

RAJKOT MUNICIPAL CORPORATION



No.: RMC/JnNURM/SWM01/0511

Detail Project Report (DPR) for

**Strengthening Primary and Secondary
Solid Waste Management in the city**

<u>Estimated Cost</u> <u>Rs. 2469 Lakhs</u>	<u>Period</u> <u>05-06 TO 10-11</u>
<u>Date of Preparation</u> _____	<u>Date of Submission</u> _____

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Abbreviations

ALV	Annual Legitable Value
APMC	Agricultural Produce Market Committee
ARV	Annual Ratable Value
BOD	Bio-Oxygen Demand
BPMC	Bombay Provincial Municipal Corporations
CA	City Administration
CBO	Community Base Organization
CCP	City Corporate Plan
CDS	City Development Strategy
CEPT	Centre for Environmental Planning and Technology
COD	Chemical Oxygen Demand
CPHEEO	Central Public Health & Environmental Engineering Organization
CUR	Capital Utilization Ratio
DA	Dearness Allowance
FOP	Financial Operating Plan
GIDC	Gujarat Industrial Development Corporation
GMFB	Gujarat Municipal Finance Board
GOG	Government of Gujarat
GOI	Government of India
GPCB	Gujarat Pollution Control Board
GSRTC	Gujarat State Road Transport Corporation
GUD & HD	Gujarat Urban Development & Housing Department
GWSSB	Gujarat Water Supply & Sewerage Board
HUDCO	Housing & Urban Development Corporation
IMR	Infant Mortality Rate
JnNURM	Jawaharlal Nehru National Urban Renewal Mission
NGO	Non Governmental Organization
NIOH	National Institute of Health
OR	Operating Ratio
PF	Provident Fund
RCC	Reinforced Cement Concrete
REA	Rajkot Engineering Association
RMC	Rajkot Municipal Corporation
RTO	Regional Transport Office
RUDA	Rajkot Urban Development Authority
SC	Schedule Caste
SPM	Suspended Particulate Matter
ST	Schedule Tribe
SWOT	Strength, Weakness, Opportunities and Threats
TDS	Total Dissolved Solids
UDPMI	Urban Development Plan Formulation and Implementation
WPR	Workers Participation Rate

Forward....

The Government of India has launched a Jawaharlal Nehru National Urban Renewal Mission (JnNURM) with the aim of encouraging the cities to initiate steps to bring improvement in the existing levels of services in a financial sustainable manner. As a part of JnNURM it has been great pleasure to finalize the Detail Project Report for “Strengthening Solid Waste Management in the City of Rajkot “.

The project report has been prepared after exhaustive study of reports as enlisted below:

- “Modernization of Solid Waste Management Practices in Rajkot City” (December 2000) by P.U. Asnani, Consultant, U.S.Aid (December, 2000)
- Municipal Solid Waste (Management & Handling) Rules 1999, notified by MoEF.
- Manual on Municipal Solid Waste Management (First Edition), 2000, by Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban Development, Govt of India
- Rajkot City Development Plan 2005-2011 prepared as per toolkit of Jawaharlal Nehru National Urban Renewal Mission (JnNURM), 2005

The detailed investigation in consultation with various stake holders and data survey were carried out by Municipal staff to support and prepare the Solid Waste Management Plan.

I gratefully acknowledge and express deep appreciation of many wonder people who made this project possible.

- Leading NGO of Rajkot.
- Community base organization and society of Rajkot city
- Staff involved in Municipal solid waste management.
- Various sanitary marts working in the city for Solid Waste Management of city.
- Hanzer Biotech Pvt. Ltd.,
- Vastu Shilp Foundation for studies and research in environment design (VSF Ahmedabad)
- National Productivity Council, Gandhinagar.
- Destromed Services for Bio Medical Waste, Rajkot.
- Officials and Officers of Rajkot Municipal Corporation
- JnNURM Rajkot team

Last but not least, I would like to thank people of Rajkot whose support make all the difference.

(Mukesh Kumar)
Municipal Commissioner

Rajkot.
June 2006

1.1 Background

Solid Waste Management is one of the most essential services for maintaining the quality of life in the urban areas and for ensuring better standards of health and sanitation. In India, this service falls short of the desired level, as the systems adopted are outdated and inefficient. Institutional weakness, shortage of human and financial resources, improper choice of technology, inadequate coverage and lack of short and long term planning are responsible for the inadequacy of service. Rajkot City has having population of one million (as per census 2001) and with an area of 104.86 Sq. Kms. The City of Rajkot though has made a good effort to modernize.

For maximizing efficiency and effectiveness of this service, it is necessary to tackle this problem systematically by going into all aspects of the 'Solid Waste Management' (SWM) and devise cost effective system which may ensure adequate level of SWM services to all class of citizens, and collection, transportation and disposal of waste in an environmentally acceptable manner in terms of Supreme Court Committee's recommendations as well as Municipal Solid Waste (Management & Handling) Rules 2000.

With a view to improving the efficiency of SWM system in the city of Rajkot, Rajkot city has prepared the Detailed Project Report as "Strengthening Solid Waste Management in the City" suggests improvements. The report envisages modernization of SWM Practices , improvement of services and practices in the city.

1.2 Need of the Project

Present Average generation of waste is about 300 gms. per capita per day, which will be about 325 grams per capita at the end of year 2011. The city is developing at a rapid pace and the population is expected to reach about 1.5 million by the year 2011. The City of Rajkot though has made a good effort to modernize, with the help of private sector, it still has these deficiencies in varying degrees and there is a need to make substantial improvement in the SWM practices prevailing in the city to raise the standards of health, sanitation and urban environment keeping pace with the rapid urbanization and growing population. Hence there is a need for strengthening and modernization of the present practice with increasing level of private sector participation private. Govt of India recently launched urban Infrastructure development mission for selected 63 cities of India as Jawaharlal Nehru National Urban Renewal Mission (JnNURM) which also encourages preparing Detail Project Report for Strengthening of Solid Waste Management for Rajkot city.

1.3 Objectives

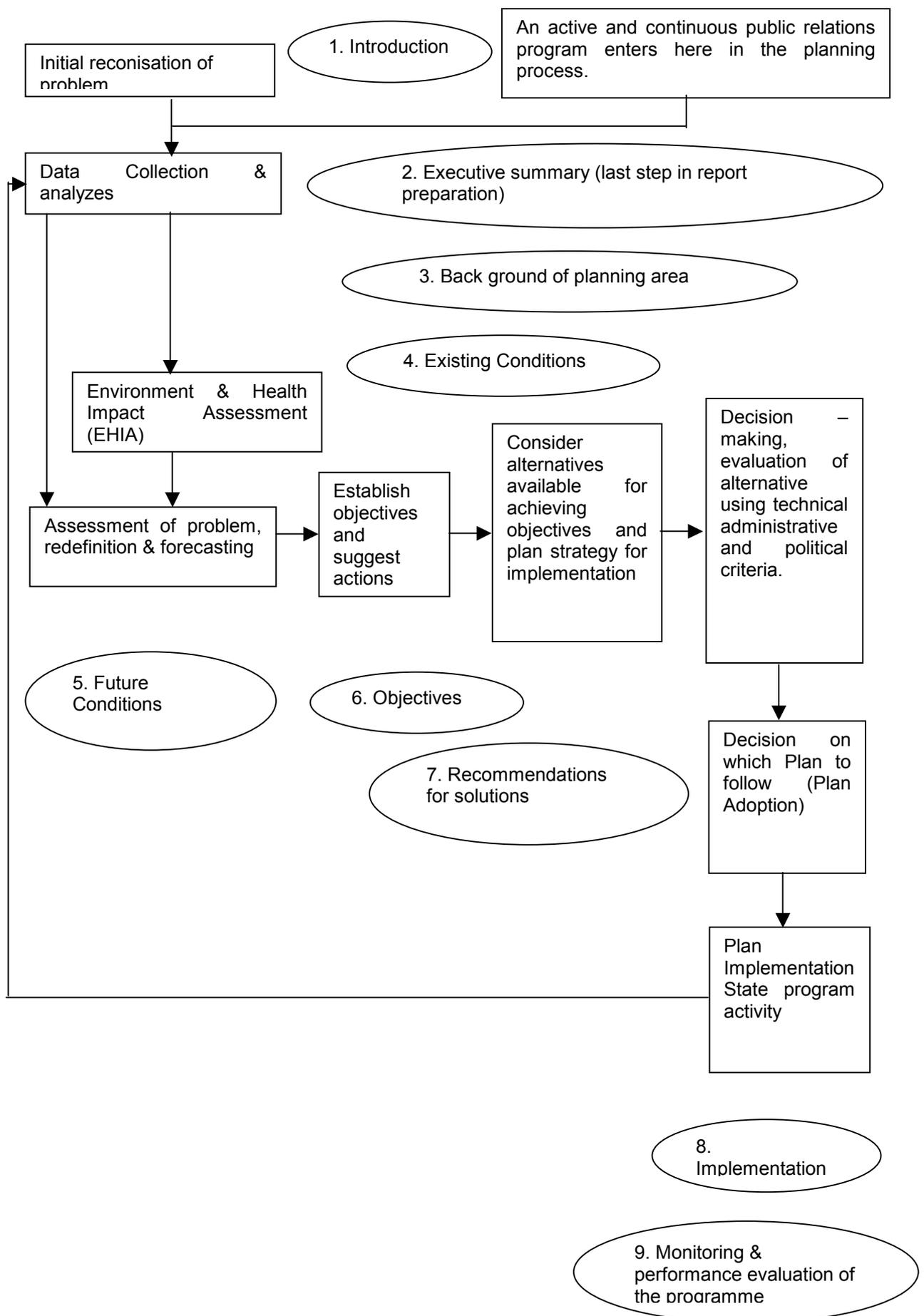
The broad objectives of the Detail Project Report (DPR) are to determine a technically and economically viable solid waste management project for a phased implementation to meet the requirements of the year 2021. Following are the specific objectives:

1. to devise a system of Storage of food/Biodegradable waste as well as recyclable waste separately at the source of generation of waste,
2. to devise cost effective systems for Primary Collection of waste from the city in general and from the slums in particular.
3. to devise efficient system of day to day cleaning of streets and public places,
4. to devise systems to eliminate the age old practice of throwing garbage on the streets or outside the dustbins causing nuisance to the people and posing a threat to the health of the community at large,
5. to modernize system of wastage storage depots which may synchronize with the system of primary collection as well as transportation of waste and simultaneously eliminate manual loading of the waste into open transportation vehicles;
6. to improve the system of transportation of waste by following the principle of 'handle waste once only',
7. to promote processing of waste for deriving Bioorganic fertilizer, reduce quantity of waste going to landfill site, derive income from the processing of waste and help agricultural production.
8. to ensure safe disposal of waste,
9. Planning for Projects identified for JnNURM
10. Project scheduling & cost estimates
11. Projects phasing
12. To prepare operational plan
13. Organizational and financial studies
14. To set recommendation with respect to JnNURM reforms & sustainability

1.4 Scope & Limitations of the study

1. The study is limited to Rajkot city admeasuring area app.104.86 sq.kms.
2. The study is limited to Modernization of Solid Waste Management system for Rajkot which are identified and outlined in City Development Plan (2005-2012)

1.5 Methodology



2.1 Preamble

Solid waste management usually refers to the collection, transfer, recycling, resource recovery (composting, waste to energy, etc.) and disposal of municipal solid waste, “ *Municipal solid waste is again defined to include refuse from households, hazardous solid waste from industrial and commercial establishments, refuse from institutions, market waste, yard waste and street sweeping (World Bank, 1994).*”

Management of municipal solid waste involves (a) development of an insight into the impact of waste generation, collection, transportation and disposal methods adopted by a society on the environment and (b) adoption of new methods to reduce this impact. (CPHEEO Manual, Janu.2000). Accordingly, waste management should be an integrated affair, which must include:

- Minimizing waste,
- Maximizing environmentally sound waste re – use and recycling
- Promoting environmentally sound waste disposal and treatment and
- Extending the coverage of waste management services

The stages involved in SWM are primarily as follows:

- Primary collection of solid waste from household levels
- Primary transportation to municipal waste bins and collection points,
- Secondary transportation of garbage from municipal bins to disposal sites, and
- Actual disposal of the waste

It is estimated that about 80,000 metric tons of solid waste are generated everyday in the urban centres of India at present. About 60% of generated are disposed off safely. The uncollected solid waste remains present in and around the locality or find its way into the open drains. Proper solid waste disposal is also hampered by the non – availability of suitable land fill site, partly due to the high land costs and partly due to rapid growth.

According to the survey carried out by CPCB in 1998 it has been observed that the total quantity of solid waste generate by 23 metro cities of India is about 30, 058 tons per day of solid waste. The per capital waste generation in small, medium and large cities/towns about 0.1kg, 0.3kg to 0.4 kg and 0.5 kg respectively. Because of this fact management of solid waste is primarily an urban issue in country like India. In urban areas the responsibility of solid waste management lays exclusively with the urban local bodies, that is, municipal governments. However, the municipalities in most states in India are not statutory responsible for collecting garbage from the households. They usually perform the third and fourth stages of the SWM function. But the households perform the first two and different arrangements are followed to accomplish the task. In many cases where residents are economically better off and environmentally conscious, community organizations are coming forward to handle at least the door to door collection of household waste and its transportation to

municipal collection points. Even though such initiatives are still at nascent stage they are slowly gaining momentum and may assume a major role in future.

There is one stage between the collection and disposal of solid waste, that is, resource recovery or segregation of degradable and recyclable materials in the garbage and actual recycling. In no Indian city is the separation of garbage between degradable and non – degradable items and recycling taken up at the municipal level. This is so not only because it is uneconomical since only 13 to 20 % of municipal waste is recyclable the remaining 80-85% is compost able, but is also extremely laboured intensive. In most cases however, secondary waste collection is not being done adequately. On an average, 20 to 30 per cent of the total waste generated remains uncollected, creating environmental hazards in urban settlements. Now a days due to increase in the environmental concern, emphasis is laid on recycling and reuse of domestic garbage is gaining momentum. The municipalities and municipal corporations themselves are unable to take up such projects of collection, segregation, and recycling or composting in an integrated manner because of the high costs involved. But NGO's and many private agencies are now providing these services to the municipalities or are independently running some projects for waste collection, segregation, recycling and composting or even bio-gas generation.

2.1.1 Policy Initiative for SWM

The country has awakened to the pathetic sanitation and wastes management situation existing in India as in the last few years, there has been lots of pressure due to international events concerning better environment and human settlements. As a result, several initiatives were taken at the national, state and local government level to go deep into the flaws in the existing situation and suggest remedies. The central and state governments initiated efforts to develop policies and programmes in this regard. The Strategy Paper on Solid Waste Management in India by the National Environmental Engineering Research Institute (NEERI) in August 1995 is one of the most exhaustive evaluations of the problem at the national level. The J.L. Bajaj Committee constituted by the Planning Commission in 1994 immediately after the plague out break, also reviewed the prevalent conditions and made specific recommendations to deal with the situation. The Interim Report of the Committee on Solid Waste Management in Class I Cities in India constituted by the central government at the apex court in June 1998 is a valuable document which contains detailed recommendations for the removal of solid waste.

2.1.2 The report of the expert (J .L Bajaj) committee of planning commission may 1995.

The main conclusion of the report was a situational analysis of the existing state of waste management in the Indian Cities and towns. The inevitable conclusion was that better sanitation standards could have been achieved in most of our cities and towns by prudent and planned allocation of available resources. Develop and support the application of appropriate low cost, eco-friendly technologies. The committee suggested large-scale public private partnership in garbage management

after reviewing some major innovative pilot projects on urban SWM through private and public initiatives.

2.1.3 Interim Report of the Committee on Solid Waste Management in the Class I cities in India, Constituted by the Supreme Court of India June 1998.

It contains deliberations on the present scenario in garbage management and detailed recommendations on number of technical, institutional and social aspects of storage, collection, transportation and disposal of garbage in class I cities. Its recommendations include steps for strengthening the institutional set-up, management information system and financial and legal provisions. The committee also recommended certain specific responsibilities not only for the local, state and central governments, but also for the citizens and the community. The Committee, findings do not really reveal anything startling but they bring into focus the pitiable situation prevailing in this country and how the local governments are failing miserably in their responsibilities for providing a cleaner environment to the urban population. The Interim Report of the Committee includes crucial recommendations meticulously categorized mandatory and discretionary with delineated work responsibilities for three categories of stakeholders i.e. the citizens, local bodies, state and central government. Several norms have also been specified for each function. Besides setting goals with a specific time frame to achieve the same, the Committee has also emphasized the role of community participation which are being followed in some of the cities can ensure long term sustainability of the system and structure of municipal solid waste disposal developed by the local bodies.

2.1. 4 Draft Notification on Municipal Solid Waste Management (Management & Handling), Rules, 1999

The Government of India, in exercise of the powers conferred by sections 3, 6 and 25 of Environment Protection Act, 1986 (Act 29 of 1986) issued a Draft Notification on the Management of Municipal Solid Waste (Management and Handling) Rules, 1999. The Draft Rule direct the state governments and UTs to authorize an appropriate agency, preferably, The State Pollution Control Boards/Committees for regular monitoring of their implementation and compliance and submit an Annual review report by 15 May each year to the Secretary, Ministry of Environment and Forests in a specified format.

2.1.5 Manual on Municipal Solid Waste Management by Central Public Health & Environmental Engineering Organization (CPHEEO),

With a view to assist and guide the Urban Local Bodies for managing the solid waste in an efficient manner, the Ministry of Urban Development , Government of India constituted an expert committee in February , 1998 by drawing experts from various field departments, academics and research institutions and Central Ministries / Departments.

The Committee after a series of deliberation framed a Manual on Municipal Solid Waste Management in the country. It includes all aspects such as Composition and Quantity of Solid Waste,

Storage of waste at source, primary collection of waste, transportation of waste, composting, energy recovery from Municipal Solid Waste, emerging technologies, sanitary land fill site, bio-medical waste, economic & financial consideration, environmental & health impact assessment, institutional aspects and capacity building, prospects of private sector participation community participation and legal aspect etc.,

For the preparation of this Detail Project Report, the CPHEEO manual, 2000 has been largely adopted. Besides, The report – “ Modernization of Solid Waste Management Practices in Rajkot city – December 2000“ by Mr. P U Asnani, Consultant , USAID as well as recommendation of the expert committee have been adopted to formulate various development & technical strategies

2.2 Sectoral Policies outlined in CDP

Cleanliness is next to Godliness. The first impression that the city creates in mind of a visitor is how clean the city is. The urbanization is done without a remarkable change in the attitude which is still rural, rustic and down to earth. The habit of throwing garbage on road and waiting for sweeper to sweep once in 24 hours needs to change.

Solid waste management is a part of health and sanitation, and according to the Indian Constitution, falls within the purview of the State list. Since this activity is non – exclusive, non – rivaled, and essential, the responsibility for providing the service lies within the public domain. The activity being of a local nature is entrusted to the Urban Local Bodies. The Solid Waste Department of Rajkot Municipal Corporation is responsible for the solid waste management (SWM) which was constituted under B.P.M.C 1949.

Strategies for solid waste management revolve around optimum use of manpower, equipping them with required gears and making the collection, transportation and disposal effective round the clock.

SWMS 1 Training & Public Awareness: Training may be given at all levels. NGOs and private sector be fully involved. IEC activities have their role in SWM but the best approach the general cleanliness is through imposition of administrative charges on erring citizens. When citizens do not throw solid waste on roads, the collection of solid waste will become efficient and easy.

SWMS 2 : Scientific approach for Sweeping: Street sweeping to be done on all the days including Sundays and public holidays. Each sweeper to be given individual containerized handcarts and long handled brooms with Metal tray and Metal plate. Sweepers to sweep the streets as per the yardstick suggested as well as collect waste from house to house with community participation using containerized handcarts fitted with bells.

SWMS 3 Waste Segregation and Reuse: Source segregation of solid waste and removal of Storage of waste at source by households, shops and establishments in two bins be insisted. Recyclable waste to be collected from the door step separately.

SWMS 4 Provision of Adequate Collection Facilities: All open waste storage sites be abolished. Open bins be also abolished and large containers of 4.5 to 7 cu.meters may be installed all

over the city at a distance of 500 meters each. Societies, multi storied buildings, commercial complexes and slums to have community bins in addition to individual bins. Litterbins may be provided at strategic locations such as parks, gardens, railway/bus stations, cinema houses, market areas, and other public places.

SWMS 5 Developing Strong Transportation Facilities: All containers to be grouped according to the frequency of their becoming full and be cleared before they start overflowing. Dumper placer system is used for transportation of containers to synchronize the system of waste storage and transportation.

SWMS 6 Setting up Transfer Stations: Three transfer stations may be set up in the city to reduce the cost of transportation of small vehicles to the proposed processing and disposal site. The transfer stations may have large containers and hauling vehicles for transporting the quantities of waste in bulk to the processing site.

SWMS 7 Augmentation of Waste Processing: Present SW processing plan has design capacity of 300 MT/day , which is about solid waste generated in the city. It is proposed to increase SW processing plant capacity for full generated waste of future.

In accordance with suggestions of citizens, elected representatives, officials & officers of RMC and other stakeholders involved in the entire city development plan following out comes envisages.

- 100% daily sweeping to entire city population
- 100% Waste Collection system before end of year 2009
- 75% waste segregation at collection
- 95% SW processed before land filling
- Development of Sanitary landfill site before end of 2007
- Quick & Prompt complaint attendance for the utility
- Dust Free Major – 32 roads

2.3 Linkage of the projects to the CDP

The aim is to discipline citizens. The aim is to change the attitude of the citizens. The aim is to make the responsibility collective. For this most difficult task, Rajkot Municipal Corporation needs to improve its system before enforcing citizens to participate in the clean city movement. The projects basically aim at improving the present system of collection, transportation and disposal of solid waste as enlisted below.

			2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	Total
Primary S.W.M	1	Const of Ward Office - 10 new ward Office	5	10	10	15	10	10	10	65
	2	Purchase of Debris (skip) containers - 100	0	20	10	10	0	0	0	40
	3	Closed container - city area & new area 1500	50	50	50	50	100	200	200	700
	4	Wheel Burrow - 5000 Nos	10	10	20	40	40	40	40	200
	5	Litter bins - 5000 Nos.	15	15	15	8	8	7	7	75
	6	Mechanical sweeper for SW	0	30	0	30	0	0	0	60
	7	I-E-C	2	3	4	4	5	5	4	28
Secondary S.W.M	1	Purchase of JCB-SWM Department-6Nos.	30	30	30	0	30	0	30	150
	2	Purchase of Dumper (14cu.mts) for transfer station-10Nos.	0	0	0	64	64	32	0	160
	3	Purchase of Dumper (8cu.mts.) for SWM Department-10Nos.	0	44	44	11	0	11	0	110
	4	Purchase of Dumper Placer for SWM department-20Nos.	0	0	80	80	0	0	0	160
	5	Purchase of vehicle for lifting of debris container-8Nos.	0	0	32	32	0	0	0	64
	6	Dead animal Pick-up vehicles-2Nos.	13	0	12	0	0	0	0	25
Tertiary S.W.M	1	Development of sanitary landfill site cost of works viz. compound wall, office, landfill site bottom lining works, way bridges etc. at Nakrawadi	100	100	100	100	0	0	0	400
	2	Compactor for land fill site at Nakrawadi-2 Nos.	0	0	0	50	50	0	0	100
	3	Purchase of Bulldozer for landfill site for Nakrawadi-1Nos.	0	0	0	0	0	60	0	60
	4	Dead Animal incinerator at Nakrawadi	20	60	0	0	0	0	0	80
Computerization of SWM	---	10	10	0	0	0	0	0	20	
Total			253	379	403	485	302	360	287	2469
Phase wise Percentage			12.2	18.4	20.3	23.6	17.2	19.6	15.6	128.0

2.4 Principles of Solid Waste Management

Municipal Solid Waste Management involves the application of principle of Integrated Solid Waste Management (ISWM) to municipal waste. ISWM is the application of suitable techniques, technologies and management programs covering all types of solid wastes from all sources to achieve the twin objectives of

- (a) waste reduction and
- (b) effective management of waste still produced after waste reduction.

Waste Reduction: It is now well recognized that sustainable development can only be achieved if society in general, and industry in particular, produces 'more with less' i.e. more goods and services with less use of the world's resources (raw materials and energy) and less pollution and waste. Production as well as product changes have been introduced in many countries, using internal recycling of materials or on-site energy recovery, as part of solid waste minimization schemes.

Effective Management of Solid Waste: Effective solid management systems are needed to ensure better human health and safety. They must be safe for workers and safeguard public health by preventing the spread of disease. In addition to these prerequisites, an effective system of solid waste management must be both environmentally and economically sustainable.

- Environmentally sustainable: It must reduce, as much as possible, the environmental impacts of waste management.
- Economically sustainable: It must operate at a cost acceptable to community.

Clearly it is difficult to minimize the two variables, cost and environmental impact, simultaneously. There will always be a trade off. The balance that needs to be struck is to reduce the overall environmental impacts of the waste management system as far as possible, within an acceptable level of cost. An economically and environmentally sustainable solid waste management system is effective if it follows an integrated approach i.e. it deals with all types of solid waste materials and all sources of solid waste. A multi-material, multi-source management approach is usually effective in environmental and economic terms than a material specific and source specific approach. Specific wastes should be dealt within such a system but in separate streams an effective waste management system includes one or more of the following options:

- (a) Waste collection and transportation.
- (b) Resource recovery through sorting and recycling i.e. recovery of materials (such as paper, glass, metals) etc. through separation.
- (c) Resource recovery through waste processing i.e. recovery of materials (such as compost) or recovery of energy through biological, thermal or other processes.
- (d) Waste transformation (without recovery of resources) i.e. reduction of volume, toxicity or other physical/chemical properties of waste to make it suitable for final disposal.
- (e) Disposal on land i.e. environmentally safe and sustainable disposal in landfills.

Solid Waste Management usually refers to the collection, transfer, recycling, resource recovery (composting, waste to energy, etc.) and disposal of municipal solid waste, “*Municipal solid waste is again defined to include refuse from households, hazardous solid waste from industrial and commercial establishments, refuse from institutions, market waste, yard waste and street sweeping (World Bank, 1994).* Management of municipal solid waste involves (a) development of an insight into the impact of waste generation, collection, transportation and disposal methods adopted by a society on the environment and (b) adoption of new methods to reduce this impact. (CPHEEO Manual, Janu.2000).

2. Management of municipal solid waste involves (a) development of an insight into the impact of waste generation, collection, transportation and disposal methods adopted by a society on the environment and (b) adoption of new methods to reduce this impact. (CPHEEO Manual, Janu.2000). Accordingly, waste management should be an integrated affair, which must include:

- Minimizing waste,
- Maximizing environmentally sound waste re – use and recycling
- Promoting environmentally sound waste disposal and treatment and
- Extending the coverage of waste management services

3. Rajkot city is one of the fastest growing city of state of Gujarat. It has connected with rail, road and air ways important city of the India. The city is spread over 104.86 sq.kms. As per census 2001, the city population is about one million. The growth rate is about 4% per annum. The city is developing at a rapid pace and the population is expected to reach about 1.5 million by the year 2011 and 2021 about 2.3 million

4. Rajkot city is characterized by a pattern of multiple land uses. The total area developed for urban activities constitute 77% of the Rajkot Municipal Area. Residential use occupies about half of this area, while industries occupy a fifth and commercial zones occupy less than 2%. in quite different ground realities. Rajkot is plagued by problems of informal sector including slum development, illegal colonies and commercial encroachments and a lack of industrial zoning and unplanned mixed land use. The total area developed for urban activities constitute about 77 % of the city area and balances constitute activities enmarked for vacant land, water bodies and other purposes. There are 84 slums having about 2 lakhs population.

5. Present Average generation of waste is about 300 gms. per capita per day, which will be about 325 grams per capita at the end of year 2011. The City of Rajkot though has made a good effort to modernize, with the help of private sector, it still has these deficiencies in varying degrees and there is a need to make substantial improvement in the SWM practices prevailing in the city to raise the standards of health, sanitation and urban environment keeping pace with the rapid urbanization and growing population. Hence there is a need for strengthening and modernization of the present practice with increasing level of private sector participation private. Govt of India recently launched urban

Infrastructure development mission for selected 63 cities of India as Jawaharlal Nehru National Urban Renewal Mission (JnNURM) which also encourages preparing Detail Project Report for Strengthening of Solid Waste Management in for Rajkot city.

6. The solid waste management (SWM) in the city is carried out by the Solid Waste Management, RMC under the supervision of Environment Engineer. Rajkot Municipal Corporation is first local body to establish Engineering Department to carry out SWM as in the recommendations of Municipal Solid Waste Management Rules. The sole responsibility of solid waste management (SWM) in the city goes to Solid Waste Management Department of RMC under the supervision of Ministry of Urban Affairs & Housing Development. As a part of decentralization entire city is divided into four zones comprising of Zone 1 (consisting ward no. 12, 13, 14, 22, 23,) Zone 2 (consisting ward no. 7, 8, 9, 10, 11, 21), Zone 3 (consisting ward no. 3, 4, 5, 6, 19, 20) and Zone 4 (consisting ward no. 1, 2, 15, 16, 17, 18).

7. Decentralization has also been attempted and a ward office is established in each ward to look after the primary collection of solid waste and street sweeping. RMC has attempted privatization at various level of Solid Waste Management. Transportation has been privatized to the extent of approximately 80 %.

8. Waste generation encompasses activities in which materials are identified as no longer being of value (in their present form) and are either thrown away or gathered together for disposal. Waste generation is, at present an activity that is not very controllable. Municipal solid waste can be broadly divided into four major categories as per source of generation i.e. domestic waste, commercial waste, institutional waste and industrial waste.

- Domestic waste consists of primarily food waste, paper, plastics, glass, metal, rags and other packaging materials. Domestic waste is the largest part (83.58%) of municipal waste. A primary data survey was carried out on the present generation of domestic waste is estimated 250.74 Metric Tons per day.
- The estimated wastes generated from trade and institutes are 10.58 tons per day. Shops, offices, Institutions shall generally throw their solid waste on the footpaths, streets, open spaces/nallas. The practices of keep the waste in form of dump in the footpaths, which remains there till sweepers collect them during street sweeping, is prevalent.
- There is large number of small hotels and restaurants in the city and all of them throw the waste on the streets or into the municipal bins. There is no arrangement of primary collection of waste from the hotels.
- There are vegetables, meat market in the city. Out of them, the new vegetable market is reasonably well managed by the City Corporation. The quantum of waste is about 19.72 Mt per day.

- Mostly the industries within the city are small and medium sized and with not much of Hazardous waste. The waste so generated gets intermingled with the MSW. For construction waste, there is no system of storage neither of construction waste nor of its primary collection. The total waste is estimated around 18.27tons per day.

9. The main system of primary collection of waste is street sweeping. Sweepers use traditional short-handled brooms where they have to bend while sweeping. The collection of waste is being carried out on the basis of SWM rules 2000. The work norms have been fixed for each sweeper for running meter length based on density of area. The work is carried out on all the days of the year including Sundays and Public holidays, out of which two days are half days to permit one statutory weekly off per week to the staff deployed.

Type of workers at RMC for Sweeping

Zone No.	Ward No.	Per m Sweepers	Part Time Sweepers	Temp. Full Time Sweepers	Total	Sani. Inspector	Sanitary Sub Inspector	Total Supervisory Staff	Sweeper/Supervisor staff
1	12-14,	350	44	31	425	2	8	10	42.5
1	22- 23	0	0	275	275	2	3	5	55
2	7-11,	585	149	34	768	6	14	20	43
2	21	0	0	100	100	0	2	2	50
3	3-6,19, 20.	538	301	26	865	6	13	19	46
4	1,2, 15-18,	610	132	34	776	6	11	17	46
Total		2083	626	500	3209	22	51	73	44

Besides, the RMC has hired services of sanitary mart for primary SWM in ward No. 21, 22 and 23. Sanitary marts are registered cooperative organization consist of persons from traditional sweeper community. The streets and roads in these wards are cleaned on alternate basis RMC inherited contract from erstwhile Nagarpalika. It is now replaced by Sanitary Marts. The coverage is still not sufficient in these areas. Besides, the RMC has also initiated community participation by providing grant in aid to residential welfare association so as they could have their own mechanism for effective collection in their respective societies and bring waste to the nearest waste storage depot. This grant is provided on basis of Rs 1500 per month per 30000 sq feet of area cleaned.

10. As per the guidelines of Hon Supreme court sweeping of the public roads, streets, lanes, and by-lanes has to be done daily if there is habitation or commercial activity on one or both sides of the street. A list of such roads and streets together with their length and width were identified and a program for their daily cleaning should be worked out by the City Corporation keeping in view the norms of work (yardsticks) prescribed. But main problem that RMC had to face was heavy traffic and commercial activities which resulted in achieving work of low quality. RMC identified 13 main

arterial roads of length 38 kms for which scrapping and brushing has to be done during the night time when traffic density is lean.

11. Transportation of waste is done regularly to ensure that the containers / trolleys and dustbin sites are cleared before they start over-flowing. The frequency of transportation is arranged accordingly. The system of transportation of waste must synchronize with bulk storage of waste at the temporary waste storage depots .

12. The work involves firstly lifting of Solid Waste collected at storage points in form of dustbins and transporting it to the transfer station, where in all the dust bins are emptied into dumper of bigger volume. Second phase of transportation comes in form of transportation of waste from transfer station to land fill site. To reduce the cost of transportation, RMC has constructed two transfer station situated on either side of the river AJI, wherein the waste from container is transferred into larger dumper. The transfer station on west side (150 ft Ring Road), which serves 10 wards and the other at (K.S. Diesel, Bhavnagar Road) serves 13 wards.

13. The lifting of containers is being done by private contractor from 15 out of 23 wards. In the remaining 8 wards the lifting of containers is done by R.M.C Second phase of transportation starts from transfer station. The waste received in containers are transferred into vehicle of bigger volume and taken to Waste Processing plant/Landfill. Transfer of waste from 2 transfer stations to land fill is privatized to private contractors. 100 % privatization is achieved in this segment of SWM.

14. RMC has established Plant at Nakrawadi in partnership with Hanzer Biotech Energies Pvt Ltd on BOO basis, wherein Processing of waste is being carried out. It is first of its kind in India with integrated technology, which uses wastes and transforms into useful by product leaving behind very less, so as to minimize burden on landfill. It is also a venture where RMC has attempted 100 % privatization. Out of 300 MT about 78% of waste is being processed and by products like compost (manure), energy fluff (green coal), & eco bricks. The reject from the processing plant and the inert waste would be taken for final disposal at Sanitary Land fill site. The EIA for Sanitary Land fill site at Nakhrawadi, was carried out by National Productivity Council, Gandhinagar. Based on the EIA design of sanitary landfill has been finalized. RMC has already acquired 80 Hectare of land for the sanitary land fill site.

15. Law is the basic instrument that defines rights and obligations. The legal framework is governing a particular infrastructure sector development. Rajkot Municipal Corporation functions as per legal provision of provision of BPMC Act,1949, TP & UD Act ,1976 and 74th CAA which provided duty, functions and powers for Urban Local Bodies in the state.

16. The present charge for solid waste management service is being levied with property tax in form of "Conservancy tax". Following table shows the present conservancy tax structure

Sr.No.	Type of Property	% of ALV of the Property /annum	Remarks	Last Revision
1	Residential	5%	Property having ALV below Rs.600 is exempted	1st April, 2006
2	Commercial	8%-12%	No Exemption	1st April, 2006
3	Industrial	9%-12%	No Exemption	1st April, 2006

Level of subsidies

Year	2004-05 (Rs.in Lakh)
Income from Conservancy Tax	521.74
Expenditure	2629.00
Income v/s Exp.	19.85%
Level of subsidy	80.15%

17. Following **issues** have been identified

- No system of door to door collection of waste
- No segregation of waste at source
- Inadequate community bin facilities
- Burning of waste on roads/ bins
- People throwing waste on streets, open space, drains, nalas etc.
- No separate system for collecting of disposal of construction waste and /or Industrial waste
- Problem of hotel & restaurant waste
- No system of collection of garden waste
- Issue of plastic begs / plastic with less than 20 microns
- Crude dumping of waste
- Need of Capacity building of RMC employees
- Use of Plastic begs / plastic thinner than 20 micron
- Lacking of public awareness
- High level of subsidy and low level of recovery for SW service

18. Following objectives are set for Modernization of SWM in Rajkot city

- Storage Improving Methodology
- Improving Primary Collection of Waste xxx
- Methods for Transportation of Waste
- Methods for Processing of Waste
- Methods for Disposal
- Development of Organizational structure

- Development of Better Trained Solid Waste Management Personnel
 - Better I-E-C Activities
 - Financial support
19. To strengthen the system Improvement following recommendations are suggested.
- Storage of waste at Source
 - Segregation of Recyclable / non-bio degradable waste
 - Primary Collection of waste
 - Sweeping of streets & Public Places
 - Cleaning of Drains
 - Provision of littering bins
 - Transportation of Waste
20. Some of the highlighted points of the above are as _
- **Scientific approach for Sweeping:**
 - Each sweeper has to be given long handled brooms with Metal tray and Metal plate. Sweepers to sweep the streets as per the yardstick suggested as well as collect waste from house to house with community participation using containerized handcarts fitted with bells.
 - **Waste Segregation and Reuse:** Source segregation of solid waste and removal of Storage of waste at source by households, shops and establishments in two bins be insisted. Recyclable waste has to be collected from the doorstep through rag pickers to be organized by NGOs only.
 - **Provision of Adequate Collection Facilities:** Large containers of 4.5 may be installed all over the city at a distance of 500 meters each. Societies, multi storied buildings, commercial complexes and slums to have community bins in addition to individual bins. Litterbins may be provided at strategic locations such as parks, gardens, railway/bus stations, cinema houses, market areas, and other public places.
 - **Developing Strong Transportation Facilities:** All containers shall be grouped according to the frequency of their becoming full and be cleared before they start overflowing. Dumper placer system shall be used for transportation of containers to synchronize the system of waste storage and transportation.
 - **Training & Public Awareness:** Training may be given at all levels. NGOs and private sector be fully involved
21. Short term strategies and Long term strategies finalized are as under :
- Identification of key issues
 - Inter - se priority among obligatory services
 - Improve collection efficiency

- Ngo/private sector participation
- Review establishment costs
- Development of strategies
- Involving community
- Passing on the waste:
- Paying fees:.
- Complaints and Supervision:
- Public information & education
- Promoting backyard composters:
- Revival of taxation based on user fee systems:.
- Construction waste management strategy:.

22. The term 'landfill' is used to describe a unit operation for final disposal of 'Municipal Solid Waste on land, designed and constructed with the objective of minimum impact to the environment by incorporating eight essential components as described by CPHEEO Manual, 2000. This term encompasses other terms such as 'secured landfill' and 'engineered landfills' which are also sometimes applied to municipal solid waste (MSW) disposal units. The term 'landfill' can be treated as synonymous to 'sanitary landfill' of Municipal Solid Waste, only if the latter is designed on the principle of waste containment and is characterized by the presence of a liner and leachate collection system to prevent ground water contamination

23. Municipal solid wastes have to be managed as per the framework of the Municipal Solid Wastes (Management & Handling) Rules, 2000 under Environment Protection Act, 1986. As per these rules, all the biodegradable municipal solid wastes shall be processed by appropriate biological processing method and only non biodegradable, inert waste will be disposed off in a landfill facility. In view of this RMC has requested National Productivity Council, Gandhinagar to conduct an Environmental Impact Assessment of its site (**Survey No: 222/P**) at Nakaravadi to assess its environmental suitability for development of an engineered Municipal Land Fill Facility (MLF). The Terms of References for Design of landfill site & EIA. The detailing are described in the report

24. Different cost and estimates are_

- Modernization of Primary Solid Waste which includes purchase of littering bins, wheel barrows, closed containers, debris containers, tricycle and mechanical sweeping machine etc., which amounts Rs. 256.23 Lakhs
- Modernization of Secondary Solid Waste which includes purchase of JCB machines, dumpers of 14 cu.mt & 8 cu.mt capacity, dumper placers for closed containers & debris containers, dead animal pick up van which estimates about Rs.259.20 Lakhs
- Modernization of Tertiary Solid Waste which includes development of land fill site –A phase-I with necessary infrastructure that estimates Rs.335.52 Lakhs

25. The Total estimated cost for Modernization of solid waste in Rajkot city is assumed

Rs.894 Lakhs in Phase-I which will take care of planning of year 2005-06 to 2007-08 , out of total JnNURM projects which are of estimated cost of Rs. 2479 Lakhs as per City Development Plan of the Rajkot city (2005-2011)

26. It is proposed to take certain administrative reforms which can be listed as under:

- Decentralization of Administration
- Ward level administration
- Involvement of Ward Committees:-
- Involvement of Ward Committees:-
- Zonal Administration
- City Level Administration
- Delegation of Powers
- Besides, it is also proposed to develop Management Information System. in the Corporation
The system development tools are suggested in the Report.

27. To make the Solid Waste Management Service financial sustainable it is proposed to increase conservancy charge 20% per annum. It is also assumed that the Solid Waste Service will be self sustained and financial viable before end of year 2010.

4.1 Regional Profile with Location Map

Rajkot city has been the main centre for industrial and commercial activities in Saurashtra region. A fairly large industrial development in the recent years along with the urbanization has led fast development of the cities. It is one of the major states in ancient India.

Rajkot is situated in the middle of the peninsular Saurashtra in central plains of Gujarat State of Western India at a height of 138 m above mean sea level. It lies between latitude 22.18 N and longitude 70.51 E. It has an area of 104.86 sq. kms

Rajkot is head quarter of Rajkot District and the city is connected with other parts of the country by Rail, Road and Air. There are two railway stations, one at Junction Plot area and another at Bhaktinager. There are broad gauge railway line of Western Railway between Viramgam-Okha-Porbandar and meter gauge railway line between Jetulsar-Veraval-Bhavanagar. It is also well



connected by broad gauge railway line with Delhi and Bombay the important two Metropolitan cities of India. Also there are major roads and NH-8 A links Kandla, NH-8 B links Porbandar and state capital Gandhinagar. Then, State highways connect Rajkot to other important towns of the region like Surendranagar, Porbandar, Junagadh, Veraval, Bhavnagar, Amreli, Bhuj, Kandla, Ahmedabad,, Baroda etc., The city is also served by an aerodrome and linked by air with

Baroda, Bhuj, Bombay, Delhi and Ahmedabad.

Location Map of Rajkot

The city does not have a long history. It was founded by the then ruler of Sardhar 1608 A. D. on the west bank of the river Aji as a small fortified town. by Ruler of Sardhar Gradually, it became a Princely State in the year 1805. The British Government developed the old city area popularly known as Sadar during 1820 to 1870. The old town and Sadar area being part of the city were developing simultaneously. Both these areas were separated by North-South Railway track then existed but subsequently railway track was removed. Both these areas merged with each other resulting in coordinated development of the town. Hence the city developed from a village, civic development was in the process and in the course of time some of the major works came to be

permanently visible. To name some of them, we can mention Raj Kumar College, Alfred High School which was subsequently named Mahatma Gandhi High School, Jubilee Garden, Railway line, Railway Junction, Lakhajiraj Railway Station which geared up the development of whole town of Rajkot. By the end of 19th century, Rajkot emerged as a premier town having a population of 36,000.

4.2 Civic Authorities

The city has 23 election wards and an elected body comprising of 69 members elected at the rate of 3 members per ward having one female member from each ward. The breakup of councilors works out as under:-

➤ General seats	38
➤ Women councilors	23
➤ Scheduled caste	4*
➤ Backward classes	7*

* Out of 4 schedule caste councilors, one is included in the women's group.

** Out of 7 backward class councilors, two are included in the women's group.

The ward-wise population and break up of the elected representatives in terms of female councilors, councilors from reserved category as well as from general category is shown in statement kept at Annexure-A. The elected body is responsible for governing the affairs of the municipal corporation. The City Corporation has a mayor whose term is for a period of two and half years and for the first time in the history of Gujarat State by an amendment in law, the mayor has been brought into the main stream of municipal administration. Unlike many other states in India, the Mayor of Rajkot enjoys certain powers to effectively carry forward the activities of city government.

The Municipal Corporation's administration is under the control of Municipal Commissioner. His appointment is made by the State Govt. from time to time. He is assisted by Deputy Municipal Commissioners and a large work force of Municipal officers and servants to discharge the functions of the Corporation. The main functions of the corporation are as under:

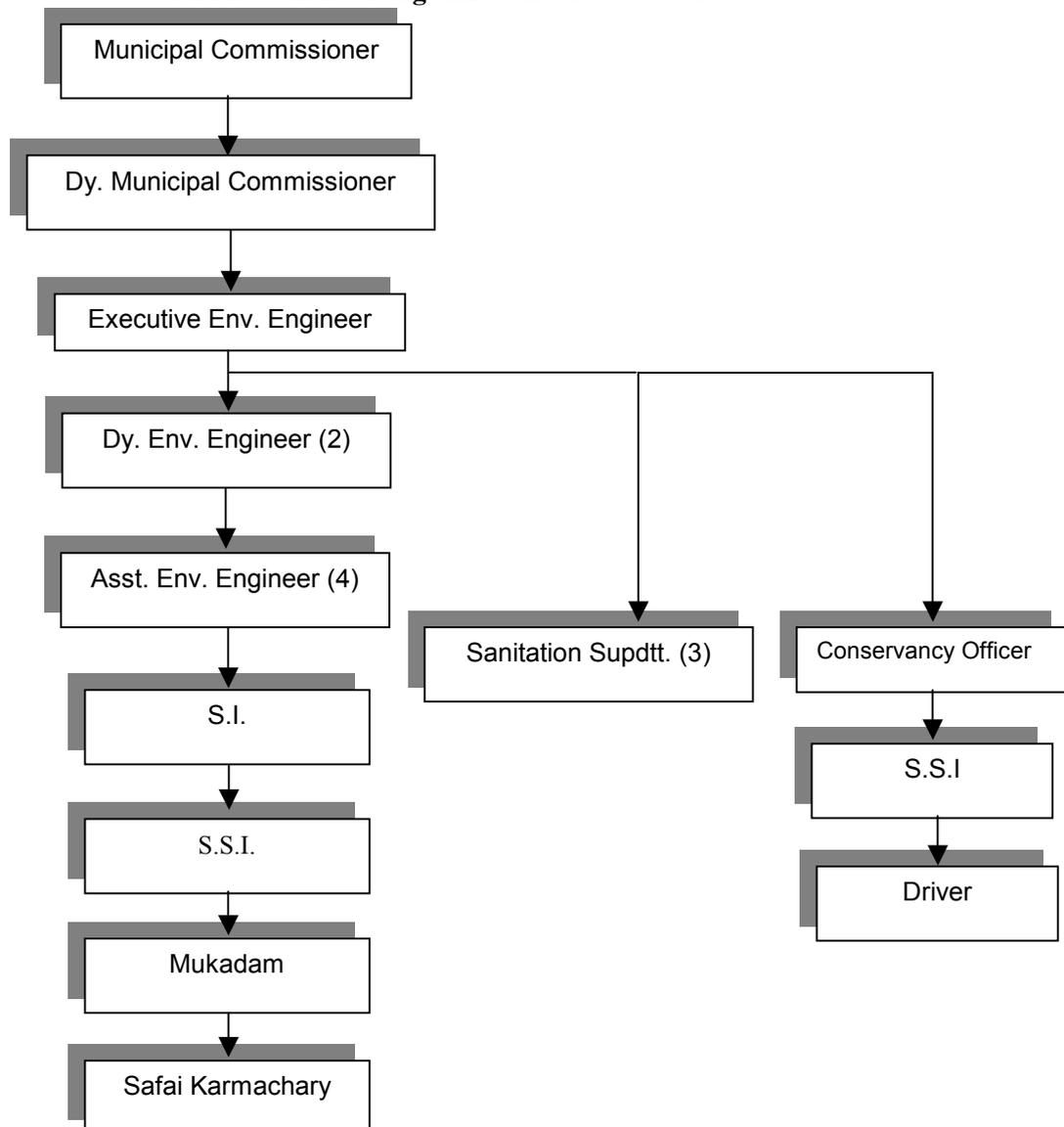
- Water supply
- Sanitation
- City cleaning and waste disposal
- Health
- Roads
- Streetlights
- Fire brigades
- Parks and gardens
- Library, etc.

The department of SWM is under the administrative control of the Deputy Municipal Commissioner and is headed by Health Officer of the City Corporation. Entire details of the staff

engaged in the SWM are given in the flow chart and the table. The chart also indicates the hierarchy of the solid waste department.

Solid waste management is a part of health and sanitation, and according to the Indian Constitution, falls within the purview of the State list. Since this activity is non – exclusive, non – rivaled, and essential, the responsibility for providing the service lies within the public domain. The activity being of a local nature is entrusted to the Urban Local Bodies. The Solid Waste Department of Rajkot Municipal Corporation is responsible for the solid waste management (SWM) which was constituted under B.P.M.C 1948. Rajkot Municipal Corporation is one of the front runners in state to form full fledged Solid Waste Management Department as per the guidelines of MSW Rules 2000. Entire details of the staff engaged in the SWM are given in the flow chart and the table. The chart also indicates the hierarchy of the solid waste department.

4.1 Flow chart of organization structure for SWM



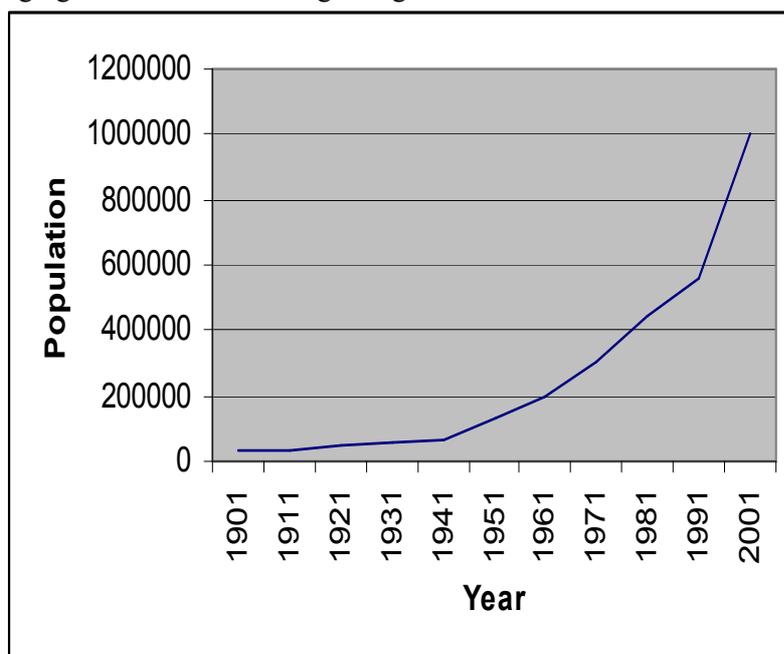
4.3 Population

The population of Rajkot city is 10, 02,000 as per the 2001 census. The population has grown from 36,151 in 1901 to 10, 02,000 by the year 2001. with an average annual growth rate of 3.29%.

During independence period Rajkot city experienced highest growth rate 99.04% in between 1941 to 1951 because of large immigrants' refugee from Pakistan. Also in the last decade the city registered the growth rate of 79.12% , this is attribute to the increasing the Corporation limit by merging the three surrounding village in June-1998.

Year	Population	Growth rate
1901	36151	---
1911	34191	-5.42
1921	45845	+34.08
1931	59122	+28.96
1941	66353	+12.23
1951	132069	+99.04
1961	194145	+47.00
1971	300112	+54.58
1981	445076	+48.30
1991	559407	+25.69
2001	1002000	+79.12

The trend of population growth is an important indicator and base for the assessment of future requirements of basic in the area for the future.



Population projections for the RMC area have been done on the basis of the past growth trends. It is required to estimate separately RMC area and newly merged area during June 1998. The population growth rate of RMC area is given in table. It has been observed that since last 100 years, the population of Rajkot City has increased at different growth rates. The growth rate of Rajkot City from 1901 to 1941 has been calculated as very nominal i.e. 0.15 on average annually. After Independence i.e. after 1951, the rate of population growth of Rajkot City has increased tremendously. Based on the above population figure for the past decades, the RMC population (excluding newly merged area) has been projected utilizing ratio methods, the geometric growth method as well as incremental increase method and graphical method. The growth rate in higher side found as 3.11% raise per annum, medium as 3.05% and lower growth rate as 2.67%. However, Population growth rate of newly merged area found population growth rate as 11.79%. Therefore, combine population growth rate for RMC old area and the merged area calculated. The combined

Year	Population Projection			Adopted Population Projection estimate
	High	Medium	Low	
2011	1,570,000	1,484,500	1,490,000	1,484,500
2021	2,215,000	2,207,000	2,232,000	2,207,000

growth rate found as 4.59% for higher side, 4.05 Medium side and 4.00% for lower side estimation. Table shows population projections for the years 2011 and 2021.

- **Density :** The population of Rajkot city is spread over an area of 104.86 sq.kms., with density of 9556 persons /sq.kms.
- **Literacy Rate:** Literacy level of Rajkot has always been higher than state literacy levels. With a total literacy rate of 73.86% in the year 2001, the

city has comparatively higher literacy rate than 69.96% of State literacy rate as well as 54.16% of National literacy rate.

- **Slum Population:** Rajkot city has 84 notified slum area having population of about 202343. It is spread in almost all wards. There are total 106574 males & 95769 female including total children of 88865 (30516 children age below 5 yrs.& 58349 children age 6-17 yrs.). It shows sex ratio as 899:1000. The caste structure is found as 33.29% SC, 2.47 % ST, 45.22 OBC (Other Backward Class) & 10.02% general. The literacy rate is observed 63.70%. Out of 44914 household of slum and urban poor, it is found in total survey of all household that (survey carried out by united research organization survey,2002), 32701 HH are living below Poverty line i.e. about 72%. The total population below Poverty line is about 147342 people. Comparing to total population of Rajkot city, which is 1002000 as per census 2001, the BPL population is about 14.7% of city population.

4.4 Housing

Housing reflects the economy & quality of life of any urban area. Poor planning mechanism leads to slum & illegal growth. Though, there exists an elaborate Regulatory Mechanism to promote, guide & control the building activities, it is often claimed that its procedure are very restrictive and difficult to comply. Such rigidity in regulation mechanism has minimized its scope. Almost 25 to 28 percent addition to the housing stock are estimated to be made informally without obtaining necessary permissions and sanctions. On one side lot of financial agencies and Govt incentives, encourages the development of housing sector where as on other side the regulation mechanism creates complex hurdle to the development. Therefore it is necessary to form housing strategy for better city and reducing slum & illegal development.

As described above there are 51.34% land is reserved for Residential purpose. Out of which 80% is being developed. **The average house holds size as per census 2001 is 5.64**, and the total number of residential property as per RMC tax branch report is 1,65,000 which describes about 40000 yet to be required.

It is observed that nearly about 5000 dwelling units are added annually to the housing stock of the city. In contrary to this, the number of applications for development permission received by RMC is as low as sixteen hundred. However, many of these applications are taken for multi-storied building having more than one dwelling unit. On these ground, it is estimated that nearly half of the dwelling unit's are constructed beyond the framework of regulation framework. The development

permission in the Rajkot city is accorded as per the provisions given in General Development Control Regulation (GDCR)- revised May-2000.

It is estimated that more than 75% dwelling units out of total houses constructed for lower income groups, 55% out of total houses constructed for MIG groups and similarly

Year	Developed land (hectares)	Undeveloped and under developed land under use (hectare)
2001/02	7744.843	2740.922
2002/03	7894.843	2591.157
2003/04	8052.740	2433.000
2004/05	8213.795	2272.205

25% for out of total houses constructed by high-income group housings are constructed without development permission.

The incessant process of urbanization and rapid industrialization has increased the population of Rajkot. From 132, 000 in 1951, the population figure rose to 1002000 in 2001 registering a growth rate of about 759 percent in five decades. Though the population has grown by leaps and bounds but the corresponding provision of housing facilities has not kept abreast. Shortage of housing facilities has contributed to the emergence of slums. At present there are 84 (74 recognized + 10 unrecognized) slum localities with an approximately population of 202371 within city Municipal limit. The slums in Rajkot are experiencing a faster growth rate than that of the city in 1972-73. There were only 24 slums, with 4927 nos of households in Rajkot in 1972-73. At present, there are 84 slums with 44914 nos of households. This indicates an increase of 468 per cent in slum population in just thirty years.

Since the slum population is 2,02,380 and the present population of Rajkot is about one million, it can be concluded that almost 20 percent of the Rajkot population live in slum areas.

Slum Housing: Most of the slum population resides either in pucca or semi-pucca houses. About

Hutment type	Number	Percentage Total
Temporary(kutcha)	513	1.15
Semi-Permanent	31971	71.18
Permanent	12430	27.67
Total	44914	100

1.15 per cent resides in huts made of kutcha (temporary) materials. Generally a house has one multi-purpose room, kitchen and verandah. The roofing material is either local tile or pre-cast slabs. As

indicated above, 71.18 per cent of the hutments in the slums in Rajkot are built of semi-permanent or temporary (kutcha) material.

4.5 Land Use

Rajkot is also affected by the wave of rapid urbanization and industrialization in the country over the last few decades. The development of trade and industry has gradually reshaped the life of the people. In the earlier period, the establishment of cloth mills in the city led to the development of new residential areas like Millpara, Harishchandra Plot, Gundawadi, Kevdawadi etc. The new Railway Station known as Bhaktinagar station also came into being.

Further, around the year 1940, new industrial estates, residential areas, schools, colleges, cinema houses came into being. Thereafter, Rajkot eventually became a vibrant trading city with a wide network of transport facilities by air, railway and road. A number of transport companies established their head offices at Rajkot. The Industrial Estates known as Bhaktinagar Industrial Estate and Aji Industrial Estate were established. Trade and Industry fast developing in the city also attracted foreign investment during these periods. This trend of city development generated rising demand for creating new civic amenities in the city.

- **Settlement pattern and growth of city :** Rajkot is a town of comparatively recent growth. In about 400 years, it has developed from a small hamlet to a prosperous town today. Up to 1820 the growth was not too rapid, but after the British government established its camp in 1822 the town opened new directions of growth. The industrial development and the urban influence of the city started with the establishment of the first textile mill in the region towards the end of 1910;. About 60 industrial units came into existence between 1900-1920 , which induced development of the city to a great extent. With the have the industries trade and commerce also flourished inviting the immigrant population to a large extent.

With increasing industrial, trade and commerce activity, there has been tremendous growth in the population of the town. The city's population has been experiencing an average growth of around 50 % since 1961. There was a sudden increase in the population in 1941-51 decade (99%) which was because of large number of government offices being established in the city of Rajkot after formation of Gujarat state, creating large number of employment opportunities. However, since then the decadal growth rate is fluctuating between 41% to 54%. The city has grown up in area from 150 hectare in 1901 to 10404 hectare in 1998. i.e. it has growth approximately 70 times of its initial size.

The city is growing rapidly in western direction. However, city is also simultaneously growing in all direction. The city can be divided in to three parts due to Aji River and railway tracks, which are passed through the city. The city has greater and prosperous development on the western side, Industrial development on Southern side and low-income housing towards northeastern side.

At present, Rajkot Municipal Corporation covers an area of 104. 86 sq.kms. including merged three area viz., Raiya, Nana-Mava and Mavdi area. The city is divided in to 23 administrative wards.

Rajkot city is characterized by a pattern of multiple land uses. The total area developed for urban activities constitute 77% of the Rajkot Municipal Area. Residential use occupies about half

Table: 4.5 Land use Break Up

Land Use	Existing Land Use as per 2001		Proposed Land Use as per DP 2011	
	Area in Hectare	Percent	Area in Hectare	Percent
Residential	4247	40.50	5502	52.47
Commercial	209	2.00	279	2.66
Industrial	628	5.99	738	7.04
Traffic & Transportation	1400	13.35	1650	15.74
Public & Semi-public	149	1.42	249	2.38
Recreational Space	123	1.17	523	4.99
Agriculture	995	9.49	800	7.63
Water bodies	236	2.25	236	2.25
Vacant Land	1510	14.40	--	--
Other	988	9.42	508	4.84
TOTAL	10484	100 %	10486	100 %

of this area, while industries occupy a fifth and commercial zones occupy less than 2%. in quite different ground realities. Rajkot is plagued by problems of informal sector including slum development, illegal colonies and commercial encroachments and a lack of industrial zoning and unplanned mixed land use.

The total area developed for urban activities constitute about 77 % of the city area and balances constitute activities enmarked for vacant land, water bodies and other purposes.

- **Residential Uses:** The residential development is spread over 54 sq.kms. high density of residential development is found in older parts of city especially Kotak street, Raghuvir para, Ramnath para, Kumbhar wada, Soni bazaar etc., The densities are low in the newly merged area especially in and around kalwad road, Raiya road, 150 feet ring road, university road and in some parts of junction area, popat para area etc. It is obvious that newly developed area where TP schemes were developed is planned. However, old city areas like Prahlad plot, Jayraj plot area are developed with a regular street pattern, well shaped plots but these area lack open space. Percentage of residential area to total area is found 51.34% while residential area to developed area is 60.23% .

- **Commercial Use:** Main commercial areas are Soni bazaar, Dharmendra road, Lakhajiraj road, area around jubilee vegetable market.etc., of old city, which is also described as city area ‘ A ’ in GDCR; Yagnik road, Dhebar road, gondal road, Jagnath area etc., which is known as city area ‘B’ etc.; and Kalwad road, amin road, university road, Raiya road, st.kabir road, pedak road etc, called ‘Other area_ as described in GDCR’. Traditionally, dana pith area was for grains & grocery whole sale and retail marketing; lakhaji raj road, kapad market and dharmendra road for clothing sale; soni bazaar for jewellery market; sadar for retail provisions stores etc., are established since long. These commercial activities demand substantial space in prime areas. The percentage of commercial area to total area is found about 1.89%, while same is to develop area seems to about 2.11%.

- **Industrial Use:** Two Industrial estates were developed by Gujarat Industrial Development Corporation. They are Bhaktinagar Industrial Estate and Aji Industrial Estate. Above which ,sorathiawadi plot area had been developed by private developers as another industrial area. Besides, National Textile mill, which is closed, occupies very prime land and is spread in huge area. Rajkot

city is developed as an industrial city hence, growth of industries and residences of industrial employees developed simultaneously which resulted in mixed land use pattern. The percentage of Industrial area to that of total area and developed area are found 20 % & 22.28% respectively.

- **Public Purposed Use:** Main components of Public purpose use can be described as open space, parks & play ground, recreational space, hospital space, schools, govt. office buildings etc., The major contribution to the component is by race course complex, which has facility of international cricket stadium, indoor stadium, hockey ground, foot ball ground etc.; garden and fun world & open ground. Other such space is Shastri Maidan. The total public purposed space to total area is 9% while it is 10% against developed area.

4.6 Transportation Corridors

The regional network includes NH-8B and State highways SH-23, SH-24 and SH-25. NH-8b from Bamanbore passes through Rajkot and leads to Porbandar. After construction of bypass to NH-8B heavy traffic has diverted to this ring road. SH-23 leads to Kalawad from Rajkot while SH-24 connects Morbi with Rajkot. Bhavnagar and Jamnagar towns are also connected to Rajkot by state highways.

The city level road network mainly consists of Gondal road, Dhebar road, Dr. Yagnik road, Jawahar road, University road, Kotharia Main road, Pedak and Sant Kabir roads. The width of road varies from less than 3 mts. to as much as of 24 mt and more, width wise details of road are as shown in table. The road net work inside the city is dense. Because of the concentration of various commercial and industrial activities in Rajkot and surrounding towns, the city road network leading to the surrounding town is heavily congested. The types of roadwork depending upon the surfaces of the road are as shown in table

Sr. No	Width of Road in mtrs.	Road Length in Kms.
1.	< 3	36 kms.
2.	3- 4.5	573 kms.
3.	4.5 - 7.00	169 kms.
4.	7.0 – 9.00	54 kms.
5.	9.0 – 12	49 kms.
6.	> 12.0	75 kms.

Sr. No	Type of road Surface	Length in kms.
1	Bituminous roads	636 kms.
2	Metalling / Stone paving	184 kms.
3	Road not paved / kutccha roads	136 kms.

5.1 Environmental Condition

The presence of industrial and commercial activities on a large scale, in and around Rajkot, tends to have strong impact on the environmental quality of the city. The concentration of polluting industries such as the foundries, electroplating units, Sari –printing, manufacturing of dyes and chemicals within the city and lack of basic infrastructure particularly, inadequate drainage connections and bio-medical waste generation tends to take its toll on the environment. Issues related to air pollution, water pollution and pollution from waste is much of concern about citizens.

Air Pollution: The principal sources of Air pollution in Rajkot are from vehicular emissions, industrial emissions, construction related activities. Uses of Kerosene as fuel by Auto- rickshaw, pollution from emission of Chhakada and relatively more numbers of the two-wheelers are sources of vehicular emissions. While sources of industrial emissions are mainly from the foundries, small scale industries and bricks manufacturing kilns.

Month	SO ₂ in µg/cu.mt.		NO _X µg/cu.mt.		SPM in µg/cu.mt.	
	Indu. Area	Resi. Area	Indu. Area	Resi. Area	Indu. Area	Resi. Area
Aug-2003	24	NA	18	NA	550	NA
Octo-03	17	17	10	14	230	120
Dece-03	18	14	24	19	310	210
Feb-04	21	7	21	7	190	210
Apr-04	25	15	21	14	320	130
July-04	7	23	14	8	180	180
Aug-04	12	10	12	13	230	210
Sep-04	13	11	18	10	240	160

Ambient air quality monitoring is carried out at three locations by Gujarat Pollution Control Board (GPCB) since 2000. The Monthly average of SO₂, NO_X, and SPM of last year as collected from two station viz., Aji GIDC Industrial area and GPCB Office- residential area are as shown in the table below: O₂ and NO_X levels in Rajkot are within the NAAQS (Monthly Average) during both the years. However, the SPM levels in Rajkot are found exceeding NASQS (Monthly Average) during both the years, particularly in Industrial Area and 50% time in a year in residential area.

Water Pollution: The city lies within the watershed expansion of Aji river basin and it is network of 19 natural drainage courses, locally known as Voklas. Unfortunately, these voklas are being used for sewage disposals resulted the pollution of water Aji- river in down stream of Aji dam. Nyari-2 dam which collects water from Aji River and Nyari River is fully polluted water dam. An analysis of different water bodies in down stream of Aji dam indicates the most of water bodies within city limit are contaminated. Pollution of under ground water due to electro-plating industries and sari-printing industries is also observed.

Pollution due to SW: The main causes for pollution include increasing household and commercial waste, commercial waste as well as bio-medical waste. Though, Rajkot Municipal Corporation is making efforts to ensure minimize the solid waste at source, but the result is not being seen up to the mark.

5.2 Geology & Soils

Geology: Rajkot forms central part of Saurashtra Peninsula and has a diverse landscape made up of plateau, hills, linear ridges and alluvial plains. The southern and western parts of the city are primarily covered by Deccan Traps, characterized by undulating topography with the presence of plateaus at some locations. In the northern part, topography is plain with gentle slope towards north and west. The average elevation attained in the district is 130 meters above mean sea level. The general topography of RMC area is almost undulating with level difference from 125 m to 158 m from south east to North West. The city of Rajkot is situated along the Aji River, which is seasonal in nature. The main tributary of Aji in the area is khokhadadi located on southwest side of Rajkot city. Two noses at natural water reservoirs (lakes) are located near Rajkot city viz. Lalpari and Randerda, at the distance of 4 kms and 6 kms respectively from the city. Across the river Aji , Aji reservoir is built up at a distance of 9 kms from Rajkot city and Aji II at a distance of 15 kms. In the RUDA area Nyari I and Nyari II reservoirs are constructed which are located within of 15 Kms to 30 Kms from the city. In addition to this, for draining storm water, Nos. of Natural courses exist, in RMC and RUDA areas which are ultimately meting to river Aji to drain storm water.

Soil Type: Soil of the entire Rajkot area can be broadly classified as medium black to shallow black. The black soil, being rich in minerals and organic matter is more fertile. These soils have been formed even from granite and gneiss parent materials. The depth of the top soil is generally 25 cm to 50 cm deep. The color of soil surface varies from light gray to dark gray and is clayey in texture. The soil reaction is neutral to alkaline with Calcium Carbonate. Beyond 50 cm depth the under ground strata are soft rock & hard rock. The vegetative cover is minimal in the open area due to lack of adequate topsoil. The topsoil is underlain with hard rock formations thereby limiting the growth of vegetation in the region. .

Ground Water Table The fluviomarine alluvium of Upper Tertiary to Quaternary age forms poor aquifer because of the predominance of argillaceous nature of formations and poor quality of ground water. The ground water occurs under water table and confined conditions. Depth of tube wells ranges from 30 to 120 meters below ground level, whereas depth to water level ranges from 20 to 100 meter below ground level. The seasonal fluctuations in the water table ranges from 1.8 to 12.0 meters. The yield from the tube wells ranges from 2.50 to 10.00 cubic meters/day. In hard rock areas the availability of ground water in a particular year is the direct response to intensity of monsoon and quick response is seen in such aquifers. In the years of normal and above normal rainfalls the water level decline. The seasonal availability of ground water also varies widely.

5.3 Climatology

Climate: The climate in the city is hot and dry. The average maximum and minimum temperatures recorded over the last 40 years are 43.5 deg C and 24.2 deg C respectively.

MONTH	TEMPERATURE in ° C			
	2003		2004	
	Minimum	Maximum	Minimum	Maximum
January	9	28	10	27.5
February	10	32	11	29
March	15.5	36	17.5	38
April	20	39	20	37
May	24	40	24.5	41.5
June	25.5	36	26.5	39.5
July	25	37	22.5	38
August	22	33	23	32
September	22	34	21	31
October	21	31	21	35
November	14.5	33	16.5	33.5
December	10	27	10.5	29

Rainfall: The average annual rainfall is 500mm. However, over the last 60 years, it has been below normal during 20 years. In these years, the city along with the Rajkot Urban Development Area (RUDA) faced acute water shortage. The average annual rainfall is observed about 500 mm. in the area.

5.4 Drainage Basins

Rajkot district forms central part of Saurashtra Peninsula and has a diverse landscape made up of plateau, hills, linear ridges and alluvial plains. The southern and western parts of the district are primarily covered by Deccan Traps, characterized by undulating topography with the presence of plateaus at some locations. In the northern part, topography is plain with gentle slope towards north and west. The east west trending linear ridge forming upland south of Rajkot forms water divide for south & southwesterly flowing drainage basin of Bhadar and north & northeasterly flowing drainage basins of Aji, Machhu etc.

The average elevation attained in the district is 133 meters above mean sea level. The general topography of RMC and RUDA areas is almost plain with a gentle slope from 120 m to 139 m from south east to North West. The land is undulating in the RUDA areas towards the north west of the town. The vegetative cover is minimal in the open area due to lack of adequate topsoil. The topsoil is underlain with hard rock formations thereby limiting the growth of vegetation in the region.

The drainage network of Rajkot district is mainly controlled by Bhadar, Machhu, Aji rivers and their tributaries. The southern half of the area forms catchments for Bhadar River, the largest river flowing from south western parts of district. Northern half falls under the catchments of Aji and Machhu rivers and their tributaries. All these rivers are seasonal and flow only in response to monsoon precipitation. The city of Rajkot is situated along the Aji River, which is seasonal in nature.

The main tributary of Aji in the RUDA area is Nyari, located on southwest side of Rajkot city. There are two natural water reservoirs (lakes) located near Rajkot city viz. Lalpari and Randera, at the distance of 4 kms and 6 kms respectively from the city. Artificial water reservoirs (dams) are located very near to the city. Aji I dam is built at a distance of 9 kms from Rajkot city and Aji II at a distance of 15 kms. Other dams in the RUDA area are Nyari I and Nyari II also located at within of 15 Kms to 30 Kms from the city. In addition to this, there are a number of nullahs and low lying areas located in RMC and RUDA areas which direct the drainage flow in the city area. In view of scant vegetation cover a substantial amount of eroded sediment settles in the dam pondages areas. However in the view of low rainfall in the past 7 years the spillways of the dams have rarely come into play.

5.5 Geographical Information System (GIS)

Each department at the municipal level has specific requirements for spatial and non-spatial data and often, there is an overlap of information crucial to these departments. An Enterprise approach enables access to information across multiple departments apart from bringing in greater efficiency, speedy decision-making and transparency in the functioning. A comprehensive enterprise municipal GIS should provide a common platform for data collection, storage, authorized and secure access to spatial and non-spatial data, harmonize the workflow of respective departments and disseminate information for the benefit of public at large. Municipal GIS/MIS should largely address the needs of various local government departments such as Local Administration, Public Works & Engineering department, Public Health Department, Water supply & Sewerage, Town and Country planning Department, Public Safety, Land records, Tourism Department etc.

Geographic information system (GIS) technology can be used for scientific investigations, resource management, and development planning. For example, a GIS might allow emergency planners, even to easily calculate emergency response times in the event of a natural disaster, or a GIS might be used to find wetlands that need protection from pollution.

Spread of computer and the use of the Internet are expected to increase in future in our urban areas. Posting of planning information on suitable web site by the urban local bodies would therefore become essential. Access to modern and responsive service will be the demand of the urban residents in future.

The benefits include:

- Municipalities have access to large-scale maps with latest information
- GIS/MIS tools help in day- to-day administration and maintenance
- Tools for Assets inventory for optimum utilization and the increase of the revenue base
- Tools for visualization for future growth areas / what if scenarios – aid effective planning for
 - Demarcation of Ward/TP/OP/FP Boundaries
 - Road Network
 - Solid Waste Management

- Water supply
- Drainage Network
- Storm Water Drainage
- Public health, and Sanitation
- Slum improvement and up-gradation
- Public amenities including Parks, gardens, and playgrounds; Street lighting, Bus-stop etc.

Rajkot Municipal Corporation is the front running in the computerization of different services provided by RMC. Computerization in RMC started in 1989, with payroll system of employees. It has got momentum in 1994-95 with introduction of online collection-assessment and billing of property tax and water charges system. More than decade has passed, and now the computerization in Rajkot Municipal Corporation has become matured.

RMC has now planned to switch over to GIS (Geographical Information System) from existing MIS based system with enough GOI support and very good user friendly ness. Rajkot Municipal Corporation is already having digitized maps of all 23 wards. RMC has already established a separate GIS laboratory for the purpose. RMC has four computers with GIS serve & work stations with necessary plotters & scanner. RMC has also purchased multi user Arc GIS software version 9. RMC is also procuring satellite images. Recently RMC procure satellite images of 0.50m x 0.50 resolution from IRC. The work of total GIS solution has been assigned to NRSA, Hyderabad.

5.6 Financial Status

The financial profile of city indicates the state of the city's finances and the capacity of the city to be able to manage its finance and mobilizing resources for maintaining infrastructural service at prescribed norms and standards. Therefore financial capacity of Rajkot Municipal Corporation finance has been assessed on income, expenditure, debt service and performance.

As per Municipal Finance code the financial the Financial Accounts of the RMC is being maintained as "Cash Basis" i.e. single entry system. However, RMC started simultaneously modified accrual system by Tally software use. Every inflow of cash and bank balance is being treated as income irrespective of the fact that whether it relates to current year or not.

The Rajkot Municipal Corporation (RMC) classifies all receipts into four categories viz, revenue receipts, capital receipts, scheme receipts, and other (miscellaneous) receipts. Revenue receipts are further divided into two main heads, (i) own revenue receipts and (ii) state transfers. Own revenue receipts consist of taxes, user charges and other fees and fines that are levied and collected by RMC. Own resource receipts i.e. the fiscal base of RMC consists of Octroi, consolidated property tax, theatre tax, vehicle tax and non-tax receipts, mainly from sale of water. Receipts under state transfers consist of education cess, which is returned to the Corporation either in full or part, and grants-in-aid under general purpose and specific purpose categories. Capital receipts represent loans contracted for

various projects and from sale of assets. Scheme receipts are amounts that the RMC receives for various project specific schemes and works. Other receipts consist of deposits, advances and the like.

Expenditure heads are also divided by the RMC into four categories, namely revenue expenditure, capital expenditure, scheme expenditure and other expenditure (miscellaneous). Revenue expenditure has three categories; (i) expenditure on establishment, wages and salaries and (ii) expenditure on operation and maintenance, and (iii) debt servicing. Expenditure is classified for each department such as general administration, fire, lighting, public health, water supply, medical care, pre-primary education, primary education, higher secondary education, technical education, public buildings and on commercial activities. Expenditure on developmental works is shown as capital expenditure, whereas expenditure on various project specific schemes is shown under schemes.

Revenue Income: Revenue account comprising of the operating income and expenditure items which is of recurring items, e.g. income from taxes, non-taxes, grants etc. and main components of revenue expenditures like expenditure on establishments, repairs & maintenance. Following paras describe more on revenue income & revenue expenditure.

The Main components of Revenue Incomes of RMC are:

- Octroi (power to collect given by statute)
- Property Tax (power to collect given by statute)
- Revenue Grants (assistance from govt., other bodies)
- Miscellaneous Incomes Rent Received (from lands, property etc., possessions)
- Public Service Charges (for services provided),
- Other Incomes

Octroi Collections : Octroi contributes the largest share (over 56% of the total revenue income) to the Revenue basket of RMC. Even a small percentage fall in Octroi Income could cause a bigger loss to RMC and as Octroi being the largest income source, there is a greater sensitivity to fluctuations from this source of income.

Property Tax: Property tax (House tax, Conservancy tax, Fire tax and Education cess) is the second largest tax Revenue source and constitutes average 35-37% of the total revenue income and 25 percent of total income. There are about 2, 08,000nos. Of built up properties are being assessed within Rajkot Municipal Corporation limits. The average growth rate of assess is about 2%. As per BPMC Act, 1949 Corporation can revise the ARV of properties once in four years however; last revision was made during year 1992. The corporation levies a tax on bases of built-up area measurement and thereby finding Annual Ratable Value (ARV) of the collection of tax. The current demand of house tax is Rs58.01 millions where as there are outstanding arrears as on 31-12-2005 is 1702 millions.

Theatre Tax: RMC collects theatre tax from theatres as well as professional entertainment shows within RMC limits. It is very nominal tax of Rs.75.00 per cinema show... Average collection of theatre tax is Rs.11.00 Lakhs per annum.

Vehicle Tax: From year 2002-03 RMC started to impose lifetime vehicle taxes. The tax structure depends on type of vehicles and age of vehicles. Up to 1/10/2005 RMC have collected Rs.30 Lakhs from about 60000 vehicles. The mechanism of collecting vehicle tax for new vehicle is comparatively easier as it is linked vehicle sellers.

Water Charges: Another important source of income is Water Charges. RMC collects water charges as part of the property tax.

Drainage Tax: From year 2003 RMC levied drainage tax on each property on the bases of 1% of ARV of property.

Revenue Grants : (assistance from govt., other bodies) Revenue grants are one of the non-tax revenue sources of RMC. Revenue grants may be for general purpose or for any specific purpose. It constitutes the third largest source of Ram's revenue income.

Miscellaneous Incomes: Rent Received (from lands, property etc., possessions), Under this head - rent received, public service charges, interest on funds invested, high school fees etc. are collected.

Public Service Charges (for services provided): Another source, public service charges, includes incomes from ambulance rent, garden income, swimming pool fees etc. Share of income from this source is negligible, despite large sum invested by RMC for development and maintenance of public places.

Other Incomes Income from penalty, administrative charges etc. is considered as other Income. It largely depends upon the special charges or drives like administrative collection charges for SWM etc.; it ranges from Rs.150 Lakhs to Rs.300 Lakhs.

Revenue Expenditure: The Corporation spends the resources for establishment, operation and maintenance and debt servicing of obligatory and discretionary services provided by it. The major heads of revenue expenditure include general administration, water works, drainage ,

Year	Revenue Account Receipts (Rs. Lakh)			
	Tax	Non-Tax	Transfers including grants	Total
2001/02	7892.71	921.43	483.25	9297.39
2002/03	9784.55	1306.55	1222.14	12313.24
2003/04	9391.98	1147.21	828.51	11367.7
2004/05	11393.19	969.07	653.27	13013.85
2005/06	11310.85	954.87	1319.64	13585.36

conservancy, roads, streetlights, public health, education, garden , fire brigade etc.,

Most of the capital works are finance by way of loans from finance

institutes, grants from the State & Central Government, as well from sale of assets. The Corporation also uses significant amount of surplus funds from the revenue account surplus of previous years.

Largely, General capital receipts are divided as follows :

1. Grants & Contribution like Sale
 - a. MP grant
 - b. MLA grants

- c. Finance commission grant
- d. Project / scheme specific grant

Capital Receipts (Rs.lakhs)					
	State government (Rs.lakhs)		Financing institutions	Market	Total
Year	Loan	Grants			
2001/02	0	274.41	0	282.61	557.02
2002/03	0	481.32	0	837.35	1318.67
2003/04	430.69	631.18	269.48	1012.94	2344.29
2004/05	0	544.18	0	2148.09	2692.27

- e. NSDP /GSDMA grant etc,
- 2. Capital profits on sale of fixed assets
- 3. Capital grant/ contribution , subsidies etc.,
- 4. Borrowings / loan
- 5. Other Capital Receipts.

Capital Expenditure: Capital Expenditure in absolute terms (Rs. in Lakhs) shows a downward trend from 2001-02 to 2002-03. However onwards it has jumped up to Rest. 413 millions. It shows more during year 2004-05 onwards because of state govt Urban 2005 year agendas.

Average growth rate of expenses was a slightly higher figure than that of Capital Receipts.

Year	Expenditure
2001/02	3334.23
2002/03	1981.91
2003/04	2202.27
2004/05	4131.080

For better financial monitoring, RMC has adopted as process of preparing scheme budget every year. In budget for the year 2002-03 and onwards, total 11 numbers of major heads has been prepared which are as under_

- Underground Drainage Project
- Urban Area Water Supply Project
- Solid Waste Management
- Town Planning
- Social & Economical Weaker Section Scheme
- Aji Industrial Settlement Yojna
- Merged Area Development Scheme
- National Slum Development Scheme
- 10th Finance Commission Scheme
- Traffic Control Scheme
- Narmada Water Supply Scheme

5.7 Status of Legislation

Law is the basic instrument that defines rights and obligations. The legal framework is governing a particular infrastructure sector development. ‘Regulatory Framework’, means the statutes, rules, regulations and administrative orders governing for various components of city development strategy. Legal and regulatory stipulations lay down a framework of planning and management and also emphasize the government’s commitment to improve quality of life of citizens. Though BPMC Act, TP & UD Act and 74th CAA describes duty, functions and powers for Urban Local Bodies in the state, but it is also necessary to set a set of such a regulatory frameworks which can develop state of art for running the show as well as total control and command approach for executing infrastructure of the city In the Gujarat, and particularly for Municipal Corporations there are three legal relevancies are essential to explore urban infrastructure development and financial resource generation. These are_

1. **74th Constitution Amendment Act (CAA)**
2. **Bombay Provincial Municipal Corporation Act, 1949**
3. **Gujarat Town Planning & Urban Development Act, 1976.**

Besides there are number of laws, like Food Adulteration Act, Animal cruelty law, the different legislation enacted in India exclusively for environmental protection and conservation are:

- a. The Air (Prevention and Control of Pollution) Act 1987
- b. The Water (Prevention and Control of Pollution) Act 1974
- c. The Environment Protection Act 1980
- d. The Forest Conservation Act 1980
- e. The Wildlife Protection Act 1972 and
- f. The Public Liabilities Insurance Act 1991

It may be interesting to note that there are about two hundred laws dealing with environmental protection both before and after Independence India. The 42nd amendment to the constitution enacted in 1974 has two Articles (Art 48-A) and (Art 5-IA (g) - throwing the responsibility on the State government and on every citizen to protect and improve the environment. A study of these laws reveals that a number of provisions are suggestive and advisory. The Indian Penal Code (IPC Section 270) provides a fine of Rupees 200/- for creating public nuisance and health hazard and Rupees 500/- for making atmosphere noxious. Thus adequate Legislations are there but they require proper review for making it more effective.

74th Constitutional Amendment Act

74th Amendment Bill was passed in December 1992. The Bill was ratified by almost all the states with few exceptions. It received the assent of the President in April 1993, and came into force on June 1, 1993. However, the Constitution – 74th Amendment – Act 1992, provides for a period of one year by way of transition during which time amendments to the existing State Acts have to be carried out so as to bring provisions of the said Amendments Act.

Salient Features of 74th Constitution Amendment Act 1992

- a. The provisions of the 74th Constitution Amendment Act 1992, being part of the constitution are applicable to all the States. They are applicable to the union territories also (243-ZB).
- b. This Act has conferred powers on the President of India to direct, by a public notification, the application of this Act to a part of a union territory also with such exceptions and modifications as he may specify in such notification (243.78 Proviso). The provisions of this 74th Constitution Amendment Act are not applicable to the scheduled areas specified in Art. 244(1) and the tribal areas specified in Art. 244(7)
- c. Definition of urban areas (243-q (1))
- d. Division of municipal area (urban local body) into wards (243-r (1))
- e. Composition of each municipal body (243.r (2))
- f. Constitution of ward committees (243-s (1)(2))
- g. Levy of taxes and fees (243-x)
 - a. The State Legislature is competent to authorize a Municipal Council to levy, collect and appropriate such taxes, duties, tolls and fees in accordance with such procedure and subject to such limits, (243-X (a))
 - b. The State Legislature is also empowered to assign to Municipal Council such purposes and subject to such conditions and limits. (243X(b))
 - c. The State Legislature is competent to make provisions to allotment of such grants-in-aid to Municipality as it may consider necessary, from Consolidated Fund of the State (243 X(c)).
 - d. Constitution of funds in the municipal financial administration (243-x(d))
 - e. Functions & Responsibilities of ULB_ Extract of Twelfth Schedule (Article 243 W) of Constitution of India

Schedule –XII gives the list of functions & responsibilities to Urban Local Bodies as describe below:

1. Urban Planning including town planning
2. Regulation of land-use and construction of buildings
3. Planning for economic and social development
4. Roads and bridges
5. Water Supply for domestic, industrial and commercial purposes
- 6. Public Health, Sanitation conservancy and solid waste management**
7. Fire services
8. Urban forestry, protection of the environment and promotion of ecological aspects.
9. Safeguarding the interests of weaker sections of society, including the handicapped and mentally retarded
10. Slum improvement and up gradation
11. Urban poverty alleviation
12. Provision of urban amenities and facilities such as forests, gardens, playgrounds

13. Promotion of cultural educational and aesthetic aspects.
14. Burials and burial grounds; cremations, cremation grounds and electric crematoriums.
15. Cattle ponds: prevention of cruelty to animals.
16. Vital statistics including registration of births and deaths,
17. Public amenities including street lighting, parking lots, bus stops and public conveniences

Bombay Provincial Municipal Corporation Act, 1949

In Gujarat, Bombay Provincial Municipal Corporation Act, 1949 was enacted for Municipal Corporation of Gujarat. The act was amended as Gujarat Act No.21 of 1989 on 05.09.1989, thereafter, for Municipal Corporations in Gujarat have to function as per the Bombay Provincial Municipal Corporation Act (Gujarat Amendment) Act, 1989. However, till to day the amendment act is popularly described as BPMC Act. The Act contents 33 main Chapters, Four Appendixes, and Four schedules. Chapter –IV about administrative set-up while Chapter-V to VIII, largely describes the powers & functions including obligatory & discretionary duties of the Corporation as well powers and mode of contractor and Acquisition of property & disposal of properties.

Relevant sections of BPMC:

Important section of BPMC Act, 1949 in respect to urban infrastructures facilities, taxes etc., are as given below:

Table: 5.6 BPMC Act, 1949 relevancy for MC Infrastructure Development		
Sr. No.	Relevant Sec. BPMC Act	Main contents of the section
1	Solid Waste Management	
	Sec.63 (2) Chapter VI	The watering , scavenging and cleansing of all public streets and places in the city and the removal of all sweepings there from
	Sec.290 Chapter XVIII	Commissioner to provide for cleansing of streets and removal refuse
	Sec.292 Chapter XVIII	Provision and appointment of receptacles depots and places for refuse etc.
2	Public Health	
	Sec.63(6) Chapter VI	Obligatory duty_ the construction or acquisition and maintenance of public hospital and dispensaries including hospitals for the isolation and treatment of persons suffering or suspected to be infected with a contagious or infectious disease and carrying other necessary measures for public medical relief.
	Sec.63(12) Chapter VI	Obligatory Duty the construction or acquisition and maintenance of public markets and slaughter houses and the regulation of all market and slaughter houses
	Sec.1 -2 Sch-A	Private Mkts & Slaughter house
	Sec.63(11) Chapter VI	Crematoria : Obligatory duty_ the maintenance, change and regulation of places for the disposal of the dead and the provision of new places
9	Environment & Slum Up-Gradation	
	Sec.280-284G Chapter-XVI	Declaration of Clearance area besides re-development area
	Sec.63/2 Chapter-VI	Clause for fund allocation of 10% budgeted exp. For the development of backward area.
	Sec. 307 -XVIII	Overcrowded dwelling
	Sec.308 - XVIII	Unsanitary huts and sheds

Gujarat Town Planning & Urban Development Act, 1976

Gujarat Town Planning & Urban Development Act 1976 enacted, which came in to force from 21st June 1976. The act extended to whole of Gujarat. The GTP & UD Act consists of eight chapters and 124 sections.

TP Schemes Micro Level Planning tools: Section 40 to section 76 describes various provisions in respect to micro level planning viz., TP scheme largely it contains three parts

1. Draft Scheme
2. Preliminary Stage
3. Final stage

It follows following path

1. Preparation of the Final Scheme by T .P. O. (Section 52/3).
2. Declaration of decision of T.P.O. to parties (Section 54).
3. Constitution of the Board of Appeal to hear and decide appeals (Section 55/1)
4. Board of Appeal's decision communicated to TPO (Section 62/2).
5. Sanction of the Final Scheme with or without the modifications (Section 65/lb)
6. Final scheme comes into force (Section 65/2)

Relevant Section of GTP & UD Act-1976 for Infrastructure Development

Table: 5.7 GTP & UD Act, 1976 relevancy for MC Infrastructure Development		
Sr. No	Relevant Sec. GTP&UD Act,1976	Main contents of the section
4.	Solid Waste Management	
	12(2)(n)	Provisions for preventing or removing pollution of water or air
9.	Finance	
	23(1)(vi-a)	To levy and collect such fees for the execution of works referred above
	23(1)(viii)	To enter into contracts, agreements or arrangements
	24(1)	Local authority functioning in the urban development area to pay contribution to development authority
	77(1)(b)	Sums to be spent for the cost of works
	77(1)(g)	Amount of the cost of infrastructure provided in the area adjacent to the area
	92	Power of authority to borrow money

Summary

In short, the intent of the CAA is to induce the state legislatures to make such laws as would lead to delegation of power and responsibility to the municipalities in respect to preparation of plans for economic development and social justice (Article 243) W (a) (1). While this is what the Constitution desires the state legislatures to do, a more specific and obligatory provision in this regard is contained in Art. 243 ZD (1), which reads as under:

“There shall be constituted in every State at the district level a district Planning Committee to consolidate the plans prepared by the Panchayats and the municipalities in the district and to prepare a draft development plan for the district as a whole.” Thus, it provides more powers and responsibilities

BPMC Act provides wide powers in the hand of Urban Governance form Tax levy to Planning as described above. Municipal Commissioner as chief executive and administrative officer is having wide powers. Democratic set up allows the people's participation as well representation of women and minorities. Directly it does not talk about the private sector participation however, by framing certain mechanism it does allow and similarly for generation funds from open market.

More than 600 Town Planning Schemes were (TPS) sanctioned and many of them became reality throughout Gujarat, as per GTPUD Act, 1976, which trumpet the success stone of the TPS. Within the prescribed frame of all above, Urban Governance is aimed to provide 100% basic services to the citizens in self-sustainable nature.

Besides, Lot of Environment related laws and thereby rules provide the city governance to do the best for solid waste management.

6

Existing SWM Conditions

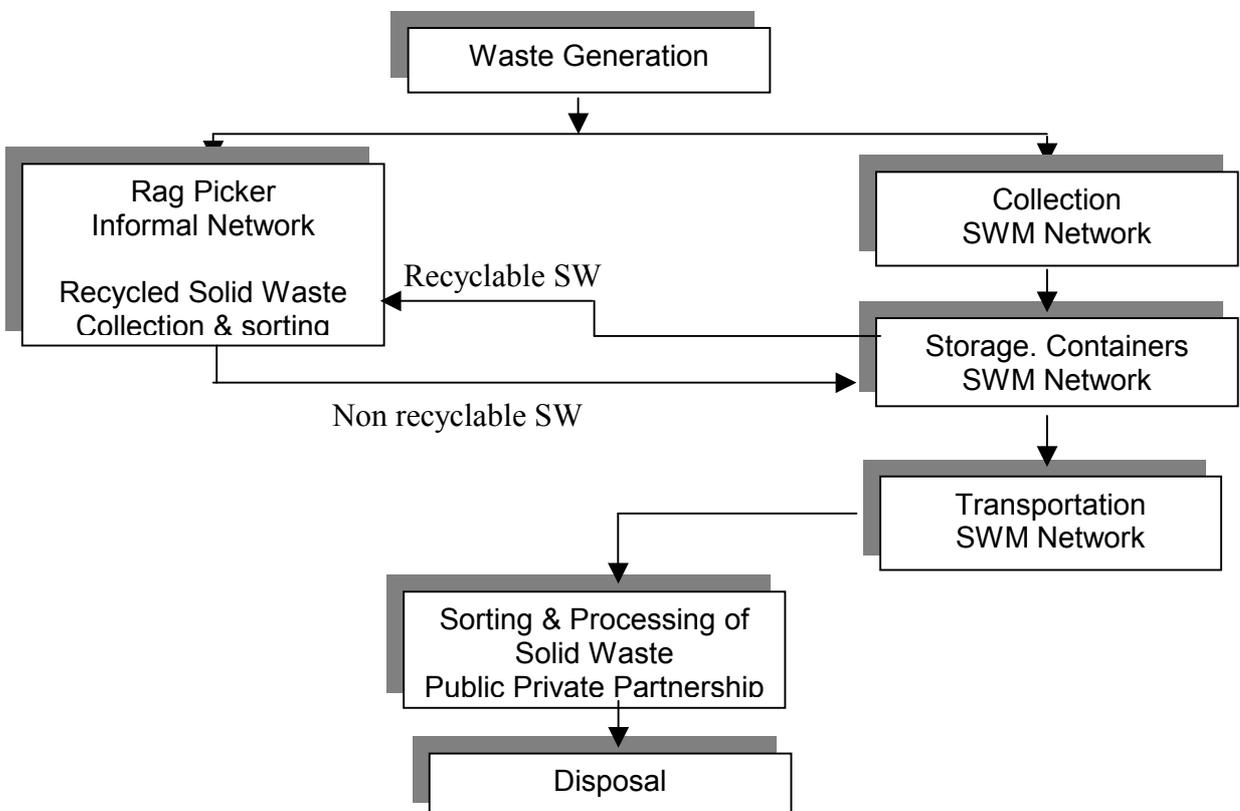
6.1 General

The sole responsibility of solid waste management (SWM) in the city goes to Solid Waste Management Department of RMC under the supervision of Ministry of Urban Affairs & Housing Development. As a part of decentralization entire city is divided into four zones comprising of Zone 1 (consisting ward no. 12, 13, 14, 22, 23,) Zone 2 (consisting ward no. 7, 8, 9, 10, 11, 21), Zone 3 (consisting ward no. 3, 4, 5, 6, 19, 20) and Zone 4 (consisting ward no. 1, 2, 15, 16, 17, 18). The activities associated with the management of municipal solid waste from the point of generation to final disposal can be grouped into the six functional elements.

- Waste generation
- Storage
- Collection
- Transportation
- Segregation & Processing
- Disposal

The inter-relationship between the elements is identified in chart 3.

Flow Diagram for the SWM



A Ward office is established in each ward to look after the primary collection of solid waste and street sweeping.

6.2 Waste Generation

Waste generation encompasses activities in which materials are identified as no longer being of value (in their present form) and are either thrown away or gathered together for disposal. Waste generation is, at present an activity that is not very controllable. In the future, however, more control is likely to be exercised over the generation of wastes. Reduction of waste at source, although not controlled by solid waste managers, is now included in system evaluations as a method of limiting the quantity of waste generated.

Municipal solid waste can be broadly divided into four major categories as per source of generation i.e. domestic waste, commercial waste, institutional waste and industrial waste. Most of the time industrial waste is not considered as part of municipal waste but in most of the Indian cities industrial waste get mixed with municipal waste and local bodies has to manage this waste.

DOMESTIC WASTE

Domestic waste consists of primarily food waste, paper, plastics, glass, metal, rags and other packaging materials. Domestic waste is the largest part (81%) of municipal waste. The city population is almost doubling after a decade. So the waste generated will also double after a decade. Followings two alternatives have been analyzed for estimating the present generation of waste. A primary data survey was carried out on the present generation of total waste is estimated 300 Metric Tons per day.

Alternative: 1

Generation of waste in Rajkot is assessed on the basis of average Indian City @ 350 grams per capita per day.

Alternative: 2

Alternatively, generation of waste is also calculated based actual survey results. For which the city base actual survey has been carried out for different categories of houses. The analyses are as under

Housing Conditions:

The type of housing and the economic level of a consumer is an important factor influencing generation of waste. People of higher income group are generally found to generate more solid waste than that of lower income group.

The areas within the walled city have very old buildings with narrow lanes demonstrating traditional planning. The newly developed area, have high rise buildings, modern row houses and

individual bungalows which show modern trends. About one-fifth of the city's population lives in slums and hutments.

Housing categories:

No authentic data is available on various housing types, except slums (BPL survey by United Research Survey).

As the entire city is divided into 23 wards, each ward has particular pattern of Housing conditions. Each ward has particular housing categories in particular. Samples were taken from the wards with highest number of particular housing categories. For example the samples of economically weaker section were taken from the ward no. 5 along the river bed of Aji. Similarly samples of HIG were taken from ward no. 12. Samples of MIG were taken from ward No. 14, Sample of LIG were taken from ward No. 4. The samples were collected from the residences on daily basis for 6 day. The samples were taken twice in a year one during winter season (December 2005) and once during summer season (March 2005). These were done to assess the seasonal changes. It was found generation in summer increases slightly. This could be attributed to number of reasons. During summer the falling of dry leaves increases and also the consumption of packaged item increases are few reasons which could be pointed out. The daily generation arrived in above table is average weekly average daily per capita generation.

Category	Ward No. with major population of particular category
EWS	1,5,19,20
LIG	4, 6, 16, 17, 21.
MIG	2,3,7,9,11,13, 14, 15, 18, 23
HIG	8,10,12,22

Field survey for Assessment of Per Capita Generation:

A sample survey was carried out in various housing categories. The results are as under_

Categories	Sample Size	Avg Daily Per capita generation (gms/day)
Economically Weaker Section	114	183.59
LIG	159	218.00
MIG	230	292.86
HIG	240	308.51
Overall Avg		250.74

In this way the various parameters of the solid waste is found out for different locality of the city. Finally based on density and per capita generation the total solid waste generated for the city is found out. The total solid waste generated and volume of the solid waste generated is shown in the above Table.

Results of Sampling of Ward No. 12 (HIG)**(Hot Season in Month of March'06)**

No. of Samples taken (family)	No. of Individuals	06-03-06 (Monday)		07-03-06 (Tuesday)		08-03-06 (Wednesday)		09-03-06 (Thursday)		10-03-06 (Friday)		11-03-06 (Saturday)		Weekly Avg
		Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Avg Daily Generation in gms/day/percapita
16	48	16.00	333.33	15.20	316.67	14.90	310.42	14.40	300.00	15.30	318.75	15.00	312.50	310.63
18	62	20.00	322.58	19.50	314.52	18.90	304.84	18.40	296.77	19.50	314.52	18.80	303.23	
10	38	11.50	302.63	11.00	289.47	11.40	300.00	11.50	302.63	11.80	310.53	11.50	302.63	
12	48	15.00	312.50	14.00	291.67	14.70	306.25	14.40	300.00	15.50	322.92	15.00	312.50	
12	44	14.30	325.00	13.80	313.64	14.10	320.45	13.70	311.36	14.00	318.18	14.20	322.73	
Total	240	76.80	320.00	73.50	306.25	74.00	308.33	72.40	301.67	76.10	317.08	74.50	310.42	
Cold Season in Month of December-2005														
No. of Samples/family	No. of Individuals	05-12-05 (Monday)		06-12-05 (Tuesday)		07-12-05 (Wednesday)		08-12-05 (Thursday)		09-12-05 (Friday)		10-12-05 (Saturday)		
16	48	16.00	333.33	14.90	310.42	14.70	306.25	14.20	295.83	14.90	310.42	15.30	318.75	306.39
18	62	20.00	322.58	18.70	301.61	19.20	309.68	18.80	303.23	19.00	306.45	19.30	311.29	
12	48	14.70	306.25	14.60	304.17	14.00	291.67	14.20	295.83	14.50	302.08	14.30	297.92	
12	44	14.50	329.55	14.00	318.18	14.10	320.45	13.70	311.36	14.30	325.00	13.90	315.91	
Total	240	76.70	319.58	72.40	301.67	72.00	300.00	71.10	296.25	74.20	309.17	74.80	311.67	

Results of Sampling of Ward No. 14 (MIG)**(Hot Season in Month of March'06)**

No. of Samples taken (family)	No. of Individuals	06-03-06 (Monday)		07-03-06 (Tues)		08-03-06 (Wed)		09-03-06 (Thurs)		10-03-06 (Fri)		11-03-06 (Satur)		Avg Daily Generation in gms/day/per capita
		Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	
12	48	16.00	333.33	15.30	318.75	15.70	327.08	15.50	322.92	15.90	331.25	15.60	325.00	312.54
12	56	16.00	285.71	16.30	291.07	16.30	291.07	16.10	287.50	16.00	285.71	16.30	291.07	
10	44	14.00	318.18	13.50	306.82	13.90	315.91	13.70	311.36	13.90	315.91	13.50	306.82	
10	40	13.50	337.50	13.00	325.00	13.30	332.50	12.90	322.50	13.20	330.00	13.30	332.50	
10	42	13.30	316.67	13.00	309.52	13.40	319.05	12.90	307.14	13.00	309.52	13.00	309.52	
Total	230	72.80	316.52	71.10	309.13	72.60	315.65	71.10	309.13	72.00	313.04	71.70	311.74	
Cold Season in Month of December 2005														
No. of Sample/famil	No. of Individuals	05-12-05 (Monday)		06-12-05 (Tuesday)		07-12-05 (Wednesday)		08-12-05 (Thursday)		09-12-05 (Friday)		10-12-05 (Saturday)		273.19
12	48	13.40	279.17	13.60	283.33	13.40	279.17	13.30	277.08	13.60	283.33	13.60	283.33	
12	56	15.60	278.57	15.50	276.79	15.00	267.86	15.30	273.21	15.50	276.79	15.50	276.79	
10	44	12.00	272.73	11.90	270.45	11.60	263.64	11.50	261.36	11.90	270.45	11.90	270.45	
10	40	11.40	285.00	11.60	290.00	11.30	282.50	11.10	277.50	11.60	290.00	11.60	290.00	
10	42	11.30	269.05	10.70	254.76	10.50	250.00	10.40	247.62	10.70	254.76	10.70	254.76	
Total	230	63.70	276.96	63.30	275.22	61.80	268.70	61.60	267.83	63.30	275.22	63.30	275.22	

**Results of Sampling of Ward No. 4 (LIG)
(Hot Season in Month of March'06)**

No. of Samples taken (family)	No. of Individuals	06-03-06 (Monday)		07-03-06 (Tues)		08-03-06 (Wed)		09-03-06 (Thurs)		10-03-06 (Fri)		11-03-06 (Satur)		Avg Daily Generat. gms/day/ per capita
		Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	
12	48	7.80	216.67	7.50	208.33	7.65	212.5	7.65	212.5	7.35	204.17	7.65	212.50	228.14
12	56	9.00	230.77	8.85	226.92	8.70	223.1	9.23	236.5	9.0	230.77	8.78	225.00	
10	44	7.05	293.75	7.20	300.00	7.20	300.0	8.25	343.8	7.725	321.88	7.65	318.75	
10	40	6.00	200.00	5.85	195.00	5.70	190.0	6.15	205.0	6.75	225.00	6.6	220.00	
10	42	6.38	212.50	5.70	190.00	5.70	190.0	6.15	205.0	6.3	210.00	6.15	205.00	
Total	230	36.23	227.83	35.10	220.75	34.95	219.8	37.43	235.40	37.12	233.49	36.83	231.60	
Cold Season in Month of December 2005														
No. of Sample /famil	No. of Individuals	05-12-05 (Monday)		06-12-05 (Tuesday)		07-12-05 (Wednesday)		08-12-05 (Thursday)		09-12-05 (Friday)		10-12-05 (Saturday)		207.86
12	48	7.13	197.92	6.98	193.75	6.75	187.50	6.90	191.67	7.13	197.92	6.75	187.50	
12	56	8.63	221.15	8.25	211.54	8.03	205.77	8.40	215.30	8.63	221.15	8.03	205.77	
10	44	6.75	281.25	6.00	250.00	5.70	237.50	6.38	265.63	6.75	281.25	5.70	240.63	
10	40	6.00	200.00	6.15	205.00	5.85	195.00	5.63	187.50	6.00	200.00	5.85	197.50	
10	42	6.15	205.00	5.70	190.00	5.40	180.00	5.25	175.00	6.15	205.00	5.40	180.00	
Total	230	7.13	197.92	6.98	193.75	6.75	187.50	32.55	204.72	34.43	216.51	31.88	200.44	

Source: Primary Survey

Results of Sampling of Ward No. 5 (EWS)**(Hot Season in Month of March'06)**

No. of Samples taken (family)	No. of Individuals	06-03-06 (Monday)		07-03-06 (Tuesday)		08-03-06 (Wednesday)		09-03-06 (Thursday)		10-03-06 (Friday)		11-03-06 (Saturday)		Weekly Avg
		Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Avg Daily Generation in gms/day/percapita
4	24	4.75	197.92	4.65	193.8	4.5	187.5	4.6	191.67	4.75	197.92	4.5	187.50	193.27
5	28	5.75	205.36	5.50	196.4	5.35	191.1	5.6	200.00	5.65	201.79	5.35	191.07	
3	22	4.50	204.55	4.00	181.8	3.8	172.7	4.25	193.18	4.5	204.55	3.85	175.00	
4	20	4.00	200.00	4.10	205.0	3.9	195.0	3.75	187.50	4.15	207.50	3.95	197.50	
3	20	4.10	205.00	3.80	190.0	3.6	180.0	3.5	175.00	3.9	195.00	3.6	180.00	
Total	114	23.10	202.63	22.05	193.4	21.15	185.5	21.7	190.35	22.95	201.32	21.25	186.40	
No. of Samples (family)	No. of Individuals	05-12-05 (Monday)		06-12-05 (Tuesday)		07-12-05 (Wednesday)		08-12-05 (Thursday)		09-12-05 (Friday)		10-12-05 (Saturday)		
		Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Wt of Sample in kg	Per capita generation gms/d	Avg Daily Generation in gms/day/percapita
4	24	4.00	166.67	3.85	160.42	3.65	152.08	3.7	154.17	3.8	158.33	3.7	154.17	173.90
5	28	5.00	178.57	4.85	173.21	4.8	171.43	4.6	164.29	4.85	173.21	4.6	164.29	
3	22	4.00	181.82	3.90	177.27	3.85	175.00	3.9	177.27	4	181.82	3.85	175.00	
4	20	4.00	200.00	3.80	190.00	3.7	185.00	3.65	182.50	3.8	190.00	3.65	182.50	
3	20	3.75	187.50	3.65	182.50	3.5	175.00	3.45	172.50	3.65	182.50	3.45	172.50	
Total	114	20.75	182.02	20.05	175.88	19.5	171.05	19.3	169.30	20.1	176.32	19.25	168.86	

INSTITUTIONAL WASTE

Institutional waste can be divided into two types of waste one is waste generated from educational institutions and other various institutions. Rajkot has the privilege of being one of the biggest educational centers in Saurashtra region. The Govt Medical College, A.V.P. Technical Institute, Atmiya College of Engineering is few of the well-known colleges of the State. Saurashtra University



is the university with various colleges under its umbrella. The estimated wastes generated from these institutes are 10.58 tons per day. Shops, offices, Institutions shall generally throw their solid waste on the footpaths, streets, open spaces/nallas. The practices of keep the waste in form of dump in the footpaths, which remains there till sweepers collect them during street sweeping, is prevalent.

Hotels and Restaurants Waste

There is large number of small hotels and restaurants in the city and all of them throw the waste on the streets or into the municipal bins. There is no arrangement of primary collection of waste from the hotels.

Market Waste

There are vegetables, meat market in the city. Out of them, the new vegetable market is reasonably well managed by the City Corporation. It remains much clean outside as well as inside barring a few unscrupulous vendors dispose of the waste on the floor. The market compound is kept free from vending and remains reasonably clean.



However, just outside the market there are large numbers of vendors who dispose of the waste on the streets.



The position of meat market is however, very poor and needs immediate attention.



Industrial Waste

Industrial waste is generally not considered as a part of municipal waste but at times in Rajkot, industrial waste gets mixed with municipal waste. Mostly the industries within the city are small and medium sized and with not much of Hazardous waste. The waste so generated gets intermingled with the MSW. The total waste is estimated around 8 tons per day. Similarly is the situation of industrial waste. Lot of foundry dispose of their waste just outside the foundry or at a common plot in the city and similarly the construction waste is also disposed of in the open space in and around the city. A huge amount of iron piles also generates in the city on account of several small scale industries located in the city of Rajkot.



Construction Waste

There is no system of storage neither of construction waste nor of its primary collection.



Bio Medical Waste

Biomedical waste contains a variety of infectious and toxic wastes generated from hospital nursing homes, and health care centers. The city has around 20 big hospitals and around 200 private nursing home & pathological laboratory. Wastes generated from these hospitals and private nursing homes are handled separately by a Private Agency called Distromed Services which got authorization with GPCB with the help of R.M.C. The total solid waste generated from these institutions is approximately 1.2 Tons per day. Rajkot Municipal Corporation SWM network ensures that Biomedical Waste does not end up at normal solid waste containers.

Total Generation of waste

Table: 6.3 Type of Waste			
Sr. No.	Type of Waste	Daily Generation	
		Tons/day	%
1	Domestic Waste	250.74	83.58
2	Trade/Institutional Waste	10.52	3.50
3	Construction waste/ Industrial waste	18.27	6.09
3.	Market Waste	19.72	6.58
4	Slaughter house waste	0.75	0.25
	Total	300	100

6.3 Collection of Waste

With the increased awareness, provision of solid waste containers all over the city, the problem of littering as eased considerably. However, strict implementation of the plan is being implemented at present. The main system of primary collection of waste is street sweeping. Sweepers use traditional short-handled brooms where they have to bend while sweeping. Earlier norms fixed for as 3000 sq. mts. of open area per sweeper, each sweeper is assigned beat of either 300 mt., 500 mt. or

700 mt. depending on the density of population. The duty hours are prescribed as 6.30 a.m to 10.30 a.m. and 3.00p.m. to 6.00 p.m. The work is carried out on all the days of the year including Sundays and Public holidays. Two days in a week are half days to permit one statutory weekly off per week to the staff deployed. Sweepers are given containerized handcarts. There are **2310 containerized handcarts. 1445 no of beats** out of **3237** beats are already attempted with **door to door collection** of garbage by using hand driven containerized handcarts.

Zone No.	Ward No.	Perm Sweepers	Part Time Sweepers	Temp. Full Time Sweepers	Total	Sani. Inspector	Sanitary Sub Inspector	Total Supervisory Staff	Sweeper/Supervisory staff
1	12-14,	350	44	31	425	2	8	10	42.5
1	22- 23	0	0	275	275	2	3	5	55
2	7-11,	585	149	34	768	6	14	20	43
2	21	0	0	100	100	0	2	2	50
3	3-6,19, 20.	538	301	26	865	6	13	19	46
4	1,2, 15-18,	610	132	34	776	6	11	17	46
Total		2083	626	500	3209	22	51	73	44

Besides, the RMC has hired services of sanitary mart for primary SWM in ward No. 21, 22 and 23. Sanitary marts are registered cooperative organization consist of persons from traditional sweeper community. The streets and roads in these wards are cleaned on alternate basis RMC inherited contract from erstwhile Nagarpalika. It is now replaced by Sanitary Marts. The coverage is still not sufficient in these areas.

Storage of waste at source

There is no system of storage of waste at source. People habituate to dispose of the waste on the streets, open spaces, drains, open nalla popularly known as “vonkala” etc., as and when wastes is generated and create a serious problem of health and sanitation.

Segregation of Recyclable Wastes

Segregation of recyclable waste is generally not practiced. Most of the recyclable material is disposed of along with domestic and trade waste on the streets in the drains etc., Therefore, recyclable waste is generally found mixed with garbage on the streets, into the municipal bins and at the dumpsites from where part of this waste is picked up by the rag pickers.

Primary Collection of Domestic, Trade and Institutional Waste

There is no system of door-to-door collection of waste nor are adequate community bin facilities given to the citizens to deposit the waste. In absence of the facility of door-step-collection and inadequacy of community bins for the collection of waste, people throw the waste on the streets, open space, drains nalla etc., All this waste is collected through street sweeping, nalla cleaning etc., Street sweeping is thus the principal method of primary collection of waste.

Informal sector

Presence of the relatively higher number of the institutions and commercial establishment, as compared to size of the city, leads to more generation of the recyclables. Rag picking is an informal income-generating activity undertaken by poor strata of society. There are 750 – 1000 rag pickers involved in the city to collect recyclable waste. Each rag pickers collects 20 to 25 kg approximately of recyclable waste. Thus approximately daily about 20 tons of the waste is recycled. They are involved in the dirty work of picking up soiled and contaminated waste to earn their living.

6.3.1 Primary Collection

The functional element of collection includes not only the gathering of solid wastes and recyclable materials, but also the transport of these materials, after collection, to the location where the collection vehicle is emptied. This location may be materials processing facility, a transfer station, or a landfill disposal site. As far as the Rajkot city is concerned the collection is no different from the conventional style. The door-to-door system of collection is only prevalent in some areas and commercial areas where the shops and commercial centers keep dustbin and collect the waste. But unfortunately this is seen very rarely. The waste stored individually by shops and establishment is most of times deposited on the streets or on the ground outside the bins. Thus streets are generally treated as receptacles of waste and the primary collection of the waste is done, by and large, through street sweeping. The sweeper popularly known as Safai Karmachary does the sweeping. The details of the Safai Karmachary engaged in the street sweeping, transportation and disposal of waste



Safai Karmachary engaged in Primary Collection

6.3.2 Waste Storage

The second of the six functional elements in the solid waste management system is waste handling, sorting, storage and processing at the source. Waste handling and sorting involves the activities associated with management of wastes until they are placed in storage containers for collection. Handling also encompasses the movement of loaded containers to the point of collection. Sorting of waste components is an important step in the handling and storage of solid waste at the source. For example, the best place to separate waste materials for reuse and recycling is at the source of generation. The waste handling, sorting, storage is not so encouraging as far as the Rajkot city is concerned, except the sorting done by the informal sector. It was found from the primary survey that some households are becoming more aware of the importance of separating newspaper and cardboard,

bottles/glass, kitchen wastes and ferrous and non-ferrous wastes as that bring them some sort of monetary benefits. About 80% of the households, shops and establishment keep bins at the source of waste generation for storage of waste. The cost of providing storage for solid wastes at the source borne by the household in the case of individual, or by the management of commercial and industrial properties. Rajkot Municipal Corporation has been placing dustbins/street bins for the temporary storage of waste collected by the sweeper as well as for the citizens to depot their domestic waste.

Sr.No.	Type of Waste Storage Depot	Numbers
1	Open sites	eliminated
2	Black small open to sky bins	eliminated
3	Closed Containers	1337
	Total	1337

As far as the distance between the two bins is considered it is not even. And the bin to population ratio is also not fixed. The uneven ratio of the bin to the population is also due the fact of the different densities of the wards. The bins location is also shown in Map 5

6.4 Quality of Waste

6.4.1 Physical Characteristics

1. Density

Knowledge of the density of a waste i.e. its mass per unit volume (kg/m³) is essential for the design of all elements of the solid waste management system viz. Community storage, transportation and disposal. At Rajkot density of waste is found in range of 490 kg/cu.mt.

2. Moisture Content

Moisture content of solid wastes is usually expressed as the weight of moisture per unit weight of wet material. Moisture Content (%) =

$$\frac{\text{Wet weight} - \text{dry weight}}{\text{Wet weight}} \times 100$$

At Rajkot Moisture content of solid waste is observed about 26% during normal season> I is s high as 52% during monsoon .However, during winter the moisture content is noted near to average i.e. 26 to 29%.

3. Size of Waste Constituents

The size distribution of waste constituents in the waste stream is important because of its significance in the design of mechanical separators and shredder and waste treatment process. Following are results observed by sold waste processing company at different time.

4. Calorific Value

Calorific value is the amount of heat generated from combustion of a unit weight of a substance, expressed as kcal/kg.. At Rajkot Calorific value had been observed about 2200 kcal/kg.

6.4.2 Chemical Characteristics

Knowledge of chemical characteristics of waste is essential in determining the efficacy of any treatment process. Chemical characteristics include (i) chemical; (ii) bio-chemical; and (iii) toxic.

Chemical: Chemical characteristics include pH, Nitrogen, Phosphorus and Potassium (N-P-K), total Carbon, C/N ratio, and calorific value.

No specific study has been carried out for chemical analysis of the waste however, Vastu Slip Foundation Ahmedabad recently carried out one city wised survey with the financial support of European commission has recently carried out the results are as under:

Sr. No	Waste Type	Amount
1	Paper and card board	5%
2	Plastics	6%
3	Rags	5%
4	Metals	2%
5	Glass	3%
6	Rubber/Leathers	4%
7	Sand / Earth	20%
8	Stones	10%
9	Compost able matter	45%

6.5 Transportation of Waste

The activities associated with the transportation municipal solid waste can be further divided in to following elements.

- Lifting of Closed Container.
- Lifting of Dead Animals
- Lifting of silt from Nalla

6.5.1 Lifting of Closed Container

Waste collected in Storage Closed containers were used to taken directly to Landfill site for final disposal. It was found uneconomical to carry approximate 2 tons of waste (capacity of container) for final disposal in the landfill site. Then it was thought to have an intermediate arrangement to transfer the waste of lesser volume into a bigger container. That gave way to the development of Transfer Station where 4-5 closed container of waste is emptied into a bigger tipper which is taken for final transportation to land fill site. Wastes from the closed container are taken to Transfer station where waste from 4 containers into dumper. This has led to saving of about Rs 70.00 lac per annum for R.M.C. Lifting of Closed Container is being carried out R.M.C in coordination with Private agencies.

Out of 23 wards, in 15 wards container lifting is being done by private agencies, and remaining wards are being done by Solid Waste Department of R.M.C

Salient Features of Contract of Container Lifting

- On prior to privatization 5 containers were lifted from each ward.
- Containers were not lifted regularly when it was being done by R.M.C
- With Privatization more efficiency has been achieved in lifting
- Each container is lifted latest by 3rd day.
- There has been also saving cost wise.

6.5.2 Lifting of Dead Animals

Dead Animals are being lifted by the private agencies on instructions of R.M.C officials and disposed by simple burial at landfill site near Sokhda village. But now incinerators will be placed for the disposal of dead animals.

Lifting of Silt from Nalla

Silt collected from Nalla has also been privatized on basis of trips per day.

Final Transportation

Transportation of waste is being carried out from transfer station to disposal yard by private agencies. About 100% of total waste is collected from various points and transferred to land fill site. The frequency of transportation is quite reasonable. The transportation of unattended waste in open plots and slums where sweeping is not done and hence waste gets accumulated is done manually and/or mechanically through variety of vehicles as under.

Types of Transportation Vehicle

Sr.No.	Type of Vehicles	Capacity	Nos.	
			Owned by R.M.C	Owned by Pvt Contractors
1	Open trucks	7.5 MT	2	0
2	Tipping Dumpers	7.5 MT	8	0
3	Tipper Trucks	3.0 MT	6	4
4	Dumper Placer	2.5 MT	19	18
5	JCB	72 HP	4	0
6	Tractors-Trailers	2 MT	8	0
7	Cess Pool	10 m ³	1	0
8	Cess Pool	4 m ³	4	0
9	Cess Pool	2 m ³	2	2

6.6 Processing of Waste

Municipal Solid Wastes have to be managed as per the frame work of the Municipal Solid Wastes (Management & Handling) Rules, 2000 under Environment Protection Act, 1986. As per

these rules, all the biodegradable municipal solid wastes shall be processed by appropriate biological processing method and only biodegradable, inert waste will be disposed off in sanitary landfill.

Rajkot Municipal Corporation has entered agreement with Hanzer Biotech Pvt Ltd., on BOO basis for waste processing. Hanzer Biotech Pvt Ltd., has set up a waste processing plant. An MOU (See Annexure 14.10) has been signed by **Hanzer Biotech Pvt. Ltd** with **Solid Waste Management Department, R.M.C** for development of Waste Processing Plant wherein the former would develop Waste Processing Plant. The byproduct of the entire process will be compost, energy pellets or fluff (green coal) and eco-bricks. Presently the project is initial phase of operation. Initial results of the project are encouraging. Presently the approximately 300 tons of waste on daily basis is taken for processing which would be upgraded to 325 tons per day shortly. End product is 45 MT of organic manure, 80 MT of green coal and 15000 Nos (approximately) of eco bricks. As per the officials of Hanzer Biotech Pvt. Ltd., the conversion rate of the waste to by product is approximately 75 – 80%. Hence approximately 85 tons per day of refuse after processing would go to land fill site.

6.7 Disposal of Waste

Rajkot Municipal Corporation has received detailed engineering design for the development of sanitary Landfill site at Nakrawadi (a village 15 km away from city limits of Rajkot), from NPC (National Productivity Council), Gandhinagar. Subsequently detailed program for systematic development of Municipal Landfill facility at its site of Nakarawadi, has been developed. The site was visited by the team of officers from NPC & RMC. RMC identified the site at Nakarawadi (Survey No: 222/p) having a land area of 170 acres.

A final design for sanitary landfill, prepared is based on the outcome of soil investigation and Environment Impact Assessment study of the site. The general objective of Landfill design is to provide a cost effective environmental friendly waste disposal facility. The more specific objective includes.

- The mitigation of any adverse impacts identified in the Site Investigation & EIA.
- The prevention of leachate pollution of nearby ground and surface water bodies.
- The provision of sufficient cover material to ensure an environmentally and aesthetically acceptable operation.

The landfill facility is designed in Phased manner for effective use of land area as well as for easy maintenance. Due to presence of a hillock at the centre of the site, it was decided to split the entire site into three phases. Whereas the Phase – I & II will be used for the construction of Sanitary Landfill site, Phase – III will be used for creating the infrastructure.

6.8 Status of Compliances of MSWM rules 2000

Details	Prior to compliance of MSWM rules 2000	Collection of Waste post (compliance of MSWM rules 2000) Positive Environmental Impact
Salient features	<ul style="list-style-type: none"> No provision of littering bin at commercial area was main problem and people were left with no option but litter on street. 	Provision of littering bin on major roads are made However, still there are places / roads without Littering bins which are suggested in this plan
Images		
Salient features	<ul style="list-style-type: none"> Collection was done in very crude & unscientifically manner which includes sweeping with short broom Sweepers were used to either open burning of waste or throwing waste in near by open box gutter water body or open plot he/she was reluctant to take the waste from generation point to collection point or open dump as distance was high. The area of the sweeping for any sweeper was not fixed scientifically or rationally. No door to door collection 	<ul style="list-style-type: none"> Sweepers are given containerized hand cart to collect waste Hence the sweeper does not practice open incineration or throwing waste into water bodies or open box gutter. The sweeping area was fixed and known as beat, which was decided rationally and logically. Improvement in door to door collection. Figures are as in following table.
Limitations	<ul style="list-style-type: none"> Usage of long handle brooms. 	<ul style="list-style-type: none"> Sweepers are relectutant to use long handle brooms.
Images		

Details	Storage Prior (compliance of MSWM rules 2000)	Storage of Waste post (compliance of MSWM rules 2000)
Salient features	<ul style="list-style-type: none"> Storage was done in very crude & unscientific manner which included storage at black cubical bins from where in garbage was transferred manually to truck or tractor. Storage of waste in this fashion attracts stray animals, flies etc., and also creates a filthy environment as waste gets scattered. The decomposition of waste when exposed to moisture in rainy season may lead to spread of epidemic. The lifting of garbage of unscientific and exposes the sweeper involved in transfer to various health hazard In monsoon the surrounding of bin gets filthy and people avoid going near bin to throw garbage. 	<ul style="list-style-type: none"> Now all the black bins are replaced by closed container of 4.5 m³. These containers are lifted by hydraulic vehicle called dumper placer vehicle Discourages stray animals as bin could be closed as and when required. As the container remains closed discourages easy decomposition of waste. Avoids such situation as the container is lifted periodically once it gets filled. The base of the container is made of concrete enabling scrapping of waste surrounding the container.
Figures		
Salient features	<ul style="list-style-type: none"> Prior to MSWM rules 2000 waste used to get in open plot and banks of water bodies. RMC did not have machinery to clean such big heaps of garbage as it was not possible to clean such plots manually The decomposition of waste when exposed to moisture in rainy season may lead to spread of epidemic. 	<ul style="list-style-type: none"> JCB which enables to lift garbage from open plot and from water bodies easily. It discourages stray animal's menace. As the waste is lifted before it becomes heaps and discourages decomposition of waste.
Figures		

Details	Prior to compliance of MSWM rules 2000	Post compliance of MSWM rules 2000 Positive Environmental Impact
Salient features	<ul style="list-style-type: none"> Main problem involved in cleaning of the main road was the heavy traffic in the day time and sweeper were reluctant to remove the dust and silt from the divider and edges of footpath due to the fear of being hit by the moving vehicles. 	<ul style="list-style-type: none"> Road cleaning vehicles were engaged to clean the divider and footpath edges which helped in removing dust & earthen material from road. Subsequently it may helpful in reducing SPM level along the main arterial roads.
Figures		
Salient features	<ul style="list-style-type: none"> There were some open places with open dust bin from where sold waste was lifted and transported to landfill site 	<ul style="list-style-type: none"> Now there are no open dustbins all are replaced by closed containers with new colour code and are being lifted by dumper placer first disposes at two transfer station located within the city and then transported to Solid Waste Processing Plant at Nakarawadi about 18 kms. Away from the city
Figures		
		

Details	Prior to compliance of MSWM rules 2000	Post compliance of MSWM rules 2000 Positive Environmental Impact
Salient features	<ul style="list-style-type: none"> There was crude dumping of solid waste and solid waste collected from city was dumped in crude way. The site was without any solid waste processing infrastructure and no control over rag pickers. 	<ul style="list-style-type: none"> Now there is an integrated solid waste processing plant with scientific segregation system operated by private operator on BOT bases. Waste is processed and forms manure, fuel pellet and eco brick. It is observed that more than 68% of waste is being processed and only about 32% of waste largely inert material is being dumped at solid waste land fill site. However, development of sanitary land fill site is at an advance planning stage.
Figures		

6.9 Extent of Private / Community / NGO Partnership in SWM

It is essential to keep streets and public places clean at all times of the day. This is possible only if waste generators cooperate and effectively participate in the waste management efforts of the local body. If people continue to throw waste on the streets indiscriminately, thinking the street and public places as receptacle of waste, it would be an uphill task for the local body cannot keep the city clean in spite of its best efforts. People, therefore, have to form a habit of storing and sorting the waste at source in their personal bins and discharge the waste into the municipal system only. The ULB has to increase its commitment level to make a serious endeavor in order to motivate households, shops and establishments not to mix recyclable waste with domestic food waste etc. and instead keep recyclable/non biodegradable wastes in a separate bin or bag at the source. Of late it has been seen that Private parties and NGOs are keen to bridge the gap between the levels achieved by ULB and desirable levels of services of SWM for a healthy environment. Rajkot Municipal Corporation is one of the torch bearers in this aspect to rest of corporation.

Primary Solid Waste Management includes collection of waste, which as explained before contains mainly following activities.

1. Primary Collection of Domestic waste

2. Street Sweeping /Night Scrapping
3. Collection of Waste from unattended areas/ open plot
4. Collection of Waste from Nallas.

Primary Collection of waste

Collection of waste in SWM is highly labour intensive and on account of increased wage structure of the Government and municipal employees this service is becoming more and more expensive. Besides, the efficiency of the labour force employed in the Municipal Corporation is far from satisfactory. High wage structure and inefficiency of the work force results into steep rise in the cost of service and yet the people at large are not satisfied with the level of service being provided by the Rajkot Municipal Corporation.

A. Involvement of NGO in Primary Collection of waste

RMC had big challenge when 3 new wards namely 21, 22 & 23, the areas under the respective nagarpalikas of Nana Mahua, Mavdi, & Raiya were merged with Rajkot Municipal Corporation. R M C felt that efforts to increase the efficiency by H.R.D. and institutional strengthening will, to some extent improve the performance but they may not be enough. Then RMC formulated such an arrangement in which sweeping is done by sweepers engaged by Cooperative society or “Mandli” as called in local language formed by their welfare association of sweeper itself. This has beared excellent results as the profit earned goes for the upliftment of sweeper community itself.

Strategy Adopted:

- It was decided to continue the contract of primary collection of waste in newly merged areas, which was adopted by then Nagarpalikas. The entire newly merged areas formed approximately 15 % in population at time of merger and with area of 30% of entire city,.
- In wake of protest from sweepers who felt their rights were being exploited by the contractors, RMC changed the pattern of contract in newly merged areas in year 2004. As per the new pattern the contract were given to the cooperative societies formed by the sweepers association itself so that community participation of sweeper could be achieve in the process.
- The sweepers are presently paid minimum wages and the societies involved in collection of waste in respective wards are paid such that rate is summation of minimum wages and profit along with providend fund.
- There are 375 sweepers in 3 newly merged areas and 7 cooperative societies.
 - Salient features of the arrangement are.
 1. Cooperative societies are reviewed for their work efficiency periodically and subsequently their work order is renewed.
 2. 8 hrs of sweeping is done in two shifts.
 3. Sweepers are given Identity card and uniform so as to have proper supervision over their work.

4. Wages are paid as per Minimum Wages Act.,
5. Provision of penalty.
 - 3 times the wages of the sweeper absent
 - Rs 150 for sweeper not wearing uniform.

Results Achieved:

- Cooperative societies cover entire 3 newly merged areas. If RMC had to provide services to these wards by its mechanism, it would have to shed approximately 5 crores annually as against the present cost of 1.66 crores.
- Sweepers are more sincere and desired satisfaction level is achieved as compared to the sweeper under R.M.C
- The problem of lack of unattended areas due to absenteeism is avoided as cooperative societies (Mandli) is responsible for arranging for back up staff.
- Sweepers in these areas are keen for door to door collection as they know the advantages of door to door collection. They could earn by segregating recyclable waste and selling them.
- Only drawback in the system is R.M.C is yet to cover the area fully when it comes to provide service on daily basis. As these areas are developing fast the present number of sweeper are very meager to cater the load
- RMC has also formulated the door to door collection plan for these areas

B. Involvement of Community Participation Primary Collection of waste

The final key question that arises when reflecting on these schemes is: who is actually **responsible** for the future of solid waste management? Clearly the development of an effective municipal waste management policy lies in the hands of not only local government, but also in those of NGOs and CBOs and of citizens. Nevertheless, it is up to local government to clearly stipulate its ultimate responsibility and to actively improve its standards and facilities relating to the provision of proper waste management services. Therefore, in the case of RMC, it has to give due attention to the specific concerns of NGOs and CBOs. In order to achieve harmony in above matter and to realize the people their role in keeping their city clean RMC has adopted following strategy.

Strategy Adopted:

- Acknowledging important role of people for the ‘sustainable development’ of Rajkot, Rajkot Municipal Corporation supported the people keen to make contribution towards above cause by involving themselves and keep their neighborhood clean on their own by managing their collection of waste.

- The collection of waste is managed by the Resident Welfare Association and the waste is brought to nearest dust bin and in return RMC pays them grant at the rate of Rs 1500 per 30,000 sq. feet.
- The Resident Welfare Association is responsible to remove dead animals less than 20 kg.
- RMC also provides them with the necessary equipment such as hand cart for door to door collection and disinfectant powder at regular intervals.
- Educational campaigns/courses with respect to recycling for example through written, oral and/or visual means, to ensure that the population understands the importance of source separation.

Results Achieved Adopted:

- Net financial saving along with no. of societies is as shown in table.
- Problems facing
 - Active pressure groups and vested interest groups like Employees' union, community based organization and political patronage were influencing the contract.
 - There were administrative problems with the then going contract
 1. unprofitable pays for contractor
 2. Exploitation of contractual labour
 3. Corruption
 4. Fake complaints

Zone No.	No. of Societies	Approximate area in sq feet	Monthly Amount paid in Rs.	Monthly Expense if work done by RMC in Rs.	Monthly Savings	% of saving
Zone 1 (east)	2	35000	1750	3920	2170	55.55
Zone 2 (West)	45	2916500	145825	326648	180823	55.55
Zone 3 (central)	1	45000	2250	5040	2790	55.55
	48	2996500	1,49,825	3,35,608	1,85,783.00	55.55

Street Sweeping /Night Scrapping

As per the guidelines of Hon Supreme court sweeping of the public roads, streets, lanes, and by-lanes has to be done daily if there is habitation or commercial activity on one or both sides of the street. A list of such roads and streets together with their length and width were identified and a program for their daily cleaning should be worked out by the City Corporation keeping in view the norms of work (yardsticks) prescribed . But main problem that RMC had to face was heavy traffic and commercial

activities which resulted in achieving work of low quality. RMC identified 13 main arterial roads of length 38 kms for which scrapping and brushing has to be done during the night time when traffic density is lean.

Strategy Adopted:

- It was decided to contract 13 main roads where scrapping of road and brushing of road would be done during night hours of 22.00 hrs to 02.00 hrs subsequent day by private agencies
- The annual cost of the project is 65 lacs with the unit rate of scrapping as 0.25 sq mts per scrapped area and around 5 tons of waste is collected daily.
- Salient features of the contract are.
 - Contract period is for 2 years
 - During the billing, scrapping area was calculated as 2.1 mts for road with divider and 1.5 mts for road without divider.
 - The bare minimum sweepers for each road are fixed.
 - The sweepers are given retro reflective jackets, face mask, and other equipments to safeguard their life from potential threats due to the scrapping and brushing during night.
 - Contractor has own tricycle for transportation of waste and silt collected and has to put it into nearest bin
 - Provision of Penalty
 1. Rs 50 for sweepers not wearing jacket
 2. Rs 50 for sweeper not wearing mask.
 3. Thrice the amount of billing amount of area for not scrapping it.
 4. Rs. 150 for not bringing tricycle.
 - Contractor is liable for any problem.

Collection of Waste from unattended areas/ open plot and waste from nallas.

In the areas where open plot are being used as receptacle for waste and where periodic cleaning is not possible or where manual cleaning is not possible it becomes extremely essential to lift the garbage through either JCB or by any tractor. Secondly in highly congested areas an option of using small vehicles for direct collection of waste instead of placing containers on the roads could be considered. In case of former RMC own JCB and does it departmentally by drawing schedule for the identified areas on regular basis. In case of latter where there are narrow by lane or where JCB could not reach, smaller vehicles of tractor size is used. For these private agencies services is being hired.

Strategy Adopted:

- It was decided to contract to Private Entrepreneurs for transporting waste from above mentioned areas and also to lift silt from open nallas periodically.
- Conditions were determined and tenders were invited.
- The rates were finalized by adopting public tendering system.
- The rates per decided for per trip of waste which was taken to transfer station wherein waste from tractor was emptied into dumper of bigger volume.
- Conditions include:
 1. Tractor loading from collection centre all over the wards.
 2. Transportation to the nearest transfer station.
 3. Having labours for lifting of garbage.
 4. Covering the waste while transportation.
 5. Payment is not done if waste is disposed elsewhere and not brought to transfer station.
- Provision of penalty.
 1. Rs 100/ per labourer if less
 2. Rs 500 if cover or talpatri is not used.

Private sector participation in Secondary Waste Management.

The work involves firstly lifting of Solid Waste collected at storage points in form of dustbins and transporting it to the transfer station, where in all the dust bins are emptied into dumper of bigger volume. Second phase of transportation comes in form of transportation of waste from transfer station to land fill site.

Transportation of waste is done regularly to ensure that the containers /trolleys and dustbin sites are cleared before they start over-flowing. The frequency of transportation is arranged accordingly. The system of transportation of waste must synchronize with bulk storage of waste at the temporary waste storage depots.

A. Lifting of Containers:**Strategy Adopted:**

- It was decided to give contract to Private Entrepreneurs for transporting waste from the waste storage depots to the landfill sites.
- Conditions were determined and tenders were invited.
- The rates per trip were finalized by adopting public tendering system.
- Fifteen out of twenty three wards have been privatized so far.
- Conditions includes: -
 1. Contractor has to purchase new hydraulic lifters for lifting of bulk containers.
 2. Transportation of containers or dust bins to the transfer station from the pick up points and placing back at its place.

3. Scrapping of waste scattered around the dust bin has to be done by contractor and sprinkling of lime around the dust bin after scrapping.
 4. Contractor has to keep a cleaner for this purpose with driver.
 5. Contractor has to keep a can of 25 lits capacity filled with water so that in case of waste in bin is burning it could put off.
 6. R.M.C will pay contractor only per trip of transportation. All other things are liability of contractor.
- Salient features
 1. Contract period is for two years
 2. Route and number of trips is fixed.
 3. Per trip approximately average of 2 tons is transported.
 4. Timing is 7 A.M. to 6 P.M.
 - Provision of Penalty
 1. Rs 100/ per point of collection not lifted
 2. Rs 100 if cleaner is absent
 3. Rs 150 per container for not scrapping and sprinkling of lime

Results Achieved

- Private contractors over 15 wards while RMC covers 9 wards out of 23 wards.
- The average cost of per trip in wards operated by Private contractors is Rs 167 per bin while the same thing when done by RMC, goes up to Rs 237 per bin. So an average saving of 30% and better services are achieved.

B. Transfer of waste from transfer station to landfill.

Transfer of waste from 2 transfer stations to land fill is privatized to private contractors. 100 % privatization is achieved in this segment of SWM.

Strategy Adopted:

- Conditions were determined and tenders were invited
- The rates were decided per trip, but with flexibility of changing it to per ton once RMC finishes the constructions of weigh bridge (on final stages), by adopting public tendering system.
- All the wards are divided into two parts and waste from each ward goes to respective transfer station. Therein from 2 transfer station transportation of waste in tippers is carried out by private contractors.
- Conditions include.
 1. Truck has to be owned by contractors and its maintenance is liability of contractor.
 2. Loading of Truck at transfer station and take from there to land fill site.
 3. Disposing as per instructions.

4. Contractor has to employ use his own labourers, materials and trucks.
 5. Route & number of trips are fixed and based on token system based on which final bill is produced avoiding the chances of any foul play.
 6. Per trip approximately 6 to 7 tons is transported.
- Provisions of Penalty.
 1. Rs. 500/ per trip if waste is not covered with talapatri or plastic cover
 2. An Rs 100 if cleaner is absent.
 - Contractor is fully responsible in case of any problem.

C. Other areas of p-p-p.

The other areas wherein RMC has attempted privatization in SWM department are as under.

- Lifting of Dead Animals is done @ Rs 4.74 lacs annually, wherein complaints are received on telephone and contractors are informed. Utmost care is taken so that the complaint is solved within 6 hours of it is received.
- Lifting of stray pigs is also done @ Rs 25 per pig. Periodically drive is organized with private contractors for lifting of pig and also sterilization is attempted to control its population.
- For cleaning Septic tank by Cess Pool rights have been given to agencies @ Rs 190 per house in 18 wards out of 23 wards.

Private sector participation in Tertiary Waste Management

Processing of waste

RMC has established Plant at Nakrawadi in partnership with Hanzer Biotech Energies Pvt Ltd on BOO basis, wherein Processing of waste is being carried out. It is first of its kind in India with integrated technology, which uses wastes and transforms into useful by product leaving behind very less, so as to minimize burden on landfill. It is also venture where RMC has attempted 100 % privatization.

6.9 SWM Cost Recovery

The present charge for solid waste management service is being levied with property tax in form of “Conservancy tax”. Following table shows the present conservancy tax structure

Sr.No.	Type of Property	% of ALV of the Property /annum	Remarks	Last Revision
1	Residential	5%	Property having ALV below Rs.600 is exempted	1st April, 2006
2	Commercial	8%-12%	No Exemption	1st April, 2006
3	Industrial	9%-12%	No Exemption	1st April, 2006

Year	2004-05 (Rs.in Lakh)
Income from Conservancy Tax	521.74
Expenditure	2629.00
Income v/s Exp.	19.85%
Level of subsidy	80.15%

Billing and Collection:

The billing system is computerized and decentralized. The collection of conservancy tax with property tax is done at three different places viz., (i) Main office building (ii) City Civic center, Amin Road (iii) City Civic Center – Krishnagar Meter readings for the domestic / Non-domestic connection are taken once a year. Bills to all property holders are sent on yearly basis.

As per BPMC Act, 1949, if the consumer does not pay the bill within 15 days of the date of issue, 18% interest is to be levied.

It is found that the collection of current demand varies from 38 % to 89% and collection arrears are about 62 to 12 %.

Expenditure Occurred t:

The costs incurred for solid waste management service as establishment expenses, SWM vehicle maintenance & diesel, lifting of closed containers, silt removal & costs for sweeping in new wards are as given below:

Account Head	Expense Rs in Lakh
Establishment	2079
SWM equipment, vehicle & diesel cost	282.45
Cost of lifting of closed containers including expense of transfer stationed silt from nalas/ natural drains, on contract basis	150
Cost of sweeping activities / door to door collection / night scrapping work etc.,	117.55
Total . . .	2629

Rajkot Municipal Corporation spends category wise expenses for SWM as below:

Table: 6.12 SWM category wise expense Rs. In lakhs (Year 2004-05)					
Primary SWM	Expense	Secondary SWM	Expense	Tertiary SWM	Expense
Establishment	1875	Establishment	215	Establishment	3
Allowances			1	Allowances	0.75
Grant to societies	14	Expenses on vehi. maintenance & Diesel	56.48	Vehicle/ Telephone bill	0.25
Telephone bill	1.5	Lifting contract bill	150		
Electric bill	4	Expenses on repairs to wheel barrow etc.	237		
Expenses for sweeping/ collection/night sweeping etc.,					
Total	1965.52		659.48		4
TOTAL					2629

7

Future Condition & Problem Definition**7.1 Relevancy for the Future**

Mr P U Asnani, consultant, United States Asia Environmental Partnership, United States Agency for internal development has given a project report on modernization of solid waste management practices in Rajkot city after carefully studying the then state of solid waste management in the Rajkot city, in Dec.2000. After almost 5 years, Rajkot Municipal Corporation has made progress in the field of solid waste management in Rajkot city.

Primary solid waste management necessarily means collection of solid waste from house holds, from streets, from all the places where waste is generated and transporting it up to the closed containers meant for the temporary storage of solid waste at number of locations all over the city. However, there is a desirable shift among the priorities with the solid waste management getting the budget allocation as a matter of importance particularly in the wake of Municipal Solid Waste rules-2000.

While strengthening the primary collection systems Rajkot Municipal Corporation was required to deal with most important and the most difficult stakeholder of successful solid waste management. They are human beings. Employees who are traditionally sweeping the streets, roads as well as the citizens of this city, both are the most difficult to handle.

RMC has carried on with the older system of sweeping the streets; however, RMC changed the area of sweeping from 3000 sq.mt per sweeper to 300, 500 and 700 running mt., depending upon the population density.

RMC also tried its hands with privatization which is rare or un attempted elsewhere for primary solid waste management. Going back to earlier years, it is necessary to mention the merger of three erstwhile Nagarpalikas into RMC in the year 1998. Rajkot Municipal Corporation inherited the areas admeasuring 36sq.km with no basic infrastructural facilities, in addition to its own 69 sq.km. The solid waste management was almost non existent into these largely residential areas. The solid waste management by the erstwhile Nagarpalikas was contracted out to private contractors.

Even, RMC tried to replace the system of private contractor to community based organization means that the system (contracting out) with solid waste management by sanitary marts. The sanitary mart is a Registered Co-operative Organization comprising of all of its members from traditional sweeper community. They knew what they need to do. Rajkot Municipal Corporation helped them to develop a managerial capacity to deal with the cleaning operations. This experiment of sanitary mart is running successfully in the newly merged areas. Similarly RMC also contracted out brushing and scraping of our major roads. The footpaths and the road dividers now are being scrapped and brushed during the night and it gives city a clean look. Because of this arrangement, RMC does not require to recruit new additional sweepers.

Rajkot Municipal Corporation has started replacing the old open to sky black containers with closed containers of 4.5 cu.mt capacity. This has solved the problem of temporary storage. So far as

other small basic equipments like containerized hand carts or wheel barrows are concerned, the same in enough quantity were procured and put in use in last five years.

Two transfer stations i.e. at 150' ring road and at near Bhavnagar road have started to reduce transportation cost of the waste. Contracting the lifting of containers by dumper placers has been started.

Fully privatization of dead animal disposal and other conservancy services are being operated.

Disposal of Bio-medical waste & hazardous waste is taken care of by private operator under direct supervision and control of Gujarat Pollution Control Board (GPCB).

An Integrated Solid Waste Processing plant is fully functioning and almost about 70 % of waste is being processed.

However, RMC needs to do lot in each section of the SWM i.e. primary, secondary as well as tertiary Solid Waste Management. Naming such activities are door to door collection of waste, total segregation of waste at source, issue of construction waste, arrangement for industrial non-hazardous waste, development of landfill site etc.,

The population growth is about 4 % per annum so the waste growth. The city economy is also boosting and habit of people to generate the waste is also changing and resulting more generation of waste.

Keeping all this it in mind here, it is attempted to identify the problems, locations, extent, persistent and its future. Besides, on the basis of MSW rule, 2000 and as per CPHEEO manual it is also here with attempted to sorting out these problems.

7.2 Type of Problem

The type of problems for solid waste management as under:

1. No system of door to door collection of waste
2. No segregation of waste at source
3. Inadequate community bin facilities
4. Burning of waste on roads/ bins
5. People throwing waste on streets, open space, drains, nalas etc.
6. No separate system for collecting of disposal of construction waste and /or Industrial waste
7. Problem of hotel & restaurant waste
8. No system of collection of garden waste
9. Issue of plastic begs / plastic with less than 20 microns
10. Crude dumping of waste
11. Need of Capacity building of RMC employees
12. Use of Plastic begs / plastic thinner than 20 micron
13. Lacking of public awareness
14. High level of subsidy and low level of recovery for SW service

7.3 Location, extent & Persistent of Problems

1. No system of door to door collection of waste: The system of door to door collection of solid waste with the involvement of Resident Welfare Associations etc is also decided at policy level and ready for implementation, however, the scheme does not taking shape. Addition to this problem RMC still has problems of recollection of the solid waste which missed out in a normal day to day circuit. The solid waste still gets accumulated, though in a reduce quantity; RMC still require certain equipment and machines in the coming years. The extent of the problem is almost whole city. RMC has planned to start Door to Door collection in Ward No. 21 22 and 23 (as per old revision), which forms about 36% of area of city and with population about 18% of that of entire city. It is planned to cover the whole city before end of the December-2006.

2. No segregation of waste at source: In Rajkot, while the quantity of food waste generated per capita has remained almost static, the quantity of packing material and non-biodegradable waste is rising up alarmingly every year. This increases the burden on local bodies which have to deal with the problem of non-biodegradable and non-recyclable components of waste that end up at the processing and disposal sites. Reduction of waste at source will decrease the quantity of waste to be processed and disposed.

All manufacturing should seriously endeavor to use re-usable packing materials so that after the delivery of goods, the packaging materials can be collected back and re-used. They could also consider minimizing or avoiding use of unnecessary packaging materials by innovative methods. The cost of packed articles and articles without packaging material could be kept different with a choice to the consumers to take articles without packaging material at low cost. The present trend towards one-time-use packing needs to be reversed. Multi-use bottling practices need to be reintroduced. Hard-to-recycle packaging like PET bottles metallic plastic firms and multi-firms packs must be phased out unless producers take responsibilities for their re-cycling or re-use.

RMC is concentrating in making efforts to build a platform where waste generators cooperate and effectively participate in the waste management efforts. If people continue throw waste on the streets indiscriminately, the local body cannot keep the city clean in spite of its best efforts. People, therefore, have to form a habit of storing and sorting the waste at source in their personal bins and discharge the waste into the municipal system only. The RMC shall make a serious endeavor to motivate households, shops and establishments not to mix recyclable waste with domestic food waste etc. and instead keep recyclable/non biodegradable wastes in a separate bin or bag at the source.

3. Inadequate community bin facilities: With adequate community bin properly put up in last five years, still some slum area and part of newly merged area are away from the facility of community bins. By enlarge norms of community bins at 500 m. radius is observed in the city area however; it is not seen in the newly merged area.

- 4. Burning of waste on roads/ bins:** Because of “NIMBAY” (Not in my back yard) syndrome and various reasons people are of habituate to burn waste in community waste bin. The habit was also observed amongst sweepers. The strict actions are being taken against such persons/ employees yet results are not visualized.
- 5. People throwing waste on streets, open space, drains, nallas etc:** Throwing of waste on streets, open space, drains, nallas etc., could be mainly attributed to lack of civic sense. Change in lifestyle of people has also attributed to the rise in generation rate. Simultaneously people do not have cultivated the required civic sense. Another main reason for people are not aware of serious consequences of throwing waste in open space , drains, nallas etc., These could chowk up the nallas and reduce the waterway, which could result in flooding as in the case of Mumbai in June'05. Similarly open throwing of waste could result in outbreak of epidemic such as plague. Another reason for people throwing waste may be attributed to the lack of fear for getting penalized. People also don't realize the benefits of their contribution towards better solid waste management. Again Solid Waste Management could not be achieved with success without the positive public participation and anticipation.
- 6. No separate system for collecting of disposal of construction waste and /or Industrial Waste.** Construction Industry is necessary for the development of any city. But main problem is disposal of construction waste. This could be attributed due to its high density which makes it extremely difficult and expensive as transportation mostly depends on weight. Again the builders avoid disposing it in areas away from city and they prefer to dump it along the water bodies, nallas or low lying areas. This results in serious consequences of flooding as natural course of water is disturbed if construction waste is dumped along its course. Lack of cooperation, lack of willingness to spend money for the disposal of construction waste, from the builders is also major reason for this problem. Apart from the builders, there are informal sector that are scattered and generate very less amount of waste. There is lack of effort to bring these all under one umbrella. As far as Industrial waste is concerned, Industries don't disclose the real amount of waste coming of their industry fearing the serious consequences from the side of Gujarat Pollution Control Board. So the exact amount of industrial waste never comes in picture. Secondly all the disposal of these wastes is done in secret manner. Lack of willingness of industry to pay for their waste, corrupt practices or intentions of the officials from regulating authorities adds up to the problem of bringing out the actual generation of waste. Apart from these there is lack of collecting system because of strict environmental laws and regulation which makes entire disposal mechanism expensive.
- 7. Problem of hotel & restaurant waste.:** Apart from large hotels, there are many small hotels and informal eateries which dispose their waste along with the waste of municipal waste, which leads to foul smell and attracts stray animals. The main culprit in the entire process is the small informal eateries and small hotels and restaurants who indiscriminately dispose the hotel waste

either into municipal waste container or along the nallas and water bodies. The amount of waste from each such informal eateries and small hotels are so meager that they could not afford to have individual waste disposal system. So it becomes utmost important to have common platform to bring all such eateries, small & medium hotels, so that they could go for various disposal system such as biomethanation, composting, etc., Secondly the other reason for such hotel & restaurant waste is lack of regular imposition of penalty.

8. No system of collection of garden waste. The number of gardens are scattered and the gardens are maintained by a separate department. The lack of coordination by garden department and Solid Waste management department is also reason for the lack of system for collection of garden waste. Again the trees and plant which hinders the electric lines or telephone lines are cut periodically by respective department. The lack of coordination within these department and Solid Waste Department leads to lack of collection of garden waste, which again attracts the stray cattle. If managed properly this waste could be collected separately by bringing the entire garden under one umbrella and develop a waste collection mechanism.

9. Issue of plastic bags/plastic with less than 20 microns: Convenience of plastic has led to indiscriminate use of this commodity and had led to menace. Use of plastic bags due to light in weight has made public forgot usage of its traditional cloth and jute bags. Most disturbing is the usage of plastic bags with less than 20 microns. Plastic bags don't last long and leads to generation of waste which is not decomposable and very expensive for the recycling. People also don't use plastic judiciously and litter the streets nalla etc.,

10. Crude dumping of waste: Crude dumping of waste is due to lack of public awareness, lack of awareness of problem arising due to indiscriminate dumping of waste. Problems like flooding due to shortening of course of the nalla or storm water drain, or outbreak of epidemic are results of dumping of waste. In real sense waste is not waste and time has come to think it as resource. If managed properly it could give amazing results with very less cost. So waste should not be indiscriminately dumped and could be properly canalized to waste management scheme of things.

11. Need of capacity building of RMC employees: RMC employees are the major key for the effective Solid Waste Management and very important stakeholder of entire process. Now Solid Waste Management is new subject and the implementing team members such as sanitary inspectors and supervisory staff who are persons working at grass root level have block minded approach. To bring innovation in the entire process needs to improve the way this people think and change the mindset of the people responsible to implement all this things. It is very difficult to unlearn negative things in mind than to learn the positive new concepts. RMC employee's negative sentiments have to be erased and new fresh positive things have to nurtured, if one has to achieve greater heights in Solid Waste Management

12. Use of plastic thinner than 20 micron : Even though Govt of India as well as Gov of Gujarat has put ban on use of plastic carrying begs/ plastics thinner than 20 microns ,people are widely using the same through out the city

13. Lack of Public Awareness: Community is in the centre of all the activities, yet it is ignored by the decision makers and made to merely wait and watch and ultimately what people get in hand is what they do not want or what is not in their priority. This creates a void between the administrators and those administered and an atmosphere of apathy is created which distances people from government initiatives.

Public awareness, effective community participation, transparent and clean administration, introduction of citizen charters and accountability at all levels can only bridge this gap. Solid Waste Management (SWM) is one such activity, where public participation is key to success. But it very sorry to note that in spite of continuous efforts by the RMC to aware the people and having set a mechanism of strong public awareness

14. High level of subsidy and low level of recovery for SW service: Rajkot Municipal Corporation is collecting conservancy tax for providing solid waste service to the citizens The service has very high level of subsidy during year 2004-05 RMC spent Rs. 2629 Lakhs against total demand of Rs. 521 Lakhs that indicates the level of subsidy is about 80% .Financial Management and special recovery plan are needed to cop up the situation

8.1 Storage Improving Methodology

Storage of waste at source is the first essential step of Solid Waste Management. Every household, shop and establishment generates solid waste on day to day basis. This waste should normally be stored at the source of waste generation till collected for disposal. In Rajkot prior to implementation of MSW rules 2000, in absence of the system of storage of waste at source, the waste is thrown on the streets, treating streets as receptacle of waste. Presently, in order to improve the system following measures have taken:

- Educating waste producers so that they cooperate and effectively participate in the management efforts of the local body.
- Enforcing people leaving in apartments to have separate waste collection system at the ground floor level of individual apartment or multi storied building.
- Efforts have been taken by RMC in educating people to store waste at source in segregated form and have two dustbins at their house to store recyclable and non recyclable waste.
- Apart for educating RMC is committed to ensure that citizens do not throw any waste on the streets, footpaths, open spaces, drains or water bodies etc., by following means
 - By putting dustbins at various public places.
 - By placing littering bins at places important with social gathering point of view such as public parks, commercial areas etc.,
 - By placing hoardings highlighting litter prohibition or throwing waste in open, near the places like water bodies, open plots etc.,
 - Finally by imposing administrative charges against the public carry in out littering.

8.2 Improving Primary Collection of Waste

In Rajkot, the primary collection of waste is slowly developing after the implementation MSWM Rules 2000. But still door step collection of waste from households, shops and establishment is insignificant and wherever door step collection system introduced through private sweepers or departmentally, the system does not synchronized further with facility of Waste Storage and Transportation of waste. The waste so stored is deposited on the streets or on the ground outside the dustbin. Thus streets are generally treated as receptacle of waste and the primary collection of waste is done, by and large, through street sweeping.

An appropriate system of primary collection of waste is designed by the R.M.C that it synchronizes with storage of waste at source as well as waste storage depots facility ensuring that the waste collected reaches the processing or disposal site through a containerized system.

Following steps are taken for the improving the situation of primary collection.

- The RMC has arranged for the collection of domestic, trade and institutional waste, biodegradable waste from the doorstep or from the community bin on daily basis.

- The RMC has arranged through Individual societies or resident welfare association for the collection of waste from their individual societies against the grant in aid given by RMC.
- Collection through community bins from private societies, multi – storied building commercial complexes.
- Collection of waste through handcart, tempo or tractor with bell/horn deployed for door step waste collection.
- House to House collection of waste from posh residential areas or from High Income group societies has been planned on full recovery basis.
- Hand carts have been provided to sweeper for the collection of waste and encouraging door to door collection of waste. It has been planned to provide tricycles to sweepers in future which would be helpful in segregation of waste also.
- It has been planned to provide brooms with long handle to avoid the problem of backache and fatigue in sweeper due to usage of conventional broom with short handle.
- RMC has engaged two mechanical sweepers and is keen in acquiring more so that sweeping in roads with high traffic volume is convenient and safe.
- Encouraging segregation at source.

8.3 Methods for Bulk Storage of Waste at storage depots

This is third essential step for an appropriate Solid Waste Management System. All the waste collected through Primary Collection system, from the households, shops and establishment has to be taken to the processing or disposal site which can either be done by taking the waste to the processing or disposal site directly necessitating a large fleet of vehicles and manpower which requires huge investment or the waste collected is taken to transfer station called “Waste Storage Depots” where the waste temporarily stored and then transported in bulk to the processing or disposal sites.

RMC has following considerations before finalizing the location of dust bin of size 4.5 cum.

- Adequate space is required for placing such bins.
- The proposed waste storage depot would not abstract the entrance of any building
- The site would not cause hindrance to the traffic
- There is adequate space for the moment of the vehicle, which may come to pick up the container.
- Location such as it should not exceed 250 meters from the work place of sanitation workers.
- Location shall be such that it has slope to maintain dry hygienic conditions.

8.4 Methods for Transportation of Waste

The transportation of the waste stored at the waste storage depots at regular intervals is essential to ensuring that containers are lifted before it gets overflow. The transportation system has to

be so designed that it is efficient, yet cost effective. The system is so designed that it synchronizes with the system of waste storage depot and should be easily maintainable in the town/city.

Looking to present situation, the transportation of waste is planned scientifically to bring about a total improve the present existing system.

- It is easy to maintain by department
- Manual loading should be discouraged and phased expeditiously and replaced by direct lifting of containers through hydraulic system or non – hydraulic devices or direct loading of waste into transport vehicles.
- It is regular and the irregularities due to machinery fault are designed to minimize.

8.5 Methods for Processing of Waste.

Rajkot Municipal Corporation has entered agreement with Hanzer Biotech Pvt Ltd., on BOO basis for waste processing. Hanzer Biotech Pvt Ltd. has set up a waste processing plant. An **MOU** (See Annexure) has been signed by **Hanzer Biotech Pvt. Ltd** with **Solid Waste Management Department, R.M.C** for development of Waste Processing Plant wherein the former would develop Waste Processing Plant. The byproduct of the entire process will be compost, energy pellets or fluff (green coal) and eco-bricks. Presently the project is initial phase of operation. Initial results of the project are encouraging. Presently the approximately 300 tons of waste on daily basis is taken for processing which would be upgraded to 325 tons per day shortly. End product is 45 MT of organic manure, 80 MT of green coal and 15000 Nos (approximately) of eco bricks. As per the officials of Hanzer Biotech Pvt. Ltd., the conversion rate of the waste to by product is approximately 75 – 80%. Hence approximately 85 tons per day of refuse after processing would go to land fill site.

As such entire waste has been transported to the site of processing at Nakrawadi. If segregation of waste is encouraged as it is not done presently, the load to be transported for the processing could be reduced. Hence the cost could also be reduced. Similarly if the bio degradable waste is removed at source and composting at local level is practiced, load of waste could also be reduced.

8.6 Methods for Disposal

Rajkot Municipal Corporation has received detailed engineering design for the development of sanitary Landfill site at Nakrawadi (a village 15 km away from city limits of Rajkot), from NPC (National Productivity Council), Gandhinagar. Subsequently detailed program for systematic development of Municipal Landfill facility at its site of Nakrawadi, has been developed. The site was visited by the team of officers from NPC & RMC. RMC identified the site at Nakrawadi (Survey No: 222/p) having a land area of 170 acres. The construction work would commence shortly.

8.7 Development of Organizational structure.

As far as the organizational structure is concerned, RMC is first Municipal Corporation in India to have environmental engineers involved in Solid Waste Management.

It is first city to separate the Solid Waste Management Department from conventional Health Department. The details of present organizational structure as tabulated below:

Sr. No.	Details of staff	Existing Set Up	Required as per MSWM rules 2000	Deficiency	Remarks
1	Environmental Engineer	1	1	Nil	Situation Vacant
2	Dy. Environmental Engineer	2	2	Nil	
3	Asst. Environmental Engineer	5	5	Nil	
4	Sanitary Officer	4	11	7	
5	Sanitary Inspector	22	23	1	
6	Sanitary sub Inspector	51	42	+9	
7.	Sanitary Supervisor (Mukadam)	17	84	67	

8.8 Development of Better Trained Solid Waste Management Personnel

Brief course content for training to various levels of staff/Officers

A. Training to sanitation workers.

1. Importance of sanitation in urban areas.
2. Present scenario of solid waste management system in the urban areas, deficiency in the system, etc.
3. Impact of inefficient SWM services on health and environment
4. Impact of inefficient SWM services on the health of sanitation workers.
5. Inefficiency of tools and equipments used and loss of manpower productivity.
6. Need for modernization of solid waste management practices.
7. Options available for improving the services.
8. Advantages of using improved tools and equipments for primary collection of waste and street sweeping.
9. Need for synchronization of storage of waste at source, primary collection of waste and waste storage depots.
10. Proper upkeep of tools and equipments and waste storage depots.

B. Training to Sanitation Supervisors of various levels.

1 to 10 as per A above.

11. Need for synchronization of transportation of waste with waste storage depot.
12. Transportation of waste on day to day basis.
13. Waste processing and disposal options, advantages and disadvantages of various technologies.
14. Sanitary land filling.

15. Public and NGO participation in waste management.
16. Building public awareness.
17. Enforcement.

C. Training for the officers looking after SWM Department.

1 to 17 as per A & B above .

18. SWM practices prevalent in other parts of the country and in the developed countries
19. Institutional strengthening, internal capacity building and human resources development.
20. Private sector participation in SWM
21. Management information system.
22. Financial aspects.
23. Health aspects.
24. Legal aspects.

8.9 Better I-E-C Activities

In order to create awareness among public to cultivate better civic sense, RMC has planned to carry out Information Education Communication activities by holding seminar, putting up hoarding board at various public places, distributing informative leaflets etc., It is also invited NGO's and private partnership for this activities. RMC has also held seminar and exhibition in coordination with state govt in recent past. RMC has also put up various hoardings conveying messages of "Clean City Healthy city" at various places.

8.10 Financial support

Solid Waste Management is one of the most essential services and need to be provided satisfactory so that health and sanitation is maintained and the environment is well protected. This necessitates provision of minimum levels of services to ensure that all streets and public places are cleaned daily and the waste generated in the city is removed regularly and disposed of in environmentally acceptable manner.

Solid Waste Management is an obligatory duty of every Municipal Corporation. It can not escape the responsibility of providing this basic service on the grounds of paucity of funds. The Municipal Corporation has to find or raise funds to maintain the minimum level of service recommended in this report.

The improved fiscal efficiency of a Municipal Corporation may even make it eligible for funding by financial institution.

Municipal Corporation should have a sinking fund for planned and timely replacement of vehicles and equipment.

9

Recommendations- System Improvement**9.1 Storage of waste at Source**

It is essential to keep the streets and public places clean at all times of day. This is possible only if waste producers co-operate and effectively participate in the waste management efforts of the Rajkot Municipal Corporation. If people keep on throwing wastes on the streets indiscriminately, the Rajkot Municipal Corporation can not keep the city clean in spite of its best efforts. People, therefore, have to form a habit of storing the waste at source in their personal bin/bins and discharge the same into the Municipal system only, at specified times.

Recommendation:

- **No Waste shall be thrown on the streets, Footpaths, open space, Drains, or Water bodies, Nallas (Vonkalas) .**
- **Waste shall be stored at source of waste generation in two Bins/ Bags, one for food waste / biodegradable waste and another for recyclable waste such as papers, plastic, metals, glass, rags etc., (See Annexure: 14.6)**
- **Waste such as used batteries, containers for chemicals, plastic pesticides, discarded medicines and other toxic or hazardous household waste (See Annexure 14.7), If and when produced, should be kept separately from the above two streams of waste**

The following measures may be taken by Rajkot Municipal Corporation to meet the above-expectations.

9.1.1 Households

All households may be directed that:-

1. They shall not throw any solid waste in their neighborhood, on the street open spaces, and vacant plots or into drains/nallas/vokalas in the city.
2. They shall Keep the food waste/bio-degradable as and when generated, in any type of domestic waste container, preferably with a cover,
3. Keep dry/recyclable wastes preferably in bags or sacks.
4. Use of A metal or plastic container with lid is advised for the storage of food/biodegradable/wet waste. A container of 15-litre capacity for a family of 5 members would ordinarily be adequate. However, a household may keep larger containers or more than one container to store the waste produced in 24 hours having a spare capacity of 100% to meet unforeseen delay in clearance or unforeseen extra loads. Wet wastes should preferably not be disposed of in plastic carry bags.

5. Keep domestic hazardous waste separately, for disposal as arranged for by the Municipal Corporation.
6. A private society, association of flats/multistoried buildings etc. shall provide a community bin facility for the members of their society/association for storage of wet domestic wastes and instruct all residents to deposit their domestic waste in these community bins to facilitate collection of such waste by the Municipal Corporation from the designated spot.
7. In case of Multi Storied buildings where it may be difficult for the waste collector to collect recyclable waste from the doorstep, the association of Multi storied Buildings may optionally keep one more community bin for the storage of recyclable material.
8. In slums, where because of lack of access or narrow lanes it is not found convenient to introduce house-to-house collection system, community bins of suitable size ranging from 8,0 to 100 liter capacity shall be placed at suitable locations by the Municipal Corporation to facilitate the storage of waste generated by them.
9. The City has 84 slum pockets having a population of 202343 living in slums. 2100 community-bins are, therefore, required to be placed in these slums @ 1 community bin/20 dwelling unit. The community bins of 80 to 100 liter capacity without a lid may be provided in the slums by the corporation to facilitate the deposition of waste by the slum dwellers in the community bin. In a situation where the corporation finds it difficult to place smaller community bins in some slums on account of lack of awareness among the slum dwellers, the Municipal Corporation may provide larger containers which may match with the Municipal Corporation's transportation system at locations which may be suitable to the slum dwellers and convenient for the Municipal Corporation to collect such waste. The slum dwellers may be directed to deposit the waste in such larger bins before the hour of clearance of waste each day.

9.1.2 Shops/ Offices/ Institutions/ Workshops etc.:

All shops and establishments may be directed that:-

1. Shops, Offices, Institutions shall refrain from throwing their solid waste /sweeping etc. on the footpaths, streets, and open spaces/nallas.
2. They, shall keep their waste on-site as and when generated in a suitable container until the time of doorstep collection.
3. The size of the, container should be adequate to hold the waste they normally generate in 24 hours with 100% spare capacity to meet unforeseen delay in clearance or unanticipated extra loads.
4. They shall keep hazardous waste separately as and when produced and dispose of as per directions given by the Municipal Corporation.
5. The association of private commercial complexes/MSBs (multi-story buildings) shall provide 4.5 cum capacity containers or suitable lift able community bin match with the waste collection and transportation system of the Municipal Corporation for the storage of waste by their members and

direct them to transfer their waste into the community bin before the prescribed time on a day-to-day basis.

6. The association should consult the Municipal Corporation in this matter in advance and finalize the type of bin and the location where such community bin/s shall be placed to facilitate easy collection of such waste.

9.1.3 Hotels and Restaurants

All hotels and restaurants may be directed that

1. They shall refrain from throwing their dry and wet solid waste/sweepings on the footpath, streets, open spaces or drains/nallas.
2. They shall also refrain from disposal of their waste into municipal street bins or containers.
3. They shall store their waste on-site in sturdy containers of not more than 100-Liter capacity. The container should have appropriate handle or handles on the top or side and rim at the bottom for ease of emptying.
4. In case of large hotels and restaurants where it may not be convenient to store waste in 100 liter or smaller size containers, they may keep larger containers which match with the primary collection and transportation system that may be introduced in the city by the Municipal Corporation, to avoid double handling of waste.
5. They shall keep hazardous waste separately as and when produced and dispose it of as per the directions.

9.1.4 Vegetable Markets

There are two main vegetable and fruit markets in the city, viz. Jubilee Market and Lakhajiraj Market. Jubilee market is a new market, which is well maintained whereas Lakhajiraj market is an old market situated in a congested area. Containers are placed in both the markets by the corporation for the storage of market waste. However, the vendors throw the waste on the floor of the market instead of putting the waste in the containers meant for this purpose. The corporation may augment this facility and for doing so the corporation may either:-

1. Direct the association of the market to provide large size containers 4.5 to 7 cmt which match with the transportation system of the corporation or
2. In the Jubilee market, the Municipal Corporation may provide large size containers with lid for the storage of market waste at suitable locations within the market on full cost/partial cost recovery as deemed appropriate and in Lakhajiraj market 4.5 cmt bins may continue to be used.

The shopkeepers may be directed that they shall not dispose of waste in front of their shop/Establishment or anywhere on the street or in open spaces and instead shall deposit their waste as and when generated into the large size container that may be provided for the storage of waste in the market.

9.1.5 Meat and Fish Markets

There is one slaughterhouse cum meat market called Sadar slaughterhouse. This slaughterhouse is in bad shape and needs immediate improvement, besides the corporation may provide a closed body containers of 4.5 or 7 cmt for storage of slaughterhouse waste.

The slaughterhouse operators and meat market owners may be directed that_

1. They shall not throw any waste in front of their shops or anywhere on the streets or open spaces.
2. They shall keep within their premises sturdy containers (of size not exceeding 100 liters) having lid, handle on the top or on the side and rim at the bottom of the container with adequate spare capacity to handle unforeseen loads.
3. The shopkeeper shall deposit meat and market waste stored by them in their personal containers in to the containers provided by the corporation on day to day basis.
4. The slaughterhouse operators shall dispose of offal and other slaughterhouse waste into the container specially provided for the purpose by the Municipal Corporation.

9.1.6 Street Food Vendors

All street food vendors may be directed not to throw any waste on the street or pavement. They must keep bins or bags for the storage of waste that generate during their activity. Their handcarts must have a shelf or canvas below for storage of waste generated in the course of business.

9.1.7 Marriage halls/Community halls/vadis, etc.

A lot of waste is generated when marriage or social functions are performed at these Places and unhygienic conditions are created. Suitable containers with lid which may Match with the primary collection or transportation system of the Municipal Corporation Should be provided by these establishments at their cost and the site of their placement Should be finalized in consultation with the Municipal Corporation to facilitate easy collection Of waste.

9.1.8 Hospital/Nursing Homes/Maternity center/Pathological laboratories/Health care centers /Establishments etc.

These establishments produce bio-medical as well as ordinary waste.

These establishments may be directed that_

1. they shall refrain from throwing any bio-medical waste on the streets or open space, as well as in to the municipal dustbins or the domestic waste collection sites
2. they shall also refrain from throwing any ordinary solid waste on footpaths, streets or open spaces/nallas
3. they shall keep colour coded bins or bags as per directions of the Govt of India Ministry of Environment in Bio-Medical waste (Management & Handling) Rules 1998, and follow the directions of CPCB & State PCBs from time to time for the storage of biomedical waste including amputated limbs, tissues, soiled bandages, used injections, syringes, etc.,

4. Private Contractor M/S Destro-Mede, Rajkot (The licensee for collection, trnsportion & incineration of bio-medical waste) will be responsible for arranging such handling as well as collect and incinerating the bio-medical waste under direct control & supervision of Gujarat Pollution Control Board. For the purpose the M/S Destro-Med should be directed to do bi-medical waste handling strictly in conformity with directions contained in the Govt. of India's aforesaid notification.
5. All medical units must keep record of daily bio-medical waste handed over to M/S Destro-Mede for incineration

9.1.10 Construction & Demolition Wastes

1. No person shall dispose of construction waste or-debris on the streets, public space, footpath or pavement or in the nallas.
2. Construction waste shall be stored until removed only within the premises of the building, or in containers from the day the facility of renting out containers is made available. In exceptional cases where storage of construction waste within the premises is not possible, the waste producer shall take prior permission of the Municipal Corporation or the State Government as may be applicable for temporary storage of such waste and having obtained and paid for such permission, may store such waste in such a way that it does not hamper the traffic, the waste does not get spread on the road and does not block the surface drain or storm water drain.
3. Municipal Corporation may create a facility of renting out skip containers through private sector for the storage of construction waste as illustrated below. The corporation may, to begin with a provision of 75 containers and two skip lifters to introduce this facility in the city.

9.1.11 Garden waste:

Large public parks and gardens in the city should as far as possible compost and utilize all garden wastes on-site., tractor trolleys may be used to store the garden waste. Private parks and gardens may also as far as possible compost their waste within the premises. However, where it is not possible to dispose of garden waste within the premises and the waste is required to be disposed of outside the premises, it shall be stored in large bags or bins on-site and transferred into a municipal system on a weekly basis on payment. The generation of such waste should as far as practicable be regulated in such a way that it is generated only a day prior to the date of collection of such waste and should be stored in the premises and kept ready for handing over to the municipal authorities or the agency that may be assigned the work of collection of such waste by the Municipal Corporation. Garden waste producers may be directed that no waste shall be thrown on streets, open spaces, and

instead the waste shall be kept within the premises for handing over to the corporation or to the person authorized by the corporation on the prescribed day.

For removal of garden waste, the city may be divided by the corporation into four divisions and each division may be covered once in a week from Monday to Thursday. The citizens may be advised to take up grass cutting, trimming only on the day prior to the day notified for clearance of garden waste from their area and keep it ready for handing over to the staff of the Municipal Corporation.

The Municipal Corporation may contract out this service on full cost recovery basis. The names of the households having private gardens may be listed in each ward and brought under the contractual arrangement.

9.1.12 Ban on Use of Plastic bags thinner than 20 microns :

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 of. This requires a very effective public awareness campaign as well as enforcement drive.

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.

Therefore to minimise use plastic packages and to ensure recycling of the plastic bags. Government set policy to ban Plastic thinner than 20 microns and directed all cities of Gujarat state to make drives for banning plastic bags.

- **Prescribed Law:**

Under Clause (viii) of sub-section (2) of section 3 read with section 25 of Environment (Protection) Act, 1986 (29 of 1986) was published in the Gazette vide S.O. 980(E) dated 20th November, 1998 entitled **Recycled Plastics Usage Rules, 1998** inviting objections from the public within 60 days from the date of the publication of the said notification and where as all objections received were duly considered; Then, by exercising the powers conferred by clause (viii) of sub-section (2) of section 3 read with section 25 of Environment (Protection) Act, 1986, the Central Government hereby notifies the rules for the manufacture and use of recycled plastics carry bags and containers :

1. **Conditions of Manufacture of carry bags and containers made of plastics:**

Subject to the provisions of rule 4, any person may manufacture carry bags or containers made of plastics if the following conditions are satisfied, namely_

- (a) Carry bags and containers made of virgin plastic shall be in natural shade or white;
- (b) Carry bags and containers made of recycled plastic and used for purposes other than storing and packaging foodstuffs shall be manufactured using pigments and colourants as per IS:9833:1981 entitled “List of pigments and colourants for use in plastics in contact with foodstuffs, pharmaceuticals and drinking water”.
2. **Recycling:** Recycling of plastics shall be undertaken strictly in accordance with the Bureau of Indian Standards specification IS:14534; 1998 entitled “The Guidelines for Recycling of Plastics”
3. **Marketing / codification:** Manufacturers of recycled plastic carry bags having printing facilities shall code / mark carry bags and containers as per Bureau of Indian Standard Specification: IS 14534:1998 entitled “The Guidelines for Recycling of Plastics” and the end product made out of recycled plastics shall be marked as “recycled” along with the indication of the percentage of use of recycled material. Other manufacturers, who do not have printing facilities, shall comply with the condition within one year of publication of these are made of “recycled material” or of “virgin plastic”.
4. **Thickness of Carry bags:** The minimum thickness of carry bags made of virgin plastics or recycled plastics shall not be less than 20 microns.

Action Plan : Please Refer annexure 14.9

9.2 Segregation of Recyclable / non-bio degradable waste

It is essential to save the recyclable waste material from going to the waste processing and disposal sites and using up landfill space- Profitable use of such material could be made by salvaging it at source for recycling. This will save national resources and also save the cost and efforts to dispose of such wastes. This can be done by forming a habit of keeping recyclable waste material separate from food wastes, in a separate bag or a bin at the source of waste generation by having a two-bin system for storage of waste at homes, shops and establishments where the domestic food waste (cooked and uncooked) goes into the Municipal system and recyclable waste can be handed over to the waste collectors (rag pickers) at the door step.

The recent rules as above published by the Government of India direct the following measures to be taken by the urban Municipal Corporation:- *“In order to encourage the citizens, municipal authority shall organize awareness programs for segregation of waste and shall promote recycling or reuse of segregated material. The municipal authority shall undertake phased program to ensure community participation in waste segregation. For this purpose, regular meetings at quarterly intervals shall be arranged by the municipal authorities with representatives of local resident welfare association and non-government organizations”*

- **The Municipal Corporation may draw up a quarterly program of conducting awareness campaign in various wards of the city utilizing the ward committees, local NGOs and resident welfare association. Simple literature may be developed for bringing in the awareness which may be publicized through media using cable net work and group meetings in different areas through NGOs.**
- **As soon as the awareness campaign picks up, the corporation may direct households, shops and establishments not to mix recyclable waste with domestic food/bio- degradable waste and instead keep in a separate bin or bag at the source of waste generation.**

The following further measures may be taken by the corporation towards segregation of recyclable waste:

9.2.1 NGO participation

The Municipal Corporation may mobilize NGOs or co-operatives to take up the work of organizing street rag-pickers and convert them to door step "waste collectors" by motivating them to stop picking up soiled and contaminated solid waste from the streets, bins or disposal site and instead improve their lot by collecting recyclable clean material from the doorstep at regular intervals of time. The Municipal Corporation may, considering the important role of rag pickers in reducing the waste and the cost to the Municipal Corporation in transportation of such waste, even consider extending financial help to NGOs and co-operatives in providing some tools and equipment to the rag pickers for efficient performance of their work in the informal sector.

9.2.2 CBO Participation

The Municipal Corporations may actively associate resident associations, trade & Industry associations. CBOs and NGOs in creating awareness among the people to segregate recyclable material at source and hand it over to a designated waste collector identified by the, NGO. The Municipal Corporation may give priority to the source segregation of recyclable wastes by shops and establishments and later concentrate on segregation at the household level.

9.2.3 Mobilization of Rag pickers

The upgraded rag pickers on becoming doorstep waste-collectors may be given an identity card by the NGOs organizing them so that they may have acceptability in society. The Municipal Corporation may notify such an arrangement made by the- NGOs and advise the people to cooperate.

This arrangement could be made on "no payment on either side basis" or people may, negotiate payment to such waste collectors for the door step service provided to sustain their efforts.

9.3 Primary Collection of waste

It is necessary to provide a daily, service to all households, shops and establishments for the collection of putrescible organic/food/bio-degradable waste from the doorstep because of the hot climatic conditions in the city. This service must be regular and reliable- Recyclable material can be collected at longer regular intervals as may be convenient to the waste producer and the waste collector, as this waste does not normally decay and need not be collected daily,. Domestic hazardous waste is produced occasionally and so such waste need not be collected from the doorstep. People could be advised or directed to put such waste in special bins kept in the city for disposal of such wastes.

Directions given in Municipal Solid Waste (Management & Handling Rules 2000.

1.

- i. *Organize house-to-house collection of municipal solid wastes through any of the methods, like community bin collection (central bin), house to house collection, collection on regular pre-informed timings and scheduling by using bell ringing of musical vehicles (without exceeding permissible noise levels).*
- ii. *Devising collection of waste from slums and squatter areas or locality including hotels, restaurants, office complexes and commercial areas.*
- iii. *Wastes from slaughter houses, meat and fish markets, fruit and vegetable markets, which are biodegradable -in nature, shall be managed to make use of such waste.*
- iv. *Biomedical waste and industrial waste shall not be mixed with municipal solid waste and such wastes shall follow the rules separately specified for the purpose.*
- v. *Collected waste from residential and other areas shall be transferred to community bin by hand-driven containerized cart or other small vehicles.*
- vi. *Horticulture and construction or demolition waste or debris shall be separately collected and disposed of following proper norms. Similarly, waste generated at dairies shall be regulated in accordance with state laws.*
- vii. *Waste (garbage, dry leaves) shall not be burnt.*
- viii. *Stray animals shall not be allowed around waste storage facility or at any other place in the city or town and shall be managed in accordance with the state laws.*

2. *The municipal authority shall notify waste collection schedule and the likely method to be adopted for public benefit in a city or town.*
3. *It shall be the responsibility of generator of waste to avoid littering and ensure delivery of waste in accordance with the collection and segregation system to be notified by the municipal authority as per Para 2 above.*

In view of the above mandatory direction, the following recommendations are made:-

Recommendations:

- **Domestic, trade and institutional food/ biodegradable waste, should be collected from the doorstep or from the community bin on a daily basis.**
- **Recyclable waste material/non biodegradable waste other than toxic and hazardous waste should be collected from the source of waste generation at the frequency and in the manner, notified by the Municipal Corporation from time to time.**
- **Domestic hazardous/ toxic waste material shown in Annexure 'F' should be deposited by the waste producers in special bins that may be provided by the Municipal Corporation at various places in the city for depositing such wastes.**
- **The Municipal Corporation should notify the arrangement of primary collection it proposed to make and direct the citizens to cooperate in the primary collection of waste accordingly.**

The following arrangements shall therefore be made by the Municipal Corporation:-

Municipal Corporation may arrange for the primary collection of waste stored at various sources of waste generation by any of the following methods or combination of more than one method:

1. Doorstep collection of waste through containerized handcarts/tricycles or other similar means with active community participation.
2. Doorstep collection of waste through motorized vehicles having non conventional horns deployed for doorstep waste collection with active Community Participation.
3. Collection through community bins from private societies multistoried buildings, commercial complexes.
4. Doorstep or lane-wise collection of waste from authorized/unauthorized slums or collection from the community bins to be provided in the slums by the Municipal Corporation.

5. House-to-house collection of waste from posh residential areas' where community participation is not likely, on full-cost-recovery basis.
6. The Municipal Corporation should provide special bins for the disposal of domestic hazardous waste listed in Annexure – 14.7 at various places in the city and notify the location to the people. These should be covered bins of a distinct colour so that they can be identified easily.

MODUS OPERANDI

9.3.1 Door step collection through containerized handcarts with bells/whistles

Each sweeper may be given a handcart having detachable containers (preferably 6) of 30 to 40 liter capacity each. A bell may be affixed to the handcart or a whistle may be provided to the sweeper in lieu of a bell. Each sweeper shall be given a fixed area or beat for sweeping plus a fixed number or stretch of houses for the collection of waste. The Municipal Corporation may, based on local conditions, fix the work norms as they deem appropriate. It is suggested that in congested or thickly populated areas, 350 running meters of road length and the adjoining houses may be given to each sweeper, whereas in less congested areas 500 to 600 running meters of the road length with adjoining houses may be allotted to a sweeper depending upon the density of population in the given area and local conditions. In low density area even 750 running meters of road length and houses can be given. Normally 150 to 250 houses coupled with the above road length may be taken as a yardstick for allotment of work to an individual sweeper.

Role of the sweeper

The sweeper should ring the bell or blow the whistle announcing his arrival at the place of his work and start sweeping the street. The people may be directed that on hearing the bell or whistle they should put their domestic biodegradable waste into the handcart of the sweeper or hand over the waste to him/her.

At places where it is not convenient for the householder to deposit the waste in the handcart/tricycle, on account of their non-availability at home when sweeper arrives in their area. they may leave the domestic waste in domestic bins or bags just outside their house on the street in the morning so as to enable the sweeper to pick up the waste and put it into the handcart.

No sweeper may be expected or directed to do house-to-house collection by asking for waste at the doorsteps, as this will affect his energy and productivity.

9.3.2 Collection through motorized vehicles

Municipal Corporation as an alternative to doorstep collection through containerized handcarts may deploy motorized vehicles having unconventional horn for the doorstep collection of waste. The driver of the vehicle should intermittently blow the horn announcing his arrival in

different residential localities and on hearing this, the householders should deposit their domestic waste directly into such vehicle without loss of time.

9.3.3 Primary Collection of waste from Societies/Complexes

In private societies, complexes and multi storied buildings, normally no sweepers are provided by Municipal Corporation, hence private sweepers are generally engaged. It may be therefore made compulsory for the management of the societies, complexes and MSBs to keep community bins or containers in which dry and wet waste may be separately stored by the members. Such bins may be placed at an easily approachable location to facilitate easy collection by the municipal staff or the contractors engaged by the Municipal Corporation. The Municipal Corporation should arrange to collect waste from these community bins/containers through handcarts, pick-up vans, or other municipal waste collection vehicles as may be convenient, on a daily.

To facilitate collection of waste from societies or commercial complexes, the Municipal Corporation should by a rule, make it obligatory for them to identify an appropriate site within their premises for keeping such bin/container for the storage of waste.

9.3.4 Collection of Waste from Slums

There are 84 slum pockets in the city. The Municipal Corporation should collect waste from slums through community bins provided by the Municipal Corporation. Residents should bring their wastes from their houses to community bins. They should bring their biodegradable waste to these bins only an hour or two before the time of clearance. The Municipal Corporation may, if so desired, engage a private contractor for collection of this waste. Performance certification by a "Mohalla Committee" may be insisted upon in such cases.

9.3.5 Collection-at-the door in posh residential areas

In posh residential areas where the residents might not be willing to bring their waste to the municipal handcart/ tricycle, collection from the doorstep may be introduced for picking up of wastes may be introduced for picking up domestic waste from households daily on full cost recovery basis and an NGO or contractor or sweeper societies may be encouraged to provide such service.

9.3.6 Collection of duly segregated recyclable/non-bio-degradable waste from households

NGOs may be activated to organize the rag pickers and convert them into doorstep waste-collectors to improve their quality of life and to reduce their health risk. This will also increase their income levels. NGOs may allot to such waste collectors specified lanes and bye-lanes comprising of 300 to 400 houses for doorstep collection of recyclables. They may also be given identity cards by the NGOs for increasing their acceptability in society. NGOs and/or the corporation may support

such waste collectors by giving them bags and tools required for collection of recyclable waste from the doorsteps. The Municipal Corporation may also inform the people of the arrangements made by the NGO and advise them to avail of the services as illustrated in the photograph below:-

9.3.7 Collection of Waste from Shops and Establishments

Shops and establishments normally open after 9 or 10 am. These timings do not Synchronize with the usual work schedule of sweepers. Under this situation one of these three alternatives may be adopted.

1. Sweepers may first carry out the work of street sweeping in the morning hours as usual and soon thereafter take up the work of door-step collection of waste, after most of the shops have opened. Waste collectors (rag pickers) may be organized to collect the recyclable waste from shops and establishments as soon as they opens, as most of such waste is recyclable. Working arrangements may be made with the shops and establishments accordingly. The shops & establishments may be asked to store waste in two bins if they produce waste other than recyclable waste also. This arrangement may be made on 'No payment' basis on either side.
2. The recyclable material received by the waste collectors directly from shops and establishments would give them a better return. The waste would be dry and not soiled and would fetch a good price in the market. This will work as an incentive for, them to continue door- to door collection.
3. The associations of markets, shops and establishments may be persuaded to organize this service with the help of NGOs and rag pickers in their market.

9.3.8 Collection of Hotel and Restaurant Waste

The hotels and restaurants may make their own arrangements for collection of waste through their own association, or the Municipal Corporation may extend help in primary collection of such waste by deploying its own manpower and machinery for door step collection of such waste on full-cost-recovery basis. The cost could be recovered on pro-rata basis. This doorstep service may be contracted out by the Municipal Corporation if so desired.

Charges for the collection of hotel waste may depend upon the quantity of waste to be picked up from the hotels and restaurants and frequency of collection required. The cost recovery may be planned according to the classification of hotels/ restaurants made on the above basis and decided in consultation with them.

9.3.9 Vegetable, Fruit, Meat Markets Waste

These wastes should be removed on a daily basis departmentally or through a Contractor on full or part-cost-recovery basis as may be deemed appropriate by the Municipal Corporation.

The large containers kept in the fruit and vegetable markets should properly be emptied during non-peak hours and the waste from meat and fish markets should be collected through a closed pick-up van service by engaging a contractor, or departmentally as deemed expedient by the Municipal Corporation.

9.3.10 Collection of garden waste

The waste stored in public and private parks, gardens, lawn plots etc. should be collected on a weekly basis by arranging a rotation for collecting such waste from different areas, on different days to be notified to the people to enable them to trim the trees and lawns accordingly and keep the waste ready. This waste may be collected through a contractor or departmentally as deemed appropriate by the urban local authority. Cost recovery shall be insisted upon, based on the volume of waste collected. The existing tractors may be deployed for weekly collection of garden waste from different areas.

9.3.11 Collection of waste from marriage halls, "wadis", community halls, etc.

A special pick up arrangement should be made for collection of waste from these establishments daily on a full-cost-recovery basis. The cost of such collection could be built into the charges for utilizing such halls. This service may be provided preferably through a contractor or departmentally, as the Municipal Corporation deems fit.

9.3.12 Collection of construction and demolition waste

1. The Municipal Corporation should prescribe the rate per ton for the collection, transportation and disposal of construction waste and debris and notify the same to the people.
2. Every person who is likely to produce construction waste may be required to deposit with the Municipal Corporation an approximate amount in advance at the rates as may be prescribed by the Municipal Corporation from time to time, for the removal and disposal of construction waste from his premises by the Municipal Corporation.
3. Such amount may be deposited at the- time when the building permission is being sought and in cases where such permission is not required, at any time before such waste is produced.
4. The charges for removal of construction waste to be doubled for those who fail to deposit the amount in advance.
5. To facilitate the collection of small quantities of construction and demolition waste generated in the city, suitable sites may be identified in various parts of the city and notified people to deposit small quantities of construction and demolition waste. Containers could be provided at such locations and small collection charge levied for receiving such waste at such sites and for its onward transportation. Rates may be prescribed for such collection by the Municipal Corporation. Contracts could be given for managing such sites.

9.3.13 Dairy and cattle-shed waste

The dairies and cattle breeders having sheds within the city limits should be asked to move the cattle sheds outside the city limits. Such waste producers should be directed not to stack the cow dung or other stable wastes within their premises or on the roadside for future use or for sale as it creates unsanitary conditions. They must, therefore, transfer the waste produced by them daily into the specified municipal storage containers nearby, which should be provided by the corporation to avoid unhygienic conditions.

9.4 Sweeping of streets & Public Places

Daily sweeping of public streets is essential where there is habitation close by isolated pockets or roads with little or no habitation around do not require daily cleaning but at the same time they cannot be ignored a schedule of street cleaning should be prepared, prioritizing the roads requiring daily cleaning and the ones which are need to be cleaned periodically.

Recommendations:

All public roads, streets, lanes and bye-lanes having habitation or commercial activity on one or both sides of the street should be cleaned on daily basis assigning clearly demarcated area to each sweeper and street sweepings should be deposited in the container placed at the temporary waste storage depot established in the city.

The following measures may be taken to ensure regular sweeping of streets and public places:

9.4.1 Street sweeping to be done on a daily basis.

Sweeping of the public roads, streets, lanes, by-lanes should be done daily if there is habitation or commercial activity on one or both sides of the street. A list of such roads and streets together with their length and width should be prepared and a program for their daily cleaning should be worked out by the Municipal Corporation keeping in view the norms of work (yardsticks) prescribed. Roads and streets with no cluster habitation which do not require daily cleaning may be put in a separate group and may be taken up for need-based cleaning on alternate days, twice a week, once a week or occasionally, as considered appropriate by the Municipal Corporation. Similarly a timetable should be prepared for cleaning of open public spaces daily or periodically to ensure that they do not become dump yards and remain clean.

9.4.2 All SWM services to be provided daily including on Sundays and Public Holidays

Working on Sundays

The generation of waste is a continuous process. As waste is produced each day, collection, transportation and disposal of waste is required to be done daily. There can be no holiday in street sweeping, primary collection, transportation, processing and disposal of waste.

The Municipal Corporation has devised a good system of giving two half days to the street sweepers instead of one full day in a week and thereby continued the round the year service. This system could be continued with the mutual understanding with the sanitation staff.

9.4.3 Substitution of Sanitation Workers

When any sanitation worker remains absent or proceeds on leave, alternate -arrangements must be made to ensure that cleaning is done as- usual. Badli workers or leave reserve could be used for this purpose. Any other satisfactory arrangements are currently in use for this purpose they only continue. Work must not suffer on account of absenteeism. Adequate leave reserve staff should be kept to ensure that a substitute is always available and the services become reliable. A 10% reserve staff may be kept on role for this purpose.

Looking to the requirement of 2100 sweepers for primary collection of waste, 210 sweepers should be kept as permanent relievers or leave reserve to meet the requirement of staff during their routine absenteeism.

9.4.4 Prevent Burning of Waste by Sweepers and the Public

Municipal Corporation should take measures to prevent burning of tree leaves and other waste by sweepers on the roadside and direct sweepers to take all waste to the communal waste storage bins/sites only. Action may be taken against the erring employees.

9.4.5 Tools to be given to Sweepers

Use of appropriate tool plays an important role in improving the efficiency of the work force. Presently most of the tools utilized by the sanitation workers are inefficient and outdated and need to be replaced by efficient tools and equipment. Traditionally the work force resists any change, even if it is for their good. Persuasion and awareness efforts will therefore be necessary to convince the workforce to adopt improved tools and equipment.

The following recommendations may be considered by the Municipal Corporation.

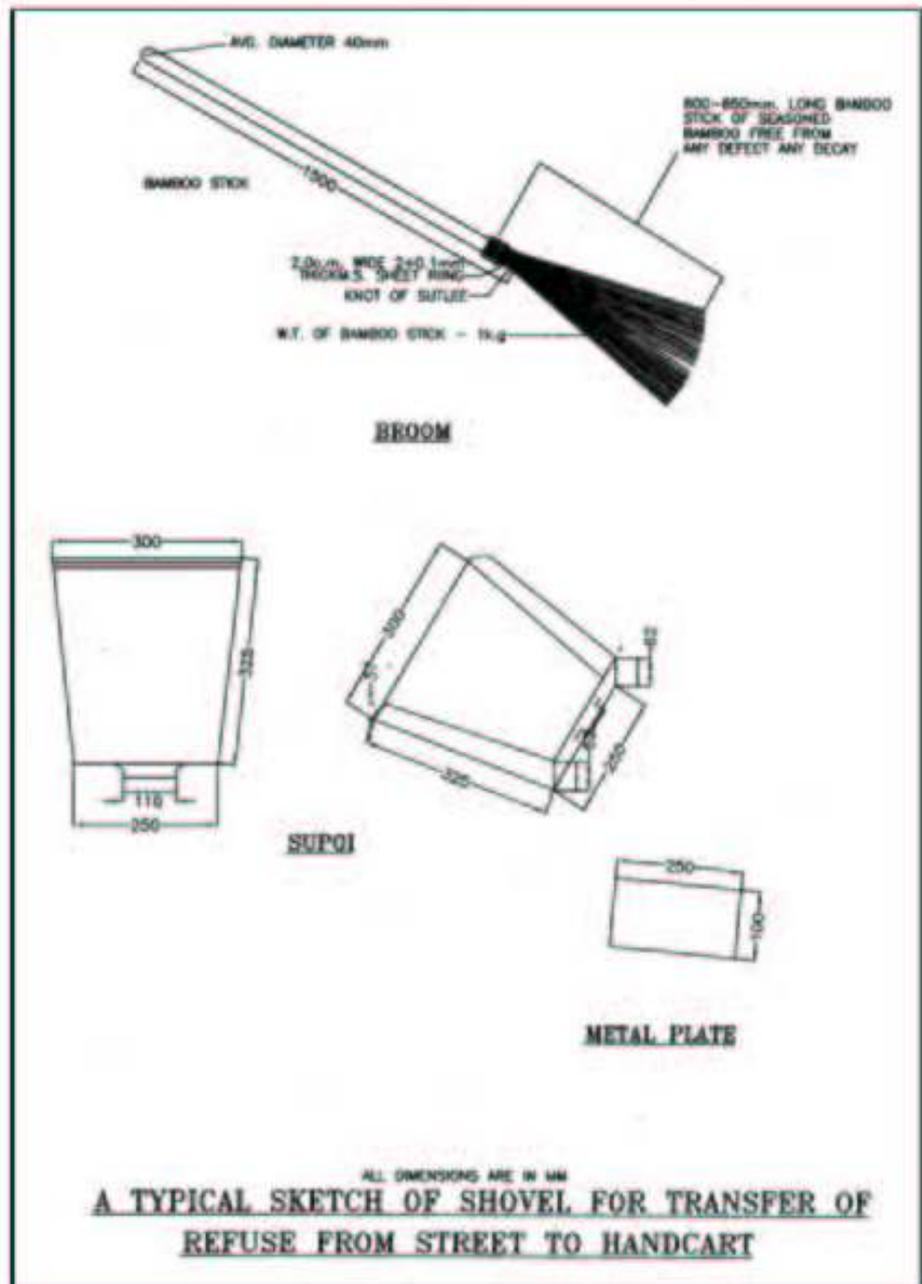
9.4.6 Brooms

Instead of using short handled brooms which require bending of the body while at work, cause fatigue to the workforce and causes back pain in the long run, the workforce may be advised to use long handled brooms as shown below which will not require bending, reduce fatigue and increase their productivity.

In cities where a broom allowance is given, or only broomsticks are provided to sweepers, they may be persuaded that long handled brooms may be used or made by them for street sweeping. While making such brooms, a metal blade which can scrape the material sticking on the street should be fixed on, the top of the broom, or a separate metal scraper may be given to the sweepers, to remove sticky material from the street while sweeping.

9.4.7 A long handled broom utilized for street sweeping.

There is no yardstick about the number of brooms to be given to sweepers per month. In some cities three brooms per month are given whereas in other cities only one broom is given per quarter of a year. One long handled broom per month is considered to be adequate for street sweeping. The bamboo (long handle) to which the broom is attached has a long life and can be reused for 612 months.



9.4.8 Metal Tray and Metal Plate

Each sweeper engaged in street sweeping should be given a metal tray and a metal plate for facilitating easy transfer of street sweeping from the streets into the handcart.

9.4.9 Hand-Carts/ Tricycles

Each sweeper engaged in street sweeping should be given a handcart leaving 4 to 6 containers or a tricycle having 8 or more containers of 30 to 40 liters capacity each as illustrated below, for ease of handling. These containers should be detachable to facilitate the direct transfer of street sweepings and household waste from the container into the communal waste, storage bins. Such containers should be lockable with a chain arrangement. The handcart should have at least 3 wheels with sealed ball bearings so that it can be used efficiently.

The Municipal Corporation has 2310 containerized handcarts and almost every sweeper do have such handcarts. However, more than 50% of hand-carts / wheel barrows are too old and need to be replaced therefore it is planned to replace each year about 10% which amounts about 275 wheel barrows per year.

9.4.10 Norms of work for Street Sweepers

Sweepers should be assigned fixed individual beats ("Pin-point" work) according to the density of the area to be swept. The yardstick of work may be prescribed by the Municipal Corporation depending on the local situation, type of roads and amount of effort required to be put in by the sweepers. However, the following guidelines may be considered while prescribing these norms:

- High density area = 300 to 350 running meters (RMT) of road length
- Medium density area = 400 to 600 running meters (RMT) of road length
- Low density area = 650 to 750 running meters (RMT) of road length.

The sweepers may be directed to sweep the roads and footpath(s) in the area allotted to them as well as collect the domestic, trade and institutional wastes in their handcart / tricycle from all the households, shops and establishments situated along, the stretch of road/street allotted to them.

Roads, which have a central verge or divider, should be considered as two roads. In such cases the length of the road allotted for sweeping should be reduced to half or alternatively separate sweepers may be engaged for sweeping two sides of the road.

The yardstick for cleaning open spaces should be prescribed based on local conditions. However, 30,000 sq.ft. of open space can be given to a sweeper for cleaning per day.

9.4.11 Cleaning the slums

The above sweeping norms are for cleaning the streets in the first 4 hours of the working day. In the remaining hours of the day, if there is a continuous 7 to 8 hours' duty, or in the evening spell, if there is broken duty, the sweepers should be assigned pin point work for cleaning the streets in slums and unauthorized settlements to ensure hygienic conditions in the city and prevent the problems of health and sanitation arising in such areas. Depending upon the density of slums, pinpoint work may be allotted to the sweepers keeping in view the above yardsticks.

9.5 Cleaning of Drains

9.5.1 Cleaning of Surface drain

In many part of the city there are open surface drains beside the road, into which quite often the sweepers and the public dispose of waste un-authorizedly. These drains need to be cleaned on a regular basis to permit free flow of wastewater. Action should be taken to ensure that sweepers and citizens do not dispose of any waste into drains.

Initially, drain cleaners reporting to the SWM department should be given the work of cleaning shallow surface drains (not more than 24" depth) up to 500 meter length per day and this length may be increased as soon as the discharge of solid waste into the drain is substantially reduced. Necessary tools should be given to the drain cleaners. They should also be given suitable seamless handcarts and shovels for transferring the silt to sites identified for depositing it. The periodicity of cleaning such drains should be worked out based on the conditions and frequency of clogging of drains. The Roster of Cleaning of such drains should be worked out and strictly followed.

Whatever waste is removed from the drains should not be allowed to remain outside the drain for long for drying. It would be desirable to deposit the wet silt into a seamless handcart as soon as it is taken out from the drain. If that be not possible or found difficult, the silt may be allowed to dry for about 4 hours outside the drain before transporting the semi-solid silt for disposal.

In special situations a maximum of 24 hours should be allowed for removal of such waste. Seamless handcarts may be used for transfer of silt from the surface drain site to the waste storage depot. Shovels should be used for transferring the contents from the seamless handcart or tricycle to a larger container kept at the temporary storage depot or communal waste storage site.

If this work can be contracted out the contractor should ensure that the silt removed from the drain is similarly lifted promptly and taken to the disposal site as per the terms of contact.

9.5.2 Removal of Silt from natural drains / Vonklas

In the wards where there are less slum pockets and there is a major problem of cleaning of nallas/vonklas, the afternoon hours could be utilized for cleaning nallas/vonklas in their respective beats. There are 19 small and big vonklas in the city, which could be taken up in a regular afternoon program, without creating any additional force in the city.

The city having 12 big nallas passing through the city, which are reasonably big and wide, a special long boom nalla cleaning machine should be procured by the local body to mechanically clean the big nallas besides using the existing staff for cleaning up the nallas passing through narrow areas or congested localities. The use of such machine will help in keeping the nallas very clean till such time, they are finally covered and the nuisances done away with.

9.5.3 Removal of Silt from Underground Drains/Manholes

The work of removal of silt from underground drains or manholes, storm water drains or surface drains deeper than 24", should be done by the Engineering Division of the Municipal

Corporation and this work should not be entrusted to the SWM department. The silt so removed should not be kept on the road/footpath for drying. This waste should be removed on the same line as suggested for silt removed from the surface drains. Wet waste only be removed immediately from the main roads and not less than in 4 hours and in other areas within 24 hours and taken to the disposal site to prevent nuisance and health hazards. This waste should not be taken to the compost plant, but may be used as landfill cover.

9.6 Provision of littering bins

For keeping the streets clean it is necessary, to provide facilities of litter bins all over the city so that people can deposit the litter in hand into such bins while on the move and keep the streets litter-free.

Recommendation:-

- **Adequate numbers of litter bins may be placed in areas at railway stations, bus stations, market places, parks and gardens and important commercial streets to prevent littering of streets and public places.**

The following action may be taken by the Municipal Corporation:

To enable citizens to dispose of their waste-in-hand such as used cans or cartoons of soft drinks, used bus tickets, wrappers -of chocolate or empty cigarette cases and the like, litter bins must be provided at all railway stations, bus stations, in all market-places, places where people gather or wait in queues and on important roads at reasonable distances ranging from 25 to 250 meters depending on local conditions.

The removal -of waste from these litterbins should be done by the pinpoint beat sweepers during their street cleaning operations. The waste from the litterbin should be directly transferred into the handcart of the sweeper.

Such facilities can be created at no cost to the Municipal Corporation by involving the private sector and giving them advertisement rights on the bins for a specified period or by allowing them to put their name on the bins as a sponsor. Litterbins should be put in posh as well as poor areas and the sponsor should put such bins in both the areas in the proportion decided by the Municipal Corporation.

Initially the local body may provide 1000 litterbins per year at strategic locations and its may be propagated and monitored. Later this facility may be extended to cover the entire city.

9.6.1 Temporary Waste Storage Depots for onward transportation of waste

The solid waste collected from the doorstep or from the community bin by the primary collection system has to be unloaded and stored at a convenient place for its onward transportation in a cost-effective manner. Temporary waste storage depots are, therefore, required to be created at suitable locations in lieu of open waste storage sites, black steel fabricated small bins. The Municipal Corporation may identify the locations where community waste storage facilities shall be created keeping in view the density of population and the quantities of waste to be deposited at each location.

The Municipal Solid waste (Management and Handling) Rules 2000 of Government of India have prescribed the compliance criteria for waste storage depots as under:

1. *Municipal authorities shall establish and maintain storage facilities in such a manner as they do not create unhygienic and unsanitary conditions around it. Following criteria shall be taken into account while, establishing and maintaining storage facility, namely:-*
2. *Storage facilities shall be created and established by taking into account quantities of waste Generation in a given area and the population densities a storage facility shall be so placed that it is accessible to users.*
3. *Storage facilities -to be set up by municipal authorities are any other agencies shall be so designed that wastes stored are not exposed to open atmosphere and shall aesthetically acceptable and user friendly.*
4. *Storage facilities or "bins" shall have "easy to operate" design for handling, transfer and transportation of waste. Bins for storage of biodegradable waste shall be painted green, those for storage of recyclable waste shall be painted white and those for storage of other wastes shall be painted black.*
5. *Manual handling of waste shall be prohibited. If unavoidable due to constraints, manual handling shall be carried out under proper precaution with due care for safety of workers.*

Keeping in view the above mandatory directions, the following recommendations are made.

Recommendations:

- **All open waste storage sites should be abolished expeditiously and all small unhygienic dust bins called black bins and other cement and masonry bins, if any, should also be replaced; in a phased manner by a temporary waste storage facility in the form of a neat mobile closed body large container or parked vehicle for temporary storage of waste through containerized hand carts/containerized tricycles etc., from the door steps and/or from the**

community bins for onward transportation of waste in a cost effective manner.

The following alternatives can be considered.

Provide large metallic containers (3 to 10 cu.mtrs) with lid at a distance not exceeding 250 meters from the place of work of the sweepers. The distance between 2 bins should, therefore, not exceed 500 meters. The distance between the bins can be determined on the basis of the load of garbage/refuse that is likely to be received at the container from the area concerned. The bins should be placed on cement concrete or asphalt-flooring having, a gradual slope towards the road to keep the site clean. The flooring should be flush with the border of the road to maintain hygienic conditions and.. Facilitate the transfer of waste from the handcart/tricycle into the container. A catch pit may be provided close by if storm water drain exists in the city.

A large container placed on a concrete floor at the waste storage depot in lieu of Street bins in lieu of open waste storage sites.

Estimated requirement of waste storage depots in the city

The quantity of waste generated in the city is stated to be 300 tons per day. This is based on volumetric/ high estimates whereas the actual weight of the solid waste transported per day have come out to be only 270 tons per day. Looking to the population of the city, if all the waste generated in the city are to be collected on day to day basis an arrangement of about 300 tons of waste per day is required to be done and the storage facility has to be created 'in such a way as to cover all the wards of the city appropriately.

Looking to a large number of bins in the city at short distances, it is considered desirable to abolish the waste storage depots at short distances as soon as door to door collection system becomes operational and the large containers may be placed at a distance of 500 metres two- 4.5 cumts. Capacity or one -7 cu.mt capacity. Therefore on an average 10 bins will be required per square kms .by following this yardstick. So for the city of Rajkot about 1000 bins of 4.5 cu. Mts capacity or 7500 of 7 cu.mts capacity are required to be placed in the wards. In another about 300 bins at other, strategic locations such as vegetable markets, slaughterhouse, cattle nuisance areas and other high-density areas having large commercial complexes or excessive generation of waste.

In all, the Municipal Corporation needs about 1300 4.5 cu.mts containers or 650 nos. of 7-cu.mts capacity. Out of this, the Municipal Corporation has 1337nos. 4.5 cu.mts. containers, which shows no need of any container, however more than 50 % of these bins are too old and are rotted and or burned , which are urgently required to be replaced. Therefore, about 250 additional containers are

required of 4.50 cumts size to make an adequate provision of storage of waste in this city for next three years including replacement.

9.6.2 Use of small vehicles for direct collection of waste from highly congested areas

In highly congested areas an option of using small vehicles for direct collection of waste instead of placing containers on the roads could be considered. Such vehicles can be parked at suitable locations in the congested areas where sweepers can bring the waste easily.

9.6.3 Small vehicle utilized for direct transfer of waste from the congested residential areas in lieu of placing large container.

9.7 Transportation of Waste

The system of transportation should be such that it can be easily maintained in the city departmentally or through private garages and the system should appropriately match with the system adopted for the storage of waste at the dust bin site i.e. at the temporary waste storage depots. Manual loading should be discouraged and phased out expeditiously and replaced by direct lifting of containers through hydraulic system or non-hydraulic device, or direct loading of waste into transport vehicles.

Mandatory provision on transportation under the Municipal Solid Waste (Management & Handling) Rules 2000. Vehicles used for transportation of waste shall be covered. Waste should not be visible to public nor exposed to open environment preventing their scattering. The following criteria shall be met viz.:-

- i. The storage facility set up by the municipal authority shall be daily attended for clearing of waste. The bins or containers wherever placed shall be cleaned before they start overflowing.*
- ii. Transportation vehicles shall be so designed that multiple handling of waste, prior to final disposal, is avoided.*

Based on the above mandatory provision of the rules. The following recommendations are made:-

RECOMMENDATION:

- Transportation of waste shall be done regularly to ensure that the containers /trolleys and dustbin sites are cleared before they start overflowing. The frequency of transportation shall be arranged accordingly. The system of transportation of waste must synchronies with**

bulk storage of waste at the temporary waste storage depots. Multiple and manual handling of waste should be avoided.

The following measures may be taken to meet the above objectives:

9.7.1 Domestic/Trade/Institutional Waste

The transportation of waste from the temporary waste storage depots/sites may be planned in accordance with the frequency of containers becoming full. The locations where the containers are placed may be grouped into four categories as under:

1. Containers which are required to be cleared more than once a day.
2. Containers which are required to be cleared once a day.
3. Containers to be cleared on alternate days.
4. Containers which take longer time to fill and need clearance twice a week.

9.7.2 Domestic Hazardous Waste.

These containers may be lifted as and when they are about to be full and should be handled by the corporation as per Hazardous Waste Handling Rules of Government of India under the guidance of Gujarat Pollution Control Board. No special vehicles may be used to lift the containers. These containers may be lifted in the third shift when required using the same dumper placer meant for transportation of domestic /institutional waste.

9.7.3 Routing of vehicles

Depending on the containers to be cleared each day, the route for lifting the container may be worked out avoiding zigzag movement of the vehicle to the extent possible.

9.7.4 Use Of Vehicles in Two Shifts

All the vehicles may be utilized in two shifts to lift containers, to ensure full utilization of the fleet of vehicles and to reduce the requirement of new vehicles.

Transportation of waste during night time may be done in areas where there is serious traffic congestion during the day and it hampers SWM operations. Work at night will increase the productivity and reduce the cost of the service.

9.7.3 Transportation of Waste from Hotels & Restaurants

The hotels and restaurants waste should be collected once or twice daily through a contract given by the association of hotels and restaurants, or at their request by the Municipal Corporation on cost recovery basis. Doorstep collection system may be introduced for the collection of this waste. Motor vehicle with close body may be used.. This entire collection and transport system could be privatized and rates may be prescribed by the association or Municipal Corporation. Initially four

large vehicles may be pressed into service and one spare vehicle may be kept to ensure reliable service. This work may be privatized. Local body need not make investment.

9.7.4 Transportation of Construction Waste and Debris

Disposal of construction and demolition waste and debris is the liability of the waste producer. If such waste is not promptly removed in a reasonable time prescribed by the Municipal Corporation, it may be removed by the Municipal Corporation on full-cost-recovery basis. One of the following methods may be adopted for transportation of construction waste and debris:

Skip-renting system for storage of construction waste may be introduced through private sector. The skips may be transported by hydraulic system at a time mutually agreed upon between the contractor and waste producer.

Till such time skip renting system is introduced, waste collection fees may be levied by the corporation or by the contractor authorized by the corporation for the removal of construction waste. Such wastes may be loaded into the trucks by using front-end loader with a combination of open three trucks, which can easily transport 100 to 150 tons of construction waste in one shift. Corporation may use existing JCB machines and tipper trucks for this purpose or contract out this service.

9.7.5 Transportation of Waste from Narrow Lanes

Quite often a small quantity of waste is disposed of in narrow lanes, which cannot be removed by sending out the usual transport vehicle. Loading rickshaws or traditional carts may be used for removal of such waste manually but very promptly.

9.7.6 Workshop Facility for Vehicle Maintenance

The Municipal Corporation must have adequate workshop facilities for the maintenance of their fleet of vehicles and containers, handcarts etc. Such facilities may be created by the Municipal Corporation departmentally or through a contractual arrangement. The workshop, public or private, should have adequate technical staff, spares and preventive maintenance schedules to ensure that at least 80% of the vehicles remain on the road each day and the down time of repair/maintenance is minimized to the extent possible.. Spare assemblies should be kept available which could be given as replacements until necessary repairs are carried out.

Team incentives should be introduced in departmental workshops for ensuring that more than 80% of vehicles remain on the road throughout the month.

The workshops should preferably be run in more than one shift. Technical staff as per the requirement may be kept in the second or third shift to ensure optimum utilization of the fleet of vehicles of the Municipal Corporation.

Since waste-transport vehicles have a useful life of 8-10 years, financial planning must ensure timely replacement of vehicles older than 10 years to minimize down time and repair costs.

Presently the Municipal Corporation has the central workshop headed by Dy. Executive Engineer (Auto) having the technical staff and the infrastructure facility. 50% of the work is done within the premises of the workshop 50% of the work is done from outside. However, interestingly all the hydraulic equipments are being maintained departmentally by the workshop. The workshop does not have the facilities of spare parts, stores, accidental job handling staff, upholstery work, auto electrical repairing, painting, rewiring, leaf spring/chassis repairing, fuel injection testing, service station operational staff and vehicle alignment and balancing- facility.

Looking to the above deficiency, either the corporation should upgrade the workshop and provide the staff according to the standard norms for running the workshop efficiently or contract out the activities of the workshop to a private sector to ensure that the workshop, which is the backbone of the solid waste management department provides services effectively.

9.8 Processing and Disposal of Waste

9.8.1 Development of Sanitary Landfill Site

Rajkot Municipal Corporation has established Integrated Solid Waste Processing Plant at Nakarawadi with the help of private operator. The plant capacity is 300 MTPD. It converts solid waste in to eco brick, fluff and organic manures. About 70 % of solid waste is being processed daily and remaining 30 % of waste is required to be disposed at land fill site. Though it is largely inert material it is desirable to design the land fill site as per CPHEEO guidelines and under expert supervision. This is a term often mistakenly used by Municipalities to refer to open dumping, presently the commonest method of waste disposal, which causes problems of sub soil water contamination. True sanitary land fills are for untreated mixed waste require impervious soil strata or liners at the bottom plus bottom piping for collecting and pumping out leachate for treatment and re-circulation, along with piping arrangements to collect, extract and use part of the methane gas generated in such anaerobic conations. The waste is also to be covered daily by soil or inert material in scientifically managed cells. These precautions are expensive but necessary.

As per MSW rules, 1999 recommendations_ “Land filling shall be restricted to non-bio degradable, inert waste and other waste that are not suitable either for recyclable or for biodegradable processing. Land filling shall also be carried out for residues of waste processing facilities as well as pre-processing rejects from waste processing facilities. Land filling of mixed waste shall be avoided unless the same is found unsuitable fro waste processing. Under unavoidable circumstances or till installation of alternate facilities, land filling shall be done as per specifications and means suggested in MSW rules, 1999”

9.8.2 Disposal of Slaughter house waste and Carcasses of Dead Animals:

The disposal of slaughter house waste and carcasses of dead animals should be done scientifically following the guidelines of Central Pollution Control Board as may be finalized and amended from time to time and the manual on solid waste management of the Govt of India should be followed for the purpose. This waste should not be mixed with municipal waste. This waste, wherever, possible could be converted in to useful product by installing carcass utilization plant. Therefore followings are the recommendation in this regards

1. Shifting of and developing new scientific Slaughter house
2. Installation of carcass utilization plant
3. Strengthening of picking up of dead animal bodies
4. Installing Dead animal incineration

10.1 General

Solid waste management is an obligatory duty of every Municipal Corporation. It cannot escape the responsibility of providing this basic service on the grounds of paucity of funds. The municipal corporation has to find or raise funds to maintain the minimum level of service. So therefore the identification of the key issues should be the given first priority.

The RMC shall make a serious endeavor to motivate households, shops and establishments not to mix recyclable waste with domestic food waste etc. and instead keep recyclable/non biodegradable wastes in a separate bin or bag at the source. Successful implementation of Short term Strategies and Long term Strategies is must for Rajkot city. These programs give numerous options by which coordination and cooperation among community and RMC can be strengthened. The municipal Corporation may therefore take the following measures simultaneously to find funds of SWM services.

10.2 Short term Strategies

1. Identification of key issues

- Enumerating the basic services, which the Municipal Corporation has to provide
- Put SWM service in that category as it is an essential service and obligatory for the Municipal Corporation to perform.
- Identification of key issues in providing basic services and preparation of plan.
- Identification of key holders and their role.
- Increasing the door to door coverage in city.
- Implementation of segregation at source so that waste handling cost of recyclable waste could be reduced.
- Increasing the efficiency of routing of the lifters for the container so that container is lifted daily.
- Educating people and increasing their awareness so that they could change their attitude towards waste management options.
- Put a ban on wasteful expenditure.

2. Inter - se priority among obligatory services

- Decide the minimum level of service the Municipal Corporation would like to provide in each category of service in a given time frame

- Estimating the requirement of funds for the same
- Fixing the inter-se priority of the essential service, giving due priority to SWM services and allocate funds for each service as per its merits.
- Decide the critical area in each service and utilize the funds to optimize the benefit of society

3. Improve collection efficiency

- Critically look into the existing efficiency of tax collection and collection of charges, fees and other income sources prescribed by the Municipal Corporation taking into account few target groups of higher income group.
- Identify the leakages or lapse in the system & plug the leakages and maximize the efficiency.
- Involving professional or private sector help in this area wherever required.
- Divert the additional funds generated through this effort to the essential services.

Note: *The revenues of the Municipal Corporation could go up to substantially through such efforts without any increase in the rates of or charges.*

4. Ngo/private sector participation

- Areas like collection of waste could be done by involving community participation or NGO/Private sector participation so as to increase the level of door to door coverage, and hence increase collection efficiency.
- Make a shift in policy. Instead of being a provider, be an enabler of the service, which can be given by the private sector or NGO or co-operative for a price to the people directly, to reduce the burden on the Municipal Corporation. In such areas, carefully monitor the performances of the NGO/Private sector to ensure required levels of service.

5. Review establishment costs

- Critically reviewing the establishment cost and the job requirements of officers and staff
- Fixing working norms carefully
- Reviewing manpower needs
- Reduction of surplus staff in some areas or it could be deployed in areas where there is shortage
- Effect economy in expenditure in all activities of the Municipal Corporation.
- All the efforts mentioned above will improve financial discipline and put the Municipal Corporation in a comfortable position to plan expenditure on essential items of work. The improved fiscal efficiency of a Municipal Corporation may even make it eligible for funding by financial institutions. Municipal Corporation should have a sinking fund for planned and timely replacement of vehicles and equipments.

10.3 Long term Strategies

- Development of Strategies based on future requirement and provision for fund required for capital investment in longer term.
- Identification of such stake holders with specific role for each stakeholders involved in Solid Waste Management.

1. Development of strategies

Present Solid Waste Management Plan was intended to support several important guiding principles,

- The 5R hierarchy of waste management: Reduce, Reuse, Recycle, and Recover, Residual Management.
- The Polluter Pay Principle.
- Bringing about fundamental changes in the way in which we think about and manage wastes.
- Having programs and systems flexible enough to accommodate and take advantage of future changes.

The development of a new Solid Waste Management Plan is divided into three stages.

Important things of the **Stage I** are as mentioned below

- Hiring an independent Project Manager for the Plan Review
- Forming the Local Solid Waste Advisory Committee comprised of roughly equal representation from government, industry and Non-Governmental groups, and the Technical Solid Waste Advisory Committee comprised primarily of municipal engineers
- Public consultation activities to inform the public of the Plan Review and solicit their input
- Conducting a Waste Flow and Recycling Audit to quantify the amount and composition of residential, industrial and construction wastes generated, recycled and disposed of by the Region. This Audit shall establish a baseline against which progress may be measured. Documenting of the baseline conditions and the existing solid waste management system after stage.

The important activities of the **Stage II** are as mentioned below:

- To evaluate the waste management options identified in the Stage 1 and recommend an overall solid waste management strategy. Evaluations were done on the basis of three major criteria: ability to divert waste from disposal, environmental and social impacts, and cost effectiveness. These will result in Comprehensive Waste Management Strategy.
- To conduct a comprehensive public consultation program to inform and solicit input from the public. The program will include television specials, newsletters and direct mailings, press releases, discussion papers, library reference centers, a Plan Review hotline, meetings and workshops for the advisory committees and the public, schools' activities, etc.

- Finalization of the solid waste strategy after having an critical examination of all the expert's reports

Stage 3 shall involve

- Preparation of the Plan in Plan Form according to the Requirements of Honourable Supreme Court Manual On Municipal Solid Waste Management, including the guidelines of GPCB

2. Involving community

- **Passing on the waste:** The most expensive way to collect waste is to sweep the waste from the streets. If the waste is kept in containers or bags that can be quickly emptied into the collection vehicle, the time spent in collecting it, and hence the cost, is greatly reduced. Somme collection systems require residents to bring the waste directly to a vehicle when it stops in the streets nearby. If residents cooperate in this way, the collection cost is less and streets are cleaner. Some systems require the waste to be kept within each property and brought out just before the collection vehicle passes, which will reduce the amount of waste that is scattered by animals and winds can be reduced.
- **Paying fees:** Another obvious and desirable form of community participation is payment for the service. Prompt payment reduces the cost of collection and interest charges, but obtaining any payment at all is often the best that one can hope to achieve. Measures to increase this sort of participation are obviously crucial to the success of any service that relies on direct user charges.
- **Complaints and Supervision:** Although complaints are rarely appreciated, they do provide a way of involving the community in supervising operations and maintenance standards. Supervisors cannot everywhere at once, so residents can provide some extra supervision provided they are encouraged to do so. Any complaint should be handled in a way that the complainant knows that the complaint will be followed up, and the action taken should be reported back to the complaint. Complaints can be about substandard service, or about inadequate storage facilities. Citizens should also be encouraged to report abuse of containers.

The involvement of residents, shopkeepers and the others can be particularly valuable in stopping illegal dumping of loads of refuse. Haulers are often reluctant to take the waste to the disposal site and may try to find a quiet place to unload it in order to save time. By informing the authorities of such places and perhaps, even identifying the offending trucks, private citizens can help minimize pollution of the environment.

3. Public information & education

The RMC along with NGO's cooperation and active participation will expand public information/education programs targeted at residential generators. All the stakeholders involved in the

SWM will develop coordinated formal communications plans and develop ongoing programs of audience research to support overall educational promotional campaigns. The Comprehensive Waste Management Strategies outlines the roles and responsibilities for expanded education in its Table. The above are in addition programs of residential communication and education, which include:

- Promote consumer conservation and reduction
- To develop the Reuse Program and to promote Reuse Guide
- Continue to promote practical Reuse actions through print and broadcast media
- Continue to develop and deliver Reuse presentations and workshops
- Continue to raise Reuse awareness through library displays and community outreach events
- Promote existing reuse, repair, renting and donation opportunities

Details of the programs of SWM plan	
Details of Work	Stakeholders to whom work is addressed
• Developing associated penalties for illegal dumping/burning	• All garbage haulers
• Developing revised disposal charges and surcharges	• Industrial establishments and garbage haulers
• Promote disposal bans	• All Municipal residents, especially Industrial establishments
• Prepare annual solid waste reports	• Staff of RMC involved in the SWM
• Describe centralized composting locations/operations	• All residents and Industrial establishments
• Develop programs to promote recyclable materials	• All residents
• Coordinate communications and education programs with RMC, private sector recycling firms, and non-profit organizations	• RMC, private organization and NGO
• Increase the general 3Rs awareness, especially, and community events and key community locations (e.g. libraries) - emphasize awareness leading to action	• All residents
• Continue school education program	• Teachers, school children, and parents
• Develop programs to promote backyard composting	• All residents
• Describe recyclables collection programs, including curb side pickup, depots, and composting facilities	• All residents
• Promote 3Rs awareness among targeted community, neighborhood, ethnic, or youth groups, emphasizing awareness that leads to action	• Targeted audience

Many organizations have already been conducting their own educational programs for some time. The intention of RMC shall be to recognize and encourage those organizations' efforts, and ensure that the governmental activities are compatible with and reinforce the nongovernmental programs, where appropriate. The RMC should inform and educate the appropriate target audiences of new initiatives

such as disposal bans and source separation requirements as they develop. This could be done, wherever practical, by including information about the new Plan initiatives and disposal alternatives into the existing communications vehicles such as the schools programs or Industrial workshops, and by the use of some new dedicated vehicles such as TV clips and newspaper articles.

4. Promoting backyard composters: Initially to promote back yard composting in small business houses or residential area, corporation or local government should initiate to subsidize the cost to some extent. The staff of RMC shall promote such programs and ensure that subsidies are distributed evenly.

5. Revival of taxation based on user fee systems: The Corporation shall implement quantity-based user fee systems for residential waste collection. In the longer run, the RMC shall add user fees for recycling and composting as appropriate. Quantity-based user fees for recycling and composting should be structured to create an economic incentive for residents to follow the solid waste hierarchy: reduction/reuse (no user fee), recycling (smaller user fee), and disposal (larger user fee). The quantity-based user fee systems shall be modified or replaced as funds or services from manufacturers' responsibility programs become available. The quantity-based user fee systems in the present proposed plan shall have variations to best accommodate the needs of each municipality. The manufacturers' responsibility programs expected from the senior governments should provide maximized contributions (in the form of funds and/or services) towards municipal 3Rs and waste collection programs. Ideally, the manufacturers' responsibility programs should eventually provide funds or services to cover all municipal waste management costs. However, any such costs that are not recovered via or borne by manufacturers' responsibility programs should be recovered via the user fee system (and not the municipal tax base, in the case of single-family residential waste). That is, for the short to medium term, until contributions from the manufacturers' responsibility programs begins, user charges should cover all of the costs for municipal waste management. The contingency, in the absence of manufacturers' responsibility programs, will be to have all the municipal waste management costs to be paid for by quantity-based user fees or utility charges (or by some combination of user charges plus municipal taxes in the case of single family residential sources).

6. Construction waste management strategy: The RMC in cooperation with private sector shall assess present and future construction waste management in the Rajkot. The private sector currently manages the majority of construction wastes and single-handedly it is not managing properly as the private bodies are responsible for the clearance of the construction waste. However, it is recognized that there is considerable movement of construction waste throughout the Rajkot and that a shortage of construction waste disposal options will occur as existing landfills close and restrictions on burning increase.

The Rajkot should examine and recommend action regarding:

- Impact of construction waste on city environment
- Available 3Rs options
- Use of construction waste as sub-base for construction
- Potential disposal and development sites
- Future generators of construction waste materials
- Expanded use of recycled concrete and asphalt regional and municipal roles in making source separation of waste happen.

7. Review, reporting and monitoring

The mechanism by which effectiveness of the management strategies and policies will be evaluated is as follows:

The RMC will implement their 5Rs initiatives, and will provide the with an annual summary of available information on:

- Municipal population figures
- Waste quantities and types received at disposal facilities
- Quantities and types of materials collected in municipal recycling programs and depots
- Measurement of impact of other initiatives, if possible other related information

While Industries and construction companies will also implement 3Rs initiatives, their annual summaries will not contain the degree of detail as the municipalities' summaries. The Industries and Construction companies will be expected to provide annual summaries of the total tonnages received, recycled and disposed, but provision of more detailed information such as breakdowns of material types and markets will be voluntary. Until all private disposal facilities install weigh scales, however, that information will have a significant margin of error. Private companies and individuals may supply information to the RMC that they expect to be kept confidential. RMC shall compile the annual summaries from the municipalities, and information from private facilities, and combine them with Regional 3Rs and disposal data, and generate an annual report that compares projected and actual waste diversion and disposal. Every 5 years, the annual report comparing projected and actual waste diversion will also contain an in-house reassessment of the RMC's solid waste quantities, composition, and other characteristics and their impacts on Regional and municipal programs. As an additional check of the review and reporting mechanism, the RMC shall establish a Plan Monitoring Committee (PMC) to monitor and advice on implementation of the Plan initiatives.

11.1 General

The term 'landfill' is used to describe a unit operation for final disposal of 'Municipal Solid Waste on land, designed and constructed with the objective of minimum impact to the environment by incorporating eight essential components as described by CPHEEO Manual, 2000. This term encompasses other terms such as 'secured landfill' and 'engineered landfills' which are also sometimes applied to municipal solid waste (MSW) disposal units. The term 'landfill' can be treated as synonymous to 'sanitary landfill' of Municipal Solid Waste, only if the latter is designed on the principle of waste containment and is characterized by the presence of a liner and leachate collection system to prevent ground water contamination.

- (a) Land filling will be done for the following types of waste:
 - (i) Comingled waste (mixed waste) not found suitable for waste processing;
 - (ii) Pre-processing and post-processing rejects from waste processing sites;
 - (iii) Non-hazardous waste not being processed or recycled.
- (b) Land filling will usually not be done for the following waste streams in the municipal solid waste:
 - (i) Bio waste/garden waste;
 - (ii) Dry recyclables.
- (c) Land filling of hazardous waste stream in the municipal waste will be done at a hazardous waste landfill site; such a site will be identified by the State Government and is likely to be operated by industries of a district/state. If such a landfill is not available, municipal authorities will dispose the hazardous waste in a special hazardous waste cell in the MSW landfill.
- (d) Land filling of construction and demolition waste will be done in a separate landfill where the waste can be stored and mined for future use in earthwork or road projects. If such a landfill site is not available, the waste will be stored in a special cell at a MSW landfill from where it can be mined for future use. Construction and demolition waste can be used as a daily cover at MSW landfills; however only minimum thickness of cover should be provided.

Municipal solid wastes have to be managed as per the framework of the Municipal Solid Wastes (Management & Handling) Rules, 2000 under Environment Protection Act, 1986. As per these rules, all the biodegradable municipal solid wastes shall be processed by appropriate biological processing method and only non biodegradable, inert waste will be disposed off in a landfill facility. In view of this RMC has requested National Productivity Council, Gandhinagar to conduct an Environmental Impact Assessment of its site (**Survey No: 222/P**) at Nakaravadi to assess its environmental suitability for development of an engineered Municipal Land Fill Facility (MLF). The Terms of References for Design of landfill site & EIA sets for following objectives _

1. To visit the proposed site, in order to assess whether the site confirms to the preliminary location criteria for site identification.
2. To collect the baseline information on the quantity of waste generation, type of waste.
3. To estimate the land area required for the disposal of the solid waste generated for 30 years.
4. To collect the information in and around the proposed site area limited to technical aspects such as Air, Surface Water, Soil, Geology, Hydrogeology and Meteorology.Ø To develop surface drainage pattern of the site area at regional and local level in order to ascertain the surface drainage run-on direction as well as magnitude
5. To develop the Land Use & Land Cover Mapping based on Remote Sensing IRS-1C
6. To carry out the Soil Investigation of the proposed site area.
7. To carry out the ambient air quality monitoring in order to ascertain the background contamination level.
8. To carry out the ground water quality monitoring in order to ascertain the background contamination level.
9. To assess potential impacts on all components of environment resulting from the construction & operation of a Municipal Landfill Facility.
10. To carry out Risk Analysis and suggest abatement methods for adverse environmental impacts likely to occur during the operation of Municipal landfill facility.
11. To help the RMC management in technical discussions with respect to EIA study and design of landfill with the Gujarat Pollution Control Board (GPCB).
12. To prepare a conceptual design of the proposed landfill facility required to be submitted to GPCB along with the EIA report

It may be noted that the site has been authorized by **Gujarat Pollution Control Board to set up and operate Waste Processing /Waste Disposal Facility vide their letter dated 31-12-2003.** (Pl. refer Annex.). The document submitted by the National Productivity Council, Gandhinagar is reproduced herewith as part of Rajkot SWM DPR.

11.2 Land Area Requirement

11.2.1 Calculation of Land Area Requirement

The solid waste generated from the Rajkot Municipality was based on the following method:

1. Present Solid Waste generation
2. Rate of Increment
3. Life of the Landfill Facility
4. Area Requirement for the development of infrastructure (Road, Green Belt etc)

Based on the present quantity of waste generation and annual increment which was estimated by **RMC**, the land area required for the development of the Landfill Facility (for 30 years) was

calculated. The area calculation included the buffer zone, no development area and the other infrastructure facilities.

11.2.2 Site Identification

Rajkot Municipal Corporation has identified one site at Rajkot (Nakarwadi) and proposed NPC, Gandhinagar to carry out the Environmental Impact Assessment of the same in order to establish its suitability for the disposal of Solid Waste. The site will be checked as per the "Location Criteria" developed by Ministry of Urban Development for the preliminary selection of site suitable for detail study.

11.2.3 Baseline Conditions

The information related to the geology, physiography, hydrogeology, meteorology, land use pattern and flood prone areas were collected from the various government agencies and institutions. This information is region specific and existing at State, District, Taluka, or Village level. The information was then interpreted with respect to the specific location of the site. The samples of ambient air, ground water and soil were collected and analysed as per the standard methods for establishing the baseline data and to evaluate the impact of solid waste dumping on the same. The Ground Water Flow Pattern and Surface Drainage Pattern were also prepared.

Ambient Air Quality

The ambient air samples were collected by High Volume Sampler near proposed disposal site by monitoring for 24 hours a day. The ambient air samples were collected and analysed for SPM, SO_x and NO_x.

Ground Water Quality

The water samples were collected from the bore wells around the study area. The water samples are analysed for **drinking water parameters** as stipulated in gazette published by Ministry of Environment & Forest (Sept'2000) in order to find out the background contamination, if any.

Soil Samples

The undisturbed soil samples were collected by Core Cutters as per IS Methods and disturbed soil samples by shovels at the depth of approximately 1.2-1.5 meter from the ground level. The soil samples were analysed to find out the geological suitability of potential disposal sites.

Ground Water Flow Pattern And Surface Drainage Pattern

The ground water flow pattern was established by taking depth of ground water at various wells in and around the study area and studying the Geology around the site. The surface drainage pattern was prepared by studying the various surface water bodies around the site as well as the general topography of the area.

Land Use Pattern

The land use pattern study was carried out in an area of 10 Km diameter around the site. The study included the following:

- Using Remote Sensing Imagery (IRS 1C).
- Interpretation of the Imagery
- Ground truth verification

11.2.4 Site Assessment and Selection

The collected information and the results of actual site sampling and monitoring done at and around the site are critically examined. The site is then evaluated based on the criteria developed by UNEP. This selection criterion was evolved to assess whether the proposed site is suitable for the disposal of solid waste based on various environmental parameters. The impact of the development and operation of the proposed landfill facility on the environment will be assessed based on the information collected as above.

11.2.5 Conceptual Design of the Landfill Facility

Based on the field investigation carried out at site and topographical maps of the area, the conceptual design of the landfill facility will be developed which is to be submitted to GPCB along with EIA report.

Waste generation encompasses activities at the end of which materials are identified as no longer being of value (in their present form) and are therefore either thrown away or gathered together for disposal. Municipal solid wastes are generated from various sources such as the Households which include kitchen & yard waste, Commercial centers such as shops, hotels & restaurant waste, Institutional areas including schools, hospitals & office waste, Construction or demolition sites such as building material waste and finally from the parks and streets such as sweepings & trimmings. All these activities produce waste, which are at present to a large extent not controllable.

The quantum of waste generated from the Rajkot Municipal Area is 300 TPD.

11.3 Land Area Calculation

The detail design of the proposed site is given below.

The total area required for the land fill site is mainly depends upon

- Present population of the city,
- Population growth rate,
- Quantity of solid waste generated,
- Characteristic of the solid waste,
- The active period for which the solid waste is to be dump,
- Area required for infrastructural facility.

As per 2001 census the population of the Rajkot city is 10.02 lacs which is growing at the rate of 4.05% annually. As per the house hold survey and actual quantification at Sold Waste Processing plant, it is observed that waste generation in Rajkot city is about 325 gm/capita/day. Integrated Solid Waste Processing Plant at Rajkot is operated by a private operator and is functioning very efficiently since December -2005. It is recorded that about 68 % of total waste is being processed and converted in to about energy pallet, manure green cock and eco bricks.

Estimation of the area, height and capacity required for land fill site. (Pl. refer CPHEEO Manul Annexure: 17.1)

- Present population = 1243250
 -
 - Average annual Growth rate = 4.00%
 -
 - Design active period =30 years.
 -
 - Present waste generation = 325 gms /capita /day
 -
 - Total waste generation per year at present = $1243250 \times 325 \times 365 / (1000 \times 1000)$
= 147480 tones
 -
 - Total biodegradable waste goes to processing plant is 68 % of total waste = 147480×0.68 tones
= 100286 tones
 -
 - Total non biodegradable waste goes to land fill site is 32% of total waste. = 147480×0.32
= 47194 tones
 - Estimated rate of increase = 4.00% (as same as popul.Growth)
 - Proposed life of land fill in year = 30
 - Waste generated after 30 years = 153068 tones
 - Total waste generated after 30 years = 3003929 tones
 - Total volume of waste in 30 years (taking density of the waste is 0.90 t/cum. As inert waste is more) = $3003929 / 0.85$
= 3534034 cum.
 - Total volume of daily cover in 30 years Taking 10 cm. soil cover for lift ht. 1.5m. = 0.1×3534034
= 353403 cum.
 - Total volume req. for liner system & cover system assuming 1.5mt. thick liner and 1mt. thick cover system and allowing the total ht. 10mt. so taking k = 0.25 = 0.25×3534034
= 883508cum.
 -
 - Volume likely to become available within 10 years Due to settlement, as waste having more inert material Taking m =0.05 = 0.05×3534034
= 176701 cum.
 - First estimate of landfill capacity = $3534034 + 353403 + 883508 - 176701$
= 4594244 cum.
 - Area required for land filling for 10mt. ht. = $4594244 / 10$
= 459424 sq.mt.
 - Area required for infrastructural facility = 15% of land filling area
= 0.15×459424
= 68914sq.mt.
 - Total area required = $459424 + 68914$
= 528338 sq.mt.
 -
 - Total area required in hectare = $528338 / 10000$
= 52.83 hectare
- Say = 53 hectare**

11.4 Environmental Settings

POTENTIAL LANDFILL SITE IDENTIFICATION

In order to select a site for conducting detailed Environmental Impact Assessment, one site was identified in the beginning as potential sites for waste disposal. The description of the site is as under:

Site No: 01

- Name of the Site: Nakaravadi
- Location: Near Pipalia Village
- Survey No: **222/P**
- **Total Land Area = 80 Hectare**

LOCATION / KNOCK OUT CRITERIA

A Location Criteria given in Guidelines developed for the Management of Municipal Waste by the Ministry of Urban Development was used to select the site on *prima facie* as the first step of site assessment and investigation. The objective of this step is to exclude the areas, which can be discarded for the setting up of landfill. The selection of an appropriate site for a landfill is dependent on several criteria, some of which absolutely exclude the possibility of establishing a landfill in certain sites.

The following key factors are considered in evaluating these criteria :-

- Existing or planned drinking water protection and catchments areas
- High flood prone area
- Area with unstable ground like swamps , moors and / or marshes
- Areas with an extreme morphology (steep slopes, danger of landslides or avalanches etc.)
- Areas endangered by swallow holes, collapse sites, deep digging etc.
- Areas nearer than 500 meters to populated areas
- Closer than 100 meters to river boundaries
- Areas nearer than 20 km to airports
- National parks, nature protection areas and nature monuments, areas with a large number of fauna and flora
- Historical, religious or other important cultural sites or heritage

APPLICATION OF LOCATION CRITERIA

The site was tested as per the Location Criteria to verify whether these sites satisfy the criteria mentioned in the Guidelines. The assessment of the site is given in tabular format in **Table 03**.

Identification		Site No:01	
Location of Site		Nakaravadi site,	
Village/City		Near Pipaliya village, Rajkot	
SI No	CRITERIA	ANSWER	REMARKS
		YES/NO	
01	LF location should not be less than 200 m from lake or pond	Yes	Not Existing
02	LF location should not be less than 100 m from a river or 30 m from non meandering stream	Yes	Not Existing
03	LF location should not be within a 100 year flood plain	Yes	No Flood Plain
04	LF location should not be less than 200 m from National / State Highway	Yes	Dist: >200 m
05	LF location should not be less than 500 m from a notified habitated area.	Yes	Dist: >500 m
06	LF location should not be less than 300 m from a public park	Yes	Not Existing
07	LF location should not be within the wetland, critical habitat area, reserved forest, coastal regulation zone.	Yes	Not Existing
08	LF location should not be less than 20 km from the airport	No	Dist=10 km
09	LF location should not be less than 500 m from the water supply well.	Yes	Dist:>1 km
Site is suitable for detailed EIA study (Y/N)		Yes, with requisite approval from airports authority	

Note:

1. The site also does not meet the **Distance from the Airport criteria**. Hence it is required that necessary approvals be taken from the regulatory agencies (Aviation Authorities) before proceeding with the development of the site. The nuisance to the airport if any from this landfill can be mitigated with proper operational and management practices. RMC has already applied for Airport Authority NOC.
2. In spite of the above, the detailed assessment of the site has been taken up as it has been identified by the Rajkot Municipal Corporation for development of the Municipal Landfill Facility and necessary authorization is given by Gujarat Pollution Control Board.

Planning of land fill

1. Considering the high ground water table and to reduce the earth cutting it is proposed that the land fill will be designed mostly above ground level
2. The below ground level depth will be 1.0 m

3. The maximum height of the landfill above the ground level will not be more than 10 m. However to achieve the total height of 10 m each of the whole landfills have to be developed completely and to be operated as single unit rather than in small cells.
4. The base of the landfill will follow the average slope of the landfill to minimize the earthwork and take advantage of the sloped topography for leachate collection and drainage.
5. Gross size of sites are as follow:
 - Site A : Rectangular 280 m x 230 m , area = 64400 sq/ m = 6.4 ha
(Approximate life= 7-8 years)
 - Site B = Rectangular 320 m x 180 m , area = 57600 sq/ m = 5.76 ha
(Approximate life= 6-7 years)
 - Site C = Rectangular 500 m x 300 m , area = 15,0000 sq/ m = 15 ha
(Approximate life= 15-16 years)
6. The landfill will be so planned that the average slope of the bottom of the landfill is same as that of average slope of the site
7. Average slope of the even portion of site A = 3.9 %, Hence, the proposed slope of the bottom landfill A is fixed at 4 %.
8. Average slope of the even portion of site B= 3 %. Hence, the proposed slope of the bottom of landfill A is fixed at 3%.
9. Average slope of the even portion of site C= 2 %. Hence, the proposed slope of the bottom of landfill C is fixed at 2 %.

Landfill Capacity

“The total size of the landfill area = 80 Ha. Out of which about 17 Hectare is reserved for Solid Waste processing plant and future need. Hence available landfill site area is about 53 Hectare.”

11.5 Landfill Layout

The site lay out has been designed with the landfill's closure and end use closely in mind. As this decided the final shape or the contours of the landfill. The landfill broadly consists the following in its proposed area:

- Body of the Facility where disposal will take place
- Supporting Infrastructure for smooth functioning of the facility

At first the plane table survey or topographical survey has been carried out to fix the boundary and the physical landmarks on the site. From the total area available the area of the proposed facility is cut as per the requirement. This is shown in **Drawing No : 01**. The plan of the Landfill facility is shown in **Drawing No : 02-04**

The supporting infrastructures have been decided based on the following:

- Size of the facility
- Volume of waste it is going to handle
- No of trips the vehicle will make on daily basis
- Loading and Unloading conditions
- No of rainy days
- Recording requirements
- Legal requirements

Based on the above requirements, the following infrastructures facilities have been proposed:

1. Fencing/ Boundary
2. Entry & Exit Gate
3. Site Access Road
4. Car & Bike Parking area
5. Weighing Scale
6. Earth Moving Equipment Shelters
7. Administrative Building
8. A small waste Inspection Laboratory
9. Temporary Waste Storage & Disposal Site for special waste
10. Areas for stockpiling Cover & Liner Material
11. Drainage facilities
12. Lechate collection sump, and treatment facility
13. Water supply facility
14. Electricity Connection
15. Green Belt
16. Location of Monitoring Well

It may be noted that the listed infrastructure facilities are given in **Drawing No: 10**. These are to be constructed as part of the development of the Integrated Solid Waste Disposal Facility

11.6 Land fill Section

In deciding the section of the landfill facility, the following data have been taken into consideration:

- Topography of the proposed Site (Undulating based on the site investigation).
- Depth of Ground Water Table (2 m below Ground Level during post monsoon phase)
- Proposed Height of the Facility (10 meter minimum-above the ground)

Based on above information, it has been decided to go for a Landfill which is above the ground. A typical schematic diagram of such a facility is described as under:

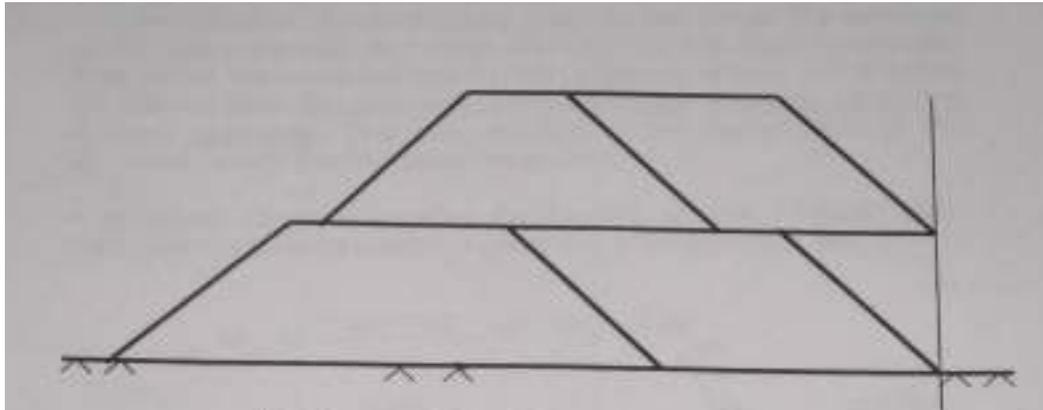


Fig 01: Above Ground Lanfill Facility

11.7 Phases of the Land fill

The proposed landfill facility has to be constructed and operated in various phases as it allows sequential use of the use of the landfill area. This facilitates the following activities for smooth functioning of the facility. At any given point of time the following four operations could be envisaged:

- Part of the Facility is having final cover
- Part of the Facility is being actively filled
- Part of the Facility is being prepared to receive the waste
- Part of the Facility is undisturbed

For ease of the operation of the landfill facility, it has been decided to split the proposed landfill area into Three Phases (Sub Area). Where as the fist two phases will be used for the dumping of the waste, the last phase will be used to construct the infrastructure facilities. Each Phase (Phase-I & II) of the landfill facility will accommodate waste as given the landfill has to be closed/ insulated by putting the final cover. The final cover subsequently in this section. The Each phase of the facility will have the following components:

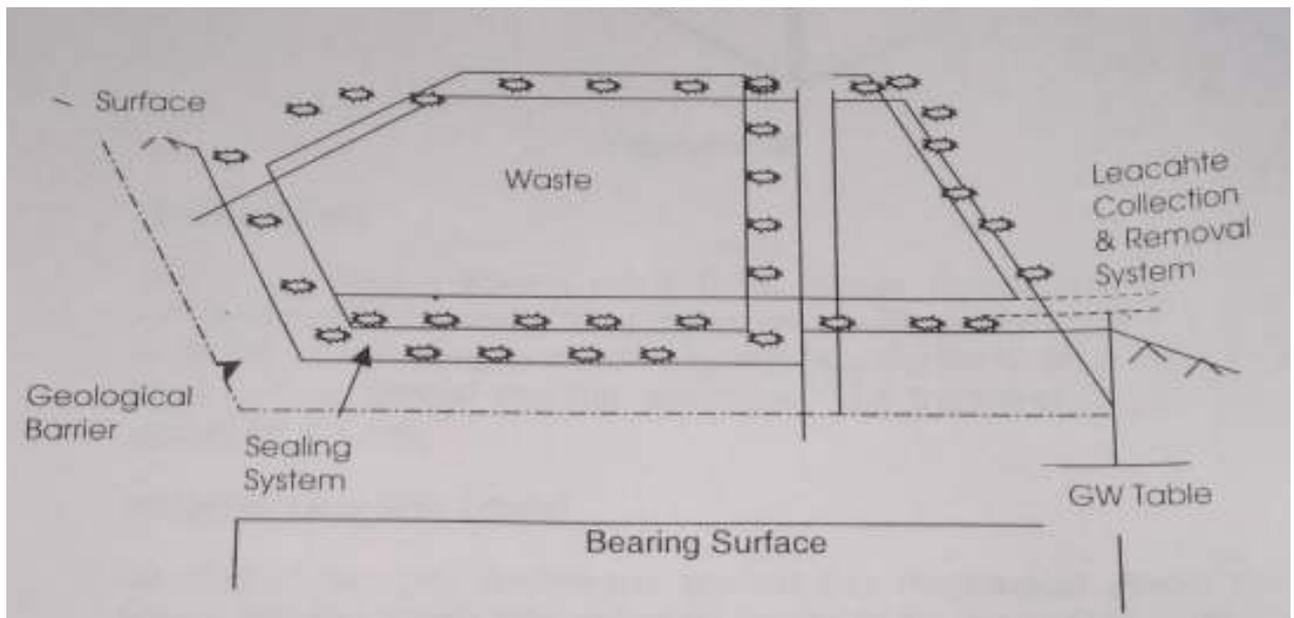
11.8 Liner Systems

11.8.1 Design of Seperation

Several precautionary measures must be taken in order to ensure environmentally safe landfill disposal of Municipal solid waste. To minimize the potential impacts on the ground water, surface water, percolation of the leachate into the ground water must be avoided. Therefore, it is imperative to have a proper sealing system of the landfill facility.

As per the guidelines on Municipal Landfill Facility, an acceptable physical separation should exist between the proposed waste body and the wet season high elevation the ground water. This applies whether the cover excavation take place on site or not. The minimum permissible separation is 2 meter. However, here in the proposed site area where the maximum ground water table is at least 2.0 m below the Ground level, the proposed separation is just adequate as per the national regulation. This has resulted in the construction of the Municipal Landfill Facility above the ground.

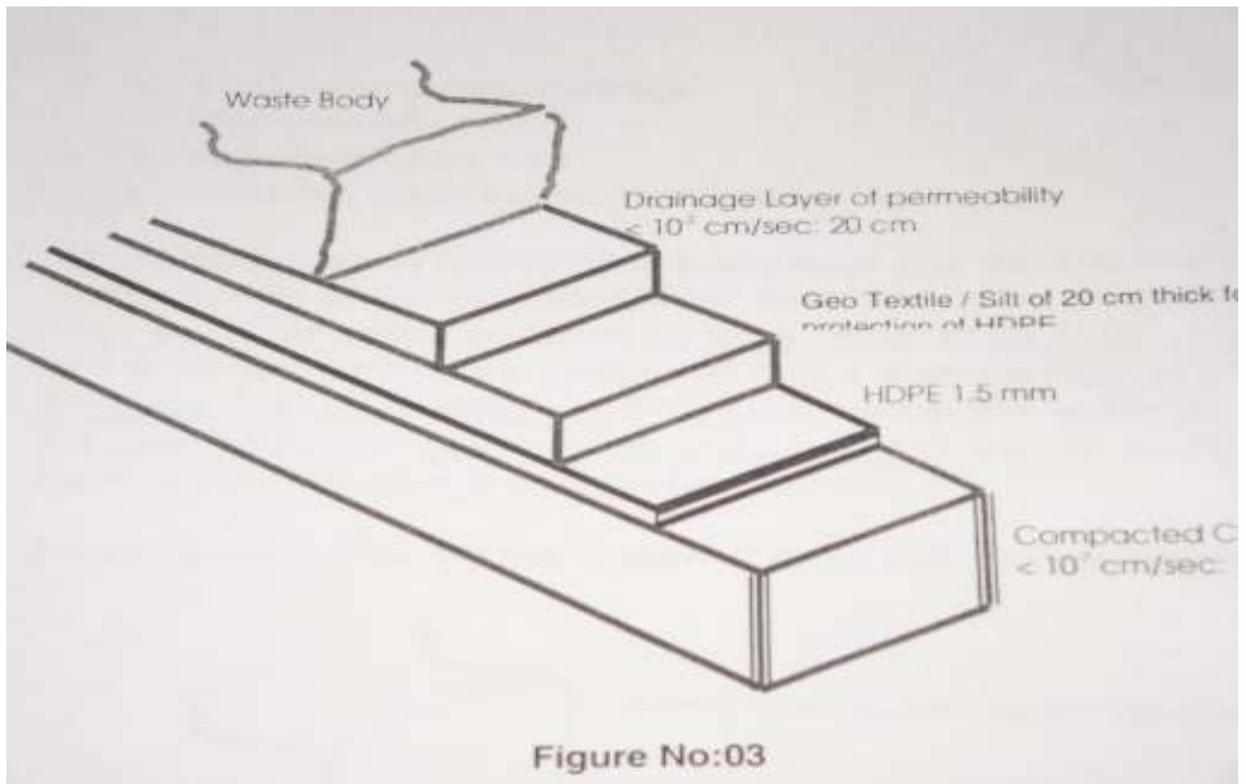
A schematic diagram showing the bearing surface, Ground Water Table and the Sealing System is given below in **Figure No : 02**



11.8.2 Bottom Liner System

11.8.2.1 Minerallic Liner

The lining system is additional to the separation or unsaturated zone comprising soil or rock between the wet season high elevation of the ground water and the landfill. These liners consist of native clayey soil/ amended soil/ admixture soil. The permeability of the soil / amended soil should be less than or equal to 1×10^{-7} cm/sec. Careful consideration has been made in selecting the liner considering the availability of a huge quantity of clay. Instead the management may go for 6 mm thick Bentomate as an alternative to the 0.9 m thick clay liner. This is a geo-synthetic clay liner constituting of Bentonite sandwiched between Geotextiles. A cross section of the bottom liner system is given below in **Figure No : 03**



11.8.2.2 Geomembranes

These are flexible sheets made from various plastic material. The recommended liner along the side as well as the bottom of the facility is HDPE. HDPE lining is effected by overlapping the strips and joining them with a special welding technique. The thickness of the liner should be 1.5 mm

11.8.2.3 Protection Layer (Geo Textiles)

To protect the geo membrane against the mechanical stress and failure thereby, either silty soil of 20- 30 cm to be put or Geo textile to be used.

11.8.2.4 Drainage Layer

The landfill facility essentially generates significant quantity of leachate due to biodegradation of the organic matter present in the waste body. These leachate are impregnated with harmful chemicals and pollutants. These are to be collected, removed, from the facility and treated. In order to collect the leachate from the waste body a drainage layer of 30 cm granular material of permeability $> 1 \times 10^{-2}$ cm/sec is put over the protective layer of Silt/ Geo textiles.

11.8.3 Top Liner System

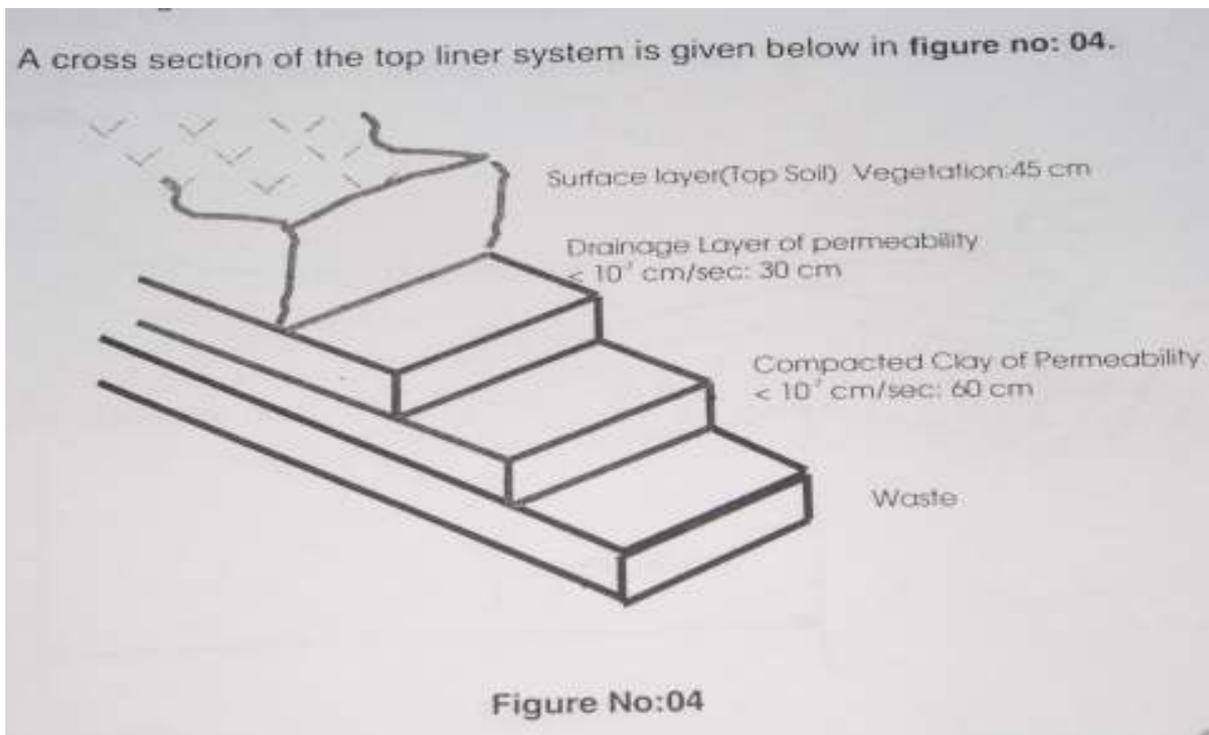
After the completion of each phase of the operation, the landfill has to be closed/ insulated by putting the final cover. The final cover has the following advantages:

- it enhances surface drainage
- minimizes infiltration
- vegetation grows on it
- controlled release of the landfill gas.

As the landfill site at Nakrawadi is a very large site, the following final cover system is recommended. Over the waste body or compacted clay / amended soil of thickness 60cm and permeability 1×10^{-7} cm/sec has to be laid. Beyond the compacted clay a drainage layer of 30cm

thickness and permeability 1×10^{-2} cm/sec will be laid uniformly. And the final vegetative cover or top soil of 45cm has to be put for restricting the soil erosion from the final cover.

A cross section of the top liner system is given below in **figure no:04**



11.9 Side Soil Bund

Side soil bund has to be constructed for resisting the sliding of the waste along the slopes. The height of the soil bund has been restricted to 2m.

11.10 Leachate Drainage, Collection & Removal

In order to collect and convey the leachate generated to the collection sump, a leachate collection system has been designed. It comprises of the following:

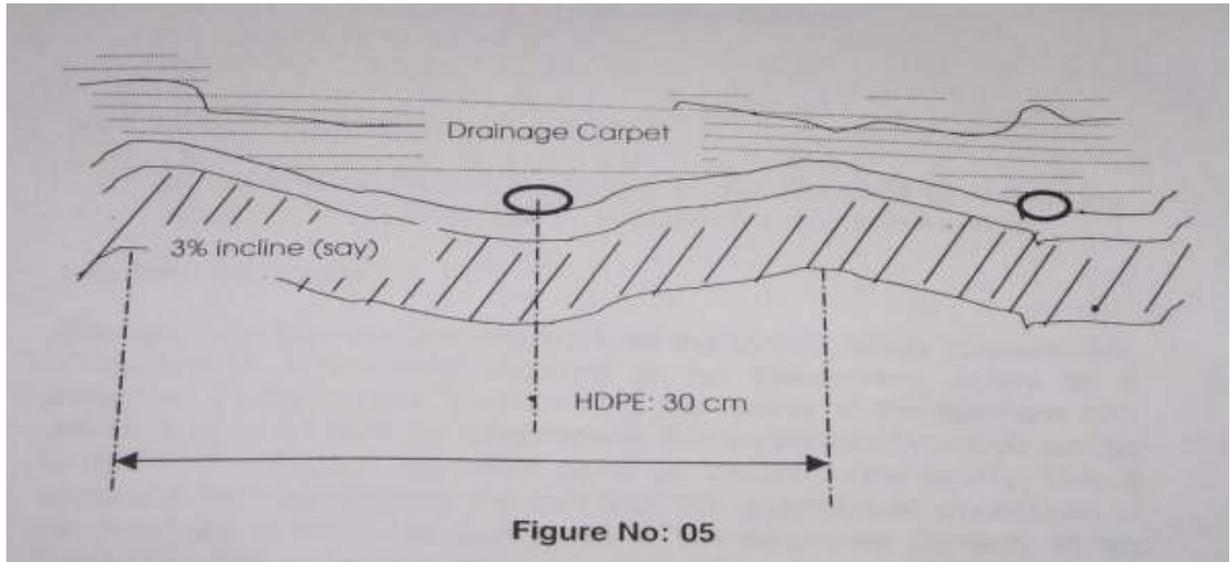
- drainage layer
- A perforated Pipe Collector System
- Sump Collection Area
- Removal of the leachate

The leachate drainage is usually achieved using graded under-liner and drains which lead to a collection system or a sump. The technical details of the leachate drainage are as under:

- Thickness of the Drainage layer : 20cm
- Material: Granulated Material/Sand
- Permeability: 0.01 cm/sec

The generated leachate will be collected in the channel due to bottom transverse slope of the site and conveyed to the sump via collector pipe due to the longitudinal slope of 0.5% (max) by gravity.

A schematic diagram of the leachate collection is given below in **figure no: 05**



The layout plan for leachate conveyance system is comprises of the following:

- Central Leachate carrying pipe in conjunction with the drainage layer slope (As per site conditions).
- Estimation of pipe diameter based on the leachate quantity.
- Design of slope of Leachate pipe.

11.10.1 Leachate Pipe:

Leachate pipe is designed covers two factors such as teh length of the pipe, dia of the pipe

- The length of the leachate collector pipe is as per the drawing no:08 longitudinal slope of 0.5% (Start to end elevation diff: as per the site geometry)

11.10.2 Pipe Diameter, Material, Size, Thickness & Perforations:

- The pipe diameter, pipe spacing are governed by the leachate head. The following specifications have been recommended;
- The diameter of the drain pipe: 300 mm (Recommended)
- Thickness of pipe (Wall thickness): 15mm
- Diameter of the perforation should be governed by the equation:

$$d_{es} \text{ (of filter) / Hole Diameter} > 1.0$$
- Recommended diamter of the hole : 15mm
- Spacing between two consecutive holes: 100mm
- Material of construction: HDPE
- Mechanical Strength: > 15T/m²

11.10.3 Leachate collection sump:

A leachate collection sump has to be designed to collection the leachate from the facility and transfer the same to the ETP

11.11 Leachate Management

The leachate that will be collected from the landfill facility contains lots of pollutants and hence required to be transported safely to a treatment facility for the treatment. As the quality of the leachate that will be generated from the operation of the landfill facility will be similar to that of the effluent, the same could be treated in the facility. This is more justified considering the fact that the quantum of generation of the leachate is very less compared to the treatment capacity of the leachate is very high and the treatment plant also looks inadequate, the leachate could be stored in a Holding tank. It is recommended that any drain whether open or covered, that is used to transfer the leachate from the leachate collection system to the leachate pond or to the treatment plant must be properly lined. This should be by means a properly laid 1.5mm thick geo membrane liner with joints welded to the same specification.

11.11.1 Surface Water Drainage System:

The surface water drainage system is designed for two purposes:

- Runoff from the surrounding areas do no drain into the active filling area there is no water logging/pomading over the final cover of the landfill facility

11.11.2 Landfill Equipment:

The landfill equipment's required for the handling of 100 to 150tpd wastes are as under in table:

Name of Equipment	Purpose	Hours of Movement	Nos.
Bull Dozers	Spreading the waste and daily cover	02-03	1
Landfill compactor (12-30 Tones)	Internal movement of the waste and daily cover	02-03	1
Water tankers	Spraying water for deducting operation	As required	1
Steel Drum Roller	Finishing phase operation	-----	1

11.12 Design of Environment Monitoring System

The basic aim of designing the monitoring system & programme is to ensure the following:

- Whether the landfill is performing as designed?
- Whether the landfill is conforming to the regulatory environment standards?

The monitoring programme could broadly be divided into two categories:

- Monitoring of the ground water quality.
- Stability of the slopes/embankments

Monitoring of the ground water quality will be carried out at the following places

- Inside the facility.
- Outside the facility

11.13 Quality Assurance Plan

11.13.1 Quality Assurance Principles

Quality in construction of the municipal land fill facility has to be insured to match highest standard. The basic purpose is to minimize the possibility of deviation from design specifications. To ensure the quality of the overall structure of the municipal land fill facility, the individual components must meet the quality standards. Quality assurance must relate to both the quality of the materials used and the workmanship in accordance with the existing state of technology.

Quality assurance is particularly important during the use of mineralic clay in land fill sealing system. The clay must confirm to the quality specifications described in the tender document. Therefore, at each and every stage of construction, the construction procedure, specifications of materials used and the test results have to be documented.

The quality assurance planning mainly involves :

- Quality assurance before the start of construction
- Quality assurance during the preparation of clay
- Quality assurance during the placement of clay in the land fill
- Quality assurance during construction for site development
 - Documentation
 - Checking

11.13.2 Quality Assurance Planning before start of Construction.

Before start of construction activity, client shall finalise the source of raw materials to be procured from. Later on there should be no change, which can affect the quality of construction. The following are the test to be conducted before start of construction:

1. On existing soil
 - Classification test
 - Atterberg's limit
 - Permeability test
 - Density test
 - Moisture content
2. Mineralic clay to be used for bottom and side liner system
 - Permeability test “ as compacted – then – saturated” samples : using flexible – wall permeability as per ASTM:D:5084 or by using consolidation cell permeameter (Olson and Daniel (1979)).
 - Density test as per IS 2720 (part 28,29,34)
 - Moisture content as per IS 2720 (part 2)

- Grain size distribution as per IS 1498 and IS 2720 (part 4 & 5)
- Strength parameters “as – compacted – then saturated” as per IS 2720 (part 10,11,12)
- Atterberg’s limit

3. 1.5 mm thick HDPE Geomembrane

Specifications

The geomembrane is normally expected to meet the following requirements :

- Thickness test $\geq 1.5\text{mm}$ (impervious)
 - Density test $\geq .94\text{ g/cc}$
 - Tensile test at yield $\geq 18\text{ KN/m}$
 - Tensile strength at break $\geq 30\text{ KN/m}$
 - Tear resistance $\geq 150\text{ N}$
 - Puncher resistance $\geq 250\text{ N}$
 - Chemical resistance
- } (Durability &
Resistance
proof quality)

The following components have to be designed/ checked for in the case of geomembranes :

- Anchor Trench
- Sliding along Slopes
- Allowable weight of Vehicle
- Uneven settlement
- Panel lay out plan

Test of several physical properties of the membrane must be performed before installation. Usually most of these tests are performed at the time of manufacturing in the manufacture’s laboratory. The owner may arrange for an independent observer to oversee the tests , conduct tests in an independent laboratory, or use a ‘split sampling’ technique. These issue of responsibility for pre-installation quality control test must be clearly mentioned or resolved during the binding process. The following are tests used for quality control purposes :

- Sheet thickness
- Puncture resistance
- Tear resistance
- Dimensional stability
- Density
- Low temperature brittleness
- Peel adhesion
- Bonded seam strength

4. 1.5 mm thick Geotextile

- Type (should be non woven, needle punched)
- Mass per unit area $> 500\text{ gm/sq.m}$

The geomembrane bid specification should include warranty coverage for transportation installation and quality control tests. The cost of project may increase due to the warranty. The experience of the company (both in manufacturing and installation), quality control during manufacturing and installation, physical installation should be asked in the bid so proper comparisons among different bidders can be made

5. Hard soil for sub base and for soil burned
 - Density
 - Grain size distribution
 - Atterburg's limit as per IS 2720 (part 5)
 - Strength parameters “ as compacted-then-saturated” as per IS 2720 (part 10,11,12)
 - Compressibility parameters as per IS 2720 (part 15)
 - CBR ratio
 - Moisture content

6. Gravel (for drainage layer)
 - Shape of particles (round shape)
 - Grain size distribution (6mm to 12mm)
 - Constant head permeability $\geq 1 \times 10^{-2}$ cm/sec, as per IS 2720 (part 30 & 37)
 - Relative density test as per IS 2720 (part 14)
 - Shear strength as per IS 2720 (part 13)

7. HDPE pipe (leachate)
 - MFI
 - Density
 - Wall thickness
 - C.B.C.

11.13.3 Quality Assurance During The Preparation of The Clay Liner

Clay Liner

Specification

The criteria for choosing clay is primarily based on the compacted permeability achievable under field condition .

The selection of material to be used as soil barrier layer will usually be governed by the availability of materials as given in the specifications.

Usually a soil with the following specification would prove suitable for liner construction. In case of the absence of the clay of such properties, the workable range is also given.

- Liquid limit > 30% (25 – 30)
- Plasticity index > 15% (10 – 15)
- Plastic limit > 10 (10 – 15)
- 50% fraction < 0.074mm (40 – 50)
- Clay fraction > 25% (18 – 25)

From the above, it is recommended that the permeability of the available soil could be achieved with addition of bentonite or other materials such as lime. The procedure for the same is described below.

Amended Soils (Compacted Clay)

In-situ available soils may be mixed with medium to high plasticity imported clay, or commercial clays such as bentonite, to achieve the required low hydraulic conductivity. Soil bentonite admixtures are commonly used as low permeability soil liners. The local soil requires 5 to 10 percent by dry weight of bentonite. The most commonly used bentonite admixture is sodium bentonite.

Medium to high plasticity clays from not too distant areas, can also be imported and mixed with the local soils. Usually high quantities of clays (10 to 25 percent) are required to achieve the required permeability.

Specifications

A competent barrier made of compacted soil – clay or amended soils – is normally expected to fulfill the following requirements:

- Hydraulic conductivity of 10^{-7} cm/sec or less
- Thickness of 90 cm
- Absence of shrinkage cracks due to desiccation
- Absence of clouds in the compacted clay layer
- Adequate strength for the stability of the liner under compressive loads as along side slopes and
- Minimal influence of leachate on hydraulic conductivity

Quality for the Raw Materials

Before the preparations of the clay liners the materials for mix shall be prepared as per the specification mentioned. The soil may be sieved and segregated separately based on their size, later on from the segregated material the aggregate shall be mixed in percentage as per the specification

A sample of aggregate shall be taken for testing before it is used for preparation of desired clay.

The testing shall be done by two parties

- By RMC
- By contractor

After the test result obtain the above two parties and finds suitable as per the specifications, then only the material has to be used for preparation of clay liner

Design Process

The design process for a compacted soil liner consist of various steps

Test Reports

The evaluated results of the test which are carried out during and after placement of clay are documented on paper by contracting firm. A note is made of the deviation. If any, from the desired values. The delivered batches of the mix are matched with the retained samples at the construction site, and the remarks are noted on the construction plan. The copy of test report should be submitted by the RMC to the NPC office for checking of the finished work. The report has to be preserved.

Test Landfill

A test field will be constructed to check whether under the prevailing local conditions the placement of the mix as per the composition specified in the design.

Quality Assurance during the placement of clay liner into the land fill

Placement of clay is carried out by using finishing machines or pavers, which can ensure a uniform distribution and good precompaction in presence of experienced personal.

Following points has to be considered while placement of clay

- Adequate load bearing capacity of sub grade
- Dry weather conditions
- No deviation for sub grade from design values
- An adequate bounding of lower layer of sealing layer with base layer

11.13.4 Quality Assurance planning during construction activity

During construction activity, RMC shall arrange for conducting for entire required test at each stage of construction in time.

- a) During placement of hard soil for sub base (with murrum)
Total thickness = 30 cm (placing in two layers of 15 cm each)
The following tests to be carried on each layer :
 - In situ density test as per IS 2720 (part 28, 29 and 34)
 - Total number of density test 32 (16 on each layer)

- In situ water content as per IS 2720 (part 2)
- Total number of water content test 12 (6 on each layer)

b) During placement of clay liner

Total thickness = 90 cm (placing in six layers of 15 cm each)

The following test to be carried out on each layer :

- In situ density test as per IS 2720 (part 28, 29 and 34)
- Total number of density test 24 (8 on each layer) on first 45 cm
- Total number of density test 24 (8 on each layer) on second 45 cm
- In situ water content as per IS 2720 (part 2)
- Total number of water content test 6 (1 on each layer) on first 90 cm
- Permeability test “as compacted-then-saturated” samples: using flexible well permeability as per ASTM : D : 5084 or by using consolidation self permeameter (Olson and Daniel (1979)).

One on each layer of 45 cm, so total number of sample are two.

c) During placement of hard soil for soil bund (with murrum)

Layer wise construction, thickness of each layer = 20 cm

The following tests to be carried on each layer :

- In situ density test as per IS 2720 (part 28, 29 and 34)
- Total number of density test 6 (3 on each layer of two soil bund)
- In situ water content as per IS 2720 (part 2)
- Total number of water content test on each layer are 6 (3 on each layer of two soil bund)

d) During placement of HDPE geomembrane and Geotextile.

- Check for thickness
- Check the joints

The quality control tests that are performed during installation include the following:

- Inspection of surface of compacted clay/ amended soil layer
- Verification of the proposed layout plan
- Check roll overlap
- Checking anchoring trench and sump
- Testing of all factory and filed seams using proper techniques over full length
- Destructive seam strength test
- Patch up repair

Geomembranes must be covered with protective layer of Geotextile as soon as possible. Bare membrane should be guarded against such damage by fencing the area or by other appropriate methods.

The following procedure may be adopted:

- At least 1.5 mm Geo Textile/ 20 cm silt should be spread on the membrane as a protective layer.
- The traffic routing g plan must be carefully made so that the vehicle (s) does not travel on the membrane directly.
- Dumping of soil on the membrane should be avoided as much as possible.

Checking

Regular checking shall be carried out after final closing of landfill facility.

11.14 Construction of Municipal Landfill Facility

11.14.1 Construction of the Municipal Landfill Facility

The construction of a landfill is broadly encompasses the site development which is comprehensively described.

11.14.2 Site Development

The following construction activities are undertaken during site development:-

- **Job No: 01** Description: Construction of site leveling works.
- **Job No: 02** Description: Soil dressing in the Cell Area
- **Job No: 03** Description: Cell Earthwork
- **Job No: 04** Description: Compaction of clay
- **Job No: 05** Description: Side Soil Bund
- **Job No: 06** Description: Installation of Geo Membrane (HDPE)
- **Job No: 07** Description: Installation of Geo Textile / Silt
- **Job No: 08** Description: Installation of of side liner
- **Job No: 09** Description: Construction of drainage Blanket
- **Job No: 10** Description: Construction of storm water drainage
- **Job No: 11** Description: Construction of Leachate pipe drainage
- **Job No: 12** Description: Leachate collection sump
- **Job No: 13** Description: Installation of pumps for transferring leachate to CWTP

Job No: 01**Description: Construction of Site Levelling Work**

Activity No.	Description	Ref Drawing No.
1.	The site has to be cleared of all the trees and bushes. After the trees are cut, the stumps have to be removed.	01
2.	Earthwork for the leveling should be done by a road roller by maintaining the soil at optimum moisture content. A bench mark has to be fixed at an immovable known point. Site shall be leveled before marking for excavation. The ground level is considered as RL 100	

Job No: 02**Description: Soil Dressing in the Cell Area**

Activity No.	Description	Ref Drawing No.
1.	Dressing of the soil and filling up of low lying areas has to be done for grading the site prior to the construction of the cell.	01
2.	Dressing shall be of same slope profile provided in design and note that stability of existing soil shall not be disturbed.	
3.	Optimum care should be taken while cutting operation of side slopes, so that stability of native soil should not be disturbed.	
4.	Before dressing work, site engineer should be aware about RLs & slope profile and it shall be maintained during excavation.	
5.	Excess soil has to be transported to the storage area.	

Job No: 03**Description: Cell Earth Work**

Activity No.	Description	Ref Drawing No.
1.	For each phase the grading has to be done at the base and the side embankment.	
2.	The soil has to be compacted top its optimum moisture content.	
3.	The compaction has to be carried out by a roller to achieve the following specifications. Procter density of Dpr > 95%	

Job No: 04**Description: Compaction of Clay**

Activity No.	Description	Ref Drawing No.
1.	Clear the borrow area by removing the shrubs and other vegetative growth. Before laying of bottom liner the sub base soil has to be well compacted and it should be checked for required slopes and RLs.	02, 03, 04
2.	Adjust the water content in the borrow area – sprinkling or irrigating for increasing the water content and ripping and aerating for lowering the water content.	
3.	The existing clay shall be pulverized to 6 mm to 20 mm size through pub mill in dry condition. The clay should be mixed with lime in a concrete mixture plant in dry condition. The percentage of lime shall not be more than 5% by weight. Transport the material to site in haulers or through conveyor systems (short distance).	
4.	Spreading and leveling of a thin layer (lift) of soil (6 layers) Thickness before compaction: 25 cm Thickness after compaction: 15 cm Total thickness: 90 cm	
5.	Spray and mix water for final water content adjustment. (30 – 40%) Optimum Moisture Content.	
6.	Compaction using Sheep foot rollers. Maximization of the compaction energy to be achieved to increase the bonding between the lifts. Wt: 12 – 18 ton Min Foot length: 200 – 250 mm Min No of Passes: 5	
7.	During compaction moisture content of clay should not be greater than 10%.	
8.	Construction quality assurance testing Check: After compaction of each layer Proctor density test should be carried out one test per every 1000 sq. mt. on each layer. Density shall not be less than 95% MOC Adequate - Compaction Adequate.	
9.	After compaction the clay layer shall be left out for natural drying and settlement for at least 5 to 6 days. If any cracks develops in clay liner, which has to be grouted with bentonite.	
10.	Placement of next lift and repletion of process till final thickness is achieved. -Each lift of clay liner be properly bonded to the underlying and overlying lifts to avoid hydraulic connection between lifts.	

Job No: 05 : Description: Side Soil Bound.

No.	Description	Ref Drawing No.
1.	The height of the landfill above the ground level is 10 meter. In order to achieve this side soil bunds have to be constructed. Height of bund: 2m	
2.	The height will be constructed in three stages 3 meter. 3 meter, 3 meter. The inside and the outside slope is 1: 2.	
3.	The side soil bunds have to be constructed with hard murrum. The material for construction of soil bunds shall satisfy the minimum dry density requirement (i.e. Not less than 1.44 gm/cc) The testing has to be carried out as per IS 2720 (PT. VII) Soil has to be laid in layers of about 15 cm and well compacted with 10 to 15 ton roller	PI<6 CBR: 4-5 Dry density: 1.4g/cc OMC:10%
4.	During laying of each layer, clay (of sidelines) shall be placed at the inner side of soil bund. Number of passing of roller shall be judged based on proctor density test. Proctor density test should be carried out one at every 500 sq. mt. on each layer and density shall not less than 95%. During compaction soil should contain optimum moisture content of 16% to 20%.	
5.	While cutting operation of side slopes, there should be provision for installing sideliner matching with slope profile.	
6.	The top width of the soil bund is 3 meter.	

Job No: 06**Description: Installation of Geo Membrane (HDPE)**

Job No.	Job Description	Ref Drawing No/Remark
01	Surface Preparation	
A	The surface of compacted clay/amended soil must be prepared for installation of synthetic membrane	
B	The surface must not contain any particles greater than 1.25cm (0.5 in.) size	Large particles may cause protuberance in the liner
02	Laying of Liner & Seaming	
A	Precautions <ul style="list-style-type: none"> The panel layout plan should be made in advance so that travel of heavy equipment on the liner can be avoided. In no case should it be allowed on the liner. Seaming of panels within 1.0m of the leachate collection line location should be avoided if possible; this issue can be finalized during the layout plan. The sub base must be checked for footprints or similar depressions before laying the liner. The crew should be instructed to carry only the necessary tools and not to wear any heavy boots (tennis shoes are preferred). Laying of synthetic membrane should be avoided during high winds (24kmps or more). 	
B	Seaming The method of seaming of HDPE (Wedge fusion/ Extrusion welding) has to be specified by the manufacturer. The guidelines of the manufacturer must be followed while seaming the liner.	
C	Anchoring After seaming operation the HDPE sheet must be anchored at the top of the first soil bunds.	

• **Job No: 07 Description: installation of Geo Textile / Silt**

Job No.	Job Description	Ref Drawing No / Remarks
01	The needle punched non-woven type Geotextile of thickness 1.5mm, having the mass per unit area greater than 500 g/Sqmt shall be uniformly placed on the HDPE sheet.	
02	The joints of geotextile should be well stitched.	

• **Job No: 08 Description: Installation of Side Linear**

Job No.	Job Description	Ref Drawing No / Remarks
01	The clay layer of side linear can be laid along with the construction of side slopes and soil bunds, so that compaction of side liner can be done at the same time during compaction of side slopes and soil bund.	
02	HDPE sheet and geo-textile shall be laid in the same manner as it is for bottom liner.	
03	The joints of HDPE sheet of bottom liner and side liner shall be of lap-joint by placing the HDPE sheet of side liner on top.	
04	The HDPE sheet of side liner shall be extended up to half width of first soil bund; the same has to be joined with the HDPE sheet to top liner during top cover operational.	

• **Job No: 09 Description: Construction of Drainage Blanket**

Activity No.	Description	Ref Drawing No
01	<i>In the bottom liner system two layers with gravel of thickness 20cm each has to be uniformly laid.</i> Gravel shall be of size 6mm to 12mm	
02	Gravel shall be of rounded particles preferable from the seashore. The permeability of gravel layer shall be greater than 1×10^{-2} cm/sec.	

• **Job No: 10 Description: Construction of Storm Water Drainage**

Activity No.	Description	Ref Drawing No
01	Storm water drain shall be constructed all along the outer periphery of soil bund	
02	Storm water drain shall be of trapezoidal shape with brick lining/pcc	
03	The inside part of drain has to be plastered with cement motor	

• **Job No: 11 Description: Construction of Leachate Pipes, Drainage**

Activity No.	Description	Ref Drawing No
01	Leachate drainage should be constructed over bottom linear system	08
02	The leachate collection drains are to be constructed as per the drawing	
03	The slope of the terrace will be as per the site topography	
04	The leachate collection will be transported to a leachate sump via longitudinal slope of 1.0%	
05	One end of leachate has to be extended up to the top of first soil bund and the other end (outlet end) has to be connected into leachate sump.	
06	The leachate drain has to be constructed with HDPE pipe of dia. 315mm and with thickness of 22mm. The pipe shall be withstanding the minimum pressure of 6 kg/cm ²	
07	The top half of HDPE pipe should be perforated with holes dia of 15mm placed at spacing of 100mm C/C. the pipes shall be perforated on the half circumference. The HDPE sheet of bottom liner should be firmly welded with the HDPE pipe just below the last perforated line so that, leachate can easily pass through into the pipe.	08
08	Over the perforated zone gravel of size 16mm to 30mm shall be placed	08
09	The channel has to be packed with drainage material.	
10	The point where the leachate pipe leaves landfill, the perforated HDPE pipe has to be connected with non-perforated HDPE pipe, which is to be inserted into 40cm ID cement concrete pipe.	
11	The point where the perforated HDPE is connected with non perforated HDPE pipe a vertical pipe of same dia. has to be connected by T-joint. This vertical pipe is called leachate well and to be used when there is chocking in the outlet pipe. Vertical pipes of HDPE shall be connected to the leachate collection pipe at an interval of 20m. Vertical pipes can be taken up to the height of waste filling.	
12	The portion below the pipes should be filled with the mixture of cement, Bentonite and sand in the ration of 3:3:94 respectively.	
13	From the leachate collection sump, the same will be transported to the sump of cell – I through the drainage system.	

- **Job No: 12 Description: Leachate collection sump**

Activity No.	Description
1	RCC sump of dia 2.5 meter, covered with RCC slab have been recommended to be constructed for collection of leachate from “leachate collection system “
2	A clear depth of 1 meter has to be maintained between the bottom of sump and leachate connection pipe.
3	About 20mm thick plastering has to be done at the inner and outer side of sump
4	Epoxy powder (which acts as water proof agent) has to be used during plastering)
5	The RCC slab has been provided with a man hole of 1 m X 1 m through which a monkey ladder has been erected
6	The man hole has to be covered with hinged steel gate in order to avoid the entry of rain water in sump

- **Job No. : 13 Description: Installation of pumps for transferring leachate to CWTP**

Activity No.	Description
1	Depending upon the existing gradient, the leachate from sump can be transferred to STP by gravity
2	Provision of two sumps of 2 HP each (discharge 10 m ³ /hr and total maximum head of 25 m) have to be installed in leachate collection sump.
3	These pumps may be installed at the RCC slab of collection sump with proper rainwater protection.

11.14.3 Top Liner

After waste is filled up to required height, clay layer of 600 mm thick has to be laid. The clay liner shall be laid in two layers each of thickness 300 mm. Each layer of clay shall be well compacted with a vibratory roller of 4 to 5 tones. Over clay liner drainage layer of thickness 300 mm should be uniformly placed. The purpose of drainage layer is to collect and convey the precipitate towards storm water drain. Over the drainage layer, 450 mm thick fertile soil for vegetation has to be laid in three layers of 150 mm each. The first layer has to be compacted, other two layers has to be left loose for the growth of vegetation. A vegetation cover has to provide at the top of the soil in order to prevent the soil erosion due to precipitate and also for better landscaping.

11.15 Material Specification

11.15.1 Material Specification for liners and drainage system

Bottom Liner:(Ref. Drg. No.5-6)

1. 2 x 45 cm thick compacted clay or compacted amended soil with permeability less than 1×10^{-7} cm/sec.
2. 1.5 mm thick HDPE Geo-membrane of following specifications:
 - Tensile strength at yield greater than 18 KN/m
 - Tensile strength at break greater than 30 KN/m
 - Tear Resistance greater than 150 N
 - Puncture Resistance greater than 250 N
3. 1 x 1.5 mm thick Geo-textile:
 - Type - Non woven, needle punched
 - Strength > 400 kg/ sq.mt
 - Mass per unit area shall be greater than 500 kg/ sq.mt
4. 1 x 20 cm thick Gravel as Leachate Drainage Layer;

Material - Seashore gravel of size 6 mm to 12 mm with permeability greater than 1×10^{-7} cm/sec

Side Liner System (Ref. Drg. No.5-6):

1. 1 x 45 cm thick compacted clay or compacted amended soil with permeability less than 1×10^{-7} cm/sec
2. 1 x 1.5 mm thick HDPE Geomembrane of following specification;
 - Tensile strength at yield greater than 18 KN/m
 - Tensile strength at break greater than 30 KN/m
 - Tear Resistance greater than 150 N
 - Puncture Resistance greater than 250 N
3. 1 x 1.5 mm thick Geo-textile/ 20 cm soil/silt:
 - Type - Non woven, needle punched
 - Strength > 400 kg/ sq.mt
 - Mass per unit area shall be greater than 500 kg/ sq.mt

Leachate Drainage System (Ref. Dwg. No. 8):

The construction details of leachate drain is as follows:

- A trapezoidal trench has to be made as per the sizes shown in drawing.
- Trench shall be lined with 1.5 mm thick HDPE Geo-membrane from all sides.
- Longitudinal slope of trench shall be 1.0 % corresponding with slope of bottom liner.
- Half of HDPE Pipe shall be placed into trench

- The bottom and sides of HDPE pipe has to be filled with the mixture of cement, bentonite and sand in the ratio 3:3:94
- Over HDPE pipe Gravel size of 16 mm to 30 mm has to be placed uniformly

Specification of material to be used for leachate drain

1. 1.5 mm thick HDPE Geo-membrane of following specifications:

- Tensile strength at yield greater than 18 KN/m
- Tensile strength at break greater than 30 KN/m
- Tear Resistance greater than 150 N
- Puncture Resistance greater than 250 N

2. Mixture of sand, cement and bentonite shall be in ratio 94 %:3%:3%, respectively

3. Specification of HDPE pipe

- Internal Dia- 271 mm
- Outer Dia-315 mm
- Wall thickness-22 mm
- Pressure Rating -6 Kg / sq.cm

Top Liner System (Ref. DWG. No. 7):

1. 1 x 60 cm thick compacted clay or compacted amended soil with permeability less than 1×10^{-7} cm/sec.
2. 1 x 30 cm thick drainage layer
Material -Sand or any other granule greater than 1×10^{-2} cm/sec with permeability
3. 1 x 45 cm , with fertile soil for vegetation
4. Vegetation cover with Grass, Shrubs,etc. having roots length < 30 cm

11.14.4 Cost Estimation

The tentative cost for the development of the municipal land fill facility for different phase is given based on the materials and prevailing rates. In these cost estimation the cost of the land acquisition is excluded. The cost of covering/ top liner system has been estimated based on the present rate of labour and materials. However, these costs will be incurred after the operating life of each phase. The detailed cost estimation is given in the next chapter .

11.14.5 Conclusion and Recommendation:

RMC intends to construct a centralized municipal land fill facility and operate the same for the disposal of the municipal waste as per the MoEF notification' Feb 2000. As per the requirement under the above rules, these wastes have to be disposed off scientifically. It has been reported that about 27, 00,000 TPA of wastes will be disposed off in the facility.

Considering the location of disposal site, the characteristic of the soil, the facility has been designed with Mineralic with HDPE as base liner with leachate collection and removal system (LCRS).

The suggested design, development, operation and closure plan of the facility will take care of the following prominent features of the facility.

- Ground water and soil protection through provision of an impermeable liner system
- Surface water protection the design of effective storm water drainage system
- Prevent the deterioration of the ambient air quality through scientifically operation plan of the land fill facility and providing green belt all around the facility
- Minimize leachate generation and treatment
- Provision of leachate collection, removal and treatment
- Closure of the facility
- Monitoring of ambient air and ground water quality during the operation and even after closure of the facility
- Periodic monitoring of the embankment with respect to the reference point to be done in order to observe the lateral and longitudinal shift. Appropriate remedial measure such as embankment stabilization, compaction etc. to be carried out.

It is therefore commended that the development of the Municipal land fill facility at Nakarawadi has to be started as per the proposed construction and operation plan of MLF at the earliest possible

Environment Impact Assessment of the Land Fill Site: As attached in Annexure

12.1 General

Preliminary cost estimates for various components of Solid Waste Management for all three components i.e. Primary SWM, SWM Waste Management and Tertiary SWM are identified different proposal are presented here. Modern at The proposed works are divided in phase wise manner and it is scheduled to complete within seven years. The proposed works are categorized as follows:

1. Modernization of Primary Solid Waste Management- which includes purchase of debris containers, closed container, wheel borrows, littering bins , mechanical sweeper etc.,
2. Modernization of Secondary SWM – which includes purchase of various vehicles like dumper placer of 14 cumts for transfer station, dumper placer of 8 cumt, dumper placer of 4.5 cumt, vehicles for lifting of debris container, dead animal pick up van etc.,
3. Modernization of Tertiary SWM which includes development of land fill site purchase of equipments like bull dozers, compactor, tractor etc.,or
4. Computerization of the Solid Waste Management Deptt., and MIS generation

12.2 Based for Cost Estimate

1. Purchase of various equipments/ vehicle

Bases for calculation of cost of various vehicles, equipments are considered as per actual market price. For the purpose of which quotation from standard co., like TATA, Shook Leyland has been collected.

2. Development of site office, / Compound wall or Infrastructure development work

Based on the Rajkot Municipal Corporation Schedule of Rates (SOR) - 2005 the rates are adopted to get abstract sheet. The measurement sheets for each idea are prepared as per the standard civil engineering practice. The specifications for the works shall generally conform to the stipulations made in “**Specifications for Road and Bridge Works (1st Edition – August 2000)**” of MORT&H.

For the purpose of analysis the rates of materials, labour and machineries has been determined as:

1. The Hire Charges of Plant and Machineries as approved by the MORT&H are given in the updated data book and the same has been adopted. For the plant & machineries used in the analysis but not covered in the data book, prevailing market rates have been adopted wherever considered appropriate.
2. The cost of materials and labour which are not described in RMC’s SOR , has been taken up from SOR (1999-2000), PWD (NH), Rajkot, Gujarat and updated with 3% escalation

per year for subsequent years. Prevailing market rates have been adopted for items not covered by the Schedule of Rates wherever considered appropriate. A total escalation of 15% i.e. 3% per year has been considered on 1999-2000 Schedule of Rates, PWD, Gujarat to arrive at unit rates of various items as on 2002-2003 (March 2003).

3. Updated rates of material, labour and machineries has been further verified with the market rates and was found to be at par with the market rates.
4. The overhead charges include the following elements:
 - Site accommodation, setting up plant, access road, water supply, electricity and general site arrangements.
 - Office furniture, equipment and communications
 - Expenditure on
 - Corporate office of contractor
 - Site supervision
 - Documentation and “ as built ” drawings
 - Watch and ward
 - Expenditure on safeguarding environment.
 - Sundries
 - Financing Expenditure
 - Sales/Turn over tax
 - Work Insurance/compensation

Contractor's profit has been taken uniformly as 10 %, over the cost of items.

3. Development of Land fill site :

Rates for HDPE liners and other special items are adopted as per the market survey, which is suggested by the NPC (Govt of India) report. The other items like excavations and filling material etc have been calculated as per RMC's SOR.

4. Computerization

For purchase of computer hardware DGSNDD rates are adopted while for design and development of MIS the actual quotation rates are adopted.

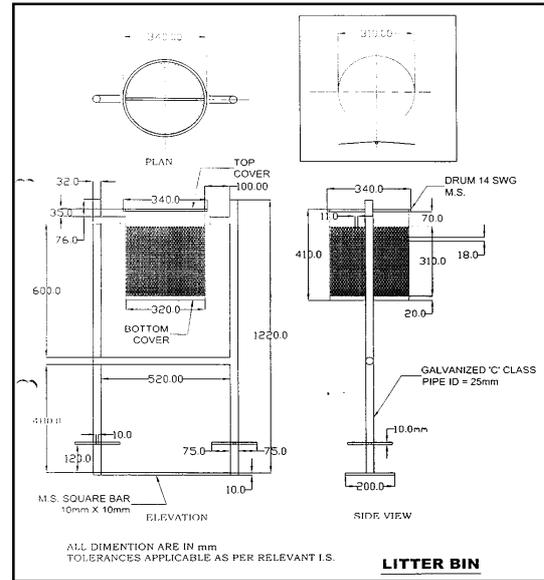
12.3 Estimated Cost for Modernization of Primary SWM

12.3.1 Purchase of Littering Bins

Specification

Litter Bin should be fabricated from galvanized "C" class pipe of ID-25 mm, standing support and 14 SWG M.S. perforated sheet in form of barrel or drum with swelling hinges.

Detailed dimensions and specifications are shown in the sketch of Litter bin.



Sr.	Details	Size
1	Galvanized "C" Class pipe	ID=25 mm, OD=32 mm- Surya / Asian / TATA
2	M.S. Perforated sheet	14 SWG Thickness
3	Perforation size	8 mm dia. Hole as per sample
4	M.S. Square Bar	10 mm x 10 mm
5	Top Cover M.S.	14 SWG Thickness
6	Bottom Cover M.S.	14 SWG Thickness
7	Swinging mechanism	120° Swing
8	Holes at bottom cover.	8 mm dia 1 No. in centre
9	Paints	Two coat of red oxide primer & synthetic enamel.
10	Colour	As directed by Rajkot Municipal Corporation.

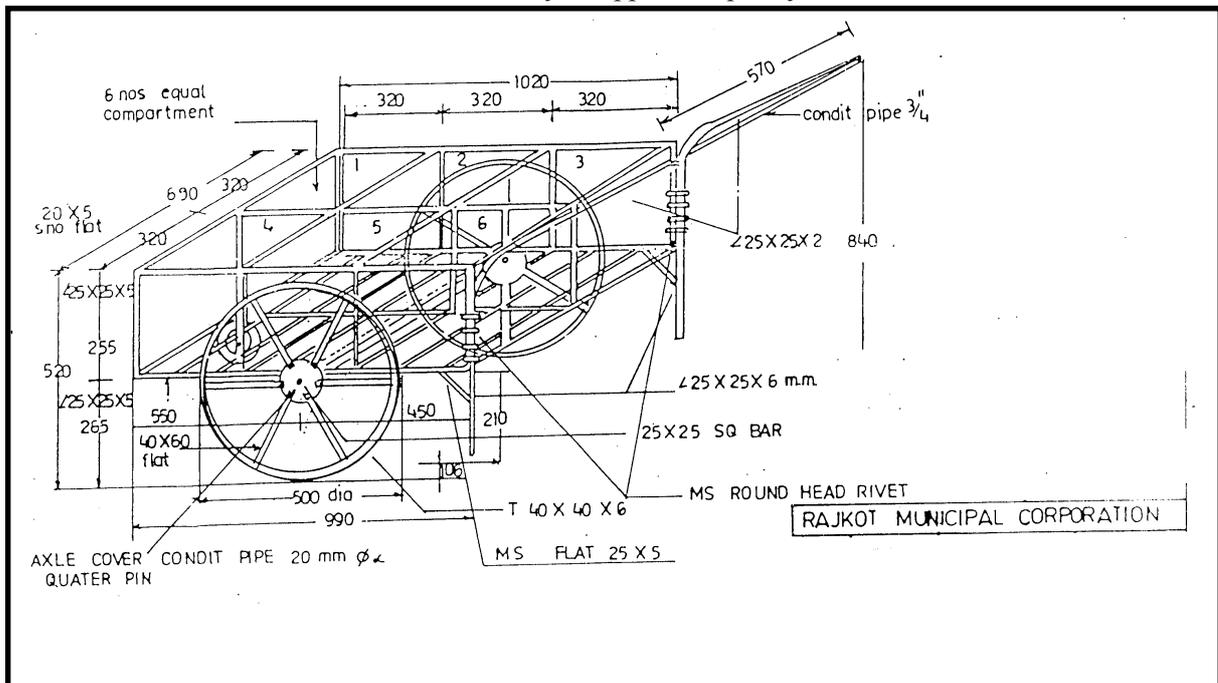
Sr. No.	Item	Unit Price in Rs.	Qty. for yr. 2005-06 to 2007-08	Total Amount Rs
1.	Manufacturing , Supply of Littering bins fixing the same in 45 cm CC(1:2:4) as per above specification s FOB at Rajkot including all taxes, VAT and Octroi etc., complete	1750	2000	35,00,000
Total				35,00,000
Rupees Thirty Five Lakhs Only				

12.3.2 Purchase of Wheelbarrow

Specification

Frame of Wheelbarrow should be fabricated from mild steel having 1020 mm x 690 mm x 255 mm. With 0.026 cu.m capacity six containers of trapezoidal section made from 22 SWG G.P. Sheet having Top 310 mm. x 320 mm, Bottom 290 x 290 mm, and Height 325 mm.

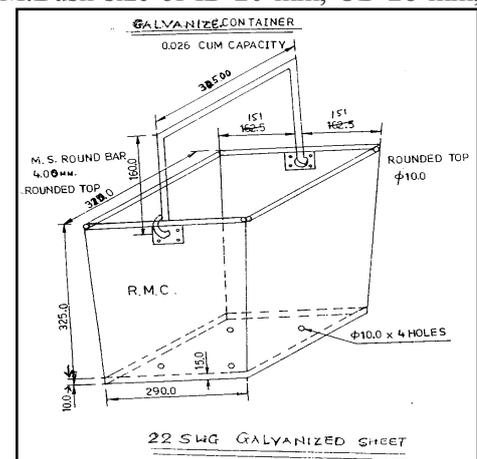
For locking the Wheelbarrow and containers, 1900 mm long 1/4" Dia. M.S. chain should be provided with 7-lever lock of 45 mm size with two key of approved quality. Two Wheels 500 mm Dia. should



be fabricated from 40 x 40 x 6 mm M.S. Tee Section. Hubs for these wheels should be fabricated made from cast iron with sealed ball bearings No.6204 ZZ should be provided front wheel (200 mm x 75 mm). 8" x 3" of Red polymers (virgin) with moulded G.M.Bush size of ID-20 mm, OD-28 mm, and length 75 mm should be provided.

Specification for Galvanized Container -6 Nos.

Details	Size
Top	320 x 320 mm
Height	325 mm
Bottom	290 x 290 mm
Thickness	22 SWG
M.S. Round Bar for handle	8 mm
Colour	As directed by RMC
R.M.C. Mark in 2" (50 mm.)	Embossed two side
Holes at bottom	10 mm Ø - 4 No. Holes
Material	Galvanized process sheet
Tolerance	As per relevant Indian Standards.



Abstract sheet for purchase of Wheel Barrow

Sr. No.	Item	Unit Price in Rs.	Req. in Nos. Quantity for yr. 2005-06 to 2007-08	Total Amount Rs
1.	Manufacturing & Supply of wheel barrow app. Weight of wheel barrows 60 kgs FOB at Rajkot workshop including all taxes, VAT and Octroi etc., complete	3300	800	26,40,000
2.	Manufacturing & supply of GI containers each are having app. GI weight 24 kgs., with above specifications -6 nos with each wheel barrows inclu. All taxes VAT and Octroi etc complete.	200	4800	9,60,000
Total				36,00,000
Rupees Thirty Six Lakhs Only				

12.3.3 Purchase of Tricycle with 8 containers**Specification for tricycle:**

Premium quality of Pedal Driven Cycle chassis with rear frame fabricated out of MS Angles and channels mounted and integrated with chassis designed to house 8 plastic containers of 20 litres capacity each as per following specification:

1. Maximum Load carrying capacity 300 kgs
2. Length 1540 mm (+/- 2%)
3. Width 0735 mm (+/- 2%)



- | | |
|----------------------|---|
| 4. Height | 0255 mm (+/- 2%) |
| 5. Rear wheels | 02 nos with heavy duty tyre & tubes |
| 6. Front wheels | 01 nos with heavy duty tyre & tubes |
| 7. Painting | one coat of red oxide and two coats of anticorrosive of synthetic enamel of black colour |
| 8. Other accessories | A bell, Cycle lock, reflectors on front and rear , Hooks for hanging Bags, holding clams etc., - A name plate on the back of tricycle frame for painting, identification number, ward or message as per the requirements. |

Specification for containers:

1. One piece moulded , heavy duty waste bin of approximate 20 liters capacity made out of FDA approved virgin grades of polyethylene material manufactured provided with 2 nos., of built flexible HDPE handles on two sides.
2. Light weight and easy to handle
3. Strong & durable
4. Length 316 mm (+/- 1.5 %)
5. Width 265 mm (+/- 1.5 %)
6. Height 405 mm (+/- 1.5 %)
7. Lid Fully closed lid
8. Colour Green/ Blue
9. Printing as per RMC's requirement

Abstract sheet for purchase of Tricycle with 8 containers (Pl. refer Annexure: 14.8 item No.1)

Sr. No.	Item	Unit Price in Rs.	Quantity for yr. 2005-06 to 2007-08	Total Amount Rs
1.	Manufacturing & Supply of Tricycle having app. Dimension L-1540 x W-735 x Height – 255 mm as per above specification with 8 bins HDPE modellers 20 liters capacity app. Dimension L-316 x W-265 x H-405 mm FOB at Rajkot workshop including all taxes, VAT and Octroi etc., complete	14960	50	7,48,000
Total				7,48,000
Rupees Seven Lakhs Forty eight Thousand Only				

12.3.4 Purchase of Closed container of 4.5 cu.mt. Capacity**Technical Specification**

Type of Container: Open Top with rear tipping.

Design: It should be made from rugged all steel fabrication, heavy duty hinges 3 Nos. may be provided in the tailgate. Two top doors (windows) on each side made of 3.0 mm mild steel or CRS



should be provided for easy manually loading of garbage in to the containers.

Dimensions:

- | | | |
|----|--------------------|--|
| 1. | Length (top): | 2780 mm |
| 2. | Width: | 1550 mm |
| 3. | Overall Height: | 1270 mm |
| 4. | Loading Height: | 870 mm |
| 5. | Volume: | 4.5 CUM Minimum |
| 6. | Weight: | 660 Kg. |
| 7. | M.S. or CRS sheet: | 3.0 mm thick |
| 8. | Support channel: | 50 X 100m "C" channel of 3.0mm
Thick M.S. sheet or CRS sheet. |

Top doors (windows) hinges, Tail gate hinges, windows support, Top bottom And from support of angles, channels and tee, anchor pins, locking Arrangement of tailgate, Corrugation of top, bottom, sides plates should be heavy Duty of rugged steel.

Abstract sheet for closed containers 4.5 cut capacity

Sr. No.	Item	Unit Price in Rs.	Req. Quantity for yr. 2005-06 to 07-08 (No.)	Total Amount Rs
1.	Providing 4.5 cu tm closed containers with above said specification including all taxes, transportation, Transit Insurance, CST/ VAT, Octroi, Entry Tax, service taxes FOB Rajkot etc., complete	40,000	250	1,00,00,000
Total				1,00,00,000
Rupees One Crore Only				

12.3.5 Construction of Wastage Storage Depot**Specification**

1. The waste storage depot shall be of 20 ft. x 20 ft.,
2. The three sides of the waste storage depot with 6" thick RCC wall having 4 ft. height.
3. There shall be RCC flooring of 6 inch thickness.
4. The flooring height shall be 6 inches above the ground from the farthest end touching the screen wall and shall gradually taper down to the ground level.
5. An approach road should be made from the road to the waste storage depot for the hand carts to reach conveniently the container placed on the flooring of the depot.

Abstract sheet for CC flooring at Waste Storage depots / container platforms

Sr. No.	Item	Unit Price in Rs.	Req. Quantity for yr. 2005-06 to 07-08 (No.)	Total Amount Rs
1.	Construction of CC Plate form of size 20' x 20' for 4.5 cu.mts containers with protection 25x25x5 mm MS angle covered at all four sides as protection	13,000	250	32,50,000
Total				32,50,000
Rupees Thirty Two Lakhs Fifty Thousand Only				

12.3.6 Purchase of 8.0 cu.mt Debris Container**Specification**

Type of Container: Open Top

Design: It should be made from rugged all steel fabrication, heavy duty hinges 3 Nos. may be provided in the tailgate.

Dimensions:

1. Length (top): 4000 mm.
2. Width: 1550 mm
3. Overall Height: 1270 mm
4. Loading Height: 870 mm
5. Volume: 8.0 CUM Minimum
6. Weight: 860 Kg.
7. M.S. or CRS sheet: 3.0 mm thick
8. Support channel: 50 X 100m "C" channel of 3.0mm

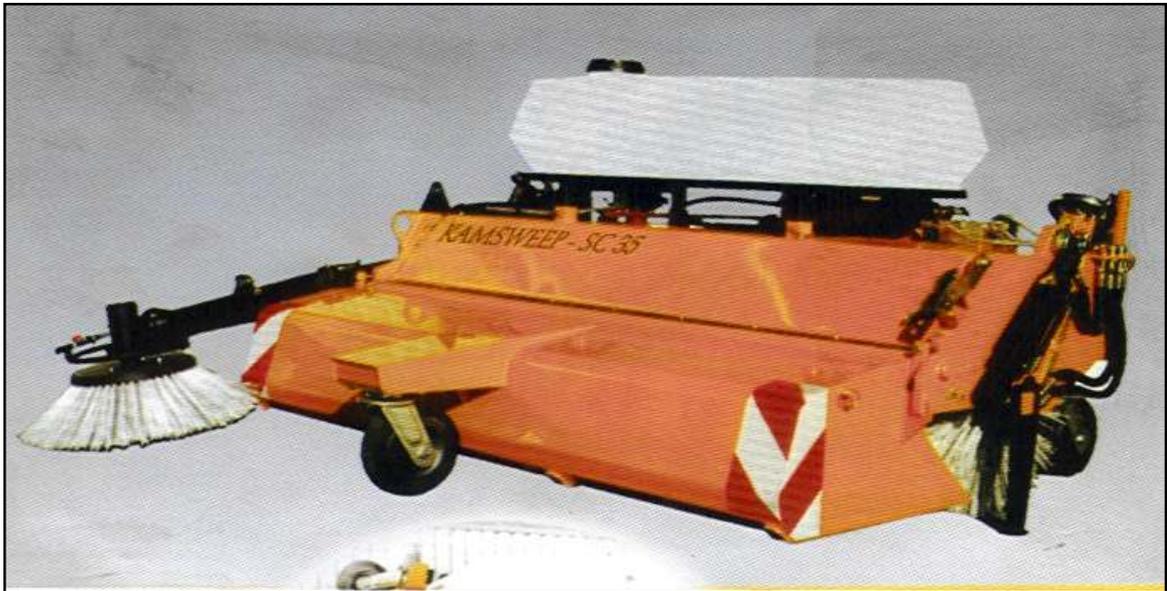
thick M.S. sheet or CRS sheet. Tail gate hinges, frame support of angles, channels and tee, anchor pins, locking Arrangement of tailgate, Corrugation of bottom, sides plates should be heavy Duty of rugged steel.

Abstract sheet for purchase of Debris containers of 8.0 cumt capacity

Sr. No.	Item	Unit Price in Rs	Req. Quantity for yr. 2005-06 to 07-08 (No.)	Total Amount Rs
1.	Supplying & Providing 8.0 cu mt open containers for collection of debris with above said specification including all taxes, transportation, Transit Insurance, CST/ VAT, Octroi, Entry Tax, service taxes FOB Rajkot etc., complete	43,000	75	32,25,000
Total				32,25,000
Rupees Thirty two Lakhs Twenty five Thosand Only				

12.3.7 Purchase of Tractor Trailed Road Vacuum Sweeper Machine**General Specification:**

- Used for fast and perfect clearing of solid surface and corners. Spiral nylon brush set of three used for surface cleaning and gutter brush for corner cleaning.
- All waste carried and throw by brush to centre and collected in to container, and same to be disposed off at disposal point.

**Technical Specification:**

Working width:	2850 mm
Collection Capacity :	3.5 cu,mts,..
Main Brush	Poly propylene width of 2100 mm
Rotary Brushes	Two

Abstract sheet for purchase of Tractor Trailed Road Vacuum Sweeper Machine (refer annexure : 14.8 quotation Item No.2)

Sr. No.	Item	Unit Price in Rs.	Quantity for yr. 2005-06 to 2007-08	Total Amount Rs
1.	Supply of Tractor Trailed Road Vacuum Mechanical sweeping machine with above specification including all taxes, transportation, Transit Insurance, CST/ VAT, Octroi, Entry Tax, RTO charges, service taxes FOB Rajkot and one year Insurance with third party coverage etc., complete	13,00,000	1	13,00,000
Total				13,00,000
Rupees Thirteen Lakhs Only				

12.4 Estimated cost for Modernization of Secondary SWM**12.4.1 Purchase of Wheeled excavator- cum – dozer (JCB) multi functional Solid Waste Removal Machine****SPECIFICATIONS:**

- ENGINE:** Four cylinder, water cooled diesel, delivering Gross power of 76 to 80 H.P. at 2200 RPM as per BS Au 141 a and net power of 72 to 74 H.P. at 2200 RPM (ISO-3046 IFN).
Max.net Torque 29.5 Kgm.
- TRANSMISSION:** Syncroshuttle transmission incorporating Torque converter, reversing shuttle and synchromesh 4 speed gear box in one resiliently mounted unit. Electro-hydraulic direction control through a steering column mounted switch for forward / reverse shuttling. Foot pedal operated, transmission disconnect switch for on- the-move gear change. Torque converter stall ratio 2.83:1.
- HYDRAULICS:** 3000-psi (207 Bar) system; Pump flow: 109 lpm at 2200 RPM. Filtration through suction strainer and return line "Filtramatic Filter".
- SERVICE CAPACITIES:**

Hydraulic system	110 lts
Fuel tank	85 lts
Engine coolant	15 lts
Engine oil	11 lts
Transmission	21 lts
- STATIC DIMENSIONS:**

(1)	Overall length	6.11 m
(2)	Overall height	3.54 m
(3)	Height to top of cab	2.86 m
(4)	Wheelbase	2.11 m
(5)	Minimum ground clearance	0.33 m
(6)	Slew ground clearance	0.50 m
(7)	Width (over bucket)	2.43 m
(8)	Trac width-Front	1.80 m
(9)	Trac width-Rear	1.71 m

7. **LOADER PERFORMANCE:**

6-in-1 clam shovel

(1)	Dump height	2.64 m
(2)	Load over height	3.13 m
(3)	Pin height	3.36 m
(4)	Reach of ground	1.52 m
(5)	Reach of full height, bucket dumped	0.76 m
(6)	Below ground level dig depth (toe plate horizontal)	0.12 m
(7)	Max rich of full height	1.06 m

(8)
Rollback of
ground

45°

(9)
Dump angle

53°

(10)
Payload



1650 Kg

(11)	Loader breakout force-bucket	4997 Kgf
(12)	Loader breakout force-arms	4206 Kgf

8. **EXCAVATOR PERFORMANCE**

(1)	Max. Dig depth	4.77 m
-----	----------------	--------

(2)	Reach-ground level to rear wheel centre	6.71 m
(3)	Reach-ground level to slew centre	5.40 m
(4)	Max. Working height	5.79 m
(5)	Max. Load over height	4.18 m
(6)	Reach of full height to slew centre	2.37 m
(7)	Bucket relation - power	185°
(8)	Side reach to centre line of machine	5.93 m
(9)	King post travel	1.06 m
(10)	Bucket fear out	4691 kgf
(11)	Dipper fear out	2531 kgf
(12)	Lift capacity to bucket pivot of full reach (no bucket fitted) (SAE j 31)	1200 kgf

Abstract sheet for purchase of wheeled excavators-cum-dozers (JCB) multi functional solid waste removal machines wheel barrow (refer annexure : 14.8 quotation Item No.3)

Sr. No.	Item	Unit Price in Rs.	Quantity for yr. 2005-06 to 2007-08	Total Amount Rs
1.	Supply of 3 DX Excavator Loader fitted with 0.24 cu.m capacity excavator bucket and 6 in 1 clam shovel loader bucket, powered by reputed co., engine of at least 76 gross HP with torque converter, shuttle reverser with necessary gear box, heavy duty standard co., tyres including all taxes, transportation, Transit Insurance, CST/ VAT, Octroi, Entry Tax, RTO charges, service taxes FOB Rajkot and one year Insurance with third party coverage etc., complete	22,00,000	4	88,00,000
Total				88,00,000
Rupees Eighty Eight Lakhs Only				

12.4.2 Purchase of 14.0 Cu.Mt. capacity Dumpers for Transportation from Transfer Station

The technical details are mentioned as under:

- Used for transportation of Solid waste from transfer station to disposal or landfill site.
- As it can be closed, container used for this purpose, it becomes the most hygienic mode of transfer of solid waste.
- Dumping or unloading of garbage by hydraulic lifting systems saves time and money.
- No slippage of hazardous solid waste.



Specification

Capacity	:	14.0 cu. m.
Chassis	:	TATA / ASHOK LEYLAND

Abstract sheet for purchase of Dumper of 14.00 cumt capacity (refer annexure : 14.8 quotation Item No.4)

Sr. No.	Item	Unit Price in Rs.	Quantity for yr. 2005-06 to 2007-08	Total Amount Rs
1.	Supply of Dumper with 14 cu.m capacity fixed on either TATA or Ashok Leyland Chassis powered by reputed co., engine for hydraulic with necessary FBV & Tipper, gear box, heavy duty standard co., tyres including all taxes, transportation, Transit Insurance, CST/ VAT, Octroi, Entry Tax, RTO charges, service taxes FOB Rajkot and one year Insurance with third party coverage etc., complete	16,50,000	2 Nos.	33,00,000
Total				33,00,000
Rupees Thirty Three Lakhs Only				

12.4.3 Purchase of 8 cu.mt capacity dumpers for the SWM department**General Specification:**

- Used for transportation of Solid waste from transfer station to disposal or landfill site.
- As it can be closed, container used for this purpose, it becomes the most hygienic mode of transfer of solid waste.
- Dumping or unloading of garbage by hydraulic lifting systems saves time and money.
- No slippage of hazardous solid waste.

**Technical Specification**

Capacity	:	8.0 cu. m.
Dimension	:	4 x 2 x 1.0 mtr.
Chassis	:	TATA-1613 / ASHOK LEYLAND - 1613 H

Abstract sheet for purchase of Dumper of 8.00 cumt capacity (refer annexure: 14.8 quotation Item No.8)

Sr. No.	Item	Unit Price in Rs.	Quantity for yr. 2005-06 to 2007-08	Total Amount Rs
1.	Supply of Dumper with 8 cu.m capacity fixed on either TATA or Ashok Leyland Chassis powered by reputed co., engine for hydraulic with necessary FBV & Tipper, gear box, heavy duty standard co., tyres including all taxes, transportation, Transit Insurance, CST/ VAT, Octroi, Entry Tax, RTO charges, service taxes FOB Rajkot and one year Insurance with third party coverage etc., complete	11,00,000	4 Nos.	44,00,000
Total				44,00,000
Rupees Forty Four Lakhs Only				

12.4.4 Purchase of Dumper Placer for 8 cu.mt capacity Debris Container

General Specification:

The hydraulically operated dumper-placer system is required for lifting up to 8.0 CUM container for loading and unloading of solid waste. The system comprises of HCV cab chassis of standard type. Hydraulically operated mechanism is to be fabricated, so it can pick-carry-dump and replace 8.0 CUM solid waste containers.

1. Hydraulic arm cylinders: 2 Nos.

Dimensions:

CCL	1650 mm to 1850 mm
OCL	2880 mm to 3080 mm
Stroke length	1230 mm
Rod	70 mm
Bore	125 mm

Rod eye and clevis mounted double acting type and mounting of cylinders.

2. Hydraulic stabilizer cylinder with base: 2 Nos.

CCL	600 mm to 675 mm
OCL	875 mm to 950 mm
Stroke length	270 mm to 275 mm
Rod	63 mm to 65 mm
Bore	100 mm

Clevis mounted double acting type and mounting of cylinders.

3. Manual control Valve: (2 Bank stack Valve) with built in pressure relief valve.

Flow	120.1 PM
Working pressure	150 Bar minimum
Relief pressure	210 Bar

4. Hydraulic pump:

Type	Axial piston pump
Flow	51 LPM
Working pressure	210 Bar
RPM	1600 rpm

Rugged S.G. Cast Iron pump body

5. Hydraulic Tank Assembly 75 Lts capacity

With return line filter cum breather oil sight glass with Standard Accessories.

6. Sub Frame: Two heavy-duty box type channel of chassis length mounted on the chassis as per sample. And flooring of chassis should be made of 5mm thick steel plate.

7. **Arms:** (2 No) should be made of Two Nos. of "C" channel 125 x 125 mm
8. **Booms:** should be made of 5mm thick steel pipe of dia 110 mm to 120 mm.
9. **Chassis and hooks** should be heavy duty.
10. **Pipes:** All flexible pipes should be of gates makes with heavy-duty fitting. Non-flexible pipes should of seamless carbon steel pipe of thickness of 3.5mm to 4.0mm.
11. **Payload capacity:** 8000 Kg. Minimum
12. **Hydraulic Oil:** Servo-68 (Indian Oil)
13. **Operating pressure:** 150 Bar
14. **Timing for Hydraulic operation**
- | | |
|--------------------------------|----------|
| Tipping time | 40 Sec. |
| Loading time | 120 Sec. |
| Empty container unloading time | 30 Sec. |
15. **Fulcrum pins locks, bush and bearings, supports and safety guards for arm cylinder,**
Locking hooks for container should be made of heavy duty

Abstract sheet for purchase of Dumper placer of 8.00 cumt capacity (refer annexure: 14.8 quotation Item No.6)

Sr. No.	Item	Unit Price in Rs.	Quantity for yr. 2005-06 to 2007-08 No.)	Total Amount Rs
1.	Supply of Dumper Placer for lifting up to 8 cumt. Solid waste on either TATA or Ashok Leyland Chassis powered by reputed co., engine for hydraulic with necessary FBV & Tipper, gear box, heavy duty standard co., tyres including all taxes, transportation, Transit Insurance, CST/ VAT, Octroi, Entry Tax, RTO charges, service taxes FOB Rajkot and one year Insurance with third party coverage etc., complete	13,00,000	3	39,00,000
Total				39,00,000
Rupees Thirty Nine Lakhs Only				

12.4.5 Purchase of Dumper Placer of 4.5 cu.mt capacity containers for the SWM department

General Specification

Functional Requirement: The hydraulically operated dumper-placer system is required for shifting of 4.5 CUM SW containers for loading and unloading of the SW transportation. The system comprises of HCV cab chassis of standard type. Hydraulically operated mechanism is to be fabricated, so it can pick-carry-dump and replace 4.50 CUM debris containers.

1. **Hydraulic arm cylinders:** with necessary cylinder base, automatic & manual operated control van control valve with necessary hydraulic pumps, tanks, pipes, frame, chassis base, etc complete which should have at least .two hydraulic cylinders for tipping, lifting, dismounting, loading and unloading of 4.50 CUM containers. With two arms of "C" channel 125 x 125 mm & brooms made of 5mm thick steel pipe of dia 110 mm to 120 mm.

2. **Timing for Hydraulic operation**

Tipping time	40 Sec.
Loading time	120 Sec.
Empty container unloading time	30 Sec.

3. **Fulcrum pins locks, bush and bearings, supports and safety guards for arm cylinder,**

Locking hooks for container should be made of heavy duty

Abstract sheet for purchase of Dumper placer of 4.50 cumt capacity

Sr. No.	Item	Unit Price in Rs.	Quantity for yr. 2005-06 to 2007-08	Total Amount Rs
1.	Supply of Dumper Placer of 4.50 cu.m capacity fixed on either TATA or Ashok Leyland Chassis powered by reputed co., engine for hydraulic with necessary FBV & Tipper, gear box, heavy duty standard co., tyres including all taxes, transportation, Transit Insurance, CST/ VAT, Octroi, Entry Tax, RTO charges, service taxes FOB Rajkot and one year Insurance with third party coverage etc., complete	10,00,000	3	30,00,000
Total				30,00,000
Rupees Thirty Lakhs Only				

12.4.5 Purchase of Dead Animal Pick up Vans**General Specification:**

Number of dead animals particularly stray animals like pigs, dogs and cattle required to be transported from the city to the dead animal incinerator (proposed). The need based on the number of dead animals is two such vehicles.



The technical details are mentioned as under:

- Used for pickup and transportation of dead animal.
- Closed container type for hygienic purpose.
- Doors are air tight, No infection of to public on road.

Specification:**Chassis Dimension:**

Wheel base: 3100 mm

Over all length: 5375 mm

Width: 2140 mm

Loading platform area: 7.5 sq.m.

Loading capacity: 3.2 Tonnes

Eng. BHP: 71

Abstract sheet for purchase of Dead Animal Pick up Van (refer annexure: 14.8 quotation Item No.8)

Sr. No.	Item	Unit Price in Rs.	Req. Quantity for yr. 2005-06 to 2007-08	Total Amount Rs
1.	Supply of Dead Animal Pick up Van including all taxes, transportation, Transit Insurance, CST/ VAT, Octroi, Entry Tax, RTO charges, service taxes FOB Rajkot and one year Insurance with third party coverage etc., complete	8,10,000	2	16,20,000
Total				16,20,000
Rupees Sixteen Lakhs Twenty Thousand Only				

12.5 Estimated Cost for Modernization of Tertiary SWM - Land fill site Development for "Site A" Phase- I (2006-2011)

12.5.1 Earth work cost

Abstract sheet for Earth work for Land fill site

Item No	Qty.	Item	Rate in Rs.	Per	Amount	Remarks
1	64400.	Earthwork in excavation of site up to 1 mtr depth	67	Cu.Mt.	43,14,800	SOR Item No (28+33)
2	57960	Bottom liner clay of .9 mtr height by contractor arranged clay	100	Cu.Mt.	57,96,000	MR
3	8190	Earthwork of clay in embankment by contractor arranged clay	100	Cu.Mt.	81900	MR
4	180	Construction of approach ramp to land fill by earth filling using excavated material	35	Cu.Mt.	6300	MR
		Total			1,09,36,100	
		Say Rs.			1,09,36,000	
Rupees One Crore Nine Lakhs Thirty Six Thousand Only						

Measurement sheet Earthwork cost

Item No	Item	Unit	Length in mt.	Breadth in mt	Height in mt	Quantity	Remarks
1	Earthwork in excavation of site up to 1 mtr depth	M ³	280	230	1	64400	RMC SOR
2	Bottom liner clay of .9 mtr height by contractor arranged clay	M ³	280	230	0.9	57960	Market Rate
3	Earthwork of clay in embankment by contractor arranged clay	M ³	260	210	0.15	8190	Market Rate
4	Construction of approach ramp to land fill by earth filling using excavated material	M ³	20	9	(2+0)/2	180	Market Rate

12.5.2 HDPE Liner works for Land fill site

Bottom Liner :(Ref. Drg. No.5-6)

1. 2 x 45 cm thick compacted clay or compacted amended soil with permeability less than 1×10^{-7} cm/sec.
2. 1.5 mm thick HDPE Geo-membrane of following specifications:
 - Tensile strength at yield greater than 18 KN/m
 - Tensile strength at break greater than 30 KN/m
 - Tear Resistance greater than 150 N
 - Puncture Resistance greater than 250 N
3. 1 x 1.5 mm thick Geo-textile:
 - Type - Non woven, needle punched
 - Strength > 400 kg/ sq.mt
 - Mass per unit area shall be greater than 500 kg/ sq.mt
4. 1 x 20 cm thick Gravel as Leachate Drainage Layer; Material - Seashore gravel of size 6 mm to 12 mm with permeability greater than 1×10^{-7} cm/sec

Side Liner System (Ref. Drg. No.5-6):

1. 1 x 45 cm thick compacted clay or compacted amended soil with permeability less than 1×10^{-7} cm/sec
2. 1 x 1.5 mm thick HDPE Geomembrane of following specification;
 - Tensile strength at yield greater than 18 KN/m
 - Tensile strength at break greater than 30 KN/m
 - Tear Resistance greater than 150 N
 - Puncture Resistance greater than 250 N
3. 1 x 1.5 mm thick Geo-textile/ 20 cm soil/silt:
 - Type - Non woven, needle punched
 - Strength > 400 kg/ sq.mt
 - Mass per unit area shall be greater than 500 kg/ sq.mt

Leachate Drainage System (Ref. Dwg. No. 8):

The construction details of leachate drain is as follows:

- A trapezoidal trench has to be made as per the sizes shown in drawing.
- Trench shall be lined with 1.5 mm thick HDPE Geo-membrane from all sides.
- Longitudinal slope of trench shall be 1.0 % corresponding with slope of bottom liner.
- Half of HDPE Pipe shall be placed into trench
- The bottom and sides of HDPE pipe has to be filled with the mixture of cement, bentonite and sand in the ratio 3:3:94

- Over HDPE pipe Gravel size of 16 mm to 30 mm has to be placed uniformly

Specification of material to be used for leachate drain

1. 1.5 mm thick HDPE Geo-membrane of following specifications:
 - Tensile strength at yield greater than 18 KN/m
 - Tensile strength at break greater than 30 KN/m
 - Tear Resistance greater than 150 N
 - Puncture Resistance greater than 250 N
2. Mixture of sand, cement and bentonite shall be in ratio 94 %:3%:3%, respectively
3. Specification of HDPE pipe
 - Internal Dia- 271 mm
 - Outer Dia-315 mm
 - Wall thickness-22 mm
 - Pressure Rating -6 Kg / cm²

Top Liner System (Ref. DWG. No. 7):

1. 1 x 60 cm thick compacted clay or compacted amended soil with permeability less than 1×10^{-7} cm/sec.
2. 1 x 30 cm thick drainage layer
Material -Sand or any other granule greater than 1×10^{-2} cm/sec with permeability
3. 1 x 45 cm , with fertile soil for vegetation
4. Vegetation cover with Grass, Shrubs,etc. having roots length < 30 cm

Abstract sheet for HDPE Liner work for landfill site

Item No	Qty.	Item	Rate in Rs.	Per	Amount	Remarks
1	64400	Both side smooth HDPE liner of 1.5 mm thickness, including unrolling, cutting, laying on place, joining the side through welding.	170	Sq.Mt.	1,09,48,000	SOR Item No (28+33)
2	4700	Side rough and top smooth HDPE liner of 1.5 mm thickness, including unrolling, cutting, laying on place, joining the side through welding and anchoring the side anchor trench	170	Sq.Mt.	7,99,000	MR
3	6440	Soil over HDPE liner	35	Cu.Mt.	2,25,400	MR
4	2976	Drainage gravel	300	Cu.Mt.	8,92,800	MR
		Total			1,28,65,200	
		Say Rs.			1,28,65,000	
Rupees One Crore Twenty Eight Lakhs Sixty Five Thousand Only						

Measurement sheet HDPE Liner

Item No	Item	Unit	Length in mt.	Breadth in mt	Height in mt	Quantity
1	Both side smooth HDPE liner of 1.5 mm thickness, including unrolling, cutting, laying on place, joining the side through welding.	Sq.mt.	280	230		64400
2	Side rough and top smooth HDPE liner of 1.5 mm thickness, including unrolling, cutting, laying on place, joining the side through welding and anchoring the side anchor trench	Sq.mt.	(260+210)x (2)	5		4700
3	Soil over HDPE liner	Cu.mt	280	230	0.10	6440
4	Drainage gravel	Cu.mt	(273+223)x 2	2	1.5	2976

12.5.3 Development of Land fill Site Infrastructure**Abstract sheet for Site development Infrastructure cost**

Item. No.	Item	Unit Price in Rs.	Quantity	Total Amount Rs
1.	Const of Office Building			7,29,000
2	Const of Compound Wall			68,21,000
3	Installation of Weigh Bridge of 50 t capacity including necessary civil structure			6,00,000
4	Const of Material Store/ Garrage			12,51,0000
8	Green belt 3m wide along the landfill as per drawing	7000	50	3,50,000
Total				97,51,000
Rupees Ninety Seven Lakhs Fifty One Thousand Only				

Item No.1 Abstract sheet for Office Building

Item No	Qty.	Item	Rate in Rs.	Per	Amount	Remarks
1	60.00	Excavation in soft murrum & hard murrum including shorting out and stocking of useful material and disposing of the excavated stuff up to 90 mt. lead	39.50	Cu.Mt.	2370.00	23+28/2
2	120.00	Excavation for foundation in soft rock and hard rock by drilling, blasting etc. complete including shorting out and stocking of useful material and disposing of the excavated stuff up to 90 mt.	135.00	Cu.Mt.	16200.00	33+38/2
3	18.00	Filling in C.C. 1:3:6	1097.00	Cu.Mt.	19746.00	61
4	138.00	Rubble masonry for foundation	494.00	Cu.Mt.	68172.00	64
5	26.20	U.C.R. Plinth masonry work	536.00	Cu.Mt.	14043.20	70
6	14.20	C.C. Coping work	1459.00	Cu.Mt.	20717.80	136
7	87.30	Brick masonry in c.m. 1:6	1059.00	Cu.Mt.	92450.70	114
8	20.00	Brick masonry partition wall	155.00	R.Mt.	3100.00	114
9	3.60	C.C. Lintel work 1:1.5:3	2672.00	Cu.Mt.	9619.20	293-A
10	1.50	C.C. chajja work	2660.00	Cu.Mt.	3990.00	295
11	16.00	Slab work 1:1.5:3	2456.00	Cu.Mt.	39296.00	291-A
12	572.00	Sand face cement plaster	57.00	Sq.Mt.	32604.00	150
13	500.00	Cement plaster with niru finishing	42.00	Sq.Mt.	21000.00	146
14	0.75	C.C. beam work 1:1½:3	2590.00	Cu.Mt.	1942.50	294-A
15	2200.00	Steel TMT for RCC work	36.00	Kgs.	79200.00	302-B
16	100.00	Kotta stone flooring	240.00	Sq.Mt.	24000.00	191
17	12.00	Step and riser of polished kota stone	219.00	Rmt	2628.00	226
18	110.00	Mosaic tiles flooring work of second quality	101.00	Sq.Mt.	11110.00	205
19	60.00	Cement lodhia work	3.00	Rmt	180.00	456
20	12.00	Granite tiles flooring work with c.m. 1:3	2251.00	Sq.Mt.	27012.00	238
21	70.00	Glazed tiles 2nd Quality	277.00	Sq.Mt.	19390.00	196
23	36.00	Polished kota stone partition work of 20 to 25 mm thick	406.00	Sq.Mt.	14616.00	227
24	17.00	Door of teakwood fully panelled with teak wood frame 125 x 75 including oil paint.	2150.00	Sq.Mt.	36550.00	309
25	5.00	Doors of Alu. Section	2500.00	Sq.Mt.	12500.00	382
26	14.00	Windows and ventilation of alu. Section	1615.00	Sq.Mt.	22610.00	381
27	1.00	European type WC white sheet cover including fixing 1 st quality	370.00	Nos.	370.00	871
28	1.00	Orissa pan white porcelain including fixing	450.00	Nos.	450.00	878
29	2.00	White glazed p-trap with fixing	77.00	Nos.	154.00	870

Item No	Qty.	Item	Rate in Rs.	Per	Amount	Remarks
30	2.00	Nahani trap of 7.6 cm dia. Complete including fixing	80.00	Nos.	160.00	875
31	2.00	Gali trap white glazed of approved quality including fixing	85.00	Nos.	170.00	873
32	5.00	P.V.C. Pipe of 110 mm. Dia (4 Kg.) necessary T, bend , Y including fixing	141.00	Rmt.	705.00	883
33	30.00	Salt glazed stoneware pipe of 150mm dia necessary special fittings including fixing	130.00	Rmt.	3900.00	855
34	5.00	Manhole chamber works 0.45 x 0.45 mt size comp.	640.00	Nos.	3200.00	605
35	5.00	Manhole frame and cover of 10 ton capacity 0.45 x 0.45 mt size comp.	780.00	Nos.	3900.00	632+633
36	2.00	cast iron flushing valve chrome plated including fixing	230.00	Nos.	460.00	836
37	50.00	15 mm dia GI pipe including necessary fitting and fixing	49.00	Rmt.	2450.00	931
38	60.00	~do~ 25 mm dia	101.00	Rmt.	6060.00	933
39	5.00	Collapsible gate work of steel including oil painting and fixing	1360	Sq.mt	6800.00	322
40	620.00	Steel work as per instruction	39.8	Kgs.	24676.00	823
41	575.00	Snowcem color work in 2 coats	17.00	Sq.mt	9775.00	
42	480.00	Plastic emulsion paint work in 2 coats and primer coat	28.00	Sq.mt	13440.00	177
43	24.00	Oil paint work to doors and windows	23.00	Sq.mt	552.00	473
44	4.00	IPS flooring work 50 mm	77.00	Sq.mt	308.00	208
45	2.00	white porcelain laboratory sink including fixing	923.00	Nos.	1846.00	827
46	75.00	Filling in plinth	75.00	Cu.Mt.	5625.00	102
47	15.00	Lime concrete work using black trap metal	292.00	Cu.Mt.	4380.00	57
48	2.00	Full way valves of brass 25 mm dia	120.00	Nos.	240.00	869
49	4.00	tested brass cock of 15 mm dia	49.00	Nos.	196.00	943
50	210.00	Lifting of soil including spreading	33.00	Cu.Mt.	6930.00	712
		Total			694134.40	
		Plus 5% Electrification			34706.72	
		Net Total			728841.12	1
		Say Rs.				7,29,000/-

Item No. 2 Abstract sheet for Compound Wall

No	Qty.	Item	Rate in Rs.	Per	Amount	Remarks
1	600.51	Excavation for foundation in clay, soft murrum, sand with hard murrum including shorting out and stacking of useful material and disposing of the excavated stuff up to 90 mts. Lead	39.50	Cu.Mts.	23720.15	23+28/2
2	1201.20	Excavation of foundation in softrock with hard stone by breakers, blasting etc.. Including shorting out and stacking of useful material and disposing of the excavated stuff up to 90 mts. Lead	135.00	Cu.Mts.	162162.00	33+38/2
3	243.00	providing & laying cement concrete 1:2 :4 P.C.C.& curing complete including cost of formwork in foundation & plinth	1097.00	Cu.Mts.	266571.00	61
4	1559.00	Uncourse rubble masonry work in foundation of approved quality foundation including leveling up etc. complete (1:6) 1 cement : 6 sand	494.00	Cu.Mts.	770146.00	64
5	1108.00	Uncourse rubble masonry work on plinth of approved quality plinth including leveling up etc. complete (1:6) 1 cement : 6 sand	520.00	Cu.Mts.	576160.00	71
6	277.20	Providing & laying ordinary cement concrete 1:2 :4 for R.C.C.copping including smooth with curing etc. comp. without the cost of formwork & reinforcement	1459.00	Cu.Mts.	404434.80	136
7	1674.75	Brick masnory work using brunt clay brick having crushing strength not less than 35kg sq.cm. in cement mortar 1:6 (1-cement: 6 - fine sand)	1059.00	Cu.Mts.	1773560.25	114
8	21368.00	20 mm thick sand face cement plaster on walls above ground level consisting of 12mm backing coat of cm 1:3 (1-cement : 3 -sand) etc. complete.	57.00	Sq.Mts.	1217976.00	150

No	Qty.	Item	Rate in Rs.	Per	Amount	Remarks
9	11550.00	Mild steel for R.C.C. work including supplying with cutting, bending, binding etc...Complete	31.80	Kgs.	367290.00	301
10	17325.00	Tor steel for R.C.C. work including supplying with cutting, bending, binding etc...Complete	33.00	Kgs.	571725.00	302
11	21368.00	Snowcem colour on wall with all labour & materials etc. Complete.	17.00	Sq.Mts.	363256.00	170
12	3812.00	11.5cm x 5cm. Square C.R.C. pipe	85.00	Rmt.	324020.00	
					6821021.20	
				Say Rs.	68,21,000	
Rupees Sixty Eight Lakhs Twenty One Thousand Only						

Item No.3 Abstract sheet for Garage for Vehicles

No	Qty.	Item	Rate in Rs.	Per	Amount	Remarks
1	40.00	Excavation in soft murrum & hard murrum including shorting out and stocking of useful material and disposing of the excavated stuff up to 90 mt. lead	39.50	Cu.Mt.	1580.00	23+28/2
2	42.00	Excavation for foundation in soft rock and hard rock by drilling, blasting etc. complete including shorting out and stocking of useful material and disposing of the excavated stuff up to 90 mt.	135.00	Cu.Mt.	5670.00	33+38/2
3	12.00	providing & laying cement concrete 1:2 :4 P.C.C.& curing complete including cost of formwork in foundation & plinth	1450.00	Cu.Mt.	17400.00	62
4	25.00	C.C. Footing 1:1½:3 with curing and without reinforcement	2121.00	Cu.Mt.	53025.00	300-A
5	14.50	C.C. Column 1:1½:3 including all shuttering, formwork, curring etc complete without reinforcement	2655.00	Cu.Mt.	38497.50	292-A
6	45.00	C.C. Beam 1:1½:3 including all shuttering, formwork, curring etc complete without reinforcement	2590.00	Cu.Mt.	116550.00	294-A
7	38.00	C.C. Slab 1:1½:3 including all shuttering, formwork, curring etc complete without reinforcement	2456.00	Cu.Mt.	93328.00	291-A
8	1.80	C.C. Lintel 1:1½:3 including all shuttering, formwork, curring etc complete without reinforcement	2672.00	Cu.Mt.	4809.60	293-A

No	Qty.	Item	Rate in Rs.	Per	Amount	Remarks
9	1.20	C.C. Chajja 1:1½:3 including all shuttering, formwork, curring etc complete without reinforcement	2660.00	Cu.Mt.	3192.00	295
10	18250	Tor Steel for R.C.C. work	33.00	Kg.	602250.00	302
11	75.00	Brick masnory work using brunt clay brick having crushing strength not less than 35kg sq.cm. in cement mortar 1:6 (1-cement: 6 - fine sand)	1059.00	Cu.Mt.	79425.00	114
12	680.00	Cement plaster 12mm thick with C.M. 1:3 with niru finishing	42.00	Sq.Mt.	28560.00	146
13	425.00	20 mm thick sand face cement plaster on walls above ground level consisting of 12mm backing coat of cm 1:3 (1-cement:3 -sand) etc. complete.	57.00	Sq.Mt.	24225.00	150
14	680.00	Plastic emulsion paint work in 2 coats and primer coat	28.00	Sq.Mt.	19040.00	177
15	425.00	Snowcem colour on wall with all labour & materials etc. Complete.	17.00	Sq.Mt.	7225.00	170
16	70.00	Cement lodhia work	3.00	Rmt.	210.00	456
17	275.00	Grey coloured cement tiles flooring for terrace	101.00	Sq.Mt.	27775.00	205
18	43.00	Lime concrete work with black trap metal including raming, curing etc. complete	292.00	Cu.Mt.	12556.00	292
19	35.00	Wearing coat for flooring with C.C. 1:1½:3 complete	1937.00	Cu.Mt.	67795.00	280
20	16.50	Window stell frame section Z-7 including oil paint, plain etc. complete	810.00	Sq.Mt.	13365.00	327
21	3.00	Door steel frame section Z-7 including oil paint etc. complete	765.00	Sq.Mt.	2295.00	326
22	35.00	Murrum filling in plinth	75.00	Cu.Mt.	2625.00	102
23	120.00	Patta work in plaster (10cm to 15cm) in C.M. 1:3	24.00	Rmt.	2880.00	163
24	25.00	Decorative Groove work in Chhaja	19.00	Rmt.	475.00	164
25	30.00	Lifting of soil including spreading	33.00	Cu.Mt.	990.00	712
				Total 1	1225743	
				Plus 2% Electrification charges	24514	
				Total 2	1250257	
				Say .. Rs.TOTAL	12,51,000	
				Rupees Twelve Lakhs Fifty One Thousand Only		

12.6 Total Estimated Cost for Modernization of Rajkot Solid Waste Management Plan Phase-I (2005-2008)

Sr.No.	Details	Amount in Rs. Lakhs	Remarks
1	Modernization of Primary Solid Waste which includes purchase of littering bins, wheel barrows, closed containers, debris containers, tricycle and mechanical sweeping machine etc.,	256.23	
2	Modernization of Secondary Solid Waste which includes purchase of JCB machines, dumpers of 14 cu.mt & 8 cu.mt capacity, dumper placers for closed containers & debris containers, dead animal pick up van	259.20	
3	Modernization of Tertiary Solid Waste which includes development of land fill site –A phase-I with necessary infrastructure	335.52	
	Total Cost	850.95	
	Add Contingencies, Sundries price acceleration as 5% of total cost	42.55	
	TOTAL	893.50	
	Say Rs in lakhs	894	
In Words _ Rupees Eight Crore Ninety Four Lakhs only			

Environmental Engineer
Rajkot Municipal Corporation

Deputy Municipal Commissioner
Rajkot Municipal Corporation

13**Proposals for Administrative steps****13.1 Institutional Aspects & Capacity Buildings**

The subject of solid waste management has remained neglected for the past several decades with the result that the level of service is highly inadequate and inefficient. For improving the solid waste management services it is essential to adopt modern methods of waste management, have a proper choice of technology, which can work in the given area successfully. Simultaneously, measures must be taken for institutional strengthening and internal capacity building so that the efforts made can be sustained over a period of time and the system put in place can be well managed. Institutional strengthening can be done by adequately decentralizing the administration, delegating adequate powers at the decentralized level, by inducting professionals into the administration and providing adequate training to the existing staff. It will also be necessary to fix work norms for the workforce as well as for supervisory staff and the output expected from the vehicles and machinery utilized. NGO/Private sector participation also needs to be encouraged and make the service competitive and efficient.

Recommendations

- **The municipal corporation should take adequate measures for institutional strengthening through induction of professionals, decentralization of administration, and delegation of powers, human resources development, private sector and NGO participation.**

This may be done as under:

13.1.1 Decentralization of Administration

In the city of Rajkot, the SWM services can be performed effectively only if its administration is adequately decentralized. Decentralization can be at least 3 tiered -one at the Ward level, second at the Zone level and third at the city level.

The SWM functions would get focused attention if all functions of the city administration are decentralized at Zone/Division levels and senior officers are placed in-charge of each Zone/Division functioning independently with adequate delegated powers.

The SWM functions are proposed to be decentralized as under:

13.1.2 Ward level administration

The ward level administration should be fully responsible for ensuring storage of segregated waste at source, primary collection of waste, street sweeping and taking the waste to bulk community waste storage sites, clearing debris and cleaning surface drains/nallas and public spaces. The cleaning of each street, lane, by-lane, markets and public space should be regularly supervised by the ward-

level supervisors. The presence of all SWM officers of the Ward in the field during/ and morning hours is most essential. A grievance redressal system should be put in place in each ward.

13.1.3 Involvement of Ward Committees:-

The 74th Constitutional Amendment envisages formation of Ward Committees in each city above three lac populations. These Ward Committees, as and when formed, may be very profitably involved in improving SWM services at the Ward level. These Committees could be motivated to help in the following areas:-

1. Creating public awareness at the Ward level;
2. Formation of Residents Association/ Neighborhood Committees to ensure public participation in source segregation of recyclable waste and deposition of domestic waste in the handcarts on time during primary do collection;
3. Involving school children to be watch dogs in preventing littering of streets by the people;
4. Interfacing with the people and officials and help in redressal of public grievances on SWM at the ward level;
5. Supporting the effort of cost recovery for the services rendered;
6. Encouraging NGO participation.

13.1.4 Zonal Administration

Administrative Zones should be made for a group of wards. Each Zone can cover a population of about three to four lakhs people. The corporation may accordingly set up three zones in the city headed by deputy Commissioners.

The Zonal administration should effectively supervise and support the work of the Ward administration and also provide Zonal level support such as construction and upkeep of flooring under the communal waste storage sites, transportation of waste from the communal storage sites to the transfer station, processing plant and disposal sites. If the Zones are not allotted adequate vehicles for the transportation of waste due to paucity of vehicles, the transportation of waste may be coordinated centrally for optimum utilization of the fleet of vehicles in two or three shifts.

13.1.5 City Level Administration

The city level administration should supervise and support the Zonal administration and in cases where the fleet of vehicles is not decentralized at the zonal level, the central SWM Department should look after the transportation of waste from the waste storage sites on a daily basis. The Central SWM department should be responsible for upkeep of vehicles, construction of transfer stations, setting up and maintenance of processing plants, incineration plants as well as for managing the disposal sites in an environmentally acceptable manner.

The central SWM department should also be responsible for the procurement of vehicles, equipment, and land for processing and disposal of waste. As a Head Office it should take policy decisions and co-ordinate the activities of all the zones and the wards and be answerable to the Municipal Commissioner and elected body for the efficient functioning of the department. It should look after the recruitment of manpower, human resources development, training etc.

13.1.6 Delegation of Powers

Authority and responsibility should go hand in hand. For fixing accountability there should be adequate delegation of fiscal and disciplinary powers to the officers and the supervisory staff responsible for managing solid waste and Carrying out all day-to-day functions smoothly.

The Head of the SWM department should also have the power to punish subordinates including supervisory staff. Adequate in-built checks may be introduced to ensure that the delegated powers are not misused.

13.1.7 Induction of Environmental/Public Health Engineers

The subject of solid waste management, is handled by environmental engineers or public health engineers with the support of mechanical/automobile engineers to handle the workshop Facilities. Qualified engineers should, be strengthen as under.

1. Public Health/Envirotimental Engineer of the level of Executive Engineer to be in-charge of the SWM department
2. Public Health/Environmental Engineers of the level of Asst. Executive Engineer per five lacs population.
3. Public Health/Environmental Engineers of **the** level of Asst. Engineer **per** 2.5 lacs population.
4. Qualified Sanitation Diploma holder-/Sanitation Officer @ I S.O. per- 1 lac Population **or** part thereof to look-after the collection, transportation, processing and disposal of waste **or @ 1 per-** 2 Sanitary inspectors, whichever is less.
5. Qualified Sanitation Diploma holder Sanitary Inspector (S.I.) @1 S.I. per 50,000 population or part thereof or 1 per 80 sweepers, whichever is less.
6. Qualified sanitation diploma holder Sanitary Sub-inspector (S.S.I.) @ I S.S.I. per 25,000 population or part thereof or @ I per 40 sweepers, whichever is less.
7. Sanitary Supervisors (Mukadams who can read, write and report) @ I S. S. per 12,500 population or part thereof, or I per 20 sweepers, whichever is less.

As discussed earlier the lower staff are shortage beside which are need to be re-organised as proposed in the chapter 8

The staff should be trained as suggested in the chapter 8

13.1.8 Encouragement to NGOs and Solid waste collector co-operatives

In Rajkot the involment of the NGO to run the show of SWM seems to very minimal though privatization is more than 60% of the service therefore it needs to encourage NGO to participate in SWM activities

NGOs may be fully involved in creating public awareness and encouraging public participation in SWM planning and practice. The Municipal Corporation may also encourage NGOs or co-operative of rag pickers to enter this field and organize rag pickers in doorstep collection of waste and provide them an opportunity to improve their working conditions and income. The Municipal Corporation 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 the extent possible.

SWM services are highly labour intensive on account of increased wage structure of the Government and municipal employees this service is becoming more and more expensive. Besides, the efficiency of the labour force employed in the Municipal Corporation is far from satisfactory. High wage structure and inefficiency of the work force results into steep rise in the cost of service and yet the people at large are not satisfied with the level of service being provided by the Municipal Corporation. Efforts to increase the efficiency by H.R.D. and institutional strengthening will, to some extent improve the performance but they may not be enough. It is, therefore, necessary that the Municipal Corporation seriously consider augmenting NGO/private sector participation in solid waste management.

Private sector participation or public private partnerships may be considered by Municipal Corporation keeping in mind the provisions of the Contract Labour (Regulation and Abolition) Act 1970 of the Government of India under which state governments can prohibit contracting out the services already being provided by the Municipal Corporation. Therefore, while considering any measure of privatization it is necessary to keep in mind the provisions of the above law, the directions that may have been issued by the state government under this law in those areas which are not prohibited and where Municipal Corporation is not currently providing a service. This will check growth in the establishment costs, bring in economy in expenditure and introduce an element of healthy competition between the private sector and the public sector in solid waste management services. There should be a right mix of private sector and public sector participation to ensure that there is no exploitation of labour as well as of the management.

NGO/private sector participation can, therefore, be considered in newly developed areas, under-served areas and particularly in areas where Municipal Corporation have not been providing service. Some examples are given below:

NGO/private participation should be encouraged in the areas of door to door collection of domestic waste, door to door collection of commercial waste, door to door collection of hotel waste, construction waste, and yard waste, and in the area of awareness and creating public participation.

The private sector may also be encouraged to develop land fill site. Supplying vehicles on rent, supplying vehicles on lease, repairs and maintenance of vehicles at private garages are also some areas where the private sector can be involved.

13.1.9 Covering of Nallas (Vonklas) :

The city has 19 vonklas. Eleven of them are big and eight are small. These nallas are a big source of nuisance in the city, but at the same time, they are essential for carrying the waste water and storm water. It is strongly recommended that a separate project may be got prepared for converting these nallas into large size storm water drains and they may be covered and the precious land which is presently wasted under the nallas may be reclaimed and utilized commercially or public purpose as may be necessary. The cost of covering of nallas would be easily recovered from the reclaimed land that would be realized and from the appreciation of value of the adjoining lands.

13.1.10 Sustainable SWM Service :

Rajkot Municipal Corporation spends each year about 25 to 30% of its revenue income to provide solid waste service. The service is highly subsidized as against expenses of about Rs.27 crores the recovery the demand is about Rs. 5 crores. This needs to cut down the subsidy in phase manner it is proposed to increase conservancy charge in the tune of 20% per year.

13.2 Management Information System

Good management is the key to keep a city clean. This requires collection of critical information which is not just for keeping the records up to-date but used effectively for taking corrective measure as well as proper planning for future. Some information is, therefore, required to be collected to have an overall idea of the prevalent situation, deficiency in the system and likely requirements for the future. Information that high lights the day deficiency in the system and can be used in taking corrective measures has to be collected at regular interval to monitor the services. Computerization of such information helps all the levels to work not harder but smarter and increases the level of jobs satisfaction.

With the advance of information technology, Geographical information system (GIS) could be introduced in large cities and MIS may be integrated in this system. Similarly, there is a need for a citizen interface to seek comments, suggestions etc., and utility services.

Information that needs to be recorded and studied includes relevant information of the department for planning process as well as specific information to know whether every one involved SWM services is performing his duty well, adequate vehicles are given to the SWM dept. by the workshop, the vehicles give their optimum output, the repairing and maintenance of vehicles and equipments at the workshop is properly done, the vehicles carrying the waste to the disposal site are optimally utilized, the processing plants are performing well, landfill sites are well managed etc...

The first thing each morning the Municipal Commissioner should see is whether anything unusual or unsatisfactory has happened needing immediate remedial measures. A list of items is given

below on which the data should be collected and kept on record for planning purpose and a few Performa are designed for monitoring the activities done by various sections of SWM department as under which may be utilized by the local bodies with suitable modifications.

GENERAL INFORMATION TO BE COLLECTED AND UPDATED FROM TIME TO TIME

1. Area of the city
2. Population of the city
3. Decadal growth of the city
4. Number of wards, their area and population
5. Ward wise information is regards to :
 - Population density in different wards
 - No. of Households, shops and Establishments
 - Vegetable/fruit/meat/fish markets
 - Number of Hotels & Restaurants
 - Number of Hospitals and Nursing Homes
 - Number of Industries
 - Number of slum pockets / their population
 - Road length width wise
 - Percentage of area covered with under-Ground sewage system
 - Percentage of area having surface Drains
 - Percentage of area having no drainage Facility
 - Total number of public toilets and Toilet seats.
 - Number of public urinals
 - Number of Nuisance spots

GENERAL INFORMATION ON SWM

Waste generation

1. Average quantity of waste produced each day.
2. Seasonal variations in daily waste generation.
3. Total quantity of waste produced annually during last 3 years
4. Breakup of the quantity of wastes generated
 - i. Household, Shops and establishment waste
 - ii. Vegetable and food market waste
 - iii. Meat, fish and slaughter house waste
 - iv. Construction & demolition waste
 - v. Hospital waste
 - vi. Industrial waste
5. Average number of carcass removed each day

Staff position

6. Number of sanitation workers deployed in the city for the collection of waste
7. Number of sanitation workers deployed for the transportation of waste
8. Ward-wise allocation of sanitation workers
9. Sweeper population ratio in each ward
10. Sweeper road length ratio in each ward
11. Sweeper supervisor ratio in each ward

Waste storage depots

12. Number of sites designed / notified for temporary of waste (Dust Bins)
13. Type and size of Dustbin provided in each ward.
14. Ward-wise Quantum of waste generated each day.

Transportation

15. Number of vehicles available with the local body for the transportation of waste, their type, size and age.
16. Number of trips made by each vehicle in one shift.
17. Number of vehicles used in:
 - First shift
 - Second shift &
 - Third shift
18. Qty. of waste transported in each shift.
19. Total qty. of waste transported each day.
20. Percentage of waste transported each day.

Waste processing and disposal

21. Number of waste processing and disposal sites in the city.
22. Their distance from the center of the city.
23. The area of these sites.
24. The qty. of waste treated/disposed of at each site.
25. The expected life of each land filled site.

Financial aspects

26. Operating cost
 - a. Cost of collection per ton/day
 - b. Cost of transportation per ton/day
 - c. Cost of disposal per ton/day

27. Allocation of revenue and capital budget for SWM vis a Vis the city Corporation's budget.

MONITORING OF SWM SERVICES

For the day-to-day monitoring of SWM services, the following data may be collected, compiled and analyzed

DAILY REPORTS TO BE SENT**(1) Collection of waste**

- i. Number of sweepers required to report for duty.
- ii. Number of sweepers actually reporting for duty.
- iii. Number of sweepers absent.
- iv. Areas left unattended
- v. Arrangements made or proposed to be made for clearing the backlog.

(2) Inspection by supervisor for street sweeping & primary collection.

- i. Number of person he is required to supervise.
- ii. Number of person supervised during the day.
- iii. Number of cases where performance found satisfactory.
- iv. Number of cases where performance was not up to the mark.
- v. Action taken or proposed to be taken.
- vi. Complaints received and attended.

(3) Inspection of cost recovery services**Such as Hotels, Hospitals, Commercial streets and offices**

- i. Number of cost recovery sites under his charge.
- ii. Number of sites inspected.
- iii. Deficiencies noticed.
- iv. Complaints received & attended.
- v. Action taken or proposed to be taken.

(4) Inspection of bulk community waste storage sites**Number of sites in the area under his charge.**

- i. Number of sites inspected.
- ii. Number of sites found well maintained.
- iii. Number of sites found ill maintained or needing repair or replacement.
- iv. Action taken

- v. Number of unauthorized waste disposal sites or sites identified during field visits
- vi. Action taken

(5) Inspection of silt removal sites & building waste disposal sites.

- i. Number of silt removal sites inspected
- ii. Number of sites found satisfactory.
- iii. Number of sites where silt was found lying outside the man hole or surface drain.
- iv. Number of construction sites/construction waste disposal sites visited
- v. No of sites where construction waste was found disposal of unauthorized.
- vi. Action taken

(6) Transportation of waste

- i. Number and type of vehicles and equipment required to report for duty.
- ii. Number and type of vehicles and equipment which actually reported for duty.
- iii. Breakdowns reported during the day and action taken.
- iv. Number of trips made to the disposal site by each vehicle
- v. Number of bins cleared during the day.
- vi. Number and locations of bins left unclear and
- vii. Arrangements made or proposed to be made for clearing the backlog.

(7) Quantities of waste transported

- i. Number of vehicles deployed during the day.
- ii. Number of trips made
- iii. Quantity of waste transported
- iv. Number of vehicles which did not make adequate trips
- v. Number of vehicles which carried less garbage.
- vi. Action taken or proposed to be taken against defaulters

WEEKLY REPORTS

(8) Inspection of processing sites

- i. Whether the plant was functional during the week
- ii. whether it received the garbage as prescribed regularly
- iii. whether the site is properly maintained and waste stacked properly
- iv. Quantity of Bio-organic fertilizer / described material proposed
- v. Quantity of produce sold during the week
- vi. Quantity of end product stock
- vii. Any irregularity in noticed
- viii. Action taken

(9) Inspection of waste disposal site

- i. Name of the site inspected
- ii. Whether all the staff present on duty during the week

- iii. Whether the required machinery was available on site on all the day
- iv. Whether the approach road and internal roads are properly made
- v. Whether the weigh bridge is functional and properly used.
- vi. Quantity of waste received at the site on the day during the week
- vii. Whether the entire waste was spread, compacted and covered on the same day.
- viii. Whether communication facilities such as telephone, wireless etc... remained functional during the week.
- ix. Whether shelter and drinking water facility is adequate
- x. Deficiencies noticed.
- xi. Remedial action taken or proposed to be taken

Record of trip made by transport vehicle at the processing and disposal sites

- i. Sr. Number
- ii. Date
- iii. Vehicle number
- iv. Name of the Driver
- v. Arrival time of the Vehicle
- vi. Trips made including this trip
- vii. Waste source and route Number
- viii. Weigh of waste in M.Tones
- ix. Deficiencies noticed
- x. Action taken

(10) Workshop performance

A

- i. Number and percentage of vehicles on road
- ii. Number and type of vehicles under repairs at Corporation's or Private workshop
- iii. Nature of breakdown
- iv. Duration of breakdown : Under one week, 1-2 weeks, 2-4 weeks and over one month
- v. Reason for delay in repairs
- vi. Expected date of vehicle to be back on road

B

- i. Number and type of vehicle and equipment required to be given to the SWM Dept. by the workshop or through the contractor
- ii. No and type of vehicle and equipment actually given
- iii. Shortfall if any
- iv. Reasons
- v. Alternate arrangements made

- C Each vehicle should maintain a logbook showing information of movement and performance as under:

VEHICLE LOG BOOK

Department:

Date:

Vehicle number:

Shift:

Driver's name:

1. Departed from workshop
2. Return to workshop
3. Fuel taken
4. Kilometer reading at start of work
5. Kilometer reading at the end of work
6. Total mileage / kilometer
7. Details of trip made and location covered
8. Inspected at point Number by at AM/PM
9. Weight recorded at weighbridge Time in Time out

Weighbridge Operator's signature

Driver's signature

User department's signature

11 Inspection of workshop stores

- i. Whether the list of fast moving items is maintained
- ii. Whether the list of critical items is maintained
- iii. Whether minimum level of stock is maintained
- iv. Item found to be out of stock
- v. Item found to be over stock
- vi. Deficiencies/irregularities noticed
- vii. Action taken

Computerization of inventory daily with in and out information, balance in stock and economic order quantity would be very useful to keep track of availability and replacement of spares.

DAILY REPORTING

(12) Monitoring of complaints

All complaints regarding SWM services should be registered at the relevant ward offices and monitored on day-to-day basis by the ward officer, who should give specific time limit to the supervisory staff of Sanitation Department to dispose of the complaints and report compliance. Reviewing the number and type of complaints and timely corrective action taken on each one must form an important part of the weekly review by senior officers.

(13) Recovery of additional cleaning charges

- | | | | |
|------|---------------------------------------|--------|--------|
| i. | Name of the ward | | |
| ii. | Areas visited | | |
| iii. | Addl. cleaning charges recovered: | Number | Amount |
| | From household | | |
| | From shop | | |
| | From offices | | |
| | From other establishment | | |
| | From road side vendors, eating joints | | |
| | TOTAL | | |

(14) Cost recoveries/penalties:

Ward wise cost recoveries made every month for a variety of services rendered

Ward wise penalties or levy of administrative charges from offenders every month

(15) Legal matters

Number of cases filed in the courts each month for violation of sanitation laws. For the effective monitoring of SWM services, the information collected in various proformas should be carefully analyzed and corrective measures taken promptly.

There should be route maps and duty charts with each of the supervisory staff, should check whether work on site is going as per schedule and whether vehicles and manpower are giving their optimum output. Wireless pagers or other communication network essential for effective communication and monitoring of services.

MONITORING PUBLIC RESPONSE**MONTHLY REPORT****(16) Public Participation**

Total number of sweepers allotted for door to door waste collection work in each ward

Number of sweepers getting good response from citizens in the matter of doorstep collection

Number of sweepers not getting response from the public

Percentage of public participation

Improvement in this area over the last month

13.4 Health Aspects

Improper Solid Waste Management gives rise to problems of health, sanitation and environmental degradation. WHO studies have indicated that twenty two diseases are directly linked to improper solid waste management practice. Rodents and vector insects transmit various diseases like dysentery, cholera, plague, typhoid, infective hepatitis and others.

Special epidemiological studies have shown that workers engaged in SWM services are exposed to high health risks and frequently suffer from respiratory track infections and are also gastro-intestinal parasites and worms. The organic component of solid waste provides food and shelter to disease-carrying rodents and insects. Indian domestic waste contains human excreta, bio-medical waste and some times other toxic and hazardous waste too. Improper management of waste can therefore spread several diseases. The rag pickers who move from street to street, bin to bin and go to dump yards to retrieve recyclable waste are most vulnerable to diseases on account of their direct contact with contaminated waste. They too are found to suffer from intestinal and respiratory infections, skin disorders and eye infection. They also suffer from injuries at open dumps, which can cause tetanus and serum hepatitis. Unscientific disposal of waste also contaminates ground water resources with heavy metal and other contaminants through leachate and pose a serious problem of environmental deterioration and health risk. It is therefore essential that all stages of solid waste management are handled carefully and health risks minimized.

Special care should be taken to ensure that_

- Containers are used for storage of waste at source as well as for the temporary bulk storage of waste at community level
- Waste stored at the source of generation is collected daily before it starts decaying and emanates foul smell
- Workers are adequately trained in waste handling and protecting themselves from the health risks involved in their occupation
- The workers are given protective clothing and shoes and persuaded or requested to use them
- Solid waste processing plant functions properly and take care to manage hazardous waste and to dispose of rejects at landfill site
- Waste should not be burnt on the street / open space or at any place as it causes pollution.
- Landfill sites are properly managed and monitored to prevent ground water pollution

Besides, managing the solid waste as indicated above. The following additional measures may also be taken to improve the sanitary condition in the city.

1. Special Attention to Slums and traditionally dirty areas: Since a city is only as clean as its dirtiest areas, which affect the health and quality of life of its entire citizen, the slums and traditionally dirty areas, whether legalized or not, should be given special attention and provided full SWM service.

2. Temporary Toilets at construction sites: All sites where labour force is deployed for carrying out construction activities should have the basic facilities of toilets and urinal to prevent open defecation. Making of such prior provision at construction sites, should be one of the conditions while granting building permission and must be adhered to.

3. Covering of building under construction: A lot of dust comes on the street from building under renovation and unhealthy conditions are created. To prevent this, it is recommended that all towns planning department should ensure that when any building is taken up for repairs, renovation, maintenance, demolition or construction it is properly covered and curtained by the owner of the structure.

4. Cattle Nuisance: No stray cattle should be allowed on the streets. All existing cattle sheds, wadas and go-shalas should be removed to the outskirts in a phased manner from the city. They should be stalled-fed and the waste produced in such stables should be disposed of by the cattle owner on daily basis at the community storage sites. Owners of these animals should be suitably charged for the disposal of such waste in the municipal system.

5. Health monitoring for sanitation workers: Corporation should take action to protect all waste handlers from the ill effect of their occupation. They should be given annual medical examination and monitoring, given appropriate health education and free medical treatment if it is felt that the illness is occupation- related.

6. Prevent indiscriminate use of pesticides: Indiscriminate use of pesticides, disinfectants etc., at the dustbin as well as the waste disposal sites must be stopped. Such use may be made only under the expert advice of the health authorities.

13.5 Legal Aspects

In Rajkot, overall public apathy is observed in the matter of handling and disposal of municipal waste. RMC is trying to correct the system by taking concerted measures involving the public at large through their active participation in the process, and by the local bodies performing their duties effectively. As, Solid waste management practices can never reach the desired level of efficiency until the public participates and discharges its obligation religiously. The system therefore, can only be improved by modernizing the solid waste management system by the Rajkot Municipal Corporation and ensuring public participation through very serious motivational efforts and by providing adequate legislative support for taking punitive measures.

For improving solid waste management practice in city, the Supreme Court Committee has give ranging recommendation defining the roles and responsibilities of the citizens, NGOs, local bodies, etc., Subsequent to the aforesaid report ,the Government of India , Ministry of Environment has notified Municipal Solid Waste (Management & Handling) Rules 2000 under the environment Protection Act 1986, these rules have clearly laid down the measures to be taken by the Municipal Corporations as well as smaller urban local bodies.

The following legal provisions may be incorporated _

1. Prohibition Against Littering the Streets, Deposition of Solid Waste on the Streets, Open Defecation, etc.

No person shall litter public streets or 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 local body, State or

Central Government or any unoccupied land or on the bank of a water-body any solid waste except in the receptacles specified in 2, 6 and 8 above or resort to open defecation.

1. Duty of Occupiers of Premises to Store Solid Waste at Source of Generation: It shall be incumbent on the occupiers of all premises to keep two receptacles, one for the storage of food/organic/bio-degradable waste and another for recyclable and other types of solid wastes generated at the said premises. The domestic hazardous waste, as may be notified by the local body, shall also be kept separately in a suitable container as and when such waste is generated.

2. Duty of Occupier not to Mix Recyclable /Non-Bio-degradable Waste and Domestic Hazardous Waste with Food Waste etc.: It shall be incumbent on the occupier of any premises to ensure that the recyclable waste as well as domestic hazardous waste generated at the said premises does not get mixed up with the food/bio-degradable waste and stored separately.

3. Duty of Societies/ Associations/ Management of Commercial Complexes to Clean their Premises and to Provide Community Bins: It shall be incumbent on the management of Co-operative Societies, Associations of residents, multistoried buildings, commercial Complexes, Institutional buildings, markets and the like to arrange for daily cleaning of their internal streets, common spaces, etc., and provide community bin/bins of appropriate size as may be prescribed by urban local body, for the temporary storage of food/biodegradable waste duly kept segregated by the members of the society/association for facilitating primary collection of food/biodegradable waste from one point by the municipal authorities. A separate community bin may similarly be provided for the storage of recyclable waste where door to door collection of recyclable waste is not practiced.

4. Community Bins to be Kept in Good Condition : Community bins as stated in 24.3.4 above shall at all times be kept in good condition, regularly maintained and shall be provided in such number and at such places as may be considered adequate and appropriate to contain the waste produced by the citizens supposed to be served by the community bins.

5. Duty of Occupiers to Deposit Solid Waste in Community Bins : It shall be incumbent on occupiers of all premises for whom community bins have been provided as per 24.3.4 above that all segregated domestic waste, trade waste, institutional waste from their respective premises to be deposited in the appropriate community bins.

6. Duty of the Corporation to Provide and Maintain "Waste Storage Depots"

It shall be incumbent on the Municipal Corporation to: -

- (i) Provide and hygienically maintain adequate Waste Storage Depots in the city 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.
- (ii) Make adequate provision for closed containers in various parts of the city for the deposition by citizens of domestic hazardous/toxic waste material adhering to the provisions of hazardous waste rules of Government of India.

7. Duty of Occupier of Households/Shops/Establishment to Hand Over the Recyclable Material/Non-Bio-degradable Waste to the Waste Collectors/ Waste Purchasers/Recyclers :

It shall be incumbent on households / shops / establishments to hand over their segregated recyclable waste / non-bio-degradable waste to the collectors, waste purchaser or recyclers as may be convenient or as may be notified by the Corporation 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.

8. Duty of Occupier of Households, Shops and Establishments to Deposit Domestic Hazardous/Toxic Waste in Special Bins Provided by the Corporation :

It shall be incumbent on households, shops and establishments to deposit domestic hazardous waste/toxic material in containers provided by the Corporation as per above.

9. 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 place or open land except at a place designated for the purpose or in conformity with conditions laid down by the municipal corporation.

10. 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.

11. 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 Municipal Corporation/Municipality, 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.

The powers to levy such penalty should also be delegated to railway authorities, cantonment authorities, notified areas, which are outside the purview of municipal corporations or municipalities in various cities so that the areas under their control can also remain neat and clean.

Other points for Consideration:

- (i) **Provision of Uniforms and Protective Equipment:** Local body to provide uniforms and other personnel protective equipment to the sanitation workers subject to their wearing/using them. It should not become a routine to provide uniforms and protective equipment with no insistence to use them. Local bodies should seriously consider providing such facilities and ensure that they are properly used to protect the health of the sanitation workers.

- (ii) **Punishment for Open Defecation and Urination on the Streets:** In the cities where adequate public toilets and urinals are provided or in the areas where such usable facilities are created by the local bodies, provisions of punishments for open defecation and urination on the streets may be considered in such areas.

ENFORCEMENT WHICH HAVE GIVEN SALUTARY EFFECT

Rajkot Municipal Corporation introduced a system of levy of administrative charges from those who litter the streets or dispose of the waste on the streets after the street cleaning was over. The administrative charges ranging from Rs.100 to Rs.50000 and were recovered on the spot from the defaulter. This was not levied as a penalty but as a charge for cleaning the street again. This brought about a sea change in the behavior of the people. Every year RMC collects average Rs.10 Lakhs by way of administrative charges and city got disciplined through these enforcement measures. People formed a habit of keeping their own bins and deposit the waste into the municipal system only. An extract of the resolution passed by the Rajkot Municipal Corporation for levying administrative charges vide the resolution No.430 dated 8/10/1997 is reproduced in the Annexure 14.10 The s Extract of the Standing Committee Resolution is produce herewith s below_

For the maintenance of health and sanitation in the city, Municipal Corporation has made an arrangement for the collection of waste from the city on day to day basis with the help of sweepers. Now, with a view to ensure that the households, shops and industrial establishments do not throw solid waste anywhere in the city and the city's health is not adversely affected, it is hereby resolved that the administrative charges should be recovered from the defaulters as under: -

Description of the Establishment	Minimum administrative charge to be levied.
1. Households	Rs.50/- Rs.250/-
2. Commercial Establishments	Rs.100/- Rs.1000/-
3. Industries	Rs.250/- Rs.2500/-

13.6 Environmental Management Plan

Environmental management plan is delineated in order to minimize adverse impact on the environment due to various activities involved in solid waste management. The various mitigation measures to be adopted during collection and disposal of wastes are as follows:

- It is preferable that the container and bins used for collection of waste should be of closed type so that the waste is not exposed and thus the possibility of spreading of disease through flies and mosquitoes is minimized
- Collection system should be properly supervised so that quick and regular removal of waste from the dustbin is practiced
- The workers directly involved in collection and disposal activities should be provided with goggles, gum boots, hand gloves, mask, etc.

- Soil cover should be applied over the compacted waste at the disposal site.
- The cover will prevent breeding of disease vectors and escape of gases of decomposition; minimize leaching, suppress foul odour, and provide better aesthetics
- Regular monitoring of carbon monoxide, methane and hydrogen sulphide should be carried out to check the emissions of such pollutants
- Open burning of waste should be discouraged
- Piped water supply should be provided at the site for sprinkling of water to keep down the dust and for fire-fighting
- Continuous monitoring of ground water quality adjoining landfill site should be carried out
- The surface water run-off should be collected and safely treated and disposed off. This will prevent accumulation of water and avoid breeding of flies, mosquitoes
- Liners should be provided at the landfill site
- Leachate collection and treatment system should be provided at the landfill site
- Tree plantation on the completed section of the landfill site as well as around the landfill site should be carried out to reduce the dust emission and minimize adverse aesthetic impact. It will also help in minimizing noise level in the surrounding.
- Necessary first aid facilities should be provided to the working staff Environmental management of waste and various environmental management issues relating to municipal solid waste landfills such as EIA for site selection, environmental investigation for site investigations and site characterization, design of environmental monitoring system, pollution prevention during operation, landfill quality assurance and quality control need to be properly addressed as appropriate for effective environmental management of municipal solid waste.
- Municipal solid waste management projects, in particular, provide an opportunity for vector-borne disease control through environmental management.

14.1 Ward wise Details

Ward	Area (sq.kms.)	As per 1991 Census		As per 2001 Census		Rise/ Fall
		Population	Density	Population	Density	
1	0.8227	29766	36181	25000	30388	-ve
2	0.7012	26738	38132	25000	35653	-ve
3	1.0900	28104	26289	29000	28431	+ve
4	1.0822	30411	28101	30000	27721	-ve
5	5.0741	29505	5815	61000	12022	+ve
6	1.7588	27097	15406	52000	29566	+ve
7	3.4360	29677	8637	52000	15134	+ve
8	0.9108	27547	30245	27000	29644	-ve
9	1.4714	26943	18311	22000	14952	-ve
10	1.5277	25669	16802	42000	27492	+ve
11	1.8571	25322	13635	28000	15077	+ve
12	2.875	25499	8869	34000	11826	+ve
13	2.9419	25222	8573	41000	13937	+ve
14	4.0682	25602	6293	37000	9095	+ve
15	1.2919	26761	20663	26000	20076	-ve
16	7.1330	25316	3549	26000	3645	+ve
17	18.8416	30999	1645	59000	3131	+ve
18	4.7052	31146	6619	46000	9776	+ve
19	5.7221	30848	5391	58000	10136	+ve
20	1.3905	31235	22463	35000	25171	+ve
Total	69.6836	559407	8028	755000	10835	
Newly Merged Area (21-23)	35.1764	81971	22330	247000	7022	
TOTAL	104.86	641378	6116	1002000	9556	

Source: RMC Census, 2001 cell

14.2 Definitions

There are many terms, which relate to the types and sources of wastes and these too must be defined. Based on the source, origin and type of waste a comprehensive classification is described below:

(i) Domestic/Residential Waste: This category of waste comprises the solid wastes that originate from single and multi-family household units. These wastes are generated as a consequence of household activities such as cooking, cleaning, repairs, hobbies, redecoration, empty containers, packaging, clothing, old books, writing/new paper, and old furnishings.

(ii) Municipal Waste: Municipal waste include wastes resulting from municipal activities and services such as street waste, dead animals, market waste and abandoned vehicles. However, the term is commonly applied in a wider sense to incorporate domestic wastes, institutional wastes and commercial wastes.

(iii) Commercial Waste: Included in this category are solid wastes that originate in offices, wholesale and retail stores, restaurants, hotels, markets, warehouses and other commercial establishments. Some of these wastes are further classified as garbage and others as rubbish.

(iv) Institutional Waste: Institutional wastes are those arising from institutions such as schools, universities, hospitals and research institutes. It includes wastes which are classified as garbage and rubbish as well as wastes which are considered to be hazardous to public health and to the environment.

(v) Garbage: Garbage is the term applied to animal and vegetable wastes resulting from the handling, storage, sale, preparation, cooking and serving of food. Such wastes contain putrescible organic matter, which produces strong odours and therefore attracts rats, flies and other vermin. It requires immediate attention in its storage, handling and disposal.

(vi) Rubbish: Rubbish is a general term applied to solid wastes originating in households, commercial establishments and institutions, excluding garbage and ashes.

(vii) Ashes: Ashes are the residues from the burning of wood, coal, charcoal, coke and other combustible materials, for cooking and heating in houses, institutions and small industrial establishments. When produced in large quantities at power generating plants and factories these wastes are classified as industrial wastes. Ashes consist of a fine powdery residue, cinders and clinker often mixed with small pieces of metal and glass.

(viii) Bulky Wastes: In this category are bulky household wastes which cannot be accommodated in the normal storage containers of households. For this reason they require special collection. In developed countries bulky wastes are large household appliances such as cookers, refrigerators and washing machines as well as furniture, crates, vehicle parts, tyres, wood, trees and branches. Metallic bulky wastes are sold as scrap metal but some portion is disposed of at sanitary landfills.

(ix) Street Sweeping: This term applies to wastes that are collected from streets, walkways, alleys, parks and vacant lots. In the more affluent countries manual street sweeping has virtually disappeared but it still commonly takes place in developing countries, where littering of public places is a far more

widespread and acute problem. Mechanised street sweeping is the dominant practice in the developed countries. Street wastes include paper, cardboard, plastic, dirt, dust, leaves and other vegetable matter.

(x) Dead Animals: This is a term applied to dead animals that die naturally or accidentally killed. This category does not include carcass and animal parts from slaughterhouses which are regarded as industrial wastes. Dead animals are divided into two groups, large and small. Among the large animals are horses, cows, goats, sheep, hogs and the like. Small animals include dogs, cats, rabbits and rats. The reason for this differentiation is that large animals require special equipment for lifting and handling during their removal. If not collected promptly, dead animals are a threat to public health because they attract flies and other vermin as they putrefy. Their presence in public places is particularly offensive and emits foul smell from the aesthetic point of view.

(xi) Construction and Demolition Wastes: Construction and demolition wastes are the waste materials generated by the construction, refurbishment, repair and demolition of houses, commercial buildings and other structures. It mainly consists of earth, stones, concrete, bricks, lumber, roofing materials, plumbing materials, heating systems and electrical wires and parts of the general municipal waste stream, but when generated in large amounts at building and demolition sites, it is generally removed by contractors for filling low lying areas and by urban local bodies for disposal at landfills.

(xii) Industrial Wastes: In the category are the discarded solid material of manufacturing processes and industrial operations. They cover a vast range of substances which are unique to each industry. For this reason they are considered separately from municipal wastes.

(xiii) Hazardous Wastes: Hazardous wastes may be defined as wastes of industrial, institutional or consumer origin which, because of their physical, chemical or biological characteristics are potentially dangerous to human and the environment. In some cases although the active agents may be liquid or gaseous, they are classified as solid wastes because they are confined in solid containers. Typical examples are: solvents, paints and pesticides whose spent containers are frequently mixed with municipal wastes and become part of the urban waste stream. Certain hazardous wastes cause explosions in incinerators and fires at landfill sites. Good management practice should ensure that hazardous wastes are stored, collected, transported and disposed off separately, preferably after suitable treatment to render them innocuous.

(xiv) Sewage Wastes: The solid by-products of sewage treatment are classified as sewage wastes. They are mostly organic and derive from the treatment of organic sludge from both the raw and treated sewage. The inorganic fraction of raw sewage such as grit is separated at the preliminary stage of treatment, but because it entrains putrescible organic matter which may contain pathogens, must be buried/ disposed off without delay. The bulk of treated, dewatered sludge is useful as a soil conditioner but invariably its use for this purpose is uneconomical. The solid sludge therefore enters the stream of municipal wastes unless special arrangements are made for its disposal.

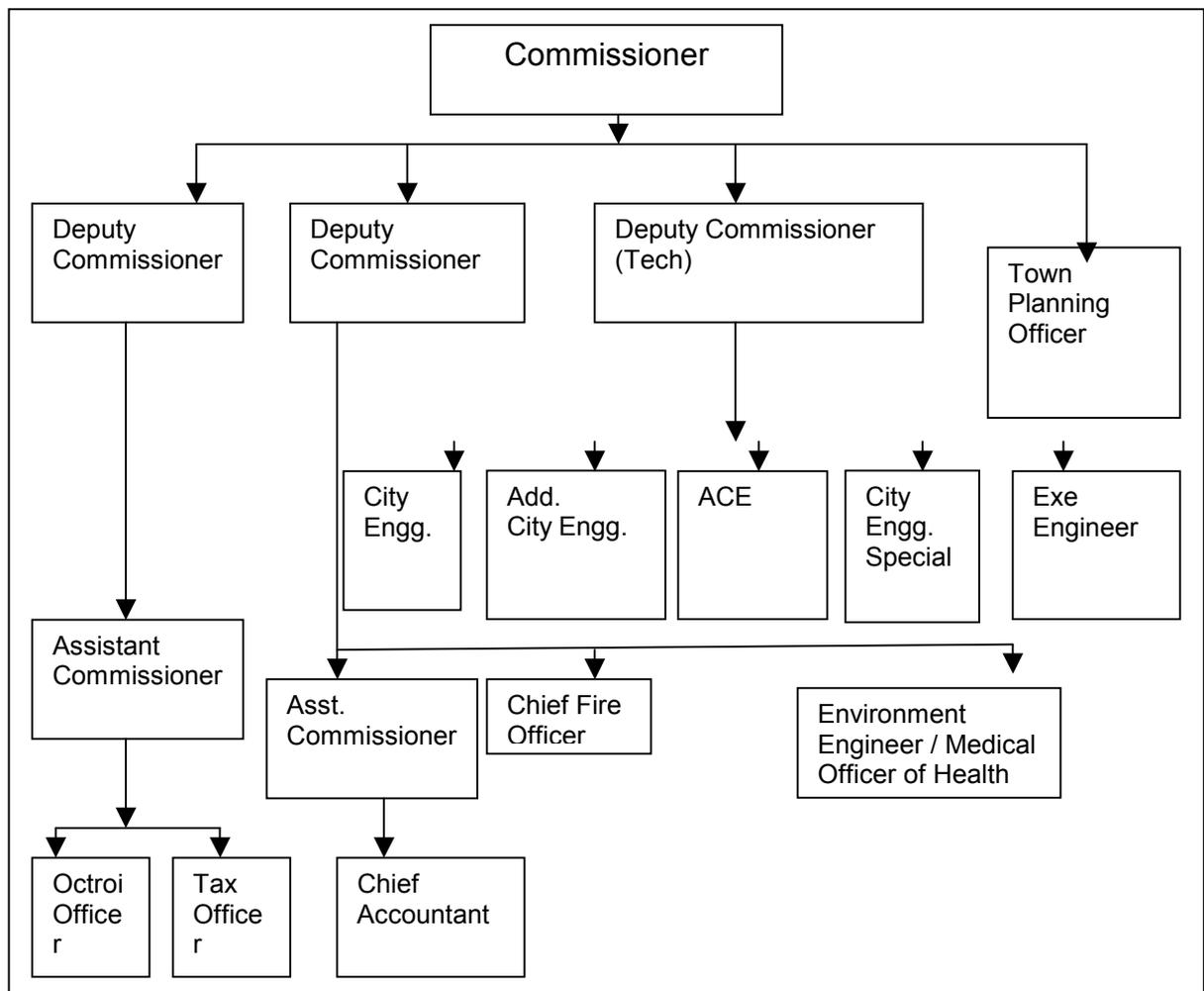
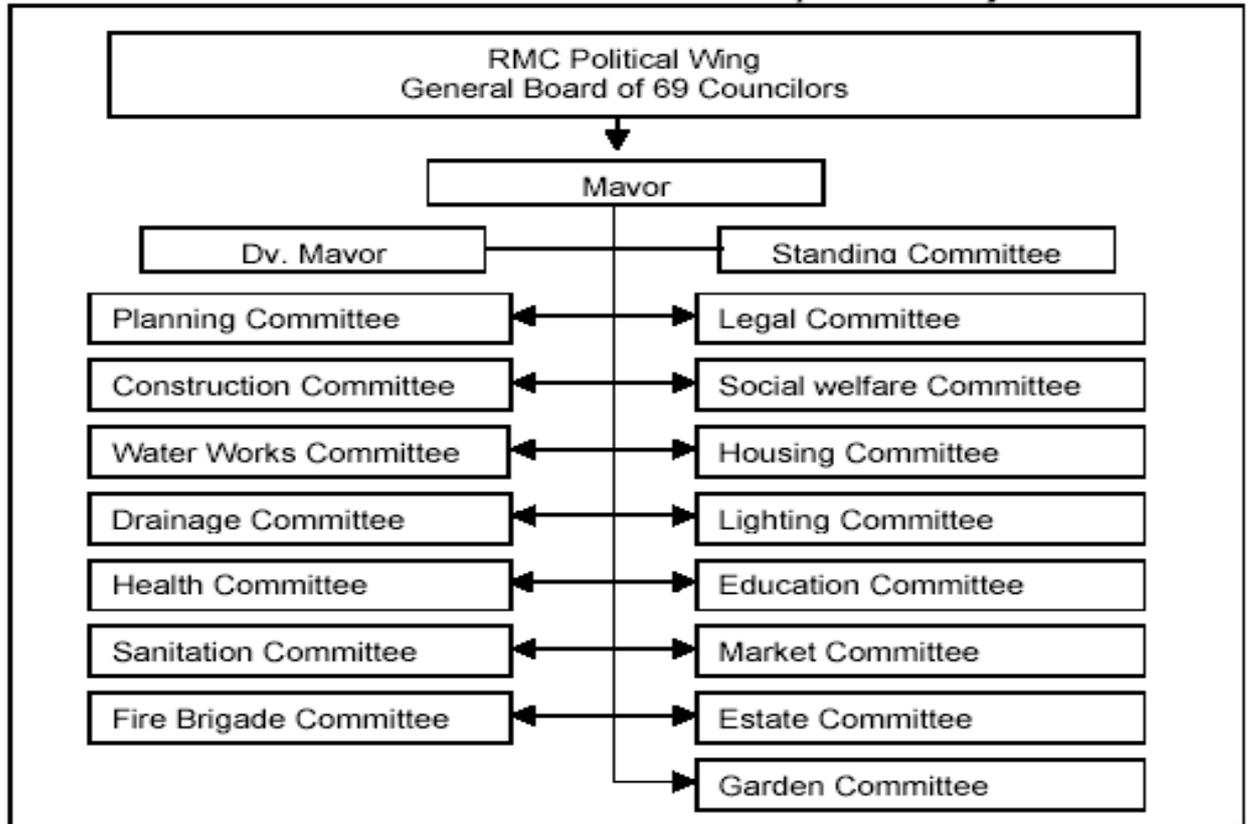
14.3 Details of the areas where sweeping is being done by RMC

Ward No.	Approximate population in 2005	Generation of waste in tons	Total Sweepers	Approximate no. of Extra sweepers required to fill the absenteeism	Yearly Cost incurred to fill this gap in lacs. (Rs.)
1	23094	7.10	104	16	6.97
2	24305	7.47	113	17	7.64
3	29358	9.02	105	16	6.97
4	29836	9.17	134	20	8.97
5	73598	22.62	167	25	10.96
6	61961	19.05	164	25	10.96
7	60929	18.73	214	32	14.28
8	26781	8.23	105	16	6.97
9	20023	6.16	127	19	8.30
10	48532	14.92	168	26	11.29
11	29071	8.94	125	19	8.30
12	37400	11.50	123	19	8.30
13	47311	14.54	126	19	8.30
14	41559	12.78	149	23	9.96
15	25696	7.90	96	14	6.31
16	26274	8.08	91	14	5.98
17	70200	21.58	244	37	16.27
18	51942	15.97	137	20	8.97
19	68861	21.17	148	23	9.96
20	36506	11.22	132	20	8.63
Total	833237	256.15	2772	416	184.32

14.4 Ward wise list of waste storage depot in Rajkot

Ward No.	Storage of Waste prior to (compliance of MSWM rules 2000)		Storage of Waste post (compliance of MSWM rules 2000)	
	Closed container	Open Dump	Closed container	Open Stand
1	6	45	29	0
2	7	42	22	0
3	6	52	26	0
4	9	75	41	0
5	10	95	65	0
6	14	100	66	0
7	15	75	43	0
8	10	55	36	0
9	5	60	33	0
10	15	75	59	0
11	20	75	66	0
12	25	50	78	0
13	20	75	64	0
14	20	95	60	0
15	10	55	38	0
16	10	75	45	0
17	15	150	73	0
18	15	145	56	0
19	0	105	70	0
20	0	85	40	0
21	0	145	85	0
22	0	135	75	0
23	0	245	167	0
Total	232	2109	1337	0

14.5 Organizational Chart of RMC



14.6 Types of Wastes to be put in the different bins

1. Types of wastes to be put in the bin meant for food waste & Bio degradable wastes

- Food waste of all kinds, cooked and uncooked , including eggshells,bons
- Flower and fruit waste including juice peels and house plant wastes
- House sweeping (not grden sweeping or yard waste ; dispose on-site)
- Sanitary towels
- Disposable diapers and incontinence pads
- Ashes

2. Types of waste Recyclable waste to be kept for collection by another by informal sector

- Paper and plastic, all kinds
- Cardboard and cartons
- Containers of all kinds excluding those containing hazardous materials
- Packaging of all kinds
- Glass, all kinds
- Metals, all kinds
- Rags, rubber, wood
- Foils, wrappings, pouches, sachets and tetrapaks (rinsed)
- Cassettes, computers diskettes, printer cartridges and electronic parts
- Discarded clothing, furniture and equipments

14.7 List of Domestic & hazardous waste

- Aerosol cans
- Batteries from flashlights and button cells
- Bleaches and household kitchen and drain cleaning agents
- Car batteries, oil filters and car care products and consumables
- Chemicals and solvents and their empty containers
- Cosmetic items, chemical based
- Injection needles and syringes after destroying them both
- Insecticide and their empty containers
- Light bulbs, tube-lights and compact fluorescent lamps (CFL)
- Medicines, discarded
- Paints, oils, lubricants, glues, thinners and their empty containers
- Pesticides and herbicides and their empty containers
- Photographic chemicals
- Styrofoam and soft foam packaging from new equipment
- Thermometers and mercury containing products

14.8 Quotations of different items

Item No. 1 Tricycle with 8 containers

		SINTEX INDUSTRIES LTD.	
33-a/cv/wb April 5, 2006		PLASTICS DIVISION 903904, 6TH FLOOR, SHELF BUILDING, NR. MUNICIPAL MARKET, NAVRANGPURA, AHMEDABAD-380 009. PHONE : 26482328, 26488730 FAX : (079) 26488010 E-Mail : sintex_ahd@iconet.net REGISTERED OFFICE : KALOL, (N.GUJARAT) 382 721. (INDIA.) PHONE : (02764) 224301 TO 224306 FAX : (02764) 220385 E-Mail : plastic@sintex.co.in • Web : http://www.sintex-plastics.com	
To Mr. P.P. Vyas Dy. Municipal Commissioner Rajkot Municipal Corporation Rajkot			
Dear Sir,			
Please refer to your requirement of Sintex products. In this regard, we are pleased to quote the lowest price for your consideration.			
Sr. No	Description	Quantity	Total value (in Rs.)
1.	Sintex make Tricycle code no. TRGBB 2-02 having approx dimension L-1540 x W-735 X Height -255 mm with 8 Bins code no. BMB 2-01 capacity 20 Ltr. Having approx dimension L-316 x W-265 x H-405 mm.	1	11,060-00
Terms & Conditions			
PRICES: The above prices are net, ex-works, Kalol, N.G. As such taxes, duties, freight, insurance, octroi, etc. will be charged extra as applicable at the time of despatch. The present rates are as under:			
Packing & Forwarding	:	Nil	
Transit Insurance	:	@ 1% of total order value	
Excise Duty	:	@ 16.32%	
VAT	:	@ 12.50%	
Freight	:	Extra at actual	
Octroi	:	Extra at actual.	
Delivery Period:			
Within 1-2 weeks from the date of receipt of your technically and commercially confirmed order.			
PAYMENT:			
30% advance alongwith order and balance 70% payment against Proforma Invoice by way of Demand Draft before despatch of the material.			
7 APR 2006		 B. Lal FF	
		WORLD'S NO. 1 Sintex TANKS • SECTIONS • DOORS • WINDOWS SUBJECT TO KALOL JURISDICTION	



Ref: sil-a/cv/wb
April 5, 2006

SINTEX INDUSTRIES LTD.

PLASTICS DIVISION

903/904, 9TH FLOOR, SHILP BUILDING, NR. MUNICIPAL MARKET,
NAVRANGPURA, AHMEDABAD-380 005.

PHONE : 26462323, 26468730 FAX : (079) 26468010

E-Mail : sintex_pld@sonal.net

REGISTERED OFFICE : KALOL (N.GUJARAT) 382 721 (INDIA.)

PHONE : (02784) 224301 TO 224305 FAX : (02784) 220385

E-Mail : plastic@sintex.co.in • Web : http://www.sintex-plastics.com

:: 2 ::

VALIDITY:

3-5 days for acceptance and thereafter subject to reconfirmation.

INSPECTION:

Inspection to be always done at our works, Kalol before despatch.

We hope our offer is in line with your requirement and you would place your valued order.

Thanking you,

Yours faithfully,
For **SINTEX INDUSTRIES LIMITED**


C.V. Vavaiya
Asst. Manager (Major Project)
Mobile No. 9898555307

Encl : Literature

CC : Mr. S M Anrao - VP (Mktg.)
Mr. Amit Doshi
SIL-Ahmedabad

WORLD'S NO.1

Sintex

TANKS • SECTIONS • DOORS • WINDOWS

SUBJECT TO KALOL JURISDICTION

Item No. 2 Mechanical Sweeping Machine

Vat no. 03301009755
 S.T./C.S.T No. 56419313 Dt. 27-04-1999



GURU NANAK ENGG. WORKS

Khanna Road, Samrala, Distt. Ludhiana (Pb)
 Phone : 01628-2261868 Telefix: 01628-2262259 Mobile: 98151-31027
 (M) - 98153-31905

QUOTATION

DATE : 22 / 04 / 2006

TO

**The Commissioner
Municipal Corporation
RAJKOT**

GUJARAT

Sub: Supply of Tractor Trailed Road Vacuum Sweeper Machine

Dear Sir,

We can supply you the under given model of Road vacuum Sweeper Machine.
Tractor will be supplied by the corporation

1) **'SOKHI' Road Vacuum Sweeper Machine Model 'T2100D' "IMPROVED"**
Machine Features of the machine.

- Max. sweeping path 9 feet.
- Dust storage capacity 3.5 Cu. Meter.
- One horizontal brush width 2100 mm.
- Two rotary brushes dia.440mm on both sides.

1. Sweeping Machine Basic Price	Rs.	10,39,240 - 00
2. Central Sales Tax @ 10%	Rs.	1,03,924 - 00
Price Ex- Factory	Rs.	11,43,164 - 00

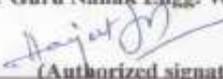
Terms and conditions

- Payment:- 100 % , at the time of Inspection and delivery
- Prices are Ex-factory SAMRALA
- Octroi, Transportation extra as per applicable
- Quotation valid up to 60 days.
- Tractor will be supplied by the corporation

Delivery : Delivery after 30 days against work order and 100% payment in shape of **D.D.**
 In favor of **GURU NANAK ENGINEERING WORKS** Payable at SAMRALA

Yours faithfully,

For Guru Nanak Engg. Works


 (Authorized signatory) Specialists in: Road Vacuum Sweeper Machine

Item No. 3 Excavator Loader fitted with 0.24 cu.m capacity excavator

DESCRIPTION - JCB 48T X 6 IN-1		PRICE/UNIT Rs.
JCB make JDX Excavator Loader fitted with 0.24 Cu. M Capacity Excavator Bucket and 6-m-1 Clean Shovel Loader Bucket, Powered by Kubota 48-1640 Engine developing 76 gross H.P and fitted with Torque Converter, Shuttle Reverser, Fully Synchronised TWD Gear Box & with Heavy duty rear Tyres and generally conforming to our technical leaflet Each		16,38,833.00
ADD: Central Excise Duty @14.32%, inclusive of 2% education cess on Excise duty Amount currently Applicable		2,67,327.00
ADD: C.S.T. @ 11.5% Against submission of Form 'C' (If C form is provided in adv. prior to machine billing)		2,38,170.00
SUB TOTAL		21,43,538.00
ADD: Loading Lashing & Temp. R.T.O. Registration.		2,000.00
ADD: Transportation Charges & Transit Insurance.		27,470.00
INSURANCE: Comprehensive Insurance including Transit Insurance from works Ballabgarh to destination/site should be arranged by the buyer at their own cost and risk.		
GRAND TOTAL		21,73,008.00

Entry Tax/Road tax (as applicable at the time of billing) to be paid to respective authority. Entry & Actuals to be paid by Customer.

Note:

- (1) The excise duty, CST/VAT etc. indicated above are based on the current rates. Any variation of these elements at the time of supply shall be to your account.
- (2) Freight indicated is only for estimate purpose and will be payable by you at actual.
- (3) Custom charges, RTO Tax at Check Post, Entry Tax if any and any other duties or charges will be extra payable by you at actual directly to the authority as applicable to the time of billing/delivery of machine.
- (4) Delivery: Within 3 to 6 weeks after receipt of order with necessary advance
- (5) Advance: Minimum 20% alongwith the order & balance 80% against machine despatch.
- (6) Validity: 30 days from the date hereof. However, price ruling at the time of delivery shall be applicable to you.

(7) Our standard terms & conditions of sales are enclosed herewith.

(8) Payment: All the payment should be drawn on 'JCB INDIA LTD' - PAYABLE AT MUMBAI* by way of Demand Draft only.

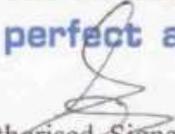
(9) Pan No. GIR No. & Sales Tax No. is required at the time of placement of order as per Govt. rules.

For JCB INDIA LIMITED

[Signature]
AUTHORISED SIGNATORY
Authorized Dealer
 Anon Equipments Pvt. Ltd.
 Plot No 222, Miskarba,
 Near Sarkhej Sarnad Chokadi,
 S.G.Highway Road, Ahmedabad
 Phone No: (079) 26890981

Head Office (JCB)
 JCB India Limited
 23/7, Mathura Road
 Ballabgarh- Haryana
 Ph.No.(0129) 2309000
 Fax: (0129) 2309060

Item No. 4 Dumper of 14 cumt Capacity

perfect auto	14.00CUM DUMPER	TATA MOTORS
(Div. of : Perfect Retreads Pvt. Ltd.) "PERFECT HOUSE" Rajkot - Gondal Road - N.H. - 8B, VAVDI, Dist. : Rajkot - 360 004. E-mail : pastelco@sancharnet.in Phone : (0281) 2370060 / 71 / 72, 2360649 Fax : 0281 - 2370061		Commercial Vehicle Dealer
No. : <u>6461</u>	Date : <u>31/3/06</u>	
Shri <u>Rajkot Municipal Corporation</u> <u>Rajkot</u>		
QUOTATION		
MODEL : <u>LPK 2516/38. Hyva F3V Tipper</u> <u>14.CM.</u>		
Dear Sir,		
With reference to your inquiry regarding above TATA Vehicle , We are pleased to furnish the relevant details as under :		
Ex-Showroom Price Rs. : <u>16,07,000/-</u>		
(Draft in favour of M/S. PERFECT AUTO Payable at RAJKOT)		
Thanking You,		
1) Delivery Period : <u>2 to 3 Month after Recd full Payment</u>		Yours Faithfully, For, perfect auto  Authorized Signatory
2) R.T.O., Insurance & Octroi as per applicable.		
3) Price ruling at the time of delivery shall be applicable.		
● S.T. TIN 24090900150 Dt. 1-7-2002 ● C.S.T. TIN 24590900150 Dt. 8-12-87		

Always at Your Best Services.....

Item No. 5 Dumper of 8 cumt Capacity

perfect auto	8.0 CUM DUMPER	TATA MOTORS
(Div. of : Perfect Retreads Pvt. Ltd.) "PERFECT HOUSE" Rajkot - Gondal Road - N.H. - 8B, VAVDI, Dist. : Rajkot - 360 004. E-mail : pesteko@sancharnet.in Phone : (0281) 2370060 / 71 / 72, 2360649 Fax : 0281 - 2370061		Commercial Vehicle Dealer
No. : <u>6458</u>	Date : <u>31/3/2006</u>	
Shri <u>Rajkot Municipal Corporation</u> <u>Rajkot.</u>		
QUOTATION		
MODEL : <u>SIK 1613/Turbo 36WB. FSV</u> <u>80.Cum. Tipper</u>		
Dear Sir,		
With reference to your inquiry regarding above TATA Vehicle, We are pleased to furnish the relevant details as under :		
Ex-Showroom Price Rs. : <u>10.75.000/-</u>		
(Draft in favour of M/S. PERFECT AUTO Payable at RAJKOT)		
Thanking You,		
1) Delivery Period : - 2 to 3 Month after Real Full Payment.		Yours Faithfully,
2) R.T.O., Insurance & Octroi as per applicable.		For, perfect auto
3) Price ruling at the time of delivery shall be applicable.		Authorised Signatory
● S.T. TIN 24090900150 Dt. 1-7-2002 ● C.S.T. TIN 24390900150 Dt. 8-12-87		
<i>Always at Your Best Services.....</i>		

Item No. 6 Dumper Placer with of 8 cumt for Debris on HCV

perfect auto	HCV DUMPER PLACER	TATA MOTORS						
(Div. of : Perfect Retreads Pvt. Ltd.) "PERFECT HOUSE" Rajkot - Gondal Road - N.H. - 8B, VAVDI Dist. : Rajkot - 360 004. E-mail : pastelco@sancharnet.in Phone : (0281) 2370060 / 71 / 72, 2360649 Fax : 0281 - 2370061		Commercial Vehicle Dealer						
No. : <u>6460</u>	Date : <u>31/3/06</u>							
Shri <u>Rajkot Municipal Corporation</u> <u>Rajkot</u>								
QUOTATION								
Dear Sir,	1 MODEL : <u>Tata SK 1613/36 with PTO Cab & Chasi</u> 2 <u>Hydraulic Operated dumper Placer System</u>							
With reference to your inquiry regarding above TATA Vehicle , We are pleased to furnish the relevant details as under :								
Ex-Showroom Price Rs. : <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: right;">8,90,000/-</td> <td style="text-align: right;">- ①</td> </tr> <tr> <td style="text-align: right;">4,00,000/-</td> <td style="text-align: right;">- 2</td> </tr> <tr> <td style="text-align: right; border-top: 1px solid black;">12,90,000/-</td> <td></td> </tr> </table>			8,90,000/-	- ①	4,00,000/-	- 2	12,90,000/-	
8,90,000/-	- ①							
4,00,000/-	- 2							
12,90,000/-								
(Draft in favour of M/S. PERFECT AUTO Payable at RAJKOT)								
Thanking You,								
		Yours Faithfully, For, perfect auto  Authorised Signatory						
1) Delivery Period : <u>2 to 3 Month after recd full payment.</u> 2) R.T.O., Insurance & Octroi as per applicable. 3) Price ruling at the time of delivery shall be applicable.								
• S.T. TIN 24090900150 Dt. 1-7-2002 • C.S.T. TIN 24590900150 Dt. 8-12-87								
<i>Always at Your Best Services.....</i>								

Item No. 8 Dead Animal Van

perfect auto	DEAD ANIMAL VAN	TATA MOTORS								
(Div. of : Perfect Retreads Pvt. Ltd.) "PERFECT HOUSE" Rajkot - Gondal Road - N.H. - 88, VAVDI, Dist. : Rajkot - 360 004. E-mail : pasteico@sancharnet.in Phone : (0281) 2370060 / 71 / 72, 2360649. Fax : 0281 - 2370061		Commercial Vehicle Dealer								
No. : <u>6463</u>	Date : <u>31-3-06</u>									
Shri <u>Rajkot Municipal Corp.</u> <u>Rajkot</u>										
QUOTATION										
MODEL : <u>LPT-40A/34 Cab.</u>										
Dear Sir,										
With reference to your inquiry regarding above TATA Vehicle, We are pleased to furnish the relevant details as under :										
<table style="margin-left: auto; margin-right: auto;"> <tr> <td>Ex-Showroom Price Rs. :</td> <td><u>5,35,000/-</u></td> </tr> <tr> <td>+ Hydraulic operated</td> <td><u>2,75,000/-</u></td> </tr> <tr> <td>Dead Animal - close tipper</td> <td><u>8,10,000/-</u></td> </tr> <tr> <td>Total</td> <td><u>8,10,000/-</u></td> </tr> </table>			Ex-Showroom Price Rs. :	<u>5,35,000/-</u>	+ Hydraulic operated	<u>2,75,000/-</u>	Dead Animal - close tipper	<u>8,10,000/-</u>	Total	<u>8,10,000/-</u>
Ex-Showroom Price Rs. :	<u>5,35,000/-</u>									
+ Hydraulic operated	<u>2,75,000/-</u>									
Dead Animal - close tipper	<u>8,10,000/-</u>									
Total	<u>8,10,000/-</u>									
(Draft in favour of M/S. PERFECT AUTO Payable at RAJKOT)										
Thanking You,										
		Yours Faithfully,								
1) Delivery Period : <u>2 to 3 month after leaving Full payment</u> 2) R.T.O., Insurance & Octroi as per applicable. 3) Price ruling at the time of delivery shall be applicable.		For, perfect auto  Authorized Signatory								
• S.T. TIN 24590900150 Dt. 1-7-2002 • C.S.T. TIN 24590900150 Dt. 8-12-87										
<i>Always at Your Best Services.....</i>										

Item No. 9 Fully Electronic automatic weigh bridge of 50 tonne capacity

Quotation / Order Form for Supply of Electronic Weigh Bridge

From: Sensita Electronics 4, Parsana Society, New Nehru Nagar, Dhebar Road, (South) Rajkot-360 002. Ph: 0281-5837877, 094283 51088	To: Rajkot Municipal Corp. Central Work Shop Rajkot	 सेन्सीता An ISO 9001-2000 CERTIFIED
Contact Person : Branch Code :	Phone No. (0.) : Dated : 09/06/06	No. 102

This is with reference to your requirement of sensita Electronics Weigh Bridge. We are giving following details.

SPECIFICATIONS

Model: SW-50T	Platform Size: 2.5x10'
Capacity: 50 TON	Type of Weigh bridge: <input checked="" type="checkbox"/> PITLESS <input type="checkbox"/> PIT TYPE
Accuracy: 5 kg	<input checked="" type="checkbox"/> Electronic <input type="checkbox"/> Mechanical <input type="checkbox"/> Electro Mechanical

Sensita's Scope of Supply	Customer Scope of Work																																			
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Description</th> <th>Quantity</th> </tr> </thead> <tbody> <tr><td>● M. S. Platforms</td><td>One Set</td></tr> <tr><td>● Foundation Plans</td><td>One Set</td></tr> <tr><td>● Load Cells Capacity 25 Ton</td><td>Four Nos.</td></tr> <tr><td>● Load Cell Make ADI</td><td>ARTECH</td></tr> <tr><td>● Load Cell Mounting Kit</td><td>Four Nos.</td></tr> <tr><td>● Digital Indicator DIT System</td><td>One each.</td></tr> <tr><td>● Junction Box</td><td>One Nos.</td></tr> <tr><td>● Display</td><td>One Nos.</td></tr> <tr><td>● Sensita Base Standard Software</td><td>Included</td></tr> <tr><td>● Civil Drawing</td><td>Included</td></tr> <tr><td>● Optional 1. Printer EPSON 80 Column</td><td>Included</td></tr> <tr><td>2. computer system</td><td>Included</td></tr> </tbody> </table>	Description	Quantity	● M. S. Platforms	One Set	● Foundation Plans	One Set	● Load Cells Capacity 25 Ton	Four Nos.	● Load Cell Make ADI	ARTECH	● Load Cell Mounting Kit	Four Nos.	● Digital Indicator DIT System	One each.	● Junction Box	One Nos.	● Display	One Nos.	● Sensita Base Standard Software	Included	● Civil Drawing	Included	● Optional 1. Printer EPSON 80 Column	Included	2. computer system	Included	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Description</th> </tr> </thead> <tbody> <tr><td>● Civil construction as per Sensita Drawing</td></tr> <tr><td>● Control Room Construction</td></tr> <tr><td>● Electrical Power Supply</td></tr> <tr><td>● Scaffolding Fitting</td></tr> <tr><td>● Unloading of Equipment at site</td></tr> <tr><td>● Unskilled labour during installation</td></tr> <tr><td>● Welding transformer - during installation</td></tr> <tr><td>● C.I. Weights at the time of stamping</td></tr> </tbody> </table>	Description	● Civil construction as per Sensita Drawing	● Control Room Construction	● Electrical Power Supply	● Scaffolding Fitting	● Unloading of Equipment at site	● Unskilled labour during installation	● Welding transformer - during installation	● C.I. Weights at the time of stamping
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SALES TAX NO. OF CONSIGNEE

STATE : _____
CENTRAL : _____

COMMERCIAL TERMS

Basic Price	Rs. 5,00,000-00
Excise Duty	Rs. -
Sales Tax / Cent. VAT 12.5 %	Rs. 62,500-00
Installation Charges	Rs. -
Freight Charges from Rajkot	Rs. -
Stamping Charges	Rs. -
Other Charges if Applicable	Rs. -
Grand Total Rs.	562,500-00

Advance Rs. _____

Delivery Period : 6 / 8 Weeks PAYMENT TERMS : Payment : 40 % advance along with confirm Order 30% against delivery of material at site & Balance 10 % after stamping & testing of weigh Bridge Guarantee Period : 12 months from the date of installation or 14 months from the date of invoice, whichever is earlier.

Terms & Conditions:

- In case of any delay in Civil works for more than 15 days after the delivery of the weigh bridge, the balance payment should be released.
- If fully completed the entire the taxes & expenses will have to be paid.
- Goods will remain the property of the Company unless full payment has been realized. Goods once sold will not be taken back or exchanged.
- Order and payment should be released of error in Sensita Marketing / Sensita Electronics Rajkot.
- This quotation is valid upto 30 days only.
- This transaction is subject to Rajkot jurisdiction.

7. Civil Work for weighbridge without office & Ramp
 Customer Sign with Rubber Stamp **Included.**

For:
 Sensita Electronics/Sensita Marketing

 authorized Signatory

14.9 Action plan for Ban on Plastic bags thinner than 20 microns

Activities	M06	A06	M06	J06	J106	A06	S06	O06	N06	D06	J06	F06
Administrative Procedure and training to SSI, SI, Officer for identification of plastic bags thinner than 20 microns .		■										
Campaign for Ban on use of Plastic bags thinner than 20 microns.			■									
Enforcement drives at whole sellers for not to sell banned plastic bags.			■									
Enforcement drives at retailers for not to use banned plastic bags.					■	■	■	■	■	■		
Review of Success of the drive.											■	
Final Verification											■	■
Planning & Campaign for next year												■

14.10 Agreement for SW processing plant

AGREEMENT**AGREEMENT BETWEEN RAJKOT MUNICIPAL CORPORATION
AND
M/S HANJER BIOTECH ENERGIES PVT. LTD (PROPOSED)****FOR MUNICIPAL SOLID WASTE TREATMENT, PROCESSING AND RECYCLING
PROJECT AT RAJKOT(GUJARAT)**

The agreement made at Rajkot on this 20th day of June 2003.

RAJKOT MUNICIPAL CORPORATION constituted under Bombay Provincial Municipal Corporation Act, having its head office at Dr. Ambedkar Bhavan, Dhebar Road, Rajkot

And

HANJER BIOTECH ENERGIES PVT. LTD, a company proposed to be incorporated under the Companies Act, 1956 having its registered office at 335, Shalimar House., Grant Road, Mumbai-07 herein referred as HBEPL

PREAMBLE

WHEREAS_ RMC is an autonomous local self government in the city of Rajkot engaged in providing basis amenities, infrastructure services, including waste collection, its disposal and overall maintenance of the city and its environment etc.

AND WHEREAS RMC wishes to encourage systematic treatment, processing and disposal of Municipal Solid Waste in accordance with MSW Rules, 200 including recovery of useful products like energy, manure so as to minimise the waste disposal in sanitary landfills. Also to ensure better hygienic conditions and minimise ground water contamination. For this purpose, HBEPL after having convinced about waste treatment and processing technology, entered into an MOU for technology tie up with Andhra Pradesh Technology Development and Promotion Center Hyderabad (APTDC) and Eco Save Systems (P) Ltd, Mumbai (ESSPL) hereafter referred to as " APTDC-ESS CONSORTIUM" which expression shall mean and include its successor and assigns.

HBEPL and their assistance are intalia engaged in manufacture of cotton yarn, generation of power, organic manure and development of other public utility services wishes to enhance its business in the area of power and organic manure from MSW using suitable technology from APTDC-ESS CONSORTIUM.

AND WHEREAS HBEPL has entered into agreement with APTDC-ESS CONSORTIUM whereby APTDC-ESS will provide technical consultancy to HBEPL for erection and commissioning of the waste conversion plant, adequate and timely technical services for smooth and continuous operations of the plant and as well as supply of waste treatment materials as per the terms and conditions agreed to the parties.

AND WHEREAS in pursuance of the corporate goals of the organisations, namely RMC and HBEPL in associations with APTDC-ESS CONSORTIUM, have agreed to work together in the field of treatment, processing, recovery of energy and organic manure from Municipal Solid Waste at Rajkot using the suitable technology.

Therefore, it is agreed to by and between the parties through this Agreement as follows:

I. SCOPE OF AGREEMENT

This agreement details the modalities and arrangement between RMC on one hand and HBEPL, on the other hand for conversion of the city solid and other organic waste in Rajkot by HBEPL using technology inputs from APTDC-ESS CONSORTIUM will assist HBEPL for timely commissioning of the waste conversion and processing plant by supply of design and engineering details. Whereas installation and commissioning is a joint venture and several responsibility of HBEPL and its machine suppliers. Further HBEPL will ensure sale of recovered products and other by-products / Co-products (processed as well as finished one) as per the company's marketing plan and arrangement. RMC shall ensure proper disposal of the remnants arising during the treatment of the Municipal Solid Waste and also the mixed heterogeneous rejected waste not required at the processing plant.

II. TERMS AND CONDITIONS

A. ROLE AND OBLIGATION OF RMC

1. RMC hereby grants to HBEPL lease and requisite authority and permission to enter upon for setting up of waste conversion plant., warehousing and infrastructure facilities with a capacity to process fresh garbage of on an average 300 tons per day on 4 hectare of land equivalent to 40,000 sq. mtrs and another 8 hectares of land equivalent to about 80,000 sq.mtrs. for stocking and treatment of waste material and to remain upon the said land and use or occupy the same for a period of 30 (thirty) years from the date of execution of this Agreement. The land particulars of lease hold land, mentioned above would be as per the lease agreement entered hereafter. If required by financial institution the land on which processing facilities exist, will be bought by the co HBEPL from RMC for ease of Mortgage/assignability
2. RMC will remain in legal possession of the land for which the leave and lease to use has been granted to HBEPL. RMC will continue to use the land for dumping of Municipal Solid Waste throughout the subsistence of this agreement, however without helping in any way, the operation of HBEPL.
3. RMC will not provide any financial assistance for setting up or running of the processing plant. It shall be the responsibility of HBEPL to arrange for necessary finance to implement and commission the project well in time. RMC will however, recommend the cost to financial institution(s) for funding or grant-in aid for waste processing project. RMC will permit HBEPL to assign/mortgage the lease hold rights to the financial institution granting the loan to HBEPL for this project.
4. RMC undertake to deliver the entire Municipal Solid Waste comprising of fresh garbage of on an average 300 Mt per day being generated currently and any further increase in the quantity to the processing plant site free of any cost, levies, etc. In case of disruption of said garbage quantity by RMC, RMC will intimate HBEPL atleast 7 days in advance for such period of disruption in supply, in which case HBEPL is free to process garbage collected from other sources. For collection and

- transport of such waste during the period of interruption RMC will re-imburese the transport cost upto a distance of 50 kms, at prevailing transport rates to HBEPL.
5. RMC shall have full right, pwer and authority at all times to act through its officers and servants and to enter in and upon part of the said site or building erected thereon for the purpose of enforcing compliance with all or any of the terms, conditions and reservations herein contained in this Agreement.
 6. RMC officials and its authorised representatives will have the tight to visit and inspect waste conversion operations at any time on working days with prior intimation to HBEPL.
 7. RMC reserves the right to bring in more entrepreneurs if need be, in case the plant set up by HBEPL does not fully meet the requirement of the cith and or HBEPL fails to set up the facilities within period of 24 months from the date of Afreement or taking over the possession of land, which ever is later. Hoever for incresed quantity of waste if additional facilities are required first choice will be given to the currenet operator.
 8. RMC will arrange for creating/providing the following tuilites upto the processing pant site Motorable access road, uptill the entrance of the premise given to HBEPL, all internal roads within the proemises will be done by HBEP
 9. The water requierment for the process, approx. 2 lac liters per day, HBEPL is required to install borewell at the site at Nakrawadi allowed by RMC, at HBEPL' cost. However, incase there is a shortfall or non-availability of water in those borewells, the RMC shall fulfill the shortfall or the requirementnt needed upto 2 lac litres per day of water supply either by tankers or by installation of pipelines from suitable source. The expenditure such as laying pipeline, installing pumping station acquisition of required land and other infrastructure wihte respect to providing electrcal installation and water shall be incurred by RMC.
 10. Electricity Power Line however, all user charges payable for such facilities will be borne by HBEPL.
 11. The RMC will allow HBEPL to accept suitable waste (s) from nearby town/rea towards improving the viablity and sustaniable operations of the waste processing plant.

B. ROLE & OBLIGATION OF HANJER BIOTECH ENERGIES PVT LTD.

1. HBEPL will pay to RMC lease rent for use of land at the rate of Re. 100 per sq.mt per year in advance within 30 days of the begining of each financial year. Lease rent will become payable from the date of Agreement is executed
2. In addition to HBEPL also assures that the APTDC-ESS CONSORTIUM "SELECTED TECHNOLOGY" as well as the pant and machinery for the project to be ste up are sutitable for the Indian environment, more particulary tha Rajkot region with regard to the smooth functioning and operation o fht eplant, machinary during the entire rated life of the plant and manchinery as also during the subsistence of Agreement for a period of 30 years with perodic additions, modifications as per the changing characteristic of waste or regulatory requirements.
3. The waste processing palnt would be stet yp by HBEPL at its own expense. It will be the resposibility of HBEPL to ensure commissioning of the plant within the time stipulated herein agret and arrange for tits proper running aznd day to day maintenance
4. HBEPL, will not hinder or raise ohjection as to lease land being used as dumping site for Municipal Solid Waste by RMC even in case of dispute arising between the parties hereto during the subsistence of Agreement and/ or the plant remaining non-functional

5. HBEPL will ensure construction of building structure, installation and commissioning of waste processing plant for manufacture of fuel pellets, power and organic manure including by-products/co-products, having capacity to process on an average 300 MT per day of city organic waste (expandable to 700 TPD MSW in future) within a stipulated period of 21 months from date of execution of the Agreement or taking over the possession of the lease hold land, whichever is later.
6. The HBEPL will strictly adhere to the time schedule specified. However, the commissioner,RMC may at its directions extend the time limit, stipulated above by a period of 90 days, on the written request if made by the HBEPL , together with reasons therof, provided the commissioner is satisfied that such an extension is necessary.
7. HBEPL shall also be liable to pay a liquidated sum of Rs. 10 lacs by way of damages in case the Agreement is cancelled due to lapse(s) on the part of HBEPL or the plant is not put up. This penalty/damages will be imposed stage wise.i.e., First Stage-Rs. 3.0 lacs incase HBEPL is unable to make necessart applications to the required staturotry Agencies and financial Institution within 8 mmonth of signing of Agreement along with possession of land (being considered as day one). Second stage- 2.0 lacs in case considerable progress is not made by processing such application within 12 month of day 1. Third stage-Rs. 5.0 Lacs in case the Project is not commission within 24 months of Day 1.
8. HBEPL will not use leased land for any purpose other than the proposed aforesaid as well as to create green belt and aforestation for use in fuel pellets and that if it ceases to do so. It will surrender the same to RMC after removing all building and machinaery there from and clearing the said site of all foundations and matrial of building erected by it thereon.
9. If the plant is to be transferred by HBEPL to aby other party a fresh agreement will have to be made by the new party with RMC on mutually agreeable terms and conditions for which HBEPL has to coordinate and support RM, till such new arrangement is finalised. This clauses has been put in the interest of the RMC, as it would be necessary to tke approval of RMC before any change of agreement.
10. That RMC will adhere to the entry point as well as the route to be travered by the garbage carrying trucks as per the agreed site palm in consultation with HBEPL. HBEPL will accordingly draw its plant layouts drawing in such a way that the entry point or the route is not altered/ affected.
11. The sale of fuel pellets/energy/manure and other co-products /by-products and disposal of end products shall be free to sell and/ or dispose off the end products at such price and on such terms and conditions as may be necessary for viability of processing plan.
12. HBEPL will ensure prompt and immidiate treatment of city waste using waste treatment materials to minimise foul smell and control of pathogens, flies at the processing plant site.
13. HBEPL will ensure proper processing and recovery of fuel lpalletes/energy/manure and co-products from the city waste to the maximum extent. The remnants arising out of the waste conversion plant will be properly disposed off by HBEPL by taking necessary permission from the RMC for sanitary landfilling of mainly mud, soil and stones coming along with the MSW supplied by RMC, at the adjoining RMC land fill site. RMC will be developing the landfill site at their own expense.
14. HBEPL will maintain the allotted waste conversion site in hygienically upgraded conditions and also created green belt around the processing unit for environment improvement

15. HBEPL will maintain proper record of production/sale and make available such details to RMC as and when required
16. RMC will obtain necessary authorisation from pollution control for development and operations of sanitary landfill site as per MSW Rules, 2000.
17. HBEPL will be responsible for any accident occurring within the premises of HBEPL and they will be responsible to take necessary insurance and precautions for the same.

C. GENERAL CONDITIONS

1. In addition to the role and obligations of each party specified above and as agreed to by all parties, the following conditions shall also be binding on parties' interest.
2. Possession of the land allotted will be handed over to HBEPL simultaneous with the execution of the agreement.
3. The building plan to be prepared by HBEPL shall be in accordance with provisions of RMC.
4. In case of default in payment of lease rent or any amount due by HBEPL to RMC, interest at the rate of 18 % per annum will be charged for such dues for this period of delay. This will be vice-versa between RMC and HBEPL.
5. The parties to the agreement may stop their activity at anytime provided they inform the other parties atleast two years in advance.
6. It is reiterated that TIME is the essence of this Agreement and this Agreement shall be treated to be cancelled if HBEPL fails to commission the plant within the time period stipulated.
7. That in the event of cancellation or voluntary surrender of the site by HBEPL, it shall be only be entitled to remove its machinery, super structure, and any other material created or built up by the HBEPL on the leased site subject to RMC's lien to adequately secure the unpaid dues, within three months of cancellation/voluntary surrender. Whereafter the same shall vest in the RMC without any liability to pay compensation to the HBEPL for the said machinery of building.
8. In the event of RMC or Government whether Central or State decide to shift the dumpyard to some other site, RMC will provide suitable and adequate alternate site to HBEPL for the plant installed by it at present site, on the same terms and conditions as are herein contained and for shifting the plant at a mutually agreed arrangement/compensation to HBEPL toward civil infrastructure work.
9. HBEPL shall be wholly responsible for fulfilling all requirements of various bye laws applicable from time to time such as employees Provident Fund Laws, Labour regulation, building bye laws, pollution control bye-laws, provisions Rajkot Municipal Corporation and regulations and bye-laws made thereunder etc. HBEPL will ensure that the necessary permissions are obtained from the authorities concerned well in time. The RMC officials will extend necessary cooperations for this.
10. Trees or any other infrastructure except the plant and structure erected and installed on the leased site by HBEPL shall remain the property of RMC and cannot be removed or disposed off without the written permission of RMC.
11. It shall be the responsibility of HBEPL to obtain necessary from the concerned authority regarding felling/ cutting of trees.
12. All the costs and expenses incidental to the execution of this Agreement including the cost of stamp duty, shall be borne by HBEPL.
13. That HBEPL shall be entitled to mortgage the plant and machinery and the structure standing on the land to any institution for raising loans or such other purpose and RMC shall not raise any objection thereof. The lease hold right will be assignable as a security to the financial institutions for availing finances for this project.

14. The terms of Agreement can be renewed for a period beyond 30 years on the terms and conditions to be settled mutually, two years before the expiry of the term and conditions of the existing agreement.

FORCE MAJEURE

Nothing in this agreement shall be construed as a failure of breach either on the part of RMC or HBEPL or both all of them I they are prevented from discharging its / their obligations under this agreement by reason of arrests, restraints by the government or people or blockades , resolutions, insurrections, mobilizations, strikes , go- slow, lock outs, civil comments, riots, accidents , acts of god , destructions of materials by fire, flood or on account of other causes beyond the control of all the parties to the Agreement.

On the occurrence of any of the force majeure condtions, the concerned party shall notify the other parties in writing of such occurrence.

1. Time of such occurrence of Force Majure conditions
2. Nature of force majeure disability
3. Anticipated duration, if such duration can be estimated

ARBITRATION

With regard to any dispute the interpretation of any of the clauses or terms and conditions above, the dispute shall be referred to mutually agreed arbitrator as per the provisions of Arbitration Act.

All disputes arising out of this agreement shall be subject to the jurisdiction of courts at Rajkot city

GENERAL

The parties to this Agreement undertake to abide by their respective roles and obligations as earmarked under different clauses as also their part of obligations enumerated.

This agreement embodies the entire understanding of the parties as to the subject matter and shall not be amended except in writing executed by the parties to this Agreement. As such, this agreement is complete in itself and renders all understandings, oral or written , and /or all previous correspondence ,if any between the parties, null and void.

In case and so long as HBEPL performs and complies with and continues to perform and comply with each and all the terms and condtions here in , may and provided but not otherwise, RMC will encure to HBEPL full and peacefull enjoyment of the rights and privilege herein and hereby conveyed through this agreement.

That this agreement is made in duplicate in 2 uniform copies in English , the original to be retained by each of the party to this agreement.

14.11 Resolution passed by RMC standing committee for levying Administrative charge**Rajkot Municipal Corporation****Standing Committee Resolution No.430 dated 8 Oct.1997.**

For the maintenance of health & sanitation in the city, it is essential to stop littering by people on streets and depositing or throwing any solid waste in public space / street for which a policy level proposal by the municipal commissioner has submitted vide No.RMC:725 dated 18-3-97 and RMC/C/336 dated 7 Oct 1997 for necessary resolution for charging on the spot fine/ administrative charges from defaulters as prescribed and to delegate powers to collect the same on the spot. The resolution read as Rajkot Municipal Corporation which had a serious problem of public apathy towards handling and management of waste introduced a system of levy of administrative charge from those who litter the street or dispose of the waste on the streets after the street cleaning. As per BPMC Act 1949 Annexure-A Chapter-14 there are certain sanitary provisions which are herewith read for passing the resolution. It describes (if anybody whosoever litters the street or public place or deposit or throws or causes or permits to be deposited or thrown any solid waste or construction debris at any place in the contravention of the provision of this Act or defecates in open places, permits the flow of any filthy metals from his premises shall be punished for which a notice of duration 24 hours will be served as per the clause No.126 of Chapter-14 of BPMC Act 1949.

As per the above said Act and Clause if anybody abide the rules Corporation can take administrative charge action against any citizen. Taking into account of above description and clauses of Acts and prevailing situation RMC herewith proposing to take administrative charge in the different category as described below:

		Minimum	Maximum
1	For Residence	50/-	100/-
2	For Commercial	100/-	1000/-
3	For Small Industries	300/-	3000/-
4	Industries	500/-	5000/-

It is very much important to dispose these different type of waste at proper place in the city area, and by this keeping the city clean and to keep aware about the B.P.M.C. Act, 1949 rules and regulation about sanitary provision as given in appendix No. A chapter No. 14.

According to B.P.M.C. Act, 1949 index A chapter No. 14, it is prohibited to dispose of waste and debris on public places. Now, with a view to ensure that the households, shops and industrial establishments do not throw solid waste anywhere in the city and the city's health is not adversely affected, it is hereby resolved that the administrative charges should be recovered from the defaulters as under:

Sr.No.		Minimum Rs.	Maximum Rs.
1.	For Residence	50/-	250/-
2	For Commercial	100/-	1000/-
3	Dispensary (Laboratory, General Practitioner, physician, pathological laboratory etc.)	100/-	1000/-
4	Small Industries and All the small industries who comes of in definition of small industries.	250/-	2500/-
4-A	Community Hall and wadis	250/-	2500/-
5.	Large Industries and large industries who comes of in definition of large industries.	500/-	5000/-
6.	Hospitals, Surgical hospital and hospital having indoor patients.	500/-	5000/-

1. Above administrative charges will be charged on daily basis.
2. Minimum administrative charge will be charged for the first instance
3. If the same place and same person abide the rules the charge will be on the basis of maximum charge.

It is further resolved that Municipal Commissioner should submit quarterly recovery statement.

The effect of this resolution will be from the date of passing this resolution.

14.12 Photos- IEC activities



14.13 People’s Perception for SWM

Followings are the views, suggestions and perceptions received in different forms like fax, e-mails, letters and personal talks during the city development plan exercises. It also includes the suggestions received by Rajkot Municipal Corporation. Duplicate and similar suggestions are combined, while irrelevant suggestions are neglected.

SOLID WASTE MANAGEMENT & HEALTH COMPONENTS

1. Sufficient staff is required street sweeping.
2. Garden waste can be used as fertilizer
3. Need of more Privatization of solid waste services
4. Need of change of sweepers' duty timings and rotation of duties. (chain-system ward-wise).
5. Use proper and efficient modern instruments for SWM.
6. Put small dustbins at closer distance instead of big containers at longer distance.
7. Remove the construction materials lying on roads.
8. Provide dustbins at each inter-section.
9. Strict cleaning of hotels and cinemas.
10. Need of providing sufficient number of dustbins at Market Places
11. Make compulsion to keep dustbin by every shopkeepers
12. Give special discount in house-tax for those who planted trees, use gobar gas plant, and solar energy.
13. Rental service of fogging and suction machine should be available.
14. Provide domestic incineration for disposal of garbage like plastic bags, leaves of trees etc.
15. Need of educating citizens and school children by organizing city level Seminars time to time
16. Attendance of sweepers must be checked on the street.
17. Put the dustbins on all main roads.
18. RMC should declare every day the disposal of garbage from each ward.
19. Increase number of sweepers in ward No. 5.
20. Need of night cleansing of all commercial area suitably after 10 p.m.
21. Need of training for segregation of garbage.
22. Need of providing Dustbin to each house.
23. Need of door to door Collection of garbage by using wheel-burrow.
24. Need of Separate collection and disposal of hospital and hotel waste.
25. Make law and enforce it for throwing garbage on road
26. Solid Waste management officer should inspect entire network & implementing.
27. Effective solid waste management schemes should be implemented.
28. The present site for the final disposal of waste is located at "sokhada " which is on east-north corner of the city. As per vastushastra that corner is known as "is an " that is known as holy corner. To keep progress of city, change the final disposal place.
29. Take legal steps against pollution of industries & vehicles.
30. Need of Shifting of mutton market
31. Purification of Aji river and provide retaining walls and plantations at both ends.
32. Cleaning of voklas and advanced planning of drainage in new Rajkot
33. Provide efficient storm water drain at kalawad-road near GHB garden at siddhi-vinayak temple to drain rain-water and at Amin-marg and housing board (west) to drain rainy water etc.
34. Construct Box-gutter at vonklas in w.no. 5.
35. Give priority to drainage connection where water supply connection exists.
36. Use and sprinkle DDT powder and use fogging machines to prevent mosquitoes' problems.
37. Stop disposal of sewage to natural drainage (vokla) near Eklavya Hall.
38. Always keep covers to the vonkalas & open gutters.
39. Need of regular cleaning of vonkalas to drain the rain-water speedily.
40. Prepare a project of "storm water drainage system" to drain rain-water.

14.14 Allotment of land by District Collector for Land fill site development

સા.કે.સ-મળીદ-૨-સા.નં.૭૨૦-૧લી-૩૦૧૨

એક્ટર સ્ત્રી,
રાજકોટ,
તા.૨૮-૧૨-૨૦૦૪

વિષય: સમ. માંગણી તા.રાજકોટ,
સરકારી પંચાયતના સ.નં.૨૨૨ પેલીની જમીન સં. ૧૦૦-૦ મુંડા
(૪.૦૪,૬૦૦ ચો.મી.) અપોસ્ટ મેન્સોર વિસ્તૃતિકરણ માટે કાળવવા આપતા
રાજકોટ મ્યુનિ. કોર્પોરેશન.

સદસ્ય : (૧) મહાનગર મહેસુલ સ્ત્રી, રાજકોટના પત્ર નં. ૩૫૫-૪૫૫-૧-સા.તા. -
પાકરાવાડી-૧લી-૩૬૦૪/૦૪ તા.૮-૧૧-૦૪ વીં અપેલ
દરખાસ્ત.

(૨) સરકારીના મહેસુલ વિભાગના ડરમ
ક્રમાંક-૪૫૫-૩૬૦૩-૮૫૬-સ, તા.૮-૧૨-૦૩ ની જોગવાઈ.

વિવરણ :

ઉપરોક્ત વંચાત-૧ તથેના મહાનગર એક્ટર સ્ત્રી, રાજકોટના પત્ર નં. ૩૫૫-૪૫૫-૧-સા.તા.-પાકરાવાડી-૧લી-૩૬૦૪/૦૪ તા.૮-૧૧-૦૪ વીં રાજકોટ મ્યુનિ. કોર્પોરેશને રાજકોટ તાજુકાના સમ પાકરાવાડીના સરકારી પંચાયતના સ.નં.૨૨૨ પેલીની વધારાની જમીન સં. ૧૦૦-૦ મુંડા (ચો.મી. ૪,૦૪,૬૦૦) અપોસ્ટ મેન્સોર વિસ્તૃતિકરણના હેતુ માટે મળાઈ જમીન આપેલ છે. તેને લાગુ વધારાની વનભારા નિષ્કલ માટે લેન્ડફીલ સાઈટ નક્કી કરવા માટે મ્યુનિ. કોર્પોરેશને મંગણી કરતાં પ્રસ્તુત ઉપરિવિત થયેલ છે. અને અભિપ્રાય આપે દરખાસ્ત આપેલ છે. મંગણીવાળા જમીન મુલકી અને પાતર છે. અને અહુવાજુવાળાઓને જમીન આપવા અહુવાજુ આપેલ છે. તેમજ મંગણીવાળી જમીન આપવા અને પાકરાવાડી સમ પચાપતે તા. ૧૦-૪-૦૪ ના તારખાં અભિપ્રાય આપેલ છે. મંગણીવાળી જમીનની સ્થાનિક માપલતકાર સ્ત્રી, રાજકોટ તાજુકાને મળાઈ છે. નવમાપા લાગી કરેલ છે. અને નિષ્કલ વેકરીસમાં વિગતો લાગી છે.

સમિતી સીલો આ અને અગાઉ સ્કા જ સર નંમરમાં અપોસ્ટ મેન્સોર વિસ્તૃતિકરણના હેતુ માટે રાજકોટ મ્યુનિ. કોર્પોરેશને જમીન સં. ૧૦૦-૦ મુંડા (ચો.મી. ૪,૦૪,૬૦૦) કાળવવા મંગણી કરી સરકારીએ નવી અભિપ્રાય અને વિકિયાપિત નિયંત્રિત કરતે કાળવવા મેજુરી આપતા તે મુજબ મળના હુકમ નં. ૯૫૮-અપોસ્ટ-સા.નં. ૭૨૦-૧લી-૩૦૧૨ તા. ૧૮-૧-૦૨ વીં વિગતે મળેલ છે. અને સ્કા રાજકોટ મ્યુનિ. કોર્પોરેશને સોપાયેલ છે. અને તે જમીનને હવત વધારાની જમીનની કાલ મંગણી છે. વધારાની આ જમીનની મંગણી કેન્દ્ર સરકારના પર્વવરણ (સુરક્ષા) અધિનિયમ હેઠળ, પનકરણા નિકાલ (આરાંપાપન અને નિષ્કલ) નિયમો ૨૦૦૦ અનુસાર નવરખાલિયાઓએ વનકરણના એવલીકરણ, વર્ગીકરણ, સ્વચ્છ પરિવહન તથા પ્રક્રિયા કરીને નિકાલ કરવાની જાવલ્યા મોકલવાની થાય છે. સરકારીના મહેસુલ વિભાગના વચાસ-૨ તથેના કાવ ક્રમાંક-૪૫૫-૩૬૦૩-૮૫૬-સ તા.૮-૧૨-૦૩ વીં મ્યુનિસિપલ સોલિટ વેસ્ટ મેનેજમેન્ટ નિયમો-૨૦૦૦ પનકરણા નિકાલ માટે લેન્ડફીલ સાઈટ નક્કી કરવા જમીન કાળવવાની નીલિ રાજ સરકારે નક્કી કરેલ છે. અને પનકરણા હેતુ માટે સરકારી આવી મંગણીવાળી જમીન મુલકી જમીન મહેસુલ અધિનિયમ-૧૮૦૦ ની કલમ-૩૮ અને ગુજરાત જમીન મહેસુલના ૧૯૭૨ નિયમોના નિયમ-૭૩ હેઠળ નીમ કરવાની જોગવાઈ કરેલ છે. અને કલમ-૩૭ નીચે નીમ કરવાની સ્ત્રીની મંગણી કરવાની હુકમમાં છે.

સ.કે.સ-મળીદ-૨-સા.નં.૭૨૦-૧લી-૩૦૧૨

રાજકોટ મ્યુ. કોર્પોરેશન

ME-05
જોગવાઈ

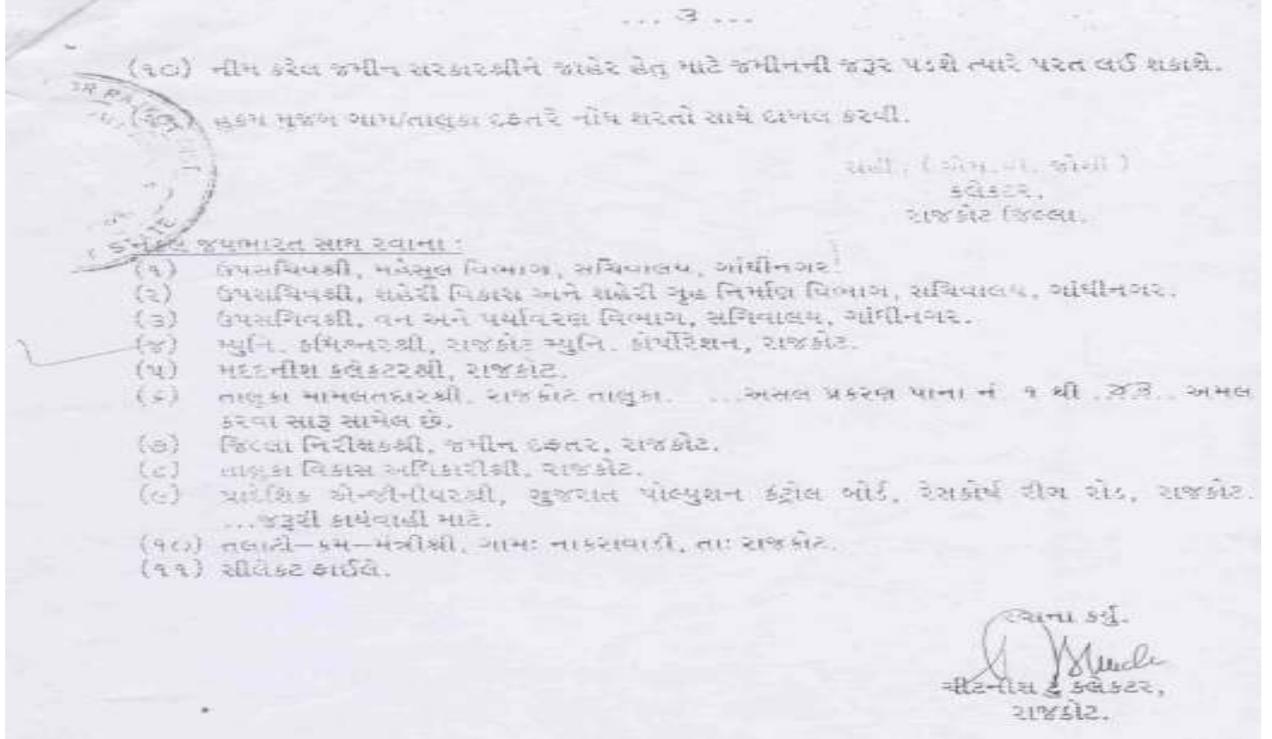


100W
TPO
જોગવાઈ

સા.કે.સ-મળીદ-૨-સા.નં.૭૨૦-૧લી-૩૦૧૨

સા.કે.સ-મળીદ-૨-સા.નં.૭૨૦-૧લી-૩૦૧૨

રાજકોટ મ્યુ. કોર્પોરેશન



14.15 NOC from Gujarat Pollution Control Board for Landfill site development



GUJARAT POLLUTION CONTROL BOARD

Paryavaran Bhavan
Sector - 10-A, Gandhinagar - 382 010
Phone : 3222756, 3222095, 3222096
Gram: CLEANWATER, Fax: (079) 3232156
Website : www.gpcb.gov.in

Authorisation under Municipal Waste (M & H) Rules 2000
[See-rule 6(2)]

File No.: MSW-66/57264
Date: 30/12/2003

31 DEC 2003

To,
Rajkot Municipal Corporation
Rajkot
District: Rajkot

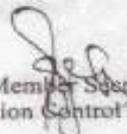
Ref: Your application number nil dt. 16/12/2003

The Gujarat Pollution Control Board after examining the proposal hereby authorizes Rajkot Municipal Corporation having their administrative office at Rajkot to set up and operate waste processing/waste disposal facility at Survey No. 222/P village Nakaravadi on the terms and conditions Special Conditions as follows and General (including the standards to comply) attached to this authorization letter.

1. The validity of this authorization is till Date: 31/12/2006. After the validity, renewal of authorization is to be sought.
2. The Gujarat Pollution Control Board may, at any time, revoke any of the conditions applicable under the authorization and shall communicate the same in writing.
3. Any violation of the provision of the Municipal Solid Wastes (Management and Handling) Rules, 2000 will attract the penal provision of the Environment (Protection) Act, 1986 (29 of 1986).

Special Conditions

1. Confirmation of land allotment has to be obtained from the District collector within 60 days from receipt of this authorization, failing which this authorization shall stand cancelled.
2. The area proposed by Municipal Corporation is insufficient to maintain disposal site for atleast 20 years. Therefore Municipal Corporation shall acquire more 86 acres of land and inform Gujarat Pollution Control Board with in 2 month time , failing which this Authorization will stand cancelled without further notice.


 (Member Secretary)
 Gujarat Pollution Control Board

Date: 30/12/2003
Place: Gandhinagar
Encl. General Conditions

Copy to the Regional Officer, Gujarat Pollution Control Board, for information and monitoring
The District Collector, For information and with recommendation, to
allot this land to the ~~Nagarpalika~~ as site is suitable as per siting criteria

Terms and conditions :-

General Conditions

1. Littering of municipal solid waste shall be prohibited in cities, towns and in urban areas notified by the State Governments. To prohibit littering and facilitate compliance, the following steps shall be taken by the municipal authority, namely :-
 - i. Organising house-to-house collection of municipal solid wastes through any of the methods, like community bin collection (central bin), house-to-house collection, collection on regular pre-informed timings and scheduling by using bell ringing of musical vehicle (without exceeding permissible noise levels);
 - ii. Devising collection of waste from slums and squatter areas or localities including hotels, restaurants, office complexes and commercial areas;
 - iii. Wastes from slaughter houses, meat and fish markets, fruits and vegetable markets, which are biodegradable in nature, shall be managed to make use of such wastes;
 - iv. Bio-medical wastes and industrial wastes shall not be mixed with municipal solid wastes and such wastes shall follow the rules separately specified for the purpose;
 - v. Collected waste from residential and other areas shall be transferred to community bin by hand-driven containerised carts or other small vehicles;
 - vi. Horticultural and construction or demolition wastes or debris shall be separately collected and disposed off following proper norms. Similarly, wastes generated at dairies shall be regulated in accordance with the State laws;
 - vii. Waste (garbage, dry leaves) shall not be burnt;
 - viii. Stray animals shall not be allowed to move around waste storage facilities or at any other place in the city or town and shall be managed in accordance with the State laws.
2. The municipal authority shall notify waste collection schedule and the likely method to be adopted for public benefit in a city or town.
3. It shall be the responsibility of generator of wastes to avoid littering and ensure delivery of wastes in accordance with the collection and segregation system to be notified by the municipal authority as per condition no. 2.
4. In order to encourage the citizens, municipal authority shall organise awareness programme for segregation of wastes and shall promote recycling or reuse of segregated materials.
5. The municipal authority shall undertake phased programme to ensure community participation in waste segregation. For this purpose, the municipal authorities shall arrange regular meetings at quarterly intervals with representatives of local resident welfare associations and non-governmental organizations.
6. Municipal authorities shall establish and maintain storage facilities in such a manner, as they do not create unhygienic and unsanitary conditions around it. Following criteria shall be taken into account while establishing and maintaining storage facilities, namely -
 - i. Storage facilities shall be created and established by taking into account quantities of waste generation in a given area and the population densities. A storage facility shall be so placed that it is accessible to users;
 - ii. Storage facilities to be set up by municipal authorities or any other agency shall be so designed that wastes stored are not exposed to open atmosphere and shall be aesthetically acceptable and user-friendly;
 - iii. Storage facilities or 'bins' shall have 'easy to operate' design for handling, transfer and transportation of waste. Bins for storage of bio-degradable wastes shall be painted green, those for storage of recyclable wastes shall be printed white and those for storage of other wastes shall be printed black;
 - iv. Manual handling of waste shall be prohibited. If unavoidable due to constraints, manual handling shall be carried out under proper precaution with due care for safety of workers.

- 7
7. Vehicles used for transportation of wastes shall be covered. Waste should not be visible to public, nor exposed to open environment preventing their scattering. The following criteria shall be met, namely-
 - i. The storage facilities set up by municipal authorities shall be daily attended for clearing of wastes. The bins or containers wherever placed shall be cleaned before they start overflowing;
 - ii. Transportation vehicles shall be so designed that multiple handling of wastes, prior to final disposal, is avoided.
 8. Municipal authorities shall adopt suitable technology or combination of such technologies to make use of wastes so as to minimize burden on landfill. Following criteria shall be adopted, namely-
 - (i) The biodegradable wastes shall be processed by composting, vermicomposting, anaerobic digestion or any other appropriate biological processing for stabilization of wastes. It shall be ensured that compost or any other end product shall comply with standards as specified in Schedule-IV;
 - (ii) Mixed waste containing recoverable resources shall follow the route of recycling. Incineration with or without energy recovery including pelletisation can also be used for processing wastes in specific cases. Municipal authority or the operator of a facility wishing to use other state-of-the-art technologies shall approach the Central Pollution Control Board to get the standards laid down before applying for grant of authorisation.
 9. Land filling shall be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling shall also be carried out for residues of waste processing facilities as well as pre-processing rejects from waste processing facilities. Land filling of mixed waste shall be avoided unless the same is found unsuitable for waste processing. Under unavoidable circumstances or till installation of alternate facilities, land-filling shall be done following proper norms. Landfill sites shall meet the specifications as given in Schedule -III of MSW Rules 2000.
 10. Specification of landfill sites shall be as per the provisions of Schedule III of MSW Rules 2000.
 11. Standards mentioned in Schedule IV of MSW Rules-2000 shall be strictly followed for Composting, Treated Leachates and incineration.
 12. Municipal Authority shall get examine the design of Landfill and other disposal facilities prior to put in operation by concern Regional Office of The Board.
 13. Procurement of additional land shall be done within 2 months of the receipt of the authorization and a proposal regarding the same shall be submitted to this board.
 14. The landfill action plan related to development of landfill site would be submitted to Gujarat Pollution Control Board immediately on receipt of the authorization and the entire work as per the action plan shall be completed immediately.

14.16 Correspondence with Air port Authority for NOC for Landfill site development

	RAJKOT MUNICIPAL CORPORATION
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R.M.C/S.W.M.No - 3377
25/9/04

DE-44/12/04

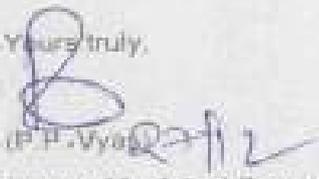
To,
The Sr. Manager (ATC),
Station In charge (Airport),
Civil Aerodrome,
Rajkot.

Subject: Request for the issuance of No Objection Certificate for development of sanitary landfill site at Nakrawadi village.

Sr.

As per the Honorable Supreme Court's guidelines and Municipal Solid Waste Management Rules, 2000, we intend to develop sanitary landfill site at survey No. 222 of village Nakrawadi located in Taluka Rajkot of District Rajkot. The proposed site of landfill is situated at approximately 11 KMS away from airport of Rajkot. Govt. of Gujarat has already allocated this land to us. We hereby enclose the details as per the format suggested by you and request you for the issuance of No Objection Certificate for the development of sanitary landfill site.

Thanking you for your prompt and positive anticipation.

Yours truly,

P.P. Vyas
Deputy Municipal Commissioner,
Rajkot Municipal Corporation,
Rajkot.

14.17 EIA by NPC for Landfill site
