development Programme (IHSDP)'. These projects covered housing and slum development for providing shelter, basic services and other related civic amenities.

When JNNURM was launched in FY 2005-06, GOI committed to an allocation of Rs. 66,085 crores over a 7 year period. However, at the end of 7 years, total allocations fell short of this commitment by Rs. 21,019 crores. The time granted for completion of the projects, on an average, was around two years. However, out of 2815 projects approved up to 31 March 2011, only 253 projects (8.9 per cent) could be completed by 31 March 2011.

In recent years, UP has implemented 26 SWM improvement projects under the JnNURM scheme, using GoI capital cost subsidies through 25-30 year PPP concession contracts that cover the comprehensive services from waste collection to disposal. Some of the projects which took off for solid waste in UP are for: Kanpur, Lucknow, Agra, Varanasi, Allahabad, Meerut, Mathura, Moradabad, Gorakhpur, Aligarh, Jhansi, Muzaffarnagr, Mirzapur, Jaunpur, Sambhal, Etawah, Raibareilly, Badaun, Fatehpur, Ballia, Mainpuri, Barabanki, Kannauj, Mirzapur, Loni, Basti

About half of the concession contracts have been suspended, or are in litigation due to the following reasons:(i) PPP contracts transferred all risks to contractors including collection of solid waste user tariffs, the performance of which was linked to the tipping fee payable; (ii) ULBs lacked funds to meet payment obligations to service providers; (iii) Most ULBs lack the capacity to manage and monitor performance of PPP concessionaires; (iv) bidders lacked experience in bidding for PPP contracts, and were not able to asses risks and opportunities adequately;(v) waste separation was not done at source, and compost sales were affected by low nutrient value and high silt content (from street sweepings) compared to subsidized fertilizers, and higher transport costs as opposed to the cost of (subsidized) fertilizers (urea); (vi) the requirement that no more than 20% of waste disposed at landfills was unachievable;(vii) there was limited market demand for compost and inputs for production of refuse derived fuels; and (viii) low level of citizen awareness resulted in low collection rate of user tariffs, which was linked to tipping fees, making it impossible for contractors to sustain services.

CHAPTER 7

WASTE QUANTIFICATION & CHARACTERISATION CURRENT & FORECAST

7.1 Introduction

The quantitative and qualitative assessment of waste in the study area, especially its physical and chemical properties are essential for determining the future technological options for its treatment and disposal. The inferences derived from this study shall be used in the process for selection of the treatment technology for municipal solid waste.

As a methodology, in the absence of any existing information on MSW, primary survey and investigation is taken up to understand the solid waste characteristics, collection system, treatment processes, disposal methods and other management issues.

Assessment of Waste composition, characteristics and quantities of solid waste is essential for:

- Sizeable increase in the floating population
- Development of the city has attracted visitors from nearby towns
- Rise in the number of students in school, colleges and other educational institutions.
- It provides the basic data on which the management system is planned, designed and operated.
- The periodic data wherever available helps in identification of changes/trend in composition and quantity of waste over a period of time are known which help in future planning.

- It provides the information for the selection of equipment and appropriate technology.
- It indicates the amount and type of material suitable for processing, recovery and recycling.

Assessment of Waste composition, characteristics and quantities of solid waste has been done as per CPHEEO Manual for Solid Waste Management and SWM Rules, 2016

7.2 Methodology for Waste Quantification

The information on the quantity of wastes generated and its composition are the basic needs for the planning a solid waste management system. For these, respondents were provided with waste collection bags to waste operators like residential Ares, and ask to collect and store all waste generated for a twenty four hour cycle was accumulated in a designated area and subsequently collected by the responded next morning from different areas in the study area. after the spatial distribution, sampling was done for different categories of generators such as residential, commercial, institutional, market, slum etc. for the residential area, sampling was further done to replace the general household and slum areas. Table 7.1 shows the location/area, which were considered for waste quantification and characterization

Table 7.1 – **Per Capita Waste Generation Range Based Ward Distribution**

Per-capita waste generation range (kg)	% age of wards falling in the range
0.25-0.30	32.69
0.31-0.41	43.61
0.42-0.52	23.70
Total	100

7.3 Sources of Waste

Household Level

The major land use in the study area is residential and comprises of about 38,105 households with a total population of 2,34,871 as per census of India, 2011. Major portion of the waste is generated by residential area only. Waste Generated is from household is normally kitchen waste (vegetable waste, fruit waste, paper, polythene, etc.) For Household waste collection, door to door collection service is provided by Arko Associates.

Hotel and Dhabas

In Mirzapur city, there are number of hotels and at present they have their own container for waste collection. After the container gets filled, it is transferred to secondary collection bins by the hotel owners.

Vegetable Market

Mirzapur has fruits and vegetable markets like Sadar bazaar, P.S South, Paliwal Phatak, Center Choraha, Bus Stand, Shivaji Marg, Rasulpur Road and M.G College and several market yards located 12-13 km from disposal site. There is a management of solid waste under the Nagar Palika Parishad for such areas but there are no secondary collection bins located in and around the vegetable market area for vendors and shopkeepers. Waste is disposed openly by them. The waste is cleared by the SWM workers of Nagar Palika Parishad.

Marriage Garden

In wedding season mainly from November to February and from May to July, waste is generated from Marriage gardens which are openly dumped at roadside and vacant plots. Waste generated from gardens is generally organic wastes (leaves, paper and grass, etc.). This is managed by Nagar Palika Parishad. Municipal workers collect wastes and dump them in secondary collection bins. Sometimes they are also burnt.

Slaughter Houses

Slaughtering waste is daily generated from slaughter houses. There is a fish market 5-6 km from disposal site in Mirzapur. Waste Generated from Fish Market, Meat Market and Slaughter houses are collected by Nagar Palika Parishad. Secondary Collection bins are placed at such markets. The shop keepers dump their waste in the community bins once in a week by SWM workers of the cooperation.

7.4 Waste quantification

The information on the quantity of wastes generated is the basic needs for the planning of a solid waste management system. The qualitative and quantitative assessment for solid waste is carried out at all the major sources of generation in Mirzapur in July The sampling and analysis methodology was adopted as per CPHEEO Manual, 2016. Detail of sampling and analysis are given in following sections. To estimate the quantity of waste generated at source by these major waste generators, a sample survey was conducted by the intern. For estimate of the municipal solid waste generated in the town area, a 3 days (Sat-Sun-Mon) detailed sampling for different types of waste generators representing general households and slum population of the town, at bulk waste generating sources such as all major vegetable markets, institutions and at major commercial establishments such as hotel and restaurants/ eateries etc. has been conducted. From the household level survey, waste generation factors (gm/capita/day) for different residents groups based on their economic profile was done in the study area due to similar level of services and infrastructure in all the mentioned categories. To assess the overall municipal waste generation of study area, quantity of wastes generated from bulk generating sources and commercial establishments is added up with the residential waste generation to obtain to total MSW generation for the study area for the year 2018. If possible then find weigh bridges in the NPP area and some records were available to assist in establishing waste quantities. The approach used in establishing waste quantities for this study is based on primary sampling of the primary waste generating sources in the study area supplemented with a comprehensive review of waste management practice in the study area.

7.5 Primary Waste Quantification Results

7.5.1 Primary waste quantification for Residential Area

Primary waste quantification survey for residential area was carried out in case of households; the selected households included joint families, nuclear families, rich families, and middle class families, educated and uneducated families. The per capita survey at residential area has been calculated with surveying each ward and considering different people from high income ground, middle income group and low income group odf the wards. The houses in wards have been identified based on residential non-slum and residential slum group of people. Plastic bags have been supplied to the identified households for collecting waste from the each individual house. After 24 hours, the waste is collected and weighed with weighing machine.

The quantified waste has been divided with the number of family members to get the individual contribution of waste. The survey was carried out for 3 days continuously in these selected houses. The average per capita has been considered for further calculations. Table-7.1 shows sampling details and per capita generation.

Table- 7.3 Waste Generating Wards Category

Waste generation range (TPD)	No. of wards	Percentage of total wards	Per capita waste generation (Kg/day)	Average waste generation (MT/day)
>10	0	0	0	0
5—10	0	0	00	0
<5	35	100	0.350	81.89
All	**35**	**100**	**0.350**	**81.89**

Ward under different range of per capita waste generation is assessed and given in **Table 4.3**. Maximum wards are observed under 0.035kg waste generations per capita per day while 21.53% of wards are observed under 0.42-0.52 kg/capita/day waste generation rate.The overall was the quantification in Nagar Palika Parishad has been carried out and presented below in table 7.4

Table- 7.4 Waste Generating Wards Category

Sr. No.	Ward	Per capita waste generation	Waste generated
		(kg/cap/day)	MTD
1	1	0.32	3.10496
2	2	0.35	3.39185
3	3	0.32	2.17024
4	4	0.35	2.6145
5	5	0.36	2.42748
6	6	0.34	2.59692
7	7	0.34	2.74516
8	8	0.35	3.09855
9	9	0.32	2.7168

Sr. No.	Ward	Per capita waste generation (kg/cap/day)	Waste generated MTD
10	10	0.31	1.64145
11	11	0.38	2.10026
12	12	0.35	1.8158
13	13	0.37	2.87305
14	14	0.35	1.5498
15	15	0.36	2.45232
16	16	0.36	1.96416
17	17	0.39	2.39343
18	18	0.39	2.38056
19	19	0.34	3.43672
20	20	0.35	2.1483
21	21	0.39	3.33372
22	22	0.35	1.43115
23	23	0.32	2.14496
24	24	0.32	2.73152
25	25	0.39	2.21598
26	26	0.35	1.77555
27	27	0.32	2.40544
28	28	0.32	1.83584
29	29	0.33	2.00541
30	30	0.32	2.41376
31	31	0.35	2.0125
32	32	0.37	1.57583
33	33	0.39	2.45973
34	34	0.39	1.97028
35	35	0.35	1.9586
Total	**38**	**-**	**81.8**
Average		**0.350**	**2.33**

Source: ULB

7.5.2- Primary Waste Quantification at Commercial Establishment

The waste from the commercial establishments like shops and offices and retail stores, and general stores, and hotels/eateries has been considered in this category. The number of commercial establishments is discussed earlier. In order to assess the waste generated by these

establishments, field visits and quantity assessment surveys were carried out in the commercial areas. Discussions were carried out with the concerned person to understand the size of the establishments (such as number of seats for hotels, number of people coming each day), waste generation per day and also the waste collection & disposal systems. The commercial establishments identified depend on the type of centers like commercial centers and streets containing market yards etc. The averaged value has been projected for further calculations Primary survey conducted for various types of hotel/eateries, estimates the total waste generated is about 20.53 MT/day

Table- 7.5 Percentage of House Hold Satisfaction for Collection and Transportation of Waste

Residential Group	D2D		Road Sweeping		Collection and transportation	
	Satisfactory	Non-Satisfactory	Satisfactory	Non-Satisfactory	Satisfactory	Non-Satisfactory
HIG	56.87	43.13	76.22	23.78	78.25	21.75
MIG	42.13	57.87	48.39	51.61	56.14	43.86
LIG	12.35	87.65	89.23	10.77	68.25	31.75
Slum	14.38	85.62	94.11	5.89	76.36	23.64
Commercial	26.78	73.22	77.39	22.61	86.37	13.63
All	**30.50**	**69.49**	**77.06**	**22.93**	**73.07**	**26.92**

The current waste generation in the Mirzapur Nagar Palika Parishad area is about **283.85 TPD** from all sources as shown in **Table 7-4**. The per capita waste generation for study area is calculated as 387 gm/ capita/ day. Service Standards and Key Assumptions for Solid Waste Management clearly mentioned average per capita waste generation by the city as 387 gm/ capita/ day have taken this value for design purpose for waste quantification for the study area and the waste generation **283.85 tons/day** in 2018. 'Report on Indian Urban Infrastructure and Services', 2011 is a result of over two years' effort on the part of the High Powered Expert Committee (HPEC) for estimating the investment requirement for urban infrastructur0e services. The HPEC was set up by the Ministry of Urban Development, Govt. of India in May 2008.

7.6 Waste projections

The future waste generation from Mirzapur has been estimated based on the population growth of the city and the per capita waste generation. The population forecasting of Mirzapur has been carried out based on Census, 2011 using arithmetical progression method including 10% floating population. Based upon the projected population and per capita waste generation estimates, the waste generation of Mirzapur is projected and given in **Table 7.6**.

Table 7.6 Year wise waste projection

Year	Population	Annual percentage growth rate	Waste @ Constant Rate (TPD)
2018	257096	1.30%	90
2019	260438	1.30%	91
2020	263824	1.30%	92
2021	267253	1.30%	94

Year	Population	Annual percentage growth rate	Waste @ Constant Rate (TPD)
2022	270728	1.30%	95
2023	274247	1.30%	96
2024	277812	1.30%	97
2025	281424	1.30%	98
2026	285082	1.30%	100
2027	288788	1.30%	101
2028	292543	1.30%	102
2029	296346	1.30%	104
2030	300198	1.30%	105
2031	304101	1.30%	106
2032	308054	1.30%	108
2033	312059	1.30%	109
2034	316116	1.30%	111
2035	320225	1.30%	112
2036	324388	1.30%	114
2037	328605	1.30%	115
2038	332877	1.30%	117

Waste generation is projected based upon annual percentage growth rate of 1.30 % and incremental per capita waste generation provisions. It is estimated that the waste generation of Mirzapur will be 117 TPD by Design Year 2038.

7.7 Waste Characterization

As discussed earlier, the sources of waste generation are residential, commercial, markets, etc. within the study area. These are further classified based on their composition, characteristics, physical and chemical characteristics as biodegradable, recyclables, combustibles, etc. For an effective SWM it is important to look into the properties of waste apart from their origin.

7.7.1 Sample Size and Location of Sampling

The selection of sample size and the sampling locations have been done through professional judgment and in consultation with Nagar Palika Parishad officials. The locations have been selected on the basis of local consultations to have a comprehensive representation of the entire area of the NPP. A reconnaissance survey was conducted prior to waste characterization to identify the location of sampling points with the objective to address different types of waste generation sources such as residential area including slum, markets, temple, commercial and institutional area.

7.7.2 Sampling and Analysis Method

Municipal Solid Waste (MSW) is collected from residential, commercial, institutional, market, slum of the study area. The total quantity of waste so collected is thoroughly mixed and then

reduced by method of quartering till a sample of such a size is obtained which can be handled personally subjected to physical analysis.

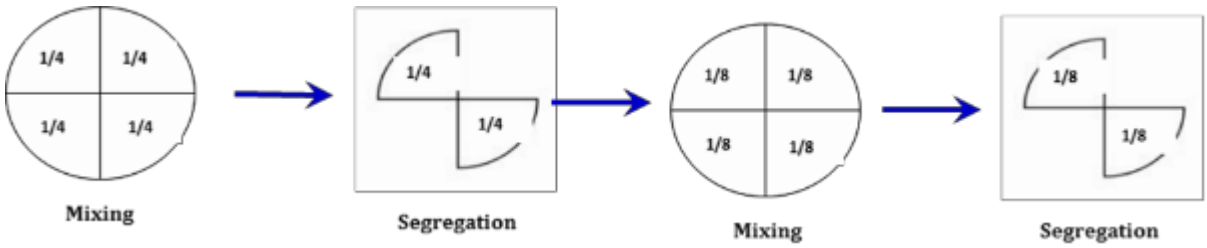


Figure 7.2: Schematic Diagram of Waste Sampling

The Physical Characteristics like moisture content, density, percentage of different components, such as, paper, plastic, glass, metal, organic matter, stones etc. were calculated.

The Chemical Characteristics like pH, moisture, density, Nitrogen, Potassium and phosphorus and C/N ratio were analyzed and represented in the report. Calorific value of the municipal solid waste (in Kcal) was also analyzed.

All the samples have been analyzed as per the standard code of practices. For MSW, crude solid waste sample as such was not ready for analysis. So, a representative homogeneous sample has been processed as per IS: 9234. The steps are as follows:

Drying: Oven has been used for drying the sample. Moisture content of the crude sample has been determined during drying process at 105º C.

Grinding or Pulverizing before Chemical Analysis: Before grinding, the segregation of various inert materials like glass, ceramics, metals, stones etc. have been done. The remaining material has been ground and sieved to form a homogenous powder, which has been used for further chemical analysis.

Mixing: Thereafter the processed sample was mixed thoroughly to generate representative waste sample for analysis for different parameters. The analysis was done as per the respective code of practices. The samples were analyzed for physical composition and chemical parameters such as density, moisture content, organic content, calorific value, and C/N ratio.

7.7.3 Waste Composition

Analysis of the results indicate that the organic content ranges from 37% to 53%, recyclable contents ranges from 7.7% to 12% and inert material is in the range of 30% to 38% of total waste generated. During the field studies, it was also noticed that the recyclables are being collected by Safai Karamchari (sanitary workers) at the bin points. Year wise physical composition of waste is given in **Table 7.8**.

Table 7.8: MSW Waste Generation Composition

Year	Population	Waste @ Constant Rate (TPD)	Total Waste (MT/Day)				
			Bio-degradable	Recyclable	Construction	Inert Waste	Miscellaneous
2018	257096	90	38.69	22.50	4.50	17.10	7.20
2019	260438	91	39.20	22.79	4.56	17.32	7.29

2020	263824	92	39.71	23.08	4.62	17.54	7.39
2021	267253	94	40.22	23.38	4.68	17.77	7.48
2022	270728	95	40.74	23.69	4.74	18.00	7.58
2023	274247	96	41.27	24.00	4.80	18.24	7.68
2024	277812	97	41.81	24.31	4.86	18.47	7.78
2025	281424	98	42.35	24.62	4.92	18.71	7.88
2026	285082	100	42.90	24.94	4.99	18.96	7.98
2027	288788	101	43.46	25.27	5.05	19.20	8.09
2028	292543	102	44.03	25.60	5.12	19.45	8.19
2029	296346	104	44.60	25.93	5.19	19.71	8.30
2030	300198	105	45.18	26.27	5.25	19.96	8.41
2031	304101	106	45.77	26.61	5.32	20.22	8.51
2032	308054	108	46.36	26.95	5.39	20.49	8.63
2033	312059	109	46.96	27.31	5.46	20.75	8.74
2034	316116	111	47.58	27.66	5.53	21.02	8.85
2035	320225	112	48.19	28.02	5.60	21.29	8.97
2036	324388	114	48.82	28.38	5.68	21.57	9.08
2037	328605	115	49.46	28.75	5.75	21.85	9.20
2038	332877	117	50.10	29.13	5.83	22.14	9.32

Source: Author's estimate

Table 7.8 indicates that biodegradable waste will increase from 90 TPD in 2018 to 117 TPD in 2038, recyclable waste from 22.5 TPD to 29.13 TPD and inert waste from 17.10 TPD to 22.14 TPD during the same period.

7.7.3.1 Physical Characteristic of Waste

Organic content (Food and Garden) was observed high (38.45%) followed by Soil content (19.40%), Construction waste (2.97%), Plastic (7.67%), Cloths (3.92%), Paper (13.69%) and Miscellaneous (10.81%), as shown in **Figures 4.1**. Physical characteristics of MSW samples are given in **Table 4.5.**

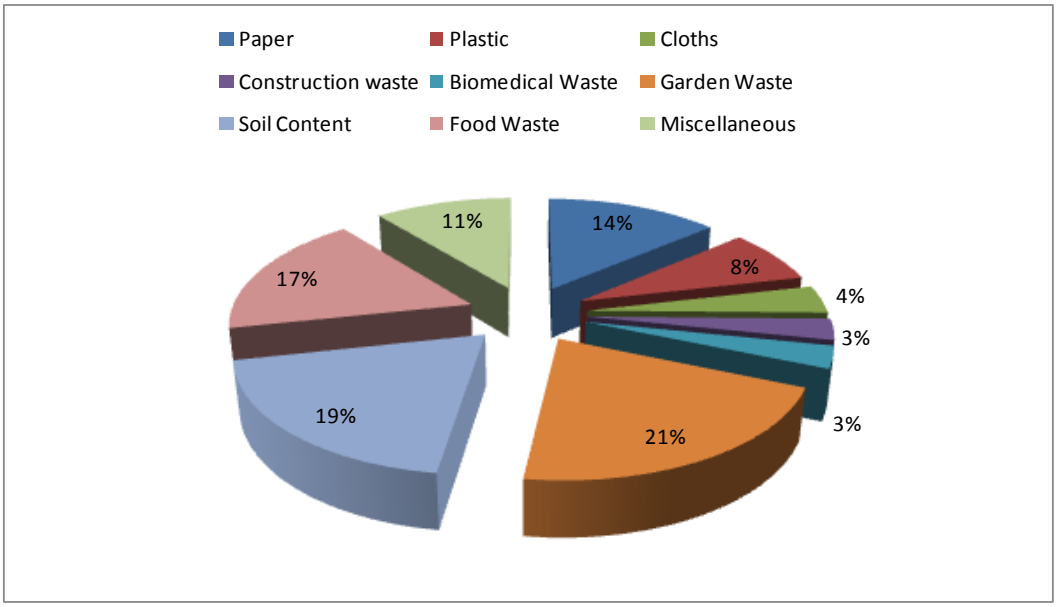


Figure 4.1: Average Solid waste Characteristics of MNNP

Table 7.9 Physical Composition of Municipal Solid Waste in MNNP and its environs

S.No.	Parameters	Unit	Results SamplesCodeNo.MSW/01,MSW/02,MSW/03,MSW/04& MSW/05.				
			Sample No.1 (LIG)	Sample No.2 (HIG)	SampleNo.3 (SLF)	SampleNo.4 (vegetable market)	SampleNo. 5(MIG)
1	Paper (%w/w),	(%w/w)	15.34	10.28	12.54	18.2	12.1
2	Plastic(%w/w)	(%w/w)	10.8	5.57	8.14	3.57	10.29
3	Cloths(%w/w)	(%w/w)	2.1	4.58	10.24	1.42	1.24
4	Construction Waste %w/w)	(%w/w)	4.1	6.53	4.2	0	0
5	Biomedical Waste(%w/w)	(%w/w)	0	1.1	0	8.24	6.13
6	Garden Waste (%w/w)	(%w/w)	30	6.24	18.6	18.64	30.88
7	Soil Content (%w/w)	(%w/w)	15.5	38.24	14.18	4.28	24.82
8	Food Waste (%w/w)	(%w/w)	6.56	14.84	11.64	42.44	12.4
9	Miscellaneous Waste(%w/w)	(%w/w)	15.6	12.62	20.46	3.21	2.14

7.7.3.2 Chemical Characteristic of Waste

Total Nitrogen, Phosphorus, and TKN parameters are essential to understand the compost characterization which is to be effectively used as fertilizer. These parameters are observed to be good. The ratio of C/N was also analyzed and found within the acceptable range 22.96-32.35 C/N ratio is considered best to be used.

The average calorific value of waste is found 1646 that varies from 1450 to 1646 Kcal/kg. Arsenic, Mercury, Cr+3 and Cr Hexa were not detected while other heavy metals like Cd, Cr, Cu, Pb, Ni, Zn and Fe were detected and found to be within permissible limit in all MSW samples (**Table 4.6**).

Table 7.10 Chemical Composition of Municipal Solid Waste in MNNP and its environs

S.No.	Parameters	Unit	Results

			SamplesCodeNo.MSW/01,MSW/02,MSW/03,MSW/04& MSW/05.				
			Sample No.1 (LIG)	**Sample No.2 (HIG)**	**SampleNo.3 (dumpsite)**	**SampleNo.4 (Vegetable Market)**	**SampleNo. 5(HIG)**
1	Bulk Density	Kg/m3	342	380	245	265	258
2	Moisture (%)	%	36.24	33.51	28.38	36.50	34.5
3	Conductivity (mS)	mS	0.32	0.28	0.34	0.36	0.32
4	Volatile Matter (%)	%	30.84	38.24	48.94	46.24	38.48
5	Ash Content (%)	%	65.44	68.04	54.06	56.04	60.24
6	Fixed Carbon (%)	%	28.06	32.16	40.26	38.26	35.60
7	Phosphorous (P2O5) (mg/L)	mg/L	ND	ND	ND	ND	ND
8	TKN (mg/kg)	mg/kg	6025	5623	6080	5660	5484
9	Total Nitrogen (%)	%	4.8	3.4	3.00	3.8	4.14
10	C/N Ratio		28:31	16:19	5:6	19:23	35:38
11	Calorific Value (Cal/gm)	cal/gm.	1450	1545	1604	1680	1646
12	Cr Hexa (mg/kg	mg/kg	ND	ND	ND	ND	ND

CHAPTER 8.

TECHNOLOGIES FOR COLLECTION AND TRANSPORTATION OF SWM PLAN

CHAPTER 8. TECHNOLOGIES FOR COLLECTION AND TRANSPORTATION OF SWM PLAN

These chapters on technology used for Solid Waste Management highlights that several shortcomings in the technologies for collection and transfer of waste used as well as lack of

technologies have contributed greatly to the current solid waste related difficulties faced by the MNNP.

Therefore, it is abundantly clear that technologies used for the collection and transfer of solid waste play an important role in achieving the goals and hence, the ultimate vision of the plan. Collection of wet, dry and domestic hazardous waste separately ensures maximum recovery of recyclables. It also enhances the potential of cost-effective treatment of such wastes which can then easily meet the minimum quality criteria defined for different products, e.g. production of compost from pure organic waste. However, it is prudent to keep in mind that local authorities in a developing nation such as India are unable to invest in the latest and the most efficient solid waste management technologies. Therefore, the technologies selected and presented by the plan need to be not only efficient in solid waste management but also the most affordable ones.

Though all possible technological interventions available today are listed in this chapter only the most essential and economically feasible ones will be selected and described in detail. Therefore, the following chapter will explicate technologies available for applying these technologies in terms of technical, financial and environmental feasibility in respect to Mirzapur Nagar Palika Parishad.

8.1 Segregation and Sorting Technologies

Waste segregation is an essential component of any Solid Waste Management system as separate waste streams will have more value and can be easily recovered, recycled or reused. Separation also ensures that the wastes are clean enough to be reprocessed or reused and thereby minimizes the loss of valuable resources through final disposal. Therefore, the plan for Mirzapur will focus greatly on introducing waste segregation especially among residents, schools and commercial establishments where recyclable waste can be soiled with food wastes, hazardous wastes, oils etc., which in turn will reduce their value. Essentially segregation at source is considered to be the best and most sound segregation system. However, segregation can also be carried out at central segregation plants set up at suitable locations.

8.1.1 Source Segregation

Segregation of the three different fractions of waste could be undertaken without mixing them, but directly depositing into separate bin / bag as and when generated. The color of the bins should be in accordance with the SWM Rules, 2016; wet waste is to be placed in a covered green bin and dry waste in a covered white bin. Urban local bodies (ULBs) should decide on an appropriately colored bin, because the SWM 2016 rule does not specify the color of the bins for storage of domestic hazardous waste.

Category 1. Food & Green waste (wet waste) - Cooked / uncooked food, vegetable, fruit, meat, bone, fish waste, leaves, grass etc.

Category 2. Recyclable & Non-bio-degradable (dry waste) - Paper, Plastics, glass, metal, ceramic, rubber, leather, rags, used cloths, wood, stone, sand, ash, thermocol, straw & packing materials etc.

Category 3. Domestic hazardous waste – Batteries, used CFLs, tube lights, chemical, paint, and insecticide containers etc.

In the case of source segregation, the waste streams are separated out by the generators themselves. This allows for the generators to directly be involved in the solid waste management system and reduce the burden of separating waste at a later stage. Source segregation is also ideal as the waste streams are cleaner and therefore operational costs as well as water and energy consumption for cleaning at a later stage can be minimized by a great deal. The type of container used for storing the separated waste streams will have to be given due consideration in this case and several factors such as container shape, size and material of construction, lifetime/durability and price/cost need to be considered. A container of 10–12 litre capacity for a family of five members should be adequate for each dry and wet waste, if collection takes place daily. In addition to this the type of house/building, the space available, and the income and education level of residents will also play an important role in deciding which containers are best suited.

Plastic bucket with lid for wet waste

Plastic bucket with lid for dry waste

Plastic bucket with lid for domestic hazardous waste

Segregation measures at households

As per 2011 census there are 38,105 households in Mirzapur Nagar Palika Parishad area. Presently, there is an absence of segregation of waste at source. Now it shall be improved to 100% by segregating and storing waste as mentioned in Solid Waste Management Rules 2016. Separation of organic and inorganic waste ensures collection and transportation of contaminated and uncontaminated waste separately while optimizing the waste processing and treatment technologies.

The ULB may take up the following to ensure segregation of waste at households.

- To direct waste generators, through display boards in public places not to throw waste in their neighborhood, on streets, open areas, drains, etc.
- Create awareness for segregation and storage of waste in three separate bins for dry waste, wet waste and household bio-medical/hazardous waste as per MSW Guidelines.
- Organize awareness campaign for segregation of waste through local NGO's, schools, local representatives etc.
- To educate about risks to human health and environment due to solid waste
- To inform, educate and motivate not to litter waste on streets and develop a habit of storing waste at source.
- Regular meetings and interactions with representatives of local resident welfare associations, community participants, NGOs, etc.
- Formulate mandatory resolutions on segregation of waste and laying penalties in case of violation.
- Provision of appropriate size of community bins wherever required.
- To identify slum location and provide community bins to enable slum dwellers to deposit waste in the bins as and when generated.

Individual households/ Community may ensure the following:

- To follow the norms/regulations made by the local body / ULB regarding management of MSW.
- To keep/store wet waste/biodegradable (kitchen waste/food waste) in a container covered with lid.
- To keep/store domestic hazardous waste, capacity of bins/bags depending upon the frequency of collection (daily, alternate day, or on demand) and quantity of waste generated
- As and when recyclable waste such as newspapers, books, glass bottles, plastic bottles, metal / iron containers, etc. are generated, it may be handed over to nearby recyclable waste dealer in order to reduce the waste quantity to dump yard.
- To keep/store dry waste/recyclable waste (plastics/paper/bottles etc.) in a separate container covered with lid.
- To store C&D waste separately as and when generated in its own premises and disposes at the collection center arranged by the ULB. In case of bulk quantities, the C&D waste generator may contact nearby authorized processing facility (else ULB) for disposal.
- To handover the segregated waste separately to the waste collector during door-to-door collection to avoid unhygienic conditions.
- Communities shall try to process segregated bio-degradable waste within their premises in consultation with the ULB

Segregation at vegetable / fruit markets

There is one vegetable with fruit markets along with thee small informal market in Mirzapur Nagar Palika Parishad. The waste generated from these markets is dumped in open areas at collection points within the market. ULB may provide adequate number of trolleys in these collection points for dumping market area waste and direct shop owners to dump waste only in bins provided. Later these bins could be emptied or transferred by tractors / collected by dumper placers based on accessibility of the bin location.

These market waste generators may try to process the segregated bio-degradable waste within the market in consultation with the ULB.

Segregation at commercial establishments/institutions/workshops

ULB may advise the following to the waste generators of shops/offices/institutions:

- To maintain separate container for storing hazardous waste and hand it over to the sanitary worker/waste collector, who in turn shall dispose the same to the authorized dealer.
- For commercial complexes and institutions, the segregated waste may be stored in separate bins for collecting wet and dry waste separately.
- For educational institutions with canteen and lab facilities, waste may be segregated and stored in separate bins for wet and dry waste separately.
- Avoid throwing of shop cleaning/sweeping waste on roads/streets/open areas.
- Use bin/container for storage of daily waste till collection by the sanitary workers.
- Waste generated from these areas would be mostly recyclable. These waste generators shall handover the segregated recyclable waste to authorized waste pickers/waste recyclers/waste dealers

Segregation at hotels/restaurants/community/function halls

The hotels and restaurants in the ULB shall be advised to:

- Avoid disposal of waste into ULB community bins
- Use separate containers with lid of adequate capacity for storing dry and wet waste. Handover the segregated waste to the sanitary worker/waste collector
- Avoid throwing of shop cleaning/sweeping waste on roads/streets/open areas
- These waste generators may try to process the segregated bio-degradable waste within their premises in consultation with the ULB

Short-term approach for segregation of waste

Segregation of waste at various sources described in above sections takes considerable time in setting up/to fall in place. Meanwhile as an immediate measure, the following are proposed. This immediate/short- term approach may be limited to period of 5 years.

- No segregation of waste at source. Collection of mixed waste from waste generators.
- Segregation can be partly done during collection of waste by sanitary workers / rag pickers – sorting of

recyclable waste

8.1.2 Waste Picking/Scavenging

Picking out recyclables from mixed wastes collected at street side bins, secondary/intermediate collection and final disposal at dumpsites is a common practice in Mirzapur as is the case of the cities in most of the other developing ULBs. Though, this system is considered to be acceptable in poor communities, the practice is risky as the scavengers/waste pickers are often exposed to hazardous wastes.

In the case of Mirzapur, waste pickers are responsible for separating out much of the valuable wastes and redirecting them to be recycled or reused. Few of the low-income dwellers in Mirzapur earn money through this practice. Therefore, the MNNP must be extremely careful in developing waste segregation system to ensure that the people whose livelihood depends on scavenging are not adversely affected by a sudden change, although, there are no authentic data available with MNNP about the scavengers.

8.1.3 De-centralized Sorting Centers

De-centralized sorting plants provide an alternative to source segregation and can be a suitable option to densely populated towns where residents do not have enough space to segregate and store wastes at homes. The waste collected from residences, commercial establishments and other sources are brought to a central point where the valuable materials are separated out and cleaned and sold for recycling. Though segregation plants can be a single large unit or several small-scale units, setting up smaller de-centralized units may be more practical in the case of Mirzapur. These plants must be equipped with water and electricity to facilitate the segregation and cleaning of waste streams. Also, they must have adequate space to store the separated waste streams in a clean and dry manner until they are taken away by recyclers. In addition to this, if cleaning is carried out with water, a waste water treatment plant will also have to be constructed or the waste water will have to be transferred to nearest treatment plant. If the waste arriving at the segregation plants are mixed and contaminated with food, oils or any hazardous wastes, they will have to undergo a thorough cleaning process. This can be far too expensive and create financial difficulties. However, to overcome this problem, partial source segregation can be introduced at source level to separate out biodegradable waste, hazardous waste and other waste. The other wastes can then be brought to the segregation plants and separated into various waste streams.

8.1.4 Secondary Segregation and Segregation at Transfer Stations

Unsegregated waste, which has not been sorted at primary level, should be segregated either at an intermediate stage (e.g., transfer station) or at the processing plant, prior to treatment, in cases where waste is brought directly to the plant from the waste collection areas. Segregation may be accomplished through manual or mechanized segregation. Multiple handling of waste should be avoided.

8.2 Waste Collection and Transportation Technologies

Waste collection includes not only the gathering of waste but also hauling this waste to locations where the waste is either temporarily stored or for final disposal. Mostly, the collection is based on an individual collector or a group of collectors who move through a collection service area with a collection vehicle and some hand tools. The vehicles used for collection can range from simple handcarts to complex and fuel intensive compactor trucks. Therefore, collecting and hauling waste can be a labor intensive and high fuel consuming activity.

Waste collection services are divided into primary and secondary collection. Primary collection refers to the process of collecting, lifting and removal of segregated solid waste from source of its generation including households, shops, offices, markets, hotels, institutions and other residential or non-residential premises and taking the waste to a storage depot or transfer station or directly to the disposal site, depending on the size of the town or city and the waste management system prevalent in the town or city. Primary collection must ensure separate collection of certain waste streams or fractions depending on the separation and reuse system applied by the respective town or city.

Secondary collection includes picking up waste from community bins, waste storage depots, or transfer stations and transporting it to waste processing sites or to the final disposal site. At the secondary collection points, segregated waste must be stored on-site in separate covered bins or containers for further collection and should be kept separate during all steps of waste collection, transportation, and processing. Further, ULBs should ensure that at the secondary storage points the waste is should be attended daily or before container starts overflowing.

The MNNP is the sole authority for the collection of Municipal Solid Waste in Mirzapur NN area, as described under the chapter on Regulatory Framework, the responsibility of collecting municipal solid waste rests solely on the municipal councils. The following table demonstrates various Door to Door Collection (DTDC) systems.

Area	Activity	System	Vehicles/Equipment's	Frequency of Service
Residential	DTDC	Common Collection bins	Hand carts/Tricycle/Auto tipper	Daily
Slum	DTDC	Common Collection bins	Hand carts/ Tricycles	Daily
Commercial	DTDC	Common Collection bins	Tricycle/Auto tipper	Daily
Market Area	DTDC	Common Collection bins	Tricycle/Auto tipper	Daily
All the above	Secondary Collection	Transfer Station	Regular/ Static Compactor	Daily

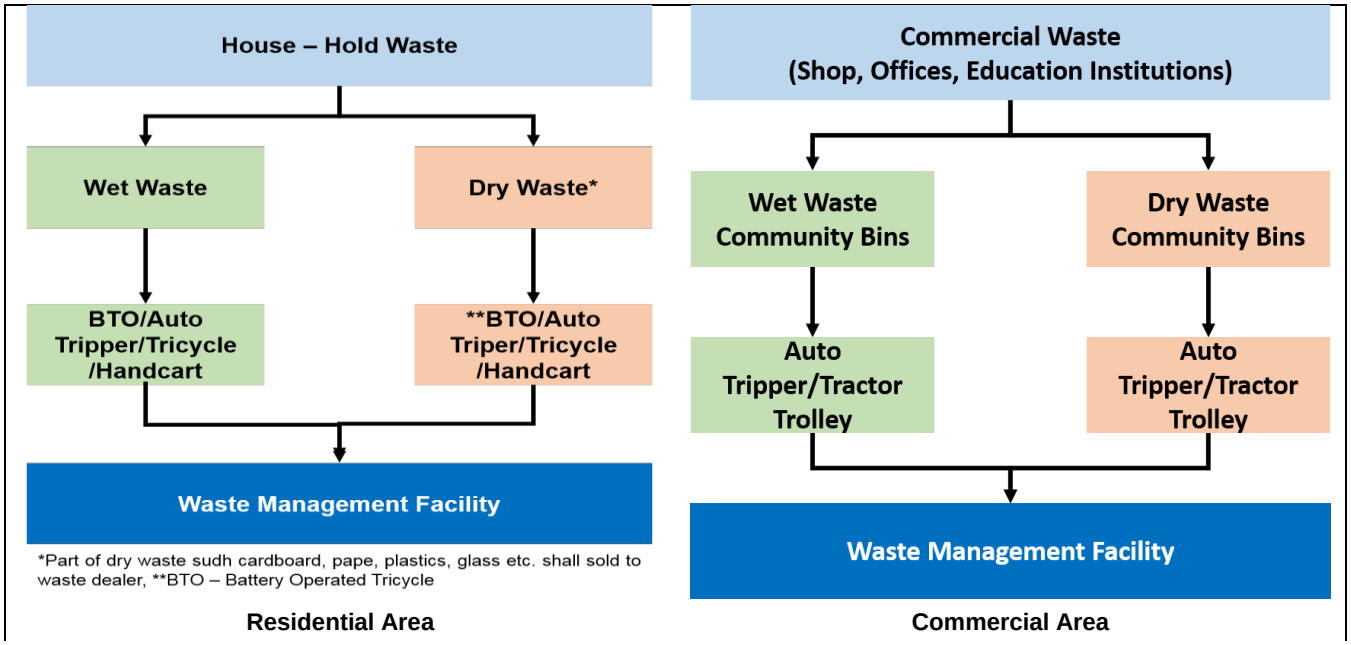
The collection of waste from households, commercial and institutional establishments is carried out manually using hand carts/tricycles, auto tippers, tractors with trailers and compactors. Domestic waste should be collected in the morning from 6 am to 11 am and in the afternoon from 3 pm to 5 pm. Waste from the commercial areas should be collected

between 10 a.m. and 2 p.m. Vegetable market waste should be collected in non-peak hours (early morning, late afternoon, or at night). The collection of market waste might also need to be done more than once a day. The collection route and frequency are often adhoc in nature and one of the issues raised by stakeholders during the stakeholder consultations was that the collection is neither regular nor efficient enough to suit the rate at which the waste is generated. In addition to this the MNNP is unable to provide collection services to some of the residents within its Nagar Palika Parishad jurisdiction due to shortfall in vehicles and collectors and unavailability of vehicles which can cover all the areas. The result of all these factors is that the MNNP is unable to collect and properly dispose all the municipal waste generated within its limits and the uncollected waste is left to decompose and cause health and environmental impacts.

To improve this situation and deliver a better service to the community, the MNNP will need to consider several changes to its existing technologies and the method of using these technologies. Fleet management and re-evaluating the collection routes and schedules are essential in optimizing the collection system.

The selection of suitable collection technologies will depend on the type and density of waste, number of generation points and roadways that need to be travelled in collecting the waste. In addition to this, the skills of the collection team and the method of discharging the load at an intermediate collection point/final disposal point will also need to be given due consideration. In the case of developing nations such as India, NPP often has to use the same vehicle for multiple purposes to cover as much area as possible so that the work can be completed with the few vehicles available.

A large variety of collection vehicles are available though not all of them will be suited to Mirzapur given its financial and physical situation. The capital and labor cost for the particular collection technology as well as the local availability of spare parts and repair skills (technical expertise) will also play a role in identifying the most suitable type of vehicle. The schematic diagram of the proposed scheme for collection and transportation is shown in **Figure 8-1**.



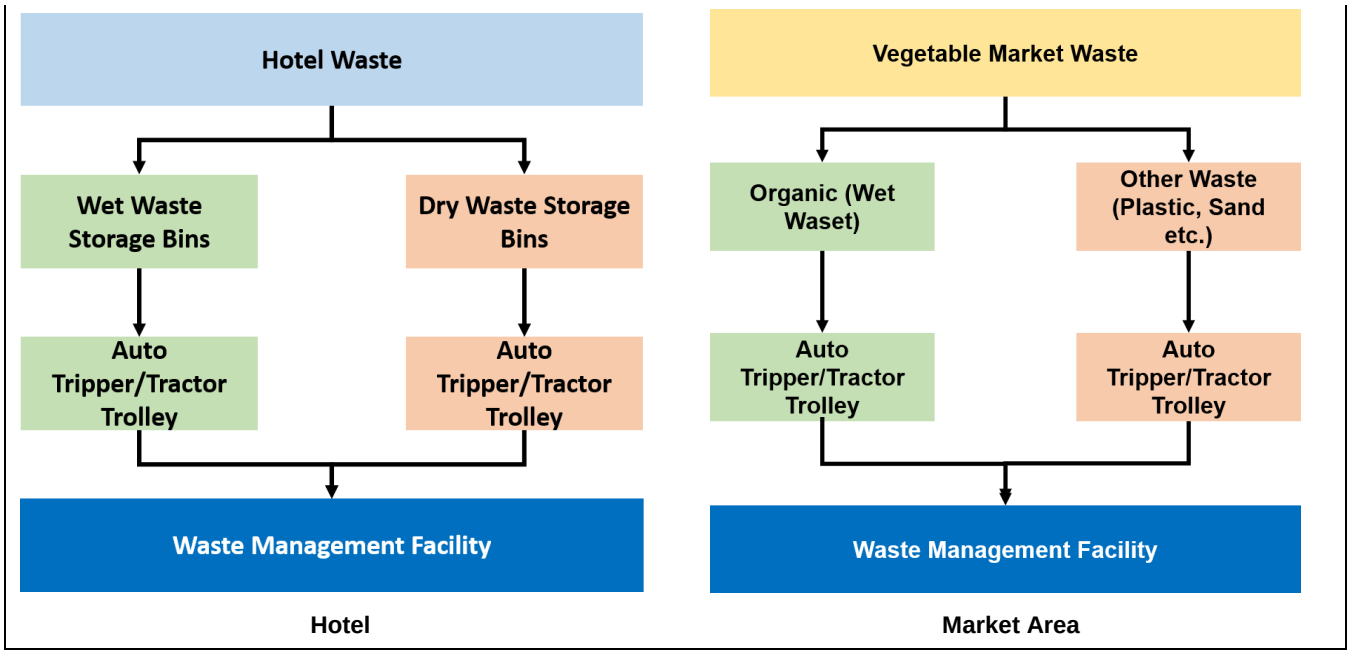
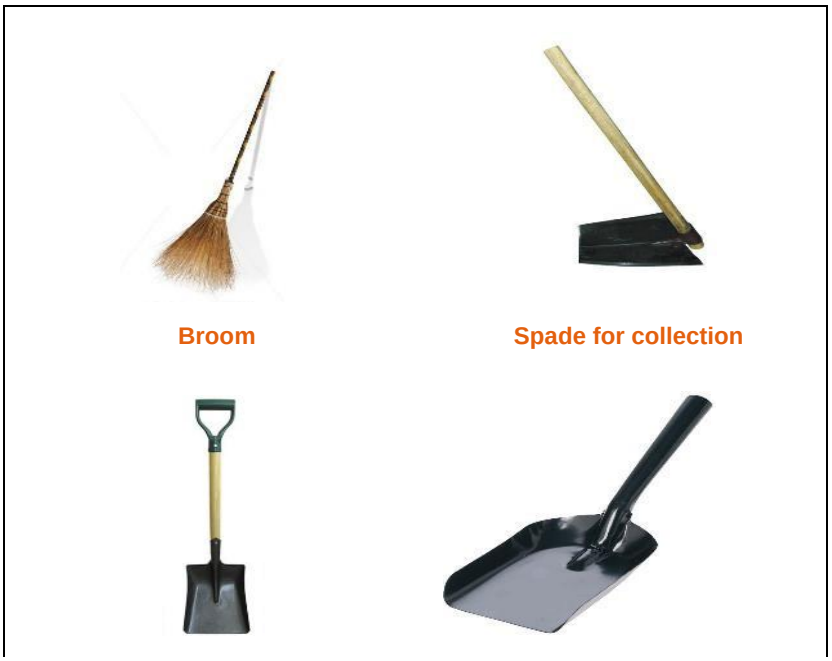


Figure 8-1: Proposed Scheme for Collection and Transportation

8.2.1 Waste Collection Hand Tools

One of the most important factors to consider in the case of waste collection is the hand tools which will be used by the waste collectors. These hand tools ensure that the collectors do not come into direct contact with the waste and thereby eliminate any adverse health effects caused due to exposure to solid waste. The main tools used in waste collection are brooms (for sweeping), spade (collecting and transferring), dust pans and large bamboo/metal baskets (transferring).

In the case of Mirzapur, waste collection is carried out by individual collectors who sweep the roadside garbage into heaps that are later picked up by the collection vehicles. Therefore, hand tools are essential for the waste collection. Hand tools make collecting waste easier and more efficient and less dangerous to the collectors.



Shovels for collection and transferring	Dust Pans for collection and transferring

Figure 8-2: Equipment for Safai Karamcharis

8.2.2 Roadside Waste Collection Bins

Collection systems in most countries depend on set out containers which are placed along the roadside for waste to be disposed into. Several types of roadside waste collection bins/containers can be used to facilitate the easier collection of solid waste. Roadside bins can be stationary or mobile types. Several such types of bin used in India are given below.

Figure 8-3: Waste Collection

A major problem with roadside bins is that they are often open top type and allow animals to gain access to the waste. In other cases, storage bins are insufficient and the waste is piled or heaped around the container. In addition to this if waste is not collected on a daily basis from some areas, the waste putrefies and gives out bad odors causing a public nuisance. In the case of Mirzapur, all the above drawbacks have made road side containers more of an eyesore than a sound waste collection system.

8.2.3 Waste Collection and Transportation Vehicles

Small Scale Collection Vehicles / Muscle Powered Vehicles

Muscle powered handcarts, pushed by people as well as tricycles with separate bins are important sound and low investment options for collecting solid waste from door to door. Such vehicles are inexpensive and easy to build and maintain. Under the prevailing fuel costs, it would be best if door to door collection can be carried out using muscle powered handcarts or tricycles.

Alternatively, there are small scale vehicles also that run on battery operated tricycles which can service small areas and areas which are inaccessible to larger collection vehicles.

The advantage of using small vehicles is that they can travel and maneuver within small or limited spaces as well as densely populated areas. They are also suitable to travel in areas that have little or no street access.

Hand Carts

Tricycles

Battery Operated Tricycles

Auto Tipper

Figure 8-4: Vehicles for Waste Collection

Non-compaction Trucks

Non-compactor trucks, a suitable alternative to compactors in areas where the waste generated is very dense and do not require to be compacted. Such vehicles are most suitable to small cities/towns where the roadways are not broad enough for large compactors.

Non-compactor vehicles need to have a waste dumping mechanism to facilitate the easy discharge of solid waste. Open trucks or tractors with trailers can lead to other issues such as waste spillage during transportation as well as rain soaking the waste which can cause aesthetic and health related problems. In addition to this such vehicles can also be compartmentalized to facilitate the collection of segregated waste streams from various sources.

Non-compactor trucks are ideal in the case of wet or dense waste which makes it difficult for the waste to be compacted. Though, the initial capital investment may be high, these vehicles can usually operate with a few waste collectors. Non-compactor trucks are also ideal for collection on longer routes.

However, there are a few disadvantages in adopting this technology in the case of Mirzapur. These include factors like the requirement for regular and scheduled maintenance, need for specialized local maintenance and repair expertise. In addition to this, at least one or two vehicles will have to be on standby to be used during downtimes.

Tractor Trailers

Tipper Trucks

Compactor Trucks

Two main types of compactors are used in the world, the fore-and-aft semi-compaction tipper with press plate and the rear-loading hydraulic-compactor. These are mostly suited and used by developed countries where they are considered to be the best waste collection and transportation technology. Compactor trucks are usually best for wastes which are less dense in nature and require to be compacted. This technology can be used to reduce waste volumes using hydraulic or mechanical pressure. A stationary type compactor is capable of being transported from one location to another and placed at any place for the refuse collection, compaction & transferring. It is to come as integral unit incorporating the container and the compaction unit. The compactor to be such that can be transported by a specially designed hook loader unit mounted on a truck chassis. However, compactors are often ineffective in situations where the waste is already very dense and moist. This makes compactors inappropriate to developing nations. One major drawback of compactors is that the initial capital cost of vehicles is very high and that maintenance work needs to be carried out regularly in order to minimize breakdowns. As seen during the field visits, the MNNP already possesses one compactor but sometimes this vehicle is often off-road due to breakdowns. In addition to this compactor are high fuels consuming vehicles raising the operating costs to a great extent. They also require well paved streets which are wide enough to allow passage and turning.

Regular Compactor

Stationery Compactor

8.2.4 Waste Collection Route Design and Operation

Any waste collection system is based on a waste collection route designed by the responsible authority/organization. The routes are designed to allow maximum use of the vehicles, equipment and human resources and ensure that waste is collected in an efficient

and planned manner. If the collection route is not well planned out it can result in poor waste collection.

To achieve efficient waste collection MNNP must consider collecting as much waste as possible with the available human and financial resources and time. Waste collection has to be carried out before the daily town area activities begin in order to avoid creating traffic and other issues. In addition to this if the vehicles used for waste collection are too small; several trips will have to be made to and from the final disposal site or the intermediate collection points leading to further time loss. Also, problems will arise wherever the terrain is too difficult for larger vehicles to pass through.

To design an optimal collection system means going beyond having the latest and the most efficient collection vehicle/technology. Several factors have to come together and work simultaneously to optimize waste collection. These factors include a well-chosen waste collection frequency, a suitable time of collection avoiding times when the streets are crowded and ensuring that all residents in the area receive the collection service at least once a week.

The "Just in time" waste collection system is also a good system which allows residents to bring out their waste at the time the collection vehicle reaches their area. A bell or horn can be used by the collector to announce his arrival and to indicate that the waste should be brought out. However, for this system to work best at least one person has to be home during the day or at the time when collection vehicle comes by.

8.2.5 Intermediate Transfer/Collection Points

Intermediate transfer stations/points are centralized facilities where waste collected by smaller vehicles is temporarily stored to be reloaded and sent for treatment, reprocessing/recycling or for final disposal. The use of transfer stations is an ideal option when there is a need for small vehicles servicing a collection route to unload its waste and return to collection quickly to reduce time loss.

However, transfer stations can have high capital costs especially if they are mechanized. A better alternative for developing nations is to make transfer stations manual involving labour to unload the waste and then reload the waste to larger vehicles.

Transfer stations also provide the ideal opportunity for MNNP to develop a centralized segregation system where recyclable waste such as plastics, paper and cardboards, glass and metal can be separated out and sent for recycling. This would also reduce the cost of having to provide too many segregation bins/bags to waste generation points such as households and commercial establishments where space can be a limiting factor.

When siting an intermediate transfer station several factors need to be considered. The location needs to be easily accessible to both small collection vehicles and larger ones such as trucks and compactors. The station should also have ample space for vehicles to come in, dump their waste, reload waste into other larger vehicle and to allow vehicles to move and turn easily. If the transfer stations are to double as centralized segregation points the space required will increase further. In addition to this, many stakeholder may feel that intermediate transfer stations can become public nuisances especially if not maintained in a proper manner. Therefore, when siting a transfer station the location

should be far enough from residences to minimize odor, noise, leachate and traffic problems.

However, in the case of Mirzapur where land space is a problem, finding a suitable location covering all the above aspects can become difficult. Mirzapur is densely populated further aggravating this situation. Therefore, it will be better to locate a few smaller transfer stations rather than a single large one. The appropriate number of transfer stations to be located within the MNNP will depend on the number of service areas and routes used by the MNNP in collection. In addition to this the distance between the service areas, the collection technology to be used and the volume of waste generated will also have to be taken into consideration. In either case, it will be the responsibility of the MNNP to ensure that the neighborhood is not adversely impacted by these stations. Transfer stations have many advantages:

- They reduce the overall traffic levels by using fewer but larger-capacity vehicles, which reduces traffic congestion and pollution.
- If primary collection vehicles have to drive longer distances to the disposal site they are more likely to be tempted to save time by illegally dumping the waste at the side of the road. Transfer stations prevent this happening.
- In areas with a low population density it is cheaper to have a transfer station that incorporates short-term storage of the waste. Small carts can deposit their waste here daily and a larger vehicle can transport the stored waste to the disposal site every few days.
- Consolidating the waste into fewer vehicles reduces vehicle wear, the need for maintenance and fuel consumption.
- Waste can be screened so that recyclable items or inappropriate waste (like tyres and vehicle batteries, which should not go to a landfill) can be taken out.
- Transfer stations reduce traffic at the disposal facility. Since fewer vehicles go to the final disposal site, traffic congestion can be avoided, the cost of operation can be minimized and public safety is improved.

8.3 Road Map for Waste management

Currently, the Nagar Palika Parishad is facing problems in efficient source segregation, proper collection & transportation, lack of manpower, technical expertise and social awareness, leading to improper waste management. Therefore, considering the current MSWM practices in the Nagar Palika Parishad with future population growth rates was waste generation rates, an attempt has been made in preparing long-term and short-term approaches for achieving a sustainable waste management.

Long term approach mainly emphasizes on achieving 100% source segregation coupled with efficient collection & transportation system, which will serve as a key in reducing the quantity of waste going to landfill and also in selecting the appropriate economically viable technology for processing, treatment & disposal of waste. Short term approach mainly focuses on immediate workable plans / proposals for clearance of waste avoiding health and environment concerns. Short-term approach helps in preparatory works and also in bridging the gap for achieving long-term goals.

The author has made an attempt in developing road map for efficient solid waste management especially for collection and transportation. The holistic road map in the form of flow chart for collection and transportation is provided in **Figure 8-2**. The road

map of best option will identify the priority areas for immediate action and low priority areas which can be addressed over time.

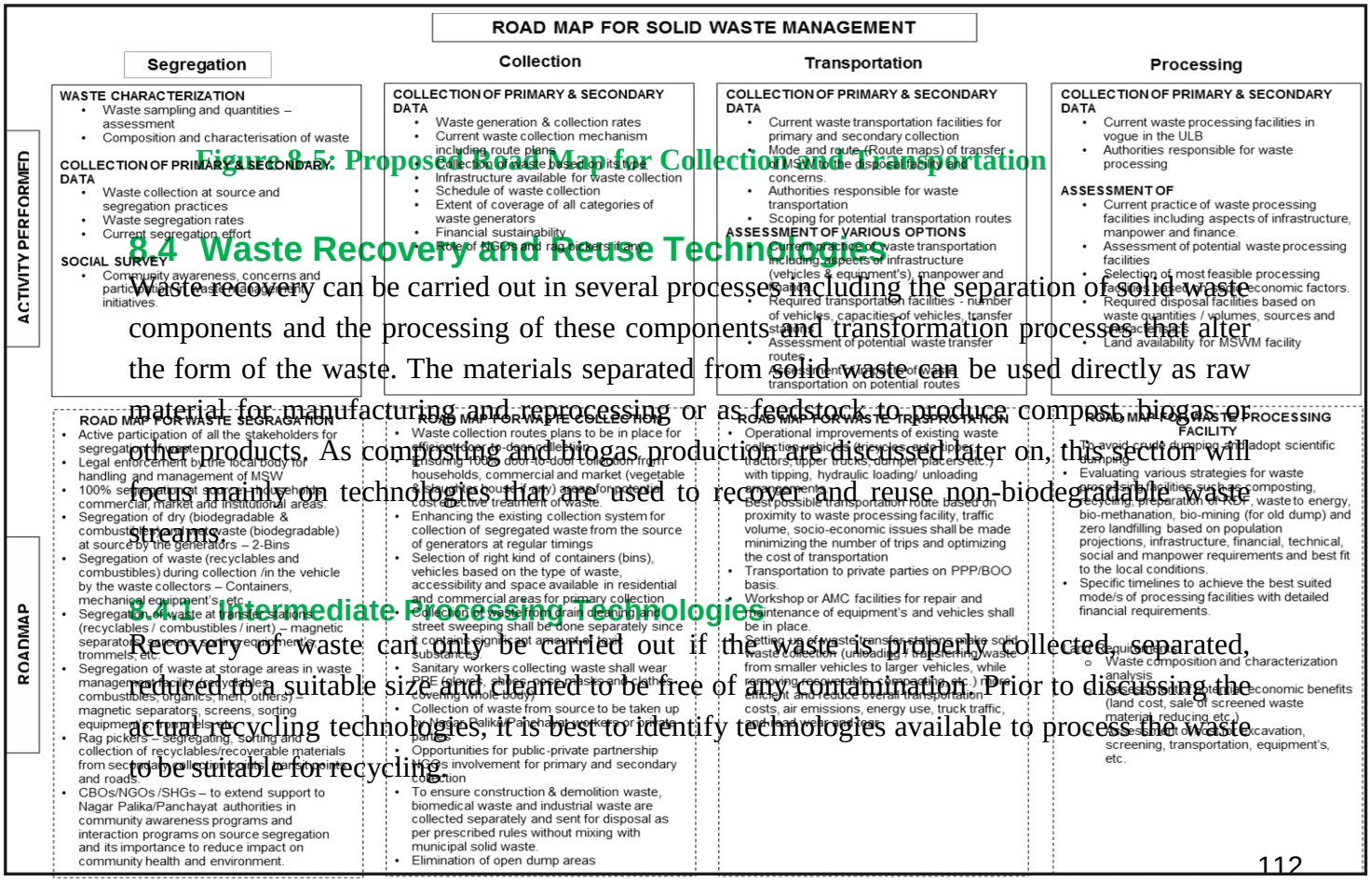


Figure 8.5: Proposed Road Map for Collection and Transportation

8.4 Waste Recovery and Reuse Technologies

Waste recovery can be carried out in several processes including the separation of solid waste components and the processing of these components and transformation processes that alter the form of the waste. The materials separated from solid waste can be used directly as raw material for manufacturing and reprocessing or as feedstock to produce compost, biogas or other products. As composting and biogas production are discussed later on, this section will focus mainly on technologies that are used to recover and reuse non-biodegradable waste streams.

8.4.1 Intermediate Processing Technologies

Recovery of waste can only be carried out if the waste is properly collected, separated, reduced to a suitable size and cleaned to be free of any contamination. Prior to discussing the actual recycling technologies, it is best to identify technologies available to process the waste to be suitable for recycling.

8.4.2 Recycling Technologies

The actual recycling technologies can vary according to the type of waste material being processed. The recycling technologies used to process plastics, paper, and construction and demolition waste are discussed in this section as these are the most abundantly available waste material in Mirzapur. Rag pickers play a key role in collecting these recyclables from streets, bins and waste dump sites. Waste prevention and recycling divert organic wastes from landfills, thereby reducing the ultimate time for decomposition and release of toxic gases from combustion of these materials. Though some recycling is in place through rag pickers, the chain of recycling process is not complete and often results in illegal burning of waste or dumping.

There is a need to integrate resource recovery component into current waste management practices. Waste should be considered as resource and waste management policy shall be formed on conversion of waste to resource in addition to safe disposal. Buy back schemes to be considered for consumer goods like paper, bottles, tyres, batteries, televisions, washing machines, water heaters, electrical tools, furniture, etc. for recoverable materials. While promoting waste recovery and recycling, there is a need to encourage and create a market for purchasing recycled products at reduced prices than actual local market rates.

Benefits from waste recycling **–**

- Recycling saves energy as manufacturing goods from recycled materials typically requires less energy than producing goods from virgin materials. Waste prevention is even more effective at saving energy.
- When products are made with less material, less energy is needed to extract, transport and process raw materials and to manufacture products.
- When energy demand decreases, fewer fossil fuels are burned and less carbon dioxide is emitted to the atmosphere.
- Waste prevention and recycling of paper products allow more trees to remain in forest which will continue to absorb / remove carbon dioxide from the atmosphere.
- Recycling of waste could also reduce burden on municipalities/Nagar Palika Parishad.
- Organic waste is most commonly recycled by composting, thereby reducing the space requirement for landfill
- Conserves resources for our children's future. Water, energy and raw material that are necessary to produce virgin products are much greater than what is necessary to produce the same products using recycling material
- Supplies valuable raw materials to industry
- Depending on community location and transportation logistics/costs to near-by recycling facilities, money can be made from recycling (buy-back) centers
- Reduces litter and windblown wastes
- Reduces pollution and health risks, especially if hazardous items such as batteries, used oil, antifreeze, and paint are recycled.

Factor to be consider for recycling

Public participation in recycling programs is one of the most important factors deciding the program's success. A well-planned public education and involvement program will encourage participation in recycling. A good recycling program structure, along with broad and constant education on how to participate and recycle, will lead to public support and

participation in a community – based recycling program. The following program options have been shown to increase public participation in recycling.

- Mandatory participation.
- Collection from individual homes and businesses instead of having people drop-off their recyclables at a collection bin or center
- Provision of special containers
- Collection of recyclables on the same day as regular trash pick-up
- Comprehensive and integrated public education

Options for Recycling

Recycling is unique method for managing solid waste because it is very flexible and adaptable to any community's situation. When considering a recycling program for any community, they must decide the best way for local residents and businesses to prepare recyclables for collection and best way to collect them. Local conditions should be taken into account when considering a recyclable program. If community does not pick up waste from individual homes (curb side pickup), educating and encouraging individuals to take recyclable materials to a drop-off center or collection bin will be very important part of the recyclables program.

Recycling programs usually involve local residents and businesses separating certain materials (e.g. newspapers, paper, plastics, glass and aluminum cans etc.) from the rest of the garbage and placing each type of material in a separate bin or bag. In some communities, recyclable materials are not separated by residents and businesses, but by others at a drop-off site, recycling center or recovery facility. Various types of recycling collection program that can be considered include

- Drop-off centers and /or bins for recyclables
- Buy-back center
- Individual pick up (i.e. curb side) recycling programs
- Special collection events

Most communities that have recycling programs provide collection bins or an area local residents can take their recyclables making three important decisions

- The community must decide what collection methods to use for collecting recyclables
- The community must decide how collection system will operate
- The community must decide what type of processing and storage facility is needed to prepare material for shipping and marketing

They are then sorted and properly packed for shipping to a recycling facility or collection center for further processing.

Drop-off Centers and/or Bins for Recyclables: A drop-off program requires residents and businesses to separate their recyclable waste and bring them to a specific drop-off bin or collection center. Drop- off centers range from single material collection points (e.g. easy-access "collection bin" containers) to staffed, multi-material collection centers. Because residents and businesses are responsible for separating their recyclables materials and taking them to a drop-off center, low participation can be a problem with these programs. Drop-off center also require residents and businesses to store their recyclables until a sufficient amount has been collected to justify a trip to the drop-off center. This can be a problem in homes and businesses where there is not much storage space available, except outdoors.

Drop-off centers work best when they are located in centralized locations that people can easily access. They are often found in locations that people go, such as the store, community center or landfill/dump site. At drop-off centers, bins or containers that are labeled can be used to

collect a wide range of recyclables, including newspapers, cardboard, aluminum cans and glass etc. For a community that is widely spread out, a drop-off center might be the most economically feasible option for collecting recyclable materials. To foster participation, money earned from recycling materials can be used for special community events or donated to the school to help with a special school trip or project. If a thorough educational and promotional effort is not made, drop-off programs tend to have lower participation rates than curb side programs.

Buy-Back Centers: Buy-back centers are commercial operations that pay local residents and businesses for recyclable materials. These programs provide a monetary incentive to participate. In this type of program, local residents are paid for their recyclables either directly or indirectly through a reduction in monthly collection and disposal fees. Typically buy-back programs involving selling recyclables to buyers in a core community. They can include scrap metal dealers, aluminium can centers or paper dealers etc. Generally, buy-back centers collect waste materials that have high resale or market value. With the exception of selling aluminium cans through the 'flying cans' program, very few communities use this option.

Individual Collection (curb side) Programs: To maximize recyclables collection most communities will establish an individual collection program that involves picking in recyclables from individual homes and businesses. If a community chooses this system for collecting recyclables it will need to seek a balance between participation by individual households and businesses and transport needs and processing requirements. Some communities have found it effective to provide both drop-off centers and individual pick-up for certain recyclables. Drop-off centers, in conjunction with individual pick-up, work well for items, such as waste oil that are hard to pick up and transport in large quantities.

As collecting recyclables materials at homes are most convenient for residents, it often leads to higher recycling rates in a community. However, it is a more expensive collection option because a community has to pay workers to collect recyclables and purchase and maintain vehicles and other equipment to transport the recyclables to a facility or area for packing and shipping. This type of recycling programs can vary greatly from community to community. Some communities require residents to separate all recyclables so they can be collected separately. Other communities have local residents use only one container for all recyclable materials then sort them after collection. The collection staff collects the recyclables and takes them to an established area at or near the landfill where they are sorted and prepared for shipping. The non-recyclable waste is then disposed of at the landfill/dump site.

Special Collection Programs: To collect more recyclables, the community might institute special recycling events or partnerships in conjunction with individual pick-up or drop-off collection programs. These events can include special collection days for large items or household hazardous waste or partnership with other businesses that promote recycling. The following programs can be used to encourage recycling and enhance a community collection program that includes recycling.

Recycling of Plastic Waste

The used plastic regularly gets mixed with municipal solid waste or gets into the drains. Plastic mixed with MSW reduces the composting efficiency by decreasing water permeability as well as air circulation. Plastic poses unique problem in MSW management as considerable

amount of time is consumed for its degradation. It also causes soil pollution and storm water drains clogged with plastic waste. To address the problem of plastic waste, at present it would be advisable to segregate it at source and send for recycling units which will have its own market value. Plastics can be classified into seven categories. However, it has been seen that the major plastic waste types found in Mirzapur are PET, HDPE, LDPE and PVC. Unfortunately, the technology for converting PET to polyester fibres is far too cost intensive to be set up as a small scale industrial unit.

Recycling of Paper and Cardboard Waste

These technologies are designed to recycle post-consumer paper and cardboard to manufacture products which range from recycled paper to building material to refuse derived fuels. Large scale paper mills that produce paper and cardboard use technologies and equipment that are financially and technically beyond the limits of many industrialists in India. The focus therefore would be to develop small scale paper recycling plants where the waste paper can be collected and converted to pulp and then produce paper. Several technological options are already available in India to recycle paper at cottage level or at micro/small industry level. The reduced capital and operational costs of these technologies make the final product more marketable.

There is a high demand both in India and aboard for handmade recycled paper. Therefore, this would be an ideal opportunity to develop a small scale recycling unit within the MNNP.

Recycling of Construction and Demolition Waste

Construction and demolition waste is usually the result of construction, renovation and repair and demolition of buildings and other man made constructions as well natural disasters. This waste is made up of about 25 - 30% wood and timber products and about 40 - 50% a mixture of concrete, asphalt, brick, sand and mortar with the remaining 30 - 35% being made up of other materials such as metals, glass, PVC and plastics, wiring parts, asbestos and contaminated wood parts. Though, construction waste may be less in quantity as discussed with concerned officials of NPP when compared to municipal waste in Mirzapur the complete bulkiness of this waste stream creates a problem of disposal. Therefore, a suitable recycling system will have to be considered to recover valuable material from this waste stream.

The most suitable system is to design a central collection point with a tipping area where the construction material can be unloaded and sorted/separated. Partial separation can be carried out using loaders or bulldozers to remove oversized or clearly recoverable materials (e.g. wood, cardboard etc.)

The remaining materials are loaded into a conveyor belt where useful material is separated manually. The separated construction waste streams are then crushed into small particles. Magnetic separation can be used to remove any small metal objects/particles that may have been missed in the manual separation process. The particles can then be screened into standard sizes and sold as road base or construction material.

The wood component in the waste once separated can be reused for construction work or recycled by shredding. Here too metal objects can be removed using magnetic separation. The wood particles can be used as fuel or to produce other value added products such as particle boards. Any corrugated cardboard can be baled and sold for recycling.

Recycling Hazardous domestic waste

Households shall handover hazardous domestic waste such as tube lights, batteries, electronic items, etc. separately to the waste collector so that it will not be mixed with MSW. The waste collector would in turn handover the waste to an authorized dealer.

Sometimes it is found to be mixed up with municipal solid waste. Most of the major hospitals are segregating biomedical waste by ensuring adequate and proper placement of colour coded waste containers with plastic liners. Biomedical waste when mixed with MSW becomes hazardous / infectious which drastically increases the chances of affecting the health of workers & rag pickers and normal waste management practices like composting and waste recycling are also adversely effected due to mixing of biomedical waste. The municipality shall ensure that biomedical waste does not get mixed up with MSW and sent to biomedical waste handling facility. Households shall also be made responsible in handing over segregated household biomedical waste if any to the waste collector.

Almost every material can be recycled; however, the value of the recycled material can vary significantly depending on the demand and its uses. Indeed, the value of a material is the driving factor for recycling enterprises or the informal sector. How a material is recycled depends not only on local policies but also on the availability of buyer, processing facilities, and transport chain gives an overview of typical recycling materials and their potential treatment options.

Table 8-1: Important Recycling Materials: Advantages and Drawbacks

Material	Advantages	Drawbacks
Paper	• Paper can be easily recycled; however, quality deteriorates with each cycle. • Paper or cardboard from recycled paper requires less energy to produce and protects forests.	• Appropriate technologies with circular processes are required to protect the environment.
Glass	• Glass has a moderate market value. • It can be sorted into colours and melted. • Use of recycled glass saves energy compared with processing raw material. • Glass can be recycled infinitely because it does not deteriorate from reprocessing.	• Broken glass can contaminate • and eliminate opportunities for recycling •
Other Metal	• Scrap metal has a high market value (especially steel, copper, silver, and platinum). • It can be recycled indefinitely because it does not deteriorate from reprocessing.	• High-value metals (such as copper and silver) are incorporated in electronic devices, but extraction can cause severe environmental impacts.

Polyethylene terephthalate (PET)	• PET can be recycled if segregated from other waste. • Reprocessing into granulate is very easy. • PET has a high market value if processing plants are available.	• More "down-cycling" than recycling occurs because quality decreases with every processing cycle.
Other Plastic	• Other plastic, such as polyethylene or polyvinyl chloride, can be recycled but has less value in the market than PET; the value depends on recycling and manufacturing options within the vicinity.	• Recycling requires tailor made machinery.
Aluminium	• Aluminium has a high market value. • It can be easily recycled by shredding and melting. • It can be recycled infinitely because it does not deteriorate from reprocessing. • Aluminium recycling significantly consumes less energy than producing aluminium from ore.	• Separate collection is important. • Recycling is suitable only if a processing plant is available.
Batteries	• Recycling recovers valuable metals. • Recycling protects the environment from heavy metals such as lead, cadmium, and mercury.	• Large variation in type and size of batteries requires specific recycling processes. • Older batteries have high heavy metal content.
Construction and Demolition (C&D) waste	• Lower quantities of C&D waste could be used as filling material in low lying areas • Higher quantities of C&D waste can be crushed to gravel and reused in road construction, landscaping, etc.	• Machinery required for crushing is maintenance intensive. • Recycled waste is valuable only if there is a lack of availability of other construction material.
Electronic Waste	• Electronic waste (such as computers or mobile phones) contains high value metals. • Electronic items can be dismantled, reused, or recycled.	• Metals are often covered with polyvinyl chloride or resins, which are often smelted or burned, causing toxic emissions.
Organic waste	• Most commonly recycled by composting or anaerobic digestion.	• Though compost is very beneficial to depleted soils, much needs to be done to improve its acceptability and marketability.

Factor impacting Recycling

When examining the various recycling and collection options, consider which system is likely to work best in your community. Factors that might impact the recycling and collection option choice include the following

- Community's population size
- Availability and distance to markets for recyclable materials
- Type transportation options are available
- Volume of recyclable materials residents and businesses generate
- How interested local residents and businesses are recycling, and
- Whether appropriate funding and staff are available to work on a recycling program

Recycling programs between communities will vary greatly because every community is different and produces different amounts and kinds of waste. The more comprehensive a community's recycling program, the more waste that can be diverted from disposal. Recycling, therefore, is one of the first waste management methods that should be used by communities faced with an impending landfill capacity shortfall.

8.5 Strategic Action Plan (Policy, Voluntary and Technological Measures)

The waste management plan for Mirzapur will encompass all stages of the waste management process from waste generation at source to final disposal. The activities under this frame work cover all stages and development of improvement measures to make the integrated waste management effective.

The goals, objectives and the targets of MNNP together with the concerns of the stakeholders will define the final desired state while the waste inventory and situation analysis led to identification of gaps. Therefore, strategies are developed to fill the gaps to reach the desired state of solid waste management in Mirzapur.

Three types of strategies are developed to address these gaps, namely policy changes, technological action and voluntary action.

The policy changes include the strengthening of the existing laws and regulations on solid waste management, enacting and enforcing new regulations where necessary and develop market based economic tools to motivate community to good practice and as a deterrent from harmful practices.

The voluntary actions include awareness, training and capacity building of different stakeholder groups to synergize the actions of different segments of the community for effective solid waste management. Any projects started by schools and NGOs/CBOs are also considered as voluntary measures

The technological measures include the broadening of the infrastructure and designing and procurement of new equipment. Setting up of new recycling and treatment plants too are under technological measures. Similarly, substitution of products and materials, change of packaging, research work carried out by universities and other research institutes for new techniques or improvement of existing methodologies too fall under technological measures.

8.5.1 Strategies for Waste Reduction

The SWM plan for Mirzapur commences with reduction of waste generation at source. This indicates that the quantity of waste to be disposed will become less and therefore the pressure on the other stages of the waste management cycle becomes less. The reduction at the point of generation focuses on prevention, reduction and reuse of the materials ending up as waste. This strategy will bring financial savings to the generators and at the same time reduce the volume to be handled by the MNNP.

This could be achieved by making suitable policy changes including enacting & enforcing regulations and economic tools, voluntary actions and technological actions.

Policy Changes and Economic Tools

- The policy changes should include suppliers' liability for all durable products and products containing hazardous materials.
- Enforcing the existing regulations on plastic thin films
- Subsidies for environmental friendly purchases

Voluntary Actions

Voluntary actions through awareness, training, communication and capacity building could provide the necessary platform to bring down the generation of waste at household levels as well as at commercial and industrial level. In addition the voluntary measures could be useful for providing the transition to implement policy changes.

- Pay back system for all empty cans & bottles and also for other old household capital goods such as electronic items and furniture by commercial houses
- Take back packaging of consumer goods as well as old household capital items and provide a discount for the new purchases.

Technological Options

- Introduction to bio degradable packing materials
- Establishment of recycling stations

8.5.2 Strategies for Source Separation

One of the adverse factors in managing municipal solid waste is the mind-set of general public and society at large with respect to segregation of waste and also asserting their rights for a clean, hygienic and safe neighborhood. Added to this, lack of awareness on waste minimization and benefits of recycling are also contributing factors. To ensure waste minimization and recycling, systematic guidelines need to be evolved and put in place by the Nagar Palika Parishad.

The changes to the current entire solid waste management approach starts form the separation of different wastes at the point of generation. Therefore, this stage should be properly addressed with correct and effective policy measures, voluntary actions and technological changes.

Policy Changes and Economic Tools

- Regulations banning mixing of hazardous waste with other wastes
- Enact Regulation to separate different wastes at source level and fines for not adhering to the practice.
- Economic incentives to families who does the source segregation

Voluntary Actions

- Establishment of a monitoring system by citizen's committees to ensure source separation
- Awareness raising through NGOs/CBOs for all the waste generators for maintaining clean and healthy surroundings
- Regular meetings with religious places, schools and commercial organizations on source segregation.

8.5.3 Strategies for Collection & Transport

The major cost of the existing solid waste management is spent on collection and transport. Though it is represents the high cost stage many segments of the community are dissatisfied with the service while about most of the population does not receive the solid waste collection service of MNNP area. Therefore, proper care must be taken to address the issues of this stage by effective policy measure, voluntary actions and technological interventions.

Policy Changes and Economic Tools

- Stipulate times for disposal of waste at households and other places
- Early morning & late evening collection system
- Fines for those who dispose waste after the given time slots
- National Standards for vehicles collecting wastes
- Fines for illegal dumping of wastes at roadside
- National regulations for safety, and maintenance of collection vehicles including noise and air emissions, leakages and cleanliness of collection vehicles

- Licensing system for all rag pickers/scavengers who collect wastes from households and other places

Voluntary Actions

- Voluntary groups to monitor and advice on punctuality in putting wastes at proper places at correct times in a proper manner for collection
- Create respect for sanitary workers and scavengers to motivate them for effective services
- Provide feedback to MNNP by the citizen's groups on the effectiveness of the collection system

Technological Options

- Provide PPE for all sanitary workers and regular inspections on usage
- Use appropriate vehicles for collection without leaks and properly covered
- Use of a compartmentalized vehicle for collection of segregated wastes
- Regular cleaning, servicing and maintenance of the waste collection and transporting vehicles
- Establish eco Kiosks at selected locations to collect segregated wastes

8.5.4 Strategies for Transfer Stations /Sorting Centers

The proposed transfer stations and sorting centers are to facilitate the segregation for wastes by MNNP/scavengers/other micro industrialists for recovery of useful resources. This will prevent any Organic and non-organic wastes ending up in the landfill site but these recoverable wastes will be directed to recycling stations or treatment plants.

Policy Changes and Economic Tools

- Transfer stations/sorting centers to handle only specified wastes
- Hazardous wastes should not be allowed at transfer stations/sorting centers
- Have separate areas for e-wastes, plastics and paper in sorting centers
- Dedicated transfer stations for meat/fish wastes as well as hazardous wastes before safe disposal
- All transfer stations/sorting centers to be operated according to national environmental regulations in force.

Voluntary Actions

- NGOs/CBOs to handle transfer stations/Sorting centers
- Awareness raising and environmental education to communities and special groups such as school children at these centers
- Cleanliness, safety and health to be given highest priority

Technological Options

- Equipped at transfer stations/sorting centers with cleaning facilities for workers
- Transfer stations to have proper layout plan
- Regular transferring of these wastes to other stations such as exchange center/recycling plants/ disposal

8.6 Involvement of stakeholders

Lack of awareness among the waste generators, untrained workers in urban local bodies, etc. are some of the main hurdles in the waste handling system. Participation of private organizations, self-help groups, NGOs etc. in waste handling is important for making city clean and green with a healthy environment. Nagar Palika Parishad authority to drive initiatives for educating and creating awareness in the community on basics of waste handling at household level, shops and establishments.

8.6.1 Nagar Palika Parishad

- In association with the political team/councilors, the local Nagar Palika Parishad authority to enforce a mandatory resolution on source segregation keeping in view of the prevailing local conditions.
- Shall organize periodic awareness programs to encourage source segregation. They shall undertake phased programs to ensure active participation in waste segregation.
- To facilitate the waste generators with proper bins and collection system at regular intervals.
- To improve the existing waste collection and transportation system in respect of required team, sufficient equipment /vehicles, monitoring mechanisms, etc.
- To identify NGOs who show their presence & acumen in the respective locality, who actually extend

their support in improving the waste collection and transportation practices and capable of motivating people with their activities.

- Regular meetings shall be arranged with different associations and NGO's representatives headed by Executive Officer and other waste management officers.
- Ensure involvement of school & colleges in the awareness campaign.
- Spread awareness with the help of print and electronic media.
- To educate community and sanitary team including workers about the importance and need for source segregation. Strictly supervise the segregation at source campaign.
- Strictly enforce penalty to the waste generator who are giving mixed waste to the sanitary workers.

8.6.2 Non-Governmental Organization (NGOs) / Community based Organization (CBOs) / Private parties

- These are generally involved in collection of wastes from different sources of generation.
- In consultation with Executive Officer of the ULB, shall carry out and organize awareness programs for residents and other stakeholders to motivate them for source segregation.
- Help in educating people to participate in the source segregation campaign
- NGOs to provide a prominent support to informal sector waste workers and enterprises to organize themselves to improve working conditions and facilities. And also make them understand about increasing their earnings and access to essential social services such as health care and schooling for their children.
- To promote the welfare of rag pickers. To involve rag pickers in door-to-door collection and source segregation of waste. Educate and motivate rag pickers to collect recyclables
- Organize seminars, workshops at schools and college level to educate and motivate students about MSW handling and management.
- Help ULB authority in preparing and imposing the action plans.
- To explore and provide new initiatives and methods for improving the system

8.6.3 Politicians/ Councilors

- Ensure full support to the ULB authority in strictly imposing laws and penalties.
- Should pass by laws to make segregation mandatory with stringent penal provision.
- To motivate local residents and other stakeholders to take healthy participation in campaign.
- Should monitor the ground works of MSW management by field visits at regular intervals.
- Shall lead the campaign of source segregation.

8.6.4 Residents/ Community

- Community participation plays a vital role in segregation of waste at source and 100% source segregation is possible only with the active participation of community generating waste.
- Waste generated shall be segregated initially as wet & dry waste and stored in two separate bins – one for wet/biodegradable waste and second for dry/Non-Biodegradable waste. Major portions of recyclables and hazardous waste to be handed over separately.
- Active participation in segregation at source campaigns and motivating one another.
- To educate neighbors about the importance of source segregation & motivate them for active involvement and participation.
- Shall be responsible from segregation of waste till handing over the waste to the collector/ sanitary worker.

8.7 Campaign Models and Enforcement Plans for Awareness among Citizens

Comprehensive training programs and massive campaigns for raising awareness among civic-body administrators, health team, and municipal team shall be taken up by the ULB in association with NGOs/CBOs etc.

8.7.1 Residents/ Community

- To initially segregate the waste in different closed bins before handing over to the waste collector and keeping a clean and healthy environment in and around the house of an individual.
- To actively participate in campaigning for source segregation and waste handling to have a healthy environment in the surroundings.
- To educate neighbors about the importance of source segregation & motivate them for active participation.

8.7.2 Schools/College

- Nagar Palika Parishad Authority to convince schools / teachers to take up awareness initiatives beginning at schools during prayers, as mini project works, social assignments, etc.
- Teachers to guide students preferably of class VI to VIII in taking up such initiatives and to take part in campaigning for awareness.

8.7.3 Self Help Groups (SHGs)

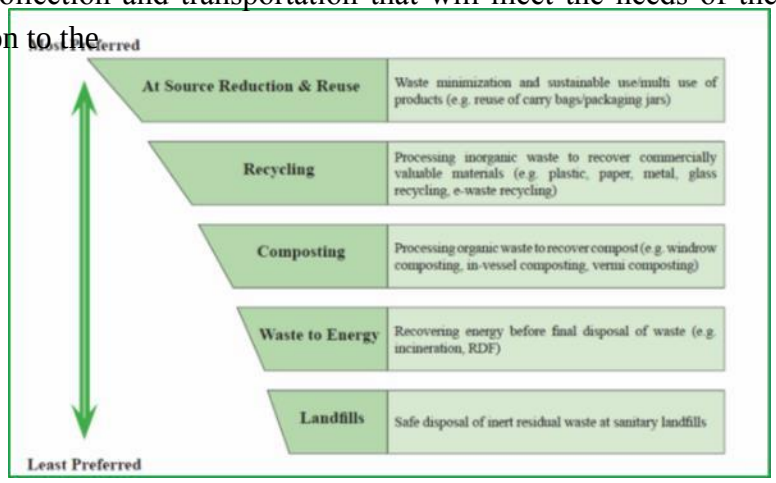
- Nagar Palika Parishad Authority in coordination with SHGs for women livelihood shall motivate SHGs to take up small initiatives in changing mind-set of people in their own locality stage by stage in understanding the need for waste segregation at household level and waste handling practices on roads.
- These SHGs shall actively participate in awareness campaigns and set a target of one member to motivate at least one family.
- The SHGs would also help in understanding individual's responsibility to segregate the waste and handover the waste in safe manner to the waste collector.

8.7.4 NGOs / CBOs

- NGOs to select or prioritize certain areas / ward and organize campaigns for creating awareness on waste handling (storing and segregation) among the people
- NGOs and CBOs to motivate the residents to store the waste properly and to keep the premises clean.
- To carry out regular motivation activities to the waste generators such as campaign, rally, demonstration, and visiting schools, slum and residential areas.
- NGOs to conduct programs for informal sectors for making them understand on their present working conditions and how to improve their earnings & living conditi

8.8 System Options and Evaluation

A number of options were identified and reviewed for Mirzapur to establish the waste management "concept" for collection and transportation that will meet the needs of the NPP area, giving consideration to the policy, regulations and practical guidance set out in preceding sections of this section. The adjoining figure shows that source reduction is the most preferred option and has the potential to reduce the quantity of waste generated and related financial & environmental costs.



The purpose of this section is to present the assumptions and evaluation of each of the technical system component options and the conclusions with respect to the formulation of the recommended technical system. The technical system component options are delineated in terms of waste segregation, primary and secondary collection and waste transportation facility. The overall portions of the Mirzapur town are as per the CPHEEO Manual, generating 151 TPD of waste with a per capita waste generation of 251 gm/person/day. The following table presents the summary of the overall collection and transportation plan.

Table 8-2: Collection and Transportation Plan for Municipal Nagar Palika Parishad as per CPHEEO Manual

Approx. Population	ULB generating tones	Primary doorstep segregated collection equipment and vehicles	Secondary collection of street waste equipment and vehicles
1,00,000 to 5,00,000	25-150 TPD	75% door-to-door collection through covered LCV 25% door-to-door collection through containerized tricycles or handcarts from narrow lanes Direct transportation of waste to processing facility if distance is under 5 km, or transportation through compactors if distance of processing facility is longer Compactors to be deployed based on capacity of vehicle and volume or weight of waste	Street sweeping and silt from the drains may be collected in containerized handcarts and taken to secondary storage depot having 1.1–4.0 m^3 metal containers. Containers to be placed at 4 per km^2 area or 1 per 5,000 population. Containers to be lifted by twin bin dumper placers or refuge collector or compactor machines. Dumper placers and compactors

based on capacity of vehicle and volume or weight of waste

Source: Table 2.4: MSW Management Plan for Municipal Councils and A, B, C class cities14 CPHEEO Manual, Page 183

8.8.1 Waste Segregation

The term segregation in municipal solid waste management system indicates separation and storage of individual constituents of waste material. The main objectives of segregation are; (i) storing of recyclables separately for reuse, (ii) storing of organic portion separately for further processing, and (iii) waste minimization for final disposal to landfill sites. The options for segregation of waste are discussed as under and further detailed out in **Table 8-3**.

Option 1: Segregation at Source: This option requires waste generators to segregate waste at source into biodegradable (wet) and non-biodegradable (dry) waste and to store waste effectively in appropriate containers. Also, suitable bins/bags for hazardous waste.

Option 2: Segregation at processing/ disposal facility: In this option waste is not segregated at source and all wastes are collected through the common waste collection system. The waste is segregated at the treatment/ disposal facility for pre-sorting of waste for appropriate treatment, recover recyclable materials and reduce burden on landfill facility.

Table 8-3: Options for Waste Segregation

Options	Advantages	Disadvantages	Recommended Option

Option 1: Segregation at Source	• Helps channelizing different waste stream for reuse, recycling, processing or disposal • Reduces cross contamination of waste	• Increase in manpower and cost for infrastructure • Requires significant community participation/ effort • Segregation will require significant education	Awareness campaigns and IEC campaigns are prerequisite for implementation of segregation at source. Therefore, as of now segregation at processing/disposal facility is recommended.
Option 2: Segregation at processing/ disposal facility	• Reduces manpower and infrastructure cost • Easy to implement • Increased efficiency through reduced handling & logistical requirement	• Recovery of recyclable material is significantly less	

Ideally, segregation of waste at source must be accorded the highest priority. However, it requires significant community participation effort and behavioral change in the citizens of Mirzapur to successfully implement it. To effective such changes within the society takes long time and it is difficult to implement segregation of waste at source from day one. It is also observed that recyclable materials with significant value normally do not reach the waste stream and are collected separately through the already existing informal recycling system. It is therefore recommended to adopt ***Option 2 (Segregation at processing/ disposal facility)*** and subsequently focus on awareness generation and community participation till source segregation and collection system is established. Compatibility of types of storage containers and handling are as follows.

Factors to be Considered	Manual	Semi-Automated	Automated	Bins
Cost Effectiveness	Most cost effective. Minimum cost. Makes manual collection easy	Moderate cost for container. Makes collection more difficult for manual labour.	Cost effective under right conditions. Tricycle/handcarts last 10 years and reduce collection costs.	Cost effective as collection work is minimized. Bins last many years with proper maintenance.
Health and Safety	Risk of injury to collectors from sharps in bags	Potential for back injury if container is overloaded. Repetitive lifting reduces worker longevity.	No lifting or exposure to waste. Minimal risk of injury to user or service provider.	Potential health and safety risk to users and collection workers due to high possibility of waste scattering

Environmental Appropriateness	Uses more natural resources. Potential source of litter	Environmentally sound. Container use reduces litter potential. Reusing container saves resources	Environmentally sound. handcart life saves resources. Proper use eliminates litter	Can be environmentally sound. High potential for overflow and negative impacts on the environment if not properly covered or serviced
Effectiveness	Effective. Easy for user and collector to handle	Very effective. Produces the desired positive effect of controlling waste at the source.	Very effective and convenient. Controls waste and reduces environmental impact.	Moderately effective. If properly designed, can be more effective
Public Acceptance	Very high. Most convenient for public	Not high acceptance as the public are used to using plastic bags	No experience, since no application here	Poor public acceptance as there are negative impacts such as odours, inconvenience, unsightly areas and pests
Efficiency	Very efficient for user and collector	Somewhat efficient. Moderately effective at a reasonable cost.	Highly efficient. Efficient to use and mechanical dumping increases collection productivity	Very efficient. Moderate cost

8.8.2 Primary Waste Collection System

Primary waste collection refers to the points of generation (typically households, shops, markets and hotels) in the municipality to secondary waste storage facilities. The key objectives of the primary collection system are to:

- Eliminating littering;
- Servicing all generators; and
- Keeping wastes contained.

Primary collection may include methods of door-to-door collection, and/or "community bin" systems where generators who are not provided with door-to-door collection services bring their waste to conveniently located bins in the neighborhood.

The purpose of waste collection is to efficiently capture the waste stream and ensure it enters the formal waste management system. Mirzapur must provide collection services and provide the necessary support, through public awareness and education programs, to implement an effective system. The public, as generators, are responsible for delivering their wastes to the system and to ensure it does not end up as litter. Given these considerations, the options available for primary collection are discussed as under and further detailed out in following section and **Table 8-4**.

Option 1 - Community bin service: This option requires waste generators to deposit their waste directly in community bins, strategically located throughout the municipality. The capacity of the bins would be such to facilitate mechanized secondary collection. Although it does not provide door- to-door collection, it meets the intent of the SWM Rules. To increase collection efficiencies and minimize direct handling of waste, a key feature of this system would be the mechanization of the means of emptying the

collection bins. This option requires a significant change in behavior and would only be successful with full participation by the citizen.

Option 2 - Door-to-door collection supplemented with community bin service: A door-to- door, daily collection service is provided by the municipality for

most households, as well commercial and institutional premises, to the extent possible. Community bins would also be positioned in suitable locations in each ward where door-to- door collection is not feasible, such as in slum and commercial/market areas, and also to ensure that generators have convenient access to disposal facilities at all times. In this case, the community bins would also serve as temporary waste storage facilities (secondary collection system) where wastes collected through the door-to-door service would be deposited by tricycle operators during their daily rounds.

For the door-to-door collection service, a whistle or bell would be used by the waste collector to indicate the arrival in a designated 'beat' or block.

Generators would carry their waste containers to the cart or handed over them to the collector for disposal in the collection vehicle. Waste collector, equipped with small collection vehicles (e.g. handcarts/tricycle vans/auto tipper) outfitted with containers, would collect wastes daily and transport the waste to secondary waste storage facilities. Also, if in future, MNNP implements segregation of waste at source system, this primary collection system can be easily synchronized with the source segregation system. Compatibility of collection frequency options are as follows

Factors to be Considered	Daily	Two Times a Week	Three Times a Week
Cost Effectiveness	Cost is high due to the requirement for increased labour and transport capacity	Least labour cost, but greater transport capacity needed depending on use of transfer stations	Less labour cost, but more transport capacity needed
Health and Safety	Minimal health risks	Longer storage time at generation location increases public and worker health risks	No obvious health/safety risks
Environmental Appropriateness	Greatest use of fuel and other resources	Uses least natural resources. More illegal dumping and litter likely if personal storage capacity is limited	Less resource use than daily collection

Effectiveness	Most effective as waste can be set out for collection and be removed every day	May not be effective if residents forget collection days. May result in litter and illegal dumping if personal storage capacity is limited	Difficult to schedule regular collection, unless staffs work 6 days per week
Public Acceptance	High level of convenience	Low. Residents may be reluctant to store waste if there is no outside storage facility	Medium level of acceptance
Efficiency	Not efficient as excessive resources are required to collect small amounts of waste	Efficient for collectors but reduces service level for customers	Somewhat efficient. Moderately effective at a reasonable cost

Option 3: Bin less collection system –The waste collected by the waste collectors in tricycle rickshaws or auto tippers can be directly transferred to the refuse compactors instead of transferring to the dumper placer bins or bins Compatible to a refuse compactor. Bins overflowing with solid waste are an eye sore in all the municipalities in India; this option completely eliminates the bins. In typical collection & transportation system a significant cost is involved in the repair & maintenance of bins; this option eliminates that cost. A lot of space is required for placement of bins on the pavement; a lot of space is saved in this option.

This option is heavily dependent on the time synchronization between the waste collectors and the refuse compactors. This option requires significant support from the local public. With regular and effective public awareness campaign, this can be one of the options which can be implemented in the Mirzapur.

Table 8-4: Options for Primary Collection of Waste

Options	Advantages	Disadvantages	Recommendation

Option 1 - Community bin service	• Lowest operating cost collection system • Provides waste collection to areas presently un-serviced or difficult to access • Meets SWM Rules	• Requires significant community participation/ effort • Segregation of waste at source will be difficult to implement in future • Unlikely to capture all the waste • Reduces employment opportunities • Resistance from people on bin placement • Littering on streets and around the bins • Low aesthetics	*Option 2 - door-to-door collection supplemented with community bins*, is the most suitable service provided to the citizens. This option conforms most readily to the SWM Rules. It would provide the greatest convenience for the waste generator, and the greatest likelihood of compliance and synchronization with respect to source segregation system in future. As a result, it would minimize inappropriate littering and provide a cleaner, healthier and safer community. This system is also presently practiced in around 40% of the wards in Mirzapur.
Option 2 - Door-to-door collection supplemented with community bin service	• Meets SWM Rules • Services all areas • Maximizes employment • Enables source-separation in future • Minimizes littering • Promotes clean environment/community • Improves community hygiene and health • Reduces vectors • Flexible • Builds on existing system/ collection approaches • Demonstrated locally • Improved collection system • Facilitates the implementation of user fees	• Potential increase in costs • Labour intensive • Dependent on community participation	
Option 3 – Bin less collection	• Direct transfer of waste from the primary collection point to secondary collection vehicles promotes a bin less arrangement. • Successful only when synchronization with primary collection and coordination exist. • Aesthetic look increases for the place	• Requires significant community participation/ effort • Potential increase in costs • Labour intensive	

A comparison of the total estimated capital and operation cost for all the three options is provided in **Table 8-5.**

Table 8-5: Options for Primary Collection of Waste – Cost comparison

Options	Unit Cost	Total (Nos.)	Remarks
Option 1 - Community bin service	• INR. 35,000/bin – 1.1m^3 bin • INR. 50,000/bin – 2.5 m^3 bin	386 - 1.1 m^3 52 - 2.5 m^3	Assuming all bins shall be lifted by refuse collectors
Option 2 - Door-to-door collection supplemented with community bin service	• INR. 35,000/bin – 1.1m^3 bin • INR. 50,000/bin – 2.5 m^3 bin • INR. 6,00,000/Auto Tipper • INR. 2,00,000/Battery operated (B.O.) Tricycle • INR. 30,000/ Tricycle • INR. 18,000/Handcarts	386 - 1.1 m^3 52 - 2.5 m^3 12 - Auto tipper 9 - B.O. Tricycle 14 - Tricycle 26- Handcarts	Assuming both Auto Tipper, Battery operated Tricycle, Tricycle /handcart can offload the collected waste into community bins as well as refuse collectors
Option 3 – Bin less collection	• INR. 6,00,000/Auto Tipper • INR. 2,00,000/Battery operated Tricycle	12 - Auto tipper 9 - B.O. Tricycle	Assuming both Auto Tipper and Battery-operated Tricycle can offload the collected waste into refuse collectors

Source: Author Calculation

Option 1, 3 could be effective in terms of overall performance and it would meet the SWM Rules. However, to be successful, these options would require a major shift in behavior for generators and adoption of a practice that is less convenient than depositing waste on the street. As such, Option 1 & 3 would be highly dependent on sustained investment in, and delivery of, a community awareness and environmental education program. It would require generators to take responsibility for their wastes and ensure it is managed appropriately. Given the current experience of generators behavior towards waste management, these options are not considered to be viable at this time. Compatibility of points of collection options are as follows.

Factors to be Considered	Door to Door	Community bin service	Bin less collection
Cost Effectiveness	High cost. Most beneficial.	Moderate cost.	Lowest cost. Least convenient to service users.
Health and Safety	Most injuries to service crews as a result of carrying and climbing stairs with a load.	Manual labour and injury risk reduced, especially with use of handcarts.	When compared to collection at buildings, waste pooling sites can be dangerous to service users and crews, particularly if the sites are not properly designed.
Environmental Appropriateness	Most environmentally sound. Controls waste at the source. No waste litter.	Environmentally sound, but if service is not frequent, some litter may remain around containers.	Potential for waste overflow, littering, insects, birds, rodents and communicable diseases.
Effectiveness	Effective if residents follow rules i.e. must put waste outside door	Very effective if handcarts used. Waste can be put out at	Very effective if collection is properly scheduled.

	within restricted hours.	residents' convenience.	
Public Acceptance	Very high. Most convenient for public.	Moderate convenience.	Not very convenient. Residents complain in having to walk to the site, aesthetics of site, pests and odours.
Efficiency	Not efficient from productivity standpoint. Requires the most labour and equipment resources.	Very efficient, reduces labour and vehicle requirements.	Low cost. Most efficient. Depends on collection frequency and citizen practice.

Hence, ***Option 2*** **- Door-to-door collection supplemented with community bin service** has been proposed for primary collection of waste in extended area of Mirzapur.

Table 8-6: Primary Waste Collection Infrastructure_2017

Waste Generation in 2017 (TPD)	Nos. of Tricycle Handcarts	Nos. of Tricycle Rickshaws	Nos. of Tricycle Rickshaws (Battery Operated)	Nos. of Auto Tippers	Community Bins (1.1m^3 and 2.5 m^3 capacity)	
	120 Kg/trip X 3 trips	150 Kg/trip X 3 trips	250 Kg/trip X 4 trips	750 Kg/trip X 4 trips	1.1m^3	2.5m^3
79.3	14	26	9	12	386	52

Source: Author Calculation

8.8.3 Secondary Waste Collection System

The secondary waste collection system consists of temporary waste storage facilities (secondary collection points) and the method of transportation used to haul waste from these storage facilities to the treatment and disposal facility. The secondary collection system primarily provides a means of consolidating waste collected in the primary system. This approach increases transportation efficiencies by eliminating relatively long distance hauling by non-motorized, low volume vehicles. In the existing system, secondary collection facilities may also serve as the primary collection point in areas, such as markets/ commercial areas, where large volumes of waste are generated.

The SWM Rules require that temporary waste storage facilities be established and maintained such that they do not create unhygienic or unsanitary conditions around the facility. These facilities must be

covered and inaccessible to stray animals.
Waste must be removed on a
daily basis, or more frequently as needed, from the secondary collection facilities, and it must be covered during transport to the treatment and disposal facility. Given these considerations, the options available for secondary collection are discussed as under and further detailed out in **Table 8-7.**

Option 1 – Refuse Compactor Trucks with Hydraulic Lift for Stationary Bins: In this option, secondary collection points would consist of medium size, covered bins (1.1 m^3 capacity) placed in designated locations as required. Some secondary collection points may need to be equipped with more than one bin to accommodate the volume of waste anticipated at the point. Medium size, rear or side loading compactor trucks, equipped with hydraulic lift units, would be used to collect waste from the secondary points and transport it to the treatment and disposal facility.

Option 2 – Dumper Placer with Dumper Placer Containers: In this option, secondary collection point would be equipped with dumper placer container and these containers are lifted by a hydraulic mechanism and transported to the treatment and disposal site by specialized vehicles called Dumper Placer (DP) Carrier. Dumper placer carriers collect the container transport it to waste treatment & disposal site, empty the container and return it to their original location. The key advantage of the closed containers is that they are easier to use and transport. This system is good for collecting waste from bulk generating sources such as markets/ commercial areas and is also used presently by MNNP.

Option 3 – Transfer Station/Static compactor with Hook loader Trucks: In this option, secondary collection point would consist of large enclosure (typically like a small room) with or bins. Waste from primary collection are deposited in the transfer station and transferred to the treatment & disposal site using static compactors. Hook loaders with bins of 8-10 m^3 capacity shall be used for transportation of waste to the processing facility. The waste is required to be loaded on to the bins either manually or using front end loader.

Option 4 - Underground waste collection system: In this option, the entire secondary collection system to receive the waste collected in primary collection system is underneath the ground to provide more space for storage of waste. In this option, waste container is hidden underground and the surroundings of the waste receptacle stay clean. The waste compactor is lowered hydraulically underground, away from the sight. For unloading the compactor is lifted above the ground for emptying.

Table 8-7: Options for Secondary Waste Collection System

Options	Advantages	Disadvantages

Option 1 – Refuse Compactor Trucks with Hydraulic Lift for Stationary Bins	• Efficient • Waste is contained and covered • Minimizes handling and direct contact • Synchronized storage and transportation • Loading and unloading - less time consuming • Independent of quantity collected in secondary storage container.	• Capital and operating cost high • Limited ability to maintain or get parts for compactor vehicles
Option 2 – Dumper Placer with Dumper Placer Containers	• Waste is contained and covered • Minimizes handling and direct contact • Synchronized storage and transportation • Loading and unloading time reduced • Demonstrated locally • Lower cost option • Parts and equipment easy to acquire	• Slower • Containers needs to be directly transported to the treatment/ disposal site
Option 3 – Transfer Station with Static compactors	• Suitable for places generating bulk waste and large quantities • Segregation of waste is possible	• Potential traffic hazard • Large collection point space requirements • Possibility of waste spillage during transfer • Secondary storage not synchronized with transportation system • If not maintained properly, can be un-aesthetic
Option 4 – Underground waste collection system	• More capacity than the traditional waste management system, • Longer emptying intervals, • Better hygiene and convenience, • Saving of space compared to above ground bins	• Expensive – High capital cost in comparison to traditional bins • Need for a special collection truck for removal of waste and further transportation

Options	Advantages	Disadvantages

- Sanitary - Lower temperatures underground slow bacterial development, significantly reducing odours;
- Appearance/Aesthetics – These containers fit into almost any setting, with customizable frames and the flexibility to surround them with landscaping, pavement or whatever fits within the surrounding development;
- Secure - The lid closes automatically to keep litter in and to ensure rodents and insects stay out;
- Safety of collection staff – These containers are emptied by using a remote control for the boom, therefore the worker never has to lift or in otherwise come in direct contact with waste.

Based on the analysis above, a combination of Option 1 and Option 2 is the most desirable option. Both is options conform most readily to the SWM Rules. It would provide a synchronized system for secondary storage, collection and transfer of waste to the treatment and disposal facility minimizing handling and direct contact with waste.

Option 1 – Refuse Compactor Trucks with Hydraulic Lift for Stationary Bins will be used for secondary storage and transfer of waste generated from residential sources. Stationary bins will be strategically located within the wards to deposit the waste after primary collection. The bins will also act as primary collection points mainly in slum areas which are inaccessible under door-to-door collection system. The stationary bins will by hydraulically emptied into the refuse compactor truck for transfer to the treatment and disposal site.

Option 2 – Dumper Placer with Dumper Placer Containers will be used for secondary storage and transfer of waste generated from vegetable/ fruit markets, commercial areas and establishment such as hotels and restaurants. Dumper placer container will be placed in markets and commercial areas and the generators are required to deposit the waste in this container which will subsequently be lifted hydraulically and transferred to the treatment and disposal site by Dumper Placer vehicle for emptying the container. The Dumper Placer vehicle will leave an empty container at the location and take away the container filled with waste.

Combination of ***option 1 and option 2 is suggested*** for the Mirzapur. The cost option for the feasible option is provided in **Table 8-8.**

Table 8-8: Options for Secondary Waste Collection System – Cost Comparison

Options	Unit Cost	Total (Nos.)	Total (Rs.)
Dumper Placer	7,50,000.00	35	2,62,50,000.00
Refuse Compactor	13,50,000.00	20	2,70,00,000.00

Source: Author's Calculation

8.8.4 Street Sweeping

Street sweeping will be carried out by the ULB. The waste from street sweeping mainly consists of

- Natural waste, these include dust blown from unpaved areas, leaves and decayingvegetation.
- Human littering

The major sources of street wastes are natural wastes, road & traffic wastes and behavioral wastes. Natural wastes and road & traffic wastes are unavoidable and have to be cleaned by street sweeping process and the behavioral wastes are largely avoidable through efficient refuse collection service. Street sweeping should be designed to meet the following objectives:

- Keeping wastes off the roads and transfer it to secondary waste collection system
- Consider equipment which are suitable for large road network & movement of traffic
- Plan frequency of sweeping to avoid disturbance to human or vehicular movements

Option 1: Manual Street Sweeping

This option involves manual sweeping of street using equipment's like shovel, brooms and tricycles. Option 2: Street Sweeping Using Mechanical Sweepers

This option uses mechanical cleaning & vacuum suction to sweep roads, saves time and labour required for sweeping and also improves the sweeping quality. Mechanical street sweepers utilize brooms and belt conveyor to move debris from the ground into a hopper and are efficient in picking up wet leaves, large aggregate particles, small limbs, smashed cans, etc. High capacity sweepers can even pick up large chunks of debris & remove hard packed dirt. **Table 8-9** shows the street sweeping norms and **Table 8-10** shows comparison of the options for street sweeping and recommends the system.

Table 8-9: Street Sweeping Norms for Small towns or Small Cities or Mega Cities

Component	Small Town	Medium City	Mega City
Equipment's	• Long handled broom • Metal tray and metal plate • Containerised handcart or tricycle • Tractor with covered trolley • Container lifting device	• Long handled broom • Metal tray and metal plate • Containerised handcart or tricycle • Secondary storage bin • Dumper placer or compactor • Mechanical street sweeper • Container lifting device	• Long handled broom • Metal tray and metal plate • Containerised handcart or tricycle • Secondary storage bins • Dumper placer or compactor • Container lifting device • Mechanical street sweeper
Staff requirement based on road density	• High density roads: 1 person per 300 – 350 running meters of road length • Medium density roads: 1 person per 500 running meters of road length • Low density roads: 1 person per 750 – 1,000 meters of road length	• High density roads: 1 person per 300 – 350 running meters of road length • Medium density roads: 1 person per 500 running meters of road length • Low density roads: 1 person per 750 – 1,000 meters of road length	• High density roads: 1 person per 300–350 running meters road length • Medium density roads: 1 person per 500 running meters of road length • Low density roads: 1 person per 750–1,000 meters of road length

Source: MSWM Manual 2016

Table 8-10: Option for Street Sweeping

Particulars	Option 1 – Manual Street Weeping	Option 2 – Mechanical Street Sweeping	Recommended Option
Advantage	• Low capital and operating cost • Increase employment opportunity • Used in areas non-traversable by mechanical sweeper	• Less time consuming and cleans larger stretch • High cleaning efficiency (3000 to 30,000 sq. m per hour)	Manual sweeping for most of the areas Mechanical sweeping is recommended only in areas where road widths are at least 5 meters bituminous.
Disadvantage	• Ill effect on sanitary workers health • More time consuming • More labor requirement	• Less employment opportunities • Inefficient in congested areas	

For street sweeping either mechanical or manual sweeping or both can be adopted. The requirement for mechanical sweepers has been estimated based on the length and width of roads and on condition of road. Based on site visit and data obtained from Nagar Palika Parishad, there is requirement[6] of two mechanical sweepers. The Nagar Palika Parishad has one mechanical sweeper available therefore there is a requirement for one more mechanical sweeper.

All remaining roads can be covered using manual labor as the equipment maneuvering in these roads may be difficult. During the field visit, it was discussed that only 20 - 25 % of the total road length can be mechanically swept.

Manual street sweeping shall be undertaken after taking in to consideration the following requirements:

- Each sanitary worker shall do the sweeping and the cleaning of the tertiary and road side drains and transfer the sweepings into the bins of the push cart and subsequently deposit it into the secondary containers/ bins kept at the intersection of sweeping routes.
- Separate sanitary workers equipped with appropriate implements may do de-silting of larger drains.
- Part of the street sweeping can be outsourced to women SHGs or other agencies through a transparent process
- Sanitary services should not suffer due to absence of any sanitation worker. Therefore, adequate manpower should be available for manual street sweeping.

8.8.5 E - Waste

The problem of e-waste has become an immediate and long-term concern as its unregulated accumulation and recycling can lead to major environmental problems endangering human health. The creation of innovative and new technologies and the globalization of the economy have made a whole new range of products available and affordable to the people changing their lifestyles significantly. New electronic products have become an integral part of our daily lives providing us with more comfort, security, easy and faster acquisition and exchange of information. But on the other hand, it has also led to unrestrained resource consumption and an alarming waste generation. The rapid growth of technology, up gradation of technical innovations and a high rate of obsolescence in the electronics industry have led to one of the fastest growing waste streams in the world which consist of end of life electrical and electronic equipment products.

As E-Waste is not a part of Municipal Solid Waste and does not come under our scope of work, we are not considering it in our report. Nevertheless, it is a growing issue in the urban sector and should be dealt in a serious manner.

CHAPTER 9-

SYSTEM DESIGN AND INFRASTRUCTURE ASSESSMENT

ASSESSMENT

The objective of any MSW treatment initiative should be to minimize the waste quantity delivered to the processing plant and landfill. Reduce, reuse, recycle and recover concept shall be adopted to reduce the waste generation. The paper, plastics, glass and metals etc. can be reused and recycled. This will enable us to save the valuable resources, while saving energy for equivalent quantity of resources can be extracted from organic portion of waste and used, whereas the inert can be delivered to landfill.

The report has brought out the key issues of proper technology selection for MSW for identifying and assessing several treatment technological options available for particular waste composition of the NPP area. The evaluation with the commercial viability and technical feasibility of different alternatives and recommendation of the best suitable option(s) for treatment will increase the efficiency of solid waste disposal system.

The focus of the report is to evaluate the present situation of MSW disposal in MNNP area, based on site visits, available data after discussions and information provided by NPP official. An approach to design a sustainable MSW collection and transportation system to meet the future challenges is presented. Various criteria are covered, such as the appropriateness of different collection and transportation options for MSW of MNNP, modularity, upgradeability, suitability, regulatory acceptability, reliability and the environmental effects of technology, including cost involved. For designing the primary & secondary collection and transportation of MSW at Mirzapur, the following has been considered.

- MNNP comprises of 55 municipal wards covering an area of 13.12 km^2, has population of about 6.04 lakhs in 2011 and generates about 283.85 tons of municipal solid waste per day. Current treatment practice involves direct dumping of waste.
- The qualitative and quantitative assessment for solid waste is carried out at all the major sources of generation. The study was conducted by ECO PRO Engineers Pvt. Ltd., Agra during field visit in March and June 2017. Quantum of waste generation varies between 391 gm/capita/day.
- The census 2011 showed that the population of the Mirzapur is 234871; decadal growth rate of the Mirzapur has decreased from 60% to 39.58 %.Considering past trend of the population and present migration pattern of the city, the future population of city is projected and given in Table 5.1. It is estimated that the population of Mirzapur will reach up to 783806 by 2031; 873602 by 2041 and 918500 by 2046.

9.1 Proposed Waste Management System

The options analysis has resulted in the identification of a recommended system, the highlights of which are as follows:

Primary Waste Collection

- Door-to-door collection service supplemented with community bin services for residential areas;
- Tricycles/handcart/battery operated tricycle with containers are used for primary collection
- Auto tipper are generally used for hotels, market areas; and
- Segregation of waste is done by providing separate bins.
- Optimize vehicle usage by scheduling waste collection from different sources.

Secondary Waste Collection

- Compactor with Hydraulic Lift for stationary bins from residential areas; and
- Dumper Placer with Dumper Placer bins for markets and commercial area
- Collection of street sweeping waste Auto tipper.

The schematic diagram and route map of the proposed scheme for collection and transportation to processing plant is shown in **Figure 9-1**

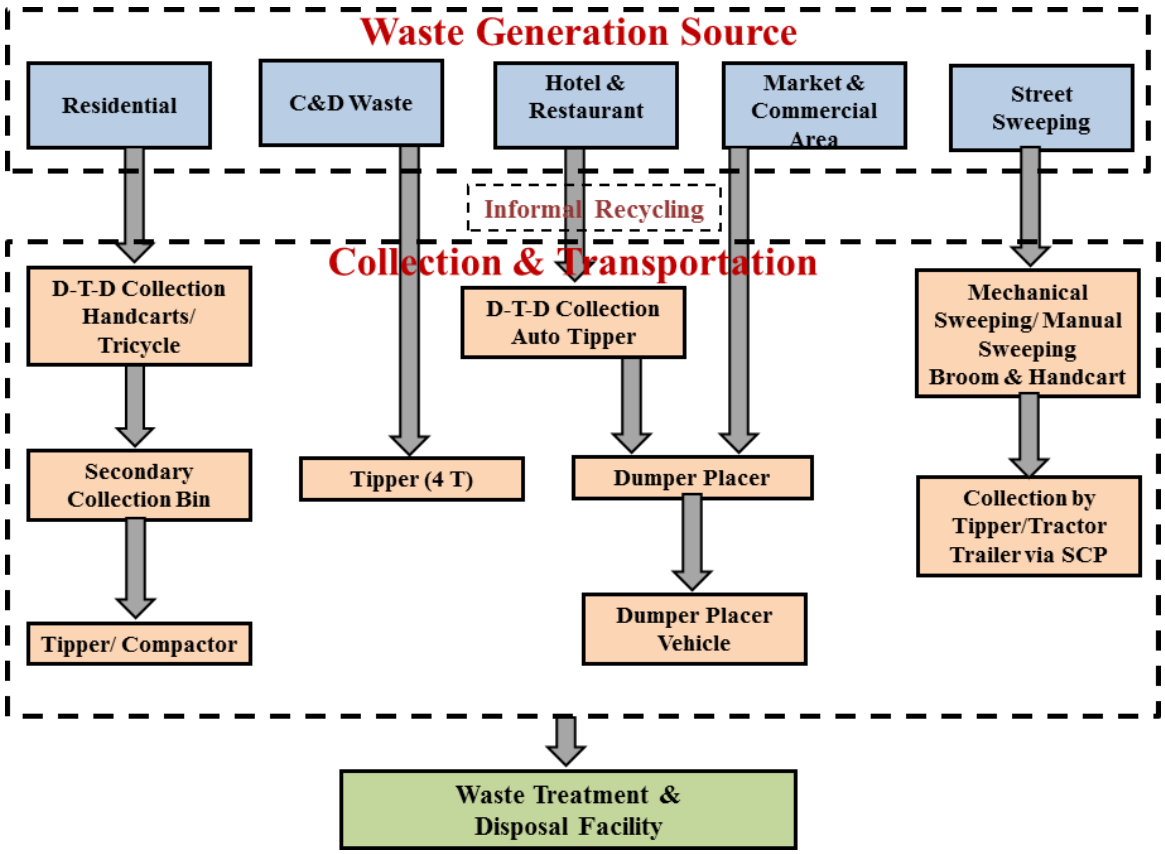


Figure 9-1: Proposed Scheme for Collection and Transportation

9.2 Basic Design – Waste Collection & Transportation

9.2.1 Primary Collection

Primary Collection is the first and prime activity in SWM. It is the practice of waste collection from its very source of generation. Primary collection includes 'house to house' or 'door to door' collection, collection of waste from commercial units like shops, hotels and restaurants. For planning and designing an effective, sustainable, cost effective and efficient primary collection system, the secondary information will be needed to determine and forecast for the planning period for each Ward of the ULB. The following options can be used for primary collection:

- Collection of garbage by Auto Tipper

It is necessary for MNNP to provide a daily service to all households, shops and establishments for the collection of bio-degradable waste from the doorstep because of the hot climatic conditions in the City. People could be advised or directed to put such waste in special bins kept in the City for disposal of such wastes as per the directions given by Nagar Palika Parishad.

Area	Activity	System	Vehicles/Equipments	Frequency
Residential	DTDC	Common Collection Bins	Auto Tipper /TATA Ace	Daily
Commercial	DTDC	-do-	Auto Tipper /TATA Ace/Compactor	Daily
All the above	Secondary Collection	Transfer Station/Dumpsite	Refuse Compactor and Dumper Placer	Daily

9.2.2 Secondary Collection and Transportation

The second activity in SWM service is the storage of waste to dustbin or Transfer station and transportation of same in larger transport vehicle, prior to dumping at the disposal site. Transportation of waste plays a vital role in SWM services. To enable designing a cost effective and efficient secondary collection system to synchronize with the operation of primary collection and transfer system, a detailed analysis of the secondary collection system and Transportation needs for planning horizon of 2018, 2023, 2028, 2033 and 2038 are made and described in this section.

Table 9-1: Total Vehicle, & Equipment Requirement for Primary & Secondary Collection and Transportation

Years	2018	2023	2028	2033	2038
Community Bin with capacity 1.1 cum	90	-	120	-	150
Community Bin with capacity 2.5 cum	40	-	55	-	70
Community Bin with capacity 4.5 cum	40	-	55	-	70
Accessories – secondary and primary (Shovel, Long handle broom, Metal tray with plate, Apron, Mask, Gloves, and Gumboot etc.)	LS	LS	LS	LS	LS
Refuse Compactor	2	6	10	15	20
Dumper Placer	5	13	20	27	35
Sweeping M/C	2	-	3	-	-
Auto Tipper	30	40	50	60	70

Years	2018	2023	2028	2033	2038
Hand cart with Bins	-	70	85	115	140
Tricycles with Bins	-	70	85	115	140
Dustbins households 12L	Requirement A/C to houses	Requirement A/C to houses	Requirement A/C to houses	Requirement A/C to houses	2,10,000

Inferences:-

- *Auto tipper are considered as 1 for EACH ward, so 38 for 38 wards.*
- *Dumper placer are considered as 1 for 4 wards in Mirzapur, so 6 will be the number taken.*
- *Refuse compactor are considered 6 as 1 RC for 5 wards.*
- *Road sweeping machine are taken as 2 as Mirzapur has not many broad roads machine will be taken for main roads for Mirzapur.*
- *Hand cart and tricycle bins are taken as 1 for rach wards so number considered is 76.*
- *Dustbins are taken 1 for each house, so 38185 is the no. of houses in Mirzapur so quantity taken is 76370 including extra for new houses and other places as well.*
- *Accessories are taken as lumpsum.*

CHAPTER 10-

CAPITAL COST AND ANNUAL *O & M* COST

CHAPTER 10- CAPITAL COST AND ANNUAL *O & M* COST

The cost for provision of MSW management services has been estimated for the collection, transportation, treatment and disposal of MSW for MNPP only. It is strongly recommended all existing infrastructure would be utilized first. We have considered all existing infrastructure to reduce capital and operation cost of this project.

A. Collection & Transportation

The cost for physical infrastructure components in the collection and transportation services includes procurement of following tools/equipments/vehicles:

a. Pushcarts and other street sweeping equipments like (long handle brooms, small brooms, gloves, boots, etc.) for street sweeping activities.
b. Auto Tipper for primary collection of waste from wards
c. Auto Tipper & Compactor for primary collection from Commercial, Hotels, Marriage homes, Institutional areas
d. Compactor and Dumper Placer for secondary collection to Dumpsite;
e. HDPE bins and community bins for primary collection from wards;
f. Dumper placers for transportation of MSW from various wards to Dumpsite.

Table 10-1: Abstract Cost for Proposed System of Collection and Transportation_2018

Sl. No.	Item	Unit Rate in INR	Required Number	Total Amount (INR) in Figures	Remarks (Unit Rate)
1	Community Bin with capacity 1.1 cum	35,000.00	60	2100000.00	Quotation from Gem portal
2	Community Bin with capacity 2.5 cum	50,000.00	20	1000000.00	Quotation from Gem portal
3	Community Bin with capacity 4.5 cum	67,300.00	10	673000.00	Quotation from Gem portal
4	Accessories – secondary and primary (Shovel, Long handle broom, Metal tray with plate, Apron, Mask, Gloves, and Gumboot etc.)	LS	LS	1500000.00	Taken as lumpsum
5	Auto Tipper	6,00,000.00	38	2,28,00,000.00	Quotation from Gem portal
6	Dumper Placer	7,50,000.00	6	4500000.00	Quotation from Gem portal
7	Refuse Compactor	13,50,000.00	5	6750000.00	Quotation from Gem portal
8	Backhoe Loader	24,50,000.00	2	4900000.00	
9	Road sweeping machine	24,38,000.00	2	4876000.00	Quotation from Gem portal
10	Hand cart with Bins	18,000	38	684000.00	Quotation from Gem portal

11	Tricycles with Bins	30,000	38	1140000.00	Quotation from Gem portal
12	Dustbins households 0.77L	96	40000	3840000.00	Quotation from Gem portal
Sub Total				**5,47,63,000.00**	
Contingencies (3%)				1642890.00	
Total				**56405890.00**	

(Source: prices of different appliances either from gem portal or budgetary qoutations mentioned in tables)

Note:

- *Requirement: CPHEEO manual 2016 "secondary waste storage capacities should be designed to accommodate atleast double the expected daily inflow of waste- sub section 2.3.9, page no.179.*
- *Considered for accessories rate as lumpsum*
- *Cost are included with all equipment's and vehicles.*
- *Accessories are including for manual road sweeping sweepers, door to door collecting sweepers, drain cleaning sweepers, other sweepers etc.*

Table 10-2: Operational Cost of Salary Expense for Primary Collection and Transportation

Sl. No.	Particulars	Unit	Quantity	Rate (INR)	Amount (INR)
1	Sanitary Inspector	Nos.	1	30000.00	30000.00
2	Supervisor	Nos.	8	20000.00	160000.00
3	Waste Collector	Nos.	76	10000.00	760000.00
4	Road Sweeper + Drain Cleaner	Nos.	20	10000.00	200000.00
5	Driver / Secondary Transport	Nos.	40	12000.00	480000.00
6	Office Management	Lumpsum			1,00,000.00
Salary of O&M Staff Per Month					**1730000.00**
Annual Salary of O&M Staff					**20760000.00**

Note:

- *Considered $^{1}/_{7}^{th}$ time extra for one day off for waste collector, road sweeper and drain cleaner, driver*
- *Considered for Road Sweeper and Drain Cleaner, 40% of the waste collector*
- *Waste collector/road sweeper daily wages rate as per PWD schedule, Govt. of UP INR 224.00 in 2015*
- *Driver daily wages rate as per PWD schedule, Govt. of UP INR 250.00 in 2015*
- *Considered salary per month for Sanitary Inspector and Supervisor as lumpsum*

Table 10-3: Annual Operation and Maintenance Cost for Primary Collection and Transportation Equipment's and Vehicles

Sl. No.	Item	Required Nos.	Annual O&M cost (INR)	Remarks
1	Hand cart	38	68400.00	Maintenance Cost @ 10% of handcart capex
2	Tricycle	38	114000.00	Maintenance Cost @ 10% of tricycle capex
3	Community Bin with capacity 2.5 cum	20	100000.00	Maintenance Cost @ 5% of total cost
4	Community Bin with capacity 1.1 cum	60	210000.00	Maintenance Cost @ 5% of total cost
5	Community Bin with capacity 4.5 cum	10	67300.00	Maintenance Cost @ 5% of total cost
6	Road sweeping machine	2	487600.00	Maintenance Cost @ 10% of vehicle cost
7	Auto Tipper	38	22,80,000.00	Maintenance Cost @ 10% of vehicle cost

8	Dumper Placer	6	450000.00	Maintenance Cost @ 10% of vehicle cost
9	Refuse Compactor	5	675000.00	Maintenance Cost @ 10% of vehicle cost
10	Backhoe Loader	2	490000.00	Maintenance Cost @ 10% of vehicle cost
Total			**2662300**	

TOTAL PROJECT COST- (**56405890.00+20760000.00+2662300.00**)

= **Rs. 7,98,28,190 (7.98 crores)**

Chapter 11:

RECOMMENDATIONS FROM PRESENT STUDY

11 RECOMMENDATIONS FROM PRESENT STUDY

The Solid Waste Management Plan for primary & secondary collection and transportation, within the above-mentioned design principles, will aim at detailing out the following recommendation for implementation

- It is recommended to minimize the volume of waste through effective waste minimization techniques which involves reuse, recycling and recovery. An effective waste minimization can reduce the costs, liabilities and regulatory burdens.
- Adoption of effective solid waste collection and transportation system will provide a framework for the development of a sustainable MSW service, which can take place with active involvement of the stakeholders.
- Source reduction and segregation should be encouraged. Source reduction will reduce the amount of waste generated, reuse materials will prevent them from entering the waste stream, and recycling will prevent materials from being disposed in landfills.
- Proper segregation of waste would lead to better options and opportunities for its treatment and scientific disposal. The municipal solid waste should be segregated into organic, inorganic, and recyclable waste, which has not been observed in current treatment practice of MNNP, but are mandatory as per Municipal Solid Waste (Management and Handling) Rules, 2016. Proper segregation ensures that one waste stream should not be mixed with other waste so that it can be taken to for treatment and disposal after segregation only.
- As per the Municipal Solid Waste (Management and Handling) Rules 2016, the municipal authority must treat the organic fraction of waste before disposal. All environment, health and safety precautionary measures supported with advanced monitoring system shall be taken and compliance of municipal solid waste handling rules and guidelines shall strictly be followed. Landfill sites shall be selected near the waste processing facility.
- MNNP needs to select appropriate recycling technologies to comply with mandatory directions of segregation or segregated dry waste like paper, card board, and plastic materials at the processing plants. Recycling should be done as a part of processing facility in order to dispose of the entire quantity of the waste received at processing plant effectively in scientific manner.
- The overall approach to the selection of treatment technologies is to comply with the mandatory, regulatory provisions of MSW Rules, CPHEEO guidelines and also satisfy the provisions of Environmental Protection Act, 1986. As a result, the treatment technology option selected shall be cost effective.

APPENDIX: SPECIFICATION OF SOLIDWASTE MANAGEMENT EQUIPMENT ANDMACHINERY

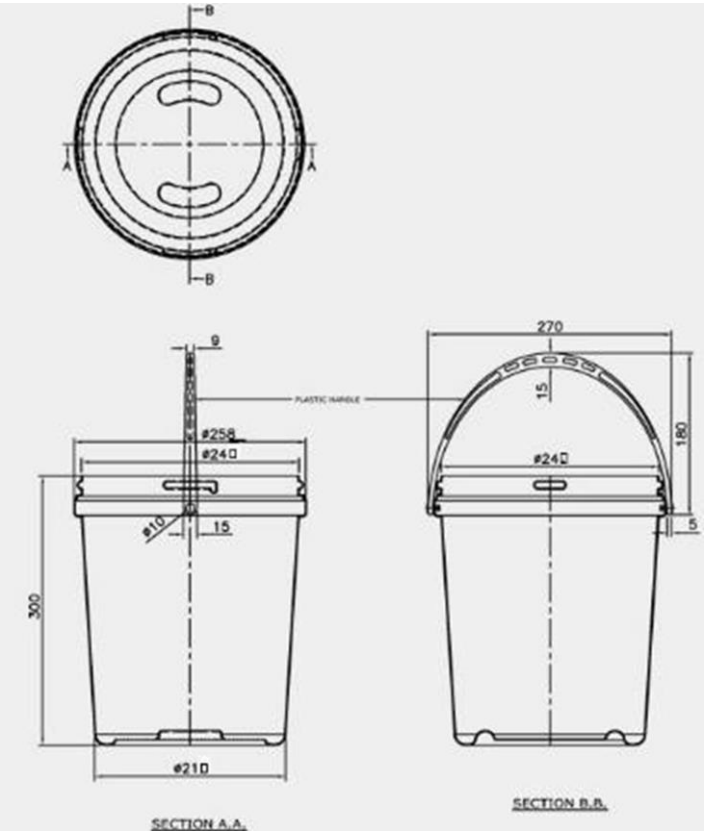
1. Domestic Bins of 12 Litres Capacity:

The bin shall be one piece moulded, heavy duty of approximately 12 litres capacity made out of virgin grade polyethylene material manufactured f

moulding process, absolutely smooth, chemical resistant, blended with stabilizers, anticorrosive, anti- acidic, non-toxic and free from joints, welds or rims provided with moulded projections and with moulded lids to prevent spreading of smell, flies, mosquitoes etc. The colour of the bins shall be as per prevalent colour codes or as approved by purchaser. Ingeneral, the Green bins shall be meant for storage of segregated biodegradable waste and white or blue bins for non- biodegradable/recyclable waste. The bins shall comply with the critical requirements of MSW Rules, 2016.

Specification of bins-

- Specially moulded projection for extra strength
- High impact strength; Twist type lockable lid; Round in shape without sharp corners or welds; Built-in bottom grip (2 nos.) for easy lifting of bin and unloading of waste
- Top diameter: 200 to 250mm
- Bottom diameter: 180 to 220mm
- Height: 250 to 320 mm
- Thickness: 1.5mm
- Volumetric Capacity: 12litres
- Lid : Fullyopenable
- Colour : Green and white or blue or asspecified.
- Durability: Reusable, washable, smoothandsanitarytosatisfythe critical needs of MSW Rules, 2016.
- Marking: Bin shall be embossed with manufacturer's logo and shall have capacity andULBs name prominently painted/stickered / screen printing over it.



Typical View of HH Bins

2. Hand Carts/ WheelBarrow

Containerized wheel barrow with 6 Nos waste containers, fabricated out of MS angles and flats to contain minimum of 6 waste containers ideal for solid waste management. to accommodate 6 waste containers and push it by hand for transfers the waste. The wheel barrow and containers should be capable for taking the loads according to use. Type: pushing type wheel barrow with raised handle of the same width of wheel barrow at about 820 mm height from the base at maximum angle 45°. The wheel barrow will contain 6 waste containers of not less than 20 litres capacity each.

Material :

Frame: M.S. Angles 25 X 25 X 5 and flat 25 X 5 Hubs: C.I. Axle : M.S. square bar 25 X 25 Handle : M.S. round bar 8 mm dimension

Bucket : Virgin grade of polyethylene
Wheels : Rear-M.S. flats & M.S. Tee, Front – HMHDPE
Dimension of the wheel bar row to accumulate the 6 containers easy to loading/ unloading Design:

Two vertical supports welded with cart provided with three wheels, should not be less than 250 mm from base and overall height of the frame from base should not be less than 500 mm.

Wheels: Two Rear wheels sturdy and strong fabricated out of MS flats & angles covered with superior quality 30 mm thick solid rubbers, should be reinforced with 8 numbers of strips connect the outer circumference to the hub capable to load bearing capacity. The hub of wheel should be minimum 70 mm dia. Suitable for 6204z bearing. Approximate size
500 mm diameter one front wheel of HMHDPE wheel of 200 mm diameter with hub &shaft.

Handle: Special round rubber grip of about 150 mm length will be provided on the handle for easy handling.

Waste Containers:

Application: For collection and transportation of solid wastes and suitable for being lifted by hand into wheel barrow.

Capacity: Container of 20 litres capacity

Material: Virgin Grade of Polyethylene material confirming to the requirement of IS 10146-1982, non- toxic, free from any contamination, chemical resistant, blended with stabilizers, anti-corrosive and anti- acidic.

Basic Qualities: Molded from special UV stabilized grades of polyethylene. 100% rust free and maintenance free. Safe In handling as no corrosion, cracking, blistering etc. .Colorful and elegant. Light weight and easy to handle. Hygienic and easy to clean, strong and durable.

Design: Rectangular in shape designed to prevent the sticking of wet waste and for easy and faster cleaning. Thickness should not be less than 3 mm. It should have 2 nos. molded inverted projection

or inverted all around projection for comfortable and safe lifting provided at bottom of the container. Each container should be covered with a lid of same material & same process of molding having a thickness of 3 mm with molded handle/ knob to lift it easily.

Manufactured from blow/Injection molding process, Molded with strengthening projection of not more than 40 mm height on the circumference. Four holes of 10 mm diameter each provided at bottom.

Durability: The container shall be 100% seamless, without any joints or welding hence no possibility of

Corrosion or contamination; Molded in one tough piece, non-toxic, strong and sturdy, absolutely smooth; Easy & safe to handle, lift by hand to satisfy the critical needs of SWM 2016.

Bucket manufacturing: The Buckets, with 3 mm thickness should be made by process of injection /rotor / blow molding. Test certificate is to be produce.

Size: 325 X 325 mm top and 290 X 290 mm on bottom approx. rectangular in shape with handle & 4 holes on bottom. Molded with one piece from virgin grade of HD polyethylene material absolutely smooth and sanitary, strong and sturdy fabricated & integrated with handle of MS provided with onelid / cover to prevent the smell/infection, ideal for storage and handling of solid waste.

Colour of waste containers: 3 bins of green colour and 3 bins of black colour in each hand cart or as specified by purchaser.

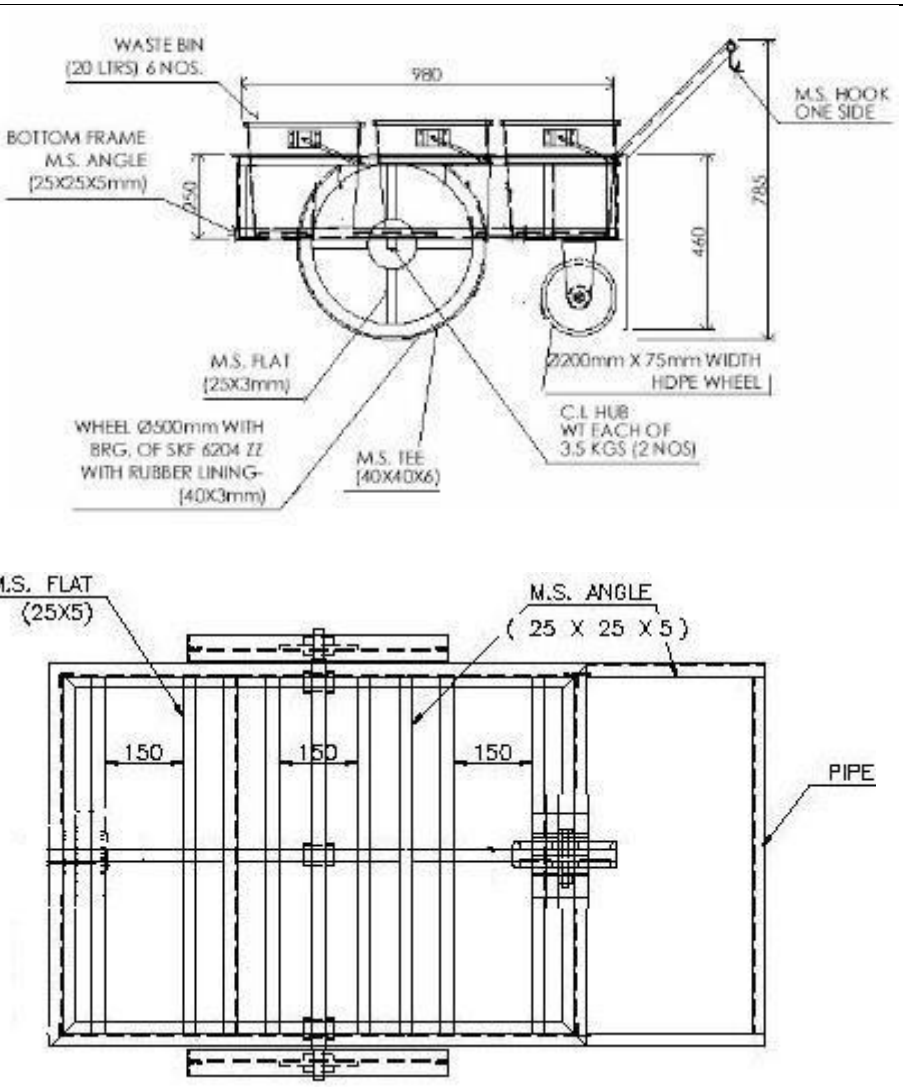
Handle: Strong and durable rec. handle, fabricated out of 8 mm MS rod with MS strips on two sides. And to be powder coated, should be strong enough to lift the load 25 litres capacity should adequately handle Solid Waste of at least 18 kg. up to 1 m height.

Name plate: For identification of the wheel barrow, MS plate is to be provided infront for easy readable and to be welded firmly with the frame as per dimension mention below:

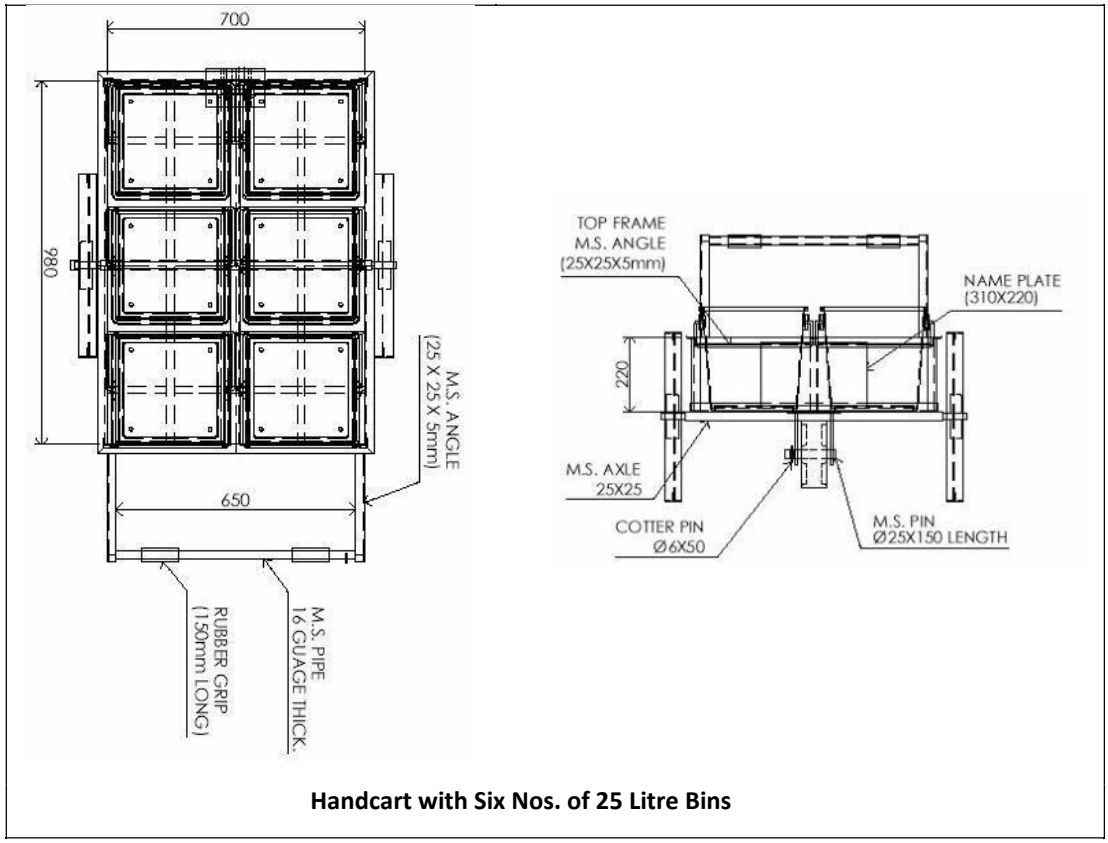
Length should not be more than 310mm.Width should not be more than 205mm approx. 20 letters to be written/ painted on the name plate, which should be minimum of 38 mm in size as per the colour shade approved by purchaser.

Accessories: Provision should be made for following additional accessories, quantity one with each wheel barrow. Long handle broom: length of broom 80 - 85 cm, weight of broom1 kg, binding material 20 gauge MS sheet ring having width of 1.5 - 2 cm, handle of broom bamboo of 135 cm length and 3 - 4 cm dia. Weight of the handle 0.9 kg, Collection plate: length 325 mm, width front 300 mm, width rear 250 mm, 22 gauge of MS sheet.

Metal plate: 100 X 250 mm sheet of 20-gauge, Bell: standard metal bell shall be mounted on the frame.



Typical Sectional View of Handcart



Handcart with Six Nos. of 25 Litre Bins

3. Specification of Containerized Cycle Rickshaw with Six (6) Numbers HDPE Container

Make of tri-cycle (cycle rickshaw): Bidder should specify its brand Make of HDPE Containers: Bidder should specify its brand

General: Frame of containerized tricycle shall be fabricated out of Mild Steel (MS). This frame is to be mounted on standard tricycle. It will be suitable to contain 6 waste containers ideal for storage and transfer of solid waste into city areas.

A. *Specifications of Containerized Cycle Rickshaw:*

Tricycle with sturdy 5 bar frames to contain six (06) waste containers, rectangular in shape of not less than 30 litre capacities; Minimum load bearing capacity of axel to be 400 kg.

Type: Tricycle with sturdy 5 bar frames with the rider to the front; big hubs with sealed bearings, two standard brakes and brake with lever reaching next to these at to lock vehicle in position; axle capacity of minimum 400 kg; color shade black.

Construction: 40 mm hollow section, MS tube minimum 2 mm thick or equivalent rectangular section to carry a maximum load of 400 Kg; 170 mm driving sprocket of anticorrosive material, sealed ball bearing, standard heavy-duty chain made of non-corrosive material with chain guard, anti-corrosive paddle with wear resistant rubber cover.

Cart: Rear carrier arrangement with support on rear axle of dimensions of about 1260 mm X 750 mm X300mm with tolerance of^{+}/-2% to accommodate 6 bins; made from sturdy tubular/ angular frame with 6 mm thick hooks placed at 30 cm c/c on top bar to

hang bags; the rear door on hinges, falling downwards with simple pin arrangement for locking; the frame next to the rider raised to a height of 600 mm; a closed hook of 16 mm rod for securing the tricycle.

Brakes: 2 standard brakes and one additional brake with a lever next to seat to lock the vehicle in position.

Wheels:
Total3wheelsofsize700mmX38mmfinthefrontand2motorcycletypeorspecifiedwheels in rear of size 300 mm X 18 mounted with sealed ball bearing; front rims shall be chromium plated and all wheels provided with mudguards; minimum 40 spokes of 12 gauge and tyre of 22ply.

Material: All mild steel material used for fabrication of tricycle and accessories should be of conforming to IS: 2062: 99(Updated).

Specification of Waste Container of HDPE

General Specifications: Molded in one piece from virgin grade of polyethylene material, absolutely non-toxic, free from any contamination and chemical reaction, UV stabilized, smooth, strong and sturdy fabricated & integrated with round handle of mild steel provided with one lid/cover to prevent the smell/infection, ideal for collection and transportation of solid waste

Capacity: Each container of 30 litres minimum capacity;

Material: Virgin Grade of Polyethylene material confirming to the requirement of IS 10146 - 1982, nontoxic, free from any contamination, chemical resistant, blended with stabilizers, anti-corrosive and anti-acidic.

Dimensions: Rectangular

Top size: 350 X 350 mm

Bottom size: 300 x 300 mm **Height**: 340 mm (minimum) Tolerance: +/- 5%

Basic Qualities:

Moulded from special UV stabilized grades of polyethylene. 100% rust free and maintenance free. Safe in handling as no corrosion, cracking, blistering etc. colorful and elegant. Light weight and easy to handle. hygienic and easy to clean, strong and durable.

Design:

Rectangular in shape designed to prevent the sticking of wet waste and for easy and faster cleaning; thickness of not less than 3 mm; should have 2 nos moulded inverted projection or inverted all around projection for comfortable and safe lifting provided at bottom of the container; each container should be covered with a lid of same material & same process of molding having a thickness of 3 mm with molded handle / knob to lift it easily; manufactured from Injection/ blow molding process.

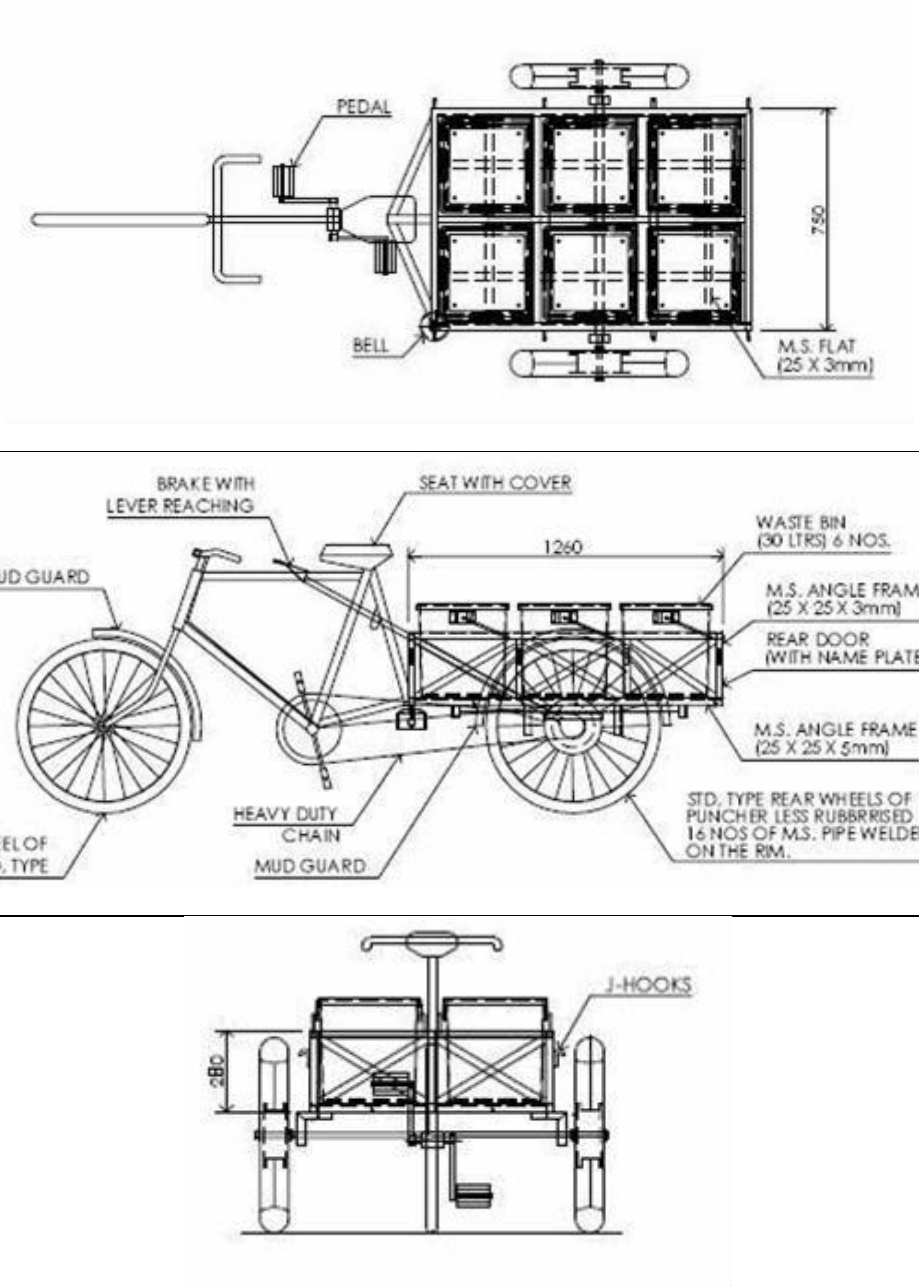
Moulded with strengthening projection of not more than 40mm height on the circumference; four holes of 10 mm diameter each provided at bottom.

Color: Green and Blue/Black as per directions of ULB

Handle: Strong & durable round handle fabricated out of 8mm MS rod with MS strip of 1.6mm thickness on two sides with heavy duty suitable rivets; the lifting handles are integrated with the strips; MS rod and strips are to be powder coated; should be strong enough to lift the load of 20kg upto the height of 1m.

Bell: Standard metal bell of diameter 100 mm and height of 70 mm shall be mounted suitably on the wheelbarrow as per client's requirement.

Painting: The equipment shall be painted with two coats of superior quality anti-corrosive primer with two coats of approved quality paint; the bidder shall get the paints and shades approved from ULB.



Typical View of Tricycles with Six Nos. of 30 Litre Bins

4. Secondary storage containers (MS) of 2.5 cubic meter

The container having compatibility with dumper placer carrier vehicle shall be closed type having minimum capacity of 2.5 cum.

Construction

- The vertical height of long side of the container (dumping side) should be more than 1.10meter & maximum height of top of the container more than 1.50meter.

- The side of the container shall be fabricated out of 2.5 mm thick M.S sheet
- Bottom out of 3 mm thick M.S Sheet. Top out of 2 mm thick M.S Sheet.
- Minimum 4 side opening door of size 700 mm X 400 mm fabricated out of 1.6 mm thick MS Sheet. Tail gate out of 1.6 mm thick M.S sheet.
- All side of container should be reinforced with IMC 75 mm X 40 mm and ISA 40 mm X 40 mm X5 mm & should have continuous welding.

Painting:

- After fabrication, the garbage container shall be thoroughly cleaned by wire brush to remove any loose material, mill scale or welding spatter.
- The container shall then be painted with two(2) coats of red oxide primer,1coat each of surface gray and/or silver paint.
- It should be followed by two (2) coats of finish paint of approved colour inside and bottom of the container shall be painted with 2 coats of black rubber paint.
- Name of Municipality: To be written on both side faces.

The overall size of the container shall be as under:

- Length - 1900 mm - 2200mm
- Width - 1200 mm - 1250mm
- Height - 1100 mm - 1150mm

Hooks for container lifting:

The hooks for lifting the bin would be integral to the framework of the bin. It shall be provided with the necessary reinforcement to handle the design weight for lifting with adequate factor of safety. The shape and size would be as per the design of the lifting tackle. The pin position and other parts of dumper placer containers shall be compatible to dumper placer units for easy operation.

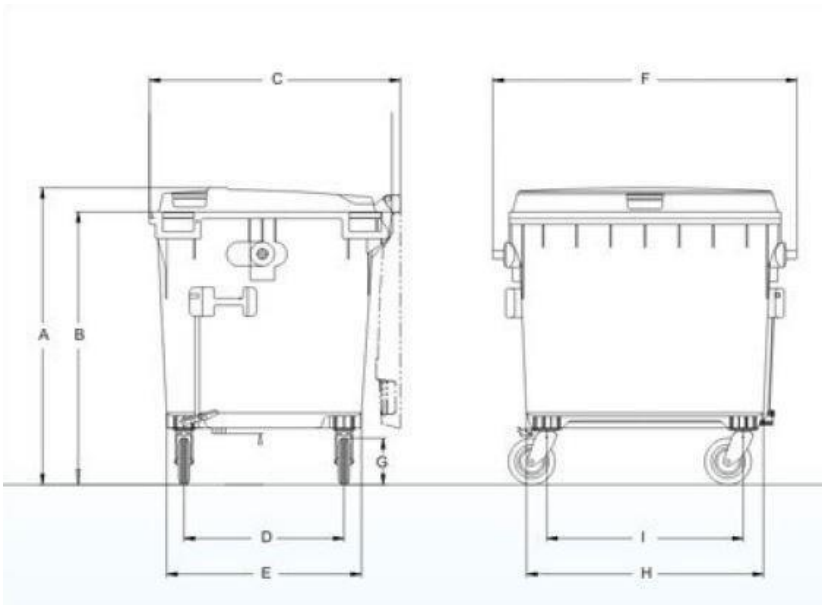
5. Secondary storage containers of 1.1 cum capacity

Stainless garbage bins for waste collection shall be provided with 4 castor wheels with blocking system. The garbage collection bins shall be of 1100 lts. capacity. These shall be closed type hygienic bins. The bin construction shall be of pressed M.S sheet for ensuring adequate structural strength required for handling with the compactor bin lifter. Also, bin shall be designed to be lightweight and with facility to be easily handled by two bin handlers.

Standard container shall have:

- Base material –steel
- LID: The metallic bin shall have a cover of plastic Injection moulded High Density Polyethylene (HDPE) hinged at one end, which shall open freely while unloading. The material shall be resistant to heat and chemicals.
- Dead weight: 125 Kg(approx.)
- Load capacity: 600 Kg(approx.)
- Adjustable spring supported lid for easy opening and closing
- Rubber Profile on the lid, which shall protect fingers before closing the lid of sections min. 3 cms between body and lid
- Handles on body
- Handle on the lid
- Painted Deep Green outside and dull black inside, along with special slogans as decided by the corporation.

- Indicative Internal dimension of the container (length, width and depth) – 1160X850X920 mm
- Upper frame angle and lower frame angles for bottom of 50 X 50 X 5 mm size.
- Side frame vertical angles (four nos.) of 50 X 50 X 5 mm size.
- Outside support on container's both Length side opposite walls of 75 X 5 mm Flat.
- Outside support on container's both width sides opposite walls of 50 X 50 X 5 mm angle. Two supports in horizontal, one upper horizontal support shall be for mounting of lifting pin made of 100 X 50 mm channel and another one made of 50 X 50 X 5angle.
- Lifting pins on both width sides of 45mm outer diameter with 4mm thick and 120 mm long MS pipe. These pins shall consist of stoppers on their both ends by 65 X 65 mm or 65 mm dia. 4 mm thick steel sheet.
- Lifting pins shall be mounted on upper horizontal side support of 100 X 50 mm channel. To support these pins, an additional horizontal 100 X 50 mm flat shall be provided inside the channel.
- Bottom of the container shall be supported by 2 nos. 100 X 50 mm channel in width and cross supported by 50 X 50 X 5angle.
- Containers shall stand over 4 nos. mild steel legs. Each leg shall be made of 120 mm long, made of 3" B class GI pipe. These legs shall be capped by 4 mm thick mild steel plate and welded with the bottom channel of 100 X 50 mm channel.
- The bins shall be designed to be lifted by compactors having universal bin lifters.
- The entire GI sheet shall be riveted with the solid rivet of aluminium / GI nut bolt of suitable size, no welding will allow on GI sheet except hooks and handles.



Constraint	Dimension in mm
A	1295
B	1215
C	1118
D	750
E	880
F	1370
G	ϕ 200
H	1090
I	850

6. Technical specifications of 8 cum volume refuse compactor vehicle (RCV) with universal lifting arrangement & tip cart system

Specification of Refuse Compactor Vehicle (RCV)

The Refuse Compactor Vehicle shall be easy to handle and allow the bin handlers to unload Solid Waste from the Bins into the Machine Tailgate hopper with minimum physical effort and maximum safety. Hand lever arrangement for operation of Compaction Cycle shall be provided. The Tailgate loading height shall not be more than 1.2 meters from the ground level.

The RCV Volume would be $8m^3$. The Tail gate hopper volume will be minimum 1.1 cubicmeter. The bin lifter should be also able to unload garbage simultaneously from two bins of size upto 240 Liters.

Refuse Collection Body

The refuse collection body shall be of 7 m^3 volume and be in torsion-free steel construction. The bottom, the side walls and the top must be dome shaped without any vertical stiffeners / ribs.

Roof panel thickness – Minimum 4 mm Side Panel thickness – Minimum 4 mm Floor thickness – Minimum 4 mm

The tailgate bearing and automatic tail gate locking shall be integrated into the rear frame of the body. The Ejection Plate shall run on synthetic guide blocks within the lateral longitudinal guides of the boat-type bottom group of the refuse collection body and must be operated by a telescopic hydraulic ram. A hydraulic control unit will regulate the withdrawal of the ejection panel during the loading process, so that the compaction is optimized. It must serve during loading as a resistance for the refuse compaction process.

TAILGATE

The tail gate shall unlock automatically and raise, to permit ejection of refuse from RCV hopper when hydraulic valve is actuated. There shall be automatic locking arrangement between tailgate and RCV hopper body. This locking system shall be completely liquid proof between tailgates and refuse collection body by using double rubber lip seal.

The Tailgate hopper shall have a Volume of minimum 1.1 m^3

Slide plate – The Slide Plate shall be actuated by 2 Hydraulic Cylinders and must run on suitable number of sliding blocks. Material of construction – IS 2062.

Packer Plate – The Packer Plate shall be actuated by 2 Hydraulic Cylinders.

TAILGATE HOPPER

Material of construction – DOMEX / HARDOX Steel

HYDRAULIC SYSTEM

The RCV shall be equipped with following hydraulic system:

Hydraulic Pump/Dual Hydraulic Pump

a) One pump supplying the pressurized hydraulic oil for Telescopic cylinder of Ejection panel, tail gate lifting & closing and bin lifting & tilting operations.
b) Another pump for operation of compaction cycle i.e. operation of sliding plate and packer plate. All hydraulic functions are achieved by the below major components:
    I. Hand operated mobile control valves supplying controlled hydraulic oil proportionally with its actuation along with integral load holding check valves to prevent reverse flow through valve when shifting.
    II. Remote pilot operated two-way valves along with pressure relief valve for creating a hydraulic resistance during withdrawal of the ejection panel for the refuse compaction process.

III. Over center valve creating a back pressure to prevent the load from free falling or over-run during lowering.
IV. 07 Hydraulic Cylinders shall be installed covering following operation.
    - 1 three-stage telescopic ram, double-acting for the ejection panel.
    - 2 hydraulic rams, double-acting for the slide plate
    - Double acting Slide-cylinders (for compacting) shall be located outside of the side walls.
    - The cylinders are mounted in pushing position.
    - 2 hydraulic rams, double-acting for the packer plate
    - 2 hydraulic rams, double-acting for the tailgate (lifting/lowering and automatic locking)

All Cylinders shall be of reputed make:- WIPRO / DANTAL / CANARA.
Working light, Rotating Beacon light, backing light, stop light, direction indicator and number plate light to be provided in the RCV.

GARBAGE LOADING SYSTEM/DEVICES

The equipment can be provided with following optional attachments for unloading the garbage into the tailgate hopper.

UNIVERSAL BIN LIFTER

The Universal Bin Lifter is capable of directly lifting and empting the garbage from a DIN Standard Bin of 1100 Ltrs. / 660 Ltrs. capacity into the tailgate hopper. The Bin Lifter is also capable of lifting and empting the garbage simultaneously from 2 Nos. DIN Standard Bins of upto 240Ltrs. Capacity. The Bin Lifter shall be provided with 4 hydraulic cylinders i.e. 2 cylinders for leveling and lifting the Bin and 2 cylinders for tipping operations.

TIP CART SYSTEM

The unit is also provided with detachable tip cart/bucket which is capable of receiving garbage directly from Auto Tippers, Rickshaws, handcarts/ wheel barrows etc. and emptying the garbage into the tail gate hopper of Refuse Compactor.
The total number of hydraulic cylinders in the equipment fitted with Universal Bin Lifter System and tip cart system shall be 11 Nos.

SAFETY FEATURES

Hose burst valve shall be fitted to the system to prevent the tailgate descending in the event of the hydraulic failure. There shall be a body prop provided on the tail gate to hold the tailgate in the open position for safety of workshop personnel when entering the body for maintenance or repair.

PAINTING

The entire unit shall be painted with two coats of superior quality anti-corrosive primer with two coats of approved quality paint to ensure long lasting, resistance to rust,

weathering and breakage. The color shade shall be purchaser's choice selected from the standard colors offered by the supplier.

Truck chassis

The equipment is suitable for mounting on 11 T GVW Truck Chassis, Wheel Base Min. 3400 mm with Driver's Cabin and PTO.

7. Twin Bin Dumper Placer for 2.5 cum capacity containers

The dumper placer/ carrier vehicle (chassis and cab) shall be rugged and durable, shall incorporate the latest technological features offered by the manufacturer/supplier. The truck chassis shall support hydraulically operated hoisting mechanism to load, offload and tip the twin containers of 2.5 cum capacity. The dumper placer shall comprise of two pairs of lift arms each actuated by double acting high-pressure rams, manually operated tipping hooks, hydraulic ball & plate type stabilizers and hydraulic system duly mounted on truck chassis with cab & PTO. Lifting arrangement shall be on the sides of the vehicle. The equipment shall confirm to the following requirements.

Basic specification:

Complete chassis kerb weight with cab only (with spare wheel and tools) shall be as per IS-9211.

a)	Make	:	Tata/Ashok Leyland/ Eicher
b)	GVW	:	Not less than 7200 Kg
c)	Pay load	:	5500 kg Minimum
d)	Engine	:	Euro IV, Turbo charged, minimum 85 HP
e)	Clutch	:	Single plate dry friction type
f)	Gear Box	:	Synchromesh type
g)	PTO	:	Power take off unit should be supplied

h) Frame: A pair of full length heavy duty box section sub-frame made of 75X40 mm and 125 X 65 mm cross sections mounted on the chassis through "U" bolts &nuts.

i) Suspension: Semi elliptical leaf spring at front and rear with auxiliary springs at rear only.

j) Cab: All steel, semi forward / full forward control driver's cab. Cabin should have minimum two nos. foam padded adjustable seats with seat belts. Cab should have all standard accessories provided by the chassis manufacturer and required under Motor Vehicles act.

k) Painting: Complete truck chassis along with dumper placer mechanism and the platform shall be thoroughly cleaned as per standard industrial practice and then applied with primer paint followed by two coats of automobile grade Paint of color shade specified by the purchaser.

Hydraulically-operated hoisting mechanism:

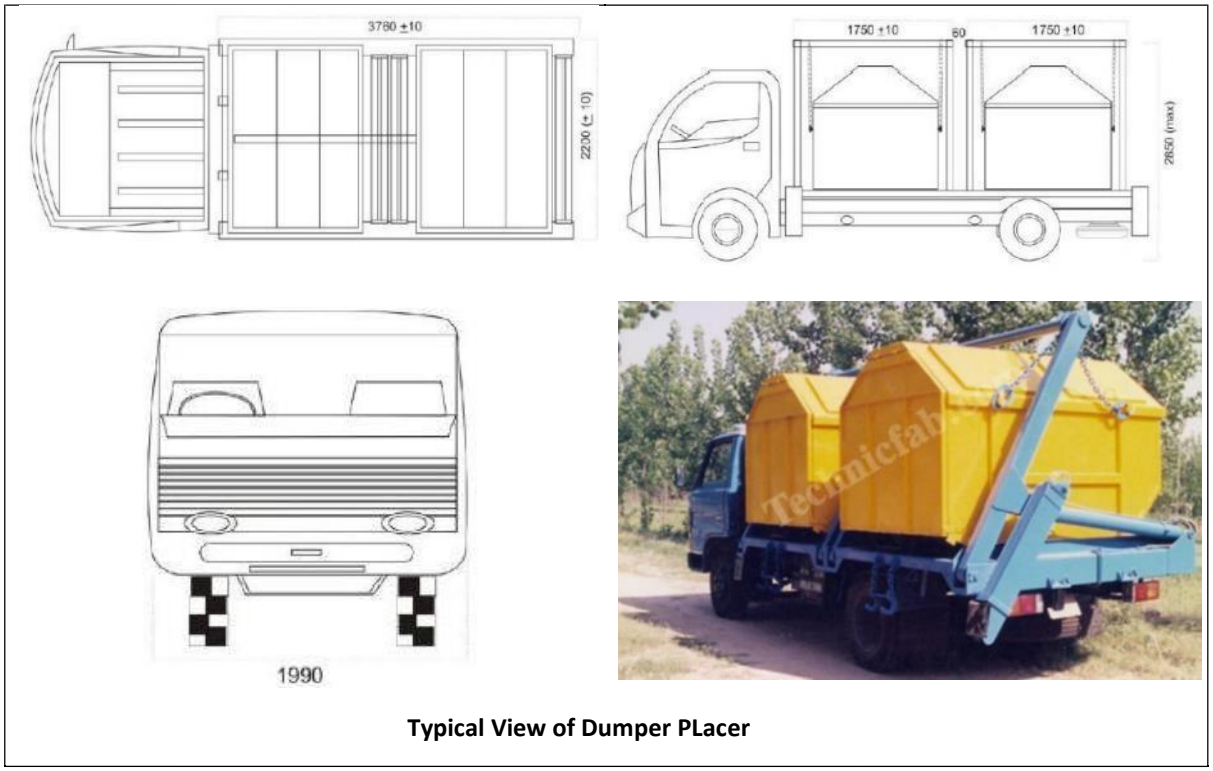
Main frame: Main frame shall be box type, made from pressed steel sections mounted on vehicle chassis through rolled mild steel channel sub-frame.

Rear-end: It shall be aesthetically pleasing and provide greater ground clearance using fix geometry for stabilizing arm movement.

Bed: The bed shall be made with adequate number of horizontal and longitudinal ISMC sections. 3-mm thick MS sheet shall be welded on top of the frame.

Boom rams: Two sets of double acting type boom rams suitable to handle twin containers shall be provided. The cylinders shall be of minimum 100-mm dia.

Boom arms: Two heavy-duty booms, having length as per design requirement of the equipment and complying with CMVR. These booms should be of welded construction.
Cylinder Guards: Cylinder guards shall be provided along the chassis length to protect lifting cum tipping cylinders on either side of the chassis.
Stabilizers: Two nos. independently controlled stabilizers, ball and plate type operating through hydraulic cylinder shall be provided to keep the vehicle leveled even on un-even surface and to balance the vehicle during loading/ unloading of containers.
Hydraulic Cylinders: Hydraulic cylinders shall be manufactured out of tubes confirming standard and shall have adequate capacity to undertake loading/unloading of containers 20 cum capacity when full and stabilizers without any adverse effect on the dumper placer or failure of cylinders. The operating pressure of hydraulic system shall be 140 kg/cm sq.
Hydraulic pressure Hose: Synthetic oil resistant rubber, double wire braided; working pressure 4500 psi, testing pressure 9000 psi, and bursting pressure 19000 psi; make gates or equivalent.
Control Valve: Spool Type hydraulic control valve is to be provided for all operations with levers accessible from driver's seat in the cabin for easy & comfortable operation. All spools should be self- centering type. A pressure relief valve is to be provided in the hydraulic circuit.
PINS: All pins used on the equipment will be made of En8 material, ground finished and hard chrome plated for longer life.



Typical View of Dumper PLacer

8. Tractor Trolley

The technical specifications of the equipment required by the purchaser are indicated in preceding paragraph. The Bidders shall complete the technical specifications for the goods offered in their entirety so as to demonstrate their compliance with the requirements of the bidding documents. Tractor, trolley shall be used for day to day multi activities by the ULBs.

Tractor

The tractor should be rugged and durable, and designed for ease of maneuverability and proper distribution of tractor, and axle induced stresses. The frame/chassis should be either fully welded or rigidly bolted to achieve this, in accordance with the manufacturer's standard procedures. It should be suitable for working under adverse site conditions, and the power train should be designed for this purpose

Basic Specification:

a) Type: tractor complete with trolley attachment provision.
b) Structure: Rugged, fully welded, durable and designed for durability and proper distribution of induced stresses.
c) Engine: Minimum Euro 2, fuel efficient, Turbo charged, 4 stroke OHV direct injection diesel engine. Minimum gross horse-power rating: 35 HP (27 KW) at manufacturer's rated RPM.
d) Cylinder: Minimum three cylinders vertical in line – 3 cylinder DI engine with integral cylinder head
e) Fuel Injection: In line fuel injection pump with variable speed mechanical governor.
f) Fuel System: Gravity and forced feed, fuel tank capacity not less than 30litres and fuel filtration should be dual stage.
g) Air Cleaner: should be of oil bath type with cyclone type transparent pre-cleaner.
h) Lubrication: Forced feed and splash type with full flow filter paper element
i) Cooling: Impeller type water pump, fan and radiator, forced feed water circulation.
j) Compression Ratio: More than17:1
k) Transmission : 8 forward and 2 reverse gears
l) Clutch: Single/Double plate dry friction type
m) Gear: 4 forward and 1reverse
n) Steering: Worm and nut type with re-circulating balls
o) Brakes : Shoe/Disk Type, Emergency brakes: hand brake with parking latch
p) Electric System : Voltage: 12 volts, Battery capacity: 12 volts, 60 Amps/hr @ 5 hr rating, Alternator capacity: minimum 12 volts 13 Amp, Head lights: 2 nos. 12 V -36 W, Brake light: 2 nos. 12 V-21, Rear light: (plough lamp)-1
q) Instrument Panel: it should have tachometer and hour meter, water temperature gauge, oil pressure gauge, ampere meter, fuel gauge, high beam indicator, left and right turn indicators, hazard warning switch, hand and foot accelerator etc.
r) Seat: longitudinal adjustable with back rest and hydraulic shock absorber
s) Wheel and Tyres: No. of wheels: Front: 2, Rear:2.
t) Hydraulics: Hydraulic system with ADDC, single acting cylinder position and mixed control provision for external circuit for double acting cylinders.
u) Painting: Paint process and paint should be superior quality to ensure long lasting structure resistant to rust, weathering and breakage.

Warning System and Essential Accessories:

a) Digital Hour mete
b) Fuel gauge
c) Water temperature gauge
d) Engine oil pressure gauge with warning light
e) Ammeter supported with warning light
f) Horn- 2pieces
g) External rear view mirrors
h) Radiator protection grill
i) Head and tail lights, cabin lights, reversing light and traffic indicator
j) Spare wheel with tyre and inner tube
k) Jack and wheel wrench
l) Anti-theft steering lock
m) Speedometer

Drawings:
The bidder should provide drawings of the goods/equipment proposed with the bid and the selected bidder should submit the working drawing for approval of the Purchaser during contract execution.

Tractor Trolley

The Tractor trolley should be rugged and durable, and designed for ease of maneuverability and proper distribution of tractor, and axle induced stresses. Tractor drawn tipping trolley should have box type load body having minimum 3cum capacity, suitable to transport and unload upto3 tonnes for all types of road gradient.

Basic Specification

a) Type: Trolley complete with proper attachment provision with tractor.
b) Structure: Rugged, fully welded, durable and designed for durability and proper distribution of induced stresses.
c) Main Chassis: ISMC 150 X 75 mm channel - 1set.
d) Sub Frame: ISMC 125 X 65 mm - 2Nos.
e) Hitch Beam: Fabricated from MS plate- press formed and welded ISMC channel 1no.
f) Cross Member: ISMC 75 X 40 mm channel -10nos.
g) Eye Hitch: Forged steel and heat treated– 1no.
h) Rear Doors: 3.00 mm HR sheet with reinforcement of 75 X 40ISMC
i) Axle: EN-8 - 63 mmsq.
j) Wheels: Ring Type – 8 mm thick – 2nos.
k) Breaks: Parking breaks – 1set
l) Tyres: 900 X 20-16 ply – 2 nos. of standard make (approved by purchaser)
m) Hydraulic Jacks: Single ram 5 - tonnes capacity hydraulic jack with minimum tipping angle of 50degree.

Painting and Lettering:
The entire surface should be first cleaned by sand blasting or any other appropriate method and given a coat of anti-corrosive primer. Bituminous or any other anti-corrosive paint shall be applied to the inside surface of the body, whereas outside surface shall be finished with two or more coats of air drying enamel paint of desired shade and colour as approved by purchaser. The bidder should get the colouring paint/ name & slogan writing approved from the purchaser.

9. Specification of Tipper of 1.5 m^3 (Three-Wheeler)

Description		Specification
Vehicle	:	Three-wheeler
Capacity	:	Upto 1.5 cum
Material	:	18-gauge M.S.C.R. sheet riveted on sides, Bottom 16 gauges MS Sheet.
Top Cover	:	From metal having 2 no open able lids either side, one flap rear side. One compartment for organic garbage $^1/_3$ of total volume & balance for inorganic garbage.
Performance		
Loading Height	:	1425 mm
Unloading Height	:	1300 mm
Tipping Angle	:	85 degrees

Unloading Time	:	20±5 sec
Bucket dimensions		
Overall Height	:	765 mm
Overall Width	:	1450 mm
Overall Length	:	1700 mm
Hydraulic pump		
Make	:	DOWTY or equivalent
Capacity	:	0.3 GPM at 1500 RPM
Drive	:	Pump drive is taken from vehicles engine
Hydraulic cylinder for bucket		
Type	:	Single acting
Material	:	M.S. honed tube & induction hard chrome plated piston rod of EN-8 material.
Stabilizer		
Operation	:	Hydraulically operated automatic jack
Accessories & safety		
	:	• Control for tipping: Ergonomically placed control in Driver's cabin for tipping of the hooper bucket & rear support (Stabilizer Activation) • Positive manual locking system for the bucket while engine maintenance process is on. • Boom cylinder cannot be operated until stabilizer is employed. • Bell is provided with the unit, useful for door-to-door garbage collection.
Paint		
Base for Aluminium base for M.S.	:	Zinc Yellow Oxide Primer (anti corrosive primer)

Description		**Specification**
Finish	:	Inside 1 coat epoxy black. Outside 2 coats synthetic enamel
Colour	:	As per choice
Engine		
Type	:	Four Stroke, single cylinder, IDI, Compression ignition
Cooling Type	:	Forced air cooled & Oil cooled
Displacement	:	416 cc
Max Power	:	8.5 bhp (6.25 kW) @ 3600 rpm
Max Torque	:	20 Nm @ 2400 rpm
Ignition Type	:	Electric start
Transmission Type	:	4 forward & 1 reverse gear
Clutch Type	:	Single plate, dry friction type, foot operated Suspended type
Electrical system		
System	:	System 12 V DC
Chassis		
Chassis Type	:	Semi Monocoque

Suspension

Front Suspension	:	Anti-drive leading link with helical compression spring & shock absorber
Rear Suspension	:	Independent suspension with spring and shock absorber

Tyres

Front Tyre Size	:	4.5x10, 8 PR
Rear Tyre Size	:	4.5x10, 8 PR

Brakes

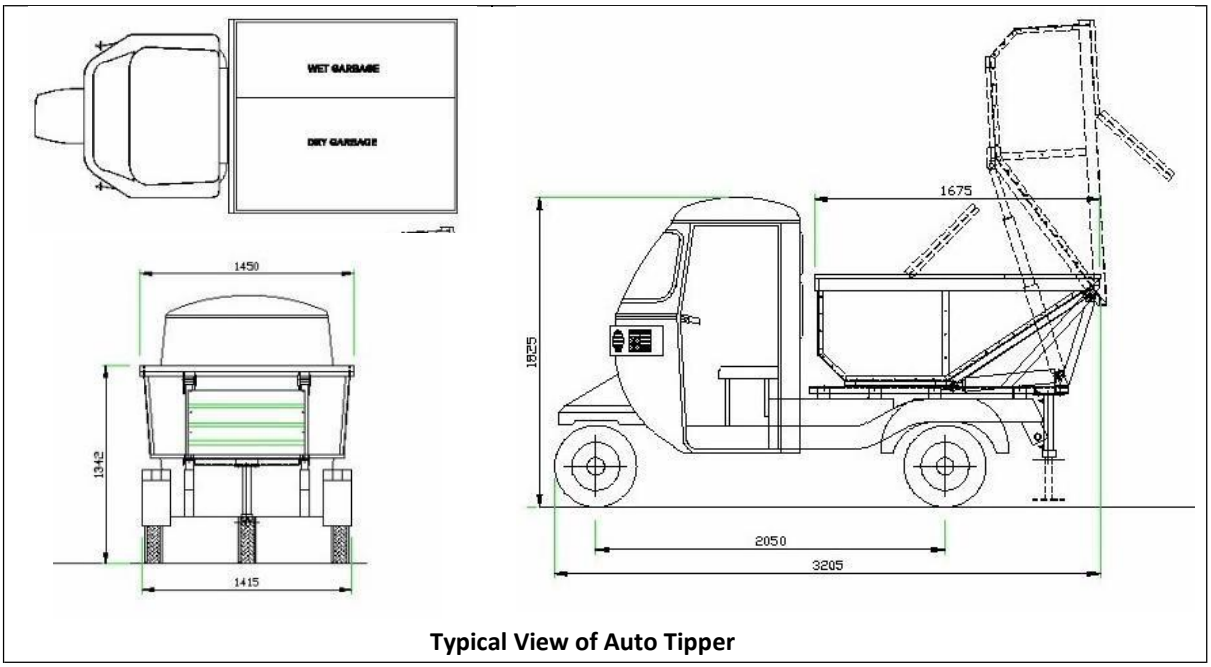
Front Brakes	:	Hydraulic brakes with auto adjuster
Rear Brakes	:	Hydraulic brakes with auto adjuster

Fuel tank

Fuel Tank Capacity	:	12 litres

Dimensions

Overall length	:	2960 mm
Overall width	:	1375 mm



Typical View of Auto Tipper

10. Specification of Battery Operated Tricycle

Description	Specification
Driving Mechanism	Pedestal Chain
Frame Structure	Made of MS Tubes
Diameter of MS Tube	28.6 mm
Thickness of MS Tube	1.63 mm
Length of Tricycle	2680 mm
Cart Frame Material	MS angle of size 25 x 25 x 3 mm
Drive (Chain Type)	Central axis differential drive
Length of Cart	1500 mm
Width of Cart	1000 mm
Height of Cart	300 mm
Material of Bottom Plate of Cart	Mild steel plate

Thickness of Bottom Plate of Cart	3 mm
Holes in Bottom Plate of Cart	Having 12 mm diameter holes at a distance of 200 mm square matrix
Lengthwise Number of Stiffeners Below the Plate form to Support the MS Plate	3 nos.
Width wise Number of Stiffeners Below the Plate form To Support the MS Plate	1 nos.
Stiffener Material	M S angle of size 25 x 25 x 3 mm
Bell	Yes
Two Reflectors at Back	Yes
Type of Reflector	Plastic
Lock for Locking the Tricycle	Yes
Tool Kit	Yes
First Aid Box	Yes
Tricycle Seat with Cover	Yes
Hangers for Broom and Wiper	Yes
Finish of Handle	Nickel and Chrome Plated
Finish of Chain Wheel	Nickel and Chrome Plated
Finish of Crank	Nickel and Chrome Plated
Finish of Rim	Nickel and Chrome Plated
Number of Front Wheel	1 nos.
Type of Front Wheel	Puncher less Rubberised Wheel
Front Rim Diameter	90:90:12 mm
Front Rim Width	2.15J x 12 mm
Front Rim Thickness	2.15J X 12 mm
Number of Spikes in Front Wheel	0 Nos
Diameter of Spike of Front Wheel	NA
Number of Rear Wheels	2 nos.
Type of Rear Wheels	Puncher less Rubberised Wheel
Forward & Reverse (Gear Type)	Available
Rear Rim Diameter	90:90:12 mm
Rear Rim Width	2.15J X 12 mm
Rear Rim Thickness	2.15J X 12 mm
Number of Spikes in Rear Wheel	0 Nos
Brake System	Drum with pedal
Battery Type	Lead – Acid Battery
Thickness of Spike of Rear Wheel	NA mm
Daimeter/ Width of Spike in Rear Wheel	0 mm
Support Details of Rear Wheels	Axel with brake drums
Number of Plastic Containers with Lid and Handle	8 nos.
Minimum Capacity of the Each Container	40 litres
Material of the Container And Lid	Virgin HDPE

Material of Handle of Container	MS Sheet
Minimum Wall Thickness of the Plastic Container And Lid	4 mm
Maximum Ash Content of the Container and Lid When Tested as per IS 14887/2014	1 %
Loading Capacity of the Tricycle	400 Kg
Suspension Front (Heavy Loading Type)	Telescopic Suspension
Suspension Rear (Heavy Loading Type)	Leaf Spring
Charging Time	6 – 7 Hrs
Colour of the Container nnd Lid	Green for wet and Blue for dry or specified by the purchaser
Pre-treatment	Two coats of red oxide after phosphate before painting
Paint	Powder Coating
Colour of the Frame	Yellow or Red or as per requirement or specified by the purchaser
Colour of the Cart	16 viscosity
Manufacturer 's Name Marked on the Tricycle	Yes
Year of Manufacturing Marked on the Tricycle	Yes
Manufacturer Drawing No.	NA

11. Truck with hydraulic lift for Transportation of Solid Waste 10 cum. Capacity

Truck chassis shall be TATA/ ASHOK LEYLAND/ EICHER/ FORCE make.

The tipping truck shall be rugged and shall incorporate latest technological features offered by the manufacturer. The vehicle shall be suitable for use to load around 10 cum garbage/debris/ waste at transfer station/compost plant, transport to landfill and unload it by tipping or by any other suitable arrangement. The vehicle should have provision to transport the garbage in covered and packed condition. Hydraulically operated covers are to be provided in such a manner that the top of load body remain fully open at the time of loading of garbage, whereas it is fully covered during transportation. The equipment shall confirm to the following specifications.

Truck Chassis

Gross vehicle weight	:	Minimum 16000 Kg.
Engine	:	Min. 120 HP (approx.) at rated RPM BS-IV Model
Gear Box	:	Synchromesh type
No. of Gears	:	5 forward and 1 reverse
Wheel base	:	Minimum 3600 mm

The truck chassis shall be suitable to handle the specified load provide satisfactory service envisaged and shall comply with all provisions of Motor Vehicles Act and MSW rules 2016.

Load Body

Load body shall be rugged and suitable to carry 10 cum garbage with hydraulically operated top to load garbage from top and cover garbage during transportation. It should have provision of hinged tail gate to unload the garbage by tipping the load body or by any other suitable arrangement. Three stage tipping cylinders at front end shall be provided with tipping angle 45 degree. The tail gate should have suitable locking mechanism. Body dimensions

shall be (approx.) length-3850 mm, width-2315 mm, height-1125 mm. Floor shall be made with minimum 4 mm MS sheet and side panel with minimum 3 mm MS Sheet.

Cabin

All steel semi/Fully forward control driver's cab. Cabin should have minimum two nos. foam padded adjustable seats with seat belts. Cab should have all standard accessories provided by truck chassis manufacturer and shall confirm to requirements of Motor Vehicles Act.

Painting

The body should be sand blasted prior to coating/painting. The body shall be coated with one coat of zinc rich primer & thenwith two coats of synthetic enamel paint to ensure long lasting structure suitable for use under hostile conditions. Colour shade/make of paint shall be as specified by the purchaser. The logo of concerned ULB, capacity of equipment and any other information asked by the purchaser shall be painted on the body.The paint shall be of good quality and ICI/ Asian/ Johnson & Nicholson / Burger make.