

**BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH, NEW DELHI
ORIGINAL APPLICATION NO. 514/2018**

IN THE MATTER OF:-

VIVEK KAMBOJ & ANR.

APPLICANT (S)

VS.

UNION OF INDIA & ORS.

RESPONDENT (S)

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DATED: 13.02.2020

CENTRAL POLLUTION CONTROL BOARD, DELHI

February 6, 2020

STATUS REPORT ON BIO-REMEDIATION OF BANDHWARI DUMPSITE, HARYANA IN THE MATTER OF O.A NO. 514 OF 2018; TITLED Vivek Kamboj & Anr. Vs Union of India & Ors

1.0 BACKGROUND

Vide Order dated 19.11.2019 in the matter of O.A No. 514 of 2018; titled Vivek Kamboj & Anr. Applicant(s) Versus Union of India & Ors (*regarding bio mining of Bandwari dumpsite*), Hon'ble National Green Tribunal directed as follows:

Para 5: *"Though the Expert Committee constituted vide order dated 05.03.2019 required assessment of damage to the environment in monetary terms and the cost of restoration, the report did not deal with this aspect. We are informed that the said assessment is yet to be done which work stand assigned to the National Environmental Engineering Research Institute (NEERI) by the Central Pollution Control Board (CPCB). Let the same be expedited and report furnished to this Tribunal before the next date."*

Para 7: *"We are of the view that there is need to take further meaningful and prompt action by preparing an appropriate action plan and executing it so as to clear the legacy waste in shortest possible time but within six months. This timeline is being fixed in view of long time which has already gone in the process. It may be ensured that bio-remediation is carried out rather than mere mechanical separation. ----- CPCB may evaluate whether clearance of legacy is being done as per applicable guidelines and furnish a report before the next date."*

2.0 Observations: -

- a) In compliance of Para 5 of Hon'ble NGT's Order in the matter, Report on "Damage Cost Assessment due to pollution from Bandhwari MSW landfill site" as prepared by NEERI is placed at **Annexure-A**.

Damage to environment in monetary terms for Air pollution, Water pollution, Soil pollution, Climatic (GHG emissions) and Aesthetics has been taken into consideration in the report and damage cost to environment is estimated at Rs 148.46 crores. Break up of Monetary Estimation of Damages is given in following Table 1.

Table 1 : Break Up of Monetary Estimation of Damages

Environment	Estimated Damage Cost in Lakhs, INR
Air	Nil
Water	2900
Soil	31*
Climatic (for last 5 years)	7,000
Aesthetic	4,946
Total	14,846

*Soil value is not considered in total, to avoid double counting, as it based on total quantum of heavy metal from leachate which is considered in water as well.

- b) In compliance of Hon'ble NGT's Directions as per aforesaid Para 7 of Order, CPCB officials inspected Bandhwari dumpsite on 4th February 2020. An overview of the observations made during the inspection is given in Table 2. The detailed inspection report of the legacy waste management through bioremediation at this site is enclosed at **Annexure B**.

Table 2: Overview of CPCB observations during inspection of Bhandwari Dumpsite

S. No.	Name of the dumpsite	Status of legacy waste management	Capacity of waste processing (TPD)	Total quantity of waste processed from Oct,2019 to Jan,2020 (MT)	No. of trommels operational	Compliance to CPCB guidelines	Annexures of inspection report
1	Bandhwari	Under progress	600	Fresh- 2777 Legacy-1913	2	Partial	Annexure-B
				Total- 4690			

i. Stabilization of Waste: -

Waste stabilization of both fresh and legacy waste through bio-remediation is being practiced at Bandwari dumpsite. Windrow and Cone methods have been adopted for fresh and legacy waste respectively and bio culture is being sprayed over windrows and trenches to stabilize the waste prior to screening at this site.

However, fumes were being generated from stabilised fresh waste being transferred to trommel, indicating that stabilization of fresh waste was not complete.

ii. **Screening of Waste:** -

The screening of fresh as well as legacy waste is being carried out. Fresh waste is screened in one trommel having 3 screen sizes (35 mm, 16 mm and 6 mm) and legacy waste is screened through ballistic separator (screen size 35mm) and then through 6 mm screen size trommel.

As per the test report of RDF, it complies with the limits for most of the parameters including limits specified for net calorific value Chlorine, Sulphur, as specified in MoHUA Guidelines on Usages of RDF under Segregated Combustible Fraction (SCF) except moisture content (for RDF prepared from fresh waste) & Ash content (for RDF prepared from legacy waste). Test reports of RDF prepared from Legacy Waste and fresh waste is placed at **Annexure-C&D** respectively. Limits of various parameters of SCF/RDF based on the usage as specified in MoHUA Guidelines is placed at **Annexure-E**.

As per the test report of the under 6 mm fraction (**Annexure-F**), the fraction complies with the limits for all the parameters specified for Organic Compost in Schedule II of SWM Rules 2016.

iii. **Disposal of Different Fractions:** -

Presently, there is no plan for disposal of screened fractions which are being dumped on-site. It is a major issue being faced creating space constraint at site.

Proper arrangement for preparation of RDF as per MoHUA guidelines has not been made and only a blower near output of trommel has been provided. No process control measure is implemented for improving quality of RDF with respect to ash & moisture content to ensure its utilization for the intended use.

iv. The records of generation of each fraction of materials recovered from the bio-mining process is placed at **Annexure-G**. As informed, 19000 MT fresh waste has been treated through bioremediation out of which 2777 MT is screened and 20000 MT legacy waste has been bio remediated out of which only 1913

MT is screened. Remaining 34300 MT stabilized waste has not been screened and is currently dumped on site .

- v. Presently, leachate is being stored in 8 ponds and its treatment is being carried out @ 150 KLD in treatment plant based on activated sludge and Dissolved Air Flotation (DAF). A new Disc Tube Reverse Osmosis (DTRO) plant of 200 KLD treatment capacity has been made operational recently. Further as informed, another DTRO plant of 200 KLD capacity will be installed by end of February, 2020 and after operation of both DTRO plants , all leachate ponds will be cleared in 3-4 months which will reclaim approx. 5-6 acre land on which Waste-to-Energy plant (for which Environmental Clearance has been obtained in Nov,2019) will be installed.
- vi. Presently, 1900 TPD fresh waste is being dumped at the dumpsite.
- vii. Affidavit (**Annexure-H**) submitted by Commissioner, Municipal Corporation, Gurugram (MCG) was shared with CPCB in which scheduled action plan regarding installation of 12 trommels and timeframe to clear the site is mentioned. It is observed that MCG has considered 2 years' time to clear existing 27 lakh tonne legacy waste. However, 1900 TPD fresh waste which is currently being dumped at site has not been taken into consideration in the plan. At the rate of 1900 TPD, additional 14 lakh tonnes of waste shall be dumped at site in 2 years.
- viii. The bio-remediation is being carried out in the open. No shed has been provided in the bio-remediation area, in absence of which work may be hampered during rain.

Final Report

Damage cost assessment due to pollution from Bandhwari MSW landfill site, Gurugram, Haryana



For

The Central Pollution Control Board, New Delhi



CSIR- National Environmental Engineering Research Institute (NEERI)

February, 2020

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**Damage Cost assessment due to pollution from Bandhwari MSW landfill,
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1. Introduction

In current scenario, solid waste management is turning crucial due to increasing waste generation rate and complexity of handling the same. Municipal solid waste dump site possesses various adverse effect on natural environment mainly due to poor/obsolete waste handling technologies. Greenhouse gases (GHG) emissions, air & soil quality deterioration, groundwater leaching, etc are inevitable due to the illicit practices such as open burning and non-engineered dumpsites. These practices serve as breeding ground for health vectors causing severe health issues. Solid waste management rules were setup based on the waste classes namely; Hazardous waste, Municipal waste, E-waste, Plastic waste, Construction and demolition, and Biomedical waste focusing on the type of treatment and disposal to be followed without disturbing the natural environment. World Bank (2016) reported that on an average, world cities for the year 2016, produced 2.01 Billion MT of waste, resulting in a footprint of 0.74Kg per person every day. The report also stated that due to rapid urbanization and industrialization, waste generation is expected to rise by 70% from current rate (i.e., 2016 year) by the year 2050.

India roughly generates 1.43 lakhs MT of waste per day as of year 2015. Out of which 15000 MT of waste generated are plastic waste (URL 01). Only 60% of the generated waste is collected (URL 02) and the remaining is dumped following unregulated practices. PIB (2016) reported that India's waste generation is growing at 4% every year. Out of total collected waste segregated at source, 50% constitutes of organic waste, 35% as recyclable waste and remaining constitutes hazardous waste. Organic degradable waste generated from households, restaurants, etc is subjected to composting either at community level or by large scale authorized third parties. Recyclable waste constitutes of 2nd largest class consisting of paper, plastics, E-waste, etc. These are collected by third party authorized rag pickers from door to door approaches and are transported to recycling unit after segregation. Hazardous waste constitutes of industrial wastes, biomedical waste, etc are disposed into engineered landfill with suitable control strategies adopted to trap the GHG's emitted and leachate generated. In order to manage solid waste effectively, segregation at source is the first key factor to be ensured followed by advanced treatment strategy and disposal. Waste segregated in cities of Delhi, Patna, Gurgaon, Gaya, Imphal is less than 33% Times of India

(2018). Due to poor segregation at source, obsolete treatment technology, and unmanaged disposal methods adopted, natural environment and human well-being are prone to impacts. Impacts due to various waste handling process such as transportation, segregation, treatment, and disposal on environment and human benefits are evaluated on monetary basis using various approaches as to generate awareness among dwellers and policymakers to adopt strategic measures and stringent policy towards mitigation. This report focuses on evaluation of costs of damages done to environment and human well-being due to municipal solid waste dumpsite located at Bandhwari Village, Gurugram. The major purpose of calculating damage cost is not to reduce the efforts of the developmental activities that are taking place, but as a strategy amount to be kept aside for maintaining sustainability of nature due to reluctant practices in waste handling & disposal followed by ensuring safe practice of treatment in municipal dumpsite from a future perspective.

2. Objective of the study

The report focuses on following negative externalities or the third party impacts, due to waste handling and disposal techniques followed in municipal dumpsite at Bandhwari village, Gurugram.

- Damage cost due to emission of greenhouse gas (GHG) on climate change;
- Damage cost due to conventional air pollutants on human health;
- Damage cost due to percolation of leachate into soil and water;
- Aesthetic loss due to dumpsite.

3. Study area

Bandhwari municipal solid dumpsite (28.402582 N, 27.171950 E) is located at Bandhwari village, Gurugram. The dumpsite covers a total area of 30.5 acres. Fig 1 shows the solid waste dumpsite located at Bandhwari village, Gurugram. The dumpsite being operational from year 2008 and disposes the waste collected from both Gurugram and Faridabad region. The landfill is designed for 20 years life span. The daily waste generation rate for the concerned areas was estimated to be around 0.45 Kg/head/day (EIA report).

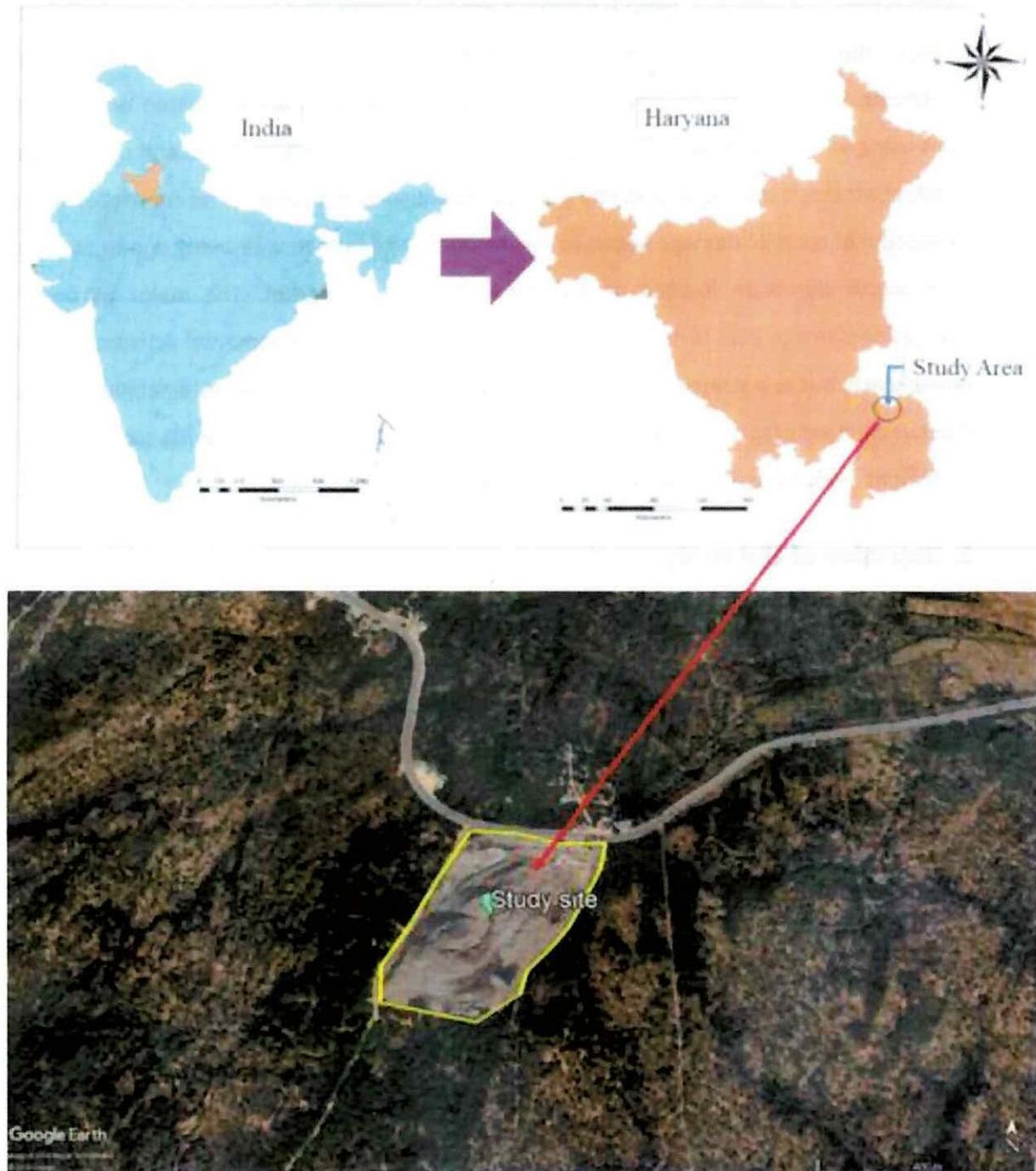


Fig 1. Solid waste dumpsite at Bhandwari village, Gurugram

4. Identification of pollutants

The methodology section focuses on developing a framework to identify, quantify and evaluate negative externalities from municipal dumpsite at Bandhwari village as shown in Figure 2. The methodology followed to quantify and evaluate damages due to impact drivers are based on onsite monitoring and several referral studies respectively. Practically, considering all the resulting negative externalities into account from the municipal dumpsite is nearly impossible. Hence available methodology, which was developed to quantify the identified impacts and valuation of the same in terms of monetary losses/diminution were considered to calculate environmental damage cost.

While identifying the overall negative externalities, the linking causalities on environment and human well-being due to the impact is determined simultaneously along with its pathway. Impact pathway methodology tracks the emission of pollutant from the source till the final impact on the receptor as shown in Figure 3. The impacts from waste collection and extends even after being dumped into the landfill. Harmful emissions due to landfill affecting receptors such as human wellbeing, biodiversity & natural environment are dependent on parameters such as site-specific conditions (Eg: Meteorological condition, water quality, etc), emission type and exposure rate. The exposure of these impact, based on dependent parameters, has long term negative impact which is estimated in terms of monetary damages.

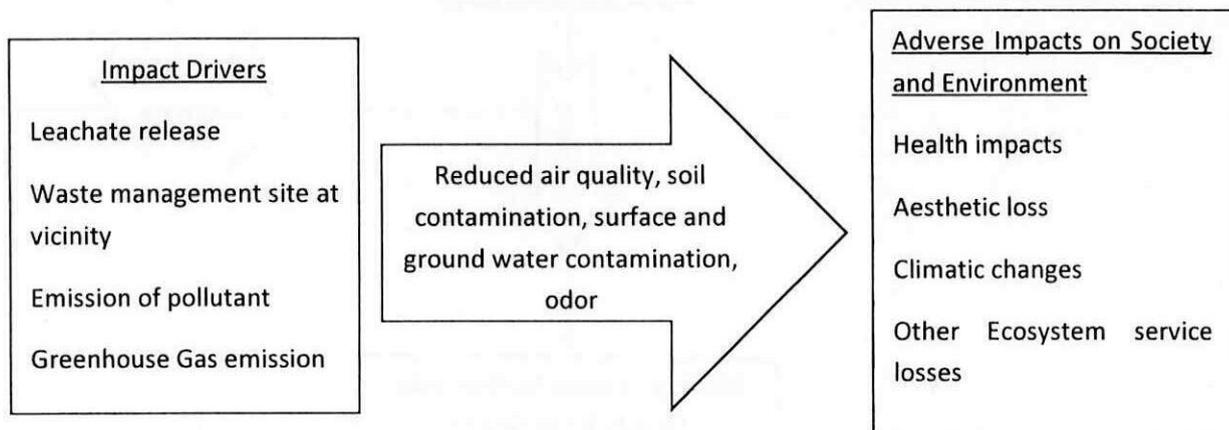


Fig 2. Externalities due to municipal dumpsite at Bhandwari village

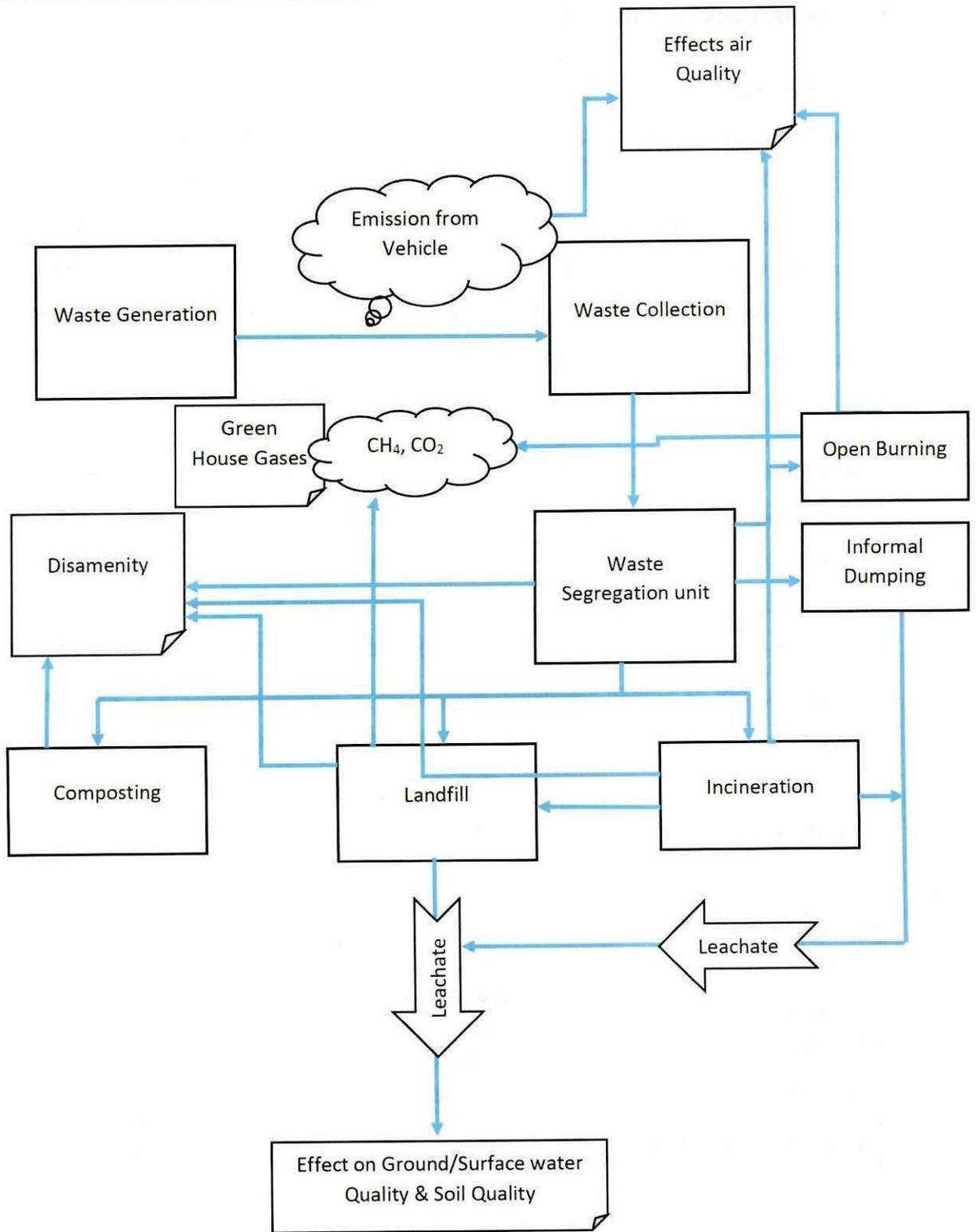


Fig 3. Generic Impact pathway of emission from municipal dumpsite

Table 1 shows the likely impact due to emission from landfill on human wellbeing and natural environment. The likely occurring damages are identified in terms of measurable and non-measurable impacts. The intangible externalities due to odor and noise were evaluated indirectly in terms of aesthetic loss/disamenity cost.

Table 1: Overview of Damage/ Emission from the solid waste dumpsite

<i>Damages</i> <i>Emissions</i>	Medium	Mortality	Morbidity	Soil Quality	Effect on agriculture crop yield	Water Quality	Climate changes	Disamenity
Particulate Matter	Air	x	x					(x)
NOx, SOx	Air	x	x					
CO	Air	x	x				x	
Leachate	Soil & Water	(x)	(x)	x	(x)	x		(x)
CH ₄ , CO ₂	Air						x	
Odor	Air							(x)
Noise	Air	(x)	(x)					(x)

x - Tangible impacts, (x) – Intangible impacts

4.1 Air Quality – Dwellers in and around the landfill site can be subjected to various health issues which may lead to mortality/morbidity, due to the release of pollutants such as PM₁₀, PM_{2.5}, SOx, NOx, CO from solid waste processing steps. Monitoring and damage assessment have been carried for above pollutants. Given the time and resource constraint, VOCs like Benzene and Benzopyrene have not be evaluated. The identified emission sources are collection vehicles, decomposition of MSW open burning near the dumpsite. Damage estimated is based on emission rate and level of exposure of the dwellers. Health issues are not limited to deteriorated air quality but also by consumption of water contaminated with heavy metals through leachate. Damage cost for the same is evaluated and included in the report.

4.2 Soil & Water quality – Soil and water (Ground/Surface) is contaminated due to leaching of leachate via poor lining or by direct discharge of leachate without treatment. Either of cases, various trace metals such as Lead (Pb), Cadmium (Cd), Mercury (Hg), dioxins, Antimony (Sb), Arsenic (Ar), Barium (Ba), Beryllium (Be), Copper (Cu), Chromium (Cr), Nickel (Ni),

selenium (Se) and Zinc (Zn) are found in considerable amount affecting the quality of soil and water. After-effects of the contamination in terms of both environmental and health effects are taken into account for the valuation of damage.

4.3 Climatic changes - The landfill gases are the natural by-product of the decomposition of organic material in landfills. The major gases are carbon dioxide (CO₂) and Methane (CH₄) which contributes to global warming and are termed as greenhouse gases (GHG). Increase in GHG results in warming up of the planet. Increase in temperature results in a change in rainfall pattern, sea level, storm pattern ultimately leading to climate change. Other than these, non-methane hydrocarbon also get released from the decomposition in small quantity compared to these major gases.

4.4 Disamenity – Disamenity is loss or discomfort to dwellers due to various processing units of solid waste management. This process results in obnoxious odor, noise, visual pollution, dust generation, etc. The discomforts thus caused to dwellers are evaluated in terms of reduction in property value than the actual market price.

5. Quantification & Valuation of pollutants

5.1. Air Environment

5.1.1 Air pollutants

Quantification of ambient air pollutants such as particulate, SO_x, NO_x, CO were carried out using high volume sampler fitted with integrated gas sampling assembly at predetermined locations for a duration of 05 days (i e., 04/06/2019 to 08/06/2019) as shown in Fig 4. Sampling location and procedures are carried as per CPCB guidelines CPCB (2011). These monitored pollutants are considered as baseline concentration for estimating the actual contribution of pollutants being emitted from different dumpsite processes. AERMOD (American meteorological society/environmental protection agency modelling) was run to study the dispersion pattern of pollutant released from dumpsite in nearby areas.

AERMOD is an advanced version of ISCST3 that incorporates the effects of vertical variations in the planetary boundary layer (PBL) on the dispersion of pollutants (USEPA, 2005). The plume growth is determined by turbulence profiles that vary with height. AERMOD calculates the convective and mechanical mixing height. It includes the concept of a dividing streamlines and the plume is modelled as a combinations of terrain-following and terrain-impacting states.

It incorporates AERMET (Meteorological Pre-processor) and AERMAP (terrain pre-processors). Input data for AERMET includes hourly cloud cover observations, surface meteorological observations, such as wind speed and direction, temperature, dew point, humidity and sea level pressure, and twice-a-day upper air soundings. The AERMAP uses gridded terrain data (digital elevations model data) to calculate a representative terrain-influence height (hc).

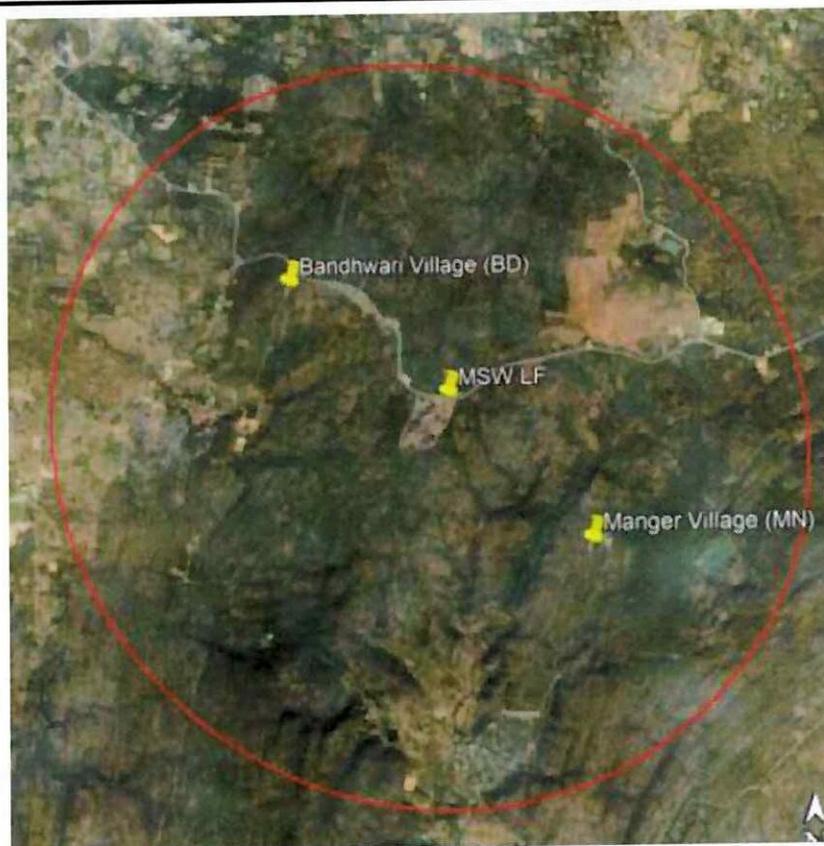


Fig 4. Air quality monitoring locations

Model Setup and Run

AERMOD has been set up for the period of 4th to 10th June 2019 using the emission rate and meteorological data. The site is located at elevation, therefore, AERMAP, the terrain pre-processor, has been run for roughness simulation. Two types of receptors are used in the model i.e. grid receptor location (20 km x 20 km) with grid cell size of 100 m² and three discrete receptor locations also defined in the model where monitoring has been carried out.

5.1.2 Mortality/ Morbidity due to emission of air pollutants

Health damages such as respiratory diseases, chronic obstructive pulmonary diseases (COPD), cardiovascular diseases and mortality are likely to be occurred due exposure of pollutants like particulates, NO_x, SO_x are estimated using WHO-approved methodologies. The threshold values for air pollutants were considered as per the NAAQS permissible limit in Table 2 (NAAQS, 2009).

Table 2. NAAQS standards for air pollutants

Pollutants	Unit	Time Weighted Average	Concentration in Ambient Air	
			Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area
Sulphur Dioxide (SO ₂)	µg/m ³	Annual *	50	20
		24 Hours **	80	80
Nitrogen Dioxide (NO ₂)	µg/m ³	Annual *	40	30
		24 Hours **	80	80
Particulate Matter less than 10 micron size (PM ₁₀)	µg/m ³	Annual *	60	60
		24 Hours **	100	100
Particulate Matter less than 2.5 micron size (PM _{2.5})	µg/m ³	Annual *	40	40
		24 Hours **	60	60
Ozone (O ₃)	µg/m ³	8 Hours **	100	100
		1 Hour **	180	180
Lead (Pb)	µg/m ³	Annual *	0.50	0.50
		24 Hours **	1.0	1.0
Carbon Monoxide (CO)	mg/m ³	8 Hours **	02	02
		1 Hour **	04	04
Ammonia (NH ₃)	µg/m ³	Annual *	100	100
		24 Hours **	400	400
Benzene (C ₆ H ₆)	µg/m ³	Annual *	05	05
Benzo (a) Pyrene Particulate Phase only	ng/m ³	Annual *	01	01
Arsenic (As)	ng/m ³	Annual *	06	06
Nickel (Ni)	ng/m ³	Annual *	20	20

Mortality and morbidity damage due to air pollutants are evaluated using value of statistical life/ cost of illness method respectively (Maji et al., 2017). Various morbidity impacts such as respiratory diseases, chronic obstructive pulmonary diseases (COPD), and cardiovascular diseases were considered for monetary damage estimation. Health risk assessment is calculated using factors such as relative risk, baseline incidence and equations suggested by (Maji et al., 2017; (Balakrishnan et al., 2011; Dholakia et al., 2014; Zhang et al., 2010b; Shang et al., 2013; Lai et al., 2013; Chen et al., 2010; Wong et al., 2008). Relative risk is the probability that a person is likely to develop diseases via exposure to that of person developing the same diseases without the exposure towards air pollutants (Rothman et al., 2008).

5.1.3 Damage cost on health due to release of pollutant in air atmosphere

PM₁₀, PM_{2.5}, SO_x, NO_x, NH₃, H₂S & CO are the major pollutants that are monitored to estimate the mortality/morbidity cost. Table 3 & 4 shows the particulate and gaseous pollutant concentration respectively monitored over the duration of 05 days. It can be observed that both PM₁₀ & PM_{2.5} has exceeded the permissible limit whereas gaseous pollutants are emitted within the NAAQS standards. Hence valuation is only carried out to mortality/morbidity resulted due to particulates eliminating gaseous pollutants.

Table 3: Daily PM₁₀ and PM_{2.5} Concentrations at the study sites

AQM Locations	Pollutants	Concentrations (µg/m ³)				
		04-06- 2019	05-06- 2019	06-06- 2019	07-06- 2019	08-06- 2019
MSW LF	PM ₁₀	231	275	334	227	322
	PM _{2.5}	126	154	230	139	168
Bhandwari (BD)	PM ₁₀	193	244	213	158	133
	PM _{2.5}	102	136	133	79	86
Manger (MN)	PM ₁₀	199	245	197	230	146
	PM _{2.5}	101	137	142	37	74
NAAQS (24Hrs Avg)	PM ₁₀	100				
	PM _{2.5}	60				

Table 4: Daily Average Gaseous Pollutants Concentrations at the study sites

AQM Locations	Monitoring Pollutants	Dates/	Concentration ($\mu\text{g}/\text{m}^3$)				
			04-06- 2019	05-06- 2019	06-06- 2019	07-06- 2019	08-06- 2019
MSW LF	SO ₂		1.1	1.7	3.8	1.4	2.9
	NO ₂		19.4	25.0	26.4	28.3	28.9
	NH ₃		90.2	86.2	149.2	63.5	118.7
	H ₂ S		3.7	2.3	3.0	1.5	1.2
	CO – 1hr (ppm)		0.565	0.743	0.603	0.424	0.876
Bandhwari Village	SO ₂		0.8	0.9	2.3	2.6	10.8
	NO ₂		18.0	38.4	57.7	62.7	75.1
	NH ₃		81.1	85.2	234.2	147.3	-
	H ₂ S		2.2	1.9	5.9	8.9	58.0
	CO – 1 hr (ppm)		0.463	0.468	0.572	0.705	0.661
Manger	SO ₂		0.5	2.7	5.9	1.7	1.2
	NO ₂		18.3	32.2	15.6	26.2	36.2
	NH ₃		83.1	59.2	24.1	46.1	46.0
	H ₂ S		1.0	1.9	1.2	1.8	1.5
	CO – 1 hr (ppm)		0.566	0.607	0.464	0.542	0.660
NAAQS (24Hrs Avg)	SO ₂		80				
	NO ₂		80				
	NH ₃		400				
	H ₂ S		-				
	CO – 1hr (ppm)		4				

5.1.4 Meteorological parameters

The secondary data on meteorological parameters were collected from the nearest IMD stations located at Aya Nagar which is approx. 8 km from the MSW site in Northwest direction. Hourly average data of one week was collected from this stations. The meteorological

parameter used in the model are wind speed, direction, station pressure, ambient temperature, rainfall, relative humidity and solar radiation data. AERMOD also need upper air meteorological data to simulate vertical atmospheric boundary layer. However, due to non-availability of upper air data for the site, upper air estimator tool has been used to simulate upper air meteorological parameters. The tool used the surface level meteorological parameter to estimate the upper air data. The meteorological data has been collected for 4th to 10th June 2019 to further correlate the concentration with primary data. Wind rose diagram and wind class frequency plot are shown in Fig 5. It is found the wind is not uni-directional during the study period and blowing from west, south and southeast direction in the dominant wind speed of 1-2 m/s (35%), and 2-3 m/s (23%). The calm wind condition was found only 2%.

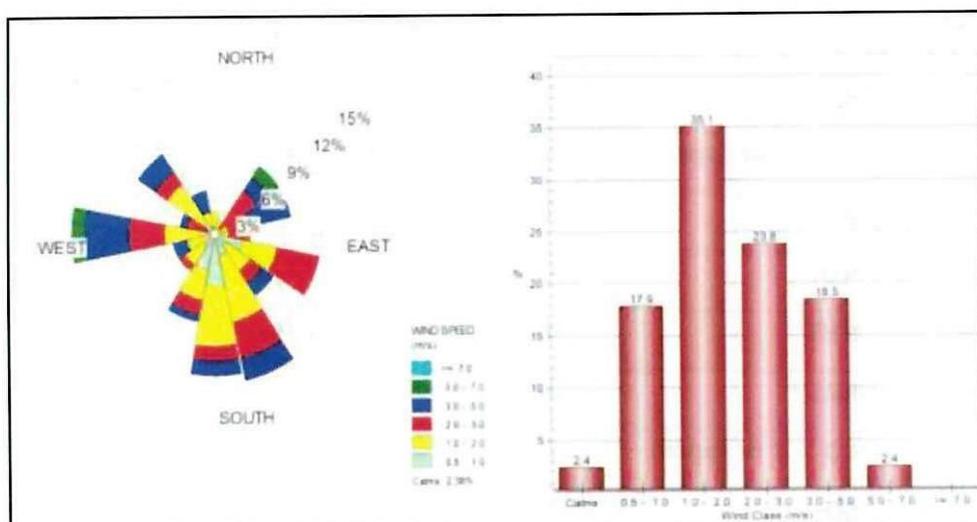


Fig 5. Wind rose diagram and wind class frequency distribution plot of the study period

5.1.5 Pollutant Emission Rate

In the present study, SWEET (“Solid Waste Emissions Estimation Tool”) version 2 has been used to compute emissions of Green House Gases (GHGs) along with criteria air pollutant such PM₁₀, PM_{2.5}, NO_x and SO₂ from the MSW dumpsite/landfill site and associated activities (The output was used to run AERMOD). The SWEET model requires information on the population of MSW collection zone, MSW generation rates, information about number and capacity of vehicles involved in the transport of MSW from source to sites, MSW composition, etc.

All the required information mentioned above about the MSW landfill site of Bandhwari, Gurugram are collected from the secondary sources such as Environment Impact Assessment Report, 2017 (prepared by Wolkem India Limited on behalf of Municipal Corporation Gurugram), data collected from Municipal Corporation Gurugram. The details of input data used in the SWEET model are presented in Table 5. The emission factor are taken as default values as per global standard. During the discussion and based on the reports, it is observed that no MSW treatment facilities such as composting, recycling, waste burning and anaerobic digestion were installed at the site till date. There were no segregation of MSW and mixed waste were dumped starting from year 2008. In this analysis, only emission generated from MSW landfill site (within landfill site) are considered. Emission from transport of MSW from cities were not considered, however, trucks movement inside the landfill site and emission from their idling conditions during unloading were considered in the analysis.

Table 5: General Data/ Assumptions Considered in SWEET for MSW Landfill/Dumpsite,
Bandhwari

Sr. No.	Parameter	Assumption & Value	References
1	MSW treatment facilities	No Treatment	Communication with MCG
2	Start Year of MSW Site	2008	EC Notification2008
3	Population in Formal Collection Zone in year 2019 (from Gurugram and Faridabad)	28,29,410	EIA Report (Extrapolated for 2019)
4	Current year Estimation	2019	-
5	Average Annual Precipitation (mm/year)	544	EIA Report
6	Mean Annual Temperature (⁰ C)	25.2	EIA Report
7	Per capita waste generation rate (kg/capita/day)	0.45	CPHEEO Manual
8	Annual Average Growth Rate in MSW generation (%)	3	CPHEEO Manual

9	Percentage of waste generated inside the collection Zone (%)	100	Assumed
10	Waste Composition	Table 6	TERI Report, 2019 (carried out on behalf of McG)
11	Number of trips of heavy duty diesel vehicles in a year	38157	Calculated based on total annual deposition and trucks capacity (16 Tons assumed)
12	Kilometre traveled by a typical vehicles inside the landfill site in a year (km)	183	0.5 km in one trip (Assumed)
13	Hours spent idling for typical heavy duty trucks per year inside the landfill site	183	30 minute per trip (Assumed)
14	Annual disposal : Most recent year data	6,10,536	Provided by McG for year 2018
15	Type of Sites (Landfill/Dump Site)	Dumpsite	-
16	Average Waste Depth(m)	20	As per discussion
17	Waste Handling Equipment (excavator, Grader, Loader, Bulldozer)	1 each	In absence of information (Assumed)

Table 6: MSW composition at Bandhwari Site (TERI Report, 2019)

Sr. No.	Material Category	Mean Composition (%) plus Standard Deviation
1	Paper	7.246 ± 1.355
2	Plastics	12.587 ± 1.095
3	Metal	1.003 ± 0.242

4	Glass	0.993 ± 0.258
5	Organics	32.695 ± 4.210
6	Others	45.476 ± 3.900

The SO₂, PM_{2.5} and PM₁₀ emission rate have been estimated for per unit area and time from the emission load was estimated using SWEET model as shown in Table 7. As per SWEET model estimates, the SO_x, PM_{2.5} and PM₁₀ emission load from MSW site were found 0.72, 0.12 and 0.14 metric Tons in year 2008 which increased to 1.01, 11.08 and 11.09 metric Tons in year 2019. There is sharp increase in the PM_{2.5} and PM₁₀ concentrations in the current years from the last year. This is because of SWEET Model does not estimate emission load from transport sector for past years and only estimate emission for current year and forecast for future years. In year 2019, the total emission load of PM₁₀ and PM_{2.5} includes emission from decomposition of MSW and emission from vehicles spent time within the landfill site premises, while previous year's emission load only includes decomposition of MSW. The emission rate for SO_x, PM_{2.5} and PM₁₀ used in the model were 7.75E-06 g/s/m², 8.54E-05 g/s/m² and 9.24E-05 g/s/m³, respectively.

Table 7: Year wise Total Emission Load of SO₂, PM_{2.5} and PM₁₀ from MSW Sites

Year	Emission Load of Criteria Pollutant (Tons)		
	SO ₂	PM _{2.5}	PM ₁₀
2008	0.72	0.12	0.14
2009	0.74	0.12	0.14
2010	0.76	0.12	0.15
2011	0.79	0.13	0.15
2012	0.81	0.13	0.16
2013	0.84	0.13	0.16
2014	0.86	0.14	0.17

2015	0.89	0.14	0.17
2016	0.92	0.15	0.18
2017	0.95	0.15	0.18
2018	0.98	0.16	0.19
2019	1.01	11.08	11.99

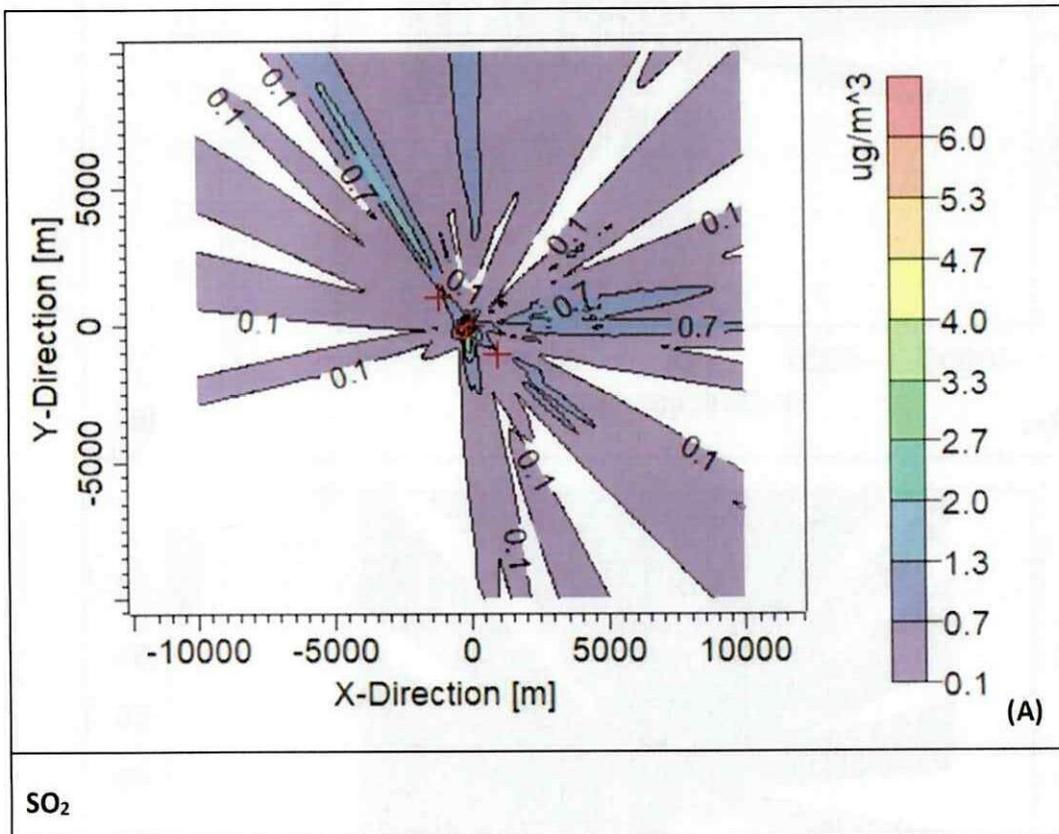
5.1.6 Predicted Concentration due to Emission from MSW site

The AERMOD prediction results for SO₂, PM_{2.5} and PM₁₀ for three sites along with Max. Ground level concentration are described in Table 8. It is found the MSW site emission contributed to 16-23% in SO₂ concentrations at selected sites of Manger and Bandhwari sites. These contribution of MSW site emission for PM_{2.5} and PM₁₀ are predicted to be 5- 38% and 3-24%, respectively. The maximum contribution are predicted at the MSW sites itself. The spatial distribution of concentration of selected pollutant emitted from MSW sites are shown in Fig 6 which indicates that maximum concentration limited to 500 m around the MSW dumpsite.

Table 8: Predicted Concentration of Pollutant emitted from MSW site

Sr. No.	Max. GLC -100, 100	MSW Site	Manger	Bandhwari Site
SO₂ (µg/m³)				
Monitored	-	2.2	2.4	3.5
Modelled	6.0	5.6	0.56	0.57
% Contribution	-	Over predicting	23	16
PM_{2.5} (µg/m³)				
Monitored	-	164	98	107
Modelled	66	62	6.3	5.8
% Contribution	-	38	6	5
PM₁₀ (µg/m³)				

Monitored	-	278	203	188
Modelled	71.6	66.0	6.8	6.2
% Contribution	-	24	3	3



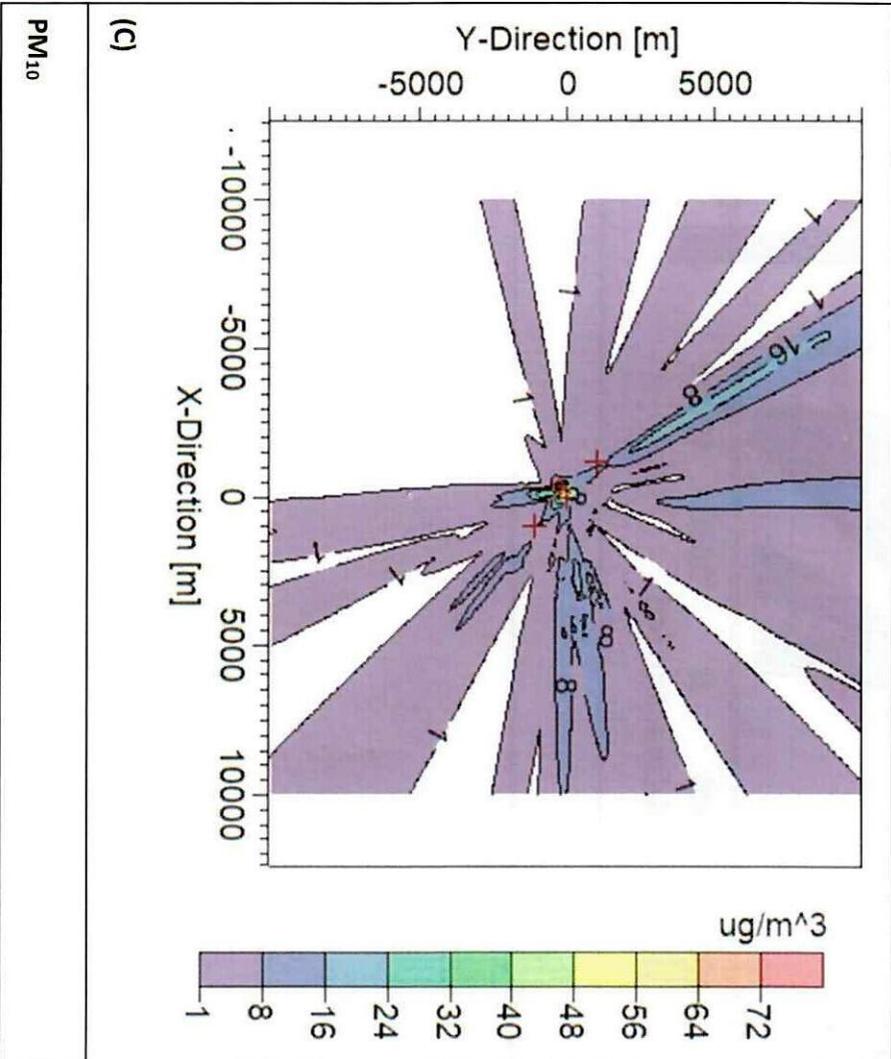
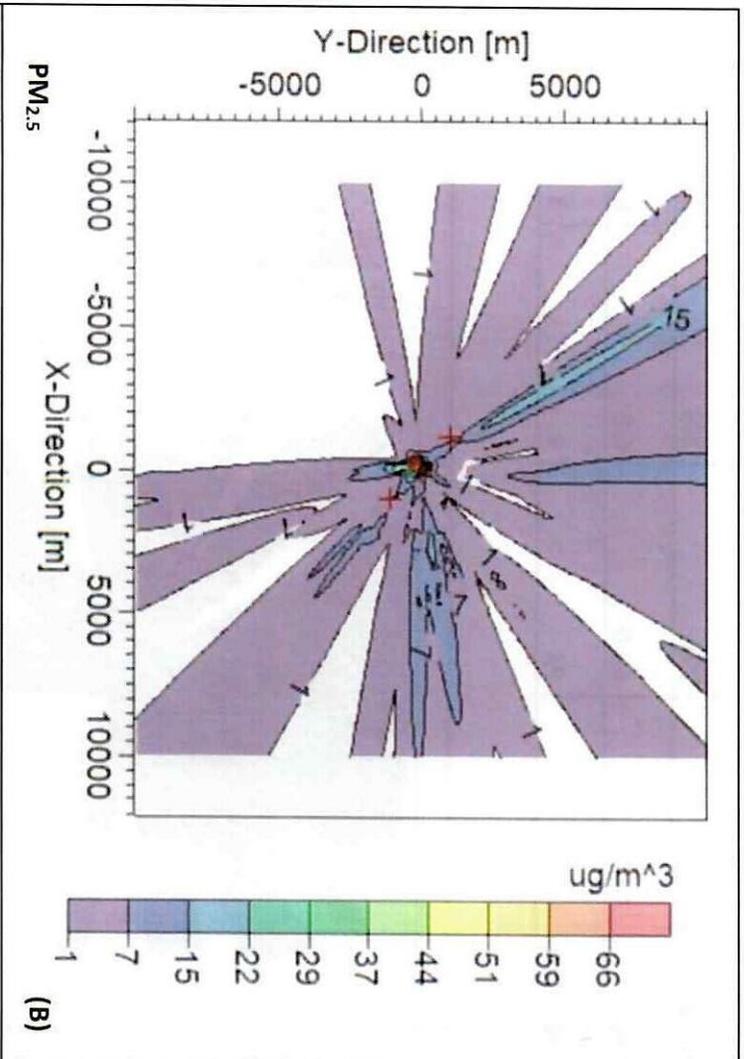


Fig 6. Isopleth of Predicted ground level concentration of pollutants emitted from MSW dumpsite

5.1.7 Damage cost due to air pollution

From Table 8, it can be noted that the pollutants emitted from municipal solid dumpsite site are well below the NAAQS concentration as shown in Table 2. Hence, no health damages are likely to occur due to release of pollutant. The maximum ground level concentration of 66 $\mu\text{g}/\text{m}^3$ was observed for Particulate matters which is slightly above the safety limit 60 $\mu\text{g}/\text{m}^3$. The receptor location being exposed to maximum concentration is within the municipal dumpsite area as shown in Fig 6 (B). Since the receptor location does not accommodate any human individuals, the effect of pollutant concentration is not taken into account. However, it should be noted that a detailed investigation with respect to VOCs emitted from dumpsite should be carried out and damage should be assessed with respect to them.

5.2. Water Environment

5.2.1 Water Quality

Leachate leaching from municipal dumpsite has tendency to percolate into nearby water bodies causing high level of contamination. This contaminated water possesses high risk to human well-being, aquatic lives, and other related ecosystems. Ground and surface water samples were collected from locations within 5km radius from the dumpsite as shown in Fig 7. The water samples were collected to analyze the presence of heavy metals that might have resulted from percolation or discharge of leachate. The analysis for trace metals such as Cu, Cd, Pb, Co, Mn, Ni, Ba, Sr, Zn, Fe, B, Mg, and total Cr was analyzed using ICP-OES as per APHA 2017 standards.

5.2.2 Damage cost due to release of leachate into ground/surface water

Untreated leachate discharged into ground is assumed to have considerable level of contribution in contaminating ground/surface water bodies. It was observed that, there were no other sources nearby the sampling locations that are likely to pollute the water bodies. Presence of heavy metals in potable water can result in various health-related issues. The damage was calculated using benefit transfer method using the values suggested by (ExternE, 1995) based on the quantity of heavy metals present in groundwater. (ExternE, 1995) used control cost methodology linked with environmental values and indices. European values

have been used as the basis for damage assessment as no Indian study has been carried out to generate India specific values. The European values have been converted to Indian values using suitable conversion factors. The cost is estimated using Eq (1) as an impact of one pollutant over linked environmental indices/values. Both environmental and health effects are studied are covered in the final damage cost.

$$\text{Damage due to heavy metal (A) = Concentration of A (Kg/l) x Leachate quantity (L) x Damage Cost due to heavy metal A x Exchange rate x Inflation} \quad \dots\dots\dots \text{Eq (1)}$$

Where,

Exchange rate for 1 EUR = 23.3993 INR as of 1995 (Indian rupee exchange rate history).

Inflation rate from year 1995 to 2019 = 4.81 (Inflation calculator)

Table 9 gives the heavy metals concentration and table 10a and 10b gives the physicochemical properties. It is lucid that nearby sampling location S1 and S2 have higher concentrations of Pb and Ni respectively. Due to lack of availability in baseline concentration related data for sampled location, Damage cost is estimated, based on Table 11 values, with respect to leachate quantity (as per Annexure –II) and corresponding heavy metal concentration in leachate. The sample collected from bore well located at dumpsite showed higher concentration of Cr, Cu, Pb, and Ni which indeed ensures that the leachate might have had significant role in contamination of ground water within the dumpsite.



Table 9. Heavy metal concentration (mg/l) in ground water

Sample code	Type of water	Sampling site	Cr	Cu	Cd	Pb	Co	Mn	Ni	Ba	Sr	Zn	Fe	B	Mg
S1	GW	Manger	0.047	0.046	BDL	0.021	BDL	0.005	BDL	0.013	0.217	0.049	0.233	0.015	10.854
S2	GW	Manger	0.010	0.001	BDL	BDL	BDL	0.010	0.475	0.020	0.252	BDL	0.189	0.007	9.407
S3	GW	Manger	BDL	0.002	BDL	BDL	BDL	BDL	BDL	0.060	0.505	BDL	BDL	0.056	16.033
S4	GW	Bandhwari	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.021	0.204	BDL	BDL	0.014	10.938
S5	GW	Bandhwari	0.004	BDL	BDL	BDL	BDL	BDL	BDL	0.048	0.389	0.006	BDL	0.022	15.799
Bore well sample with in the dumpsite (B1)			0.466	0.1	BDL	0.059	0.086	1.383	0.02	0.296	0.969	0.483	0.768	0.17	21.032
MSW LEACHATE		MSW site leachate	1.082	1.380	0.019	1.000	0.053	0.499	0.361	0.964	1.249	1.121	9.697	4.139	24.589
Permissible Limit – BIS 10500:2012			0.05	0.05	0.003	0.01	-	0.1	0.02	0.7	-	5	0.3	0.5	30

 Concentration exceeding the permissible limit

Table 10 (a): Physio-Chemical properties of water bodies at sampled locations

S.No.	Parameters	Manger			Bandhwari		Ground water Sample from MSW Site	Standard values (IS 10500:2012)
		S1	S2	S3	S4	S5		
1.	Temp.	29.3	29.6	32	29.7	32.2	25.1	
2.	EC	590	600	1470	820	1150	3940	
3.	pH	6.9	6.07	6.34	6.64	6.8	6.66	6.5-8.5
4.	Turbidity	0.29	0.11	0.32	0.13	0.22	58	1/5
5.	Colour	0	0	0	0	0	0.11	5/15
6.	TDS	315	401	925	368	492	2143	500/2000
7.	TSS	4	5	6	4	1	77	-
8.	COD	17.76	23.04	7.68	14.68	35.36	123	-
9.	BOD	0.60	1.40	2.20	2.80	1.20	3.6	-
10.	TKN	8.40	8.40	2.80	5.60	25.21	28.01	
11.	ORTHO PHOSPHATE	0.01	0.05	0.01	0.12	0.11	0.02	-
12.	TOTAL PHOSPHATE	0.14	0.13	0.15	0.16	0.14	0.06	-
13.	AMMONIA	0.084	0.104	0	0	0	0.1	0.5/No relaxation
14.	Chloride	35	33	172	41	86	119	250/1000
15.	Sulphate	20.86	26.15	67.30	11.95	36.87	277	200/400
16.	Fluoride	0.17	0.37	0.14	0.56	0.51	0.95	1/1.5
17.	Nitrate	14.93	33.16	223.03	35.50	32.34	0.96	45/ No relaxation
18.	Total hardness	192	200	320	180	104	660	200/600
19.	Total Alkalinity	314	386	290	350	446	1676	200/600

Table 10 (b): Physio-Chemical properties of leachate

Leachate	Temp	EC	pH	Turbidity, NTU	Color, Hz Unit	TSS, mg/L	TDS, mg/L	Sulphate, mg/L	Chloride, mg/L
		37.5	42900	7.17	-	-	2530	22800	242.92
Leachate	Fluoride, mg/L	Nitrate, mg/L	Ammonia, mg/L	COD, mg/L	BOD, mg/L	TKN, mg/L	Orthophosphate, mg/L	Total phosphate, mg/L	
			803	36096	2003.41	137	41.59	195	

*the correct results for the two parameters could not be found because of interference due to pollution load. Turbidity, Colour, TH and alkalinity not done. The damage was assessed with respect to EPA 1986 inland surface water discharge standards.



Fig 7. Groundwater sampling locations

Table 11. Damage cost due to emission of pollutants per Kg in water

Pollutant per Kg	Damage cost (Euro, 1995) (ExternE, 1995)
Lead (Pb)	178
Cadmium (Cd)	622
Mercury (Hg)	1,022
Dioxins	62,824,889
Antimony (Sb)	121,366
Arsenic (As)	308
Barium (Ba)	31
Beryllium (Be)	44,928
Copper (Cu)	5
Chromium (Cr)	17,479
Nickel (Ni)	12
Selenium (Se)	16,125
Zinc (Zn)	1
Physio-Chemical pollutants	Damage cost (Euro, 2010) (Sancho et al., 2010)
Biological oxygen demand	0.033
Chemical oxygen demand	0.098
Suspended solids	0.005
Nitrogen	16.3535
Phosphate	30.944

Leachate, carrying hazardous heavy metals beyond the safety limit needs to be treated in leachate treatment plant (LTP) before being discharged into water bodies or ground. Generally in case of dumpsite no such treatments are carried out for leachate before its discharge. Percolation of leachate into nearby water sources can bring harm to aquatic life and humans depending on it. Damage cost of water environment over the years can accelerate to higher value bringing a threat to sustainability, if implementation of mitigative measures with respect to treatment and restoration is further delayed. Higher loading of

physio-chemical pollutants in the final leachate outlet is shown in Table 10(b). The discharged pollutant concentration was compared with environmental protection act (EPA), 1986 inland surface body discharge standards to determine the breached concentration and the resulting damage is estimated to be 15 crore as given in Table 12 below. Environmental damage cost due to the presence of heavy metals in water samples at S1 & S2 locations respectively is 13.4 lakhs INR and is about 14 crores INR in case of groundwater beneath the dumpsite area.

Table 12: Damage cost estimated due to leachate into water bodies

Sampling location where standards have breached	Pollutants breaching the standards	Leachate Concentration (mg/l) for the pollutants	Leachate Volume (Million Litre)	Damage cost in Euros	Total Damage (INR, Lakhs)
S1 & B1	Pb	1	65.3	178	0.31
S2 & B1	Ni	0.361	65.3	12	13.08
B1	Cr	1.082	65.3	17,479	1389.6
B1	Cu	1.380	65.3	5	0.5
Leachate	BOD	2003.41	65.3	4,252	4.59
	COD	36090	65.3	2,29,354	247.9
	Suspended solid	2530	65.3	793	0.85
	Nitrogen	803	65.3	8,04,091	869
	Phosphate	195	65.3	3,83,922	414.9
Total damage	S1 & S2 combined (calculated with respective heavy metal values for S1 and S2) = 13.4 lakhs MSW dumpsite (based on leachate)= 14 crore Breached leachate discharge concentration (Physio-chemical) = 15 crore				

5.3 Soil Environment

5.3.1 Soil Quality

Soil samples were collected from locations within 5km radius from the dumpsite as shown in Fig 8. The samples were collected to analyse the presence of heavy and trace metals that might have resulted from percolation or discharge of leachate. The analysis for trace metals such as Cr, Cu, Cd, Pb, Ni, Ba and Zn was carried out based on (Wuana, 2011) and on the basis of availability of damage cost values for those heavy metals.

5.3.2 Damage cost due to release of leachate into soil

Fruit and vegetable bearing plants have tendency to extract minerals and nutrient from soil during their growth. Similarly, heavy metals from leachate contaminated soil will be taken up by plants generating an inventory of heavy metals beyond safety limits in fruits and vegetable which when consumed by humans result in health damages. (ExternE, 1995) has suggested damage cost value as in Table 13 based on avoided cost method with respect to presence of heavy metals in soil and its impact on environmental values/indices. Due to non-availability of Indian studies related to environmental damages cost assessment, European values have been suitably adopted in Indian scenario and used for the current study. Further, the heavy metal concentration have been taken as it is as there are not India specific soil standards. It is assumed that higher heavy metals than the baseline limit are due to percolation from leachate being discharged into the land.

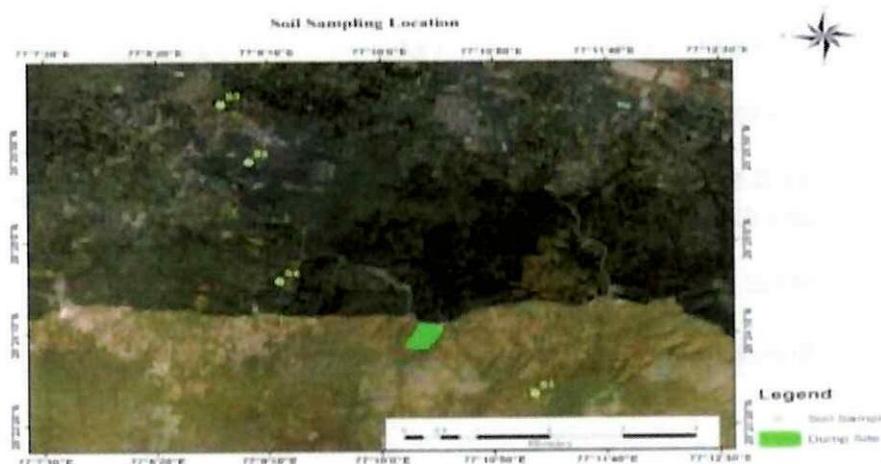


Fig 8. Soil sampling locations

Table 13. Damage cost due to emission of pollutants per Kg into the soil

Pollutant per Kg	Damage cost (Euro, 1995)
Lead (Pb)	5
Cadmium (Cd)	1514
Barium (Ba)	37
Copper (Cu)	1
Chromium (Cr)	320
Nickel (Ni)	4
Zinc (Zn)	1

(Source: ExternE, 1995)

Leachate, when released untreated not only contaminates water bodies, but also soil quality. Continuous discharge of untreated leachate into soil surface results in the formation of inventory for hazardous heavy metals. Table 14 shows the concentration of heavy metals in soil in mg/kg. It can be observed that average concentration of as Cr, Cu, Cd, Pb, Ni, Ba and Zn is found to be relatively high which probably is due to discharge of leachate into the ground. Economic valuation is carried out using monetary damage value suggested in Table 13. The damage valuation is limited to heavy metals such as Cr, Cu, Cd, Pb, Ni, Ba & Zn due to lack of damage values available for other polluting heavy metals.

Damage cost was carried out with respect to release of total quantity of leachate and corresponding heavy metal concentration using Eq (1). Leachate quantity considered for calculation is 65.3 Million liters (Annexure-II). Corresponding heavy metal concentration in leachate is shown in Table 9. Table 15 shows the environmental damage cost resulted due to release of untreated leachate into the soil surface.

Total damage cost due to release of leachate into the soil is estimated to be 30.8 Lakhs INR. The estimation is done on the basis of total release of heavy metals on soil due to whole of leachate and gives a value of total probable damage due this heavy metal release. In comparison with all the heavy metals, chromium accounts for 82.5% of total damage cost followed by barium and cadmium. Damage cost keeps on escalating, in case no mitigative measures are followed in terms of leachate treatment before the discharge.

Table 14: Heavy metal Concentration in mg/Kg in the soil samples of all the sites

Sample code	Sampling site	Cr	Cu	Cd	Pb	Co	Mn	Ni	Ba	Sr	Zn	Fe
MSW	MSW site	70	65	4	43	8	288	22	77	47	76	7804.82
S1	Manger	172	45	1	32	5	221	23	55	22	179	9719.62
S2	Gwalpahari	70	49	2	33	6	275	19	78	38	73	11017.02
S3	Mandi	64	43	1	26	7	286	23	59	41	69	12469.42
S4	Bandhwari	44	26	1	16	5	227	16	37	14	45	10321.62

Table 15: Damage cost estimated due to the release of heavy metals into soil

Heavy Metals	Heavy metal concentration (mg/l)	Leachate concentration (Million Litre)	Damage cost in Euro (1995)	Total Damage (INR, Lakhs)
Cr	1.082	65.3	320	25.4
Cu	1.38	65.3	1	0.1
Cd	0.019	65.3	1514	2.1
Pb	1	65.3	5	0.4
Ni	0.361	65.3	4	0.1
Ba	0.964	65.3	37	2.6
Zn	1.121	65.3	1	0.1

5.4 Climatic Environment

5.4.1 Greenhouse gas emission

In the present study, In the present study, SWEET ("Solid Waste Emissions Estimation Tool ") version 2 has been used to computes emissions of Green House Gases (GHGs). The details of input data used in the SWEET model are presented in Table 5.

5.4.2 Social cost of carbon

Environmental damage cost due to the emission of GHG's is estimated based on social cost of carbon (SCC). SCC also known as the shadow pricing for carbon emission is the most commonly used metric to calculate economic damages from carbon dioxide and has been estimated by USEPA and is based on global averages and hence can be used for India as well. It represents the economic change associated with climate change due to additional release of CO₂. The damage is computed as net difference in climate change with a baseline change in climate pathway with additional increase in CO₂. GHG such as CH₄, water vapor, nitrous oxide emitted from dumpsite via various process such as transportation, treatment, etc estimated using SWEET models were computed in terms of CO₂ equivalent. Social carbon cost as of 2019 is reported to be 1065.9 INR per ton emission of CO₂ (USEPA, 2017). Despite having country level estimates reported by various researchers such as (Ricke et al., 2018) which is based on population & GDP, SCC suggested by USEPA was taken into consideration for valuation as this considers the impact of carbon emission globally.

5.4.3 Damage cost associated with climate change due to the release of CO₂

The SWEET model has been run using the above information and with default assumption for emission factor. The vehicular emission factor of heavy-duty diesel trucks are matched ARAI, 2008 emission factor for all pollutants and found more or less similar for all pollutants. The estimated global warming potential (GWP) equivalences of Carbon Dioxide (CO₂e) are described in Table 16. As per model estimates, the GHGs (CO₂e) emission from MSW landfill sites increased from 52,191 metric Tons to 1,99,176 metric Tons from the year 2008 to 2019, respectively which is 3.8 times. The values are shown in Table 17.

Table 16: Year-wise Total Emission Load of GHGs

Year	Total GHG (CO ₂ e)
2008	52191
2009	71966
2010	89628
2011	105550
2012	120046
2013	133380
2014	145772
2015	164403
2016	168444
2017	179012
2018	189225
2019	199176

Table 17: Year-wise Total Emission Load of GHG (CO₂e) from different activities of MSW

Year	CO ₂ e				Total
	Waste Collection & Transport	Waste Burning	Landfills & LFG Combustion	Waste Handling Equipment	
2008	51319	20	0	852	52191
2009	52906	20	18161	878	71966
2010	54542	21	34159	905	89628
2011	56229	22	48365	933	105550
2012	57968	22	61093	962	120046
2013	59761	23	72603	992	133380
2014	61609	24	83116	1023	145772
2015	63515	25	99809	1054	164403
2016	65479	25	101852	1087	168444
2017	67504	26	110361	1121	179012

2018	69592	27	118451	1155	189225
2019	71744	28	126213	1191	199176

Social cost of carbon is carried out based on total CO₂ emitted from the year 2008-2019 as estimated by SWEET model. Table 18 shows the damage cost on climate change in terms of carbon cost due to CO₂ emission from various landfill operations/process. It can be observed that SCC kept rising over the years due to increase in CO₂ emissions. Total SCC estimated over the years is 172.5 crores INR as of 2019 with an average emission of about 14 Cr per year. Social cost of carbon per ton CO_{2e} emission was considered as \$11.8 (3% average) as of 2007 for the year 2019 (URL 04). Mitigative and compensation measure must be adopted with stringent policies to curb CO₂ emissions from Bandhwari dumpsite. NGT recommends to consider damages for 5 years (URL 05), hence 70 Crores for climatic externalities.

Table 18: Social cost of carbon due to the release of CO₂ from dumpsite operations

Year	CO ₂ emission (tonnes/year)	SCC (million, INR)
2008	52191	55.6
2009	71966	76.7
2010	89628	95.5
2011	105550	112.5
2012	120046	127.9
2013	133380	142.1
2014	145772	155.3
2015	164403	175.2
2016	168444	179.5
2017	179012	190.8
2018	189225	201.7
2019	199176	212.3

5.5 Aesthetic Environment

5.5.1 Other externalities such as disamenity cost/aesthetic loss

Disamenity cost/aesthetic loss is the most common monetary loss in and around the areas nearby municipal dumpsite. The aftereffect of aesthetic loss is drop in real estates price when compared to nearby land. Various other impacts such as noise, foul odor and visual disturbance due to poor solid waste management practices result in loss of aesthetic value of environment. Rather than considering each externality individually, all are clubbed together and are evaluated in terms of aesthetic loss.

5.5.2 Aesthetic loss

Aesthetic loss is estimated in terms of percentage loss in property value due to presence of municipal dumpsite at the vicinity and is evaluated using hedonic pricing method. Hedonic method evaluates the economic value of goods with respect to direct or indirect effect of another marketed goods. Land depreciation losses due to landfill are evaluated based on Table 19. The study carried out by (Nelson, 1978) considered a total depreciation of 10% and 4% of current land price for a radius <200m and between 200 to 1000m respectively, for dump area is > 500m². Radius 1 & 2 considered for land disamenity is shown in Fig 9. Since the depreciation values have been given in percentage, they have been directly used in Indian context for lack of other literature.

Table 19. Land depreciation value by hedonic pricing (Nelson, 1978; Arif & Doumani, 2014)

Active site	Area (m ²)	Radius 1 (m)	Radius 2 (m)	Losses 1	Losses 2
Municipal dump site	≥ 500	+ 200	>200 to <1000	10%	4%
Data Used for calculations					
Municipal dumpsite	123429.23	(300+200)= 500	(300+800) = 1100	Total area 1 (m ²) * land price (per m ²) *10/100	Total area 2 (m ²) * land price (per m ²) *4/100

Data used for aesthetic loss calculation is shown in Table 19. Total dumpsite area constitutes to 123429.23 m² (EIA report) and the same was considered for calculation. Overall radius covering the landfill area is measured using geographical information system (GIS) and is

299.9m (≈ 300 m). Radius 1 and 2 is the sum of study area radius (300m) and recommended increase as mentioned in Table 19. The recommended increase used in the study for radius 1 and 2 was 200m and 800m (assumed) respectively. Total area was measured using Eq (2). The corresponding total area 1 and 2 was measured using Eq (3) & Eq (4) respectively. The total incurred loss in land price corresponding to total area 1 and 2 was calculated with reference to Table 19 and current land rates at Bandhwari village.

$$\text{Area} = \pi * \text{radius}^2 \quad \text{Eq (2)}$$

$$\text{Total area 1} = \text{Area 1} - \text{Dumpsite area} \quad \text{Eq (3)}$$

$$\text{Total area 2} = \text{Area 2} - \text{Area 1} - \text{Dumpsite area} \quad \text{Eq (4)}$$



Fig 9. GIS representation of area considered for hedonic pricing

5.5.3 Land price depreciation due to Aesthetic loss/Disamenity cost

Poor management of solid waste results in depreciation of nearby land price due to disamenities prevailing from the solid waste dumpsite. Waste heaps, untreated leachate were common site in the study area as shown in Fig 10. The mentioned unpleasant quality of municipal dumpsite will have monetary effect on nearby land prices which is estimated based on figures shown in Table 19. Total land depreciation cost due to Bandhwari municipal

dumpsite estimated to be 49.46 crores INR. Estimation was carried out based on the values suggested by (Nelson, 1978; Arif & Doumani, 2014) as in Table 20. As most of the land area within 1000m radius fall under barren land, Price of same was considered for estimation. The current land rates at Bandhwari villages is 2718 per m² (URL 03).

Table 20: Land depreciation cost due to the presence of nearby municipal dumpsite

Land purpose	Total area (m2)	Area 1 (m2)	Area 2 (m2)	Land price (per m2)	Total area 1 (m2)	Total area 2 (m2)	Loss in area 1 (INR)	Loss in area 2 (INR)	Total loss (INR, Lakhs)
Municipal dumpsite	123429.23	78571.43	38028.57	2718.157	66601.67	28937.14	181033799.8	314622718.1	4946



Fig 10: Disamenities observed at Bandhwari municipal dumpsite

7. Results & Conclusion

The report focuses on identifying and estimating monetary losses (in 2019 Rupees) on the environment due to the operation of Bandhwari municipal dumpsite. The damage was assessed with a consideration that there is no major polluting industries existing in nearby vicinity other than the dumpsite. The study estimates a total incurred damage of about ₹ 148.46 Crore due to externalities from Bandhwari dumpsite. The breakup is shown in Table 22. The cost for damages includes drivers of externalities like greenhouse gas emissions, air pollution, water pollution, soil pollution and aesthetic loss.

Table 22: Break Up of Monetary Estimation of Damages (reported in 2019 values)

Environment	Estimated Damage Cost in Lakhs, INR
Air	Nil
Water	2900
Soil	31*
Climatic (for last 5 years)	7,000
Aesthetic	4,946
Total	14,846

*Soil value is not considered in total, to avoid double-counting, as it based on total quantum of heavy metal from leachate which is considered in water as well.

The valuation of damages is done for greenhouse gas emissions using social cost of carbon approach recommended by USEPA. The social cost of carbon is indirect measure of loss in economy due to emission of CO₂ and is contributing by 73% of total damage due to Bandhwari municipal dumpsite. Air pollution damages are not valued as the emissions hardly breach the limits and the area in which emissions are higher, no population exposure is there. Further, the leachate contaminated groundwater and soil damages are valued using cost transfer method and ExternE report valuations. Groundwater sample analysis shows lead and nickel exceeding the BIS standards at sampling locations near the dumpsite. Groundwater beneath the dumpsite showed high contamination due to heavy metals such as Cr, Cu, Pb & Ni. Physio-chemical characteristics such as BOD, COD, SS, N, P of the treated leachate showed higher

concentration and have contributed to half of the total damage cost in water environment. The leachate is valued for the damages which it can cause due to contamination of soil and water. The damages to water are considered as overall damages. The total quantum of heavy metals due to leachate is fixed and is used for valuation for both soil and water, however, higher damages are seen for water and hence considered in total. Aesthetic losses due to dumpsite are valued using hedonic pricing method. GHG emissions are a part and parcel of any dumpsite. If proper control systems are kept in place these emissions can be controlled and may be utilized as well and hence maximum damages can be averted. Leachate also should be controlled and treated scientifically.

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Inspection report for legacy waste dumpsite		
Serial No.	Item	Remarks
1		General Information
	A	City & Location of Dumpsite Bandhwari, Haryana
	B	Name, Designation & Contact Details of Nodal Officers for Biomining Mr. Mahavir Prasad, Addl. Commissioner, MCG
	C	Stage of Biomining (Planned/Being Executed/Completed) Executed on 5 th October 2019
2		Volume of Waste
	A	Has Contour Survey of site been Done (Y/N) Yes in June 2019
	B	Length (Initial -M) 400 m
	C	Width (Initial -M) 250 m
		Height (Initial -M) 30-31 m
		Total Volume (Cub. Meter) 27 lakh cu. m.
3		Characteristics of Waste Fresh waste report is attached as Annexure - 1
4	A	Leachate Characteristics Untreated leachate test report attached as Annexure - 2 . Treated leachate test report attached as Annexure - 3 . Photo of treated & untreated leachate is also attached (Photo-I)
5		Baseline Survey
	A	Ground Water Analysis Test report of ground water analysis is attached as Annexure - 4 .
	B	Soil Analysis Test report of soil analysis is attached as Annexure - 5 .
	C	Quantity Of Waste Processed Per Day (TPD) As informed, around 100 TDP is being processed.
6		Process Flowsheet of Bio-Mining Biomining Process Flowsheet is attached as Annexure - 6 .
7		Stabilization of waste
	A	Type of biomining method Adopted (Tractor tiller, Trench method; Cone Method; Windrow, Thin Layer Method) Cone method for legacy waste (Photo-II a) and Windrow method for fresh waste (Photo-IIb)

	B	Machinery used for Excavating Dumpsite (Tractor Tiller Etc)	Excavator
	C	Machinery Used for preparing Windrows (JCB etc)	Excavator & JCB
	D	Are large objects removed prior to windrow preparation	Yes
	E	Are Windrows Turned Every 4-5 Days	Yes
	F	Duration of Stabilization	5-6 weeks.
	G	Bio-culture Used	Yes
	H	Is End Product Stabilized (No Heat / Gas /leachate /Smell)	During inspection, it was observed that fresh waste was found emitting vapors indicating that it is not stabilized properly. However, no vapor was found in stabilized legacy waste (Photo-III).
	I	Is leachate Being Generated From the waste	Yes
	J	If Yes, methodology for leachate Management Adopted	Biological and chemical treatment. A leachate treatment plant of capacity 150 KLD is already in operation for treatment of collected leachate. (Photo-IVa). Further, to expedite the process of treatment of leachate, 1 Disc Tube Reverse Osmosis System (DTRO) of 200 KLD is installed (Photo-IVb) and another DTRO of same capacity is to be installed by the end of February, 2020 as informed.
8		Processing Of Legacy Waste	
		Machinery Used For processing of legacy waste	
	a	Screening	
	i	Trommel (Number & Capacity (TPD)	For screening of legacy waste, a 300 TPD Ballistic Separator (35 mm sieve size) (Photo-V) alongwith trommel 6 mm screen sizes) is operational. (Photo-Va). A 300 TPD trommel machine is operating for screening of fresh waste having Screen size – 35 mm, 16 mm and 6 mm (Photo-VI).
	ii	Size of screens used (Mostly used	35 mm in Ballistic Separator and 6 & 16

		150 mm, 80 to 100 mm, 24 to 50mm, 1216 mm and 4-6)	mm in Trommels.
	iii	Vibrating Screen (No)	No
	iv	Electromagnet (For separating ferrous metals)	No
	v	Air Classifier (for separating light material from heavy organic)	Yes
	vi	Disc/Star (No)	No
	b	Handling	
	i	Loader (No.)	4 Nos.
	ii	Conveyor (No.)	12 Nos.
	iii	Fork Lift (No.)	Nil.
	iv	Categories in which the waste is segregated (Compost/Recyclables/RDF/C&D/Inerts etc.)	Refused Derived Fuel (RDF, Photo- VII (a)), inert (+6 to -16 mm); Photo- VII (b)), compost (-6 mm fraction); Photo-VII(c) and C&D and inert waste (-16 to+35) (Photo- VII(d))
	v	Quantity of items which is being generated in each category	As informed, 45% RDF, 10% C&D, 20% Compost & 25% inert are generated from the legacy waste and 40% RDF, 20% Compost, 20% C&D, & 20% inert are also generated from fresh waste after screening.
	vi	Quantity of items being utilized of different categories	Screen fractions are being dumped at site.
	vii	Documents supporting usage of different fractions (Bioearth/Recyclable/RDF/Other wastes)	
	viii	Analysis results of fine earth	Yes (Annexure-7)
	ix	Frequency of testing of bio-earth	-
9		Miscellaneous	
	a	Have fires being reported at the site	No
	b	Methodology to tackle fires	-
	c	Is fresh waste being dumped at the site	Yes
	d	Percentage land recovered so far	Only 7-8 m height of the heap of legacy waste is reduced.

	e	Is third party audit of biomining being done	No
10		<p>Other observations:</p> <ol style="list-style-type: none"> 1. As informed, total 1900 TPD fresh waste is being dumped at dumpsite. 2. Municipal Corporation Gurgaon (MCG) has agreement with M/s. Eco Green for bio-mining/bio-remediation and installation of Waste to Energy plant. Further, MCG, Gurgaon got EC from MOEF&CC for installation of 15 MW waste to energy plant (Annexure-8) 3. As informed, 12 Trommel Machines are to be procured for treating the legacy waste. 4. As informed, 19,000 metric ton of Fresh waste & 20000 MT of legacy waste have been treated through bio-mining/bio-remediation only out of which only 4690 MT waste has been screened (Legacy: 1913 MT; & Fresh:2777) through trommel into segregated fractions of RDF, Inert & Compostable till date. Remaining stabilized waste (34310 MT) is dumped near trommel. 5. Screen fractions are being dumped at the dumpsite. A down fall has been noted in the bio-mining/bio-remediation and screening processes due to lack of space and disposal of screen fraction. 6. Landfill side slopes were covered with HDPE liner to control excess leachate generation during monsoon season by mixing of garbage with rainwater (Photo-VIII). 7. 8 leachate collection ponds have been constructed at dumpsite to store the leachate generated from the landfill (Photo -IX). 8. Leachate is being treated in 150 KLD leachate treatment plant along with DAF unit. At present, Ecogreen is transporting the treated leachate to Behrampur Sewerage Treatment Plant for final disposal. 	
11		Recommendations	-
		Name & Designation of Inspecting Officer	Pankaj Agarwal, Sct. E, CPCB & Atanu Dey, RA
		Date of Inspection	04/02/2020

Photographs

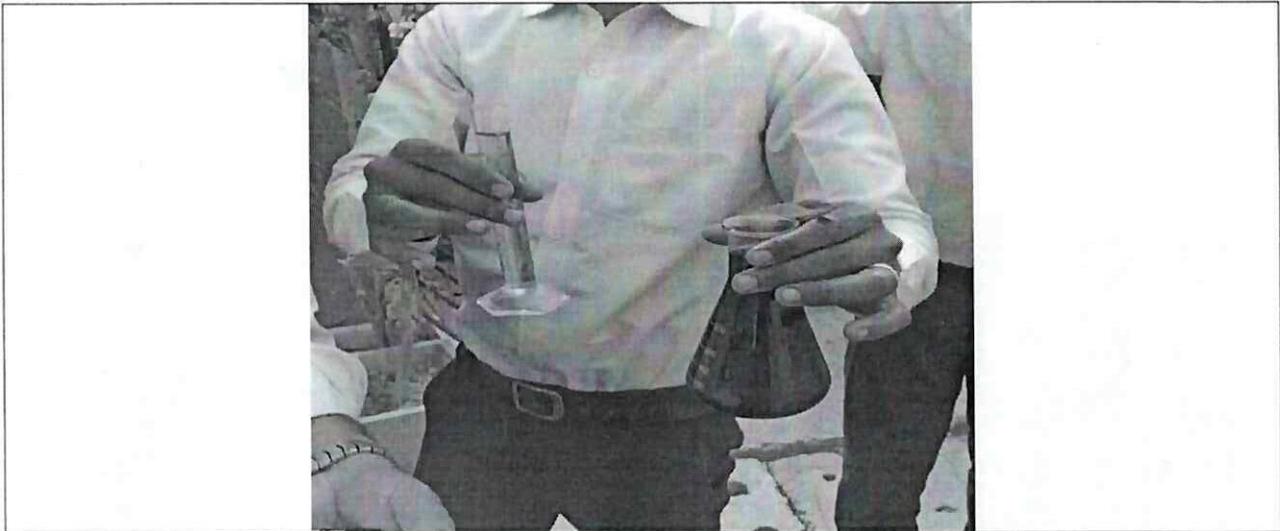


Photo I: Treated and Untreated Leachate

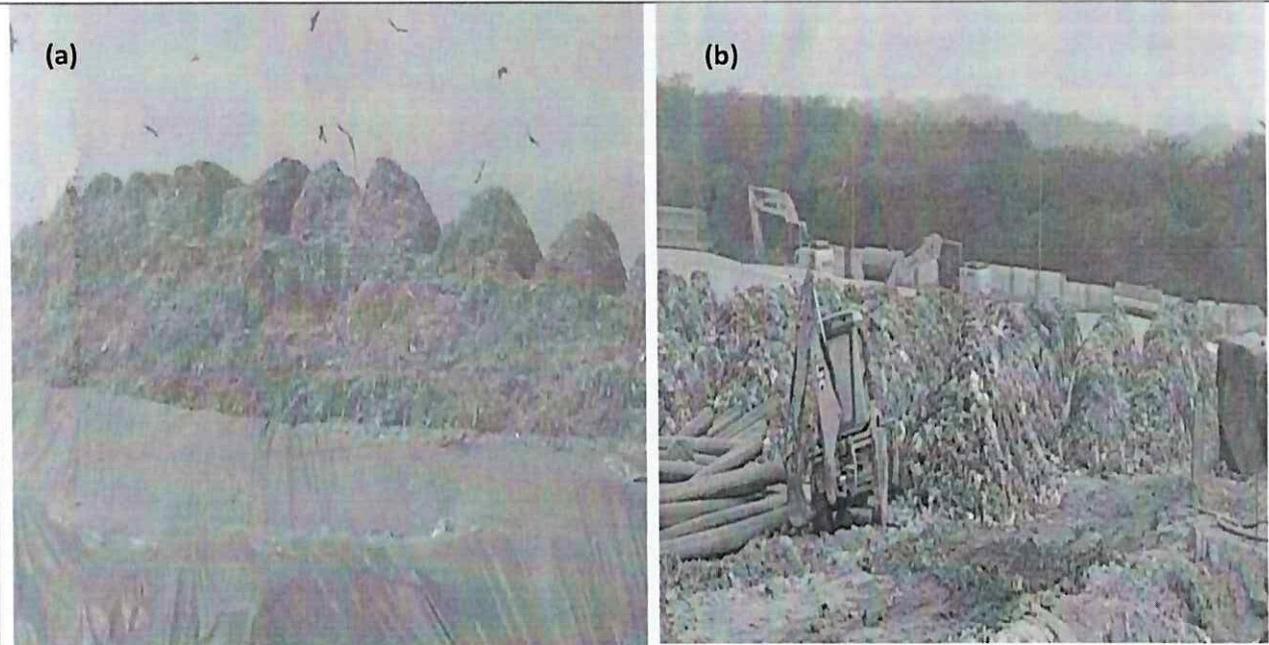


Photo II: Biomining methods (a) Cone Method for Legacy Waste (b) Windrow for fresh waste



Photo III: Heat is generated before screening the waste (not stabilized properly)

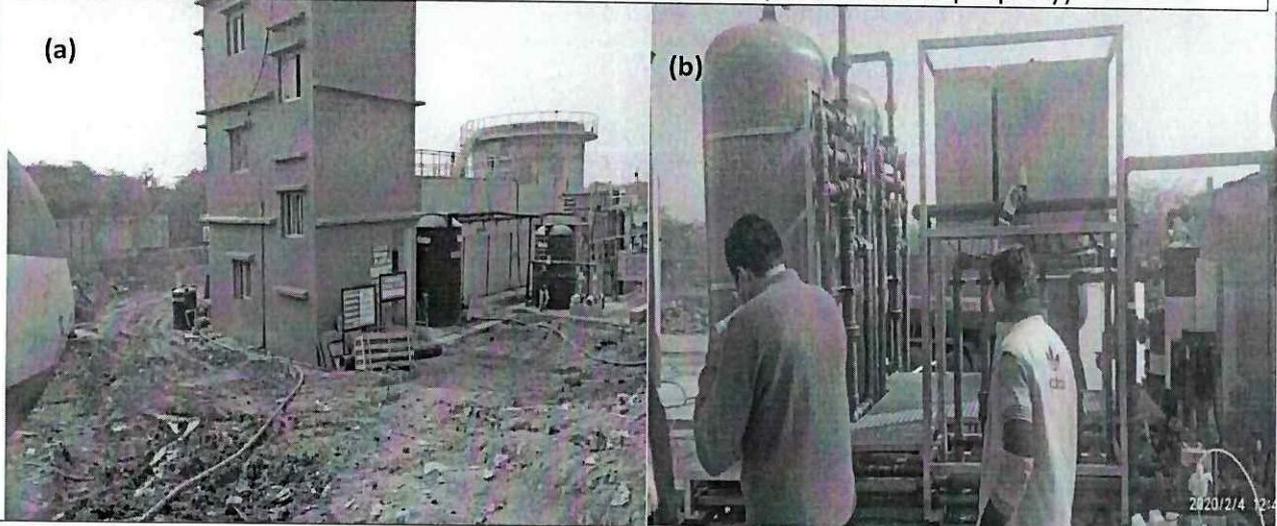


Photo IV: Leachate treatment plants;(a) Biological & Chemical treatment plant (b) DTRO system

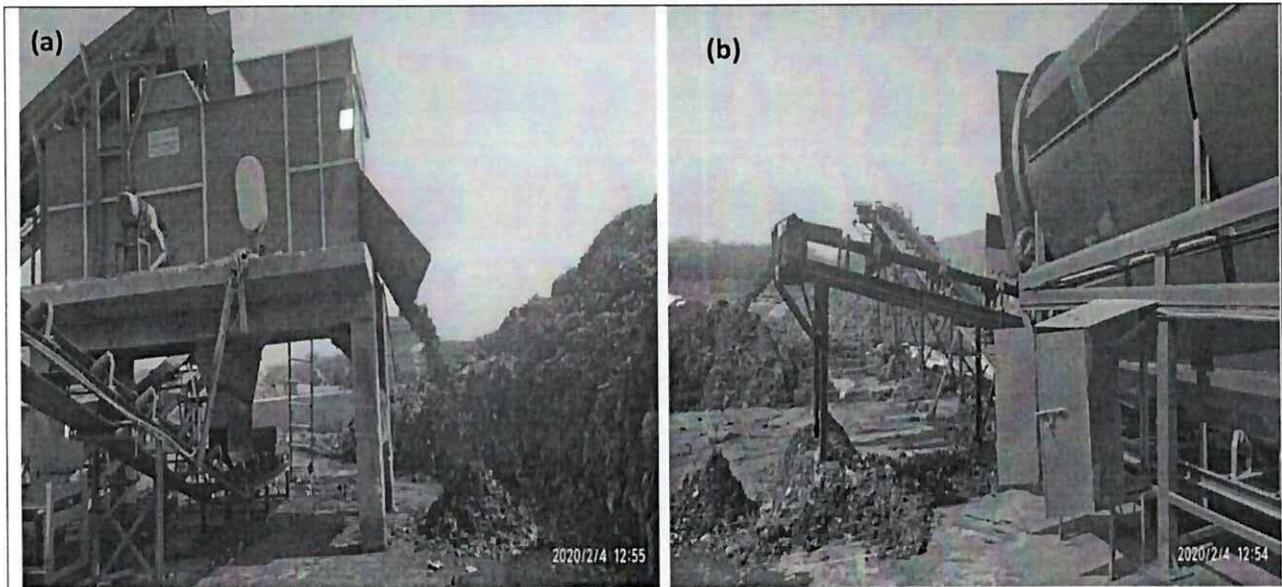


Photo V: (a) Ballistic Separator (Capacity: 300 TPD; Sieve Size: 35 mm)(b) Trommel (Capacity: 300 TPD; Sieve size : 6 & 16 mm combined) for legacy waste.

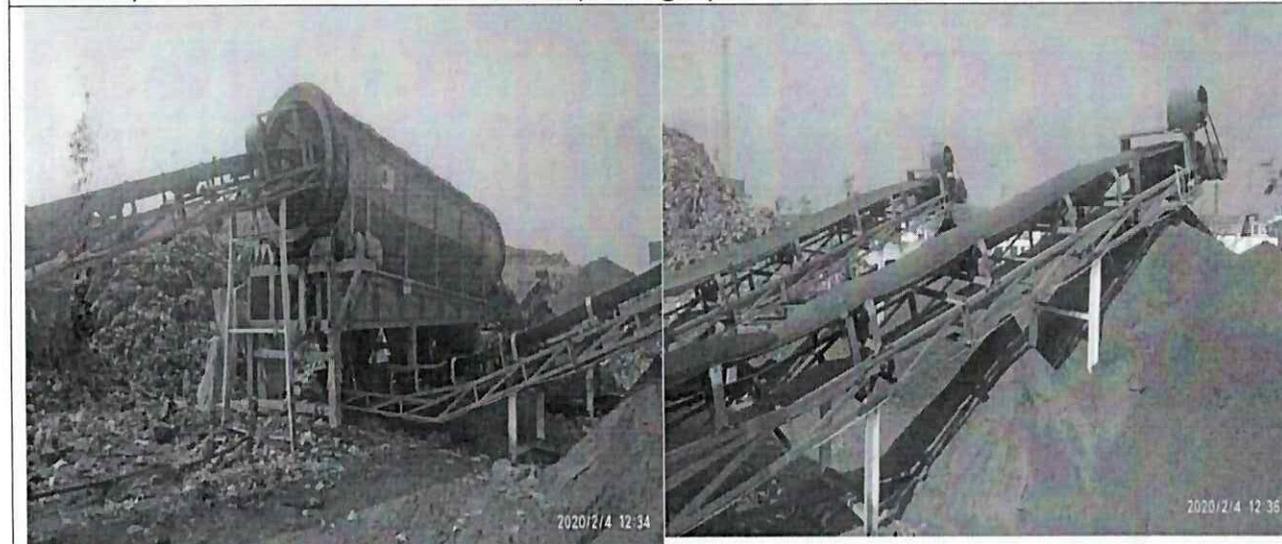


Photo VI: Trommel (Capacity: 300 TPD; Sieve Size: 6 mm, 16 mm & 35 mm) for fresh waste

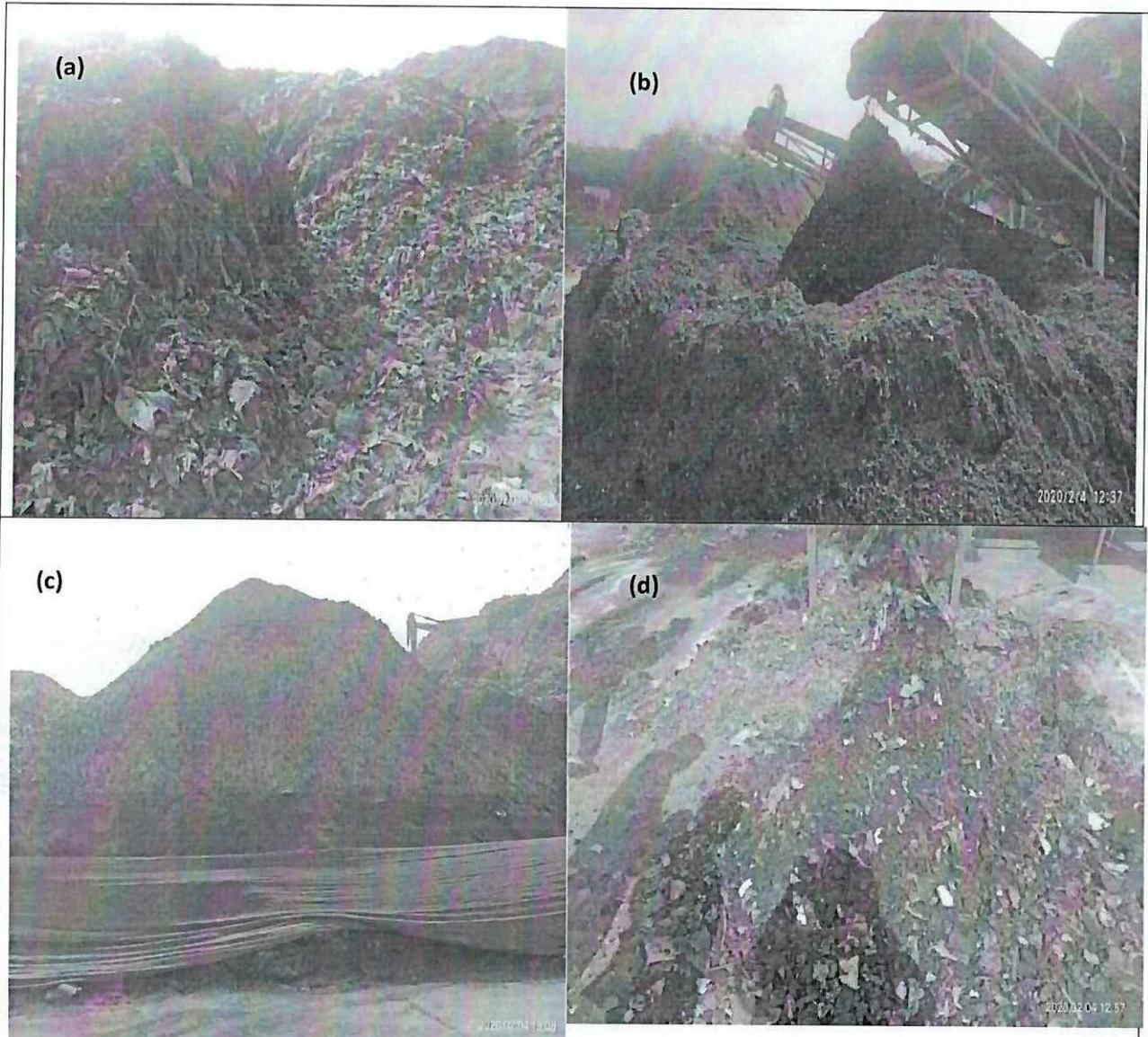


Photo VII: (a) RDF (b) inert (c) compost (d) C& D waste



Photo-VIII: Landfill side slopes were covered with HDPE liner



Photo-IX: Leachate collection pond at site (Total No. 8; Capacity: 40,000 m³)

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DATE: 03/09/2019

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Report Issued To: **M/s Ecogreen Energy Gurgaon- Faridabad Pvt. Ltd.,
Unit No.228-236,Tower-A,Space I-Tech Park, Sector-47,
Sector-49,Gurgaon-122018(HR).**

Date of Sampling : 22.08.2019

Sampling Location: Bhandwari Plant, Sector-32, Zone-4, Gurgaon, Vehicle No. HR 38R-9695

Total wt. (kg) : 2450

Weather : Clear/Rainy

Temperature(°C) : 40

MSW SAMPLING METHODOLOGY

1. Truck/Vehicle from identified area had been taken for the sampling. The net weight of the content was determined by weighing on a weighbridge – near/ on the way to site and empty weight of the truck was taken after emptying the entire truck contents at the landfill site for sampling. Whole MSW was dropped on plastic sheet so that there is no intermixing with the exiting components in the landfill. The truck contents were physically separated for the components. Each of these fractions was weighed individually using a suitable weighing device.
2. Density of MSW was calculated with the help of truck. Truck was completely filled up with waste up to the top level without compacting it and then truck has been weighed with the help of weighing machine containing waste. Empty weight of the truck has also been taken in order to know the exact weight of the waste. Total volume of the truck was taken out by measuring the truck with the help of footrule and accordingly density of MSW was calculated.

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MSW PHYSICAL SEGREGATION REPOTS

S NO.	TYPE OF WASTE	TOTAL WT (Kg)	PERCENTAGE (%)
1	Kitchen waste	122	4.97
2	Lemon Chhilka / Maiz Chhilka	730	29.79
3	Vegetables	242	9.87
4	Dry Sugar Canes	54	2.73
5	Coconut shell/hair	1.8	0.07
6	Straw/Hey	48	1.95
7	Flowers	17	0.69
8	Green leaves/Green Matter	142	5.79
9	Dry leaves/Dry Matter	125	5.1
10	Wooden Pieces	18	0.73
11	Broom	1.5	0.06
12	Cardboard (wooden)	12	0.48
13	Paper/Cardboard	97	3.95
14	Textile/cotton/Jute	128	5.22
15	Rubber/Leather/ Tyre	8	0.32
16	Polythene/plastic	109	4.44
17	PVC	14.8	0.6
18	Metals	4.7	0.19
19	Glass	14.3	0.58
20	Inert and other	298	12.16
21	Sand/soil/earth	158	6.44
22	Stones/brick/concrete	82	3.34
23	Ceramic and other	7.4	0.3
24	Human Hair	0.003	0.0001
25	Batteries	0.02	0.0008
26	Gobber	14	0.57
27	Hazardous waste (if any)	0	0



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28	CONSTRECTION MATERIA	0	0
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** Report End**

For Black Globe Enviro Pvt. Ltd.



Authorized Signatory

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Issued To:

Client Code : M1316
MUNICIPAL CORPORATION GURUGRAM
EXECUTIVE / ASSISTANT ENGINEER
(SWM)

GURUGRAM
HARYANA-122002
Kind Attn: -

Date 08/05/2019
Job No. 1905-1-411-130
Booking No. RG1920/1/1367
Booking Date 01/05/2019
Customer Ref No. MEMO NO.
Customer Ref Date EE(SWM)/MCG/2019/19130
20/04/2019
ULR NO. TC544419000007986F

Sample Description :

ONE SAMPLE OF UNTREATED LEACHATE WATER DRAWN BY OUR REPRESENTATIVE ON 24.04.2019 FROM LTP BANDHWARI PLANT, MUNICIPAL CORPORATION GURGAON WAS RECEIVED.

S.No. Tests	Results	Protocol
1. pH	8.6	IS: 3025 Pt-11-1983, RA 2012
2. Total Dissolved Solids, mg/l	24500	IS: 3025 Pt- 16-1984, RA 2012
3. Total Suspended Solids, mg/l	2800	IS: 3025 Pt-17-1984, RA 2012
4. Biochemical Oxygen Demand, mg/l (at 27 °C for 3 days)	9343	IS: 3025 Pt-44-1993, RA 2009
5. Chemical Oxygen Demand, mg/l	16800	APHA 22nd Ed. 5220
6. Oil and Grease, mg/l	458	APHA 22nd Ed. 5520

DOR: 01.05.2019
DOC: 08.05.2019

AUTHORISED SIGNATORY
EMPLOYEE CODE : (608)

GC-01(Rev-05)

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Annex-3

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GURGAON FARIDABAD TOLL, VILLAGE
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Date 28/05/2019

Job No. 1905-1-411-2684

Booking No. RG1920/1/1969

Booking Date 14/05/2019

Customer Ref No. W.O NO. EEGFPL/SI/19-20/245

Customer Ref Date 06/05/2019

ULR NO. TC544419000009257F

Sample Description :

ONE GRAB SAMPLE 3- DAF OUTLET AT LTP BANDHWARI, GURGAON DRAWN BY OUR REPRESENTATIVE ON 18.05.2019, FROM ECO GREEN ENERGY GURGAON FARIDABAD PVT. LTD., LTP BANDHWARI GURGAON MRKED AS "DAF OUTLET" WAS RECEIVED.

S.No. Tests	Result	Protocol
1. pH	7.2	IS:3025,Pt-11-1983,RA 2012
2. Total dissolved Solids, mg/l	4074	IS:3025,Pt-16-1984,RA 2012
3. Total Suspended Solids, mg/l	20	IS:3025,Pt-17-1984,RA 2012
4. Chemical Oxygen Demand, mg/l	328	APHA 22nd Ed 5220
5. Biochemical Oxygen Demand, mg/l (for 5 days at 20°C)	95	APHA 22nd Ed 5210
6. Oil & Grease, mg/l	3	APHA 22nd Ed.5520
7. Total Chromium (as Cr), mg/l (Detection Limit: 0.01 mg/l)	Not Detected	IS:3025,Pt-2-2004,RA 2009
8. Lead (as Pb), mg/l (Detection Limit: 0.01 mg/l)	Not Detected	IS:3025,Pt-2-2004,RA 2009
9. Cadmium (as Cd), mg/l (Detection Limit : 0.01 mg/l)	Not Detected	IS:3025,Pt-2-2004,RA 2009
10. Nickel (as Ni), mg/l (Detection Limit : 0.01 mg/l)	Not Detected	IS:3025,Pt-2-2004,RA 2009
11. Mercury (as Hg), mg/l	0.08	APHA 22nd Ed.3112

AUTHORISED SIGNATORY
EMPLOYEE CODE : (6087)

GC-01(Rev-05)

Page 1 of 2

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Fax : 91-11-27667676, 27667207

SR1-C1 (Rev. 02)

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Website : www.shriraminstitute.org
E-mail id : customercare@shriraminstitute.org

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NO. : C1/0000175262

12. Zinc (as Zn), mg/l	0.05	IS:3025,Pt-2-2004,RA 2009
13. Copper (as Cu), mg/l (Detection Limit: 0.01 mg/l)	Not Detected	IS:3025,Pt-2-2004,RA 2009
14. Arsenic (as As), mg/l (Detection Limit: 0.005 mg/l)	Not Detected	IS:3025,Pt-37-1988,RA 2009
15. Fluoride (as F), mg/l	0.2	APHA 22nd Ed.4500-F
16. Cyanide (as CN), mg/l (Detection Limit: 0.05 mg/l)	Not Detected	IS:3025,Pt-27-1986,RA 2009
17. Phenolic Compound (as C ₆ H ₅ OH), mg/l (Detection Limit: 0.01 mg/l)	Not Detected	IS:3025,Pt-43-1992,RA 2009
18. Ammoniacal Nitrogen (as N), mg/l	29	IS:3025,Pt-34-1988,RA 2009
19. Total Kjeldahl Nitrogen (as N), mg/l	34	IS:3025,Pt-34-1988,RA 2009

D.O.R. 18.05.2019
D.O.C. 28.05.2019


AUTHORISED SIGNATORY
EMPLOYEE CODE : (2081)

GC-01(Rev-05)

Page 2 of 2

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SR1-C1 (Rev. 02)

Phone : 91-11-27667267, 27667983, 27667860 Fax : 91-11-27667676, 27667207
See overleaf for terms & conditions



**ENVIRONMENT LAB
TEST CERTIFICATE**

Issued To : Ecogreen Energy Pvt. Ltd.
603-607, ILD Trade Centre,
Sector-47,
Sohna Road,
Gurgaon, Haryana - 122001

Description : Ground Water, Location: Bore well Water(Bandwari Landfill Site)

Report No: 11-090217-02
Report Date: 23/02/2017
Sample Received On : 09/02/2017
Sampled By: AES Labs (SM 4.1)

Analysis Start Date: 09/02/2017
Analysis End Date : 23/02/2017

RESULTS

Parameter	Test Method	Results	Units
Chemical Analysis			
Calcium (as Ca)	APHA 3500 (B)	133	mg/l
Magnesium (as Mg)	APHA 3500 (B)	35	mg/l
Sodium (as Na)	APHA 3500 (B)	360	mg/l
Carbonates (as CaCO ₃)	IS 3025 Pt 51:2001	592	mg/l
Bicarbonate (as CaCO ₃)	IS 3025 Pt 51:2001	722	mg/l
Chloride (as Cl)	IS 3025 Pt 32:1988	276	mg/l
*Hydroxides(as CaCO ₃)	APHA 2130 (B)	591	mg/l
Silica Reactive	APHA 4500 (D)	42	mg/l
Fluoride (as F)	APHA 4500 (D)	1	mg/l
pH Value at 25°C	APHA 4500 (B)	7.44	-
Turbidity	APHA 2130 (B)	<1.0	NTU
Solids Dissolved (TDS)	IS 3025 Pt 16:1984	1171	mg/l
Silica Colloidal	APHA 4500 (C)	0.6	mg/l
BOD 5 days at 20°C	APHA 5210(B)	4	mg/l
COD (as O ₂)	IS 3025 Pt 58:2006	66	mg/l
M.Alkalinity(as CaCO ₃)	IS 3025 Pt 23:1966	559	mg/l
Colour	IS 3025 pt 4: 1983	<1.0	Hazen
*Cobalt (as Co)	APHA 3111 (B)	ND (<0.05)	mg/l
*Silt Density Index(SDI)	Membrane Filtration	0.043	-
Conductivity at 25°C	IS 3025 Pt 14:1984	1748	µS/cm
General Parameters			
Potassium (as K)	APHA 3500 (B)	2	mg/l



Description : Ground Water, Location: Bore well Water(Bandwari Landfill Site)

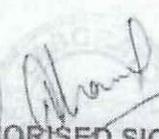
Analysis Start Date : 09/02/2017
Analysis End Date : 23/02/2017

RESULTS

Parameter	Test Method	Results	Units
Iron (as Fe)	APHA 3111 (B)	0.2	mg/l
Manganese (as Mn)	APHA 3111 (B)	ND (<0.02)	mg/l
Sulphates (as SO ₄)	APHA 4500 (E)	239	mg/l
Nitrate (as N)	APHA 4500-NO ₃ E	<1.0	mg/l
Temperature	IS 3025 Pt 9:1984	23	°C
Odour	IS 3025 Pt 5:1983	Agreeable	-
Hardness Temporary (as CaCO ₃)	APHA 2340 (C)	478	mg/l
Hardness Permanent	APHA 2340 (C)	41	mg/l
Hardness Total (as CaCO ₃)	APHA 2340 (C)	519	mg/l
Oxygen Dissolved	IS 3025 Pt 38:1989	7	mg/l
Solids Suspended (TSS)	IS 3025 Pt 17:1984	<1.0	mg/l
Alkalinity Phenolphthalein	IS 3025 Pt 23:1986	33	mg/l
Microbiological Analysis			
Total Bacteria Count	IS 5402:2002	1000	cfu/ml

Total Parameters : 34

Note(s) : ND means Not Detected. The values enclosed in brackets are the detection limits of the mentioned test method.
Parameter(s) marked with a # are not NABL accredited.



AUTHORISED SIGNATORY

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 - Samples received shall be destroyed after four weeks from the date of issue of the certificate unless specified otherwise.
 - This certificate shall not be used in any advertising media or as evidence in the Court of Law without prior written consent of the laboratory.



**A REPORT ON SUB-SOIL
INVESTIGATION & TESTING
CONSTRUCTION OF WASTE PLANT
BANDAHRI VILLAGE**

For ECOGREEN ENERGY GURGAON FARIDABAD PVT. LTD.



Neevinternational

Property of ECOGREEN ENERGY GURGAON FARIDABAD PVT. LTD

By Eng. Sameer Verma (Mtech Civil) and
Ch. Eng Rohit Kapoor
9/10/2017



For ECOGREEN ENERGY GURGAON FARIDABAD PVT. LTD.

9/10/2017

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For *ECOGREEN ENERGY GURGAON FARIDABAD PVT. LTD.*

9/10/2017

ANNEXURES

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For *ECOGREEN ENERGY GURGAON FARIDABAD PVT. LTD.*

9/10/2017

INTRODUCTION:

Construction of Waste Management Plant is proposed at Bandhari village Faridabad - Gurgaon Highway. (U.P.). The construction work is being carried out by construction agency Eco Green Energy Gurgaon Faridabad PVT. Ltd. They have assigned the soil investigation and testing works to our concern M/s Neev International, 3/246 Vipul Khand Gomti Nagar, Lucknow. The objective of present investigation is to study the Geotechnical behavior of underneath soil on the basis of Index properties and based on that; suggest allowable bearing capacity of the soil under fully loaded conditions.

SCOPE OF WORK & LOCATION:

The scope of work includes carrying out various field tests for obtaining necessary details and collection of soil samples for laboratory testing in order to have further information related with the soil properties. The fieldwork consisted of drilling four bore holes up to 10.0 m from the existing ground level at the site, and then carrying out necessary tests. Following tests were carried out in the lab:

-

1. Moisture content
2. Sieve Analysis
3. Atterberg's limit
4. Consolidation test
5. Specific gravity
6. Bulk density



For **ECOGREEN ENERGY GURGAON FARIDABAD PVT. LTD.**

9/10/2017

PERIOD OF INVESTIGATION & POSITION OF WATER TABLE:

The investigations were carried out in the month of October 2017. The weather was clear and water table was intercepted up to at about of 8.50 m depth at the time of sub-soil exploration below exiting ground level.

SITE INVESTIGATION & INSITU TESTS:

The soil investigations work was carried out in two steps .In the first step in-situ tests were carried out at the site and undisturbed, disturbed and SPT soil samples were collected. Secondly, these samples were subjected to different tests in the laboratory to obtain the various soil parameters required for evaluation of bearing capacity of the soil. In the field, 150 mm nominal diameter bore-hole drilling was carried out with the help of hand operated auger and casing arrangement in accordance with IS: 1892-1979. During boring, visual observations regarding the nature of the out coming soil were made, for having a preliminary idea about the sub-soil strata. Standard penetration Test was conducted as in-situ test along with Dynamic Cone Penetration Test, which was also conducted at the site.

STANDARD PENETRATION TEST:

Out of a number of similar tests, this test is one of the most important one conducted at the site. This test is specially suited for cohesion less soils, that are difficult to be sampled, and it is extremely useful for reporting relative density and angle of shearing resistance of cohesion less soils. It may also be used for determining the unconfined compressive strength of cohesive soils.

The standard Penetration Test (SPT) is conducted in a borehole using a standard split spoon sampler. The split spoon consists of a Driving Shoe about



For *ECOGREEN ENERGY GURGAON FARIDABAD PVT. LTD.*

9/10/2017

75 mm long, having a steel tube about 450 mm long which could be split into two halves longitudinally and coupling at the top of the tube about 150 mm long. The inside and outside diameters of the split tube are 35 mm and 50.8 mm respectively. The test is carried out by driving the split spoon sampler into the soil by a hammer weighing 65.0 Kg and falling freely from a height of 750 mm, through the guide rod. Each hammer blow drives the sampler into the soil. Number of blows for each penetration of 150 mm of the sampler are recorded in succession till total penetration becomes 450 mm. Nos. of blows for first 150 mm penetration are discarded considering them as seating drives. The total number of blows recorded for the last two 150 mm penetration are added to report SPT number (N), the recorded value of standard penetration number is corrected for dilatancy corrections as well as overburden correction. The standard penetration tests were conducted as per IS:2131-1963 in each bore hole at a regular interval of 1.50 metres and the values are indicated in the bore log chart attached with this report.

SAMPLING:

The undisturbed samples were collected at a regular interval of 1.50 metres in each borehole or at change of strata. The undisturbed soil samples were taken using open drive sampler having thin walls and internal diameter of 100 mm as per IS: 2132-1981. After the recovery of the sampler from the borehole they were immediately sealed with wax properly so as to avoid moisture loss and labeled with all the necessary details and forwarded to the laboratory for further investigations. Those samples, which slipped during collection, were not considered for testing. Disturbed soil samples were also taken at every meter depth of the soil from the general ground level and kept in polythene bags with details such as depth, borehole number etc. The disturbed soil samples were tested only for sieve analysis and Atterberg's limits.

LABORATORY INVESTIGATIONS:

ecogreen

5 ©



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9/10/2017

The recovered soil samples from the site of the investigations from bore holes were tested for various index properties as per the various parts of IS: 2720. The test results are enclosed as Annexure- 02 to this report. The disturbed soil samples were tested for sieve analysis, Atterberg's limits, harmful salts etc., while the undisturbed samples were tested for shear parameters and consolidation properties etc., besides the index properties. The details of the results are also annexed with this report.

METHODOLOGY AND REPORT:

Bearing capacity of shallow foundations has been worked out on two considerations. The foundation should be safe against shear failure as per IS: 6403-1981 and it should also be safe against excessive settlement as per IS: 8009 part part – I. The depth of foundation is governed by IS: 1080-1980. The safe bearing capacity was worked out on the basis of shear parameters and settlement was evaluated under this loading. Total settlement was checked so that it remains within the permissible limits.

BEARING CAPACITY CALCULATIONS:

Bearing capacity calculations, for arriving at safe bearing capacity, have been carried out on the basis of laboratory results of the soil samples collected from the site. Due corrections have been made in the recorded standard penetration values (N). The Bearing capacity calculations have been carried out for Strip footings in lieu of the structures proposed at site.

RECOMMENDATIONS AND CONCLUSIONS: -

- 1) In all the boreholes the strata are almost similar in nature. It consists of silty clay of low plasticity (CL) ,sandy clay (SC), gravelly clay (GC) and well graded gravel as per I.S. Specification.



For ECOGREEN ENERGY GURGAON FARIDABAD PVT. LTD.

9/10/2017

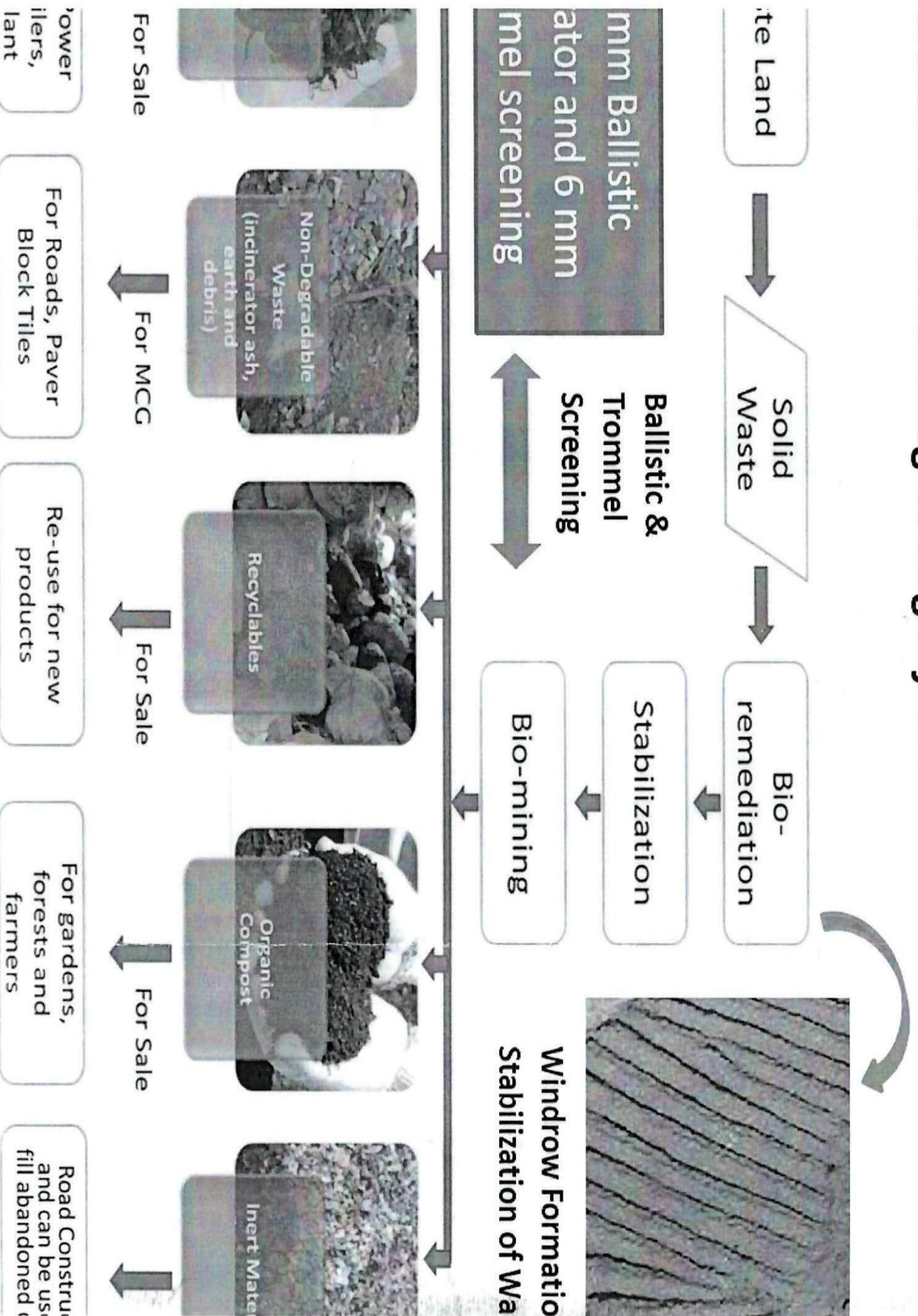
- 2) Observing bearing capacity from shear as well as from settlement criteria, it is revealed that shear failure consideration will govern the design of foundation rather than the settlement.
- 3) Water table was encountered up to at about of 8.50m depth below existing ground level at the time of sub-soil exploration.
- 4) The values of allowable bearing capacity at 1.50m & 2.0m depth below existing ground level have been evaluated for isolated footing of 1.50 m widths and the results are tabulated below: -

B.H. NO.	S.L. No.	Depth (m)	Type of footing	Foundation Width (m)	Allowable Bearing Capacity (T/m ²)
1	i	1.50	Isolated Footing	1.50	9.41
	ii	2.0		1.50	11.64
2	i	1.50	Isolated Footing	1.50	8.99
	ii	2.0		1.50	12.08
3	i	1.50	Isolated Footing	1.50	12.44
	ii	2.0		1.50	14.04
4	i	1.50	Isolated Footing	1.50	12.89
	ii	2.0		1.50	14.77

Based on the above observations Isolated footing may be recommended at 1.50m/2.00m depth.

Remediation & Biomining of Legacy Waste

Annexure-6





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272, Phase-IV, Sec-57, HSIIDC, Kundli, Sonapat-131028 (Haryana)

Ph. : 7082301442, 9250014551 Email : aalkundli@gmail.com

Website : www.aalkundli.com

TEST CERTIFICATE

Page 1 of 1

Issued To:

M/s Ecogreen Energy Gurgaon-Faridabad
Pvt. Ltd.

Unit No.228-236, Tower-A,
Space I-Tech Park, Sector-49,
Gurgaon - 122018 (HR)

Sample Description:

One sample described as Legacy Waste (6-mm) -
Compost, Location: Bhandwari Plant,
Gurgaon, was received.

Report No.

AAL MIS-20191126002

Date of Receiving:

26/11/2019

Date of Starting:

25/11/2019

Date of Completion:

06/12/2019

Date of Reporting:

06/12/2019

Sample Qty.

2 Kgs.

Sample Packing Condition:

Polythene Bag

TEST RESULT

(Standards As Per FCO Schedule-IV Part-A: 1985)

S. No.	Test Parameters	Unit	Results	Limits	Test Method
1	Colour	-	Blackish	Dark Brown to Black	Visual
2	Odour	-	No foul odour found	Absence of foul odour	FCO Sch.IV Part-A:1985
3	Moisture Content	%	22.24	15-25	FCO Sch.IV Part-D2:1985
4	Bulk Density	g/cc	0.97	<1.0	FCO Sch.II Part-B3:1985
5	Organic Carbon	% by weight	13.5	12 Min.	FCO Sch.IV Part-D5:1985
6	Total Nitrogen (as N)	% by weight	1.25	0.8 Min.	FCO Sch.II Part-B3:1985
7	Total Phosphate (as P ₂ O ₅)	% by weight	0.84	0.4 Min.	FCO Sch.IV Part-D8:1985
8	Total Potash (as K ₂ O)	% by weight	0.75	0.4 Min.	FCO Sch.IV Part-D9:1985
9	C/N Ratio	-	15.29	<20.0	FCO Sch.IV Part-D7:1985
10	pH Value (1:2)	-	7.40	6.5 - 7.5	FCO Sch.III Part-D1:1985
11	Electrical Conductivity	dSm ⁻¹	3.57	4.0 Max.	FCO Sch.IV Part-D4:1985
12	Arsenic (as As)	mg/kg	BDL (DL=5.0)	10 Max.	FCO Sch.IV Part-D10:1985
13	Cadmium (as Cd)	mg/kg	BDL (DL=3.0)	5.0 Max.	FCO Sch.IV Part-D10:1985
14	Chromium (as Cr)	mg/kg	32.16	50 Max.	FCO Sch.IV Part-D10:1985
15	Copper (as Cu)	mg/kg	74.38	300 Max.	FCO Sch.IV Part-D10:1985
16	Nickel (as Ni)	mg/kg	16.34	50 Max.	FCO Sch.IV Part-D10:1985
17	Lead (as Pb)	mg/kg	10.06	100 Max.	FCO Sch.IV Part-D10:1985
18	Zinc (as Zn)	mg/kg	243.32	1000 Max.	FCO Sch.IV Part-D10:1985
19	Mercury (as Hg)	mg/kg	BDL (DL=0.1)	0.15 Max.	Cold Vapor Testing
20	E.Coli	cfu/gm	Absent	Nil	FCO Sch.III Part-D1C:1985
21	Particle Size (Sieve Analysis)	Retained %	Passing %		IS 2386 (P-1)-1963
	6.0mm	72.6	27.4		

End of Report



Authorised Signatory

Note: 1. The Result indicated above refer to the tested sample and listed test parameters only, endorsement of products is neither inferred nor implied.
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4. This report shall not be used in any advertising media or as evidence in the court of law without prior written consent of the laboratory.
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Ph. : 7082301442, 9250014551 Email : aalkundli@gmail.com

Website : www.aalkundli.com

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Page 1 of 1

Issued To: M/s Ecogreen Energy Gurgaon-Faridabad

Pvt. Ltd.

Unit No.228-236, Tower-A

Space I-Tech Park, Sector-19,

Gurgaon - 122 018 (HR)

Sample Description: One sample described as Legacy Waste (6 mm) -

Compost. Location: Bhandwari Plant,

Gurgaon, was received.

Report No. AAL MIS-20191126002

Date of Receiving: 26/11/2019

Date of Starting: 26/11/2019

Date of Completion: 06/12/2019

Date of Reporting: 06/12/2019

Sample Qty. 2 Kgs.

Sample Packing Condition: Polythene Bag

TEST RESULT

(Standards As Per FCO Schedule-IV Part-A: 1985)

S. No.	Test Parameters	Unit	Results	Limits	Test Method
1	Colour	-	Blackish	Dark Brown to Black	Visual
2	Odour	-	No foul odour found	Absence of foul odour	FCO Sch.IV Part-A:1985
3	Moisture Content	%	22.24	15-25	FCO Sch.IV Part-D2:1985
4	Bulk Density	g/cc	0.97	<1.0	FCO Sch.II Part-B3:1985
5	Organic Carbon	% by weight	13.5	12 Min.	FCO Sch.IV Part-D5:1985
6	Total Nitrogen (as N)	% by weight	1.25	0.8 Min.	FCO Sch.II Part-B3:1985
7	Total Phosphate (as P ₂ O ₅)	% by weight	0.84	0.4 Min.	FCO Sch.IV Part-D8:1985
8	Total Potash (as K ₂ O)	% by weight	0.75	0.4 Min.	FCO Sch.IV Part-D9:1985
9	C/N Ratio	-	15.29	<20.0	FCO Sch.IV Part-D7:1985
10	pH Value (1:2)	-	7.40	6.5 - 7.5	FCO Sch.III Part-D1:1985
11	Electrical Conductivity	dSm ⁻¹	3.57	4.0 Max	FCO Sch.IV Part-D4:1985
12	Arsenic (as As)	µg/kg	BDL (DL=5.0)	10 Max.	FCO Sch.IV Part-D10:1985
13	Cadmium (as Cd)	µg/kg	BDL (DL=3.0)	5.0 Max.	FCO Sch.IV Part-D10:1985
14	Chromium (as Cr)	µg/kg	32.16	50 Max.	FCO Sch.IV Part-D10:1985
15	Copper (as Cu)	µg/kg	74.38	300 Max.	FCO Sch.IV Part-D10:1985
16	Nickel (as Ni)	µg/kg	16.34	50 Max.	FCO Sch.IV Part-D10:1985
17	Lead (as Pb)	µg/kg	10.06	100 Max.	FCO Sch.IV Part-D10:1985
18	Zinc (as Zn)	µg/kg	243.32	1000 Max.	FCO Sch.IV Part-D10:1985
19	Mercury (as Hg)	µg/kg	BDL (DL=0.1)	0.15 Max.	Cold Vapor Testing
20	E.Coli	cfu/gm	Absent	Nil	FCO Sch.III Part-D1C:1985
21	Particle Size (Sieve Analysis)	Retained %	Passing %		
	6.0mm	72.6	27.4		IS 2386 (P-1)-1963

End of Report

Authorised Signatory

Note: 1. The Result Indicated above refer to the tested sample and listed test parameters only, endorsement of products is neither inferred nor implied.
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5. The non-perishable sample received shall be destroyed after one month and perishable sample shall be destroyed after one week from the date of issue of report unless specified.

F.No.10-74/2016-IA.III
Government of India
Ministry of Environment, Forest and Climate Change
(IA.III - Section)

Indira Paryavaran Bhawan,
JorBagh Road, New Delhi - 110003
Date: 1st November, 2019

To,
The Assistant Nodal Officer
M/s Gurgaon Municipal Corporation
Directorate of Urban Bodies
Bays No. 11-14, Sector - 4, Gurugram (Haryana)

Subject: Integrated Solid Waste Processing Facility at Bandhwari Village, Gurgaon District, Haryana by M/s Gurgaon Municipal Corporation - Environmental Clearance - regarding.

Sir,

This has reference to your online proposal No.IA/HR/MIS/100246/2016 dated 26.03.2019 submitted to this Ministry for grant of Environmental Clearance (EC) in terms of the provisions of the Environment Impact Assessment (EIA) Notification, 2006 under the Environment (Protection) Act, 1986.

2. The proposal for grant of environmental clearance to the project "Integrated Solid Waste Processing Facility at Bandhwari Village, Gurgaon District, Haryana by M/s Gurgaon Municipal Corporation was considered by the Expert Appraisal Committee (Infra-2) in its 40th meeting held on 23.04.2019 and 43rd meeting held during 20-22 August, 2019. The details of the project, as per the documents submitted by the project proponent, and also as informed during the above meeting are as under:

- (i) The proposed MSW disposal site is situated in Village Bandhwari, Tehsil and District Gurugram in Haryana. The nearest railway station is Faridabad at a distance of 13.7 km in East direction. Indira Gandhi International airport is the nearest airport at an aerial distance of 18.10 km in NNW direction'
- (ii) The proposed project is categorized under Item "7(i) Common Municipal Solid Waste Management Facility (CMSWMF)" in the EIA Notification, dated 14th September, 2006 and its amendments. The project falls under interstate boundary of Haryana and Delhi which is distance about 0.98 km from project site so the proposed project falls under Category 'A', and require appraisal at MoEF&CC.
- (iii) Expected Waste Quantity -1165 TPD in 2015; 1565 TPD by 2025 and 2100 TPD by 2035.
 - a. Composting- 147 TPD
 - b. Sanitary Landfill Design Life of Landfill is 20 Years
 - c. Power Plant - 15 MW
- (iv) Terms of Reference was granted by MoEFCC vide letter F.No. 10-74/2016-IA.III dated 27.03.2017 and subsequent amendment in ToR was granted on 05.03.2019.
- (v) Asola Wildlife Sanctuary is within 5.82 km NE direction from the project site.
- (vi) During construction phase water requirement will be about 8-10 KLD which will be brought from Municipal Corporation of Gurugram. During operational phase total water requirement in the project will be about 837 KLD which will meet from nearby STP at Behrampur by Gurugram Metropolitan Development Authority.
- (vii) Power up to 500 KW will be sourced from local grid during construction phase and will be backed up through 1 D.G sets of 630 KVA. During operation phase auxiliary

J. Rose

supply from proposed power plant (15 MW) will cater the need of the MSW processing facility and same shall again be backed through Grid supply & DG set.

- (viii) Greenbelt has been planned in the periphery of the proposed project site which along with the other planned green areas within the site, will cover about 33% of the total project area
- (ix) The generation of primary data as well as collection of secondary data and information from the site and surroundings was carried out during winter season i.e. December, 2016 to February, 2017. One-month additional study was done in February, 2019.
- (x) Public Hearing was conducted by Haryana State Pollution Control Board Gurugram on 21st March, 2018 at Project Site, Village Bandhwari, District Gurugram, Haryana.
- (xi) Employment potential: During construction phase - 500 persons will be employed. During operational phase - 2000 on site (About 1900 temporary employees will be hired for primary collection, transportation and miscellaneous jobs
- (xii) Estimated Project Cost is Rs. 330.48 Crores.
- (xiii) Benefits of the project: Employment Potential, Benefit to the Urban Local Body, Organized Collection of MSW and Improvement in Social & Physical Infrastructure.

3. The project/activity is covered under category B of item 7(i) Common Municipal Solid Waste Management Facility (CMSWMF) of the Schedule to the EIA Notification, 2006 and its amendments, and requires appraisal at State Level. However, due to applicability of General Condition i.e. Interstate Boundary of Haryana and Delhi is at distance about 0.98 km from the site, the project is appraised at Central level by sectoral EAC.

4. The proposal was earlier considered by EAC in its 40th meeting held on 23.04.2019. The Committee deliberated upon the issues raised during the Public Hearing/Public Consultation meeting conducted by the Haryana State Pollution Control Board on 21.03.2018. The issues were raised regarding air pollution, health issues of the local residents and ground water pollution by the proposed plant etc. The Committee noted that issues have satisfactorily been responded by the project proponent and incorporated in the final EIA-EMP report. The Committee also noted that Asola Wildlife Sanctuary is situated at 5.82 km NE direction from the project site. The EAC was informed that Eco Sensitive Zone of Asola Wildlife Sanctuary has not been notified in the State of Haryana and hence NBWL clearance will be required for the project. Also the project proponent has not applied for the NBWL clearance. Accordingly, the Committee asked the project proponent to submit the status of clearance from National Board for Wild Life (NBWL), revised Leachate Treatment Scheme (Plan) for the proposed project and revised water balance.

5. Project Proponent has submitted the additional information on Ministry's website on 10.07.2019. Accordingly, proposal was re-considered by EAC in its 43rd meeting held during 20-22 August, 2019. During deliberation the project proponent that the Municipal Corporation, Gurugram is leading Urban Local Body for "Integrated Solid Waste Management Processing Facility of Capacity 2100 TPD" at Bandhwari, Gurugram for Municipal Corporation, Gurugram and Faridabad. The proposed site is situated at a distance of more than 300 meters from the boundary points of Asola Bhatti Wildlife Sanctuary (MoEF&CC Notification No. 5.0. 2996 (E) dated 11th September 2017) and is beyond Eco Sensitive Zone of Asola Bhatti Wildlife Sanctuary which is 100 meters at ID Point P-9 & P-10 (nearest points to proposed site) (refer MoEF&CC Notification No. 5.0. 1911 (E) dated 31st May 2019). The project proponent also submitted a letter No. 992 dated 09.04.2019 issued by Forest & Wildlife Department, Government of Haryana stating that proposed site is situated at a distance of 27.5 km from boundary of Sultanpur National Park.

J. Rose

6. The EAC, based on the information submitted and clarifications provided by the Project Proponent and detailed discussions held on all the issues, recommended the project for grant of environmental clearance with stipulated specific conditions along with other Standard EC Conditions as specified by the Ministry vide OM dated 4th January, 2019 for the said project/activity, while considering for accord of Environmental Clearance. As per recommendations of the EAC, the Ministry of Environment, Forest and Climate Change hereby accords Environmental Clearance to the project "Integrated Solid Waste Processing Facility at Bandhwari Village, Gurgaon District, Haryana by M/s Gurgaon Municipal Corporation under the provisions of the EIA Notification, 2006 and amendments/circulars issued thereon, and subject to the specific and general conditions as under: -

A. Specific Conditions:

- (i) Consent to Establish/Operate for the project shall be obtained from the State Pollution Control Board as required under the Air (Prevention and Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974.
- (ii) Green Belt along the periphery in 3 tier. The landscape planning should include plantation of native species. The species with heavy foliage, broad leaves and wide canopy cover are desirable. Water intensive and/or invasive species should not be used for landscaping.
- (iii) Ground water monitoring for Physico-Chemical parameters to be carried out and record maintained by providing piezometric wells along the flow channel (up and down).
- (iv) Leachates to be collected and utilized within project after proper treatment.
- (v) Environmental Monitoring Programme shall be implemented as per the EIA report and guidelines prescribed by CPCB for hazardous waste facilities. Periodical ground water/soil monitoring to check the contamination in and around the site shall be carried out.
- (vi) The Company shall review the unit operations provided for the treatment of effluents, specially the sequencing of MEE after tertiary treatment, the source of permeate when no R.O. is recommended and the treatment of MEE condensate. The scheme for treatment of effluents shall be as permitted by the Pollution Control Board/Committee under the provisions of consent to establish.
- (vii) On line real time continuous monitoring facilities shall be provided as per the CPCB or State Board Directions.
- (viii) Project Proponent shall develop green belt, as committed. At least 10 m thick greenbelt shall be developed in the periphery of sanitary landfill facility.
- (ix) Pre-medical check-up to be carried out on workers at the time of employment and regular medical record to be maintained.
- (x) Emergency plan shall be drawn in consultation with SPCB/CPCB and implemented in order to minimize the hazards to human health or environment from fires, explosion or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil or surface water.

B. Standard Conditions:

I. Statutory compliance:

- i. The project proponent shall obtain forest clearance under the provisions of Forest (Conservation) Act, 1980, in case of the diversion of forest land for non-forest purpose involved in the project.

S. Bose

- ii. The project proponent shall obtain clearance from the National Board for Wildlife, if applicable.
- iii. The project proponent shall prepare a Site-Specific Conservation Plan & Wildlife Management Plan and approved by the Chief Wildlife Warden. The recommendations of the approved Site-Specific Conservation Plan / Wildlife Management Plan shall be implemented in consultation with the State Forest Department. The implementation report shall be furnished along with the six-monthly compliance report (in case of the presence of Schedule-I species in the study area)
- iv. The project proponent shall obtain the necessary permission from the Central Ground Water Authority, in case of drawl of ground water / from the competent authority concerned in case of drawl of surface water required for the project.
- v. A certificate of adequacy of available power from the agency supplying power to the project along with the load allowed for the project should be obtained.
- vi. All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department shall be obtained, as applicable by project proponents from the respective competent authorities.

II. Air quality monitoring and preservation:

- i. The project proponent shall install 24x7 continuous emission monitoring system at process stacks to monitor stack emission with respect to standards prescribed in Environment (Protection) Rules 1986 and connected to SPCB and CPCB online servers and calibrate these systems from time to time according to equipment supplier specification through labs recognized under Environment (Protection) Act, 1986 or NABL accredited laboratories. (for projects involving incineration).
- ii. As proposed, air pollution control device viz. gas quencher; treatment with mixture of hydrated lime and activated powder for adsorption of partial acidity and VOCs (if any); bagfilter/ESP for removal of particulate matter; venturi scrubber followed by packed bed scrubber with caustic circulation to neutralize the acidic vapours in flue gas; and demister column for arresting water carry over will be provided to the incinerator. Online pollutant monitoring shall be provided as per CPCB guidelines for monitoring particulate matter, SO₂, NO_x and CO from the incinerator stack. The periodical monitoring of Dioxins and Furans in the Stack emissions shall be carried out.
- iii. Analysis of Dioxins and Furans shall be done through CSIR-National Institute for Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram or equivalent NABL Accredited laboratory.
- iv. Incinerator shall be designed as per CPCB guidelines. Energy shall be recovered from incinerator.
- v. Gas generated in the Land fill should be properly collected, monitored and flared.
- vi. The project proponent shall install system to carryout Ambient Air Quality monitoring for common/criterion parameters relevant to the main pollutants released (e.g. PM₁₀ and PM_{2.5} in reference to PM emission, and SO₂ and NO_x in reference to SO₂ and NO_x emissions) within and outside the project area at least at four locations (one within the project area and three outside the project area), covering upwind and downwind directions.

III. Water quality monitoring and preservation:

- i. The project proponent shall install continuous effluent monitoring system with respect to standards prescribed in Environment (Protection) Rules 1986 and connected to

J. Bose

SPCB and CPCB online servers and calibrate these systems from time to time according to equipment supplier specification through labs recognized under Environment (Protection) Act, 1986 or NABL accredited laboratories.

- ii. Sufficient number of Piezometer wells shall be installed in and around the project site to monitor the ground water quality in consultation with the State Pollution Control Board / CPCB. Trend analysis of ground water quality shall be carried out each season and information shall be submitted to the SPCB and the Regional Office of MoEF&CC.
- iii. The depth of the land fill site shall be decided based on the ground water table at the site.
- iv. Rain water runoff from the landfill area and other hazardous waste management area shall be collected and treated in the effluent treatment plant.
- v. Total fresh water use shall not exceed the proposed requirement as provided in the project details. Prior permission from competent authority shall be obtained for use of fresh water.
- vi. The Company shall ensure proper handling of all spillages by introducing spill control procedures for various chemicals.
- vii. All leachates arising from premises should be collected and treated in the ETP followed by RO. RO rejects shall be evaporated in MEE. Toxicity Characteristic Leaching Procedure (TCLP) test to be performed on leachates.
- viii. Scrubber water, leachate water or wheel wash effluent shall be treated in the effluent treatment plant followed by RO to achieve zero liquid discharge.
- ix. Sewage Treatment Plant shall be provided to treat the wastewater generated from the project. Treated water shall be reused within the project.
- x. A certificate from the competent authority for discharging treated effluent/ untreated effluents into the Public sewer/ disposal/drainage systems along with the final disposal point should be obtained.

IV. Waste management:

- i. No non-hazardous wastes, as defined under the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, shall be handled in the premises.
- ii. The solid wastes shall be segregated, managed and disposed as per the norms of the Solid Waste Management Rules, 2016.
- iii. Any wastes from construction and demolition activities related thereto shall be managed so as to strictly conform to the Construction and Demolition Waste Management Rules, 2016.
- iv. A certificate from the competent authority handling municipal solid wastes should be obtained, indicating the existing civic capacities of handling and their adequacy to cater to the M.S.W. generated from project.

V. Transportation:

- i. Project should ensure that the site is properly cordoned off from general movement and no unauthorized person or goods permitted to enter the premises. Necessary security provision should be made as a condition in the Authorization under the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 to prevent unwanted access.

S. Bose

- ii. Traffic congestion near the entry and exit points from the roads adjoining the project site shall be avoided. Parking should be fully internalized and no public space should be utilized.
- iii. A detailed traffic management and traffic decongestion plan shall be drawn up to ensure that the current level of service of the roads within a 02 kms radius of the project is maintained and improved upon after the implementation of the project. This plan should be based on cumulative impact of all development and increased habitation being carried out or proposed to be carried out by the project or other agencies in this 02 Kms radius of the site in different scenarios of space and time and the traffic management plan shall be duly validated and certified by the State Urban Development department and the P.W.D./ competent authority for road augmentation and shall also have their consent to the implementation of components of the plan which involve the participation of these departments.

VI. Green belt:

- i. Green belt shall be developed in an area as provided in project details, with native tree species in accordance with Forest Department. The greenbelt shall inter alia cover the entire periphery of the project site.
- ii. Top soil shall be separately stored and used in the development of green belt.

VII. Public hearing and Human health/safety issues:

- i. Emergency preparedness plan based on the Hazard Identification and Risk Assessment (HIRA) and Disaster Management Plan shall be implemented.
- ii. Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.
- iii. Occupational health surveillance of the workers shall be done on a regular basis.

VIII. Corporate Environment Responsibility:

- i. The company shall have a well laid down environmental policy duly approved by the Board of Directors. The environmental policy should prescribe for standard operating procedures to have proper checks and balances and to bring into focus any infringements/deviation/violation of the environmental / forest / wildlife norms / conditions. The company shall have defined system of reporting infringements / deviation / violation of the environmental / forest / wildlife norms / conditions and / or share-holder's / stake holders. The copy of the board resolution in this regard shall be submitted to the MoEF&CC as a part of six-monthly report.
- ii. A separate Environmental Cell both at the project and company head quarter level, with qualified personnel shall be set up under the control of senior Executive, who will directly report to the head of the organization.
- iii. Action plan for implementing EMP and environmental conditions along with responsibility matrix of the company shall be prepared and shall be duly approved by competent authority. The year wise funds earmarked for environmental protection measures shall be kept in separate account and not to be diverted for any other purpose. Year wise progress of implementation of action plan shall be reported to the Ministry/Regional Office along with the Six Monthly Compliance Report.
- iv. Self-environmental audit shall be conducted annually. Every three years third party environmental audit shall be carried out.

J. Bose

IX. Miscellaneous:

- i. The project proponent shall make public the environmental clearance granted for their project along with the environmental conditions and safeguards at their cost by prominently advertising it at least in two local newspapers of the District or State, of which one shall be in the vernacular language within seven days and in addition this shall also be displayed in the project proponent's website permanently (for projects involving incineration).
- ii. The project proponent shall prominently advertise it at least in two local newspapers of the District or State, of which one shall be in the vernacular language within seven days indicating that the project has been accorded environment clearance and the details of MoEFCC/SEIAA website where it is displayed (For projects involving only Landfill without incineration).
- iii. The copies of the environmental clearance shall be submitted by the project proponents to the Heads of local bodies, Panchayats and Municipal Bodies in addition to the relevant offices of the Government who in turn has to display the same for 30 days from the date of receipt.
- iv. The project proponent shall upload the status of compliance of the stipulated environment clearance conditions, including results of monitored data on their website and update the same on half-yearly basis.
- v. The project proponent shall submit six-monthly reports on the status of the compliance of the stipulated environmental conditions on the website of the ministry of Environment, Forest and Climate Change at environment clearance portal.
- vi. The project proponent shall submit the environmental statement for each financial year in Form-V to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently and put on the website of the company.
- vii. The criteria pollutant levels namely; PM_{2.5}, PM₁₀, SO₂, NO_x (ambient levels as well as stack emissions) or critical sectoral parameters, indicated for the project shall be monitored and displayed at a convenient location near the main gate of the company in the public domain (in case of incineration involved).
- viii. The project proponent shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities, commencing the land development work and start of production operation by the project.
- ix. The project authorities must strictly adhere to the stipulations made by the State Pollution Control Board and the State Government.
- x. The project proponent shall abide by all the commitments and recommendations made in the EIA/EMP report, commitment made during Public Hearing and also that during their presentation to the Expert Appraisal Committee.
- xi. No further expansion or modifications in the plant shall be carried out without prior approval of the Ministry of Environment, Forests and Climate Change (MoEF&CC).
- xii. Concealing factual data or submission of false/fabricated data may result in revocation of this environmental clearance and attract action under the provisions of Environment (Protection) Act, 1986.
- xiii. The Ministry may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory.
- xiv. The Ministry reserves the right to stipulate additional conditions if found necessary. The Company in a time bound manner shall implement these conditions.

J. K. Sane

- xv. The Regional Office of this Ministry shall monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the officer (s) of the Regional Office by furnishing the requisite data / information/monitoring reports.
- xvi. The above conditions shall be enforced, inter-alia under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and the Public Liability Insurance Act, 1991 along with their amendments and Rules and any other orders passed by the Hon'ble Supreme Court of India / High Courts and any other Court of Law relating to the subject matter.
- xvii. Any appeal against this EC shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.
7. This issues with the approval of the Competent Authority.

S. Bose
(Dr. Subrata Bose)
Scientist 'F'

Copy to:

1. The Secretary, Directorate of Environment, Government of Haryana, SCO 1-2-3, Sector 17-D (Second Floor), Chandigarh.
2. The Addl. Principal Chief Conservator of Forests (Central), Ministry of Environment, Forest and Climate Change, Regional Office (NZ), Bay No. 24-25, Sector 31-A, Dakshin Marg, Chandigarh -160030.
3. The Chairman, Central Pollution Control Board Parivesh Bhavan, CBD-cum-Office Complex, East Arjun Nagar, New Delhi - 110 032.
4. The Member Secretary, Haryana Pollution Control Board, C-11, Sector-6, Panchkula-134109 Haryana
5. Monitoring Cell, MoEF&CC, Indira Paryavaran Bhavan, New Delhi.
6. Guard File/ Record File/ Notice Board.
7. MoEF&CC website.

S. Bose
(Dr. Subrata Bose)
Scientist 'F'



ARIHANT ANALYTICAL LABORATORY PVT. LTD.

AN ISO 9001:2015, ISO 14001:2004, OHSAS 18001:2007 CERTIFIED LABORATORY

272, Phase-IV, Sec-57, HSIDC, Kundli, Sonapat-131028 (Haryana)

Ph. : 7082301442, 9250014551 Email : aalkundli@gmail.com

Website : www.aalkundli.com

TEST CERTIFICATE

Page 1 of 1

Issued To: M/s Ecogreen Engergy Gurgaon-Faridabad Pvt. Ltd.
Unit No.228-236, Tower-A,
Space I-Tech Park, Sector-49,
Gurgaon - 122 018 (HR)

Sample Description: One sample described as MSW-RDF Sample from Ballistic Separator for Legacy Waste, (Municipal Solid Waste-Refuse-Derived Fuel), Location: Bhandwari Plant, Gurgaon, was received.

Report No. AAL MIS-20200103006

Date of Receiving: 03/01/2020

Date of Starting: 03/01/2020

Date of Completion: 13/01/2020

Date of Reporting: 13/01/2020

TEST RESULT

S. No.	Test Parameters	Unit	Results	Test Method
A	Proximate Analysis			
1	Moisture Content	%	14.72	ASTM D3173-87-1996
2	Ash Content	%	27.37	ASTM D3174-97
3	Volatile Matter	%	34.68	ASTM D3175-89a-1997
4	Fixed Carbon	%	23.23	ASTM D3172-89-1997
B	Ultimate Analysis			
5	Moisture Content	%	14.72	ASTM D3173-87-1996
6	Ash Content	%	27.37	ASTM D3174-97
7	Carbon Content	%	39.10	ASTM D3178-89-1997
8	Hydrogen	%	3.68	ASTM D3178-89-1997
9	Sulphur (as S)	%	0.49	ASTM D3177-89-1997
10	Oxygen	%	14.37	ASTM D3176-89-1997
11	Nitrogen	%	0.27	ASTM D3179-89-1997
C	Other Parameters			
12	Total Solid	% by mass	85.28	IS 10158-1982
13	Loss on Ignition	% by mass	57.34	EPA SW 846-1010
14	Selenium (as Se)	mg/kg	0.29	USEPA 6010C-2007
15	Potassium (as K ₂ O)	% by mass	0.16	USEPA 6010C-2007
16	Sodium (as Na ₂ O)	% by mass	0.12	USEPA 6010C-2007
17	Chloride (as Cl)	% by mass	0.01	EPA SW 846-9253
18	Calcium Oxide (as CaO)	% by mass	2.62	USEPA 6010C-2007
19	Magnesium (as Mg)	% by mass	0.29	USEPA 6010C-2007
20	Silica Content (as SiO ₂)	mg/kg	114.61	USEPA 6010C-2007
21	Sulphate (as SO ₄)	% by mass	0.14	EPA SW 846-9038
22	Iron (as Fe)	% by mass	1.3	USEPA 6010C-2007
23	Copper (as Cu)	mg/kg	96.4	USEPA 6010C-2007
24	Cadmium (as Cd)	mg/kg	BDL (DL=3.0)	USEPA 6010C-2007
25	Zinc (as Zn)	mg/kg	15.38	USEPA 6010C-2007
26	Nickel (as Ni)	mg/kg	13.63	USEPA 6010C-2007
27	Mercury (as Hg)	mg/kg	BDL (DL=0.5)	USEPA 6010C-2007
28	Organic Carbon	% by mass	29.14	IS 2720 (P-22)-1972
29	Phosphate (as P)	mg/kg	119.24	IS 10158-1982
30	Bulk Density	gm/cc	0.21	IS 2720 (P-3)-1963
31	C/N Ratio	-	144.81	By Calculation
32	Lead (as Pb)	mg/kg	17.09	USEPA 6010C-2007
33	Chromium (as Cr)	mg/kg	63.21	USEPA 6010C-2007
34	Arsenic (as As)	mg/kg	BDL (DL=5.0)	USEPA 6010C-2007
35	Titanium (as TiO ₂)	mg/kg	168.6	USEPA 6010C-2007
36	Gross Calorific Value (As Air Dry Basis)	Cal/gm	2614.6	ASTM D 5865-99a
37	Net Calorific Value (As Air Dry Basis)	Cal/gm	2279.1	ASTM D 5865-99a

****End of Report****

Authorised Signatory

Note: 1. The Result indicated above refer to the tested sample and listed test parameters only, endorsement of products is neither conferred nor implied.
2. Total liability of our laboratory is limited to the invoice amount.
3. This report shall not be reproduced wholly or in part without written consent of the laboratory.
4. This report shall not be used in any advertising media or as evidence in the court of law without prior written consent of the laboratory.
5. The non-perishable sample received shall be destroyed after one month and perishable sample shall be destroyed after one week from the date of issue of report unless specified.



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Website : www.aalkundli.com

TEST CERTIFICATE

Page 1 of 1

Issued To: M/s Ecogreen Ennergy Gurgaon-Faridabad Pvt. Ltd.
Unit No.228-236, Tower-A,
Space I-Tech Park, Sector-49,
Gurgaon – 122 018 (HR)

Report No. AAL MIS-20200103007

Date of Receiving: 03/01/2020

Date of Starting: 03/01/2020

Date of Completion: 13/01/2020

Sample Description: One sample described as MSW-RDF Sample from Trommel for Fresh Waste, (Municipal Solid Waste-Refuse-Derived Fuel), Location: Bhandwari Plant, Gurgaon, was received.

Date of Reporting: 13/01/2020

TEST RESULT

S. No.	Test Parameters	Unit	Results	Test Method
A	Proximate Analysis			
1	Moisture Content	%	37.14 *	ASTM D3173-87-1996
2	Ash Content	%	21.38 *	ASTM D3174-97
3	Volatile Matter	%	36.16	ASTM D3175-89a-1997
4	Fixed Carbon	%	5.32	ASTM D3172-89-1997
B	Ultimate Analysis			
5	Moisture Content	%	37.14	ASTM D3173-87-1996
6	Ash Content	%	21.38	ASTM D3174-97
7	Carbon Content	%	22.37	ASTM D3178-89-1997
8	Hydrogen	%	2.96	ASTM D3178-89-1997
9	Sulphur (as S)	%	0.44	ASTM D3177-89-1997
10	Oxygen	%	15.32	ASTM D3176-89-1997
11	Nitrogen	%	0.39	ASTM D3179-89-1997
C	Other Parameters			
12	Total Solid	% by mass	62.86	IS 10158-1982
13	Loss on Ignition	% by mass	54.44	EPA SW 846-1010
14	Selenium (as Se)	mg/kg	2.03	USEPA 6010C-2007
15	Potassium (as K ₂ O)	% by mass	0.19	USEPA 6010C-2007
16	Sodium (as Na ₂ O)	% by mass	0.11	USEPA 6010C-2007
17	Chloride (as Cl)	% by mass	0.01	EPA SW 846-9253
18	Calcium Oxide (as CaO)	% by mass	2.62	USEPA 6010C-2007
19	Magnesium (as Mg)	% by mass	0.26	USEPA 6010C-2007
20	Silica Content (as SiO ₂)	mg/kg	138.36	USEPA 6010C-2007
21	Sulphate (as SO ₄)	% by mass	0.11	EPA SW 846-9038
22	Iron (as Fe)	% by mass	3.12	USEPA 6010C-2007
23	Copper (as Cu)	mg/kg	130.32	USEPA 6010C-2007
24	Cadmium (as Cd)	mg/kg	BDL (DL=3.0)	USEPA 6010C-2007
25	Zinc (as Zn)	mg/kg	8.14	USEPA 6010C-2007
26	Nickel (as Ni)	mg/kg	2.34	USEPA 6010C-2007
27	Mercury (as Hg)	mg/kg	BDL (DL=0.5)	USEPA 6010C-2007
28	Organic Carbon	% by mass	14.68	IS 2720 (P-22)-1972
29	Phosphate (as P)	mg/kg	36.22	IS 10158-1982
30	Bulk Density	gm/cc	0.36	IS 2720 (P-3)-1963
31	C/N Ratio	-	57.35	By Calculation
32	Lead (as Pb)	mg/kg	14.26	USEPA 6010C-2007
33	Chromium (as Cr)	mg/kg	22.29	USEPA 6010C-2007
34	Arsenic (as As)	mg/kg	BDL (DL=5.0)	USEPA 6010C-2007
35	Titanium (as TiO ₂)	mg/kg	14.68	USEPA 6010C-2007
36	Gross Calorific Value (As Air Dry Basis)	Cal/gm	2468.14	ASTM D 5865-99a
37	Net Calorific Value (As Air Dry Basis)	Cal/gm	1800.00 ✓	ASTM D 5865-99a

****End of Report****

Authorized Signatory

Note: 1. The Result Indicated above refer to the tested sample and listed test parameters only, endorsement of products is neither implied nor intended.
2. Total liability of our laboratory is limited to the invoice amount.
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S. No	Parameters	SCF	RDF - Grade III	RDF - Grade II	RDF - Grade I
1.	Intended Use [†]	Input material for the Waste to Energy plant or RDF pre-processing facility	For co-processing directly or after processing with other waste materials in cement kiln	For direct co-processing in cement kiln	For direct co-processing in cement kiln
			Grade III	Grade II	Grade I
2	Size	Anything above 400mm has to be mutually agreed between Urban Local Body/ SCF Supplier and Cement Plants.	< 50 mm or < 20 mm depending upon use in ILC or SLC, respectively		
3	Ash – maximum permissible	< 20 % [#]	< 15 %	< 10 %	< 10 %
4	Moisture – maximum permissible	< 35 %	< 20 %	< 15 %	< 10 %
5	Chlorine – maximum permissible	< 1.0 % [#]	< 1.0 %	< 0.7	< 0.5
6	Sulphur – maximum permissible	< 1.5 % [#]	< 1.5 %		
7	* Net Calorific Value (NCV) – in Kcal/kg (Average figure of every individual consignment)	> 1500 KCal/kg net	> 3000 KCal/kg net	> 3750 KCal/kg net	> 4500 KCal/kg net
8	Any other parameter	SCF – any offensive odour to be controlled. **	RDF – any offensive odour to be controlled.	RDF – any offensive odour to be controlled.	RDF – any offensive odour to be controlled.

Note: † It is up to the ULB, Cement and other industries to mutually decide which standard of RDF need to be produced.

If the blending process is done in cement plants, the deviations in recommended limit for ash, chlorine and sulphur content can be mutually agreed between urban local body /SCF Supplier and cement plants.

* band width of variations acceptable in NCV can be mutually decided between RDF manufacturer and cement plants.

** Since odour is still largely a matter of perception and there is no satisfactory equipment to measure different types of odour, no quantitative figure has been given.

For initiating the RDF usage in cement industry, the Committee Members agreed that different RDF types have different calorific values, and so the cost of each combustible fraction have to be expressed in INR per 1000 Kcal/kg to be comparable. The commercial acceptability of properly processed RDF was agreed at Rs. 0.4 per 1000 Kcal/kg by the members with reference to the specifications as defined in the guidelines. It is also suggested that RDF prices be dynamic and linked with the cost of coal.

In overall, once RDF of the quality/specifications is made available, on a dependable basis, within the transport influence zone of 400 km of a cement plant, market forces would prevail upon where the ULB, the RDF processors and cement plants would negotiate an agreeable cost of RDF considering various factors.

To begin with, the suggestive maximum and minimum prices of the respective grades of RDF as worked out for guidance is presented below:

Unit	SCF	RDF Grade III	RDF Grade II	RDF Grade I	Industrial Coal	Petcoke
Kcal/Kg	1500	3000	3750	4500	3000-4200	7900-8300
Minimum Rs./Tonne (assumed @ Rs. 0.4 per 1000 Kcal/kg)	600	1200	1500	1800	4500	9000
Maximum Rs./Tonne (assumed @ Rs. 0.8 per 1000 Kcal/kg)	1200	2400	3000	3600		



ARIHANT ANALYTICAL LABORATORY PVT. LTD.

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272, Phase-IV, Sec-57, HSIIDC, Kundli, Sonapat-131028 (Haryana)

Ph. : 7082301442, 9250014551 Email : aalkundli@gmail.com

Website : www.aalkundli.com

TEST CERTIFICATE

Page 1 of 1

Report No.	AAL MIS-20191126002		
Issued To:	M/s Ecogreen Energy Gurgaon-Faridabad Pvt. Ltd.	Date of Receiving:	26/11/2019
	Unit No.228-236, Tower-A,	Date of Starting:	26/11/2019
	Space I-Tech Park, Sector-49,	Date of Completion:	06/12/2019
	Gurgaon - 122 018 (HR)		
Sample Description:	One sample described as Legacy Waste (6 mm) - Compost), Location: Bhandwari Plant, Gurgaon, was received.	Date of Reporting:	06/12/2019
		Sample Qty.	2 Kgs.
		Sample Packing Condition:	Polythene Bag

TEST RESULT

(Standards As Per FCO Schedule-IV Part-A: 1985)

S. No.	Test Parameters	Unit	Results	Limits	Test Method
1	Colour	-	Blackish	Dark Brown to Black	Visual
2	Odour	-	No foul odour found	Absence of foul odour	FCO Sch.IV Part-A:1985
3	Moisture Content	%	22.24	15-25	FCO Sch.IV Part-D2:1985
4	Bulk Density	g/cc	0.97	<1.0	FCO Sch.II Part-B3:1985
5	Organic Carbon	% by weight	13.5	12 Min.	FCO Sch.IV Part-D5:1985
6	Total Nitrogen (as N)	% by weight	1.25	0.8 Min.	FCO Sch.II Part-B3:1985
7	Total Phosphate (as P ₂ O ₅)	% by weight	0.84	0.4 Min.	FCO Sch.IV Part-D8:1985
8	Total Potash (as K ₂ O)	% by weight	0.75	0.4 Min.	FCO Sch.IV Part-D9:1985
9	C/N Ratio	-	15.29	<20.0	FCO Sch.IV Part-D7:1985
10	pH Value (1:2)	-	7.40	6.5 - 7.5	FCO Sch.III Part-D1:1985
11	Electrical Conductivity	dSm ⁻¹	3.57	4.0 Max.	FCO Sch.IV Part-D4:1985
12	Arsenic (as As)	mg/kg	BDL (DL-5.0)	10 Max.	FCO Sch.IV Part-D10:1985
13	Cadmium (as Cd)	mg/kg	BDL (DL-3.0)	5.0 Max.	FCO Sch.IV Part-D10:1985
14	Chromium (as Cr)	mg/kg	32.16	50 Max.	FCO Sch.IV Part-D10:1985
15	Copper (as Cu)	mg/kg	74.38	300 Max.	FCO Sch.IV Part-D10:1985
16	Nickel (as Ni)	mg/kg	16.34	50 Max.	FCO Sch.IV Part-D10:1985
17	Lead (as Pb)	mg/kg	10.06	100 Max.	FCO Sch.IV Part-D10:1985
18	Zinc (as Zn)	mg/kg	243.32	1000 Max.	FCO Sch.IV Part-D10:1985
19	Mercury (as Hg)	mg/kg	BDL (DL-0.1)	0.15 Max.	Cold Vapor Testing
20	E.Coli	cfu/gm	Absent	Nil	FCO Sch.III Part-D1C:1985
21	Particle Size (Sieve Analysis)	Retained %	Passing %		
	6.0mm	72.6	27.4		IS 2386 (P-1)-1963

End of Report

Authorised Signatory

- Note:**
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Details of waste Processed Via Trommels

Month	Total Received Waste in Ton	Total RDF Material in Ton	Total Compost Material in Ton	Total Inert Material in Ton
Nov-19	664.5	382.8	165.62	115.58
Dec-19	2244	1200.89	435.83	605.28
Jan-20	1781	869.79	442.58	467.63
Total	4690	2453	1044	1188

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Total Legacy waste segerated Treated Till date

Month	Total Received Waste in Ton	Total RDF Material in Ton	Total Compost Material in Ton	Total Inert Material in Ton
Nov-19	664.5	382.8	165.62	115.58
Dec-19	787	405	171	209
Jan-20	461	230	115	115
Total	1913	1018	452	440

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Total Fresh waste segerated Treated Tili date

Month	Total Received Waste in Ton	Total RDF Material in Ton	Total Compost Material in Ton	Total Inert Material in Ton
Dec-19	1457	795.89	264.83	396.28
Jan-20	1320	639.79	327.58	352.63
Total	2777	1435.68	592.41	748.91

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Commissioners of Municipal Corporation Gurugram & Municipal Corporation Faridabad alongwith other related officers of both Corporations and representatives of Concessionaire i.e., M/s Ecogreen Gurgaon Faridabad Private Limited.

3. That a scheduled action plan was prepared in above said meeting for installing 12 trommel machines by clearing required land in stages in coordination with Concessionaire for treating legacy waste in shortest possible time. The action plan is depicted as under:-

Sr. No	Trommel Machine Installation Date	Working Period upto	Qty. of processed waste per day per Trommel Machine (Tons)	Working Days	1st Year Total Treated Waste (Tons)	Waste treated in double shifts (Tons)
1.	17.11.2019	16.11.2020	300	365	109500	219000
2.	17.12.2019	16.11.2020	300	335	100500	201000
3.	16.01.2020	16.11.2020	300	305	91500	183000
4.	15.02.2020	16.11.2020	300	275	82500	165000
5.	17.03.2020	16.11.2020	300	245	73500	147000
6.	16.04.2020	16.11.2020	300	215	64500	129000
7.	16.05.2020	16.11.2020	300	185	55500	111000
8.	16.06.2020	16.11.2020	300	155	46500	93000
9.	16.07.2020	16.11.2020	300	125	37500	75000
10.	15.08.2020	16.11.2020	300	95	28500	57000

11.	15.09.2020	16.11.2020	300	65	19500	39000
12.	16.10.2020	16.11.2020	300	35	10500	21000
1st Year Total Treated Waste by the 12 Trommel Machines					720000	1440000
2nd Year Total Treated Waste 109500 X 12 Trommel Machines (in Tons)					1314000	2628000
Grand Total (in Tons)						4068000
70% of Grand Total (in Tons)						2847600

Estimated legacy waste as per assessment done by Concessionaire and response filed on dated 18.02.2019 before this Hon'ble Tribunal is approx. 27.5 Lakh Tons. Thus considering the quantity of legacy waste submitted by Concessionaire, deployment of twelve (12) Trommels by working in double shift, it will take two (2) years time period to treat legacy waste.

The deployment of 12 Trommel Machines requires around 2.5 acre of land to operate but presently at the site no space is available. Thus above schedule is planned in phased manner so that waste is treated and parallel space will be reclaimed for deployment of next trommel. Since the Concessionaire has deviated from agreed schedule, thus MCG has issued work order to third party agency for deployment of trommel at site at the risk and

cost of Concessionaire. The copy of work order dated 20.01.2020 is attached as **Annexure R - 2.**

4. Methodology for Processing:-

4.1 For processing of legacy waste

The treatment & disposal of Legacy MSW is being done by Bio-remediation and Bio-mining. The first step is to excavate legacy waste, loosen it and make windrows so that the leachate can be dried up through solar exposure and all the entrapped methane is removed from the heap. For excavation, Concessionaire has started processing at two different locations.

Till date 20,000 metric tonne of legacy waste has been scientifically treated through bio remediation and around 35-45% of volume reduction is achieved. Further around 16,000 metric tonne waste is ready for Bio-mining and out of which 1596 metric tons have been processed through trommel.

The process adopted is as per CPCB Guidelines 2019 and SWM Rules 2016. By adopting this process, problem of pathogen, flies, odour and birds are being controlled.

4.2 For processing of fresh waste

Waste of approx 350-400 Tonne is sent to windrows on daily basis for stabilization and drying. Bio-culture solution is sprayed for enhancing the decomposition. After 4-5 weeks and turning of waste at regular intervals, stabilized waste is sent to screening through trommel. Stabilization reduces 40 - 45 % moisture and gases.

Till date 19,000 metric tonne of fresh waste has been scientifically treated through bio remediation and 40-45 % of volume reduction is achieved. Further around 5,000 metric tonne of fresh waste has been screened through trommel into segregated fractions of Refuse - derived fuel (RDF), Inert and compostable material.

For the purpose of screening of fresh and legacy waste two nos. of trommels of capacity 300 Tonne per day each, have been installed and operational at site.

5. That Bandhwari Landfill site lies in between Gurugram and Faridabad and is of size of approximately 30 acres, every part of which has been utilized which includes eight (8) leachate collection tanks of 40,000 KL capacity, which further led to space constraints. A leachate treatment

plant of capacity 150 KLD is already in operation for treatment of collected leachate. Additionally to speed up the process of treatment and vacating space covered by the leachate collection ponds/tanks, Concessionaire has installed one Disc Tube Reverse Osmosis (DTRO) of capacity 200 KLD and another DTRO of same capacity will be installed by the end of February, 2020. After installation and operation of both DTRO machines, all leachate ponds will be cleared in 3-4 months which will reclaim approximately 6-7 acres of land.

The earmarked map of plant site with current amenities is attached as **Annexure R/3**.

6. That as stated in interim report dated 20.09.2019 for allotment of 30 Acres land at Village Pali, Faridabad to Concessionaire for storage of segregated fractions, it is submitted in this context that land at Pali under the ownership of Municipal Corporation Faridabad was found to be protected forest land, under Section 4 & 5 of the Punjab Land Preservation Act, 1900.

Similarly, as stated in Compliance Affidavit dated 13.11.2019 for transportation of fresh waste generated from the area of Municipal Corporation Gurugram to Farukhnagar, which also couldn't be initiated due to grant of stay/restraining to dump garbage vide order dated

21.12.2019 in CS No. 647/2019 titled as Rishipal Vs M.C Farrukhnagar by Ld. Civil Judge, Pataudi, Gurugram. The case is listed for hearing on 29.01.2020 before the Ld. Court. The Copy of order dated 21.12.2019 is attached herewith as **Annexure - R/4.**

7. That processed segregated fractions at present are being stored inside plant site by Concessionaire in available space. Concessionaire has requested to allot land around Bandhwari landfill site for storage of Refused Derived Fuel (RDF) & Compost etc., issue of same has been discussed in a meeting held on 14.12.2019 under the Chairpersonship of Principal Secretary to Government of Haryana, Urban Local Bodies Department wherein it has been asked to both Corporations i.e; MCG & MCF to allot 5-8 acres land to Concessionaire on lease basis for storage of Refused Derived Fuel (RDF) & Compost etc. However, due to non-availability/non-existence of land with Municipal Corporation, Gurugram and applicability of Ministry of Environment and Forests - Aravali Notification, 1992 around Bandhwari landfill site, no such land has been earmarked at present. Alternatively Municipal Corporation, Gurugram is approaching other authorities like Gurugram Metropolitan Development Authority (GMDA) and Haryana Shahari Vikas Pradhikaran (HSVP)

to make additional land available to Concessionaire in and around Gurugram.

In view of above, it is submitted that Municipal Corporation, Gurugram is taking sincere efforts for treatment of legacy waste as per direction of this Hon'ble Tribunal. It is further undertaken to comply with the directions passed by this Hon'ble Tribunal.

It is humbly submitted that delay of one day in filing the present report is regretted. It is humbly prayed that delay of one day may kindly be condoned.

The action plan along with progress report as on 15.01.2020 is submitted for kind perusal and consideration of this Hon'ble Tribunal.

Place: Gurugram
Date: 21.01.2020


(Vinay Pratap Singh, IAS)
Commissioner,
Municipal Corporation,
Gurugram.

Item No. 13

Court No. 1

**BEFORE THE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH, NEW DELHI**

Original Application No. 514/2018
(Earlier O.A. No. 415/2015)
(I.A No. 689/2019)

(With Report dated 13.11.2019)

Vivek Kamboj & Anr.

Applicant(s)

Versus

Union of India & Ors.

Respondent(s)

Date of hearing: 19.11.2019

CORAM: HON'BLE MR. JUSTICE ADARSH KUMAR GOEL, CHAIRPERSON
HON'BLE MR. JUSTICE S.P WANGDI, JUDICIAL MEMBER
HON'BLE MR. JUSTICE K. RAMAKRISHNAN, JUDICIAL MEMBER
HON'BLE DR. NAGIN NANDA, EXPERT MEMBER
HON'BLE MR. SAIBAL DASGUPTA, EXPERT MEMBER

For Applicant(s): Mr. Rahul Choudhary, Advocate

For Respondent(s): Mr. Rajkumar, Advocate for CPCB
Mr. Sameer Singh, Advocate
Mr. Anil Grover, AAG with Mr. Rahul Khurna,
Advocate
Mr. Amit Khatri, Commissioner, MCG
Ms. Sonal Goyal, Commissioner, MCF

ORDER

1. This order may be read in continuation of order dated 10.07.2019. The issue for consideration is the remedial action for dealing with the legacy waste at Gurugram which includes waste of Faridabad. The matter has been pending before this Tribunal for the last four years. This Tribunal has repeatedly recorded findings of incapacity and incompetence of the concerned authorities in dealing with the matter for scientific disposal of waste so as to ensure compliance of the statutory procedure under the Solid Waste Management Rules, 2016

and also inability of the contractor hired in producing the results. The dumped waste has resulted in leachate being discharged into the water bodies, contaminating the ground water and polluting the surface water, apart from causing air pollution and hazard to public health.

2. We may briefly note the factual background and proceedings which have taken place so far. The application was originally filed on 16.09.2015 with the grievance of unscientific disposal of solid waste causing leachate, contamination of ground water and pollution of surface water. The Tribunal directed necessary steps to be taken and report to be furnished by the CPCB. The matter was then considered on 18.01.2018 in light of the report of the CPCB. It was noted that the Municipal Corporation of Gurugram (MCG), Municipal Corporation of Faridabad (MCF) and the Urban Local Bodies, Haryana had entered into an agreement with M/S Ecogreen Energy Gurugram Faridabad Pvt. Ltd. (hereinafter referred to as Concessionaire) on 14.08.2017 to establish an Integrated Solid Waste Management Plant to cater for collection, transportation, processing and disposal of waste generated from Gurugram-Faridabad Cluster, comprising Municipal limits of Gurugram and Faridabad for a period of 20 years. In September 2017, the MCG handed over Bandhwari landfill site to the Concessionaire and the latter was responsible for establishment of Waste-to-Energy Plant at the landfill site and for management and treatment of the legacy waste at landfill site. The construction for the Waste-to-Energy plant is said to have begun in April 2018 in accordance with the SWM Rules and NGT orders to eliminate unscientific open dumping and burning of wastes at the landfill site. The Concessionaire pleaded

that the Bandhwari dumpsite was already 20-25 meters above the ground level, and the land allotted to them was already 60% covered in legacy wastes.

3. After considering the report of the CPCB, vide order dated 10.07.2018 the application was disposed of with the following directions:

- (i) Concessionaire will start working on management of legacy waste as per the suggestions made by CPCB;
- (ii) Concessionaire will implement segregation of municipal solid wastes as per the rules;
- (iii) Concessionaire will address the issue reports in Hindustan Times, dated 29.06.2018; and
- (iv) State of Haryana will also be responsible for the above as the Concessionaire is merely an agency.

4. The compliance report, furnished in pursuance of above, was considered on 21.08.2018 and since the same was found to be unsatisfactory, a further inspection was directed to be conducted. Accordingly a report dated 04.10.2018 was submitted showing unsatisfactory state of affairs which was noticed in the order dated 01.03.2019 and 05.03.109 when the Tribunal *inter alia* directed formation of a joint committee of CPCB, IIT Delhi and NEERI to determine the monetary cost of damage caused to the environment.

Again on 14.03.2019, directions were issued as follows:

“An action plan has been filed which proposes setting up of segregation unit for the incoming waste and inviting experts for scientific treatment of legacy waste and leachate. Since most of the remedial actions mentioned in action plan are proposed to be undertaken in future, in the light of serious past failures, it will be appropriate that the Municipal Corporation, Gurgaon is required to furnish performance guarantee in the sum of Rs. 25 lakhs to the satisfaction of CPCB within one month undertaking to comply with the steps mentioned in the action plan, within the timelines proposed. We order accordingly. It is made clear that the amount of Rs. 25

lakhs will stand forfeited in the case of default and may be recovered from the erring officers of the Corporation.”

5. The matter was thereafter reviewed on 10.07.2019 as follows:

“

9. *Though the Expert Committee constituted vide order dated 05.03.2019 required assessment of damage to the environment in monetary terms and the cost of restoration, the report did not deal with this aspect. We are informed that the said assessment is yet to be done which work stand assigned to the National Environmental Engineering Research Institute (NEERI) by the Central Pollution Control Board (CPCB). Let the same be expedited and report furnished to this Tribunal before the next date.*

10. *The joint interim report dated 25.05.2019, filed in pursuance of order dated 23.04.2019, submitted by Commissioner, MCF and Additional Municipal Commissioner, MCG is to the effect that the Director General, Urban Local Bodies Department, Haryana visited the landfill site at Bandhwari on 04.05.2019 and evaluated the steps taken by the Concessionaire on the site. Thereafter issues were discussed in meetings with the Commissioner, MCG and Additional Municipal Commissioner, MCF. Chief Secretary reviewed the progress through video conferencing while Commissioner, MCG visited the site on multiple occasions. The following are the salient featured appearing from the interim report dated 25.05.2019 and the supplementary report dated 07.07.2019:*

- (i) Three leachate storage tanks were functional at the time of filing the interim report dated 24.05.2019 and now all five leachate storage tanks are functional and leachate is being pumped out in those tanks.*
- (ii) Leachate treatment plant with the capacity 150 KLD has been installed but to attain the required parameters, additional DAF unit of 50 KLD fixed at the outlet of existing LTP on pilot basis. Current leachate of 13000 KL in the collection tanks is expected to be treated by 31.07.2020*
- (iii) Treatment of Legacy waste and fresh waste at the site: Installation of conveyor belt is in process and the Ballistic separator of capacity 500 TPD is going to be functional very shortly.*
- (iv) Waste accumulated at the landfill site has been reshaped and is being with HDPE lining so that rain water does not perforate within MSW to the excessive leachate. The covering of the waste by Concessionaire is likely to be completed by 15.07.2019.*

11. Since unfortunately, the unsatisfactory state of affairs in dealing with the legacy waste is continuing not only at Gurugram and Faridabad but also at several places in the country which is one of the causes of large number of deaths and diseases, damage to the flora & fauna and the

environment. Pending prosecution of the polluters or the erring officers for their inaction or collusion and recovery of damages on 'Polluter Pays' principle, emergent measures are required to deal with the problem to prevent further damage.

12. *In the last week, on 05.07.2019, dealing with an identical problem from the State of Haryana (at Gohana, District Sonipat), the Tribunal observed¹:*

“ 3. The timeline proposed is in conflict with the statutory timelines under the SWM Rules, 2016. Such leisurely timeline is not only in conflict with the Rules but also at the cost of the environment. If such longer timeline is permitted unconditionally, the result will be that damage to the environment will continue. The timeline is also in violation of order of this Tribunal in O.A. No. 606/2018 passed in the presence of the Chief Secretary, Haryana on 06.03.2019, requiring that the entire State be made fully compliant with the Rules in maximum period of one year.

4. Accordingly, we direct the Chief Secretary, Haryana to take remedial steps so that timeline of December 2021 for waste to energy plant is appropriately preponed. The Chief Secretary may indicate progress in this regard in the next report to be furnished to this Tribunal in O.A. No. 606/2018.”

13. *Consistent with the above direction, the present matter may also be dealt with by the Chief Secretary of Haryana accordingly. In the said monitoring, the issues inter alia to be considered may include steps to prevent burning of wastes particularly in the new sectors where collection of waste facility is not adequate, testing of samples of underground water to explore contamination and remedial steps required.*

14. *However, in view of continued damage to the environment and public health and long delay which has taken place in scientifically handling the legacy waste in question, we consider it necessary to give further direction in light of development which have come to light while dealing with other similar cases. There are reports that legacy waste has been successfully handled at Indore which fact was noticed in a recent order of the Tribunal dated 02.07.2019²:*

“In this regard, we have been informed during the hearing by Dr. A. B Akolkar, former Member Secretary, CPCB how the situation at Indore was

¹ O.A 1011/2018

² O.A 113/2019

tackled. He has informed that 15 lakh MT old waste was dumped at Devguradiya in 100 acre area during 2016-17, (First Phase) 50,000 cum old waste was bio-mined and green belt developed in bio-mined area. Subsequently, in the second phase, 5,50,000 cum waste during 2017 was bio-mined. In the third phase, 9,00,000 cum of work was bio-mined in 2018 by employing more machinery. The machinery used for operations include; Trommels, Horizontal screens, excavators, back hoe loaders and dumpers. The recyclables recovered from the biomining process was sent for recycling, recyclable polythene was sent to cement plants and also for road making. The soil recovered was used for refilling the ground on the same site where greenery is developed. The recovered construction and demolition waste was recovered and sent to C&D processing facility to produce building materials. The leftover of the legacy waste was sent to secured landfill. Valuable land (80%) has been recovered by bio-remediation process of legacy waste.”

15. In view of the above, the Tribunal directed that legacy waste issue of Pirana landfill site in Ahmadabad city in Gujarat be dealt with on the Indore pattern. ..
16. We are of the view that present situation has also to be dealt with on the said pattern.
17. Accordingly, we direct the State of Haryana to transfer a sum of Rs. 20 Crores to an ESCROW account with liberty to the State to recover the said amount from the concerned stakeholders in accordance with the Solid Waste Management Rules, 2016.
18. We direct constitution of the following Committee to deal with the matter:
 - (1) Chief Secretary, Haryana, Chairman;
 - (2) Finance Secretary, Haryana, Member;
 - (3) Urban Local Bodies Secretary, Haryana, Member;
 - (4) Commissioner, Municipal Corporation, Faridabad, Member;
 - (5) Commissioner, Municipal Corporation, Gurugram, Member;
 - (6) Representative, CPCB, Member;
 - (7) Member Secretary, SPCB, Haryana, Member.

The Secretary, Urban Local Bodies, Haryana, will be the nodal officer for coordination and compliance.

19. The Committee may co-opt any other technical persons/agencies. After removing of legacy waste from the entire or part of the land, the State may consider using part of the recovered land for

*Integrated Waste Processing and Treatment Facility and also for Treatment, Storage and Disposal Facility (TSDF) for hazardous waste. At the periphery a bio-diversity park can be developed to improve the air quality and ambience. The Committee may have the Commissioner, Municipal Corporation, Indore ***or his nominee** as special ***invitee**. The Committee may meet preferably within two weeks and after taking stock of the situation, plan to start further action within one month from today.*

20. *The work already awarded may be taken into account and if necessary reviewed having regard to urgency of the situation. If Indore model is to be adopted, wholly or in part, no further tender process is necessary.*
21. ***The legacy site may be cleared within six months. If the satisfactory progress is not made, the amount of the ESCROW account may be directed to be forfeited. The ESCROW account will be operated by the representative of CPCB. These directions will also be applicable to handling of ESCROW account directed to be created in terms of order dated 02.07.2019 in the State of Gujarat where the amount is Rs. 75 Crores and the same timeline will apply to Pirana also.***
22. ***An interim report of the steps taken may be furnished to the Tribunal by the Secretary, Urban Local Bodies, Haryana within one month by e-mail at judicial-ngt@gov.in.***

6. Accordingly, we have further considered the matter in the light of affidavit filed on behalf of Municipal Corporation, Gurgaon on 13.11.2019 with the effect that two trommels machines are being installed with the capacity of 300 TPD each which will work in double shifts. More machines will be installed as soon as more space will be available.
7. We are of the view that there is need to take further meaningful and prompt action by preparing an appropriate action plan and executing it so as to clear the legacy waste in shortest possible time but within six months. This timeline is being fixed in view of long time which has already gone in the process. It may be ensured that bio-remediation is carried out rather than mere mechanical separation. Failure to

comply may result in coercive action, including stoppage of salaries and entries in ACRs of concerned Municipal Commissioners. Municipal Commissioner, Gurgaon may file progress report as on 15.01.2020 by 20.01.2020 by e-mail at judicial-ngt@gov.in. CPCB may evaluate whether clearance of legacy is being done as per applicable guidelines and furnish a report before the next date by e-mail at judicial-ngt@gov.in.

8. Response to I.A No. 689/2019 filed by the applicant may also be furnished before the next date by the concerned authority.

A copy of this order be sent to CPCB by e-mail.

List for further consideration on 19.02.2020.

Adarsh Kumar Goel, CP

S.P Wangdi, JM

K. Ramakrishnan, JM

Dr. Nagin Nanda, EM

Saibal Dasgupta, EM

November 19, 2019
Original Application No. 514/2018
(Earlier O.A. No. 415/2015)
AK