File No. : MA/P/C-10/3S-156/2017: UD & MA Department
File Name: Procurement of bins, equipment and vehicles for transportation of MSW under Panihati Municipality

Notes prepages

The File may be referred for approval of the Chief Secretary to consider the Scheme *Solid Waste Management in Panihati Municipality* under Mission Nirmal Bangla(U)/ Swacch Bharat Mission (U) for at a total Estimated Cost of Rs.4522.39 Lakh as per DPR as proposed at NSP-9

13/2/18
Sougata De
Assistant Financial Advisor
UD & MA Department

13/2/18
(Amit Gangopadhyay)
Financial Advisor
UD & MA Department

Secretary, U.D & M.A. Department

SS (CS Ghosh)

There are other proposal of SWM recd from SUDA, that also needs approval of State Level Committee headed by CS. Please tag file and place consolidated proposal urgently

15.02.2018

Pl. put-up accordingly

Suman DIR (SUDA)

May pl. do the needful

15/2

15/2

B.N. Kog

CM PM

19/2/18

EE P)

19.2.18

Form No. XVI. S. I. 1924

2017

Government of West Bengal
Note Sheet

Municipal Affairs Department

Cell - 10

File No.MA/P/C-10/3S-156/2017

Subject : Procurement of bins, equipment and vehicles for transportation of MSW under Panihati Municipality

Notes and Orders

Papers are taken from SUDA file No. 277/2017

Pud placed below may kindly be seen

The Director, SUDA has informed that pursuant to a decision taken by the higher authority, the bin, equipments and vehicles for transportation of Municipal Solid Waste for Panihati Municipality should have to be procured centrally by SUDA with an objective to collect, reduce (if necessary) and transport the Solid Waste to its respective dumping ground.

Total Project cost stands at Rs. 4522.39 lakh (cp-1)

The project is divided into two parts: 1. Procurement of equipment and vehicles for transportation of MSW for Rs. 906.76 lakh and

2. Construction and O & M for Compost Plant (100 TPD) for Rs. 3615.63 lakh

If approved, fund for1st part may be released from H/A '72-2217-05-193-SP-006-35-00'

Fund for 2nd part may be released from H/A '72-2217-05-192-SP-006-35-00'

Statement 'A' for part 1 and Statement A & F for part 2 are placed below'

Submitted

Suman

27.11.2017

Notes above.
AAFS, for point no. 1, may be accorded, as there is available fund.
After that, proposal may be sent to FD for Administrative approval and augmentation of Budget

27/11

File No. : MA/P/C-10/3S-156/2017: UD & MA Department
File Name: Procurement of bins, equipment and vehicles for transportation of MSW under Panihati Municipality

Notes prepages

The File may be referred to the Finance Department, Group R, for necessary Administrative Approval for the Scheme Solid Waste Management in Panihati Municipality at a total Estimated Cost of Rs.4522.39 Lakh as per DPR and Release of fund of Rs.900 Lakh under H/A 72-2217-05-192-SP-006-V-35 as proposed at NSP-1

20/12/17
Sougata Dey
A.O. to Financial Advisor
UD & MA Department

19/12/17
(Amit Gangopadhyay)
Financial Advisor
UD & MA Department

Secretary, U.D & M.A. Department

Urban Development Deptt.
U/O No. 762
Dt. 20/12/17

May be approved.
FD concurrence will be sought.
19.12.2017

MA & UD

Secretary

21/12/17

Urban Development Deptt.
U/O No. 801
Dt. 26/12/17

FD

22.12.2017

PRC
27/12/17

MA/P/C-10/3S-156/2017

a. F.A. of the Administrative Deptt has mentioned at nsp-2 the H/A 72-2217-05-192-SP-006-35-V" from which the Administrative approval for the instant project may be accorded but there is no fund position at present under this H/A.
b. On the other hand, Statement – A (two) and Statement – F are confusing. BP under the H/A : "72-2217-05-193-SP-006-35-V" in the current financial year 2017-18 is Rs. 3210.60 lakh leaving the balance amount of Rs. 1874.61 lakh and Statement 'A' has been furnished for financial sanction and release of Rs. 900.00 lakh under the H/A "72-2217-05-192-SP-006-35-V" in the current financial year 2017-18.

We may request the Administrative Department to resubmit the file with clarifications with reference to 'X'.

Sd/- P. Kadyan
08/01/2018
Sd/- H. K. Dwivedi
08/01/2018

To
The UD & MA Department

10.01.2018
S.O., Finance Department

TS/DD

Pl. resubmit.

11.01.18

SS (S. Ghosh)
May kindly see as the H/A as mentioned are related to MA Branch of this Deptt.
11.1.18

Suman

11/1/18

From Pre-page

The Director, SUDA has informed that pursuant to a decision taken by the higher authority, the bin, equipment and vehicles for transportation of Municipal Solid Waste for Panihati Municipality should have been procured centra.ly by SUDA with an objective to collect, reduce (if necessary)and transport the solid Waste to its respective dumping ground.

The project is divided into two parts as follows:

Sl. No.	Description of work	Estimated cost including 3% Contingency (Rs. In Lakh)	Estimated cost without 3% Contingency (Rs. In Lakh)
1.	Procurement of equipment and vehicles for transportation of MSW	: 906.76	: 880.35
2.	Construction and O & M for Compost Plant (100 TPD)	: 3615.63	: 3510.32
	Total	**4522.39**	**4390.67** [Flag 'R']

Under the above stated circumstances the following may be considered:

1. Administrative Approval for Procurement of equipment and vehicles for transportation of MSW at an estimated cost of Rs. 906.76 lakh including 3% contingency may be accorded vide No. 1324 – F.B. dated 20.12.2017 of F.D, Budget Branch. Fund will be released during the next F.Y. 2018-2019 under the Head of A/c. '72-2217-192-007-SP-35-0-v'.

2. After issue of the Administrative Approval as stated in col. 1 above the file may be sent to Finance Department, Gr. 'N', for their concurrence for 'Construction and O & M for Compost Plant (100 TPD)'at an estimated cost of Rs. 3615.63 lakh including 3% contingency. The said fund will be released during the next F.Y. 2018-2019 under the Head of A/c. '72-4217-60-051-SP-018-53-00-v'.

S.S.(S.(2.)

Submitted

Suman

15.01.2018

Pls write to dir(SUDA) with a copy to Add. dir for clarification regarding fund; as mentioned in note

15/1

Suman

S.S.(S.(2.)

order above
Draft placed for approval.
Suman
15/1/18

Suman
S.S.(S.(2.) F/C placed.
15/1/18

Draft ~~placed~~ signed. F/C file
15/1/18

D.O.No. 44/MA dt. 15.1.18 Signed

15/1/18

As discussed with S. S. (S.G.)

The Director, SUDA vide this Department's letter no. 44/MA dt. 15.01.18 (CP-12) was informed to enlighten this Deptt. about procurement of equipment, bins and vehicles made by Director, SUDA from the fund of Mission Nirmal Bangla (U) / Swachh Bharat Mission (U) received for Panihati Municipality. But no reply has been received from Director, SUDA.

A reminder letter may be issued.

Draft placed below for approval.

Suman
24.01.2018

24.01.18

S.O. (B&P)

S.S. (S.G.)

24/1/18

Suman

Pl. send via email.

24/1/18

Suman

mail sent

O.D No. 71/MA dt. 24.01.18.

No. SUDA – 277/2017 (Pt) 1393 dated 31.01.2018 received from Director, SUDA (cp-18)

Pud (cp-18) placed below may kindly be seen

In reference to this Department's Letter no. 71/MA dt. 24.01.2018 (cp-16) and 44/MA dt. 15.01.2018 (cp-12) the Director, SUDA has informed the following:

1. The Detailed Project Report for Solid Waste Management of Panihati Municipality, as prepared by the Kolkata Metropolitan Development Authority (KMDA), had already been splitted by them in two parts, one is the Procurement of Primary Equipments for collection & Vehicles for transportation of MSW and the other is for Construction of Sanitary Landfill (42 TPD) and Compost Plant (1000TPD).
2. The total Project cost amounting to Rs. 4522.39 lakh including the cost of procurement of equipments of Rs. 906.76 lakh (excluding the vehicles required for operation of the Compost Plant and SLF), have been approved by the State Government.
3. As the procurement of such equipments would have to be made from the fund of Mission Nirmal Bangla (U) / Swachh Bharat Mission (U), the file with all the details of the project had been put up for approval of the Chief Secretary. On approval Govt. of India will be moved for allocation of Central Share under Swachh Bharat Mission (U) Cp-18).

Submitted
Suman
31.01.2018

31/1/18

1/2/18

Pl. see next pg.

Government of West Bengal
Department of Urban Development & Municipal Affairs
MA Branch, Nagarayan, DF-8, Sector- I,
Salt Lake City,Kolkata – 700 064

No.1049/MA/C-10/2M-2/2017 Dated, Kolkata, the 21st day of November, 2017

From : Special Secretary to the Government of West Bengal

To : The Director,
State Urban Development Agency,
ILGUS Bhavan, Block HC, Sector III, Salt Lake
Kolkata 700 106

Sub: Revised DPRs for Integrated Solid Waste Management Under Mission Nirmal Bangla (U)/SBM(U)
Ref: Note of director, SUDA dated 26.10.2017

Sir,

With reference to above, I am directed to request you to kindly revise the DPRs of 10 (ten) ULBs in the light of the following:

(i) Estimate for bulk purchase of compactors, dumpers and bins will be done centrally by SUDA covering all Municipalities draft be moved for approval of fund under SBM; and

(ii) Estimates/DPRs for landfill sites, Compost Plants, Biogas Plants for each Municipality be proposed separately and AA & FS be sought for by SUDA.

This is issued with the approval of Secretary, UD & MA Department.

Yours faithfully,

Special Secretary to the Government of West Bengal

No.1049/1/MA/C-10/2M-2/2017 Dated, Kolkata, the 21st day of November, 2017

Copy forwarded to shri B.N.Kar, WBCS (Exe.), Addl. Director, SUDA, ILGUS Bhavan, HC Block, Sector III, Salt Lake, Kolkata 700 106

Special Secretary

Revised DPR
21.11.17

সুডা

রাজ্য নগর উন্নয়ন সংস্থা

SUDA

STATE URBAN DEVELOPMENT AGENCY

"ইলগাস ভবন", এইচ-সি ব্লক, সেক্টর-৩, বিধাননগর, কলকাতা-৭০০ ১০৬, পশ্চিমবঙ্গ

"ILGUS BHAVAN", H-C Block, Sector - III, Bidhannagar, Kolkata - 700 106, West Bengal

-18

ক্রমিক নং SUDA - 277 / 2017 (pt) 1393 তারিখ 31-01-18.

From : Director, SUDA and
State Mission Director, MNB (U)

To : The Special Secretary to the Government of West Bengal
Urban Development & Municipal Affairs Department
Nagarayan, DF-I, Sector- I, Salt Lake City, Kolkata – 700 064

Suman pl. process

Sub. : Procurement of Bins, Equipments and Vehicles for transportation of MSW for Panihati Municipality by State Urban Development Agency (SUDA).

Ref.: 1. Memo no.: 71/MA/C-10/3S-156/2017 dt. 24.01.2018 of the Sp. Secretary, Govt. of WB
2. Memo no.: 44/MA/C-10/3S-156/2017 dt. 15.01.2018 of the Sp. Secretary, Govt. of WB
3. Memo no.: 1049/MA/C-10/2M-2/2017 dt. 21.11.2017 of the Sp. Secretary, Govt. of WB

Madam,

With references above, it is to mention that the Detailed Project Report for Solid Waste Management of Panihati Municipality, as prepared by the Kolkata Metropolitan Development Authority (KMDA), had already been splitted by them in two parts, one is the Procurement of Primary Equipments for collection & Vehicles for transportation of MSW and the other is the Construction of Sanitary Landfill (42TPD) and Compost Plant (100TPD).

Now, you may be aware that as per decision taken by the State Government, such Bulk purchase of Equipments and Vehicles may be done centrally by the Director, SUDA and Construction of SLF, Compost/Bio-gas/Vermi-Compost Plant (if any) may be proposed separately.

Here, the total Project amounting to Rs. 4522.39 Lakh including the cost of procurement of equipments of Rs. 906.76 Lakh (excluding the vehicles required for operation of the Compost Plant and SLF), have been approved by the State Government.

As the procurement of such equipments would have to be made from the fund of Mission Nirmal Bangla (U)/Swachh Bharat Mission (U), the file with all the details of the project had been put up for approval of the Chief Secretary. On approval Govt. of India will be moved for allocation of Central share under Swachh Bharat Mission (U).

This is for your kind information and record.

Yours faithfully,

Director, SUDA

SUDA – 277/2017 (Pt.)/ Date: 31.01.2018

Copy forwarded for information to:

1. The Addl. Director, ILGUS & Addl. State Mission Director, MNB (U)

MA DEPTT., M.A. BRANCH * Govt. of W.B. * 430 31/1/18

Director, SUDA

দূরভাষ : ২৩৫৮ ৬৪০৩ / ৫৭৬৭, ফ্যাক্স : ২৩৫৮ ৫৮০০

Tel : 2358 6403/5767, Fax : 2358 5800, E-mail : wbsudadir@gmail.com

Account Section : 2358 6408

-17

Gmail

Joint Secretary MA & UD Department <jsudmadeptt@gmail.com>

Procurement of vehicle & equipment by SUDA for Panihati Municipality

1 message

Joint Secretary MA & UD Department <jsudmadeptt@gmail.com> Wed, Jan 24, 2018 at 2:39 PM
To: "Director, SUDA" <wbsudadir@gmail.com>, BADRI NARAYAN Kar <karbnarayan@gmail.com>

Sir,

Kindly see the attachment.

--
- Regards

Special Secretary
Urban Development & Municipal Affairs Department

71.pdf
1143K

Government of West Bengal
Department of Urban Development & Municipal Affairs
'Nagarayan', DF-8, Sector- I,
Salt Lake City,Kolkata – 700 064

No.71/MA/P/C-10/3S-156/2017 Dated, Kolkata, the 24th day of January, 2018

From : Special Secretary to the Government of West Bengal

To : The Director,
State Urban Development Agency,
ILGUS Bhavan, Block HA, Sector III, Salt Lake
Kolkata 700 106

Sub: Procurement of vehicle & equipment by SUDA for Panihati Municipality
Sir,

With reference to above, I am directed to state that in this Department's letter No. 44/MA dt. 15.01.2018 you were requested to enlighten about the procurement of equipment, bins and vehicles made by Director, SUDA from the fund of Mission Nirmal Bangla (U) / Swachh Bharat Mission (U) received for Panihati Municipality. The clarification has not been received yet.

Now, I am further directed to request you to kindly submit fund flow chart and name of the executing agency for taking necessary action from this end.

Enclo. As stated

Yours faithfully,

Special Secretary to the Government of West Bengal

No.71/1/ MA/C-10/3S-156/2017 Dated, Kolkata, the 15th day of January, 2018

Copy forwarded for information to:

Additional Director and Addl. Mission Director, State Urban Development Agency

Special Secretary

Reminder Director, SUDA
6.01.2018

Draft

-15

Government of West Bengal
Department of Urban Development & Municipal Affairs
'Nagarayan', DF-8, Sector- I,
Salt Lake City,Kolkata – 700 064

No. 71 P/ /MA/C-10/3S-156/2017 Dated, Kolkata, the 24th day of January, 2018

From : Special Secretary to the Government of West Bengal

To : The Director,
State Urban Development Agency,
ILGUS Bhavan, Block HA, Sector III, Salt Lake
Kolkata 700 106

Sub: Procurement of vehicle & equipment by SUDA for Panihati Municipality
Sir,

With reference to above, I am directed to state that in this Department's letter No. 44/MA dt. 15.01.2018 you were requested to enlighten about the procurement of equipment, bins and vehicles made by Director, SUDA from the fund of Mission Nirmal Bangla (U) / Swachh Bharat Mission (U) received for Panihati Municipality. The clarification has not been received yet.

Now, I am further directed to request you to kindly submit your views and fund flow chart and name of the executing agency for taking necessary action from this end.

Enclo. As stated

Yours faithfully,

Special Secretary to the Government of West Bengal

No./1/ MA/C-10/3S-156/2017 Dated, Kolkata, the th day of January, 2018

Copy forwarded for information to:

Additional Director and Addl. Mission Director, State Urban Development Agency

for

Special Secretary

Reminder Director, SUDA
4.01.2018

Government of West Bengal
Urban Development & Municipal Affairs Department
"Nagarayan", DF-8, Sector – 1, Bidhannagar,
Kolkata- 700064.

No.3885 -UD/P/M/B/2F-171/2017 Date: 04.12.2017

From: The Joint Secretary,
To the Govt. of West Bengal.
To : The Principal Accountant General (A&E) W.B.
Treasury Building, Kolkata – 700001.

Sub; Administrative approval for ***"Improvement of Efficiency by replacement/repairing of Electro Mechanical Equipments-in different L.S./M.P.S.under Titagarh and Panihati Zone.."***

Sir,

I am directed by order of the Governor to say that the Governor has been pleased to accord administrative approval for execution of the scheme for ***"Improvement of Efficiency by replacement/repairing of Electro Mechanical Equipments-in different L.S./M.P.S.under Titagarh and Panihati Zone. "*** at an estimated cost of Rs. **5,57,00,000**/- **(Rupees Five Crore Fifty Seven Lakh)** only subject to :-

(i) Strict observation of all relevant Financial Rules and Regulation including e-tender Rules vide Finance Department's Memo No. 6932-F(Y),dated 29.08.2013.
(ii) Timely completion of work to avoid escalation of cost.
(iii) Non-Deviation of allotted fund from the approved scheme.
(iv) Submission of U.C. & Physical Progress Report with six months from the drawal of the fund.

2. I am further directed to say that expenditure for the said scheme shall be debitable to the head of account "4217- Capital Outlay on Urban Development -60- OTHER URBAN DEVELOPMENT PROGRAMME– 051 – Construction – SP- State Plan (Annual Plan & XII th Plan) – 014- Kolkata Metropolitan Development Authority [UD] -53- Major Works/Land and Buildings " **("4217-60-051-SP-014-53-V")**- under Demand No. 72-UD in the State Budget.

3. This issues with the concurrence of the Financial Advisor of UD&MA Department vide U.O.No.439 /UD&MA dated 29.11.2017.

4. Kolkata Metropolitan Development Authority will execute the project.

5. Copy of Work Order is to be submitted along with Utilisation Certificate for 1st installment.

Yours faithfully,

Joint Secretary

-13-

Gmail

Joint Secretary MA & UD Department <jsudmadeptt@gmail.com>

Procurement of vehicle & equipment by SUDA for Panihati Municipality

1 message

Joint Secretary MA & UD Department <jsudmadeptt@gmail.com> Mon, Jan 15, 2018 at 5:33 PM
To: "Director, SUDA" <wbsudadir@gmail.com>

Sir,

Kindly see the attachment.

--
- Regards

Special Secretary
Urban Development & Municipal Affairs Department

440001.pdf
1684K

Government of West Bengal
Department of Urban Development & Municipal Affairs
'Nagarayan', DF-8, Sector- I,
Salt Lake City,Kolkata – 700 064

No.44/ MA/C-10/3S-156/2017 Dated, Kolkata, the 15 th day of January, 2018

From : Special Secretary to the Government of West Bengal

To : The Director,
State Urban Development Agency,
ILGUS Bhavan, Block HA, Sector III, Salt Lake
Kolkata 700 106

Sub: Procurement of vehicle & equipment by SUDA for Panihati Municipality
Sir,

With reference to above, I am directed to forward herewith a copy of note of Addl. Mission director, MNB (U) and to request you to kindly enlighten about the procurement of equipment, bins and vehicles made by director, SUDA from the fund of Mission Nirmal Bangla (U) / Swachh Bharat Mission (U) received.

Enclo. As stated

Yours faithfully,

Special Secretary to the Government of West Bengal

No.44/1/ MA/C-10/3S-156/2017 Dated, Kolkata, the 15th day of January, 2018

Copy forwarded for information to:

Additional Director and Addl. Mission Director, State Urban Development Agency

Special Secretary

Government of West Bengal
Department of Urban Development & Municipal Affairs
'Nagarayan', DF-8, Sector- I,
Salt Lake City,Kolkata – 700 064

No. 44/ MA/C-10/3S-156/2017 Dated, Kolkata, the 15th day of January, 2018

From : Special Secretary to the Government of West Bengal

To : The Director,
State Urban Development Agency,
ILGUS Bhavan, Block HA, Sector III, Salt Lake
Kolkata 700 106

Sub: Procurement of vehicle & equipment by SUDA for Panihati Municipality
Sir,

With reference to above, I am directed to forward herewith a copy of note of Addl. Mission director, MNB (U) and to request you to kindly enlighten about the procurement of equipment, bins and vehicles made by director, SUDA from the fund of Mission Nirmal Bangla (U) / Swachh Bharat Mission (U) received.

Enclo. As stated

Yours faithfully,

Special Secretary to the Government of West Bengal

No. 44/1/ MA/C-10/3S-156/2017 Dated, Kolkata, the 15th day of January, 2018

Copy forwarded for information to:
Additional Director and Addl. Mission Director, State Urban Development Agency

Special Secretary

Panihati swm
15.01.2018

GOVERNMENT OF WEST BENGAL
FINANCE DEPARTMENT
BUDGET BRANCH
NABANNA, HOWRAH

No.1324 - F.B. **Dated: Howrah, 20th December, 2017**

Memorandum

Subject: Enhancement of delegated financial power of certain Departments

In order to facilitate the expeditious implementation of development schemes and welfare programmes, the State Government has introduced the system of Financial Advisers in Administrative Departments vide this Department Memo No. 152 – FB dated 27/04/2012.

Further amendments and clarifications were made to the aforesaid G.O. vide Memo No. 1056 – FB dated 10/09/2012 and 4986-F(Y) dated 21/09/2016.

In terms of Para 2(i) of Memo No. 152 – FB dated 27/04/2012, Financial Advisers were delegated to accord concurrence for administrative approval upto Rs 10.00 Crore.

It has been under active consideration of the Government for some time past to enhance the financial power of the Head of the Departments for administrative approval of certain Departments to further expedite the implementation of development schemes and to reduce the time for getting approval for the schemes.

After careful consideration of the matter, the Governor has been pleased to enhance the limit of financial power of the Additional Chief Secretary/ Principal Secretary/ Secretary in charge of the Departments for administrative approval for any plan expenditure upto Rs. 20.00 Crore within the budgetary allocation with concurrence of Financial Adviser of Public Works Department, Urban Development & Municipal Affairs Department, Panchayats & Rural Development Department, Health & Family Welfare Department, Irrigation & Waterways Department, Water Resources Investigation & Development, Public Health Engineering Department and Housing Department in partial modification of Para 2 (i) of the Memo No 152 – FB dated 27/04/2012

Notwithstanding anything contained in any other G.O. in this regard, Para 2(i) of the Memo No 152 – FB dated 27/04/2012, thus stands amended. Necessary amendments shall be made in West Bengal Financial Rules, 1978 in due course.

(H. K. Dwivedi)
Principal Secretary
to the Government of West Bengal
Finance Department

No. 1324/1(300) - FB **Dated: Howrah, 20th December, 2017**

Copy forwarded for information & necessary action to:

1. The Principal Accountant General (A&E), West Bengal, Treasury Buildings, 2, Govt. Place (West), Kolkata-700 001.
2. The Principal Accountant General (Audit), West Bengal, Treasury Buildings, 2, Govt. Place (West), Kolkata-700 001.
3. The Accountant General (R.W. & L.B. Audit), West Bengal, C.G.O. Complex, 'C' East Wing, 5th Floor, Salt Lake, Sector-I, Kolkata-700 064.
4. Accountant General (E &RSA) West Bengal, 3rd MSO Building, CGO Complex, DF Block, 5th Floor, Sector-1,Salt Lake, Kolkata-700 064.
5. ..... Group/ Branch, Finance Deprtment.
6. Sr. P.S. to Chief Secretary.
7. The Additional Chief Secretary/Principal Secretary/Secretary, ... Department.
8. The Director of Treasuries & Accounts, West Bengal, 3rd Floor, Mitra Building, 8 , Lyons Range, Kolkata – 700 001.
9. The State Information Officer, National Informatics Centre, Bidyut Bhaban, Ground Floor, D.J. Block, Sector-II, Salt Lake, Kolkata- 700 091
10. The Pay & Accounts Officer, Kolkata Pay & Accounts Office-I 81/2/2, Phears Lane Kolkata 700 012
11. The Pay & Accounts Officer, Kolkata Pay & Accounts Office-II P-1 Hyde Lane Kolkata 700 012
12. The Pay & Accounts Officer, Kolkata Pay & Accounts Office-III IB Market, 1st Floor, Salt Lake, Sector-III Kolkata 700 106.
13. The Commissioner, ...Division
14. District Magistrate, ... District.
15. The Treasury Officer,.....Treasury.

(S. Hasan)
Assistant Secretary

STATEMENT – A

Administrative Approval and Plan Release

(For CS/CN form 'C' and for EAP form 'D' should also be used)

1	Name of the Scheme with locational details	:	Procurement of equipment & vehicles by SUDA for Panihati Municipality
2	Type of the Scheme	:	
3	Whether a new scheme of the year or an ongoing scheme: (Furnish copy of G.O. regarding Administrative Approval in case of ongoing scheme)	:	New Scheme
4	Date of Administration approval	:	
5	Original Project Cost	:	
6(a)	Date of commencement of work	:	
6(b)	Expected duration	:	
6(c)	Phasing of expenditure	:	

Year	Amount to be spent

7	Whether clearance from authorities like SPB/ SLSSFC/ GFC etc obtained, if so whether copies of their approval attached	:	
8	Budget Provision (excluding Incentive) (Head of Account-wise)	:	72-2217-05-192-SP-006-35 – Rs. 15256.3975 lakh
9	Cumulative release (Head of Account-wise)	:	72-2217-05-192-SP-006-35 – Rs. 15256.3975 lakh
10	Balance available (Head of Account-wise)	:	72-2217-05-192-SP-006-35 – Nil
11	Expenditure incurred (Head of Account-wise)	:	
12	Physical achievement	:	
13	Amount for which utilization certificate submitted	:	
14	Amount requested for release (Head of Account-wise)	:	72-2217-05-192-SP-006-35 – Rs. 900.00 lakh
15	Detailed Justification of the proposal	:	Scientific management of Municipal Solid Waste of Panihati Municipality

27.11.17

-7-

Statement – F
(Re-appropriation / Augmentation)

From :

1. Demand No. : 72
2. Head of Account :
3. Plan/Non Plan : Plan
4. BE :
5. Amount released so far :
6. Balance :
7. Proposed amount for re-appropriation :
8. Net Balance :

To (*) :

9. Demand No. : 72
10. Head of Account : 72-2217-05-192-SP-006-35 -00
11. Plan/Non Plan : Plan
12. BE : 72-2217-05-192-SP-006-35 – Rs. 15256.3975 lakh
13. Amount utilized so far : 72-2217-05-192-SP-006-35 – Rs. 15256.3975 lakh
14. Reasons for proposed re-appropriation / augmentation : To meet up the cost of construction & O & M for Compost Plant under Panihati Municipality
15. Proposed amount for re-appropriation / augmentation : 72-2217-05-192-SP-006-35 – Rs. 3615.63 lakh
16. Total : 72-2217-05-192-SP-006-35 – Rs. 3615.63 lakh

(*) This portion is to be used for proposal of augmentation

27.11.2017

27.11.17

Statement A & F
27.11.2017

STATEMENT – A

Administrative Approval and Plan Release

(For CS/CN form 'C' and for EAP form 'D' should also be used)

1	Name of the Scheme with locational details	:	Procurement of equipment & vehicles by SUDA for Panihati Municipality
2	Type of the Scheme	:	
3	Whether a new scheme of the year or an ongoing scheme: (Furnish copy of G.O. regarding Administrative Approval in case of ongoing scheme)	:	New Scheme
4	Date of Administration approval	:	
5	Original Project Cost	:	
6(a)	Date of commencement of work	:	
6(b)	Expected duration	:	
6(c)	Phasing of expenditure	:	

Year	Amount to be spent

7	Whether clearance from authorities like SPB/ SLSSFC/ GFC etc obtained, if so whether copies of their approval attached	:	
8	Budget Provision (excluding Incentive) (Head of Account-wise)	:	72-2217-05-193-SP-006-35 – Rs. 3210.60 lakh
9	Cumulative release (Head of Account-wise)	:	72-2217-05-193-SP-006-35 – Rs. 1150.08 lakh
10	Balance available (Head of Account-wise)	:	72-2217-05-193-SP-006-35 – Rs. 2060.52 lakh
11	Expenditure incurred (Head of Account-wise)	:	
12	Physical achievement	:	
13	Amount for which utilization certificate submitted	:	
14	Amount requested for release (Head of Account-wise)	:	72-2217-05-193-SP-006-35 – Rs. 456.00 lakh
15	Detailed Justification of the proposal	:	Scientific management of Municipal Solid Waste of Panihati Municipality

27.11.2017

Govt.of West Bengal

Actual Budget Released for Financial Year 2017-2018

Head of Account: 72-2217-05-193-SP-006-35-00-Grants for creation of Capital Assets

Department Code & Name	BP	Reappropriation/ Augmentation	Total RE	Ceiling Amount	Released Amount	Balance Amount
MA-Urban Development and Municipal Affairs	200000000	121060000	321060000	321060000	133599000	187461000

Reappropriation/Augmentation Details

UO Details

U.O. No.0047 dt.01/04/2017 Rs.66000000 U.O. No.0814 dt.03/07/2017 Rs.84000000 U.O. No.1559 dt.15/09/2017 Rs.30000000 U.O. No.1893 dt.02/11/2017 Rs.141060000

Head of Account wise Total: 321060000

Released Details

Memo Number	Memo Date	Allotment Id	Distributed To	Allotment Type	Total Allotment Released(Rs.)	Total Withdrawal(Rs.)	Net Allotment Released(Rs.)
Draft(Sanction)/MA/P/C-10/1G-1/2015	13/11/2017	613130	DIRECTOR, SUDA	Allotment	35200000	35200000	0
400(Sanction)MA/P/C-10/1G-1/2015	14/11/2017	613478	DIRECTOR, SUDA	Grant-in-Aid	35200000	0	35200000
335(Sanction)/MA/P/C-10/3S-100/2017	07/09/2017	514584	S.D.O. KURSEONG	Grant-in-Aid	62614000	0	62614000
MA/P/C-10/	02/01/2018	656310	S.D.O. KURSEONG	Sanction-cum-Allotment	18591000	18591000	0
497(Sanction)/MA/P/C-10/3S-100/2017	02/01/2018	658323	S.D.O. KURSEONG	Grant-in-Aid	18591000	0	18591000
179(Sanction)/MA/P/C-10/3S-74/2017	30/06/2017	324083	Sub-Divisional Officer, Ranaghat	Grant-in-Aid	17194000	0	17194000
				Head of Account wise Total:	187390000	53791000	133599000

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NOTE SHEET

SUDA

(4)

"X" & "Y" in NSP 1 & 2
may be Considered for approval.

24/11/17

Secretary
UDMA Deptt.

May be approved.

24.11.2017

HMIC MAEUD

27/11/17

Suman

27/11/17

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NOTE SHEET

SUDA

If approved this file may be sent to the Secretary, UD & MA Department, Govt. of WB, for further necessary action from his end.

Submitted.

Enclosures: As stated.

Addl. Mission Director, MNB(U)

24/11/2017
Executive Engineer (C), KMDA
MNB (U), SUDA

Notes above may kindly be perused
The DPR for SWM project in Panihati Municipality may be approved. Total project cost is Rs. 45.22 Crore. This cost includes the cost of Bins, vehicles, equipments needed for primary collection and transportation.
Procurement of such items may be made centrally from SUDA. Compost plant and landfill site may be executed by KMDA
The vehicles required in landfill site ~~may~~ and compost plant may also be procured centrally by SUDA on substantial progress of execution of those components.
placed for kind consideration.

24/11/2017

Director, SUDA

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NOTE SHEET

SUDA

2017
STATE URBAN DEVELOPMENT AGENCY
NOTE SHEET
File No.: SUDA- /2017

Sub.: Immediate procurement of Bins, Equipments and Vehicle for transportation for **Panihati Municipality** as per the DPR prepared and placed for sanctioning.

Pursuant to a decision taken by the higher authority, the bins, equipments and vehicles for transportation, i.e. all the items required for Primary and Secondary Collection of Municipal Solid Wastes for **Panihati Municipality**, should have to be procured centrally by SUDA with an objective to collect, reduce (if necessary) and transport the Municipal Solid Waste to its respective dumping ground.

A Detailed Project Report for the Solid Waste Management Project for Panihati Municipality amounting to **Rs. 4522.39 Lakh** (CP-1) had already been prepared by Kolkata Metropolitan Development Authority (KMDA) and submitted to State Government for sanctioning.

This Project, as prepared by KMDA, may be sub-divided into two parts, one is for the Bins, Equipments and Vehicles for transportation, i.e. items required for Primary and Secondary collection and transportation of MSW, for which an amount of **Rs. 906.76 Lakh** (including 3% contingency) had been kept in provision and another portion is the construction and O&M of Compost Plant (100TPD) and Sanitary Landfill (42TPD) along with the vehicles required, for which an amount of **Rs. 3615.63 Lakh** (including 3% contingency) had been estimated by them.

As per decision the first part of the DPR, i.e. the procurement of equipments, bins and vehicles amounting to Rs. 906.76 Lakh, may be made by the Director, SUDA from the fund for Mission Nirmal Bangla (U)/Swachh Bharat Mission (U) received. The individual items for primary collection, transportation etc. as proposed by KMDA is listed below (CP-2):

Items	Amount as estimated (in Lakh)
1. Household Bins (10L)	Rs. 333.1524
2. Tricycle van with 6nos. 60L bins	Rs. 11.7832
3. 6nos. 50L bins for existing tricycles	Rs. 3.4692
4. Fabrication and fitting charges of bins For existing tricycles	Rs. 2.8000
5. Battery operated auto-rickshaw	Rs. 107.2000
6. 8nos. 60L bins	Rs. 6.36232
7. Auto-tipper	Rs. 108.0000
8. Compactor bin 1100L	Rs. 34.33797
9. Road side bins 240L capacity	Rs. 35.00989
10. TT containers	Rs. 203.5000
11. Repairing of existing containers	Rs. 12.5000
12. Wheel barrow for street sweeping	Rs. 13.08825
13. Long Hand brooms, metal tray with plate, Shovels, gloves, masks, apron, raincoat Safety boot etc.	Rs. 9.1459
	TOTAL- Rs. 880.35 Lakh
Add 3% contingency =	Rs. 26.41 Lakh
	Rs. 906.76 Lakh

Now, the above items, amounting to Rs. 906.76 Lakh, may be purchased centrally from SUDA directly, for immediate distribution to the Panihati Maunicipality as they are suffering badly due to need of these items.

Contd.: 2

Kolkata Metropolitan Development Authority

(1)

No:- 296/SD&SWM/KMDA/W-28/12 dated:- 28.6.2017

From
Director General
Water & Sanitation Sector,
KMDA.

To
The Director
SUDA
ILGUS BHAVAN
H-C Block, Sector-III, Bidhannagar
Kolkata-7000106.

Sub: - Detailed Project Report for Municipal Solid Waste Management facility of Panihati Municipality.

Ref: - SUDA-W/2015 (Pt-I)/1483 dated-07.09.2016

Sir,

With reference to above, enclosed please find herewith DPR for Municipal Solid Waste Management facility of Panihati Municipality at a cost of Rs 4522.39 Lakhs.

DPR has been prepared by the Sanitation & SWM, Water & Sanitation Sector, KMDA in consultation with the Panihati Municipality & may be considered under Mission Nirmal Bangla (Swachh Bharat Mission- Urban) under above noted reference.

Enclo: - As Stated.

Yours faithfully,
30/6/17
Director General
Water & Sanitation Sector, KMDA

No: - dated:-

Copy forwarded for information to.

1. The Chief Executive Officer, KMDA
2. The Chairman Panihati Municipality.
3. The Chief Engineer-in-charge, Sanitation & SWM Water & Sanitation Sector, KMDA.

Director General
Water & Sanitation Sector, KMDA

DETAILED PROJECT REPORT
FOR
SOLID WASTE MANAGEMENT
IN
PANIHATI MUNICIPALITY

UNDER

KOLKATA METROPOLITAN DEVELOPMENT AUTHORITY

MAY, 2017

25.6.17
Chairman
Panihati Municipality

Prepared By

ENVIRONMENTAL ENGINEERING SERVICES

ABBREVIATIONS

BOD	**Biochemical Oxygen Demand**
CAA	**Constitution Amendment Act**
CAGR	**Compound Annual Growth Rate**
CBOs	**Community Base Organizations**
CO	**Carbon Monoxide**
COD	**Chemical Oxygen Demand**
CO_2	**Carbon Dioxide**
CH_4	**Methane**
CPHEEO	**Central Public Health and Environment Engineering Organization**
CPCB	**Central Pollution Control Board**
CSP	**City Sanitation Plan**
EPA	**Environment (Protection) Act, 1986**
GAP	**Ganga Action Plan**
GoI	**Government of India**
GL	**Ground Level**
Gpcd	**Gram Per Capita Per Day**
HCl	**Hydrogen Chloride**
ICDS	**Integrated Child Development Scheme**
IGES	**Institute of Global Environment and Science**
JNNURM	**Jawaharlal Nehru National Urban Renewal Mission**
Kcal	**Kilo Calorie**
Kg	**Kilo Gram**
Km	**Kilo Meter**
KUSP	**Kolkata Urban Services for the Poor**
M	**Meter**
LCRS	**Leachate collection and Removal System**

MSW	**Municipal Solid Wastes**
MS	**Mild Steel**
MSWM	**Municipal Solid Waste Management**
MT	**Metric Tons**
MoEF	**Ministry of Environment and Forests**
NGOs	**Non-Governmental Organization**
NCRD	**National River Conservation Directorate**
N	**Nitrogen**
NO2	**Nitrous Oxide**
NRCP	**National River Conservation Plan**
O2	**Oxygen**
O&M	**Operation & Maintenance**
P	**Phosphorus**
PPE	**Personal Protection Equipment**
PPP	**Public Private Partnership**
RDF	**Refuse Derived Fuel**
SCP	**Secondary Collection Point**
SHGs	**Self Help Groups**
SO2	**Sulphur Dioxide**
SPM	**Suspended Particulate Matter**
SWOT	**Strength, Weakness, Opportunities and Threats**
TDS	**Total Dissolved Solids**
TPD	**Tons Per Day**
ULBs	**Urban Local Bodies**
WBPCB	**West Bengal Pollution Control Board**

ACKNOWLEDGEMENT

Environmental Engineering Services, Kolkata acknowledges sincere thanks to the **Kolkata Metropolitan Development Authority (KMDA)** having given the opportunity to prepare Detailed Project Report for Integrated Municipal Solid Waste Management of **Panihati Municipality**.

We would like to place on record our gratitude to Sri. Swapan Ghosh (Chairman of Panihati Municipality), Executive Engineer, Assistant Engineer, Health Officer, all the councilors of Panihati Municipality and other employees of Municipality & ward representatives and also Mr. Subrata Deb Roy (Addi. Chief Engineer) and Mr. Satinath Jana (Executive Engineer) of KMDA, Unnayan Bhaban, Kolkata for supplementing and whole heartedly supporting us to undertake action research and develop final feasibility report of Panihati City.

We also thanks to Sanitary Inspector of Panihati Municipality, Supervisors for their help in undertaking the Primary Survey of the city and unstinted support in accomplishing this assignment. This study would not have been possible without the facilitation and cooperation of Panihati Municipality.

We express our sincere thanks to all the people who supported and assisted us to accomplish this study report as per the guidelines of **CPHEEO Manual on Solid Waste Management 2016 & Municipal Solid Waste Management Handling Rules 2016** for the project "*Detailed Project Reports (DPRs) for Integrated Municipal Solid Waste Management of Panihati City*"

We hereby submit Detailed Project Report on Integrated municipal waste management of Panihati City.

Team Members,

Environmental Engineering Services

Kolkata, West Bengal

PREFACE

Environmental Engineering Services has undertaken Feasibility study for Solid Waste Management under assigned project "Detailed Project Reports for Integrated Municipal Solid Waste Management of Panihati" by **Kolkata Metropolitan Development Authority (KMDA).** A detailed study was carried out for the Panihati City (municipal limit) for assessment of waste generation, primary and secondary collection/transportation, waste processing etc. to observe the existing Solid Waste Management system in Panihati. 4.6 acres of land has been identified for Waste Processing Plant and 3.6 acres of land for Sanitary Landfill site for Panihati city only.

The feasible plan is formularized to improve the solid waste management system of Panihati city, considering outcome of the study undertaken for situation analysis and gaps identification. The plan is formulated in accordance to the guidelines given in **CPHEEOs Manual on Municipal Solid Waste Management 2016 and "Municipal Solid Waste Management Handling Rules 2016"**.

Detailed Project Report has been prepared considering result of the primary and secondary data analysis, stakeholder's consultation. The report is prepared to improve the SWM services includes collection of waste from house-to-house, waste segregation, waste collection and transportation, waste processing facility for compositing and energy recovery options and engineered landfill site for proper waste disposal.

The Detailed Project Report includes project introduction, project background, situation analysis of planning area, status of the existing solid waste management system; gaps identification, feasibility assessment for proposed MSW management system i.e. primary collection, secondary storage and transportation, equipments & machinery, design of processing facility i.e. waste to compost plant and Material Recovery Facility, cost estimates (capital cost). It also covers aspects of public private participation (PPP) in the various components of MSW, proposed institutional framework and community participation through IEC.

EXECUTIVE SUMMARY

1. PROJECT BACKGROUND

Municipal Solid Waste Management (MSWM), one of the basic urban services, has been considered by Panihati Municipality (PM) for intervention to address lack of development of infrastructure and sanitation issues. Looking to the existing SWM system, the Ministry of Environment & Forest has notified Municipal Solid Waste (Management & Handling) Rules 2016 under the Environment Protection Act 1986. According to these rules, all the municipal authorities were expected to improve solid waste management practices in terms of aforesaid rules by December, 2003. The report is prepared to improve the SWM services includes collection of waste from house-to-house, waste segregation, waste collection and transportation, waste processing facility for compositing and energy recovery options and engineered landfill site for proper waste disposal.

2. PROJECT OBJECTIVES

The broad objectives of the Detail Project Report (DPR) would be to determine a technically and economically viable solid waste management project for a phased implementation to meet the requirements of the year 2030. Following are the specific objectives:

- To analyze the existing solid waste management system;
- To devise a system of Storage of non - Biodegradable waste as well as recyclable waste separately at the source of generation of waste;
- To devise cost effective systems for Primary Collection of waste from the city in general and from the slums in particular;
- To devise an efficient system of day to day cleaning of streets and public places;
- To devise systems to eliminate the age old practice of throwing garbage on the streets or outside the dustbins causing nuisance to the people and posing a threat to the health of the community at large;
- To promote processing of waste for deriving Bio-organic fertilizer, reduce quantity of waste going to landfill site; derive income from the processing of waste and help agricultural production;
- To improve the system of transportation of waste;
- To ensure safe disposal of waste;

- Project scheduling & cost estimates;
- Project phasing & to prepare action plan;
- Organizational and financial studies;
- To set recommendation with respect to reforms & sustainability.

3. SCOPE OF THIS REPORT

This Detailed Project Report (DPR) covers an introduction to project, background of planning area, status of existing SWM system, proposed MSW management system with cost estimates, equipment specifications, engineering drawings & design of various facilities, operational & maintenance aspect, PERT charts and strategy & action plan for IEC & capacity building.

4. EXISTING SOLID WASTE MANAGEMENT

- People generally throw the waste in front of the house or shop or on the streets from there sanitary workers collect the waste into Tricycle or pushcart.
- Door to door Collection starts from 6:00 am and continue up to 11:00 am.
- No segregation of waste at source. Crude dumping of waste.
- Nearly 386 temporary and permanent sanitary workers are working in the city.
- There are 140 tricycle and pushcarts engaged for collection of municipal solid waste. Waste handlers make 3-4 trips and collect waste at average 180-200 nos. houses at daily basis. At present door to door, collection is done in only 25-30% area of total area of a ward at daily basis.
- Sweepers use brooms to sweep, collect and transport waste up to nearer container using Pushcarts. The total length of the drains in Panihati is 716 km and length of road is 361 km.
- There are 58 secondary collection points (TT containers) and as many open dumps are located at irregular intervals in 35 wards of the city.
- The Secondary Collection vehicles such as dumper, compactor, tractor trailer etc. are involved in the solid waste transportation which performs on an average 3 to 4 trips per day.
- No separate system for collecting of disposal of construction waste.
- Need of capacity building of municipal employees.
- Presently, all the transportation vehicle of PM disposes into dumping ground which covered 4.5 Acre area with coordinates 22.691679 and 88.385808 at Ramchandrapur, Panihati.
- Lacking of public awareness.

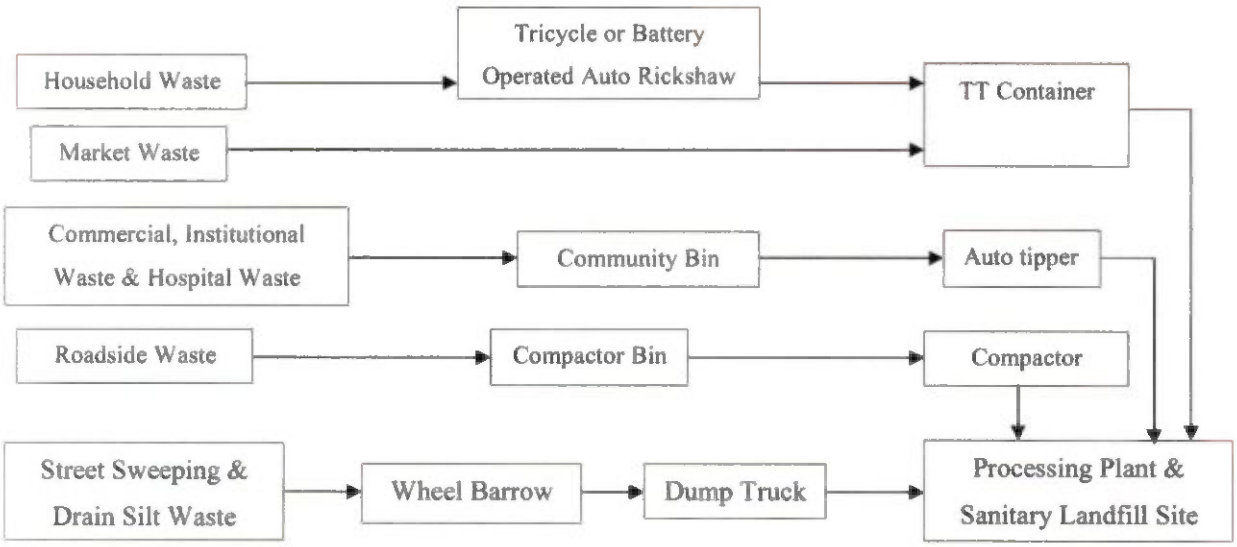
5. QUANTIFICATION AND CHARACTERIZATION OF SOLID WASTE

- The average daily waste generation from Panihati is around 135 TPD in 2017.
- Per Capita Solid Waste generation in Panihati 330 gm/day in 2017.
- The waste collected by rag pickers amounts to about **7.0-8.0%** per cent of the total waste generated in the city.
- Based on the survey Biodegradable waste are 48.30% and Non Biodegradable waste is 51.70%.

6. FOLLOWING OBJECTIVES ARE SET FOR DEVELOPMENT OF SWM IN PANIHATI MUNICIPALITY

- Storage Improving Methodology
- Improving primary collection of waste
- Methods for transportation of waste
- Methods for processing of waste
- Methods for disposal
- Development of organizational structure
- Development of better trained solid waste management personnel
- Better IEC activities
- Financial support

7. PROPOSED MSW MANAGEMENT SYSTEM



- Storage of waste at source
- Segregation of recyclable / non-bio degradable waste
- Primary collection of waste
- Sweeping of streets & public places
- Cleaning of drains
- Provision of littering bins
- Transportation of waste

- **Manpower Requirement for Primary Collection, Road Sweeping and Drain Cleaning**

Sl No.	Description of Equipments	Vehicle No.	Waste cum Sweeper Collector	Drivers	Helper
		Nos.	Nos.	Nos.	Nos.
1	Tricycle van with 6 nos. of 50 lit bins	142	142		
2	Battery operated Auto Rickshaw	67	67		
3	Wheel barrow for Street Sweeping & drain cleaning -110 lit	189	189		
4	Auto tipper	12		12	24
5	Movable compactor	2		2	4
6	Tractor	18		18	36
Total		**430**	**398**	**32**	**64**

- **The Proposed Estimated of Tools/Equipments required for Collection and Transportation of waste is as given below -**

Primary Equipments		
Sl. No	**Description of Items**	**Required Number**
1	House hold Bin 10 lit	195972
2	Tricycle van with 6 nos. of 50 lit bins	44
	6 nos. 50 lit bin for existing tricycle	588
3	Battery operated Auto Rickshaw	67
	8 nos. of 60 lit bins	536
4	Auto tipper	12
5	Compactor bin -1100 lit	73

Executive Engineer
Plng. Divn. & KSWMIP
SD & SWM KMDA

Office of the Panihati Municipality ★ ESTD-1900 ★ B.T. Road, Panihati, (N)24-Pgs.

28.8.17
Chairman
Panihati Municipality

Superintending Engineer,
Planning Circle, SD & SWM Sector
K.M.D.A.

Chief Engineer-In-Charge
Sanitation, K.M.D.A.
Water & Sanitation Sector
K.M.D.A.

6	Road side bins- 240 lit capacity	887
7	TT Container	110
8	Wheel barrow for Street Sweeping & drain cleaning -110 lit	189

- **Vehicles & Manpower Requirement for Processing Plant & Sanitary Landfill Facility**

- The total land requirement has been worked out for Processing Plant 4.6 Acres & Sanitary landfill facility is 3.6 Acres.
- Vehicles requirement for Processing Plant is as given below -

Processing Plant Operation Vehicle		
Sl No	**Vehicle Type**	**Number**
1	Loader cum Backhoe	2
2	Tractor attached loader	3
3	Water tanker with slurry pump	1
4	Tractor	1
5	Tipping trolley	4
6	Dumper 6 m3	1

- Man power Details for Processing Plant is as given below –

List of Manpower details of Processing Plant		
Sl. No.	**Particulars**	**Nos.**
1	Plant Manager (Env. Engineer) - B.E	1
2	Supervisor – B.Sc.	2
3	Accountant --- B.Com	1
4	Chemist - B Sc	1
5	Weigh Bridge Operator - H.S.C	1
6	Mechanic – ITI	1
7	Labourers	10
8	Tractor Driver	1
9	Tractor Attached Loader Driver	2
10	Dumper Driver	1
11	Loader Cum Backhoe Driver	1

Executive Engineer
Plng. Divn. & KSWMIP
SD & SWM KMDA

Chairman
Panihati Municipality

Chief Engineer-in-Charge
Water & Sanitation Sector
K. M. D. A.

12	Rag pickers	8
13	Security Guard	4
14	Gardener	2

- Vehicles requirement for Sanitary Landfill Site is as given below –

Landfill Operation Vehicle		
Sl No.	**Vehicle Type**	**Number**
1	Bulldozer	1
2	Excavator	1
3	Loader cum Backhoe	1
4	Dumper 10 m3	1

- Man power Details for Sanitary Landfill Site is as given below –

List of Manpower Details of Landfill		
Sl. No.	**Particulars**	**Nos.**
1	Assistant manager – Landfill	1
2	Supervisor – B.Sc.	2
3	Electrician	1
4	Laborers	6
5	Excavator Driver	1
6	Dozer Driver	1
7	Loader Driver	1
8	Dumper Driver	1
9	Gardener	2
10	Security Guard	4

Executive Engineer
Plng. Divn. & KSWMIP
SD & SWM KMDA

Office of the Panihati Municipality ESTD-1900 B.T. Road, Panihati, (N)24-Pgs.

29.6.17
Chairman
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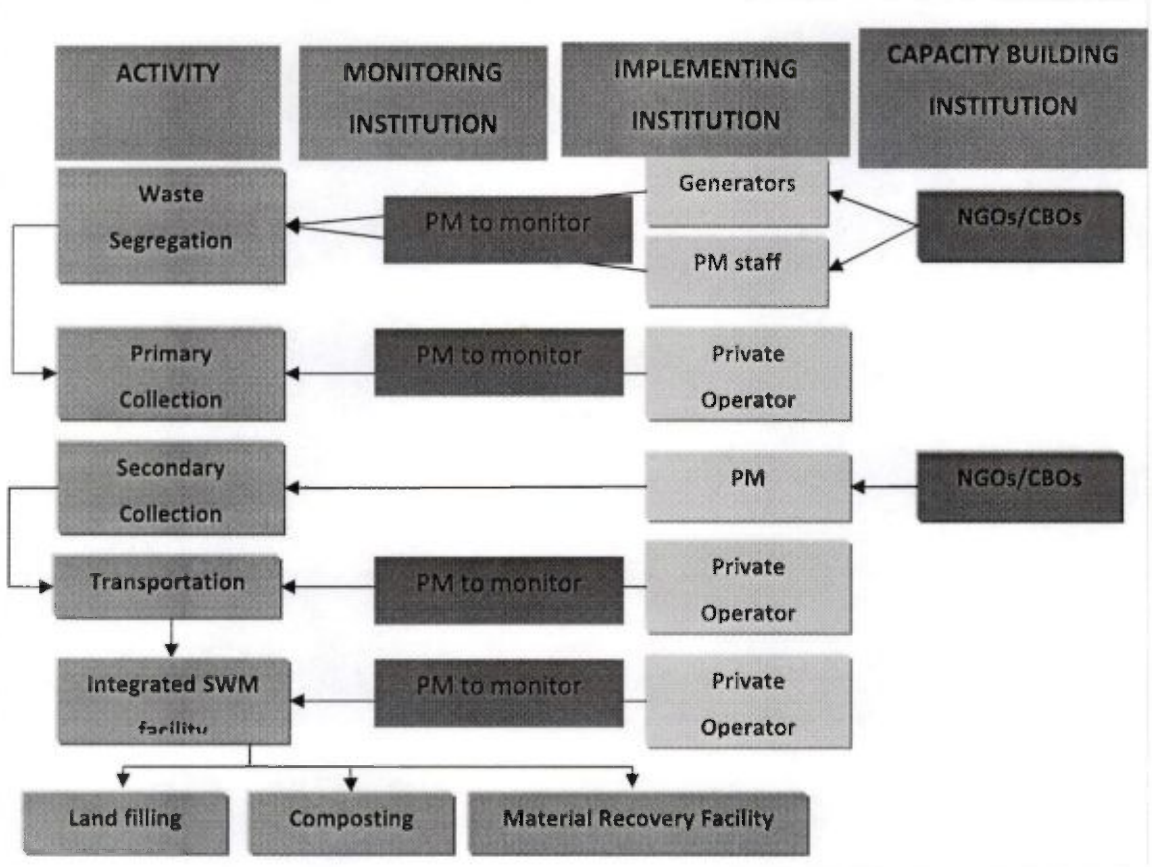
Superintending Engineer,
Planning Circle, SD & SWM Sector
K.M.D.A.

Chief Engineer-In-Charge
Sanitation & S.W.M.
Water & Sanitation Sector
K.M.D.A.

PROPOSED INSTITUTIONAL FRAMEWORK



IEC Material & Public Awareness

- Bringing of attitudinal and behavioural changes among the residence about the segregation of waste and sanitation improvement
- Public awareness through informing and educating the masses on various aspects of solid waste management and achieve the target of receiving segregated waste from each household.
- Integration and involvement of private sweepers and Rag Pickers in improving MSW management.
- Proposed Financial Budget for IEC materials which shows in below -

Sl. No.	IEC materials and methods for one year budget	Quantity
1	Sanitation Booklet (4page)	2,00,000
2	Sanitation Leaflet (One page)	4,00,000

Executive Engineer
Plng. Divn. & KSWMIP
SD & SWM KMDA

Office of the Panihati Municipality ESTD-1900 B.T. Road, Panihati, (N)24-Pgs.

25.6.17
Chairman
Panihati Municipality

Superintending Engineer,
Planning Cell, SD & SWM Sector
K.M.D.A.

Chief Engineer-In-Charge
Sanitation & S.W.M.
Water & Sanitation Sector
K. M. D. A.

3	Banner (4'-0"x2'-0") flex	500 nos.
4	Hoarding (20'-0"x10'-0"x6'-0") for one year	100 nos.
5	Advertisements to Newspaper TV & Other Media	L.S
6	Workshop, Seminars	100 nos
7	Miking 10 sets (Weekly one year)	520 times
8	Student Rally Each Month	12 nos

COST ESTIMATION

Estimated Cost for SWM System	
A. Collection System	
A.1 Procurement of vehicles for Primary Collection & Secondary Transportation	**87,120,322.89**
A.2 Procurement PP Equipments for primary collection	**914,590.00**
B. Processing Plant	
B.1 Construction of Processing Plant & Material Recovery Facility	**150,144,581.26**
B.2 Procurement of Machineries for the plant	**30,000,000.00**
B.3 Procurement of vehicles for Operation of the plants	**12,470,000.00**
C. Sanitary Landfill	
C.1 Construction of Sanitary Landfill Phase-1	**59,268,046.69**
C.2 Construction of Sanitary Landfill Phase-2	**48,885,199.07**
C.3 Procurement of Vehicles for Operation of the landfill	**19,864,000.00**
D. Social Awareness Program (Per Year)	**10,000,000.00**
E. One year O&M of CP & SLF	**20,400,000.00**
Sub Total	**439,066,739.91**
Contingency – 3%	**13,172,002.20**
Total	**452,238,742.11**

Executive Engineer
Plng. Divn. & KSWMIP
SD & SWM KMDA

Office of the Panihati Municipality

28.6.17
Chairman
Panihati Municipality

Superintending Engineer,
Planning Cell, SD & SWM Sector
K.M.D.A.

S.K.Bandyopadhyay
Chief Engineer-In-Charge
Sanitation & S.W.M.
Water & Sanitation Sector
K. M. D. A.

OPERATION & MAINTENANCE ARRANGEMENT & REVENUE GENERATION

Escalation of O&M Cost per year after full utilization- 5.0%

Escalation Factor- 1.05

Expense over the Project Life

Expenses	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
O&M cost for the project	88,514,304.00	92,940,019.20	97,587,020.16	102,466,371.17	107,589,689.73	112,969,174.21	118,617,632.92	124,548,514.57	130,775,940.30	137,314,737.31
Total O&M	**88,514,304.00**	**92,940,019.20**	**97,587,020.16**	**102,466,371.17**	**107,589,689.73**	**112,969,174.21**	**118,617,632.92**	**124,548,514.57**	**130,775,940.30**	**137,314,737.31**

Escalation of Revenue after every 3years after full allocation- 12%

Escalation factor- 1.20%

Revenue from Sanitation & Recyclable Items

Year	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Total O&M	55,444,800.00	89,367,240.00	102,867,240.00	102,867,240.00	102,867,240.00	123,440,688.00	123,440,688.00	123,440,688.00	148,128,825.60	148,128,825.60
Total Revenue	**55,444,800.00**	**89,367,240.00**	**102,867,240.00**	**102,867,240.00**	**102,867,240.00**	**123,440,688.00**	**123,440,688.00**	**123,440,688.00**	**148,128,825.60**	**148,128,825.60**

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CHAPTER 1 INTRODUCTION TO THE PROJECT

Waste disposal is one of the major problems being faced 1the world over and India is no exception. Management of Solid Waste, though an essential service, is given low priority. This, coupled with lack of financial resources, institutional weaknesses, improper choice of technology & rapid urbanization, whose ramifications are more pronounced with uncontrolled growth rate of population, has made this service far from satisfactory, thus creating serious environmental and health problems.

1.1 SOLID WASTE MANAGEMENT (SWM).....A DEFINATION

Solid Waste Management (SWM) is an organized process of storage, collection, transportation, processing and disposal of solid refuse residuals in an engineered sanitary landfill. It is an integrated process comprising several collection methods, varied transportation equipment, storage, recovery mechanisms for recyclable material, reduction of waste volume and quantity by methods such as composting; refuse derived fuel (RDF), waste-to-energy and disposal in a designated engineered sanitary landfill.

The selection of a suitable SWM process is driven by the source and quality of waste produced. Solid waste is generated from a number of sources which include households (kitchen and yards), commercial areas (shops, hotels and restaurants), industries (raw material and packaging), institutions (schools, hospitals and offices), construction and demolition sites, wild and domesticated animals (carcasses of dead animals, manure), parks (fallen branches, leaves from trees) and streets (sand, silt, clay, concrete, bricks, asphalt, residues from air deposition and dust).

1.2 CURRENT STATUS OF SWM IN INDIA

Management of Municipal Solid Wastes (MSW) continues to remain one of the most neglected major issues in Indian cities due to the rapid urbanization, urban population growth and industrialization. Most of local administrations are directly dumping MSW without any segregation and treatment to the open dumping site, this manner of inappropriate disposal of MSW is become a major threat to the environments and public health in developing countries like India.

Level of urbanization increased from 27.81% in 2001 Census to 31.16% in 2011 Census. The proportion of rural population declined from 72.19% to 68.84%.Per capita waste generation increasing by 1.3% per annum. With urban population is increasing between 3– 3.5% / annum. Annual increase in waste generation is around 5% annually. India produces 42.0 million tons of municipal solid waste annually at present. Per capita generation of waste varies from 200 gm to 600 gm per capita / day. Average of waste generation rate is 0.4 kg per capita per day in 0.1 million plus towns. Collection efficiency is between 50% to 90% of solid waste generated.

The Local Governing Bodies (LGBs), viz. municipalitiesare responsible for providing SWM services in the urban areas. In most of the urban areas, insufficient funds, use of obsolete/ inefficient technologies, lack of public awareness/training and improper infrastructure have resulted in a state of poor management of solid waste.

1.3 PROBLEMS DUE TO SOLID WASTE

Accumulation of solid waste in open areas is an eyesore, diminishing real estate and property value, a breeding ground for insects and other vectors (rats and mice, wild and domesticated animals). It also causes odour nuisance, reflects the unorganized nature of the community and creates a poor environment for growing children.

Improper and unorganized disposal of Municipal Solid Waste (MSW) in open areas and landfills have a negative impact on the living conditions of human beings as well as the overall environment. It results in spread of communicable and non-communicable diseases among human beings and animals, thus affecting the welfare, livelihood and economic productivity. In addition, it causes contamination of soil, rivers, surface water, ground water and generation of toxic & greenhouse gases.

In recent years, the river has become grossly polluted as most of the solid waste being generated in our society is ultimately disposed of into rivers. Also the pollutants generated in the catchment area of the river is transported regularly or occasionally by leaching, drainage and surface water run-off during the monsoon. The main pollutants are topsoil, plant residues, dumped garbage and dead bodies, agricultural residues etc.

1.3.1 Need of Solid Waste Management System

Looking to the existing SWM system, the Ministry of Environment & Forest has notified Municipal Solid Waste (Management & Handling) Rules 2016 under the Environment Protection Act 1986. According to these rules, all the municipal authorities were expected to improve solid waste management practices in terms of aforesaid rules by December, 2003. But, the situation did not improve as expected for want of adequate technical know-how and lack of human and financial resources.

Therefore, the study has been undertaken to assess the existing SWM system, gaps identification and proposed plan in accordance to the MSW Rule 2016. The report is prepared to improve the SWM services includes collection of waste from house-to-house, waste segregation, waste collection and transportation, waste processing facility for compositing and energy recovery options and engineered landfill site for proper waste disposal.

1.4 INITIATIVES TO IMPROVE SWM

Some of the key initiatives and recommendations are briefly discussed below:

1.4.1 Hon'ble Supreme Court Of India Recommendations

In recent years, the current SWM system in India has received considerable attention from the Central & State Governments and local municipalities. The first initiative was taken by the Hon'ble Supreme Court of India in 1998, which resulted in the formation of a committee to study the current status of SWM in Indian cities. This committee identified the deficiencies/gaps in the existing SWM system in the country and prepared the "***Interim Report on SWM Practices in Class I Cities***" (*Class I cities are cities with a population ranging between one lakh to ten lakhs{1, 00,000 –10, 00,000}).*

1.4.2 Municipal Solid Waste Management Rules

As a second initiative, the Ministry of Environment and Forests (MoEF), GoI, published "***Municipal Solid Waste (Management and Handling) Rules, 2016***" (*MSW Rules 2016*). These rules were developed in conformance with sections 3, 6 and 25 of the Environment Protection Act, 1986 and aim at standardization and enforcement of SWM practices in the urban sector. They dictate that, "*Every municipal authority shall, within the territorial area of the, be responsible for the implementation of the provisions of these rules and infrastructure development for collection, storage segregation, transportation, processing and disposal of municipal solid wastes*". In addition, "CPCB shall coordinate with State Pollution Control Boards (SPCBs) and Pollution Control Committees (PCCs) in the matters of MSW disposal and its management and handling".

1.4.3 Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

The Atal Mission for Rejuvenation and Urban Transformation (AMRUT) is another notable initiative undertaken by Government of India. The scheme is dependent with public private partnership model(PPP) model. AMRUT provides funding for urban infrastructure development in cities and towns of the country. This mission was initiated in 2015 and projects will be executed by ULBs. In case the ULBs do not have adequate capacity to handle projects, the State Government may recommend in SAAP, upon a Resolution passed by the ULB, for the execution of the projects by specialized parastatal agencies of the State or Central Governments. Such arrangements should necessarily be executed by way of a tripartite Memorandum of Understanding (MoU) amongst the State Government, the specialized Parastatal agencies and the concerned. In such a case, the capacity of the ULBs will be augmented through the capacity building component of the AMRUT. The maintenance and upkeep of the created assets will be the responsibility of the ULB and the State Government.

1.4.4 Swachh Bharat Abhiyan

Swachh Bharat Abhiyan is a campaign by the Government of India to clean the streets, roads and infrastructure of the country's 4,041 statutory cities and towns.The campaign was officially launched on 2nd October 2014 at Rajghat, New Delhi. It is India's largest ever cleanliness drive with 3 million government employees, and especially school and college students from all parts of India, participating in the campaign. One of the major objectives of this mission is to establish modern and scientific Municipal Solid Waste Management in the cities of India.

1.5 PROVISIONS OF MSWM PLAN- LONG TERM AND SHORT TERM

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

Successful implementation of Short term Strategies and Long term Strategies is must for Panihati area. These programs give numerous options by which coordination and cooperation among community and Panihati (PM) can be strengthened.

1.5.1 Short term Strategies

1.5.1.1 Identification of Key Issues

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

1.5.1.2 Inter - Se Priority among Obligatory Services

- Decide the minimum level of service they would like to provide in each category of service in a given time frame
- Estimating the requirement of funds for the same
- Fixing the inter-se priority of the essential service, giving due priority to SWM services and allocate funds for each service as per its merits.
- Decide the critical area in each service and utilize the funds to optimize the benefit of society

1.5.1.3 Improve Collection Efficiency

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

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

1.5.1.4 NGO/Private Sector Participation

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

1.5.1.5 Review Establishment Costs

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

1.5.2 Long term Strategies

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

1.5.2.1 Development of Strategies

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

- The 5R hierarchy of waste management: Reduce, Reuse, Recycle and Recover, Residual Management.
- Bringing about fundamental changes in the way in which we think about and manage wastes.

- Forming the Local Solid Waste Advisory Committee comprised of roughly equal representation from government, industry and Non-Governmental groups and the Technical Solid Waste Advisory Committee comprised primarily of municipality engineers.
- Public consultation activities to inform the public of the Plan Review and solicit their input.
- Conducting a Waste Flow and Recycling Audit to quantify the amount and composition of residential, industrial and construction wastes generated, recycled and disposed of by the Region. This Audit shall establish a baseline against which progress may be measured. Documenting of the baseline conditions and the existing solid waste management system after stage.
- To evaluate the waste management options identified and recommend an overall solid waste management strategy. Evaluations were done on the basis of three major criteria: ability to divert waste from disposal, environmental and social impacts, and cost effectiveness. These will result in Comprehensive Waste Management Strategy.
- To conduct a comprehensive public consultation program to inform and solicit input from the public. The program will include television specials, newsletters and direct mailings, press releases, discussion papers, library reference centers, a Plan Review hotline, meetings and workshops for the advisory committees and the public, schools' activities, etc.

1.5.2.2 Involving Community

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

inadequate storage facilities. Citizens should also be encouraged to report abuse of containers.

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

1.5.2.3 Public Information& Education

The Panihati Municipality (PM) along with NGO's cooperation and active participation will expand public information/education programs targeted at residential generators. All the stakeholders involved in the SWM will develop coordinated formal communications plans and develop ongoing programs of audience research to support overall educational promotional campaigns. The Comprehensive Waste Management Strategies outlines the roles and responsibilities for expanded education in its table. The above are in addition programs of residential communication and education, which include:

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

Many organizations have already been conducting their own educational programs for some time. The intention of PM shall be to recognize and encourage those organizations' efforts and ensure that the governmental activities are compatible with and reinforce the non-governmental programs, where appropriate. The PM should inform and educate the appropriate target audiences of new initiatives such as disposal bans and source separation requirements as they develop. This could be done, wherever practical, by including information about the new Plan initiatives and disposal alternatives into the existing communications vehicles such as the schools programs or Industrial workshops, and by the use of some new dedicated vehicles such as TV clips and newspaper articles.

- **Promoting backyard composters:** Initially to promote back yard composting in small business houses or residential area, Municipality or local government should initiate to subsidize the cost to some extent. The staff of PM shall promote such programs and ensure that subsidies are distributed evenly.
- **Revival of taxation based on user fee systems:** The Municipality shall implement quantity-based user fee systems for residential waste collection. In the longer run, the PM shall add user fees for recycling and composting as appropriate. Quantity-based user fees for recycling and composting should be structured to create an economic incentive for residents to follow the solid waste hierarchy: reduction/reuse (no user fee), recycling (smaller user fee) and

disposal (larger user fee). The quantity based user fee systems shall be modified or replaced as funds or services from manufacturers' responsibility programs become available. The quantity-based user fee systems in the present proposed plan shall have variations to best accommodate the needs of each. The manufacturers' responsibility programs expected from the senior governments should provide maximized contributions (in the form of funds and/or services) towards municipal 3Rs and waste collection programs. Ideally, the manufacturers' responsibility programs should eventually provide funds or services to cover all municipal waste management costs. However, any such costs that are not recovered via or borne by manufacturers' responsibility programs should be recovered via the user fee system (and not the municipal tax base, in the case of single-family residential waste). That is, for the short to medium term, until contributions from the manufacturers' responsibility programs begins, user charges should cover all of the costs for municipal waste management. The contingency, in the absence of manufacturers' responsibility programs, will be to have all the municipal waste management costs to be paid for by quantity-based user fees or utility charges (or by some combination of user charges plus municipal taxes in the case of single family residential sources).

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

The Panihati should examine and recommend action regarding:

- Impact of construction waste on city environment
- Available 3Rs options
- Use of construction waste as sub-base for construction
- Potential disposal and development sites
- Future generators of construction waste materials
- Expanded use of recycled concrete and asphalt regional and municipal roles in making source separation of waste happen.
- **Review, reporting and monitoring:** The mechanism by which effectiveness of the management strategies and policies will be evaluated is as follows: The PM will implement their 5Rs initiatives, and will provide with an annual summary of available information on:
- Municipal population figures
- Waste quantities and types received at disposal facilities
- Quantities and types of materials collected in municipal recycling programs and depots

- Measurement of impact of other initiatives, if possible other related information

PM shall compile the annual summaries from the municipalities and information from private facilities, and combine them with Regional 3Rs and disposal data, and generate an annual report that compares projected and actual waste diversion and disposal. Every 5 years, the annual report comparing projected and actual waste diversion will also contain an in-house reassessment of the PM solid waste quantities, composition, and other characteristics and their impacts on Regional and municipal programs. As an additional check of the review and reporting mechanism, the RMC shall establish a Plan Monitoring Committee (PMC) to monitor and advice on implementation of the Plan initiatives.

1.6 PROJECT OBJECTIVE AND DATA SOURCES

1.6.1 Objectives

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

- To analyze the existing solid waste management system;
- To devise a system of Storage of non - Biodegradable waste as well as recyclable waste separately at the source of generation of waste;
- To devise cost effective systems for Primary Collection of waste from the city in general and from the slums in particular;
- To devise an efficient system of day to day cleaning of streets and public places;
- To devise systems to eliminate the age old practice of throwing garbage on the streets or outside the dustbins causing nuisance to the people and posing a threat to the health of the community at large;
- To promote processing of waste for deriving Bio-organic fertilizer, reduce quantity of waste going to landfill site; derive income from the processing of waste and help agricultural production;
- To improve the system of transportation of waste;
- To ensure safe disposal of waste;
- Project scheduling & cost estimates;
- Project phasing &to prepare action plan;
- Organizational and financial studies;
- To set recommendation with respect to reforms & sustainability.

1.6.2 Scope of Study

The scope of work includes the following:

- Detailed survey of the prevailing conditions
  - Quantity Assessment (Collected, Transported and Disposed Off);
  - Sampling and Analysis of waste for Quality Assessment;
  - Equipments and Manpower Availability;
  - Gap analysis based on the *MSW Rules 2016*
- Design an MSW management system in accordance with MSW Rules, 2016
  - Primary Collection – Door To Door Collection, Segregation of waste
  - Secondary Storage and Collection Bins (Household bins, Community Bins)
  - Primary Collection Vehicles (for Collection and Transfer to Processing Facility)
  - Transfer Station – Feasibility Assessment if required
  - Waste Transportation Facility – Vehicles for waste transportation from waste storage to processing facility and regional landfill site
  - Waste Processing Facility – Waste Processing equipments/machinery
    - Methods of Composting;
    - Refused Derived Fuel (RDF);
    - Waste to Energy;
    - Land Requirement;
    - Design Specifications and Drawings;
  - Disposal of Waste – Individual/Regional Landfill site Development Plan
    - Land Requirement
    - Equipments/ Machinery
    - Design Specification & Drawings
  - Cost Estimates
    - Capital Cost (Equipments, Vehicles, Treatment plant, Landfill site etc)
    - Operation & Maintenance Cost
    - Recovery of Cost
  - Environmental Compliances Requirements
    - Environment, Health and Safety (EHS)- EIA

1.6.3 Approach and Methodology

The study proposes an integrated SWM management and implementation plan for Panihati Municipal area. In order to address each of the problems associated with the current SWM system in Panihati, a series of steps were adopted, which are summarized in *Figure 1.1*

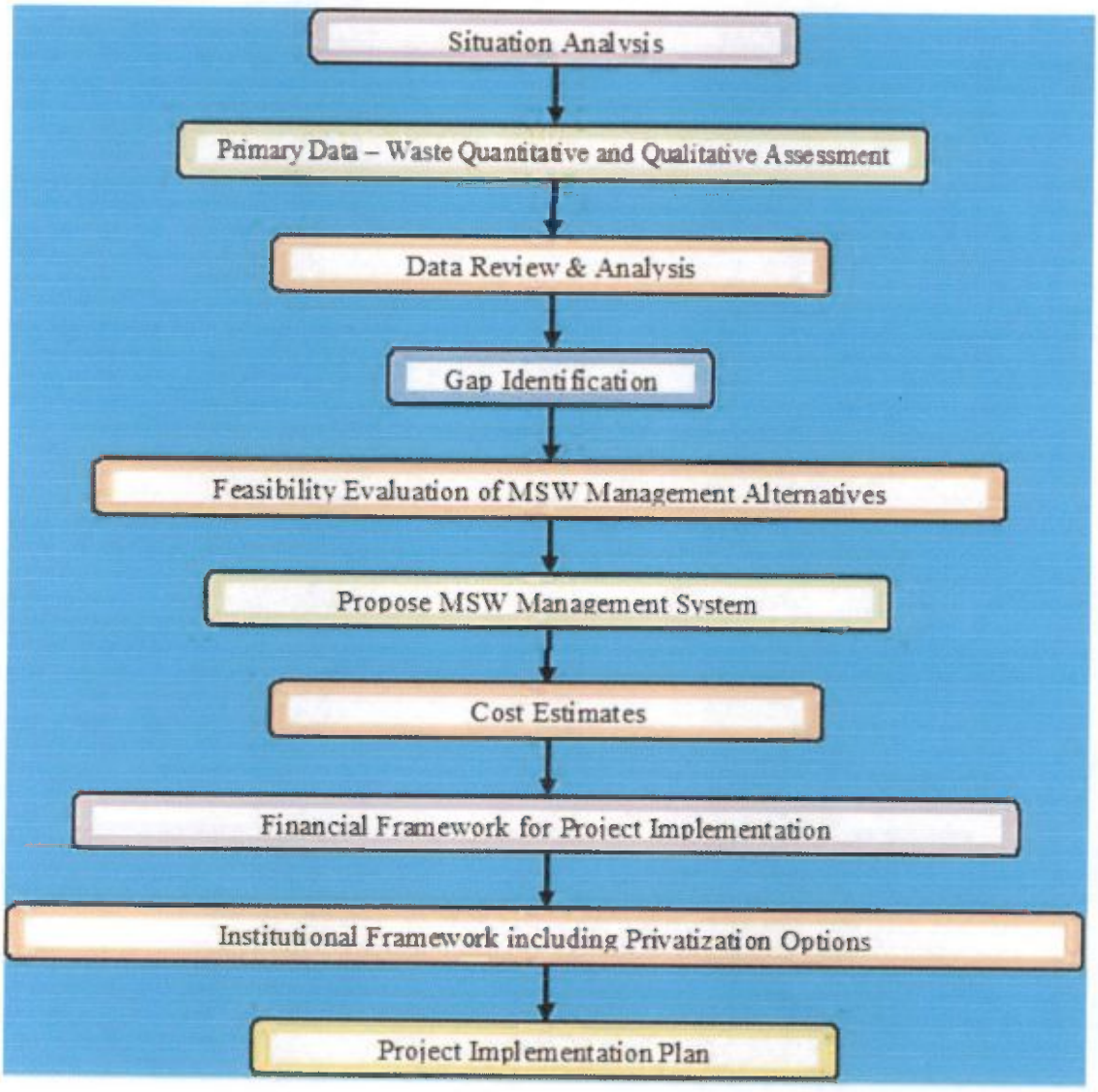


Figure 1-1: Approach and Methodology

1.6.4 Situation Analysis

To assess the situation and identify the gaps, project team interacted with officials ofPanihati. The objective of the meetings was to get acquainted with their views and first hand information on existing SWM management system to identify gap areas. Secondary data was collected after discussions with Panihati's officials to understand the present practice of waste management and disposal system in Panihati.

Detailed questionnaires were prepared to collect information from relevant organizations in a streamlined and organized fashion at macro level. In this regard, following preliminary information was also collected to help in framing the methodology for primary data collection.

- City Map of Panihati with Municipal Limits;
- Population Details;
- Organization structure;
- Total Number of Households;
- List of Markets (Commercial Markets, Mandies);
- List of Hospitals;
- List of Hotels& Restaurants ;
- List of Parks, Gardens, Community hall;
- Number of persons involved in SWM;
- Existing Trenching Location;
- New selected land area for Processing facility & SLF;
- List of existing Vehicles, Waste transportation equipments;
- Ward-wise population distribution;

Figure 1-2: Stakeholder's Consultation

Project team undertaken primary data generation/site survey in accordance to the gaps identified with secondary data collected.

1.6.4.1 Primary Data – Quantitative and Qualitative Assessment

A comprehensive assessment was carried out for waste quantification and characterization. A study was conducted at various waste generation sources, secondary storage and waste disposal sites to ascertain the waste quantity.

Project team has provided sampling polythene bags to the household/commercial/institution owner/representative for collection of solidwaste produce in a day in plastic bags and samewas collected on next day. On site quantity assessment has been carried out by survey team through weighing machine.

a) **House Holds** – Composite Sampling and analysis was carried out for 5 days consecutive from households. Composite samples for three days from households were collected and analyzed in laboratory. On site weight measurement has been performed for all samples;

b) **Commercial Place** – Composite sampling and analysis was conducted from commercial places i.e. hotels, shops, vegetable/ fish markets etc.;

c) **Institutional Place** – Composite sample from institutions/ offices was collected and analyzed in laboratory;

d) **Medical Institution** – Composite sample of domestic solid waste from hospitals/nursing homes was collected and analyzed.

e) **Open Dump/Trenching ground** – Composite sample were collected and analyzed from open dump/ trenching grounds.

Sampling and analysis from the open dump/ trenching grounds was conducted to ensure representative sampling for various sources.

During the primary survey, the project team interacted with nearby residents, took photographs of the site and conducted waste quantification and characterization.

1.6.4.2 Data Review and Analysis

The waste quantity and characterization details gathered during primary survey were reviewed and analyzed. Measured waste quantity was also verified on recommended waste quantity in accordance to the CPHEEO manual. The data was duly complied and details are provided in chapter 4 of this report.

1.6.4.3 Gap Identification

Gaps identification was undertaken with reference to the MSW Rules 2016 and the existing MSWM scenario as per the results of the primary survey. During the survey awareness level of general public in regard to segregation of waste and other environmental friendly waste management practices was accessed. Following are the highlights of this exercise

- Comparison of default per capita waste generation factors with per capita waste generation figure as derived from the survey;
- Adjudging the availability and requirement of waste management equipments, the analysis was used for conceptualization of the proposed plan;
- The existing waste management is not organized & scheduled and hence, requires up gradation;
- The awareness level regarding the SWM rules and the acceptability is very low.
- The residents & the shop keepers dump waste at the nearest open dump site and/ or on the streets or in vacant plots;
- Many of the Eating joints/ Hotels/ Restaurants/ Dhabas/Guest Houses/ Banquet Halls of the City are unauthorized. Hence the Panihati Municipality is not able to formulate a detailed plan for waste collection from these places.

1.6.4.4 Feasibility Evaluation of MSW Management Alternatives & Proposal, Detailed Engineering, BOQ and Cost Estimates of the MSWManagement Plan

Feasibility assessment was undertaken considering result of the Primary and Secondary data analysis, stakeholder's consultation, and expert judgment of consultant. The feasible options are considered and proposed a most suitable MSW management model for implementation.

Further, detailed engineering, cost and estimates for this plan will develop and consider for producing a finance model.

CHAPTER 2 EVOLUTION OF SOILD WASTE MANAGEMENT

Solid wastes comprise all the wastes arising from human and animal activities that are normally solid and are discarded as useless or unwanted. It is an all-inclusive, encompassing heterogeneous mass of throwaways from urban community as well as homogeneous accumulation of agricultural, industrial and mineral wastes.

2.1 SOLID WASTE...ACONSEQUENCE OF LIFE

From the days of primitive society, human and animals have used the resources of the earth to support life and to dispose-off wastes. During the early times, the disposal of human and other wastes did not pose a significant problem, for the population was small and amount of land available for the assimilation of wastes was large. Although emphasis is currently being placed on recycling the energy and fertilizer value of solid wastes, indications of recycling may still be seen in the primitive, yet sensible agricultural practices in many of the developing nations where farmer recycle solid wastes for fuel or fertilizer values.

Problems with disposal of wastes can be traced from the times when humans first began to congregate in tribes, villages & communities and accumulation of wastes became a consequence of life. Littering of food and other solid wastes in medieval towns – the practice of throwing wastes on unpaved streets, roads, streets and vacant land, led to breeding of rodents with their attendant fleas. It was not until 19th century that public health control measures became vital and food wastes were collected and disposed off in a manner to control rodents and flies, the vectors of disease.

Ecological phenomena such as water and air pollution have also been attributed to improper management of solid wastes. For example, liquid (leachate) from dumps and un-engineered landfills have contaminated ground water. Although, nature has the capacity to dilute, disperse, degrade, absorb or otherwise reduce the impact of unwanted residues in the atmosphere; ecological imbalances have occurred where the natural assimilative capacity has been exceeded

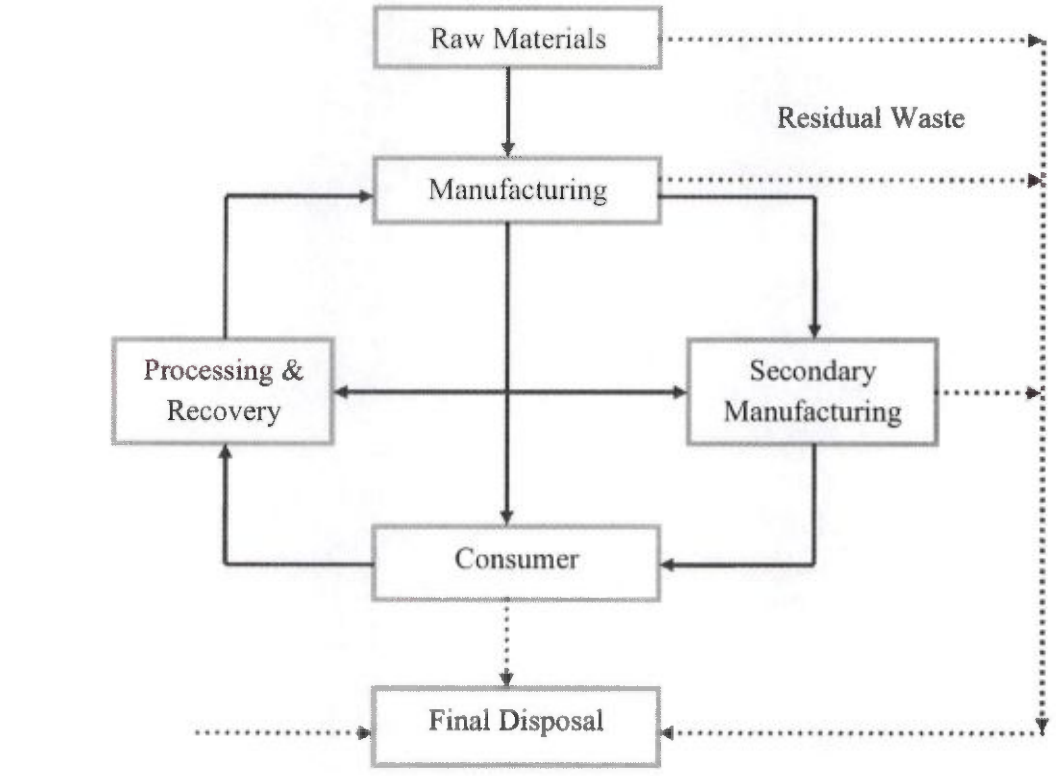
2.2 WASTE GENERATION IN TECHNOLOGICAL SOCIETY

The development of technological society can be traced to the beginnings of the Industrial Revolution (renaissance era), unfortunately, so can major increases in solid waste disposal problems. Thus, along with the benefits of technology, have also come the problems associated with the disposal of resultant wastes.

2.2.1 Materials flow & Waste Generation

An indication of how and where the solid wastes are generated in our technological society is shown in simplified materials flow diagram in *Figure. 2.1.* Both technological & consumptive processes result in formation of solid waste. Solid Waste is generated in the beginning with the usage of raw materials and thereafter at every step in the technological process as the raw material is converted to product for consumption. The process of consumption of products also results in generation of solid waste. It is apparent from figure that society receives raw material as inputs from environment and

gives solid waste as output to environment and the best way to reduce the amount of solid wastes that must be disposed off, is to limit the consumption of raw materials and increase the rate of recovery and reuse of waste materials.



Flow Chart of Materials Flow & Generation of Solid Waste in a Technological

2.2.2 The Effects of Technological Advances

Modern technological advances in the production and packaging of goods create a constantly changing set of parameters for designing solid waste facilities. For example, the latest trend of use of frozen food and packaged meals reduce the quantities of food wastes in the homes but increase the quantities at agricultural processing plants. These continuing changes present problems in designing engineering structures for processing solid wastes as they involve large capital expenditures and must be designed to be functional for at least 25 years.

Therefore, every possible prediction technique must be used in this ever changing technological society so that flexibility and utility can be designed into facilities. In short, a facility should be functional and efficient over its useful life.

2.3 THE DEVELOPMENTOFSOLID WASTE MANAGEMENT

Solid Waste Management may be defined as discipline associated with the control of generation, storage, collection, transfer & transport, processing and disposal of solid wastes in a manner, that is in accord with the best principles of public health, engineering, conservation, aesthetics and other environmental considerations and also, responsive to public attitudes.

2.3.1 Historical Development

The most commonly recognized methods for the final disposal of solid wastes at the turn of the century were dumping on land, dumping in water, plowing into the soil, feeding to hogs, reduction and incineration. However, not all these methods were applicable to all type of wastes. Plowing into the soil was used for food wastes and street sweepings whereas feeding to hogs and reduction were used specifically for food wastes. Enlightened solid waste management, with the emphasis on controlled tipping (popularly known as sanitary land filling), began in the early 1930s in the developed countries and much later in the developing countries. However, absence of efficient and proper methods of disposal resulted in scenic blights, created serious hazards to public health including water and air pollution, increased vectors of disease and adversely affected land values.

2.3.2 Functional Elements of Solid Waste Management System

The activities associated with the management of solid wastes from the point of generation to final disposal are divided into following functional elements:

I. Waste Generation

II. Waste Handling & Separation at Source

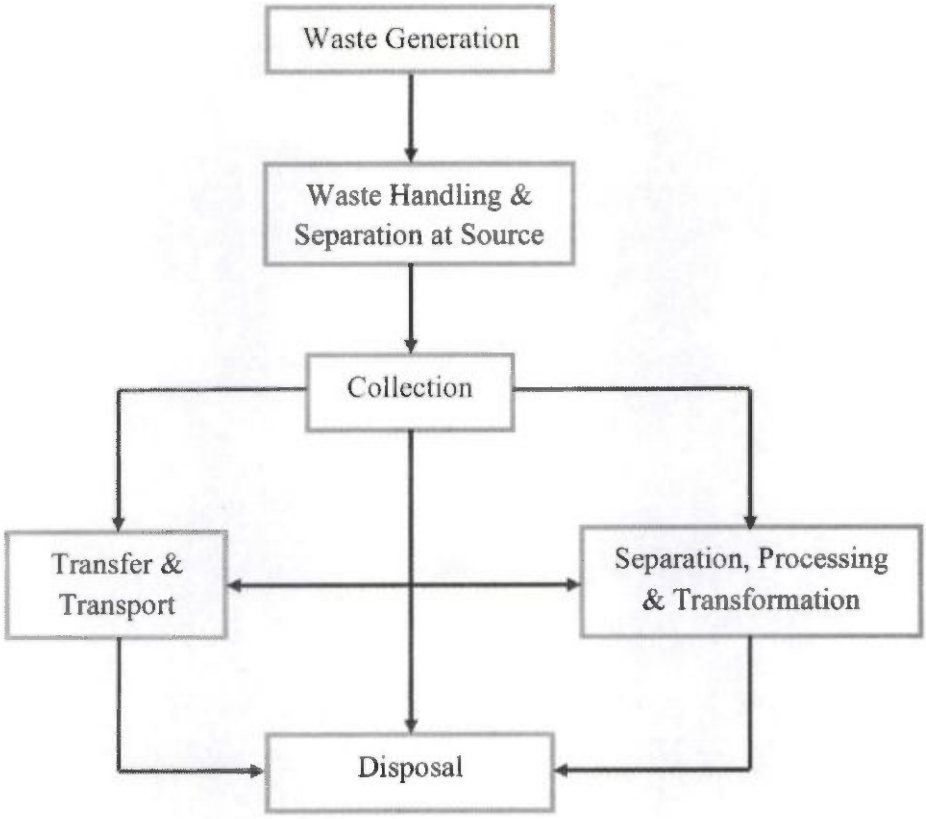
III. Collection

IV. Separation, Processing & Transformation

V. Transfer & Transport

VI. Disposal

The inter-relationship between these functional elements is identifyingin flow chart shown in below.



Flow Chart of Inter-relationship between functional elements in SWM System

i. Waste Generation

Waste generation encompasses activities in which materials are identified as no longer being of value and are either thrown away or gathered together for disposal. It is important to note that in waste generation, there is identification step and that this step varies with each individual waste.

Waste generation is, at present an activity that is not very controllable. Source reduction, though not controllable, is now included in system evaluation as a method of limiting the quantity of waste generated.

ii. Waste Handling & Separation at Source

Waste handling and separation involves the activities associated with the management of wastes until they are placed in storage containers for collection. Handling also encompasses a movement of loaded containers to the point of collection. Separation of waste components is an important step in the handling and storage of solid waste at source. From standpoint of material specifications and revenue from sale of recovered materials, the best place to separate the recovered materials for reuse and recycling, is the source of generation.

On-site storage is of primary importance because of public health concerns and aesthetic considerations. Open ground storage and unsightly makeshift containers, both of which are undesirable, are often seen at many residential and commercial sites.

iii. Collection

The functional element of collection includes not only the gathering of wastes but also the transport of these materials, after collection, to an intermediate location, where the collection vehicle is emptied. This intermediate location can be materials processing facility (waste storage depot, WSD) or a transfer station. In small cities, where final disposal sites are nearby, the hauling of wastes is not a serious problem. But in large cities, where the haul distance to the point of final disposal is often greater, the haul may have significant economic implications. Where long distances are involved, transfer and transport facility is normally used.

iv. Separation, Processing & Transformation

The recovery of separated materials, separation & processing of solid waste components and transformation of solid wastes that occur primarily in locations away from source of waste generation are encompassed by this functional element. Processing often includes separation of bulky items, separation of ferrous metals, manual separation of waste components and volume reduction by compaction.

Transformation processes are used to reduce volume and weight of waste requiring disposal and to recover conversion products. The most commonly used chemical transformation process is combustion, which is used in conjunction with recovery of energy in the form of heat. The most commonly used biological transformation process is composting. The selection of given set of processes depends on the waste management objectives to be achieved.

v. Transfer and Transport

This element involves two steps, viz. transfer of waste from smaller collection vehicles to larger transport equipment and second, subsequent transport of wastes to final disposal site.

vi. Disposal

Disposal is the final functional element in the solid waste management system. Today, disposal of waste by land filling is the ultimate fate of all solid wastes. A modern sanitary landfill is not a dump, rather it is an integrated, engineered facility used for disposing solid waste on land without creating nuisance or hazards to public health and safety.

In most cities, planning for waste disposal involves dealing with, development authority and other agencies. Thus, land-use planning becomes a primary determinant in the site selection, design and operation of processing facilities and landfills. Environment Impact Assessment (EIA) is required for any new landfill site to ensure compliance with public health, aesthetics and future use of land.

CHAPTER 3 PANIHATI CITY PROFILE

***Panihati** is a Municipal area in north Kolkata under Khardaha / Ghola police stations under Barrackpur City Police of Barrackpore subdivision. in Kolkata in the Indianstate of West Bengal. It is a part of the area covered by Kolkata Metropolitan Development Authority. Panihati Municipality started its journey on 1st April 1900 with a population with a population of 11,178 only. Today with 19.43 sq. km area, the Municipality now comprises 35 wards with a population 3, 77,351 (as per 2011 Census).*

3.1 HISTORY AND IMPORTANCE OF THE PROJECT TOWN

Reference of the glorious heritage of this Place is found in the ancient literature. Reference of Sukchar is found in the voyage route of Chand Sadagar "Manasa Mangal" written by Bipradas Pillai in 1495. The Bhagirathi Map from Suti to Gangasagar prepared by Jao De Barros in 1550 BS, mentions Agarpara and Barnagar. Panihati has been depicted as a prosperous and sacred place in Chaitanya Charitamrita, Chaitanya Bhagabat, Chaitanya Mangal & other texts. W. W. Hunter in the 'Statistical Account of Bengal, 1875, mentioned "Strictly speaking with the exception of Calcutta, there was no large river side cities, with community living by water traffic. The following is the list of the chief trading towns and villages showing principal articles for which each is noted. The Hooghly - Baranagar, Dakshineswar, Agarpara, Panihati and Sukchar". It is also worth to note from the 24 Parganas District Gazetteer "Chaitanya then stopped at a very populous and prosperous village called Panihati. According to 'Chaitanya Bhagabata' no other village on the eastern bank of the Bhagirathi was as populous and prosperous as Panihati in those days." Chaitanya Deb had taken Sannyas exactly 500 years back in the year 1510 and his first visit to Panihati was in the year 1514. Panihati was a major centre of Vaishnab Culture through Nityananda Mahaprabhu and Raghav Pandit also.

3.2 GEOGRAPHICAL CONDITIONS

Panihati has an average elevation of 13 metres (42 feet).

Panihati covers two important Railway stations from Sealdah north main section line - 1)Sodepur -a densely populated urban city connected to the northern side of Kolkata by Barrackpore Trunk Road and with Barasat via Sodepur Road through Madhyamgram. 2) Agarpara — which shares its borders with Kamarhati and North Dumdum Municipality. Panihati Municipality is located on BT Road, Kolkata - 700110 at the western side of Sodepur Rail station.

The Municipality is located in North 24 Parganas District on the eastern bank River Hooghly. It is bounded by Khardaha Municipality on the north, Kamarhati Municipality on the south, Border of North DumDum Municipality and Bilakanda Panchayat area on the west.

The B.T. Road passes through the town from North Barrackpur to South connecting Dunlop–Dunlop- Shyambazar. Sodepur Station Road starting from the Municipality crosses the station through Flyover to Barasat Road to Kalyani Highway and also to Madhyamgram Jessore Road to Dum Dum International Airport to the South and Barasat to the North. This road is a major route to the international border of Bangladesh. There are many arterial roads. Sodepur is an important node

on the Indian Eastern Railway map with the highest nos. of daily commuters. Agarpara is another station. Panihati ferry service is operating in the Municipal area - from Panihati Ghat to Konnnagar Ghat. In the early days, river traffic was the major source of communication and ghats of the river Ganga were used for trade/business.

3.3 LOCATION AND EXTENT

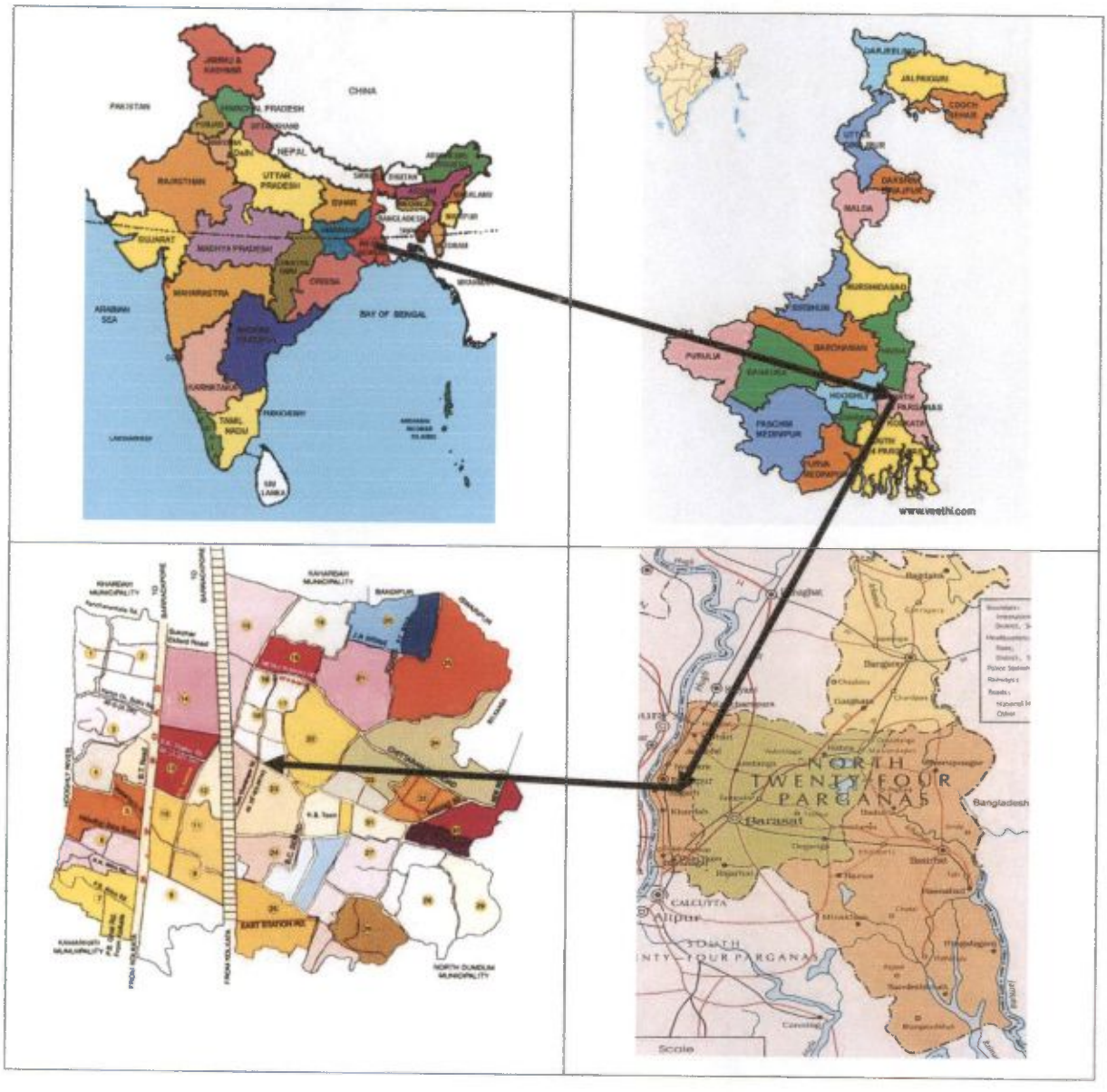


Figure 3-1: Location of Panihati Municipality

3.4 CLIMATE CONDITIONS

The climate of this region like rest of the Gangetic Plains in West Bengal is tropical with monsoon season spreading from early June to early October. The weather remains dry during the winter (mid-November to mid- February) and humid during the summer in the range between 50–95 %. During the months of April and May, thunderstorms, sometimes accompanied by hail, frequently occur at dusk. Winter prevails for a short period with chilling dry wind coming from the northeast. The

average rainfall varies between 150-200 cm/yr. The maximum temperature is about 40°C in the month of May and minimum temperature is 10°C in the month of January.

3.5 POPULATION

As of 2011 India census, Panihati had a population of 3, 77,351. Males constitute 50.2% of the population and females 49.8%. Panihati has an average literacy rate of 91.92%, higher than the national average of 74.04%: male literacy is 94.02% and, female literacy is 89.82%. In Panihati, 7% of the population is under 6 years of age (Census 2011).

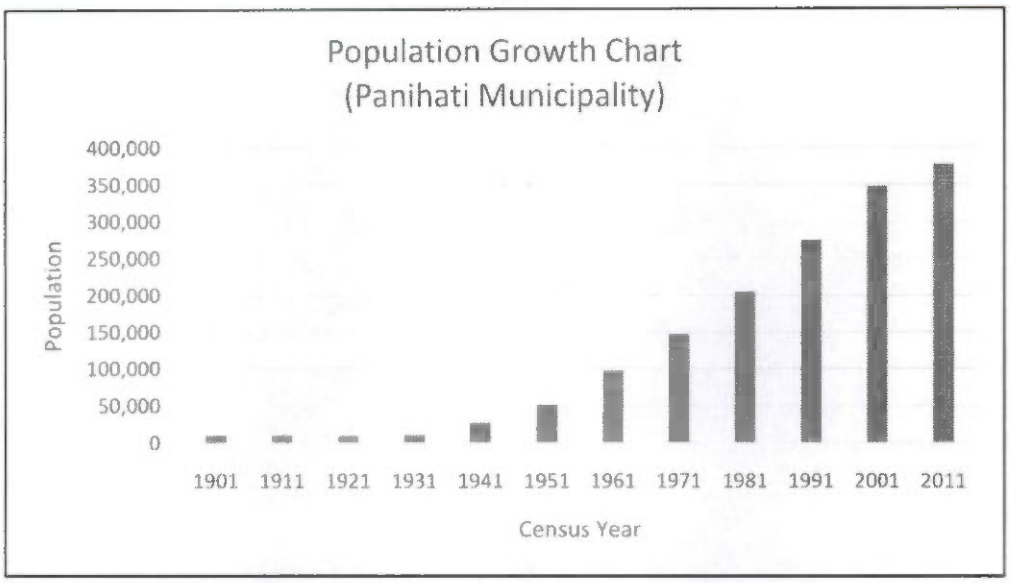
The populations of panihati have been plotted from the previous census available till 2011 and then the trend has been formulated to forecast the future projections. The total population of the Panihati area is expected to reach to about 5.50 lacs by Year 2045.

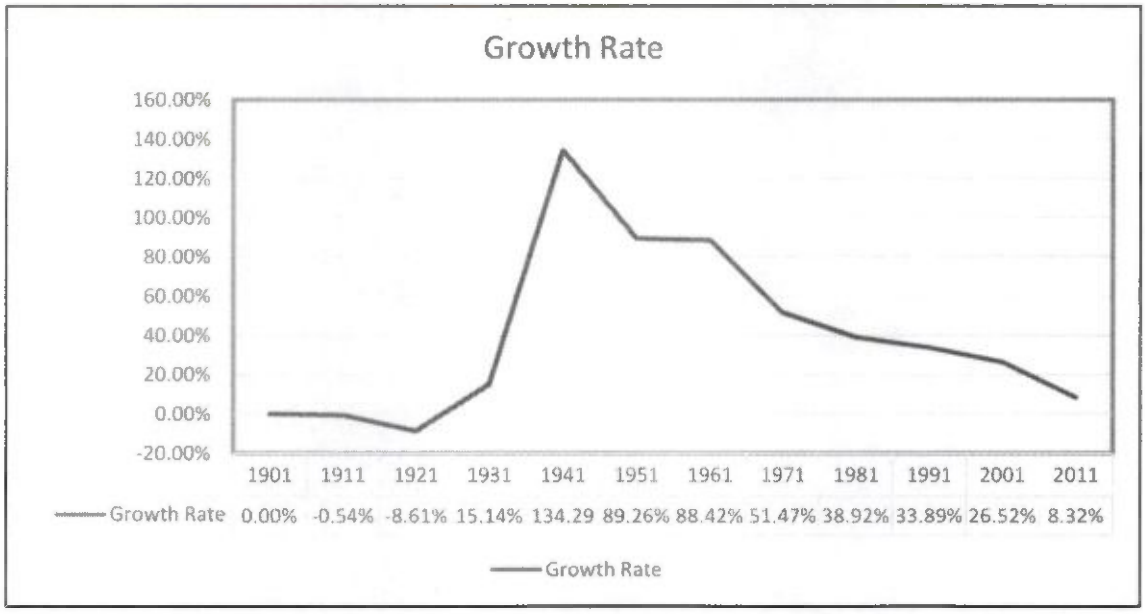
3.5.1 Demographic Growth & Population Projection

The Decadal growth rate in Panihati experience changes in consecutive decades since 1901-1911 till 2001 to 2011. There was enormous increase in population from 1961. Due to the industrial growth in the region there was a huge influx of population occurred. Majority of People migrated from Bangladesh in this period and settled over. The population growth was optimized in last 2 decades, in census 2001 with 26.52% growth rate and census 2011 with a growth rate of 8.32%.

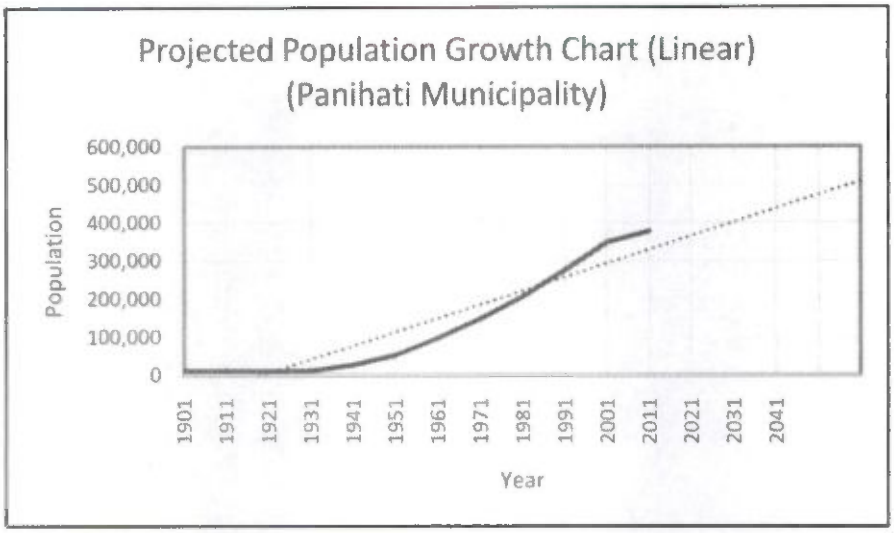
Table 3-1: Overall Population & Growth Rate

Year	Total Population (No.)	Growth Rate
1901	11,178	---
1911	11,118	-0.5
1921	10,161	-8.6
1931	11,699	15.13
1941	27,410	134.29
1951	51,875	89.25
1961	97,741	88.41
1971	1,48,046	51.46
1981	2,05,668	38.91
1991	2,75,359	33.88
2001	3,48,379	26.51
2011	3,77,351	8.31





Graph 3-1: Decadal Growth Rate of Population of Panihati Municipality



Graph 3-2: Graphical Representation of Population Change inPanihati Municipality

As per consultation, it was decided that the method of projection that is more relevant to the population of 2011 (as per Census - 2011) should be adopted for projection. For this the population of Year 2001 was taken as base data and thereafter the population of year 2011 was projected usingarithmetic progression, geometric progression and incremental increase method. Now after comparing the statistics of the projected population with the population as per Census 2011, it is observed that variation is minimum in the case of arithmetic progression and incremental increase method. But the result getting from geometrical progression method is very conflict with Census data of 2011. Therefore, the averages of arithmetic and incremental methods have been considered for population projection for 30 years.

Table 3-2: Projected Population

Year	Arithmetic	Incremental	Design Population
2012	382943	382650	382797
2013	388535	387895	388215
2014	394128	393088	393608
2015	399720	398226	398973
2016	405312	403312	404312
2017	410904	408344	409624
2018	416496	413323	414910
2019	422089	418249	420169
2020	427681	423121	425401
2021	433273	427940	430606
2022	438865	432705	435785
2023	444457	437418	440937

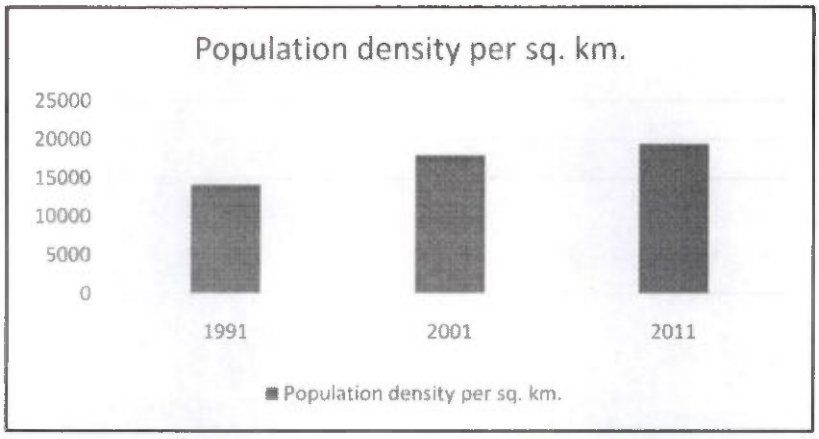
Year	Arithmetic	Incremental	Design Population
2024	450050	442076	446063
2025	455642	446682	451162
2026	461234	451234	456234
2027	466826	455733	461280
2028	472418	460179	466298
2029	478011	464571	471291
2030	483603	468910	476256
2031	489195	473195	481195
2032	494787	477427	486107
2033	500379	481606	490993
2034	505972	485732	495852
2035	511564	489804	500684
2036	517156	493823	505490
2037	522748	497789	510268
2038	528340	501701	515021
2039	533933	505560	519746
2040	539525	509365	524445
2041	545117	513118	529117
2042	550709	516816	533763
2043	556301	520462	538382
2044	561894	524054	542974
2045	567486	527593	547539

3.5.2 Population Density

Panihati has a very high population density 19.38 sq.km. area of Panihati Municipality has accommodate 3.77 Lakh persons as per 2011 census. Population density in Panihati Municipal has increased gradually. In 1991 population density was 14208 persons/sq. km. which increased to 17976 persons in 2001. In 2011 the figure is 19470.

Table 3-3: Population Density

Census Year	1991	2001	2011
Population density per sq. km.	14208	17976	19470



Graph 3-3: Population Density

Table 3-4: Ward wise Population Density

Ward no.	Area (sq. km)	Male	Female	Total	Density per sq.km
1	0.39	4231	4123	8354	21420.51
2	0.55	6240	5791	12031	21874.55
3	0.54	5888	5948	11836	21918.52
4	0.44	4799	4643	9442	21459.09
5	0.47	4437	4403	8840	18808.51
6	0.43	4509	4232	8741	20327.91
7	0.46	10718	9238	19961	43393.48
8	0.62	6304	5903	12207	19688.71
9	0.22	3886	3831	7717	35077.27
10	0.34	4585	4219	8804	25894.12
11	0.32	3557	3593	7150	22343.75
12	0.18	3740	3621	7361	40894.44
13	0.44	5789	5879	11668	26518.18
14	0.68	4256	4082	8338	12261.76
15	0.59	6982	7105	14087	23876.27
16	0.47	4147	4226	8373	17814.89
17	0.47	5919	6094	12013	25559.57
18	0.38	5067	5157	10224	26905.26
19	0.45	6559	6579	13138	29195.56
20	0.6	2802	2729	5531	9218.33
21	0.64	7225	7185	14410	22515.63
22	0.55	4843	4967	9810	17836.36

Ward no.	Area (sq. km)	Male	Female	Total	Density per sq.km
23	0.68	3434	3423	6857	10083.82
24	0.52	4719	4908	9627	18513.46
25	0.53	4361	4391	8752	16513.21
26	0.65	7558	7540	15098	23227.69
27	0.94	9879	9941	19820	21085.11
28	0.63	5752	5588	11340	18000.00
29	0.65	5143	4583	9726	14963.08
30	0.92	5874	5998	11872	12904.35
31	0.55	6808	7352	14160	25745.45
32	0.32	4132	4057	8189	25590.63
33	0.53	4843	4887	9730	18358.49
34	0.92	6716	6520	13236	14386.96
35	1.23	4507	4401	8908	7242.28
Total				**377351**	

3.6 SETTLEMENTS IN CITY

The settlements in city identified in Panihati municipal area includes school, colleges / institutes,hospitals, nursing home, police stations, post offices, banks, cinema halls, stadium, libraries, fire station, playground, park garden, ghat, club etc.. The Panihati city is well connected with through railway and roads. A list of detail social infrastructures is identified and provided in below matrix.

3.6.1 Number of Households, Shops, Commercial Establishments & Institutions

Table 3-5: List of Nos. of Households, Commercial Establishments & Institutions

Sl. No.	Items	Classification	Nos.	Ward No.
1	Household Nos.		85985	1 to 35
2	Park Garden		20	
3	Play ground		14	
4	Bank		15	4,8,13,14,16,17,21,23,25,31,32
5	Institutions	Higher Secondary School / Secondary School	34	1 to14
		Primary School	80	1 to23, 25 to 28, 30 to 35
		Research Institute & Engg. College	7	8,13,23,33
6	Health Centre	Nursing Home	7	2,4,10,16,18

Sl. No.	Items	Classification	Nos.	Ward No.
		Hospital	2	31,32
		Municipal Maternity Home	1	
		Regional Diagnostic Centre	2	
		Extended Specialist Out Patient Dpt.	1	
		Municipal Health Sub-centre	40	
		Municipal Health Administrative Unit	6	
7	Bus Terminus		4	8,10,14,35
8	Ghat		10	1,3,4
9	Public Library		72	
10	Club		3	2,19
11	No. of Reading room		21	
12	Stadium		1	
13	Auditorium		4	3,13,15,25
14	Cinema Hall		3	

3.6.2 Number of Hotel, Restaurants & Banquet Halls

Table 3-6: Nos. of Hotel, Restaurants & Banquet Halls

Sl. no.	Type of Markets	Ward No.	Nos.
1	Hotel & Restaurants	6,11,12,13,14,16,22,23	34
2	Banquet Hall	2,3,6,8,10,13 to 19,21,22,23,25 to 28,30 to 33,35	64

3.6.3 Number of Large Markets (Vegetable, Meat & Fish)

Table 3-7: List of type of Markets

Sl. no.	Type of Markets	Ward No.	Nos.
1	Daily Markets	1,13,14,15,27,30,31,34,35	14
2	Food & Vegetable Wholesale	14,30	3
3	Wholesale Commodity Market	4,7,8,31	5
4	Commercial Complex	1 to 35	61
5	Others	1 to 14, 16,17,19,22 to 25,31 to 34	25

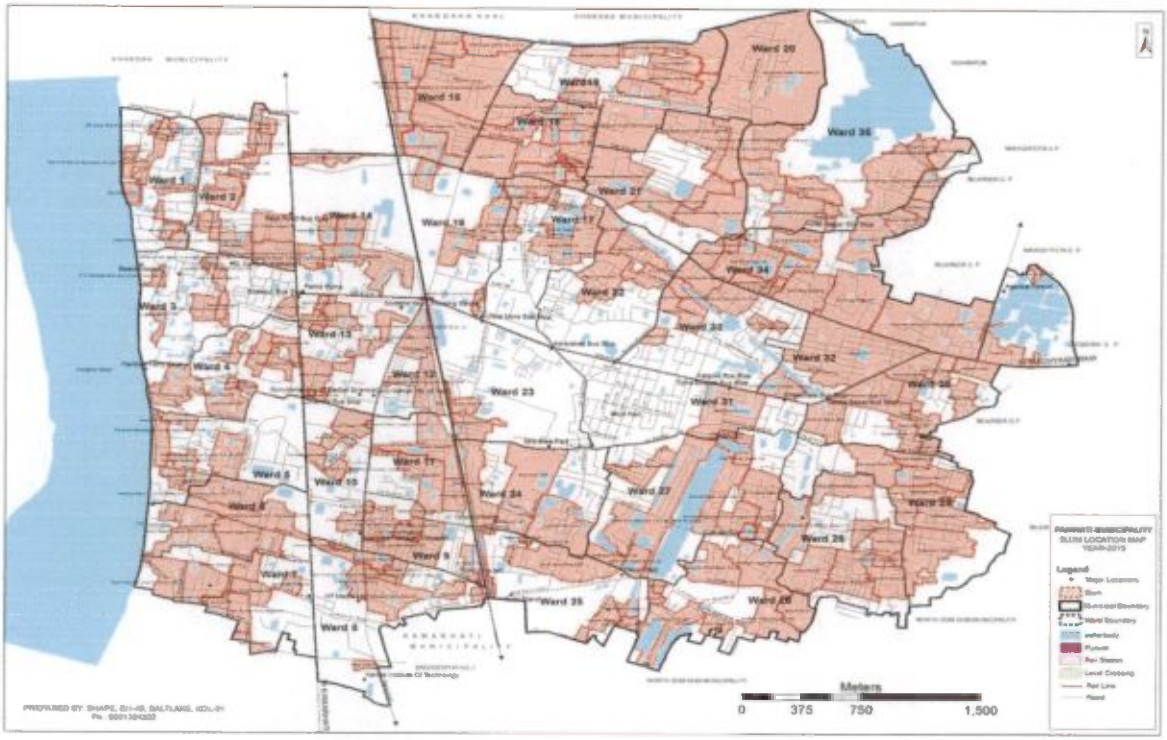
3.6.4 Slums & Other Informal Settlements

Usually, Urban Slum areas are heavily populated with the poor people who have migrated from the poor rural backgrounds. Under section-3 of the Slum Area Improvement and Clearance Act, 1956, slums have been defined as mainly those residential areas where dwellings are in any respect unfit for human habitation by reasons of dilapidation, overcrowding, faulty arrangements and designs of such buildings, narrowness and faulty arrangement of streets, lack of ventilation, light or sanitation facilities or any combination of these factors which are detrimental to safety, health and morals. Thus, conceptually slums are compact overcrowded residential areas (and not isolated or scattered dwellings) unfit for habitation due to lack of one or more of the basic infrastructure like drinking water, sanitation, electricity, sewerage, streets etc.

In ULB like Panihati, migration has played an important role in accelerated urban growth. However, it concomitantly results in transfer of rural poverty to urban areas. These rural migrants are attracted to Panihati for economic reasons regardless of the fact that physical infrastructure in terms of housing; drinking water supply; drainage etc. is not so adequate in Panihati. Most of the slums have no basic civic services like sewerage, drainage, water supply and sanitation facilities.

3.6.4.1 Salient features of Slums in Panihati:

- There are total 19890 slum householdsidentified in Census 2011
- Total Slum Population: 91153,
- Total slum area in sqkm 9.48748
- Population density of slum area
- Percentage of slum area of total area 48.96%



Map 3-1: Slums Location Map of Panihati Municipality

3.6.5 Industries & Their Profile

The Panihati city has Paper, Steel, Wire, Oil, Garments, Motor, Biscuits, Plywood factory etc. Factories and its related activity is important occupation of the people of Panihati other than service and business. Panhati is on of the major trade center in the district. The economy of the town is mainly depending on business and handicrafts. Many industries of town area are Jute, cotton, chemical, latex and rubber, sugar industries etc. Earlier Agarpara was famous for the manufacturing of boats. The local *AGHORE* community was attached with that industry. Later they came under the *GANGA ACTION PLAN* project of the govt.The house hold industries and informal sector play significant role in providing employment and income generation.

Table 3-8: List of Industries

Sl. No.	Name of Industry	Ward No.
1	Dey Steel Fabricator Private Ltd.	2
2	Hindustan Wire	2
3	Shyamal Powder Mill	3
4	Central Wire Store Room	4
5	Century Coco Oil Industries	6
6	Till Ltd. Tractors	7
7	NGB Work Shop	8
8	RDB Industry	8

Sl. No.	Name of Industry	Ward No.
9	Hindustan Times Press	8
10	Agarpara Garments Factory	8
11	GNB Motors Limited	12
12	Rolling Mill	14
13	Oncast Ispat L.T.D	14
14	Raja Biscuit Factory	14
15	Texmaco Industry	25
16	Texmaco	8
17	Victory Tower Industry	3

3.7 LAND USE PLAN

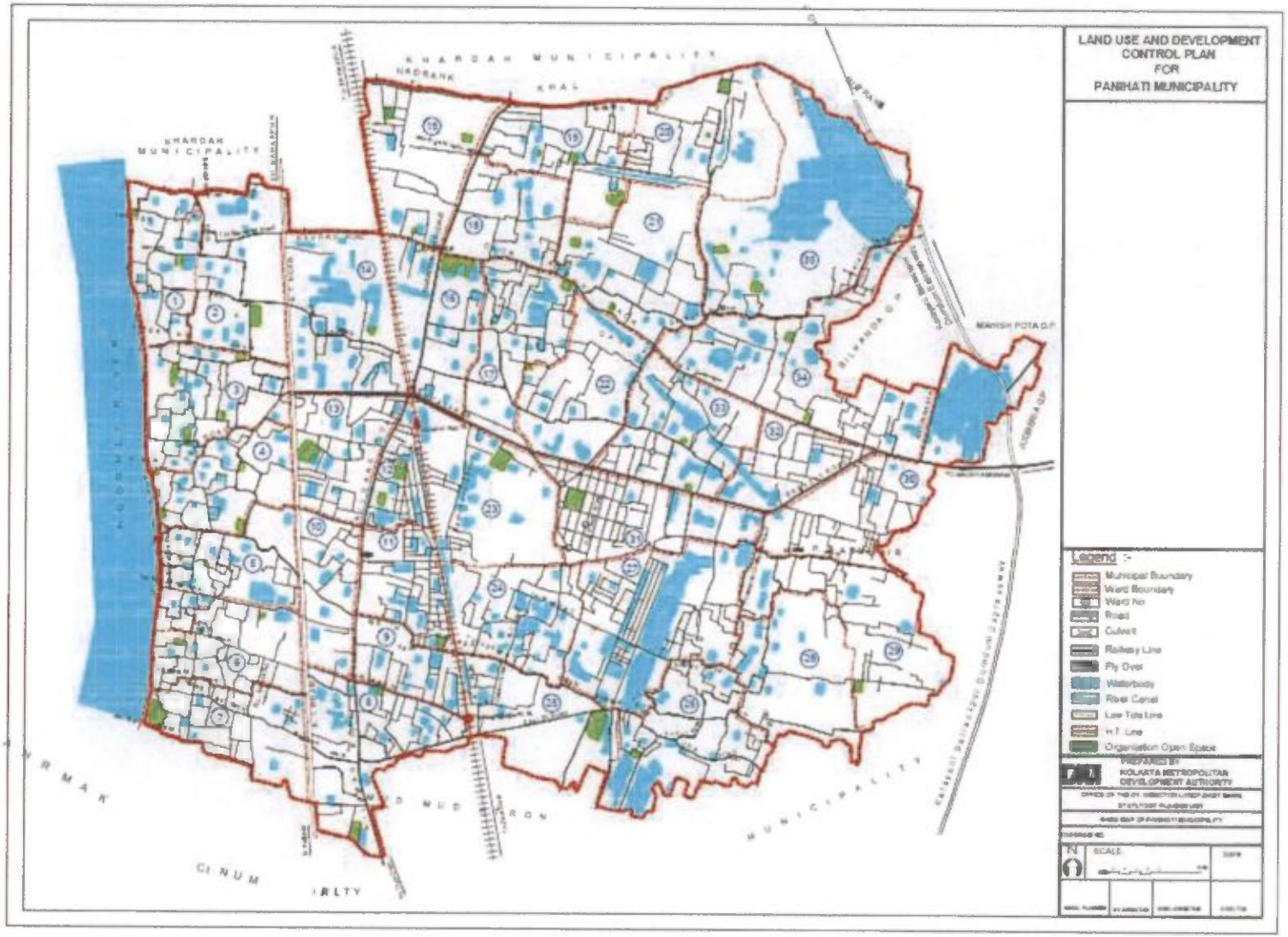
A land use classification system was adopted for the study of the present nature of land use in the Panihati Municipality as well as for future proposals.The major land use categories are summarized below:

- Residential
- Commercial
- Industrial
- Public / Semi-Public
- Transportation
- Parks and Open Spaces/recreational
- Undeveloped comprising of the following:
  - Agricultural and Vacant Land
  - Water bodies (including river)

The predominant existing land use of Panihati Municipalityis a mixed one. The Municipal area is predominantly residential with large chunk of landmarked for industrial use. There are few open spaces in some of the wards with small water bodies spread all across the wards. Commercial area is comparatively small. Public and semi-public areas are mostly predominant in few wards.The core area of the city is also major commercial/trading hub where all wholesale and retail activities are performed. The trade/market places acted as the pull factor for the growth of the city. This has resulted in intense development in the core, diminishing towards to the periphery.

Table 3-9: Existing Land Use Pattern of the Panihati Municipality

Sl. No.	LANDUSE	Area in SQM	Percentage to Total Area of the Municipality
1	Residential area	10564463.30	54.5905



Map 3-2: Panihati LUDCP Map

3.8 PHYSICAL INFRASTRUCTURE

3.8.1 Linkages of Rail, Roads, Port & Air

The B.T. Road passes through the town from North Barrackpur to South connecting Dunlop–Dunlop- Shyambazar. Sodepur Station Road starting from the Municipality crosses the station through Flyover to Barasat Road to Kalyani Highway and also to Madhyamgram Jessore Road to Dum Dum International Airport to the South and Barasat to the North. This road is a major route to the international border of Bangladesh. There are many arterial roads. Sodepur is an important node on the Indian Eastern Railway map with the highest nos of daily commuters. Agarpara is another station. Panihati ferry service is operating in the Municipal area - from Panihati Ghat to Konnnagar Ghat. In the early days, river traffic was the major source of communication and ghats of the river Ganga were used for trade/business.

3.8.2 Storm Water Management

The Panihati Municipal area has open drainage network. The waste water along with sewage is discharged into the River Ganga.

In the absence of proper drainage and sewerage system all the city drain waste (liquid / solid) gets an outlet into the Ganga river and other small water bodies or lowlying areas. This has resulted into degradation of the water bodies. The banks of Ganga river are getting encroached leaving a narrow channel for water flow; the channel is getting clogged by aquatic plants like water hyacinth due to high amount of nutrients from the sewage water and other waste disposal.

Figure 3-2: Condition of Open Drains

The open drains are full and choked with solid waste and carrying waste water from households as well. Drains are in pathetic situation due to lack maintenance and frequent cleaning. During field survey it was found that most of them are open, hence people throw MSW indiscriminately into them as if they are meant for the purpose. Open drains, being without proper outlets, get choked during the monsoon with full of loads and thus tend to overflow resulting in water logging problems

3.8.3 Sewage Management

There is no sewerage system; hence most of the sewage gets an outlet into drains. Households having access to either Under Ground Drainage Facility or Septic Tank are considered to have access to a safe disposal facility. In the absence of any underground sewerage system, the major mode of sewerage disposal is on site sanitation. Septic tanks are the major form of sanitation for the domestic

sewage. During the rainy season, the situation turns more critical. The wastewater continues to remain stagnant for a considerable period in the low lying areas of the city. Quality of water is getting deteriorating day by day. This leads to unhygienic and insanitary condition in the city because of sewages, effluents are all flowing through street surface drains.

3.8.4 Water Supply System

Panihati is situated at the right side of Ganga River. A grand success of the Municipality that has been achieved through JNNURM is acquiring the Central Govt. approval on the project for construction of 13 MGD SURFACE WATER TREATMENT PLANT (SWTP) to provide treated surface water (135 lpcd) to all wards of ULB in 24X7 pattern and to reduce the dependency on the already depleting ground water reserve to a considerable extent.

Table 3-10: Water Supply Existing Situation

Population	:	3, 77,351 (Year : 2011)
No. of House Connection	:	32,000
No. of Pump Houses	:	56 Nos.
No. of Deep Tubewells	:	56 Nos. of 20 Horse Power
No. of Hand Tubewells	:	2050 Nos.
No. of Stand Post	:	3000 Nos.
Length of Pipeline	:	1,45,000 Mtr.
Per Head Supply of Water	:	95 liter/day
Water Supply Rate	:	7hrs/day
Geographical Coverage	:	75%

3.9 ECONOMIC PROFILE

Panihati is one the fast developing cities of West Bengal. The economy of the city is both dependent of agricultural income as well as from industries and service providers based here. Agricultural business forms a decent means of income in panihati. The soil type of this area is clayey and loomy which is good for farming. The closeness of the Ganga river helps a lot in this regards. The major crops sown here include wheat, potato, pulses, jute, oilseeds etc. but the major production here is rice. People cultivate paddy crops for self consumption as well as for trading. Apart from this, horticulture crops cultivation are also promoted hugely here. Brinjal, cabbage, cauliflower, tomato and chilli are the major vegetable cultivated here whereas mango, banana, papaya, jackfruit are fruits grown here. Live stock business also provides a considerable income in this locality. Poultry farming, cattle farming are popular means of livestock business here. The town has educational facilities of *Secondary Schools,Research & Engineering Colleges*. With the fast development of the town several commercial establishments have emerged.A good number of people are engaged in trade and business.

Industries are the major source income in this city. Panihati is the proud owner of some of the major industries of the state. From the Rubber and Latex industry, Bengal waterproof, or the ever popular "Duckback" manufacturers have their factory set in panihati from the year 1932. Cotton industries also have their share in panihati industrial growth. Bangasree and sodepur cotton mills are the other two famous cotton industries of the area which is presently clubbed under national Textile Municipality headed by the State Govt.

The importance of this town is steadily increasing being situated on *Sealdah - Barrackpur*rail line and *B.T Road to Jessore Road Connection via Sodepur Barasat Road*. The town is electrified and has normal communication and telephone facilities as well. The economic prosperity of this small town is linked with the commerce it supports. Commercial establishments form an inherent part.The house hold industries and informal sector play significant role in providing employment and income generation.

3.10 INFORMATION ABOUT PANIHATI MUNICIPALITY

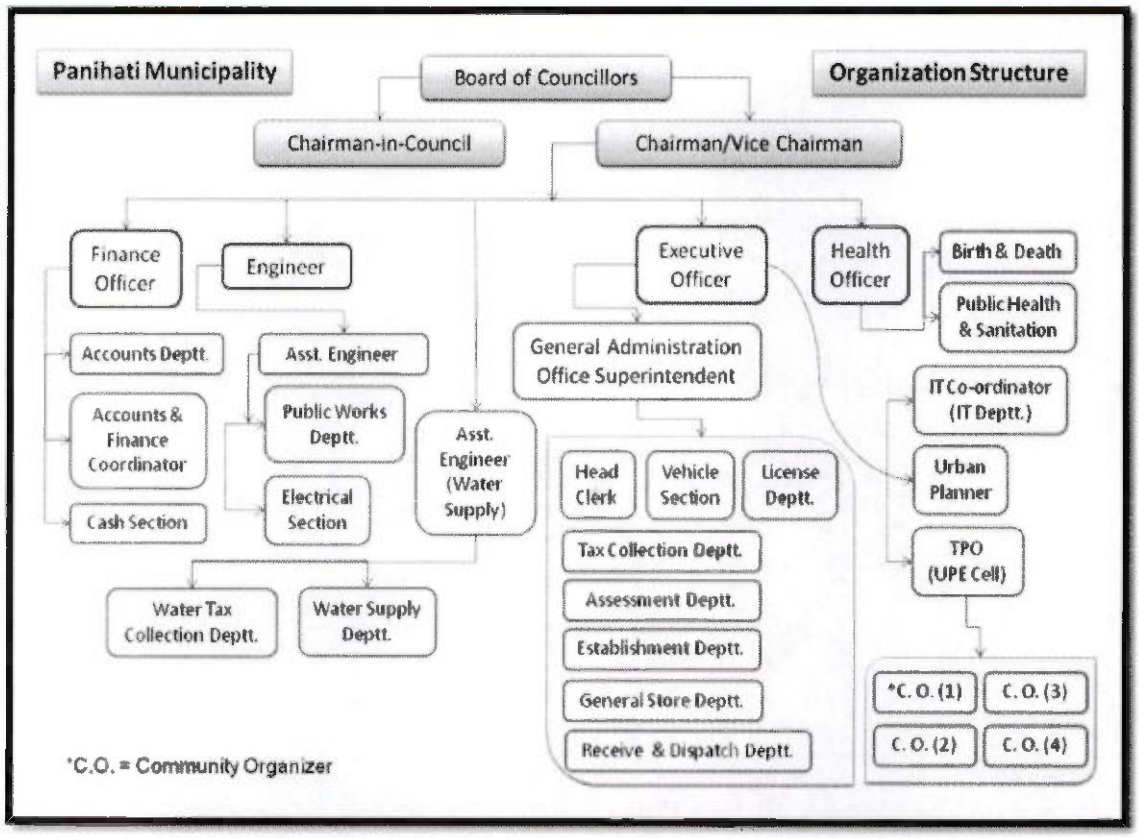
3.10.1 Administrative Setup of Panihati

India has a multi-tiered, decentralized system of governance that includes the central (federal) government, state government and local administration by ULB. The ULBs include urban Municipalities and MunicipalCorporation. All three tiers have specific roles and responsibilities as established under the constitution and ensuing legislation.

The central government takes a leadership role in developing county-wide legislation and policy. State governments are charged with the responsibility of delivering regulatory programs at the state level and also have authority to establish state-level legislation. However, the management of solid waste is an obligatory function of the ULBs and municipalities are responsible for providing waste management services within their jurisdiction.

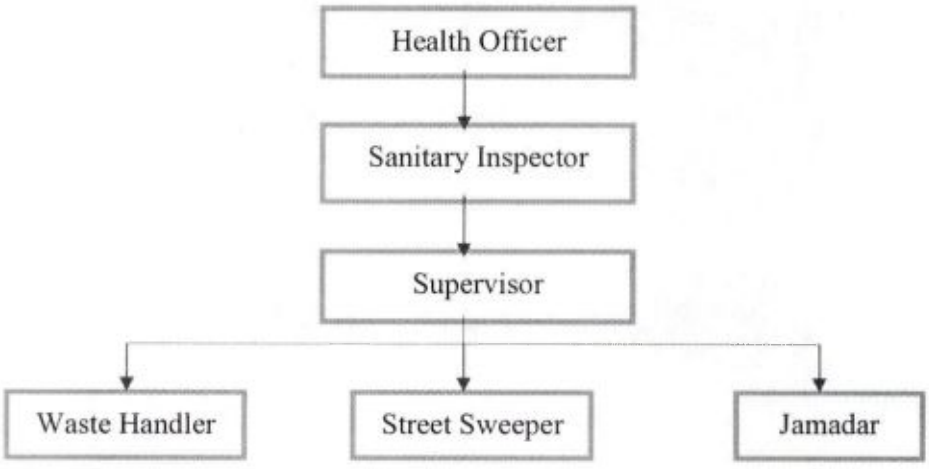
There are functional committees on various subjects, namely executive committee, finance committee, health committee, building and works committee, rules and byelaws committee, garage committee, license committee house tax committee, electric and public lighting committee. The chairman elected by the majority of Councilors is the executive head of the Panihati Municipality, presides over the meetings of the Board of Councilors, and is responsible for the governance of the body.

Flow Chart of Organization Structure of Panihati Municipality



3.10.2 Administrative Setup of Sanitation Department of Panihati Municipality

Safe disposal of solid waste generated in an urban area is the obligatory function of the respective urban local body – it is Panihati Municipality in case of Panihati town. SWM department, headed by Sanitary Inspector (SI) with support from Waste handlers, Jamadars, street sweepers are responsible for the solid waste management component in the town.



Flow Chart of Organizational Set-up of SWM Department

3.11 PLACES OF INTEREST

The Panihati Mahotsab tala and Raghab Mandir/ Pat Bari are famous Baishnab Pilgrimage which was sanctified by great men like Sri Chaitanay Deb, Nityananda Maha Prabhu, Raghab Pandit, Sri Ram Krishna Paramahansa, Swami Vivekannda. Sodepur Khadi Pratsithan was the "second home "called by Mahatma Gandhi where he used to live while staying in Bengal. Gobinda Home is also on the river Ganges famous for Rabindra Nath Tagore and other eminent personalities. Other notable places are: Sodepur Pinzrapole, Giribala Thakurbari, Baromondir, Paine Bari, Anondomoyee Ashram and nos of places along the river bank, at Ghola, Natagarh, Panshila and Agarpara area. Various festivals and fairs are organised in the municipal area. Panihati Book Fair and Panihati Mela have become very popular and a testimony of the rich culture of the area.

CHAPTER 4 STATUS OF EXISTING SOLID WASTE MANAGEMENT IN PANIHATI

This chapter reveals an overview of existing solid waste management system in Panihati Municipal area. The various sources of waste generation, the current primary and secondary waste collection practices, waste transportation and disposal mechanisms. The gaps are identified in accordance to the MSW Rule 2016 in this chapter.

A comprehensive study is undertaken for quantitative and qualitative analysis of municipal solid waste generated from various sources. The information provided in this chapter is based on discussions with various stakeholders, Panihati, local residents and site investigations and detailed survey performed by consultant's project team.

4.1 AN OVERVIEW OF WASTEGENERATION&ITSMANAGEMENT

A comprehensive approach was adopted to get explore the existing scenario of waste generation and its management includes the following major points (details of these points has been given in the following sections):

- Identification of major sources of waste generation, based on the field survey and discussions with various stakeholders in Panihati;
- Estimation of quantity and characteristics of waste generated in the prime/identified sources as well as at the final disposal point;
- Analysis of findings of the quantification and characterization of waste;
- Study of handling and management of waste from the generation point to ultimate disposal.

4.1.1 Approach adopted for Estimation of Waste Generation

Identification of waste generation sources were undertaken in accordance to CPHEEEO MSW Rules 2016 and stakeholder's consultation viz Executive Engineer, Assistant Engineer, Vehicle In-charge, Sanitary inspector, Safai karamcharis, residents, etc. Based on the discussion with various stakeholders (related to the waste generation & its management) & primary information of core sources of waste generation has been identified. This exercise has carried out to get the focus points of waste generation & its management.

The primary sources of solid waste generation in Panihati are the local households, markets,commercial establishments / shops, hotels & restaurants, institutions, function/marriage halls, offices, hospitals etc.This has been done with the understanding that waste generated from various parts of the city is dumped into the open dumps/dustbins, if available (waste collection points). In addition, commingled waste collected from the secondary collection points, is ultimately dumped into disposal facilities i.e. dumpsites/trenching grounds.From the household level survey, respective waste generation factors (gm/capita/day) for different residents have been assessed based on weighted average and are used in this report to calculate the total residential waste generation in the town. To assess the overall municipal waste generation of Panihati municipal area, quantity of wastes generated

from all major bulk generating sources and commercial establishments is added up with the residential waste generation to obtain the total MSW generation in the town for the year 2017.

4.1.1.1 Sample Size & Locations of Sampling

The selection of sample size and the sampling locations have been done through professional judgment and in consultation with municipal officials. The locations have been so chosen that it would give the representative characteristics of wastes at different source of generation, at secondary collection points and also at disposal site. For this purpose reconnaissance survey was conducted to identify the location of sampling points with the objective to address different types of waste generation sources such as residential area, commercial area, institutional area, secondary collection points and markets etc. shown in *Figure 4.1*

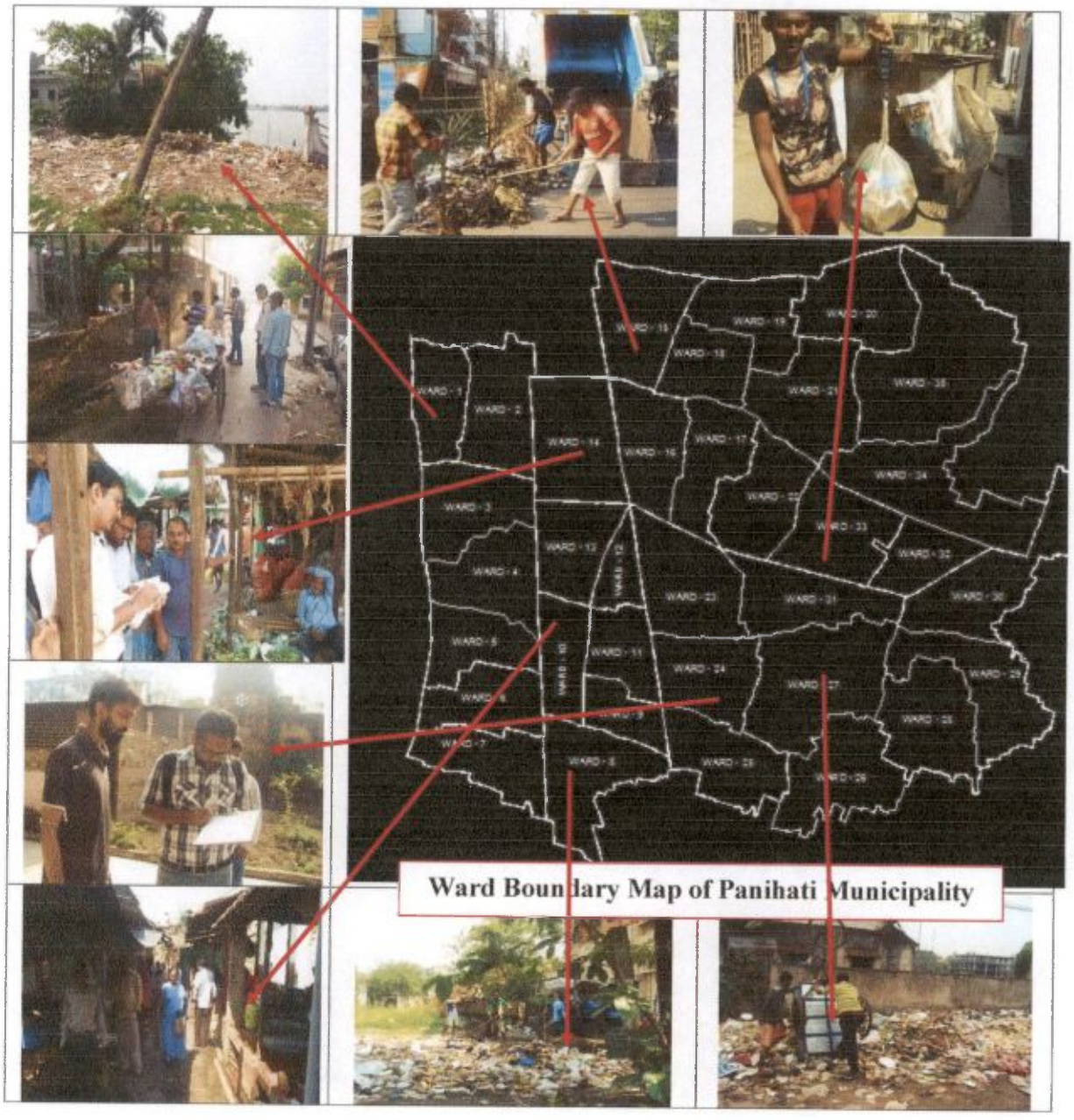


Figure 4-1: Location of Waste Sampling in Panihati Municipality

4.1.2 Residential Areas – Colonies, Apartments, Complexes

Primary waste quantification survey at household level was carried out in various housing categories such as household, slum area, apartment etc. Households of various categories primarily contribute domestic waste. Based on the assessment of the Panihati, it is estimated that of the total 3, 77,351 populationresiding in Panihati Municipal area. The households of the city based on the housing typology can be categorized as independent bungalows, independent houses of low, middle and high income groups, tenements, individual flats, apartments and huts or economically weaker section dwellings. Finally based on density and per capita generation the total solid waste generated for the municipality was found out. The waste generation at different level of household has different.

The Households per capita assessment surveys were carried out for three days i.e.from 17th (Friday), 18th (Saturday)and 20th (Monday)of March 2017. A day before the sampling survey, each ofthe councilors of selected ward, supervisors and secretary of club were briefed about the purpose of the survey and modalities of waste collection.

On the day of sampling, the survey team collected the waste from each households of individual income group at around7:30 am in the morning with waste handler and sample of waste put into tricycle after weighing it. The same procedure wasfollowed for all the five days of sampling.

While at average 70nos. households were selected for 150 nos. sampling survey (Annexure 27) which illustrated in thetable below. Present a wide variation ranging from around 22 gm per capita per day to a maximum of around 730 gm per capita per day.

Table 4-1: Results of Primary Waste Quantification Survey at Household Level

Ward No.	No. of Individuals	17.03.2017		18.03.2017		20.03.2017		Avg. daily Generation in gms/day/capita of individual family
		Weight of Samples of per days in gms	Per Capita Generation in gms	Weight of Samples of per days in gms	Per Capita Generation in gms	Weight of Samples of per days in gms	Per Capita Generation in gms	
33	4	990	248	1015	254	870	218	240
33	2	730	365	820	410	850	425	400
33	4	650	163	720	180	845	211	185
33	2	380	190	300	150	420	210	183
33	4	965	241	875	219	745	186	215
24	2	280	140	350	175	300	150	155
24	4	1908	477	1845	461	1675	419	452
24	4	590	148	650	163	752	188	166
24	3	905	302	1075	358	810	270	310
24	3	1350	450	1220	407	1035	345	401

Ward No.	No. of Individuals	17.03.2017		18.03.2017		20.03.2017		Avg. daily Generation in gms/day/capita of individual family
		Weight of Samples of per days in gms	Per Capita Generation in gms	Weight of Samples of per days in gms	Per Capita Generation in gms	Weight of Samples of per days in gms	Per Capita Generation in gms	
24	3	1185	395	1010	337	945	315	349
24	5	1570	314	1470	294	1275	255	288
24	3	928	309	820	273	845	282	288
24	6	290	48	660	110	785	131	96
24	4	1218	304	1020	255	1120	280	280
24	4	325	81	315	79	445	111	90
24	4	505	126	485	121	525	131	126
24	3	570	190	620	207	745	248	215
25	4	1490	373	1210	303	1145	286	320
25	6	1795	299	1895	316	1642	274	296
25	4	1065	266	920	230	1284	321	272
25	5	1428	286	1285	257	1352	270	271
25	5	1100	220	1345	269	950	190	226
25	21	4643	221	5320	253	4575	218	231
25	10	1945	195	2130	213	1875	188	198
25	3	718	239	860	287	963	321	282
25	3	688	229	750	250	645	215	231
25	2	600	300	485	243	575	288	277
4	6	500	83	685	114	820	137	111
4	4	1890	473	2075	519	2275	569	520
4	8	1120	140	1450	181	950	119	147
4	3	1010	337	950	317	1245	415	356
4	5	1390	278	1545	309	1685	337	308
4	3	250	83	420	140	365	122	115
4	5	500	100	450	90	650	130	107
4	4	485	121	535	134	645	161	139
1	4	1385	346	1195	299	1220	305	317
1	3	658	219	510	170	450	150	180
1	5	583	117	720	144	650	130	130
1	4	500	125	420	105	470	118	116
1	3	623	208	620	207	765	255	223

Ward No.	No. of Individuals	17.03.2017		18.03.2017		20.03.2017		Avg. daily Generation in gms/day/capita of individual family
		Weight of Samples of per days in gms	Per Capita Generation in gms	Weight of Samples of per days in gms	Per Capita Generation in gms	Weight of Samples of per days in gms	Per Capita Generation in gms	
1	13	1875	144	2100	162	1645	127	144
1	3	433	144	520	173	745	248	189
1	4	1418	354	1610	403	1845	461	406
11	4	1125	281	1225	306	975	244	277
11	4	1163	291	1145	286	1365	341	306
11	4	700	175	620	155	920	230	187
11	3	578	193	618	206	752	251	216
11	1	250	250	342	342	390	390	327
11	3	615	205	736	245	852	284	245
11	3	980	327	1095	365	745	248	313
11	3	838	279	678	226	820	273	260
11	10	1500	150	1490	149	1350	135	145
11	4	960	240	870	218	1052	263	240
12	6	1290	215	970	162	1062	177	185
12	3	942	314	1045	348	1245	415	359
12	4	1045	261	1030	258	955	239	253
12	3	550	183	450	150	630	210	181
12	3	780	260	820	273	655	218	251
12	6	1405	234	1510	252	1356	226	237
15	7	1600	229	1845	264	1565	224	239
15	4	800	200	720	180	920	230	203
15	6	1867	272	1645	274	1745	291	279
15	5	595	198	475	95	650	130	141
15	4	475	286	345	86	555	139	170
8	3	1175	198	1575	525	1365	455	393
8	7	2200	230	2100	300	1875	268	266
8	5	1950	235	1875	375	1745	349	320
8	7	1478	338	1545	221	1500	214	258
8	3	1308	205	1505	502	1520	507	404

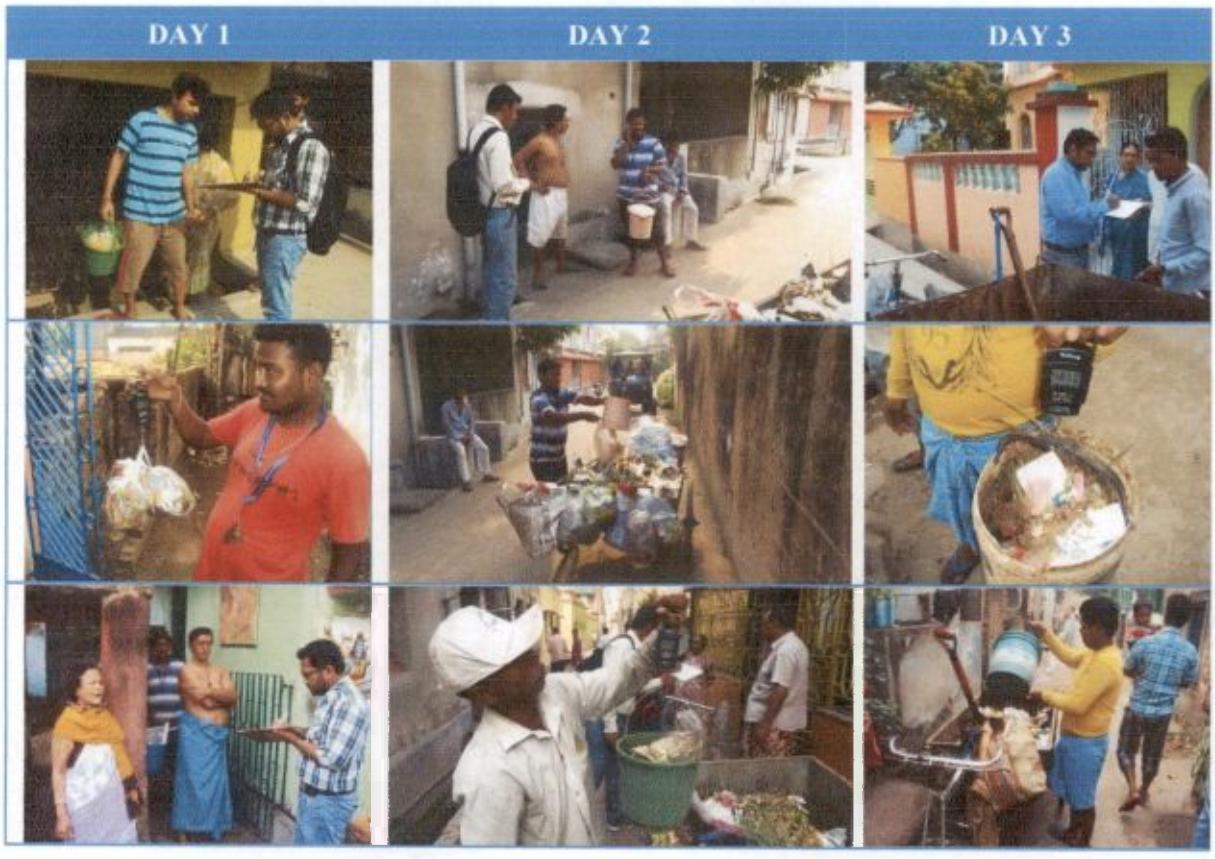


Figure 4-2: Waste Quantification at different Wards in Panihati Municipality

Thus, average per capita generation from households is estimated to be around **280 gram/day**. To arrive at the waste generated by households the per capita generation rate has been applied to the population. Thus, the total waste generated by domestic household in Panihati is around **114.7 MT/day**.

Table 4-2: Estimation of MSW Generated from Households

Description	Description Value
Per Capita Generation of household waste in gm./day	280
Population of Panihati -2017	409624
Total Quantity of Waste Generated, T/day	114.7

4.1.3 Commercial Establishments

There are more or less about 150 commercial establishments operating in Panihati, majority of them are Bank, Community hall, Public Library, Park garden, Playground, Ghats etc. These items contribute to the solid waste generation in Panihati. In order to assess the waste generated by these establishments, field visits and assessment surveys were carried out at commercial areas like along Sodepur-Barasat Road, Panchkori Sadhukhan Road, C.R Road, Subhash Chandra Road, Ekford

Road, Nilgaung Road, Raja Ram Chandra Ghat Road, Iswar Chatterjee Road, Harish Chandra Dutta Road etc.

Samples were selected randomly with the support of Panihati Municipality (PM) and survey was conducted to estimate the unit generation rate. The survey has been conducted two daysi.e. 21st (Tuesday) and 22nd (Wednesday) of March 2017. Total of 10 nos. establishments were selected and field assessments surveys were carried out.

Table 4-3: Results of Waste Quantification Survey at Commercial Establishments

Type of Establishments	Quantity	Unit Waste Solid Waste Generation Range, kg/unit/day	Unit Waste Solid Waste Generation Rate, kg/unit/day	Waste Generation in Kg/day
Park Garden	20	10-20	15	300
Play Ground	14	5-10	8	112
Bank	15	5	5	75
Bus terminus	4	10	10	40
Public Library	72	10-15	12	864
Auditorium	4	5-8	6	24
Cinema Hall	3	10	10	30
Ghat	10	5-10	8	80
Total				**1525**

Based on the survey it was concluded that Commercial Establishments in Panihati generates **1.525T** of solid waste on every day.

4.1.4 Hotels & Restaurants

To estimate the waste quantity generated from commercial establishments, different hotels, restaurants, eateries in the city were surveyed. Discussions were carried out with the concerned person to understand the size of the establishments (such as number of seats for hotels/ restaurants), waste generation per day and also the waste collection & disposal systems. The Households per capita assessment surveys were carried out for three days i.e. from 20th (Monday), 21st (Tuesday) and 22nd (Wednesday)of March 2017 (Annexure 30).Table 4.3 & 4.4provide the waste quantification results of such commercial establishments.

Table 4-4: Results of Waste Quantification Survey at Hotels/ Restaurants

Sl. No.	Ward No.	Hotels / Restaurants Name	Solid Waste Generation Range as per survey in kg/unit/day	Waste Quantity (Kg/ day)	Waste generation factor (kg/ Estb./day)	No. of similar establishment as per Municipality	Total waste (Kg/day)
1	13	Hotel Ramakrishna	20-30	25			
2	13	Aahar	25-35	30			
3	13	Dey Hotel &Restraint	35-45	40			
4	13	M/S Sodepur Inn	50-60	55			
5	11	Sudha Hotel &Restaurant	35-40	38			
6	16	Hungry Horse Tandoori Hotel &Restaurant	25-30	27			
7	16	Sova Restaurant& Hotel	25-35	30	30	34	**1020**
8	14	Rakhi Hotel	20-25	23			
9	6	S.S Hindi Hotel &Restaurant	25-30	28			
10	13	Ahar	20-25	23			
11	12	Gouri Family Restaurant	20-30	25			
12	22	Sudha Suniti Restaurant& Hotel	25-30	28			
13	23	Monorama Cabin	15-20	18			

Figure 4-3: Waste Quantification at Hotels & Restaurants in Panihati Municipality

4.1.5 Institutional Waste- Schools, Colleges, Universities

To estimate the waste generated by institutional activities like educational institutes, research institutesetc. the per capita generation rate as indicated by CPHEEOhas been considered. With reference to the CPHEEO manual the per capita waste generation by institutions is 0.05 to 0.2 kg/capita/day. Total of 5nos. establishments were selected (Annexure 29) and field assessments surveys were carried out.The Households per capita assessment surveys were carried out for two days i.e. 17th (Friday) and18th (Saturday) of March 2017.

Table 4-5: Results of Waste Quantification Survey at Institutions

Type of Establishments	Quantity	Unit Waste Solid Waste Generation Range, kg/unit/day	Unit Waste Solid Waste Generation Rate, kg/unit/day	Waste Generation in Kg/day
Higher Secondary School	34	20-30	25	850
Secondary School				
Primary School	80	15-20	18	1440
Research Institute & Engg. College	7	65-75	70	490
Total				**2780**

Based on the survey it was concluded that Waste generates from institutions in Panihati**2.78T**(approx) every day.

Figure 4-4: Waste Quantification at Institutions in Panihati Municipality

4.1.6 Fruit and Vegetable Markets, Fish and Meat Markets

Primary waste quantification was carried out at vegetable markets and fruit markets. The survey was done through the visual observation and assessment on the percentage filled of the containers (SCPs) placed in those markets. In addition to the observation, consultation and discussion was also carried out with the market with market committee members and vendors to understand the lifting schedule and their assessment of the waste generation quantity from that specific market. The Households per capita assessment surveys were carried out for three days i.e. 20th (Monday), 21st (Tuesday) and 22nd (Wednesday)of March 2017 (Annexure 28).The outcome of the survey is presented through the **Table 4.6**and **Figure 4.5**below.

Table 4-6: Results of Waste Quantification Survey at Market

Sl. No.	Ward No.	Name of Daily Market	Waste Generation (Kg/day)
1	10	Mollarhat Bazar	600
2	14	Sukchar Bazar	500
3	14	Municipal Market (Vegetable)	1800
4	14	Municipal Super Market	600
5	15	Pansila Super Market	500
6	25	Sen Bazar	800

Sl. No.	Ward No.	Name of Daily Market	Waste Generation (Kg/day)
7	27	Ushumpur Battla Bazar	700
8	30	Ghola Bazar	600
9	31	Bijoypur Bazar	500
10	32	C' Block Bazar	1000
11	34	Kadamtola Bazar	800
12	35	Parthapur Bazar	500
13	13/14	Paschimanchal Market	400
14	13/14	Vivekananda Market	300
Total			**9600kg/day**

Sl. no.	Type of Markets	Ward No.	Nos.	Waste Generation (Kg/day)
1	Daily Markets	1,13,14,15,27,30,31,34,35	14	9600
2	Food & Vegetable Wholesale	14,30	3	400
3	Wholesale Commodity Market	4,7,8,31	5	200
Total				**10200 Kg/day**

Figure 4-5: Waste Quantification at Markets in Panihati Municipality

4.1.7 Hospitals & Nursing Homes (Excluding Bio-Medical Waste)

There are about 59 Health service centerswhile some major hospitals namely Panihati State General Hospital, Sumangal Hospital, M/S Dewan Medicare, North view Nursing Home & Child Care, Green View Nursing Home, Midland Medicare Limited, etc. are situated in Panihati area. Beside above, there are several numbers of allopathic, ayurvedic and homeopathic and other dispensaries. Generally, bio-medical waste is classified in terms of body tissues, bandages, syringes, needles, glass and plastic bottles and Chemical and Pharmaceutical waste. Every hospital and nursing homes collects green waste and medical waste separately in yellow plastics and blue plastics. SembRamkey Environmental Management Pvt. Ltd. Collects biomedical waste from hospitals and nursing homes for treatment of septic and non-septic waste in regular basis. Panihati Muncipality collects only green waste from these establishments. As according to CPHEEO Guidelines, the per capita waste generated by hospitals will be around 1.5 kg/bed/day, of which 75 per cent will be domestic waste and 25 per cent, will be bio-medical waste.The Households per capita assessment surveys were carried out for two days i.e. 21st (Tuesday) and 22nd (Wednesday)of March 2017 (Annexure 28).

Table 4-7: Results of Waste Quantification Survey at Hospitals

Type of Establishments	Quantity	Unit Solid Waste Generation Range, kg/unit/day	Unit Waste Solid Waste Generation Rate, kg/unit/day	Waste Generation in Kg/day
Nursing Home	7	15-20	18	126
Hospital	2	40-50	45	90
Municipal Maternity Home	1	20-25	22	22
Regional Diagnostic Center	2	10-15	12	24
Extended Specialist Out Patient Dpt.	1	10	10	10
Municipal Health Sub-center	40	10-15	12	480
Municipal Health Administrative Unit	6	5-10	8	48
Total				**800**

Based on the survey it was concluded that Waste generates from institutions in Panihati **0.8 T** every day.

Figure 4-6: Waste Quantification at Hospitals in Panihati Municipality

4.1.8 Street Sweeping and Drain Cleaning

Street sweeping and drain cleaning are not regular function of the municipality and the supervisory mechanism is a critical area identified for improvement in order to achieve the 100% coverage.

Sources of Street Wastes:

The major sources of street wastes in municipality included:

- Natural waste comprising dust blown from unpaved areas, decaying vegetation like fallen leaves, blossoms and seeds originated from trees and plants.
- Road traffic waste like oil, rubber, accidental spillage of load of vehicles in addition to the construction wastes.
- Behavioural wastes include litter thrown by pedestrians, households, establishments and outsiders along with human spittle and excrement of domestic pets.
- Storm water drains/Sewer cleaning wastes.

From the observations made on-site, the natural wastes and road & traffic wastes are unavoidable and to be cleaned by street sweeping process. However, the behavioral wastes are largely avoidable

provided an efficient refuse collection service if in operation for the use of pedestrians. But it was evident from the observation during the field visit that the success was requiring a continuing program of public education and awareness backed by legislation and efficiently operating enforcement measures. In the wards, there is no formal door to door collection programs, generators must either carry their waste to a secondary collection point or leave their waste on the street where it is collected as part of the municipal street sweeping service. Depositing waste in open drains is also very common in Panihati Street sweepers are responsible for not only cleaning the roads and footpaths of dirt and silt, but also for collecting rubbish deposited by businesses and residents.

One of the major activities of the solid waste management is street sweeping, which is time consuming and labor intensive.Due to open drainage system, desilting of drains is also necessary. Since throwing and indiscriminate disposal of waste on to streets is prevalent, collection of waste is mainly through street sweeping. Sweepers use traditional brooms to sweep, collect and transport waste up to collection points using tricycle. The drains get de-silted when they get filled up to brim with sewage or before the start of monsoon rains to prevent water logging. The silt is left on road side for drying for a day or two before being disposed of. Open defecation was observed in open dumps.Based on the survey it was concluded that Waste generates from street sweeping and drain cleaning work at average **3-3.5T** every day.

Figure 4-7: Street Sweeping & Drain Cleaning Activity

4.1.9 Other Sources

This term applies to wastes that are collected from streets, walkways, alleys, parks and vacant plots. Street wastes include paper, cardboard, plastic, dirt, dust, leaves and other vegetable matter. In the more affluent countries manual street sweeping has virtually disappeared but it still commonly takes

place in developing countries, where littering of public places is a far more widespread and acute problem. Mechanized street sweeping is the dominant practice in the developed countries.

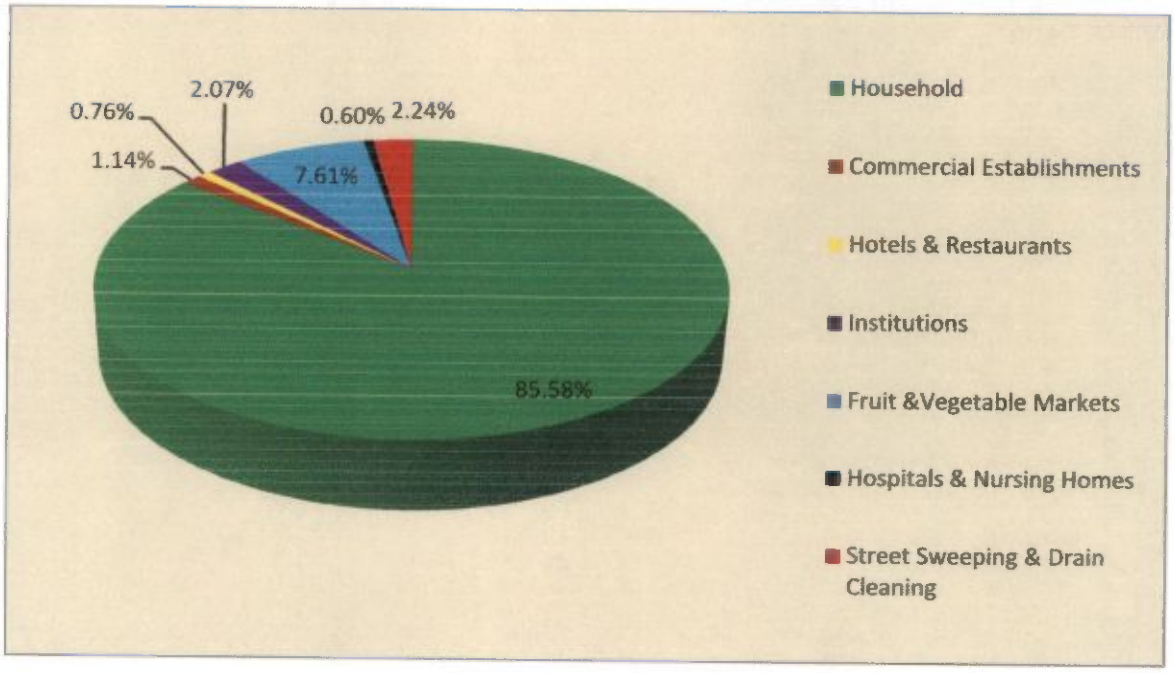
4.1.10 Quantity of Waste Generation

It is quite evident that the residential area covers the major portion of the land use, which reflects that the study area is densely populated. The distribution of potential sources of MSW in municipality is presented in *Table 4.8* below. A comparative waste composition at different potential sources is shown in *graph 4.1.*

Table 4-8: Potential Sources of Waste at Panihati Municipality

Sl. No.	Type of Establishments	Waste Generation in T/day
1	Household	114.7
2	Commercial Establishments	1.525
3	Hotels & Restaurants	1.02
4	Institutions	2.78
5	Fruit &Vegetable Markets	10.2
6	Hospitals & Nursing Homes	0.8
7	Street Sweeping & Drain Cleaning	3
	Total	**134.025 T/day**

Graph 4-1: Comparative Waste Composition at Different Potential Sources



Additionally, studies have also been conducted to analyze the pattern of waste generation and collection at the municipality level. Although the aforementioned Table 4.8 indicates 135 tons per day of waste generation which has been assumed as the optimal generation of waste, though there may be increase due to 100% coverage of street sweeping and which would not have any adverse impact on waste processing activities since street sweeping contains mostly inert material.

4.2 FUTURE WASTE GENERATION TRENDS

The solid waste quantitiesgenerated by an individual are directly proportional to the quantity of material consumed and thusthe increase in per capita solid waste quantities would be directly proportional to the per capitaincrease in GNP. Various studies, as mentioned below, are been made to assess the increase inthe per capita waste generation per annum based on which the increase in per capita wastegeneration for Panihati is adopted.

As per the report published by Urban Development Sector Unit, East Asia and Pacific Region ofThe World Bank in 1999, the urban per capita waste generation rate for most of the low incomecountries will increase by approximately 0.2 kg per annum because these countries have relativelyhigh annual growth rates of GNP and urban population.

As stated in the paper titled Municipal solid waste management in Indian cities – A review byMufeed Sharholy, Kafeel Ahmad and Gauhar Mahmood of Department of Civil Engineering, JamiaMilliaIslamia University and R.C. Trivedi of Central Pollution Control Board in the journal of WasteManagement 28 (2008) 459–467, The amount of MSW generated per capita is estimated toincrease at a rate of 1 – 1.33% annually.

Mr.Kurian Joseph, Senior Lecturer in Environmental Engineering from Center for EnvironmentalStudies, Anna University in his publication "Perspectives of Solid Waste Management in India" hasquoted that the estimated annual increase in per capita waste quantity is about 1.33% per year.Thus considering the various references, the average annual growth rate of per capita generationrate has been taken as 1.33%.

Assuming this projection rates, it is projected that the per capita generation in Panihati will increasefrom 330 gm/day to 474 gm/day by the target year 2045 and the total waste generated from 135MT/day to 259 MT/day.

Table 4-9: Project Generation Trends of Solid Waste in Panihati

Year	Design Population	Per Caipta Generation, gm/day	Waste (TPD)
2017	409624	330	135
2018	414910	334	139
2019	420169	339	142
2020	425401	343	146
2021	430606	347	150
2022	435785	352	153

Year	Design Population	Per Caipta Generation, gm/day	Waste (TPD)
2023	440937	357	157
2024	446063	361	161
2025	451162	366	165
2026	456234	371	169
2027	461280	375	173
2028	466298	380	177
2029	471291	385	182
2030	476256	390	186
2031	481195	395	190
2032	486107	401	195
2033	490993	406	199
2034	495852	411	204
2035	500684	416	208
2036	505490	422	213
2037	510268	427	218
2038	515021	433	223
2039	519746	438	228
2040	524445	444	233
2041	529117	450	238
2042	533763	456	243
2043	538382	462	249
2044	542974	468	254
2045	547539	474	259

4.3 QUANTIFICATION & CHARACTERIZATION OF WASTE

The physical composition of the waste sample shows that the percentage of compostable matter is high at the source generation i.e. household and market. Waste characteristics vary not only from town to town but even within the same town, as it depends on factors such as the nature of local activities, food habits, cultural traditions, socio-economic factors, climatic conditions and seasons etc. The physical and chemical characteristics aid in deciding the desired frequency of collection, precautions to be taken during transportation and methods of processing and disposal.

4.3.1 Sampling Criteria

The physical characteristics of solid waste are analyzed in this section. For this purpose, sampling surveys were carried out at Sukchar area of the city. The sampling program comprised collecting

twodays i.e., 20th (Monday) and 21st (Tuesday) of March 2017 and performing on site characterization of the same.In order to represent the waste characteristics from different parts of the city, the samples werecollected from different secondary collection points collecting waste from various parts of the city. The sampleanalysis comprised;

- For the purpose of sampling survey a temporary weighing arrangement was prepared at the sampling site.
- Onsite characterization by way of segregation and weighing the percentage of eachconstituent in terms of paper, plastic, rags, organic and inorganic components at site

For each sampling, collect 10kg – 15kg mixed fresh waste from 4-5 different locations. The origin of eachweight of waste is recorded. Then mixed thoroughly 40-60 kg of waste and divided into four equal parts. Using coning and quartering method about 40-60 kg of composite samplefrom original collected solid waste. The two diagonally opposite parts are retained for analysis and the other two are discarded. The retained parts are again mixed thoroughly and samples of 10-15 kg are taken for physical analysis. A schematic diagram for collection of sample is shown in *Figure 4.9*.

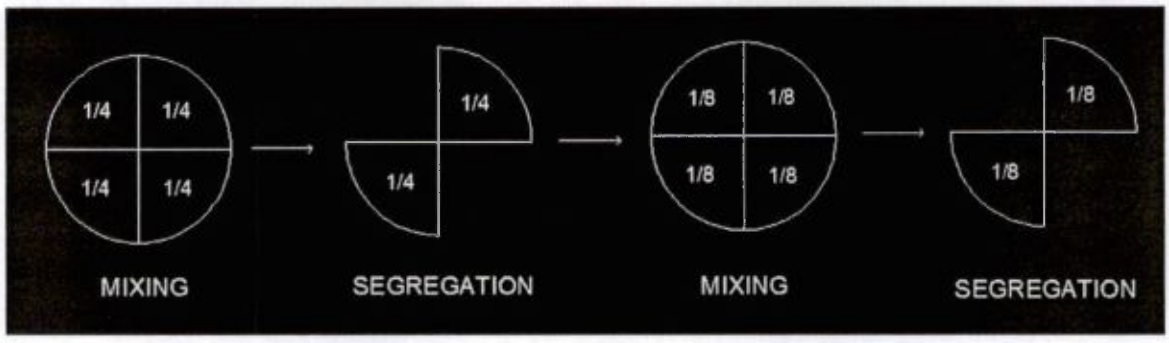


Figure 4-8: Schematic Diagram of Waste Sampling

4.3.2 Physical Characteristic of MSW

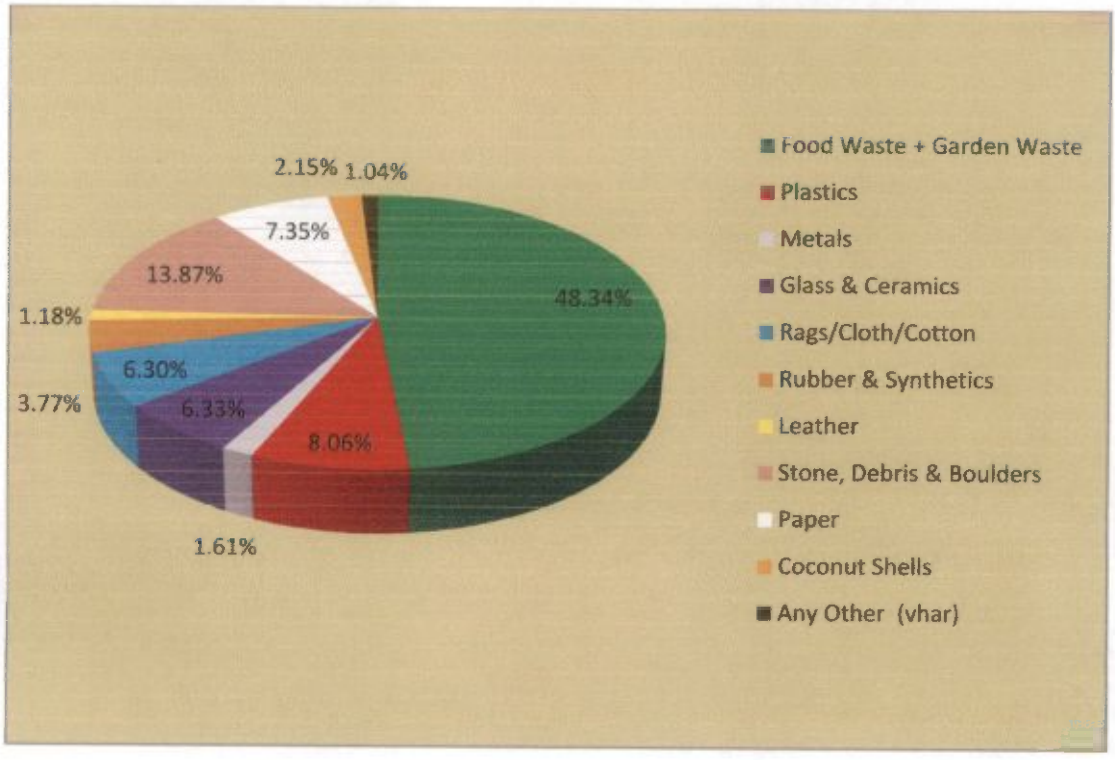
The majority of waste is generated by residential, commercial sources such as vegetable and fruit markets, hotels & restaurants and municipal activities such as street sweeping and drain cleaning. From the household level survey, respective waste generation factors (gm/capita/day) for different residents have been assessed based on weighted average and are used in this report to calculate the total residential waste generation in the town. To assess the overall municipal waste generation of Panihati municipal area, quantity of wastes generated from all major bulk generating sources and commercial establishments is added up with the residential waste generation to obtain the total MSW generation in the town for the year 2017.

Figure 4-9: Pictures of Physical Characterization of MSW

Table 4-10: Summary of Physical Composition of the MSW of Panihati Municipality

Sl. no.	DATE / Parameter	17-03-2017 % of each Parameter in Total quantity of Solid Waste	18-03-2017 % of each Parameter in Total quantity of Solid Waste	20-03-2017 % of each Parameter in Total quantity of Solid Waste	21-03-2017 % of each Parameter in Total quantity of Solid Waste	22-03-2017 % of each Parameter in Total quantity of Solid Waste	AVERAGE % of each Parameter in Total quantity of Solid Waste (3 days)
1	Food Waste + Garden Waste	46.89%	45.91%	48.66%	52.36%	47.88%	48.34%
2	Plastics	9.07%	5.03%	9.85%	7.89%	8.45%	8.06%
3	Metals	1.23%	0	3.91%	0	2.89%	1.61%
4	Glass & Ceramics	4.08%	8.75%	5.39%	6.23%	7.22%	6.33%
5	Rags/Cloth/Cotton	6.42%	7.65%	4.32%	7.46%	5.67%	6.30%

Sl. no.	DATE / Parameter	17-03-2017 % of each Parameter in Total quantity of Solid Waste	18-03-2017 % of each Parameter in Total quantity of Solid Waste	20-03-2017 % of each Parameter in Total quantity of Solid Waste	21-03-2017 % of each Parameter in Total quantity of Solid Waste	22-03-2017 % of each Parameter in Total quantity of Solid Waste	AVERAGE % of each Parameter in Total quantity of Solid Waste (3 days)
6	Rubber & Synthetics	4.56%	5.03%	3.59%	3.57%	2.12%	3.77%
7	Leather	1.53%	1.11%	0	2.21%	1.06%	1.18%
8	Stone, Debris & Boulders	15.23%	13.63%	14.78%	11.24%	14.45%	13.87%
9	Paper	7.55%	8.61%	6.23%	6.89%	7.45%	7.35%
10	Coconut Shells	2.75%	3.32%	1.58%	1.06%	2.02%	2.15%
11	Any Other (vhar)	0.69%	0.96%	1.69%	1.09%	0.79%	1.04%



Graph 4-2: Graphical Representation of Constituents of Solid Waste

4.4 EXISTING MSW COLLECTION SYSTEM

This chapter analyzes the physical components of the solid waste management prevailing in municipal area in terms of collection, transportation, treatment and disposal. The situation analysis addresses both the qualitative and quantitative aspects in terms of process, mechanism, tools and equipments used and other related issues. The impacts of the floating population on the system in terms of quantity and quality of the wastes are also considered for the detailed analysis. Deficiency analyses are undertaken, comparing the prevailing situation with that of the various standards/norms available. Finally, the issues and problems related to the various aspects like collection, transportation, treatment and disposal of the wastes are summarized for necessary action towards improving the solid waste management in the town.

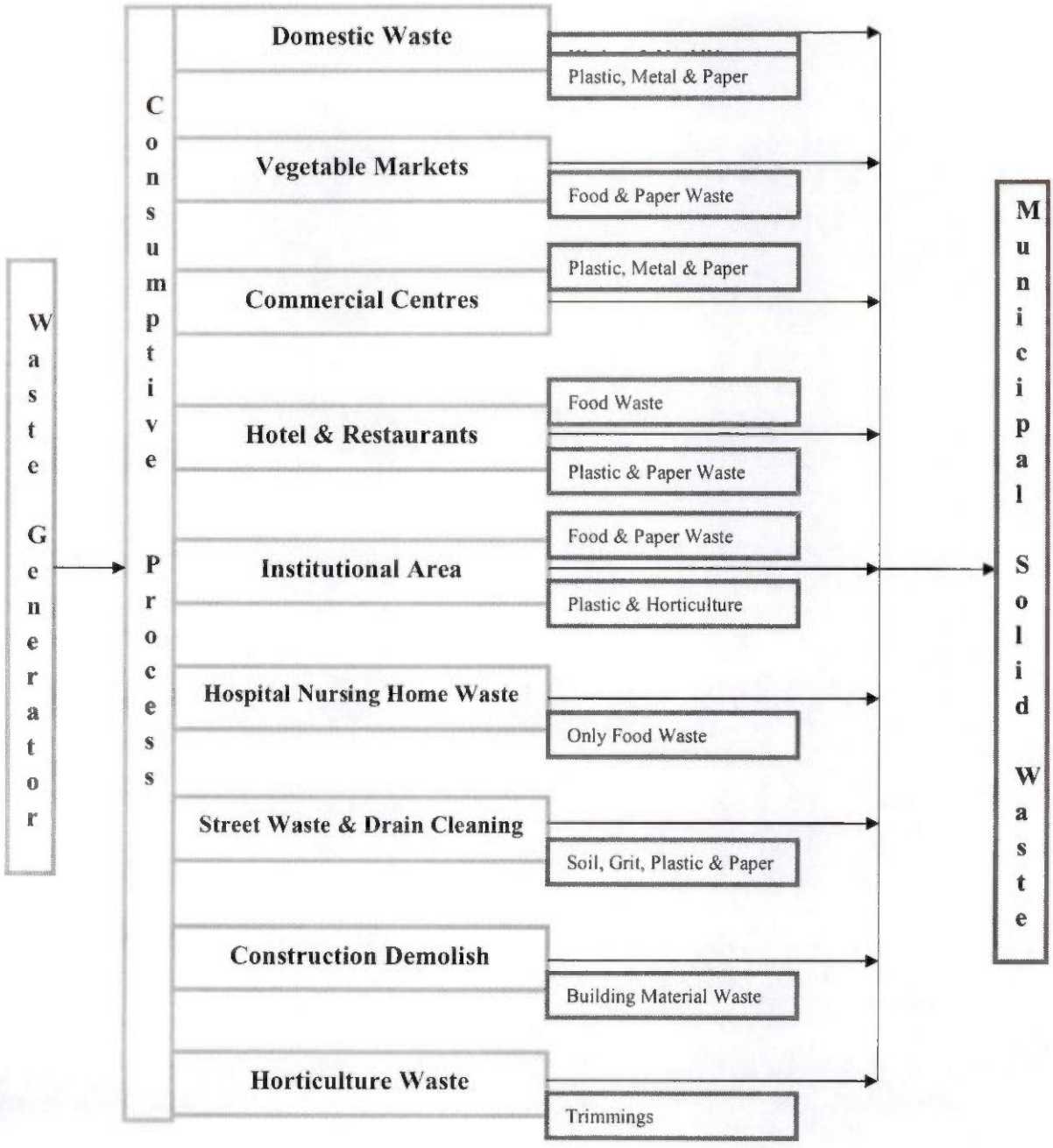
The existing system of municipal solid waste collection, transportation and disposal is carried out by municipality under the ambit of the Conservancy Departments.

4.4.1 Source of the Waste

Following are the major sources of generation of solid waste in the Panihati Municipality

- Domestic Waste;
- Commercial Areas Waste;
- Institutional Waste;
- Vegetable Markets Waste;
- Hotels and Restaurants Waste;
- Hospital-Nursing Home Waste except Biomedical Waste;
- Construction-Debris Waste;
- Horticultural waste;
- Street Sweeping &Drain Cleaning Waste;

Flow Chart for Process of Generation of Waste in Panihati Municipality



4.4.1.1 Domestic Waste

Domestic waste consists of primarily food waste, paper, plastics, glass, metal, rags and otherpackaging materials. Domestic waste is the largest part **(85.58%)** of municipal waste. A primary data survey was carried out on the present generation of total waste is estimated 135 Metric Tons per day. The households of the city based on the housing typology can be categorized as independent bungalows, independent houses of low, middle and high income groups, tenements, individual flats,

apartments and huts or economically weaker section dwellings.As the entire city is divided into 35 wards, each ward has particular pattern of Housing conditions. Each ward has particular housing categories in particular.

The type of housing and the economic level of a consumer is an important factor influencing generation of waste. People of higher income group are generally found to generate more solid waste than that of lower income group. The areas within the walled city have old buildings with narrow lanes demonstrating traditional planning. The newly developed area, have high rise buildings, modern row houses and individual bungalows which show modern trends.

4.4.1.2 Commercial Waste

Commercial establishments such as ceremonial house, shops, trading units, dairies, juice shops, hardware, electrical and electronics, workshopssmall time street-traders, banks, bus terminus, public library, park garden, playground and related generate solid waste which mainly comprises of paper, plastics, food leftovers, vegetables rejects and other inorganic material. The quantity of solid waste generated from the above said units are about **1.14%**of the total waste generation.

4.4.1.3 Institutional Waste

Institutional waste can be divided into two types of waste one is waste generated from educational institutions and other various institutions. The estimated wastes generated from these institutes are **2.07%** of the total solid waste generation. Schools, Institutions, Research collages shall generally throw their solid waste on the footpaths, streets, open spaces/nallas. The practices of keep the waste in form of dump in the footpaths, which remains there till sweepers collect them during street sweeping, is prevalent.

4.4.1.4 Market Waste

There are vegetables, meat market, and fruit market in the city. Out of them, the new vegetable market is reasonably well managed. It remains much clean outside as well as inside barring a few unscrupulous vendors dispose of the waste on the floor. The market compound is kept free from vending and remains reasonably clean. However, just outside the market there are large numbers of vendors who dispose ofthe waste on the streets.The estimated wastes generated from these markets are **7.61%** of the total solid waste generation.

4.4.1.5 Hotels and Restaurants Waste

There is large number of small hotels and restaurants in the city and all of them throw the waste on the streets or into the municipal bins. There is no arrangement of primary collection of waste from the hotels. The estimated wastes generated from these hotel & restaurants are **0.76%** of the total solid waste generation.

4.4.1.6 Hospital-Nursing Home Waste except Biomedical Waste

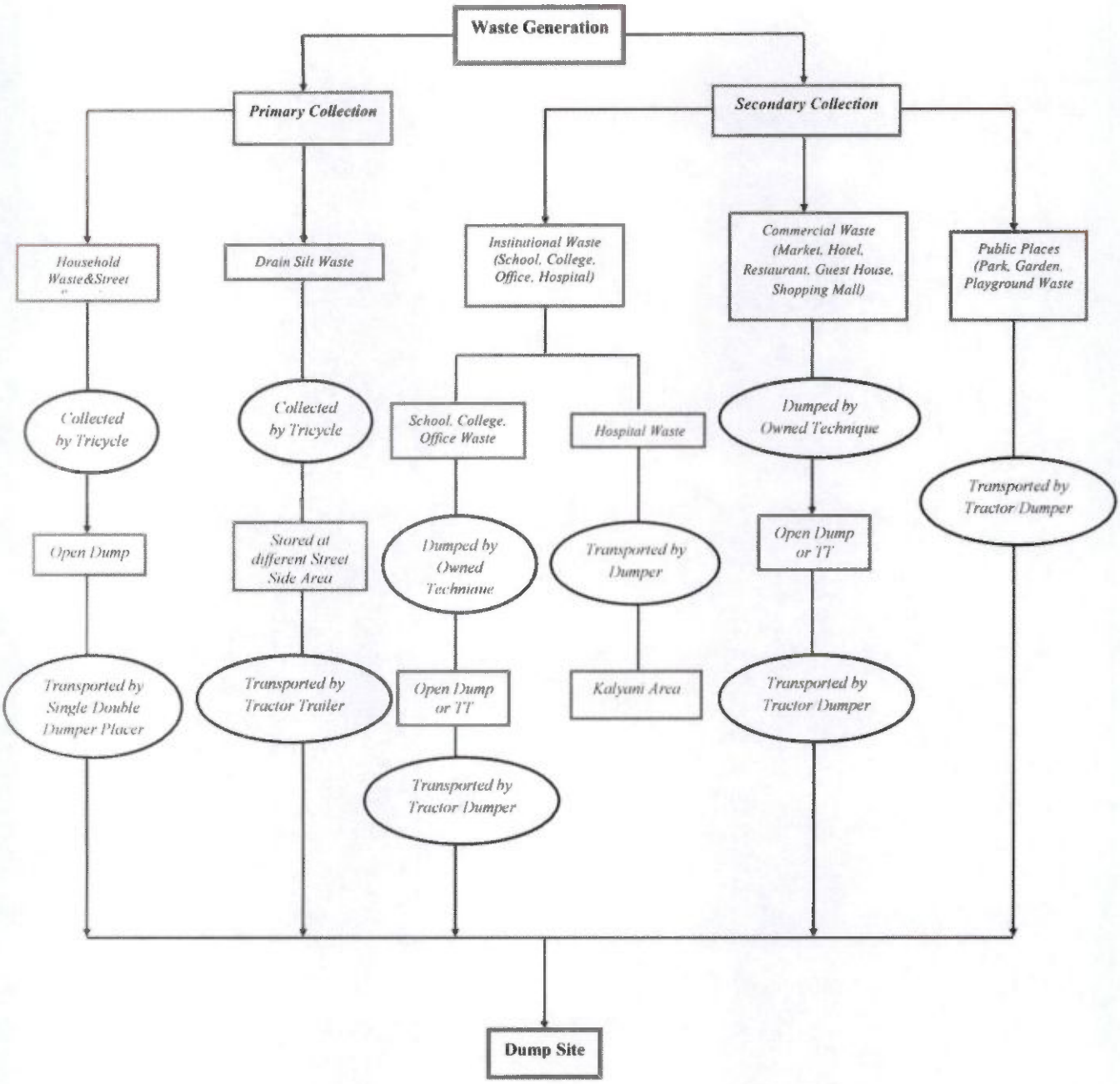
Biomedical waste contains a variety of infectious and toxic wastes generated from hospital nursing homes, and health care centres. The city has around 2 big hospitals and around 7 private nursing

homes &50 pathological laboratory.In orders to understand the biomedical waste management practices in the municipal area; survey was conducted in Panihati State General Hospital and Nursing Homes. From the survey, it was observed that the medical establishments (hospitals and nursing homes) have separate biomedical waste collection and segregation system. Each establishment has made a contract agreement with SembRamky Environmental Management Pvt. Ltd. and sent their respective wastes to SembRamky Environmental Management Pvt. Ltd. for incineration and the monthly biomedical waste report send to West Bengal Pollution Control Board. The biomedical waste is presently being managed in accordance to the Biomedical Waste (Management & Handling) Rules and management of this waste is not under the scope of Panihati Municipality and therefore outside the scope of this study. In Panihati, no major process industry exists from where industrial hazardous waste could be expected.The estimated wastes generated from these hospitals & health centres are **0.60%** of the total solid waste generation

4.4.1.7 Construction-Debris, Drain Cleaning & Road Sweeping Waste

There is no system of storage neither of construction waste nor of its primary collection. The municipality also collects waste generated from street sweeping waste & drain silt. Municipality send dumper vehicle to collection point after getting information from waste generator. After collection of construction debris material, waste generator paid relevant charges around 500 rs for collection, transportation and disposal for per trip of vehicle. The estimated wastes generated from construction debris & road sweeping are **2.24%** of the total solid waste generation.

4.5 MSW COLLECTION SYSTEM OF PANIHATI MUNICIPALITY



Flow Chart of Collection System of Panihati Municipality

4.6 PRIMARY COLLECTION SYSTEM

4.6.1 Household Waste Collection System

Existing system of MSW collection is performed by the Panihati Municipality(PM) with the help of tricycles. The door-to-door system of collection is only prevalent in some areas and commercial areas where the shops and commercial centres keep dustbin and collect the waste. But unfortunately this is seen very rarely. The waste stored individually by shops and establishment is most of times deposited on the streets or on the ground outside the bins.The Household Waste Collection of this area is currently being practiced in 15 wards among 35 wards. Primary collection would be carried out by engaged some NGO's in 15 wards.Household waste generators give 15rs to 20rs to sanitary workers of NGO's. The sanitary workers of NGO's place the collected waste at the nearest open vats orTT container for secondary collection. The waste collection timings generally range from 6:00 AM and 11:00 AM. They are involved in the work of picking up soiled and contaminated waste to earn their living.After completion of work, waste handlers kept their vehicles into different areas like Municipality ward office, ward councilor's house, club area etc.Waste handlers make at avg. 3-4 trips and collect waste at average 150 nos. houses at daily basis At present door to door collection is done in only 20-30% area of total area of a ward at daily basis. Thus, PMneed to engage more infrastructure and resources to initiate the 100% door-to-door collection of waste.

Figure 4-10: Pictures of Household Waste Collection

4.6.2 Street Sweeping& Drain Silt Waste Collection System

The process of street sweeping of waste is still in primitive nature in the municipal area. The sanitary workers are found sweeping the streets using brooms to make small heaps of solid waste as shown in Figure 4.13. These heaps of solid waste are then taken to nearest temporary waste storage point by handcarts/baskets. In most cases, one sanitary worker was found sweeping and making the heap and another lifting the same using handcarts/baskets and taking it tothe nearest temporary waste storage point. Apart from these, there were many undesignated open yards across the municipality where sanitary workers were found collecting/sweeping the waste during early hours of morning and making heaps for subsequent transportation. It is observed that all roads and streets were not being swept on daily basis. In practice, certain important roads and markets were swept daily, some were swept on alternate days or twice a week, some were swept occasionally or not at all due to options of adequate number of sanitary workers and supporting machineries.With a total road length of 361 km, street sweeping waste is the one of the major component of solid waste in area.The sanitary workers collect

the waste from house in Tricycle, simultaneously sweeping the streets during primary collection.The waste collection timings generally range from 7:00 AM and 12:00 noon.

At places, waste generated from various sources is disposed off in the storm water drains criss-crossing the length and breadth of the town, degrading over a period of time, thus becoming a part of drain silt.As observed during reconnaissance survey of the town, there is no connectivity between road-side drains which result in accumulation of sewage at dead ends and resulting in unhygienic condition for the residents. Waste is observed to be dumped mainly in drains and some open plots by the residents, shop keepers etc. The total length of the drains in Panihati is 716 km. During survey, it has been observed that most of the drain networks not with adequate in size and damaged at many places and it is improper to drain out the rain water, causing water logging problems in many wards.

Figure 4-11: Pictures of Street Sweeping & Drain Sludge Waste Collection

4.6.3 Primary Waste Storage at Generation

Storage of waste at source is not practiced in a scientific manner in accordance with CPHEEO norms. Waste is thrown onto streets, drains and in some cases water bodies and low lying areas due to absence of effective door to door collection mechanism. There is a partial and rudimentary system of door to door collection which is being practiced in some areas. Un-segregated waste is collected with the help of tricycles and emptied into the TT container or bins or open dump placed within some wards at specific locations. Construction/demolition wastes are also generated in the city to a significant extent from repair, maintenance and reconstruction activities. Construction related waste is deposited after salvaging useful material on the periphery of the roads abutting the dwellings, low lying areas and small quantities were also found along with the garbage at the present dumping site.

Figure 4-12: Primary Waste Collection Storage

During survey of the existing system, it was observed that containers/bins of insufficient capacity and numbers have not been provided at strategic locations for receipt and storage of domestic, trade and institutional waste. Essentially, segregation of waste into biodegradable, non-biodegradable and recyclable material is not in practice.It has been also seen that waste are overflowing from the container or open dump and that scattered the specific storage point which signifies that the collection of waste is not done in regular way. The following list describes the location of TT containers, open vats where waste collector puts waste after primary collection.

Table 4-11: List of TT Containers & Vat

Ward No.	Sl. No.	Ward Sl. No.	Vat / Container	Place	Collection Frequency
1	1	1	Container	Milan Sangha	2 Day
	2	2	Container	Shishu Uddhan	2 Day
2	3	1	Container	Tejpal	1 Day
	4	2	Container	Patua tala	2 Day
	5	3	Container	Raja Road (Sibaji Sangha)	1 Day
	6	4	Container	Raja Road (Karmadakha Chandrachur)	Daily
	7	5	Container	Sukchar Park	2 Day
	8	6	Container	Club Road (Raja Basti)	Daily
	9	7	Container	B.T Road (Raja Basti)	1 Day
	10	8	Container	B.T Road	1 Day
	11	9	Container	Club Road (Sukchar Club)	1 Day
	12	10	Container	Dr. Gopal Chatterjee Road (Satadal School)	2 Day
	13	11	Container	Dr. Gopal Chatterjee Road (Joyprakash Nagar)	2 Day
	14	12	Container	Joyprakash Nagar	2 Day
	15	13	Vat	Raja Basti	2 Day
3	16	1	Vat	Chiruni Kata Gali	2 Day

Ward No.	Sl. No.	Ward Sl. No.	Vat / Container	Place	Collection Frequency
	17	2	Vat	Pearless Nagar Vat-1	Daily
5	18	1	Vat	Burning Ghat	After 2 Day
8	19	1	Container	Babulal Rajghoria	2 Day
11	20	1	Container	Laha Bagan	1 Day
	21	2	Container	6No Rail Gate	1 Day
13	22	1	Vat	Govt. Qtr. (Mother Dairy)	Daily
	23	2	Vat	Govt. Qtr. (Baroda Bank)	Daily
14	24	1	Container	Syding Bazar	Daily
	25	2	Container	Iswachar Chatterjee Road	1 Day
	26	1	Container	Godrej Prakriti	Daily
15	27	1	Container	Santi Nagar Khalpar	1 Day
	28	2	Container	Santi Nagar Bazar	1 Day
	29	3	Container	Santi Nagar Cycle Dokan	Daily
	30	4	Container	Santi Nagar Chasma Goli	1 Day
	31	5	Container	Sadhur More	Daily
	32	6	Container	Rani Rashmoni Nagar	1 Day
	33	7	Container	Uttarayan	Daily
16	34	1	Container	Jiban Krishna Chatterjee Road	Daily
	35	2	Container	School Road	Daily / 1 Day
	36	3	Container	Deshbandhu School For Girls	1 Day
	37	4	Container	1No. D.B. Nagar	Daily
	38	5	Vat	Police Fari	1 Day
	39	6	Vat	Gosto Kanan	1 Day
17	40	1	Container	Kayer More	Daily
18	41	1	Container	Dakhin Panshila	1 Day
	42	2	Container	Panchantala Bazar	1 Day
19	43	1	Container	Panshila Boys School	Daily
	44	2	Container	Kalitala Math	1 Day
22	45	1	Container	Amrabati Math	2 Day
	46	2	Container	Bistu Bhader More	2 Day
26	47	1	Container	Ushampur D.B.N Rd. Near Pukur Par	Daily
27	48	1	Container	Prasanna Chatterjee Road	Daily
	49	2	Container	Subhas Nagar	1 Day

Ward No.	Sl. No.	Ward Sl. No.	Vat / Container	Place	Collection Frequency
	50	3	Container	Kalyan pur	Daily
	51	4	Container	5No. Azad Hind Nagar	1 Day
28	52	1	Container	Rakha Kali Tala	Daily
	53	2	Vat	P.C Road, Majumder Para	2 Day
30	54	1	Container	Manik Danga Road	Daily
	55	2	Container	Nibaran pur	1 Day
31	56	1	Container	H.B Town, Road No.-6	Daily
	57	2	Container	H.B Town, Road No.-7	1 Day
	58	3	Container	Tritha Bharati	1 Day

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

4.7 SECONDARY WASTE COLLECTION SYSTEM

Presently mixed waste (bio-degradable and recyclable) are collected from residential and market area and brought to secondary collection points which are in form of 2 m^3 capacity of TT containers and open vats. There are about 58 such collection points of which about 49 numbers are TT containers and the rest are in form of open vats where municipal waste collectors collect waste. These besides as many as open dump placed in whole municipal areas where collection of waste is not running in regular way. These storage points are not only facilitating the residents to deposit the wastes in these storage points but also enabled the municipal sanitary workers to carry and deposit the wastes swept by them. It is observed that the MS Containers are placed along the roadsides and important locations, but not maintaining the spacing. The present secondary collection system (as shown in **Fig 4.15**) is not sufficient to meet the requirement of waste generated in the city.

Figure 4-13: Secondary Collection System

As discussed, in primary collection system, Primary waste collectors dispose waste into nearer big TT containers or open dumps which is secondary collection points. All Secondary Collection Vehicles start from Municipality garage in the morning at 8:00 pm and continue up to 4:00 pm.The waste from secondary collection points is transported by using tractor trailers, dumpers, covered trailer, compactor dumped into Present Dumping Site at Ramchandrapur, Panihati.Secondary collection points including road side bins would be aesthetically designed with adequate capacity and placed at optimal locations.

In addition to the above vehicles, Panihati owns four big cesspool (tractor mounted),threesmallcesspool (tractor mounted),and one drain cleaning vehicle (3000 litre capacity) as shown in Figure 4.16 which Panihati rents out to the residents to collect waste from septic tank on a commercial basis by charging charge Rs 800/- per day.

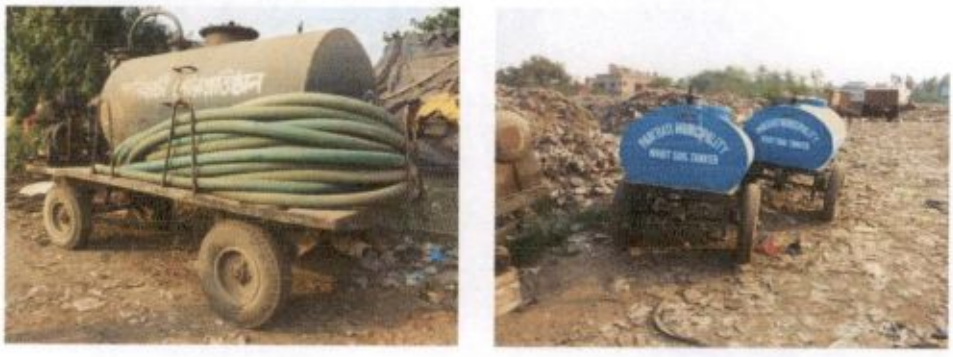


Figure 4-14: Cesspool & Drain Cleaning Machine in Panihati Municipality

4.8 MSW TRANSPORTATION SYSTEM

The drivers involved for waste collection and transportation reach the Panihati Municipality located at B.T Road(WardNo.13)in the morning (6:00 am) where they are briefed by respective Municipal Officials and Supervisors regarding the locations from where the waste is to be collected and route to be followed. Municipality informed that there are no specific routes followed by drivers as the location from where waste is to be lifted keeps on changing on day to day basis. Based on quantity of waste at a particular location, sometimes JCB also send along with Tractor. Also, allocation of fuel depends upon the route to be taken and no. of locations to be visited by a particular driver/ vehicle. The regular routes for vehicles are Ambika Mukherjee Road to Subhas Chandra Road to Ramchandrapur Road to Nilgunj Roadto Fery Fund Road to Raja Ram Chand Ghat Road.

This is verified by respectiveMunicipal officials. The drivers are required to make entries in log book in the afternoon when they return from work regarding the amount of fuel used, no. of locations visited, timing, etc. The existing dumpsites are located at **Ramchandrapur** (ward No.23). The vehicles make at avg. three trips per day to transport the MSW to dumpsite. It takes about an hour or two to make one trip depending on the distance and traffic conditions prevailing at that time.

Table 4-12: Transportation of Vehicles

Sl. No.	Vehicle Type	Numbers in Working Condition	Purpose	Capacity
1	Tractor	23	Used to transport 3m3 containers from secondary collection to dump site	-
2	Dumper	3	Used to collect waste from markets and street waste and transport to dumpsite	3m3
3	Compactor	2	Used to collect waste from big markets and transport to dumpsite	8m3
4	Refused Trailer	18	Used to collect waste from open dumps and street waste and transport to dumpsite	3m3
5	Loader cum Back hoe	1	Used to load the waste from secondary collection point to tractor trailer	1m3 bucket
6	Closed Container	50	Used to load the waste from secondary collection point and transport the waste to dump site	2m3
7	JCB	1	Used to load the waste from secondary collection point to tractor trailer	1m3 bucket
8	Cesspool	4	Used to transport septic sludge from household to dumpsite	3000 lit
9	N.S Tank	3	Used to transport septic sludge from household to dumpsite	1500 lit

4.9 EXISTING MSW PROCESSING SYSTEM

This section describes the waste processing and disposal mechanisms for each type of wastes adopted in Panihati city.Municipal Solid Wastes have to be managed as per the frame work of the Municipal Solid Wastes (Management & Handling) Rules, 2016 under Environment Protection Act, 1986. As per these rules, all the biodegradable municipal solid wastes shall be processed by appropriate biological processing method and only biodegradable, inert waste will be disposed off in sanitary landfill.

At present there is no scientific solid waste processing and disposal facility in Panihati. Thus, creating unhygienic and environmentally unsafe conditions. Presently, they use a dump site at Ramchandrapur (ward no.23) for disposal of solid waste as well as septic sludge.

4.9.1 Recyclables Waste

Segregation of recyclable waste is generally not practiced. Most of the recyclable material is disposed of along with domestic and trade waste on the streets just beside the drains etc. Therefore, recyclable waste is generally found mixed with garbage on the streets into the municipal bins and at the dumpsites from where part of this waste is picked up by the rag pickers. Based on the present practices of rag picking activities in Panihati municipal area, kabadiwalas purchase recyclable waste from residential and commercial establishments (mainly glass bottles and newspaper) while rag-pickers collect recyclables from market places, dustbins, and dumping sites, and sort them before selling off. However, these recyclables are not segregated to the maximum possible extent, thereby allowing them to be a part of the final disposed waste.

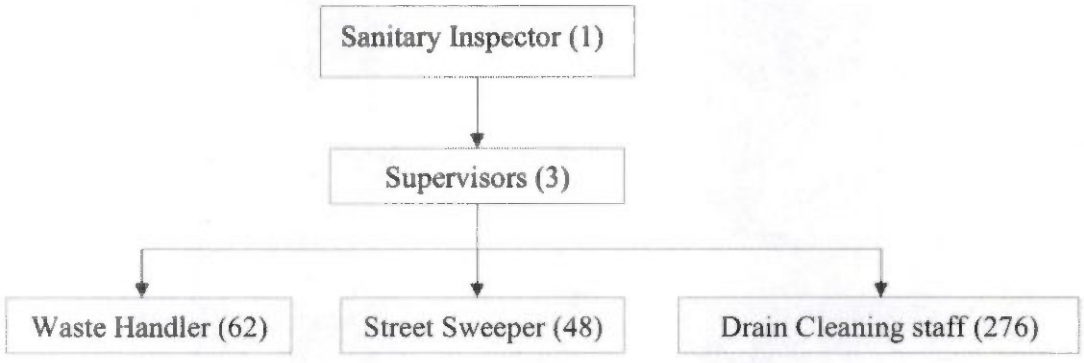
4.9.2 Bio-degradable Wastes

The bio-degradable waste is not segregated either at the primary collection points, secondary collection points or at dumping sites. The segregation of organic waste is not practiced at any stage in MSW management at Panihati. Most of the bio-degradable waste at other collection points has been found to be eaten by cattle, grazing on the open dumping locations.

4.9.3 Non-biodegradable Wastes

Street sweepings and drain silt is a major constituent of the non-biodegradable wastes. This type of waste is disposed of at the dumping sites along with other wastes without any prior processing.

4.10 INFRASTRUCTURE EXISTING FOR SWM



Flow Chart of Infrastructure of Panihati SWM

4.10.1 Manpower

The municipality has engaged about 386 workers (26 nos. permanent, 171 nos. Daily Rated and 189 nos. W.B.U.E.S) for collection of solid waste from collection points and transportation of waste to dumping site. There are 8-10 Labours engaged in each ward for waste collection, street sweeping and drain cleaning work.

Table 4-13: Details Statement of Ward wise Labour Distribution

Ward no.	Permanent	Daily Rated	W.B.U.E.S
1	1	1	7
2	0	4	7
3	1	5	5
4	0	3	6
5	0	5	5
6	0	6	3
7	0	4	8
8	1	4	4
9	1	4	6
10	1	2	8
11	1	2	8
12	1	5	6
13	1	6	4
14	0	3	8
15	1	6	6
16	0	4	6
17	1	5	4
18	2	6	2
19	0	7	5
20	0	6	2
21	1	6	6
22	3	4	6
23	0	6	4
24	2	5	4
25	1	7	3
26	1	7	3
27	0	11	5
28	0	3	7
29	0	6	4
30	1	7	5
31	2	4	7
32	2	2	7
33	0	2	11

Ward no.	Permanent	Daily Rated	W.B.U.E.S
34	0	6	5
35	1	7	2

4.10.2 Equipment/Vehicles

The sanitary workers of the municipality are provided with the tools/equipments like brooms, bamboo sticks, metal scrapers, tricycles/baskets and shovels for the street cleansing & drain sludge operation. The broom is made of bunch of sticks obtained from coconut leaves. A bamboo stick is also provided along with a metal strap fixed on one end and bunch of broom on the other side. Generally, short but vigorous strokes are given while sweeping and heavy silt gets dislodged when greater effort is exerted. However, it is strenuous for the worker and large amount of dust is air-borne during sweeping posing a public health risk. Tricycles are used to carry household wastes, street sweeping waste to the nearest temporary waste storage points or TT Container. In some areas street sweeping are collected to container/bins through baskets. In large container bins are overloaded or waste are spilled during unloading from tricycles/baskets resulting to unhygienic conditions around the storage container locations. At some areas street waste are collected by dumper or tractor trailer by using metal scrapers, bucket to load into vehicles.

Although the above system has been operating since last few years, it is very common to see solid waste in various places of the municipal area especially in commercial areas. The reasons being:

- Behavioral pattern of the local inhabitants and floating population,
- Solid waste thrown by the shop keepers,
- Organic wastes from domestic and stray animals spread mainly in commercial areas,
- Wastes produced by the street hawkers and road side vegetable vendors and
- Wastes generated from various small eateries.

To effectively manage the above, there is an immediate need for evolving an efficient system of collection of waste per applicable norms and operate the same in an organized manner.There are 140 Metallic cage van engaged for collection of solid waste of household waste, street waste and drain sludge waste. The following list describes the quantity of vehicles Panihati Municipality (PM) used for the purpose of solid waste collection.

Table 4-14: Equipment Details of PM

Name of Vehicles	Working Condition
Back Hoe Loader (JCB)	1
Loader (Tractor Fitments)	2
Tractor	23
LCV	3
Cesspool Emptier	4

Name of Vehicles	Working Condition
Refused Trailer Open – Non Tipping	8
Refused Trailer Open - Tipping	10
Covered Hydraulic Tipping Trailer	50
NS Tank	3
Metallic Cage of Tricycle Van	140
Compactor Movable	2
Hook Loader	1

Figure 4-15: Vehicles of Panihati Municipality used for SWM

4.10.3 Equipment Repair Facility

Panihati Municipality is having Vehicle Garage and Vehicle Depot. They have vehicle mechanics for repairing purpose of any damaged vehicles. At present all thevehicles are placed within Panihati Municipality garage and do repairing and washing. All drivers kept their vehicles into municipality garage after completion of work.

Figure 4-16: Vehicle Repairing Facility

4.11 STATUS OF PRESENT DISPOSAL & PROPOSED LANDFILL SITE

4.11.1 Existing Disposal Site

At present, Panihati Municipality does not have any waste treatment or processing facility for treating the municipal solid waste generated in the town. As specified above, transfer of waste to the collection points is done by ULB owned tricycles which is further taken to dumping site by means of ULB owned vehicles (Tractors, Compactors and Dumper Placers). The Panihati Municipality manages to collect and transport approximately 130 to 150 MT of waste to the disposal site based on varying number of trips assigned and undertaken by existing vehicles. Solid wastes collected from various locations in the municipal area is directly disposed off by open dumping at the dumping site located at the ward no. 23 of the municipality over an extent of approximately 4.5 acres. The Figure 4.19 is showing the location of the existing dumping site.

Figure 4-17: Present Situation of Existing Dumping Site

Figure 4-18: Disposal Site of Panihati

There is no segregation of waste and as such mixed waste comprising domestic, commercial and construction waste and silt removed from drain are brought to the disposal ground. Panihati does not have any engineered landfill site for disposal of waste. The entire quantity of waste which is collected is sent for disposal to the dumping site.

Figure 4-19: Vehicles unload into Disposal site

4.11.2 Proposed landfill site

As per Panihati Municipality consultation, the land for Sanitary landfill site is identified at ward no. 34 at Anandanagar near Kalyani Highway which is shown in below.

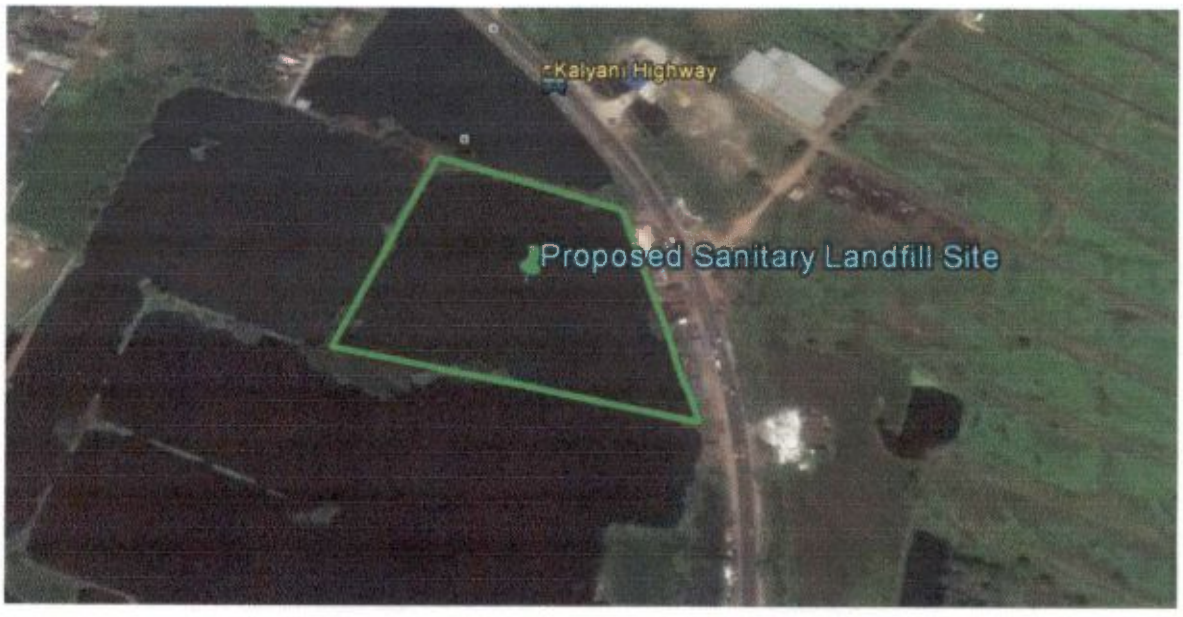


Figure 4-20: Proposed Site for Sanitary Landfill site at Panihati

4.12 DEFICIENCY ANALYSIS–EXISTING SOLID WASTE MANAGEMENT SYSTEM

The solid waste management system of Panihati is not a properly structured collection andtransportation system. There are issues that need to be addressed such as mixed composition ofwaste, absence of segregation practice, door to door collectionis running in only 20-30% area of the each of the total 35 wards, improper handling of waste by waste handler, deficit of safety management, lack of awareness about disposal of waste among the people and absence of scientific disposal options. The issues identified with the current managementSolid Waste Management practices in Panihati need improvements to make it more effectiveand efficient. The following aspects of the present system shall be addressed to establish aRegional Solid Waste Management System for the city.

Table 4-15: Deficiency Analysis in present scenario of SWM in Panihati

Components	Remarks
Segregation at Source	• Absence of segregation of waste at the source of generation. • Recyclables including newspapers, plastics and metals arecollected by rag pickers.
Primary Collection	• Door to Door collection is going in only 20% - 30% area of total area of each ward. • Door to Door collection is regular in only 15 wards among 35 wards. • Waste Collection is not practiced in regular way in Slum area. • Unhealthy and unhygienic waste disposal practices followed bythe big

Components	Remarks
	generators. • Absence of proper Safety equipments like hand gloves, mask etc.
Secondary Collection	• Insufficient number of Secondary collection points. • Secondary collection point waste are not removed in daily basis • Absence of provision to dump the waste in separate biodegradable (green)/recyclable (blue) containers. • Poor maintenance of collection points. • Mixing of drain silt at this level. • Open dump waste, Street wastesare not removed at regular basis.
Street Sweeping& Drain Cleaning	• Inefficient Street sweeping & drain cleaningoperations. • The current sweeping does not cover all the roads, drains and streets • Absence of proper Safety equipments like hand gloves, mask etc.
Transportation	• Absence of arrangement for lifting of waste from congested by lanes of markets and remote areas of the city. • Absence of proper Vehicle maintenance system
Community Participation	• Community participation is totally absent.
Public Awareness	• Absence of significant educational programs, campaigns, NGO activities for public awareness on solid waste management, significance of recycling, reuse and segregation of MSW.
Disposal	• Absence of waste processing practices. • Absence of scientific disposal • Absence of proper processing plants. • Absence of recorded data regarding quantity of waste dumping at dump site on every day.

CHAPTER 5 PROPOSED MSW MANAGEMENT SYSTEM

This chapter provides an integrated SWM plan for primary and secondary waste collection systems and transportation system for Panihati city. The proposed plan also includes the infrastructure requirements, quantities, and corresponding cost estimates for the collection and transportation systems. The proposed SWM system is broadly based on the 4R Environmental Protection Rules (Reduce, Recycle, Reuse, and Recovery) and is in accordance with the MSW 2016 Rules. The primary aspects of the proposed plan include the following:

- Compliance with Municipal Solid Waste Management & Handling Rules of 2016
- Compulsory segregation at the source,
- provision of collection and transportation of segregated waste,
- processing and proper disposal is considered for MSW handling
- Elimination of manual handling of waste, provision of the proper PPEs to the workers 100% collection and transportation of the generated waste
- Maximum recovery of resources by segregating recyclables and biodegradable Advocate 4R's i.e. reduce, recycle, reuse, and recover materials in MSW management
- Adopt proven technologies for waste processing, Promote information education and communication across the stakeholders to ensure system efficiency and sustainability
- Ensure economic sustainability of the proposed system by introducing public private partnership in MSW management,
- Adequate health and safety provisions for workers at all stages of waste handling,
- Regular environmental monitoring at waste processing and disposal facilities,
- Have robust complaint-handling system in place,
- Conduct regular internal and external independent audits on the efficiency of entire SWM system

5.1 PROPOSED INTEGRATED SOLID WASTE MANAGEMENT SYSTEM (ISWM)

The development options related to generation should evolve a sustainable strategy towards reduction of wastes to be handled by the local body. The above mentioned documents also suggest that the reduction of wastes adding to the municipality services is the most essential step towards the improvement of solid waste management in the municipal area. The proposed system is designed for ISWM includes following major components:

Segregation and Storage Waste at Source of Generation-Improvement measures should evolve effective strategies so as to mobilize the community and citizens towards synchronizing their system

of waste storage at source with the primary collection of the wastes by the municipality and co-operate with the authority to maintain clean streets and neighborhood in particular city/town in general. The main objectives of segregation are; (i) storing of recyclables separately for reuse, (ii) storing of organic portion separately for further processing and (iii) waste minimization for final disposal to landfill sites.

Collection & Transportation of Waste –A well define system for waste collection at source level (door to door collection), secondary storage and collection bins (household bins, community bins), Vehicles for primary collection and transportation to processing facility and regional landfill site.

Processing Facility – Collected waste from various sources will be transported to processing facility. The received waste will be segregated to recyclable and processing. The processing would design in line with waste quality and quantity for composting and RDF.

Sanitary Landfill Site – Compliance with client input regional landfill site to be designed and developed for cluster cities. The proposed site for regional landfill is located at Muragacha, Panihati. The proposed regional landfill detail is given chapter no 5.

5.1.1 Basis of Design for Proposed SWM Plan

In order to propose a waste management plan and infrastructure/equipment for primary and secondary waste collection and transportation systems for Panihati city, the following points were considered:

- Past population estimates based on Census surveys
- Projected populations for the design period Spread of Panihati city
- Current MSW quantities as per Consultant's field survey data
- Projected MSW quantities based on the current values
- Current and projected per-capita waste
- Characterization of the current and projected waste quantities
- Ward wise quantity of waste generation
- Existing waste dumping sites/secondary waste collection locations

In the proposed MSWM system there will be on-source segregation of 100% waste and therefore, once the MSWM as per the proposed design is in place, the overall quantity of recyclable waste will increase.

5.2 SUGGESTED SYSTEM FOR WASTE STORAGE AT SOURCE

It was observed that the municipal solid wastes generated from households, market entities, shops, restaurants, hotels etc do not follow storage at source. Lack of proper storage at source coupled with absence of door-to-door collection system is leading to throwing of wastes on streets, roads sides.

In view of the above, waste storage at source and collection should be strengthened through awareness campaigns. The following measures are to be implemented at Panihati to improve the overall environmental conditions at the earliest.

- For maintaining streets, roads and other public places clean, it is extremely important that the public effectively participate/co-operate in the waste management efforts of local bodies.
- Residential households shall store waste in two bin system, supplied to them by Panihati Municipality and deposit to the waste collectors who come for door-to-door collection at a specified time every day.

The collection shall be on daily basis for biodegradable wastes. Further, to avoid other problems like odour and fly/insects nuisance, the wastes are to be kept in closed bins. Non- biodegradable wastes and hazardous domestic wastes shall be collected separately once in a month.

5.2.1 Individual Households

The local inhabitants shall be advised to keep two separate bins for the purposes of segregation of wastes at source and adopt appropriate mode of disposal of such wastes from the source.

- To begin with, the segregation shall be done in two categories - one bin for the Wet Waste or biodegradable waste (Kitchen waste, house sweepings, etc) and the second bin for the Dry Waste or non-biodegradable wastes (Recyclables such as paper, plastics, metals, glass, etc).
- The biodegradable waste degrades and generates liquid, it is advisable to use non-corrosive container with lid for the storage of food/bio-degradable/wet waste. A container of 10 liters capacity for a family of about 5 to 6 members would generally be sufficient for wet waste. However, it is advisable that a household should keep larger container or standby container to store the additional wastes produced in 24 hours. The household may have a spare capacity of 100% to meet unforeseen delay in clearance or unforeseen extra loads. Wet wastes should preferably not be disposed of in plastic carry bags.

Figure 5-1: 10lit Household Bin

- Dry wastes may be stored in similar container but of different colour.
- The recommended colour coding system for storage of different types of wastes is mentioned below in *Figure 6.2.*
- Dry waste can be also stored in bags.

Every household shall be covered by waste collectors on daily basis for collection of biodegradable wastes. Two bins (10liters capacity each, blue and green)shall be supplied free of cost one time (approx. 97986 HHs x 2 = 195972 nos. HDPE bins will be required for storage of MSW in residential households).

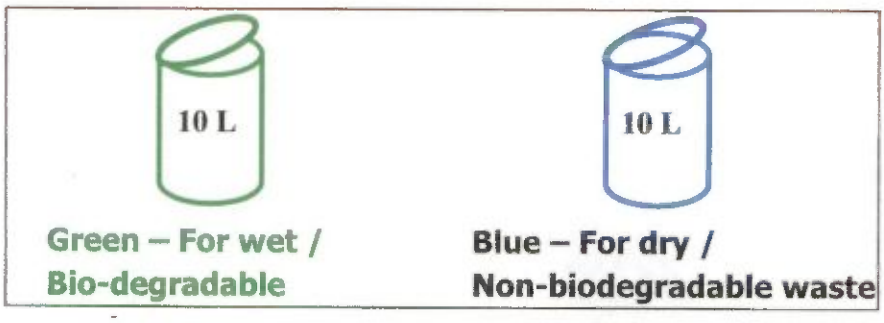


Figure 5-2: Recommended Waste Storage Containers at Source

5.2.2 Housing Complexes/Society

In case of multi storied buildings and housing complexes/society, it is practically difficult to have door-to-door collection system. It is recommended to have community bins within the premises of such housing complexes and societies. Every household should have small 10 Liter waste bin for storage of wet and dry wastes and the wastes may be transferred to the waste community bin placed for such multi storied buildings or group of such buildings as the case may be based on quantity of waste generation. Municipalitymay ask the housing societies to place suitable bins or in turn may place such bins on cost recovery basis. Daily services will be provided by Panihati Municipality to collect wastes from such places in tipper vehicles.

5.2.3 Commercial Establishments

All shops and establishments may be instructed not to throw their solid waste/sweepings etc. on the road. They should store their waste as and when generated in suitable size containers. The size of the may vary from shop to shop depending upon daily waste generation and should be adequate to hold the waste that they generate daily with 100% spare capacity to meet unforeseen delay in clearance or unanticipated extra loads in plastic containers – one for biodegradable items and another for non-biodegradable items. The hazardous wastes generated from these establishments should bestored separately and should be consulted for arranging for disposal of such wastes.

Figure 5-3:240lit Community Bin

Non-biodegradable wastes and domestic hazards wastes shall be collected by Panihati Municipality(PM) once in a month.

5.2.4 Hotels & Restaurants

The hotels and restaurants shall store waste at source in two bin system arranged by them. A container of 100-litre capacity would be adequate which should have appropriate handle(s) on the top or side and rim at the bottom for ease of emptying. The container should be such that it is easy to handle and empty.

In case of large hotels and restaurants where it may not be convenient to store waste in 240 litre or smaller size containers, they may hire the higher capacity bins of required numbers from the municipality.

They may be directed to keep hazardous waste separately as and when produced and dispose it off as per the directions of the PM and shall be collected separately once in a month or as per call basis when required.

5.2.5 Vegetable markets

Vegetable markets produce waste, which is ideal for biological processing. In view of this, it is desirable that all vegetable market waste should be stored and collected separately without allowing it to get mixed with other wastes in TT container.

The vegetable market shops should be clearly instructed not to throw their waste on road/street side. This is very much essential as the vegetable waste cause's nuisance due to faster degradation rate and also by attracting stray animals.

Figure 5-4: TT Container

Panihati Municipality should ensure that the wastes are lifted from the markets regularly. Further, they shall also instruct shopkeepers to store their wastes in color-coded containers. The shopkeepers may be advised to empty their waste bins into the nearest mobile garbage bins placed by Panihati Municipality.

5.2.6 Meat & fish markets

Waste from fish/meat market emanates very bad smell and therefore it is desirable that these wastes are not at all thrown outside.

Shopkeepers should be strictly instructed not to dispose or store waste at open places in front of their shops/establishments or anywhere on the streets/road. At these markets, the shops shall be advised to keep all wastes into TT container or their own containers. The shopkeepers may be advised to empty their waste bins into the nearest separate garbage bins placed by PM before closing their shops.

5.2.7 Street food vendors

All the street food vendors are not keeping their own dust/waste bins and some of them are throwing their wastes on roadside. This should be strictly prohibited.

They should keep their own dust bin/waste bin of bucket size.At the end of the day, all the vendors should be asked to transfer waste to the nearest garbage bin points of 240 lit sizes.

5.2.8 Marriage / Community Halls

These are the places, which generate high amount of waste occasionally when such functions are held in these establishments.

These establishments should be instructed to install their own large size containers for storage of waste at source. These establishments should give prior intimation to PM for any function being organized so that they can direct it's conservancy staff to collect waste from these containers next day or in the evening of the same day. The charges for waste collection/lifting are to be paid in advance to be decided by municipal authority suggested Rs. 100 per tricycle container load.

5.2.9 Bio-medical Waste

Bio-medical waste should be stored & treated strictly in compliance with the Bio-medical Waste (Management & Handling) Rules, 2016. They should ensure segregation of infectious and non-infectious waste and store them separately.

Bio-medical waste should not be allowed to be thrown at bins of PM.Only those wastes, which are not listed in the Bio-medical Waste (Management & Handling) Rules, 2016 i.e. general waste, which is not infectious or treated bio-medical waste, can be stored separately for lifting by the PM.

The health care establishments should follow the directions of Central & State Pollution Control Board from time to time for the handling, storage and treatment of Bio-medical waste.

5.2.10 Construction & Demolition Waste

No such waste should be allowed to be stored on the road or outside the premises of construction site.

The construction and demolition waste should be stored within the premises itself. As such wastes can be directly reused for filling low lying areas or even in construction of WBM approach road etc.PM shall collect such waste from each activity spot on advance payment for hiring 1 m^3 capacity vehicle.

In case, it is not feasible for construction site owner to store the construction debris within the premises, they should provide prior information to the PM and may store their waste in tractor trolley or large container, whichever is feasible for lifting of waste immediately from the site on advance payment to at the rate to be decided by them.

5.3 WASTE SEGREGATION AND PRIMARY COLLECTION

The term sorting indicates separation and storage of individual constituents of waste material so as to facilitate material and energy recovery and reduce the load on the final disposal of solid wastes in the landfill. The desirable sorting recyclable materials - Paper, plastic, cardboard and cartons, streams are:

- Dry containers, packaging, glass, metals, tags, rubber, wood, foils, wrappings, pouches, sachets, tetra-packs (rinsed), cassettes, computer diskettes, printer cartridges and electronic parts, discarded clothing, furniture and equipment;

- Bio-waste and garden waste- Food waste (Including eggshells and bones), flowers and vegetable wastes, house sweepings, household inert (sweepings /ashes);
- Hazardous material in household waste: Aerosol cans, batteries from flashlights and button cells, bleaches and household kitchen and drain cleaning agents, car batteries, oil filters and car care products and consumables, cosmetic items (Chemical based), Insecticides and their empty containers, light bulbs, tube lights and compact fluorescent lamps (CFL), Paint, oils, lubricants, glues, thinner and their empty containers, pesticides and their empty containers, photographic chemicals, Styrofoam and soft foam packing from new equipment, thermometers and mercury -containing products.

5.3.1 Measures

- Panihati Municipality (PM) shall educate for colour coded bins (two nos.) to all householders for storage of waste.
- It is suggested that, all the householders should be asked to segregate wastes at source as per following guidelines to make the solid waste management system more effective by ensuring 100 % segregation.

The residents should be educated that separating it at source for recycling could make profitable use of such material. This will help save national resources and also save the cost and efforts to dispose of such wastes. This can be done by cultivating a habit of keeping recyclable waste material separate from food wastes, in a separate bag or a bin at the source of waste generation.

- Door-to-door collection of waste to be done through containerized cycle rickshaws. Waste collectors will collect waste on a day-to-day basis in two types of bins - green bins for bio-degradable and blue bins for non-biodegradable.
- PMshould train all of its sweepers/sanitary workers on segregation and recycling and they should also be advised to collect recyclable wastes separately.
- It is essential to save the recyclable waste material from going to the waste processing and disposal sites and use of landfill space. Therefore, the owner of waste processing plant should be advised to carry out waste segregation by hand picking to segregate contraries and sale them to recyclers or if it is not feasible, the processing plant operator should allow registered scavengers to enter the premises of the compost plant and picking recyclable waste. This would ensure reduction in rejects reducing burden on landfill.

Figure 5-5: Door to Door Collection

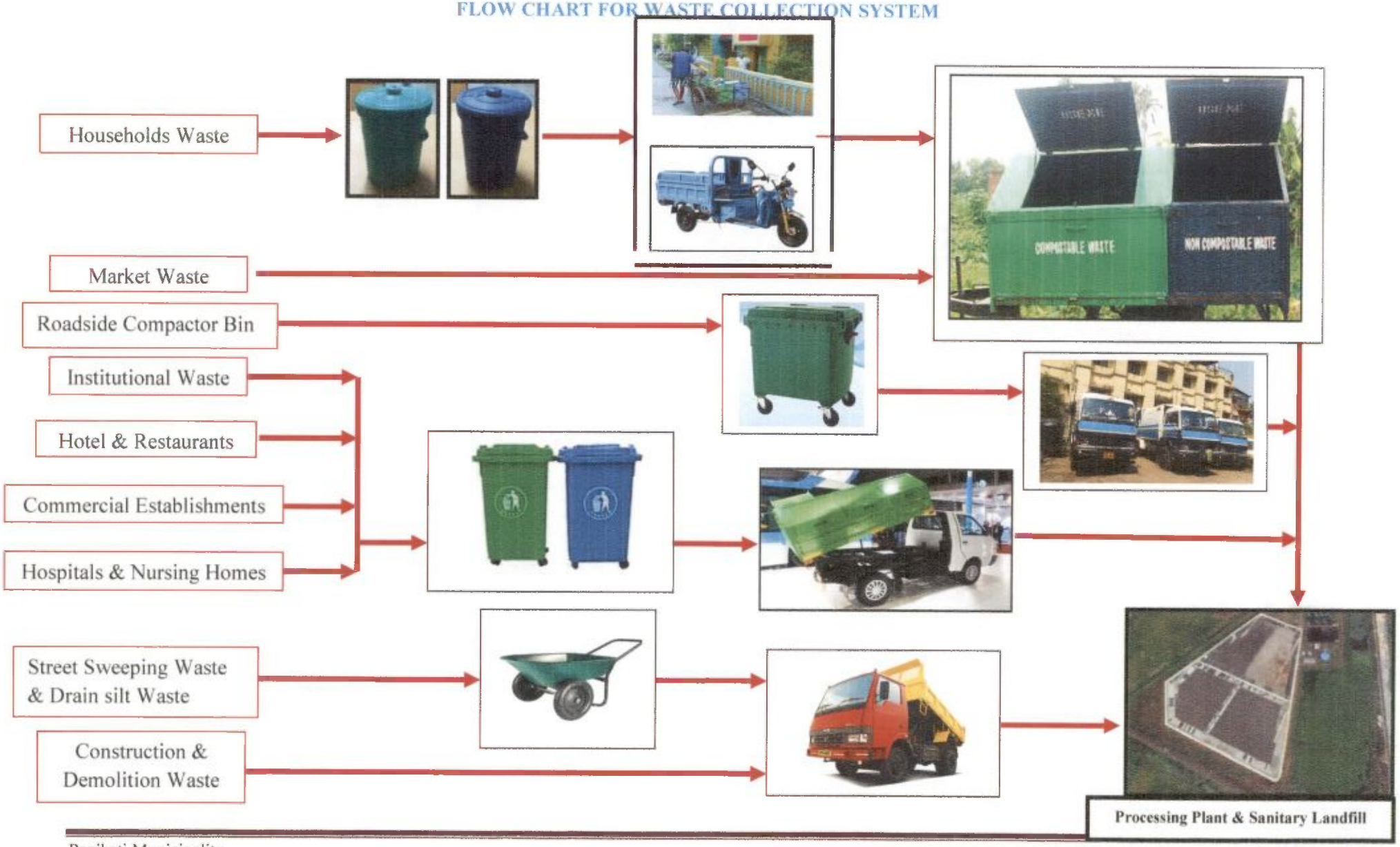
- PM should mobilize voluntary organizations and NGOs to take up the work of organizing street rag-pickers and elevate them to door step "Waste Collectors" by motivating them to stop picking up soiled and contaminated solid waste from streets, bins or disposal sites and instead improve their lot bycollecting recyclable clean materials from the door step at regular intervals of time. They should be given uniform, safety kits and necessary tools like trolleys/bags, etc by PM to do the job. They may collect payment directly from the householders, shopkeepers, hoteliers, etc. This will result in employment of such underprivileged people as well as enable source segregation of waste.
- PM should associate and involve residents, market & restaurants associations and NGOs in increasing awareness among the people to segregate recyclable material at source and hand it over to a designated waste collector identified by NGOs. The local body may give priority to the source segregation of recyclable waste by shops and establishments and latter concentrate on segregation at the household level. This arrangement could be made on payment basis to such waste collectors for the doorstep service provided to sustain their efforts.

5.4 PROPOSED COLLECTION AND TRANSPORTATION OF WASTE SYSTEM

The proposed Collection & Transportation plan includes following components:

- Primary Collection-Door to Door collection for Residential area
  - Household bins
  - Primary Collection Vehicles (Tricycles& Auto-tippers)
- Collection of C & D categories waste
- Street Sweeping & Drain Cleaning
- Secondary Waste Storage System
- Transportation of waste from secondary collection points to the Treatment Facility/landfill.

FLOW CHART FOR WASTE COLLECTION SYSTEM



5.4.1 Primary Waste Collection System

Primary collection has been proposed to be done on door to door basis by means of household bins and a number of primary collection vehicles.

The efficiency of the proposed waste management plan described below is determined by the segregation of waste at the primary collection level. For this purpose, following approach needs to be adopted by the residents as well as the Panihati Municipality (PM) personnel.

The modus operandi for primary collection of waste should be based on following:

- Door-to-door collection of waste should be initiated;
- As discussed in this chapter for implementation of door step waste collection using tricycles or hand trolleys keeping this in view, it is recommended to do the door step waste collection through public private partnership;
- Private sector's role for door to door waste collection and community awareness has to be clearly defined;
- Door-to-door waste collection system should cater to all the households and efforts should also be made to collect waste from shops and restaurants in daytime;
- Avoid double handling of waste and keep it only two tier as far as possible i.e., first up to waste storage depot and second from waste storage depot to processing and disposal site;
- Waste from litter bins/ community bins/containers placed in market areas, hotels, restaurants area, institutional areas, and commercial complexes should be lifted every day and transported to the waste storage depot to avoid flooding of bins or containers.

The waste will be stored by the generators in two separate bins, one for bio-degradable and one for recyclables.

Door-to-door waste collection will be privatized in the entire Panihati city. Area wise responsibility will be assigned to private operators. Waste collectors will collect waste on a day-to-day basis in two types of bins - green bins for bio-degradable and white bins for recyclables. Door-to-door collection of waste will be through rickshaw trolleys.

PM safaikaramcharis shall do street sweeping on a day-to-day basis. The street sweeping waste will be collected in wheelbarrows. The waste collectors will transfer bio-degradable and non-biodegradable waste to the secondary collection location and will sell the recyclable waste.

Figure 5-6:Resident put Recyclable waste into Blue bin

The existing infrastructure for secondary collection of waste will be upgraded to comply with MSW Rules 2016 and additional

secondary collection locations will be developed to ensure that no primary collection staff has to travel more than 250m for dumping of waste.

The PM safaikaramcharis shall re-use the construction and demolition wastes for filling-up the man-made low-lying areas. The feasibility for recycling of construction waste for making bricks may be explored later with assessment of C&D waste quantity may possible after compliance of proper system of waste collection. The local residents shall hand-over the construction waste generated from private construction activities to PM workers for proper use.

5.4.2 Primary Collection of wastes from Society / Complexes

The door-to-door collection of waste shall be done on a day-to-day basis between 6:00 AM and 1:00 PM. The PM shall ensure that infrastructure is made available for undertaking this activity in compliance with the MSW Rules 2016.

In residential complex, collection at the door pick up of wastes may be introduced for picking up domestic waste from households daily on 'full cost recovery' basis and an NGO or contractor may be encouraged to provide such service. The bins will be placed at strategic location considering location, population density in consultation with PMto ensure that the bin or container is easily accessible and convenient to empty.

Awareness program will be conducted for resident's to store their organic (wet) and inorganic (dry) waste separately.

5.4.3 Collection of waste from Vegetable &Fruits, Meat and Fish Markets

The market shops should be clearly instructed not to throw their waste on street side. This is very much essential as the waste cause's nuisance due to faster degradation rate and also by attracting stray animals. Particularly waste from fish/meat market emanates very bad smell and therefore it is desirable that these wastes should be kept in containers. The municipality should ensure that the wastes are lifted from the markets increased frequencies daily. Shop owners in the sabzi mandi shall be directed to directly place their waste in the nearest TT container. In addition, sweepers employed shall pick up any waste littered and place it in the container.

5.4.4 Marriage/Community halls

These are the places which generate high quantity of waste even though not on daily basis when functions are held in these establishments. There are roughly about 64 marriage halls in municipal area. These establishments should be instructed to install their own large size containers for storage of waste at source in dining halls and in kitchen. These establishments should give prior intimation to the municipality for any function being organized and shall hire dumper bins from municipality.

Table summarizes the overall management of MSW at the primary collection level.

Table 5-1: Primary Waste Collection System

Category	Source/Waste Generator	Type of Waste	Requirement	Generator Responsibility	Implementation
I	Residential Commercial Institutional Hotels/ Restaurants/ Eating Joints	Bio-degradable Non-Biodegradable Recyclable	Segregation at source Day-to-day collection	1. Storage in 2-bins	1.Private/NGOs waste collectors 2.Rag-pickers
II	Markets	Bio-degradable Non-Biodegradable Recyclable	Segregation at source Day-to-day collection	1. Storage in TT container	PM waste collectors suggest to market vendors
III	Street sweeping and drain silt	Mixed Waste	Accumulate all waste & stored into wheel barrow	1. Storage in Wheel Barrow	PM safaikaramcharis – also to be brought under PPP format overtime
IV	Construction	Non-biodegradable	Time of construction	Handover to PM	PM waste collectors - also to be brought under PPP format overtime

It is proposed that primary waste collection shall be done by private operators/NGOs. Presently, in Panihati there is limited system of primary collection of waste. It is proposed that PM shall identify private operators/NGOs for this purpose and authorize them for undertaking this activity. The private operators/NGOs shall be assigned responsibility area wise. The private operator/NGO authorized for a particular area shall ensure that there is proper waste collection as per the plan from all sources in his area.

5.4.5 Sweeping of Street & Public Places

Most of the development options suggested focus on the improvement of working environment of the sanitary workers and fixing norms for each sanitary worker so that the factor of accountability may be established to review the performance of each sanitary worker. All the streets in Panihati shall be sweeped daily and main market should be cleaned twice a day. The following important things to be considered for sweeping:

- Street sweeping activity shall also include surface drain cleaning
- Handcarts/Wheel barrow shall be used for collection of waste & shall be transported to the nearest bins.
- In addition, mechanical sweepers shall be procured for this purpose

5.4.6 Garden Wastes

There are about 20 parks in the municipality. These parks should be instructed to reuse all plant wastes on site by pit (Anaerobic) composting. Only in cases where it is not possible, municipality should collect and process at the waste processing site.

To be collected on a weekly basis by arranging a rotation for collecting such waste from different areas on different days to be notified to enable them to trim the trees and lawns accordingly and keep the waste ready.

5.4.7 Suggestion – Banning the Use of Polythene/ Plastic Bags

The use of plastic bags, which has grown exponentially in the last decade, poses a major problem as far as the MSW management is concerned. This is a great concern for any city.

Apart from the fact that plastic waste chokes the drain, suffocates animals to death that eat them, it also makes MSW unfit for any biological treatment. Also, being non-biodegradable, the total quantity of plastic waste cumulatively increases with time. Incineration, the alternative treatment for non-biodegradable waste, has not found a strong foothold in Indian conditions. Also, combustion of plastic leads to air pollution related problems.

The polythene bags being very thin require a large number to be collected before they make up a saleable weight. Since the rag picker normally gets paid per kilo of plastic bags collected, it would take him/her throughout the day to collect about 800 bags needed to make up one kilo to fetch an amount of Rupees 10 to 12. On the other hand, heavier plastics would be faster and easier to collect. Another major use of plastic which is picking up is the use of mineral water bottles and use of disposable plastic glass and cutlery at the restaurants, particularly, the fast food joints.

Numerous measures, which can be taken to cut down the use of plastic items, would include:

- Impose ban on use of thin plastic bags (of thickness < 20 microns). The thick bags being more expensive will discourage the indiscriminate use of plastic bags within the city.
- Encourage the use newspaper bags, wherever possible
- Make jute, cotton bags and thick plastic bags available at the major shopping centers. The citizens should be made to pay a nominal amount to procure these bags.
- Discourage use of packing in fast food joints. Encourage them to use the items made of biodegradable material.

5.4.8 Role of Private sector in Solid Waste Management (SWM)

Role of private sector in SWM is growing in India.Surat, Ahmedabad, Nagpur, Hyderabad, Chennai has seen successful examples of Public Private Partnership in SWM. Outsourcing to private sector improves the financial viability of the SWM.The scope of private sector participation in various activities related to solid waste management is presented in following *Table 5.2.*

Table 5-2: Public Private Partnership Options in Solid Waste Management

Sl. No.	Activity	PM	Private Sector	Implementation Options
1	Door to Door Collection		Yes	Service Contract
2	Street Sweeping	Yes		Service Contract
3	Procurement and Maintenance ofBins		Yes	BOT and its variance/Separate EPC* and O&M Contract
4	Transportation of waste to integrated facility	Yes	Yes	Concession/O&M Contract
5	Design, development, operation and maintenance of Processing Facility		Yes	DBO/ Separate EPC and O&M Contract
6	Design, development, operation and maintenance of sanitary landfill site	Yes	Yes	BOT** and its variance/DBO***/ Separate EPC and O&M Contract

** EPC: Engineering, Procurement and construction*

*** BOT – Build, Operate and Transfer*

****DBO – Design, build and operate*

Table 5-3: Examples of PPP in Solid Waste Management in India

Sl. No.	Services on PPP	Examples
1	Door to Door waste Collection	Bangalore, Ahmedabad, Nagpur, Jaipur, North Dumdum, New Barrackpore (West Bengal), Gandhinagar, Vejalpur (Gujarat), Kanpur, Delhi
2	Street Sweeping	Surat, Hyderabad
3	Storage and Transportation	Surat, Ahmedabad, Mumbai, Delhi
4	Integrated Treatment and Disposal	Delhi, Mumbai, Bangalore, Kolkata, Chennai, Hyderabad, and Ahmedabad
5	Integrated primary collection, street sweeping, storage and transportation	Chennai, Kanpur, Delhi, Hyderabad, Ranchi, Aligarh, Moradabad, Varanasi etc.

It is therefore proposed here to implement PPP for SWM in Panihati.

In PPP, private employed for door to door waste collection (see table 5.3) shall charge a stipulated amount from the generator. The stipulated charges for different categories of generators shall be well publicized through leaflets, advertisements and posters. PMshall take strict administrative action for effective implementation of door step waste collection through public private partnership. The different categories of waste generators that shall be charged are as given below in*Table 5.4.*

Table 5-4: Categories of waste generators for door to door waste collection

Sl. No.	Category
1	Households
2	Commercial (Offices & Banks etc.)
3	Dhabas, Restaurants & Fast Food
4	Pan/Tea Shop
5	Hotels/Guest Houses
6	Big Offices
7	Schools & Colleges
8	Shops/Pvt. Professional Offices
9	Factories/Workshops/Sheds
10	Cinema Hall
11	Bakeries/Food Joints

5.4.9 Fees for Marriage Halls/Community Halls

For lifting waste from marriage halls, community halls and other public places like parks where functions are held, Panihati Municipality may charge generator fees at nominal rate.

5.4.10 Penalty for littering

Cess / fees to be levied strictly to prevent littering of waste on streets/roads. A provision of penalty should be levied in the municipal laws for throwing waste on road.

5.4.11 Fees for construction/demolition waste

Fees at nominal rate to be charged for lifting construction/demolition waste from the construction site as present case.

5.4.12 Role of sweepers

- The role of sweepers engaged for door step waste collection shall be clearly defined. Their roles shall be informed to the residents through resident association, leaflets, advertisements, etc. All the residents shall be requested to cooperate.
- The residents should give their wet & dry waste separately. Collection of dry waste shall be made separately once in two days by the same sweepers or by regularized rag pickers.
- In case, the sweeper gets mixed waste, he should be able to recognize between dry and wet waste so that he can put them separately in two drums.
- In case of non-availability of resident, the sweeper should lift the waste bags/containers left outside, if any.

5.4.13 Required Infrastructure for Households

The infrastructure is calculated at ward level. Considering waste storage separately at household level; 1, 95,972 Nos. of bins estimated for 97,986 household (2 bins/household).

Figure 5-7: Tricycle Trolley & Battery Rickshaw with 6 bins

Based on field survey, it is proposed to use Tricycles and Battery Rickshaw for door-to-door collection of waste. Both will be used as Primary Collection Vehicles. Both the vehicles are used to collect waste from residential areas and transport it to nearest allocated TT container (Secondary Collection Points).This facility has been proposed because:

- Easy to move in narrow lanes with tricycles or battery rickshaw.
- Easy to transfer the waste from bins to TT containers.
- Give faster mode of transportation and save time of transportation than Handcarts or Pushcarts.

It is assumed that about 40% of House hold will be covered by Tricycles and remaining 60% will be catered by Battery Operated Rickshaw which will transport waste to compactor station or TT container which will carry the waste to processing facility.

It is proposed to have Tricycle with Six nos. 50 litre bins & Battery Operated Rickshaw with Eight nos.60 litre bins for door-to-door collection of waste. Among them 3 green colour bins will be used for collection of biodegradable waste and remaining 3 blue colour bins will be used for non-biodegradable waste for Tricycle. The distribution of bins for waste collection has been done on the basis of the waste characteristics received from the households. The waste received from the households mainly comprises of biodegradable waste therefore 3 out of 6 bins have been allocated for this purpose. Battery Operated Rickshaw will be used those areas where TT container are located at far distance from collection area. Battery Operated Rickshaws has faster mode of transportation than tricycle which also reduce travel time of transportation. Tricycle will be used at those areas where secondary collection points are nearer to collection areas.

The ward wise quantity of waste generation from each ward is projected based on projected population (considering ratio of ward wise area) ward and per capita waste generation in Panihati.

This activity shall be undertaken by private operator. The private operator shall have sufficient number of workers to do waste collection all 365 days a year.

5.4.14 Collection of Waste from Commercial Areas

The shops and Commercial establishments shall organize for primary collection of waste with the help of private waste collectors authorized in their area. Most of the waste from commercial areas is recyclable. Therefore it is proposed that rag pickers shall collect recyclable waste from shops and establishments as soon as they open. There will be a secondary waste collection point in every market area; therefore shopkeepers themselves shall dispose off their waste in these collection points.

Auto tippers will be proposed for collection of waste from commercial areas like institutions, hotels, restaurants, hospitals & nursing homes (only biodegradable waste), offices etc. Auto tippers are proposed to collect the waste from all community bins where roads are sufficiently wide for turning of vehicle and areas where large quantity of waste is generated and also the area of expanse is large etc. The usual timings of waste collection from commercial establishments as well as community bins start at early morning from 8:00 am to 2:00 pm.

This type of vehicle is introduced because of the following reasons:

- To reduce multiple handling of the waste as suggested in MSW rules 2016
- It gives faster mode of transportation.
- It requires less manpower.
- Can transport large quantity of waste at a time
- It collects waste from source and directly unloads at Processing Facility.

5.4.15 Collection of Market Waste

All the Shop owners in the sabzi mandi and the vendors shall be directed to directly place their waste in the nearest TT container which located in every market. Tractor vehicles will be engaged to collect TT containers from markets and transport to processing plant because of having more biodegradable waste. The usual timings of waste collection will not be feasible for markets as shops normally open after 9:00 am. It is proposed that street sweeping in market area shall be done in the early morning hours and waste collection shall be done from 7:00 am to 9:00 am.

5.4.16 Collection of Construction and Demolition Waste

The construction and demolition waste will be collected on need basis. It is the responsibility of generator to inform PM that construction waste need to be collected from the site. The PM shall collect this construction waste in existing tractors and trucks and transport it for reuse or recycle.

Municipality to prescribe the rate per ton for the collection and disposal of construction waste and debris and notify the same. The charges for removal of construction waste to be doubled for those who fail to deposit the amount in advance.

5.4.17 Street sweeping & Surface drain cleaning

It is recommended to carry out daily sweeping of streets. Surface drain cleaning shall be done in parallel to street sweeping activity.

The street sweeping shall be done on a day-to-day basis. It is desirable to split the 8 hours of duty of sweepers into two shifts (5:00 AM – 9:00 AM and 10:00 AM –2:00 PM). The street sweeping is to be done by PM safai karamcharis as per the proposed plan.

5.4.18 Work Norms

Except the roads and streets with no habitation or less density of habitation, it is strongly recommended to render services pertaining to sweeping, lifting garbage from the community and litter bins, lifting garbage from the waste storage depots on daily basis including Sundays and public holidays.

The Panihati Municipality (PM)should publish notification to this effect and invite general public to complain and bring it to the notice of in case their area is not cleared.

Sanitary services should not suffer due to absence of any sanitation worker. In order to assure this, alternate arrangements must be made to ensure that all sanitary services are provided even when any sanitary worker is on leave or absent.

Clear cut and specific work norms need to be devised for sanitary workers, sweepers, jamadars, sanitary inspectors and health officers who are directly involved in SWM services.

The work norms can be devised depending upon local conditions. It is advisable to start the work as early as possible in the morning so as to avoid interference with routine activities of the residents.

The work norms should be such that they are applicable to individuals so as to allow measurement of their work performance. The work norms for group of sanitary workers are never successful.

The work norms may also be in compliance with government policy and court orders.

5.4.19 Temporary Storage of Wastes

The temporary storage points provided in Panihati partially meet the requirements provided in the manual as well as the recommendations as provided by the report of the committee constituted by the Hon'ble Supreme Court of India. Some of the improvement measures suggested along with the specifications and norms to be followed are as follows:

Provide containers at a distance of +average 500 meters from the place of work of the sanitary workers. The average distance between 2 containers should therefore not exceed 750 meters. The distance between the containers shall be determined on the basis of the load of waste / refuse that is likely to be received at the container from the area concerned and also it depends on the population density of that particular area.

Figure 5-8: Temporary Storage of Waste

The containers should be placed on cement concrete or asphalt flooring having a gradual slope towards the road to keep the site clean. The flooring should be flush with the border of the road (i.e. drains) to maintain hygienic conditions and facilitate the transfer of waste from the tricycle into the container. In areas where placement of large containers is inconvenient, small containers of 1.5 cu. m (already lies with municipality) size may be placed on the roads, lanes and by-lanes at short distances of about 500 m. These containers should also be kept on paved flooring and cleared daily.

It is suggested to use innocuous agents like bleaching powder and other permitted insecticides to prevent the menace of breading of flies and mosquitoes at the community storage points. Further, such an application of innocuous agents would facilitate maintaining hygienic and odorless environment at the community storage points however avoiding the spillage around the community bins is the best way to abate the above problems.

5.4.20 Waste Transportation System

The MSW transportation system for Panihati city is proposed in combination with the waste collection system described in the preceding section. The requirement of transportation vehicles has been estimated based on the following plan.

The PM workers shall transport the bio-degradable waste (green containers) from secondary collection points to processing facility on a day-to-day basis. The PM workers shall transport the non-biodegradable waste (Blue containers) from secondary collection points to a designated integrated waste processing facility at least once in two days.The waste from bins shall be transported using compactors. Hydraulically operated equipment shall be used for transportation of waste. The waste, under any circumstances, shall not be handled manually.Cattle lifting vehicles shall be used for lifting of stray animals and dead animals from the city.

It is also proposed to use GIS and GPS tools to have a complete hold on the transportation network - GIS to calculate the optimum routing between two points and the GPS which can track the exact location of the trucks in real time. In GIS-base routing system, each secondary collection point will be coded into database along with the street map of the service area. The software then will automatically calculate the shortest route between each stop. Criteria such as total number of stops

and estimated waste quantity per stop can be programmed into the system. GIS and GPS system will allow viewing the exact location of trucks and tracking efficiency of the transportation system.

5.4.21 Optimal Collection Route Design and Operation

A route is the path followed by a single collection vehicle for waste collection on a single day. The route charts for door to door collection of all the wards of municipality by tricycles have been arrived for each ward with the locations of TT containers where they have to unload the collected waste. The time of collection for each street should be intimated to households and the timing should be maintained regularly.

5.5 PROPOSED INFRASTRUCTURE REQUIRED FOR COLLECTION, HANDLING AND TRANSPORTATION OF MSW

5.5.1 Equipments Used for Collection of the Waste

- Tricycle Van with 6 nos. of 50 lit bins
- Battery operated Auto Rickshaw with 8 nos. of 60 lit bins
- 240 lit capacity (community bins) road side bins
- TT Container
- Auto tipper
- Tractor
- Refuse collector Compactor Bin - 1100 lit
- Movable Compactor
- Wheel barrow for Street Sweeping & drain cleaning -110 lit

5.5.1.1 Number of Tricycles Van with 6 nos. of 50 liters bins

It is assumed that 40% waste of per day generated waste is collected by the tricycle and transport to SCP

- Total population of year 2023 = **440937 (calculated)** (Assume life of tricycle 5 years)
- For every 1250 population 1 no. tricycle provided
- Therefore Nos. of tricycles required = **142**

5.5.1.2 Number ofBattery operated Auto Rickshaw with 8 nos. of 60 lit bins

It is assumed that 60% waste of per day generated waste is collected by the tricycle and transport to SCP

- Total population of year 2023 = **440937 (calculated)** (Assume life of tricycle 5 years)
- For every 4000 population 1 no. battery tricycle provided

- Therefore Nos. of battery tricycles required = **67**

5.5.1.3 240 lit capacity Community bins(road side bins)

Two numbers of community bins are placed at the following location.

- To be provided in the road side to collect street waste

1no. bin provided at 5 nos. locations of each ward; Nos. of ward = 35

Therefore Nos. of bins required at road side = 35X5 = 175 nos.

Also, in the municipal area there are,

- Hotels & Restaurants = 34 nos. X 2 = 68 nos.
- Institutions = 121 X 2 = 242 nos.
- Commercial Establishments = 142 X 2 = 284 nos.
- Hospitals & Nursing Homes = 59 X 2 = 118 nos.

Therefore, Total nos. of community bins with 240 lit required = 175+68+242+284+118 = **887nos.**

5.5.1.4 Number of TT Container

- It is assumed that 80% population served by TT container
- Capacity of TT container is 2m3; density of fresh waste 0.4tn/m3; Per capita solid waste generation = 330 gm (estimated)
- Population served by each container = (2*0.4*1000)/0.33= 2424.242424
- Nos. of TT container provided at locality = (440937*80%)/2424.242424= 145.51
- Also, TT container is provided in each market; Total nos. of major Markets = 14

Therefore, total nos. of TT container required = 146 + 14 = **160 nos.**

5.5.1.5 Number of Auto Tipper (AT)

Auto tipper directly collect the waste from the institutions, hotels, restaurants, commercial establishments hospital & nursing homes and road side community bins and take it to compost plant.

It is assumed that one Auto tipper collect waste from 80 nos. community bins

- Total nos. of community bins required = 175+68+242+284+118 = **887 nos.**

Therefore, total auto tipper required = (887/80) **=12 nos.**

5.5.1.6 Number of Tractors

It is assumed that one tractor carries 3 nos. TT containers per trip and it complete 3 nos. trips per day. Therefore, one tractor carries 3 X 3 = 9 nos. TTcontainers per day.

Total nos. of TT containers are provided = 160 nos.

- The required nos. of tractors are = (160/9) = **18 nos.**

5.5.1.7 Refuse Collector Compactor Bins

It is assumed that 1no. Compactor bin is provided for every 1200 population and it served 20% of total population.

- The required nos. of compactor bins of 1100 lit are = (440937*20%)/1200 = 73

5.5.1.8 Number of Movable Compactors

It is assumed that 14nos. compactor bins collected by movable compactor in each trip.

Total number of trips done by compactor per day = 3 nos.

Total nos. of compactor bins are provided = 73 nos.

- Required numbers of compactors are = 73/ (14*3) = **2.**

5.5.1.9 Drain Cleaning

Total length of the drain is = 716 km. Drain cleaning is done by providing wheel barrow of 110 lit to each labour with shovels.Drain would be cleaned once after two weeks.

- Length of drain cleaned by one person per day = 0.5 km

Drain cleaning work done per day = 716/14 = **51.14 km**

Nos. of man power required for drain cleaning work = 51.14 × 2 = 102.29 or 103 nos. and required nos. of wheel barrow for drain cleaning purpose = 103 nos.

5.5.1.10 Road Sweeping

Total length of the Road is = 361 km. Road Sweeping cleaning is done by providing wheel barrow of 110 lit to each labour with shovels.

- Length of drain cleaned by one person per day = 1.0 km.
- It is assumed that 15% of the road will be swept daily i.e 55 km.
- It is assumed that 30% of the road will be swept per week i.e 16 km.
- It is assumed that 55% of the road will be swept after every two week i.e 15km.

Therefore, total length of the road will be swept at daily basis = 55+16+15 = **86 km**.

Nos. of man power required for road sweeping work = 86×1 = 86 nos. and required nos. of wheel barrow for road sweeping purpose = 86 nos.

Apart from the above following Manpower is also required

- Supervisor @1 per ward = 35 Nos.
- Sanitary Inspector = 1 No.
- Health Officer = 1 No.

Table 5-5: Vehicle Requirement for Primary Collection, Secondary Collection, Road Sweeping and Drain Cleaning

Sl. No	Description	Equipment Numbers	Already exist	Gaps	Drivers	Helpers
1	House hold Bin 10 lit 2 nos.	195972	-	195972	-	-
2	Tricycle van	142	140	2	142	-
2.1	6 nos. of 50 lit bins	142×6	-	-	-	-
3	Battery operated Auto Rickshaw	67	-	67	67	-
3.1	8 nos. 60 lit bin	67×8	-	-	-	-
4	Community Bin 240 lit 1 no.	887	-	887	-	-
5	Auto tipper	12	-	12	12	24
6	TT Container	160	50	110	-	-
7	Tractor	18	23	0	18	36
8	Compactor bin -1100 lit	73	-	73	-	-
9	Movable compactor	2	2	0	2	4
10	Wheel barrow for Street Sweeping & drain cleaning -110 lit	189	-	189	189	-

5.5.2 Tools to be given to Sweepers

Adequate number and types of tools should be given to sweepers to execute efficient sweeping and waste collection.

Requirements of equipments for street sweeping and drain cleaning other than hand carts, wheel barrows have been shown in *Table 5.6*.PPEs required for the street sweeping staff include gloves, boots, safety mask and uniform.

Table 5-6: Requirement of Equipments for Street sweeping and Drain Cleaning

Sl. No.	Equipments / Implements	Quantity
1	Long hand brooms	189
2	Metal tray with Plate	189
3	M. S. Shovel	189
4	Gloves	462
5	Mask	462
6	Apron	462
7	Rain coat	462
8	Safety Boot	494

5.6 PROPOSED PROCESS FACILITY

With compliance to the client and stakeholders input process facility to be developed at city level for processing the waste into Compost Plant and Material Recovery Facility.

5.6.1 Overview of Different Waste Processing Technologies

The waste treatment and processing technologies can be classified into following categories:

- Thermo-mechanical process
- Physical Process
- Bio-conversion Processes
  - Aerobic decomposition
  - Anaerobic decomposition

*Table 5.7*presents the technologies expressed in terms of the three major groups (thermal, biological & physical) that have been considered for evaluation purpose for processing MSW of Panihati.

Table 5-7: List of Identified MSW Processing Technologies

Waste Processing Technology Group	Waste Processing Technology
Thermal Processing Technologies	Incineration (Mass burn)
	Pyrolysis
	Pyrolysis / Gasification
	Plasma Arc Gasification
Biological Processing Technologies	Aerobic Digestion (Composting)
	Anaerobic Digestion (Biomethanation)
	Landfill as Bioreactor (Bioreactor Landfill)

5.9.1.3 Planning & Development of Compost Plant

Composting has been proposed for processing of waste generated in municipal area. A typical flow chart of windrow composting is shown in *Figure 5.11*.

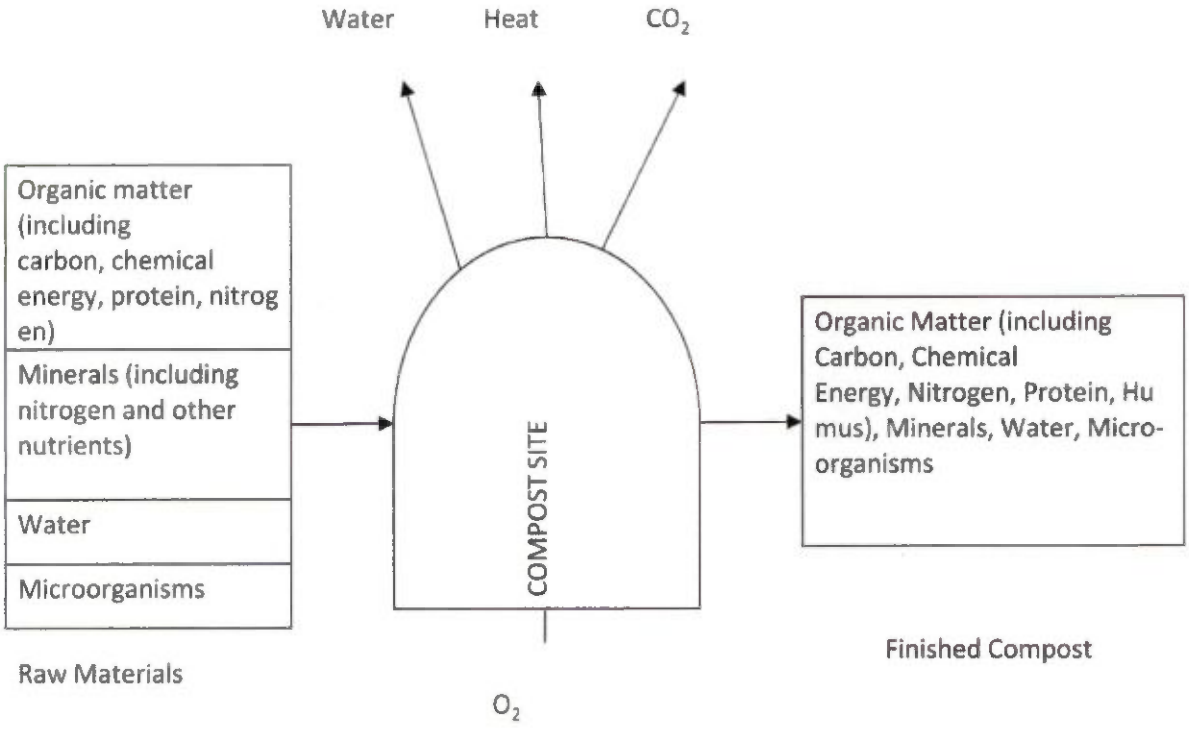


Figure 5-11: Flow Chart of Windrow Composting Process

All activities associated with composting operations need careful selection of design and control to produce good quality product while minimizing environmental impacts. The compost plants are designed primarily in view of the quality of feedstock received at the site. Activities which should be considered for composting include,

- Manual separation of inert material and send it to landfill.
- Windrowing of the organic under sized waste material
- Maintaining moisture levels, weekly turning on the windrow
- Screening/curing and receiving compost
- Rejected materials send to landfill.
- Packing and Storage of compost.

5.9.1.4 Receipt, Handling and Pre-processing of MSW (Tipping Area)

The waste collected from the city is received through an earthen embankment ramp with a water-bound macadam (WBM) surface by tippers in this area. The waste will be unloaded on an elevated

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Biological Processing Technologies	Aerobic Digestion (Composting)
	Anaerobic Digestion (Biomethanation)
	Landfill as Bioreactor (Bioreactor Landfill)

Waste Processing Technology Group	Waste Processing Technology
Physical Processing Technologies	Refuse-Derived Fuel (RDF)
	Densification / Pelletisation
	Mechanical Separation
	Size reduction

5.6.2 Thermal Processing Technologies

Thermal technologies are those technologies that operate at temperatures greater than 600°C and have higher reaction rates. Thermal technologies include advanced thermal recycling (a state of the art form of waste to energy facilities) and thermal conversion (a process that converts the organic carbon based portion of the MSW waste stream into a synthetic gas which is subsequently used to produce products such as electricity, chemicals or green fuels). These technologies are briefly described below:

5.6.2.1 Incineration

Incineration is an alternative solution in the waste disposal crisis when landfill space is limited. Incineration reduces the waste volume and generates heat and power for commercial use. For MSW, incineration will depend on two main factors, moisture and heating value. Both factors have seasonal variability which must be considered while designing an incinerator. Air pollution is also a major concern because contaminated or hazardous household wastes create the air emission and ash from the facility. Explosive materials shall be sorted out to avoid harming the incinerator. Thus special attention is required for MSW burning operation which will further increase the cost of the project.

Combustion technologies used for MSW are stoker-fired incinerator, fluidized bed incinerator and rotary kiln incinerator. Each technology is suitable for converting waste to energy but with different advantages and disadvantages. Heat from the combustion process is used to turn water into steam that will be routed to a steam turbine-generator for power generation. The used steam is then condensed in condenser and routed back to the boiler. Residues produced include bottom ash (which falls at the bottom of the combustion chamber), fly ash (which exits in the combustion chamber with the flue gas) and residue (including fly ash) from the flue gas cleaning system.

The major environmental concern of incinerator is stack pollutants formed during combustion comprising particulates, nitrogen oxide (NO_x), sulphur dioxide (SO_2), carbon monoxide (CO), metals, hydrogen chloride (HCl), dioxins and furans and unknown gaseous pollutants.

Emission control system and equipments are necessary to meet the stringent ambient air quality requirements such as dust collector, combustion temperature and retention time control, lime and ammonia scrubber (with or without catalyst reactor), activated carbon absorber etc. With proper equipments, emissions including dioxins and furans can be reduced to comply with the stringent emission standards, when the operating temperature is maintained to more than1100°C.

5.6.2.2 Pyrolysis

In Pyrolysis, at high temperatures of 300°C to 600°C, thermal degradation of organic carbon based materials is achieved through the use of an indirect, external source of heat, in the absence of almost complete free oxygen. This thermally decomposes some of the volatile components form tar and oil, which can be removed and reused as a fuel. Most pyrolysis systems are closed systems and there are no waste gases or air emission sources. The balance of the organic materials that are not volatile or liquid that is left as a char material can be further processed or used for its adsorption properties (activated carbon). Inorganic materials form a bottom ash that requires disposal, although some pyrolysis ash can is used for manufacturing brick materials.

5.6.2.3 Pyrolysis/ Gasification

Pyrolysis is also referred to as destructive distillation or carbonization. It is the process of thermal decomposition of organic matter at high temperatures(about 900oC) in an inert (oxygen deficient) atmosphere or vacuum, producing a mixture of combustible carbon monoxide, methane, hydrogen, non-combustible carbon dioxide, water, nitrogen, pyroligenous liquid, chemicals and charcoal. The pyroligenous liquid has a high heat value and is a feasible substitute of industrial fuel oil.

Gasification involves thermal decomposition of organic matter at high temperatures in presence of limited amounts of air/ oxygen, producing mainly a mixture of combustible and non-combustible gas (Carbon monoxide, hydrogen and carbon dioxide). This process is similar to pyrolysis, involving some secondary /different high temperature (>1000°C) chemistry which improves the heating value of gaseous output and increases the gaseous yield (mainly combustible gases CO+ H_2) and lesser quantity of other residue. In these processes, besides energy recovery, proper destruction of the waste is also ensured.

5.6.2.4 Plasma Arc Gasification

In Plasma Arc Gasification process, alternating current (AC) and/or direct current (DC) electricity is passed through graphite or carbon electrodes with steam and/or oxygen/air injection (less than stoichiometric) to produce an electrically conducting gas (a plasma) typically at temperatures greater than 2200°C. This system converts organic carbon-based materials, including tar, oil and char to syngas composed primarily of H_2, CO and inorganic materials to solid, vitreous slag. Like Pyrolysis and conventional Gasification, Plasma Arc Gasification is a closed system; therefore there are no waste gases and no emission sources in the Plasma Arc Gasification process. After cooling and cleaning in emission control systems, the syngas produced by plasma arc gasification can be utilized in boilers, gas turbines or internal combustion engines to generate electricity or to make chemicals. The final emission products are CO_2 and water. The furans and dioxins in the emissions are extremely low and lower than the recommended USEPA emission norms.

5.6.3 Biological Processing Technologies

Biological technologies operate at lower temperatures and lower reaction rates. Biological processing technologies are focused on the conversion of organics in the MSW. MSW consists of dry matter and moisture. The dry matter further consists of organics (i.e. whose molecules are carbon-based) and minerals also referred to as the ash fraction. The organics can be further subdivided into biodegradables such as food waste or refractory organics which are non-biodegradables such as plastic. Biological technologies can only convert biodegradables component of the MSW. Byproducts can vary which include electricity, compost and chemicals. Various biological processing technologies are briefly described below.

5.6.3.1 Composting

Composting is one of the most popular and techno-economically viable mechanisms for processing and disposal of biodegradable waste. The process uses biological mechanism of microorganism to breakdown organic matter of MSW. There are two major types of process; aerobic and anaerobic.

The aerobic method uses aerobic bacteria to work under suitable environment i.e. moisture, temperature, oxygen content and carbon/nitrogen ratio of organic matter. This method normally produces good quality compost containing nitrogen and sulfate does not cause the odour problem. The finished compost can be used as an offset for fertilizers in the agriculture industry and other related uses such as landscaping, green cover development, barren land reclamation etc.

The other method is operated under anaerobic environment and normally causes odour problems, such as hydrogen sulfide and ammonia. This method uses longer time for acquiring mature to digest and gives lower quality of fertilizer. Normally compost plant is processedunder aerobic condition and requires aeration system which consequently needs energy consumption.

5.6.3.2 Anaerobic Digestion

Adoption of anaerobic digestion technology to treat organic waste and convert it to an energy source was widely used during the last ten years. The process involved includes collecting organic wastes, crushing and digesting in anaerobic tank. By product of the process is biogas which will be utilized for energy generation. However, sorting and removal of inorganic material is necessary by establishing a recycling center to purchase material from communities or installing front end sorting system at the facility. The residues that do not have further value will be disposed by landfill. Micro organisms in digester will digest organic matters and produce biogas as byproduct.

The biogas normally consists of 60 - 70% of methane and 30 - 40% of carbon dioxide. Biogas heating value is approximately 20 - 25 MJ/m^3 which is equivalent to a half kilogram of the Liquefied Petroleum Gas (LPG). Dried excess sludge from the biogas digester can be made available as good organic compost/soil conditioner.

The important requirement for implementing this technology is that organic waste must be separated from other wastes. Front-end sorting systems comprising sorting belts, magnetic separators and labors as well as public campaign such as waste separation shall cause higher investment cost to the project. With high percentage of organic waste, the anaerobic digestion is appropriate treatment with broad

advantages such as preventing odour, producing energy in the form of biogas, getting compost/soil conditioner as by-products and helping reduce landfill volume requirement.

5.6.3.3 Bioreactor Landfill

A bioreactor landfill is a wet landfill designed and operated with the objective of converting and stabilizing biodegradable organic components of the waste within a reasonable time frame by enhancing the microbiological decomposition processes. The technology significantly increases the extent of waste decomposition, conversion rates and process effectiveness over what would otherwise occur in a conventional wet landfill. Stabilization in this context means that landfill gas and leachate emissions are managed within one generation (twenty to thirty years) and that any failure of the containment system after this time would not result in environmental pollution. There is better energy recovery including increased total gas available for energy use and increased green house reduction from reduced emissions and increase in fossil fuel offsets. These factors lead to increased community acceptance of this waste technology. Management of a bioreactor landfill requires a different operating protocol to conventional landfills. Liquid addition and recirculation is the single most important operational variable to enhance the microbiological decomposition processes. Other strategies can also be used to optimize the stabilization process, including waste shredding, pH adjustment, nutrient addition and temperature management.

5.6.4 Physical Processing Technologies

Physical technologies involve altering the physical characteristics of the MSW feedstock. The MSW is subjected to various physical processes that reduce the quantity of feedstock and increase its heating value. It may be densified or palletized into homogeneous fuel pellets and transported and combusted as a supplementary fuel in utility boilers. These technologies are briefly described below.

5.6.4.1 Refuse Derived Fuel (RDF) Technology

The process of conversion of garbage into fuel pellets involves primarily drying, separation of combustibles from garbage, size reduction and pelletisation after mixing with binder and /or additives required. Typically, the non-combustible items are removed, separating glass and metals for recycling. The combustible waste is shredded into a smaller, more uniform particle size for burning. Pelletisation involves segregation of the incoming waste into high and low calorific value and shredding them separately, to uniform size. The different heaps of the shredded waste are then mixed together in suitable proportion and then solidified to produce RDF pellets. It is also important to ensure that the RD pellets are not burned indiscriminately or in the open but only in the dedicate incineration facilities or other well designed combustion systems, having all necessary pollution control systems. The calorific value of raw garbage is around 1000 Kcal/kg while the pellets resulting from the solidifying process is around 4000 Kcal/kg. About 15-20 tons of fuel pellets can be produced after treatment of 100 tons of raw garbage (Source: TIMES (TERI Information Monitor on Environmental Science) Volume 5, Number 1(June 2000)). These pellets could be used for heating in the boilers and the steam thus generated, in turn could be used to produce power. Typical flow sheet for RDF technology is shown inbelow.

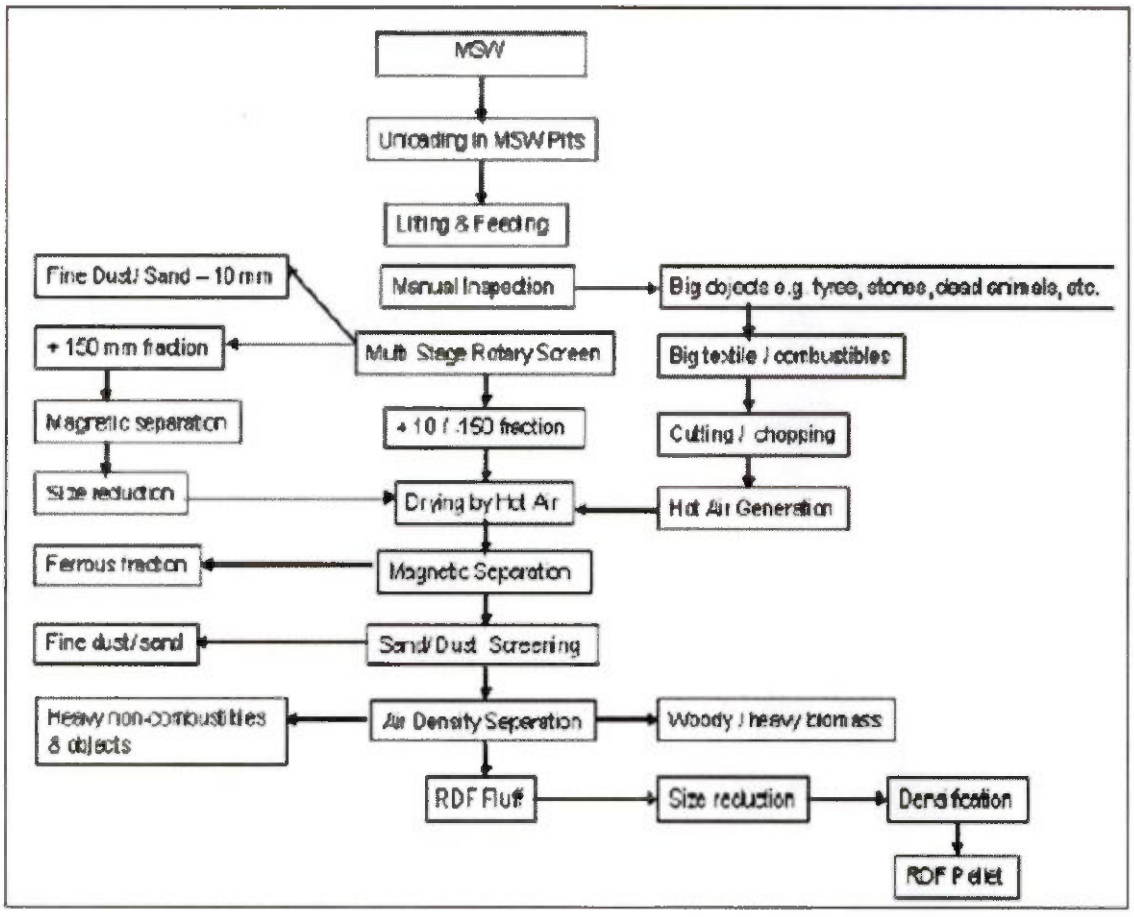


Figure 5-9: Typical Flow Sheet for RDF Technology

5.6.4.2 Mechanical Separation

Mechanical separation is utilized for removing specific materials or contaminants from the inlet MSW stream as a part of the pre-treatment process. Contaminants may include construction and demolition (C&D) debris, tires, dirt, wet paper, coarse materials and fine materials. Generally, solid waste reaching the dumping sites is un-segregated or mixed contains C&D debris and other contaminants. Therefore, it is essential to remove these contaminants from the incoming MSW by mechanical separation before processing the waste further by either biological, physical and thermal technologies (except Plasma Arc Technology).

However, in the study area, reuse of C&D debris (more than 90%) has been proposed. Therefore, the MSW reaching the dumping grounds does not require the elaborate mechanical separation process. This MSW has high organic content, fit to be directly used for various technologies after manual sorting only.

5.6.4.3 Size Reduction

Size reduction is often required to allow for more efficient and easier handling of materials, particularly when the feed stream is to be used in follow-on processes. Sizing processes include passive, moving and vibrating screens and trommels. In order to reduce the size of the entire stream

or portions of it, mechanical equipment such as shredders is utilized. This allows for other physical processes such as dryers, magnetic and eddy current separators and densification equipment to work more efficiently. Magnetic and eddy current separators may be installed both up- and down-stream of shredders to increase the recovery of metals.

5.7 TECHNOLOGY RELIABILITY CRITERIA

As a first step towards technology selection, the identified technologies have been evaluated for their reliability for MSW treatment internationally. The reliable technologies without reservations for large scale application for MSW for Bhatpara have been assigned category 1. The internationally proven technologies that require some caution for use in study area from the point of view of sophistication of the technology or scale of application have been assigned category 2. The technologies that do not have adequate track record internationally and cannot be considered for study area have been assigned category 3. The results of this evaluation are presented on *Table 5.8.*

Table 5-8: MSW Treatment Technologies-Potential Reliability of Operations

Sl. No.	Technology Category	Comments
Category 1 – Internationally Proven and Easy to Implement in India		
1	Bioreactor Landfill	A number of installations with capacities over 5000 tons per day are in operation in US. Though no such landfill is functional in India the technology is simple and can be easily implemented in India. However the existing MSW rules specify that only inert will have to be disposed in the landfills.
2	Composting	A number of installations have satisfactorily worked in India. The technology is simple and easy to implement.
Category 2 – Internationally Proven but Require Higher Sophistication		
1	Refuse Derived Fuel	Large scale plants are in operation in US. The technology is relatively simple and two medium scale plants are in operation in India, these plants utilize agricultural wastes / biomass to enhance the calorific value. The technology is simple and easy to implement. There are 2 facilities producing RDF in India.
2	Anaerobic Digestion of mixed MSW (Bio-methanation)	Plants are operational in Europe; however bio-methanation is applicable only to organic fraction of MSW and requires very high level of source segregation and pre-processing of mixed waste. No successful demonstration of sustainable application in India.
3	Incinerator and heat recovery	Large plants have been in operation in US and Europe and parts of Asia. This technology, however, requires higher sophistication and process control. There are recently established plants in India.
Category 3 – Insufficient successful experience		
1	Plasma Arc Gasification	Medium scales mixed waste plants are operational in Japan. The technology, however, requires high degree of sophistication and process control and is expensive. No Plasma Arc gasification plant in India.

Sl. No.	Technology Category	Comments
2	Gasification and Pyrolysis	Although the technology is well proven with woody biomass, there is insufficient operational experience with MSW. No plant in India is under operation at present.

Since the current MSW rules do not permit the disposal of MSW containing organic substances in a landfill, the bioreactor landfill component has not been considered here.

In Category 3, the technologies of gasification and pyrolysis have been eliminated from further considerations, as these technologies have not been attempted in India and are known to be expensive also. For the remaining technologies, next level evaluation has been done using environmental and social acceptability criteria.

5.8 EVALUATION OF VARIOUS WASTE TREATMENT TECHNOLOGIES

The comparison of the different technological options discussed above is as given below in *Table 5.9.*

Table 5-9: Comparison of the Various Waste Treatments Technological Options for MSW

Sl. No.	Option for Waste to Energy Conversion of MSW	Advantages	Disadvantages
1.	Composting (windrows type)	• Inoculums, enzymes not needed • Comparatively less technologically involved process • Compost recovery is possible • Cost Economic/ Feasible Solution • Low Maintenance • Easy Management	• No energy recovery • Heat loss through open windrow surfaces • Open system-Difficulty in operation during rainy season, liable to bad odour, rodent and fly menace, if not operated properly, visible pollution and social resistance • Large land area required
2.	Anaerobic digestion	• Energy recovery is possible • Enclosed system - all the gases can be collected for use • Controls green house emissions • Less land area required	• Proper segregation of waste required • Proper maintenance of process conditions required
3.	Composting	• Time of treatment is less, thus	• High energy involved

Sl. No.	Option for Waste to Energy Conversion of MSW	Advantages	Disadvantages
	(In-vessel type)	large quantity is processed • Not affected by climatic features such as cold temp and rainy period • Less land areas required	• High installation cost • Trained manpower requirement • Technologically involved process • Cost intensive in comparison to windrow
4.	Vermi composting	• Comparatively less technologically involved process • Compost recovery is possible	• No energy recovery • Earthworm culture is required • Open system-Difficulty in operation during rainy season, liable to bad odour , rodent and fly menace , if not operated properly, visible pollution and social resistance • Large land area required
5.	RDF Pellet	• More careful segregation of waste leading to less emissions • Energy recovery is possible • Less land area is required •	• Low moisture content in waste • Drying of waste required • Burning of pellets in controlled conditions with Air Pollution Control Devices installed • Low calorific value of Indian waste • Very low quantity waste is being generated at Panihati for self sustainable power generation
6.	Pyrolysis / Gasification	• High energy recovery • Low land area	• Technologically involved process • Low calorific value of Indian fuel

5.9 RECOMMENDATION FOR SETTING UP A WASTE PROCESSING PLANT – WINDROW COMPOSTING &MATERIAL RECOVERY FACILITY

While identifying and selecting the technologies for Panihati Municipality, following considerations have been kept paramount:

- The technology is suitable to treat the waste characteristics of the study area in an environmentally sustainable manner.

- The technology meets the regulatory requirements (i.e. confirms to the MSW Rules, 2016 requirements) and is socially acceptable with minimum impacts to the environment and citizens.
- The technology is economical and commercially available.

Based on the technology reliability, environmental and social acceptability and waste suitability criteria as present in the previous sections of the chapter the following technology found to be suitable for processing of waste generated at the study area.

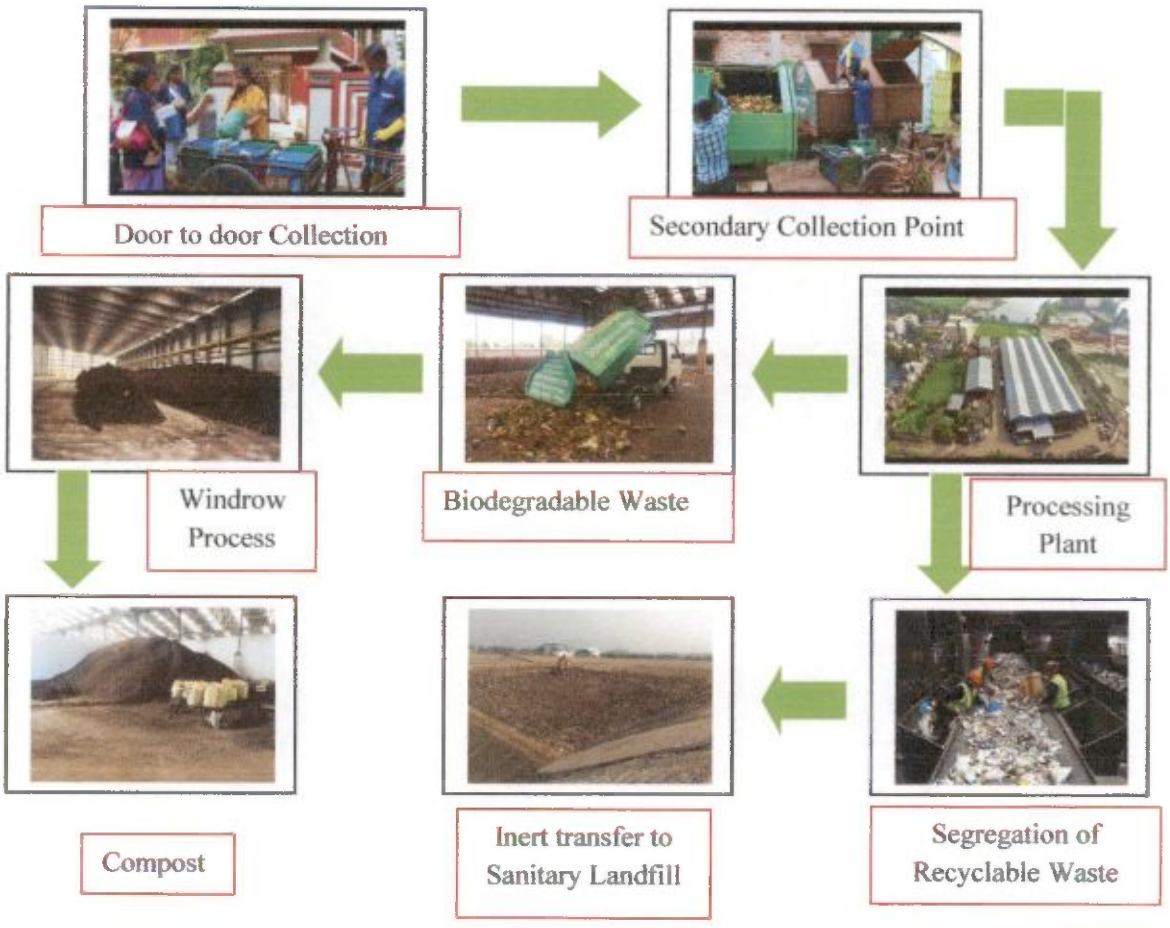
Composting

The shortlisted technologies might be applicable to the quantity of waste generated in the study area, but the feasibility needs to be checked considering the quantum of waste and its mixed nature. At present the MSW for processing facility is about 100 MT/day. The quantity will keep on increase in per capita generation and natural growth of the population. Also in future the integrated facility might receive wet waste (highly biodegradable) and dry waste (combustible) separately. Thus considering these aspects feasibility of the shortlisted technologies has been discussed as following.

The processing facility can consider the remaining shortlisted one technology i.e.,Composting. Composting is low capital intensive and easy to operate and have considerable track record in India. Hence composting may be preferred as process technology option and process remnants may be disposed off at landfill site.

As mentioned in the previous sections, compost processing has been proposed to process the waste generated for selected ULB. Since, the incoming waste to compost plant is organic in nature; higher rate of production of compost may be expected with lower percentage of rejects, the overall rejects going to landfill shall be 25-30%. The schematic diagram of the proposed scheme for collection, treatment and disposal is shown in *Figure 5.10.*

Figure 5-10: Proposed Scheme for Waste Collection, Treatment & Disposal



5.9.1 Design of Processing Facility

5.9.1.1 Introduction

The waste collected from the municipal area would be containing organic waste, recyclables and inert waste. Considering the local setting of municipality, land availability and the quantum of biodegradable waste generated, composting is recommended for selection. Composting is feasible only at a smaller scale of operation for non-hazardous organic waste.

Composting is the biological degradation of organic materials under controlled aerobic conditions. The process is used to stabilize organic bio-solids (a term used to describe organic biodegradable matter derived from domestic waste) prior to their use as a soil amendment or mulch in landscaping, horticulture and agriculture. The final product of this treatment process is called 'fertilizer grade compost' and used as a soil conditioner.

Panihati Municipality reportedly generates an estimated quantum of approximately 135 MT of solid waste per day which comprises waste from houses, markets, road sweepings and hotels/eateries. Approximately 48.34 percent of the total wastes generated are biodegradable component which shall form the raw-material intake at the proposed composting facility.

The municipality owns land to an extent of 4.5 acres at Ramchandrapur which is presently used as a dumping ground and they have proposed a new land for processing facility and sanitary landfill site which capacity of 4.6 acre and 3.6 acre. This location beside Kalyani Highway (ward no. 34) is considered for the proposed Composting Facility and Sanitary Landfill site.

5.9.1.2 Design Considerations

The following design considerations have been adopted in planning and designing Processing Facility for the study area.

- The facility is designed for processing MSW to compost.
- The installed capacity of the entire plant shall be 100 MT/day in accordance with the future increase in waste quantities.
- For the purpose of designing the plant equipments, the operations have been planned for 1 shift initially with 8 hours effective operating hours daily.
- MSW shall be treated by spraying a suitable bio-culture on the waste. Chemicals may be needed to eliminate insects, flies and odour.
- The overall rejects reaching the scientific landfill would be around 25-30% of the incoming waste to the processing facility.
- The proposed landfill shall be developed as per the MSW Rules 2016; CPHEEO manual and other relevant guidelines / specifications.
- The infrastructure of the plant will be constructed for 20 years but the machineries were designed for 7 years.

The total municipal solid waste generation is 135 TPD for the year 2017. The biodegradable portion in the waste is 48.34%. The projected biodegradable waste quantity for the year 2019, 2023, 2029, 2034 and 2039 is as given below in *Table 5.10.*

Table 5-10: Biodegradable Waste Generation

Year	Population of Panihati Planning Area	Total Waste Qty in TPD	Waste for Processing in TPD
Year 2019	420169	142	68.64
Year 2024	446063	161	77.83
Year 2029	471291	182	87.98
Year 2034	495852	204	98.61
Year 2039	519746	228	110.22

ground (Hopper) in the receipt area. The receiving pit will be constructed of provided in a Reinforced Cement Concrete (RCC) enclosure with a steel bin of 50 MT capacities.

The waste will be segregated manually for foreign materials such as paper, glass, plastic, polythene, etc. Depending on the quality of the material, it will be sent to recyclable units for recovery or RDF plant or to the landfill site for final disposal.

The segregated organic waste will be dozed into a receiving pit through a dozer or front end loader. The waste will then be drawn by a reciprocating feeder (R-feeder) and put on to a conveyor to facilitate removal of inert material/iron and other metallic material.This segregated material will then be transferred to a surge hopper in the screening plant.

The material from surge hopper is drawn by an R-feeder and put on to a flat picking conveyor that runs at a speed of 0.8 m/sec. The sorting of non-organic material will be done manually by deploying workers on either side of the slow moving picking conveyors.The sorted out organic material will be sent to a shredder for sizing through.

The rejects from the picking conveyors will be transferred to reject hopper for appropriate disposal.The shredded material from the shredder yard will be transferred to windrows through front end loaders or through conveyor arrangement and telescopic chute. The additives inoculums etc. will then be added for controlled aerobic treatment.

5.9.1.5 Waste to Compost Plant

The compostable waste primarily comprises of Organic material such as kitchen and yard waste, refuse from vegetable markets, food waste from hotels and restaurants; green & horticultural waste; cow dung and dairy waste etc. Biological treatment of organic material involves using naturally occurring micro-organisms to decompose the bio-degradable components of waste under controlled conditions.

Composting can be achieved using three types of micro-organisms – bacteria, actinomycetes and fungi. In the initial stages, the bacteria, fungi, and protozoa activities cause the temperature in the compost plant to increase to 65-70°C, which is called the thermophilic stage. In this stage, the bacterial and actinomycetes activity causes decomposition, resulting in a fall in temperature, when the fungi activity resumes. This stabilized condition is known as mesophilic stage, when the composting material becomes dark brown due to humus synthesis. In addition to temperature, air supply, moisture content, particle size of MSW, acidity/alkalinity, and chemical characteristics are the other factors which influence the microbial activity in a windrow. Several factors affect the rate of decomposition of the bio-degradable material as described below:

- ***Micro-organisms:***In order to expedite the process, additives such as cellulolitic, lignolytic, or cow dung solution shall be added to the organic waste. Micro-organisms such as azotobactor and phosphorus solubilizing microbes (PSM) will need to be added during the pre-processing stage for initiating the microbial activity.

- ***Moisture content:***The moisture content of the bio-degradable waste needs to be maintained within the range of 55-60%. Additional water will need to be mixed with the bio-degradable waste, if required, to keep the moisture content within the range of 55-60%.
- ***Air supply:***Sufficient air supply is required to maintain a high rate of decomposition, removal of carbon dioxide and volatile organic compounds, and buffering of the pH. This can be done manually by regular turning of the windrows. The automated process involves controlled air supply through self propelled windrow turners installed on the ground of the composting area.
- ***Temperature:***A temperature range of 65-70oC is conducive for sanitization of MSW. In addition, the disease-causing micro-organisms are killed and weeds are destroyed at this temperature. Further, a high rate of decomposition is achieved in the temperature range of 35-45oC.
- ***Particle size of MSW***:Smaller particle size of compostable material provides greater surface area for the micro-organisms to act up on. However, the particle size should not be too small so as to compact the organic matter and reduce void space.
- ***Acidity/alkalinity:***A pH range of 6.5-7.8 is most suitable for the composting process.
- ***Chemical characteristics:***A C: N ratio, 20:1 to 25:1 is ideal for maximum decomposition of organic matter.
- ***Waste Densities Adopted:***For the purpose of design, a density of 0.45 T/m3 is assumed for the incoming waste and 0.60 T/m3 is assumed for the compost (within the range 0.6-0.9 T/m3).

The bio-degradable waste segregated at the source is collected and transported to the Compost Plant. The Process Design for MSW Compost Plant involves various steps as described below.

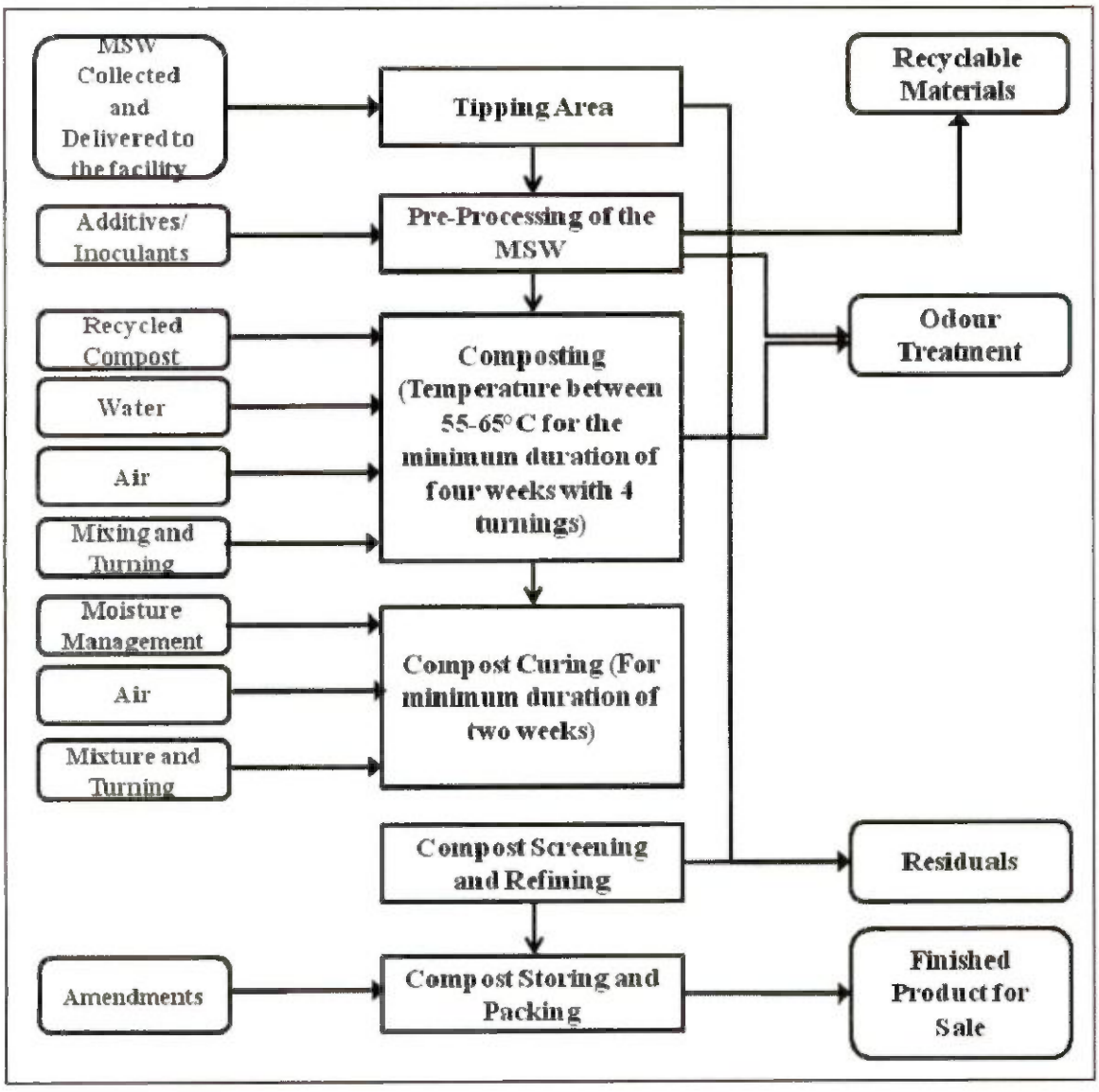


Figure 5-12: Process Design for MSW Composting Unit

5.9.1.6 Basic Design of Processing Plant

5.9.1.6.1 Waste Receiving Platform

It is a Reinforced Cement Concrete (RCC) platform on where only biodegradable wasteis unloaded and then spread by the loader for manual sorting of recyclables and some unwanted material like big stones, tyres etc. which are unwanted in composting are removed. 3-4 numbers of labours are positioned at the platform for sorting of recyclables and removal of inert material. Each labour is equipped with gloves, mask, gumboot, dress, cap, metal forks.

5.9.1.6.2 Windrow Platform

Organic waste after segregation at waste receiving platform and presorting area will be brought to windrow platform where one day waste will be piled up in semicircular shape in long rows. There

will be seven rows for each day waste and these rows of waste will be shifted to new position in longitudinal direction every week. Cow dung slurry as a culture is to be sprayed on the fresh windrow heap for better and faster degradation of organic matter. Total detention period of waste at windrow platform will be 28 - 35 days. Windrow platform is also an R.C.C concrete platform in continuation with waste receiving platform, having drain at the outer periphery which has a slope of around 2% from the central part of the compost pad and connected to a leachate collection tank. The drain will be provided at the periphery because it is easy to clean and has less chance of breakage as compared to the case of central drain. Heavy vehicular movement over central drain cover can result in the drain getting broken and choked up. Also central drains are very difficult to clean.

There will be brick masonry wall at the outer periphery of the platform so that waste will not be blown away. The height of the wall is around 1.2 m. The leachate collection drain will be outer side of the wall.

As the waste is received at windrow platform, bio-culture mixed with water shall be spread on it for faster degradation of organic matter and to make windrow odour free and to some extent fly free also.

There will be continuous measurement of temperature and moisture inside the heaps; these are the most important parameters controlling the process of composting. For monitoring the temperature and moisture measuring probes will be used. Records of the same will be maintained for each heap and if quality of the final compost is not up to the required standards then some changes will be initiated on the basis of this analysis. Labourers will be required for spraying of water, culture and checking temperature on windrow platform.

5.9.1.6.3 Monsoon Shed

After 4 weeks, waste will be shifted from windrow platform to monsoon shed (covered area) by loader. Monsoon shed is R.C.C platform with permanent roof at the top, the height of the roof is around 6.5m for better aeration inside the shed. There will be cladding of 1.5 m from the top of the roof to protect the material from rain all around the compost pad area.

Waste will be kept for 10-15 days and during this period full degradation of the organic waste will be completed and waste will get fully stabilized.

5.9.1.6.4 Preparatory Section

The degradation of organic waste shall be 85% completed at the monsoon shed, i.e. the organic fraction shall be stabilized as compost. The contained impurities in the waste such as plastics, pieces of textile and other inert material shall then be separated out. For this purpose preparatory facility shall be set up considering the following equipment:

- **Feeder Conveyor:** This shall be the first equipment that receives digested waste from the monsoon shed. Loader shall be used to transfer waste from monsoon shed to conveyor. From here the waste material shall be loaded in trommel.
- **Trommel-35 mm:** Trommel (as shown in *Figure 5.12*) is specially designed rotary screen to rejects all material having overall size above 35 mm and all undersized material is forwarded to next equipment

- **Reject 35 mm Conveyor:** It serves the purpose of removing all oversize refuge of the trammel. A Trolley is placed just beneath the reject conveyor which takes care of over sized material. The unwanted material is transfer to the landfill.
- **Transfer Conveyor:** It is meant to take material coming through screens of 35mm trommel and feed the material to 16 mm trommel.

Figure 5-13: Typical View of Prepatory Section

- **Trommel-16mm:** Trommel is specially designed rotary screen to rejects all material having overall size above 16 mm and all undersized material is forwarded to next equipment
- **Reject 16 mm Conveyor:** It serves the purpose of removing all oversize refuge of the trammel. A Trolley is placed just beneath the reject conveyor which takes care of over sized material. The unwanted material is transfer to the landfill.
- **Transfer Conveyor:** It is meant to take material coming through screens of 16mm trommel and drop material to curing area.
- **Rejection** from trommel mainly consists of undigested organic matter and inert material. This material can be used as masks on the fresh garbage windrows. This masking prevents bird attraction and also assists in decomposition process.

5.9.1.6.5 Curing Area

- The semi finished stabilized material drops at the curing area with the transfer conveyor belt and is then stacked to a height of 1 to 1.5 m with the help of loader. The detention time of the waste is around 15 days, for removal of moisture to the extent of less than 15%. Under these conditions screening of stabilized waste shall take place more effectively while passing through 6 mm screen in the refinement section.
- Moisture is measured with the help of moisture probe.

- Some additives as rock phosphate may be added at this stage to improve quality of final product.

5.9.1.6.6 Refinement Section

- Semi finished compost is feed on screen (4mm) with the help of loader. The screen separates material on the basis of overall size. It rejects all material having size above 4 mm, as compost particle size is less than 4 mm so it will pass through the sieve and is forwarded to the density separator.
- **Density Separator / Gravity Separator:** This is to segregate material on the basis of difference of density. Density Separator separates all eventual metal pieces (ferrous and non-ferrous), pebbles, sand and all undigested but same sized impurities.

Figure 5-14: Typical View of Refinement Section

5.9.1.6.7 Quality Check Area

- The compost shall be transferred from refinement section to a closed room by wheel barrow. This room has a rolling shutter at the entrance connected to refinement section and exit connected to the storage and packing section.
- The purpose of the room is to check the quality of the compost before packing.
- After required tests, if the quality of compost is not matching with the *Organic Manure Standard* then nutrient will be added and mixed with the compost.
- Requirement of two labourers who are equipped with gloves, masks and apron for packing of manure and marking batch number and N, P, K value of the compost along with brand name of the product
- Manure bags are then weighed on electronic weighing machine and transferred to storage and packing section.

- Batch number shall be marked on each packed bag and transferred to the storage and packing section.
- A store keeper will be placed to maintain the records at the storage and packing section.

5.9.1.6.8 Storage and packing section

From the refinement section, compost is then passed through the packing section for final packing. At this section, compost is weighed and then packed in bags. Bags are then stitched using a portable sewing machine and finally stacked in the finished goods warehouse.

5.9.1.7 Operation Details

- Biodegradable waste pursuant to segregation at the source level will be received at the screening section of the waste processing complex.
- Foreign material that is unacceptable will be removed and disposed off in the sanitary landfill. Recyclable material, if any may be removed at this stage.
- The aforementioned screening shall be performed through suitable equipment such as mechanical screeners/manual operation
- Bio-degradable waste prior to entering the windrow platform shall also be shredded and ground to uniform size (10 – 15 mm dia. particle size).
- The prepared waste shall be delivered from the screening pad to the windrow platform using heavy vehicles.
- Windrows which are essentially semi-circular formations of the waste assay in the specified dimension shall be prepared.
- The constructed windrow pile should be formed as a semi-circular cross-section allowing a space of 2.5 m between each pile.
- This clearance should be maintained for equipment ease of access to the windrows. Once windrows are initially formed and settled, a windrow turner will be used to turn and aerate the piles.
- The turning may be done for every 3 days initially and thereafter, based on monitoring results it may be turned approximately once in a week. More the turnings take lesser the process time.
- The windrow turner will not only aerate the pile but will also increase the surface area available to microbes and accelerating the composting process.
- A reduction in pile size will also occur as a result of initial turnings. The individual sections will be monitored to ensure a proper environment for active composting to be maintained. Temperature, being the prime indicator of microbial activity should be monitored daily along the windrow using long stem digital thermometers.

- The windrow or section of windrow will also be turned if the temperature varies from the thermophilic range (45 °C - 60°C).
- The optimum moisture content for composting is between 50-60%, while that in the incoming waste it is much lower at an average of 30%. Further during composting the moisture content tends to reduce and necessary moisture can be similarly added during turning.
- The moisture content will be checked periodically using the "squeeze test" (A handful of material from within the windrow will be squeezed; if a few drops of water are generated the windrow can be assumed to contain the proper range of moisture 40% to 60 %) deviance from the range requires turning of the windrow. On the other hand if there is more water than few drops, turning is done to aerate and dry pile to prevent anaerobic conditions. The water requirement will be taken from the runoff collection tank.
- Eventually, through turning and mixing the windrow will be homogenized and will uniformly degrade. Composting and curing will be judged complete when pile temperatures decrease to near ambient and is moderate for 3-4 weeks.
- After six week, the formed windrow is broken down and passed through rotary screen of the suitable square mesh to remove oversize particles. Finished compost will be stored separately. The specification of compost quality as per MSW, 2016 shall be met as mention is *Table 5.11*. Compost rejects and inert waste should go to the landfill site.

Table 5-11: Standards for Compost

Parameters	Concentration not to exceed *(mg/kg dry basis , except pH value and C/N ratio)
Arsenic	10.00
Cadmium	5.00
Chromium	50.00
Copper	300.00
Lead	100.00
Mercury	0.15
Nickel	50.00
Zinc	1000.00
C/N ratio	20-40
PH	5.5-8.5

5.9.1.8 Mass balance for Compost Plant

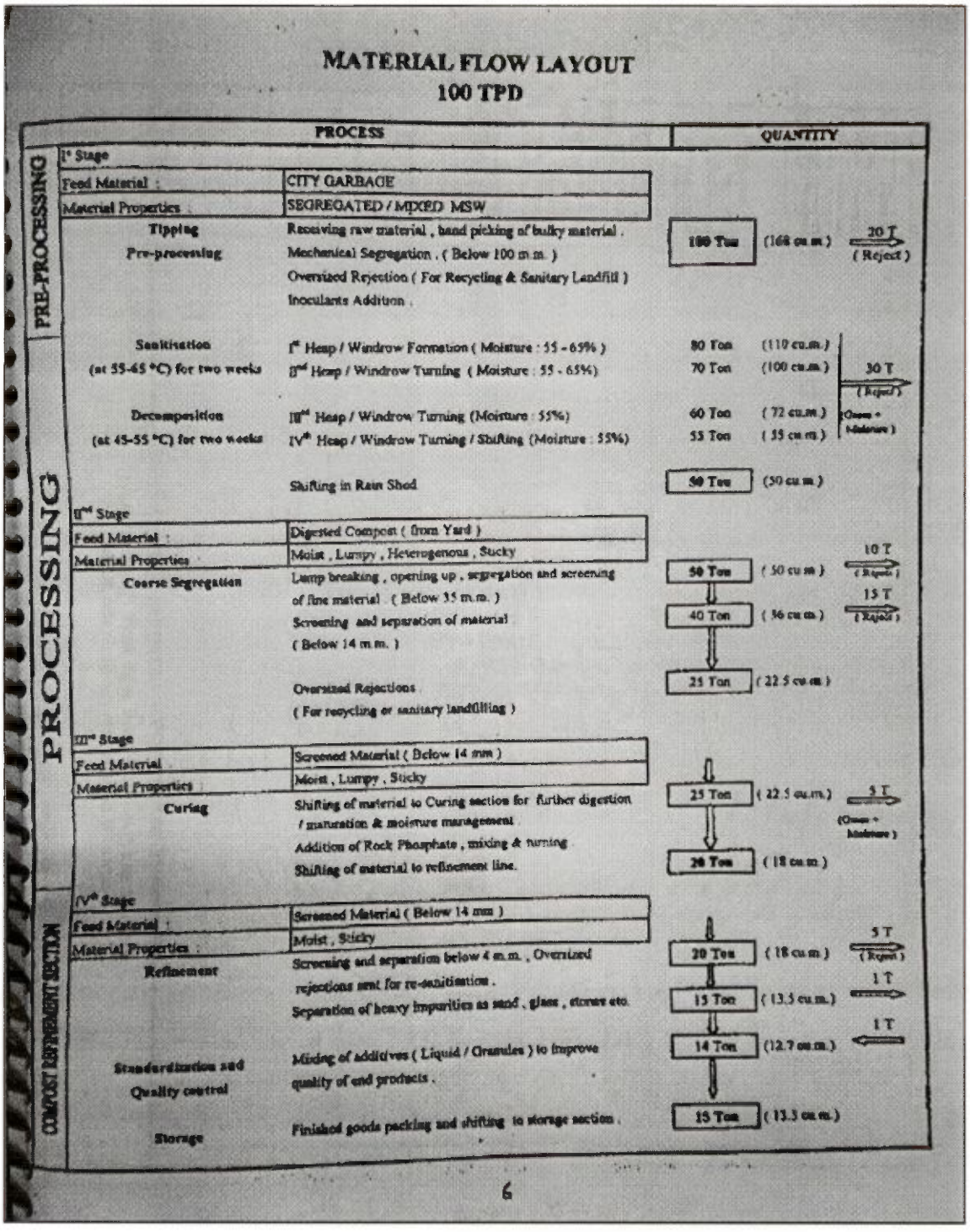


Figure 5-15: Material Flow Sheet

5.9.2 Area Calculation for Waste Processing Plant

Table 5-12: Area Requirement of Compost Plant

Sl. No.	Description	Dimension
1	Waste Receiving Platform	580 Sq m
2	Windrow Platform	5090 Sq m
3	Monsoon Shed	1700 Sq m
4	Preparatory Section M/c	600 Sq m
5	Curing Area	1490 Sq m
6	Refinement Section	200 Sq m
7	Godown	216 Sq m
8	Material Recovery Facility	40m × 25m
9	Administrative building & workshop	14.75m × 7.25m
10	Parking	25m × 10m
11	Guard Room	3.75m × 3.25m
12	Substation	6m × 5m
13	Weighbridge Cabin	3.5m × 2m
14	Weighbridge Platform	9.3m × 3.6m
15	Boundary wall 2m height	670 m
16	Drain	660 m
17	Road 6.0 m wide	190 m
18	Main Entrance Gate	6 m wide

5.9.3 Machineries Requirement for Waste Processing Plant

Table 5-13: Machineries Requirement

Sl. no	EQUIPMENTS	100 TPD QTY	COMMENTS
1.	**YARD MANAGEMENT**		
a)	Loader Backhoe/ Turning Equipment	1NO	Turning of Windrow.
b)	Front Wheel Loader	1NO	Shifting & Feeding of Materials.
c)	Tractor With Tipper Trolley	1NO	For materials movement to landfill site.
d)	Dumper	1NO	For materials movement to landfill site.
f)	Water Tanker With Slurry Pump	1NO	For sprinkling of water & slurry on garbage.