For Conduction of Public Hearing

Executive Summary of EIA

For

Establishment of "Integrated Municipal Solid Waste Management Facility" at Narela-Bawana Notified Site

Submitted To:
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EXECUTIVE SUMMARY

BACKGROUND

Municipal Corporation Delhi has identified site for the development of an Integrated MSW Management Facility (IMSWF) at Narela - Bawana Notified Site in compliance with various provisions stipulated in the MSW Rules, 2000. MCD has selected M/s. Delhi Municipal Solid Waste Solutions Ltd. to develop the Integrated MSW Management Facility (IMSWF) at the identified site. The project falls under category 'A' since Bawana Reserved Forest falls within 2.5 km radius of site, Shri Krishna Sultanpur Reserved Forest within 4.5 km radius of site, and Haryana State Boundary is within 5 km radius of the site. Hence, in accordance with the EIA Notification, 2006 a rapid EIA has to be carried out and an Environment Management Plan (EMP) has to be developed. M/s. Delhi Municipal Waste Solutions Ltd. entrusted M/s. Ramky Enviro Engineers Ltd., New Delhi to carry out the rapid Environment Impact Assessment studies to obtain Environmental Clearance. Accordingly, the Form – 1 was submitted to the Ministry of Environment & Forests (MoEF) for the scoping. Subsequently, the MoEF has issued TOR vide their letter No. F.No. [10-67/2009-IA.III] dated October 2009. This EIA has been carried out in accordance to the issued TOR by the MoEF in order to obtain the Environment Clearance (EC) for establishment of Integrated Waste Management Facility which is a need of an hour for the burgeoning problem of Municipal Solid Waste Management in Delhi.

The main objective of the EIA study is to identify and assess the environmental impacts associated with the development of IMSWM, on the physical, biological and socio- economic environment and to prepare a management plan to incorporate mitigate adverse potential impacts on the environment. The study has been carried out in an area falling within 10 km radius of the proposed site. A detailed approach and methodology consisting of baseline survey, predictive modelling for impact prediction and environmental management plan has been followed for carrying out this study.

The EIA study has been done in line with regulatory requirements under the EIA notification September, 2006, as per the prescribed TOR and applicable rules/guidelines of Ministry of Environment and Forests, Govt. of India, Including general/sectoral provisions.

The proposed Narela Bawana Notified site measuring approximately 100 acre (40 Hectares) of land (57' 39", E 03' 42" and N 48' 21", 04' 14") is located in Northern part of Delhi along Haryana border on Narela Bawana road at a distance of about 5-6 kms from Bawana village towards Narela Village. The site is bounded by Western Yamuna canal and high tension wire and electric substation on south, village Sanoth on north east and Narela – Bawana road on north. Sanoth village and Bawana settlements are located 1.00km and 2.70 km away from the proposed site, respectively. The site is accessible through Narela Bawana road. It is located at an aerial distance of 14 km from Old Delhi railway station and 23 km from nearest airport of Safdarjang airport (Fig: E1).

LOCATION MAP OF THE STUDY AREA

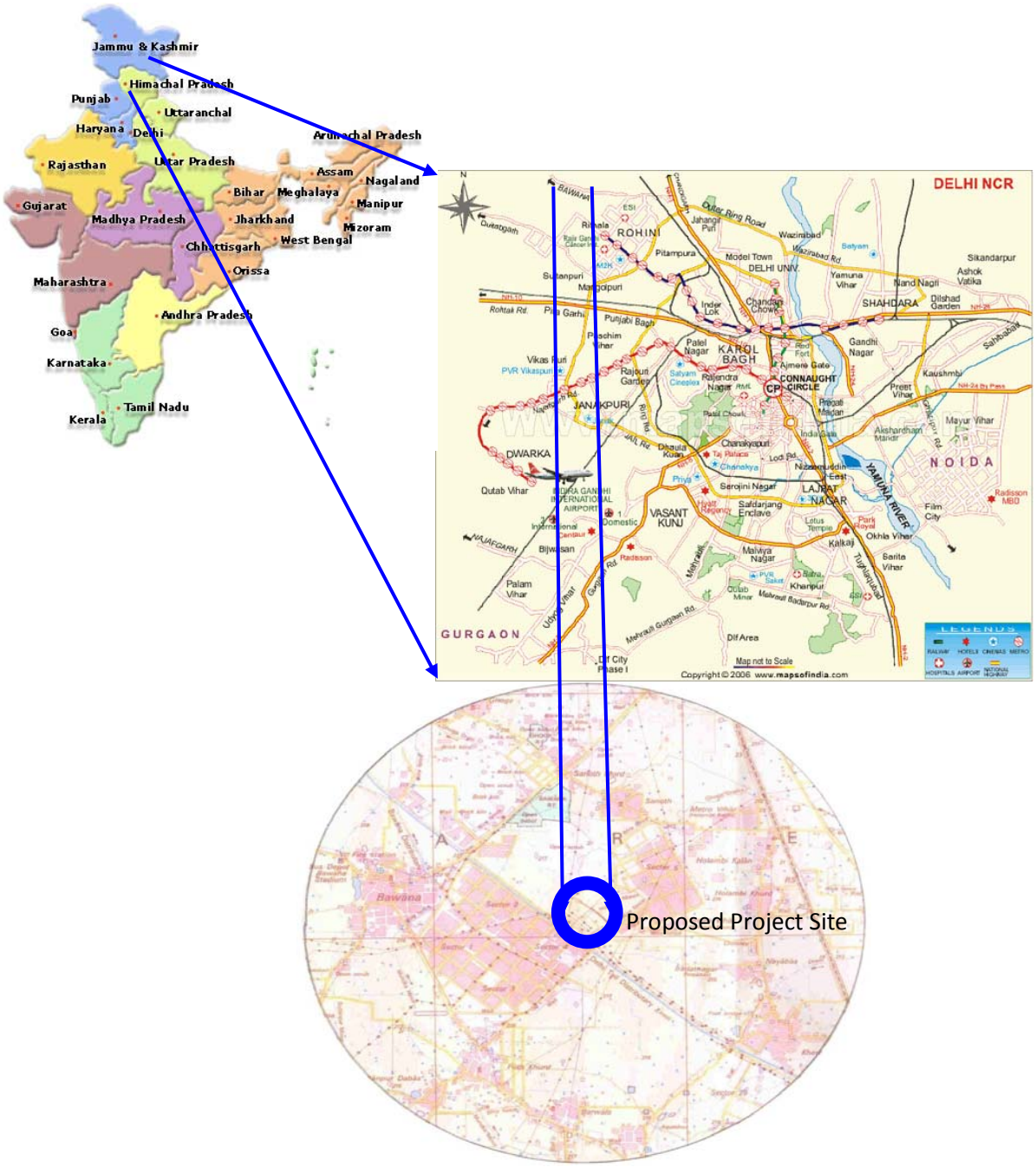


Figure – E 1: Project Study Area

Ecological aspects of the project area were studied with respect to ecologically sensitive areas, hilly areas, bio-diversity (Flora and Fauna), wetlands & water bodies and habitations (settlements). The key inferences from ecological assessment and site assessment in terms of environmental sensitivities are presented below:

- There is no wildlife sanctuary and park within study area
- No hilly area falls within study area
- Except for Water Body near Western Yamuna Canal, a natural (seasonal) drain and Western Yamuna Canal, all water bodies are more than 2.9 km away from the proposed site. Western Yamuna Canal passes through the southern side and is around 550 m away from the boundary of the proposed site. Daryapur water body is on the eastern side and passes along the periphery of the site.
- A small scrub forest is located 744 meters away from the proposed site.
- Major settlements are located about one kilometer from the proposed site.
- Bawana reserve forest is located within 2.5 km radius of the site
- Sri Krishna Sultanpur reserve forest is located within 4.5 km radius of the site
- Haryana state boundary within 5 km radius of the site

Salient Features of the project

The proposed project involves Integrated Solid Waste Management (ISWM) of Municipal waste. Integrated Solid Waste Management is the application of suitable techniques, technologies and management practices, covering all types of municipal solid wastes from all sources to achieve the following objectives of:

(a) Waste reduction and,

(b) Effective Management of Waste produced after waste reduction

(c) Generation of Electricity from waste

Proposed Integrated municipal solid waste processing facility has been planned for up to 4000TPD of waste at Narela Bawana site.

The Salient features of the project are presented below.

Table -E-1: Salient features of Project

Total Project Cost	Rs. 70 Crores for Phase – I Rs. 378 Crore for Phase – II		
Type of Project	Establishment of "Integrated Municipal Solid Waste Management Facility" at Narela - Bawana Notified Site		
Project Area	100 Acres		
G T sheet No	H43W13, H43X2, H43W14, H43X1		
Land Co-ordinates	N , E 03'42'' and N , E		
Proposed Facilities	Total of 4000 TPD of waste being processed through two Phases		
	Phase	*Quantity Processed*	*Components*
	Phase-I	1000TPD	MRF, Composting, RDF, SLF
	Phase-II	3000 TPD	Power Plant, SLF
Land Use	Reserved & Notified under Master Plan 2021		
Water requirement	PHASE – I: 155.2 /day (One time) 15.2 /day (Regular) PHASE – II: 1117 /day (One time) 908 /day (Regular)		
Waste water generation	PHASE – I: 154.16 /Day PHASE – II: 231.8 /day		
Source of water	Phase-I: Delhi Jal Board Phase-II: Delhi Jal Board		
Power requirement	Phase – I: 1000 KVA for Phase –II: Approx. 48 MU (15% of total power generation)		

Power supply	North Delhi Power Ltd. (NDPL) for Phase – I. Auxiliary power requirement of 15% for phase-II
MSW processing facility	Up to 4000 TPD
Project Accessibility	The site is accessible through Narela Bawana Road.
Nearest Railway Station	Old Delhi Railway Station (about 14 Km away)
Nearest Airport	Safdarjung Airport, New Delhi
Bawana reserve forest	Within 2.5 km radius
Sri Krishna Sultanpur reserve forest	Within 4.5 km radius
Haryana state boundary	Within 5 km radius

Note: Phase-II will start after commissioning of Phase-I

Figure – E2: Site Photographs

The site is characterised by the high tension line and the sewage line passing through the proposed site (Fig: E2 & E3). However, **out of 150 acre of total site area, 50 acre area** falling under the high tension lines, towards the Western Yamuna canal side, has been left out. The site layout plan is shown in Figure – E4.

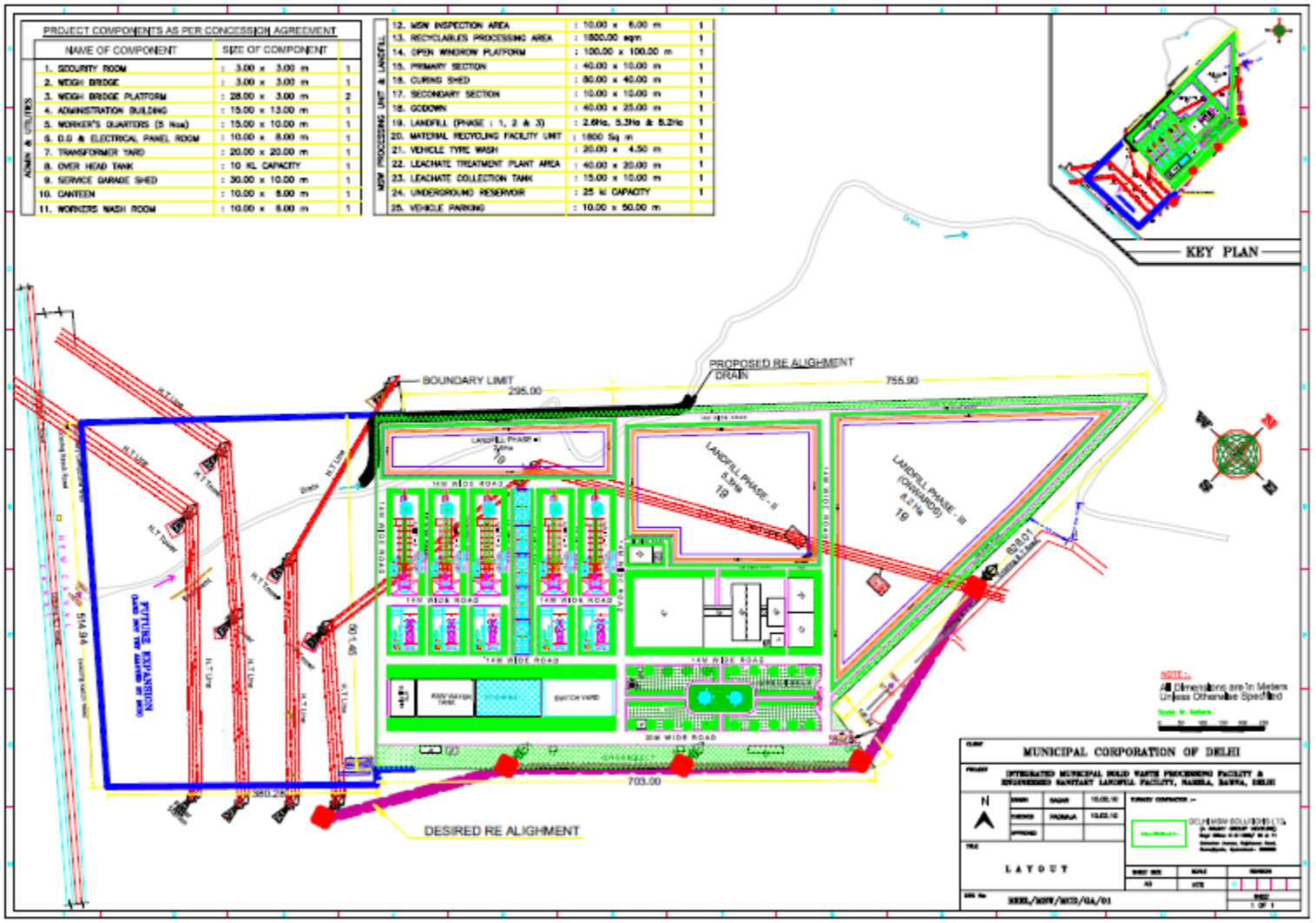


Figure E4: Layout Plant of project site

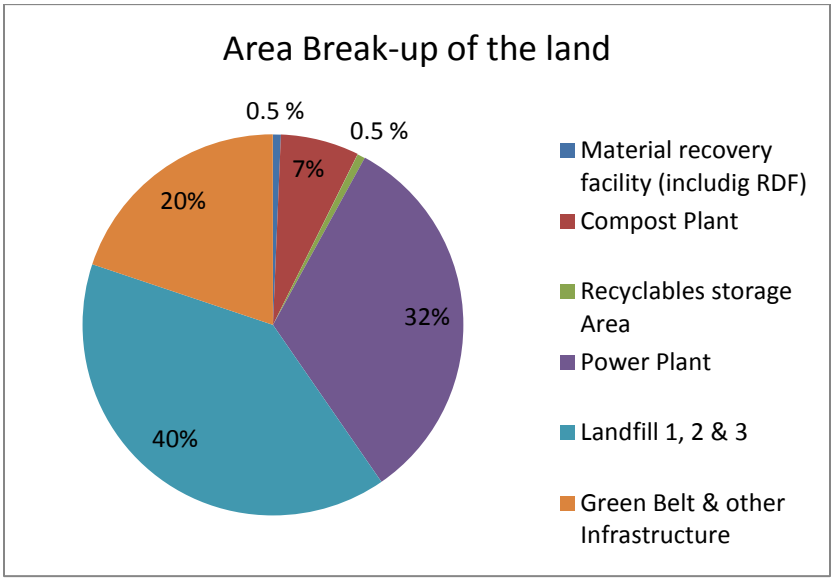
Proposed land use of the site

In the IWMF, disposal area with a total of 3 cells has been proposed. Thus total of approximately 12, 86,260 tonnes of solid waste shall be disposed off in this facility up to closure of the facility, which has been planned for 25 years. The breakup of proposed 100 acres is given below:

Table – E 2: Break up of proposed land

S. No.	Facility	Area (Ha)	%
1.	Material recovery facility (includig RDF)	0.27	0.5
2.	Compost Plant	2.7	7
3.	Recyclables storage Area	0.27	0.5
4.	Power Plant	13.1	32
5.	Landfill 1, 2 & 3	16.1	40
6.	Green Belt & other Infrastructure	8.03	20
TOTAL		**40.47**	

Figure – E 5: Pie-chart for proposed land use



INTEGRATED MSW MANAGEMENT FACILITY AT NARELA – BAWANA NOTIFIED SITE – PROCESS DESCRIPTION

4000 TPD of municipal solid waste will be treated in two phases; Phase-I which will process 1000 TPD of waste will compose of a material recovery Facility (MRF) to reclaim metals and recyclables, and sort out organic and combustible material for composting and RDF facilities. Phase-II will compose of a power plant based on Mass-burn technology, which will process 3000 TPD of waste. Following is the process flow sheet for the entire proposed integrated municipal solid waste management facility:

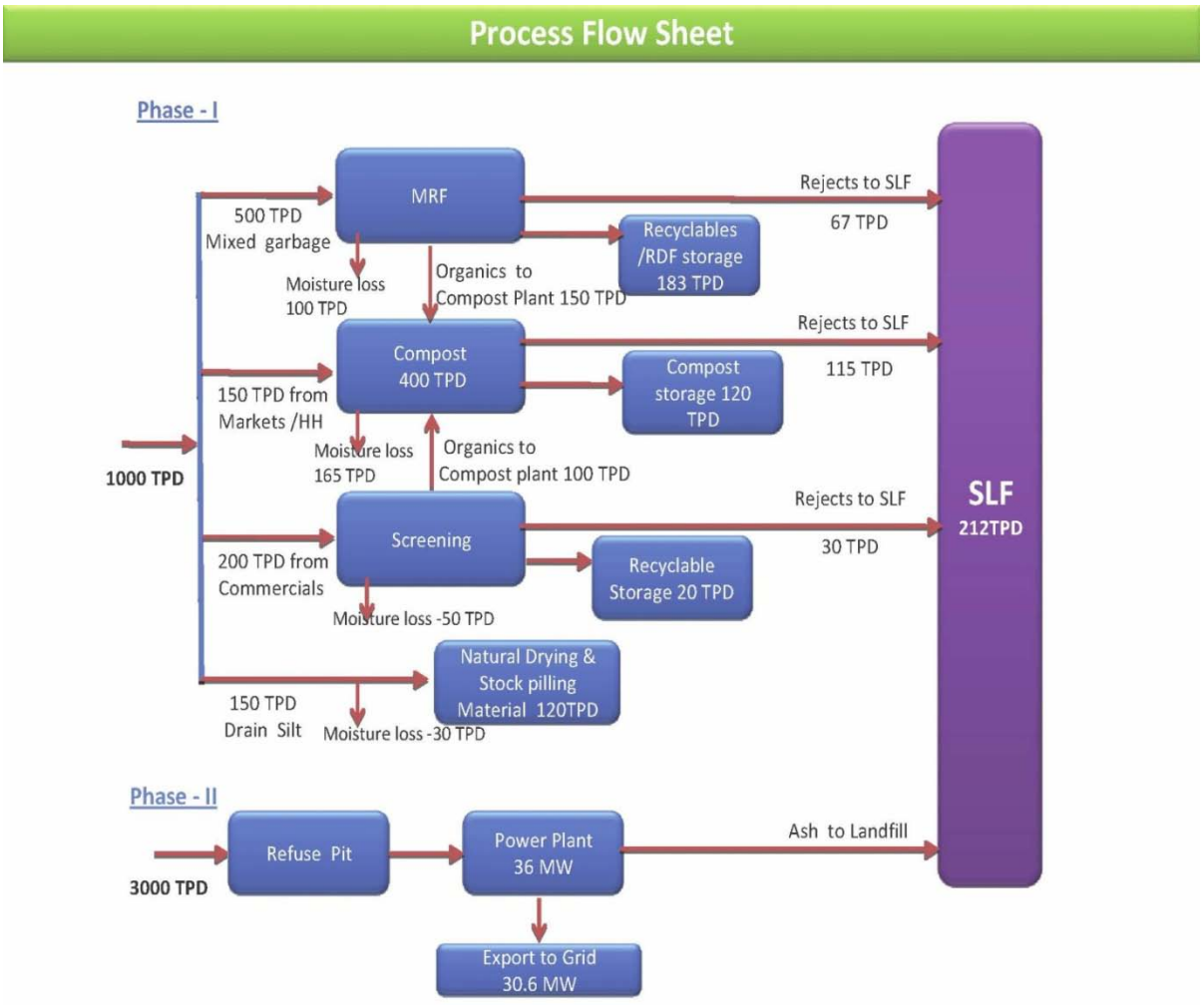


Figure – E 6: Material Balance of MSW

Material Recovery Facility

A materials recovery facility (MRF) accepts materials, whether source separated or mixed, and separates processes and stores them for later use as raw materials for remanufacturing and reprocessing. MRFs may be high and low technology facilities; the main function of the MRF is to maximize the quantity of recyclables processed, while producing materials that will generate the highest possible revenues in the market. MRFs can also function to process wastes into a feedstock for biological conversion or into a fuel source for the production of energy. Although these waste management options of chemical transformation of wastes through combustion in conjunction with energy recovery and biological transformation in the form of aerobic and anaerobic composting are viable and proven technologies.

MRFs serve as an intermediate processing step between the collection of recyclable materials from waste generators and the sale of recyclable materials to markets for use in making new products. There are basically four components of a MRF facility: sorting, processing, storage, and load-out. These activities promote efficient and effective operation of a recycling program. For the purpose of the project MRF is the first step for mixed waste processing prior to Composting and RDF facility.

a. Screening and Sorting

In order to augment the segregation process further to the source segregation at generator level, it is proposed to recover material at the site before processing of waste for ensuring high productivity of the processes. At every unit, an unloading ramp with MS Hopper with a moving bottom will be provided. Material from hopper will be fed to a rotary cage drum with 100 mm screen through a feeding conveyor. Over size rejects from the cage drum will be discharged to a slow moving sorting belt. The recyclables like plastics, glasses etc. will be picked up manually and stored in bins, below the sorting platform manually. Remaining residues will be conveyed to solar drying yard for further processing to recover RDF. But for the sorting operation on the belt, all other operations of the plant are mechanized. Magnetic separators will be deployed for separation of iron from the waste by using electro-magnet and will be sent to recyclable yard.

b. Processing

After sorting, the municipal waste has been segregated into organic, combustible and recyclable material. Post sorting the segregated materials is made to go through processes of Composting and

RDF production; while recycles are stored. Process of Compost and RDF has been described in the following sections.

c. Storage & Load-out

Once the municipal waste has been processed (in the form of compost or RDF), the next step is storage of the processed matter and its transportation for marketing

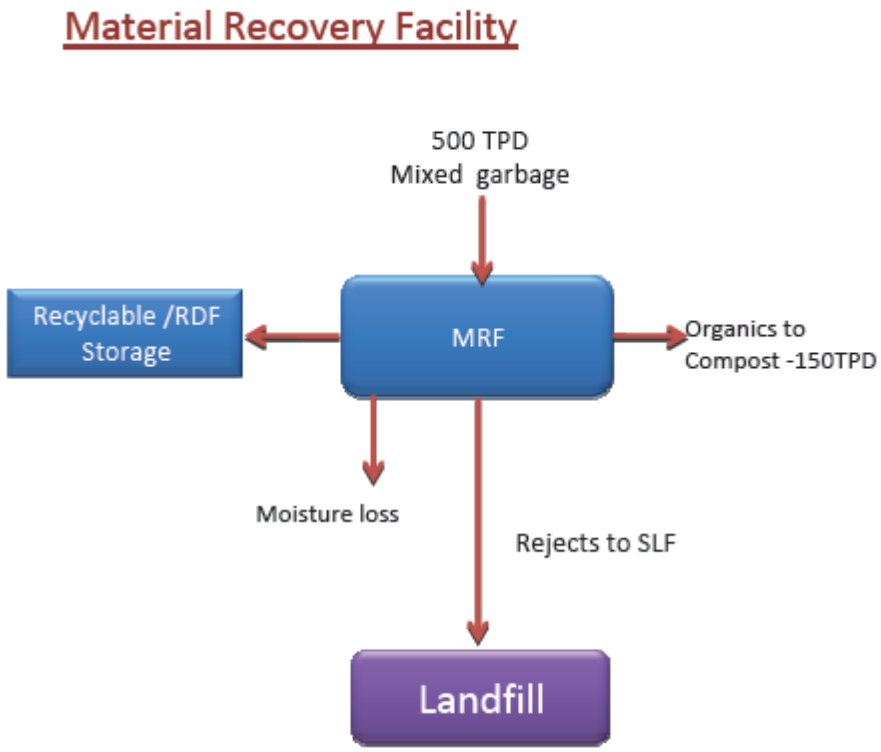


Fig- E7: Process flow of MRF

Refuse Derived Fuel (RDF)

Refuse-derived fuel (RDF) is a fuel produced by shredding and dehydrating municipal solid waste (MSW) in a converter. Therefore, the by-products of the compost plant are taken as the input to the RDF pellets manufacturing plant. It is proposed to produce about 183 TPD of RDF.

Composting

The main processing technology shall be Aerobic Composting. The organic material present in MSW will be converted in to stable mass by aerobic decomposition. Aerobic micro organisms oxidize organic compounds to carbon dioxide and oxides of nitrogen and carbon from organic compounds used as a source of energy, while nitrogen is recycled.

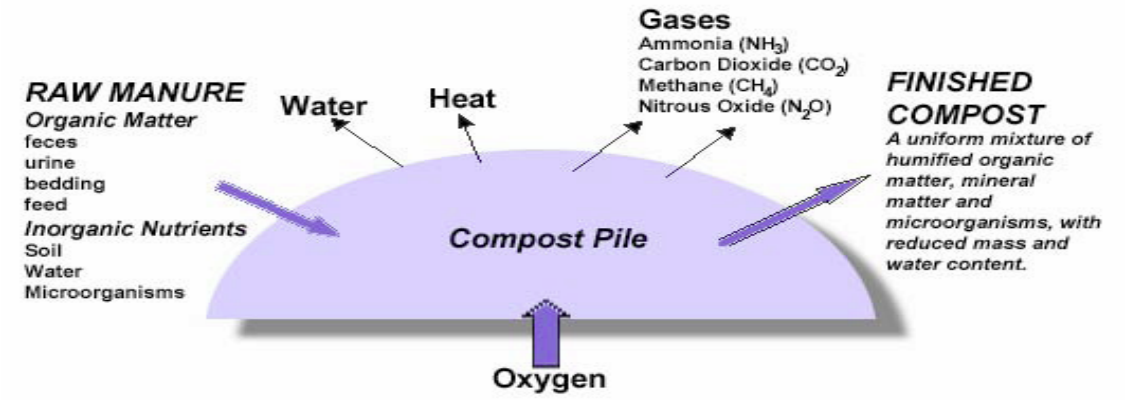


Fig E8: Aerobic Composting Process

The proposed windrow system of processing is to install one module of processing with capacity of 400 TPD. The Compost facility will process 400 TPD MSW, i.e. 150 TPD from incoming solid waste, 150 TPD from MRF, and 100 TPD from Screening section. The compost facility will have margin of design of about 20% for handling situations of increased garbage during special days of importance such as festivals, public holidays etc.

The module will have a concrete platform where windrow piling operations will be organized. Each day's receipts will be formed in to a long windrow of trapezoidal cross section. Adequate area will be provided to handle total incoming waste. The height of each windrow will be limited to 2.5 meters to ensure effective aeration. During windrow processing, care will be taken to maintain the required temp/moisture levels. An appropriate microbial culture will be applied for biodegradation. The retention period for the waste in the windrows will be 6 weeks. The windrows will be turned every week to ensure proper aerobic conditions. Each windrow will be monitored daily and corrective actions will be taken to facilitate fast and steady composting. The innoculous will be spread over the heap to avoid odor. During exothermic composting process moisture will get evaporated and volume gets reduced to around 50%.The semi digested matter is now ready for screening, and further stabilization will be accomplished in curing.

Sanitary landfill

The primary objective of land filling is the safe long-term disposal of wastes, both from health and environmental view point. Ultimate solution for Waste Disposal is an engineered Sanitary Landfill. All efforts done by way of processing and recovery of recyclables are aimed at reducing landfill burden as well as for reducing pollution potential of the wastes sent to Landfill. The typical cross-section of sanitary landfill (SLF) is shown in Figure – E 9.

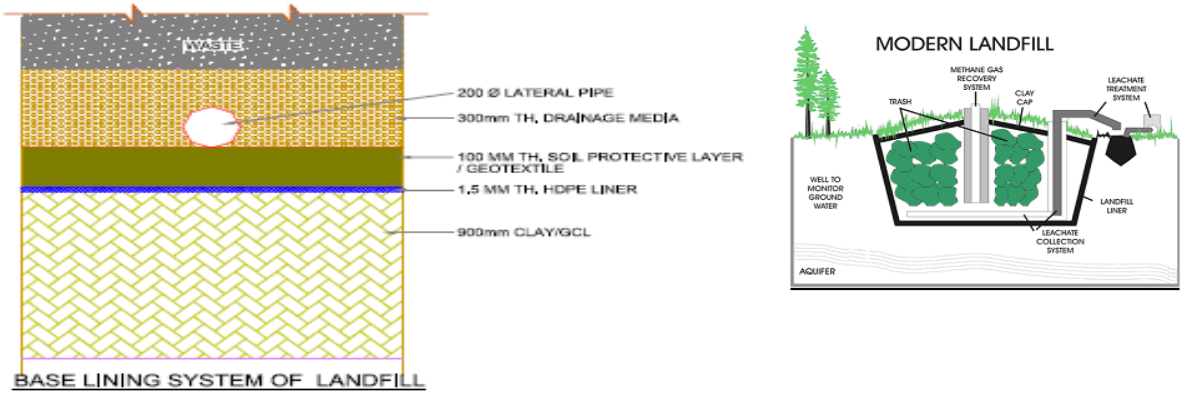


Figure – E 9 Typical Cross Section of MSW SLF

Waste-to-Energy Plant

Waste-to-energy (WtE) or energy-from-waste (EfW) in its strictest sense refers to any waste treatment that creates energy in the form of electricity or heat from a waste source that would have been disposed of in landfill. In a WTE plant, biodegradable as well as non –biodegradable components of MSW are combusted at high temperatures. The heat of combustion is used to produce steam that drives a generator of electricity. A WTE plant that provides net electricity output to utilities is equivalent to a saving of fossil fuel such as oil/coal/etc. .

The current proposal is to establish an Integrated MSW management facility encompassing energy recovery in addition to existing process through establishment of a 36 MW power plant having MSW processing capacity 3000 TPD and ash to be sent to Landfill is less than 20% of Input waste. Plant

Load factor achievable is considered as 80% from second year onwards. The power plant constitutes of 5 Boilers, 42 bar and 410 °C, of capacity (Steam Output) 37.5 TPH. 5 multistage, impulse, nozzle governed Steam Turbine Generators are to be installed having bleed cum extraction condensing of Min. 7.5 MW nominal capacity. An Air Cooled Condenser is considered in lieu of WCC in this proposal since water is not available at this site. The Total Power Generation – Installed is 315.36 MU and the In – House Consumption – MU (15%) is 47.3 MU. Net Saleable Power is 268.05 MU. The estimated regular water requirement for **phase II** is 908 KL per Day, while one-time water demand is 1117 KL per Day. The Total Project Cost is Rs. 37800 lakhs (for phase II).

Salient features of the power plant unit are mentioned below:

Table E3: Salient features of power plant facility

S No	Description	Value/Quantity
1	MSW Processing Capacity	3000 TPD
2	Inert to be sent to Landfill	< 20% of Input waste
3	Power Plant Installed Capacity	36 MW
4	Plant Load factor (from II year)	80%
5	Number of Boilers to be installed	5 nos
6	Capacity of Each Boiler (Steam Output)	37.5 TPH
7	Operating Parameters of Boilers	42 bar and 410 Deg C
8	Number of Steam Turbine Generators	5
9	Type & Capacity of STG	Multistage, impulse, nozzle governed bleed cum extraction condensing of Min. 7.5 MW nominal capacity

10	Condenser	ACC
11	Total Power Generation (MU) – Installed	315.36 MU
12	In –House Consumption – MU (15%)	47.3 MU
13	Net Saleable Power (MU)	268.05 MU
14	Water Requirement in KL/day	1500 KL per Day
15	Total Project Cost (Rs lakhs)	Rs. 37800 lakhs

Water Management

The source of water will be from Delhi Jal Board for Phase- I & II and aggregate water requirement for the Phase-I have been estimated to be about 155.2 /day, whereas for Phase-II demand is 1117 /day. The water balance table is given below.

Table – E 3: Regular Water Requirement

S. No.	Source	Quantity m^3/day
PHASE - I		
1.	Drinking and cooking	5.2
2.	Other domestic purposes	10
TOTAL		**15.2**
PHASE-II		
1.	WTP (for diverting treated water to RO-DM plant and cooling tower)	892
2.	Domestic Use	16
TOTAL		**908**

One time water demand for Phase-I will be 155.2 m^3 per day for domestic and industrial (composting & RDF) and green-belt purpose. However, in view of recycling of the entire treated wastewater in green-belt, the regular water demand is 15.2 m^3/day. For Phase-II one-time water demand comes out to be 1117 m^3/day for domestic and industrial (boiler water requirement, cooling tower, ash quenching), the waste-water treated is re-used for

ash-quenching hence reducing the regular demand to 908 m^3/day. The water balance for Phase- I and Phase-II is presented in the following Figures E10 & E11.

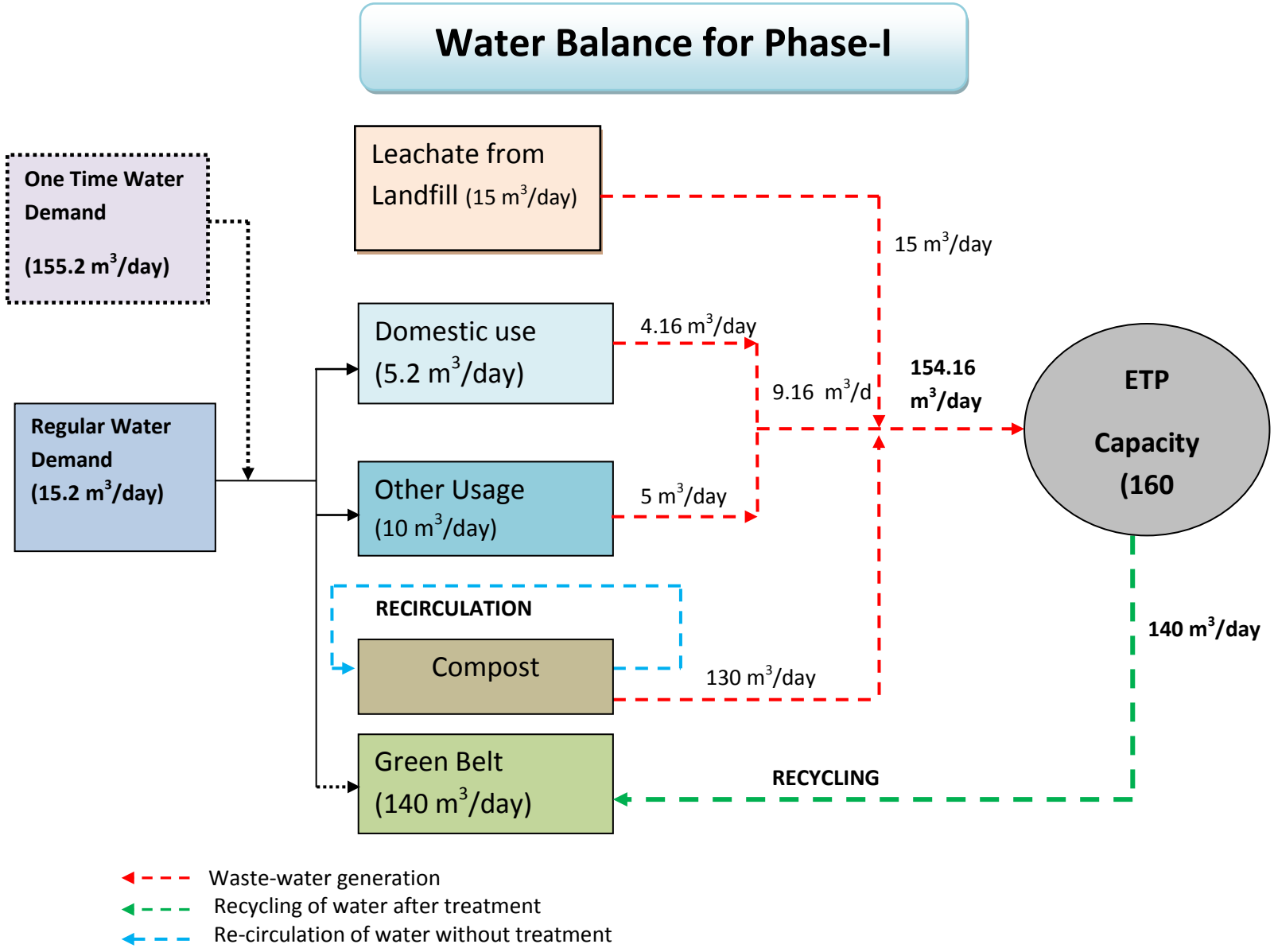


Fig: E10 Water Balance for Phase-I

Water Balance for Phase-II

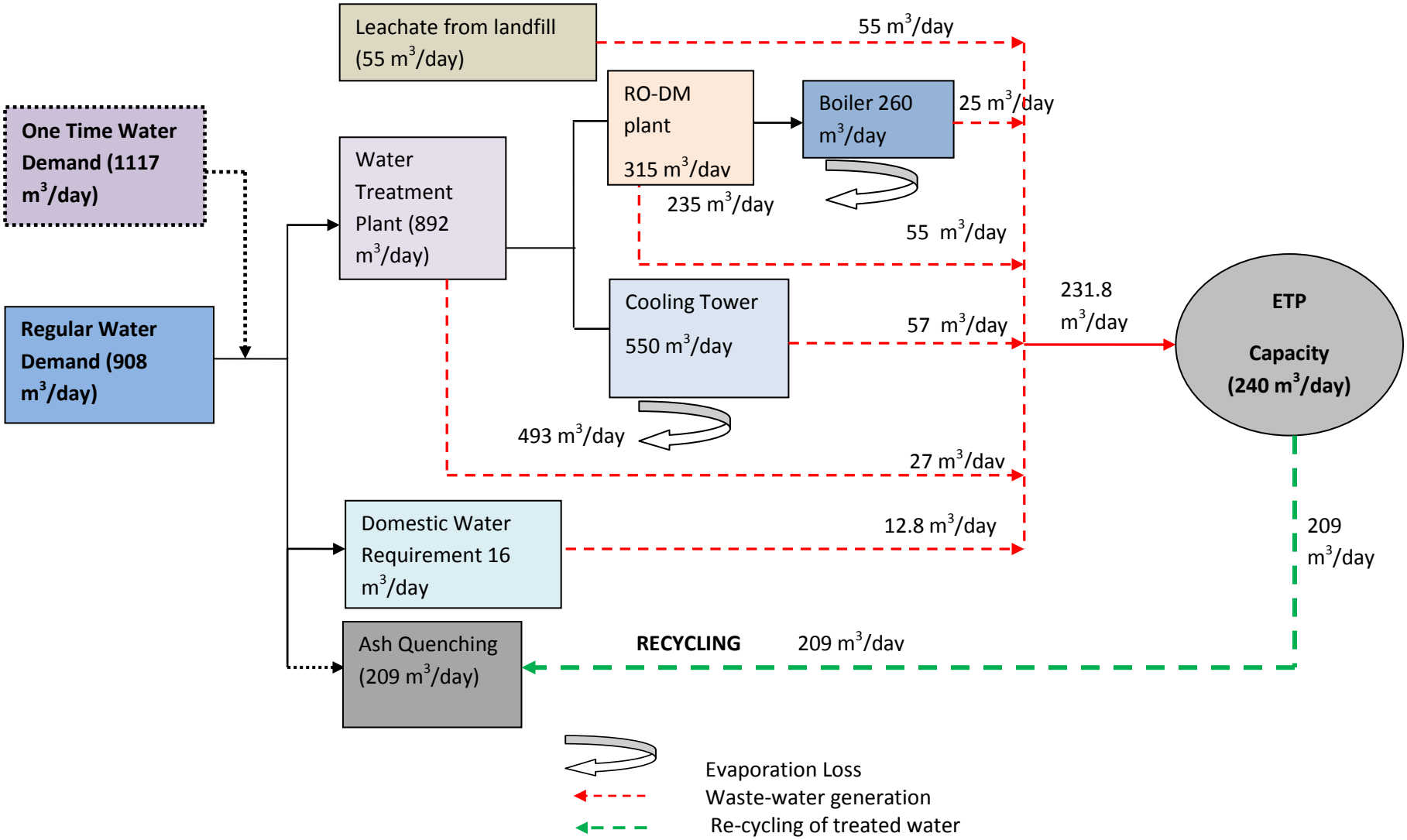


Fig: E11 Water Balance for Phase-II

Waste-water Management

The wastewater generates from the compost & landfill is known as Leachate. In addition, the wastewater is also generated from Domestic sources and other sources (boiler blowdown, cooling-tower blowdown, treatment plants). Though only the inert are going to be disposed of in the landfill however, as a precautionary measure, the wastewater generated from the landfill operation will be taken to the Effluent Treatment Plant. Quantity of waste-water/leachate produced from Phase-I&II have been tabulated below:

Table-E4: waste-water generation from Phase-I and Phase-II

S. No.	Source	Quantity m^3/day
PHASE - I		
1.	Drinking and cooking	4.16
2.	Other domestic uses	5
3.	Leachate from Landfill	15
4.	Leachate from Compost	130
TOTAL		154.16
PHASE - II		
1.	Boiler	25
2.	Cooling Tower	57
3.	WTP	27
4.	Domestic purpose	12.8
5.	Leachate from Landfill	55
6.	RO-DM plant	55
TOTAL		231.8

Phase-I:

Waste water will be generated from the following sources:

- Leachate from Landfill. Though only the inert are going to be disposed of in the landfill however, as a precautionary measure, the wastewater generated from the landfill operation will be taken to the Effluent Treatment Plant.
- Leachate from compost windrows.

- Waste water from Domestic Demand.
- Waste water from Other usage

In order to provide effective treatment, a two stage biological treatment has been suggested for the leachate treatment. In the first stage anaerobic treatment system followed by aerobic treatment activated sludge process in extended mode has been provided. The leachate and other wastewater going to ETP of Phase-I has been estimated to be about 154.16 m^3 per day. However, on the safer side, the Effluent Treatment Plant (ETP) for Phase-I has been designed for 160 m^3 per day. The detailed design criteria along with the treatment scheme are discussed in the following section.

Design criteria for leachate treatment

Design information

Waste water Generation	: 154.16 m^3/day
Design flow	: 160 m^3/day
Type of ETP	: Activated sludge
Operating Hours	: 24

PHASE – II:

Waste water will be generated from the following sources:

- Leachate from Landfill. Though only the ash is going to be disposed off in the landfill however, as a precautionary measure, the wastewater generated from the landfill operation will be taken to the Effluent Treatment Plant.
- Waste water from Water Treatment Plant.
- Waste water from RO/DM plant.
- Blow down water from Boiler & Cooling tower
- Waste water from Domestic Demand.

Similar to Phase - I, a two stage biological treatment has been suggested for the Effluent treatment. In the first stage anaerobic treatment system followed by aerobic treatment activated sludge process in extended mode has been provided. The disinfection will be carried out with the help of UV treatment. The leachate and other wastewater going to ETP of Phase-II has been estimated to be about 231.8 m^3 per day. However, on the safer side, the Effluent Treatment Plant (ETP) for Phase-II

has been designed for 240 m^3 per day. The detailed design criteria along with the treatment scheme are discussed in the following section.

Design criteria for Effluent Treatment Plant (PHASE – II)

Design information

Waste water Generation : 231.8 m^3/day

Design flow : 240 m^3/day

Type of ETP : Activated sludge

Operating Hours : 24

EFFLUENT QUALITY FOR PHASE – I & II:

The following effluent quality is considered for designing the Wastewater Treatment plant

Table E5 : Raw water quality

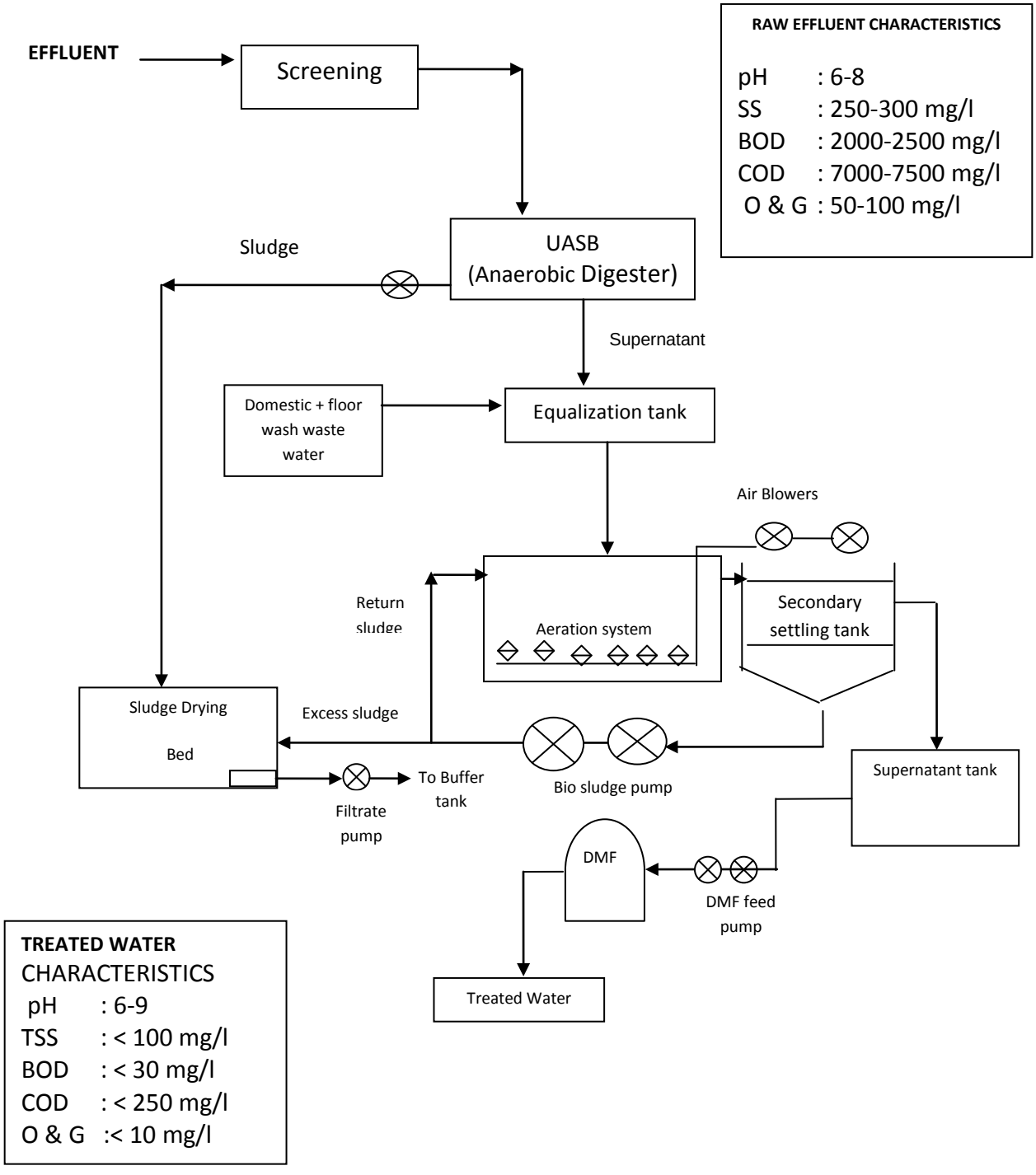
S.No.	Parameters	Units	Value
1	pH		6.0 – 9.0
2	Suspended Solids (SS)	mg/l	350
3	Biological Oxygen Demand (BOD)@27^0C	mg/l	2500
4	Chemical Oxygen Demand (COD)	mg/l	7500
5	Oil & grease	mg/l	50-100

Table E6: Treated water quality

S. No.	Parameters	Units	Value
1	pH		6-9
2	Suspended Solids (SS)	mg/l	< 100
3	Biological Oxygen Demand (BOD)@ 27^0C	mg/l	< 30
4	Chemical Oxygen Demand (COD)	mg/l	< 250
5	Oil & grease	mg/l	<10

The process flow of Leachate treatment is given in Figure – E 12.

Figure – E 12: Process Flow Leachate Treatment System



Environmental Impact Assessment

The objective of the present study is to assess environmental impacts due to proposed Integrated MSW Management Facility at Narela – Bawana Notified site comprising of Compost Plant (560 TPD), RDF plant (400 TPD) and a Landfill (192 TPD) at village Narela near Narela – Bawana Road. The current environmental quality status around the identified project site represents the baseline status for the proposed project. The monitoring carried out at various points is shown in Figure12

Figure – E 12: Monitoring Locations

The summary of results obtained after site specific monitoring for post monsoon season is presented in tables E6:a to f; below

Table E7 (a): Air Results

SUMMARY OF AIR MONITORING RESULTS							Standards
	Locations						
Parameters	AQ1	AQ2	AQ3	AQ4	AQ5	AQ6	
SPM	334	423	374	377	358	349	200
RSPM	310	218	125	179	221	209	100
NOx	29	46	25	43	41	24	80
SO2	12	13.5	12	13	12	10	80
CO	2330	1165	2330	1165	2330	1165	2000

CH4	1879	1800	1918	1896	1895	ND	-
HC	4.6	4.68	ND	5.58	4.3	ND	-

Table E7 (b): Noise Results

SUMMARY OF NOISE MONITORING RESULTS				
Location	Day Time		Night Time	
	Leq dB (A)	Limit Leq dB (A)	Leq dB (A)	Limit Leq dB (A)
NQ1	65.56	65	58.59	55
NQ2	69.91	65	58.69	55
NQ3	68.39	65	59.27	55
NQ4	69.93	65	59.86	55
NQ5	63.87	65	58.13	55

Table E7 (c): Surface and Ground Water Results

S.No.	Test Parameters	Unit	RESULT					Permissible limit in the absence of alternate source as per IS: 10500
			SW1	SW2	SW3	SW4	SW5	
1	Turbidity	NTU	8.4	9.7	4.8	7.8	8.9	10
2	pH	-	7.64	8.08	7.99	7.19	7.09	6.5-8.5
3	Temperature	(^{0}c)	23	23	23	23	22	NS
4	Total Suspended	mg/L	72	130	34	150	63	NS
5	Total	mg/L	332	148	104	576	412	600
6	Chloride	mg/L	307.27	202.15	11.12	731.78	363.87	1000
7	Fluoride(asF)	mg/L	1.36	1.46	0.24	1.35	0.5	1.5
8	Nitrate (as NO_3)	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	45
9	Phosphate (as P)	mg/L	5.57	0.52	<0.05	1.17	2.77	NS
10	Lead as Pb	mg/L	ND	ND	ND	ND	ND	0.05
11	Sulphate(as SO_4)	mg/L	176	118.5	36	286	213	400
12	Cadmium as Cd	mg/L	ND	ND	ND	ND	ND	0.01
13	Calcium	mg/L	64	28.8	30.42	113.6	100.8	200
14	Magnesium	mg/L	41.79	18.47	6.8	95.26	38.88	100
15	Sodium as Na	mg/L	198	179	10.7	158	126	0

16	Potasium as k	mg/L	42.2	28.1	1.7	14	27.1	N.S.
17	Zinc as Zn	mg/L	0.023	0.053	0.045	0.385	ND	15
18	Total Nitrogen (as	mg/L	41.16	2.24	11.48	8.4	31.08	NS
19	Total Phosphorus	mg/L	13.53	1.32	<0.05	2.8	6.64	NS
20	Total Alkalinity	mg/L	416	248	84	436	356	600
21	Phenolic	mg/L	ND	ND	ND	ND	ND	NS
22	Oil & Grease	mg/L	7	4	<1.0	17	4	NS
23	BOD (3 days ,270C)	mg/L	35	4.5	<2.0	61	17.5	NS
24	COD	mg/L	89.6	96	6.4	112	51.2	NS
25	Total Coliform	MPN/100ml	1600	900	240	900	ND	0

S. No.	Test Parameters	Unit	RESULT					Permissible limit in the absence of alternate source as per IS: 10500
			GW1	GW 2	GW3	GW4	G W5	
1	Turbidity	NTU	<1.0	2.8	<1.0	2.9	1.3	10
2	pH	-	7.11	7.28	6.95	7.49	7.1	6.5-8.5
3	Temperature	(^{0}c)	22	21	22	21	21	NS
4	Total Suspended	mg/L	3.67	32	4	36.5	19	NS
5	Total Hardness (CaCO3)	mg/L	236	580	464	368	560	600
6	Chloride	mg/L	36.39	909.	392.17	341.2	574	1000
7	Fluoride(as F)	mg/L	1.55	1.78	1.2	0.64	0.8	1.5
8	Nitrate (as NO_3)	mg/L	<1.0	<1.0	<1.0	<0.1	21.	45
9	Phosphate (as P)	mg/L	<0.01	0.32	<0.01	ND	<0.	NS
10	Lead (as Pb)	mg/L	ND	ND	ND	ND	ND	0.05
11	Sulphate(as SO_4)	mg/L	78.2	267	107.5	172.5	292	400
12	Cadmium as Cd	mg/L	ND	ND	ND	ND	ND	0.01
13	Calcium	mg/L	56	155.	188.8	102.4	172	200
14	Magnesium	mg/L	23.33	46.6	95.26	27.22	31.	100
15	Sodium (as Na)	mg/L	32.1	182	164	133	162	0

16	Potasium as k	mg/L	2.9	4.9	16.1	3	4.6	N.S.
17	Zinc as Zn	mg/L	ND	0.04	0.808	0.02	2.7	15
18	Total Nitrogen (as N)	mg/L	10.92	9.24	9.8	1.96	1.96	NS
19	Total Phosphorus	mg/L	<0.01	0.818	<0.01	1.5	<0.01	NS
20	Total Alkalinity	mg/L	212	400	380	240	268	600
21	Phenolic	mg/L	ND	ND	ND	ND	ND	NS
22	Oil & Grease	mg/L	<1.0	<1.0	<1.0	<0.1	<1.0	NS
23	BOD (3 days ,270C)	mg/L	<2.0	6	3	<2.0	4.5	NS
24	COD	mg/L	3.2	16	9.6	6.4	12.	NS
25	Total Coliform	CFU/100ml	3.2	5	25	45	12.	0

Table E7 (d): Soil Results

SUMMARY OF SOIL MONITORING RESULTS						
SN	Parameters	Unit	SQ1	SQ2	SQ3	SQ4
1	pH (at 25^{o}C) (1:5)		8.1	8.77	7.99	7.96
2	Texture					
	Sand	%	65.65	52.69	58.25	53.59
	Clay	%	15.24	16.95	18.25	21.76
	Silt	%	19.11	30.36	23.5	24.65
3	Total phosphorous	As P_2O_5	0.59	0.2	0.62	0.31
4	Sodium	as Na, mg/kg	479.54	522.27	344.86	303.93
5	Total Sodium	as Na_2O,	17414.95	18128.53	14835.96	30387.29
6	Total Potassium	as K_2O, mg/kg	21228.04	20037.15	25036.54	22229.99
7	Nitrate	as N, mg/kg	9.79	5.8	2.66	7.26
8	Total Sulphate	as So_4, mg/kg	692.26	751.67	147.39	3496.99
9	Chloride	as Cl, mg/kg	1716.75	202.05	40.13	6721.12
10	Zinc	as Zn, mg/kg	79.57	58.86	78.8	83.28
11	Cadmium	as Cd, mg/kg	ND	ND	ND	ND

12	Lead	as Pb, mg/kg	27.59	27.48	12.89	12.93
13	Permeability	mm/sec	$9.0x10^{-3}$	$7.5x10^{-3}$	$8.2x10^{-3}$	$7.1x10^{-3}$

Table E7 (e): Weather monitoring Results

SUMMARY OF WEATHER MONITORING RESULTS								
MONTH	TEMPERATURE ^{0}C		RAINFALL	RELATIVE HUMIDITY		WIND DIRECTION (FROM)	WIND SPEED (KM/HR)	Day Condition
	Maximum	Minimum	(mm)	0830 IST	1730 IST	Average	Average	
January	21.7	8.9	5.8	91	55	Calm/West	6.9	Haze, Fog
February	26.1	11.2	4.7	83	42	WNW	8.0	Haze, Fog
March	31.4	16.0	9.6	70	33	WNW	7.1	Haze
April	36.9	22.2	3.2	42	23	WNW	10.6	Haze, widespread dust
May	40.1	25.9	65.8	51	34	NW	6.8	Haze, Partly Cloudy
June	40.9	28.2	19.0	51	33	NW	10.7	Haze, Scattered Clouds
July	35.8	28.0	161.2	73	57	SE	5.9	Haze, Cloudy
August	35.4	27.2	216.6	77	66	WSW	7.8	Haze
September	34.1	25.1	191.2	80	61	NW	2.8	Haze
October	33.0	19.2	5.4	67	43	WNW	5.5	Smoke
November	NA	NA	NA	NA	NA	West	NA	Smoke

December	NA	NA	NA	NA	NA	W/WNW	NA	Smoke, Shallow Fog

Table E7 (f): Traffic Density Results

SUMMARY OF TRAFFIC DENSITY RESULTS										
	1		2		3		4		5	
	Prahladpur – Shahbad	Shahbad to Prahladpur	Poothkurd– Bawana	Bawana to Poothkurd	Metro Vihar – Bawana	Bawana to Metro Vihar	Vardhman plaza road– Sanoth village	Sanoth to Vardhman plaza rd.	Alipur to Singhu border	Singur to Alipur
Average, PCU/hr	182	179	221	245	141	136	51	40	955	141
At 9:00 to 11:00 (PCU/hr)	273	223	220	177	113	93	40	37	906	204
At 18:00 to 22:00 (PCU/hr)	207	188	413	410	219	187	74	56	1193	128

Following table – E7 describes the baseline scenario of the project site. Baseline information includes meteorological status; air, water, soil quality; noise levels, fauna-flora status, and traffic density. The baseline study was carried out by collection of both primary as well as secondary data.

Table – E8: Baseline environmental status

Parameters	Baseline status
Meteorology	A micro-meteorological station was set-up at project site during the study period (i.e. September to December). Following parameters were recorded Max. Av. Temperature: 3 4 ˚C Min. Av. Temperature: 18 ˚C Av. wind speed : 2m/s Predominant wind direction: W & WNW
Ambient Air Quality	Ambient air quality was monitored at 6 locations within a 10 km radius of the project site. The observed SPM levels were in range of 310 to 460 µg/m3, while RSPM was in range of 130 to 240 µg/m3. SO_2 (in range of 7-20 µg/m3) and NOx (18-52 µg/m3) levels came out to be well below NAAQS (i.e. 80 µg/m_3 for both SO_2 & NOx). CO levels are well below NAAQS at 3 locations. HC levels exceeds at one location due to illegal burning of tyres.
Noise Levels	Noise monitoring was carried out at five locations. The results at all the 5 locations exceed NAAQSRN only by 3-5dB.

Water Quality	5 Groundwater samples and 5 surface water samples were analyzed. Surface and Groundwater has been found to be of average quality with most of the parameters under permissible limits as per IS: 10500 (in the absence of an alternate source). Due to highly saline soil and contamination of water with waste-water respectively, the concentration of turbidity, total hardness, sodium and Coliform count are exceeding the permissible standards. Among Groundwater total hardness, chlorides, fluorides, sodium and Coliform count are exceeding the permissible limits. This may be due to high soil salinity, improper handling during sampling and over exploitation.
Soil Quality	Physiography of the project area within 10 km radius consists of alluvium soil extending into the Yamuna flood Plain. Majority of the areas is covered by fine to coarse loamy soils with different levels of moisture retention capacity. Soil samples from 4 locations were taken. Sand proportion in the samples was observed to vary from 52-65%. Soil of the area is slightly basic with a pH range of 7. 9 to 8.7. Permeability tests show that permeability of the soil is good.
Biological Environment	Delhi falls under the biogeography province 4A- Semi arid Punjab plains. There is no wildlife sanctuary and park within study area. No hilly area falls within study area. Except Western Yamuna Canal, all water bodies are more than 2.9 km away from the proposed site. Western Yamuna Canal passes through the Western side and is 0.89 km away from the centre of the proposed site. A small open babul forest is located 1.73 km away from the proposed site. Major settlements are located about 1 km from the proposed site. No threatened or endangered plant or animal species are known to exist in and around the site.

Socio-economy	The total population in the study area is 3, 01,500 with 54% males and 46% females. 24% of the total population is schedule caste. The female to male ratio is 0.876. Narela has the highest population followed by Mundaka and Bawana. The occupational pattern in the study area shows that majority of population falls in "others" category followed by farmers, landless labourers and small business. The majority of people interviewed during the survey indicated that the construction and operation of "Integrated MSW Management Facility" in the area will not affect their daily lives.

Anticipated Environmental impacts and mitigation measures

Analysis of Impacts of three phases of the project; pre-construction, construction and operational phase; on Air, Water, Noise, Ecology and Social impacts was carried out and mitigation measures to reduce the impacts have been suggested. Each is discussed briefly below:

a. Air Environment

Air environment including AAQ and odour generation due to the project was accounted. The major sources of pollution during three phases are entrainment of construction material, transportation flue gases, and odour due to composting and landfill activities. Measures taken to reduce the impacts are; water sprinkling and tarpaulin covering to reduce entrainment, strategic planning for transportation, and mixing of innocuous spread over heap, regular puncturing of compost windrows, etc…

b. Water Environment

Water pollution of surface and ground-water might occur due to run-offs and leaching down of leachate generated. Measures have been suggested to avoid water pollution. Landfill will be lined with clay and synthetic liners to avoid leaching, and leachate from the landfill will be collected and treated. Industrial demand of water will be reduced by re-using the waste-water treated in ETP for compost and RDF facilities.

c. Noise

Noise pollution will be resulted from transportation and DG sets. To reduce noise pollution, high-grade machinery will be used, there will be no noise-causing activity during night times

and DG sets will either be silent or will be acoustic enclosed.

d. Ecology of the Area

Site clearing does not seem to impact the ecology of the area to great extent, since there are no endemic or endangered species in the area. Additionally development of green belt with relevant species will have positive impact on the overall environmental conditions.

e. Social Impacts

Social impacts envisaged are all positive, as the site does not involve any re-location, the project provides employment opportunities to the local people, it establishes infrastructure and amenities, provides better municipal solid waste management facilities, project generates compost and alternate fuel (RDF), and recovers material as raw material for industries.

Impact Analysis

The impacts of various activities of development of the Integrated Waste Management Facility (IWMF) have been assessed on various environmental components during construction and operation of the facility. The impact matrix is shown in the following Tables – E 9 & E 10.

The various impacts of the project activities have been judged for various parameters to assess the suitability of project. The parameters considered and the weightage with the reasons is given in a Tabular form. The impacts have been assessed on the scale of (-) 5 to (+) 5.

The impact of various aspects of the project activity on various environmental components i.e. Land-use, Environmental pollution, Aesthetic environment & Socio-economic have been summarized in a form of matrix & is presented in Table-E8 & E9.

Using a MATRIX System having two-dimensional phenomena with its impact magnitude makes the impact potentials. All the impacts are confined within the study region of 10 km radius from the proposed site. This also incorporates the influence of the Environmental Management Plan (EMP) also i.e. impacts predicted for both, with & without EMP. The

MATRIX System developed for the purpose of quantitative evaluation of the environmental impacts assumes the following:

The notations used in preparing the matrix are as follows:

(+) Sign indicates Beneficial Impact

(-) Sign indicates Adverse Impact

The notation '0' signifies no impact of the activity.

A- Weightage without EMP

B- Weightage with EMP

Table – E9: Environmental Impact Assessment of the Project without Mitigation Measures

S.No.	Name of Activity/ Target	Construction Phase		Operation phase							
				Air Emission		Effluent Disposal		Noise pollution		Overall Project benefits	
		A	B	A	B	A	B	A	B	A	B
1	Land-use: - Natural Vegetation	-1	+2	-1	0	-1	0	0	0	0	+3
	- Crops	0	0	0	0	0	0	0	0	0	0
	- Forest & Species Diversity	-1	0	0	0	0	0	0	0	0	0
2	Environmental Pollution - Water Environment	-4	+2	0	0	-5	-1	0	0	0	0
	- Air Environment	-3	-1	-4	-2	0	0	0	0	0	0
	- Land Environment	-1	0	0	0	-3	-1	0	0	0	0
	- Noise Environment	-2	0	0	0	0	0	-1	0	0	0
3	Aesthetic Environment: - Visual Air/ Water Quality - Odour - Landscape	0	0	-2	-1	-2	0	0	0	0	0
		-4	-1	-2	-1	-2	0	0	0	0	0
		-1	+3	0	0	-1	0	0	0	0	+3
4	Socio Economic Environment - Employment Opportunities & Economic Development - Human Health	0	+2	0	0	0	0	0	0	0	+4
		-1	0	-3	+1	-4	0	+2	0	0	+2
	- Basic Amenities	+2	+2	0	0	-1	+1	0	0	0	+3

Table – E 10: Summary of Environmental Impact Assessment of the Project with Mitigation Measures

S.No.	Parameter	Construction Phase		Operation Phase		Overall Project benefits	
		Without EMP	With EMP	Without EMP	With EMP	Without EMP	With EMP
1	Land Use	-2	+2	-2	0	0	+3
2	Environmental Pollution	-10	+1	-12	-4	0	0
3	Aesthetic Environment	-5	+2	0	+1	0	+3
4	Socio Economic Environment	+1	+4	-6	+2	0	+9
	Total	**-16**	**+9**	**-20**	**-1**	**0**	**+15**

It may be noted that the Environmental Clearance is sought for installation of Integrated MSW management Facility. The installation of Integrated MSW management Facility will have no negative impact as it will only lead to management of Municipal Solid Waste, Preparation of manure in the form of compost, preparation of Refuse Derived Fuels (RDF), recycling of water etc, thus conserving the natural resources and improving the quality of the environment and lifestyle of the people.

The proposed project will be beneficial to the development of state in general & local population in particular. The project will also be able to provide source of segregated raw material for the recycling industries. It will generate employment not only in the construction phase but also help in formalizing the informal recyclers and rag-pickers, and give them a permanent source of income.

The project aims at improving the solid waste infrastructure of the entire city and also has indirect positive impacts on ecology by development of a green belt and rain water harvesting. It also promotes sustainable agriculture by producing compost.

The Project will have overall impact by the development of the area in form of ancillary works like transportation, Supply chain, restaurant, etc. The success of the project may attract other states to develop similar facilities. It will lead to conversion of unorganized sector thus leading to overall development of quality of life of people of the state.

The intangible benefit will be to the Environment as all the four zones from which waste is collected are scattered and individually cannot effort to put up an Integrated MSW management Facility thus polluting the water resources, of the area as well as air and soil.

ENVIRONMENTAL MANAGEMENT PLAN

Environment Management Plan (EMP) is a site specific plan developed to ensure that the project is implemented in an environmentally sustainable manner. EMP provides measures to be taken to avoid or minimize the environmental impacts by the project activities.

Table: E11: showing mitigation measures and action plans for the EMP

Mitigation Measures		
	Construction Phase	**Operational Phase**
Air Environment	1. Dust Control Plan: water will be sprinkled using water trucks, handheld sprays and automatic sprinkler systems 2. Idling time reduction to reduce emissions 3. Rapid On-site construction to reduce time and hence air-pollution	1. Pollution control equipment for Boiler stack will be used. These are: a. Electro-static precipitator b. Bag-filters 2. Activities will be carried out in covered area with proper ventilation, under negative pressure 3. Waste will be unloaded into two pits 4. Control of odor by spraying herbal insecticides 5. Pollution control equipment for HAG used in RDF: a. Cyclones & dust-settling chamber b. Secondary shredder provided with bag-filter c. Dust collection will be carried

Noise Environment	1. Construction Equipment producing maximum noise level will be fitted with Noise Shields 2. No noise generating activity during night hours 3. Job rotation and hearing protection (like earmuffs/plugs) for workers	1. Suitable noise abatement enclosures for DG sets, turbo generator, compressors 2. Noise producing static equipment (like Blow off valves, discharge pipes, relief valves) will be equipped with silencers 3. Hearing protection (like earmuffs/plugs) for workers 4. Insulation will be provided for reducing heat loss and noise pollution 5. Green belt help abating noise
Water Environment	1. Avoid excavation during monsoon season 2. No discharge of wastewater to soil & ground-water 3. Check dams will be provided to prevent construction runoff 4. temporary soak pits and septic tanks will be constructed for latrines & community toilets 5. Leak-proof containers to be used for oil & grease storage & transportation 6. Stacking & loading areas will be made impervious with proper garland drains	1. Storm water management plan: a. Regular inspection and cleaning of storm drains. b. Cover waste storage areas. c. Avoid application of pesticides and herbicides before wet season. d. Secondary containment and dykes in fuel/oil storage facilities. e. Conducting routine inspections to ensure cleanliness. f. Preparation of spill response plans, particularly for fuel and oil storage areas. g. Good housekeeping in the above areas. 2. Leachate management: a. Leachate will be collected from the compost windrows b. Waste water from Floor Wash c. Waste water from Domestic Demand 3. Two stage biological treatment: a. First Stage: anaerobic treatment system followed by aerobic treatment activated sludge process in extended mode b. Second phase will involve UV

		treatment
Ecological Environment		1. Green belt development for an area of 33%
Socio-economic Environment		1. Jobs to local workers 2. Training to rag-pickers & workers

ENVIRONMENTAL MONITORING PLAN

Environmental monitoring is carried out to evaluate the effectiveness of implementation of an EMP. The frequency of monitoring shall be as per indicated below or in consultation with Independent Engineer. Number of samples will be in accordance with the standards prescribed /followed for these kinds of projects drawn on annual basis. The monitoring protocol and location selection will have to done carefully. A suggested monitoring protocol, based on the predicted impacts, is given in following Tables E:12-14

Table E 12: Leachate and water quality monitoring.

Sl. No.	Description	Frequency
	During Active Operations Period	
1	Leachate quantity	Daily
2	Leachate quality	Weekly
3	Ground water quality – within the site	Once in 3 months
4	Ground water quality – outside the site	Once in 6 months
5	Air Quality	Once every 2 months

Table E 13:

Air Quality Monitoring

Sl. No.	Description	Acceptable Levels
1	Sulphur dioxide	120 µg/m^3 (24 hours)
2	Suspended Particulate Matter	500 µg/m^3 (24 hours)
3	Methane	Not to exceed 25% of Lower Explosive Limit (equivalent to 650 mg/m^3)
4	Ammonia daily average	0.4 mg/m^3 (24 hours)
5	Carbon monoxide	2 mg/m^3 (1 hour average) 1 mg/ m^3 (8 hour average)

Table E-14: Suggested monitoring program

Sr. No.	Type	Locations	Parameters	Period and Frequency
1	Stack emission monitoring	Stack of HAG	SO2, NOx, SPM, CO,	24-hr average every quarter.
2	Ambient Noise	Near the site Project site main gate	dB(A) levels	Hourly Day and Night time Leq levels every quarter during operation phase.
3	Waste Characterization	Rejects	Physical and Chemical composition	Annual

ENVIRONMENTAL MANAGEMENT CELL

Apart from having an Environmental Management Plan, it is also necessary to have a permanent organizational set up charged with the task of ensuring its effective implementation of mitigation measures and to conduct environmental monitoring. The major duties and responsibilities of Environmental Management Cell shall be as given below:

- To implement the environmental management plan,
- To assure regulatory compliance with all relevant rules and regulations,
- To ensure regular operation and maintenance of pollution control devices,
- To minimize environmental impacts of operations as by strict adherence to the EMP
- To initiate environmental monitoring as per approved schedule.
- Review and interpretation of monitored results and corrective measures in case monitored results are above the specified limit.
- Maintain documentation of good environmental practices and applicable environmental laws as ready reference.
- Maintain environmental related records.
- Coordination with regulatory agencies, external consultants, monitoring laboratories.

Maintain of log of public complaints and the action taken

PROJECT BENEFITS

In view of an uphill task being faced by Delhi for managing the municipal solid waste generated to the tune of about 7,000 TPD from the entire Delhi region, the proposed Integrated Waste Management Facility at Narela – Bawana site would be beneficial to the society. The present three landfill sites located at Ghazipur, Okhla and Bhalsava are already overflowing and facing the public opposition. Under these circumstances, the facility developed scientifically is a welcome step towards solving this ever increasing problem. The establishment of such Integrated Waste Management Facility in Delhi is going to benefit in many ways not only to the society but also to the government, as highlighted below.

1. Disposal of waste in an environmentally safe manner in scientifically designed facility.
2. Utilization of waste in more productive manner such as compost and as an alternative fuel and for the generation of electricity.
3. Protect the environment through contamination of surface & ground water by disposing of the minimum quantity of left over waste in the scientifically designed SLF.

4. Provide an employment to the local people to improve the socio-economic status.
5. Improving the image of capital by providing a scientific solution to the municipal wastes.

Hence the project is strongly recommended for the Establishment of Integrated Waste Management Facility at the notified Narela – Bawana site by the consultant.