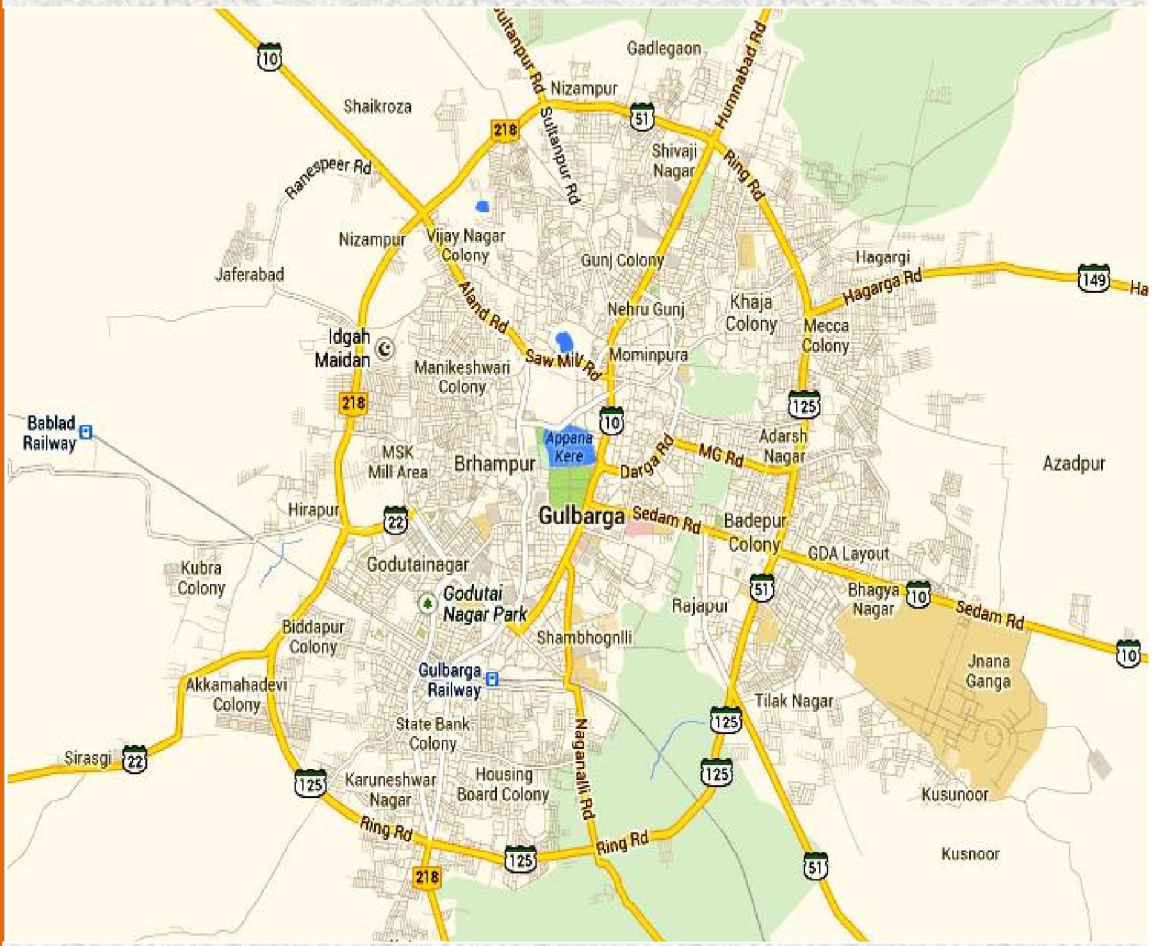
DETAILED PROJECT REPORT: MUNICIPAL SOLID WASTE COLLECTION & TRANSPORT PLAN FOR GULBARGA

March 2014



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Abbreviations

GMP – Gulbarga Mahanagara Palike

DPR – Detailed Project Report

SWM- Solid waste management

MSW- Municipal solid waste

TPD – Tons per Day

ISWM- Integrated solid waste management

ULB- Urban Local Body

TTPL- Tide Technocrats Private Limited

KUIDFC - Karnataka Urban Infrastructure Development and Finance Corporation

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Executive summary

The Gulbarga Mahanagara Palike (GMP) is looking for improving efficiencies in solid waste management (SWM) practices focusing on improving collection & transportation efficiency of the municipal waste generated in the city. This report brings out the present situation of solid waste management at Gulbarga and the proposals to improve the same.

The project activity aims at

a. Establishing effective waste collection mechanism with a view point to collect more than 90% of the solid waste generated in the municipal area.
b. Conducting efficient waste transportation mechanism to be able to carry out 100 % of the collected waste.
c. Environmental consciousness and job creation for the local youth.

Gulbarga is one of the larger cities in north Karnataka and is a well known historical, commercial and education centre. It is the administrative head quarters of Gulbarga District and is located at a distance of 613 km from state's capital Bangalore. The city is located at 17° 22' N and 76° 47' E. The Gulbarga Municipal Corporation has classified Gulbarga into 55 wards for administrative purposes. It covers an area of about 64 square km and has a population of 5,43,147 as per the 2011 census.

The Gulbarga Mahanagara Palike is responsible for providing basic civic services like roads, water supply & sewerage, health & sanitation, storm water and solid waste disposal for the city of Gulbarga. GMP has hired "TIDE Technocrats Pvt. Ltd" as consultants for preparation of DPR on Municipal Solid Waste Collection & Transport plan for Gulbarga, preparation of RFP and for supporting GMP in outsourcing the SWM works to private service providers.

The total waste generation in Gulbarga city is estimated to be about 197 tons per day (TPD). The GMP is collecting and disposing about 132 TPD of waste every day. The efficiency of collection and disposal is about 66%. Door to door collection of waste and segregation of waste at source are not practiced in the city. The waste generators dump the waste in open locations and container bins. The container bins are of 3 m^3 and 4.5 m^3 capacity. There are 164 bins spread across the city. The sweeping, collection and drain cleaning activity are handled by poura karmikas and hired labours managed by GMP. The transportation of waste happens with the twin bin dumper placers, tractor trailers and a compactor. The waste is transported to the landfill site located at udnoor which is spread across 28 .19 acres of land. It has been allotted for treatment & disposal of Solid waste.

Bio medical waste generated by Hospitals and clinics is separately collected by the Common Healthcare waste Appropriate Management Plant (CHAMP) facility. The GMP spends about

Rs. 9.40 Crore per annum for solid waste management at an average cost of Rs. 1951 per ton of waste collected.

The major waste generation is from households which constitutes to about 62% of the waste generated. The other major waste contributors are street sweeping, markets and commercial shops. In Gulbarga the waste generated from Domestic generators is a major contributor of waste accounting for about 62 % of the total waste generated in the city. It is assessed that out of this only around 50% is collected. Commercial and institutional waste generated is around 24 tonnes each day and 70% of it is usually collected. Since most of the trading areas are in the city center and container bins are being provided to large generators the waste collection mechanism here is better than other waste generators.

The synopsis of the waste generation per day is presented in table below.

S N	Waste generators	No of waste generators	Avg waste per source in kgs	Total waste in Kg	Total waste in tonnes
1	Household	102830	1.2	123396	123.40
2	Commercial shops	14861	1.6	23777.6	23.78
3	Hospitals (MSW)	514	5.1	2621.4	2.62
4	Small hotels	530	4.1	2173	2.17
5	Large hotels	53	11	583	0.58
6	Markets (major)	15	1230	18450	18.45
7	street sweepings				
	Type A	202.47	29	5871.63	5.87
	Type B	645.31	9.1	5872.321	5.87
	Type C	138.78	4.1	568.998	0.57
8	Educational institutes	682	6.4	4364.8	4.36
9	Miscellaneous waste	5%		9383.93	9.38
	Total	KGs		197062.69	**197.06**

The composition of the waste becomes crucial to decide an efficient SWM system. The table below gives the physical compositon of the waste disposed in landfill at Gulbarga.

S.N	Particulars	11-Dec-13	12-Dec-13	13-Dec-13	Average
1	Plastic material	13.2	13	14	13.40
2	Paper	8.2	9	9.4	8.87
3	Cloth piece	11	10.4	11.2	10.87
4	Organic waste	35.6	31.4	31.3	32.76
5	Glass Pieces	0.6	0.6	0.6	0.67
6	Wood pieces	4	2.4	2.4	2.93
7	Metal pieces	0.6	0.6	0.6	0.60
8	Silt, stone & Moisture	32.4	34.4	31.8	32.86
		101.4	99.4	100.2	100.27

The Gulbarga city is estimated to have total roads of about 986 km in GMP limits spread across all the 55 wards. Presently the street sweeping operations in all the 55 wards are managed by GMP. The GMP manages the street sweeping operations by its Paura karmikas and labours hired through manpower supplying agency. Transportation of the solid waste generated in the city is being managed by GMP. Primary transportation refers to transporting of waste generated from waste generators to the waste storage depot. Primary transportation of waste is not practiced presently in Gulbarga. There are no intermediate storage depots in Gulbarga except container bins. GMP is presently managing the secondary transportation with its vehicles and hired vehicles. Compactor, dumper placers and tractor trailers are used as secondary transportation vehicles.

GMP has set up Municipal Solid Waste disposing site at Udnoor village towards located at a distance of about 13 kms from the city center. The waste brought to the depot by compactors, dumper placers and tractors is dumped inside and JCB is deployed to form heaps of the wastes. The waste heaps are not covered with inert material.

The detailed plan for setting up an efficient collection and transportation plan of MSW generated in Gulbarga is presented. MSW 2000 rules are considered as the basis for the proposed plans in conjunction with state level normative standards for key operations like collection, sweeping, transportation and management of waste.

The mechanism of solid waste management system in Gulbarga requires a reorganized model to meet the requirements of of the MSW rules 2000. The major effort required in this regard is towards the improvement of the waste collection and transportation.

To improve the efficiency of of collection and transportation, decentralized collection and transportation plan has been suggested by classifying the GMP area into packages. It is proposed to bring in the private sector into the solid waste management processes on a longer term with performance based contracting. This would enable efficient management of the systems in a better way over a long time as the existing staffs of the GMP retires and recruitment of new staff by GMP is restricted.

The 55 wards of the city are classified into packages based on proximity. The classification is to ensure that the total waste generation is restricted to around 15- 20 tons per day so that the SWM processes are manageable. All the wards in the city have been classified into 15 packages. Each package consists of 3 to 5 wards considering the quantity and waste generated by each proposed package. 11 of the 15 packages will be outsourced to private service providers. The remaining 4 of the 15 packages will be managed by the GMP staff. The existing GMP staff would be redeployed to manage these 4 packages. The redeployment of GMP is proposed in the peripheral areas.

The contracting shall be undertaken as a performance based contract through E procurement portal of government of Karnataka. The Request for proposal (RFP) and

contracting document for out sourcing has been formulated. The performance based contract would involve a payment of 60% of the fee as fixed component based on provision of the required man power and equipment. 40% of the fee shall be variable component

The detailed cost estimates of the proposed package based collection and transport plan has been prepared and presented in annexure 5. The synopsis is given as table 9.1. This cost does not include the fixed cost of the GMP consisting of the salaries of the permanent staff.

The budgeted annual expenditure for the year 2013- 14 for collection and transport of MSW is Rs 9.4 crores. This includes about Rs 4.95 crore towards salaries and allowances. Rs 3 crore towards hiring vehicles and Rs 1.2 crores towards outsourced operating expenditures.

The estimated expenditure for the package based collection and transport plan is Rs 11.6 crores per annum. The total cost including the salary and allowance would be 16.55 crores. The total cost of collection and transport would increase from Rs 9.4 crores to Rs 16.55 crores.i.e., an increase of 7 crores.

At present the waste collection is about 65% of the waste generated in the city. The collection process is not as per MSW 2000. Door to door collection and waste segregation is not in practice. The proposed package based plan would meet the MSW rules 2000. To achieve this GMP would have to spend 7 crore rs additionally per annum.

A detailed plan for collection and transport has been prepared for the Gulbarga Mahanagara Palike. The plan envisages a combination of municipal managed system and out sourced areas for collection and transport of MSW. 12 month out sourcing plan has been proposed. By implementing the proposed collection and transport plan the GMP would achieve the standard set by MSW rules 2000.

1 Introduction

1.1 Report Overview

The state of Karnataka is undertaking many efforts in improving the solid waste management systems in its cities. As part of its efforts the preliminary requirement is preparation of detailed project report to provide an overall direction for the activity and implementation of efficient solid waste management practices in each city. This document gives the detailed project report (DPR) for efficient Collection and Transport systems of municipal solid waste generated in Gulbarga city. There is an existing plan for processing and disposal of municipal waste and the same has been provided. The proposal is based on the SWM policy of Karnataka, meets the MSW Rules 2000 standard and the present thinking on door to door collection and an end to end waste collection and transport concept.

1.2 Project Appreciation

The Gulbarga Mahanagara Palike (GMP) is looking for improving efficiencies in solid waste management (SWM) practices focusing on improving efficiency of collection, transportation and processing of the municipal waste generated in the city. This report brings out the present situation of solid waste management at Gulbarga and the proposals to improve the same.

The project activity aims at

d. Establishing effective waste collection mechanism with a view point to collect more than 90% of the solid waste generated in the municipal area.
e. Conducting efficient waste transportation mechanism to be able to carry out 100 % of the collected waste.
f. Environmental consciousness and job creation for the local youth.

Gulbarga is one of the larger cities in north Karnataka and is a well known historical, commercial and education centre. The Gulbarga Mahanagara Palike is responsible for providing basic civic services like roads, water supply & sewerage, health & sanitation, storm water and solid waste disposal for the city of Gulbarga. Solid Waste Management is an important component of the services provision and accounts for the largest component of the operations budget of the GMP. A detailed project report for deployment of the SWM services was required to work out the way forward and implementation.

Gulbarga Mahanagara Palike has hired “TIDE Technocrats Pvt. Ltd” as consultants for preparation of Detailed Project Report on Integrated Municipal Solid Waste Management Collection & Transport planning for Gulbarga and for preparation of RFP and for supporting GMP in outsourcing the SWM works to private service providers. This report is the final Detailed Project Report for collection and transport of MSW in Gulbarga.

1.3 Scope of Work

The broad scope of work for the project includes development of technical and economically viable solid waste management plan along with the design of collection, transportation, treatment disposal infrastructure. The outline of scope of work for the overall project includes the following activities.

a. Collection & compilation of data
b. Interaction with ULB, local stakeholders and obtaining preliminary information
c. Submission of draft DPR
d. Presentation of the plans and receiving comments and inputs.
e. Submission of final DPR

The structure of the detailed project report has been detailed in the next section.

1.4 Work Done in this Study

To draft the detailed project report for Gulbarga, The following sets of activities have been done by M/S Tide Technocrats Private Limited.

a. Field visits and data collection

A team of consultants from M/S Tide Technocrats had visited the city from 10 of December to 14 December 2013. The team visited various parts of the city to understand the existing infrastructure and SWM mechanism in the city. The team interacted with various stake holders of SWM system. Following table gives details of the team's visit in Gulbarga.

Table 1.1: Consultant team's field visit details

S.N	Day	Activity
1	10 Dec 2013	Interaction with Environment engineers of ULB, sanitary inspectors and health officers about the design of data collection plan, Team's plan of activities and assistance required by the ULB. The TTPL team hired and trained survey teams for conducting various studies like waste character, waste quantity and sampling. The team hired 5 people from Gulbarga for conducting sampling study on different type of waste generators. Total of around 150 samples were selected which included 90 households and 60 commercial establishments consisting of shops, hotels, medical institutions, markets and roads. The survey team provided plastic covers to the respondents to store the waste generated which would be measured for next 3 days.
2	11 Dec 2013	The team conducted physical character analysis of the waste collected

		in the city at Landfill site located near Udnoor village. 5 samples were analyzed using the quartering technique for understanding the waste character. Each sample was segregated to take weights of the components in MSW. The details of the analysis are provided in annexure 2. **Day 1 of Waste quantity analysis** The TTPL team had hired a weighing bridge at Gulbarga named "Bandookwala" weigh bridges for weighing full and empty weights of all the vehicles entering the dumpsites of all the vehicles. 65 vehicles were weighed at the weighbridge. The details of quantity analysis are provided in annexure 2. **Day 1 of sampling study of waste generators** The survey team visited the pre selected waste generators and weighed the waste collected and distributed plastic covers to store waste for the next day's analysis.
3	12 Dec 2013	Day 2 of Waste physical character analysis at the landfill site. 5 samples were analyzed following the procedure conducted in the previous day Day 2 of Waste quantity analysis included measuring weights of all the vehicles entering the landfill Day 2 of sampling study of waste generators and distribution of plastic covers for storing the waste for analysis.
4	13 Dec 2013	Day 3 of Waste physical character analysis at the landfill. 5 samples were taken using quartering technique. The procedure followed in first 2 days was followed Day 3 of Waste quantity analysis- All the vehicles entering the land fill were weighed in the weighbridge. Day 3 of sampling study of waste generators. The survey team weighed the waste collected in the plastic covers at the selected waste generator location
5		The TTPL team visited many areas of the city to study the existing SWM scenario for photo documentation. The team interviewed the sweepers, truck drivers of MSW vehicles, waste generators and Sanitary inspectors for understanding the existing SWM scenario. All the sanitary inspectors were interviewed about the ward boundaries, location of the dumper placer bins.
5	04 Jan 2014	Draft DPR, RFP, contract document, estimates and maps were submitted to GMP

6	04 Jan 2014	The team of Tide technocrats started survey of commercial establishments in each of the 55 wards. The team along with sanitary inspectors visited each and every ward and counted the number of different commercial establishments including shops, hotels, education institutions, medical centers and etc.
7	06 Jan 2014	The chief consultant of Tide Technocrats conducted visit to Gulbarga. Presented the DPR and RFP document, cost estimates, maps and individual ward level maps with a presentation to the administrative officer.
8	05 Jan 2014	The consultants met and interacted with various stake holders of GMP including AEE, GIS team, Municipal commissioner and Environment Engineers.
9	06 Jan 2014	The team conducted visits to the landfill site. The consultants presented the suggested SWM plan to all the sanitary inspectors and engineering section of GMP for their inputs and suggestions.
10	14 Jan 2014	The survey of commercial establishment was concluded on 14 January 2014. All 55 wards were visited in 10 days by the team.

The inputs and corrections suggested by the GMP and its stake holders were considered for drafting the final DPR, RFP, Estimates and maps..

b. **Primary data collection undertaken**

Primary data collected for preparation of this report includes the following key features

i. average waste generated by key waste generators in Gulbarga,
ii. physical character of the waste disposed at Gulbarga,
iii. Quantity of the waste collected and transported to the landfill
iv. Type of roads swept daily, twice a week and once in a week
v. Average length of street swept by each SWM staff.
vi. Waste movement mechanism in the city.
vii. Location of secondary bins for waste collection
viii. Approximate estimation of open points in the city.
ix. Survey on commercial establishments of the city in all the 55 wards

The primary data gathered by the team of TTPL was compiled and used in this DPR report.

c. Secondary Data Collection & Assessment:

Secondary data required for the report like existing ward wise population of the city, weather information, standard average quantity of waste generated per waste generator, area of the city, total population of city in the past, other reports on SWM were gathered from various sources. A review of the available documents about Gulbarga and the previous

studies on solid waste management systems in Gulbarga was done. The gathered data was compiled as per the requirement of DPR.

d. Design and report preparation:

Using the data collected by the primary resources, secondary resources and interaction with stake holders and GMP staff a collection, transport DPR is prepared. The DPR has considered the future population growth and prospective increased growth in the city. A detailed cost estimation and financial sustainability analysis has been done and presented in the report. All the designs and estimates are provided along with the report as annexure.

e. Review process:

The draft report, cost estimates, designs and drawings were submitted to GMP for review. This final DPR document has been prepared by incorporating all the suggestions, comments and inputs of GMP. The GMP shall further review the report, seek the state government clearance as required and the final report would be drafted to meet the requirements of using the document for implementation.

1.5 Structure of the Report

Table 1.2: Structure of the Report

Chapter	Heading	Contents
Chapter 1	Introduction	The chapter provides and introduction to study, the terms of reference, study methodology and outline of the study.
Chapter 2	City Profile	The City profile brings out the nature and details of the city. The demography, importance, climate and structure of the city are brought out.
Chapter 3	Present SWM scenario in Gulbarga	The existing waste management systems in the city in presented. The waste assessment undertaken is presented. The strengths and lacunae of the systems are brought out to enable further planning.
Chapter 4	Proposed SWM Action plan for Gulbarga	The proposed efficient plan for waste management in the City.
Chapter 5	Institutional Aspects & Capacity Building'	The Gulbarga team for solid waste management, the institutional structure and the capacity building requirements are presented.
Chapter 6	Health Aspects	The sanitation requirements of the city have been presented in this chapter.

Chapter 7	Legal Aspects	Various legal provisions that need to considered and included for an effective SWM been presented here.
Chapter 8	Public Awareness	Information Education and Communication is a significant component of the solid waste management process of a city. A concept and operational schema for the public awareness required has been presented in this chapter.
Chapter 9	Financials	The summary of the financials of the plan and the conclusions are presented here.
Annex 1	GMP data	The basic data on the wards and other features of the GMP Area are presented in this report.
Annex 2	Waste Quantity and Quality	The supporting information on the waste arrivals at the GMP Landfill and data on the quality of waste is presented.
Annex 3	Drawings and Maps	The collection & transport drawings have been presented. The drawings are referred in the main body of the report.
Annex 4	Photo introduction	A selection of photos that brings out the various features of the city and the waste management practise is presented in this annexure.
Annex 5	Detailed Estimates	Detailed estimate of the collection and transport plan is presented.
Annex 6	Package Wise Details	The proposal for waste collection and transport is based on 15 packages. The details of the packages have been presented.

2 City Profile

2.1 Background

Gulbarga is an historical city located in north east of Karnataka. It is the administrative capital of Gulbarga District and is located at a distance of 613 km from state's capital Bangalore. It is the head quarters of the Gulbarga district. The city is located at 17° 22' N and 76° 47' E. Gulbarga was earlier known as 'Kalburgi', which means stony land in Kannada. Gulbarga was formerly in the Hyderabad state of Nizam and became a part of Karnataka State after re-organization of states. Recorded history of this district dates back to the 6th Century A.D. The district was ruled by various dynasties of kings. In 1948 Hyderabad state became a part of Indian Union and in 1956.

Gulbarga is known for its historical monuments built during bahumani kings, religious places and is more importantly as a commercial hub for the Hyderabad Karnataka region. Gulbarga is primarily a regional market and service center for the district and also a education center and is home to the Jnana Ganga University and other education centers including Medical, Engineering, pharmacy, Dental, Law, Nursing and other Colleges. Gulbarga is served by a major rail line connecting Bangalore to Mumbai and New Delhi and has a national highway. The nearest airport is in Hyderabad. The city is at a distance 212 KM from Hyderabad, 360 KM from Hubli and 606 KM from Mumbai. The city is well connected by road and train to its neighbouring districts.

2.2 Profile of the city

The city is fast growing with significant activity on going on the infrastructure development. The city is divided into 55 wards which are administrative units of development. The ward-wise data on the various facilities and infrastructure in the city is given in Annexure 1. An analysis of the data in relation to the geographical proximity of the wards shows the major commercial center of Gulbarga is old city now demarcated around the Supermarket area covering the wards Ayyarwadi (ward 17), Rangeen Masjid (ward 24), Khari Bowli (ward 26), Sandal galli (ward 27), Gazipur (ward 31), Chappal Bazar (ward 32) and the Fort area (ward 33). The extension area of Jayanagar (ward 46), Basaveshwar colony (ward 28), Bhavani nagar (ward 3) and the railway station area in ward 52 also have significant commercial activities. Lodges are distributed in mainly residential areas.

Mixed land use is commonly present but on ground the commercial establishments are observed more on main roads and conversion of residential areas into offices is still not very common. The three major hospitals in Gulbarga are the Government general hospital in ward 47, Basaveshwar hospital on the Sedam in ward 46 and the KGN hospital in ward number 48. The clinic and nursing homes are usually distributed all round the city. The major action in Gulbarga is in the central wards due to higher population density. The effort in ensuring cleanliness would be higher. The extension areas are rapidly developing and would be engines of growth of the city. In the longer run the extension area would generate

more waste and would also lead the change in the character of the waste generation. It is essential now to tackle both these areas simultaneously with appropriate strategies so that an efficient functional solid waste management system can be established and operated.

2.3 Topography and Climate

Gulbarga is largely composed of the Deccan Trap. It represents a monotonous, treeless extensive plateau landscape with an average elevation of 457.50 meters from the mean sea level. However the river plains of the Krishna, the Bhima, with the intervening watersheds, the step like landscapes, lateritic scarpments, residual hills and ridges break the monotony of this extensive plateau. The general slope is towards the east. This region is largely covered with rich black cotton soils.

The climate of Gulbarga is generally dry. The maximum temperature during summer rises up to 46° C. The minimum temperature during winter is about 16° C. The winter season is from December to February, which is followed by summer season from March to May. June to September is the monsoon months. The period from October to November forms the post-monsoon season. The period from October to March, covering the post-monsoon and winter seasons, is generally pleasant. The city receives an average annual rainfall is about 720 – 800 mm. Major amount of rainfall is during the retreating monsoon.

2.4 Population of the city

The Gulbarga Municipal Corporation has classified Gulbarga into 55 wards for administrative purposes. It covers an area of about 64 square km and has a population of 5,43,147 as per the 2011 census. The population of the city in 2001 was 430108. The average population growth rate over the last 3 decades 1981-11 is 35.6 % per decade. The annual average growth of population over the period 1981-2011 is 3.56 % per annum. The population of Gulbarga over time and projected present population are given in table 2.1.

Table 2.1: Population of Gulbarga, past & projected

Year	Population	Decadal Growth rate
1981	218621	-
1991	303139	38.65%
2001	430108	41.88%
2011	543147	26.28%
2014 *	603244	35.6%**
2021*	736507	35.6%**

* Forecasted

** Average decadal growth rate

Source: Census of India 1981-2011 and projection at 3.56 % annual compound growth rate.

The population density of the city is increasing over the past 3 decades. The population density has almost doubled in the period from 1981 –2011. The city is growing very fast with a very rapid urbanization. The table 2.2 gives the details of the decadal population density.

Table 2.2: Growth in Population density

S. N	Year	Population	Gross Density (Persons / km2)
1	1981	218621	3363
2	1991	303139	4663
3	2001	430108	6617
4	2011	543147	8486

The details of the ward wise population and area occupied by each ward is presented below in the table 2.3. It is seen that the population between wards varies significantly. The map 1 in the annexure 3 gives road map of the city while the map 2 depicts the population density of the wards. From the map it can be observed that the density of population is very high in the old town area and is lower in the extension areas.

Table 2.3: Ward wise population, area and density (2011 population)

Ward No.	Name of the Ward	Area in sq. Km	Population as of 2011	% to total population	Population density in sq.km
1	Kapnoor	2.49	12621	2.32	5074
2	Buland Pervez Colony	1.74	12634	2.33	7269
3	Bhavani Nagar	0.93	7971	1.47	8586
4	Bilalabad	0.34	14468	2.66	42078
5	Syed Galli	0.54	7592	1.40	13949
6	Tanda Filter Bed	1.67	6613	1.22	3950
7	Rajiv Gandhi nagar	0.55	8047	1.48	14596
8	Shivaji Nagar	0.26	7249	1.33	27748
9	Gunj Bank Colony	0.97	3097	0.57	3205
10	Naya Mohalla	0.22	5202	0.96	23516
11	Khaja Colony	0.32	10278	1.89	32460
12	Mehaboob nagar	0.23	6946	1.28	30201
13	Yadulla Colony	1.33	17133	3.15	12928
14	Pashpur area	0.84	14145	2.60	16793
15	Siddi Ambar Katta	0.20	7982	1.47	40374
16	Imli Mohalla	0.97	5318	0.98	5455
17	Ayyarwadi	0.71	7061	1.30	9980
18	Mahadev Nagar	1.39	13365	2.46	9586
19	Santosh colony	0.38	8039	1.48	21157
20	Medina Colony	1.93	16355	3.01	8477

21	New Ragvendra colony	0.65	10589	1.95	16181
22	Chowdeshwar Colony	2.24	15446	2.84	6885
23	Kabad galli	1.81	19993	3.68	11059
24	Rangeen Masjid	0.35	10075	1.85	28666
25	Menduk Galli	0.10	9333	1.72	90867
26	Khari Bowli	0.18	5708	1.05	31864
27	Sandal Galli	0.27	6544	1.20	24403
28	Basaveshwar colony	0.52	9636	1.77	18676
29	Adarsh Nagar	1.76	13918	2.56	7897
30	Gubbi Colony	4.07	12596	2.32	3099
31	Gazipura	0.27	5048	0.93	18625
32	Chappal Bazar	4.27	11095	2.04	2601
33	Katgarpur	1.42	8027	1.48	5639
34	Kumbar Galli	0.21	5006	0.92	23307
35	Rayar Colony	0.23	8445	1.55	36620
36	Semata Colony	0.43	11703	2.15	27043
37	Jeelanabad	0.39	7531	1.39	19516
38	Heerapur	5.47	16218	2.99	2967
39	ILH, Shanti nagar	0.37	7164	1.32	19456
40	Waddar Galli	0.25	9275	1.71	36807
41	Vidya Nagar	0.37	6964	1.28	19069
42	Sangemeshwar Colony	0.35	8180	1.51	23409
43	Jagat	0.50	4870	0.90	9823
44	Attar Compound	0.95	7703	1.42	8109
45	Mangarwadi Colony	0.93	12339	2.27	13214
46	Jaya nagar	2.30	10393	1.91	4518
47	Police Quarters	4.43	5989	1.10	1353
48	Yateem Khana	2.71	4847	0.89	1791
49	Khuba layout	0.95	6808	1.25	7194
50	Godutai colony	1.32	12175	2.24	9231
51	Venkatesh nagar	1.13	4268	0.79	3790
52	Hamalwadi bus stand	0.33	8695	1.60	26403
53	Tarfile	0.35	10736	1.98	30811
54	Rehmath nagar	0.46	16820	3.10	36820
55	N GO Colony	3.44	17334	3.19	5037
	Addition villages	0.23	9560	1.76	41565
Total		**64.00**	**543147**	**100**	**8487**

2.5 Slum Population

Gulbarga has 60 slums out of which 42 are notified and 18 are un notified slums. The total area ocrupied by the slums is 1.48 sq km. the total population of slums in the city is 60,190

residing in 12084 slum households. The percentage of slum population to that of city is about 11.08 %. The major slum areas are located near Lambani Tandya, Sanjay nagar, Barhampur Waddaragalli, Syed galli roza. The slums population in the city is slowly expected be shifted to proposed relocation sites at Kesaratagi and Sanjeev nagar by Karnataka slum development board.

2.6 Major tourist centres

Though Gulbarga city is the commercial hub to the neighbouring districts, it has few fine tourist attractions in the city which are as follows.

a. Sharana Basaweshwara Temple

It is a famous Hindu temple located in the heart of the city. The temple is dedicated to an eminent Hindu religious philosopher, Shri Sharana basaveshwara a lingayat saint of 18th century known for his Dasoha (Giving is earning) and Kayaka — an advancement of the Karma. The temple houses the Samadhi of Sharana Basaveshwara at the center called the garbha gudi. It has a lake adjacent to it which attracts many devotees and tourists. A chariot festival, Jatra, is held every year in honor of Sharana Basaveshwara which attracts huge crowds.

b. Hazrat Khwaja Bande Nawaz Musoleum

Syed Muhammad Hussaini, commonly known as Hazrat Khwaja Banda Nawaz Gaisu Daraz , was a famous Sufi saint of the Chishti Order, who advocated understanding, tolerance and harmony among various religions. He was a disciple of Sufi saint of Delhi, Hazrat Nasiruddin Chiragh Dehlavi. After the death of Chiragh Dehlavi, he took on the mantle of the successor (khalifa). When he moved to Daulatabad around 1398, owing to the attack of Timur on Delhi, he took the Chishti Order to South India. He finally settled down in Gulbarga, at the invitation of Bahamani Sultan, Taj ud-Din Firuz Shah. A tomb is built in his memory. People from various walks of life, irrespective of caste and creed, assemble even today to celebrate the urs (death anniversary) which takes place on the 15, 16 and 17 day of Zul-Qa`dah of Muslim calendar at the famous Bande Nawaz dargah in Gulbarga every year.

c. Old moated fort

One of the most visited tourist attractions of Gulbarga is its old fort which is in a deteriorated state. It has number of interesting buildings inside including the Jama Masjid, reputed to have been built by a Moorish architect during the late 14th or early 15th century who imitated the great mosque in Cordoba, Spain. The mosque is unique in India, with a huge dome covering the whole area, four smaller ones at the corners, and 75 smaller still all the way around. The fort itself has 15 towers.

d. Sri kshetra Gangapur

Sri Kshetra Ghangapur is a famous pilgrimage center of God Sri Sadguru Dattatreya, situated very close to Gulbarga. Thousands of pilgrims visit the holy shrine every year.

e. Buddha vihar

Buddha Vihar of Siddarth trust is another place of attractions in Gulbarga, attracting all ages of community. It is located about 2 KM from Gulbarga university, It has a big meditation hall

f. Uttaradi mata

The Uttaradi Matha of the Dwaita School of philosophy of Madhvacharya. The remains of one of its most prominent saints, Sri Jayatirtha, are buried in a Brindavana here. He was a commentator of the celebrated Anuvyakhyana of Madhvacharya, which itself is a commentary upon the Brahma Sutras. For this commentary, called Nyaya Sudha, he is popularly known as Teekacharya. Thousands of devotees visit the place every year.

2.7 Gulbarga Mahanagara Palike

Gulbarga Mahanagara Palike (GMP) is the urban local body (ULB) responsible and involved in managing the various civic systems and services in the city of Gulbarga. The GMP has an elected council of corporators who are supported by administrative support. The GMP is responsible for infrastructure development and for providing basic services like solid waste management, water supply, underground drainage, development and maintenance of roads, street lights, sanitation and other facilities in the city.

2.7.1 Political Set up

The elected members of Gulbarga city have 1 Member of Parliament and 2 Members of Legislative Assemblies (MLAs) each representing both north and south parts of Gulbarga city. Shri Mallikarjun Kharge represents the city in Parliament. Mr. Qumar UL Islam represents north Gulbarga city and Mr. Dattatraya c Patil Revoor represents south Gulbarga city. These 3 are the honorary members of the municipal body.

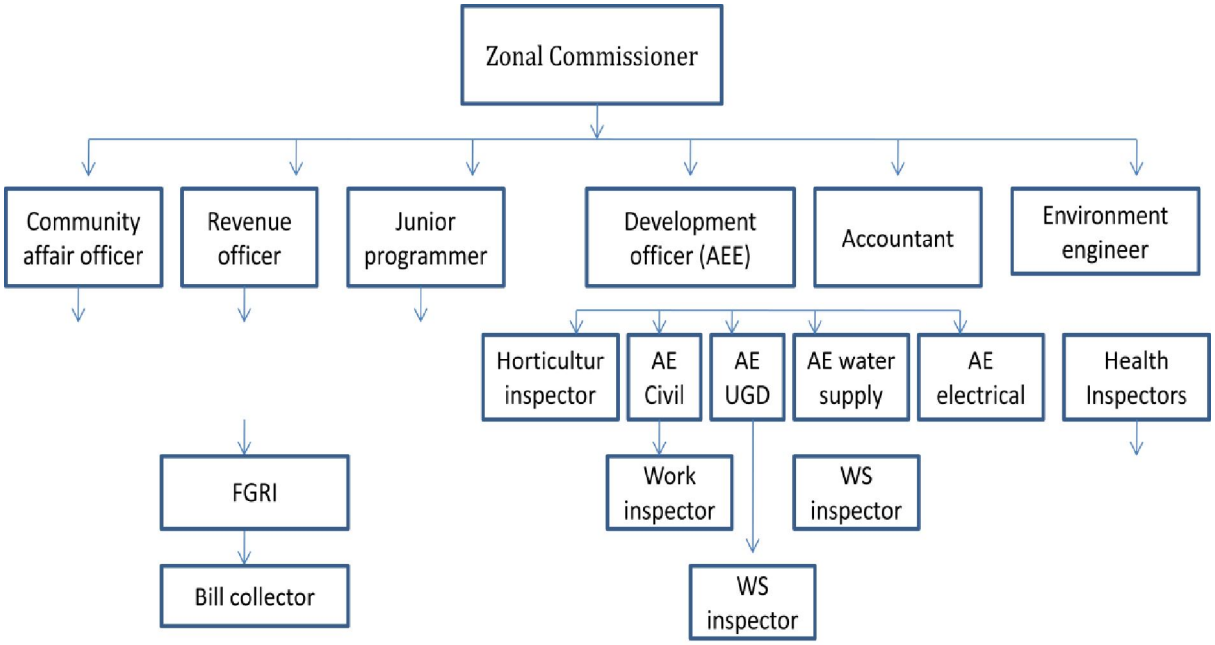
The Gulbarga having 55 wards has 55 elected members representing each ward. The council has various standing committees for different types of works including works, health, finance etc to enable smooth operation of GMP. Municipal elections are held once in 5 years. The previous elections were held in 2012. The council conducts general body meeting every month.

2.7.2 Administrative Set Up

Gulbarga Mahanagara Palike has various departments for the effective management and administration. The Commissioner is the chief executive of the Municipal Council. The executive power of the GMP is vested with the Municipal Commissioner appointed by the Government of Karnataka. Organisation chart of the GMP is given below. The GMP has the following departments

- Community affairs department
- Revenue Department
- Accounts department
- Administration department
- Data management department.
- Environment section

Chart 2.1: organisation chart of GMP



2.8 Solid waste Management

The government of Karnataka has created a post of Environmental Engineer in the urban local bodies that is responsible for the various environmental functions of the urban local body. The solid Waste Management activity is managed by the senior Environmental Engineer. GMP has deployed 3 environment engineers presently for managing the SWM

activities. The senior environment is responsible for managing the various aspects of the municipal waste management. He is supported by junior environment engineers, Senior and junior health Inspectors. The Environmental engineer is also responsible for sanitation of the city. Gulbarga has undertaken improvements of its solid waste management systems based on the policy of the Government of Karnataka. There is an active sweeping, secondary collection and transport systems operational with an assessed efficiency of collection of about 66 %. The collected waste is dumped in the authorized landfill located at Udnoor. The GMP is taking up initiatives to start processing of waste dumped at the land fill.

3 The Present Scenario of SWM system in Gulbarga

3.1 Earlier Studies on SWM in Gulbarga

Two project reports on SWM and a case study exclusively on Bio Medical Waste Management in Gulbarga were prepared earlier. The first project report was prepared in 2006 by Wilbur Smith Associates Private Limited (WSAPL) in association with Tamil Nadu Urban Infrastructure and Financial Services Ltd (TNUIFSL) and second report was prepared by Administrative Staff college of India. The case study was prepared in 2005 by Centre for Environment Education.

A "Feasibility Study" was conducted in 2006 with aid of Karnataka Urban Infrastructure Development and Finance Corporation (KUIDFC), the nodal agency for the proposed project, it was conducted to identify infrastructure development needs and priorities in a selected 25 towns and Gulbarga was one of the towns. The broad goal of the project was to address issues pertaining to regional imbalances within Karnataka, through focused urban infrastructure investments. In the study one of the objectives was to assess the status of environmental infrastructure (comprising water supply, sewerage & sanitation and SWM). The study identified the required infrastructure needs to be catered to the ULB's growth, and identified urban management reforms required to facilitate infrastructure creation and maintenance, and identified project development activities required to facilitate project execution.

A study on City Sanitation Plan (CSP) of Gulbarga City Corporation was conducted in 2011. Gulbarga is one of the 8 cities whose CSPs have been prepared by ASCI in partnership with Directorate of Municipal Administration (DMA), Government of Karnataka and City Managers' Association, Karnataka (CMAK). The objective of the study was to identify the various areas that are affected by various issues with different sectors of sanitation, (viz. sewerage, SWM, storm water drainage and water supply). The study in turn had paved the way for the preparation of the proposal for various strategies to alleviate the sanitary conditions of the place, so that Gulbarga may well overcome the various plaguing issues and thereby a healthy sanitized environment prevails for the citizens.

A case study "Unique Endeavor of a partnership between an NGO, Government and End Users towards Biomedical Waste Management" had been undertaken and implemented in Gulbarga by the "Healthcare Establishment Waste Management and Education Programme" (HEWMEP) project. Common Healthcare waste Appropriate Management Plant (CHAMP), a Common Treatment Facility for biomedical waste management was set up. This project was funded by Indo-Norwegian Environment Programme (INEP) Govt. of Karnataka started in 2002 and was ready by end of 2004. The CTF has been, in fact, functioning May 2005. The processing technologies that are being used at CHAMP are incineration, autoclaving, shredding, chemical disinfection, liquid effluent treatment, deep burial and secured landfill. The CHAMP facility at Gulbarga has been among the most advanced in India, which will ensure safe and sound disposal of healthcare waste.

3.2 Overview of SWM in Gulbarga

A detailed presentation of the existing Solid Waste management system in Gulbarga is presented in this chapter to provide an understanding of the system prevalent in the city.

The total waste generation in Gulbarga city is estimated to be about 197 tons per day (TPD), of which about 132 TPD of waste is collected. Door to door collection of waste and segregation of waste at source are not conducted in the city. The waste generators dump the waste in open locations and collection bins. The collection bins are of 3 m^3 and 4.5 m^3 capacity. There are 164 bins spread across the city. The sweeping, collection and drain cleaning activity are handled by poura karmikas and hired labours managed by GMP. The transportation of waste happens with the twin bin dumper placers, tractor trailers and a compactor. The waste is transported to the landfill site located at udnoor which is spread across 28 .19 acres of land. It has been allotted for treatment & disposal of Solid waste.

Bio medical waste generated by Hospitals and clinics is separately collected by the Common Healthcare waste Appropriate Management Plant (CHAMP) facility. It caters to all the healthcare establishments of the Gulbarga and independently handles the process of collection, transportation, treatment and disposal of healthcare waste. The processing equipments that are installed at CHAMP site are incinerator, autoclaves, shredders, chemical treatment facility, liquid effluent treatment, deep burials and secured landfills. Attention is given to the problems of incineration emissions. The biomedical waste landfill is a separate site adjacent to the dumping ground which has an area of 3 acres.

The GMP spends about Rs. 9.40 Crore per annum for solid waste management at an average cost of Rs. 1951 per ton of waste collected.

3.3 Municipal Solid waste generation and its composition

A detailed estimation of the quantity of municipal solid waste generated in Gulbarga and its composition has been carried out and presented in this section. The estimate of the municipal solid waste generated in the city has been done by conducting a 3 day detailed sampling for different types of waste generators in Gulbarga. The quantity of waste collected and disposed off in the landfill was estimated by conducting actual measurements of all the vehicles carrying waste to the dumpsite over a 3 day period. All the incoming vehicles at land fill site were weighed for 3 consecutive days and the total quantity of waste collected and transported waste was estimated.

The waste composition of the waste disposed at land fill site was analysed to know the physical character of the waste. This waste composition sampling of the waste was done over three days by selecting 5 samples on each day from the vehicles arriving at the dumpsite. The sampling was done using a quartering technique starting from about 500 kg sample to reach about 100 kgs of waste. The Physical analysis was carried on these 100 kg

samples. The detailed waste generation rates and composition are presented in the subsections.

3.3.1.Waste generation estimate based on generators.

The major sources of generating waste in Gulbarga are households, commercial establishments, hospital and clinics, educational institutions, markets, hotels and street sweeping operations. To estimate the quantity of waste generated at source by these major waste generators, a sample survey was conducted by the consultant team. A sample of waste generators representing each type were selected for weighing the waste generated at at source for 3 consecutive days. The average quantity of waste generated by these waste generators was calculated by aggregating the weight generated by each source on 3 selected days. About 8 waste generators were selected which are major contributors for the waste generated in the city.

The samples selected for survey included all types of participants of each generator type. For example in case of households, the selected households included joint families, nuclear families, rich families, middle class families, Educated and uneducated families. The families selected were also from different religious backgrounds and from different localities. Same procedure was carried for weighing the waste at commercial shops, hotels and other major waste generators. The response to the survey showed that about 80% of the respondent involved in the study stored the waste for a day for our team to collect the weights. The team collected the stored waste and entered the quantity estimated in each day in the prescribed questionnaire. To get a sample of 140 waste generators around 180 to 200 waste generators were approached.

To arrive at number of waste generators in the city, data like ward wise population, slum and non slum households and street lengths of all type of roads were obtained from secondary sources. Households are taken from the census, street length from the GMP, Other sources like hospitals, commercial shops, educational institutions and markets were obtained through the primary survey conducted by TTPL in Gulbarga. Major markets were individually assessed by the survey team. The detailed data on the sampling and waste generators is presented in Annexure 2.

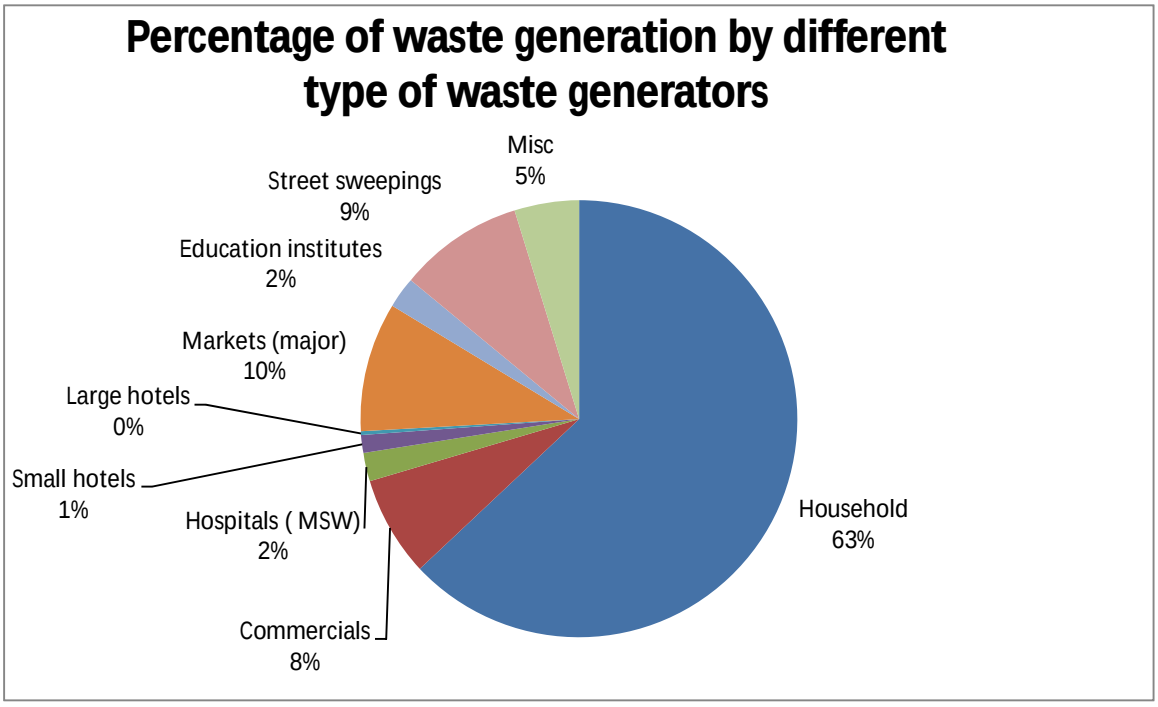
The major waste generation is from households which constitutes to about 62% of the waste generated. The other major waste contributors are street sweeping, markets and commercial shops. The Other types of waste generators generate lesser quantity of municipal wastes. Based on the sampling study conducted and the number of waste generators existing in the city, it is estimated that the waste generation in Gulbarga is about 197 tons per day. The synopsis of the waste generation per day is presented in table below.

Table 3.1: Data of waste generation based on generators

S N	Waste generators	No of waste generators	Avg waste per source in kgs	Total waste in Kg	Total waste in tonnes
1	Household	102830	1.2	123396	123.40
2	Commercial shops	14861	1.6	23777.6	23.78
3	Hospitals (MSW)	514	5.1	2621.4	2.62
4	Small hotels	530	4.1	2173	2.17
5	Large hotels	53	11	583	0.58
6	Markets (major)	15	1230	18450	18.45
7	street sweepings				
	Type A	202.47	29	5871.63	5.87
	Type B	645.31	9.1	5872.321	5.87
	Type C	138.78	4.1	568.998	0.57
8	Educational institutes	682	6.4	4364.8	4.36
9	Miscellaneous waste	5%		9383.93	9.38
	Total	KGs		197062.69	**197.06**

Source: Study conducted by TTPL

Chart 3.1: Waste generation chart of Gulbarga city



Source: Data compiled by TTPL

3.3.2.Normative Estimate of Waste generation

The population of Gulbarga as per census conducted in 2011 is about 5.43 Lakhs. Gulbarga city being the hub for education, administration, commercial activity and medical services in the Hyderabad Karnataka region experiences about 0.5 lakh of floating population on an average. The central bus terminus and the railway station are the gate ways of the floating population. The movement of the floating population is seen much near the super market area, mini vidhan soudha, station road, central bus terminus and railway station area.

Considering a per capita waste generation of 350 grams by the residents of the city, the normative waste quantity in Gulbarga is estimated to be around 190 TPD. The floating population of the city is contributing to the waste quantity by adding up about 5-7 tons of waste every day. Considering the normative standards and the quantity of waste generated by different waste generators, it is estimated that the Gulbarga city generates about 197 TPD of waste every day.

3.3.3.Waste delivered to disposal site, vehicles used and timing

To estimate the quantity of waste disposed in the land fill site, A survey of all the vehicles reaching the dumping site was undertaken for 3 days from 11th December to 13th December 2013. All the MSW collected and transported from the city is bought and disposed in the land fill site located at Udnoor. The landfill site located at udnoor is the only landfill site where the waste is disposed by GMP. All the tractors, dumper placers and compactors were weighed at "Bandukwallah" weigh bridge for all trips prior to dumping at site. Loaded and tare weights of all the vehicles were obtained from the weigh bridge. The data on waste carried by all the vehicles for 3 days is presented in Annexure 2. The consolidate data is presented in table below.

Table 3.2: Data of waste delivered to disposal site

S N	Days	Compactors	Dumper placer Trips	Tractors trips	Total no of vehicles	Waste quantity in Kgs
1	11-Dec-13	1	9	57	67	131402
2	12-Dec-13	1	9	52	62	128281
3	13-Dec-13	1	9	55	65	134155
	Average	1	9	55	65	131279
	In Tons					**131.28**

Source: Study conducted by TTPL

Based on the study conducted it is noted that Gulbarga city waste disposal site receives an average quantity of waste at about 131.28 tons /day.

The land fill site receives wastes carried in 65 trips on an average every day. There are 3 dumper placers doing 9 dumper trips together, total 55 tractor trailer trips and 1 compactor trips on an average per day. It is estimated that about 26 Tons of waste from dumper placers, 8 tons of waste from compactors and about 97 tons of waste from tractor trailers is dumped in the landfill site.

There are totally 8 dumper placers owned by GMP of which 3 were operational during the study conducted. On an average each dumper placer transports the waste in 3 trips per day. Each dumper placer transports about 2.7 tons of solid waste per trip in a day. There are totally 58 tractors involved in transportation of waste from city to land fill. 13 tractor trailers are owned by GMP and 45 are hired from private parties by GMP. On an average each tractor trailer transports about 1.7 tons of municipal waste per trip in a day. Each tractor trailer transports waste in 1 trip a day. Few of the tractors conduct 2 trips a day. There is 1 compactor of 14 cubic meter capacity owned by GMP which collects waste from compactor bins located at various waste sources. The particular compactor does a single trip per day. The compactor transports about 8 tons of municipal waste per day on an average.

Table 3.3: Data on transportation of waste to disposal site

S N	Vehicle type	No of vehicles	No of trips	Day 1 tonnes	Day 2	Day 3	Average
1	Compactors	1	1	7.47	8.47	7.83	7.92
1	Dumper placers	3	9	25.26	24.51	28.73	26.16
2	Tractors	58	55	98.67	95.3	97.59	97.18
3	Total	76	65	131.4	128.28	134.15	131.28

Source: Data compiled by TTPL team

Dumper placers and compactor are used for clearing the waste stored in container bins and compactor bins. The wastes carried by these dumper placers and compactors generally consist less silt and stone materials. Tractor trailers collect and transport wastes from open points and open drainages in the city. The waste transported in tractor trailers contain more of silt and ash content which increases ash content in the samples analysed. Tractors also collect and dispose street sweeping waste in many streets.

3.3.4. Timings of waste disposal

Collection and transportation of waste in Gulbarga city happen from morning 6.30 onwards and continue till 3.30 PM in the afternoon. Dumper placers in the city start operating at 6.30 AM every day. Each Dumper placer collects waste filled container bins from their respective location and start transporting to the land fill site. They arrive in landfill at about 8.15 AM. They keep carrying waste in second and third trips to the land fill till around 1 PM.

Tractor trailers start their operation at 7 AM every day. Tractors arrive late to landfill site as they collect waste from open points and drainages which have to be manually uploaded to tractors. Tractors start arriving at dump site at 9.30 AM and stop bringing wastes usually at 3.30 PM every day. The table below gives the details of the timings of vehicles entering waste disposal site.

Table 3.4: Data on timings of vehicles entering disposal site

S. N	Vehicle type	Start time (AM)			End time (PM)			Earliest Time in	Last Time out
		Day 1	Day 2	Day 3	Day 1	Day 2	Day 3		
1	Dumper placer	8.30	8.10	8.40	3.10	2.15	2.40	8.10 AM	2.15 PM
2	Tractors	8.50	9.25	9.10	4.40	3.30	3.50	8.50 AM	3.30 PM

Source: Study conducted by TTPL

3.3.5.Estimate of waste generation, collection efficiency and projection

The total waste generation as per generator based assessment 197 TPD. The normative estimation of waste quantity for the city is about 210 TPD. The estimated waste generation of 197 TPD in 2013 is adopted as a realistic waste generation quantity for Gulbarga. An average quantity of about 132 TPD of waste is collected and disposed in the landfill site every day. The present collection and transportation efficiency of MSW in Gulbarga is calculated to be about 67%.

The waste generation would increase with increase in population and with growth in waste generation rates. The waste generation has been estimated for a 20 year time frame at 5 year intervals and presented in table below. The population growth rate is taken at 3 % per annum and the waste generation rate is expected to grow at 1 % per annum. The waste quantities are expected to increase from the present level of 197 TPD to 458 TPD in the next 20 years. With better segregation and improvement in the waste collection systems a decrease in waste delivered to the disposal occur. The table below gives details of the projected and estimated waste generation in Gulbarga.

Table 3.5: Estimation of waste generation and projection

Year	Population	Waste generation rate	Waste Quantity in
2013	543147	364	197
2018	638198	382	244
2023	749882	401	301
2028	881112	421	371

2033	1035306	442	458

Source: Study conducted by TTPL

3.3.6.Composition of waste

The composition of the waste becomes crucial to decide an efficient SWM system. To understand the waste character disposed in the land fill in Gulbarga, An analysis of the composition of the fresh waste was conducted for 3 days. 5 samples were selected and analysed for 3 consecutive days by using the quartering technique.

500 kg of fresh waste was selected randomly by the waste carrying vehicles for conducting the quartering technique. About 100 kg of waste from the selected 500 kg of waste was selected for conducting waste composition analysis. The selected 100 kg sample was segregated with the help of rag pickers and each segregated material is weighed.

The analysis shows an organic content in the waste of 32.7 %, 24.27 % recyclable materials, 32.87 % of silt and stones and miscellaneous items of 13.54%. The quantity of silt and stone is high because of collection of waste from roads while sweeping. The details of the type of segregated waste and the quantity of each type in the selected 15 samples are presented in annexure 2. Photo documentation of the waste characterisation is provided in annexure 5 of this report. The particulars of waste composition and analysis conducted are presented below based on the analysis conducted at the landfill. The table below gives the average waste composition of selected samples.

Table 3.6: Physical composition of waste in Percentage

S.N	Particulars	11-Dec-13	12-Dec-13	13-Dec-13	Average
1	Plastic material	13.2	13	14	13.40
2	Paper	8.2	9	9.4	8.87
3	Cloth piece	11	10.4	11.2	10.87
4	Organic waste	35.6	31.4	31.3	32.76
5	Glass Pieces	0.6	0.6	0.6	0.67
6	Wood pieces	4	2.4	2.4	2.93
7	Metal pieces	0.6	0.6	0.6	0.60
8	Silt, stone & Moisture	32.4	34.4	31.8	32.86
		101.4	99.4	100.2	100.27

Source: Study conducted by TTPL

3.4 Storage of domestic waste at source

Storage of waste at source is not practised among the domestic waste generators in Gulbarga. The waste generators dispose the waste at multiple locations like primary

container bins, drainages or open points. This has resulted in many open dumping points in the city. There are more than 850- 900 open points in the city. These open points attract stray animals and create nuisance for the city. To arrive at the number of open points a survey was done at different localities, were our survey had visited and the numbers of open points were counted. The following table gives the details of the approximate number of open points in the city.

Table 3.7: Details of approximate number of open points in the city

S. N	Ward numbers	No of open points
1	Ward number 31	16
2	Ward number 36	12
3	Ward number 16	19
4	Ward number 03	12
5	Ward number 54	21
	Average Open points per ward	16
	Open points in 55 wards of the city	**880**

Source: Study conducted by TTPL

GMP has provided concrete bins in some areas, there are around 50-60 concrete bins. These bins are old and not in good condition. This concrete bins are not effectively utilised in some areas and waste is being thrown around the concrete bin rather than throwing in it. This makes the area appear like an open point. Waste dumped by waste generators in concrete bins and in open points it is cleared every day and dumped in the dumpsite by tractors.

The GMP has placed container bins of capacity 3 m3 and 4.5 m3 in various locations of each ward. Few of the waste generators who are located very nearer to the container bins dispose the waste into the container bins.

3.5 Storage of Market and trade wastes at source

Wastes generated from shops, offices and other commercial establishments like hospital, hotel, restaurants, construction and demolition wastes, etc., are either thrown on streets or disposed into container bins if the bin is placed within 50 meters of the distance.

Gulbarga GMP has provided container bins for market places. Gulbarga has about 9 major vegetable and fruit markets. Some major markets like Super/Main market, Kanni market and Old Tanga Stand market and APMC have been provided with container bins to make it possible for the waste generators to dump waste in container bins. Main markets have been provided with 2 container bins each considering large waste generated at these sources.

These container bins are cleared on a daily basis. On an average around 10- 15 tonnes of waste is generated from markets alone. There are other smaller markets in the city that generate about 200 kg a day. There are number of markets which happen once in a week.

Only few main markets like fruit market near super market, tanga stand market are provided with container bins. Other markets which are not densely populated and dump the waste in open points which are removed by GMP through tractors. Usually the market waste which is dumped in open points is cleared through tractors. It is observed that waste dumped in open points attracts stray animals and make the place dirtier.

3.6 Segregation of recyclables wastes

There is no systematic mechanism of Segregation of recyclable waste in Gulbarga. Segregation of waste is not practiced at generator level or at disposal. The waste generators like households, commercial establishments and other institutions usually dump recyclable and non recyclable waste together in open points or in container bins located nearby. Very few of the commercial establishments like hotels practice the segregation of waste by storing food waste separately which is given to animal husbandry units.

Around 30 rag pickers are operational at land fill site located at Udnoor. These rag pickers collect the recyclables from the waste heaps dumped by the waste carrying vehicles. The rag pickers also collect the recyclables like plastics and metals from the container bins and open points of the city. There are approximately around 140 rag pickers in the city who collect the waste and sell the recyclables to kabadiwalas.

Presently there is no mechanism of collection, transportation or processing of the bio degradable and non bio degradable waste in Gulbarga.

3.7 Primary Collection of Domestic, Trade and Institutional wastes

In Gulbarga the waste generated from Domestic generators is a major contributor of waste accounting for about 62 % of the total waste generated in the city. It is assessed that out of this only around 50% is collected. Commercial and institutional waste generated is around 24 tonnes each day and 70% of it is usually collected. Since most of the trading areas are in the city center and container bins are being provided to large generators the waste collection mechanism here is better than other waste generators.

There is no primary collection of domestic waste in the city. There are no self help groups to collect waste. The waste is been dumped into open points and containers provided. In the city centers the GMP compactors collects the waste from the containers whereas in others places the tractor trailers are employed to collect the waste from the open points.

There are no Self help groups, Residential welfare associations to actively participate in the process of Solid waste management in the city. The Segregation and recycling of waste is also not practised in the city. There are few rag pickers in dumpsites wherein they segregate and collect few recyclable materials which will weigh around 40 kilograms per day.

3.8 Hospital and Nursing home wastes

Bio medical waste generated by Hospitals and clinics is separately collected by the Common Healthcare waste Appropriate Management Plant (CHAMP) facility. It caters to all the healthcare establishments of the Gulbarga city and independently handles the process of collection, transportation, treatment and disposal of healthcare waste from medical establishments. The processing equipments that are installed at CHAMP site are incinerator, autoclaves, shredders, chemical treatment facility, liquid effluent treatment, deep burials and secured landfills. Attention is given to the problems of incineration emissions. To avoid the generation of dioxins and furans during incineration, essential air pollution control equipments are in place disposed at landfill.

3.9 Hotels and Restaurants Waste

In Gulbarga city there are a large number of restaurants and hotels with lodging facilities. Most of the hotels and restaurants are located in station road and city bus stand area. To understand the quantity of waste generated by hotels, a survey was conducted by weighing waste generated for 3 consecutive days in 7 small sized hotels and 7 hotels with lodging facilities. The following table gives details about quantity of waste generated by hotels

Table 3.8: Details about quantity of waste generated by hotels

S. N	Generator type	Total no. of generators	Avg. waste generated by generator/ day	Total waste / day in tonnes
1	Small hotels	530	4.1 kg	2.17
2	Hotels with lodging facility	53	11 kg	0.58
	Total	583		2.75

Source: Study conducted by TTPL

On an average a small hotel without lodging facility generates around 4.1 kg of solid waste apart from food waste and large hotels with lodging facility generate waste of around 11 kg per day. Considering that there are about 583 numbers of small hotels in the city there would be around 2.2 tonnes of solid waste is generated each day in the city from hotels. In case of large hotels, the waste generated is about 0.58 tonnes a day. In total this particular type of generator generates around 2.78 tonnes of waste each day. This waste generated estimation is excluding the glass materials which are carried by rag pickers from restaurants

with beverages availability. The quantity of waste generated is relatively small but dispersed and in many location dumped in open areas.

3.10 Market Wastes

Gulbarga city is the district head quarters of Gulbarga district and main commercial place for the whole districts comprising of 7 taluks namely Afzalpur, Aland, Chincholi, Chittapur,Gulbarga, Jewargi and Sedam. Farmers from various places of the district bring their farm products to sell in Gulbarga city making it a commercial hub for the whole district. Gulbarga city has an APMC market which is main commercial hub for Gulbarga district. GMP has provided container bins in the major market areas for storage of waste. Main market places in Gulbarga city are APMC market area, Super/Main market, Kanni market and Old Tanga Stand market. In the remaining markets, the waste is dumped on the ground and tractors collect the waste. There is no dumper bin or RCC bins available in the small and other markets for the storage of waste.

There are about 15 markets in the city most of them are being provided with container bins which are collected and transported daily. Considering that each container bin of 4.5 cubic metre sizes contains a waste of 2 tonnes, around 18 to 20 tonnes of market waste is generated each day from markets. Super market is being provided with 2 container bins which are cleared daily. APMC market is also being provided with 2 container bins which are cleared alternative days. Considering the number of containers filled which are kept in market areas, we estimate the waste to be around 18 to 20 tonnes.

3.11 Construction Waste

Construction and demolition waste mostly consist of inert and non biodegradable material such as concrete, plaster, metal, wood etc. These wastes are heavy, having high density often bulky and occupy considerable storage space either on the road or communal waste bin/container. Most of the construction waste is generated from outskirts of the city where there is a rapid pace of growth and construction.

Construction debris is dumped in a big low lying area near Shrana basaveshwara temple. This is around 1.5 km from the city centre.

3.12 Street Sweeping

The Gulbarga city is estimated to have total roads of about 986 km in GMP limits spread across all the 55 wards. Presently the street sweeping operations in all the 55 wards are managed by GMP. The GMP manages the street sweeping operations by its Paura karmikas and labours hired through manpower supplying agency. There is no detailed plan for conducting street sweeping in the city at present. The streets of the city are classified into 3 types of roads based on the frequency of sweeping. The classifications of roads are as below

1. **Type A**- the streets which are swept every day are classified as type "A" Roads. These roads are located in city centres, near bus stand, commercial areas and common areas which need daily sweeping to keep them clean.

2. **Type B**- Roads coming under this type are located in not so busy areas like semi residential- commercial areas, school areas, etc. where the locality is not as densely populated like Type A roads and would require sweeping twice a week to keep them clean.

3. **Type C**- Roads coming under this type are located in purely residential areas where there is considerably less dirt and people commuting. Commercials centres are very less. These types of roads require sweeping once in a week to keep clean.

The street sweeping work is carried out from 6.00 AM to 12.00 PM in the morning hours. The shift could extend till 1 PM in case of excess waste or inefficient operation of sweepers. Street sweeping happens usually in single shift unless there is a lot of waste generated in a day or there are special occasions in the city.

3.13 Frequency of Street Sweeping

The frequency of sweeping in 3 categories, i.e., Type A (High density areas like city centre, commercials and important areas), Type B (Medium Density areas and housing colonies) and Type C (Low density areas and fringe areas is given in table below. Most of the non metalled roads and Gunta layouts are not considered for street sweeping. Out of 986 km Road length only 202 km is considered for daily sweeping whereas other streets are swept once in 2 days or once in a week. The table below gives details of each type of road and the frequency of sweeping.

Table 3.9 : Details on frequency of sweeping depending on the categories

Parameter	Length of roads in km	Frequency of Sweeping
Type A (city centre, commercial areas & important areas)	202.4	Daily
Type B (Medium density areas and housing colonies)	369.6	Twice a week
Type C (low density areas and fringe areas)	445.9	Once a week

Source: Analysis from GMP data

On an average each sweeper sweeps around 700 to 800 m^2 in per day. The sweeping rate is lower than normative standard rate of 1000 m^2 per day as set by the government of Karnataka. It is learnt during the filed studies that huge number of open points and waste being disposed on the streets by waste generators are the causes for slower street sweeping operations.

3.14 Tools Used

Gulbarga city has a dusty atmosphere and there is lot of dust along with the waste in the city. Significant amount of waste is disposed on the streets. Most of the main streets consist of waste materials like plastic covers, paper waste etc. The Sweeping staffs are provided only with short hand brooms, metal plates and wheel barrows. The street sweeping staffs are not provided with long hand brooms, gloves, uniforms, masks, sweeping carts, gum boots and metal trays. None of the workers wear jackets or mask to cover themselves from dust while sweeping. Sweepers use their hands and brooms to collect waste from waste heaps and put into plastic bags. Sweepers in some areas have been provided with metal plates and pushcarts.

Container bins of 3 m^3 and 4.5 m^3 containers as intermediate waste storage depots. These container depots are considered as part of the transport system. There is no intermediate transfer station in Gulbarga.

3.15 Work Norms

GMP has deployed around 657 sweepers for sweeping 986 km length of roads in the city. There are about 217 staff employed by GMP and about 440 employees are hired through private man power supplying agencies. The average total length of roads swept each day including type A, type B and Type c roads is about 437 Kms. The average distance of street swept by each street sweeper considering the absence and scavengers deployed is about 750 meters per person.

3.16 Transportation of wastes

Transportation of the solid waste generated in the city is being managed by GMP. Primary transportation refers to transporting of waste generated from waste generators to the waste storage depot. Primary transportation of waste is not practiced presently in Gulbarga. There are no intermediate storage depots in Gulbarga except container bins.

Secondary transportation refers to collection of waste from intermediate storage points like dumper bins and open points to disposal unit. GMP is presently managing the secondary transportation with its vehicles and hired vehicles. Compactor, dumper placers and tractor trailers are used as secondary transportation vehicles. The numbers of vehicles involved in secondary transportation are presented below in table 3.10.

3.10: Details of vehicle involved in transportation of waste

S. N	Type of vehicle	No of vehicles	Waste collecting point	Disposing point	Owned by	Managed by

1	Compactors	1	Markets, Households & domestic generators	Disposal site	GMP	GMP
2	Tractors	13	Open points	Disposal site	GMP	GMP
3	Tractors	45	Open points	Disposal site	Private	GMP
3	Dumper placers	8	Container bins	Disposal site	GMP	GMP

3.17 Processing and disposal of wastes

GMP has set up Municipal Solid Waste disposing site at Udnoor village towards south west of the city. The landfill is located at a distance of about 13 kms from the city center. The total area of the landfill site is about 28 acres 19 guntas. The landfill site is walled on two sides. The facility has been provided with a watchman's room. GMP has not deployed any trip entry recorders for the trips of each vehicle on all days. The disposal site is not being provided with a 24 hour watch man and weighing bridge.

The waste brought to the depot by compactors, dumper placers and tractors is dumped inside and JCB is deployed to form heaps of the wastes. The waste heaps are not covered with inert material.

Bio medical waste generated by Hospitals and clinics is separately collected by the Common Healthcare waste Appropriate Management Plant (CHAMP) facility. It caters to all the healthcare establishments of the Gulbarga city and independently handles the process of collection, transportation, treatment and disposal of healthcare waste from medical establishments. The processing equipments that are installed at CHAMP site are incinerator, autoclaves, shredders, chemical treatment facility, liquid effluent treatment, deep burials and secured landfills. Attention is given to the problems of incineration emissions. To avoid the generation of dioxins and furans during incineration, essential air pollution control equipments are in place. The biomedical waste treatment facility is a separate site located at Sy No- 1139, sharan sari asha giri village in Afjal pur road

4 Proposed Action Plan for Management of MSW

The detailed plan for setting up an efficient collection and transportation plan of MSW generated in Gulbarga is presented. The suggestions, inputs and corrections given by the GMP and its stake holders have been included in drafting this report. MSW 2000 rules are considered as the basis for the proposed plans in conjunction with state level normative standards for key operations like collection, sweeping, transportation and management of waste.

4.1 Overall Concept of waste management proposed

The mechanism of solid waste management system in Gulbarga requires a reorganized model to meet the requirements of of the MSW rules 2000. The major effort required in this regard is towards the improvement of the waste collection and transportation.

To improve the mechanism of collection and transportation, decentralized collection and transportation plan has been suggested by classifying the GMP area into packages. It is proposed to bring in the private sector into the solid waste management processes on a longer term with performance based contracting. This would enable efficient management of the systems in a better way over a long time as the existing staffs of the GMP retires and recruitment of new staff by GMP is restricted.

The overall concept of re organised SWM system is presented in the flow chart below. It is proposed that collection from all the waste generators would be at door step in each of the existing 55 wards. This would include residential, commercial and institutional facilities. Door to door collection of waste will reduce the burden of secondary collection system due to reduced number of open points. The MSW from markets and other common places would be collected through sweeping teams. The waste collected from door to door system and by the sweeping teams deployed for market areas and other public spaces will be disposed in the landfill. Roads sweeping and drain cleaning would be a separate waste flow from collection to disposal.

The 55 wards of the city are classified into packages based on proximity. The classification is to ensure that the total waste generation is restricted to around 15- 20 tons per day so that the SWM processes are manageable. All the wards in the city have been classified into 15 packages. Each package consists of 3 to 5 wards considering the quantity and waste generated by each proposed package. The classification of GMP area into 15 individual packages is presented in Collection and transport map presented as annexure 3 with this report. Individual package wise maps consisting of ward level details, container bins locations, type A, Type B and Type c roads are also presented as part of annexure 3.

11 of the 15 packages will be outsourced to private service providers. The remaining 4 of the 15 packages will be managed by the GMP staff. The existing GMP staff would be redeployed to manage these 4 packages. The redeployment of GMP is proposed in the

peripheral areas. The core areas and busy streets of the city would be managed by the outsourced private service providers. The table below gives the proposed classification of wards into packages in the GMP area.

Table 4.1: Proposed classification of GMP area into packages

S. N	Package No.	Wards	Total Wards	Proposed responsibility	Area km^2	House holds	Population
1	P 1	2,12,13,14	4	Out Source	4.14	8461	50858
2	P 2	5,10,11,15	4	Out Source	1.28	5372	31054
3	P 3	4,9,16,25,26	5	Out Source	2.57	6248	37924
4	P 4	6,7,18,19,23	5	Out Source	5.81	11190	56057
5	P 5	17,24,31	3	Out Source	1.41	5067	56057
6	P 6	27,28,29	3	Out Source	2.55	5541	27211
7	P 7	33,34,41,42	4	Out Source	2.35	5690	28177
8	P 8	35,36,37,40	4	Out Source	1.30	7060	36954
9	P 9	38,39,50	3	Out Source	7.15	6979	35557
10	P 10	48,49,51,52	4	Out Source	5.11	5039	24618
11	P 11	43,44,45,47	4	Out Source	6.81	5935	30901
12	G 1	1,3,8,32	4	GMP	7.95	7509	32889
13	G 2	20,21,22	3	GMP	4.83	7942	42390
14	G 3	30,46	2	GMP	6.37	4676	22989
15	G 4	53,54,55	3	GMP	4.25	9095	44890
		Total	55		64	100969	527540

The overall waste management system for the city has been designed for 220 Tons of waste per day by considering 10% of extra waste to that of present waste generation. The waste generation quantity is expected to grow along with the increased commercial activities and increased the population of the city. The MSW collection and transportation system has been designed with the 10% extra capacity to accommodate the possible increase in the quantity of waste generated in the city.

All the SWM activities of the outsourced and GMP packages would be completely managed by the respective service provider. The solid waste management activities include door to door collection of waste from households, commercial establishments, hotels and other major generators, street sweeping, general cleaning, market waste removal, drain cleaning, and cleaning of toilets.

The proposed concept requires establishing primary waste collection and transportation system. This would result in reduced burden of solid waste management on secondary transportation and will reduce the number of open points in the city. Resource recovery is a significant component of the new proposal. 1 Dry waste collection centre would be set up in each of the 15 Packages. It is also proposed to integrate the informal and recycling sector

involving rag pickers and kabadiwalas prevalent in Gulbarga into the formal system by recognizing their work and by providing required support services.

The transportation of the waste will be classified into primary and secondary transportation. The primary transportation vehicles will be auto tippers, hand carts and 4 wheeled vehicles involved in door to door collection. These primary transportation vehicles will collect the waste from the generators on a daily basis and dispose the waste into waste collection bins. The secondary transportation will be by compactors, dumper placers and tractor trailers. The compactors and dumper placers will be used to transport the waste from collection bins to the land fill site. Tractor trailers will be used to transport drainage waste and construction and demolition debris. The table below gives the list of the duties assigned and frequency of SWM operations required to be conducted.

Table 4.2: The proposed SWM duties of each package

S. N	Particulars	Duties	Frequency
1	Door to door collection	Households	Daily
		Commercial establishments including shops, hotels etc.	Daily
		Solid waste generated in hospitals	Daily
		Waste from institutions like school, college, temple, theater & malls	Daily
2	Sweeping	Sweeping of type A roads	Daily
		Sweeping of type B roads	Twice a week
		Sweeping of type C roads	Once in a week
		Markets	Daily
		Public places like parks and government office areas	Daily except Sunday or on holidays
3	Drain cleaning	Drain cleaning of drainages	Once in a week
4	Transportation	Transportation of collected waste from door to door collection operations	Daily
		Transportation of market waste	Daily
		Transportation of waste from commercial establishments	Daily
		Transportation of solid waste from medical units	Daily
		Transportation of secondary bins	Daily in the core areas of the city, Twice a week in external areas of city

4.2 Waste Flow Processes

The municipal wastes generated in the city will be collected using the following different types of collection systems as follows

a. Door to door waste collections system

Collection of municipal wastes from Households and commercial establishments like provision stores and institutions like colleges, temples, theatres, malls etc would be part of door to door collection system. The primary transportation vehicles like hand carts, auto tippers or 4 wheeled tippers will be used for door to door collection. The deployed door to door collection vehicles would visit each and every waste generator in the deployed area. The collected waste will be disposed by these vehicles into the nearest compactor or container bins which are called secondary storage points. Dumper placers or compactors would carry these wastes to the land fill site for disposal.

b. Sweeping, parks and grounds, general cleaning operations

Conducting street sweeping operations, cleaning and removal of waste from public places, office areas, administrative areas, markets, parks and other general places are considered for collection of waste using sweeping mechanism. The street sweeping staff would clean these areas regularly considering the quantity of waste generated in these generators. The package wise maps provided with this report in annexure 3 give the locations of these general cleaning areas. The classification of type a, type B and type C roads for sweeping is also provided in the maps.

The Waste generators which generate more waste will be cleaned daily, average waste generators will be cleaned twice a week and less waste generators will be cleaned once in a week. The municipal solid waste collected from these operations will be disposed into the secondary waste storage points like compactor bins or container bins. Dumper placers and compactors transport the waste from these points to the landfill site.

c. Removal of debris

Construction of commercial and residential buildings is increasing in the city of Gulbarga. The construction activities are witnessed more in the peripheral areas of the city. Presently there is no system for collection and disposal of construction and demolition waste in the city. This construction and demolition debris should not be treated along with the municipal solid waste. Disposing this waste in the land fill would result in closure of landfill in shorter span of time.

It is proposed that the construction and demolition waste generated in the city will be collected using tractor trailers. The removal of construction and debris waste would be responsibility of the respective service provider of each package. The waste generators would inform the respective package service provider for removal of the debris. The

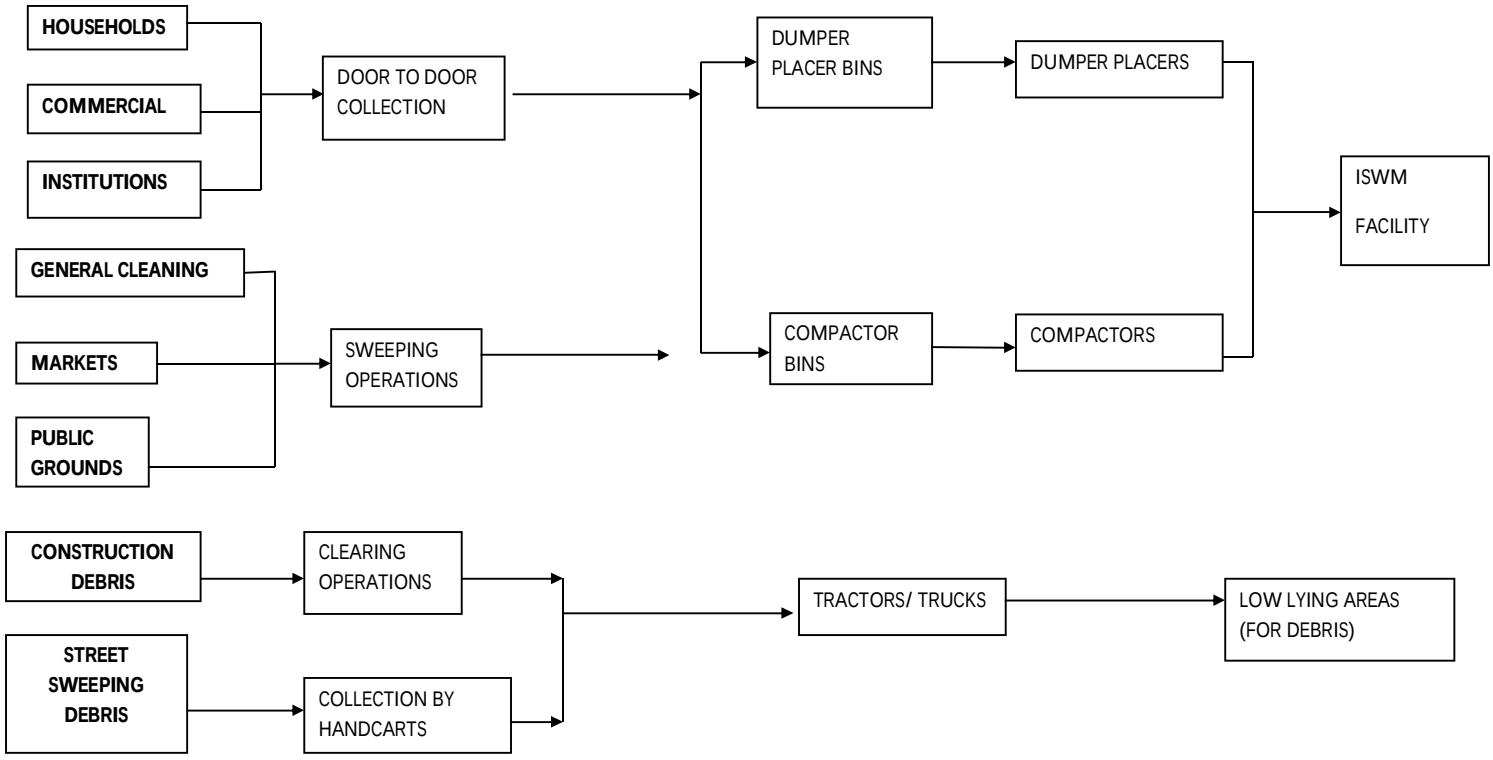
service provider would collect the debris and dispose the same into low lying areas of the city. It is proposed that the removal of debris could be charged for generating revenues to GMP.

d. Street sweeping debris

The street sweeping operations is expected to consist of silt and stone materials which are suggested to be not included with solid waste flow. The municipal waste generated in street sweeping would be included in solid waste flow but the debris collected during street sweeping would be collected using tractor trailers. The sweeping debris would be disposed into low lying areas along with the construction and demolition waste.

The GMP should identify the low lying areas of the city and insist that the service providers or the waste generators do not dispose the construction waste elsewhere in the city. The following flow chart gives details of the waste flow mechanism in Gulbarga city.

PROPOSED WASTE FLOW FOR GULBARGA



4.3 Door to Door Collection block and routing plan

Door to door collection of waste would be introduced for collection of waste from residential and commercial waste generators in Gulbarga. Each service provider would be responsible for conducting door to door collection operations in the allotted packages. The service provider shall provide the man power, vehicles and equipments required for the door to door collection mechanism.

The proposed door to door collection system will eradicate open points in the city. The residents and other waste generators are expected to store the waste and hand over the waste to the door to door waste collection staff. GMP should insist the waste generators to dispose the waste only through door to door step mechanism and avoid throwing the waste into open points and drainages. The door to door waste collection staff would collect the waste each and every day including national holidays and Sundays.

4.3.1 Door to door collection plan

The door to door collection operations will be done using a combination of auto tippers, hand carts and 4 wheeled tippers. The numbers of each type of vehicles required for door to door collection have been calculated in the estimates for each individual package. The city requires about 48 auto tippers, 19 four wheeled vehicles, 88 hand carts for conducting door to door collection operations. The table 4.3 below gives the number of primary vehicles required for the city in each packages. The man power requirement analysis for door to door collection system is considered as part of the total man power required for packages. The table 4.4 gives details of the man power required for each packages. Each service provider is expected to deploy the required vehicles, equipments and man power.

The geographical features of peripheral areas and core areas of the city are distinct in Gulbarga. A combination of vehicle usage has been suggested for door to door collection for different packages for effective operations. Different types of vehicles have been deployed considering the broadness of roads and number of households to be covered. The packages consisting of wards located in the peripheral areas should be deployed with the fast moving 4 wheeled tippers. The 4 wheeler tipper vehicles can move faster and have higher capacity than auto tippers ensuring that more number of houses can be covered.

The semi peripheral areas of the city are a combination of old city and newly developed lay outs. It is suggested that door to door collection of waste should conducted using a combination of 4 wheel tippers and auto tippers in these areas.

The packages covering the old city areas or central areas of the city are suggested to be deployed with a combination of auto tippers and hand carts as the roads are narrow and crowded. Hand carts are suggested to be used in small and narrow streets where auto tippers cannot move. The details of percentage of waste to be collected by each type of vehicle by in each package have been provided in annexure 5 as detailed Estimates. The

synopsis of the vehicles required for conducting primary and secondary transportation of solid are presented below in the table.

Table 4.3: Number of vehicle required for the city

S. N	Packages	Sweeping carts	Hand carts	Auto Tipper	4 W tipper	Tractor Trailer	Compactor	Dumper Placer
1	Package 1	43	0	3	3	2	1	0
2	Package 2	22	10	4	0	1	1	0
3	Package 3	33	16	6	0	1	1	0
4	Package 4	38	7	5	2	2	1	0
5	Package 5	34	9	3	0	1	1	0
6	Package 6	22	9	3	1	1	1	0
7	Package 7	37	11	4	0	2	1	0
8	Package 8	32	11	4	0	1	1	0
9	Package 9	70	0	2	2	2	1	0
10	Package 10	37	0	1	2	1	1	0
11	Package 11	45	10	4	0	1	1	0
12	GMP 1	30	0	3	2	1	0	2
13	GMP 2	47	0	2	3	2	0	1
14	GMP 3	39	0	2	1	2	0	1
15	GMP 4	44	5	2	3	2	0	2
	Total	**573**	**88**	**48**	**19**	**22**	**11**	**6**

Source: cost estimation prepared by TTPL

4.4 Streets Classification, street sweeping and sanitation plan

4.4.1 Street classification

The Total length of all roads in the GMP limits is about 986 kms. The roads of the city have been classified for SWM purposes as Type A, type B and type C roads based on the frequency of sweeping. Type A roads are swept daily, type B roads are swept twice a week and type C roads are swept once in a week. Annexure 1 gives details of the length of all type of roads in each ward. Individual ward wise classifications of type of roads have been given in annexure 3 in form of maps.

4.4.2 Street sweeping and sanitation plan

The street sweeping operation is proposed to be part of the package wise contracting out to private/ GMP parties. The street sweeping, general cleaning, drain cleaning and sanitation operation will be responsibility of the service provider of individual packages as classified in the table 4.1 above.

The waste collected as part of the street sweeping and other general cleaning will be collected using sweeping carts by each street sweeping staff. Each of the street sweeping staff should be given with a long broom and street sweeping cart to increase the efficiency

and swifter movement of the street sweeping staff. The street sweeping staff should not be involved in drain cleaning to increase the efficiency of street sweeping staff. The street sweeping staff should be provided with uniforms, gloves, masks, gum boots and proper health care facilities as safety tools. The sweeping staff should also be provided with required tools like long brooms which shall be replaced once in 3 months, sweeping carts, metal trays and ghamellas. The GMP should insist that each service provider gives the safety tools and operational tools for street sweeping staff.

The secondary transportation of street sweeping and drain cleaning shall be conducted using tractor trailers. It is suggested that the street sweeping waste to be disposed along with the construction and debris waste as the street sweeping waste consists high quantity of silt and stones. It is recommended to not mix the waste collected by door to door collection operation with the street sweeping waste. It is recommended to dispose these 2 types of waste separately to increase the life of land fill and decrease the quantity of waste carried and disposed to landfill.

The number of staff required for conducting street sweeping operations, drain cleaning and other general cleaning has been estimated for individual packages in the detailed estimate provided along with this report as annexure 5. The synopsis of the man power required for the proposed system is provided here in the table below.

Table 4.4: Number of man power required for individual packages

S. N	Package	***Manpower***	
		Drivers	Street sweeping staff
1	Package 1	9	64
2	Package 2	6	45
3	Package 3	8	64
4	Package 4	10	66
5	Package 5	5	55
6	Package 6	6	45
7	Package 7	7	64
8	Package 8	6	56
9	Package 9	7	88
10	Package 10	5	51
11	Package 11	6	68
12	GMP 1	8	46
13	GMP 2	8	66
14	GMP 3	6	54
15	GMP 4	9	69
	Total	**106**	**901**

Source: cost estimation prepared by TTPL

4.5 Secondary bins and transportation of waste

4.5.1 Secondary bins

The container bins will serve as secondary storage points in the proposed solid waste management system. The waste collected from door to door waste collection mechanism, sweeping of market area, public grounds will be disposed in to these container bins. These container bins will be emptied by using dumper placers and compactors. The dumper placers and compactors will dispose the waste collected into land fill site located at udnoor.

GMP is presently using 3 m^3 and 4.5 m^3 container/ compactor bins as secondary bins. There are about 108 container bins of 3 m^3 and 56 container bins of 4.5 m^3 size placed presently in GMP area. The location of the container and compactor bins are shown in collection and transport map number 05 as provided in annexure 3.

It is proposed to introduce 37 additional 3 m^3 container bins for the designed collection and transport plan. The possible locations of the proposed to container bins are also shown in collection and transport map number 05 as provided in annexure 3.

The detailed estimates for individual packages give the package wise existing and additional requirement of container bins. It is proposed to procure only 3 m^3 bins in near future as these bins could also be shifted by compactors with better efficiency. It is proposed to not remove any of the existing containers. Removing any of the existing containers may result in forming a new open point in that location. The containers which are not in good condition should be repaired or replaced by new container in same location. The container bins should be placed on a concrete platform to make it convenient for the people to dispose waste inside the bin. Concrete bins will also avoid stray animals from getting inside the container bin and create nuisance. The table below gives the details of additional container bins required per each ward based on the volume of waste generated.

The proposed locations for the required 37 additional container bins to be placed are provided in container location map as part of annexure 3.

4.5.2 Transportation of waste

The Proposed transportation plan for the waste generated and collected will be conducted by a combination of primary and secondary transportation of waste in Gulbarga. Primary transportation of waste is suggested to be conducted as Door to door collection mechanism. The details of the suggested primary transportation mechanism are provided above in this chapter.

Secondary transportation refers to collection of waste from secondary waste storage points and disposing the waste to the land fill site. It is proposed to use compactors and dumper

placers to remove the waste from the container bins. For disposal of street sweeping waste (silt & stones) and construction and debris waste tractor trailers shall be used.

The proposed transportation system requires 22 tractor trailers, 11 compactors and 6 dumper placers for Gulbarga. The details of the requirement of individual package wise secondary transportation vehicles is provided in the table 4.3 presented above in this chapter. The redeployment plan for the existing secondary transportation is provided as a part of redeployment plan in this chapter.

4.6 Redeployment of existing resources

The GMP has acquired its own resources for managing the SWM operations in Gulbarga over a period of time. The details of the existing resources in terms of vehicles and man power have been provided in chapter 3 in this report.

It is suggested that the existing resources like equipments, man power and vehicles of GMP shall be deployed in GMP managed packages as required. The detailed estimates provided with this report as annexure 5 gives the requirement of vehicles and equipments for managing the GMP packages and resources packages. The extra resources shall be provided to the packages 1-6. These packages which are being provided with equipments shall be charged for redeployment. The calculation of the cash out flows for packages with and without redeployment of vehicles has been provided in detailed estimates. The synopsis presented below gives the redeployment plan of vehicles and equipment presently owned by GMP.

Table 4.5 : Vehicle and equipment redeployment plan

S. N	Vehicles	Available	GMP requirement	Excess / Short	To be procured	Requirement in Outsourced	GMP provision for Outsourced Packages	Redeployment plan
1	Sweeping carts	0	160	-160	160	413	0	
2	Handcarts	180	5	175	-175	83	82	As sweeping cart for BMP packages
3	Auto Tipper	34	9	25	-25	39	25	Redeployed in package 1-6
4	4 W tipper	0	9	-9	9	10	0	
5	Tractor Trailer	13	7	6	-6	15	6	Redeployed in package 1-4
6	3m3 Compactor / DP container (some of existing DP bins would be converted to	95	0	95	-95	122	0	All container provided and owned by BMP

	Compactor bins)							
7	1 m3 Compactor Container		0	0	0	0		
8	3m3 DP container	32	47	-15	15	0		
9	Compactors	2	0	2	-2	11	0	
10	Dumper Placer	8	6	2	-2	0	0	

Source: cost estimation prepared by TTPL

The existing paura karmikas shall be re deployed into GMP managed packages. The GMP managed packages would require about 248 Paurakarmikas and 36 drivers. About 13 numbers of driving staffs and 31 numbers of paurakarmikas have to be hired additionally for managing the GMP packages. The man power available with GMP is not suggested to be out sourced to private parties. The details of the manpower required for each packages is presented in the annexure 5 as part of detailed estimates. The table below gives the synopsis of the staff requirement for the GMP managed packages and to be hired or outsourced staff.

Table 4.6 : Man power redeployment plan

S.N	**Man Power**		**Requirement for GMP Packages**					
			GMP 1	GMP 2	GMP 3	GMP 4	Total	Excess /Short
1	Driver	23	8	8	6	9	31	-8
2	Pourakarmikas	217	46	66	54	69	235	-18

Source: estimation by TTPL

4.7 Contracting Plan

It is proposed that the 11 packages identified to be out sourced to private parties shall be contracted out. The contracting shall be undertaken as a performance based contract through E procurement portal of government of Karnataka. The Request for proposal (RFP) and contracting document for out sourcing has been formulated. The major features of the contracts are as follows.

a. All the 11 packages will be invited as part of a single invitation to bid. The scope of work for each of the package shall be as follows.

i. Undertake door-to-door collection of solid waste in segregated form from residences, apartments, residential complexes, shops, commercial centers, institutions and other waste generators and deliver to the designated IWMF.
ii. Promote segregation of waste from the waste generators.
iii. Set up a run a dry waste recycling facility.
iv. Undertake sweeping of roads as per the agreed schedule, drain cleaning of drains les than 1.2 m depth and transport the wastes to the designated site.
v. Collect, transport and dispose off the debris to the designated site. The collection would include the loading and unloading of the debris.
vi. Undertake cleaning of the markets, parks and public areas as specified for the given package. Provide any other cleaning services required in the work area.
vii. All services in the proposed zones must conform to the provisions of Municipal Solid Waste (Management & Handling) Rules 2000 as amended from time to time
viii. Providing manpower, Collection, Segregation and Transportation machinery (including but not limited to vehicles and bins) to conform to the specification provided in work specifications of the Draft Contract, for different road widths and standards to enable collection, segregation, and transportation from the Project Area.
ix. Providing required number of vehicles with operator/drivers for collection, segregation and transportation of solid waste.
x. Providing for other facilities specifically stated in the contract agreement including manpower for monitoring and grievance redressal and facilities for labor like gloves and uniform etc.

b. Bidders shall be allowed to submit bid for a maximum of 3 packages.
c. No single bidder shall be given out 1 contract
d. Preference shall be given for bidders who have experience in conducting SWM operations in Gulbarga.
e. The performance based contract would involve a payment of 60% of the fee as fixed component based on provision of the required man power and equipment. 40% of the fee shall be variable component payable as follows
    i. Adherence to the standards of minimum staff and vehicle deployment (10 %)
    ii. Meeting the package level performance indicators (10 %)
    iii. Setting up and Operation of dry waste collection centre. (10 %)

iv. Deduction for non-response to Complaints received. (10 %)

f. The period of the contract shall be 60 months.

g. The engineers estimate for contracting has been included under the annexure 5 under the detailed estimates.

4.8 Dry waste recycling

It is proposed to set up dry waste recycling units under each packages in the city. These dry waste collection facilities would collect waste from their wards or blocks, recycle the waste and recover possible resources and dispose the inert in to the land fill.

It is proposed to set up 15 dry waste collection centers in the city. Each private/ GMP party managing SWM package shall be asked to set up and managed a dry waste recycling center. The space for the decentralized waste processing facility shall be provided by the GMP. GMP should consider providing a monthly tipping fee and viability gap funding. The GMP shall provide required training for the private parties or GMP staff for setting up and operating the decentralized SWM facilities.

4.9 Innovative Efforts Proposed

Sustainable waste management system requires people participation and innovative efforts. Stake holder interaction and involvement contributes to the success of SWM system. To attain interactive SWM system, following measures are suggested to be taken up by GMP:

a. Promote generator level waste management for small and bulk waste generators. Towards this end the GMP should empanel various vendors and organize buyer seller meets. This would encourage the residents to come forward. The GMP should consider providing property tax rebate for such investments in SWM system.
b. Set up waste collectors and recyclers network and promote them. This would be for the small scale recyclers of all kind operating in the city.
c. The rag pickers and other related recycling industry members should be provided encouragement and minor incentives.
d. Set up decentralized facilities at public facilities like the market and government offices for waste management.
e. Set up a service level benchmarking of the SWM services with people participation as assessors / observers.
f. Supporting for ward level or package level awareness creation about SWM system by NGOs or Self help groups.

5 Institutional Aspects

5.1 Decentralization of Administration

The solid waste management functions require focused attention. The functions are already decentralized significantly in Gulbarga. The 55 wards in the city have been classified into 4 zones in the city. 3 of the 4 zones are headed by 3 environment engineers and the other 1 zone is managed by the assistant executive engineer of GMP. The senior Environmental engineer is responsible for efficient operation of SWM activities in the city. He is assisted by 2 environment engineers, 1 assistant executive engineer, 1 senior sanitary inspector and 16 sanitary inspectors. The details of the existing decentralized administration are presented as below in the table presented below gives management team.

Table 5.1: Details of existing decentralised administration of Gulbarga

Zone No.	Ward Numbers	Sanitary inspector	Environment Engineer
1	50,53,54	Basavaraj Patil	Baburao
	48,49,51,52	Rajashekar	
	43,45,47,30,46	Avinash kumar	
	44	Aravind patil	
2	35,36,37	Hanumanth	AEE deployed
	38,39,40	Vinod Gajare	
	33,34,41,42	Ramachandra Dange	
	55	Basavaraj Patil	
3	11,12,14,15	Peerappa poojari	Abhay kumar
	2,5,10,13	Naagaraj	
	16,24,25,26	Sharanu Tengali	
	27,28,29,31	Mallikarjun anavara	
	4,9	Hanumanth (DRR)	
4	20,21,22	Jatteppa janakara	Mujammil alam
	8,32	Rajendra Kattemani	
	6,7,18,19,23	Bheem singh	
	1,3	Deepak chowhan	
	17	Sharanu tengali	

The GMP is looking forward for incorporating new method of managing the sanitation and SWM mechanism. The EMP is looking forward for classifying the 55 wards into 15 packages. Each package consists of 2 to 5 wards which will be outsourced to private parties who will manage the operations of each package. The consultant team has classified the city into packages by considering the geographical proximity of wards in the packages, the quantity of waste generated and in tune to the possible extent to suit the existing management of wards by sanitary inspectors.

GMP is looking forward for outsourcing managing of 11 of the 15 packages to the private parties. Private party who enter into contract for managing each package will be responsible for managing all the SWM operations of the package. The rest 4 packages consisting of 10

wards will be managed by the existing SWM staff including sweepers, peons, sanitary inspectors and environment engineers. The proposed classification of the packages is provided above in the table 4.1

5.2 Delegation of powers

As per the state health policy the MSW systems are now managed by the senior Environmental Engineer. The complete powers of delegation rest with the senior environment engineer of the city.

The Gulbarga Mahanagara Palike has delegated the powers for Municipal Solid Waste Management to the Environmental engineer and he is responsible for carrying out all day-to-day functions smoothly. The senior environment engineer is reported by the other 2 environment engineer and 1 assistant executive engineer. The sanitary inspectors report to junior environment engineers. The sanitary inspectors are assisted by supervisors who manage peons and the street sweeping staff.

5.3 Need of Manpower

The available staff in the Gulbarga Mahanagara Palike would be redeployed to the wards to be managed by the GMP. The others wards would be outsourced. There is no requirement of additional manpower as the private parties responsible for managing the packages would procure their required man power.

5.4 Human Resources Development

Human resources development is very essential for the internal capacity building, training & motivation. Incentives for outstanding services for non performers are essential for proper human resource development.

Municipal Systems are subject to many pulls and pressures. There is a need to keep the staff motivated to perform and give their optimum output to improve the level of services of the city and the image of the Municipal council. Imparting training in practice from the sweeper onwards at all levels is essential to improve the service through up gradation of knowledge of new technology and attitude. Such kind of courses designed locally is required to meet the need of different level of staff.

Solid waste management is a participative activity and involves many stake holders. A sense of pride in the work would motivate all to perform and give their optimum output to improve the level of services of the city and the image of the organization.

5.5 Work Norms

The work norms proposed in Gulbarga are as per the Karnataka state policy. The standard rate of sweeping is 1 km per sweeping staff in Karnataka. Gulbarga being center of

commercial activities and being a dusty place makes it tough for the street sweeping staff to sweep 1 km of the length. Presently around 750 meters of street is swept on an average by the existing street sweepers which are near to the standard.

5.6 Inter Departmental Coordination

Solid Waste Management Department requires support of multiple departments in within the GMP, particularly the departments related to Roads, water supply and Sewerage and Engineering. At present the coordination among this department happens on personal basis. It is appropriate to standardize these processes.

The procurement procedures for the Solid Waste Management equipment also need to be expedited and simplified. There is a need to develop a monitoring mechanism using the like Geographic Information System (GIS), Management Information System (MIS) for the effective Solid Waste Management.

5.7 Participation of Stakeholders

Encouragement of residents, resident welfare associations, NGO's, municipal staff, recycling sector is essential for a sustained and clean solid waste collection systems in the city. There is scope for improvement in this area in Gulbarga. The Gulbarga Mahanagara Palike may also encourage NGOs or cooperative of rag pickers to enter this field and organize rag pickers in door step collection of waste and provide them an opportunity to improve their working conditions and income. The Gulbarga Municipal Council can give incentives to NGOs in their effort of organizing rag pickers in primary collection of recyclable and/or organic waste and provide financial and logistic support to extent possible.

5.8 Incentives to the private sector

Gulbarga Mahanagara Palike is looking forward for giving long term contract on collection and transportation of municipal solid waste to private parties. The private parties shall be paid monthly wise based on the number of wards they manage and the quantity of waste they clean. The private party will manage the street sweeping, Door to door collection, waste collection and transportation of waste from generators to the landfill site.

5.9 Levy of SWM cess and Administration Charges

The Gulbarga Mahanagara Palike is not levying SWM cess charges separately at present. Debris dumping charges and SWM charges are collected along with the property taxes by the the revenue department of the GMP. The GMP intends to incorporate and maintain the same procedure for collection of levy of SWM cess.

6 Health Aspects

6.1 Special Attention to Slums and Traditional dirty areas

In Gulbarga about 60,000 people live in slums and urban poor colonies as per census conducted in 2011. The slum population accounts to about 11% of the total population city. There are about 12000 households in the city majority of which are below the poverty line. Slums and traditionally dirty areas have to be given special attention in terms of creating awareness and collection of waste from all generators. Collection and transportation of municipal solid waste must be done on all days including holidays for effective solid waste management in the slums and traditionally dirty areas. Special awareness needs to be developed among slum residents for storing the waste and handing it over to door to door collection units or dump into container bins rather than throwing it into open points.

6.2 Implementation of low cost sanitation program to prevent open defecation

The city of Gulbarga has significant open defecation and stands at over 40 % in the slums. There is a need to make serious efforts to eliminate open defecation by providing sanitation options and making cleaning of public toilets part of its sweeping contracts. Further effort is required to ensure that this happens effectively. Levy and charges shall be imposed for open defecation in the city and awareness about safe sanitation must be created among the people of the city.

6.3 Temporary toilets at construction sites

Construction of civil structures like roads, bridges and buildings have been growing steadily concentrated mainly away from the core areas of the city. While basic facilities like toilets and urinals to prevent open defecation do exist at these construction sites, the provision of temporary toilets are not strictly enforced through construction permits. This should be included as part of every permit for construction and implementation needs to be strictly monitored and enforced.

6.4 Covering of buildings under construction

It is necessary to cover construction sites especially in the core areas. This would avoid movement of dust and debris and ensure proper site management and debris control. GMP should make it mandatory to cover the dust during the construction and demolition of buildings and other infrastructures.

6.5 Cattle and Pig Nuisance

Stray animals pose a very serious threat to effective Municipal waste collection and storage. Very often garbage bins are pillaged by these animals, spreading the waste and in the process also spreading infectious diseases among the city's residents. Stray animals are

present in large numbers in city that hamper MSW management efforts. This has been further exacerbated by the large number of open dumping points in the city. Once the numbers of open points are controlled, the nuisance decreases. The container bins should not have any holes as there are chances of stray animals trying to enter them for food.

6.6 Health Monitoring for sanitation workers

To ensure the effective health and safety of employees involved in SWM services, measures like annual medical examination and monitoring must be made mandatory, health education and free medical treatment must be provided. The system should be made comprehensive so as to cover all of the large number of staff involved in the city waste and sanitation services. Also, it must become standard practise to conduct medical examination of employee's bi- annually. The same shall be included in the contracts signed with the private sector and community based organizations. A group insurance for health coverage is also to be taken.

6.7 Prevent indiscriminate use Pesticides

Pesticides are in use for various pests. Indiscriminate use of pesticides, insecticides etc., at the dustbins as well as the waste disposal sites shall be stopped. Such use may be made only under the expert advice of the health authorities in exceptional circumstances.

7 Legal Aspects

7.1 Introduction

The legal framework for solid waste management stems from the Municipality Act, the state policy on solid waste management and the MSW rules 2000 and associates rules. It is advisable to incorporate in the responsibilities of the various stakeholders to enable enforcement of proper solid waste management.

7.2 Proposed Provisions

The following legal provisions may be incorporated in the Gulbarga Mahanagara Palike

a. Prohibition against littering the streets, deposition of solid waste on the streets, Open Defecation etc;

No person shall litter on public places or deposit or cause or permit to be deposited or thrown upon or along any public street, public place land belonging to the GMP.

b. Duty of household not to mix recyclable/non-biodegradable waste and domestic hazardous waste with food waste etc.

To ensure that the recyclable waste as well as non biodegradable waste generated at the said premises do not get mixed up with the food/biodegradable waste and is stored separately.

c. Duty of Societies/Associations/Management of Commercial complexes to clean their premises and to provide community bins

Management of societies, Associations of residents, commercial establishments, institutional, markets by organising for daily cleaning of their internal streets, common spaces etc and provide community bins of appropriate sizes. A separate community bin may be provided for the storage of recyclable waste where door to door collection of recyclable waste is not practiced.

d. Community bins to be kept in good condition

At all the times, community bins are to be kept in good condition, regularly maintained and shall be provided in such a number and places as may be considered adequate and appropriate to contain the waste produced by citizens for whom community bins are provided.

e. Duty of occupiers to deposit solid waste in community bins

It is the duty of Occupiers of all premises for whom community bins have been provided to segregate domestic waste, trade waste, institutional waste from their respective premises and deposit in the appropriate community bins.

f. Duty of GMP to provide and maintain "Waste Storage Bins".

Provide and hygienically maintain adequate Waste Storage Bins in the Municipal areas and place large mobile receptacles at such places for the temporary storage of waste collected from households, shops and establishments as well as from streets and public spaces until the waste is transported to processing and disposal sites.

Make adequate provision for closed containers in various parts of the city for the deposition by citizens of domestic hazardous/toxic waste materials adhering to the provisions of hazardous waste rules of Government of India.

g. Duty of Occupier of households/shops/commercial establishments to hand over the recyclable material/non-biodegradable waste to the waste collectors.

It shall be incumbent on households/shops/establishments to handover their segregated recyclable waste/non-biodegradable waste to the collectors of waste purchaser or recyclers as may be convenient or as may be notified by the local body from time to time. Such waste shall not be disposed off on the streets or in municipal bins or open spaces along with the organic/food/bio-degradable waste.

h. Duty of GMP to collect waste from community bins and onward transport

It shall be incumbent for local bodies to remove all solid waste deposited in community bins on a daily / alternate day basis and transport to processing or disposal sites.

i. Duty of local bodies to clean all public streets, open public spaces and slum areas

It shall be incumbent on local bodies to arrange for cleaning of all public streets having habitation on both or either side, and all slums on all days of the year or as per classification plan including Sundays and public holidays.

j. Duty of local body to arrange for processing of food/biodegradable waste through appropriate technology and disposal of rejects

It shall be incumbent for the local bodies to arrange for the processing of food/organic/biodegradable waste produced in the city and dispose the rejects and non biodegradable waste in an environmentally acceptable manner.

k. Prohibition against deposition of building rubbish

No person shall deposit or cause or permit to be deposited any building rubbish in or along any street, public space or open land except at a place designated for the purpose or in conformity with conditions laid down by the GMP.

l. Prohibition on disposal of carcasses etc.,

No person shall deposit or otherwise dispose of the carcass or parts of any dead animal at a place not provided or appointed for this purpose

m. Punishment for littering on streets and depositing or throwing any solid waste in contravention of the provisions of this act

Whosoever litters the street /or public places or deposits or throws or causes or permits to be deposited or thrown any solid waste or construction debris at any place in contravention of the provisions of this Act permits the flow of any filthy matters from his premises shall be punished on the spot with a fine not less than Rs.50/- as may be prescribed under the rules framed by the State Govt. from time to time. Such spot fines may be collected by officers authorized by the GMP, not below the rank of sanitary inspector. The amount of fine imposed shall be recoverable as arrears of property taxes. The amount of fine shall be kept higher for repeat offences so that the areas can also remain neat and clean.

8 Public Awareness

8.1 Introduction

Everyone is concerned with the growing problems of waste disposal in urban areas with the scarce availability of land for processing and disposal of waste and environmental remediation measures becoming ever more expensive. It is therefore necessary to not only think about effective ways and means to process and dispose of the waste that we generate each day, it is also essential to seriously consider how to avoid or reduce the generation of waste in the first place and to consider ways to re-use and recycle the waste, so that the least quantity of waste needs to be processed and disposed off.

8.2 Reduce Reuse Recycle (R-R-R)

In Gulbarga there is very negligible action on Reduce, Reuse and Recycling of waste. The quantity of packaging waste material and non-bio-degradable waste is going up alarmingly every year. This increases the burden on local bodies to deal with the problem of non-biodegradable and non-recyclable components of waste landing up at processing and disposal sites.

Recycling of waste by all concerned:

All manufacturers producing a variety of domestic and non-domestic products, food as well as non-food should be persuaded to seriously endeavour to use re-usable packaging materials so that after the delivery of goods, the packaging materials could be collected back and used over and over again. They could also consider minimizing or avoiding use of unnecessary packaging materials by innovative methods.

Incentives & product discount should be given to consumers for the return of packaging or bottling materials in good condition, to the waste producers or retailers to promote re-use.

The cost of packed articles and article without packaging material could be kept different with a choice to consumers to take the article without the packaging material at low cost.

Reuse:

Efforts should be made to encourage collection of re-usable material through waste collectors, waste producers, NGOs and private sector instead of allowing reusable waste to land up on the disposal sites. Bottles, cans, tins, drums and cartons can be reused.

Recycling:

In this era of excessive packaging materials being used, a lot of recyclable waste material is generated. All-out efforts are necessary to retrieve recyclable material from the households, shops and establishments and fed to the recycling industries through intermediaries such as waste purchasers, waste collectors/NGOs, etc.

8.3 Public Participation

Public participation is the basis for improving the solid waste management. This requires lot of effort. Public participation is essential in the following activities.

1. Reduce, Reuse & Recycling (R R R) of waste.

2. Not to throw the waste/litter on the streets, drains, open spaces, water bodies, etc.

3. Storage of organic/bio-degradable and recyclable waste separately at source.

4. Primary collection of waste

5. Community storage/collection of waste in flats, slums, societies, commercial complexes, etc and other waste source generators.

6. Pay adequately for the services provided.

The local body should decide the methodology to be adopted for reaching the community and seeking their cooperation and effective participation in SWM services. This is a very difficult area of activity and unless this is done meticulously, desired results will not be achieved.

The essential steps in this direction is to select representative samples of the community and go through a consultative process to ascertain the perceptions of the people about the SWM services being given to them, their expectations and extent to which they are willing to support and participate in the process. Their choice of technological options available also needs to be ascertained.

There is a need to interact with the community to Identify problems of waste management through site visits and consultation with local population at the time when the community is generally available for interaction. It may either be in early morning or late evening. The areas may be selected by following the method of drawl of representative samples. Situation analysis may be done by the persons who know the subject reasonably well, know local language and can communicate with local population effectively. Such persons may be Non-Governmental Organisations, Community Based Organisations or knowledgeable individuals. They should try to find out the prevalent situation of waste management in the area under observation and ascertain the perceptions of the people about the services provided. In this exercise the local councillors, local leaders, NGOs, etc., may be invited to participate.

Finding out optional solutions:

Having identified the deficiencies in the system and known the public perceptions, the next essential step is to think of optional solutions to tackle the problems, workout the cost implications and level of public participation needed.

Consult community on options available:

There should be second round of consultative process where the options worked out may be discussed with the community along with cost implications and their support required. Their suggestions may be sought on each solution proposed. The community may be encouraged to give their views. If we ask the people straight away the solutions of the problems they may not be able to give right kind of suggestions as they have no exposure of various technological options. Therefore, they must be first appraised of the options available and then asked to give their considered opinion on what will work in their area and how much they are willing to cooperate.

8.4 IEC & Capacity Building

There is a need for capacity building to promote the concept of waste segregation at source. A detailed plan for capacity building has to be developed. An overview of the concepts, mass awareness program involved and training is presented here. A budget for the mass awareness campaign has been included in the estimates. The success of the segregation concept is based on the consistent follow up over a long period of time.

In Solid Waste Management (SWM) the people, partnerships, coalitions, resources and skills very are essential to its successful implementation. Multiple approaches have to be adopted for creating awareness and participation including.

- Conducting IEC campaigns
- Providing access to repositories of information and resources (e.g. databases, libraries and web sites)
- Trainings (public, customized or on-line)
- Consultation (e.g. coaching, facilitating, expert advice and conducting research)
- Publications
- Coordinating alliances
- Web based forum for interaction among different players

Information, Education and Communication (IEC) campaigns are critical for working with individuals, communities and societies to promote positive behaviours. The IEC strategies should combine approaches and methods that enable individuals, families, groups, organizations and communities to play active role in achieving, protecting and sustaining the desired behavioural change. Solid Waste Management is an activity in which volunteerism and public participation are the keys to success. It is not only the technology but public

attitude and behaviour that are going to make the difference. A participation model for implementation of Segregation and a table giving details of activities to be practiced are presented below.

Table 8.1: Capacity building requirements of various constituents of SWM

Target Group	**Area covered in brief**	**Topics**
Elected Representatives- Group 1 (Mayor/ President, Dy Mayor/Vice President, Standing Committee Chairman in charge of SWM)	General Orientation on: 1. Solid Waste Management- Technical, Institutional, Financial and legal aspects	Technical Aspects: (i) 4R Concept-Reduce, reuse, recover, recycle Institutional Aspects: (i) Collection & Storage (ii)Transportation (iii)Transfer Stations (iv) Role of NGOs/ CBOs Financial Aspects: (i)Budgeting for SWM (ii) Cost recovery for SWM services Legal Aspects: (i) MSW(M&H) Rules, 2000 (ii) MSWM in Kerala Municipalities Act (iii)Byelaw
	2. Mobilization for Action, Human Resource Development	(i) Interactive process for Strategic thinking (by communities, NGOs, professionals& ULB) to prioritize SWM issues and to identify resources to address them. (ii) Interactive process for improving the efficiency, effectiveness and the performance of local SWM systems. (iii) Steps for Improving SWM
Elected Representatives- Group 2 (All elected representatives except those mentioned above)	General Orientation on Solid Waste Management	(i) SWM Scenario in India (ii) Solid Wastes-Overview (iii) Collection, Storage, Transfer Stations, Transportation (iv) Technology Options for SWM (v) Challenges in the SWM in India (vi) Causes for Non- compliance of Rules (vii) Steps for Improving SWM

Senior Officers (Secretary, Engineer/s, Division Heads)	General Orientation on SWM Plan Preparation and Implementation including technical & technological aspects	(i) Need for Planning-present inadequacies and shortfalls. (ii) How to prepare an SWM Plan (preliminaries like quantitative and qualitative survey of MSW , Identification of technology options, community mobilization, facilitating alliances Implementation of SWM Plan Different technology options Role of different players
	1. Financial Management	(i) Budgeting for SWM (ii) Cost recovery for SWM Services
	2. Legal Policy aspects	(i) MSW(M&H)Rules, 2000
	3. Monitoring & Evaluation	i. What is Monitoring? ii. What is Evaluation? iii. Record keeping and Documentation Importance of Monitoring& Evaluation Monitoring Tools
	4. Human Resource Management for SWM	(i) Human resource for SWM- Capacity Assessment (ii) Human Resource Development For SWM(developing personal and organizational skills, knowledge, abilities of staff; opportunities for employee training, employee career, performance, coaching, mentoring, succession planning, key employee identification etc) (iii) Human Resource Management System for SWM(payroll, work time, benefits, recruiting, training, performance record, service data record etc)
Field Workers	1. Orientation on Effective Collection, Segregation and Transportation of Solid Waste	(i) Different Types of MSW (ii) Handling of Hazardous/dangerous items (iii) Primary Collection and Transportation (iv) Tips for effective collection and transportation

(Source: Data by TTPL)

As part of this project a budget for awareness creation has been included with the following objectives.

a To undertake an awareness campaign to reach about 80,000 household, commercial establishments and institutions on a door to door basis using Pamphlets and one to one interaction over a period of 3 months.
b To undertake a campaign for organizing awareness days at about 150 schools, educational institutions and other centres across the city.
c Carrying out 'Waste Management waste Day Events' once a week for a period of 6 months.

These activities would be carried after the procurement of the vehicles and setting up of the integrated waste processing management facility with scope for processing segregated waste and recovering resources from the collected segregated waste. The message in the IEC would be communicate the action taken by the SMC and the expectations from the community for ensuring that an segregation based integrated waste management facility becomes a reality.

9 Financials

9.1 Summary of Financial Requirement & Sources of Funding

The detailed cost estimates for the proposed municipal waste collection and transport plan has been prepared and presented in annexure 5. The detailed estimates includes package wise requirement of vehicles, equipments and man power required for managing managing SWM activities. The detailed estimates also gives package details like number of households, commercial establishments, public spaces, street lengths and other key information required for the managing SWM activities in the package.

The GMP budgeted annual expenditure for the year 2013- 14 for collection and transport of MSW is Rs 9.4 crores. This includes about Rs 4.95 crore towards salaries and allowances to GMP staff, About Rs 3 crore towards hiring vehicles and Rs 1.2 crores towards outsourced operating expenditures.

The estimated expenditure for the package based collection and transport plan is Rs 10.96 crores per annum. The total cost including the salary and allowance would be 15.91 crores. The total cost of collection and transport would increase from Rs 9.4 crores to Rs 15.91 crores.i.e., an increase of 6.51 crores.

At present the waste collection is about 65% of the waste generated in the city. The collection process is not as per MSW 2000. Door to door collection and waste segregation is not in practice. The proposed package based plan would meet the MSW rules 2000. To achieve this GMP would have to spend Rs. 6.51 crore additionally per annum. The synopsis of the detailed estimates of GMP managed and to be outsourced packages is given below in table 9.1 and 9.2. This cost does not include the fixed cost of the GMP consisting of the salaries of the permanent staff.

Table 9.1 : synopsis of O &M cost estimation for GMP managed packages

O & M Costs by component for BMP Packages excluding manpower costs but including outsourced D2D vehicle drivers						
			GMP 1	GMP 2	GMP 3	GMP 4
a	Manpower (D2D)		45888	45888	27533	0
b	Manpower (sweeping		0	0	0	0
c	Vehicle		133445	111436	88126	145807
d	Tools & equipment		6138	9858	8370	9300
e	Personal Safety Equipment		5110	7884	6716	7592
F	Space for Recycling		10000	10000	10000	10000
g	Sub total	699092	200581	185066	140745	172699
h	Service charges @ 5 %		2294	2294	1377	0
I	PF & ESI (18.36 %)		8425	8425	5055	0
J	Total Costs per month	726962	211300	195785	147177	172699
	Total Costs per annum	8723551	2535608	2349428	1766126	2072388
	Costs per day	5975	6947	6437	4839	5678

Table 9.2 : synopsis of the O & M components of the outsourced packages

O & M Costs by component for Outsourced Packages													
			Package 1	Package 2	Package 3	Package 4	Package 5	Package 6	Package 7	Package 8	Packag 9	Pack 10	Packag 11
a	Manpower (D2D)		130550	154130	239582	198437	128178	154130	162517	162517	87033	69468	154130
b	Manpower (sweeping etc)		488822	278354	370612	446887	378999	278354	438500	362225	715273	404161	471257
c	Vehicle		134130	70282	89664	131855	74055	94054	106036	83096	130263	96656	83780
d	Tools & equipment		9114	4650	6696	8184	6882	4650	7998	6510	14136	7440	8928
e	Personal Safety Equipment		10646	7438	10500	11083	8750	7438	10354	9042	13854	8167	10792
f	Space for Recycling		10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
g	Sub total	7671247	783262	524854	727054	806446	606864	548626	735405	633390	970560	595892	738887
h	Service charges @5 %		30969	21624	30510	32266	25359	21624	30051	26237	40115	23681	31269
i	PF & ESI (18.36 %)		113717	79404	112032	118482	93118	79404	110347	96343	147304	86958	114821
j	Total Costs per month	9136882	927948	625882	869596	957194	725341	649654	875803	755970	1157979	706531	884977
	Total Costs per annum	109642587	11135383	7510595	10435162	11486334	8704103	7795859	10509637	9071649	13895748	8478380	10619732
	Costs per day	27308	30508	20577	28589	31469	23847	21359	28794	24854	38071	23228	29095

For implementation of the proposed package wise collection and transport plan, GMP would have to invest about 6.00 crore additionally as capital investments required. The table 9.3 below gives the particulars on which the GMP would have to invest as capital investment.

Table 9.3 : capital investment required by GMP

A	Vehicles & intermediate storage vehicles	Unit	Quantity	Rate	Amount
1	Sweeping Carts	Number	573	3000	1719000
	Auto Tipper	Number	14	280000	3920000
2	4 Wheel drive tippers	Number	19	550000	10450000
3	3 m3 Compactors / DP containers	Number	27	60000	1620000
4	Compactors	Number	9	4600000	41400000
B	**GPS & RFID**				
1	GPS for vehicles	Number	114	11000	1254000
2	RFID for containers, handcart & sweeping carts	Number	831	2000	1662000
	Total				**62025000**

9.2 Conclusions

A detailed plan for collection and transport has been prepared for the Gulbarga Mahanagara Palike. The plan envisages a combination of municipal managed system and out sourced areas for collection and transport of MSW. 12 month out sourcing plan has been proposed. By implementing the proposed collection and transport plan the GMP would achieve the standard set by MSW rules 2000.

Annexure 1: Gulbarga Mahanagara Palike Data

1.1 GMP data consisting of population, number of households and area of the city.

Sl.No	Ward No	No of HH	Male Population	Female Population	Total Population	ward Area	Density
1	0001	2305	6454	6167	12621	2.49	5074
2	0002	2088	6467	6167	12634	1.74	7269
3	0003	1662	4082	3889	7971	0.93	8586
4	0004	2305	7345	7123	14468	0.34	42078
5	0005	1283	3926	3666	7592	0.54	13949
6	0006	1388	3383	3230	6613	1.67	3950
7	0007	1563	4142	3905	8047	0.55	14596
8	0008	1517	3710	3539	7249	0.26	27748
9	0009	597	1584	1513	3097	0.97	3205
10	0010	873	2679	2523	5202	0.22	23516
11	0011	1732	5209	5069	10278	0.32	32460
12	0012	1183	3474	3472	6946	0.23	30201
13	0013	2833	8740	8393	17133	1.33	12928
14	0014	2357	7207	6938	14145	0.84	16793
15	0015	1484	4108	3874	7982	0.20	40374
16	0016	953	2669	2649	5318	0.97	5455
17	0017	1391	3542	3519	7061	0.71	9980
18	0018	2574	6723	6642	13365	1.39	9586
19	0019	1680	4115	3924	8039	0.38	21157
20	0020	2811	8596	7759	16355	1.93	8477
21	0021	1955	5393	5196	10589	0.65	16181
22	0022	3176	8004	7442	15446	2.24	6885
23	0023	3985	10183	9810	19993	1.81	11059
24	0024	1838	5049	5026	10075	0.35	28666
25	0025	1518	4733	4600	9333	0.10	90867
26	0026	875	2970	2738	5708	0.18	31864
27	0027	1193	3343	3201	6544	0.27	24403
28	0028	1724	4948	4688	9636	0.52	18676
29	0029	2624	7094	6824	13918	1.76	7897
30	0030	2608	6487	6109	12596	4.07	3099
31	0031	1003	2518	2530	5048	0.27	18625
32	0032	2025	5680	5415	11095	4.27	2601
33	0033	1591	4055	3972	8027	1.42	5639
34	0034	1089	2573	2433	5006	0.21	23307
35	0035	1647	4275	4170	8445	0.23	36620
36	0036	2316	5947	5756	11703	0.43	27043
37	0037	1307	3858	3673	7531	0.39	19516
38	0038	3235	8224	7994	16218	5.47	2967
39	0039	1298	3607	3557	7164	0.37	19456
40	0040	1790	4694	4581	9275	0.25	36807
41	0041	1263	3483	3481	6964	0.37	19069

42	0042	1747	4109	4071	8180	0.35	23409
43	0043	1003	2399	2471	4870	0.50	9823
44	0044	1503	3906	3797	7703	0.95	8109
45	0045	2266	6279	6060	12339	0.93	13214
46	0046	2068	5342	5051	10393	2.30	4518
47	0047	1163	3014	2975	5989	4.43	1353
48	0048	955	2435	2412	4847	2.71	1791
49	0049	1395	3410	3398	6808	0.95	7194
50	0050	2446	6174	6001	12175	1.32	9231
51	0051	923	2160	2108	4268	1.13	3790
52	0052	1766	4300	4395	8695	0.33	26403
53	0053	2008	5380	5356	10736	0.35	30811
54	0054	3356	8638	8182	16820	0.46	36820
55	0055	3731	8841	8493	17334	3.44	5037
	Addition villages	1861	4892	4668	9560	0.23	41565
Total		**102830**	**276552**	**266595**	**543147**	**64.00**	**8487**

1.2 GMP data consisting of types of streets and area.

Ward No	Type A	Type B	Type C	Total	Area in Sq km
1	0.36	14.7	6.9	21.98	2.49
2	5.43	26.2	0.0	31.66	1.74
3	2.53	14.0	0.0	16.56	0.93
4	1.72	1.9	5.3	8.96	0.34
5	2.89	6.3	0.0	9.23	0.54
6	1.72	30.2	0.8	32.75	1.67
7	2.53	9.8	0.0	12.30	0.55
8	1.27	3.4	1.2	5.88	0.26
9	3.35	8.8	1.4	13.57	0.97
10	3.89	0.0	0.0	3.89	0.22
11	0.90	5.8	0.0	6.69	0.32
12	1.09	4.9	0.0	5.97	0.23
13	3.44	20.4	0.0	23.88	1.33
14	1.00	6.8	0.0	7.78	0.84
15	2.35	0.0	0.0	2.35	0.20
16	1.45	11.4	2.2	15.02	0.97
17	4.61	7.4	0.0	12.03	0.71
18	2.17	17.6	0.5	20.36	1.39
19	1.27	5.8	0.0	7.06	0.38
20	4.52	24.4	0.0	28.95	1.93
21	0.45	9.4	0.0	9.86	0.65
22	19.45	28.8	0.0	48.22	2.24
23	0.45	32.2	1.5	34.20	1.81
24	1.90	4.3	0.0	6.24	0.35

25	0.00	1.6	0.0	1.63	0.10
26	1.45	2.6	0.0	4.07	0.18
27	1.72	2.3	0.0	3.98	0.27
28	1.99	7.9	0.0	9.86	0.52
29	2.71	30.4	0.0	33.11	1.76
30	3.98	50.3	4.9	59.17	4.07
31	1.72	5.3	0.0	7.06	0.27
32	1.54	1.7	31.8	35.01	4.27
33	7.15	6.6	0.0	13.75	1.42
34	3.62	0.0	0.0	3.62	0.21
35	6.15	0.0	0.0	6.15	0.23
36	2.26	9.1	0.0	11.40	0.43
37	8.96	6.4	0.0	15.38	0.39
38	24.06	33.7	0.0	57.72	5.47
39	8.50	3.2	5.6	17.28	0.37
40	0.90	4.3	0.0	5.25	0.25
41	7.15	0.0	0.0	7.15	0.37
42	6.88	0.0	0.0	6.88	0.35
43	2.99	3.3	0.0	6.24	0.50
44	7.69	8.2	0.0	15.92	0.95
45	0.45	1.7	0.0	2.17	0.93
46	4.89	13.8	10.3	28.95	2.30
47	2.99	24.0	0.0	26.96	4.43
48	1.63	9.3	19.0	29.94	2.71
49	8.14	7.5	0.0	15.65	0.95
50	3.35	18.4	0.0	21.71	1.32
51	1.72	19.5	0.0	21.17	1.13
52	1.18	4.3	0.0	5.43	0.33
53	0.90	4.3	1.2	6.33	0.35
54	2.71	69.8	0.0	72.56	0.46
55	2.35	1.2	46.1	49.67	3.44
Villages					0.27
Total	**202.47**	**645.31**	**138.78**	**986.55**	**64.0**

Annexure 2: Waste Quality and Quantity

Annexure 2.1

Quantity of MSW disposed in Landfill at Udnoor, Gulbarga

2.1.1 Summary of quantity analysis conducted at Gulbarga

S N	Days	Compactors	Dumper placer Trips	Tractors trips	Total no of vehicles	Waste quantity in Kgs
1	11-Dec-13	1	9	57	67	131402
2	12-Dec-13	1	8	52	62	128281
3	13-Dec-13	1	9	55	65	134155
	Average	1	9	55	65	131279
	In Tons					131.28

2.1.2 Details of quantity analysis conducted on Day 1 dated 11 December 2013

S.N	Date	Vehicle no		Vehicle Type	Trip	Gross wt	Tare Wt	Nett wt
1	11-Dec-13	KA32	T8254	Tractor	1	5905	3470	2435
2	11-Dec-13	KA32	T3143	Tractor	1	5080	3355	1725
3	11-Dec-13	KA32	T3866	Tractor	1	5770	3585	2185
4	11-Dec-13	KA36	C6204	Tractor	1	5985	3230	2755
5	11-Dec-13	KA32	B9311	Tractor	1	4780	2955	1825
6	11-Dec-13	KA32	A9577	Dumper placer	1	8480	5370	3110
7	11-Dec-13	KA32	A9575	Dumper placer	1	8690	5225	3465
8	11-Dec-13	KA32	T1653	Tractor	1	4200	3245	955
9	11-Dec-13	KA32	TA4618	Tractor	1	6015	4065	1950
10	11-Dec-13	KA32	B9315	Tractor	1	4105	2935	1170
11	11-Dec-13	KA32	T6000	Tractor	1	5225	3480	1745
12	11-Dec-13	KA33	T7134	Tractor	1	4895	3525	1370
13	11-Dec-13	ME	P4525	Tractor	1	6525	3575	2950
14	11-Dec-13	KA32	A9580	Dumper placer	1	7365	5340	2025
15	11-Dec-13	KA32	A9577	Dumper placer	1	7980	5370	2610
16	11-Dec-13	KA32	A9575	Dumper placer	1	8012	5225	2787
17	11-Dec-13	KA32	1194	Tractor	1	4290	3300	990
18	11-Dec-13	KA32	T8754	Tractor	1	6115	3405	2710
19	11-Dec-13	KA32	T1085	Tractor	1	5350	3730	1620
20	11-Dec-13	KA32	B3195	Tractor	1	4915	3345	1570
21	11-Dec-13	KA32	B9308	Tractor	1	5360	2970	2390
22	11-Dec-13	KA32	T8563	Tractor	1	5300	3580	1720
23	11-Dec-13	KA32	4756	Tractor	1	6095	3385	2710
24	11-Dec-13	KA32	A3973	Tractor	1	3880	3215	665
25	11-Dec-13	KA32	T8842	Tractor	1	4810	3495	1315
26	11-Dec-13	KA32	A4491	Tractor	1	4605	3395	1210
27	11-Dec-13	KA32	C0641	Tractor	1	4375	3455	920
28	11-Dec-13	KA32	T1415	Tractor	1	5680	3475	2205

29	11-Dec-13	KA32	B3971	Tractor	1	5780	3240	2540
30	11-Dec-13	KA32	T6071	Tractor	1	4355	3510	845
31	11-Dec-13	KA32	T5883	Tractor	1	4710	3435	1275
32	11-Dec-13	KA32	B9310	Tractor	1	5265	2985	2280
33	11-Dec-13	KA32	B6919	Compactor	1	18565	11095	7470
34	11-Dec-13	KA32	B9313	Tractor	1	4130	2945	1185
35	11-Dec-13	KA32	T0990	Tractor	1	4345	3115	1230
36	11-Dec-13	KA32	T6339	Tractor	1	5745	3480	2265
37	11-Dec-13	KA32	B3157	Tractor	1	4330	3210	1120
38	11-Dec-13	KA32	B9307	Tractor	1	4440	2970	1470
39	11-Dec-13	KA07	4682	Tractor	1	4490	3055	1435
40	11-Dec-13	KA32	B3158	Tractor	1	6040	3220	2820
41	11-Dec-13	KA32	B9314	Tractor	1	5500	2965	2535
42	11-Dec-13	KA32	C132	Tractor	1	5535	3325	2210
43	11-Dec-13	KA32	B9317	Tractor	1	3850	2935	915
44	11-Dec-13	KA32	B4845	Tractor	1	5880	3435	2445
45	11-Dec-13	KA32	B9312	Tractor	1	4135	2970	1165
46	11-Dec-13	KA32	B9316	Tractor	1	4615	3010	1605
47	11-Dec-13	KA32	226	Tractor	1	5175	3290	1885
48	11-Dec-13	KA36	T6204	Tractor	1	4390	3230	1160
49	11-Dec-13	KA32	T6071	Tractor	2	4355	3510	845
50	11-Dec-13	KA32	T0990	Tractor	2	4395	3115	1280
51	11-Dec-13	KA32	T2061	Tractor	1	4645	3315	1330
52	11-Dec-13	KA32	T8732	Tractor	1	4825	3325	1500
53	11-Dec-13	KA32	T8732	Tractor	2	4740	3315	1425
54	11-Dec-13	KA32	T8563	Tractor	2	4540	3580	960
55	11-Dec-13	ME	P4902	Tractor	1	3435	3010	425
56	11-Dec-13	KA32	B2798	Tractor	1	5310	3280	2030
57	11-Dec-13	KA32	B9311	Tractor	2	4465	2955	1510
58	11-Dec-13	KA32	T8254	Tractor	1	6650	3470	3180
59	11-Dec-13	KA32	A9580	Dumper placer	2	8480	5340	3140
60	11-Dec-13	KA07	4682	Tractor	2	4430	3055	1375
61	11-Dec-13	KA32	A9575	Dumper placer	3	7365	5225	2140
62	11-Dec-13	KA32	T5601	Tractor	1	5740	3470	2270
63	11-Dec-13	KA32	A9577	Dumper placer	3	8290	5370	2920
64	11-Dec-13	ME	P4902	Tractor	2	3825	2000	1825
65	11-Dec-13	CG13	ZG53B	Tractor	1	5050	2000	3050
66	11-Dec-13	KA 32	A9580	Dumper placer	3	8410	5340	3070
67	11-Dec-13	KA32	T3866	Tractor	2	5770	3585	2185
	Total							**131402**
	Total in tons							131.4

2.1.3 Details of quantity analysis conducted on Day 2 on 12 December 2013

S.N	Date	Vehicle no		Vehicle type	Trip	Gross wt	Tare Wt	Nett Wt
1	12-Dec-13	MEP	4525	Tractor	1	5545	3560	1985
2	12-Dec-13	KA32	2797	Tractor	1	4870	3285	1585
3	12-Dec-13	KA32	8254	Tractor	1	5475	3465	2010
4	12-Dec-13	KA32	T3143	Tractor	1	5237	3355	1882
5	12-Dec-13	KA32	B9311	Tractor	1	4970	2955	2015
6	12-Dec-13	KA32	A9577	Dumper placer	1	8440	5370	3070
7	12-Dec-13	KA36	6204`	Tractor	1	5460	3245	2215
8	12-Dec-13	KA32	5601	Tractor	1	5015	3470	1545
9	12-Dec-13	KA32	B9307	Tractor	1	5710	2965	2745
10	12-Dec-13	KA32	T3143	Tractor	2	5372	3355	2017
11	12-Dec-13	KA32	A9575	Dumper placer	1	8620	5225	3395
12	12-Dec-13	KA32	TA 4618	Tractor	1	6100	4065	2035
13	12-Dec-13	KA 32	T 8732	Tractor	1	4485	3330	1155
14	12-Dec-13	KA32	A9580	Dumper placer	1	8790	5340	3450
15	12-Dec-13	KA32	A9577	Dumper placer	1	7980	5370	2610
16	12-Dec-13	KA28	7464	Tractor	1	5645	3660	1985
17	12-Dec-13	KA32	T8842	Tractor	1	5250	3500	1750
18	12-Dec-13	KA32	T1653	Tractor	1	4392	3245	1147
19	12-Dec-13	KA32	B9315	Tractor	1	4261	2933	1328
20	12-Dec-13	KA32	A9575	Dumper placer	1	8012	5225	2787
21	12-Dec-13	KA32	B 9310	Tractor	1	4205	2980	1225
22	12-Dec-13	KA32	T6000	Tractor	1	5346	3480	1866
23	12-Dec-13	KA32	T4491	Tractor	1	4385	3390	995
24	12-Dec-13	KA32	A9580	Dumper placer	1	8680	5340	3340
25	12-Dec-13	KA32	B 9351	Tractor	1	4915	3015	1900
26	12-Dec-13	KA32	1194	Tractor	1	4307	3300	1007
27	12-Dec-13	KA32	T8754	Tractor	1	6287	3405	2882
28	12-Dec-13	KA33	T7134	Tractor	1	5260	3560	1700
29	12-Dec-13	KA32	T1085	Tractor	1	5350	3730	1620
30	12-Dec-13	KA32	B3195	Tractor	1	5172	3345	1827
31	12-Dec-13	KA32	9313	Tractor	1	4735	2945	1790
32	12-Dec-13	KA32	T8563	Tractor	1	5362	3580	1782
33	12-Dec-13	KA32	B4845	Tractor	1	5630	3440	2190
34	12-Dec-13	KA32	4756	Tractor	1	6229	3385	2844
35	12-Dec-13	KA32	A3973	Tractor	1	3880	3215	665
36	12-Dec-13	KA32	C0641	Tractor	1	4375	3455	920
37	12-Dec-13	KA32	B9308	Tractor	1	4785	2970	1815
38	12-Dec-13	KA32	6339	Tractor	1	5635	3470	2165
39	12-Dec-13	KA32	226	Tractor	1	6395	3265	3130
40	12-Dec-13	KA07	5682	Tractor	1	5469	3055	2414
41	12-Dec-13	KA32	B3971	Tractor	1	5838	3240	2598
42	12-Dec-13	KA32	B9317	Tractor	1	4010	2935	1075
43	12-Dec-13	KA32	T3866	Tractor	1	4970	3575	1395
44	12-Dec-13	KA32	B9314	Tractor	1	5875	2950	2925
45	12-Dec-13	KA32	T5883	Tractor	1	5195	3435	1760
46	12-Dec-13	KA32	B3797	Tractor	1	4975	3275	1700

47	12-Dec-13	MEP	4525	Tractor	2	6240	3560	2680
48	12-Dec-13	KA32	T6071	Tractor	1	4845	3480	1365
49	12-Dec-13	KA36	6204	Tractor	1	4795	3245	1550
50	12-Dec-13	KA32	B6919	Compactor	1	19565	11095	8470
51	12-Dec-13	KA32	T7134	Tractor	2	4905	3565	1340
52	12-Dec-13	KA32	8354	Tractor	1	6170	3465	2705
53	12-Dec-13	KA32	T5601	Tractor	1	5500	3475	2025
54	12-Dec-13	KA32	A9577	Dumper placer	2	8240	5370	2870
55	12-Dec-13	KA32	TA 4618	Tractor	2	5195	4065	1130
56	12-Dec-13	KA32	T6071	Tractor	1	4915	3480	1435
57	12-Dec-13	KA32	B9316	Tractor	1	4615	3010	1605
58	12-Dec-13	KA32	3866	Tractor	1	5080	3575	1505
59	12-Dec-13	KA32	T8732	Tractor	2	4225	3330	895
60	12-Dec-13	KA32	A4845	Tractor	1	4500	3445	1055
61	12-Dec-13	KA32	T5601	Tractor	1	5890	3475	2415
62	12-Dec-13	KA32	A9575	Dumper placer	2	8220	5225	2995
	Total							**128281**
	Total in tons							**128.281**

2.1.4 Details of quantity analysis conducted on Day 3 on 13 December 2013

S.N	Date	Vehicle no		Vehicle type	Trip	Gross Wt	Tare Wt	Net Wt
1	13-Dec-13	MEP	4525	Tractor	1	5760	3560	2200
2	13-Dec-13	KA32	T3866	Tractor	1	5140	3580	1560
3	13-Dec-13	KA32	T8732	Tractor	1	7200	3495	3705
4	13-Dec-13	KA32	B2797	Tractor	1	5700	3285	2415
5	13-Dec-13	KA32	T5601	Tractor	1	4660	3475	1185
6	13-Dec-13	KA28	7464	Tractor	1	5470	3670	1800
7	13-Dec-13	KA32	T2574	Tractor	1	4650	3345	1305
8	13-Dec-13	KA32T	6339	Tractor	1	5590	3465	2125
9	13-Dec-13	KA32	B6919	Compactor	1	18942	11095	7847
10	13-Dec-13	KA32	B3195	Tractor	1	5237	3345	1892
11	13-Dec-13	KA32	A9575	Dumper placer	1	8420	5225	3195
12	13-Dec-13	KA32	1400	Tractor	1	4600	3200	1400
13	13-Dec-13	KA32	T6071	Tractor	1	7185	3510	3675
14	13-Dec-13	KA32	A9577	Dumper placer	1	7820	5370	2450
15	13-Dec-13	MEP	4902	Tractor	1	3735	2000	1735
16	13-Dec-13	KA32B	3971	Tractor	1	4620	3240	1380
17	13-Dec-13	KA32	T8754	Tractor	1	5275	3405	1870
18	13-Dec-13	KA32T	1653	Tractor	1	4290	3245	1045
19	13-Dec-13	KA32	TA4618	Tractor	1	6195	4060	2135
20	13-Dec-13	KA32	B9311	Tractor	1	4580	2950	1630
21	13-Dec-13	KA32	B9307	Tractor	1	4065	2965	1100
22	13-Dec-13	KA32	A9580	Dumper placer	1	8460	5340	3120
23	13-Dec-13	KA32	B4845	Tractor	1	5315	3440	1875
24	13-Dec-13	KA32	B3971	Tractor	1	5873	3240	2633

25	13-Dec-13	KA32	T0583	Tractor	1	5340	3510	1830
26	13-Dec-13	KA32	4756	Tractor	1	6229	3385	2844
27	13-Dec-13	KA32	226	Tractor	1	4135	3270	865
28	13-Dec-13	KA32	A9577	Dumper placer	2	8920	5370	3550
29	13-Dec-13	KA32	T4491	Tractor	1	5390	3390	2000
30	13-Dec-13	KA32	B9308	Tractor	1	4880	2965	1915
31	13-Dec-13	KA32C	641	Tractor	1	5035	3455	1580
32	13-Dec-13	KA32	B3195	Tractor	2	4385	3325	1060
33	13-Dec-13	KA32B	9310	Tractor	1	5110	2985	2125
34	13-Dec-13	KA32	T5883	Tractor	1	4350	3435	915
35	13-Dec-13	KA32	9313	Tractor	1	4515	2940	1575
36	13-Dec-13	KA32	B9312	Tractor	1	3750	2975	775
37	13-Dec-13	KA 32	A9580	Dumper placer	2	8210	5340	2870
38	13-Dec-13	KA32	C132	Tractor	1	4950	3320	1630
39	13-Dec-13	KA32	B9317	Tractor	1	4055	2935	1120
40	13-Dec-13	KA32	B3157	Tractor	1	5265	3210	2055
41	13-Dec-13	KA32	B9316	Tractor	1	4410	3015	1395
42	13-Dec-13	KA32	A9575	Dumper placer	2	8895	5245	3650
43	13-Dec-13	KA32	T6239	Tractor	1	3600	2850	750
44	13-Dec-13	KA07	4682	Tractor	1	4910	3055	1855
45	13-Dec-13	KA39	T1415	Tractor	1	4805	3475	1330
46	13-Dec-13	KA32	T3866	Tractor	2	4750	3580	1170
47	13-Dec-13	KA32	A9577	Dumper placer	3	8790	5350	3440
48	13-Dec-13	MEP	4525	Tractor	1	6255	3575	2680
49	13-Dec-13	KA32	C132	Tractor	2	5795	3320	2475
50	13-Dec-13	KA32	T7134	Tractor	1	4920	3540	1380
51	13-Dec-13	KA32	B9315	Tractor	1	4160	2935	1225
52	13-Dec-13	KA32	A9575	Dumper placer	3	8610	5260	3350
53	13-Dec-13	KA32	TA4618	Tractor	2	5700	4060	1640
54	13-Dec-13	KA32	A9580	Dumper placer	3	8453	5340	3113
55	13-Dec-13	KA32	B4845	Tractor	2	4495	3440	1055
56	13-Dec-13	KA32	9313	Tractor	2	4820	2960	1860
56	13-Dec-13	MEP	4902	Tractor	2	3720	3010	710
57	13-Dec-13	KA32	T8732	Tractor	2	4820	3495	1325
58	13-Dec-13	KA32	B9317	Tractor	2	4150	2945	1205
59	13-Dec-13	KA32	8254	Tractor	1	6650	3465	3185
60	13-Dec-13	KA32	B2797	Tractor	2	5550	3280	2270
61	13-Dec-13	KA36	6204	Tractor	1	5231	3245	1986
62	13-Dec-13	KA 32	B9312	Tractor	2	4620	2955	1665
63	13-Dec-13	KA 32	B9316	Tractor	2	4510	3015	1495
64	13-Dec-13	KA 32	B9311	Tractor	2	4890	2920	1970
65	13-Dec-13	KA32	T3143	Tractor	2	5345	3355	1990
	Total							**134155**
	Total in tons							134

Annexure 2.2

Estimation of waste generated in Gulbarga

S N	Waste generators	No of waste generators	Avg waste per day in kg	Total waste in Kg	Total waste in tonnes	Percentag
1	Household	102830	1.2	124424	124.42	62.96
2	Commercial Establishments	8623	1.7	14659	14.66	7.42
3	Hospitals (MSW)	514	8.1	4163	4.16	2.11
4	Small hotels	530	4.9	2597	2.60	1.31
5	Large hotels	53	11	583	0.58	0.30
6	Markets (major)	9	2100	18900	18.90	9.56
7	Street sweepings					
	Type A	202.47	29	5872	5.87	2.97
	Type B	645.31	17.4	11228	11.23	5.68
	Type C	138.78	8.7	1207	1.21	0.61
8	Educational institutes	682	6.7	4569	4.57	2.31
9	Miscellaneous waste	5%		9410	9.41	4.76
	Total	KGs		197614	**197.61**	100.00

Annexure 2.3

2.3.1 Waste composition of the waste received Gulbarga on day 1

Date of Sampling – 11th December 2013

S.N	Particulars	Sample1	Sample2	Sample3	Sample4	Sample5	Average
	Sample weight	102	98	103	105	99	101
1	Plastic material	14	9	15	17	11	**13**
2	Paper	10	6	7	9	9	**8**
3	Cloth piece	13	15	8	9	10	**11**
4	Food waste	12	14	19	11	8	**13**
5	Stones	11	8	12	10	18	**12**
6	Glass pieces	0	1	0	2	0	**1**
7	Wood pieces	3	6	5	2	4	**4**
8	Metal pieces	1	0	1	1	0	**1**
9	Grass & leaves	21	18	17	23	15	**19**
10	Silt & moisture	17	21	19	21	24	**20**

2.3.2 Waste composition of the waste received Gulbarga on day 2

Date of Sampling – 12th December 2013

S.N	Particulars	Sample1	Sample2	Sample3	Sample4	Sample5	Average
	Sample weight	97	102	96	102	100	99
1	Plastic material	7	13	16	17	12	**13**
2	Paper	11	8	6	13	7	**9**
3	Cloth piece	11	13	9	8	11	**10**
4	Food waste	15	12	11	7	9	**11**
5	Stones	14	16	13	6	17	**13**
6	Glass pieces	0	1	0	1	1	**1**
7	Wood pieces	2	2	3	2	3	**2**
8	Metal pieces	0	1	0	2	0	**1**
9	Grass & leaves	17	15	20	20	19	**18**
10	Silt & moisture	20	21	18	26	21	**21**

2.3.2 Waste composition of the waste received Gulbarga on day 3

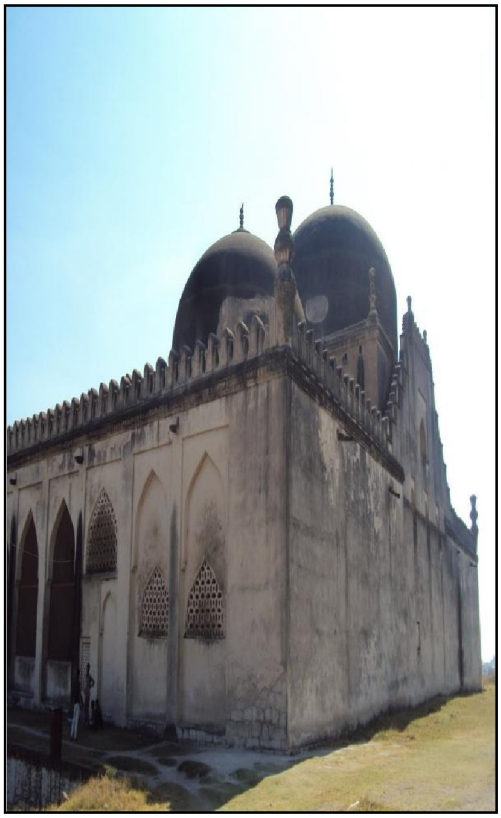
Date of Sampling – 13th December 2013

S.N	Particulars	Sample1	Sample2	Sample3	Sample4	Sample5	Average
	Sample weight	95	103	98	102	101	100
1	Plastic material	16	13	11	17	13	**14**
2	Paper	8	8	11	13	7	**9**
3	Cloth piece	12	13	12	8	11	**11**
4	Food waste	12	12	15	7	9	**11**
5	Stones	8	16	12	6	17	**12**
6	Glass pieces	0	1	0	1	1	**1**
7	Wood pieces	3	2	2	2	3	**2**
8	Metal pieces	0	1	0	2	0	**1**
9	Grass & leaves	19	16	15	20	19	**18**
10	Silt & moisture	17	21	20	26	21	**21**

Annexure 3: Drawings and Maps

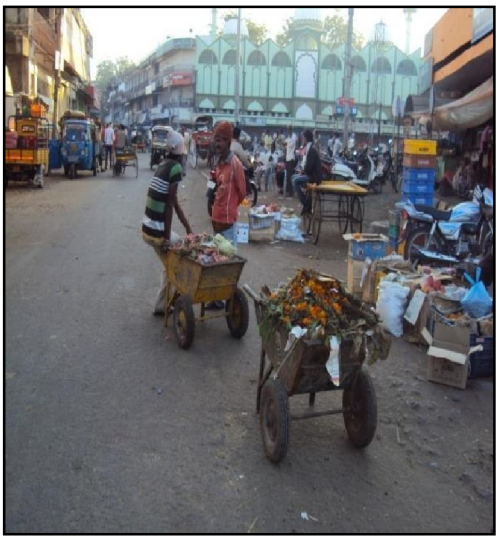
Annexure 4: Photo Introduction

4.1 Historical extractions in the city



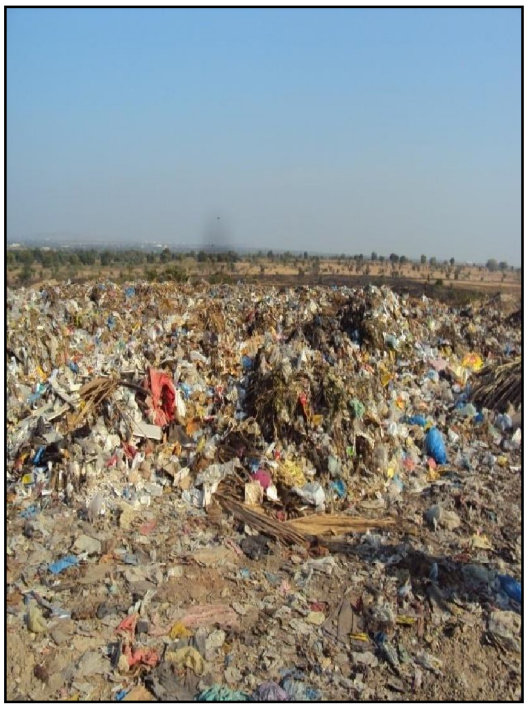
4.2 open points in the City

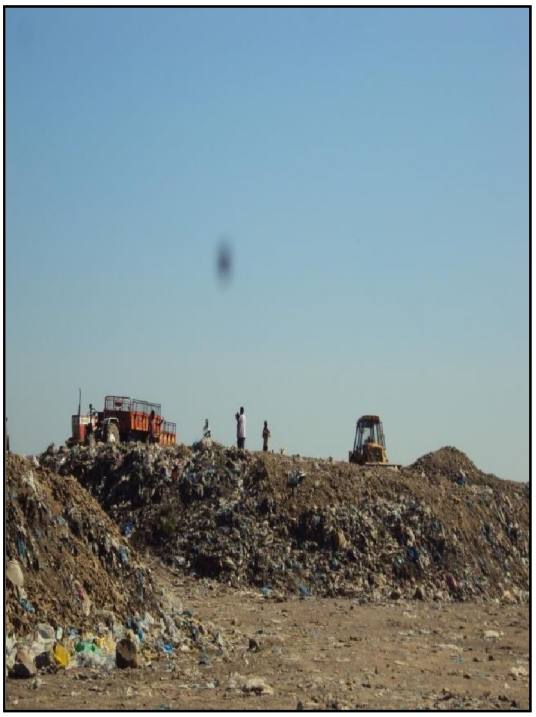
4.3 Transportation of waste in the city



4.4 sampling of the waste

4.5 Photos of the dumpsite





4.6 Analysis of waste at Dumpsite

Annexure 5: Detailed Estimates