Gmail

Director, SUDA <wbsudadir@gmail.com>

Work order for "Procurement of 60 numbers Battery operated Hydraulic Tipper Three wheelers vehicle for Dumping Solid Wastes in Ashokenagar-Kalyangrah & Habra Municipality"

1 message

Executive Engineer <north24pgsdivisionmed@gmail.com> Wed, Feb 28, 2018 at 2:06 PM
To: Ashokenagar-Kalyangarh Municipality <chairman_akm@yahoo.com>, Habra Municipality <habramunicipality@gmail.com>, Chief Engineer <ce_medte@yahoo.com>, "Sudip Sengupta S.E East Circle" <seec.med@gmail.com>, Director SUDA Manindra Nath Pradhan <wbsudadir@gmail.com>

Sir,
Please find the attachment.

work order.pdf
423K

(37) o/c

Government of West Bengal

Office of the Executive Engineer, North 24-Parganas Division,

Municipal Engineering Directorate

7, K.B. Bose Rd. (2nd floor) Barasat , North 24-Pgs
Kolkata-700 124
Phone No.:- (033) 2584-4288
Email :- north24pgsdivisionmed@gmail.com

No. : MED/N24PGS/ 1586 /1S-09/2017 Date:- 28/2/18

From :- The Executive Engineer,
North 24-Pgs. Divn., M. E. Dte.

To :- Kulkarni Power Tools Limited
1/1, Kimber Lane, Ground Floor
Kolkata - 700017

Sub : Work order for "Procurement of 60 numbers Battery operated Hydraulic Tipper Three wheelers vehicle for Dumping Solid Wastes in Ashokenagar-Kalyangrah & Habra Municipality"

Ref: NIeT No. WBMAD/SE/EC/NIQ-03/2017-18 (2nd Call)
Tender ID : 2017_MAD_137421_1

Time of Completion – 60 (Sixty) days

Your quoted rate of **₹2,27,040.00** (Rupees Two Lakh Twenty Seven Thousand Forty) only per unit for supply of 60 numbers Battery operated Hydraulic Tipper Three wheelers vehicle conforming to Technical Specification as laid down in NIeT which has been accepted by the Superintending Engineer, East Circle, M.E. Directorate vide acceptance no. **ME/SE(E)/599/1S-523/2014 dt.05.01.2018** on behalf of the Governor of the State of West Bengal.

Now, you are requested to start the supply as detailed below in consultation with the Chairman, Ashokenagar-Kalyangarh & Habra Municipality respectively and Assistant Engineer and Sub-Assistant Engineer mentioned below. The date of commencement of the supply will be reckoned from the date of issue of this work order. It is to mention here that the time is the essence of the contract. On failure to start the supply within the stipulated time the Government as per rule will forfeit Earnest Money deposited by you.

This order should be treated as formal work order.

Sl. No.	Description or specification of materials to be supplied	Total Quantities of each to be supplied	Places at which to be delivered	Quantities to be delivered at each place
1	Procurement of 60 numbers Battery operated Hydraulic tipper three wheelers vehicle for dumping solid wastes.	60 nos.	Ashokenagar-Kalyangarh Municipality	28 nos.
			Habra Municipality	32 nos.

28/2/18
Executive Engineer
North 24-Pgs. Division, M.E. Dte.

Executive Engineer
North 24 Parganas Division
Municipal Engineering Directorate
Deptt. of U.D. & M.A.
Government of West Bengal

Mail

No. : MED/N24PGS/ /1S-09/2017 Date:-

Copy forwarded for information to :

1) The Chairman, Ashoknagar-Kalyangarh Municipality
2) The Chairman, Habra Municipality
3) The Chief Engineer, M.E.Dte. Bikash Bhavan (1st floor), Salt Lake City, Kolkata- 700 091
4) The Director, SUDA, Ilgus Bhavan, Salt Lake City, Kolkata - 700106
5) The Commissioner of Income Tax
6) The Superintending Engineer, East Circle, M.E.Dte.
7) The District Magistrate, North 24 Parganas
8) The District Information & Cultural Officer, North 24 Parganas
9) M. Rahaman, Assistant Engineer of this division
10) Sri Saroj Das, S.A.E, Habra Municipality
11) Sri Tapan Kumar Dutta, S.A.E, Ashokenagar-Kalyangarh Municipality

They are requested to look after the work.

12) The Divisional Accounts Officer, Grade – I of this division.

28/2/18

Executive Engineer
North 24-Pgs. Division, M.E.Dte

Executive Engineer
North 24-Pgs. Division
Municipal Engineering Directorate
Deptt. of U.D. & M.A.
Government of West Bengal

DETAILED PROJECT REPORT

MUNICIPAL SOLID WASTE MANAGEMENT

ASHOKNAGAR-KALYANGARH AND

HABRA MUNICIPALITY

2Reuse

MARCH 2016

RECYCLE REDUCE REUSE

Preface

The urban solid waste problems are growing exponentially in the cities and urban centers of this country. Inadequate and inappropriate solid waste management policy is imposing threats on the environment, polluting the natural resources which in turn endangers the eco-system by large. It has reached disastrous proportions nowadays. The problem has become critical further for the reasons of lower socio-economic structures, inadequate resources, lack of techno management initiatives and community participation as a whole. Coupled with budgetary restrictions, poorly motivated staff, inadequate vehicles and implements the solid waste management has become one of the burning problems of the local bodies. The existing infrastructure is barely adequate to cope up with today's need.

This detailed project report, "**Proposed Solid Waste Management System**" for Ashoknagar-Kalyangarh-Habra Cluster Mode has been prepared for improvement of the present solid waste management system of the town and also for proper surveillance and sustainability of the system. The report emphasizes upon the adequate steps for collection, transportation and processing through generation of bio-gas & disposal of solid waste generated by the community. **The total project cost is Rs. 3232.20 lakh.** The most vital component of this project is the procurement of land in the near vicinity of the town. The project will be implemented and managed by the respective Municipality with the technical assistance and guidance of M. E. Directorate.

Hope, this project will not only improve the environmental condition of the town and the health of the community, as a whole but will also fetch a good amount of revenue from the project.

*Thus **waste to wealth.***

CONTENT

SWM : HABRA & ASHOKNAGAR - KALYANGARH MUNICIPALITY IN CLUSTER MODE

PROJECT SUMMARY

POPULATION	:		269133	
AREA	:		42.44	SQ.KM
NO. OF HOLDINGS	:		61825	Nos.
NO. OF WARDS	:		24+23	Nos.
NO. OF DAILY MARKETS	:		40	Nos.
NO. OF COMMERCIAL CENTRES	:		6	Nos.
NO. OF HOTELS	:		0	Nos.
NO. OF HOSPITALS	:		10	Nos.
QUANTITY OF WASTE				
A) DOMESTIC WASTE	:		50.00	MT
B) MARKET WASTE	:		18.00	MT
GARDEN/AGRICURTURAL WASTE	:		2.00	MT
D) HOTEL WASTE	:		2.00	MT
D) TRADE WASTE	:		40.00	MT
E) OTHERS WASTE	:		8.00	MT
TOTAL QUANTITY OF WASTE	:		120.00	MT
PROJECT COST				
A) PLANT, MACHINERY, EQUIPMENTS FOR COLLECTION, TRANSPORTATIONS AND DISPOSAL	:	Rs.	1001.14	LAKH
B) DEVELOPMENT OF LANDFILL SITE	:	Rs.	167.70	LAKH
C) CONSTRUCTION OF BIO-GAS PLANT	:	Rs.	1969.22	LAKH
D) CONTINGENCIES	:	Rs.	94.14	LAKH
TOTAL PROJECT COST	:	Rs.	3232.20	LAKH
ROJECT PERIOD	:		2	YEARS
& M COST PER YEAR	:		685.71	LAKH
REVENUE			PER YEAR	
TOTAL REVENUE GENARATION	:	Rs.	939.60	LAKH
O & M COST	:	Rs.	685.71	LAKH
SURPLUS (AFTER RE-PAYMENT OF LOAN, IF ANY)	:	Rs.	253.89	LAKH
LAND REQUIRED				
A) FOR SANITARY LANDFILL	:		5.6	ACRES
B) FOR BIOGAS PLANT AND OTHERS	:		1.5	ACRES
TOTAL LAND REQUIRED	:		7.1	ACRES

P. Sarkar

Prabodh Sarkar
Chairman
Ashoknagar-Kalyangarh Municipality

CHAIRMAN
HABRA MUNICIPALITY

INTRODUCTION

Solid Waste Management system involves activities associated with generation, collection, transfer & transport and processing and disposal of solid wastes generated by the community. It involves planning, organization, administration, finance, legal and engineering aspects involving interdisciplinary co-ordination. This aspect received scanty attention in most of the municipal towns resulting in insanitary conditions. An effective solid waste management scheme can be drawn by means of a harmonic integration between the available in house resources and the latest technologies.

Solid Waste Management is an obligatory function of Urban Local Bodies (ULBs) in India. However, this service is poorly performed resulting in problems of health, sanitation and environmental degradation. With over 3.6% annual growth in urban population and the rapid pace of urbanization, the situation is becoming more and more critical with the passage of time. Infrastructure development is not in a position to keep pace with population growth owing to the poor financial health of most of the urban local bodies. Solid Waste Management is one among the essential services, which suffers the most in such a situation. Lack of political will, inadequate financial resources, institutional weakness, improper choice of technology and public apathy towards Solid Waste Management has made this service far from satisfactory.

India has 4378 cities and towns as per 2001 census which comprises as under.

Type of cities/towns	Population range
Above 1 million	35
Above 1 lakh	358
Above 50000	401
Below 50000	3584
Total	4378

Waste generation ranges from 200 gms. to 600 gms per capita per day in cities ranging from l Lac to over 50 Lakh population. The larger the city, the higher is the per-capita waste generation rate. The total waste generation in urban areas in the country is estimated to exceed 100000 tons a day.

Indian mixed waste has a large proportion of compost able material and inerts. As per recent studies compost able matters are approximate 55% and inert materials 30 %. The component of recyclable material is between 15%.

A study of Indian cities has shown the Chemical Composition as under:

Chemical Characteristics of Municipal Solid Waste in Indian Cities

Population Range (in millions) ⟶	0.1 to 0.5	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	> 5
Physical Characteristics					
Paper (as %)	2.91	2.95	4.71	3.18	6.43
Rubber Leather And Synthetics (as %)	0.78	0.73	0.71	0.48	0.28
Glass (as %)	0.56	0.35	0.46	0.48	0.94
Metals (as %)	0.33	0.32	0.49	0.59	0.8
Total compostable matter (as %)	44.57	40.04	38.95	56.67	30.84
Inert (as %)	43.59	48.38	44.73	49.07	53.9
Chemical Characteristics					
Moisture (as %)	25.81	19.52	26.98	21.03	38.72
Organic matter (as %)	37.09	25.14	26.89	25.6	39.07
Nitrogen as Total Nitrogen (as %)	0.71	0.66	0.64	0.56	0.56
Phosphorous as P2O5(as %)	0.63	0.56	0.82	0.69	0.52
Potassium as K2O(as %)	0.83	0.69	0.72	0.78	0.52
C/N Ration	30.94	21.13	23.68	22.45	30.11
Calorific value* in Kcal/kg	1009.89	900.61	980.05	907.18	800.7

Source: Manual on Municipal Solid Waste Management 2000- CPHEEO
**Calorific Value on dry weight basis*

The prevalent SWM practices in the country are highly deficient. Generally no storage of waste is being done at source and instead, domestic, trade and institutional wastes, including bio-medical and industrial waste, are thrown on the streets, footpaths, drains and water bodies treating them as receptacle of waste. Recyclable waste material is also not segregated at source and is disposed of on the streets, along with domestic, trade and other wastes. Construction and demolition wastes also pose a serious problem as these wastes are also deposited on the roadside or open spaces, obstructing traffic and causing nuisance.

Generally no processing of waste is done in the country except in a few cities where decentralized or centralized composting is done on a limited scale. Here, the marketing of compost is posing a problem due to ineffective marketing mechanism. A few cities have recently attempted to set up waste to energy plant; their success is yet to be evaluated. Disposal of waste is done in a most unscientific manner. Generally crude open dumping is adopted for disposal of waste in low-lying areas. Most local bodies' deposits waste at the dump-yards without ascertaining the suitability of the land for waste disposal and do not bother to spread or cover the waste with inert material. These sites emanate foul smell, become breeding grounds for flies, rodent and pests, and pose a serious threat to underground water resources and overall environment. System of waste management in the country is thus out-dated, unscientific and highly inefficient.

The laws governing the urban local bodies do not have adequate provisions to deal with the situation effectively officials dealing with SWM service do not have the necessary powers to punish defaulters. Filling of cases in the court for sanitation offences is cumbersome, takes a lot of time and energy of the staff and does

not give the desired results as the punishment imposed at the end of long drawn proceedings is too small to have any salutary effect on the offender.

Looking to the deplorable situation of solid waste management in the country, public interest litigation was filed in the Supreme Court of India seeking direction to central government, state governments and city governments to manage the waste scientifically in an environmentally acceptable manner. Having realized the gravity of the situation, the Hon'ble Supreme Court constituted an expert committee to look into all aspects of solid waste management and make recommendation to improve the situation in class-1 cities.

The Committee so formed considered various options to improve solid waste management practices in these cities and, looking to the present state of SWM practices in urban areas in the country, the institutional capabilities of local bodies, their financial health and other priorities, recommended a minimum level of services that each local body must provide and gave technological options which the local bodies may consider while choosing the technology suitable for their cities, etc.

This Project Report is for identification of deficiencies and giving suggestions for development of a comprehensive Solid Waste Management System in Ashoknagar-Kalyangarh and Habra Municipality as per the directives of Hon'ble Supreme Court and subsequent order No. 290/C-12/M/3S-1/97 Pt.V dated 6th January, 2005 of Department of Municipal Affairs, Govt. of West Bengal.

TOWN PROFILE
ASHOKNAGAR-KALYANGARH AND HABRA

BACKGROUND

Ashoknagar Kalyangarh is a popular city and a municipality under Ashoknagar police station of Barasat Sadar subdivision in North 24 Parganas district in the state of West Bengal, India. Ashoknagar has a rich heritage of political consciousness, education & cultural movements. It has been a seat of refugee movement. Ashoknagar was planned by Dr. B.C Roy. Principal architects of Ashoknagar were late Congress leader Tarun Kanti Ghosh, late congress leader Keshab Bhattacharjee, late CPI leader Sadhan Sen and late CPI(M) leader Nani Kar. Till now drama and children festivals of national standards are held every year. The area has two beautiful parks – Sanghati Park and Millennium Science Park. It has a degree college, two hospitals, several high schools, good libraries, an Engineering & Management Institution, two community halls and a stadium. The area is well connected to Kolkata through rail and road networks.

Habra Municipality is situated within Habra police station under Barasat subdivision in the district of North 24- parganas. It was established in 1979 with a Government nominated Board. Initially nineteen wards were carved out of Panchayet areas to make way for the Municipality. The mauzas included with it are Habra, Kamarthuba,Joygachi,, Hatthuba, Kamarthuba, Ashrafabad Hijalpukur, Nagarthuba, Haria, and Akrampur.. At that time population of Habra Municipality stood at 72,500 approx. Later, three more mauzas viz. Ayra, Belgoria and Daharthuba included out of panchayet area.

HISTORY

In the British period it was an Airbase of the British Airlines. After Independence Dr. Bidhan Chandra Roy, the CM of West Bengal that time developed that Airbase to a planned city for the refugees from Bangladesh. Formerly this place was known as "Habra Urban Colony".

GEOGRAPHY

Ashoknagar is located at 22.833°N 88.633°E.

POPULATION

As of 2001 India census, Ashoknagar Kalyangarh had a population of 111,475. Males constitute 51% of the population and females 49%. Ashoknagar Kalyangarh has an average literacy rate of 79%, much much higher than the national average of 59.5%; with 53% of the males and 47% of females literate. 9% of the population is under 6 years of age.

Currently the Habra Municipality has an area of 21.82 sq. km and population as per census 2011 is 1, 47,221.

CLIMATE AND RAINFALL

The main seasons are summer, rainy season, a short autumn, and winter. The summer in the delta region is noted for excessive humidity, with the highest day temperature ranging from 38 °C (100 °F) to 45 °C (113 °F). In early summer brief squalls and thunderstorms known as Kalbaisakhi or Norwesters, often occur. The Project Area receives the Bay of Bengal branch of the Indian Ocean monsoon that moves in the northwest direction. Winter (December–January) is mild with average minimum temperatures of 19 °C (66.2 °F). A cold and dry northern wind blows in the winter, substantially lowering the humidity level.

EXISTING LAND USE

The Landuse within the Ashokagar-Kalyangarh Municipal Area is specified below:

i)	Residential Area	13 Sq.km
ii)	Industrial Area	1 Sq.km
iii)	Water bodies	14 Sq.km
iv)	Agricultural Area	5 Sq.km
v)	Other (Please specify)	0.24 Sq.km
TOTAL Municipal area		20.64 Sq.km

The Landuse within the Habra Municipal Area is specified below:

i)	Residential Area	17.44 Sq.km
ii)	Industrial Area	
iii)	Water bodies	1.09 Sq.km
iv)	Agricultural Area	1.526 Sq.km
v)	Other (Please specify)	1.744 Sq.km
TOTAL Municipal area		21.80 Sq.km

COMMUNICATION

Railway Station (s) :

Municipality	Name of Station	Ward No	No. of Trains Halt	Approx. No. of Transit Passengers
Ashoknagar-Kalyangarh	ASHOKNAGAR ROAD	19	UP- 44, DN- 55	129770/ MONTH
Habra	HABRA	9& 13	91	20,000/DAY

Bus Terminus :

Municipality	Name of Bus Terminus	Ward No.	No. of Buses Ply	Approx. No. of Transit Passengers
Ashoknagar-Kalyangarh	**KALYANGARH BHATSALA**	**04**	**10**	**500/ DAY**
Habra	**JAYGACHI**	**06**	**71**	**3500/DAY**

MAP

MAP

1.0 PRESENT SCENARIO OF SOLID WASTE MANAGEMENT SYSTEM IN WEST BENGAL

1.1 SOLID WASTE MANAGEMENT SYSTEM

The state of West Bengal witnessed significantly high level of Urbanization during the decades of seventies and eighties. The urban population in West Bengal was estimated as 27.39% of the total population in the 1991 census report as against 25.70% for the entire country. In terms of density of urban population, West Bengal is much ahead of other states. The over all density of urban population in West Bengal in 1990-91 was estimated as 6207 individuals per square kilometer against the national average of 4098.

While the urban towns in West Bengal have rapidly increased in terms of activities and population, the municipal services available at these urban centers are yet to reach the adequate level. Solid wastes in the urban areas are generated from a multitude of sources out of domestic, commercial, institutional & industrial activities. If these wastes are not stored, collected, hauled and disposed off safely and timely, the same cause aesthetic problems and severe impact upon the public health, by means of pollution of air, soil and natural water sources. Therefore Solid Waste Management (SWM) is one of the crucial civic services, without which no pollution abatement measure can be full proof and sufficient. Although SWM is the single largest item of expenditure in the municipal budge, this service suffers from critical deficiencies.

In the wake of fast growing environmental consciousness and increasing public health problems, the concern in respect of inefficient SWM has metamorphosed into an alarming situation, which has inspired the urban local bodies to look for appropriate cost effective technology along with fiscal support.

The different components of the SWM for a particular town can be designed in a no. of ways depending on local conditions e.g. climate, waste characteristics, urban structure, transport economics and desired level of services.

1.2 EXISTING INFRASTRUCTURE & DEFICIENCIES

At present there is no National or State Plan for an integrated approach to deal with the Solid Waste Management System. In the matter of financial resources, the small and medium municipalities are much weaker / compared to the bigger municipalities. The bigger municipalities employ 5 staff per 1000 population, whereas the small and medium municipalities can hereby employ 2 to 3 staff per 1000 population.

1.3 SOLID WASTE CHARACTERISTICS

Community produces variety of wastes ranging from metal to textile produces and from ash to vegetable produces which have different physical and chemical composition. Apart from that, industrial and medical wastes used to get mixed up with municipal wastes frequently, which are usually disposed off indiscriminately without any special treatments.

The average properties of solid waste based upon past studies may be predicted as per following :

Table-1

Character	Contents		Percentage
Physical :			
(i)	Earth & Ash Content	:	48%
(ii)	Fermentable	:	37%
(iii)	Stones & non-degradables	:	12%
(iv)	Density	:	560 to 600 kg/cu.m.
(v)	Calorific value	:	800 to 980 kcal/kg.
Chemical :			
(i)	Moisture	:	45%
(ii)	P^H value	:	6.80
(iii)	Nitrogen	:	0.5%
(iv)	Phosphorus	:	0.52%
(v)	Potassium	:	0.50%
(vi)	Organic matters	:	38%
(vii)	Carbon	:	20%
(viii)	C / N ratio	:	40

1.4 QUANTUM OF SOLID WASTE

The quantum of Waste generation depends upon the size of the town as well as its, socio-economic conditions. However, it was estimated that the generation of solid waste range from 200 to 600 gms. per capita per day depending upon the category, size and nature of activities in the town.

1.5 STORAGE AND COLLECTION

1.5.1 Existing Solid Waste Management

At present the refuse in municipal areas is disposed by uncontrolled dumping at places wherever low land is available. Landfill sites do not conform to any long term regional land use planning. Garbage removal is done only on intervals and there are always some accumulation of garbage on road side. Operational control for environmental protection and control of fly breeding is inadequate. Covering and compaction are not practiced.

1.5.2 Primary Collection

Primary collection starts at the household or at the community facilities. In all the municipal towns under consideration, house collection is almost non-existent and community facilities are scarcely provided. Practically none of the municipal bodies collects solid waste regularly from all areas except from market areas. The existing methods of garbage collection consists of following operation: i) Street sweeping, ii) Collection of road side garbage heaps and sweeping into box type hand carts or wheel barrows, iii) unloading the hand carts into bigger garbage vats or into bigger heap sites on main road.

1.5.3 Secondary Collection & Transfer

This particular activity in solid waste handling in municipal bodies involve picking up manually from the dumps of solid waste and loading into conservancy trucks / trailers. This results in wastage of labour and time for vehicles apart from the health risks of the workers and public at large, which are also exposed to danger of contamination of ground water, which is the main source of drinking water in most of the municipal bodies. In some small and medium towns, tractor-trailer system is being used extensively for transportation and in some small towns animal carts are also employed.

In most cases, the design of transportation vehicle is not appropriate and also not conducive to labour and vehicle productivity. The trucks which are used for transportation of the garbage to the dumping ground are found to be very inconvenient because (i) Excessive loading height of the trucks making manual loading difficult, (ii) they can not carry more than 3-4 tons of garbage due to its low density and high bulkage (iii) Excessive wear and tear of the body due to corrosive nature of the garbage (iv) Idle time lost in loading of the trucks.

1.6 DISPOSAL

More than 90% collected solid wastes in most of the municipal towns are disposed by filling up low lands scattered within the municipal areas in an uncontrolled, haphazard and insanitary manner which is a potential health risk for the community. Orthodox type composting in few towns is also practiced.

1.7 DEFICIENCIES AND SHORT COMINGS IN THE PRESENT SYSTEM

The overall picture of solid waste management in the municipal towns is not quite satisfactory and needs to be improved in order to achieve proper environmental sanitation. The basic short-comings and problems associated with solid waste management in municipal towns are as follow :

1. Population explosion, uncontrolled urbanization, slum area proliferation.
2. Socio-economic crisis (huge external debt, economic austerities, prolonged recession, high rate of inflation, high rate unemployment, social disorder, etc.)
3. Accelerated and uncontrolled generation of municipal wastes and industrial hazardous wastes.
4. Negligence and lack of interest for an effective solid waste management plan.
5. Insufficient public education and limited community participation.
6. In appropriate design of primary handcarts and collection vehicles causing multiple handling of waste and environmental problems.
7. The small and medium municipalities are lacking considerably in the servicing and workshop facilities for the mechanical transport fleet.
8. The location of disposal grounds and their sizes are not decided on the basis of optimum haulage and rotational transportation routing.
9. Disposal of solid waste by land filling method is not generally carried out in a proper sanitary method.
10. Regular analysis and monitoring of solid waste characteristics are not done and presence of toxic and hazardous materials cannot be ruled out.

2.0 RECOMMENDATIONS OF THE SUPREME COURT APPOINTED COMMITTEE FOR MODERNIZATION OF SOLID WASTE MANAGEMENT PRACTICES ARE BRIEFLY AS UNDER

☆ **Ban on Throwing of Wastes on the Streets**

No waste shall be thrown on the streets, footpaths, open spaces, open drains or water bodies.

☆ **Storage of waste at source**

Waste shall be stored at source of generation in 2 bins/bags, one for food/bio-degradable wastes and another for recyclable waste. Domestic hazardous waste, as and when produced, shall be kept separately from the above two streams.

Multi storied buildings, commercial complexes and group housing shall additionally provide community bins for storage of waste generated by their members. Community bins shall also be provided in slums by the local body for the community storage of waste by slum dwellers.

☆ **Doorstep Collection of Waste**

Both the streams of waste, organic/ bio-degradable waste as well as recyclable waste shall be collected from the doorstep. Containerized handcarts or containerized tri-wheel cart or small-motorized vehicles shall be used for daily collection of food/ bio-degradable waste from the doorstep through public participation using a bell, whistle or horn as a means of announcing the arrival of the collection staff.

For collection of recyclable waste from the doorstep NGOs may be encouraged to organize the rag pickers. They may allot them the work of collection of recyclable material from the doorsteps instead of picking it up from the streets, bins or dump-yard, thereby upgrading their status. This waste can be collected once or twice a week according to the convenience of the households, shops or establishments.

Hazardous toxic waste material, which is occasionally generated, shall however be disposed of by the citizens in special bins to be provided in the city at suitable locations by the urban local bodies.

☆ **Sweeping of Streets on All Days of the Year**

Sweeping of streets and public places having habitation or commercial activities on one or both sides shall be done on all days of the year irrespective of Sundays and public holidays. Arrangements for rotating weekly rest-days are to be made by the local bodies.

☆ **Work Norms for Sweeping of Streets**

Work norms ranging from 250 to 750 running meters of road length have been recommended, depending on the density of the area and local conditions. Giving a demarcated "pin point" area for street sweeping and waste collection is also recommended for optimum utilization of manpower.

☆ **Provision of Litterbins at Public Places**

Provision of litterbins at railway stations, bus stations, market places, parks, gardens and important commercial streets may be made, to prevent littering of streets.

☆ **Abolition of Open Waste Storage Sites and other Un-hygienic Street Bins**

The pathetic condition of street bins must be corrected by the provision of neat mobile closed body containers into which waste can be directly transferred from the containerized hand carts or tri-wheel cart and all open waste-storage sites as well as cement concrete or masonry bins must be abolished in a phased manner.

☆ **Transportation of Waste to Synchronize with Waste Storage Facility - Dispense with Manual Loading of Waste**

For the transportation of waste, a system which synchronizes with both primary collection and bulk waste storage facilities may be introduced. Manual loading and multiple handling of waste may be dispensed with and instead, hydraulic vehicles for lifting the containers may be used in larger cities and tractor trolleys or a tractor container combination may be used in smaller cities.

Transportation of waste shall be done on a regular basis before the temporary waste-storage containers start over-flowing. For economy in expenditure, the vehicle fleet should be used in at least two shifts. Workshop facilities may be optimized to keep at least 80% of the vehicle fleet on road. Transfer stations may be set up in cities where the distance to waste-disposal sites is more than 10 Kms.

☆ Processing And Disposal Of Waste:

Conversion of Organic Waste / Bio-degradable Waste into Bio-organic Fertilizer (Compost)

With the availability of land for processing and disposal of waste becoming scarce and the food and bio-degradable component useful to agriculture going waste, measures for conservation of land and organic waste resource shall be taken and Organics shall be returned to the soil. To meet these objectives, all food waste and bio degradable waste shall be composted, recyclable waste shall be passed on to the recycling industry and only rejects shall be land filled in a scientific manner. Decentralized composting with public and NGOs/CBO participation, may be encouraged wherever possible, and centralized composting of the rest of the waste may be done. Microbial or vermi composting processes may be adopted. A variety of composting options has been given in the report and their processes are explained.

☆ Caution Against Using Unproven Technologies

Local bodies are cautioned not to adopt expensive technologies of power generation, fuel polarization, incineration etc. until they are proven under Indian conditions and the Government of India or expert agencies nominated by the Government of India advises cities that such technology can be adopted.

☆ Land To Be Made Available On Priority For Processing And Disposal Of Waste

Availability of land for setting up processing plants and for disposal of waste is a major problem faced by urban local bodies. Government wasteland must therefore be given on top priority for this purpose free or at nominal cost, and if such land is not available or not found suitable, private land should be acquired or purchased through negotiated settlement. A Committee at the district level should identify suitable land and State Governments should form Empowered Committees to give speedy final clearance and prompt possession of suitable land to the ULB.

☆ Criteria for Site Selection, Site Development and Landfill Operations

Criteria for site selection, development of land fill sites and scientific landfill operations may be adopted. Remediation of old abandoned landfill sites should also be done as suggested in the detailed report. Bio-medical waste, industrial waste and slaughterhouse waste may be managed as per the relevant Rules and guidelines of the Government of India and/or Central Pollution Control Board.

☆ Institutional Strengthening and Capacity Building

Institutional strengthening is the key to success of the SWM system. Professionalism in administration, decentralization of administration, delegation of financial and administrative powers, induction of environmental/public health engineers in the solid waste management services and fixation of work norms and proper supervisory levels are recommended. Human resource development through training at various levels needs to be taken up.

☆ NGO/Private sector Participation in SWM Services

There is a need to improve accountability and the level of services through NGO/Private sector participation in SWM services to improve overall performance without harming the interests of the existing staff.

☆ Enforcement

A system of levy of administrative charges or special cleaning charges from those who litter the streets or cause nuisance on the streets may be introduced and powers to punish offenders may be given to the local bodies through suitable additions to the Municipal acts & rules.

☆ Management Information System

MIS is the key to monitoring the performance of manpower and machinery and to help in planning for the future. Detailed management information systems should be introduced.

☆ Financial Aspects

The poor financial health of ULBs is major constraint in improving SWM systems. The financial condition of local bodies may first be improved by setting the house in order and a series of measures towards financial discipline, avoidance of wasteful expenditure, prioritizing the expenditure on essential services, as recommended in the report may be taken. Taxes, user charges and fees should be raised and linked to the cost-of-living index. Area-based property-tax reforms may be taken up to improve the finances of the ULBs.

☆ Health Aspects

Improper SWM practices give rise to problems of health and sanitation. Twenty-two types of diseases are associated with improper SWM practices. Proper management of processing and disposal sites, special attention to cleaning of slums, provision of low cost sanitation facilities to prevent open defecation, prevention of cattle nuisance, proper training to the workforce and use of protective clothing are some of the measures the local body should take immediately to protect the health of the citizens and the work force.

☆ Legal Aspects

Citizens' active participation may be ensured through massive public awareness campaigns. Simultaneously, adequate provisions may be made in local State laws governing the local bodies to ensure public participation and action against defaulters. Legislative provisions to be made by each State have been suggested in the report.

☆ Public Awareness Strategy

Public awareness campaign using information, education and communication (I-E-C) techniques may be used. Waste Reduction, Reuse, Recycling (R-R-R) may be advocated to reduce the burden on the local body and citizens may be motivated to store waste at source in a two-bin system, co-operate with the doorstep primary collection system and keep the city litter-free. Hygienic Solid Waste Management needs to find a place in the National Agenda.

☆ NGO, Public and Private Sector Participation.

Supreme court committee has laid emphasize on active involvement of non-governmental organizations (NGOs) in creating awareness among the people, in organizing the rag pickers for collection of recyclable material and in organizing door step collection from households, shops and establishments.

A lot of emphasizes is to be given on public participation, without which no system would ever succeed. Public participation in the area of storage of waste at source, & at the community level and in the primary collection of waste is highly advocated and insisted upon. Legal provisions are also suggested to take action against the citizens if they fail to comply in spite of repeated instructions through awareness campaign to cooperate in the system.

Private sector participation is the key to success in the areas where higher technologies are involved and where personalized services are proposed to be given. With ever increasing cost of manpower and relatively lower efficiencies of public sector undertakings, it has been strongly recommended that private sector should be involved in the area of door step collection of waste ***from hospitals, nursing homes, hotels, restaurants, commercial complexes, households, etc. as well as in the area of transportation of waste and setting up solid waste treatment and disposal facilities in the urban areas.***

2.1 ISSUES TO BE ADDRESSED

The following issues need to be addressed during policy formulations.

i) Effective public participation in segregation of recyclable waste and storage of waste at source.

ii) Public participation in primary collection of waste

iii) Sweeping of streets and primary collection of waste on all the days of the year irrespective of Sundays and public holidays.

iv) Provision of closed body mobile waste storage depots and abolition of open waste storage sites.

v) Safe and separate storage as well as doorstep collection of biomedical waste, hotel and restaurant waste, yard waste, etc., on full cost recovery basis.

vi) Avoid the need of multiple handling of waste through the adoption of principal of "handle waste once only" in the matter of collection, transportation and disposal of waste.

vii) Transportation of waste on day to day basis in closed body vehicles.

viii) Processing of waste for generating compost, power and other useful products.

ix) Disposal of waste in an environmentally acceptable manner through establishment of sanitary landfill sites.

x) Grant of land for processing and disposal of waste.

xi) Institutional strengthening and human resources development.

xii) Institutional strengthening and human resources development.

xiii) Introducing element of cost recovery.

xiv) Encouraging private sector participation in waste management

xv) Welfare of the staff engaged in solid waste management services.

xvi) Creation of public grievances redressal mechanism.

xvii) Provision for enforcement of sanitation laws and rules.

2.2 SCOPE OF THIS REPORT

This report will deal with Solid Waste Management System of the town **Ashoknagar-Kalyangarh** and the **Habra Municipality** in the district of North 24 Parganas of West Bengal. The objective of this report is to analyze the present situation and recommend for **"Planning and Development of Modernized Practices for Sustainable Solid Waste Management System in the Municipalities of West Bengal"**

The following chapters will discuss about the appropriate technology and methodology for handling, collection, transportation, processing & final disposal of municipal solid waste and also design a comprehensive Solid Waste Management System for Ashoknagar-Kalyangarh Municipality and Habra Municipality. The necessary recommendations and directions are also furnished below.

This project report is prepared by Municipal Engineering Directorate, Govt. of W.B., as per the request of Municipal Authority for compliance of Govt. order.

3.0 COLLECTION OF WASTE

3.1 DEVELOPMENT OF POLICIES AND CHOICE OF APPROPRIATE TECHNOLOGY AND METHODOLOGY

The success of any solid waste management system largely depends upon the three factors (i) Collection, (ii) Transportation & iii) Disposal. So, to make success clear assessment on the quantity of solid waste to be handled is very much essential. In respect of Ashoknagar-Kalyangarh and Habra town a figure of 300 gm/cap/day is fairly reasonable for consideration. The verity of solid waste generally generate in a Municipal town are domestic, market, trade, Hospital / Clinical Waste in nature. Waste from street sweepings, sewer line cleanings and construction debris etc. also get into the access with the main waste.

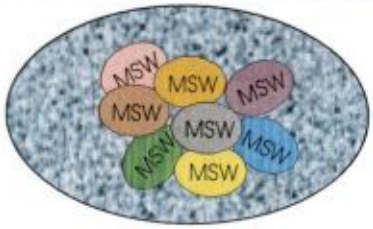
With a view to improve upon the present collection, transport and disposal methods in the municipality, future solid waste management works are to be carried out on the basis of the principles stated below.

Cost of transportation is one of the major components of solid waste management system. Routing and scheduling of vehicles are of prime important from economic point of view. For convenience and economic consideration of as collection and transportation of solid waste the whole Ashoknagar-Kalyangarh-Habra Cluster municipal area may be divided in three zones as given in the following table.

Table No. - 2

ZONES	AREA & WARD NOS.	
Zone A	HABRA	1, 2, 3, 4
Zone B		5, 6, 7
Zone C		8, 9, 10, 11 & 12
Zone D		13, 14, 15, 16
Zone E		17, 18, 19, 20
Zone F		21, 22, 23, 24
Zone I	Ashoknagar Kalyangarh	1, 2, 3 & 23
Zone II		4, 5, 6, 7 & 8
Zone III		9, 10, 11, 16, 17 & 18(P)
Zone IV		12, 13, 14, 15 & 22(P)
Zone V		18(P), 19, 20, 21 & 22(P)

FLOW CHART FOR SWM SYSTEM



Collection from point of generation

DOMESTIC WASTE

To be collected from house to house by wheel barrow and Transferred either to community bins or directly to container (HLDC) kept at Transfer Stations. Waste from community bins shall be collected by Hook Lift dumper carrier.

HOTEL

Waste stored by the Hotels in their containers is to be collected directly by HLD.

MARKET WASTE

To be collected at a particular time of a day in HLDC kept at a particular place and the containers are to be transported to Disposal site .

WASTE FROM TRADE & COMMERCE

To be collected either by wheel barrow or directly at Community Bins / Dumper Containers at a particular place and the containers are to be transported to Disposal site.

WASTE FROM ROAD SIDE LITTRE BINS

To be cleaned daily and the waste to be transferred to Wheel Barrows and from it to nearby HLDC.

TRANSPORTATION

To Processing and Disposal / Site(s)

Recovery of Recyclable materials

Degradable waste to be processed

Non-Degradable waste to be disposed off by sanitary landfill

Value addition and realization of economic value by proper placement and marketing of the product

Volume reduction through Compactor

Monitoring, and Evaluation of the total systems & adoption of necessary modification required

3.1.1 Collection

The local body shall be the responsible for the arrangement for the collection of waste stored at various sources of waste generation on a daily basis. This shall be done by any of the following methods or combination of more than one method:

i) The garbage is to be suggested to be separated in accordance with their classes at the point of generation. This practice will help to dispose off the garbage effectively at the dumping ground, as well as reduction of massive handling activities of the cumulated garbage mass at a centralized point.

ii) The garbage is suggested to be containerized at the point of generation. This will not only help to reduce the collection time but will also reduce the health hazards. Therefore the service level will be better.

iii) Door-step collection of domestic waste through handcarts or similar other devices with active community participation.

iv) Collection through community bins from private societies multi storied buildings, markets, commercial and Office complexes etc.

v) Door-step collection of waste from authorized / unauthorized slums or collection from the community bins to be provided in the slums by the local bodies.

vi) Door-step collection of waste from posh residential areas on full-cost-recovery basis.

3.1.2 People's Participation in Collection:

Success of the effective solid waste management particularly primary collection system largely depends on the proper co-ordination between people who are the generator and the staff who are the collector.

The average municipal solid waste characteristics depict high moisture content, with a relatively high density. Conventional metal bins and dumpers are found to be deteriorating within a short period due to the corrosive action of the waste mass. Hence, an appropriate design of the primary collection bins, with the help of modern technology is of prime necessity in order to reduce the recurring capital as well as maintenance costs.

3.2 MODUS OPERANDI

3.2.1 Door-step collection through containerized handcarts with bells / whistles

For domestic waste collection each collector may be given a tyre-mounted wheel barrow having eight detachable 20 litres containers and provided with a bell or whistle. Each collector shall be given a fixed area or beat for sweeping plus a fixed number or stretch of houses from which to collect the domestic waste. In congested or thickly populated areas, 300 running meters of road length and the adjoining houses may be given to each sweeper, whereas in less congested areas 500 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 areas even 500 running meters of road length can be given. Normally 50 to75 houses coupled with the above road length may be taken as a yard stick for allotment of work to an individual sweeper.

3.2.2 Role of the Collector

The collector 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.

No collector may be expected or directed to do house to house collection by asking waste from the doorsteps to save his time energy and productivity.

3.2.3 Collection of waste from Societies / Complexes

In the private societies / complexes / multi stories buildings normally no collectors are provided by the local bodies and private collectors are generally engaged. It may be therefore be made compulsory for the management of the Societies / Complexes etc. to keep the bins in which waste has been stored at the easily approachable location to facilitate easy collection by the municipal staff. The local body shall arrange to collect waste from these community bins through handcarts, tricycles of pick up vans etc. as may be convenient on day to day basis.

3.2.4 Collection of Wastes from Slums

The local body shall collect waste from slums on bell system along their main access-lanes, with residents bringing their wastes to the handcart from their houses and / or from the community bins by using the pick-up vans or containerized handcarts or other means which may be convenient transferring the waste to the municipal waste storage sites for daily clearance. The local body may, if so desire engage a private contractor

for daily collection of this waste. Performance certification by "Maholla / Bastee Committee" may be insisted in such cases.

3.2.5 Collection from the door-steps in posh residential areas

In the posh residential areas where the residents might not be willing for community participation and bring their waste to the municipal hand cart, door-step collection of wastes may be introduced for picking up domestic waste from households on day to day basis. Such service may be provided on full cost recovery basis and contractor may be engaged to provide such service if so desired to ensure that the waste generated from posh area is collected regularly and taken to the waste storage sites.

3.2.6 Collection of Duly Segregated Recyclable / Non-degradable Waste from Households

NGOs may be activated to organize the rag-pickers in the city and the rag-pickers may be allotted lanes and bye lanes comprising of 150 to 250 houses for door-step collection of recyclables. The rag-pickers may be given identity cards by the NGOs for increasing their acceptability in the society. NGOs and / or the corporation may support the rag-pickers by giving them nylon bags for collection of recyclable waste from the door-steps. Otherwise, all recyclables to be separated at centralized separation platform as proposed in this DPR.

3.2.7 Collection of Waste from the Shops and Establishments

The shops and establishments normally open after 9 a.m. These timings do not synchronize with the work schedule of the 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 wastes, after most of the shops open.
2. Rag pickers may be organized to collect the recyclable waste from the shops and establishments as soon as the shops get opened as most of such waste is recyclable. Working arrangement 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. The rag pickers may be organized to collect recyclable waste from such establishments on a daily basis. This arrangement may be made on 'No payment' basis on either side.

   The recyclable material received by the rag-pickers directly from the 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. The associations of markets, shops and establishments may be persuaded to make an endeavor in organizing this service with the help of NGOs and rag-pickers in their market.
3. Door-stop collection service from the shops and establishments may be contracted out on 'full cost-recovery' basis.

3.2.8 Collection of Hotel and Restaurant Waste

The hotels and restaurants may make their own arrangements of collection or be given door step collection service for their food wastes by the urban local body on full cost recovery and pro-rate basis. This door step service may be contracted out by the local body 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.

The cost recovery may be planned according to the classification of hotel / restaurant made on the above basis and decided in consultation with them.

A survey of the Waste Generation of the hotel / restaurants may be made before the collection rates are introduced and notified.

3.2.9 Meat And Fish Waste

Meat and fish waste from the meat / fish markets should be removed on a daily basis departmentally or through contractor on full cost recovery basis.

3.2.10 Sweeping Of Streets & Public Spaces

Sweeping of all the public roads, streets, lanes, by-lanes should be done daily if there is habitation or commercial activities on both the sides or on either side of the street. A list of such roads and streets together with their length and width should be prepared and a programme of their daily cleaning should be worked out by the local body keeping in views the norms of work (yardstick) prescribed. However, the roads and streets, where there is no habitation around and they do not require daily cleaning, may be put in a separate group and may be taken up for cleaning periodically depending upon the need of cleaning those roads or streets. Cleaning of such roads, streets etc. may be included in the list of periodical cleaning of such spaces to ensure that they

do not become the dump yards and remain clean. A programme should be worked out for cleaning such roads, streets and open spaces according to the periodicity of cleaning decided upon and may be adhered to.

3.2.11 Transfer Of Waste

Collectors shall transfer the waste collected from Door to door to a container kept at transfer station of their respective zones from where the container would be transported to dumping site by prime movers.

The waste collected in community bins / litter bins shall be directly transported to dumping site by prime movers.

Details of the transportation system and nature of vehicles have been given in Chapter 4 below.

3.3 Tools to be given to Sweepers

With a view to ensure that the sweepers, more particularly female workers can work conveniently, appropriate types of tools and equipment should be given to them.

3.3.1 Brooms

The brooms should have a long handle to facilitate cleaning of the street without bending the body. In the cities where the broom allowance is being given or only broom sticks are provided to the sweepers, it should be ensured that long handle brooms are 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 the sticking material from street while sweeping.

There is no yardstick about the number of brooms to be given to the sweepers per month. In some cities three brooms are given per month whereas in some cities only one broom is given per quarter of a year. One long handle broom per month considered being adequate for street sweeping. The bamboo (long handle) to which the broom is attached need not be given once a month as it has a long life. The same bamboo should be reused while making the broom. The bamboo may be replaced as and when required. It could be once in six months or once a year depending upon the local conditions of the city.

3.3.2 Metal Tray and Metal Plate

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

3.3.3 Hand-Carts / Wheel Basrrows

Each sweeper engaged in street sweeping should be given a handcart having 8 containers of 20 liters capacity each. These containers should be detachable to facilitate the direct transfer of street sweeping from the container into the communal waste storage bins. Such containers should be lockable with a chain arrangement. The handcart should have sealed ball bearing and at least 3 wheels so that it can be used efficiently. Containerized tricycles can be used in lieu of the handcarts.

3.3.4 Norms Of Work For Street Sweepers

The sweepers may be assigned "Pin point" work according to the density of the area to be swept. The following yardstick can be adopted :

1. In high density area 300 RMT of road length covering about 200 to 175 houses
2. In medium density area 500 RMT of road length covering about 150 to 125 houses
3. In low density area 750 RMT of road length covering about 125 to 100 houses

The sweepers may be directed to sweep the roads and footpaths in the area allotted to them as well as to collect the domestic, trade and institutional wastes in their handcart from the households, shops and establishments situated on the road / street allotted them.

3.3.5 Cleaning of Surface Drains

Ashoknagar-Kalyangarh Municipality has separate sewer line system. The sewer lines should be clean and regular intervals by using **Sewer Line Suction cum Jetting Machine (SLSJM).** The waste from the suction operation should be directly transported to dumping site.

In some areas of Ashoknagar-Kalyangarh Municipality and also Habra Town there are open surface drains. In these drains quite often the sweepers and the people dispose of the waste un-authorized. These drains are required to be cleaned on regular basis to permit free flow of waste-water. Action should be taken to ensure that the sweepers and the citizens do not dispose of their waste into the drains.

Drain cleaning should be done regularly at least twice in a weak and the cleaner should be given suitable handcarts and shovels for transferring the waste to the site identified for depositing such waste. The periodicity of cleaning such drains should be worked out looking to the conditions of clogging of drains.

3.3.6 Provision of Litter Bins

For the facility of the citizens to dispose of their waste in hand such as used cans of soft drinks, used bus tickets, wrapper of chocolate or empty cigarette cases etc. litter bins should be provided in all the market places, office complex areas, places of public gathering and on the important roads at reasonable distance ranging from 25 meters to 250 meters depending on the density of the road or market place. The removal of waste from these litter bins should be done by the sweepers during their street cleaning operations. The waste from the litter bin should be directly transferred into the handcart of the sweeper.

Such facility may be created at no cost to the local body 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 sponsor. Litter bins 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 local body.

3.3.7 Temporary Waste Storage Depot for Bulk Community Waste

The Bulk community waste storage has to be properly linked with Collection System adopted by the city / town where house to house collection.

The local body may depend upon the system of Collection adopted in the town, identify the locations where community waste storage facilities shall be created.

3.3.8 Segregation Of Recyclable / Non-Degradable Waste

The local body shall make serious endeavor to motivate households, shops and establishments to segregate recyclable / non-degradable wastes at the source of waste generation and hand over such waste to the rag-pickers. The arrangement may be made on 'no payment on either side basis' for collecting the recyclable / non-degradable wastes by the rag-pickers and simultaneously mobilize NGOs to take up the work of organizing rag-pickers and motivating them to collect recyclable wastes from the doorstep instead of picking up solid waste from the streets, bins or disposal sites. This step may create some earnings to some BPL persons.

The Local Bodies may actively associate resident associations, trade & street associations & NGOs in the awareness campaign to motivate people for segregation of such waste at source.

Priority must be given for the source segregation of recyclable wastes by shops and establishments. Efforts may be made to introduce segregation of recyclable waste at source and its collection from the doorstep by the rag-pickers. In case of households such an arrangement may be made within one year.

The rag-pickers may be given an identity card by the NGOs organizing them so that they may have acceptability in the society. The Local body may notify such an arrangement made by the NGOs and advise the people to cooperate.

As soon as this arrangement is made and a reasonable awareness campaign is carried out it shall be made compulsory to do source-segregation from the date that may be notified by the local body.

4.0 TRANSPORTATION OF WASTE

Transportation of waste is very important aspect so far cost is concerned. Proper planning and management of man machine and vehicle is of utmost important to minimize the cost.

a) The waste collected from door-to-door shall be transferred to transportation containers viz. **Hook Lift Dumper Containers 5 to 7.5 cu.m. capacity (HLDC), Hydraulic Dumper Container (HDC),** etc. kept at transfer station located at various zones.

b) The transportation of waste from the bulk community waste storage sites or transfer stations 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 is given below. These containers should be of about 1000 ltr. capacity still bins with **Swivel Castor Wheel Automatic Lifting** arrangement and are to be transported directly to dumping site by prime movers .

a) The containers which are required to be cleared more than once a day.
b) The containers which are required to be cleared once a day.
c) The containers to be cleared on alternate days or twice a week.
d) The containers which take longer time to fill to be cleared once a week.

The various types of transportation vehicles which may be used for transportation of waste from Ashoknagar-Kalyangarh and Habra Municipal area to dumping site are **Hook Lift Dumper Carrier (Hydraulic), Hydraulic Dumper Carrier, Tractor-Trailer, Ordinary Truck.**

4.1 Transportation Of Waste From Hotels & Restaurants

The hotels and restaurants waste shall be collected on day to day basis either departmentally or through a contract. Door-step collection system may be introduced for the collection of this waste. Eight refuse collectors with back loading facility or motor vehicle with close body may be used. This entire collection and transport system could be privatized and rates may be prescribed by the local body. 33% spare vehicles may be kept to ensure reliable service.

4.2 Transportation of Construction Waste

Removal of construction waste is the liability of waste producer. If he does not remove the construction waste, it may be removed by the local body on full cost recovery basis. One of the following methods may be adopted for transportation construction waste:

i) Here skip renting system may be introduced; the skips shall be transported by hydraulic system at the time mutually agreed between the parties i.e. local body and waste producer.

ii) The local bodies may also use front-end loaders and trucks, hydraulic dumper truck for transportation construction waste.

4.3 Transportation of Waste from Narrow Lanes

Quite often small quantity of waste is disposed of in the narrow lanes which cannot be removed by sending out usual transport vehicle. Wheel barrows may be used for removal of such waste.

Small vehicles may be used for the collection of waste from narrow lanes and transfer the same to containers kept at nearby transfer station for transportation of waste to dumping site. The transfer stations itself should be transported to the dumping ground by the Prime Movers. Facility of ramp may be provided for transferring the waste from the collecting vehicles to the transportation vehicles. The requirements of such large container are worked out on the basis of total quantity of waste expected to be brought to the transfer station.

4.4 Type of Vehicles to be Used

The vehicle which synchronizes well with the community waste storage system shall be utilized to prevent multiple handling of waste which may be done as under.

i) Wheel Barrows with 8 containers of 20 lts. Capacity; 4 for Bio-degradable and 4 for non-degradable for house to house collection for solid waste.

ii) The box type or wheel borrows are suggested to be replaced preferably with containers / bins in narrow lanes.

iii) The filled up containers are proposed to be hauled away by prime movers and in doing so the filled up skips / containers / trailers being replaced by empty one. The transfer station needs to be designed in a proper manner by constructing suitable ramps and vehicles bays for transferring waste from the primary collection fleet to transportation vehicles / containers.

iv) The container lifting devises such as Dumper placers / skip lifters/ Hook Lift Dumper Carrier may be utilized for transportation of large size containers to the transfer station of the disposal site.

4.5 Routing of vehicle

Routing and scheduling of vehicles are of prime important for management of waste transportation system. 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.

4.6 Workshop Facility for Repairing and Maintenance of the Vehicles

The Municipalities must have adequate workshop facility for the regular maintenance to the various types of accessories and fleet of vehicles. Such facility may be created by the local body departmentally or through a contractual arrangement. The workshop should have adequate technical staff and spares 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 give as replacement till such time necessary repairs are carried out. The workshop should be preferably headed by an automobile or mechanical expert.

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

The workshop should be run in more than one shift. Technical staff as per the requirement may be kept in the second or third shifts to ensure that more than 80% of vehicles remain on the road for optimum utilization of the fleet of vehicles of the local body.

5.0 DISPOSAL OF WASTE

The disposal of waste, processing of degradable waste and disposal of non-degradable waste, is one of the most important aspects of integrated waste management as unscientific disposal of waste can cause irreparable damage to the environment and subsoil strata and human health and life. No local body should therefore allow any dumping of waste at unauthorized sites. Suitable landfill sites must therefore be urgently identified and designated as Landfill Sites for the disposal of rejects from the Compost Plant and for non-biodegradable waste. Municipality should arrange required land for disposal of waste keeping in view the requirements of the city for at least the next 15 – 20 years. Depending upon the quantity of waste to be disposed of annually, the requirement of land has been worked out below and the land may be acquired accordingly.

Composting is the process of waste disposal which our predominantly agricultural country must follow. It can be done by aerobic and anaerobic processes. The aerobic process is a biological oxidation process where the organic portion of the waste is decomposed and a material useful to agriculture having N: P: K values is produced. This process can be completed in 45 to 50 days.

An aerobic process of composting is very slow. It takes about 180 days to make compost. It is therefore not desirable to go for anaerobic composting. Besides it does not kill pathogens.

The aerobic composting is suitable under Indian conditions. Indian waste generally contains 30% to 50% of organic wastes. It also has the required moisture content, C/N ration etc. It is a low cost option and does not require high skills. It has a market potential and land requirement for disposal of waste gets reduced.

Disposal of SW involves processing of bio-degradable portion of the waste into manure and generation of bio gas and disposal of the remaining after recovery of recyclable materials of the total solid waste.

DISPOSAL TECHNOLOGIES

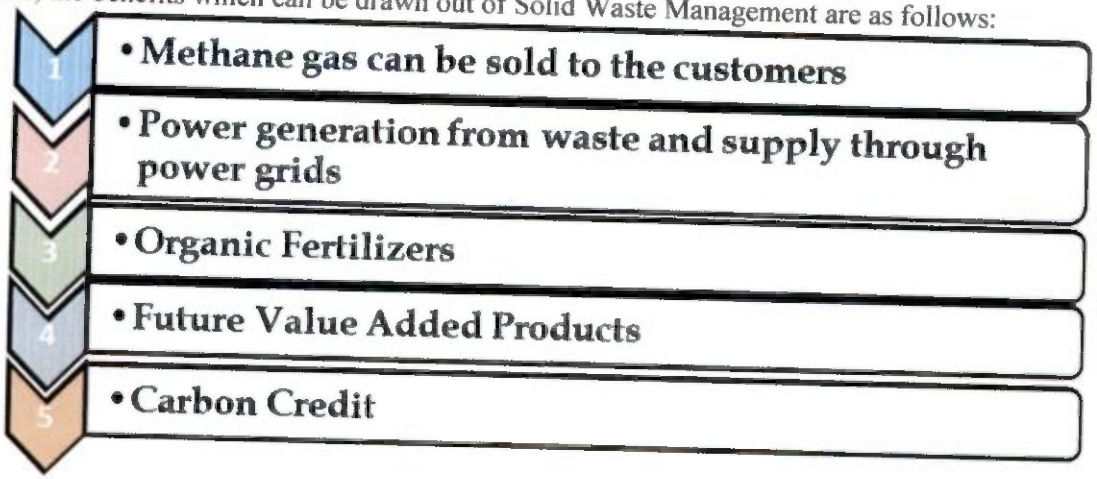
Municipal garbage is to be disposed of by the combination of i) processing of waste and generation of **bio-gas** and ii) disposal **(Sanitary Land Filling)**. The bio-degradable waste from households and daily market waste are proposed to be composted and other types of wastes will be disposed off by Sanitary Landfill. The refuge from hospitals and nursing homes with high pathogenic contents are proposed to be disposing off as per the regulation related to disposal of Bio-medical waste. The market wastes having high organic contents are very efficient for composting. In view of the fact that municipal garbage carries high quantity of cinder, ash, silt, earth and other inorganic materials and as such it does not have any fuel value. So the possibility of generation of power from solid waste appears to be difficult unless separation of organic and inorganic constituent of waste is made directly at source.

Most preferred disposal option suitable for small and medium size municipal town is the combination of processing of waste by Composting and disposal of the remaining by Sanitary Landfill method.

5.1 Generation of BIO-GAS

According to the Ashoknagar-Kalyangarh-Habra Municipality estimation, approximately 121 MT of waste is generated daily basis in the Towns. It was seen that for the Municipality the amount of the Biodegradable Waste generated (81 MT) was considerably higher in comparison to the Non Biodegradable waste. Thus, a Bio gas Plant layout is ideal for the Project Area and will be designed for the Cluster Towns. Primarily, twelve 5 MT Bio gas Plants are proposed for Ashoknagar-Kalyangarh-Habra Cluster.

At a glance, the benefits which can be drawn out of Solid Waste Management are as follows:



Benefits of Solid Waste Management

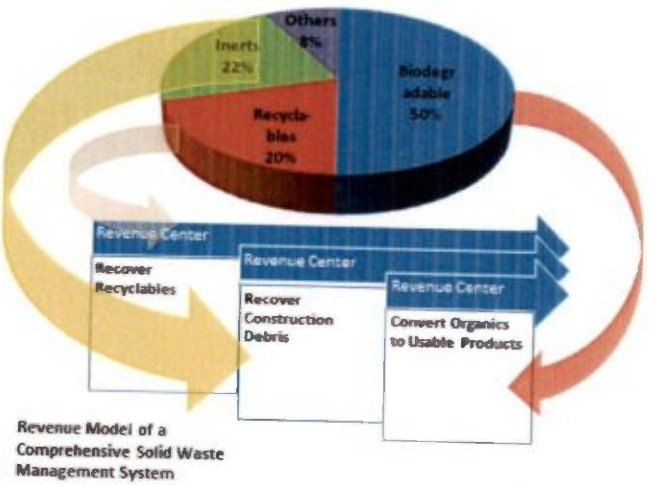
5.2 Waste Generation Trend

The Project Area is well known for its tourism and horticultural importance in West Bengal. Following are the major sources for generation of Solid Waste:

Domestic;
Commercial Areas and Vegetable Markets;
Household and other factories;
Hotels and Restaurants;
Health Care Facilities
Slaughter House;
Street Sweeping and Construction Activities
Horticultural Waste

The following diagram shows the proposed approach for a comprehensive solid waste management system. The overall solution should be a combination of the following:

Sorting and segregation
Recovery of Recyclables
Recovery of inerts
Conversion of biodegradables to valuable products like biogas and fertilizers



Revenue Model of a Comprehensive Solid Waste Management System

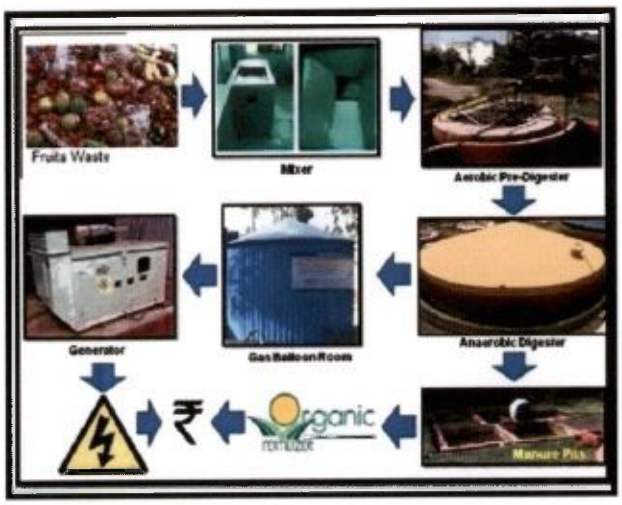
Solid Waste Sorting Operation

The collected solid waste will be segregated into biodegradable and non biodegradable components. The non-biodegradable components will be sorted into paper, plastic, glass, metals and inerts. There is a ready market for all of these sorted materials in Siliguri and other urban centers for these recyclable markets. It is recommended that Ashoknagar-Kalyangarh assigns one of the companies operating in the region for sorting the waste so that the biodegradable component can be fed into the biogas generating facility.

Solid Waste Handling Technique

Approximately 131 MT of solid waste is generated on a daily basis. Thus the expected Biodegradable Waste to be generated daily is approximately 81 MT. It is recommended that biogas plant should be setup for optimal utilization of the processed waste.

Science of the Process



Waste Processing Flow Diagram

The principle as explained in the figure above produces organic manure (soil conditioner) and biogas based on the process of Bio-Methanation. The organically rich biodegradable portion of solid waste is mixed with recycled water to form slurry. The slurry is then aerobically digested in Pre-digester, where organic matter is converted to organic acids. Prior to Pre-digestion, final digestion is required. The Pre-digestion is accentuated by addition of hot water and intermittent aeration. Pre-digestion reactions are exothermic and temperature rises to 40 °C by itself. Hot water obtained using solar heater is added to raise the temperature to 50 °C.. Their main role is to digest proteins and low molecular weight carbohydrates to produce volatile fatty acids.

The smaller molecules like proteins and simple carbohydrates are degraded during Pre-Digestion. The pH of the feed slurry to Pre-digester is around 7-8. The retention time (Hydraulic time) of 4 days is maintained in the Pre-digester. After the Pre-digestion the pH reduces to 4-5 pH units. The predigested slurry is further digested under anaerobic conditions for about 15 days. The process of methanogenesis takes place in this digester. Methane and carbon dioxide are the terminal products of this process. Methane is produced from two primary substrates viz. Acetate and Hydrogen/ Carbon dioxide (Formate). At this stage the organic acids are converted by consortium of methane bacteria to methane and carbon dioxide. The undigested lignocelluloses and hemi celluloses then flow out as high quality organic manure slurry. The pH of this slurry ranges from 7.5-8. Since the waste is processed at higher temperature, weed seeds are killed completely and the manure becomes weed free.

The three steps of Biogas production are as follows; 1) Hydrolysis 2) Acidification and 3) Methanogenesis. Various bacteria are involved in these processes.

Hydrolysis

In the first step (hydrolysis), the organic matter is analyzed externally by extra cellular enzymes (cellulose, amylase, protease and lipase) of microorganisms in the pre-digester tank. Converting solid waste into liquid form in the mixer stimulates this step. Bacteria start decomposing the long chains of the complex

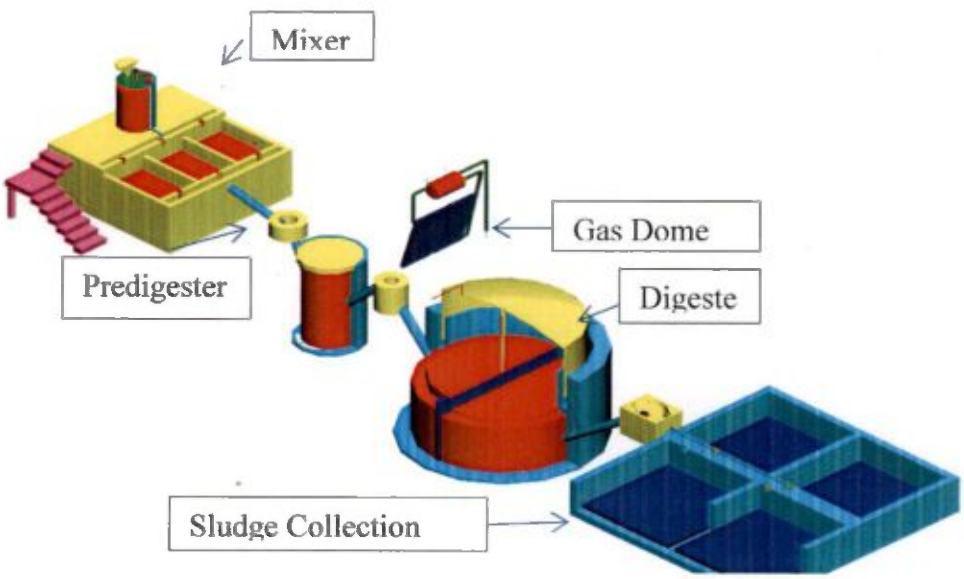
carbohydrates, proteins and lipids into shorter parts. Proteins are split into peptides and amino acids. Simple carbohydrates and proteins are degraded completely.

Acidification

Acid-producing bacteria involved in the second step convert the intermediates of fermenting bacteria into acetic acid (CH3COOH), hydrogen (H2) and carbon dioxide (CO2) in the Pre-digester. These bacteria of the genus bacillus, are aerobic and facultative anaerobic, and can grow under acidic conditions. The aerobic conditions in the pre-digester will be maintained by an air compressor..The bacteria use the oxygen dissolved in the solution producing acetic acid, thereby reducing the compounds with a low molecular weight into alcohols, organic acids, amino acids, carbon dioxide, hydrogen sulphide and traces of methane. The pH of the raw slurry falls from 7.5 to about 4.5 to 5.5 in the pre-digester. , Various zones are formed in the pre-digester and different bacteria dominate these zones. Addition of hot water helps in eliminating the mesophilic bacteria and selection of thermophilic bacteria. But these thermophilic bacteria can operate at lower temperatures also. Hence hot water added even once a day should be sufficient for maintaining the pure consortium in the pre-digester. However if it is possible to maintain the temperature of pre-digester in the range of 50-55oC throughout the day, the performance of pre-digester will be enhanced and the holding time may be further reduced, by maintaining temperature in the range of 50-55.C, throughout the day.. The hot water helps in hygienization of the slurry by killing the enteric bacteria that may be present in the waste. Some Gram negative Enterobacteria and Coliform bacteria have been isolated in the raw slurry. However in the second zone these bacteria are totally eliminated. From the pre-digester tank, the slurry enters the main tank where it undergoes anaerobic degradation by a consortium of archaebactereacea belonging to Methanococcus group.

Methane Formation

Methane-producing bacteria, in the third step, decompose compounds with a low molecular weight. . In contrast to acidogenic and acetogenic bacteria, methanogenic bacteria belong to the archaebacteria group, a group of bacteria with a very heterogeneous morphology and a number of common biochemical and molecular-biological properties that distinguish them from all other bacterial genera. It is advisable to circulate the generated biogas back into the system using a small compressor. This would enhance the reduction of Carbon dioxide to methane and enrichment of methane fraction in the biogas. The separation of two stages in methane production helps in improving the purity of methane gas, thereby increasing its fuel efficiency. However, the average composition round the year would depend on how effectively pre-digester temperatures can be maintained. It is taken through a GI pipeline to utility points. Drains for condensed water vapor are provided online. The biogas burns with a blue flame and is ideal for cooking. Alternately, it can be used to produce electricity in a dual fuel biogas-diesel engine.



Process Schematic of the Waste to Biogas-Organic Fertilizer System

5.3 SANITARY LANDFILLING

This is presently the commonest method of waste disposal. But it has associated problems of land and sub soil water contamination besides availability of land is becoming scares from year to year for filing of waste. Efforts have therefore to be made to minimize the wastes going to the landfill by resorting to composing of organic waste and only rejects should be land filled from the dates that may be notified by the local bodies after setting up of the Compost Plant.

This method will have to be followed for the greater mass of waste with a proper sanitation approach, in place of the present process of indiscriminate dumping. Adequate precaution against leachate pollution, fly, insect, odor and other unsightly problems, will have to be ensured for proper environmental protection. The fuel gas generated at landfill site can be salvaged and put into proper use for energy recycling. Assistance from developed countries to achieve this object will be of high necessity. A conceptual arrangement for sanitary landfill system has been given below.

5.2.1 Identification of Suitable Lands for Disposal of Waste Site selection :

Local bodies must identify suitable landfill sites 1) for the disposal of rejects from the compost plants and 2) for making a secured landfill for the disposal of non-biodegradable items following the directions of central or state pollution control boards. Such sites should be large enough to meet their requirement of waste disposal for 15 to 20 years and capital investments could be made for making the site fit for disposal of wastes.

a) The landfill site should be at least 0.5 km. away from the habitation so that it does not cause nuisance to the people on account of emission of foul smell etc.
b) It should have relatively impervious soil strata.
c) It should have good approach roads.
d) It should large in size.
e) Landfill site should be very near to compost area to minimize transport cost.
f) Landfill site should not be very near to water bodies like lake, cannel, river etc.

5.2.2 Development of Site

a) If the soil has some porosity, it should be made impervious before being used for land filling, by liners of compacted clay, plastic of concrete.
b) Approach roads may be made to connect the landfill site to the main road.
c) Internal approach roads are made to facilitate easy movements of vehicles and tipping of wastes at the landfill site during the monsoon months.
d) The local bodies should set up monitoring stations near the major landfill sites to ensure that quality of subsoil water does not get affected on account of leachate emerging from the landfills. A leachate pit is required at the lowest point for pumping leachate.
e) A small store room may be constructed at the landfill site to store the tools and equipment required.
f) A compound wall or fencing by barbed wire may be done to prevent blowing of waste due to air, controlling the entry of unauthorized persons and conceal the unsightly appearance of the of the landfills. The site should be surrounded be adequate no. of trees.
g) In large cities having population above 5 lakh a mechanical or computerized weighbridge may be installed for monitoring the quantities of wastes being carried by the vehicles to the landfill.
h) Trees may be grown around to create a green belt to improve the environmental conditions and screen the site from the people vies.

5.2.3 Landfill Operation

i) Compost-yard rejects and non-degradable may be brought to the landfill site for disposal.
j) Bulldozers may be used on a daily basis for spreading and compacting of such waste and covering it with inert material.
k) The waste may be covered with 7 to 10 cm. thick layer of inert materials such as construction wastes to avoid any foul smell and breeding of rodents and insects.
l) The landfills may be carefully monitored against subsoil contamination through leachate.
m) Gardens or playgrounds may be developed on the landfill and they may be made useful to the society or put to a profitable use.
n) On-site construction is not recommended for ten years after closure of the site (or 25 years in temperate regions).
o) Waste should not be allowed to be burnt at the landfill to avoid air-pollution.
p) Toilets should be constructed to prevent open defecation and make arrangements for extinguishing accidental fires.
q) Records may be maintained of the wastes received at the landfill and the number of trips made by each transport vehicle on day to day basis.

Landfill Section

Landfill may have different types of sections depending on the topography of the area. The Landfill may take the following forms: (a) above ground landfills (area landfills), (b) below ground landfills (trench landfills), (c) slope landfills, (d) valley landfills (canyon landfills) and (e) a combination of the above.

In case of Ashoknagar-Kalyangarh-Habra, a combination of above ground landfills (area landfills) may be adopted.

Phasing of Landfills Operation

Landfill is to be operated in phases because it allows the progressive use of the landfill area, such that at any given time a part of the site may have a final cover, a part being actively filled, a part being prepared to receive waste, and a part undisturbed;

The term 'phase' describes a sub-area of the landfill. A 'phase' consists of cells, lifts, daily cover, intermediate cover, liner and leachate collection facility, gas control facility and final cover over the sub-area.

Each phase is to be typically designed for a period of 12 months. Phases are generally filled from the base to the final/intermediate cover and capped within this period leaving a temporary un -restored sloping face.

It is recommended that a 'phase plan' may be drawn as soon as the landfill layout and section are finalized. It must be ensured that each phase reached the final cover level at the end of its construction period and that is capped before the onset of monsoons. For very deep or high landfills, successive phases should move from base to the top (rather than horizontally) to ensure early capping and less exposed plan area of 'active' landfills.

The term cell is used to describe the volume of material placed in a landfill during one operating period, usually one day. A cell included the solid waste deposited and the daily cover material surrounding it. Daily cover usually consists of 15 to 30 cm of native soil that is applied to the working faces of the landfill at the end of each operating period. The purposes of daily cover are to control the blowing of waste materials; to prevent rate, flies and other disease vectors from entering or exiting the landfill; and to control the entry of water into the landfill during operation.

A lift is a complete layer of cells over the active area of the landfill. Typically, each landfill phase is comprised of a series of lifts. Intermediate covers are placed at the end of each phase; these are thicker than daily covers, bench (or terrace) is commonly used where the height of the landfill will exceed 5 m. The final lift includes the cover layer. The final cover layer is applied to the entire landfill surface of the phase after all landfilling operations are complete. The final cover usually consists of multiple layers designed to enhance surface drainage, intercept percolating water and support surface vegetation.

5.2.4 Liner System for Control of Leachate

Leachate control within a landfill involves the following steps: (a) prevention of migration of leachate from landfill sides and landfill base to the subsoil by a suitable liner system: and (b) drainage of leachate collected at the base of a landfill to the sides of the landfill and removal of the leachate from with the landfill.

Liner systems comprise of a combination of leachate drainage and collection layer(s) and barrier layer(s). A competent liner system should have low permeability, should be robust and durable and should be resistant to chemical attack, puncture and rupture. A liner system may comprise of a combination of barrier materials such as natural clays, amended soils and flexible geo-membranes. Three types of liner systems viz. **Single Liner System, Single Composite Liner System and Double Liner System** are usually adopted.

a) **Single Liner System :** Such a system comprises of a single primary barrier overlain by a leachate collection system with an appropriate separation/protection layer. A system of this type is used for a low vulnerability landfill.

b) **Single Composite Liner System :** A composite liner comprises of two barriers, made of different materials, placed in intimate contact with each other to provide a beneficial combined effect of both the barriers. Usually a flexible geomembrane is placed over a clay or amended soil barrier. A leachate collection system is placed over the composite barrier. Single composite liner system are often the minimum specified liner system for non-hazardous wastes such as MSW.

c) **Double Liner System :** In a double liner system a single liner system is placed twice, one beneath the other. The top barrier (called the primary barrier) is overlaid by a leachate collection system. Beneath the primary barrier, another leachate collection system (often called the leak detection layer) is placed followed by a second barrier (the secondary barrier). This type of system offers double safety and is often used beneath industrial waste landfills. It allows the monitoring of any seepage which may escape the primary barrier layer.

Considering the advantages of composting liner system, in Indian conditions it is recommended that for all MSW landfills the following single composite liner system be adopted as the minimum requirement.

a) A leachate drain layer 30 mm thick made of granular soil having permeability (K) greater than 10^{-2} cm. /sec.
b) A protection layer of silty soil of 20 – 30 cm thick.
c) A geo-membrane of thickness of 1.5 mm.
d) A compacted lay barrier and amended soil barrier of 1 mm thick having permeability (K) 10^{-7} cm. /sec.

To achieve good composite action the geomembrane must be placed against the clay with good hydraulic contact. To achieve intimate contact the surface of a compacted soil liner on which the geomembrane is placed should be smooth-rolled with a steel dump roller. All oversized stones in the soil should be removed prior to rolling. Also the geomembrane should be placed and back fill in a way that minimizes wrinkles.

Cut-Off Walls : When a landfill is underlain, at shallow depths, by an impervious layer, vertical cutoff walls may be constructed around a landfill to intercept off-site migration. Cut-off walls are physical barriers (typical made of bentonite or bentonite-soil mix) and such barriers are aided by active pumping used to remove leachates from within the perimeter of the cutoff wall.

Leachate Drainage, Collection and Removal

A leachate collection system comprises of a drainage layer, a perforated pipe collector system, sump collection area, and a removal system.

The leachate drainage layer is usually 30 cm thick, has a slope of 2% or higher and a permeability of greater than 0.01 cm/sec. A system of perforated pipes and sumps are provided within the drainage layer. The pipe spacing is governed by the requirement that the leachate head should not be greater than the drainage layer thickness. Pipe material selection is based on design requirements: HDPE pipes are most commonly used; other materials can also be examined for feasibility.

Leachate is removed from the landfill by (a) pumping in vertical wells or chimneys, (b) pumping in side slop risers, or (c) by gravity drains rough the base of a landfill in above-ground and sloped landfills. Side slope risers are preferred to vertical wells to avoid any down drag problems. Submersible pumps have been used for pumping for several years; educator pumps are also being increasingly used. In some landfills, the leachate is stored in a holding tank (for a few days) before being sent for treatment.

The possibility of fall in efficiency of the drainage system due to clogging associated with solid deposits and microbial growth can be controlled by a number of options, including back-flushing or breakthrough water after leachate head build-up.

Treatment of Leachate:

Control / Management of leachate is very complicated. The five/ alternative methods viz. **a) discharge to lined drains; b) discharged to waste water treatment system; c) re-circulation; d) evaporation of leachate; e) treatment of leachate** may be considered in this regard.

Out of the above five the Recirculation Method may be considered suitable for small to medium landfill site. This method of treatment of leachate is to re-circulate it through the landfill. This has two beneficial effects : i) the process of landfill stabilization is accelerated and ii) the constituents of the leachate are attenuated by the biological, chemical and physical changes occurring with the landfill. Recirculation of leachate requires the design of a distribution system to ensured that the leachate passes uniformly throughout the entire waste. This method also accelerates the process of gas generation.

Final Cover System

A landfill cover is usually composed of several layers, each with a specific function. The final cover system must enhance surface drainage, minimize infiltration, vegetation and control the release the landfill gases. The landfill cover system to be adopted will depend on the gas management plan by (a) controlled passive venting; (b) uncontrolled release; or (c) controlled collection and treatment/reuse.

For all landfill sites where controlled gas venting is planned, the cover system is recommended. Gas vents will be placed at a spacing of 30 m to 75 m on the landfill cover and the level of methane will be monitored regularly. If methane concentration exceeds permissible limit a gas collection and treatment system will be installed with flaring facility.

For sites where landfill gas recovery is to be undertaken, the placement of passive and/or active gas venting systems will be governed by the energy recovery system. In such case a cover of granular soil of 45 cm thick over the waste followed by barrier layer of compacted clay of 60 cm deep followed by a protection layer of 2 cm is to be given. Over the protection layer one layer of granular soil of 30 cm followed by a top layer of thickness 45 cm with soil suitable for vegetation growth will improve the efficiency of gas recovery system by minimizing the loss of gas to the environment.

For uncontrolled release of gas (in small, shallow and remote sites) a cover of 60 cm depth is recommended.

The cover system adopted at any landfill must satisfy the minimum requirements published by regulatory agencies CPCB.

Slope Stability Aspects and Seismic Aspects

The stability of a landfill should be checked for the following cases.

1. Stability of excavated slopes.
2. Stability of liner system along excavated slopes.
3. Stability of temporary waste slopes constructed to their full height (usually at the end of a phase).
4. Stability of slopes of above-ground portion of completed landfills.
5. Stability of cover systems in above-ground landfills.

Closure and Post Closure Maintenance of Landfill Site

Determination of the end-use of a landfill site is an essential part of the plan for landfill closure and post-closure maintenance. Some possible uses of closed landfill sites near urban centers include parks, recreational areas, golf courses, vehicle parking areas and sometimes even commercial development.

A closure and post-closure plan for landfills involves the following components:

- Plan for vegetative stabilization of the final landfill cover.
- Plan for management of surface water run-off with an effective drainage system.
- Plan for periodical inspection and maintenance of landfill cover and facilities.

5.4 Introduction of Recycling System

In view of the fact that municipal wastes constitute variety of materials which have a good salvage value. Prospect of alternative disposal system based on the traditional practice can be explored in the non formal sector. We may also develop some resource recovery approach which propose to include :

i) Improved sorting technique and reduction of occupation hazards of pickers.
ii) Measures to reduce the health risk of workers.
iii) To develop a comprehensive plan of the existing agro pisi-culture system to improve utilization of garbage to increase productivity of vegetables and fish.

5.5 Disposal of slaughter-house waste and carcasses of dead animals etc.

The disposal of slaughter house waste and carcasses of dead animals should be done scientifically following the directions / guidelines of the Ministry of Environment, Govt. of India. This waste should not be mixed with municipal waste.

This waste could be converted into a useful product by installing a carcass-utilization plant with financial support Govt. of India's Ministry of Agriculture and Animal Husbandry.

Municipal authority should take appropriate steps for lifting, transportation and disposal of Carcass. Suitable mechanism is required to be developed for reporting of the dead animals found with in the municipal area. On receiving the information the "Dead Animal Carrier Van" should reach the spot as soon as possible but not later than one hour to lift the Carcass and to transport the same to dumping ground. The "Dead Animal Carrier Van" should be a covered one having chain-pulley system for lifting and placing the dead animals into the van. There are number of options for disposal of carcass.

The best method is to keep the dead animal in open air on an impervious platform at the remotest corner of the dumping ground so that it can be used as food for vultures. This is the most economic and easy method of disposal of carcass. Survival of vultures has become very important now a days for maintaining the ecological balance and this method of disposal of carcass will be very much effective in this regard.

The other options are :

i) Secured burial of carcass in impervious burial pits. This method is to be adopted where the dumping ground is located very near to the locality.

ii) A raised platform may be constructed to keep the dead animal in open air for feeding the same as food for vultures. This method may be adopted where the dumping ground is located far away from the locality.

iii) Shred the carcass into small pieces and mixed it in windrow where Windrow Composting facility exists. This will not only increase the process of decomposition but also will enhance the nutritious value of the compost manure.

The skin of the animal, if valuable, can be extracted before it is disposed off. After the carcass is feed by the vultures, the bones can be collected for use in bio-fertilizer.

In slaughter house liquid waste should be carried separately to the septic tank where anaerobic decomposition will take place and the effluent from the tank may be discharged to the normal drain after chlorination. Carcass of the slaughter house may be mixed with the vermi compost after initial decomposition of the same in solar light.

Private parties / NGOs may be engaged for collections and transportation of carcass on service charge basis. They may be allowed to extract the valuables from the carcass to minimize the cost of operation.

5.6 Disposal of Industrial Waste

Industrial waste is required to be stored, transported and disposed of by industries as per the guidelines of the respective State Pollution Control Boards. However, the local bodies may extend help to the industries in the transportation and disposal of non-hazardous industrial waste on full cost-recovery basis. This work can be contracted out by the local bodies in consultation with the industries associations etc. and strictly monitored by both the local body and the State Pollution Control Board.

6.0 DESIGN OF THE SYSTEM

6.1 Quantum of Solid Waste

The success of any solid waste management system largely depends upon the three factors (i) Collection, (ii) Transportation & iii) Disposal. So, to make success clear assessment on the quantity of solid waste to be handled is very much essential.

Total quantity of waste generated per day from various sources in Ashoknagar-Kalyangarh-Habra Cluster is given below :

Generation Points	Total (in kg.)	Quantity of Waste (in Kg.)	
		Waste Type	
		Bio-degradable	Non-degradable
Domestic	74012	44407	29605
Daily & Wholesale Market	43060	34448	8612
Hotels	0	0	0
Agricultural/ Garden	1000	1000	0
Sub-total	118072	79855	38217
Commercial Centres	8180	0	8180
Railway Station	1000	0	1000
Bus Stand	200	0	200
Sub-total	9380	0	9380
Street Sweepings	1000	0	1000
Drain Cleanings	600	0	600
Sub-total	1600	0	1600
Cess pool	1200	1200	0
Clinical	347	0	347
Total	130598	81055	49543

Data Validation by Solid Waste Sampling

A detailed sampling exercise was performed at the Ashok Nagar Kalyangar and Habra solid waste dumping ground to estimate the quality of the solid waste reaching the site. The assumption was that through the quantity of the waste will vary with seasons, the overall sorting practices and the solid waste generation points will remain the same during all the seasons. The following Table shows the result of the sampling exercise.

Municipality	Tare Weight (KG)	Full Weight (KG)	Waste Total	Plastic	Metal	Glass	Paper	Biodegradable	Biodegradable (%)
Ashok Nagar	4150	6060	1910	220				1690	88%
Habra	3190	4560	1370	190				1180	86%
Cluster Total	7340	10620	3280	410				2870	88%

The following conclusions can be drawn from the sampling exercise:

Nearly all the glass, paper and metals are sorted out of the solid waste even before it can reach the solid waste facility. One aspect that is a good practice as the recyclables are definitely gets recycled under this procedure. The pre-sorting would reduce the revenue that the solid waste facility could have earned by selling the recyclables to the scrap market

The remaining plastic was mostly of low grade thin sheet. The only applicable process for conversion this plastic is to breakdown the plastic into dirty fuel through Pyrolysis so that it can be subsequently sold as furnace oil to factories.

The final solution will not require any process for recycling glass, metal and paper as these components can be expected to be drawn back into the economy.

The main revenue sources from the process will be from

- Gas and or electricity generated from the biogas
- Organic fertilizer
- Fuel oil from the plastic pyrolysis
- Selling any other recyclables recovered will be sold in the market through solid waste

Biodegradable materials will account for 85-90% of the waste finally reaching the solid waste facility. It is projected that as the waste reaching the solid waste site is after the sorting done by rag pickers and the residents, the biodegradable part as a percentage of the whole waste generated is expected to be close.

Therefore, the plant should be designed on the basis of the overall waste tonnage expectation while using the solid waste quality observed during the sampling process.

BASIC CONSIDERATIONS

1. Domestic Waste shall be segregated (bio-degradable and non-degradable) at generating points House to House in separate containers.

2. Each family would preserve the degradable waste in green container & non-degradable waste in yellow container.

4. House to House collection shall be done by Wheel Barrows having eight containers; four for bio-degradable and another four non-degradable waste.

5. There will be number of Transfer Stations in each zone . **(For Zones please see Table No. 2)**

6. At Transfer Stations waste from Wheel Barrow shall be transferred to Community Bins / Dumper / Refuse Trailer from a ramp.

7. Market Waste should be collected through Community Bin(s) to be placed at suitable points.

8. Trade Waste should be collected by Wheel Barrows or through Community Bin(s) to be placed at suitable points

9. Waste from Market shall have to be dumped in Transfer Stations. Each Market\Commercial Centre should have one Transfer Station in the form of containers. No road side open vat should be allowed. All road side bins must have cover and with necessary arrangement for tilting directly on to the transportation vehicles.

10. From Transfer Stations waste shall be transported to disposal site by prime movers.

11. Penalty may be imposed for haphazard throwing of waste.

12. Variety of non-degradable waste can be recycled after processing.

13. NGOs may be encouraged for employing daily wage earners to collect the non-degradable waste and to sale them.

14. One Wheel Barrow will cover about 50 to 75 holdings in a day and will make three trips to Transfer Stations.

15. Each and every hotels should keep two containers one yellow another green for storing their non-degradable & degradable waste respectively which shall be collected by the transportation vehicles at the particular time on each day.

16. Capacity of Refuse Trailer is 1.0 – 1.5 MT.

17. Capacity of Dumper / Truck is 5 – 7.5 MT

18. In an average one Tractor will be able to make 4 - 5 trips per day.

19. Moisture content in organic waste is about 60%.

20. Domestic SW contains about 60% organic matter and remaining 40% is inert materials.

21. Hotels generate SW @ 750 gm/bed and contains about 50% organic matter and remaining 50% is inert materials.

22. Market SW contains about 80% bio-degradable matter and remaining 30% is inert materials.

23. Assumed that Trade Waste contains about 10% bio-degradable matter and remaining 90% is inert materials.

24. Assumed that Agricultural Waste contains about 100% bio-degradable matter neglecting the very few mixed inert materials.

25. Assumed that Clinical Waste generated @ 1500 gm per bed/day.

26. In Clinical Waste infectious material is 25%.

6.2 PROCESSING AND DISPOSAL OF WASTE

The solid waste of Ashoknagar-Kalyangarh-Habra Cluster is proposed to be disposed of partly by processing and partly by sanitary landfill method. Bio-degradable part will be processed bio gas will be generated.

Present land availability to Ashoknagar-Kalyangarh Municipality for disposal of SW is about 7.5 acres located at a distance of 2 Km from the central place of the town. The detailed design of the disposal system is given below.

6.3.1 Design Of Solid Waste Processing System

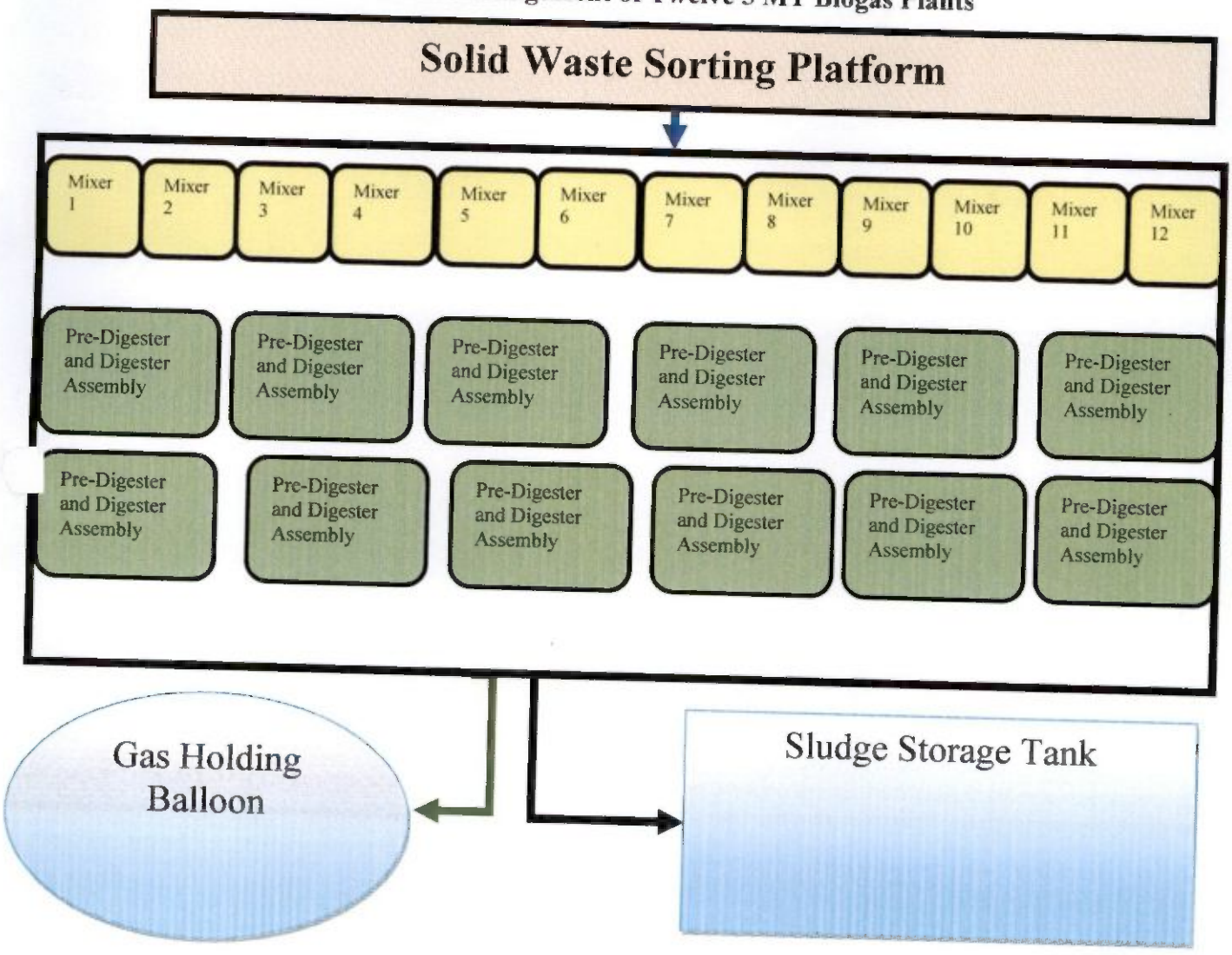
The Solid Waste Management Facility in Ashoknagar-Kalyangarh-Habra Cluster ProjectArea is shown in figure below. It is proposed to be a Biogas Plant, which will produce electricity in the long run.

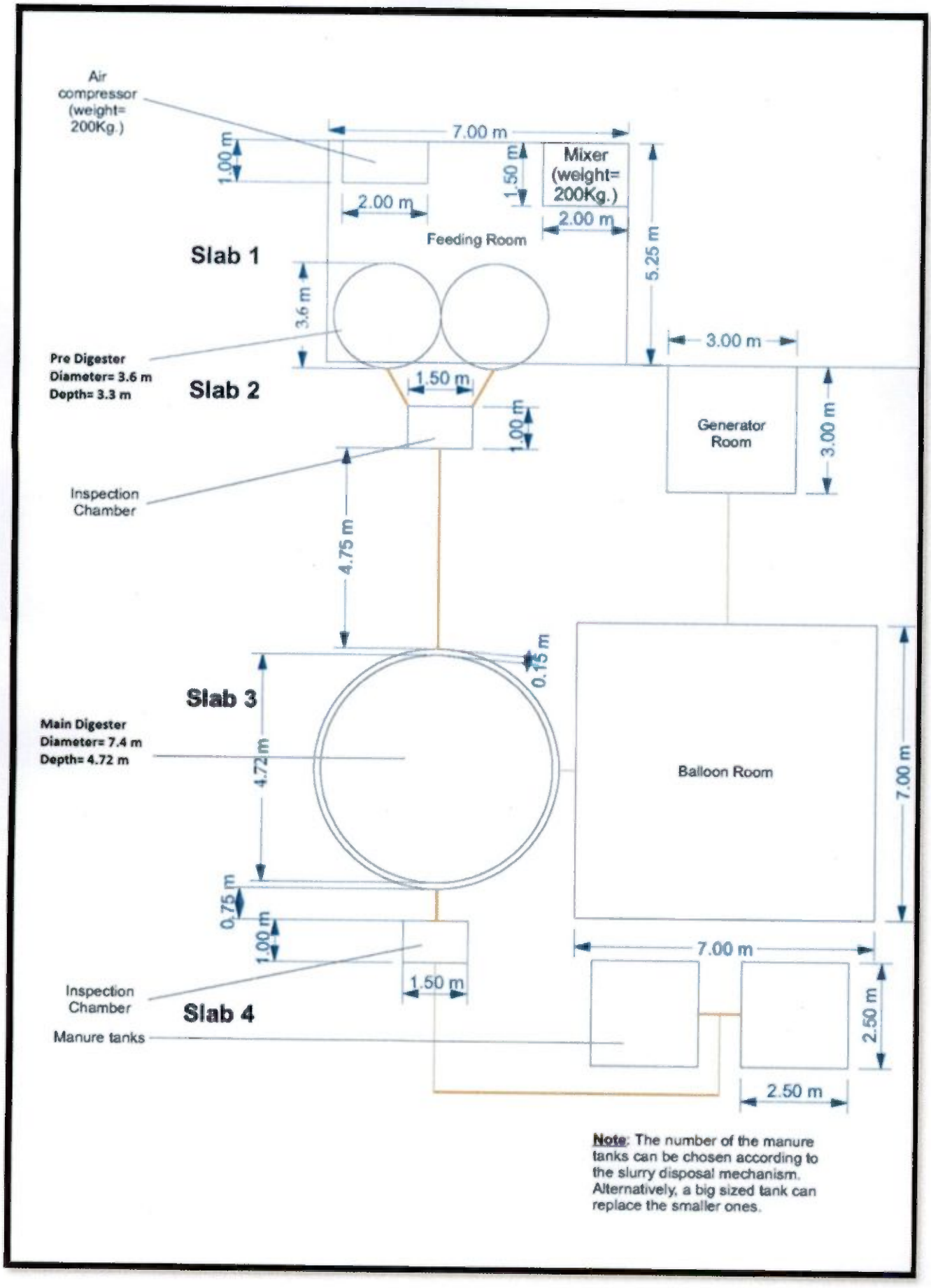
Proposed Layout

The Bio-Gas Plant at Ashoknagar-Kalyangarh-Habra Cluster Project Area

Total capacity to be provided at the site is 60 MT per day. This will be done by a combination of five 5 ton plants. This would provide a sufficient redundancy and flexibility to the operation with changing load with different seasons. The Bio-Gas Plant Facility at Ashoknagar-Kalyangarh-Habra will require an area availability of approximately 3600 sq.m, to handle a capacity of 60 MT of Biodegradable wastes, on daily basis as shown in figure below. Any additional available land can be used as a sorting facility.

Overall Arrangement of Twelve 5 MT Biogas Plants





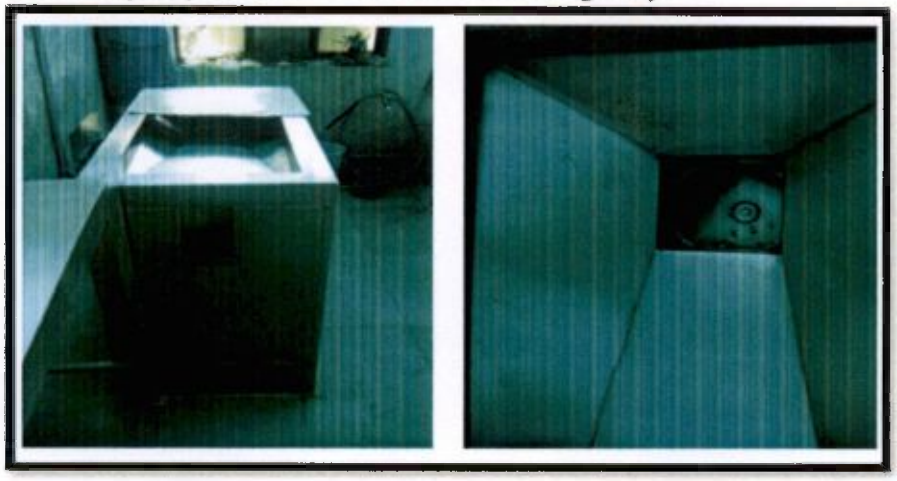
Proposed Biogas Plant Layout (each 5 MT Plant) for Ashoknagar-Kalyangarh-Habra Solid Waste Management

Components of Biogas Plant

Following are the major components will be installed at each of the SWM Facilities (Biogas Plants) in Ashoknagar-Kalyangarh-Habra Cluster is as shown in the figures below.

- A Mixer for crushing the solid waste

Here the organically rich bio-degradable portion of solid waste is mixed with recycled (depending on availability) and/or fresh water to form a uniform slurry. The water ratio needed for this technology is 1:1 i.e., for 100 kg of waste, 100L of water will be needed. All of the required water need not necessarily be fresh water; Recycled water from the plant and from Sewage treatment plants can also be used. It is important to maintain the ratio, as addition of excess amount of water can lead to washing away of culture, thereby ceasing the process. The microbial quality of water needs to be checked regularly.



A Typical Mixer for crushing Biodegradable Waste

- Thermophilic Aerobic Pre-Digester Tank

Each 5 MT Bio-Gas Plant will have two Aerobic Pre-Digesters. Each Pre-Digester will be 2500 mm in diameter and 4000 mm deep. The Pre-Digesters will be aerobic in nature as name suggested. The Pre-Digester will receive flow of oxygen through air supplied by compressor housed in the Mixing and Feeding Room. The slurry will be aerobically digested in the pre-digester, where organic matter is converted to organic acids. The pre-digestion is accelerated by addition of hot water and intermittent aeration. Predigestion reactions are exothermic and the temperature rises up to 40oC by itself. The main role of the bacteria is to digest proteins and low molecular weight carbohydrates to produce volatile fatty acids. The retention time in the pre-digester is 4 days. Before introducing the slurry in the Main Digesters, it will pass through 1500 mm x 2500 mm inspection chambers. The aeration grid in the chamber will be as shown in figure below.

A Typical Pre-Digester

- Air Compressor

The air compressor will be placed in the Mixing and Feeding Room. The pre- digester requires aerobic condition. To maintain aerobic conditions in the pre-digester aeration is given at regular intervals using a

compressor. Aeration not only supplies oxygen but also enhances the uniformity in the slurry and in-turn promotes proper digestion for further fermentation in the main digester.

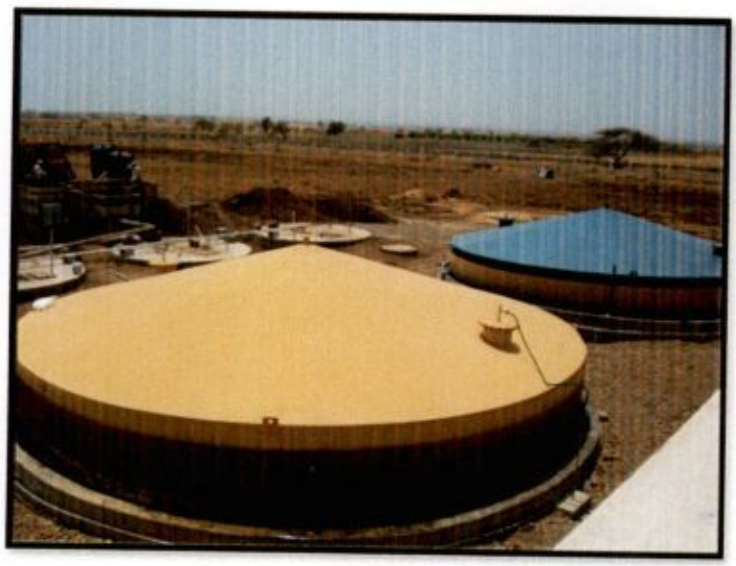
Typical Air Compressor

- Solar Unit for Hot Water

The Solar Power will be used for heating water which will be used for raising temperature in Aerobic Pre-Digester. Low temperatures arrest microbial growth and halt the process of bio-methanation.

- Main Digester tank

This is the heart of the Biogas Plant. There will be a main digester for each 5 MT Plant. The digester will be anaerobic in nature. The Main Digester will be 5400 mm in diameter and 6000 mm deep with floating roof. The predigested slurry will be further digested under anaerobic conditions for about 15 days. The process of methanogenesis takes place in this digester. Methane and carbon dioxide are the terminal products of this process. At this stage the organic acids are converted by consortium of methanogenic bacteria to methane and carbon dioxide which get collected in the dome above the main digester. The excess gas will be stored in a gas balloon as shown in the figure below. The undigested slurry will be transported to Manure Pits as explained below.



Typical Anaerobic Digester

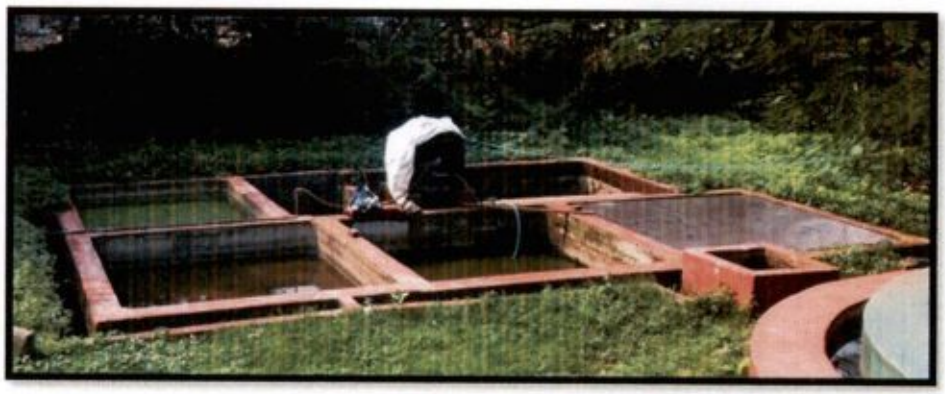
- Gas Holder/Gas Balloons

Balloons are required to store the gas produced, when the production is higher than the utilization, as this results in the gas escaping from the water seal.

A Typical Gas Balloon

- Manure pits

The undigested lignocelluloses and hemicelluloses that flow out of Main Digesters as high quality organic manure slurry. The pH of this slurry ranges from 7.5-8. Since the waste is processed at higher temperature, any weed seeds are killed completely and the manure becomes weed free. Depending upon the raw materials used and the conditions of digestion, this sludge contains many elements essential to plant life – Nitrogen, Phosphorous, Potassium plus small amount of salts (trace elements), indispensable for plant growth such as boron, calcium, copper, iron, magnesium, sulphur, zinc, etc. It is a good source of all the essential elements needed for restoring the fertility of the soil. The Manure Pits will be located on end of the 5 MT Biogas Plant as shown below.



A Typical Manure Pit

- Effluent water collection and recirculation system

The sludge flows out into the manure pits, the water separated here is recycled to the mixer for feeding. Hence brick/concrete tanks are used to store this water.

6.3.2 Technical Specifications of Bio-Gas Plant

Specifications of the Tanks & Pits

Table 3:

Specifications of the Tanks & Pits

S.No	Description	Nos	Dimensions	Volume of Each Tanks/Pits/ (cu.m.)	Total Volume of Tanks/Pits (cu.m.)
A	Primary Digester	2	3.6 m Dia x 3.3 m Deep	33.57	67.14
B	Main Digester	1	7.4 m Dia x 4.72 m Deep	202.90	202.90
C	Manure Pits	4 Cells	4.0 x 4.0 x 4.35	72	288
D	Outlet Chambers	2 Cells	2.050 x 8.0 x 1.65	12.38	24.79
E	Water Recycling Tank	1	: 5.95 x 2.7 x 1.75	28.11	28.11

Specifications of the Mechanical Equipment

Table 4:

Specifications of the Mechanical Equipment

S.No	Description	Specifications
A	Mechanical Mixer	7.5 HP/7 KW with double cutting arrangement
B	Compressor	3 HP/3 KW Phase 3 Fauji Make
C	Slurry Pump	3 HP/3 KW

As mentioned earlier, the following equipment will be installed at the plant:

Specifications of other Ancillary Items

Table 5:

Specifications of the Ancillary Items

S.No	Description	Specifications
A	Main Digester Gas Dome	4 mm M.S. Sheet with FRP coating
B	Gas Pipeline	GI pipe Class C
C	Air Compressor Grid in Pre-Digesters	GI Pipe Class C
D	Bio-gas Balloon/Bag for extra Gas Storage	Polyethylene Bags
E	Biogas Flame Arrestor	
F	Plumbing Accessories	Check Valves, Isolation Valves, Control Valves, etc
G	Shell & Tube Heat Exchangers	200 SS 304
H	Recycling Water Line	150 mm uPVC SH 40
I	Inspection Lids	Cast Iron
J	Burners	
K	Bucket Conveyor	
L	Solar Heater	
M	Small Incinerator for Non Recyclables	

Technology Comparison

The following technology options were considered as a solution for the solid waste management facility:

1. Scientific landfill for handling the entire solid waste generated.
2. Windrow and or Vermi Composting
3. Waste to Energy via Incineration
4. Waste to Energy via Syngas (Gasifier or Plasma Arc) process
5. Sorting followed by bio-gasification

The following table provides the summary of the comparison

Technology	Land Requirement	End Product	Viability
Scientific Landfill	High. Does not need sorting to function	Landfill gas at low rate for several years.	Will need substantial land and high capital cost to construct. The gas generation is gradual. Not viable primarily due to land constraints
Windrow or Vermi Compost	Moderate. Needs sorting to operate	Compost	Difficult to have all the compost consumed by the customers. A few days of lack of collection will lead to accumulation at the site. Uncertainty of feed quality will also cause reluctance among farmers to accept the final product. Limited viability.
Waste to Energy: Incineration	Moderate. But needs land for ash/residue disposal	Electricity	High moisture and low carbon in the waste makes the process very inefficient leading to very low electricity generation. Air pollution is also a major concern. The land requirement goes up due to the Requirement of ash dispoal within the premises. The capital cost is also very high. Not viable
Waste to Energy: Syn Gas	Moderate. Needs land for ash disposal	Electricity	High moisture and low carbon in the waste makes the process very inefficient leading to very low electricity generation. The land requirement goes up due to the Requirement of ash dispoal within the premises. The capital cost is also very high. Not viable
Bio-methanation after sorting	Relatively low. But needs sorting for functioning.	Biogas/Electricity and Organic Fertilizer	If sorting is done properly, the gas (and if converted to electricity) is viable end product. No end residue of the process other than the products. The cost is reasonable. Viable for these applications.

Based on above criteria Bio-methanation after sorting is hereby proposed.

Sustainability

The proposed biogas plant will generate Biogas and if needed electricity along with some organic fertilizer on a daily basis. Each of these components generate predictable revenue for the duration of the plant operation. The main product is biogas that can be easily used for cooking and other applications. That can generate a substantial revenue at the rate of Rs 30-60 per kg with a generation rate of 60 cubic meter of biogas per ton. In case the gas is converted to electricity, the state electricity board has to mandatorily purchase the electricity. The electricity generation rate is about 100 KWH per ton of solid waste. The organic waste also has a readily available market in the tea plantations or pineapple farms or other organic farming community. For every one ton of solid waste, about 60-80 kg of organic waste is generated and that can be sold for Rs 1 to 4 per kg. This revenue stream is reliable as the end product is easily transportable to the customers and has ready market. Therefore, once the plant is in operation, the plant can sustain its operation and maintenance cost purely based on the revenue. In reality, there will be some additional revenue also from recycle operation, but that is not being discussed in this section. Since biogas is a non-polluting gas, it is also environmental friendly and hence sustainable from this point of view also.

6.3.3 Disposal by Modified Sanitary Landfill (MSLF)

Total wastes to be disposed of in MSLF = (Non-Degradable Waste part of A, B, C, D & E category (of Table – 13) waste per day	49.54 MT
30% of projected (final year) waste generation	57.00 MT
Maximum of above two	57.00 MT
Approximate Vol. of Solid Waste to be at Landfill site per day	114.00 CUM
Vol. of Solid Waste to be disposed off per year	41040.00 CUM
Assuming 52% compaction, compacted Vol. of Solid Waste	19699.20 CUM
It is recommended that the disposal will be done above ground level (area landfill) Let us consider that the total depth of MSLF is 20 M above GL. Earth cover 30 CM.	
So, Area required for yearly dumping	999.96 SQM
For 15 years required area will be	14999.39 SQM
Considering change in habits, increase land requirement by 10%	16499.33 SQM
Add service area @ 10%	18149.26 SQM
or Area in Acres	4.48 Acres
Land requirement for Bio-gas plant	1.5 Acres
So, total land require for bio gas plant and sanitary landfill	5.98 Acres

The landfill site is to be operated in phases because it allows the progressive use of landfill area, such that at any given time a part of the site will have final cover, a part being actively field, a part being prepared to receive waste and a part is undisturbed.
Each phase is designed for a period of 12 months. Phases are to be filled from the base to the final /intermediate cover and capped within the period leaving a temporary un-restored sloping phase.

In this case Landfill site area required to be develop in 3 phases each phase will be used for 5 years period; so area required for 5 years	5000 SQM
Cell size to be provided Length :	50 Mtr
Width :	20 Mtr
Contact Surface Area :	7800 SQM
Adding 30% extra for 5 years dumping :	10140 SQM

Linear will be provided on the contact surface area of the cell of each phase before the commencement of landfill operation. The cost of construction of linear for each phase (for 5 years dumping) has therefore been considered in the project cost.

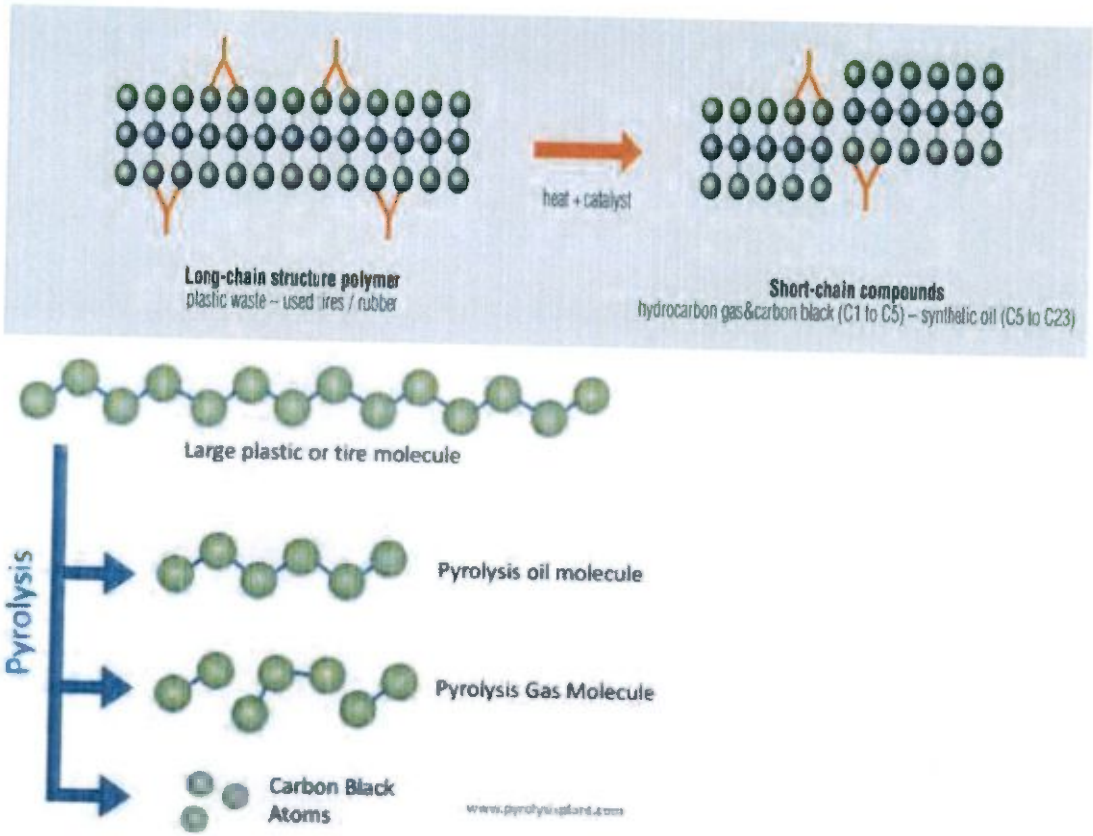
Plastic to Fuel Facility

Technology Proposed: Pyrolysis

Pyrolysis is a process of thermal degradation in the absence of Oxygen

- The plastic / rubber is pyrolized at 370 - 420 degrees centigrade and the pyrolysis gases are condensed in a series of condensers to get fuel oil.

- Alternately, the gases can be directly fed into the gas engines to produce Electricity



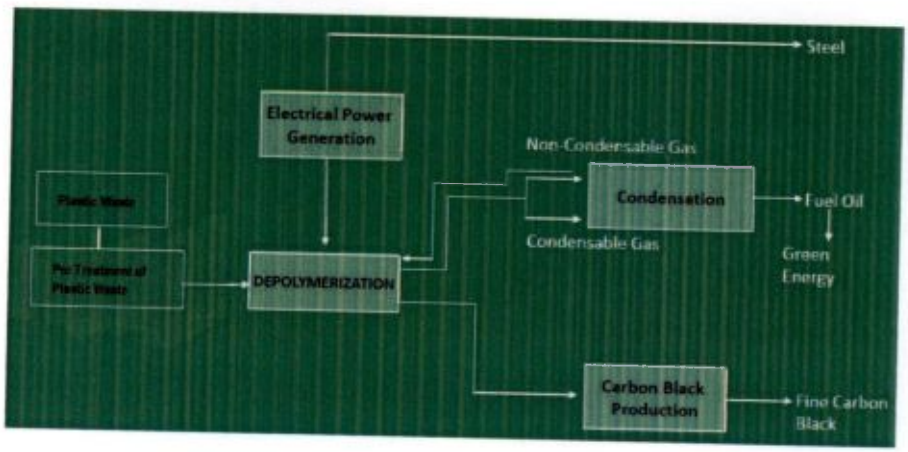
Brief Science of the Process

• De-polymerization is a decomposition or cracking of the material without the participation of oxygen.

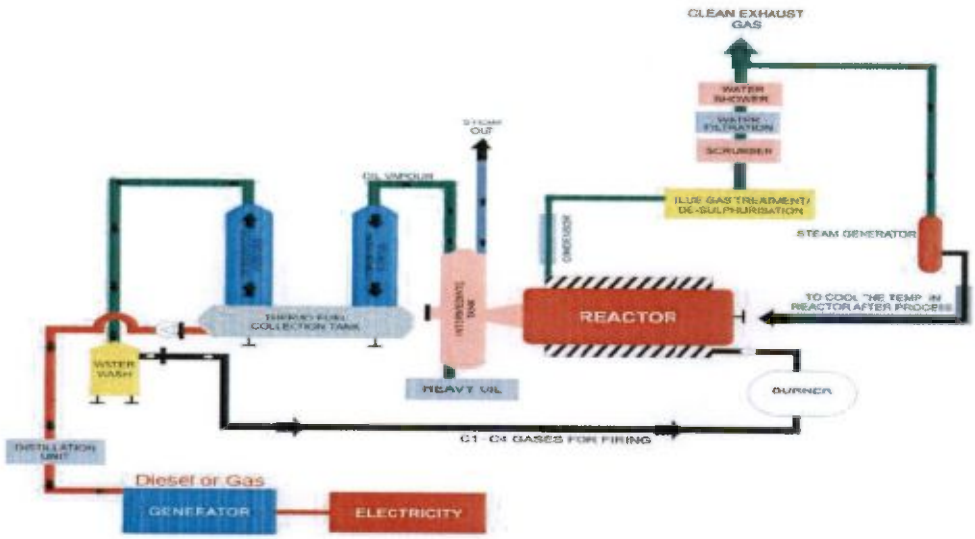
• Waste plastics are long chain Polymers containing more than 50,000 carbon atoms directly linked by the cross link or branched chains.

• Depolymerization decomposes the long chain to shorter chains to result in the byproducts.

Brief Schematic of the Process



Schematic of Oil Extraction Plant



Economics of the Project

Economics Based on Revenue Generation from Sorting of Recyclables

The Operation and Maintenance Cost and the Revenue Generation associated with Sorting and Sale of Recyclables are calculated and provided in the table below:

Table 6:

Economics for Sorting and Selling of Recyclables

Economics – Sorting and Sale of Recyclables	
Operation and Maintenance Cost per month	
Workers (150)	Rs. 1050,000
Supervisors (16)	Rs. 224,000
Safety Equipments and Additional Accessories	Rs. 80,000
Total O&M Cost per month	Rs. 13,54,000
Revenue Generation per day	
Sale of Recyclables (24 MT)	Rs. 1,92,000
Revenue generated per month	Rs. 57,60,000
Revenue generated per year	Rs. 6,91,20,000

N.B. – It was seen at the time of sampling that huge recyclables had been picked up by the rag pickers in the mid-way. Revenue generation from selling of recyclables will completely depend on the imposition of restriction to such practice.

Economics Based on Revenue Generation from Sorted Waste

The plant can have potentially two end products besides the organic fertilizer. It can generate biogas or it can generate electricity (using this gas in a generator). The economic viability of both the options is listed separately.

Revenue generated using biogas as the final product

The table below shows the Revenue generated where Biogas is the final product

Table 7:

Revenue Generation when Biogas is end product

Case I: End Product: Biogas		
Biogas Produced on Daily Basis:	1800	Kg
Revenue from Biogas sale	Rs. 30	per kg
Daily Revenue	Rs. 54,000	
Monthly Revenue	Rs. 16,20,000	
Annual Revenue	Rs 1,94,40,000	

Revenue generated using electricity as the final product

The table below shows the Payback analysis where Electricity is the final product

Table 8:

Revenue Generation when Electricity is end product

Case II: Electricity		
Plant Generator Rating	50 x 12= 600 (12 biogas plants)	Kw
Hours of Operation	10	hours per day
Energy Produced Daily	500 x 12 = 6000	KWH
Excess Electricity for Sell:	6000	KWH
Unit Price for Sell:	Rs. 5	per KWH
Daily Revenue	Rs. 30,000	
Monthly Revenue	Rs. 9,00,000	
Annual Revenue	Rs. 1,08,00,000	

Revenue Generation from Plastic Fuel

Fuel yielded for each MT of Plastic Waste	600 litres
Cost of each litre of Fuel	Rs. 25
Revenue generated per MT of plastic Waste	Rs. 15000
Revenue generation per Month	Rs. 4,50,000
Revenue generation per year	Rs. 54,00,000

** Besides the above revenue sources the city can gain some additional revenue from Organic Fertilizers. In several communities, with this type of systems, cities are selling this product to organic farmers and commercial crop growers. However, the proximity to tea plantations may prove to be a major factor for selling organic fertilizers. Based on experiences with the other system, if the city manages to identify appropriate customers it can generate revenue as shown below:

60 MT Waste generates around (10%) 6 MT or 6000 kg Organic Fertilizer

Rate of Organic Fertilizer= Rs. 3/kg

Revenue from Organic Manure= Rs. 18,000 per day.

Annual Revenue= Rs. 64,80,000

This additional revenue can be included to the above mentioned revenue alternatives, in case prospective buyers for organic manures are sourced.

From the tables above, we can easily project the Case I to be a more viable option. The table below presents the viability analysis for both the options.

Viability analysis for both the options considered

Parameters	Case I: Biogas as the end product	Case II: Electricity as the End Product
Buyers	Hotels, Restaurants, Hospitals, etc	Buyers are easily available and Electricity can be sold to the SEBs or can be used by the Municipality.
Transport and Supply	Biogas needs to be transported in specialized storage trucks, from source to site.	Electricity can be directed to the customers through Transmission Line
Plant Machineries at Source	Biogas can be extracted directly from the Gas Balloons. The Process is less complicated in comparison to Electricity Generation	On the other hand, for Electricity Generation, Generators, Gas Turbines and other accessories are required, along with transmission lines.
Operation and Maintenance	O &M Cost is lesser in comparison to Electricity Generation	The Generators depreciates with time. Thus more O & M Cost is involved
Economic Viability	It involves less Capital cost and yields greater revenue	Capital cost is more and revenue yield is 1/3 rd that of the previous option

Thus from the above table, Case I, that is Biogas as final product is found to be the more viable option. Thus, it is the selected option for the proposed SWM facility. Provisions are already proposed so that in the near future, electricity can be generated from the facility, whenever required.

Transportation and Selling of Generated Biogas

The proposed solution for collection of generated biogas from site and transporting it to the prospective buyers are as follows:

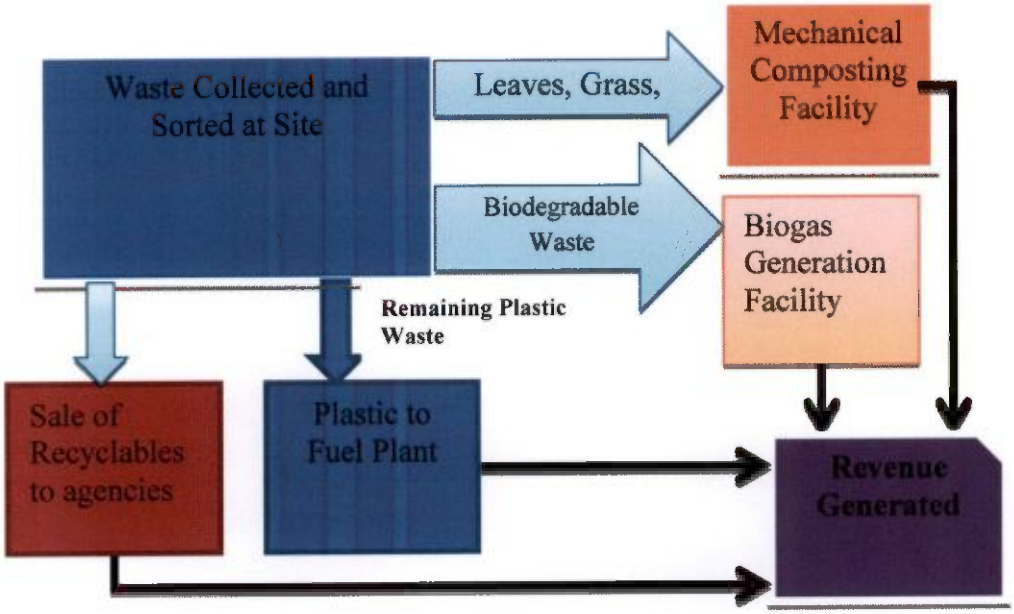
The Biogas is to be collected in Steel Bullets that are mounted on trucks and delivered to customers consuming commercial gas

This alternative will provide the following:

1. A truck mounted bullet with blower will fill up about 1 ton from the gas balloon
2. At start, it is projected that Ashoknagar-Kalyangarh and Habra will sell this gas to three commercial gas consumers. Initially, three bullets (one bullet at each customer site) will be setup. Each of these tanks will have a capacity to store about 1 ton of biogas.
3. The truck mounted tank will be filled up once every two weeks and a customer's tank will be filled up. The customer is responsible for receiving the gas into their kitchen and any other usage point
4. The purchaser will be sent a bill on a preset pricing structure.

Conclusion

The proposal intends to offer an integrated solution for Solid waste management for the Ashoknagar-Kalyangarh-Habra Cluster. The suggested alternative will create a regular sustainable solution in concern with "Zero Discharge" of waste along with generating electricity or Biogas, thereby generating revenue on a regular basis.



Two revenue streams have been discussed; one with electricity and the other with biogas as the end product. The revenue with the biogas option is substantially better than the electricity. However, the ease of portability and readily available customers make the electricity alternative an easier alternative.
The organic waste being generated (approximately 6 tons per day) also can be sold to the plantations and other entities interested in organic farming. The value for the organic waste has not been included in the payback analysis as the pricing for the end product is not clear for the surrounding market. However, once started, the project will certainly generate additional revenue from the fertilizer sales.

The overall cost including setting up the system for the at source sorting operation, transportation, processing, capping, and land-filling is Rs. 3232.20 Lakhs and the City will gain revenue from the Recyclables, Gas (or electricity), Fuel sales, Organic fertilizers etc.

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Basic Ward wise Information : ASHOKNAGAR-KALYANGARH MUNICIPALITY

Annexure I

Ward No.	Area (sq. km.)	No.of Holdings	Population (2011)	Daily & Wholesale Market		Commercial centres		Hotels		Hospitals		Domestic Waste Collection System Followed	Market/ Commercial Waste Collection System Followed	Distance from the Dumping Ground (in Km.)
				No.	Appr. Quantity of Waste Generated (in mt)	No.	Appr. Quantity of Waste Generated (in mt)	No.	Total No.of Beds	No.	Total No.of Beds			
1	6.83	1184	5714	1	0.2							Community Bin Collection	Vat Collection	8
2	1.30	1403	6514											7
3	0.47	872	4342	1	0.4									7
4	0.68	959	4451	2	0.5									6
5	1.22	1082	5559	1	0.41									7
6	1.18	1574	6918	1	0.42					1	50			5
7	0.42	1095	3885	1	1.03									4
8	0.45	999	4409											6
9	0.84	523	5978	2	0.42									5
10	0.53	1240	4672	1	0.31	1	0.78							4
11	0.59	1371	5757	1	1.5									4
12	0.49	1042	3629	1	0.4					1	10			4
13	0.93	1504	7303	1	0.25									4
14	0.49	931	3209	1	0.5									3
15	0.970	1244	5457											3
16	0.450	967	3478											3
17	0.530	1464	6670			1	0.8							4
18	0.420	936	3614	1	0.22					1	30			5
19	0.600	1411	5123	2	1.55					1	10			5
20	0.280	890	4896	1	0.2									6
21	1.000	1320	6245	1	0.31									7
22	2.730	1421	8376	1	0.2									7
23	6.830	1978	5713	1	0.24									8
Total	**20.64**	**27410**	**121912**	**21**	**9.06**	**2**	**1.58**	**0**	**0**	**4**	**100**			

Basic Ward wise Information : HABRA MUNICIPALITY

Annexure IA

Ward No.	Area (sq. km.)	No.of Holdings	Population (2011)	Daily & Wholesale Market		Commercial centres		Hotels		Hospitals		Domestic Waste Collection System Followed	Market/ Commercial Waste Collection System Followed	Distance from the Dumping Ground (in Km.)
				No.	Appr. Quantity of Waste Generated (in mt)	No.	Appr. Quantity of Waste Generated (in mt)	No.	Total No.of Beds	No.	Total No.of Beds			
1	1.200	2075	8972			1	2					Community Bin Collection	Vat Collection	2
2	0.720	1288	4586	1	2									1.5
3	1.320	1255	8489											1
4	0.708	993	4557											1
5	0.611	1410	6074											0.5
6	0.780	2172	6599	2	2.5	1	1.2							1
7	0.582	1230	4763	3	7									1
8	0.820	1722	5943	1	2					1	131			1.5
9	0.912	2413	5167	2	1.35	1	0.5							2
10	1.080	817	7275	1	2									2.5
11	1.108	1739	5471	1	1									2.5
12	1.123	1556	3766	1	1.3									3
13	0.553	957	6563	1	2									3
14	0.854	1463	6317											2
15	0.876	1573	7017	1	1.5									2.5
16	0.890	1202	6008	1	2.25									3.5
17	1.123	1731	6747	2	1.2									4
18	1.309	2058	8024	1	1.55									3
19	0.820	1458	4710	2	2.25									2
20	0.811	929	5482	2	1									1.5
21	0.880	1378	7280	1	1.25									1.5
22	0.795	1150	6002	1	1									2
23	0.720	706	6420	2	0.85									3
24	1.205	1140	4989			1	2.9							
Total	**21.80**	**34415**	**147221**	**26**	**34**	**4**	**6.6**	**0**	**0**	**1**	**131**			

Ashoknagar-Kalyangarh Municipality

Annexure - II

Wardwise Population as per Census Year - 2011	
Ward No.	**Population**
1	5714
2	6514
3	4342
4	4451
5	5559
6	6918
7	3885
8	4409
9	5978
10	4672
11	5757
12	3629
13	7303
14	3209
15	5457
16	3478
17	6670
18	3614
19	5123
20	4896
21	6245
22	8376
23	5713
Total	**121912**

Ashoknagar-Kalyangarh Municipality

Annexure - IIA

Zonewise Population as per Census Year - 2011		
Zone No.	**Ward Nos.**	**2011**
I	1, 2, 3 & 23	22283
II	4, 5, 6, 7 & 8	25222
III	9, 10, 11, 16, 17 & 18(P)	27625
IV	12, 13, 14, 15 & 22(P)	25188
V	18(P), 19, 20, 21 & 22(P)	21594
Total		**121912**

Ashoknagar-Kalyangarh Municipality

Annexure - IIB

Growth Trend			
Arithmatic Increase Method			
Sl. No.	Year	Population	Increase in Population
	(1)	(2)	(3)
1	1981	54455	
			42292
2	1991	96747	
			14728
3	2001	111475	
			10437
4	2011	121912	
	Total		67457

$$\text{Average increase per decade (x)} = \frac{\text{Total increase in population}}{\text{Number of decades}}$$

Hence, X = 67457 / 3

= 22486

Therefore, average rate of increase per decade with respect to population in the year of 2011,

x = 18.45 %

Ashoknagar-Kalyangarh Municipality

Annexure - IIC

Growth Trend				
Geometric Increase Method				
Sl. No.	Year	Population	Increase in Population	Percentage increase in population i.e. growth rate (r)
	(1)	(2)	(3)	(4) = Co. (3)/ Col. (1) x 100
1	1981	54455		
			42292	42292/ 54455 x 100 = 77.66 %
2	1991	96747		
			14728	14728/ 96747 x 100 = 15.22 %
3	2001	111475		
			10437	10437/ 111475 x 100 = 9.36 %
4	2011	121912		

The geometric mean of the growth rate (r) = $(n-1)^{th}$ root of the multiplication of all 'r's

= (77.66 x 15.22 x 9.36 x) ^ 1/3

= 21.60

Ashoknagar-Kalyangarh Municipality

Annexure - IID

Growth Trend				
Incremental Increase Method				
Sl. No.	Year	Population	Increase in Population in each decade	Incremental Increase i.e. increment on the increase
	(1)	(2)	(3)	(4)
1	1981	54455		
2	1991	96747	42292	-27564
3	2001	111475	14728	-4291
4	2011	121912	10437	
		Total =	67457	-31855

Average increase per decade (X) = 22486

and average of incremental increases (Y) = -15928

Therefore, average rate of increase per decade with respect to population in the year of 2011,

x = 18.45 %

and average rate of incremental increase per decade with respect to population in the year of 2011,

y = -13.06 %

Ashoknagar-Kalyangarh Municipality

Annexure - IIE

Computation of n values for different design years

Last known year	Future Year		Difference in years	Difference in decades (n)
(1)	(2)	(3)	(4)	(5) = Col. (4)/ 10
2011	Base year	2018	7	0.7
2011	Intermediate year	2028	17	1.7
2011	Final year	2038	27	2.7

Computation of zonewise Projected Population in different design years

Population in last known census year (P_o) (2011)			Arithmetic Increase Method				Geometric Mean Method				Incremental Increase Method			
			x(%)	$P_n = P_0(1+\frac{n.x}{100})$			r(%)	$P_n = P_0(1+\frac{r}{100})^n$			x(%)	$P_n = P_0\{1+\frac{nx}{100}+n(n+1).\frac{y}{100x2}\}$		
Zone No.	Year	P_o(2011)		Base Year	Intermediate Year	Final Year		Base Year	Intermediate Year	Final Year		Base Year	Intermediate Year	Final Year
				2018	2028	2038		2018	2028	2038		2018	2028	2038
I	2011	22283	0.00	22283	22283	22283	0.00	22283	22283	22283	0.00	24730	31719	42819
II		25222		25222	25222	25222		25222	25222	25222		27991	35902	48467
III		27625		27625	27625	27625		27625	27625	27625	y(%)	30658	39323	53084
IV		25188		25188	25188	25188		25188	25188	25188	18.45	27954	35854	48401
V		21594		21594	21594	21594		21594	21594	21594		23965	30738	41495
Total		121912		121912	121912	121912		121912	121912	121912		135298	173536	234266

Ashoknagar-Kalyangarh Municipality

Annexure - IIF

Computation of Design Population in different zones for different Design Years

Methods	Zone - I			Zone - II			Zone - III			Zone - IV			Zone - V		
	Base Year	Inter Year	Final Year	Base Year	Inter Year	Final Year	Base Year	Inter Year	Final Year	Base Year	Inter Year	Final Year	Base Year	Inter Year	Final Year
	2018	2028	2038	2018	2028	2038	2018	2028	2038	2018	2028	2038	2018	2028	2038
Arithmetic Increase Method	22283	22283	22283	25222	25222	25222	27625	27625	27625	25188	25188	25188	21594	21594	21594
Geometric Mean Method	22283	22283	22283	25222	25222	25222	27625	27625	27625	25188	25188	25188	21594	21594	21594
Incremental Increase Method	24730	31719	42819	27991	35902	48467	30658	39323	53084	27954	35854	48401	23965	30738	41495
Average of the three Methods	23099	25429	29129	26145	28782	32971	28636	31525	36112	26110	28744	32926	22385	24642	28228

Total Design Population of the Town:

Base Year	:	**126375**
Intermediate Year	:	**139122**
Final Year	:	**159366**

HABRA MUNICIPALITY

Annexure - II G

Wardwise Population as per Census Year - 2011			
Ward No.	**Population (Nos.)**	**House Holds (Nos.)**	**Area (Sq. Km.)**
1	8972	2075	1.2
2	4586	1288	0.72
3	8489	1255	1.32
4	4557	993	0.708
5	6074	1410	0.611
6	6599	2172	0.78
7	4763	1230	0.582
8	5943	1722	0.82
9	5167	2413	0.912
10	7275	817	1.08
11	5471	1739	1.108
12	3766	1556	1.123
13	6563	957	0.553
14	6317	1463	0.854
15	7017	1573	0.876
16	6008	1202	0.89
17	6747	1731	1.123
18	8024	2058	1.309
19	4710	1458	0.82
20	5482	929	0.811
21	7280	1378	0.88
22	6002	1150	0.795
23	6420	706	0.72
24	4989	1140	1.205
Total	**147221**	**34415**	**21.8**

HABRA MUNICIPALITY

Annexure - II H

Zonewise Population as per Census Year - 2011				
Zone No.	**Ward Nos.**	**Population (Nos.)**	**House Holds (Nos.)**	**Area (Sqm.)**
A	1, 2, 3, 4	26604	5611	3.95
B	5, 6, 7	17436	4812	1.97
C	8, 9, 10, 11 & 12	27622	8247	5.04
D	13, 14, 15, 16	25905	5195	3.17
E	17, 18, 19, 20	24963	6176	4.06
F	21, 22, 23, 24	24691	4374	3.60
Total		**147221**	**34415**	**21.80**

HABRA MUNICIPALITY

Annexure - II I

Growth Trend			
Arithmatic Increase Method			
Sl. No.	Year	Population	Increase in Population
	(1)	(2)	(3)
1	1981	74434	
			25789
2	1991	100223	
			27472
3	2001	127695	
			19526
4	2011	147221	
	Total		72787

$$\text{Average increase per decade (x)} = \frac{\text{Total increase in population}}{\text{Number of decades}}$$

Hence, X = 72787 / 3

= 24262

Therefore, average rate of increase per decade with respect to population in the year of 2011,

x = 16.49 %

HABRA MUNICIPALITY

Annexure - II J

Growth Trend				
Geometric Increase Method				
Sl. No.	Year	Population	Increase in Population	Percentage increase in population i.e. growth rate (r)
	(1)	(2)	(3)	(4) = Co. (3)/ Col. (1) x 100
1	1981	74434		
			25789	25789/ 74434 x 100 = 34.65 %
2	1991	100223		
			27472	27472/ 100223 x 100 = 27.41 %
3	2001	127695		
			19526	19526/ 127695 x 100 = 15.29 %
4	2011	147221		

The geometric mean of the growth rate (r) = $(n-1)^{th}$ root of the multiplication of all 'r's

= (34.65 x 27.41 x 15.29) ^ 1/3

= 23.63

HABRA MUNICIPALITY

Annexure - II K

Growth Trend				
Incremental Increase Method				
Sl. No.	Year	Population	Increase in Population in each decade	Incremental Increase i.e. increment on the increase
	(1)	(2)	(3)	(4)
1	1981	74434		
			25789	
2	1991	100223		1683
			27472	
3	2001	127695		-7946
			19526	
4	2011	147221		
Total =			72787	-6263

Average increase per decade (X) = 24262

and average of incremental increases (Y) = -3131.5

Therefore, average rate of increase per decade with respect to population in the year of 2011,

x = 16.49 %

and average rate of incremental increase per decade with respect to population in the year of 2011,

y = -2.13 %

Habra Municipality

Annexure - II M

Annexure - II L

Computation of n values for different design years

Last known year	Future Year		Difference in years	Difference in decades (n)
(1)	(2)	(3)	(4)	(5) = Col. (4)/ 10
2011	Base year	2018	7	0.7
2011	Intermediate year	2028	17	1.7
2011	Final year	2038	27	2.7

Computation of zonewise Projected Population in different design years

Population in last known census year (P_0) (2011)			Arithmetic Increase Method				Geometric Mean Method				Incremental Increase Method			
			x(%)	$P_n = P_0(1+\frac{n.x}{100})$			r (%)	$P_n = P_0(1+\frac{r}{100})^n$			x(%)	$P_n = P_0\{1+\frac{nx}{100}+n(n+1).\frac{y}{100x2}\}$		
Zone No.	Year	P_0 (2011)		Base Year	Intermediate Year	Final Year		Base Year	Intermediate Year	Final Year		Base Year	Intermediate Year	Final Year
				2018	2028	2038		2018	2028	2038	16.49	2018	2028	2038
A		26604		29675	34062	38449		30863	38156	47172		29339	32764	35623
B		17436		19449	22324	25200		20228	25007	30916	y(%)	19228	21473	23347
C		27622		30811	35366	39921		32044	39616	48977		30461	34017	36986
D		25905	16.49	28896	33167	37439	23.63	30052	37154	45933		28568	31903	34687
E		24963		27845	31961	36078		28959	35803	44263	-2.13	27529	30743	33426
F		24691		27542	31613	35685		28644	35412	43780		27229	30408	33061
Total		147221		164218	188493	212772		170790	211148	261041		162354	181308	197130

Habra Municipality

Annexure - II M

Zone No.	Population (2011)	Design Population (Average of three methods)		
		Base Year	Intermediate Year	Final Year
		2018	2028	2038
A	26604	29959	34994	40415
B	17436	19635	22935	26488
C	27622	31105	36333	41961
D	25905	29172	34075	39353
E	24963	28111	32836	37922
F	24691	27805	32478	37509
Total	**147221**	**165787**	**193650**	**223648**

Annexure - N

Projected waste generation			
Year	Projected Population	Projected waste generation as per Manual in MT	Projected waste generation considering present rate of the town in MT i.e. @0.49 kg/C/D
1	2	3	4
Base Year 2018	292162	61	143
Intermediate Year 2028	332772	70	163
Final Year 2038	383014	80	188

Conclusions:

1. As there are huge gap between manual provision and actual data collected from ULB(s) with respect to total generation of waste, the basic design is proposed considering present estimated genaration i.e.131 MT/Day except provision for sanitery land fill.
2. As the Bio gas plants are designed in modular manner hence another one or more module can be added as & when required. Provision of land for future expansion is earmarked.
3. Land for sanitery land fill is to be calculated on the basis of Final year generation of column 4 i.e. 30% of 188MT

Table 3.1 Quantity of Municipal Solid Waste in Indian Urban Centres

Population Range (in Millions)	Number of Urban Centres (sampled)	Total population (in Million)	Average per capita value (kg/capita/day)	quantity (tonnes/day)
< 0.1	328	68.3	0.21	14343.00
0.1 - 0.5	255	56.914	0.21	11952.00
0.5 - 2.0	31	21.729	0.25	5432.00
1.0 - 2.0	14	17.184	0.27	4640.00
2.0 - 5.0	6	20.597	0.35	7209.00
> 5. 0	3	26.306	0.50*	13153.00

* 0.6 kg/capita/day generation of MSW has been observed in metro cities

Source: Manual on MSW Management 2000

Domestic Waste: ASHOKNAGAR-KALYANGARH MUNICIPALITY

Table - 10

Ward No.	Distance from the Dumping site (in KM.)	No. of Holdings	Population	Domestic Waste generate (in Kg.)	No. of Container (20 lit.) required	No. of Tyre-Mounted Wheel Barrow Required	Remarks
1	8	1184	5714	1571	118	24	In areas where house to house collection by wheel barrow will not be possible, combination of collection in community bin system and house to house collection by Wheel Barrow shall have to be adopted. Capacity of Community Bins - 200 lit.
2	7	1403	6514	1791	140	28	
3	7	872	4342	1194	87	17	
4	6	959	4451	1224	96	19	
5	7	1082	5559	1529	108	22	
6	5	1574	6918	1902	157	31	
7	4	1095	3885	1068	110	22	
8	6	999	4409	1212	100	20	
9	5	523	5978	1644	52	10	
10	4	1240	4672	1285	124	25	
11	4	1371	5757	1583	137	27	
12	4	1042	3629	998	104	21	
13	4	1504	7303	2008	150	30	
14	3	931	3209	882	93	19	
15	3	1244	5457	1501	124	25	
16	3	967	3478	956	97	19	
17	4	1464	6670	1834	146	29	
18	5	936	3614	994	94	19	
19	5	1411	5123	1409	141	28	
20	6	890	4896	1346	89	18	
21	7	1320	6245	1717	132	26	
22	7	1421	8376	2303	142	28	
23	8	1978	5713	1571	198	40	
TOTAL		**27410**	**121912**	**33526**	**2739**	**547**	

1 wheel barrow will covered about 50 to 75 holdings

Domestic Waste: HABRA MUNICIPALITY

Table - 10A

Ward No.	Distance from the Dumping site (in KM.)	No. of Holdings	Population	Domestic Waste generate (in Kg.)	No. of Container (20 lit.) required	No. of Tyre-Mounted Wheel Barrow Required	Remarks
1	2	2075	8972	2467	208	42	In areas where house to house collection by wheel barrow will not be possible, combination of collection in community bin system and house to house collection by Wheel Barrow shall have to be adopted. Capacity of Community Bins - 200 lit.
2	1.5	1288	4586	1261	129	26	
3	1	1255	8489	2334	126	25	
4	1	993	4557	1253	99	20	
5	0.5	1410	6074	1670	141	28	
6	1	2172	6599	1815	217	43	
7	1	1230	4763	1310	123	25	
8	1.5	1722	5943	1634	172	34	
9	2	2413	5167	1421	241	48	
10	2.5	817	7275	2001	82	16	
11	2.5	1739	5471	1505	174	35	
12	3	1556	3766	1036	156	31	
13	3	957	6563	1805	96	19	
14	2	1463	6317	1737	146	29	
15	2.5	1573	7017	1930	157	31	
16	3.5	1202	6008	1652	120	24	
17	4	1731	6747	1855	173	35	
18	3	2058	8024	2207	206	41	
19	2	1458	4710	1295	146	29	
20	1.5	929	5482	1508	93	19	
21	1.5	1378	7280	2002	138	28	
22	2	1150	6002	1651	115	23	
23	3	706	6420	1766	71	14	
24	0	1140	4989	1372	114	23	
TOTAL		**34415**	**147221**	**40486**	**3443**	**688**	

1 wheel barrow will covered about 50 to 75 holdings

Trade Waste : ASHOKNAGAR-KALYANGARH MUNICIPALITY

Table -11

Ward No.	Area (sq. km.)	No.of Holdings	Population	Daily & Wholesale Market		Commercial centres		Hotels			Total Quantity of Waste Generated (MT)	Distance from the Dumping Ground (in Km.)
				No.	Appr. Quantity of Waste Generated (MT)	No.	Appr. Quantity of Waste Generated (MT)	No.	Total No. of Beds	Total . Quantity of Waste Generated (MT)		
1	6.83	1184	5714	1	0.2	0	0	0	0	0	0.20	8
2	1.30	1403	6514	0	0	0	0	0	0	0	0.00	7
3	0.47	872	4342	1	0.4	0	0	0	0	0	0.40	7
4	0.68	959	4451	2	0.5	0	0	0	0	0	0.50	6
5	1.22	1082	5559	1	0.41	0	0	0	0	0	0.41	7
6	1.18	1574	6918	1	0.42	0	0	0	0	0	0.42	5
7	0.42	1095	3885	1	1.03	0	0	0	0	0	1.03	4
8	0.45	999	4409	0	0	0	0	0	0	0	0.00	6
9	0.84	523	5978	2	0.42	0	0	0	0	0	0.42	5
10	0.53	1240	4672	1	0.31	1	0.78	0	0	0	1.09	4
11	0.59	1371	5757	1	1.5	0	0	0	0	0	1.50	4
12	0.49	1042	3629	1	0.4	0	0	0	0	0	0.40	4
13	0.93	1504	7303	1	0.25	0	0	0	0	0	0.25	4
14	0.49	931	3209	1	0.5	0	0	0	0	0	0.50	3
15	0.97	1244	5457	0	0	0	0	0	0	0	0.00	3
16	0.45	967	3478	0	0	0	0	0	0	0	0.00	3
17	0.53	1464	6670	0	0	1	0.8	0	0	0	0.80	4
18	0.42	936	3614	1	0.22	0	0	0	0	0	0.22	5
19	0.6	1411	5123	2	1.55	0	0	0	0	0	1.55	5
20	0.28	890	4896	1	0.2	0	0	0	0	0	0.20	6
21	1	1320	6245	1	0.31	0	0	0	0	0	0.31	7
22	2.73	1421	8376	1	0.2	0	0	0	0	0	0.20	7
23	6.83	1978	5713	1	0.24	0	0	0	0	0	0.24	8
24	0	0	0	0	0	0	0	0	0	0	0.00	0
TOTAL	**20.64**	**27410**	**121912**	**21**	**9.1**	**2**	**1.6**	**0**	**0**	**0**	**10.64**	

Trade Waste : HABRA MUNICIPALITY

Table -11A

Ward No.	Area (sq. km.)	No.of Holdings	Population	Daily & Wholesale Market		Commercial centres		Hotels			Total Quantity of Waste Generated (MT)	Distance from the Dumping Ground (in Km.)
				No.	Appr. Quantity of Waste Generated (MT)	No.	Appr. Quantity of Waste Generated (MT)	No.	Total No. of Beds	Total . Quantity of Waste Generated (MT)		
1	1.2	2075	8972	0	0	1	2	0	0	0	2.00	2
2	0.72	1288	4586	1	2	0	0	0	0	0	2.00	1.5
3	1.32	1255	8489	0	0	0	0	0	0	0	0.00	1
4	0.708	993	4557	0	0	0	0	0	0	0	0.00	1
5	0.611	1410	6074	0	0	0	0	0	0	0	0.00	0.5
6	0.78	2172	6599	2	2.5	1	1.2	0	0	0	3.70	1
7	0.582	1230	4763	3	7	0	0	0	0	0	7.00	1
8	0.82	1722	5943	1	2	0	0	0	0	0	2.00	1.5
9	0.912	2413	5167	2	1.35	1	0.5	0	0	0	1.85	2
10	1.08	817	7275	1	2	0	0	0	0	0	2.00	2.5
11	1.108	1739	5471	1	1	0	0	0	0	0	1.00	2.5
12	1.123	1556	3766	1	1.3	0	0	0	0	0	1.30	3
13	0.553	957	6563	1	2	0	0	0	0	0	2.00	3
14	0.854	1463	6317	0	0	0	0	0	0	0	0.00	2
15	0.876	1573	7017	1	1.5	0	0	0	0	0	1.50	2.5
16	0.89	1202	6008	1	2.25	0	0	0	0	0	2.25	3.5
17	1.123	1731	6747	2	1.2	0	0	0	0	0	1.20	4
18	1.309	2058	8024	1	1.55	0	0	0	0	0	1.55	3
19	0.82	1458	4710	2	2.25	0	0	0	0	0	2.25	2
20	0.811	929	5482	2	1	0	0	0	0	0	1.00	1.5
21	0.88	1378	7280	1	1.25	0	0	0	0	0	1.25	1.5
22	0.795	1150	6002	1	1	0	0	0	0	0	1.00	2
23	0.72	706	6420	2	0.85	0	0	0	0	0	0.85	3
24	1.205	1140	4989	0	0	1	2.9	0	0	0	2.90	0
TOTAL	**21.8**	**34415**	**147221**	**26**	**34.0**	**4**	**6.6**	**0**	**0**	**0**	**40.6**	

Clinical Waste : ASHOKNAGAR-KALYANGARH MUNICIPALITY

Table - 12

Ward No.	Area (sq. km.)	No.of Holdings	Population	Hospitals		Total Quantity of Clinic Waste Generated Daily (MT)	Total Quantity of infectious & hazardous Waste Generated Daily (MT)	Total Quantity of non-hazardous Waste Generated Daily (MT)	Total Quantity of hazardous & infectious Clinic Waste Generated in three days (MT)	Distance from the Dumping Ground (in Km.)
				No.	Total No. of Beds					
1	6.83	1184	5714	0	0	0.00	0.00	0.00	0.00	8
2	1.30	1403	6514	0	0	0.00	0.00	0.00	0.00	7
3	0.47	872	4342	0	0	0.00	0.00	0.00	0.00	7
4	0.68	959	4451	0	0	0.00	0.00	0.00	0.00	6
5	1.22	1082	5559	0	0	0.00	0.00	0.00	0.00	7
6	1.18	1574	6918	1	50	0.08	0.02	0.06	0.06	5
7	0.42	1095	3885	0	0	0.00	0.00	0.00	0.00	4
8	0.45	999	4409	0	0	0.00	0.00	0.00	0.00	6
9	0.84	523	5978	0	0	0.00	0.00	0.00	0.00	5
10	0.53	1240	4672	0	0	0.00	0.00	0.00	0.00	4
11	0.59	1371	5757	0	0	0.00	0.00	0.00	0.00	4
12	0.49	1042	3629	1	10	0.02	0.00	0.01	0.01	4
13	0.93	1504	7303	0	0	0.00	0.00	0.00	0.00	4
14	0.49	931	3209	0	0	0.00	0.00	0.00	0.00	3
15	0.97	1244	5457	0	0	0.00	0.00	0.00	0.00	3
16	0.45	967	3478	0	0	0.00	0.00	0.00	0.00	3
17	0.53	1464	6670	0	0	0.00	0.00	0.00	0.00	4
18	0.42	936	3614	1	30	0.05	0.01	0.03	0.03	5
19	0.6	1411	5123	1	10	0.02	0.00	0.01	0.01	5
20	0.28	890	4896	0	0	0.00	0.00	0.00	0.00	6
21	1	1320	6245	0	0	0.00	0.00	0.00	0.00	7
22	2.73	1421	8376	0	0	0.00	0.00	0.00	0.00	7
23	6.83	1978	5713	0	0	0.00	0.00	0.00	0.00	8
24	0	0	0	0	0	0.00	0.00	0.00	0.00	0
TOTAL	**20.64**	**27410**	**121912**	**5**	**100**	**0.15**	**0.04**	**0.11**	**0.11**	

There are 15 Nos. Private Clinic, 55 nos. Pathological Laboratories. Total quantity of waste generated from those establishment will be about 100 kg.

Note: i) Assumed that Clinical Waste generated @ 1500 gm per bed. ii) 25 % of the Clinical Waste generated is infectious in nature

Clinical Waste : HABRA MUNICIPALITY

Table - 12A

Ward No.	Area (sq. km.)	No.of Holdings	Population	Hospitals		Total Quantity of Clinic Waste Generated Daily (MT)	Total Quantity of infectious & hazardous Waste Generated Daily (MT)	Total Quantity of non-hazardous Waste Generated Daily (MT)	Total Quantity of hazardous & infectious Clinic Waste Generated in three days (MT)	Distance from the Dumping Ground (in Km.)
				No.	Total No. of Beds					
1	1.2	2075	8972	0	0	0.00	0.00	0.00	0.00	2
2	0.72	1288	4586	0	0	0.00	0.00	0.00	0.00	1.5
3	1.32	1255	8489	0	0	0.00	0.00	0.00	0.00	1
4	0.708	993	4557	0	0	0.00	0.00	0.00	0.00	1
5	0.611	1410	6074	0	0	0.00	0.00	0.00	0.00	0.5
6	0.78	2172	6599	0	0	0.00	0.00	0.00	0.00	1
7	0.582	1230	4763	0	0	0.00	0.00	0.00	0.00	1
8	0.82	1722	5943	1	131	0.20	0.05	0.15	0.15	1.5
9	0.912	2413	5167	0	0	0.00	0.00	0.00	0.00	2
10	1.08	817	7275	0	0	0.00	0.00	0.00	0.00	2.5
11	1.108	1739	5471	0	0	0.00	0.00	0.00	0.00	2.5
12	1.123	1556	3766	0	0	0.00	0.00	0.00	0.00	3
13	0.553	957	6563	0	0	0.00	0.00	0.00	0.00	3
14	0.854	1463	6317	0	0	0.00	0.00	0.00	0.00	2
15	0.876	1573	7017	0	0	0.00	0.00	0.00	0.00	2.5
16	0.89	1202	6008	0	0	0.00	0.00	0.00	0.00	3.5
17	1.123	1731	6747	0	0	0.00	0.00	0.00	0.00	4
18	1.309	2058	8024	0	0	0.00	0.00	0.00	0.00	3
19	0.82	1458	4710	0	0	0.00	0.00	0.00	0.00	2
20	0.811	929	5482	0	0	0.00	0.00	0.00	0.00	1.5
21	0.88	1378	7280	0	0	0.00	0.00	0.00	0.00	1.5
22	0.795	1150	6002	0	0	0.00	0.00	0.00	0.00	2
23	0.72	706	6420	0	0	0.00	0.00	0.00	0.00	3
24	1.205	1140	4989	0	0	0.00	0.00	0.00	0.00	0
TOTAL	**21.8**	**34415**	**147221**	**5**	**131**	**0.20**	**0.05**	**0.15**	**0.15**	

There are 15 Nos. Private Clinic, 55 nos. Pathological Laboratories. Total quantity of waste generated from those establishment will be about 100 kg.

Note: i) Assumed that Clinical Waste generated @ 1500 gm per bed. ii) 25 % of the Clinical Waste generated is infectious in nature

ASHOKNAGAR-KALYANGARH MUNICIPALITY

Estimation of Total Waste Generation Per Day in the Town

Table - 13

Category	Generation Points	Total (in kg.)	Quantity of Waste (in Kg.)		Remarks
			Waste Type		
			Bio-degradable	Non-degradable	
A	Domestic	33526	20115	13410	To be transported to Bio Gas / Compost plant site except the non-degradable portion of domestic and hotel waste
	Daily & Wholesale Market	9060	7248	1812	
	Hotels	0	0	0	
	Agricultural/ Garden	500	500	0	
	Sub-total	43086	27863	15222	
B	Commercial Centres	1580		1580	To be transported to land fill Site
	Railway Station	500		500	
	Bus Stand	100		100	
	Sub-total	2180		2180	
C	Street Sweepings	500		500	do
	Drain Cleanings	300		300	
	Sub-total	800		800	
D	Cess pool	600	600		To be transported to trenching site
E	Clinical	150		150	To be transported to secured burial site
	Total	46816	28463	18352	

Note:

i) Domestic SW contains about 60% organic matter and remaining 40% is inert materials
ii) Moisture content in organic waste is about 50%
iii) Hotels generate SW @750gm/bed and contains about 50% organic matter and remaining 50% is inert materials
iv) Market SW contains about 80% bio degradable matter and remaining 20% is inert materials
iv) Assumed that trade waste contains about 10% bio degradable matter and remaining 90% is inert materials
v) Assumed that Agricultural waste contains about 100% bio degradable matter neglecting the very few inert materials
vi) In hospital waste
a) Infectious & hazardous waste is 0.038 MT
b) Non-hazardous waste is 0.113 MT

HABRA MUNICIPALITY

Estimation of Total Waste Generation Per Day in the Town

Table - 13A

Category	Generation Points	Total (in kg.)	Quantity of Waste (in Kg.) Waste Type		Remarks
			Bio-degradable	Non-degradable	
A	Domestic	40486	24291	16194	To be transported to Bio Gas / Compost plant site except the non-degradable portion of domestic and hotel waste
	Daily & Wholesale Market	34000	27200	6800	
	Hotels	0	0	0	
	Agricultural/ Garden	500	500	0	
	Sub-total	74986	51991	22994	
B	Commercial Centres	6600		6600	To be transported to land fill Site
	Railway Station	500		500	
	Bus Stand	100		100	
	Sub-total	7200		7200	
C	Street Sweepings	500		500	do
	Drain Cleanings	300		300	
	Sub-total	800		800	
D	Cess pool	600	600		To be transported to trenching site
E	Clinical	197		197	To be transported to secured burial site
	Total	83782	52591	31191	

Note:

i) Domestic SW contains about 60% organic matter and remaining 40% is inert materials
ii) Moisture content in organic waste is about 50%
iii) Hotels generate SW @750gm/bed and contains about 50% organic matter and remaining 50% is inert materials
iv) Market SW contains about 80% bio degradable matter and remaining 20% is inert materials
iv) Assumed that trade waste contains about 10% bio degradable matter and remaining 90% is inert materials
v) Assumed that Agricultural waste contains about 100% bio degradable matter neglecting the very few inert materials
vi) In hospital waste
a) Infectious & hazardous waste is 0.049 MT
b) Non-hazardous waste is 0.147 MT

ASHOKNAGAR-KALYANGARH MUNICIPALITY
REQUIREMENT OF TRANSFER STATIONS AND VEHICLES

Table - 14

Zone No	Ward Nos	Distance from the Dumping site in KM.	No. of Holdings	Population	Domestic Waste generate in MT	Daily & Wholesale Market		Commercial Centres		Hotel			Total quantity of waste (MT)	Type of Transfer Station to be Deployed		No. of House to House Collection Bucket	Type of Prime Mover to be Deployed						
						No.	SW Quantity (MT)	No.	SW Quantity (MT)	No.	No, of bed	SW Quantity (MT)		LB	CB		HLDC	HLD	TR	RT	HDT	WB	ComM
I	1	8	1184	5714	1.57	1	0.2	0	0.0	0	0.0	0.00	1.77	22	13	2368							
	2	7	1403	6514	1.79	0	0.0	0	0.0	0	0.0	0.00	1.79	26	15	2806							
	3	7	872	4342	1.19	1	0.4	0	0.0	0	0.0	0.00	1.59	16	10	1744							
	23	8	1978	5713	1.57	1	0.2	0	0.0	0	0.0	0.00	1.81	36	22	3956							
Sub Total	**Avg.**	**7.5**	**5437**	**22283**	**6.13**	**3**	**0.84**	**0**	**0.00**	**0**	**0**	**0.00**	**6.97**	**100**	**60**	**10874**	4	1	1	4	1	85	1
II	4	6	959	4451	1.22	2	0.5	0	0.0	0	0.0	0.00	1.72	17	10	1918							
	5	7	1082	5559	1.53	1	0.4	0	0.0	0	0.0	0.00	1.94	20	12	2164							
	6	5	1574	6918	1.90	1	0.4	0	0.0	0	0.0	0.00	2.32	29	17	3148							
	7	4	1095	3885	1.07	1	1.0	0	0.0	0	0.0	0.00	2.10	20	12	2190							
	8	6	999	4409	1.21	0	0.0	0	0.0	0	0.0	0.00	1.21	18	11	1998							
Sub Total	**Avg.**	**5.6**	**5709**	**25222**	**6.94**	**5**	**2.36**	**0**	**0.00**	**0**	**0.00**	**0.00**	**9.30**	**104**	**62**	**11418**	5	1	2	4	1	90	
III	9	5	523	5978	1.64	2	0.4	0	0.0	0	0	0.00	2.06	10	6	1046							
	10	4	1240	4672	1.28	1	0.3	1	0.8	0	0	0.00	2.37	23	14	2480							
	11	4	1371	5757	1.58	1	1.5	0	0.0	0	0	0.00	3.08	25	15	2742							
	16	3	967	3478	0.96	0	0	0	0	0	0	0	0.96	18	11	1934							
	17	4	1464	6670	1.83	0	0.0	1	0.8	0	0	0.00	2.63	27	16	2928							
	18(P)	5	277	1070	0.29	1	0.2	0	0.0	0	0	0.00	0.51	5	3	554							
Sub Total	**Avg.**	**4.2**	**5842**	**27625**	**7.60**	**5**	**2.5**	**2**	**1.6**	**0**	**0.0**	**0.00**	**11.63**	**108**	**65**	**11684**	5	1	2	4	1	90	1
IV	12	4	1042	3629	1.00	1	0.4	0	0.0	0	0	0.00	1.40	19	11	2084							
	13	4	1504	7303	2.01	1	0	0	0	0	0	0	2.26	27	16	3008							
	14	3	931	3209	0.88	1	1	0	0	0	0	0	1.38	17	10	1862							
	15	3	1244	5457	1.50	0	0	0	0	0	0	0	1.50	23	14	2488							
	22(P)	7	948	5590	1.54	1	0.2	0	0.0	0	0	0.00	1.74	17	10	1896							
Sub Total	**Avg.**	**4.2**	**5669**	**25188**	**6.93**	**4**	**1.35**	**0**	**0.00**	**0**	**0.00**	**0.00**	**8.28**	**103**	**61**	**11338**	5	1	2	4	1	90	

V	18(P)	5	659	2544	0.70	0	0.00	0	0.00	0	0.00	0.00	0.70	12	7	1318								
	19	5	1411	5123	1.41	2	1.6	0	0.0	0	0	0.00	2.96	26	15	2822								
	20	6	890	4896	1.35	1	0.2	0	0.0	0	0	0.00	1.55	16	10	1780								
	21	7	1320	6245	1.72	1	0.3	0	0.0	0	0	0.00	2.03	24	14	2640								
	22(P)	7	473	2786	0.77	0	0.0	0	0.0	0	0	0.00	0.77	9	5	946								
Sub Total	**Avg.**	**6.0**	**4753**	**21594**	**5.94**	**4**	**2.06**	**0**	**0**	**0**	**0**	**0.00**	**8.00**	**87**	**51**	**9506**	4	1	2	4	1	75		
TOTAL	**Avg.**	**5.5**	**27410**	**121912**	**33.526**	**21**	**9.06**	**2**	**1.58**	**0**	**0**	**0**	**44.166**	**502**	**300**	**54820**	**23**	**5**	**9**	**20**	**5**	**430**	**2**	

Abbreviations :

LB :	**Litter Bins (about 20 to 40 lit capacity)**	**TS :**	**Transfer Station**
HLDC :	**Hook Lift Dumper Container (5 - 7.5 Cum. capacity)**	**ComM**	**Compactor(Mobile)**
HLD :	**Hook Lift Dumper Carrier (Hydraulic)**	**SLSJM:**	**Sewer Line suction cum Jetting Machine**
HDT :	**Hydraulic Dumper Truck**	**RSM :**	**Road Sweeping Machine**
CB :	**Community Bins (200 lits.)**	**TR:**	**Tractor**
WB:	Wheel Barrow	**RT:**	**Covered Refused Trailer with Hydraulic system**

Note:

I) SLSJM - 1 no., RSM - 1 no. HDT or ordinary truck - 2 nos, 1 tractor & 2 trailer are to be kept and maintained by Central Office and shall be deployed as per the requirement to various Zones to cater unscheduled generation of waste such as waste from festival houses / fairs, garden waste, construction debri etc.

II) Construction Debri is to be carried by hydraulic dumper truck or by ordinary truck as per user charge basis.

III) Hook Lift Dumper Containers (HLDC) may be kept near all market places and that will be lifted by Hook Lift Dumper Carrier (HLD) for transporation to dumping ground.

IV) Wheel Barrow will collect the domestic waste from door to door and also the waste from litter bins and transfer the same to the community bins or hydraulic dumper containers kept at suitable points.

V) There must be 2 community bins at a place; 1 green for bio-degradable waste and 1 yellow for non-degradable waste.

VI) Hook Lift Dumper Carrier (Hydraulic) will go on lifting the waste from the community bins kept at specified places and also the waste from the hotels stored in the containers and transport the same to dumping ground. In areas where quantity of waste is less the waste can be lifted on alternate days.

VII) Provide atleast one 200 ltrs. Bins at each commercial centres.

VIII) Every hotel should keep 1 green container and 1 yellow container for storing their degradable & non-degradable waste respectively which should be collected daily by municipality. No road side vat should be allowed for dumping the hotel waste.

HABRA MUNICIPALITY
REQUIREMENT OF TRANSFER STATIONS AND VEHICLES

Table - 14A

Zone No	Ward Nos	Distance from the Dumping site in KM.	No. of Holdings	Population	Domestic Waste generate in MT	Daily & Wholesale Market		Commercial Centres		Hotel			Total quantity of waste (MT)	Type of Transfer Station to be Deployed		No. of House to House Collection Bucket	Type of Prime Mover to be Deployed						
						No.	SW Quantity (MT)	No.	SW Quantity (MT)	No.	No, of bed	SW Quantity (MT)		LB	CB		HLDC	HLD	TR	RT	HDT	WB	ComM
A	1	2.00	2075	8972	2.47	0	0.0	1	2.0	0	0	0.0	4.5	30	18	4150							
	2	1.5	1288	4586	1.26	1	2.0	0	0.0	0	0	0.0	3.3	19	11	2576							
	3	1	1255	8489	2.33	0	0.0	0	0.0	0	0	0.0	2.3	18	11	2510							
	4	1	993	4557	1.25	0	0.0	0	0.0	0	0	0.0	1.3	14	9	1986							
Sub Total	**Avg.**	**1.4**	**5611**	**26604**	**7.3161**	**1**	**2.0**	**1**	**2.0**	**0**	**0**	**0.0**	**11.3**	**81**	**49**	**11222**	4	1	2	4	1	90	1
B	5	0.5	1410	6074	1.67	0	0.0	0	0.0	0	0	0.0	1.7	20	12	2820							
	6	1	2172	6599	1.81	2	2.5	1	1.2	0	0.0	0.0	5.5	32	19	4344							
	7	1	1230	4763	1.31	3	7.0	0	0.0	0	0.0	0.0	8.3	18	11	2460							
Sub Total	**Avg.**	**0.8**	**4812**	**17436**	**4.7949**	**5**	**9.5**	**1**	**1.2**	**0**	**0**	**0.0**	**15.5**	**70**	**42**	**9624**	4	1	1	3	1	75	
C	8	1.5	1722	5943	1.63	1	2.0	0	0.0	0	0.0	0.0	3.6	25	15	3444							
	9	2	2413	5167	1.42	2	1.4	1	0.5	0	0	0.0	3.3	35	21	4826							
	10	2.5	817	7275	2.00	1	2.0	0	0.0	0	0	0.0	4.0	12	7	1634							
	11	2.5	1739	5471	1.50	1	1.0	0	0.0	0	0	0.0	2.5	25	15	3478							
	12	3	1556	3766	1.04	1	1.3	0	0.0	0	0	0.0	2.3	23	14	3112							
Sub Total	**Avg.**	**2.3**	**8247**	**27622**	**7.59605**	**6**	**7.7**	**1**	**0.5**	**0**	**0**	**0.0**	**15.7**	**120**	**72**	**16494**	4	1	2	4	2	130	
D	13	3	957	6563	1.80	1	2.0	0	0.0	0	0	0.0	3.8	14	8	1914							
	14	2	1463	6317	1.74	0	0.0	0	0.0	0	0	0.0	1.7	21	13	2926							
	15	2.5	1573	7017	1.93	1	1.5	0	0.0	0	0	0.0	3.4	23	14	3146							
	16	3.5	1202	6008	1.65	1	2.3	0	0.0	0	0	0.0	3.9	17	10	2404							
Sub Total	**Avg.**	**2.8**	**5195**	**25905**	**7.12388**	**3**	**5.8**	**0**	**0.0**	**0**	**0**	**0.0**	**12.9**	**75**	**45**	**10390**	4	1	1	3	1	80	
E	17	4.0	1731	6747	1.86	2	1.2	0	0.0	0	0	0.0	3.1	25	15	3462							
	18	3.0	2058	8024	2.21	1	1.6	0	0.0	0	0	0.0	3.8	30	18	4116							
	19	2.0	1458	4710	1.30	2	2.3	0	0.0	0	0	0.0	3.5	21	13	2916							
	20	1.5	929	5482	1.51	2	1.0	0	0.0	0	0	0.0	2.5	13	8	1858							
Sub Total	**Avg.**	**2.6**	**6176**	**24963**	**6.86483**	**7**	**6.0**	**0**	**0.0**	**0**	**0**	**0.0**	**12.9**	**89**	**54**	**12352**	4	1	2	3	1	100	

F	21	1.5	1378	7280	2.00	1	1.3	0	0.0	0	0	0.0	3.3	20	12	2756								
	22	2.0	1150	6002	1.65	1	1.0	0	0.0	0	0	0.0	2.7	17	10	2300								
	23	3.0	706	6420	1.77	2	0.9	0	0.0	0	0	0.0	2.6	10	6	1412								
	24	0.0	1140	4989	1.37	0	0.0	1	2.9	0	0	0.0	4.3	17	10	2280								
Sub Total	**Avg.**	**1.6**	**4374**	**24691**	**6.79003**	**4**	**3.1**	**1**	**2.9**	**0**	**0**	**0.0**	**12.8**	**64**	**38**	**8748**	4	1	1	3	1	70	1	
TOTAL	**Avg.**	**1.9**	**34415**	**147221**	**40.486**	**26**	**34.0**	**4**	**6.6**	**0**	**0**	**0.0**	**81.1**	**499**	**300**	**68830**	**24**	**6**	**9**	**20**	**7**	**545**	**2**	

Abbreviations :

LB :	**Litter Bins (about 20 to 40 lit capacity)**	**TS :**	**Transfer Station**
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HLD :	**Hook Lift Dumper Carrier (Hydraulic)**	**SLSJM:**	**Sewer Line suction cum Jetting Machine**
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Note:

I) SLSJM - 1 no., RSM - 1 no. HDT or ordinary truck - 2 nos, 1 tractor & 2 trailer are to be kept and maintained by Central Office and shall be deployed as per the requirement to various Zones to cater unscheduled generation of waste such as waste from festival houses / fairs, garden waste, construction debri etc.

II) Construction Debri is to be carried by hydraulic dumper truck or by ordinary truck as per user charge basis.

III) Hook Lift Dumper Containers (HLDC) may be kept near all market places and that will be lifted by Hook Lift Dumper Carrier (HLD) for transporation to dumping ground.

IV) Wheel Barrow will collect the domestic waste from door to door and also the waste from litter bins and transfer the same to the community bins or hydraulic dumper containers kept at suitable points.

V) There must be 2 community bins at a place; 1 green for bio-degradable waste and 1 yellow for non-degradable waste.

VI) Hook Lift Dumper Carrier (Hydraulic) will go on lifting the waste from the community bins kept at specified places and also the waste from the hotels stored in the containers and transport the same to dumping ground. In areas where quantity of waste is less the waste can be lifted on alternate days.

VII) Provide atleast one 200 ltrs. Bins at each commercial centres.

VIII) Every hotel should keep 1 green container and 1 yellow container for storing their degradable & non-degradable waste respectively which should be collected daily by municipality. No road side vat should be allowed for dumping the hotel waste.

TYPES OF VEHICLES TO BE USED FOR COLLECTION AND TRANSPORTATION OF MUNICIPAL SOLID WASTE

1. House to House Collection

2. Hand Cart / Wheel Barrow

3. Transfer of SW after Collection through Wheel Barrow

4. Litter Bins (LB)

5. CGB: Community Garbage Bins (1000 ltr.; Steel bins with swivel castor wheels automatic lifting arrangement

6. Cess- Pool Emptier

7. Hydraulic Dumper Container
(HDC)

8. Hook Lift / Hydraulic Dumper Carrier / Skip
(HLD)

9 Tractor & Cover Refused Trailer
with Hydraulic system
(TR & RT)

10. Hydraulic Dumper Truck
(HDT)

11. Road Sweeping Machine
(RSM)

12. Sewer Line Suction cum Jetting Machine
(SLSJM)

ABSTRACT COST ESTIMATE

Table - 15

Sl. No.	Particulars	Amount
		(Rs. in lakh)
1	Plant, Machinery, Equipments for Collection, Transportations and Disposal	**1001.14**
2	Development of Land Fill Site	**167.70**
3	Construction of Bio-gas Plant	**1969.22**
	Total	**3138.06**
	Contingencies @ 3%	94.14
	Grand Total	**3232.20**

REQUIREMENT OF VEHICLES AND ACCESSORIES

Table - 15A

Sl. No.	Particulars	Habra	Ashoknagar Kalyangarh	Total Requirements	Remarks
1	Litter Bins (20 - 40 lit.)	500	500	1000	
2	Hook Lift Dumper Container (HLDC 5 - 7.5 Cum. capacity)	24	23	47	
3	Hook Lift Dumper Carrier (Hydraulic)- HLD	6	5	11	
4	Community Bins (200 lit. capacity)	300	300	600	
5	House to House Collection Bucket	68830	54820	123650	
6	Tractor	9	9	18	
7	Covered Refuse Trailer with Hydraulic system	20	20	40	
8	Pay-Loader/Bull-dozer	1	1	2	
9	Hydraulic Dumper Truck - HDT / Ordinary Truck	7	5	12	
10	Cess Pool Emptier	4	3	7	
11	Sewer Line suction cum Jetting Machine			0	
12	Road Sweeping Machine	2	2	4	
13	Wheel Barrow	545	430	975	
14	Compactor (mobile)	2	2	4	
15	Compactor (stationary)	0	0	0	
16	Shovels	300	300	600	
17	Spade	300	300	600	
18	Gloves , Masks, Gomboot etc.				LS

Note:

i) Assuming one Wheel Barrow will cover in an average 65 nos. holdings.

ii) House to house bucket shall be supplied to each family only once. Replacement of those bucket whenever required due to damage shall have to be arranged by the individual family.

iii) Community Bins should have necessary arrangement for tilting the same, either manualy or mechanically, for transfering waste directly to the transportation vehicles

ADDITIONAL REQUIREMENT OF VEHICLES AND ACCESSORIES

Table - 15B

Sl. No.	Particulars	Total Requirement	Existing nos.			Additional Requirement	Rate (Rs.)	Amount (Rs.)	Remarks
			Habra	Ashoknagar Kalyangarh	Total				
1	Litter Bins	1000			0	1000	1560	1560000	No road side open vat should be allowed. 1 Cess-pool Emptire - suction pump mounted on tanker-trailers suitable for narrow lane is required to be provided
2	Hook Lift Dumper Container (HLDC 5 - 7.5 Cum. capacity)	47			0	47	90000	4230000	
3	Hook Lift Dumper Carrier (Hydraulic)- HLD	11			0	11	2473200	27205200	
4	Community Bins (200 lit. capacity)	600	50	16	66	534	9875	5273250	
5	House to House Collection Bucket	123650			0	123650	86	10633900	
6	Tractor	18	7	8	15	3	850000	2550000	
7	Covered Refuse Trailer with Hydraulic system	40	16	15	31	9	150000	1350000	
8	Pay-loader/Bull-dozer	2		1	1	1	4500000	4500000	
8	Hydraulic Dumper Truck - HDT / Ordinary Truck	12	5	0	5	7	200000	1400000	
9	Cess Pool Emptier (Tanker-Trailer fitted with suction pump)	7	1	4	5	2	1050000	2100000	
10	Sewer Line suction cum Jetting Machine	0			0	0	1200000	0	
11	Road Sweeping Machine	4			0	4	3000000	12000000	
12	Wheel Barrow	975			0	975	9850	9603750	
14	Compactor (mobile)	4			0	4	4300000	17200000	
13	Compactor (stationary)	0			0	0	10000000	0	
14	Shovels	600			0	600	380	228000	
15	Spade	600			0	600	300	180000	
16	Gloves , Masks, Gomboot etc.	0			0			100000	
							TOTAL	**100114100**	
							Say Rs.	**1001.14**	**lakh**

Cost of Development of LandFill Site

Table - 15C

SL. NO.	PARTICULARS	AMOUNT Rs. (in lakh)
1	Construction of Approach Road to landfill site 1000 mt. length width 3.5m. @ Rs. 3220 per m.	32.2
2	Site Development	30.0
3	Cost of providing linear (for 5 years dumping)	25.0
4	Construction of protection wall (CRM) 500 m. @ 2500/- per m	22.0
5	Construction of surface run-off diversion drain	15.0
6	Construction of leachate circulation & treatment system at Landfill site	40.0
7	Tree plantation	1.0
8	Construction of Site Office	2.5
	TOTAL	167.70

Estimated Cost for 60 MT Bio gas Plant

Table - 15D

Sl No.	Item	Cost (in Rs.)
1	Civil Cost	**43,883,427.40**
2	Sorting facility	**20,000,000.00**
2	Mechanical	**73,938,578.48**
3	Gas storage	**16,200,000.00**
4	Gas transport	**900,000.00**
5	Composting	**6,000,000.00**
6	Plastic to fuel	**36,000,000.00**
	TOTAL	**196,922,005.88**

Total Tonnage	**130.60**	MT
Total Tonnage to be Processed	**81.05**	MT
Recommended layout:	12	Units @5 MT/Unit
Total System tonnage	**60**	**MT**

Table - 15E

ESTIMATE OF CIVIL WORK FOR 60 MT FOUNDATION AND COLUMNS ,BEAMS; SLABS FOR PROP. BIOGAS LAYOUT FOR HABRA AND ASHOKNAGAR-KALYANGARH						
Sl. No	**Description**	**Page Ref**	**Quantity**	**Unit**	**Rate (in Rs.)**	**Amount (in Rs.)**
1	Earth work in excavation of foundation trenches or drains, in all sorts of soil (including mixed soil but excluding laterite or sandstone) including removing, spreading or stacking the spoils within a lead of 75 m. as directed. The item includes necessary trimming the sides of trenches, levelling, dressing and ramming the bottom, bailing out water as required complete. (a) Depth of excavation not exceeding 1,500 mm.	BUILDING WORKS 2015 P-1 It-2.a	2580.00	m3	120.47	310,812.60
2	Earth work in filling in foundation trenches or plinth with good earth, in layers not exceeding 150 mm. including watering and ramming etc. layer by layer complete. (Payment to be made on the basis of measurement of finished quantity of work) (a) With earth obtained from excavation of foundation	BUILDING WORKS 2015 P-1 It-3.a	520.00	cu.m	78.31	40,721.20
3	Ordinary Cement concrete (mix 1:2:4) with graded stone chips (20 mm nominal size) excluding shuttering and reinforcement,if any, in ground floor as per relevant IS codes. (b) River bazree	BUILDING WORKS 2015 P-12 It-3.b	220.00	cu.m	7,116.00	1,565,520.00
4	Ordinary Cement concrete (mix 1:1.5:3) with graded stone chips (20 mm nominal size) excluding shuttering and reinforcement if any, in ground floor as per relevant IS codes (ii) River Bazree	BUILDING WORKS 2015 P-15 It-7.ii	2333.33	cu.m	8,150.40	19,017,600.00
5	Hire and labour charges for shuttering with centering and necessary staging upto 4 m using approved stout props and thick hard wood planks of approved thickness with required bracing for concrete slabs, beams and columns, lintels curved or straight including fitting, fixing and striking out after completion of works (upto roof of ground floor) (c) Steel shuttering or 9 to 12 mm thick approved quality ply board shuttering in any concrete work	BUILDING WORKS 2015 P-27 It-12.c	11000.00	sq.m	490.80	5,398,800.00
6	125 mm. thick brick work with 1st class bricks in cement mortar (1:3) in ground floor.	BUILDING WORKS 2015 P-32 It-30	4000.00	sq.m	1,149.60	4,598,400.00
7	Reinforcement for reinforced concrete work in all sorts of structures including distribution bars, stirrups, binders etc initial straightening and removal of loose rust (if necessary), cutting to requisite length, hooking and bending to correct shape, placing in proper position and binding with 16 gauge black annealed wire at every intersection, complete as per drawing and direction. (i) Tor steel/Mild Steel	BUILDING WORKS 2015 P-28 It-15.i	134.00	MT	75,680.40	10,141,173.60
8	Plaster (to wall, floor, ceiling etc.) with sand and cement mortar including rounding off or chamfering corners as directed and raking out joints including throating, nosing and drip course, scaffolding/staging where necessary (Ground floor).[Excluding cost of chipping over concrete surface] (iii) With 1:3 cement mortar (b) 15 mm thick plaster	BUILDING WORKS 2015 P-164 It-15.i	10000.00	sq.m	243.60	2,436,000.00
9	Neat cement punning about 1.5mm thick in wall,dado,window sill,floor etc. NOTE:Cement 0.152 cu.m per100 sq.m.	BUILDING WORKS 2015 P-166 It-8	8000.00	sq.m	46.80	374,400.00
Total						**43,883,427.40**

Table - 15F

ESTIMATE OF MECHANICAL WORK

Item	Specification	Qty	Rate (in Rs.)	Amount (in Rs.)
Blower	TWIN LOBE 10 HP KSB	12	82,813.00	993,756.00
Mixer	7.5 HP	12	225,000.00	2,700,000.00
Sludge Pump	KIRLOSKAR 250 L WITH 3 HP MOTOR	12	21,000.00	252,000.00
Solar Panel	EVACUATED GLASS TUBE WHS	12	71,543.00	858,516.00
Balloon	120 CU.M	0	168,750.00	0.00
Compressor	5 HP CROMPTON GREAVES	12	63,000.00	756,000.00
Generator	For electricity	4	2,000,000.00	8,000,000.00
Piping	AS PER REQ	LUMPSUM	10,000,000.00	10,000,000.00
Steel Tank	Per Kg	229,624.49	135.00	30,999,306.48
Installation for Fabrication (Bamboo Scaffolding incl of Labour)			600,000.00	600,000.00
Submersible Pump	KSB MAKE	12	39,900.00	478,800.00
Gas Burner	BIOGAS	12	8,500.00	102,000.00
Gas Meter	BIOGAS	12	17,850.00	214,200.00
pH Meter		12	7,000.00	84,000.00
Electricals		LUMPSUM	4,000,000.00	4,000,000.00
Protective Coating	GLASS EPOXY COATING	LUMPSUM	9,600,000.00	9,600,000.00
Transportation			300,000.00	300,000.00
Shed for Sorting Area and Control Panel (sq.ft)	Working Shed	5000	200.00	1,000,000.00
Small Incinerator		6	500,000.00	3,000,000.00
			Total	**73,938,578.48**

Table - 16

ESTIMATION OF LABOUR COST FOR HOUSE TO HOUSE COLLECTION

SL.NO.	HEAD	NOS.	RATE PER MONTH (Rs.)	AMOUNT (Rs,)
1	For House to House collector	100	4500	450000
2	Supervisor for House to House collection	10	6000	60000
TOTAL				**510000**

Table - 17

Operation and Mainetenance Cost for Bio Gas plant

Categories	Unit	Quantity	Rate (in Rs.)	Expenses Per Month (in Rs.)
1.Bio Gas Operators	Each	10.00	7,000.00	70,000.00
2. Supervisor	Each	2.00	10,000.00	20,000.00
3. Chemist	Each	0.50	15,000.00	7,500.00
4. Administration Charges	Lump sum			20,000.00
5. Regular visit charges of technical experts for technical support	Per Visit	1 per month	10,000.00	10,000.00
Sub-Total for Manpower on Monthly Basis				127,500.00
B. Ancillary Items				
1. Upkeep & maintenance charges. (Apron, hand gloves, mask, gumboot, cap, phenyl, liquid soap, soap, duster, hard broom, soft broom, first aid kit, spade, water pipe.	Lump sum			30,000.00
2. Repairs & replacement of machinery parts, changing of oil and mixer and compressor belts.	Lump sum			50,000.00
3. Miscellaneous	Lump sum			5,000.00
Sub-Total for Ancillary Items				85,000.00
C. Electricity				
Average projected Electricty consumption is 10 KWH per ton	kwh	600.00	6.00	108,000.00
Monthly cost				320,500.00
Total Operation & Maintenance Cost per Year				**3,846,000.00**

Table -18

a) Transportation from Ashoknagar Kalyangarh

ESTIMATION OF OPERATIONAL COST

Transportation expenditure includes carrying cost of garbage per day from the spot of collection to Dumping Station cum Bio-gas Plant. The estimate for running cost of each type of prime- movers is given below :

Assume cost of Diesel = Rs. 60 /Lit
Cost of Lubricant = Rs. 264 /Lit

Table - a

1. DUMPER TRUCK / ORDINARY TRUCK

Speed of Vehicle - 20 KM/Hr
Average Distance of dumping site is 5.5 KM
Parking Distance - 2 KM
Carrying capacity - 5 MT
No. of trips / day/ vehicle (8 hrs. working shift) is 2
Total Km done / day = 26 KM

HEAD	CONSUMPTION SPECIFICATION	QUANTITY	RATE (Rs.)	AMOUNT (Rs.)
Diesel	`@ 6 Km/lt.	4.3 ltr.	60 per ltr.	260.00
Lubricant	`@ 100 Km/lt.	0.3 ltr.	264 per ltr.	68.64
Labour	For loading & unloading	2 nos.	150 per head/day	300.00
Truck Driver	One	1 nos.	400 per head/day	400.00
Truck Cleaner	One	1 nos.	150 per head/day	150.00
				1178.64
			say	**1179**

Table - b

2. TRACTOR

Speed of Vehicle - 20 KM/Hr
Average Distance of dumping site is 5.5 KM
Parking Distance - 2 KM
Carrying capacity - 3 MT
No. of trips / day/ vehicle (8 hrs. working shift) is 3
Total Km done / day = 37 KM

HEAD	CONSUMPTION SPECIFICATION	QUANTITY	RATE (Rs.)	AMOUNT (Rs.)
Diesel	`@ 6 Km/lt.	6.2 ltr.	60 per ltr.	370.00
Lubricant	`@ 100 Km/lt.	0.4 ltr.	264 per ltr.	97.68
Tractor Driver	One	1 nos.	300 per head/day	300.00
Tractor Cleaner cum unloader	One	1 nos.	150 per head/day	150.00
				917.68
			say	**918**

Table - c

3. HOOK LIFT DUMPER CARRIER (HLD)

Speed of Vehicle - 20 KM/Hr
Average Distance of dumping site is 5.5 KM
Parking Distance - 2 KM
Carrying capacity - 5 MT
No. of trips / day/ vehicle (8 hrs. working shift) is 2
Total Km done / day = 26 KM

HEAD	CONSUMPTION SPECIFICATION	QUANTITY	RATE (Rs.)	AMOUNT (Rs.)
Diesel	`@ 6 Km/lt.	0.3 ltr.	60 per ltr.	20.00
Lubricant	`@ 40 Km/lt.	0.1 ltr.	264 per ltr.	13.20
Driver	One	1 nos.	400 per head/day	400.00
Cleaner / Loader	Two	2 nos.	150 per head/day	300.00
				733.20
			say	**733**

Table - d

4. MOVABLE COMPACTOR

Speed of Vehicle - 20 KM/Hr
Average Distance of dumping site is 5.5 KM
Parking Distance - 2 KM
Carrying capacity - 10 MT
No. of trips / day/ vehicle (8 hrs. working shift) is 2
Total Km done / day = 26 KM
Actual hour of operation 4 Hrs.

HEAD	CONSUMPTION SPECIFICATION	QUANTITY	RATE (Rs.)	AMOUNT (Rs.)
Diesel : For Movement	`@ 3 Km/lt.	8.7 ltr.	60 per ltr.	520.00
Diesel : For Operation	`@ 6 lit/hr.	24 ltr.	60 per ltr.	1440.00
Lubricant	`@ 40 Km/lt.	0.4 ltr.	264 per ltr.	105.60
Driver	One	1 nos.	500 per head/day	500.00
Cleaner	One	1 nos.	200 per head/day	200.00
				2765.60
			say	**2765.6**

Table - e

5. ROAD SWEEPING MACHINE

Speed of vehicle - 8 Km per hr.
Average Distance to be travelled per day 15 Km.

HEAD	CONSUMPTION SPECIFICATION	QUANTITY	RATE (Rs.)	AMOUNT (Rs.)
Diesel	For 15 km @ 5 Km/lt.	3 ltr.	60 per ltr.	180.00
Lubricant	For 15 km @ 40 Km/lt.	0.3 ltr.	264 per ltr.	79.20
Driver	One	1 nos.	400 per head/day	400.00
Cleaner	One	1 nos.	150 per head/day	150.00
				809.20
			say	**809**

Table - f

6.PAY LOADER / BULL DOZER

Average Distance to be travelled per day 8 Km.
Actual hour of operation 4 hrs.

HEAD	CONSUMPTION SPECIFICATION	QUANTITY	RATE (Rs.)	AMOUNT (Rs.)
Diesel : For Movement	For 8 km @ 5 Km/lt.	1.80 ltr.	60 per ltr.	108.00
Diesel : For Operation	For 4 hrs.@ 3 lit/hr.	12 hr.	60 per ltr.	720.00
Lubricant	For10 km @ 40 Km/lt.	0.4 ltr.	264 per ltr.	105.60
Driver	One	1 nos.	500 per head/day	500.00
Cleaner	One	1 nos.	150 per head/day	150.00
				1583.60
			say	**1583.6**

Table - g

7. CESS POOL EMPTIER

Average Distance to be travelled per day 20 Km.
Actual hour of operation 2 hrs.

HEAD	CONSUMPTION SPECIFICATION	QUANTITY	RATE (Rs.)	AMOUNT (Rs.)
Diesel : For Movement	For 20 km @ 8 Km/lt.	1.2 ltr.	60 per ltr.	72.00
Diesel : For Operation	For 2 hrs.@ 2 lit/hr.	4 hr.	60 per ltr.	240.00
Lubricant	For 20 km @ 40 Km/lt.	0.5 ltr.	264 per ltr.	132.00
Driver	One	1 nos.	400 per head/day	400.00
Cleaner	One	1 nos.	150 per head/day	150.00
				994.00
			say	**994**

Total Cost of Transportation per day

(excluding the cost of depreciation & cost of capital)

Table -h

PARTICULARS	COST PER DAY (Rs.)	NO.	TOTAL DAILY COST (Rs.)	MONTHLY COST (Rs.)	YEARLY COST (Rs.)
DUMPER TRUCK / ORDINARY TRUCK	1179	5	5893.2	176796	2121552
TRACTOR	918	9	8259.12	247773.6	2973283.2
HOOK LIFT DUMPER CARRIER	733	5	3666	109980	1319760
MOVABLE COMPACTOR	2765.6	2	5531.2	165936	1991232
ROAD SWEEPING MACHINE	809	2	1618.4	48552	582624
PAY LOADER / BULL DOZER	1584	1	1583.6	47508	570096
CESS POOL EMPTIER	994	3	2982	89460	1073520
TOTAL			29534	886006	10632067

So, total monthly cost of transportation of solid waste (excluding the cost of depreciation & cost of capital) of the town is Rs. 886006/- only.

Table -18A

b) Transportation from Habra

ESTIMATION OF OPERATIONAL COST

Transportation expenditure includes carrying cost of garbage per day from the spot of collection to Dumping Station cum Bio-gas Plant. The estimate for running cost of each type of prime- movers is given below :

Assume cost of Diesel = Rs. 60 /Lit
Cost of Lubricant = Rs. 264 /Lit

Table -a

1. DUMPER TRUCK / ORDINARY TRUCK

Speed of Vehicle - 20 KM/Hr
Average Distance of dumping site is 1.9 KM
Parking Distance - 2 KM
Carrying capacity - 5 MT
No. of trips / day/ vehicle (8 hrs. working shift) is 2
Total Km done / day = 12 KM

HEAD	CONSUMPTION SPECIFICATION	QUANTITY	RATE (Rs.)	AMOUNT (Rs.)
Diesel	@ 6 Km/lt.	1.9 ltr.	60 per ltr.	116.00
Lubricant	@ 100 Km/lt.	0.1 ltr.	264 per ltr.	30.62
Labour	For loading & unloading	2 nos.	150 per head/day	300.00
Truck Driver	One	1 nos.	400 per head/day	400.00
Truck Cleaner	One	1 nos.	150 per head/day	150.00
				996.62
			say	**997**

Table - b

2. TRACTOR

Speed of Vehicle - 20 KM/Hr
Average Distance of dumping site is 1.9 KM
Parking Distance - 2 KM
Carrying capacity - 3 MT
No. of trips / day/ vehicle (8 hrs. working shift) is 3
Total Km done / day = 15 KM

HEAD	CONSUMPTION SPECIFICATION	QUANTITY	RATE (Rs.)	AMOUNT (Rs.)
Diesel	@ 6 Km/lt.	2.6 ltr.	60 per ltr.	154.00
Lubricant	@ 100 Km/lt.	0.2 ltr.	264 per ltr.	40.66
Tractor Driver	One	1 nos.	300 per head/day	300.00
Tractor Cleaner cum unloader	One	1 nos.	150 per head/day	150.00
				644.66
			say	**645**

Table - c

3. HOOK LIFT DUMPER CARRIER (HLD)

Speed of Vehicle - 20 KM/Hr
Average Distance of dumping site is 1.9 KM
Parking Distance - 2 KM
Carrying capacity - 5 MT
No. of trips / day/ vehicle (8 hrs. working shift) is 2
Total Km done / day = 12 KM

HEAD	CONSUMPTION SPECIFICATION	QUANTITY	RATE (Rs.)	AMOUNT (Rs.)
Diesel	@ 6 Km/lt.	0.3 ltr.	60 per ltr.	20.00
Lubricant	@ 40 Km/lt.	0.1 ltr.	264 per ltr.	13.20
Driver	One	1 nos.	400 per head/day	400.00
Cleaner / Loader	Two	2 nos.	150 per head/day	300.00
				733.20
			say	**733**

Table - d

4. MOVABLE COMPACTOR

Speed of Vehicle - 20 KM/Hr
Average Distance of dumping site is 1.9 KM
Parking Distance - 2 KM
Carrying capacity - 10 MT
No. of trips / day/ vehicle (8 hrs. working shift) is 2
Total Km done / day = 12 KM
Actual hour of operation 4 Hrs.

HEAD	CONSUMPTION SPECIFICATION	QUANTITY	RATE (Rs.)	AMOUNT (Rs.)
Diesel : For Movement	@ 3 Km/lt.	3.9 ltr.	60 per ltr.	232.00
Diesel : For Operation	@ 6 lit/hr.	24 ltr.	60 per ltr.	1440.00
Lubricant	@ 40 Km/lt.	0.4 ltr.	264 per ltr.	105.60
Driver	One	1 nos.	500 per head/day	500.00
Cleaner	One	1 nos.	200 per head/day	200.00
				2477.60
			say	**2477.6**

Table - e

5. ROAD SWEEPING MACHINE

Speed of vehicle - 8 Km per hr.
Average Distance to be travelled per day 15 Km.

HEAD	CONSUMPTION SPECIFICATION	QUANTITY	RATE (Rs.)	AMOUNT (Rs.)
Diesel	For 15 km @ 5 Km/lt.	3 ltr.	60 per ltr.	180.00
Lubricant	For 15 km @ 40 Km/lt.	0.3 ltr.	264 per ltr.	79.20
Driver	One	1 nos.	400 per head/day	400.00
Cleaner	One	1 nos.	150 per head/day	150.00
				809.20
			say	**809**

Table - f

6.PAY LOADER / BULL DOZER

Average Distance to be travelled per day 8 Km.
Actual hour of operation 4 hrs.

HEAD	CONSUMPTION SPECIFICATION	QUANTITY	RATE (Rs.)	AMOUNT (Rs.)
Diesel : For Movement	For 8 km @ 5 Km/lt.	1.80 ltr.	60 per ltr.	108.00
Diesel : For Operation	For 4 hrs.@ 3 lit/hr.	12 hr.	60 per ltr.	720.00
Lubricant	For10 km @ 40 Km/lt.	0.4 ltr.	264 per ltr.	105.60
Driver	One	1 nos.	500 per head/day	500.00
Cleaner	One	1 nos.	150 per head/day	150.00
				1583.60
			say	**1583.6**

Table - g

7. CESS POOL EMPTIER

Average Distance to be travelled per day 20 Km.
Actual hour of operation 2 hrs.

HEAD	CONSUMPTION SPECIFICATION	QUANTITY	RATE (Rs.)	AMOUNT (Rs.)
Diesel : For Movement	For 20 km @ 8 Km/lt.	1.2 ltr.	60 per ltr.	72.00
Diesel : For Operation	For 2 hrs.@ 2 lit/hr.	4 hr.	60 per ltr.	240.00
Lubricant	For 20 km @ 40 Km/lt.	0.5 ltr.	264 per ltr.	132.00
Driver	One	1 nos.	400 per head/day	400.00
Cleaner	One	1 nos.	150 per head/day	150.00
				994.00
			say	**994**

Total Cost of Transportation per day

(excluding the cost of depreciation & cost of capital)

Table - h

PARTICULARS	COST PER DAY (Rs.)	NO.	TOTAL DAILY COST (Rs.)	MONTHLY COST (Rs.)	YEARLY COST (Rs.)
DUMPER TRUCK / ORDINARY TRUCK	997	7	6976.368	209291.04	2511492.48
TRACTOR	645	9	5801.904	174057.12	2088685.44
HOOK LIFT DUMPER CARRIER	733	6	4399.2	131976	1583712
MOVABLE COMPACTOR	2477.6	2	4955.2	148656	1783872
ROAD SWEEPING MACHINE	809	2	1618.4	48552	582624
PAY LOADER / BULL DOZER	1584	1	1583.6	47508	570096
CESS POOL EMPTIER	994	4	3976	119280	1431360
TOTAL			29311	879320	10551842

So, total monthly cost of transportation of solid waste (excluding the cost of depreciation & cost of capital) of the town is Rs. 879320/- only.

Table - 19

ESTIMATION OF TOTAL O & M COST FOR SOLID WASTE MANAGEMENT SYSTEM

SL.NO.	PARTICULARS	AMOUNT PER MONTH (Rs.)	AMOUNT PER YEAR (Rs.)	Remarks
1	Operation cost of vehicles	1765326	21183912	
2	Maintenance cost of vehicles	1501712	18020538	
3	O & M cost for Landfill Operation	167700	2012400	
4	Labour cost for bio-gas composting	320500	3846000	
5	Cost for Sorting and Selling of Recyclables	1354000	16248000	
6	Labour cost for collection	510000	6120000	
7	Cost of depreciation of vehicles & Plant & Machinery @20%	25029	300342	
8	Cost of consumables	20000	240000	
9	Cost of fuel & energy	30000	360000	
10	Marketing Expenses	10000	120000	
11	Miscellaneous	10000	120000	
	TOTAL	**5714266**	**68571192**	
		Say Rs.	**685.71**	**lakh**

RECOMMENDATIONS

PROPOSED SOLID WASTE MANAGEMENT SYSTEM
FOR
ASHOKNAGAR-KALYANGARH-HABRA CLUSTER

Procedure to be followed by Ashoknagar-Kalyangarh Municipality and Habra Municipality

1) SEGREGATION OF MUNICIPAL SOLID WASTES

- Segregation of Bio-degradable & non-degradable wastes should be done at source. However a sorting operation also to be done before feeding Bio-gas plants to ensure smooth functioning.
- This should be made possible by vigorous awareness Campaign and by group meetings in each Ward, announcements, leaflets etc. prior to launching of the project and thereby ensuring community participation. Ward level S.W.M. Committees should be the instrumental in this matter.
- Provide two polythene containers, preferably not suitable for storage of liquid, one is **Green** another is **Yellow** to each family for collection of **bio-degradable SW and non-degradable SW respectively.**

(The containers shall be supplied by the Municipality once only. Replacement of the containers if required subsequently shall be arranged by the individual occupiers of the holdings themselves. For convenient Municipality may arranged to sale those containers to the tax-payers)

- Segregation of Bio-medical wastes should be done as per prescribed rules.

{*Note*: **Bio-degradable SW means which are basically organic in nature and biologically degradable which includes kitchen waste, fruit & vegetable waste, food waste, leaves & trees, agricultural waste, discarded cloths, papers, wood etc. and non-degradable SW are basically inorganic in nature and biologically not degradable it includes plastic & PVC items, PET Bottles, metal & metal foils, ashes, cinders, stones, bricks etc.**}

2) COLLECTION OF MUNICIPAL SOLID WASTES

- Each ward should be divided into 2 & 3 beats comprising of 175 – 200 waste generating points which include Domestic units, Shops, Hotels & Restaurants and other Commercial Establishments.
- For each beat there should be one Collector and a Supervisor for the whole ward i.e. for two or three beats.
- One Wheel Barrow or Three wheeled Motor Van may be provided for 2 or more beats as per the requirement.
- Solid wastes shall have to be collected every day between 7 a.m. to 10 a. m. by the Collectors by blowing whistle. Segregation of bio-degradable and non-degradable wastes are to be done at source.
- Each residential /domestic unit should be provided with two containers – one for bio degradable wastes and the other for non bio-degradable wastes in **Green & Yellow** containers respectively. Wastes from those containers should be collected in separate bins on the wheel barrows.
- For house to house collection of solid waste involvement of NGO's is to be encouraged. Persons from BPL families of that locality or near by localities may be involved for house to house collecting of solid waste.
- They may be allowed to collect Rs. 30/- from APL families to Rs. 10/- from each BPL family for house to house collecting of solid waste. All implements for collection of solid waste should be provided by the municipal authority. (This will not only reduce the cost of collection on the part of civic body but will also ensure effective and efficient cleaning system.)
- Uprooted plants, grass and cut branches of trees and leaves should be collected separately.
- After collection the solid waste it should be carried to transporting vehicle posted at transfer stations.
- Bio-degradable wastes and non-degradable wastes should be transported separately by covered vehicles.

- By 2 p.m. each day the bio-degradable wastes are to be carried to the processing site and the trailers/compactors with non-degradable wastes are to be carried to the landfill sites for disposal.
- The whole operation is to be monitored by Ward level Solid Waste Management Committees specially formed jointly by public and Municipal Administrators
- Littering of wastes in streets and drains shall have to be stopped by providing litter bins at suitable locations.

3) STORAGE OF MUNICIPAL SOLID WASTES

- Solid Wastes is to be stored by the waste generators in two separate bins of different colour provided for them by the Municipality and that should be collected within 24 hours.
- Storing of wastes in Vats or dumping by the road side should be prohibited. Road side Vats should be gradually turned into flower or plant pots. Where house to house collection is not possible Community bin collection method is to be adopted.
- After collection of solid waste it should be taken straight to the waiting trailers / Dumpers / truck at transfer stations.
- Colour Codes of Collection bins and trailers should be strictly followed.

4) TRANSPORTATION OF SOLID WASTES

- From waste generating points waste should be transferred to the transfer stations i.e two wheeled refuse trailers /Dumper or covered truck by specially designed Wheel Barrows. The vehicles either should have to compartments each for bio-degradable and non-degradable waste or there should be separate vehicles for bio-degradable and non-degradable waste for transportation. **Compactors to be used for non-bio degradable wastes.**
- Raised platforms i.e. ramp are to be built for hauling of wheel barrows / bins up to the height of transfer stations to make collection cleaner and to avoid multiple handling of Waste.
- Transfer stations should be carried by the prime movers straight to the sites in a train within 2/3 hours.

5) PROCESSING OF WASTES

- Bio-degradable wastes mainly Kitchen trash, market wastes comprising of vegetables wastes, fish etc. should be processed through 12 Nos. Bio-Gas Plant of capacity 5 MT each. Bio gas plants may be earmarked ULB wise and may be installed in phases as under:

ULB	Expected quantity of Bio-Degradable Waste	No. of 5 MT Bio-gas plant to be installed in 1st Phase	No. of 5 MT Bio-gas plant to be installed in 2nd Phase
Habra	**52.6**	4	4
Ashoknagar-Kalyangarh	**28.5**	2	2

- The plastic / rubber to be pyrolized at 1 MT Pyrolisis plant to get 600 Lit fuel oil per day.
- The organic waste being generated (approximately 6 tons per day) also can be sold to the plantations and other entities interested in organic farming. The value for the organic waste has not been included in the payback analysis as the pricing for the end product is not clear for the surrounding market. However, once started, the project will certainly generate additional revenue from the fertilizer sales.

Packaging and Marketing of Bio-Fertilizer

The bio-fertilizer produced should be sent to the market in good packaging and market the same by creating a Brand Name of the product. Appropriate efforts are to be given for enhancing for the brand value.

Packaging should be made in five kg. twenty kg. and fifty kg. containers. Dealers and distributors' network is to be developed in the nick market. Good marketing strategy and product placement will definitely fetch a good revenue to the Municipalities.

6) DISPOSAL OF MUNICIPAL SOLID WASTES

- Non-degradable, inert wastes are to be carried daily in the landfill site.
- After the expiry of life time the landfill site in future will be use for floriculture.
- Bio-medical Solid wastes should be disposed of in accordance with the bio-medical Wastes Management & Handling Rules.

7) MANAGEMENT REGULATIONS FOR SOLID WASTE DISPOSAL AND RECYCLING ISSUED BY THE MUNICIPAL LEVEL SOLID WASTE MANAGEMENT COMMITTEE

Management Regulations relating to solid waste disposal and recycling should be adopted by the both Municipal Boards after exhaustive discussion with all concerned and the board of councilors meetings in due time.

8) ADMINISTRATION

Institutional Strengthening & Human Resources Development

It is necessary to provide adequate training to all the levels of staff engaged in SWM services. The lower level staff such as sweepers, sanitation supervisors up to the level of Sanitary sub-inspectors should be given training locally in various aspects like storage, segregation of waste and primary collection of waste etc. whereas the sanitary inspectors and above may be given training in modern technologies of waste management, transportation, planning, personnel management programme within and outside the city or state. The senior officers of SWM department should be given adequate training through workshops and visits to various parts of the country and abroad.

Decentralization of Administration

SWM services can be performed effectively only if its administration is adequately decentralized. The decentralization can be at least 3 tiered- one at the Ward level, second at the Zone level, third at the city level. **For creating a competitive environment in regard to performance of SWM systems "Cleanliness Awards" should be given each year to the best performing ward(s).**

SW MANAGEMENT SYSTEM AT MUNICIPAL LEVEL

Level	Responsible for
Ward level	Awareness Campaign, Motivation, Collection of waste
Zonal level	Transportation of waste, Training & capacity building of the staff
City level	Processing, disposal & overall management, Research Development & Upgradation